Chapter 16

Northwest Lowlands 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.

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Cover Photos

Top left: *Extensive wetlands border the Black River. Communities includes Northern Sedge Meadow, Poor Fen, and in the distance, a black spruce Muskeg. Western Douglas County. Photo by Eric Epstein, Wisconsin DNR.*

Bottom left: *The Golden-winged Warbler is a neotropical migrant songbird that finds important nesting habitat in the deciduous shrub swamps and extensive forests of the Northwest Lowlands. Photo © Laurie Smaglick Johnson.*

Top right: *The St. Croix is the Northwest Lowland's largest river. Biodiversity and recreational values are exceptional. A watershed that is mostly forested and minimal streamside development contribute to the maintenance of high water quality. Photo by Drew Feldkirchner, Wisconsin DNR.*

Center right: *This undeveloped drainage lake occupies a forested watershed that is lightly populated and contains acid peatlands of bog, fen, and conifer swamp. Black Lake State Natural Area, Douglas County. Photo by Eric Epstein, Wisconsin DNR.*

Bottom right: *After an absence of several decades, the gray wolf has recolonized parts of northern and central Wisconsin. With its vast forests, low road density, and proximity to a source population in adjacent Minnesota, the Northwest Lowlands played an important role. Photo by John and Karen Hollingsworth, U.S. Fish and Wildlife Service.*

June Dobberpuhl

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Christina Isenring

Northwest Lowlands Ecological Landscape at a Glance

Physical and Biotic Environment

Size

The Northwest Lowlands encompasses 675 square miles (431,842 acres), representing 1.2% of the area of the state. This is Wisconsin's smallest ecological landscape, but it adjoins and outside of Wisconsin is considered part of a much larger ecoregion that extends to the west and south into Minnesota.

Climate

Typical of northern Wisconsin, the mean growing season is 122 days, mean annual temperature is 41.8°F, mean annual precipitation is 30.6, and mean annual snowfall is 49 inches. The cool temperatures and short growing season are not adequate to support agricultural row crops; less than 3% of the land here is used for agricultural purposes, and most of this is in the southern "hook" of the Northwest Lowlands in Burnett County. The climate is favorable for the growth of forests, which cover almost 70% of the ecological landscape. The cool temperatures and short growing season and the absence of moderating Great Lakes influence, along with numerous and large acid peatlands, result in almost boreal-like conditions in parts of the Northwest Lowlands Ecological Landscape.

Bedrock

Bedrock outcroppings are rare except in association with the basalt ridge that follows the Douglas County fault line and forms part of the northern boundary of the Northwest Lowlands. Waterfalls, cliffs, bedrock glades, and rock-walled gorges are associated with this bedrock feature. Localized, usually small, exposures of sandstones and conglomerates occur in some of the stream gorges.

Geology and Landforms

The major landforms are ground and end moraines, with drumlins present in the southwestern portion of the ecological landscape. Topography is gently undulating. In the northern part of the Northwest Lowlands, many stream valleys run southwest in roughly parallel courses. This is caused by bedrock ridges that were created by harder strata of lava alternating with weaker sedimentary rocks; these were later tilted upward due to rifting and continental collision. This bedrock feature influences the surface topography of the Northwest Lowlands, especially where glacial deposits are thin.

Soils

Soils are predominantly loams, with significant acreages of peat deposits in the poorly drained lowlands. Major river valleys have soils formed in sandy to loamy-skeletal alluvium or in non-acid muck. Alluvial soils range from well drained to very poorly drained and include areas subject to periodic flooding.

Hydrology

This ecological landscape occupies a major drainage divide and contains the headwaters of many streams that flow north toward Lake Superior or south toward the St. Croix River system. Important rivers include the St. Croix, Black, Tamarack, Spruce, and Amnicon. Lakes are uncommon except in the heavily agricultural southernmost (and almost disjunct) part of the ecological landscape in Burnett County. Impoundments, all small, have been created by constructing dams on the Tamarack and Black rivers and on several creeks. The St. Croix River is fed by springs, spring ponds, and seepages. The Namekagon River enters the St. Croix in northwestern Burnett County near the boundary of the Northwest Sands and Northwest Lowlands ecological landscapes.

Current Land Cover

The present-day forests are extensive and relatively unbroken, occupying just under 70% of the ecological landscape. Forests consist mainly of aspen, white birch, sugar maple, American basswood, spruce, and fir. Minor amounts of eastern white pine, red pine, and northern red oak are also present. Older successional stages are currently rare, as almost all of this land is managed as "working forests." The large undisturbed and hydrologically intact peatland complexes consist of mosaics of black spruce-tamarack swamp, muskeg, open bog, poor fen, shrub swamp, and occasionally northern white-cedar swamp. The St. Croix River corridor includes forested bluffs and terraces, which support communities unlike those found in most other parts of the ecological landscape. These include

mesic maple-basswood forest, dry-mesic forests of oak or oak mixed with pine, black ash-dominated hardwood swamps, and numerous forested seeps. Less extensive areas of marsh and sedge meadow also occur along the St. Croix. In most of this ecological landscape, minor amounts of land are devoted to agricultural and residential uses, and most of these land uses are concentrated along State Highway 35. The major exception to this pattern is the area that wraps around the south end of the Northwest Sands, which is a mix of agricultural lands and scattered, dry, oak or oak-pine woodlots.

Socioeconomic Conditions

The county included in this socioeconomic region is Douglas County.

Population

The population was 44,159 in 2010, 0.8% of the state total.

Population Density

34 persons per square mile in 2010 (includes the city of Superior, which is not in the Northwest Lowlands)

Per Capita Income

$26,396

Important Economic Sectors

The largest employment sectors in 2007 were Government (16.5%), Tourism-related (15.0%), Retail Trade (11.8%), and Health Care and Social Services (10.3%). Forestry is the sector that has the largest impact on the natural resources in the ecological landscape.

Public Ownership

The most significant federal ownership is the St. Croix National Scenic Riverway, administered by the National Park Service. State-owned lands include portions of Governor Knowles State Forest, Pattison State Park, several state natural areas, and the Gandy Dancer State Trail. The Douglas County Forest occupies a major portion of this ecological landscape. A map showing public land ownership (county, state, and federal) and private lands enrolled in the forest tax programs in the Northwest Lowlands can be found in Appendix 16.K.

Other Notable Ownerships

Minnesota's Nemadji State Forest and St. Croix State Park are just across the state line, immediately west of this ecological landscape.

Considerations for Planning and Management

Avoid fragmentation of extensive forests, wetlands, and potential travel and dispersal corridors, e.g., via infrastructure development or management activities; select a subset of forest interior species to monitor; identify opportunities to increase older forest, the abundance of conifers, and large forest patches; conduct aquatic surveys of headwaters streams; assess adequacy of protection for the aquatic and terrestrial resources of the St. Croix-Namekagon river system and identify opportunities to increase that protection if and where it's needed. The St. Croix corridor is used heavily by migratory birds and may be important for other taxa as well. Ensure that Wisconsin DNR property managers have the background and inventory information they need to develop new property master plans. Communicate across jurisdictional borders (this includes Minnesota) to increase awareness of issues beyond individual property boundaries and enhance management compatibility where that would be advantageous.

Management Opportunities

The Northwest Lowlands is one of the few Wisconsin ecological landscapes with large areas of remote habitat. The northern portion of the Northwest Lowlands features extensive forests and large undisturbed wetlands that are largely unbroken by farms, urban areas, or other developments, and only a few major roads cross this portion of the ecological landscape. Maintaining this large, contiguous area of undeveloped and lightly roaded forest is a major opportunity. In addition, there are opportunities to develop and maintain older forest, increase structural attributes associated with older forests, and identify high conservation value forests on public lands. Areas with the potential to increase the diminished conifer component could also be identified; areas adjacent to existing stands of lowland conifers and muskeg might be especially good candidates for this.

There are several opportunities to work with partners across administrative (federal, state, county, private) boundaries. For example, the Northwest Lowlands Ecological Landscape is a small part of an ecoregion that extends well into Minnesota.

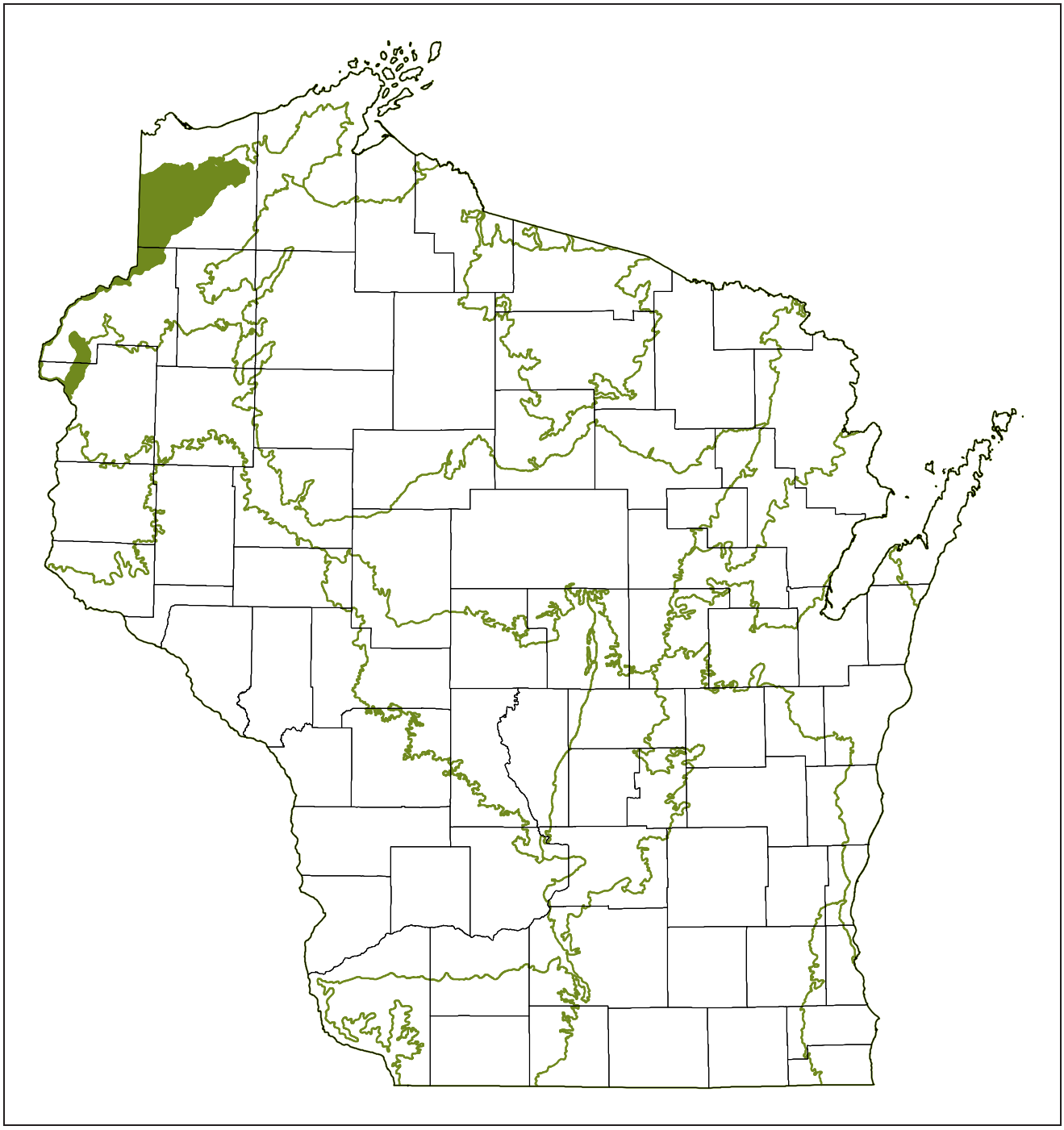
Unfragmented Douglas County landscape contains vast working forests of northern hardwoods and aspen, abundant peatlands, and scattered headwaters streams. Photo by Eric Epstein, Wisconsin DNR.

Undisturbed wetland composed of sedges and forbs occurs between more acid wetland communities and upland northern hardwood forests. Photo by Christina Isenring, Wisconsin DNR.

Black Lake Bog, a two-state designated Natural Area on the Minnesota-Wisconsin state line, provides opportunities to cooperate and coordinate management with Minnesota DNR for wide-ranging fauna such as gray wolf, moose, and some birds and the habitat these species require. The National Park Service (NPS) has primary stewardship responsibilities for resources in and immediately adjacent to the St. Croix River. State, county, and private entities have opportunities to continue to work with NPS on basic inventory, monitoring, and management projects pertinent to this area. In general, there are good opportunities to provide and maintain corridors for species moving within the ecological landscape as well as to and from other ecological landscapes.

The St. Croix River is an exceptional aquatic resource and supports outstanding aquatic diversity with numerous rare species. The forested corridor along the upper St. Croix also supports significant populations of rare and sensitive birds. Maintaining an unbroken natural landscape and protecting stream corridors (e.g., the Spruce and Tamarack rivers) and the watersheds of streams that flow into the St. Croix River is important for maintaining the high-quality aquatic habitats, recreational opportunities, and aesthetic values of this ecosystem. Several streams, such as the Black and Amnicon rivers, originate in this ecological landscape, flow north to Lake Superior, and offer opportunities to maintain important aquatic and shoreline habitats and contribute to high water quality within the Northwest Lowlands Ecological Landscape and beyond.

The large, intact peatlands here are outstanding natural features and contain some of Wisconsin's best examples of peatland communities. Many sensitive species are dependent on these wetlands to provide suitable breeding and foraging habitat. Several of the large wetlands have been identified as high conservation priorities and merit the strongest protection possible. In addition, these wetlands are the headwaters areas of some of the most important streams in the Northwest Lowlands Ecological Landscape.



Northwest Lowlands Ecological Landscape

Barbara Delaney

Northwest Lowlands 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 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. "Northwest Lowlands 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," in Part 1 of this publication.

General Description and Overview

The Northwest Lowlands Ecological Landscape forms a triangular wedge in northwestern Wisconsin, bounded on the north by the Superior Coastal Plain and on the south and east by the Northwest Sands Ecological Landscape. The major landforms are ground and end moraines, with drumlins present in the southwestern portion. Topography is gently undulating. Bedrock outcroppings are rare except in association with the basalt ridge that follows the Douglas County fault line and forms part of the northern boundary of the Northwest Lowlands. Maximum local relief is approximately 350 feet. Waterfalls, cliffs, bedrock glades, and rock-walled gorges are local but important geological features. Local exposures of sandstones and/or conglomerates occur in some of these gorges. Soils are predominantly loams, with significant acreages of peat deposits in the poorly drained lowlands. This ecological landscape comprises a small portion of the Mille Lacs Uplands Subsection (212Kb) that extends westward into Minnesota (Cleland et al. 1997; for details on Subsections, see the "Introduction" in Part 1 and also the "Ecological Landscapes, NHFEU Provinces, Sections, and Subsections" map in Appendix G, "Statewide Maps," in Part 3, "Supporting Materials).

The historical upland vegetation of this ecological landscape was almost entirely forest, composed mostly of white birch (*Betula papyrifera*), balsam fir (*Abies balsamea*), sugar maple (*Acer saccharum*), aspen (*Populus* spp.), and white spruce (*Picea glauca*), with some eastern white (*Pinus strobus*) and red pine (*Pinus resinosa*) on the drier ridges. The lowlands supported extensive wet forests of black spruce (*Picea mariana*) and tamarack (*Larix laricina*) and some northern white-cedar (*Thuja occidentalis*) and black ash (*Fraxinus nigra*) swamps. The notes made by federal General Land Office surveyors during the mid-19th century indicate that overall tree densities were high in this ecological landscape, and ***witness trees*** included many large individuals (Schulte and Mladenoff 2001). The ecological landscape at that time was likely a ***mosaic*** made up of young, recently disturbed forests interspersed with patches of ***old-growth forest***. The present-day forests remain extensive and relatively unbroken, occupying about 68% of the ecological landscape (WDNR 1993). Forests now consist mainly of aspen, white birch, sugar maple, American basswood (*Tilia americana*), spruces (*Picea* spp.), and balsam fir. Minor amounts of eastern white pine and red pine and northern red oak (*Quercus rubra*) are also present. Older successional stages are currently very rare. Large undisturbed peatland complexes are composed of mosaics of black spruce-tamarack swamp, muskeg, open bog, poor fen, shrub swamp (mostly alder-dominated), and northern white-cedar swamp. Among the notable sensitive species here are gray wolf (*Canis lupus*), moose (*Alces americanus*), Gray Jay (*Perisoreus canadensis*), arctic fritillary (*Boloria chariclea*), subarctic darner (*Aeshna subarctica*), and bog bluegrass (*Poa paludigena*). Many birds and invertebrates with generally boreal ranges are found here. Road density is notably low in the northern section of the ecological landscape.

This heavily forested ecological landscape occupies a major drainage divide and contains the headwaters of many streams flowing north toward Lake Superior or south toward the St. Croix River system. Among the major rivers are the St. Croix, Black, Tamarack, Spruce, and Amnicon. Lakes are uncommon and are typically associated with peatland complexes. Rare aquatic species include the river redhorse (*Moxostoma carinatum*), gilt darter (*Percina evides*), and several dragonflies and damselflies (Order Odonata). Water quality is very good in this ecological landscape as development is light and watersheds are mostly forested.

The total area for the Northwest Lowlands Ecological Landscape is approximately 431,000 acres, about half of which is in public ownership. Most of these public lands are county forests, with small portions under federal or state jurisdiction.

Socioeconomic data suggest that the forest products and processing industries are not major contributors to jobs in Douglas County (4% of total industrial output); however, this may be due to the influence of data from the city of Superior on the rest of the county. The county is heavily forested and mostly managed by county forest departments for wood products and secondarily for recreation.

Agriculture is not a major contributor to the economy in Douglas County. The county has the second lowest percentage of land area (85,000 acres) in farmland, the lowest market value per acre of products sold, the second lowest milk production per acre, and the third lowest per acre production of corn. (Farmland includes all land under farm ownership such as cropland, pastureland, and woodland.)

The number of state parks, forests, and recreation areas, as well as fishery and wildlife areas, is the second fewest among all ecological landscapes. However, when the small size of the is considered, the Northwest Lowlands Ecological Landscape has the highest percentage of public land compared to total area of all ecological landscapes in the state.

Compared to the other ecological landscape approximations, Douglas County is sparsely populated. The population density (34 persons per square mile) is about one third that of the state as a whole (105 persons per square mile). Douglas County had a population density of 44,159 in 2010, with a -1% population change, and the lowest population density among ecological landscape county approximations (USCB 2012a). Population density for the Northwest Lowlands Ecological Landscape would be much lower if estimates for the city of Superior, located in northern Douglas County but outside of this ecological landscape, were not included. In

general, Douglas County has a very low percentage of people under the age of 18 and is not racially diverse. It has an above average percentage of high school graduates. The per capita income is below the statewide average. The largest economic sectors of the Douglas County economy are government, tourism, and retail trade, which contribute 43% of total jobs.

Environment and Ecology

Physical Environment

Size

The Northwest Lowlands Ecological Landscape encompasses 675 square miles (431,842 acres), representing 1.2% of the area of the state. It is the smallest ecological landscape in Wisconsin but is contiguous with the Mille Lacs Uplands Subsection (212Kb), a large amount of somewhat similar lands and waters to the west in Minnesota (Cleland et al. 1997). For additional descriptive information and maps of the Mille Lacs Uplands, see the Minnesota Department of Natural Resources publication *Tomorrow's Habitat for the Wild and Rare: An Action Plan for Minnesota Wildlife* (MDNR 2006). Also see the "Landtype Associations of the Northwest Lowlands" map in Appendix 16.K at the end of this chapter.

Climate

There are no weather stations in this ecological landscape, so data from three stations just outside of the ecological landscape were used for these summaries (Danbury, Foxboro, and St. Croix Falls; WSCO 2011). This ecological landscape has a continental climate, with cold winters and warm summers, similar to other northern ecological landscapes.

Based on 30 years of data, the average length of the growing season is similar here to most other northern ecological landscapes at 122 days (base 32°F). There is a wide disparity among the data from only three weather stations, and data should be viewed with caution. The growing season ranges from 100 days in Foxboro to 144 days in St. Croix Falls. The differences among stations followed a distinct latitudinal gradient.

Temperature here is similar to other northern ecological landscapes. The mean annual temperature is 41.8°F, the mean January minimum temperature is -2°F, and the mean August maximum temperature is 80.4°F.

The Northwest Lowlands exhibits the lowest precipitation in the state, based on the limited available data. Annual precipitation averages 30.6 inches and ranges from 30.3 inches to 30.6 inches, more than an inch less than other northern ecological landscapes. Annual snowfall averages 49 inches and ranges from 40.7 to 56.1 inches, over 8 inches less than other northern ecological landscapes.

The cool temperatures and short growing season are not adequate to support agricultural row crops, and less than 3% of the ecological landscape is used for agriculture (most of which occurs in the southern "disjunct hook" of the ecological landscape in Burnett County). The climate is favorable for forests, which cover almost 68% of the ecological landscape. The cool temperatures and short growing season, along with numerous coniferous wetlands and locally strong representation of white spruce and balsam fir in the uplands, result in or suggest almost boreal-like conditions or transition to boreal-like conditions.

Bedrock Geology

The Northwest Lowlands Ecological Landscape is primarily underlain by late Precambrian bedrock of volcanic origin, primarily basalt and gabbro of the Keweenawan Supergroup (Dott and Attig 2004). (Nomenclature used here is according to the Wisconsin Geological and Natural History Survey Open-File Report *Bedrock Stratigraphic Units in Wisconsin;* WGNHS 2006.) See the map "Bedrock Geology of Wisconsin" in Appendix G, "Statewide Maps," in Part 3. An ancient geologic event known as the "midcontinent rifting" took place in what is now northwestern Wisconsin and Upper Michigan, including the Northwest Lowlands Ecological Landscape. At around 1.1 billion years ago, the embryonic continent consisted mainly of ancient Laurentian Shield rocks, when it was nearly separated by volcanic eruptions. Lava flowed for approximately 20 million years, producing the basalt, rhyolite, and gabbro that are now exposed in the Penokee Range and elsewhere and underlie the Northwest Lowlands Ecological Landscape (Dott and Attig 2004).

After the volcanic period, the crust slowly subsided due to the weight of the accumulated lava. The subsidence created a synclinal structure whose low-lying bowl is located beneath Lake Superior. Then, at about 900 million years ago, a continental collision in eastern North America produced compressive forces that uplifted sections along faults in the center of the rift, exposing the volcanic rocks of the Penokee Range and raising the bedrock beneath the Northwest Lowlands Ecological Landscape. Rift structures can still be detected in rocks beneath Lake Superior and have been traced in underground formations south to Kansas and east to Ontario near Lake Huron. See Dott and Attig (2004) and LaBerge (1994) for more detailed descriptions of the rifting and continental collision episodes. The orientation of topographic features in this part of the state, with ranges of hills running southwest-northeast, is due to the structure of the syncline and the major geologic faults. These bedrock structures are described by Clayton (1984) as "partly buried basalt hogbacks." If glacial sediment did not obscure the bedrock structures, more of the ridge-and-valley topography created by harder strata of lava alternating with weaker sedimentary rocks, tilted upward due to rifting and continental collision, would be apparent (Schultz 2004). Orientation of the bedrock ridges is the reason why streams tend to run toward the southwest in roughly parallel courses and also partially explains the surface topography of the southern part of the ecological landscape where glacial deposits are thinner.

There is a lack of specific information about the bedrock beneath this ecological landscape. Based on the generalized

statewide map of bedrock geology, about 76% of the area is underlain by volcanic and metamorphic rock, and the remainder is underlain by sandstone. Elevation of the Precambrian surface is relatively high at over 1,000 feet; for comparison, the highest elevations of Precambrian rock are at around 1,600 feet in the North Central Forest Ecological Landscape, and the lowest are at -2,000 feet in the southeast corner of the state. The thickness of glacial sediment over bedrock is typically 50 to more than 100 feet, but about a quarter of the ecological landscape has bedrock within about 5 to 50 feet of the surface. Schultz (2004) described the "St. Croix Range" as lava outcrops that run along the northwest side of the upper St. Croix River in Douglas County. Additional outcrops of volcanic rock occur within the Douglas Range, which is the edge of the uplifted section of Keweenawan volcanic rock that lies along the northern border of the Northwest Lowlands Ecological Landscape. Waterfalls, cliffs, exposed bedrock glades, and rock-walled gorges, such as those at Pattison State Park, are associated with the volcanic bedrock. Local exposures of Precambrian sandstones and/or conglomerates also occur in some of the Douglas Range gorges. Cambrian sandstones border much of the St. Croix River in Burnett and Polk counties and underlie the disjunct portion of the Northwest Lowlands Ecological Landscape in southwest Burnett and northwest Polk counties (Johnson 2000).

Landforms and Surficial Geology

The Northwest Lowlands formed in glacial moraines and till plains of the Copper Falls Formation, deposited by the Superior Lobe during the Late Wisconsin glaciation, between about 20,000 and 11,500 years ago (Figure 16.1). This glacial landscape is a small portion of a large system of till plains and moraines that extend westward into Minnesota. See the description of the Mille Lacs Uplands Subsection (212Kb) on the Minnesota DNR website (MDNR 2015a). The Copper Falls till is typically a reddish-brown sandy loam, derived by glacial action from the reddish Precambrian sandstone bedrock (Keweenawan Formation) in the Lake Superior basin and from meltwater stream sediments. It is only slightly calcareous. The thickness of glacial deposits primarily ranges from around 50 to more than 100 feet over bedrock but is thinner in about a quarter of the area. Clayton's (1984) report is the primary reference on glacial geology for this ecological landscape.

The Copper Falls Formation was deposited during the time when the Superior Lobe advanced as far south as the St. Croix and Chippewa Moraines and then retreated and readvanced several times. Readvances included the Tiger Cat Advance, Hayward Advance, Swiss and Airport Advances, and Lake Ruth Advance (Clayton 1984). The southern part of the Northwest Lowlands Ecological Landscape (Landtype Association 212Kb32) was not covered by any of the glacial advances after the Hayward Advance, allowing a longer time period for washing and reworking of the surface. This partially explains the difference in topography; the southern part of the ecological landscape is an undulating till plain with thin till draped over older dense till or Precambrian bedrock, forming small knolls and ridges.

