



Rapid Ecological Assessment for Yellowstone Lake & Blackhawk Lake Managed Lands

A Rapid Ecological Assessment Focusing on Rare Plants, Selected Rare Animals, and High-quality Natural Communities

Properties included in this report are:

Lafayette County	Iowa County
Yellowstone Wildlife Area	Blackhawk Lake Wildlife Area
Yellowstone Lake State Park	
Yellowstone Savanna State Natural Area	
Streambank Protection Fee Area	

Wisconsin's Natural Heritage Inventory Program
 Bureau of Endangered Resources
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Cover Photos:

- Top left: View of Blackhawk Lake from Pine Relict to the north. Photo by Amy Staffen.
- Top right: View of Blackhawk Lake and Emergent Marsh. Photo by Jeff Lorch.
- Bottom: Scottish highland cattle at Yellowstone Lake State Park. Photo by Kelly Kearns.

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Yellowstone and Blackhawk Lakes Managed Lands at a Glance

Exceptional Characteristics and Opportunities of the Study Area

- **Rare Animals and Plants.** Yellowstone and Blackhawk Lakes Managed Lands (YLBL) supports numerous rare species. Twenty-five rare animal species have been documented at YLBL, including one State Endangered species, five State Threatened species, 19 Special Concern species, and two associated rare animal assemblages. Six rare plant species are also known from YLBL, including two State Threatened and four Special Concern species.
- **Grassland Bird Conservation.** Since the North American Breeding Bird Survey began in 1966, grassland birds have declined more steeply than any other group of birds in North America and the Midwest. The grasslands of YLBL provide breeding habitat for at least 17 grassland bird species.
- **Oak Savanna Restoration.** Oak savannas were historically common in Wisconsin but are now rare throughout the state, thus their restoration is critical to the survival of many rare plants and animals that depend on them. Opportunities exist at YLBL to restore Oak Opening, Oak Woodland, and Oak Barrens (Blackhawk Lake only) on a landscape scale and within a matrix of other habitats. An opportunity to contribute to the science of oak savanna restoration exists at Yellowstone Lake, where research on the effects of fire and grazing is ongoing.
- **Older Forest Conservation.** The Southern Dry-mesic Forest along the south shore of Yellowstone Lake offers an opportunity to protect and restore a high-quality ecosystem, as well as to manage for older forest. Older forests (greater than 100-120 years old) in Wisconsin are rare and declining, largely due to timber harvesting and conversion to other land uses.
- **Herptile Conservation.** The variety of aquatic, wetland, and upland habitats of YLBL are well-suited to a number of herptile species, including several rare amphibians. Although no rare reptiles were documented at Blackhawk Lake, the Oak Barrens and Sand Prairie habitats show potential for supporting them.

Site Specific Opportunities for Biodiversity Conservation

Two ecologically important sites were identified at YLBL. These “Primary Sites” were delineated because they generally encompass the best examples of 1) rare and representative natural communities, 2) documented occurrences of rare species populations, and/or 3) opportunities for ecological restoration or connections. These sites warrant high protection and/or restoration consideration during the development of the property master plan.

- **Yellowstone Forest.** This site comprises 290 acres of mostly Southern Dry-mesic Forest with very large, old canopy trees (up to 36 inch DBH red oak, bur oak, and basswood) and at least 121 native ground layer species (some of which are rare).
- **Yellowstone Savanna.** This site comprises 240 acres, and harbors remnant Dry Prairie and Oak Opening buffered by old field. The Oak Opening is currently undergoing restoration, and is graced with large oaks (18-24 inch DBH) and scattered savanna indicator species such as eastern figwort. The Dry Prairie is small, but still retains many characteristic species and one rare plant.

community locations into the NHI database, identifying ecologically important areas, and providing interpretation of the findings through reports and other means.

Existing NHI data are often the starting point for conducting a biotic inventory to support master planning. Prior to this project, NHI data for YLBL were limited to: 1) the Statewide Natural Area Inventory, a county-by-county effort conducted by WDNR's Bureaus of Research and Endangered Resources between 1969 and 1984 that focused on natural communities but include some surveys for rare plants and animals and 2) taxa specific surveys.

The most recent taxa-specific field surveys for the study area were conducted during 2010-11. Surveys were limited in scope and focused on documenting high quality natural communities, rare plants, breeding birds, herptiles, and terrestrial invertebrates. The collective results from all of these surveys were used, along with other information, to identify ecologically important areas (Primary Sites) at YLBL.

Survey locations were identified or guided by using recent aerial photos, USGS 7.5' topographic maps, various Geographic Information System (GIS) sources, information from past survey efforts, discussions with property managers, and the expertise of several biologists familiar with the properties or with similar habitats in the region. Based on the location and ecological setting of properties within YLBL, key inventory considerations included the identification of high quality grasslands, oak savannas, pine relicts, upland forests, and cliffs, as well as the location of habitats that had the potential to support rare species. Private lands, including easements, surrounding Yellowstone and Blackhawk Lakes were not surveyed.

Within this report scientific names have been used with first mention of species, thereafter the common name has been used. A list of all scientific names mentioned in the text is included at the end of this document.