Moraines in the northern part of the ecological landscape (Landtype Association 212Kb01) have steep, hummocky topography resulting from deposition of thick till that melted out onto the upper surface of the stagnant ice sheet (***supraglacial till***) and was draped onto large ice blocks, which then melted slowly so that till materials collapsed into the depressions left behind. The moraines include many ice-walled and ice-dammed lake plains. There are few drumlins in the ecological landscape because the till was deposited by melting of the ice sheet rather than being molded beneath moving ice. There are several eskers (Clayton 1984). The many wetlands that occur in the ecological landscape are the result of impeded drainage caused by the underlying dense till.

The St. Croix and the Bois Brule river valleys are important landscape features that lie along most of the southern boundary of the Northwest Lowlands Ecological Landscape. These valleys were an outlet for Glacial Lake Duluth from approximately 9,600 to 9,900 years ago, when the water stood at elevations up to 1082 feet (the current elevation of Lake Superior is 603 feet). This channel also drained previous glacial lakes that formed in front of the ice sheet whenever outlets at the east end of the Lake Superior basin were blocked by ice. The large size of the valleys leads to questions about the amount of water required to carve such a channel. Clayton (1984) thought it most likely that Glacial Lake Ontonagon in the western Upper Peninsula of Michigan drained catastrophically at around 11,000 years ago (the end of the

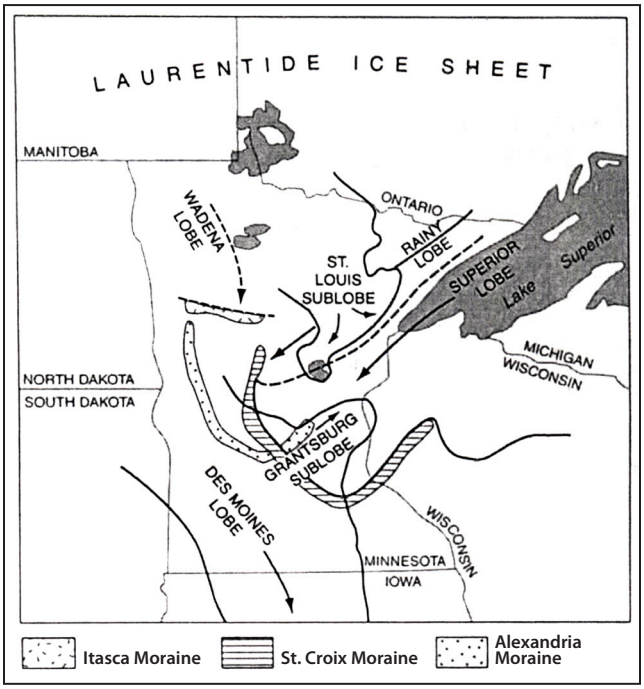


Figure 16.1. *Extent of the Superior Lobe connecting the disjunct portion of the Northwest Lowlands with deposits in Minnesota. Figure reprinted from Wright (1998) courtesy of Minnesota Geological Survey.*

Porcupine Advance) when an ice dam melted and the lake breached the barrier. The rapidly draining lake flowed westward along the edge of the ice sheet, joining the Bois Brule valley just south of the current crossing of U.S. Highway 2. Because the ice sheet blocked the Lake Superior basin, water running through the Bois Brule channel drained southward into the St. Croix valley and the Mississippi River. The quantity of water draining from Glacial Lake Ontonagon would have been large enough to cut the valleys now occupied by the St. Croix and Bois Brule rivers.

A small area of this ecological landscape is disjunct from the rest of the Northwest Lowlands in Wisconsin but is connected through deposits of the Superior Lobe in Minnesota. The disjunct area is located south of the westernmost end of the Northwest Sands Ecological Landscape in southwest Burnett and northwest Polk counties, including the town of Cushing and extending north to Grantsburg. It is a moraine of the Trade River Formation, deposited by the Grantsburg Sublobe of the Des Moines Lobe, formed of calcareous sandy loam till (Johnson 2000). Des Moines Lobe deposits are typically more calcareous than those of the Superior Lobe because they incorporated limestone and dolomite from Paleozoic bedrock deposits in central Manitoba. The Trade River Formation lies over material deposited by the Superior Lobe, particularly Copper Falls stream sediments. The mode of deposition was similar to the rest of the ecological landscape; pitted and hummocky topography formed when supraglacial till collapsed into depressions left when stranded ice blocks melted.

A map showing the Landtype Associations (WLTA Project Team 2002) in this ecological landscape, along with the descriptions of the Landtype Associations, can be found in Appendix 16.K at the end of this chapter.

Topography and Elevation

The lowest elevation in the Northwest Lowlands Ecological Landscape is approximately 754 feet, at the St. Croix River in the southernmost part of the ecological landscape in Polk County. The highest elevation is 1,369 feet, at the site of the former Summit Lookout Tower in Douglas County. Topography is typically undulating or rolling but ranges from nearly level in wetlands and outwash deposits to hilly and steep in moraines and along river valleys.

Soils

Most upland soils formed in reddish-brown, noncalcareous, dense sandy loam to loamy sand till of the Copper Falls Formation. Intermixed with the till are soils formed in outwash sand and gravel. The dominant soil is moderately well drained and loamy with a sandy loam surface, moderately slow permeability, and moderate available water capacity. Overall, the soils range from moderately well drained to somewhat poorly drained and generally have sandy loam to silt loam surface textures, moderate to slow permeability, and moderate available water capacity. The dense till impedes water infiltration in some locations, creating wetlands. Many areas are underlain with igneous bedrock. Aeolian silt (loess) deposits on the surface typically range from 6 to 24 inches thick (Hole 1976). Most lowland soils are very poorly drained to poorly drained loamy till or non-acid muck. The major river valleys have soils formed in sandy to loamy-skeletal alluvium or in non-acid muck. Alluvial soils range from well drained to very poorly drained and have areas subject to periodic flooding. Soils of the disjunct portion of the ecological landscape, in southwest Burnett and northwest Polk counties, are characterized by a fine sandy loam surface over calcareous sandy loam till. These soils are moderately well drained to somewhat poorly drained. The disjunct area also contains very poorly drained non-acid muck soils.

Hydrology

Basins

This small ecological landscape lies within only two major basins. Approximately 40% is within the Lake Superior basin, and 60% is within the St. Croix basin. Only 12 watersheds occur, at least in part, within this ecological landscape (see Appendix 16.A). The major hydrologic feature here is the St. Croix River, which forms the state border and the southwestern border of the ecological landscape.

The northern edge of the Northwest Lowlands, although only 10 miles south of the city of Superior, has a scarcity of major roads and is largely isolated from impacts of urban and other development. A large portion of this ecological landscape is composed of roadless blocks that range in size from 13.5 to 33 square miles (TNC 2002). This lack of development has helped maintain very good water quality in two ways. First, there are few industrial and municipal treated water discharges into streams. Second, forests cover a high percentage of the ecological landscape, helping to maintain a natural stream flow regime and protecting against stream bank and gully erosion. The St. Croix River is a good example of a large, fast, northern river with high water quality (W. Smith, Wisconsin DNR, personal communication).

Inland Lakes

According to the Wisconsin DNR's 24K Hydrography Geodatabase (WDNR 2015c), there are only 76 named lakes, totaling 5,050 acres, in the Northwest Lowlands Ecological Landscape. Small, unnamed lakes, generally associated with bogs and other wetlands, are much more common. There are 715 unnamed lakes identified here totaling 1,116 acres.

The largest lakes in the Northwest Lowlands are Amnicon (426 acres), Lyman (403 acres), Nebagamon (914 acres), and Minnesuing (413 acres). These are all in the Amnicon and Bois Brule watersheds and are popular for a wide range of recreational activities. Lyman Lake has been deepened slightly by a low-head dam at its outlet. Some of the other smaller lakes here, such as Gander, Steele, Dowling, Cream, McGaw, Breitzman, and Black, are associated with significant wetland complexes and exhibit healthy water conditions and

This shallow, softwater drainage lake is within a vast wetland of marsh, meadow, fen, and bog. Black Lake State Natural Area, Douglas County. Photo by Eric Epstein, Wisconsin DNR.

good floristic diversity. They support important assemblages of aquatic invertebrates, which often include one or more rare species. Several named lakes here are sloughs within the St. Croix River floodplain, and these provide habitat for some of the many rare species associated with that river. Wild rice (*Zizania* spp.) beds naturally occur in Douglas County on Amnicon and Bear lakes (Wisconsin DNR unpublished data, SEH 2014).

Impoundments

There are 4,167 acres of impoundments behind 32 dams in this ecological landscape, with a volume of 20,671 acre feet of water (WDNR 2015c). These impoundments are generally small and shallow compared to some of those in other ecological landscapes. Small impoundments still exist on the Tamarack River, Glendenning Creek, Cranberry Creek, and Moose Branch Creek (a tributary to the Moose River in Douglas County) as well as other small creeks. Radigan Flowage, covering 140 acres with depths ranging from 2 to10 feet, supports wild rice. Stateline Flowage (58 acres) on the West Branch of Hay Creek also supports wild rice.

The Nevers Dam was constructed across the St. Croix River by the Weyerhauser Lumber Company in 1889 about 11 miles upstream from St. Croix Falls. It was the largest wood driven-pile dam in the world and stored water in a 15-mile long reservoir to enable the company to float logs over a shallow stretch of the river (McMahon and Kamanski 2002). More importantly, it regulated the number of logs released to downstream mills, avoiding costly log jams at the rocky St. Croix River dalles narrows below the dam. Long challenged as an impediment to navigation, the dam was removed after being damaged by high river flows in 1954. The dikes and other remnants provide a reminder to the dam's historical significance in the logging era. Twelve dams have been removed for lack of maintenance, previous abandonment, or other reasons, helping to restore normal stream flows and improve habitat connectivity.

Rivers and Streams

There are 548 miles of perennial streams flowing here, including about 60 miles of the main stem of the St. Croix River, several other rivers and creeks, and many smaller streams running into Lake Superior (WDNR 2015c). Among the important waters flowing to Lake Superior are the Nemadji River and its tributaries, the Black River, the upper Amnicon River, Balsam Creek, Poplar Creek, and Nebagamon Creek, a tributary to the Bois Brule River.

The St. Croix River may be the most biologically diverse stream in Wisconsin (W.A. Smith, Wisconsin DNR, personal communication). Between the Gordon Dam just below the St. Croix's headwaters downstream to the Indianhead Flowage at St. Croix Falls are 102 free-flowing miles designated as the St. Croix National Scenic Riverway, administered by the National Park Service. The riparian zone is managed in a natural state, with little evidence of human settlement or other modifications visible from the river. The water is clear but slightly tannin stained. The stream gradient is moderate with some mild rapids. Bottom materials include sand, gravel, and boulders.

Much of the watershed here features sandy soils. Numerous small springs and seeps flow through the sandy stream margins, supplying the St. Croix with fresh, clean groundwater at intervals of roughly every 100 to 200 feet. The clean gravel and sand bottom of the upper St. Croix is ideal for burrowing invertebrates, and the rock component provides a firm substrate for mussel populations (W.A. Smith, Wisconsin DNR, personal communication).

Tributaries to the St. Croix River originating in Wisconsin include the Clam, Trade, Wood, and Yellow rivers as well as Dingle, Spruce, Toad, Tamarac, Chase, Grote, and Moose creeks. While these streams contribute to the flow of the St. Croix, in some cases they detract from its water quality, and only the lower few hundred yards of them are within the boundary of the Northwest Lowlands (much of this ecoregion is to the west of Wisconsin, in Minnesota). The last mile of the Namekagon River meets the St. Croix in this ecological landscape. Several of the St. Croix's tributaries hold populations of rare aquatic invertebrates. While most of the Clam River exhibits good to excellent water quality, the Clam River below Clam River Flowage has only "fair" water quality and introduces some nutrients into the St. Croix (Wisconsin DNR unpublished data). Neither the Clam nor the Trade rivers exhibit a highly diverse aquatic fauna related to a lack of habitat diversity. Significant tributaries enter the St. Croix from Minnesota, and water quality of these streams is generally good. An exception is the Snake River, which originates in a largely agricultural watershed and brings in excess nutrients and silt.

Springs

There are only two documented springs in this ecological landscape (Macholl 2007), but numerous spring seeps have been noted along the banks of the St. Croix River during biological inventories at an estimated frequency of about 25

Spring seepage along the St. Croix River in Burnett County. Springs and seepages support a number of rare habitat specialists and merit additional inventory and protection. Photo by Drew Feldkirchner, Wisconsin DNR.

per linear mile (W.A. Smith, Wisconsin DNR, personal communication). Governor Knowles State Forest, in westernmost Burnett County, contains many seeps that flow from the base of the adjoining bluffs into the St. Croix River along the entire length of the property (Feldkirchner 2010). Further investigation will likely result in the documentation of additional springs in this part of Wisconsin.

Wetlands

The Northwest Lowlands contains abundant wetlands that help to maintain good water quality while providing habitat for a diverse array of plants and animals. According to the Wisconsin Wetlands Inventory (WDNR 2012c), there are more than 128,000 acres of wetlands in this ecological landscape. The Northwest Lowlands ranks 12th out of 16 ecological landscapes in wetland acreage but ranks first for the amount of wetlands as a percentage of the total ecological landscape (29.8%). Forested and shrub/scrub wetlands are the most abundant types wetland communities, totaling over 76,000 and 45,000 acres, respectively.

The "Northwest Lowlands Bogs" is a large complex of wetlands (acid peatlands) designated as a ***Conservation Opportunity Area*** (COA) in the Wisconsin Wildlife Action Plan (WDNR 2005b). In addition, many of the wetlands in

Small portion of a vast peatland complex composed of fen, bog, muskeg, and conifer swamp. Belden Swamp, Douglas County. Photo by Emmet Judziewicz.

this ecological landscape (including large, intact peatlands and river corridors) are designated as Lake Superior Priority Wetland Sites (WDNR 1997), which contain the best examples of wetland and aquatic features of both the coastal and interior portions of the Lake Superior basin. These wetlands include extensive acid peatlands composed of a continuum from Open Bog, Poor Fen, Muskeg, and Northern Wet Forest (both Black Spruce Swamp and Tamarack Swamp) and other wetland communities such as Emergent Marsh, Northern Sedge Meadow, and Alder Thicket. They shelter numerous Species of Greatest Conservation Need (see the "Fauna" section below for details).

Water Quality

Surface water quality in the Northwest Lowlands is generally very good. There are many ***Outstanding Resource Waters*** (ORW) and ***Exceptional Resource Waters*** (ERW) here. These are surface waters that have very good to excellent water quality, support valuable fisheries 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 on the introduction of pollutants, with ORWs being the most restricted. These designations are intended to meet federal Clean Water Act obligations and prevent activities that lower water quality or degrade aquatic habitats. They are also used to inform and guide land use changes and human activities near these waters.

There are 46 Outstanding Resource Waters or Exceptional Resource Waters in the Northwest Lowlands Ecological Landscape. The St. Croix River has very good water quality and is a designated ORW throughout its length in the Northwest Lowlands. Other ORW streams include the Namekagon, Amnicon, Spruce, and Moose rivers as well as Nebagamon, Minnesuing, Kaspar, and Hansen creeks. Nebagamon, Lower Twin, Steele,

and Little Steele lakes are also ORW waters. Streams designated as ERW include Wolf, Beebe, Big Balsam, Clemens, and Pine creeks as well as Benson, East, Brant, Bear, and Ekdall brooks. A complete list of ORW and ERW in this ecological landscape can be found on the Wisconsin DNR website (WDNR 2012a).

No streams and only five lakes are formally listed as impaired by pollutants under section 303(d) of the U.S. Clean Water Act. Waters designated as impaired on the ***U.S. Environmental Protection Agency (EPA) 303(d) list*** exhibit various water quality problems including ***polychlorinated biphenyls*** (PCBs) in fish, sediments contaminated with industrial metals, mercury from atmospheric deposition, bacteria from farm and urban runoff, and habitat 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 an ORW or ERW. 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.

The designation of several 303(d) lakes in this sparsely populated and developed area is caused by ubiquitous atmospheric deposition of mercury, largely from coal combustion in the U.S. and, increasingly, from China. The five 303(d) impaired waters here (with impairments in parentheses) are Amnicon Lake (mercury via atmospheric deposition, sedimentation from heavy shoreline development, and total phosphorus via nonpoint sources); Trade, Lyman, and Minnesuing lakes (atmospheric mercury); and Round Lake (Eurasian water milfoil). The complete list of 303(d) impaired waters and criteria can be viewed at the Wisconsin DNR's impaired waters web page (WDNR 2012b).

Biotic Environment

Vegetation and Land Cover

Historical Vegetation

Several sources were used to characterize the ***historical vegetation*** of the Northwest Lowlands, 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 over 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 from 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 Northwest Lowlands Ecological Landscape was dominated by a mixture of different forested communities (Figure 16.2) (also see the map "Vegetation of Wisconsin in the Mid-1800s" in Appendix G, "Statewide Maps," in Part 3). However, the scale of Finley's data might have made it difficult to identify and map the open wetlands. In addition to scale-related issues and the federal public land survey data, the large acid peatlands of the Northwest Lowlands all supported a component of bog conifers (black spruce and tamarack). At the larger sites, such as Black Lake, Belden Swamp, and Ericson Creek, this would have been an open, relatively sparse growth of small, spindly trees. The most open (treeless) areas would have been roughly toward the centers of these peatland sites, though this may vary with the topography of subsurface glacial deposits or bedrock, groundwater movement, groundwater chemistry, depth and density of peat deposits, and other factors.

Federal public land survey information has been converted to a database format, and relative importance values 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 within a given land area. This analysis indicates that there was a high degree of heterogeneity in tree species in this ecological landscape. Eastern white pine had the highest RIV (17.7%), followed by tamarack (14.0%). Sugar maple, white birch, yellow birch (*Betula alleghaniensis*), spruce species, and aspen all had RIVs of 5% or higher. See the map "Vegetation of the Northwest Lowlands in the Mid-1800s" in Appendix 16.K at the end of this chapter.

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

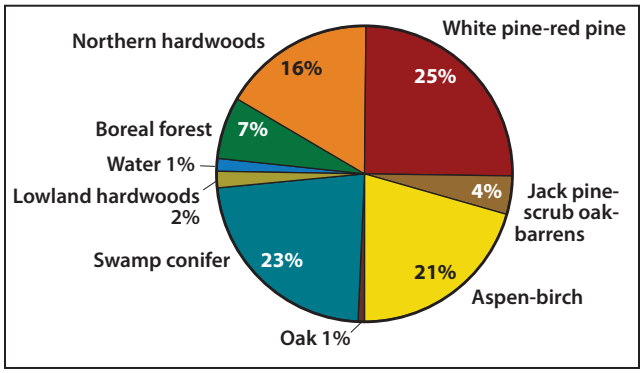


Figure 16.2. *Vegetation of the Northwest Lowlands Ecological Landscape during the mid-1800s as interpreted by Finley (1976) from the federal General Land Office public land survey information.*

(NLCD) were used. Results among these data sets often 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 appropriate for the specific factor being discussed. Information on data source 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 cover, land use, features, and attributes. It is based on satellite imagery from 1992, so it does not represent present day information. We use it in this book to offer a general view of the broad patterns of land use and land cover in Wisconsin's ecological landscapes.

The Northwest Lowlands Ecological Landscape encompasses roughly 431,000 acres, of which approximately 68% was forested and 32% was nonforested in 1992 (Figure 16.3; WDNR 1993). WISCLAND land use/land cover data from 1992 also indicates that about 28% of the ecological landscape was classified as either forested or nonforested wetland (124,100 acres), which is the highest percentage of wetlands of all 16 ecological landscapes.

The Wisconsin Wetlands Inventory offers a more detailed assessment of wetlands than is available from WISCLAND data but is limited to those wetlands identified from aerial photography (WDNR 2012c). Similar to the WISCLAND estimates, Wisconsin Wetlands Inventory data indicate that wetlands comprise 29.6% of the land cover of the Northwest Lowlands. Over 76,000 acres of these wetlands are forested, with scrub/shrub wetlands occupying another 45,000 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," in Part 1 of the book.

Forest Inventory and Analysis (FIA) data from 2004 was compiled from point samples of forested lands to assess the timber resources of the nation (USFS 2004). It contains more information and offers more specific information about forested lands than WISCLAND on forest types and species compositions, which can then be generalized across the ecological landscapes. Because FIA data are derived from on the ground sampling as opposed to the interpretation of remote imagery such as that obtained from satellites or air photos, the numbers may lead to different assessments on the status and composition of forests than WISCLAND. According to FIA data summarized in 2004, approximately 70% of the Northwest Lowlands Ecological Landscape is forested. The predominant forest ***cover type*** group is aspen-birch (43% of the forested area), followed by northern hardwoods (23%), and swamp conifers (21%). All other forest types occupy less than 10% of the forested area (Figure 16.4).

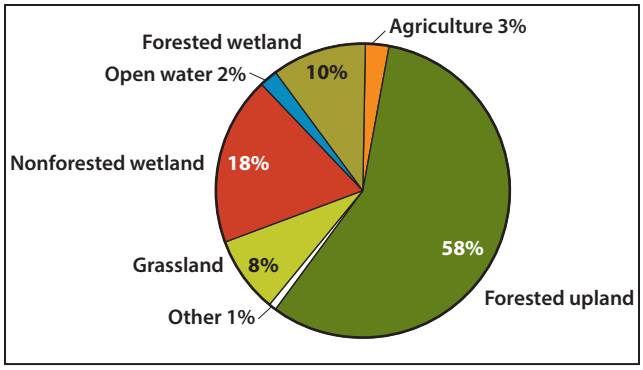


Figure 16.3. *WISCLAND land use/land cover data showing categories of land use classified from 1992 LANDSAT satellite imagery for the Northwest Lowlands Ecological Landscape (WDNR 1993).*

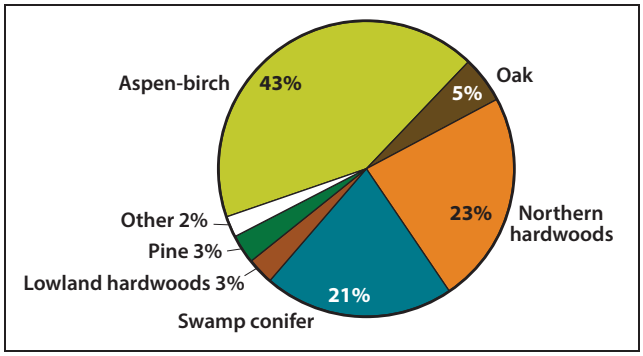


Figure 16.4. *Forest Inventory and Analysis data (USFS 2004) showing forest type as a percentage of forested land area (greater than 17% crown cover) for the Northwest Lowlands Ecological Landscape. See Appendix C, "Data Sources Used in the Book," in Part 3, "Supporting Materials," for more information about the FIA data.*

Changes in Vegetation Over Time

The purpose of examining historical conditions is to identify ecosystem factors that formerly sustained species and communities that are now altered in number, size, or extent or that have been changed functionally (for example, by constructing dams or suppressing fires). Although many data are limited to specific snapshots in time, they provide valuable insights into Wisconsin's ecological capabilities as well as historical conditions. 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. We do not mean to imply that entire ecological landscapes should be restored to their historical conditions as this is neither possible nor necessarily desirable within the context of providing for other human needs and desires. Information on the strengths and limitations of the vegetation change data and the methodologies employed are provided in Appendix C, "Data Sources Used in the Book," in Part 3.

Current forest vegetation (based on FIA) is primarily aspen-birch (*Betula* spp.) (27.4% RIV), red maple (*Acer*

rubrum) (15.3% RIV), lowland hardwoods (13.7% RIV), northern hardwoods (13.5% RIV), and fir-spruce (12.2% RIV) (Figure 16.5). Aspen-birch has increased dramatically (from 14.7% to 27.4% RIV), as has red maple (from 0.03% to 15.3% RIV). Pine species (*Pinus* spp.) have decreased from 24.6% to 5.3% RIV. Most notably, eastern white pine has decreased from 17.7% to 1.7% RIV. Tamarack has also decreased from 14.0% to 3.3% RIV.

The proportion of conifers in the Northwest Lowlands has declined precipitously, including very large decreases for eastern white and red pines. Older forests are now uncommon. At least some, perhaps most, of the fir-spruce noted in FIA is lowland conifer, rather than upland boreal communities where white spruce and balsam fir would be among the leading dominants on upland sites. The boreal conifers were mentioned frequently in the federal public land survey notes, where Boreal Forest was probably underrepresented because quaking aspen (*Populus tremuloides*) and white birch are both characteristic members of boreal forest communities in the western Great Lakes region. This is especially true in young stands, following major disturbance events such as fire or spruce budworm (*Choristoneura fumiferana*) outbreaks. Mature boreal forests would often have been mixtures of coniferous and deciduous trees, including white spruce, balsam fir, eastern white pine, white birch, and quaking aspen.

The large acid peatland complexes have remained mostly intact, and several of the largest and least disturbed have been protected through the joint efforts of Douglas County, the Wisconsin DNR, and the Minnesota DNR (e.g., Belden Swamp, Empire Swamp, and Black Lake Bog ***state natural areas***). Black Lake Bog straddles the state line and has been designated a state natural area in both Wisconsin and Minnesota.

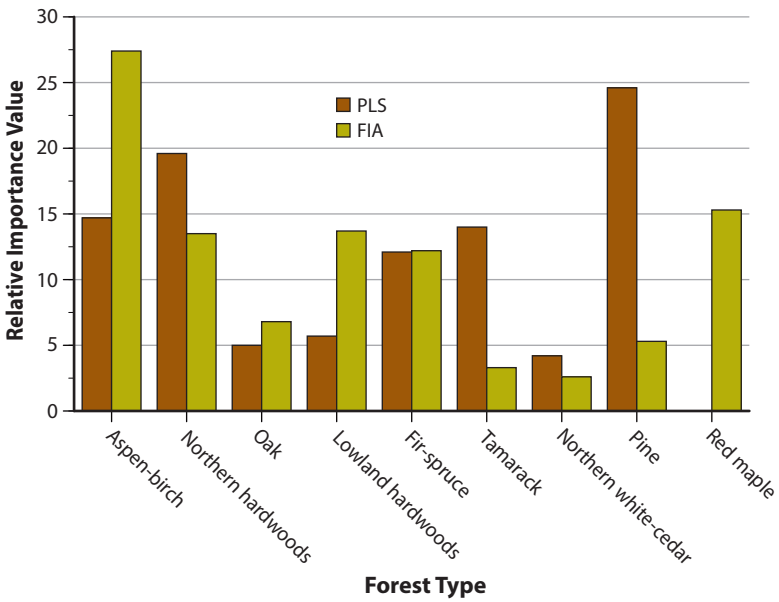


Figure 16.5. *Comparison of tree species' relative importance value (average of relative dominance and relative density) for the Northwest Lowlands Ecological Landscape during the mid-1800s, when federal General Land Office public land survey (PLS) data were collected, with 2004 estimates from Forest 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.*

Agriculture is limited in the Northwest Lowlands, with the vast majority occurring in the southernmost part of the ecological landscape, which curls around the southern edge of the Northwest Sands Ecological Landscape (see the map "WISCLAND Land Cover of the Forest Transition Ecological Landscape" in Appendix 16.K at the end of the chapter). In this area, there has been some conversion of pine barrens and dry or dry-mesic oak and pine forests to cropland and pasture. The soils and climate in the southernmost parts of the Northwest Lowlands are somewhat more conducive to agricultural uses than areas farther north.

Natural Communities

This section summarizes the abundance and importance of the 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, status, and distribution of the natural communities found in the Northwest Lowlands, 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 Northwest Lowlands is forested, and Northern Mesic Forest is the most common and widespread forest community type. Some areas now typed as aspen-birch were formerly composed of mesic hardwoods, others were pine-dominated (note the large decrease in eastern white pine-red pine), and still others may have been stands of Boreal Forest, where mixtures of upland coniferous and deciduous species co-occurred. Quite a bit of the vegetation in this ecological landscape was recorded in the federal public land survey and later mapped as aspen-birch (Finley 1976). In today's northern hardwood forests, virtually all stands here (as elsewhere throughout Wisconsin) are second-growth and are overwhelmingly dominated by sugar maple. Associates include yellow birch and American basswood. Eastern hemlock (*Tsuga Canadensis*) reaches its western range limits here but occurs only in the northeasternmost extremity of the Northwest Lowlands near Lake Minnesuing in Douglas County. Aspen is abundant on mesic sites, and managed aspen stands have

replaced Northern Mesic Forest, Boreal Forest, and various pine-dominated communities in many areas. Historically, eastern white pine was an important component of northern hardwood and (probably) boreal forests in the region as well as in dry-mesic forests dominated by pines. It is now relatively uncommon or highly localized.

Some of the stands in the northern part of the ecological landscape have retained a boreal flavor, with balsam fir common in the understory and an occasional presence of white spruce. Sites receiving cold air drainage or on soils poorly suited to good growth of mesic hardwoods (e.g., soils that are too heavy, too rocky, or too coarse-textured) may have some potential for boreal or boreal-transition forest development.

Dry-mesic forests dominated by eastern white and red pines are rare and often associated with unusual site conditions. Examples may be found in the rock-walled gorges along the Black River, on small "islands" or peninsulas associated with the large peatland complexes, and at scattered locations on the bluffs flanking the St. Croix River. Oaks (*Quercus* spp.) can be locally important on the sandier sites, especially those bordering the Northwest Sands Ecological Landscape. Northern red oak is fairly widespread. Northern pin (*Quercus ellipsoidalis*) and bur oaks (*Quercus macrocarpa*) occur on drier sites, and white oak (*Quercus alba*) is present in the southern portion of the ecological landscape.

The bedrock walls of the canyon created by the Black River as it exits the northern edge of the Northwest Lowlands supports a forest composed mostly of conifers such as eastern white pine, northern white-cedar, red pine, white spruce and balsam fir. Photo by Eric Epstein, Wisconsin DNR.

Dry forests, usually dominated by oaks or occasionally by red pine, are rare and most often associated with sites on shallow coarse-textured soils where bedrock is close to the surface. Jack pine (*Pinus banksiana*) is present on the ecological landscape's southern and southeastern edges, usually on very dry sites adjacent to the Northwest Sands.

Black Spruce Swamp is the most common lowland forest community. Tamarack is often present in these stands and can be dominant in other conifer swamp communities. These conifer swamps comprise major portions of large acid peatland ecosystems. Wet-mesic forests are uncommon and scattered, usually in small patches, except on low benches along the St. Croix River. These sites receive ground water seepage from the adjoining bluffs and sandy uplands to the east. Northern white-cedar (Northern Wet-mesic Forest) is dominant at some locations; black ash (Hardwood Swamp) is dominant in others. Toward the southernmost part of the ecological landscape along the St. Croix River, a Floodplain Forest variant is present at a few sites, with silver maple (*Acer saccharinum*), ashes (*Fraxinus* spp.), bur oak, and box elder (*Acer negundo*) among the common co-dominants or associates. The numerous seeps along the St. Croix feed many of the wetlands within the river corridor, contribute to high water quality, and support habitat specialists, some of them rare.

Savannas. Savannas were likely a minor component in the Northwest Lowlands Ecological Landscape at the time of Euro-American settlement, in marked contrast to the adjacent Northwest Sands Ecological Landscape. These communities are currently absent from the northern part of the ecological landscape. Barrens communities can be found

This acid, somewhat open, conifer swamp is dominated by black spruce, ericaceous shrubs, sedges, and sphagnum mosses and supports many boreal vertebrates and insects. Photo by Eric Epstein, Wisconsin DNR.

The Dry Prairie, Pine Barrens, and Northern Dry Forest communities pictured here occur only on sandy sites in the southernmost part of the Northwest Lowlands. Photo by Thomas Meyer, Wisconsin DNR.

This large wetland is composed mainly of sphagnum mosses, sedges, and low ericaceous shrubs. In the distance, woody cover increases—mostly stunted swamp conifers such as black spruce and tamarack. Photo by Eric Epstein, Wisconsin DNR.

in small pockets along the St. Croix River, especially on the upper slopes of south- or west-facing bluffs.

Shrub Communities. Alder Thicket is a common tall shrub wetland community throughout most of the Northwest Lowlands Ecological Landscape, where it borders streams and the upper margins of the large peatland complexes. Alder (*Alnus* spp.) is also common along the St. Croix and some of its tributaries, especially in areas receiving groundwater seepage. Thickets of bog birch (*Betula pumila*) occur locally within the acid peatlands, which also support stands of low ***ericaceous shrubs***. Willow-dominated (*Salix* spp.) areas of Shrub-carr are prominent in a few areas, such as the extensive semi-open wetlands that occur along the St. Croix River adjacent to Governor Knowles State Forest. Burned or cutover dry forests in the southern part of the ecological landscape often go through a shrubby (or "grub") stage, but areas of such vegetation are limited here, and the stages are short-lived unless the vegetation is managed specifically to maintain semi-open barrens conditions.

Herbaceous Communities. The common herb-dominated natural communities in the Northwest Lowlands are all wetlands. Sedges (*Carex* spp.) dominate the large open peatland communities such as Poor Fen and Northern Sedge Meadow. Less acidic, sometimes seepage-fed sedge-dominated areas occur in the lowlands along the St. Croix River, where areas of Emergent Marsh are also found. Small patches of dry prairie occur in the southern part of the ecological landscape on a few of the steep, sandy bluffs, on south or west slopes above the St. Croix River. These are closely associated with the overgrown oak and pine barrens and xeric forests found just to the east of the bluffs in the Northwest Sands.

Miscellaneous Communities and Habitats. Bedrock outcroppings are highly localized, and the most prominent examples are found on the northern edge of the ecological landscape where gorges were cut through an escarpment by the Black River. There is potential for rare plants in these habitats, though conducting detailed surveys for flora in such areas is daunting as the rock surfaces are sheer and often wet, with vertical drops of several tens of meters.

Areas of Surrogate Grassland occur on some of the abandoned or less intensively used agricultural lands. These are generally much smaller than grasslands found in the adjacent ecological landscapes.

Aquatic Communities. See the "Hydrology" section of this chapter and Chapter 7, "Natural Communities, Aquatic Features, and Selected Habitats of Wisconsin."

Forest Habitat Types

The Northwest Lowlands Ecological Landscape is dominated by four habitat type groups: wet-mesic to wet, mesic to wet-mesic, mesic, and dry-mesic (Table 16.1). Dryer sites are of minor occurrence here.

Wet-mesic to wet forested lowlands typically occur on poorly drained peat and muck soils. On nutrient medium to rich sites, stands can be dominated by swamp hardwoods or swamp conifers. On nutrient poor to medium sites, most stands are dominated by swamp conifers.

Mesic to wet-mesic sites are associated with somewhat poorly drained loamy and sandy soils, typically nutrient medium to poor, although rich sites also occur. On nutrient poor sites, common overstory dominants are aspen, white birch, red maple, balsam fir, white spruce, and eastern white pine; potential late-successional dominants are red maple, balsam fir, white spruce, and eastern white pine. On nutrient-medium to nutrient-rich sites, common overstory dominants are aspen, white birch, red maple, ashes, sugar maple, and oaks; potential late-successional dominants are red maple and sugar maple, accompanied by ashes, American basswood, yellow birch, and balsam fir.

Table 16.1. *Forest habitat type groups and forest habitat types[a] of the Northwest Lowlands Ecological Landscape (NWL EL).*

Northern forest habitat type groups[b] common within the NWL EL	Northern forest habitat types common within the NWL EL	Northern forest habitat types minor within the NWL EL
Wet-mesic to wet (WM-W)	Forest Lowland (habitat types not defined)	
Mesic to wet-mesic (M-WM)	ArAbVCo AAtRp	ASaI
Dry-mesic (DM)	AVCl ACl	AVDe AAt
Mesic (M)	AAs	ACaCi
Northern forest habitat type groups minor within the NWL EL		
Dry to dry-mesic (D-DM)		PArVAm PArVAa-Po

Source: Kotar et al. (2002).
[a]Forest habitat types are explained in Appendix 16.B ("Forest Habitat Types in the Northwest Lowlands Ecological Landscape") at the end of this chapter.
[b]Groups listed in order from most to least common:
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.

Mesic sites are typically associated with loamy soils that are well to moderately well drained and nutrient medium to rich. Most stands are dominated by aspen and white birch, or sugar maple accompanied by any of red maple, American basswood, oak, white birch, or eastern white pine. Potential late-successional dominants are sugar maple with red maple, American basswood, and yellow birch.

Dry-mesic sites are typically associated with loamy to sandy soils that are well to moderately well drained, and nutrient medium. Most stands are dominated by aspen and white birch or northern red oak, red maple, and sugar maple; occasional associates include American basswood, white ash (*Fraxinus americana*), yellow birch, white oak, eastern white pine, balsam fir, and white spruce. Potential late-successional dominants are sugar maple and red maple with American basswood, yellow birch, eastern white pine, and balsam fir.

Flora

The Wisconsin Natural Heritage Inventory tracks 24 species of rare plants that have been documented in the Northwest Lowlands as of 2009. Of these, three are Wisconsin Endangered, six are Wisconsin Threatened, and 13 are Wisconsin Special Concern. Appendix 16.C includes information on all rare species documented in this ecological landscape since 1970, including legal status, state and global ranks, number of statewide populations, and number of populations in the Northwest Lowlands compared with the number of known populations statewide. This information is periodically updated, as new information becomes available.

None of the rare plants documented here are known to occur only in the Northwest Lowlands nor are there any rare plant species for which 50% or more of their state populations are in this ecological landscape.

Significant Flora in the Northwest Lowlands Ecological Landscape

- Rare plant species (and many rare animals) occur in the large intact peatlands in the northern part of the Northwest Lowlands.
- The peatlands are large and remote and merit additional survey work.
- The St. Croix River corridor harbors populations of rare plants that occur in habitats such as spring runs, seepages, and forested seeps.
- Dry open bluffs above the St. Croix River support rare prairie and barrens plants limited to rare habitats.
- Bedrock exposures such as cliffs and gorges provide critical habitat for specialized plants. Gorges in the north merit additional survey work.
- Lakes and streams in the remote, northern part of the ecological landscape are difficult to access and have not been well surveyed. These aquatic habitats have potential to support rare species.

Species with 25%–50% of their known Wisconsin populations occurring here are the Wisconsin Endangered lesser wintergreen (*Pyrola minor*), the Wisconsin Threatened bog bluegrass (*Poa paludigena*) and northern bur-reed (*Sparganium glomeratum*), and the Wisconsin Special Concern russet cotton-grass (*Eriophorum chamissonis*). Another rare plant is the Laurentian bladder fern (*Cystopteris laurentiana*), a Wisconsin Special Concern species. This plant was documented recently (post-2009) at Pattison State Park near the falls of the Black River.

Russet cotton-grass is a rare sedge known in Wisconsin only from a few peatlands in the far north. Photo by Joe Mirenna.

The Wisconsin Threatened northern bur-reed has been documented at several locations within this ecological landscape. Photo by June Dobberpuhl.

To date, detailed botanical surveys have occurred only within the St. Croix National Scenic Riverway, on Governor Knowles State Forest, and in several of the large peatland complexes. Although the number of rare plant populations found in the Northwest Lowlands Ecological Landscape to date is small, rare plants have been documented in a broad spectrum of natural communities, including upland forests, lowland forests, peatlands, shrub swamps, bedrock habitats, and sand prairie/barrens complexes. Additional botanical surveys are warranted for remote peatlands that have not previously received much attention, stream corridors other than the St. Croix, and in uncommon and unusual habitats such as the bedrock exposures associated with the Douglas County fault.

This small ecological landscape is part of a much larger ecoregional Subsection, the Mille Lacs Uplands (212Kb), that lies mostly within Minnesota (Cleland et al. 1997). For a list of Minnesota's rare plants in that part of the Mille Lacs Uplands, see MDNR (2015b).

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 as occurring in the Northwest Lowlands. 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 Northwest Lowlands was important historically for many wildlife species, especially mixed deciduous-coniferous forest and peatland species. These included the gray wolf, moose, American black bear (*Ursus americanus*), American beaver (*Castor canandensis*), and North American river otter (*Lontra canadensis*). As with the rest of the state, wildlife populations changed following late 19th and early 20th century logging, slash fires, and Euro-American settlement.

Based on fur harvest sales and trapping records, both the American beaver and the North American river otter were abundant statewide, but populations of both species declined dramatically as a result of unregulated trapping and hunting for the fur trade through the 1700s and mid-1800s (Schorger 1965, Schorger 1970). Populations of both species have since recovered, and both are now found throughout the Northwest Lowlands Ecological Landscape.

Historically, the gray wolf was found throughout the state (Schorger 1942). After the southern part of the state was settled and bounties were imposed, gray wolves remained only in the more remote portions of northern Wisconsin by the 1920s (Thiel 1993). Gray wolf populations continued to decline in northern Wisconsin until 1958 when the last Wisconsin gray wolf was thought to have been killed by a car in Bayfield County. Occasional sightings of gray wolves occurred throughout the 1960s and 1970s, but they were thought to be lone gray wolves wandering here from Minnesota or Michigan. Not until the late 1970s was breeding by gray wolves documented in Wisconsin. By 2012 the Wisconsin gray wolf population had increased to over 800 individuals (Wydeven et al. 2012).

This ecological landscape was very important to gray wolf reestablishment in the state. Gray wolves emigrated from Minnesota into and through the Northwest Lowlands because of the low road density, large blocks of unsettled land, and availability of white-tailed deer as a food source. From the early 1980s to the mid-1990s, this ecological landscape was the stronghold of the gray wolf in the state. Gray wolf populations here became a source population that increased and dispersed into other parts of the state. After the mid-1990s, the gray wolf population increased rapidly and dispersed throughout northern and central Wisconsin. Today the Northwest Lowlands remains an important dispersal corridor for gray wolves moving between Minnesota and Wisconsin. Though small, this ecological landscape has the highest density of gray wolf packs in the state with all available habitat occupied by ten gray wolf packs and 41 individuals. (Wydeven et al. 2008).

Moose were once fairly common in Wisconsin. They were found throughout the northern third of the state, but there were reports of moose as far south as the Lake Winnebago area as well as one report each from Green Lake and Sauk counties (Schorger 1956). The largest moose population was in the northwestern part of the state (Figure 16.6), most likely in the Northwest Lowlands and Northwest Sands ecological landscapes because of their abundant wetlands and lakes. The moose is mentioned as one of the principal game animals of American Indians in the Superior area in 1820 (Schorger 1956). Due to uncontrolled hunting, the moose was rare in much of Wisconsin by 1866 (Schorger 1956). However, moose seemed to persist in the northwestern part of the state. In the fall and winter of 1884, it was reported that "a hunter had exceptional success in killing five moose in Douglas County" (Schorger 1956). After 1900, few moose existed in the state until the 1960s, when moose began to be seen again in northwestern Wisconsin as the Minnesota moose population increased. Today there are few moose in the state; estimates are from 20 to 40 animals, depending on the year. Most moose wander into Wisconsin from Michigan and Minnesota. A calf was born in Florence County in the summer of 2008, but it is unclear if Wisconsin has a permanent moose population. Moose do not survive well in areas with high populations of white-tailed deer (*Odocoileus virginianus*) because white-tailed deer are often infected with a brain parasite that doesn't harm the white-tailed deer but is lethal to moose. In all, there have been more than 280 observations of moose reported to the Wisconsin DNR over the last decade. In 2007 there were 37 moose sightings in Wisconsin, but some may have been repeat sightings of the same animal.

American black bears were historically abundant throughout the northern and central parts of the state and remained in the north throughout settlement in reduced numbers. The Northwest Lowlands is located in what is now considered primary American black bear range (Figure 16.7) by Wisconsin DNR.

White-tailed deer were historically found across the state but were more abundant in the southern half of Wisconsin at the time of Euro-American settlement (Schorger 1953). Northern Wisconsin, much of which was vegetated with

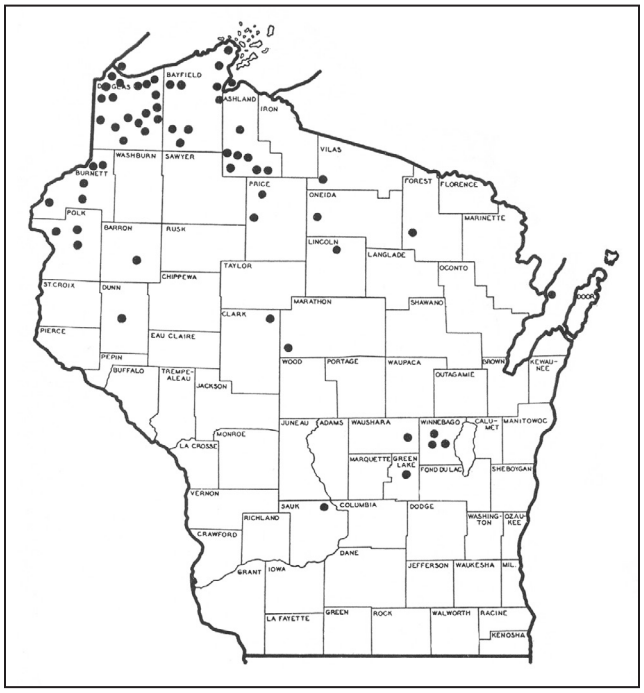


Figure 16.6. *Probable range of the moose in Wisconsin prior to Euro-American settlement. Figure reproduced from Schorger (1956) by permission of the Wisconsin Academy of Sciences, Arts and Letters.*

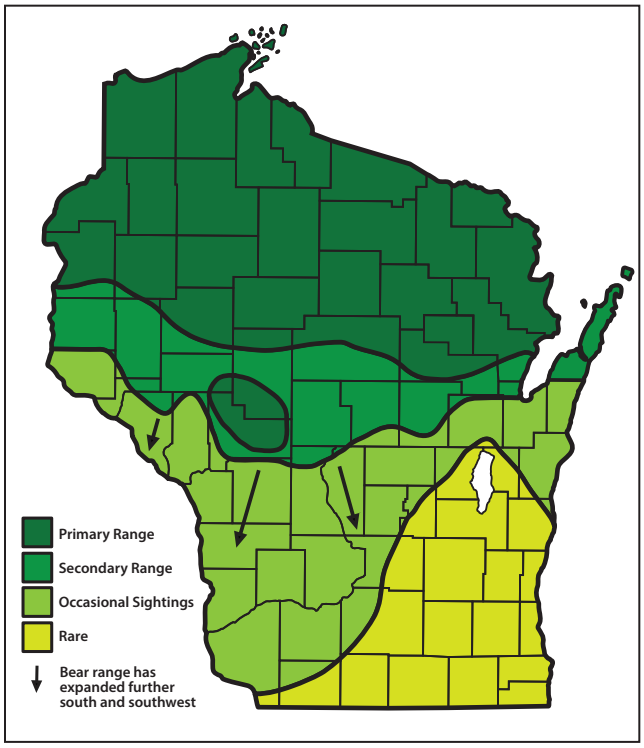


Figure 16.7. *Wisconsin American black bear range.*

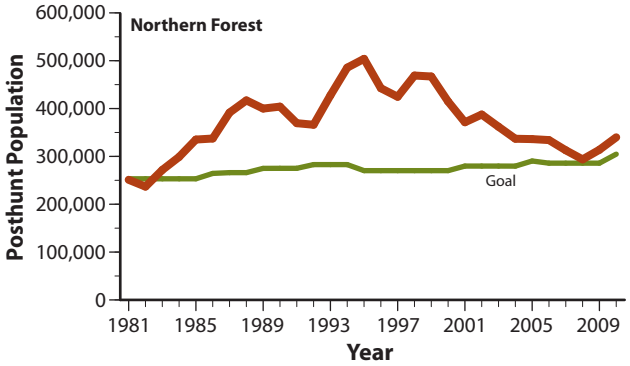


Figure 16.8. *White-tailed deer population size in relation to population goals in the northern forest deer management region, 1981– 2010 (Wisconsin DNR unpublished data).*

mature to old-growth mixed deciduous-coniferous forest, was not optimal habitat, so the white-tailed deer population would have been limited. The white-tailed deer range expanded and the population increased in northern Wisconsin after the large-scale logging of the late 1800s (Schorger 1953). Logging was often followed by fire, and the mature mixed conifer-hardwood forest in northern Wisconsin was replaced by young deciduous trees, including vast acreages of aspen, white birch, and other forage plants that provided abundant food for white-tailed deer. As with the rest of the state, white-tailed deer are more numerous in the Northwest Lowlands today than they were before Euro-American settlement. Large portions of the forest are now maintained as early successional deciduous species, especially quaking aspen, resulting in more favorable white-tailed deer habitat. However, because of the climate and the small amount of agriculture found here, ***carrying capacity*** for white-tailed deer is still low relative to most other parts of Wisconsin. Therefore, white-tailed deer population goals have been set at 15–20 deer per square mile. The white-tailed deer herd has often been above goal for most northern forest deer management units in the last decade. Only in 2008–11 have white-tailed deer populations been near or below goals in northern Wisconsin (Figure 16.8).

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. To ensure that all native species are maintained in Wisconsin somewhere, "significant wildlife" includes both common species and species that are considered "rare" (in this book "rare" includes species listed as "endangered" or "threatened" by either the State of Wisconsin or the federal government or species that are listed as "special concern" by the State of Wisconsin). Four categories of species are discussed (which may overlap): rare species, Species of Greatest Conservation Need (SGCN), responsibility species, and socially important species (see definitions in the text box). Because maintaining or restoring wildlife communities and habitats are the most efficient way to manage and benefit a majority of species, we also discuss management of different wildlife habitats in which significant fauna occur. See Appendix 16.C for a comprehensive list of the rare animals known to exist in the Northwest Lowlands Ecological Landscape in 2009. (Note that both the Wisconsin Natural Heritage Working List [WDNR 2009] and the statutory lists of endangered, threatened, and special concern species are working documents that change periodically.)

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 (SGCN)** 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 in the future.
- **Responsibility species** are both common and rare species whose populations are highly 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 included in a particular ecological landscape, 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.

Rare Species. As of November 2009, the Wisconsin Natural Heritage Working List had documented 64 rare fauna within the Northwest Lowlands Ecological Landscape, including two mammals, 15 birds, four herptiles, six fishes, and 37 invertebrates (WDNR 2009). These include two U.S. Endangered species, one candidate for future U.S. listing, 5 Wisconsin Endangered species, 12 Wisconsin Threatened species, and 47 Wisconsin Special Concern species. See Appendix 16.D for the number of species per taxon with special designations documented within Northwest Lowlands Ecological Landscape.

■ ***Federally Listed Species:*** The gray wolf, for which the Northwest Lowlands Ecological Landscape remains very important, was removed from the federal endangered species list in January 2012, granting management authority to the State of Wisconsin. The Wisconsin state legislature passed a law in April 2012 authorizing hunting and trapping seasons for gray wolves and directed that wolf hunting and trapping seasons be held starting in the fall of 2012. The first hunting and trapping seasons of gray wolves were conducted during October-December 2012. Gray wolves are being managed under a 1999 wolf management plan (WDNR 1999) with addenda in 2006 and 2007, but the plan is being updated to reflect the change in status from an endangered species to a hunted and trapped animal in Wisconsin. The Karner blue butterfly (*Lycaeides melissa samuelis*) is listed as U.S. Endangered and occurs here at the northwestern edge of its range, with only two documented occurrences within this ecological landscape. It is managed under a Habitat Conservation Plan approved by the U.S. Fish and Wildlife Service. The spectacle case mussel (*Cumberlandia monodonta)*, the only U.S. ***candidate species*** for federal listing in the Northwest Lowlands, is found in the St. Croix River and is listed as a Wisconsin Endangered species.[1] The Bald Eagle (*Haliaeetus leucocephalus*) (formerly U.S. Threatened) is also found here. Since its delisting, the Bald Eagle is federally protected under the federal Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. Both the gray wolf and the Karner Blue butterfly are designated Wisconsin Special Concern species due to their high numbers within the state.

■ ***Wisconsin Endangered Species:*** One Wisconsin Endangered mammal, the American marten (*Martes americana*), occurs in the Northwest Lowlands. No Wisconsin Endangered birds, herptiles, or fishes have been documented in this ecological landscape. Two Wisconsin Endangered mussels, spectacle case and purple wartyback (*Cyclonaias tuberculata*), and two other invertebrates, extra-striped snaketail (*Ophiogomphus anomalus*) and Saint Croix snaketail (*Ophiogomphus susbehcha*), occur here (WDNR 2009).

■ ***Wisconsin Threatened Species:*** No Wisconsin Threatened mammals occur here. There are four Wisconsin Threatened birds: Red-shouldered Hawk (*Buteo lineatus*), Yellow Rail (*Coturnicops noveboracensis*), Spruce Grouse (*Falcipennis canadensis*), and Hooded Warbler (*Setophaga citrina,* listed as *Wilsonia citrina* by the Wisconsin Natural Heritage Working List); two Wisconsin Threatened herptiles: wood turtle (*Glyptemys insculpta*) and Blanding's turtle (*Emydoidea blandingii*); three Wisconsin Threatened fish: river redhorse, greater redhorse (*Moxostoma valenciennesi*), and gilt darter; one Wisconsin Threatened mussel: salamander mussel (*Simpsonaias ambigua*); and one Wisconsin Threatened invertebrate, pygmy snaketail (*Ophiogomphus howei*), that have been documented in this ecological landscape (WDNR 2009).

The gilt darter (Wisconsin Threatened) is one of several rare fish known to occur in the upper St. Croix River. Photo by John Lyons, Wisconsin DNR.

■ ***Wisconsin Special Concern Species:*** Wisconsin Special Concern species found in this ecological landscape include one mammal, 11 birds, 2 herptiles, 2 fishes, and 31 invertebrate species (WDNR 2009; see Appendix 16.C for a complete rare species list).

■ **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 the Wisconsin or federal lists as well as other species that are declining. There are 45 species, including 10 mammals, 24 birds, 6 herptiles, and 5 fish, listed as SGCN for the Northwest Lowlands Ecological Landscape (see Appendix 16.E for a complete list of SGCN in this ecological landscape and the habitats with which they are associated).

■ **Responsibility Species.** This ecological landscape continues to be important for the gray wolf. It was the first Wisconsin ecological landscape colonized by gray wolves moving east from Minnesota in the early 1970s, and the lack of development and low road density provide habitat and serve as a dispersal corridor between Wisconsin and the source population in Minnesota. Although the Northwest Lowlands is the smallest ecological landscape (431,800 acres) in the state, it had ten gray wolf packs and at least 41 individual gray wolves in 2007 (Wydeven et al. 2008), with all suitable habitat occupied. In the absence of additional roads and human development that would fragment habitat and create dispersal barriers, this ecological landscape is likely to remain highly important to the state's gray wolf population.

In addition to the gray wolf, the habitat characteristics of the ecological landscape make it important for other wide-ranging mammals such as bobcat (*Lynx rufus*), American black bear, and North American river otter. Also, the extensive wetland habitat and low white-tailed deer populations here offer the best place in the state for sustaining a viable moose population.

[1] When this material was written, it was based on the 2009 Wisconsin Natural Heritage Working List (WDNR 2009). Spectacle case (*Cumberlandia monodonta*) mussel was listed as U.S. Endangered in 2012.

The Golden-winged Warbler (*Vermivora chrysoptera*) is a rare and declining species over most of its North American breeding range, and approximately 65% of its continental population is found in Wisconsin and Minnesota (Rich et al. 2004). This ecological landscape, with its alder-lined streams and abundant shrub-bordered peatlands, is considered the core area for the Golden-winged Warbler in the state due to its abundance here (Steele 2007).

The extensive peatlands of the Northwest Lowlands offer important habitat for conifer-dependent boreal species such as Gray Jay, Canada Warbler (*Cardellina canadensis*, listed as *Wilsonia canadensis* by the Wisconsin Natural Heritage Working List), Red Crossbill (*Loxia curvirostra*), Northern Saw-whet Owl (*Aegolius acadicus*), Black-backed Woodpecker (*Picoides arcticus*), Olive-sided Flycatcher (*Contopus cooperi*), Great Gray Owl (*Strix nebulosa*), Cape May Warbler (*Setophaga tigrina,* listed as *Dendroica tigrina* on the Wisconsin Natural Heritage Working List), Connecticut Warbler (*Oporonis agilis*), and Evening Grosbeak (*Coccothraustes vespertinus*). Increasing the diminished conifer component in some of the upland forests adjacent to these peatlands will also benefit species such as Black-throated Green Warbler (*Setophaga virens*), Blackburnian Warbler (*Setophaga fusca*), Nashville Warbler (*Oreothlypis ruficapilla*), and many other northern boreal forest bird species that require or prefer coniferous habitat. Open peatland birds include American Bittern (*Botaurus lentiginosus*), Le Conte's Sparrow, and Sedge Wren (*Cistothorus platensis*). Rare boreal butterflies and moths (the Lepidoptera family), such as the bog fritillary (*Boloria eunomia*), freija fritillary (*Boloria freija*), frigga fritillary (*Boloria frigga*), and red-disked alpine (*Erebia discoidalis*), have also been documented here, and the arctic fritillary is known in Wisconsin only from wetlands in the Northwest Lowlands Ecological Landscape. There is high potential for additional rare butterfly and moth discoveries here because

Gray wolf. Photo by Gary Kramer, courtesy of U.S. Fish and Wildlife Service.

Deciduous shrub swamps and young forests in some parts of northern Wisconsin provide continentally important breeding habitat for the Golden-winged Warbler. Broods use nearby older forests after fledging. Photo by Brian Collins.

The arctic fritillary is a boreal species that reaches its southernmost range limits in the acid peatlands of northwestern Wisconsin. Photo by Ann Thering.

of the abundant high quality habitat, geographic location, and the difficulty of surveying remote areas with difficult access.

The ecological landscape supports a high diversity of rare aquatic species including fish (gilt darter and river redhorse), amphibians (mink frog), dragonflies (Saint Croix snaketail, pygmy snaketail, and extra-striped snaketail) and mussels (spectacle case and purple wartyback). The St. Croix River system, which runs along the eastern and southern edges of the Northwest Lowlands, is especially noteworthy as a major repository of aquatic species diversity.

American marten was found throughout the forested regions of Wisconsin prior to Euro-American settlement but was considered extirpated by 1925 (Woodford and Dumyahn 2011). American martens have since been reintroduced at three different locations in Wisconsin, and the main focus has been two areas of the Chequamegon-Nicolet National Forest (both in the North Central Forest Ecological Landscape). However, in recent years, American martens have also been detected in the Northwest Lowlands through hair sampling and winter track surveys. This location is far from the reintroduced populations, and there may be potential for American martens to further disperse into this ecological landscape from Minnesota, where American martens are abundant enough to allow for trapping seasons.

Socially Important Fauna. Species such as white-tailed deer, moose, American black bear, American beaver, North American river otter, fisher (*Martes pennanti*), bobcat, Ruffed Grouse (*Bonasa umbellus*), American Woodcock (*Scolopax minor*), Mallard (*Anas platyrhynchos*), Wood Duck (*Aix sponsa*), and Ring-necked Duck (*Aythya collaris*) are all important here for hunting, trapping, and wildlife viewing. Many migratory birds use the St. Croix River valley, creating recreational opportunities for bird watchers and providing opportunities for the monitoring and study of wildlife populations by researchers. The diversity of species associated with boreal and open wetland habitats in the northern portion of the ecological landscape creates additional opportunities for scientists, conservation planners, and bird watchers. This ecological landscape has an important warmwater fishery, supporting populations of muskellunge (*Esox masquinongy*), northern pike (*Esox lucius*), walleye (*Sander vitreus*), smallmouth bass (*Micropterus dolomieu*), largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), yellow perch (*Perca flavescens*), black crappie (*Pomoxis nigromaculatus*), and other panfish sought by anglers. It has high-quality coldwater streams supporting brook trout (*Salvelinus fontinalis)*, as well as nonnative brown trout (*Salmo trutta*), and to a lesser extent, rainbow trout (*Oncorhynchus mykiss*).

Wildlife Habitats and Communities. The acid peatland complexes of Black Spruce Swamp, Tamarack (poor) Swamp, Muskeg, Open Bog, Poor Fen, and Northern Sedge Meadow are among the least disturbed and largest examples in the state. Many Species of Greatest Conservation Need use these wetlands, including boreal chorus frog (*Pseudacris maculata*), four-toed salamander (*Hemidactylium scutatum*), mink frog (*Lithobates septentrionalis*), Black Tern (*Chlidonias niger*), Bobolink (*Dolichonyx oryzivorus*), Connecticut Warbler, Golden-winged Warbler (bog edges and stream corridors), Le Conte's Sparrow (*Ammodramus leconteii*), American water shrew (*Sorex palustris*), woodland jumping mouse (*Napaeozapus insignis*), bog fritillary, freija fritillary, Harris' checkerspot (*Chlosyne harrisii*), and red-disked alpine (WDNR 1997). These wetland habitats can be harmed by fragmentation and hydrologic disruption caused by roads, ditches, dikes, or other developments, and inappropriate motorized uses can damage sensitive vegetation or facilitate the introduction and spread of invasive plants. Natural disturbances such as fire and insect outbreaks can benefit these wetlands. Allowing natural disturbances to occur and avoiding further fragmentation would help these communities stay intact and function as sustainable ecosystems.

The abundant wetlands of the Northwest Lowlands Ecological Landscape are used by both forest and grassland birds.

Significant Wildlife in the Northwest Lowlands Ecological Landscape

- Important core habitat and dispersal corridor for the gray wolf as well as other wide ranging mammals such as the bobcat, American black bear, and North American river otter.
- Best place in the state to sustain a viable population of moose.
- Considered the core area in Wisconsin for the continentally declining Golden-winged Warbler.
- The large peatlands provide important habitat for boreal animals, especially invertebrates and birds.
- Resident birds of the intact, extensive peatland habitats include Yellow Rail, Le Conte's Sparrow, American Bittern, Northern Harrier, Palm Warbler, Lincoln's Sparrow, Sedge Wren, and Wilson's Snipe.
- The St. Croix River supports many rare aquatic animals, including fish such as the gilt darter and river redhorse, odonates such as the Saint Croix snaketail, pygmy snaketail, and extra-striped snaketail, and mussels such as the spectacle case and purple wartyback.
- The St. Croix River corridor receives heavy use by migratory birds during the spring and fall. Resident birds along the St. Croix include Bald Eagle, Red-shouldered Hawk, and Great Blue Heron, as well as many neotropical passerines.

Examples of species that use coniferous wetlands are Winter Wren (*Troglodytes hiemalis*), Nashville Warbler, Cape May Warbler, Connecticut Warbler, Canada Warbler, Yellow-bellied Flycatcher (*Empidonax flaviventris*), Gray Jay, Red Crossbill, Northern Saw-whet Owl, Black-backed Woodpecker, Hermit Thrush (*Catharus guttatus*), and Great Gray Owl. Examples of birds that use the more open fen, meadow, bog, and muskeg habitats are Sedge Wren, Yellow Rail, Sora (*Porzana carolina*), Swamp Sparrow (*Melospiza georgiana*), Wilson's Snipe (*Gallinago delicata*), American Bittern, Northern Harrier (*Circus cyaneus*), Lincoln's Sparrow (*Melospiza lincolnii*), Palm Warbler (*Setophaga palmarum*), and Le Conte's Sparrow. See the Wisconsin Bird Conservation Initiative's All-Bird Conservation Plan (Kreitinger et al. 2012) for more details in maintaining bird species in these habitats. Alder-lined streams and shrubby peatland edges provide habitat for a variety of species such as the Golden-winged Warbler, Black-billed Cuckoo (*Coccyzus erythropthalmus*), Chestnut-sided Warbler (*Setophaga pensylvanica*), Alder Flycatcher (*Empidonax alnorum*), Mourning Warbler (*Geothlypis philadelphia*), American Woodcock, Veery (*Catharus fuscescens*), wood turtle, and snowshoe hare (*Lepus americanus*).

The Sedge Wren is a habitat specialist that breeds in wet grasslands such as fens and sedge meadows. Photo © Laurie Smaglick Johnson.

Aspen and young northern hardwood forests cover almost two-thirds of the Northwest Lowlands Ecological Landscape, benefiting early successional species such as white-tailed deer, Ruffed Grouse, American Woodcock, Chestnut-sided Warbler, and Golden-winged Warbler (see the "Current Vegetation" section). However, sometimes these forests include a significant component of fir and spruce and have potential for management as boreal-transition forest. This is an important management consideration for stands adjoining or near coniferous wetlands. Wildlife that use these conifer habitats are often specialists, and include Sharp-shinned Hawk (*Accipiter striatus*), Black-backed Woodpecker, Olive-sided Flycatcher, Yellow-bellied Flycatcher, Golden-crowned (*Regulus satrapa*) and Ruby-crowned (*Regulus calendula*) Kinglets, and Blackburnian, Cape May, Nashville, and Connecticut Warblers (Steele 2007). Species such as Black-backed Woodpecker, Gray Jay, and Yellow-bellied Flycatcher may be largely confined to the larger conifer swamps here, as they are elsewhere in their northern Wisconsin ranges.

This area often has an influx of birds in winter that typically inhabit more northerly areas, including Great Gray Owl, Boreal Owl (*Aegolius funereus*), Northern Hawk Owl (*Surnia ulula*), and Gyrfalcon (*Falco rusticolus*). In the winter of 2004–2005, there was a very large irruption of Great Gray Owls, Northern Hawk Owls, and Boreal Owls into many parts of northern Wisconsin, including the Northwest Lowlands when vole numbers in Canada were the lowest they had been for many years. Since voles comprise up to 80% of their diets, these birds moved south into Wisconsin to find food rather than face starvation.

The Wisconsin DNR Aquatic Macroinvertebrate Atlas contains data collected across the state (WDNR 2015a). These data are obtained through assessing species rarity and abundance and can be used to help identify lakes, wetlands, and streams that provide high quality habitat supporting a high diversity of aquatic macroinvertebrates. Among the lakes in the Northwest Lowlands that support rare species, Tozer Lake

Among the boreal Odonates inhabiting the large peatlands of the Northwest Lowlands is the subarctic darner. Photo by Arnold Sennhauser.

is home to a rare predacious diving beetle (*Neoporis vittatus*); Lake Minnesuing hosts three rare species, including a rare water scorpion (*Ranatra nigra*); and McGraw Lake has the Aurora damselfly (*Chromagrion conditum*). Black Lake and Breitzman Lake bogs host many rare invertebrate species, including the Wisconsin Special Concern lake darner dragonfly (*Aeshna eremita*), and are two of only three known sites in Wisconsin for the Wisconsin Special Concern subarctic darner dragonfly. Black Lake provides habitat for two other rare species, including the black meadowhawk dragonfly (*Sympetrum danae*). Breitzman Lake supports seven other rare species, including the forcipate emerald dragonfly (*Somatochlora forcipata*).

Many headwaters streams are located in undeveloped forested watersheds and are generally free-flowing, and few have been adversely impacted by agriculture. This is a rich area with many important habitats for a host of uncommon aquatic invertebrate species. There are likely over 100 species of dragonflies and damselflies (Odonates) in the Northwest Lowlands. Spring seeps along the St. Croix River are also important habitats for invertebrates, and the many poor fens in and around Empire Bog support numerous uncommon dragonflies in the emerald family (Corduliidae), including the forcipate emerald dragonfly.

Over 70 miles of the St. Croix River either crosses the Northwest Lowlands or forms its western and southern borders. The St. Croix River system is highly significant for aquatic biota and is associated with many natural communities of excellent quality. Aquatic invertebrate populations of the middle stretch of the St. Croix River may be the most diverse of any river of comparable size in Wisconsin, with slightly more species diversity and slightly more rare species (91) than even the lower Chippewa and Wolf rivers (W.A. Smith, Wisconsin DNR, personal communication).

The St. Croix River is an important part of the limited geographic range of the globally rare Saint Croix snaketail (Wisconsin Endangered). Photo by Ken Tennessen.

The St. Croix is an enormously important habitat for many river dragonflies in the clubtail family (Gomphidae), some of which are quite rare. Rare dragonfly species documented in the St. Croix River include the pygmy snaketail and the Saint Croix snaketail. The mussel community in the St. Croix River is the most intact of all rivers of comparable size in Wisconsin. Rare mussel species include the spectacle case, a federally listed species as of 2012, and the purple wartyback.

The St. Croix River here features abundant spawning habitat for lake sturgeon (*Acipenser fulvescens*), with firm bottom flats for young of the year. However, there are relatively few deep pools, which provide essential cover for adult lake sturgeon. Evidence suggests that adult lake sturgeon were overexploited by largely unregulated angling through the 1950s. Despite more restrictive regulations in the 1970s and 1980s, the population continued to decline and the river was closed to lake sturgeon sport fishing in 1994. An inter-agency lake sturgeon management plan for the upper St. Croix was established in 2004. Recent sampling shows that, while the adult population is still low, natural recruitment is increasing. The population is expected to recover without restocking programs that risk compromising genetic diversity (Dammen 2009). Other rare fish species that occur in the St. Croix River include the gilt darter, river redhorse, and greater redhorse. Wisconsin DNR research scientists have been studying lake sturgeon, river redhorse, greater redhorse, and gilt darter populations in this stretch of the St. Croix River, and they recorded all four species in 2009.

Birds frequently use both the Wisconsin and Minnesota portions of the St. Croix River valley during migration and for nesting. Both southern and northern bird species are found here, corresponding to its location along the ***Tension Zone*** (Mossman 1991). Species that reach their extreme northern breeding range limits here include Hooded Warbler, Louisiana Waterthrush (*Parkesia motacilla,* listed as *Seiurus motacilla* on the Wisconsin Natural Heritage Working List), and Prothonotary Warbler (*Protonotaria citrea*). Four species are on the Working List: Red-shouldered Hawk, Hooded Warbler, Prothonotary Warbler, and Louisiana Waterthrush (WDNR 2009).

The Wisconsin Threatened river redhorse is one of the rare aquatic species inhabiting the biologically rich St. Croix River system. Photo by John Lyons, Wisconsin DNR.

The Red-shouldered Hawk (Wisconsin Threatened) is an area-sensitive forest raptor that breeds in larger tracts of older forest and does much of its hunting in wetlands, including those associated with large river systems. Portions of the upper St. Croix River corridor provide suitable habitat for this species, along with other specialists such as the Louisiana Waterthrush. Photo © Laurie Smaglick Johnson.

Natural and Human Disturbances

Fire, Wind, and Flooding

Fire was an uncommon historical disturbance in this ecological landscape (Frelich and Lorimer 1991, Schulte and Mladenoff 2005). Stand-replacing fires were very rare and had a return interval of over 4,000 years, likely due to the abundant wetlands here, which served as natural firebreaks.

Heavy wind throw was more frequent here than in adjoining ecological landscapes (Shulte and Mladenoff 2005). This ecological landscape contains a higher prevalence of wet soils, organic soils, and lowland conifer forest, making it prone to windthrow. The return interval for heavy windthrow for this ecological landscape averaged 565 years with a range of 400–800 years based on surveyors records from the mid-1800s. Heavy windthrow was due to the small amount of open water, soil texture, and high water content in the soil in addition to climate and vegetation variables (Schulte et al. 2005).Topographic relief is generally subdued in the Northwest Lowlands (except in several stream gorges at the northern edge of the ecological landscape) and would have offered little protection to the forests here. This ecological landscape is only somewhat influenced by Lake Superior effects, such as its ability to moderate climate and ameliorate severe thunderstorms (Schulte and Mladenoff 2005). Windthrow events were small in scale. Canham and Loucks (1984) reported a mean patch size for windthrow in northern Wisconsin of 230 acres. Because windthrow return intervals were longer than the maximum age of shade tolerant trees, the Northwest Lowlands Ecological Landscape was likely dominated by mature to old-age forests (Frelich and Lorimer 1991).

The extent and frequency of flood disturbance prior to Euro-American settlement is unknown. Most of the streams here are headwater streams, and flooding was doubtfully great in historical times. As this ecological landscape is relatively undeveloped, and its hydrology is not greatly impacted by agriculture or residential use, increased flooding in the future seems unlikely. There are few water gauging stations here, but a gauging station just south of the Northwest Lowlands on the upper St. Croix River at Danbury shows much variability but no upward or downward trend in peak flows from 1914 to 2008 (USGS 2009).

Forest Insects and Diseases

The Northwest Lowlands supports a variety of forest types, each of them associated with different insects and diseases that attack the dominant trees. Thus, there are a number of insects and diseases that can periodically affect forests in this ecological landscape.

Aspens are now common here and are among the tree species that can be impacted by forest tent caterpillar (*Malacosoma disstria*), aspen heart rot fungus (*Phellinus tremulae*), and aspen Hypoxylon canker fungus (*Hypoxylon mammatum*). White birch can be affected by bronze birch borer (*Agrilus anxius*), and drought can predispose these trees to many diseases.

Conifers, including red and eastern white pines, and white spruce, can be affected by Annosum root rot, caused by the fungus *Heterobasidion annosum*, particularly in plantations. Red pines are also subject to "pocket mortality," caused by a complex of insects and the fungal species *Leptographium terrebrantis* and *L. procerum*. Red pine is also susceptible to Diplodia pine blight fungus (*Diplodia pinea*) and pine sawfly (*Neodiprion* spp., *Diprion* spp.). White pine blister rust is an introduced fungal disease caused by *Cronartium ribicola*.

Gypsy moth (*Lymantria dispar*) is a nonnative insect whose major outbreaks are currently limited to portions of the state farther east but is likely to periodically affect oak and aspen forests here in the future. The two-lined chestnut borer, *Agrilus bilineatus,* is a bark-boring insect that attacks oaks. Oak wilt is a vascular disease caused by the native fungus *Ceratocystis fagacearum*.

Emerald ash borer (*Agrilus planipennis*) is an exotic insect native to Asia. As of 2015, this extremely serious forest pest has been confirmed in 35 Wisconsin counties, including

Douglas County. 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 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 could have serious effects on the numerous black ash swamps found in this ecological landscape. See the Wisconsin emerald ash borer website (WDATCP 2015) for up-to-date information on its current distribution.

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 2015b) and at the U.S. Forest Service Northeastern Area forest health and economics web page (USFS 2015).

Invasive Species

The road density in the Northwest Lowlands is the lowest of any ecological landscape in the state. Since human travel is a major vector for transport of a variety of invasive species, this ecological landscape currently is not heavily impacted by invasive species. However, increases in tourism, recreation, and further development may lead to introductions throughout the ecological landscape. The heavy recreational use of the St. Croix National Scenic Riverway warrants careful monitoring of campgrounds and boat landings for the presence and spread of invasives along this important corridor.

Terrestrial invasives are not yet widespread or abundant here compared to many other ecological landscapes, but care is needed to prevent their spread and introduction. In forested communities, glossy and common buckthorns (*Rhamnus frangula* and *R. cathartica*), nonnative honeysuckles (e.g., *Lonicera tatarica*, *Lonicera* x *bella*), garlic mustard (*Alliaria petiolata*), Japanese barberry (*Berberis thunbergii*), Dame's rocket (*Hesperis matronalis*), black locust (*Robinia pseudoacacia*), and amur maple (*Acer ginnala*) already pose problems, though they're localized at this time. Japanese knotweed (*Polygonum cuspidatum*) is also present here. These species may initially colonize disturbed areas and forest edges but, once established, can continue to invade surrounding habitats, including forests. Along roads and in open or partially forested areas, spotted knapweed (*Centaurea biebersteinii*), wild parsnip (*Pastinaca sativa*), leafy spurge (*Euphorbia esula*), Canada thistle (*Cirsium arvense*), and common tansy (*Tanacetum vulgare*) are present.

In aquatic and wetland ecosystems, Eurasian water-milfoil (*Myriophyllum spicatum*), curly pondweed (*Potamogeton crispus*), rusty crayfish (*Orconectes rusticus*), common reed (*Phragmites australis*), purple loosestrife (*Lythrum salicaria*), and reed canary grass (*Phalaris arundinacea*) are the primary problem species. Watercress (*Nasturtium officinale*) is also present in this ecological landscape and can be dominant along spring runs and in seepages.

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

Land Use Impacts

Historical Impacts. As with most of the state, major land use changes in the latter half of the 19th and early part of the 20th centuries, especially large-scale logging (the ***Cutover***), had immense ecological impacts in the Northwest Lowlands. An almost complete removal of trees occurred during this time, and severe fires often followed the logging. Access to forested lands and delivery of logs to sawmills were expedited by use of streams entering Lake Superior or connected to the St. Croix system to float logs to the mills. Streams were cleared of large woody material, stream bottoms and banks were scoured during log drives, and bark and other woody debris were deposited on lake bottoms.

Many past land use impacts are still apparent today. For example, the forests here exhibit different species compositions, age structures, and patch sizes from the pre-Cutover forests (Schulte et al. 2007). Due to past logging practices, there are very few older forests (most are less than 100 years old), and conifers (e.g., eastern white pine, red pine, white spruce, balsam fir, and, on some sites, northern white-cedar) are now underrepresented in the forest canopy. The ***stream morphology*** was changed when log drives scoured river bottoms, and the streams were more susceptible to rapid runoff and erosion during spring snowmelt and large rain events because of the loss of forest cover.

Current Impacts. The Northwest Lowlands has the least amount of human development (e.g., roads and other infrastructure, agriculture, housing development, etc.) in the state, yet it has been modified greatly with few truly undisturbed areas remaining. Human-caused disturbances here include the long-term conversion of land to roads, buildings, and utility corridors. Shorter-term disturbances result from logging and recreational pursuits. Some effects are indirect, such as the high level of herbivory by white-tailed deer, largely the result of human activities that affect the size of white-tailed deer populations. Today's impacts are multiple and pervasive, in contrast with historical times, and affect most of the ecological landscape almost constantly. Historically, most disturbances shifted spatially over time, leaving portions of the ecological landscape undisturbed for long time periods.

Forest Management. As with most of Wisconsin, there is now a lack of older forest in this ecological landscape. The current focus on stand-level forest management has resulted in many small to medium-sized patches of similar species composition and age-class structure, while at the broader scale there has been a loss of patch size and age-class diversity. The creation of large amounts of edge habitat throughout this

ecological landscape has promoted habitat generalists at the expense of interior forest specialists, area-sensitive species, and disturbance-sensitive species.

Ecological simplification and homogenization are taking place, with aspen, white birch, and red maple increasing at the expense of other tree species, especially conifers, but including certain hardwoods. Eastern white and red pines, once abundant in this ecological landscape, are now limited to infrequent, small, isolated individuals or stands. Specialized or more sensitive ground flora, such as lilies (Liliaceae family), orchids (Orchidaceae family), and other insect-pollinated species and groups, are decreasing in abundance, while generalists, nonnative species, and wind-pollinated species are increasing (Rooney and Waller 2003, Schulte et al. 2007).

The practice of creating and maintaining forest openings should be discontinued. Forest openings were designed to increase the amount of open and edge habitat for white-tailed deer when white-tailed deer populations were far less abundant than they are now. White-tailed deer populations have been at or above stated goals in the northern forest through the 1990s and 2000s. After a series of severe winters, deer populations have now been at or below goals since 2008. Managing to provide additional habitat for white-tailed deer when they are already overabundant is counterproductive, as the negative effects of excessive white-tailed deer browse are well documented statewide. In this ecological landscape, white-tailed deer browse is especially problematic in the southern portion, where browse sensitive species appear to be more common. There should be efforts to maintain white-tailed deer populations at (or below) the established population goal to avoid further damage to native forest vegetation. The practice of creating forest openings has also led to forest fragmentation that harms rare or declining forest interior species and creates pathways for the introduction of invasive species. Although forest openings may provide habitat for species other than white-tailed deer, these other species are usually widespread and common generalists that are not experiencing population declines.

Development. Although this ecological landscape is the least developed in the state, parcelization and dispersed rural residential development has fragmented contiguous habitats and reduced their effective size, increased land values and the cost of public services, and created long-term alterations of aquatic and terrestrial systems. Among the ecological consequences of these factors are an increase in generalist species and nonnative habitats (e.g., roads, utility rights-of-way, lawns, landscaping), feeding of white-tailed deer (resulting in artificially high populations), introduction of invasive plants, and predation by free-ranging or feral dogs and cats.

Changes in Hydrology. Although the hydrology in the Northwest Lowlands remains relatively intact, road construction, dams, and other developments have eliminated some wetlands and degraded or altered others. In addition to direct habitat loss, eliminating wetlands can cause increased sedimentation and flood severity and lead to a build-up of pollutants and pesticides in lakes and streams.

Altering natural hydrologic regimes in this ecological landscape has negative consequences and should be avoided. Changes such as lowering water levels can result in conversion of sedge meadows into shrub thickets. Removal of coniferous trees from forested wetlands may result in conversion to a shrub thicket, for example, in stands dominated by northern white-cedar or tamarack. Changes in hydrology or forested cover may create additional management costs and challenges, such as the need for increased prescribed burning to prevent sedge meadows from becoming shrub thickets. When conversion of a bog, fen, muskeg, or sedge meadow to other communities or land cover takes place, it reduces the amount of natural habitat available for native peatland species and impacts the entire peatland ecosystem.

Management Opportunities for Important Ecological Features of the Northwest Lowlands

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 always 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. Rather we suggest that planning and management efforts incorporate broader spatial and temporal considerations and address the variety of scales and structures approximating the ***natural range of variability*** within an ecological landscape—especially those that are missing, declining, or at the greatest risk of disappearing over time.

Both ecological and socioeconomic factors were considered when identifying 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," in Part 1.

Significant ecological management opportunities that have been identified for the Northwest Lowlands Ecological Landscape include

- extensive contiguous forests;
- upper St. Croix River corridor;
- large intact acid peatlands;
- remote areas: large public land base, few developments;
- stream headwaters; and
- miscellaneous natural features.

Natural communities, community complexes, and important ecological features for which there are management opportunities in the Northwest Lowlands are listed in Table 16.2. Locations where these important ecological places may be found within the ecological landscape are on the map "Ecologically Significant Places within the Northwest Lowlands Ecological Landscape" in Appendix 16.K at the end of this chapter.

Outstanding Ecological Opportunities in the Northwest Lowlands Ecological Landscape

- Forests here are extensive, and in many areas, unbroken. Maintenance of these conditions is a major opportunity. Current and future management needs include maintaining sufficient areas of both very young and older forests and restoring diminished cover types in configurations that complement rather than conflict with one another.
- Some of Wisconsin's largest, least disturbed acid peatland complexes occur here, and these support a broad spectrum of bog, fen, and conifer swamp habitat specialists.
- The upper St. Croix River corridor connects several ecological landscapes, contains natural communities and habitats that do not occur elsewhere in the Northwest Lowlands, and supports an exceptionally diverse array of resident and migratory aquatic and terrestrial species.
- Headwaters streams here flow north to Lake Superior and south to the St. Croix River system.
- Important attributes of the Northwest Lowlands Ecological Landscape include the presence of remote areas, limited developments, and a large public land base.
- Miscellaneous natural features are found here such as remnant stands of old-growth forest; stands of upland forest with a high proportion of conifers, dispersal, feeding, and resting areas for some large mammals and many migratory birds; and bedrock exposures, ephemeral ponds, seepage areas, and scattered rare species habitats.

Extensive Contiguous Forests

The northern portion of this ecological landscape features extensive forests that are relatively unbroken by farms, urban areas, or other developments. Only a few major roads cross the northern part of the Northwest Lowlands (State Highway 35 and several county highways). Virtually all of these forests are second-growth and managed primarily for timber

Extensive forest cover is unbroken save for scattered wetlands and narrow stream corridors. Major cover types are northern hardwoods, trembling aspen, and conifer swamp. Western Douglas County. Photo by Eric Epstein, Wisconsin DNR.

Table 16.2. *Natural communities, aquatic features, and selected habitats associated with each ecological feature within the Northwest Lowlands Ecological Landscape.*

Ecological features[a]	Natural communities,[b] aquatic features, and selected habitats
Extensive contiguous forests	Boreal Forest Northern Dry Forest Northern Dry-Mesic Forest Northern Hardwood Swamp Northern Mesic Forest Northern Wet-Mesic Forest Northern White-cedar Swamp Northern Wet Forest Black Spruce Swamp Tamarack Swamp Ephemeral Pond
Large intact peatland complexes	Black Spruce Swamp Tamarack (Poor) Swamp Northern Wet-mesic Forest Northern Hardwood Swamp Northern White-cedar Swamp Alder Thicket Shrub-carr Northern Sedge Meadow Poor Fen Open Bog Emergent Marsh Inland Lake
Upper St. Croix River corridor	Northern Dry Forest Northern Dry-mesic Forest Northern Mesic Forest Northern Hardwood Swamp Northern White-cedar Swamp Black Spruce Swamp Tamarack (Poor) Swamp Forested Seep Alder Thicket Shrub-carr Northern Sedge Meadow Ephemeral Pond Coolwater Stream Warmwater River Warmwater Stream Springs and Spring Runs
Stream headwaters	Coldwater Stream Coolwater Stream
Remote undeveloped areas	Northern Mesic Forest Black Spruce Swamp Tamarack (Poor) Swamp Northern Hardwood Swamp Northern White-cedar Swamp Alder Thicket Northern Sedge Meadow Open Bog Poor Fen Muskeg

Continued on next page

Table 16.2, *continued*.

Ecological features[a]	Natural communities,[b] aquatic features, and selected habitats
Miscellaneous natural features	Ephemeral Pond Bedrock Glade Dry Cliff Moist Cliff Scattered rare species populations

[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.

("working forests") and secondarily for recreational activities. The most common upland cover types now are quaking aspen and maple-dominated northern hardwoods. Historically, eastern white pine was widespread and common, but it is now local and scarce. Other, more abundant conifers in the past were red pine, white spruce, and balsam fir. While these species are seldom dominant in today's forests, in some areas, balsam fir and, less commonly, eastern white pine and white spruce are present and sometimes common as understory trees, imparting a boreal flavor to the second-growth forests here and representing opportunities to increase their now greatly diminished coniferous component.

Lowland forests in the northern part of the Northwest Lowlands Ecological Landscape are composed mostly of the bog conifers, black spruce, and tamarack. Limited acreages of swamp hardwoods and northern white-cedar are also present, especially along the St. Croix River in the southern part of the ecological landscape.

The forest communities associated with the St. Croix River corridor differ in kind and configuration from those found farther north. Lowland environments along the St. Croix include areas of floodplain forest, swamp hardwoods, and northern white-cedar swamp. Terraces above the current floodplain support stands of mesic forest, with maples, ashes, and northern red oak among the canopy dominants. In some areas, such as the Governor Knowles State Forest, unusual mesic forests, with bur oak, ash, and sugar maple over a diverse herb layer, occur along streams and their associated older terraces. The mesic to dry-mesic forests on the steep side slopes along much of the St. Croix in Burnett and Polk counties are more or less continuous. Eastern white and, rarely, red pines occur in small remnant stands and as scattered individuals mixed with the dominant hardwoods. In the southernmost part of this ecological landscape, small amounts of dry forest and (overgrown) pine-oak barrens vegetation occur on droughty, coarse-textured sands. These areas represent the edge of one of the state's largest areas of dry forest and barrens, located in the adjacent Northwest Sands Ecological Landscape.

This remote portion of the Northwest Lowlands Ecological Landscape straddles the Wisconsin-Minnesota border and features headwaters streams, large peatlands, and vast tracts of second-growth forest. Photo by Eric Epstein, Wisconsin DNR.

Management Opportunities, Needs, and Actions

- Maintain large areas of unbroken forest with low road densities, especially around the major peatland complexes and along the Minnesota-Wisconsin border.
- Identify upland forests throughout the ecological landscape with the potential to increase the coniferous component, especially historically important species such as eastern white pine, balsam fir, and white spruce. Areas adjacent to existing stands of lowland conifers are especially good candidates because they would be most likely to benefit wildlife requiring extensive coniferous cover.
- Identify areas in which to develop and maintain stands of older forest, which are presently rare or absent. Young and medium-aged forests are currently well represented and are likely to remain so.
- Look for opportunities to include scarce or absent structural features (large trees, large coarse woody debris, multi-layered canopies, large patches, etc.) into forest management plans.

- Work with managers and planners to identify high conservation value forests on all certified state and county forestlands.
- Work with interested private and public owners and managers to identify and establish connecting corridors that cross administrative (federal, state, county, private) boundaries.

Upper St. Croix River Corridor

The St. Croix-Namekagon river system was one of the original eight selected in 1968 to become part of the Wild and Scenic Rivers program administered by the National Park Service. The St. Croix enters the Northwest Lowlands from the northeast and then flows southwest and south. The southern part of the ecological landscape is a narrow, linear corridor that is bisected by the Wisconsin-Minnesota state line. This is one of the Upper Midwest's most important major river systems because of its good water quality, general condition, and the diverse aquatic biota it supports. Fish, mussels, and dragonflies are among the taxa for which this river system is especially important.

The entire length of the St. Croix through the Northwest Lowlands Ecological Landscape is free-flowing. The only dams on the upper St. Croix are above and below the Northwest Lowlands (at Gordon, in the Northwest Sands Ecological Landscape, and downstream at St. Croix Falls, in the Forest Transition Ecological Landscape). The dam at St. Croix Falls is considered the boundary between the upper St. Croix and the lower St. Croix.

Much of the land adjoining the St. Croix River is forested, protecting water quality and providing high quality habitat for many plants and animals. The value of this forested corridor to migratory and resident birds is particularly noteworthy. The corridor is likely an important connector of the extensive forests of northern Wisconsin and northeastern Minnesota with the Mississippi River (into which the St. Croix flows) and points south.

The National Park Service, with jurisdiction over the St. Croix River throughout the Northwest Lowlands Ecological Landscape, has the primary land management responsibilities for the river and the lands immediately adjoining it. In the Northwest Lowlands Ecological Landscape, the St. Croix National Scenic Riverway extends from just below the Gordon Dam in southwestern Douglas County, downstream to central Polk County. Other public lands in the vicinity of the St. Croix include Governor Knowles State Forest, state wildlife areas, state natural areas, and county forestlands. The boundaries between the National Park Service ownership and state and county forests are often very abrupt, sometimes showing stark contrasts between lands managed by different public agencies. This is in part a reflection of differing management philosophies and is an issue that needs attention in some areas. There are sites within the National Scenic Riverway that might benefit from a more active approach to management (e.g., in the restoration, and eventually, maintenance, of large eastern white and red pines, and in maintaining prairie and barrens remnants, and oak forests), and sites on the state and county lands that might be appropriate for a broader management approach and less focus on management at the stand level (this might include extended rotations, designation of old-growth areas, and designation of areas to maintain in a semi-open condition). Ecological factors also have influence in the observed differences in management approaches and outcomes. For example, in Polk and Burnett counties, ecological characteristics of the forests bordering the St. Croix differ significantly from those on the excessively drained sands above the bluff line just to the east. Nevertheless, opportunities exist to increase communication and coordination among agencies regarding areas of mutual interest, which is desirable from ecological and socioeconomic perspectives.

Management Opportunities, Needs, and Actions

- Protection of the St. Croix River system offers an exceptional opportunity to conserve a high diversity of native aquatic species, including many rare aquatic animals.
- Continue work on reduction of sediments and pollutants to improve water quality throughout the St. Croix system and maintain the conditions needed by the many sensitive organisms inhabiting the river and its tributaries.
- A key management priority is to ensure that sufficient flow is maintained at all times to sustain all native aquatic life dependent on the river, its varied substrates, and its tributaries.
- The St. Croix River corridor presents excellent opportunities to manage, restore, and protect numerous natural communities that are rare or absent away from the river's floodplain and adjoining bluffs. These opportunities are best developed in the southern part of the ecological landscape and do not occur farther north or to the east, in the adjacent Northwest Sands Ecological Landscape.
- Continue to provide strong protection to lands adjoining the St. Croix River, its tributaries, and the entire corridor. Identify protection gaps and additional protection needs and opportunities.
- Monitor water quality, vegetation, and selected taxa (such as rare and representative native species of conservation concern). Invasive plants and animals should be monitored and controlled throughout the ecological landscape.
- Coordinate conservation work with federal, state, and county governments and with the Minnesota Department of Natural Resources. Much of the larger ecoregion within which this ecological landscape occurs is to the west in the state of Minnesota. Several sites of exceptionally high conservation significance, e.g., Black Lake Bog and much of the St. Croix River corridor, share a common boundary with Minnesota, and there are already good examples of the benefits to be derived through interagency and interstate cooperation and coordination.

- Work with public and private partners to help better define opportunities for public agencies, nongovernmental organizations (NGOs), and private individuals.
- An investigation of impacts to the management opportunities offered by tributary streams entering the St. Croix from Minnesota is needed to clarify potential problems, specify management opportunities of mutual interest, and design and implement appropriate actions.

Large, Intact Acid Peatlands

Acid peatlands are well developed and extensive in the northern part of the ecological landscape. Many sensitive species are dependent on these wetlands, which provide them with suitable habitat for breeding and foraging. Among the important peatland communities are Black Spruce Swamp, Tamarack Swamp, Muskeg, Open Bog, Poor Fen, and Northern Sedge Meadow. Several of the Douglas County peatlands are the headwaters areas for important stream systems.

These peatland complexes are exceptional because of their size, condition, and context. Several sites on the Douglas County Forest have been designated as state natural areas: Belden Swamp, Black Lake Bog, and Erickson Creek Forest and Wetlands. These peatlands form the core of an Important Bird Area, Moose Junction Peatlands (Steele 2007), as well as a Conservation Opportunity Area (WDNR 2008a). One of the peatland sites, Belden Swamp, was included in a statewide study of peatland biodiversity and climate change (Anderson et al. 2008). Another site, Empire Swamp, has been studied recently by aquatic invertebrate specialists who documented many rare emeralds (dragonflies) here (R. DuBois, Wisconsin DNR, personal communication). Black Lake Bog is on the Minnesota-Wisconsin state line and has been designated a Natural Area in both states.

Several peatlands here were identified as high conservation priorities following the conclusion of a study of Wisconsin wetlands in the Lake Superior basin (WDNR 1997).

Management Opportunities, Needs, and Actions

- Maintain or restore site hydrology to protect important wetlands.
- The Douglas County peatlands contain the headwaters of a number of important streams, including the Black, Amnicon, Spruce, Tamarack, and Moose rivers, and Bear, Ericson, and Cranberry creeks.
- Belden Swamp, a large undisturbed peatland complex in western Douglas County, was an intensive study site in Wisconsin DNR's recently completed Peatlands Project, and (along with several other large peatland complexes in the Northwest Lowlands) offers opportunities for long-term study and monitoring of environmental and vegetation change in northwestern Wisconsin.
- The peatlands are the vegetative focal point of an Important Bird Area, Moose Junction Peatlands. Increasing the amount of upland conifers in areas adjoining conifer swamps would benefit many area- or context-sensitive habitat specialists, including many boreal animals.
- Monitor selected taxa of conservation concern from a cross section of peatland habitats, e.g., American Bittern, LeConte's Sparrow, Connecticut Warbler, Golden-winged Warbler, Veery, mink frog, and boreal invertebrates (e.g., Lepidopteran and Odonata).

Stream Headwaters

The northern part of this ecological landscape is situated on a major drainage divide. Streams originating in this area flow either north to Lake Superior or south to the St. Croix River system. Northward-flowing streams such as the Black and Amnicon rivers descend to the Superior Coastal Plain and Lake Superior across an escarpment created by the Douglas Fault. Streams flowing south toward the St. Croix River, including the Spruce and Tamarack rivers, often occupy straight, parallel valleys. This is caused by bedrock ridges that were created

This large undisturbed peatland complex north of Black Lake is made up of Poor Fen, Open Bog, Muskeg, and Black Spruce Swamp communities, among others. The individual depicted is local author/biologist Michael Van Stappen. Photo by Emmet Judziewicz.

Upper reaches of a stream flowing through a heavily forested undeveloped part of the Northwest Lowlands. Photo by Eric Epstein, Wisconsin DNR.

by harder strata of lava alternating with weaker sedimentary rocks, tilted upward due to rifting and continental collision. This bedrock feature influences the surface topography of the ecological landscape, especially where glacial deposits are comparatively thin. Several important streams originate in the large undisturbed peatlands in Douglas County.

Management Opportunities, Needs, and Actions

- Protect stream hydrology by minimizing barriers to flow, maintaining wetlands along the stream corridors, and ensuring that any road or rail crossings have adequate culverts.
- Protect and maintain the extensive peatlands that contain stream headwaters.
- Follow ***best management practices*** (BMPs) for water quality (WDNR 2010).
- Additional survey work is needed to better document the ecological values of these streams. Many stretches are remote and difficult to access.
- These streams are little impacted by agricultural land uses, and their flows are maintained by water stored in and beneath the large expanses of wetlands here. Forest cover in the watersheds should be maintained at their present high level, and efforts to minimize water quality impacts from forest management and other land use activities should continue.
- As part of the ***Total Maximum Daily Load*** (TMDL) process, regional watershed and resource management staff should work with the Douglas County Land Conservation Department to determine if cattle are still degrading water quality and habitat in Balsam and Empire Creeks.
- Fish should be collected and analyzed from the upstream ***reaches*** of the Nemadji River and its tributary, the Black River, to evaluate levels of mercury and determine whether this contaminant is being distributed upstream in any significant concentrations from known areas of contaminated sediments near Lake Superior.

Remote Areas: Large Public Land Base, Few Developments

The northern portion of this ecological landscape is lightly populated and has few developments. It is overwhelmingly dominated by natural vegetation, including extensive second-growth forests and large, intact peatlands. Major roads are few and secondary roads exist mostly to accommodate periodic logging episodes.

The Northwest Lowlands is one of very few Wisconsin ecological landscapes that contain large areas of remote habitat. Major public landowners include Douglas County, Wisconsin Department of Natural Resources, and the National Park Service. Minnesota's Nemadji State Forest adjoins the Northwest Lowlands on the west. This portion of the Northwest Lowlands may be an important connector and travel route for wide-ranging mammals traveling between Minnesota and northern Wisconsin.

Portions of the ecologically significant St. Croix River corridor, while less remote than the northern parts of the ecological landscape, now have a high level of protection and provide an area of continuous forest that links the extensive forests of the north with important landscape features to the south. The St. Croix corridor runs northeast with few breaks through the Northwest Sands Ecological Landscape and connects with the Bois Brule River at "Divide Swamp" in central Douglas County. From there, the Bois Brule continues north all the way to Lake Superior through the Brule River State Forest.

Management Opportunities, Needs, and Actions

- Maintain large contiguous areas with low road densities to provide habitat for species that are sensitive to human intrusions and disturbance.
- Maintain large blocks of unbroken ownerships wherever possible.
- Maintain large, unfragmented landscapes with little human development, including the lowland complexes that provide greater visibility along stretches of Highway 53 as crossing areas for dispersing gray wolves (Kohn et al. 2000).
- Identify and maintain important north-south and east-west travel and dispersal corridors for mammals, birds, and others and develop plans to maintain or restore them.
- Monitor changes in landscape pattern over time, including infrastructure and residential development.

Miscellaneous Features

Several ecologically important natural communities, selected habitats, and aquatic features known from the Northwest Lowlands do not fit neatly into the categories mentioned above. Examples include rare forest communities (which may or may not be found within more extensive forests) as well as certain forest patch sizes, successional, and developmental stages. These include remnant stands of old-growth forest of all types, stands of upland forest with a high proportion of conifers, and areas of forest that can provide connectivity between other forest patches. Also important are suitable dispersing, feeding, and resting areas for species that need those habitats, such as some large mammals and many migratory birds. Other features that fall into the miscellaneous category include bedrock exposures, ephemeral ponds, seepage areas, and scattered rare species habitats.

Management Opportunities, Needs, and Actions

- Identify and protect rare or geographically restricted natural communities and natural communities with rare attributes, such as remnant stands of old-growth forest, upland coniferous forest, or stands that may increase viability of other features if protected rather than developed.

Big Manitou Falls and Gorge State Natural Area occurs on the Douglas Fault, where the Black River has created a conifer-clad canyon and waterfall. This site is at the boundary of the Northwest Lowlands and Superior Coastal Plain ecological landscapes. Pattison State Park, Douglas County. Photo by Aaron Carlson.

- Work with interested private and public partners to conserve both rare and representative resources throughout this ecological landscape.
- Where appropriate, restore the diminished component of coniferous species to the ecological landscape's upland forests. Seek opportunities adjacent to or near conifer swamps and along stream corridors.
- Identify significant migration, dispersal, and travel corridors and seek ways to restore, maintain, and protect them.
- Assist private individuals and NGOs by helping them prioritize protection priorities for the Northwest Lowlands, such as rare species habitats or features that are especially representative of this ecological landscape.
- Survey bedrock exposures for occurrences of habitat specialists, especially invertebrates, vascular plants, and nonvascular plants.
- Biological surveys are needed for the southernmost part of the Northwest Lowlands in Polk and parts of adjoining Burnett County.

Socioeconomic Characteristics

Economic data are available only on a political unit basis, generally with counties as the smallest unit that can be used practically in a document with a geographic scope as broad as this one. Therefore, socioeconomic information in this book is summarized using county boundaries that approximate ecological landscapes unless specifically noted as being based on other factors. Demographic data in the book are presented using county data as well since they are often closely associated with economic data. Data for Douglas County is used to approximate the Northwest Lowlands Ecological Landscape, due to the size, shape, and location of the ecological landscape (Figure 16.9).

History of Human Settlement and Resource Use

American Indian Settlement

There is little evidence of large-scale habitation of prehistoric peoples in the Northwest Lowlands, but many scattered small sites reveal a history of small-scale habitation and use. See "Statewide Socioeconomic Conditions" in Chapter 2, "Assessment of Current Conditions," for further discussion of the history of human settlement and resource use in Wisconsin. Currently, there are no tribal lands or significant American Indian populations within this ecological landscape, but the St. Croix Chippewa Reservation at Danbury, in the Northwest Sands Ecological Landscape, is immediately adjacent to the St. Croix River and the Northwest Lowlands.

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 region, 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). During the 18th and early 19th centuries, a succession of French, British, and American fur trade companies came to the area to trade with its inhabitants. By 1820, however, the valley's beaver population was severely depleted, and trade eventually ended (MHS 2015).

Figure 16.9. *Northwest Lowlands, Douglas County.*

During the early 1800s, American Indian tribes began ceding large parcels of land to the U.S. government, and permanent Euro-American settlement began in earnest. Finnish, Polish, and Russian settlers populated this area of the state during the mid- to late 1800s. They relied mainly on fishing and lumbering for their subsistence, but agriculture gradually began to play a role in local economies.

Early Agriculture

Officially, permanent Euro-American settlement began with the founding of Douglas County in 1854 (NACO 2010), but agriculture was not prominent in the area at that time. This region had no farms in 1850 (ICPSR 2007), and by 1860 there were reportedly only eight established farms in Douglas County. By 1900 the number of farms had grown to 257, while the population had reached 36,335. The population in Douglas County continued to grow in each of the subsequent decades until reaching 49,771 in 1920, with 1,557 established farms. Thereafter the population fluctuated in Douglas County, as did the number of farms. Farm numbers continued to grow in Douglas County, even through the Great Depression, reaching 2,103 farms in 1940 (Figure 16.10). The number of farms decreased sharply by 1950 as some smaller, marginal farms were driven out of production.

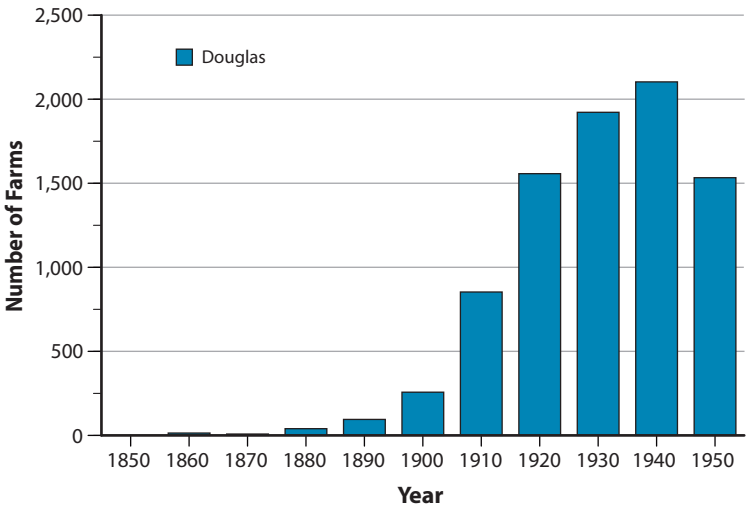


Figure 16.10. *Number of farms in Douglas County between 1850 and 1950 (ICPSR 2007).*

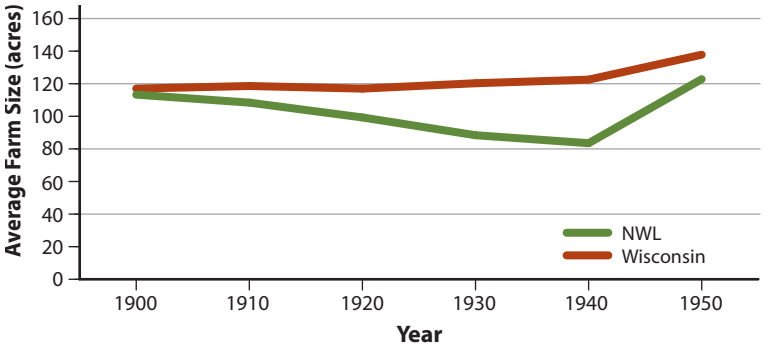


Figure 16.11. *Average farm size in Douglas County between 1900 and 1950 (ICPSR 2007).*

Farms tended to be smaller, on average, in Douglas County than in the state as a whole. However, following World War II, failure of many smaller marginal farms, followed by farm consolidation and mechanization increased the average size of farms in Douglas County (Figure 16.11). By 1950 farm size was closer to the state average at 123 acres compared to 138 acres statewide (ICPSR 2007). That trend continued throughout much of the remaining 20th century.

Farms in Douglas County historically have been less productive than those in the state as a whole. In 1910 all crops harvested in Douglas County had an estimated total value of $0.3 million, which increased to $1.5 million by 1920 (ICPSR 2007). However, total value of all crops in Douglas County plummeted in 1930 ($0.8 million) and fell further in 1940 ($0.6 million). Total value of all crops indicates the extreme influence of the Great Depression on agriculture. Total value of crops in Douglas County comprised only 0.3% of total crop value in the state in 1940, and these crops came from farms comprising 0.8% of all Wisconsin farm acreage.

Douglas County grew much more "hay and forage" crops than "cereals" crops as farms matured. The 1910 federal agricultural census listed cereals as only 8.7% of the total value of all crops harvested in Douglas County, and cereals comprised only 12.4% by 1940 (ICPSR 2007). Meanwhile, "hay and forage," associated with livestock farming, was 45.6% of total value of crops harvested in Douglas County in 1910 and had risen to 59.8% of total crop value by 1940. Note that many of these farms were not in the Northwest Lowlands Ecological Landscape; rather they were in the Superior Coastal Plain Ecological Landscape to the north.

Early Mining

Iron, lead, and copper, among other minerals and metals, drew large groups of settlers to Wisconsin during the 19th and early 20th centuries. However, extensive mining of iron and copper did not occur in the Northwest Lowlands Ecological Landscape.

Early Transportation and Access

In the early 19th century, Euro-American settlers to this area found an extensive network of American Indian trails throughout the territory. These trails were widened into roads suitable for ox carts and wagons as these settlers entered and passed through the area during the 1830s (Davis 1947). A system of military roads was developed

in Wisconsin around the same time, connecting key cities and forts. By 1870, however, the importance of railroads had caused these relatively primitive roadways to become of secondary value.

The Northern Pacific Railroad line connected Duluth, Minnesota with the city of Superior, Wisconsin (actually in the Superior Coastal Plain Ecological Landscape) before continuing east across northwestern Wisconsin to Washburn and Ashland. Several other companies also operated railroad lines throughout Douglas County. Among these were the Lake Superior Lumber Company, the St. Croix and Duluth, the Washburn and Northwest, the David Tozer Lumber Company, and the South Range Narrow Gauge.

See the "Statewide Socioeconomic Assessments" section in Chapter 2, "Assessment of Current Conditions," in Part 1 of the book for further discussion of the history of transportation in Wisconsin.

Early Logging Era

The logging industry became established in the Northwest Lowlands Ecological Landscape in the latter half of the 19th century. Extensive, sometimes intense, fires often followed logging operations, burning through the flammable slash and debris left behind. Eastern white pine was the original tree of choice, and after its depletion, loggers turned to other conifers and hardwoods. Access to trees and delivery to sawmills was expedited by the network of waterways that were used to float logs to the mills. Scouring of river bottoms and deposition of bark from these log drives removed woody habitat along the banks and stream bottoms and covered the sand and gravel river beds with bark, greatly reducing habitat for aquatic animals. Subsequent transportation of logs to mills was facilitated by the establishment of railroads. The timber industry attracted settlers and helped support other economic activities in Douglas County, such as agriculture, mining, housing construction, and railroad building, which in turn helped support the timber industry.

Roth (1898) described forest conditions in some of the northern Wisconsin counties at the close of the 19th century. He described the northern third of Douglas County (in the Superior Coastal Plain, outside of the Northwest Lowlands Ecological Landscape) as a boreal mixed forest, with eastern white pine, white and yellow birch, other hardwoods, and some northern white-cedar and tamarack. South of this area the forest was similar, but the forests contained a higher proportion of hardwoods mixed with pines. Large jack pine and red pine dominated to the south and east of the St. Croix River, though this is mostly in the Northwest Sands Ecological Landscape. Though Roth reported the pinery to be cut-over along Lake Superior and along the railroads and the St. Croix River, an estimated 3.5 billion ***board feet*** of pine remained in Douglas County at the end of the 19th century. Though hardwoods were reportedly secondary to the forest composition of Douglas County, they comprised an estimated 700 million board feet in 1898. Harvests of these species were not heavy, but oak harvests comprised 25% of the yield, despite its small share of the forest cover (Roth 1898). By comparison, today there are only 328 million board feet of pine and 709 million board feet of hardwood ***sawtimber*** in Douglas County forests (USFS 2009).

Resource Characterization and Use

The Northwest Lowlands is Wisconsin's smallest ecological landscape (675 square miles), and it has the lowest human population (43,287). There are only about 12 square miles of surface water.

Agriculture is not a major factor in the economy of the Northwest Lowlands Ecological Landscape. In fact, it ranks 15th (out of 16 ecological landscapes) in the percentage of land area in agriculture and 16th in net income per farmed acre among all ecological landscape county approximations. This region produces very little corn or milk.

The Northwest Lowlands Ecological Landscape has the fifth highest percentage of its land in forest. But these forests are not particularly productive due to the poorer soil types here compared with some other parts of the state. It ranks 13th of all the ecological landscapes in terms of volume per acre and 10th in terms of removals.

Although the Northwest Lowlands Ecological Landscape does not use a large amount of energy for its very low population, it has two hydroelectric sites and produces about 2% of the state's total woody biomass. Because this is an area with very low wind power potential, there are no commercial wind facilities or ethanol plants here.

The Land

Of the 431,842 acres of land that make up the Northwest Lowlands Ecological Landscape, 68% is forested (see the "Current Vegetation" section of this chapter). About 45% of all forested land is privately owned while 54% belongs to the state, counties, or municipalities, and 1% is federally owned (USFS 2009).

Minerals

Douglas County does not have full disclosure of mining revenues, but it is involved in the production of nonmetallic minerals. In 2007 there was one mining establishment (WDWD 2009).

Water (Ground and Surface)

Water Supply

The data in this section are based on the Wisconsin DNR's 24K Hydrography Geodatabase (WDNR 2015c), which are the same as the data reported in the "Hydrology" section of this chapter; however, the data are categorized differently here so the numbers may differ slightly. Surface water covers 7,659 acres in the Northwest Lowlands Ecological Landscape, or 2.2% of the total area. The approximately 319 lakes (over 1 acre in size) add up to 6,374 acres, which is 83% of the surface water. Lake Nebagamon is the only lake over 500 acres. Of the

2,732 acres of streams and rivers, the St. Croix River is by far the largest river in this region. There are 20 impoundments covering 4,167 acres.

Water Use

Groundwater is in good supply and of high quality here. Two of the three municipal drinking wells have wellhead protection plans. No private wells tested since 1990 have had high nitrate-nitrogen levels. However, ongoing threats to water quality are present, with 74 Leaking Underground Storage Tank (LUST) sites, 70 Environmental Repair (ERP) sites, two spill sites, and two Voluntary Party Liability Exemption (VPLE) sites (USGS 2008). (Note that most of these are in the Superior Coastal Plain Ecological Landscape.)

Each day 9.2 million gallons of ground and surface water are withdrawn in the Northwest Lowlands Ecological Landscape (Table 16.3). About 84% of the withdrawals are from surface water (USGS 2010). Of the 44,159 people that reside in Douglas County, 64% are served by public water sources and 36% are served by ***private wells***. The largest water withdrawals are for agriculture (39%) and public supply (34%).

Recreation

Recreation Resources

Land use, land cover, and ownership patterns partly determine the types of recreation that are available to the public. The Northwest Lowlands Ecological Landscape has a much higher percentage of forest and wetlands and a lower proportion of agricultural land compared to most of the rest of Wisconsin (see Chapter 3, "Comparison of Ecological Landscapes," in Part 1 of the book and/or the map "WISCLAND Land Cover (1992) of the Northwest Lowlands" in Appendix 16.K at the end of this chapter). The surface area in water is below average.

The Northwest Lowlands Ecological Landscape has the highest percentage of public land in the state, which is mostly county land. Federal land constitutes only about 1% of ownership, all in a narrow strip along the St. Croix. State land is also limited in the Northwest Lowlands. The density of campgrounds (private and public) as well as multi-purpose trails is very high, but the number of visitors to state properties is the lowest in the state. The number of Land Legacy sites in this ecological landscape is second lowest, and there are no sites with high recreation potential (WDNR 2006b).

Supply

Land and Water. The Northwest Lowlands Ecological Landscape accounts for only 1.2% of Wisconsin's total land area (the smallest ecological landscape) and only 0.8 % of the state's acreage in water (see Chapter 3, "Comparison of Ecological Landscapes"). There are 314,231 acres of forestland here, which is about 2% of the total forest acreage in the state (USFS 2009). Streams and rivers make up 30% of the surface water area and lakes, and reservoirs make up 70% (WDNR 2015c). The largest river is the St. Croix and the largest lake is Lake Nebagamon, which covers almost 1,000 acres.

Public Lands. Public access to recreational lands is vital to many types of recreational activity. In the Northwest Lowlands Ecological Landscape, almost 250,400 acres, or 58% of all land and water, is publicly owned (WDNR 2005a). This is significantly higher than the statewide average of 19.5% public ownership and ranks this ecological landscape highest out of 16 ecological landscapes in the proportion of public ownership. There are about 19,800 acres of state recreational lands, 19,200 acres of federal lands, and 200,800 acres of county lands.

State-owned lands and facilities provide recreation in the Northwest Lowlands Ecological Landscape. There are over 14,600 acres of state forestland including parts of the Brule River and Governor Knowles State Forests and about 300 acres in state parks (part of Pattison State Park). In addition, there are 2,100 acres of fisheries and wildlife management lands. The largest of these, Danbury Wildlife Area, provides over 1,000 acres of recreational land (WDNR 2005a).

Campgrounds. Camping is a favorite recreational activity in the Northwest Lowlands Ecological Landscape, where there are 36 public and privately owned campgrounds, providing about 1,313 campsites (Wisconsin DNR unpublished data). With 2% of the state's campgrounds, this ecological landscape ranks 14th (out of 16 ecological landscapes) in terms of the number of campgrounds, but third in campground density (campgrounds per square mile of land).

Trails. The Northwest Lowlands Ecological landscape has about 975 miles of recreational trails (Table 16.4) and ranks fourth (out of 16 ecological landscapes) in trail density (miles of trail per 100 square mile of land). Compared to the rest of the state, there is a higher density of all trail types with

Table 16.3. *Water use (millions of gallons/day) in the Northwest Lowlands Ecological Landscape.*

County	Ground-water	Surface water	Public supply	Domestic[a]	Agriculture[b]	Irrigation	Industrial	Mining	Thermo-electric	Total
Douglas	1.5	7.7	3.1	0.8	3.6	0.4	1.0	0.3	–	**9.2**
Percent of total	16%	84%	34%	8%	39%	4%	11%	3%	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.

the exception of road bike and snowmobile trails (Wisconsin DNR unpublished data).

Land Legacy Sites. The Land Legacy project has identified over 300 places of significant ecological and recreational importance in Wisconsin, and seven are either partially or totally located within the Northwest Lowlands Ecological Landscape. One of them, the St. Croix River, is rated as having a high level of conservation significance (WDNR 2006b).

State Natural Areas. The Northwest Lowlands Ecological Landscape has 12,897 acres designated as state natural areas, all of which are publicly owned (including by government and educational institutions; Wisconsin DNR published data). The largest state natural areas in this ecological landscape include the Erickson Creek Forest and Wetlands (2,418 acres, Douglas County), Black Lake Bog (2,206 acres, Douglas County), Big Island (2,046 acres, Burnett County), Belden Swamp (1,862 acres, Douglas County), and Empire Swamp (1,538 acres, Douglas County). For more information on Wisconsin state natural areas, see the Wisconsin DNR website (WDNR 2015e).

Demand

Fishing and Hunting License Sales. Of all license sales, the highest revenue producers for Douglas County were resident hunting licenses (32% of total sales), nonresident hunting licenses (22% of total sales), nonresident fishing licenses (20% of total sales), and resident fishing licenses (18% of total sales) (Wisconsin DNR unpublished data). Table 16.5 shows a breakdown of various licenses sold in Douglas County in 2007. This county accounts for about 1% of total license sales in the state. However, persons buying licenses in Douglas County may travel to other parts of the state to use them.

Recreational Issues

Results of a statewide survey of Wisconsin residents indicated that a number of current 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 public access to lands and waters, invasive species, and poor water quality, are common across many regions of the state (WDNR 2006a).

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 2006a). Recreational motorized vehicles include snowmobiles, ATVs, motor boats, and jet skis. ATV use is especially contentious. ATV riding has been one of the fastest growing outdoor recreational activities in Wisconsin. Although there are many ATV trails here, many ATV riders are looking primarily to public lands for places to expand their riding opportunities.

Timber Harvesting. A high percentage of statewide residents are concerned about timber harvesting in areas where they recreate (WDNR 2006a). Their greatest concern about timber harvesting is large-scale visual changes (i.e., large openings) in the forest landscape. Forest thinning and harvesting that creates small openings is more acceptable. Silent-sport enthusiasts as a group are the most concerned about the visual impacts of harvesting, while hunters and motorized users are somewhat less concerned.

Loss of Access to Lands and Waters. With the ever-increasing development along shorelines and continued parcelization of

Table 16.4. *Miles of trails and trail density in the Northwest Lowlands Ecological Landscape compared to the whole state.*

Trail type	Northwest Lowlands (miles)	Northwest Lowlands (miles/100 mi^2)	Wisconsin (miles/100 mi^2)
Hiking	51	3.9	2.8
Road biking	40	3.1	4.8
Mountain biking	78	6.0	1.9
ATV: summer & winter	373	28.7	9.3
Cross-country skiing	132	10.2	7.2
Snowmobile	300	23.1	31.2

Source: Wisconsin DNR unpublished data.

Table 16.5. *Fishing and hunting licenses and stamps sold in Douglas County.*

County	Resident fishing	Nonresident fishing	Misc. fishing	Resident hunting	Nonresident hunting	Stamps	Total
Douglas	8,092	4,638	902	12,630	1,377	7,158	34,797
Total	**8,092**	**4,638**	**902**	**12,630**	**1,377**	**7,158**	**34,797**
Sales	**$184,577**	**$205,597**	**$13,793**	**$317,472**	**$218,136**	**$67,044**	**$1,006,619**

Source: Wisconsin DNR unpublished data, 2007.

private and even some public lands, there has been a loss of readily available access to lands and waters. Another element that may play into the perception of reduced shoreline and water access is a lack of information about where to go for recreational opportunities. This element was highly ranked as a barrier to increased outdoor recreation in a statewide survey (WDNR 2006a).

Agriculture

Farm numbers in Douglas County decreased 20% between 1970 and 2002 (USDA NASS 2004). There were approximately 490 farms in 1970 and 391 in 2002. During this same time period, average farm size increased from 186 acres to 217 acres; this is higher than the statewide average of 201 acres. Overall farm acreage decreased slightly from the 1970s to 2002 (Figure 16.12). In 1970 there were about 91,000 acres of farmland, and by 2002 acreage was down to 85,000 acres, a decrease of 7%. For Douglas County, the percentage of land in farms was 10%.

Agriculture plays a very limited role in the economy of Douglas County. In 2002 net cash farm income was $96,000, or an average of $1.13 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 Douglas County was $4.7 million (less than 1% of the state total); 34% of this amount came from crop sales, while the remaining 66% was from livestock sales.

In 2007, 304 acres of farmland had been sold, all of which stayed in agricultural use at an average selling price of $1,648 per acre, the lowest price for agriculture land in the state (USDA NASS 2009).

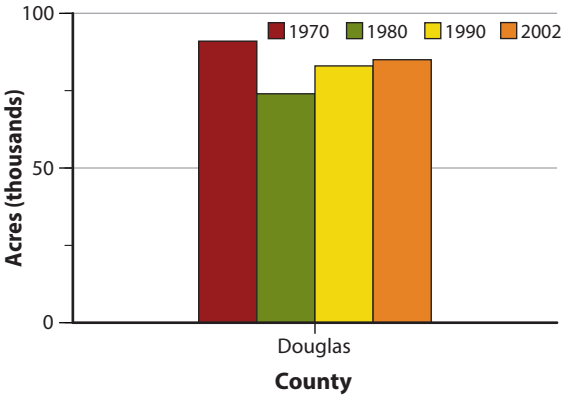


Figure 16.12. *Acres of farmland by county and year (USDA NASS 2004).*

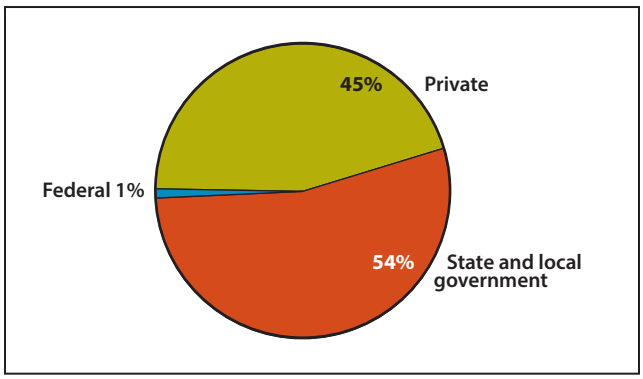


Figure 16.13. *Timberland ownership in the Northwest Lowlands Ecological Landscape (USFS 2009).*

Timber

Timber Supply

Based on 2007 Forest Inventory and Analysis data (USFS 2009), 75% (314,231 acres) of the total land area for the Northwest Lowlands Ecological Landscape is forested. Due to the small size of this ecological landscape, this is only 2% of Wisconsin's total forestland acreage (USFS 2009). Forestland is defined by FIA for forest resource purposes as any land with more than 17% canopy cover (USFS 2007).

Timber Ownership. ***Timberland*** is defined by Forest Inventory and Analysis as forestland capable of producing 20 cubic feet of industrial wood per acre per year that is not withdrawn from timber utilization. Of all timberland within this ecological landscape, 45% is owned by private landowners, 54% is owned by state and local governments, and only 1% is federally owned (USFS 2009; Figure 16.13).

Growing Stock and Sawtimber Volume. There were approximately 336 million cubic feet of ***growing stock*** volume in the Northwest Lowlands Ecological Landscape in 2007, or 2% of the state total (USFS 2009). Most of this volume (75%) was in hardwoods, similar to the proportion of hardwoods statewide (74% of total growing stock volume). Hardwoods made up a comparatively lower percentage of ***sawtimber volume*** (65%) in the Northwest Lowlands Ecological Landscape. In comparison, statewide sawtimber hardwood volume was 67% of total volume.

Annual Growing Stock and Sawtimber Growth. Between 1996 and 2007, the timber resource in the Northwest Lowlands Ecological Landscape increased by 16 million cubic feet, or 5% (USFS 2009). Most of the increase, 88%, occurred in softwood volume. Sawtimber volume increased by 124 million board feet, or 18%, again mostly in softwoods.

In the Northwest Lowlands Ecological Landscape, timberland acreage remained unchanged at 312,361 acres in 1996 and 312,536 acres in 2007 (USFS 2009). Statewide, timberland acreage increased by 3% during the same time period.

Timber Forest Types. According to FIA data (USFS 2009), the predominant forest type groups by acreage are aspen (37%), maple-basswood (15%), and bottomland hardwoods (12%,) with smaller amounts of white birch and upland red maple (see Appendix H, "Forest Types That Were Combined into Forest Type Groups Based on Forest Inventory and Analysis (FIA) Data," in Part 3, "Supporting Materials"). Acreage is predominantly in the seedling/sapling size class for the aspen

type but dominated by poles in the maple-basswood and bottomland hardwood types (Table 16.6).

Timber Demand

Removals from Growing Stock. The Northwest Lowlands Ecological Landscape has about 1.6% of the total growing stock volume on timberland in Wisconsin (USFS 2009; see "Socioeconomic Characteristics" in Chapter 3, "Comparison of Ecological Landscapes," in Part 1). Average annual removals from growing stock were 12 million cubic feet, or about 3.3% of total statewide removals (349 million cubic feet) between 2002 and 2007. Average annual removals to growth ratios vary by species (Figure 16.14; only major species shown). Removals exceeded growth for quaking aspen, white birch, red maple, red pine, sugar maple, balsam fir, northern white-cedar, and black spruce.

Removals from Sawtimber. The Northwest Lowlands Ecological Landscape has about 1.4% of the total sawtimber volume on timberland in Wisconsin (USFS 2009). Average annual removals from sawtimber were about 26 million board feet, or 2.5% of total statewide removals (1.1 billion board feet) between 2002 and 2007. Average annual removals to growth ratios vary by species (see Figure 16.15; only major species shown). Sawtimber removals exceeded growth for aspen, red pine, northern white-cedar, white birch, and balsam fir.

Price Trends

Northern red oak and miscellaneous hardwoods were the highest priced hardwood sawtimber species in Douglas County in 2007 (WDNR 2008b). There were no major softwood sawtimber species. Sawtimber prices for 2007 were generally much lower for hardwoods compared to the rest of the state. For pulpwood, red pine is the most valuable species with a rate of $28 per cord. Pulpwood values in Douglas County were lower for hardwoods and much lower for softwoods compared to the statewide average.

Infrastructure

Transportation

The transportation infrastructure of the Northwest Lowlands Ecological Landscape is much less developed than in the rest of the state. For instance, road mile density is 40% lower (WDOT 2000) and railroad density is 59% lower than for the state as a whole (WDOT 1998). There are no airports (WDOT 2010) or shipping ports (WCPA 2010) in the Northwest Lowlands Ecological Landscape (but major facilities are nearby in the city of Superior) (see Table 16.7).

Table 16.6. *Acreage of timberland in the Northwest Lowlands Ecological Landscape by forest type and stand size.*

Forest type[a]	Seedling/sapling	Pole-size	Sawtimber	Total
Aspen	61,423	34,900	19,915	116,238
Sugar maple-beech-yellow birch	8,142	22,302	16,260	46,704
Black ash-American elm-red maple	3,921	28,356	6,016	38,293
Paper birch	9,235	14,377	654	24,267
Red maple-upland	–	12,980	3,175	16,154
Tamarack	4,998	2,617	6,073	13,688
White oak-red oak-hickory	–	4,892	6,984	11,877
Black spruce	8,313	1,963	–	10,276
Hard maple-basswood	–	3,315	3,628	6,943
Red pine	–	–	6,349	6,349
Mixed upland hardwoods	1,587	–	2,835	4,422
Northern red oak	–	–	3,620	3,620
Sugarberry-hackberry-elm-green ash	–	–	2,678	2,678
Other pine-hardwood	–	2,617	–	2,617
Eastern white pine	–	–	2,464	2,464
Balsam fir	–	–	1,837	1,837
Post oak-blackjack oak	1,325	–	–	1,325
Northern white-cedar	–	–	1,309	1,309
Nonstocked[b]	–	–	–	794
Elm-ash-locust	–	682	–	682
Total	**98,944**	**129,001**	**83,797**	**312,536**

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.

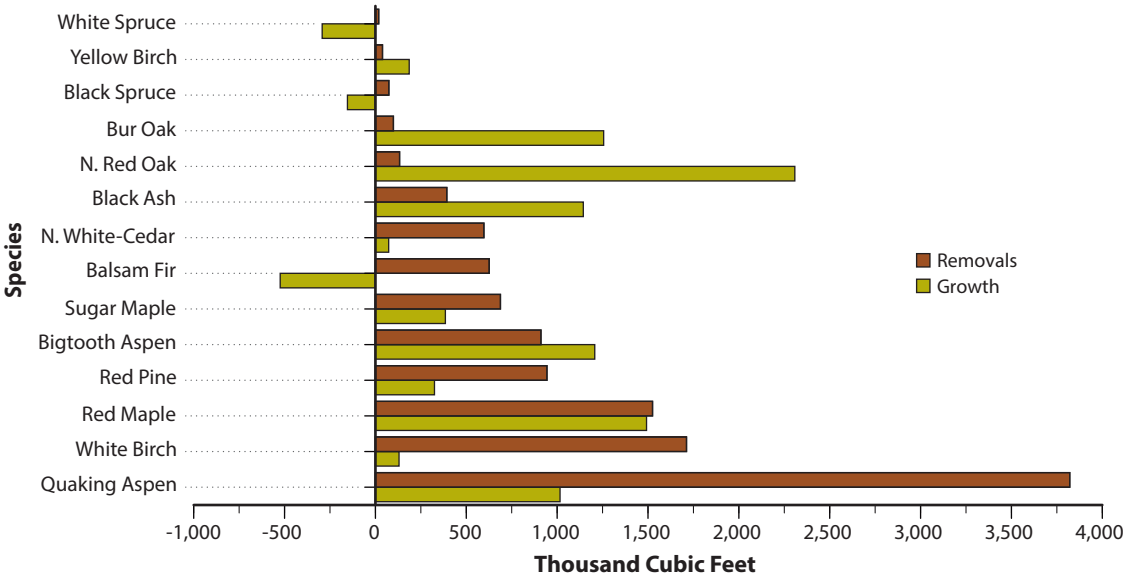


Figure 16.14. *Growing stock growth and removals (selected species) on timberland in the Northwest Lowlands Ecological Landscape (USFS 2009).*

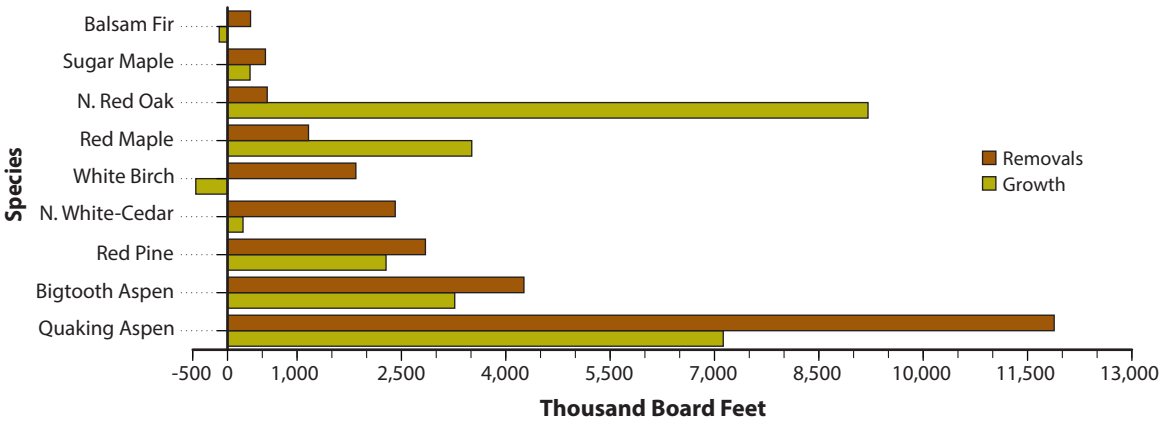


Figure 16.15. *Sawtimber growth and removals (selected species) on timberland in the Northwest Lowlands Ecological Landscape (USFS 2009).*

Table 16.7. *Road miles and density, railroad miles and density, number of airports, airport runway miles and density, and number of ports in the Northwest Lowlands Ecological Landscape.*

	Northwest Lowlands	State total	% of state total
Total road length (miles)[a]	1,353	185,487	1%
Road density[b]	2.1	3.4	–
Miles of railroads	26	5,232	1%
Railroad density[c]	4.0	9.7	–
Airports	0	128	0%
Miles of runway	0	95.7	0%
Runway density[d]	0	1.8	–
Total land area (square miles)	658	54,087	1%
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) (WDOT 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 2009–2010 web page (WDOT 2010).
[e]Data from Wisconsin Commercial Ports Association (WCPA 2010).

Renewable Energy

Hydroelectric and wind turbine power are the only renewable energy sources quantified by county in Wisconsin Energy Statistics (WDOA 2006) produced by the Wisconsin Department of Administration. Some general inferences can be drawn from other sources regarding the potential for renewable energy production in Douglas County.

Other than woody biomass, the Northwest Lowlands Ecological Landscape has a limited potential to produce a significant amount of renewable energy. The Northwest Lowlands Ecological Landscape has 1.7% of all woody biomass in Wisconsin, generates 0.5% of state's hydroelectric power, and produces very little corn that could be used for ethanol. This ecological landscape does not have any ethanol plants or wind energy generating sites.

■ **Biomass.** Woody biomass is Wisconsin's most-used renewable energy resource, and the Northwest Lowlands Ecological Landscape produces 17.3 million oven-dry tons of logging residue or 1.7% of total statewide production (USFS 2009). About 75% of the land base is forested, and this remained virtually unchanged in the last decade. Firewood for home heating is an important use of biomass in the Northwest Lowlands Ecological Landscape.

■ **Hydroelectric.** There are two hydroelectric power sites that generate 7.2 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 Northwest Lowlands Ecological Landscape produced only 7,465 bushels of corn in 2002, or less than 0.01% of total production in the state (USDA NASS 2004). Acreage in agriculture, at only 10% of the land base, decreased by 7% between 1970 and 2002. Growing corn and establishing ethanol production here would be difficult. There are no ethanol plants in the Northwest Lowlands Ecological Landscape (Renewable Fuels Association 2015).

■ **Wind.** There are currently no sited or permitted industrial wind facilities in the Northwest Lowlands Ecological Landscape (WWIC 2014). Mean annual power densities are generally below 100 W/m^2 (watts/square meter) in this part of the state, with very limited potential for wind generation (USDE 2015).

Current Socioeconomic Conditions

Demography

Douglas County is sparsely populated, with the exception of the city of Superior, located on the coast of Lake Superior in the Superior Coastal Plain Ecological Landscape. Because Superior lies outside of the boundaries of the Northwest Lowlands Ecological Landscape, the data cited below (which includes Superior) greatly exaggerates or otherwise skews many demographic metrics for the ecological landscape itself. The population is largely Caucasian but includes a small American Indian population. Douglas County has an aging, declining population, but its residents are comparatively better educated than many of their northern Wisconsin neighbors. Though home values are very low, property values are elevated somewhat by higher recreational property values.

Population Distribution

The U.S. Census Bureau estimated the 2010 population of Douglas County at 44,159, or 0.8% of the state's total population (USCB 2012a). Douglas County (including the city of Superior, which, as stated above, is outside the boundaries of the Northwest Lowlands Ecological Landscape) is classified as a metropolitan county by the U.S. Department of Agriculture Economic Research Service. This ecological landscape is located in the sparsely populated southwest portion of the county. Superior (population of 26,625 in 2007) is the only urban center (defined as those cities with at least 2,500 inhabitants) in Douglas County and comprises over 60% of the county's population (USCB 2009). Officially, 38.4% of the population in Douglas County is categorized as "rural." The ecological landscape proper would have a much higher rural population percentage because most of the people in the county live in Superior.

Population Density

The population density in 2010 of Douglas County was 34 persons per square mile, compared to 105 persons per square mile in Wisconsin as a whole (USCB 2012a). However, as noted above, the physical boundaries of the Northwest Lowlands Ecological Landscape do not include the city of Superior, and this ecological landscape itself is among the most sparsely populated in the state.

Population Structure

■ **Age.** The population of Douglas County is somewhat older and aging compared to the rest of the state. Approximately 21.4% of the 2010 population in Douglas County was under 18 years old, compared to 23.6% statewide, while 14.4% of the population is 65 or older, compared to 13.7% statewide (USCB 2012a). A slightly lower percentage of persons are aged 25 to 49 (35.9%) in Douglas County compared to the statewide average of 36.9%. This indicates out-migration of young people from the county and is also an indicator of slowed growth and lowered birth rates. Douglas County's median age of 37.7 years old is moderately higher than the statewide average of 36 years (USCB 2009).

■ **Minorities.** Douglas County is less racially diverse than the state as a whole. In 2010, 93.2% of the population in Douglas County was white, non-Hispanic, compared to 86.2% statewide. The American Indian population comprised 2.0% of Douglas County's population in 2010, compared to 1.0% for the entire state (USCB 2012a).

Education. According to the 2010 federal census, 90.5% of Douglas County residents 25 or older graduated from high school, slightly more than the 89.4% statewide average. Douglas County compares favorably to its rural northern neighbors in terms of higher education attainment but is below statewide levels; 22.0% of Douglas County residents have received at least a bachelor's degree or higher, compared to 25.8% statewide average (USCB 2012a).

Population Trends

While Wisconsin's overall population grew by 62% from 1950 to 2006, Douglas County's combined population actually shrunk by more than 6%, according to U.S. Census Bureau estimates (USCB 2009). Compared to statewide growth, population loss in Douglas County has been sporadic as the effect of early to mid-century failing settlements and farms has moderated and the transfer of seasonal homes to permanent residences has fluctuated. From 1950 to 1960, Douglas County had a negative population change (-3.7% population loss), followed by moderate losses in the 1960s (-0.8% population loss) and the 1970s (-0.5% population loss). The 1980s saw even greater population loss (-6%) in Douglas County. From 1990 to 2000, population grew in Douglas County, but at a rate slower than the rest of the state (3.7% compared to 9.6% statewide).

Housing

Housing Density. Douglas County has a low housing density (17.5 housing units per square mile of land in 2010) compared to the statewide average housing density of 48.5 units per square mile, according to the U.S. Census Bureau (USCB 2012b). Again, this figure is greatly inflated by including the city of Superior in the analysis.

Seasonal Homes. Seasonal and recreational homes are relatively common in Douglas County, comprising 8.8% of housing stock in 2000, compared to the statewide average of 6.3% (USCB 2012c).

Housing Growth. Douglas County has consistently had slower housing growth than has occurred statewide. Douglas County housing growth from 1950 to 1960 (21.7%) was just over half of the statewide average (40.4%) but drew closer to statewide housing growth through the 1960s and nearly even with it in the 1970s (26.1% in Douglas County versus 30.3% statewide). Since then, housing growth in Douglas County has declined to levels just over half of that of the state as a whole. From 2000 to 2007, Douglas County experienced only 5.7% housing growth, while state housing stock grew by 10.3% (USCB 2009).

Housing Values. According to the U.S. Census Bureau, median housing value in 2010 in Douglas County ($130,200) was seventh lowest among counties statewide, much lower than the state as a whole ($169,000) (USCB 2012a).

The Economy

Douglas County supports higher levels of government and service jobs compared to the state as a whole. Wages in the service sector tend to be lower than in other economic sectors, with a higher proportion of part-time and seasonal jobs. Conversely, manufacturing sector jobs associated with higher wages are not well represented in Douglas County. There is a net increase of retirement age adults and out-migration of young adults, implying a smaller available workforce. Relative age of the remaining population is increasing. Per capita and household incomes and average wages per job are lower in Douglas County, while unemployment and poverty rates are higher than in the state as a whole. The port city of Superior makes Transportation and Warehousing an important economic sector in Douglas County.

Income

Per Capita Income. Total personal income for Douglas County in 2006 was $1.16 billion (0.8% of the state total). Per capita income in 2006 in Douglas County ($26,396) was well below the statewide average of $34,405 (USDC BEA 2006).

Household Income. Douglas County had lower median household income levels in 2005 ($39,420) than the statewide average ($47,141), according to U.S. Census Bureau estimates (USCB 2009).

Earnings Per Job. In 2006, average earnings per job for Douglas County was $31,072, compared to the statewide average of $36,142 (USDC BEA 2006). However, of the three measures of personal income, earnings per job in Douglas County compared most favorably with statewide levels, ranking 23rd among Wisconsin's 72 counties.

Unemployment

Douglas County had slightly higher 2006 average annual unemployment (5.0%) than the state as a whole (4.7%) (USDL BLS 2006) (Table 16.8). Unemployment rates became much higher throughout the state in 2008 but have become lower again.

Poverty

Poverty Rates. The U.S. Census Bureau estimated that Douglas County's 2005 poverty rate for all people (12.4%) was significantly higher than for the state as a whole (10.2%) and 11th highest among counties statewide (USCB 2009).

Child Poverty Rates. Compared to the statewide average (14%), 2005 estimates of poverty rates for people under age 18 were also higher in Douglas County (18.3%) (USCB 2009).

Residential Property Values

Average residential property value in Douglas County ($100,809 per housing unit) was well below the statewide average ($134,021 per housing unit) (Table 16.9).

Table 16.8. *Economic indicators for Douglas County 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%**
Douglas County	**$26,396**	**$31,072**	**5.0%**	**12.4%**

[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.

Table 16.9. *Property values for Douglas County 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**
Douglas County	**$2,157,611,600**	**21,403**	**$100,809**

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.

Important Economic Sectors

Douglas County provided 19,902 jobs in 2007, or about 0.6% of the total employment in Wisconsin (Table 16.10; MIG 2009). The Government sector (16.5% of all employment in Douglas County) is the leading source of employment in Douglas County, followed in importance by the Tourism-related sector (15.0%), Retail Trade (11.8%), Health Care and Social Services (10.3%), and Transportation & Warehousing (9.9%). For definitions of economic sectors, see the U.S. Census Bureau's North American Industry Classification System web page (USCB 2013). Economic sectors of secondary importance in terms of employment include Other Services (7.2%), Construction (6.0%), Manufacturing (non-wood) (5.8%), and Wholesale Trade (4.3%). The remaining sectors combined make up less than 20% of all employment in Douglas County (see Table 16.10).

Importance of economic sectors within Douglas County when compared to the rest of the state was evaluated using an economic base analysis to yield a standard metric called a location quotient (Quintero 2007). Economic base analysis compares the percentage of all jobs in Douglas County 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 Douglas County are in the manufacturing sector and 10% of all jobs in the state are in the manufacturing sector, then the location quotient would be 1.0, indicating that Douglas County contributes jobs to the manufacturing sector at the same rate as the statewide average. If the location quotient is greater than 1.0, Douglas County is contributing more jobs to the sector than the state average. If the location quotient is less than 1.0, Douglas County is contributing fewer jobs to the sector than the state average.

When compared with the rest of the state, Douglas County had eight sectors of employment with location quotients higher than 1.0 (Figure 16.16, Appendix 16.I). Transportation and Warehousing has the highest location quotient among sectors in Douglas County, due in major part to the Lake Superior shipping port in Superior. Other sectors providing a percentage of jobs higher than the state average, listed in order of their relative importance in Douglas County, are Utilities, Government, Other Services, Tourism-related, Retail Trade, Wholesale Trade, Construction, and Health Care and Social Services. Higher paying jobs in management, financial sectors, and manufacturing are underrepresented in Douglas County, accounting for the region's relatively low wages per job.

Compared to the rest of the state, Douglas County has the highest quotient for the Other Services sector, which consists primarily of equipment and machinery repairing, promoting or administering religious activities, grant making, advocacy, 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 Retail Trade, Passenger Transportation, and 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), but with only 1% of the jobs in the county, the Forest Products and Processing Sector is a minor employer and producer. However, as discussed earlier in this chapter, there is room for expansion in this sector.

Urban Influence

The U.S. Department of Agriculture's Economic Research Service (USDA ERS) divides counties into 12 groups on a continuum of urban influence, with 1 representing large metropolitan

Table 16.10. *Total and percentage of jobs in 2007 in each economic sector within Douglas County. The economic sectors providing the highest percentage of jobs in Douglas County are highlighted in blue.*

Industry sector	Wisconsin employment	% of Wisconsin total	Douglas County employment	% of Douglas County total
Agriculture, Fishing & Hunting	110,408	3.1%	267	1.3%
Forest Products & Processing	88,089	2.5%	202	1.0%
Mining	3,780	0.1%	3	0.0%
Utilities	11,182	0.3%	123	0.6%
Construction	200,794	5.6%	1,199	6.0%
Manufacturing (non-wood)	417,139	11.7%	1,145	5.8%
Wholesale Trade	131,751	3.7%	846	4.3%
Retail Trade	320,954	9.0%	2,344	11.8%
Tourism-related	399,054	11.2%	2,988	15.0%
Transportation & Warehousing	108,919	3.1%	1,980	9.9%
Information	57,081	1.6%	123	0.6%
Finance & Insurance	168,412	4.7%	443	2.2%
Real Estate, Rental & Leasing	106,215	3.0%	249	1.3%
Professional, Science & Tech Services	166,353	4.7%	477	2.4%
Management	43,009	1.2%	156	0.8%
Administrative and Support Services	166,405	4.7%	567	2.9%
Private Education	57,373	1.6%	25	0.1%
Health Care & Social Services	379,538	10.7%	2,040	10.3%
Other Services	187,939	5.3%	1,433	7.2%
Government	430,767	12.1%	3,292	16.5%
Totals	**3,555,161**		**19,902**	**0.6%**

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

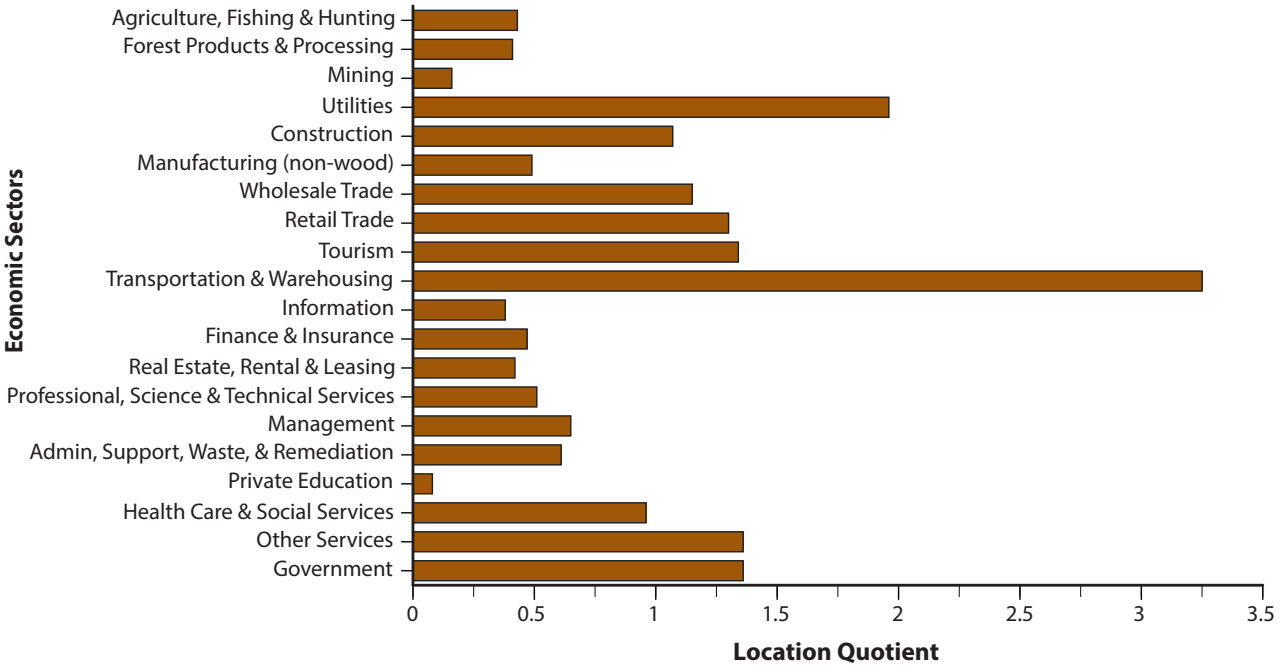


Figure 16.16. *Importance of economic sectors within Douglas County compared to the rest of the state. If the location quotient is greater than 1.0, Douglas County is contributing more jobs to that economic sector than the state average. If the location quotient is less than 1.0, Douglas County is contributing fewer jobs to that economic sector than the state average.*

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 (USDA ERS 2012b). 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. Douglas County, with the cities of Superior and neighboring Duluth, Minnesota, is classified as a smaller metropolitan area.

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 U.S. Department of Agriculture's Economic Research Service (USDA ERS) 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 counties (USDA ERS 2012a). Douglas County was classified as a nonspecialized county in 2004, according to the USDA ERS economic specialization definitions.

Policy Types

The USDA ERS also classifies counties according to "policy types" (e.g., "nonmetro recreation" or "retirement destination" counties) deemed especially relevant to rural development policy (USDA ERS 2012a). In 2004 Douglas County received none of these special classifications.

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 use of land, 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 ecosystems 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, diverse, 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. See "Integrated Ecological and Socioeconomic Opportunities" 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 16.A. *Watershed water quality summary for the Northwest Lowlands Ecological Landscape.*

Watershed number	Watershed name	Area (acres)	Overall water quality and major stressors[a] (Range = Very Poor/Poor/Fair/Good/Very Good/Excellent)
LS01	St. Louis and Lower Nemadji rivers[b]	101,759	Poor to Good; hab fill & dredging; clay sed; Hg; biota deformities; NPS excess nutrients; PAHs and other toxic organics; PCBs; some good wetlands and tribs
LS02	Black and Upper Nemadji rivers	80,399	Good to Very Good; turbid w/ clay silt; bank grazing on two tribs; impoundment; low flows; leaky septics; algae
LS03	Amnicon and Middle rivers	184,908	Good; some clay turbidity, habitat loss, and excess plant growth; past history of fecal coliform
LS04	Bois Brule River	127,773	Very Good to Excellent; many springs; numerous ORW
SC09	Wolf Creek	70,515	Good to Very Good; temp; sed; several eutrophic lakes
SC10	Trade River	124,754	Good to Very Good; sed; NPS; beaver dams; some lakes slightly eutrophic
SC11	Wood River	140,951	Very Good; stream habitat damage, turbidity and beaver dams; some mesotrophic lakes
SC12	Clam River[b]	132,393	Very Good; beaver dams, temp and habitat damage; a few lakes moderately eutrophic
SC13	North Fork Clam River	111,045	Excellent; stream temp & habitat; lakes: good trophic status
SC14	Lower Yellow River	133,726	Very Good; streams meet potential; lakes: good trophic status
SC15	Shell Lake and Upper Yellow River	106,666	Very Good to Excellent; elevated temps and modified habitat; lakes: good trophic status
SC16	Upper Tamarack	98,924	Very Good to Excellent; Radigan Flowage has winterkill
SC17	St. Croix and Moose rivers	126,257	Very Good to Excellent; beaver dams; habitat damage
SC18	Upper St. Croix and Eau Claire rivers[b]	177,851	Very Good to Excellent; lakes mesotrophic – some Hg

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 the Northwest Lowlands, so overall impacts of land uses within this ecological landscape are unlikely to impact water quality within the watershed to any appreciable degree.

Abbreviations
Hab = Stream habitat damage.
Hg = Mercury contamination of fish, mainly deposited by coal combustion, or sometimes by industry.
ORW = Outstanding Resource Water (very good to excellent water quality, with no point source discharges).
NPS = Nonpoint source pollutants, such as farm or parking lot runoff, or septic system leakage.
PAH = Polycyclic aromatic hydrocarbon contamination, often with other toxic substances.
PCBs = Polychlorinated biphenyl industrial pollutants in sediment and aquatic life.
PS = Point source pollutants, such as treated municipal and industrial wastewater.
Sed = Excess sedimentation.
Temp = Elevated temperatures in some stream reaches.
Tribs = Streams that are tributary to the stream(s) after which the watershed is named.

Appendix 16.B. *Forest habitat types in the Northwest Lowlands 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 Northwest Lowlands Ecological Landscape
AAs	*Acer saccharum/Arisaema atrorubens* Sugar maple/Jack-in-the-pulpit
AAt	*Acer saccharum/Athyrium filix-femina* Sugar maple/Lady fern
AAtRp	*Acer saccharum/Athyrium filix-femina-Rubus pubescens* Sugar maple/Lady fern-Dwarf raspberry
ACaCi	*Acer saccharum/Caulophyllum thalictroides-Circaea quadrisulcata* Sugar maple/Blue cohosh-Enchanter's nightshade
ACl	*Acer saccharum/Clintonia borealis* Sugar maple/Yellow beadlily
ArAbVCo	*Acer rubrum-Abies balsamea/Vaccinium-Cornus canadensis* Red maple-Balsam fir/Blueberry-Bunchberry
ASaI	*Acer saccharum/Sanguinaria canadensis-Impatiens capensis* Sugar maple/Bloodroot-Jewelweed
AVCl	*Acer saccharum/Vaccinium angustifolium-Clintonia borealis* Sugar maple/Blueberry-Yellow beadlily
AVDe	*Acer saccharum/Vaccinium angustifolium-Desmodium glutinosum* Sugar maple/Blueberry-Pointed-leaved tick trefoil
PArVAa-Po	*Pinus strobus-Acer rubrum/Vaccinium angustifolium-Auralia nudicaulis Polygonatum pubescens* variant White pine-Red maple/Blueberry-Wild sarsaparilla Hairy Solomon's seal variant
PArVAm	*Pinus strobus-Acer rubrum/Vaccinium angustifolium-Amphicarpa bracteata* White pine-Red maple/Blueberry-Hog peanut

Source: Kotar et al. (2002).

Appendix 16.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 Northwest Lowlands (NWL) 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 NWL	EOs in WI	Percent in NLW	State rank	Global rank	State status	Federal status
MAMMALS								
Canis lupus (gray wolf)	2008	20	204	10%	S2	G4	SC/FL	LE
Martes americana (American marten)	2008	1	3	33%	S3	G5	END	
BIRDS[b]								
Accipiter gentilis (Northern Goshawk)	1981	1	141	1%	S2B,S2N	G5	SC/M	
Ammodramus leconteii (Le Conte's Sparrow)	2007	2	22	9%	S2S3B	G4	SC/M	
Buteo lineatus (Red-shouldered Hawk)	2008	9	301	3%	S3S4B,S1N	G5	THR	
Caprimulgus vociferus (Whip-poor-will)	2007	1	1	100%	S3B	G5	SC/M	
Coccyzus americanus (Yellow-billed Cuckoo)	2007	3	39	8%	S3B	G5	SC/M	
Coturnicops noveboracensis (Yellow Rail)	1996	2	22	9%	S1B	G4	THR	
Cygnus buccinator (Trumpeter Swan)	1999	2	22	9%	S4B	G4	SC/M	
Falcipennis canadensis (Spruce Grouse)	1990	1	32	3%	S1S2B,S1S2N	G5	THR	
Haliaeetus leucocephalus (Bald Eagle)	2007	23	1286	2%	S4B,S2N	G5	SC/P	
Oporornis agilis (Connecticut Warbler)	2003	1	27	4%	S2S3B	G4	SC/M	
Picoides arcticus (Black-backed Woodpecker)	2007	1	17	6%	S2B	G5	SC/M	
Protonotaria citrea (Prothonotary Warbler)	2007	2	40	5%	S3B	G5	SC/M	
Seiurus motacilla (Louisiana Waterthrush)[c]	2007	5	34	15%	S3B	G5	SC/M	
Wilsonia canadensis (Canada Warbler)[c]	2009	5	20	25%	S3B	G5	SC/M	
Wilsonia citrina (Hooded Warbler)[c]	2007	1	32	3%	S2S3B	G5	THR	
HERPTILES								
Diadophis punctatus edwardsii (northern ring-necked snake)	1996	1	23	4%	S3?	G5T5	SC/H	
Emydoidea blandingii (Blanding's turtle)	2008	1	316	0%	S3	G4	THR	
Glyptemys insculpta (wood turtle)	1993	4	262	2%	S2	G4	THR	
Hemidactylium scutatum (four-toed salamander)	1996	4	63	6%	S3	G5	SC/H	
FISHES								
Acipenser fulvescens (lake sturgeon)	1979	2	99	2%	S3	G3G4	SC/H	
Cycleptus elongatus (blue sucker)	1979	1	8	13%	S2	G3G4	THR	
Fundulus diaphanus (banded killifish)	1978	1	105	1%	S3	G5	SC/N	
Moxostoma carinatum (river redhorse)	1979	12	43	28%	S2	G4	THR	
Moxostoma valenciennesi (greater redhorse)	1989	4	56	7%	S3	G4	THR	
Percina evides (gilt darter)	1983	13	26	50%	S2	G4	THR	
MUSSELS/CLAMS								
Alasmidonta marginata (elktoe)	1997	2	44	5%	S4	G4	SC/P	
Cumberlandia monodonta (spectacle case)[d]	1988	1	5	20%	S1	G3	END	C
Cyclonaias tuberculata (purple wartyback)	1997	2	16	13%	S1S2	G5	END	
Pleurobema sintoxia (round pigtoe)	1997	1	50	2%	S3	G4G5	SC/P	
Simpsonaias ambigua (salamander mussel)	1988	1	51	2%	S2S3	G3	THR	
BUTTERFLIES/MOTHS								
Atrytonopsis hianna (dusted skipper)	1999	1	31	3%	S3	G4G5	SC/N	
Boloria chariclea (arctic fritillary)	1996	6	6	100%	S1S2	G5	SC/N	
Boloria eunomia (bog fritillary)	1996	12	49	24%	S3	G5	SC/N	
Boloria freija (freija fritillary)	2004	9	20	45%	S2S3	G5	SC/N	
Boloria frigga (frigga fritillary)	1996	1	9	11%	S2	G5	SC/N	
Callophrys henrici (Henry's elfin)	1979	1	19	5%	S1S2	G5	SC/N	

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Appendix 16.C, *continued.*

Scientific name (common name)	Lastobs date	EOs[a] in in NWL	EOs in WI	Percent in NWL	State rank	Global rank	State status	Federal status
Catocala whitneyi (Whitney's underwing moth)	1999	1	10	10%	S3	G3G4	SC/N	
Erebia discoidalis (red-disked alpine)	1996	2	8	25%	S2	G5	SC/N	
Erynnis martialis (mottled dusky wing)	1977	1	10	10%	S2	G3	SC/N	
Hesperia metea (cobweb skipper)	1996	1	12	8%	S2	G4G5	SC/N	
Lycaeides melissa samuelis (Karner blue)	1996	2	316	1%	S3	G5T2	SC/FL	LE
Lycaena dorcas (dorcas copper)	1996	3	23	13%	S1S2	G5	SC/N	
Oeneis chryxus (chryxus arctic)	1996	1	9	11%	S2?	G5	SC/N	
Papaipema beeriana (Liatris borer moth)	1997	1	11	9%	S2	G2G3	SC/N	
DRAGONFLIES/DAMSELFLIES								
Aeshna eremita (lake darner)	2002	2	15	13%	S3	G5	SC/N	
Aeshna subarctica (subarctic darner)	1998	2	2	100%	S1	G5	SC/N	
Chromagrion conditum (aurora damselfly)	1996	3	17	18%	S3	G5	SC/N	
Enallagma vernale (Gloyd's bluet)	1996	1	2	50%	S1	G4	SC/N	
Ophiogomphus anomalus (extra-striped snaketail)	1994	1	14	7%	S3	G4	END	
Ophiogomphus howei (pygmy snaketail)	1999	2	33	6%	S4	G3	THR	
Ophiogomphus susbehcha (Saint Croix snaketail)	2000	1	3	33%	S2	G1G2	END	
Somatochlora forcipata (forcipate emerald)	1997	1	10	10%	S2	G5	SC/N	
Sympetrum danae (black meadowhawk)	1998	1	6	17%	S3	G5	SC/N	
BEETLES								
Cicindela patruela patruela (a tiger beetle)	1999	2	26	8%	S2	G3T3	SC/N	
Cymbiodyta acuminata (a water scavenger beetle)	1996	1	7	14%	S3	GNR	SC/N	
Hydroporus vittatus (a predaceous diving beetle)	1996	1	17	6%	S3	GNR	SC/N	
MISCELLANEOUS INSECTS/SPIDERS								
Booneacris glacialis (wingless mountain grasshopper)	2005	1	8	13%	S3	G5	SC/N	
Chloealtis abdominalis (Rocky Mountain sprinkled locust)	2005	2	7	29%	S2?	G5	SC/N	
Dolania americana (American sand burrowing mayfly)	1989	1	1	100%	S1	G4	SC/N	
Macdunnoa persimplex (a flat-headed mayfly)	1991	1	3	33%	S1?	G4	SC/N	
Parameletus chelifer (a primitive minnow mayfly)	1992	1	2	50%	S1?	G5	SC/N	
Pseudiron centralis (a flat-headed mayfly)	1992	1	10	10%	S3	G5	SC/N	
PLANTS								
Arethusa bulbosa (swamp-pink)	1975?	1	96	1%	S3	G4	SC	
Asclepias ovalifolia (dwarf milkweed)	2007	2	60	3%	S3	G5?	THR	
Botrychium minganense (Mingan's moonwort)	1979	1	17	6%	S2	G4	SC	
Callitriche hermaphroditica (autumnal water-starwort)	1996	1	11	9%	S2	G5	SC	
Carex assiniboinensis (Assiniboine sedge)	2007	4	33	12%	S3	G4G5	SC	
Carex prasina (drooping sedge)	1993	1	31	3%	S3	G4	THR	
Carex tenuiflora (sparse-flowered sedge)	2006	7	84	8%	S3	G5	SC	
Cypripedium parviflorum var. *makasin* (northern yellow lady's-slipper)	1975?	1	78	1%	S3	G5T4Q	SC	
Cypripedium reginae (showy lady's-slipper)	2007	4	99	4%	S3	G4	SC	
Cystopteris laurentiana (Laurentian bladder fern)	1979	1	11	9%	S2	G3	SC	
Dalea villosa var. *villosa* (silky prairie-clover)	2008	3	18	17%	S2	G5	SC	
Deschampsia cespitosa (tufted hairgrass)	2007	1	17	6%	S2	G5	SC	
Epilobium palustre (marsh willow-herb)	2004	1	37	3%	S3	G5	SC	
Eriophorum chamissonis (russet cotton-grass)	1996	2	6	33%	S2	G5	SC	
Juncus vaseyi (vasey rush)	1996	2	30	7%	S3	G5?	SC	

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Appendix 16.C, *continued.*

Scientific name (common name)	Lastobs date	EOs[a] in in NWL	EOs in WI	Percent in NWL	State rank	Global rank	State status	Federal status
Liatris punctata var. *nebraskana* (dotted blazing star)	1989	2	20	10%	S2S3	G5T3T5	END	
Myriophyllum farwellii (Farwell's water-milfoil)	1971	1	60	2%	S3	G5	SC	
Petasites sagittatus (arrow-leaved sweet-coltsfoot)	2005	1	31	3%	S3	G5	THR	
Poa paludigena (bog bluegrass)	2008	14	41	34%	S3	G3	THR	
Pyrola minor (lesser wintergreen)	1996	1	3	33%	S1	G5	END	
Ranunculus gmelinii (small yellow water crowfoot)	1996	1	16	6%	S2	G5	END	
Salix planifolia (tea-leaved willow)	1999	2	9	22%	S2	G5	THR	
Sparganium glomeratum (northern bur-reed)	1996	5	19	26%	S2	G4?	THR	
Talinum rugospermum (prairie fame-flower)	1994	2	54	4%	S3	G3G4	SC	
COMMUNITIES								
Alder Thicket	2007	3	106	3%	S4	G4	NA	
Black Spruce Swamp	2007	2	41	5%	S3?	G5	NA	
Boreal Forest	1982	2	36	6%	S2	G3?	NA	
Floodplain Forest	1984	3	182	2%	S3	G3?	NA	
Forested Seep	2007	3	15	20%	S2	GNR	NA	
Hardwood Swamp	2008	7	53	13%	S3	G4	NA	
Lake—Soft Bog	1982	2	52	4%	S4	GNR	NA	
Muskeg	2007	1	45	2%	S4	G4G5	NA	
Northern Dry Forest	2008	2	63	3%	S3	G3?	NA	
Northern Dry-mesic Forest	2007	6	284	2%	S3	G4	NA	
Northern Mesic Forest	1996	2	383	1%	S4	G4	NA	
Northern Sedge Meadow	2007	4	231	2%	S3	G4	NA	
Northern Wet Forest	2008	6	322	2%	S4	G4	NA	
Northern Wet-mesic Forest	2007	3	243	1%	S3S4	G3?	NA	
Oak Barrens	2007	2	38	5%	S2	G2?	NA	
Open Bog	2007	3	173	2%	S4	G5	NA	
Pine Barrens	2007	1	56	2%	S2	G2	NA	
Sand Prairie	2007	1	28	4%	S2	GNR	NA	
Shrub-carr	2008	3	143	2%	S4	G5	NA	
Southern Mesic Forest	2008	3	221	1%	S3	G3?	NA	
Springs and Spring Runs, Soft	2006	1	12	8%	SU	GNR	NA	
Stream—Fast, Soft, Cold	1979	1	15	7%	SU	GNR	NA	
Tamarack (Poor) Swamp	1979	1	33	3%	S3	G4	NA	
OTHER ELEMENTS								
Bird rookery	1997	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 Canada Warbler (*Cardellina canadensis*), Hooded Warbler (*Setophaga citrina*), and Louisiana Waterthrush (*Parkesia motacilla*).

[d]The spectacle case (*Cumberlandia monodonta*) mussel was 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.

Status and ranking definitions continued on next page

Appendix 16.C, *continued.*

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.

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 16.D. *Number of species with special designations documented within the Northwest Lowlands Ecological Landscape, 2009.*

Listing status[a]	Taxa					Total fauna	Total flora	Total listed
	Mammals	Birds	Herptiles	Fishes	Invertebrates			
U.S. Endangered	1	0	0	0	1	2	0	2
U.S. Threatened	0	0	0	0	0	0	0	0
U.S. Candidate	0	0	0	0	1	1	0	1
Wisconsin Endangered	1	0	0	0	4	5	3	8
Wisconsin Threatened	0	4	2	4	2	12	6	18
Wisconsin Special Concern	1	11	2	2	31	47	15	62
Natural Heritage Inventory total	**2**	**15**	**4**	**6**	**37**	**64**	**24**	**88**

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]The spectacle case (*Cumberlandia monodonta*) mussel was listed as U.S. Endangered in 2012 and is not included in the numbers above.

Appendix 16.E. *Species of Greatest Conservation Need (SGCN) found in the Northwest Lowlands 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.

Wood turtle.
Photo by Drew Feldkirchner.

	MAJOR				IMPORTANT								
	Northern Sedge Meadow	Northern Wet Forest	Open Bog	Warmwater Rivers	Alder Thicket	Boreal Forest	Coolwater Streams	Emergent Marsh	Northern Dry-mesic Forest	Northern Mesic Forest	Northern Wet-mesic Forest	Submergent Marsh	Warmwater Streams
Species That Are Significantly Associated with the Northwest Lowlands Ecological Landscape													
MAMMALS													
Gray wolf		H	M		H	H			H	H	H		
Northern flying squirrel		H				H			H	H	H		
Water shrew		H			M	H	H			M	H		M
Woodland jumping mouse		M				M				H	M		
BIRDS[a]													
American Bittern	H		H					H					
American Woodcock					H					M			
Black-backed Woodpecker		H				M							
Black-billed Cuckoo					H					M			
Brown Thrasher													
Canada Warbler		M			M	H			M	M	H		
Connecticut Warbler		M	M										
Golden-winged Warbler		M	M		H				M	M			
Le Conte's Sparrow	H		M										
Least Flycatcher						M			M	H			
Louisiana Waterthrush							H						
Northern Harrier	H		M										
Olive-sided Flycatcher		H	M			M					M		
Veery		M			H	H			M	M			
HERPTILES													
Boreal chorus frog	H		H					H					
Four-toed salamander	M	M	H		H	M	M	H		H	H		
Mink frog	H		H	H	M		H	H				H	H
Wood turtle	M	M		H	H		H			H	M	H	H

Continued on next page

Appendix 17.E, *continued.*

Moose.
Photo by Kate Banish, U.S. Fish and Wildlife Service.

	MAJOR				IMPORTANT								
	Northern Sedge Meadow	Northern Wet Forest	Open Bog	Warmwater Rivers	Alder Thicket	Boreal Forest	Coolwater Streams	Emergent Marsh	Northern Dry-mesic Forest	Northern Mesic Forest	Northern Wet-mesic Forest	Submergent Marsh	Warmwater Streams
FISH													
Gilt darter				H									H
Greater redhorse				M									H
Lake sturgeon				H									
River redhorse				M									
Species That Are Moderately Associated with the Northwest Lowlands Ecological Landscape													
MAMMALS													
American marten						H			H	H			
Eastern red bat	M	M	M	M	M	M	H	M	M	M	M	M	M
Hoary bat	M	M	M	M	M	M	H	M	M	M	M	M	M
Moose	M	M	M	M	H	H		H		M	H	H	M
Northern long-eared bat	M		M	M	M		H	M	M	M		M	M
Silver-haired bat	M	M	M	M	M	M	H	M	M	M	M	M	M
BIRDS													
Black Tern	M							H				M	
Blue-winged Teal	M							H				M	
Bobolink	H		M										
Boreal Chickadee		H				M							
Northern Goshawk						M			M	H			
Osprey				H									
Red Crossbill									H				
Rusty Blackbird			M		M			M					
Solitary Sandpiper			M				M	H					M
Wood Thrush										M			
HERPTILES													
Mudpuppy				H									
Pickerel frog	H	M	M	H	M		H	H		M	M	H	H
FISH													
Longear sunfish				M									M

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

Appendix 16.F. *Natural communities[a] for which there are management opportunities in the Northwest Lowlands Ecological Landscape.*

Major opportunity[b]	Important opportunity[c]	Present[d]
Black Spruce Swamp	Boreal Forest	Northern Dry Forest
Tamarack (poor) Swamp		
	Northern Dry-Mesic Forest	Hardwood Swamp - Northern
Northern Sedge Meadow	Northern Mesic Forest	
		Surrogate Grasslands
Alder Thicket	Northern White-cedar Swamp	
		Ephemeral Pond
Open Bog	Shrub-carr	
Muskeg		Bedrock Glade
	Emergent Marsh	Dry Cliff (Curtis' Exposed Cliff)
Alder Thicket	Submergent Marsh	Moist Cliff (Curtis' Shaded Cliff)
Warmwater River		
	Coolwater Stream	Coldwater Stream
	Warmwater Stream	Impoundment/Reservoir
		Inland Lake

[a]See Chapter 7, "Natural Communities, Aquatic Features, and Selected Habitats of Wisconsin," of the book 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 16.G. *Public conservation lands in the Northwest Lowlands Ecological Landscape, 2005.*

Property name	Size (acres)[a]
STATE	
Brule River State Forest[b]	690
Danbury State Wildlife Area[b]	1,320
Fish Lake State Wildlife Area[b]	280
Governor Knowles State Forest[b]	10,160
Pattison State Park[b]	345
Miscellaneous lands[c]	725
FEDERAL	
St. Croix National Scenic Riverway[b]	19,260
COUNTY FOREST[d]	
Burnett County Forest [b]	17,350
Douglas County Forest [b]	174,490
TOTAL	**224,620**

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

[a]Actual acres owned in this ecological landscape.

[b]This property also falls within adjacent ecological landscape(s).

[c]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.

[d]Locations and sizes of county-owned parcels enrolled in the Forest Crop Law program are presented here. Information on locations and sizes of other county and local parks in this ecological landscape is not readily available and is not included here, except for some very large properties.

Appendix 16.H. *Land Legacy places in the Northwest Lowlands Ecological Landscape and their ecological and recreational significance.*

The *Wisconsin Land Legacy Report* (WDNR 2006b) identified seven places in the Northwest Lowlands 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]
BB	Bois Brule River	Large	Substantial	Limited	xxxxx	xxxxx
CA	Chase Creek	Medium	Moderate	Moderate	xxxx	x
EB	Empire and Belden Swamps	Large	Substantial	Limited	xxxx	x
MU	Manitou Falls - Black River	Small	Substantial	Limited	xx	xx
SX	St. Croix River	Large	Substantial	Limited	xxxxx	xxxx
TA	Trade River Wetlands	Small	Limited	Moderate	xxx	x
UT	Upper Tamarack and Spruce Rivers	Medium	Moderate	Moderate	xxxx	x

[a]**Conservation significance.** See the *Wisconsin Land Legacy Report* (WDNR 2006b), 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 16.I. *Importance of economic sectors (based on the number of jobs) within the Northwest Lowlands (Douglas County) 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 16.J. *Scientific names of species mentioned in the text.*

Common name	Scientific name
Alder Flycatcher[a]	*Empidonax alnorum*
Alders	*Alnus incana*
American basswood	*Tilia americana*
American beaver	*Castor canandensis*
American Bittern	*Botaurus lentiginosus*
American black bear	*Ursus americanus*
American marten	*Martes americana*
American water shrew	*Sorex palustris*
American Woodcock	*Scolopax minor*
Amur maple	*Acer ginnala*
Annosum root rot fungus	*Heterobasidion annosum*
Arctic fritillary	*Boloria chariclea*
Ashes	*Fraxinus* spp.
Aspens	*Populus* spp.
Aspen heart rot fungus	*Phellinus tremulae*
Aspen Hypoxylon canker fungus	*Hypoxylon mammatum*
Aurora damselfly	*Chromagrion conditum*
Bald Eagle	*Haliaeetus leucocephalus*
Balsam fir	*Abies balsamea*
Birches	*Betula* spp.
Black ash	*Fraxinus nigra*
Black crappie	*Pomoxis nigromaculatus*
Black locust	*Robinia pseudoacacia*
Black meadowhawk dragonfly	*Sympetrum danae*
Black spruce	*Picea mariana*
Black Tern	*Chlidonias niger*
Black-backed Woodpecker	*Picoides arcticus*
Black-billed Cuckoo	*Coccyzus erythropthalmus*
Black-throated Green Warbler	*Setophaga virens*
Blackburnian Warbler	*Setophaga fusca*
Blanding's turtle	*Emydoidea blandingii*
Bluegill	*Lepomis macrochirus*
Bobcat	*Lynx rufus*
Bobolink	*Dolichonyx oryzivorus*
Bog birch	*Betula pumila*
Bog bluegrass	*Poa paludigena*
Bog fritillary	*Boloria eunomia*
Boreal chorus frog	*Pseudacris maculata*
Boreal Owl	*Aegolius funereus*
Box elder	*Acer negundo*
Bronze birch borer	*Agrilus anxius*
Brook trout	*Salvelinus fontinalis*
Brown trout	*Salmo trutta*
Bur oak	*Quercus macrocarpa*
Canada thistle	*Cirsium arvense*
Canada Warbler	*Cardellina canadensis*, listed as *Wilsonia canadensis* by the Wisconsin Natural Heritage Working List
Cape May Warbler	*Setophaga tigrina*
Chestnut-sided Warbler	*Setophaga pensylvanica*
Clubtail family	Gomphidae
Common buckthorn	*Rhamnus cathartica*
Common reed	*Phragmites australis*
Common tansy	*Tanacetum vulgare*
Connecticut Warbler	*Oporornis agilis*
Curly pondweed	*Potamogeton crispus*

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Appendix 16.J, *continued.*

Common name	Scientific name
Dame's rocket	*Hesperis matronalis*
Diplodia pine blight fungus	*Diplodia pinea*
Dragonflies and damselflies	Order Odonata
Eastern hemlock	*Tsuga canadensis*
Eastern white pine	*Pinus strobus*
Emerald ash borer	*Agrilus planipennis*
Emerald dragonflies	Family Corduliidae
Eurasian honeysuckles	*Lonicera tatarica*, *Lonicera* x *bella*
Eurasian water-milfoil	*Myriophyllum spicatum*
Evening Grosbeak	*Coccothraustes vespertinus*
Extra-striped snaketail	*Ophiogomphus anomalus*
Fisher	*Martes pennanti*
Forcipate emerald	*Somatochlora forcipata*
Forest tent caterpillar	*Malacosoma disstria*
Four-toed salamander	*Hemidactylium scutatum*
Freija fritillary	*Boloria freija*
Frigga fritillary	*Boloria frigga*
Garlic mustard	*Alliaria petiolata*
Gilt darter	*Percina evides*
Glossy buckthorn	*Rhamnus frangula*
Golden-crowned Kinglet	*Regulus satrapa*
Golden-winged Warbler	*Vermivora chrysoptera*
Gray Jay	*Perisoreus canadensis*
Gray wolf	*Canis lupus*
Great Gray Owl	*Strix nebulosa*
Greater redhorse	*Moxostoma valenciennesi*
Gypsy moth	*Lymantria dispar*
Gyrfalcon	*Falco rusticolus*
Harris' checkerspot	*Chlosyne harrisii*
Hermit Thrush	*Catharus guttatus*
Hooded Warbler	*Setophaga citrina*, listed as *Wilsonia citrina* by the Wisconsin Natural Heritage Working List
Jack pine	*Pinus banksiana*
Japanese barberry	*Berberis thungbergii*
Japanese knotweed	*Polygonum cuspidatum*
Karner blue butterfly	*Lycaeides melissa samuelis*
Lake darner	*Aeshna eremita*
Lake sturgeon	*Acipenser fulvescens*
Largemouth bass	*Micropterus salmoides*
Laurentian bladder fern	*Cystopteris laurentiana*
LeConte's Sparrow	*Ammodramus leconteii*
Leafy spurge	*Euphorbia esula*
Lesser wintergreen	*Pyrola minor*
Lilies	Family Liliaceae
Lincoln's Sparrow	*Melospiza lincolnii*
Louisiana Waterthrush	*Parkesia motacilla*, listed as *Seiurus motacilla* by the Wisconsin Natural Heritage Working List
Mallard	*Anas platyrhynchos*
Mink frog	*Lithobates septentrionalis*
Moose	*Alces americanus*
Mourning Warbler	*Geothlypis philadelphia*
Muskellunge	*Esox masquinongy*
Nashville Warbler	*Oreothlypis ruficapilla*
North American river otter	*Lontra canadensis*
Northern bur-reed	*Sparganium glomeratum*

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Appendix 16.J, *continued.*

Common name	Scientific name
Northern Harrier	*Circus cyaneus*
Northern Hawk Owl	*Surnia ulula*
Northern pike	*Esox lucius*
Northern pin oak	*Quercus ellipsoidalis*
Northern red oak	*Quercus rubra*
Northern Saw-whet Owl	*Aegolius acadicus*
Northern white-cedar	*Thuja occidentalis*
Oak wilt fungus	*Ceratocystis fagacearum*
Oaks	*Quercus* spp.
Olive-sided Flycatcher	*Contopus cooperi*
Orchids	Family Orchidaceae
Palm Warbler	*Setophaga palmarum*
Pine sawflies	*Neodiprion* spp. and *Diprion* spp.
Pines	*Pinus* spp.
Predacious diving beetle	*Neoporis vittatus*
Prothonotary Warbler	*Protonotaria citrea*
Purple loosestrife	*Lythrum salicaria*
Purple wartyback	*Cyclonaias tuberculata*
Pygmy snaketail	*Ophiogomphus howei*
Quaking aspen	*Populus tremuloides*
Rainbow trout	*Oncorhynchus mykiss*
Red Crossbill	*Loxia curvirostra*
Red maple	*Acer rubrum*
Red pine	*Pinus resinosa*
Red pine pocket mortality fungi	*Leptographium terrebrantis* and *L. procerum*
Red-disked alpine	*Erebia discoidalis*
Red-shouldered Hawk	*Buteo lineatus*
Reed canary grass	*Phalaris arundinacea*
Ring-necked Duckv	*Aythya collaris*
River redhorse	*Moxostoma carinatum*
Ruby-crowned Kinglet	*Regulus calendula*
Ruffed Grouse	*Bonasa umbellus*
Russet cotton-grass	*Eriophorum chamissonis*
Rusty crayfish	*Orconectes rusticus*
Saint Croix snaketail	*Ophiogomphus susbehcha*
Salamander mussel	*Simpsonaias ambigua*
Sedge	*Carex* spp.
Sedge Wren	*Cistothorus platensis*
Sharp-shinned Hawk	*Accipiter striatus*
Silver maple	*Acer saccharinum*
Smallmouth bass	*Micropterus dolomieu*
Snowshoe hare	*Lepus americanus*
Sora	*Porzana carolina*
Spectacle case	*Cumberlandia monodonta*
Spotted knapweed	*Centaurea biebersteinii*
Spruce budworm	*Choristoneura fumiferana*
Spruce Grouse	*Falcipennis canadensis*
Spruces	*Picea* spp.
Subarctic darner	*Aeshna subarctica*
Sugar maple	*Acer saccharum*
Swamp Sparrow	*Melospiza georgiana*
Tamarack	*Larix laricina*
Two-lined chestnut borer	*Agrilus bilineatus*
Veery	*Catharus fuscescens*
Walleye	*Sander vitreus*

Continued on next page

Appendix 16.J, *continued.*

Common name	Scientific name
Water scorpion	*Ranatra nigra*
Watercress	*Nasturtium officinale*
White ash	*Fraxinus americana*
White birch	*Betula papyrifera*
White oak	*Quercus alba*
White pine blister rust fungus	*Cronartium ribicola*
White spruce	*Picea glauca*
White-tailed deer	*Odocoileus virginianus*
Wild parsnip	*Pastinaca sativa*
Wild rice	*Zizania* spp.
Willows	*Salix* spp.
Wilson's Snipe	*Gallinago delicata*
Winter Wren	*Troglodytes hiemalis*
Wood Duck	*Aix sponsa*
Wood turtle	*Glyptemys insculpta*
Woodland jumping mouse	*Napaeozapus insignis*
Yellow birch	*Betula alleghaniensis*
Yellow perch	*Perca flavescens*
Yellow Rail	*Coturnicops noveboracensis*
Yellow-bellied Flycatcher	*Empidonax flaviventris*

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

Appendix 16.K. *Maps of important physical, ecological, and aquatic features within the Northwest Lowlands Ecological Landscape.*

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

Note: *Go to http://dnr.wi.gov/topic/landscapes/index.asp?mode=detail&Landscape=14 and click the "maps" tab.*

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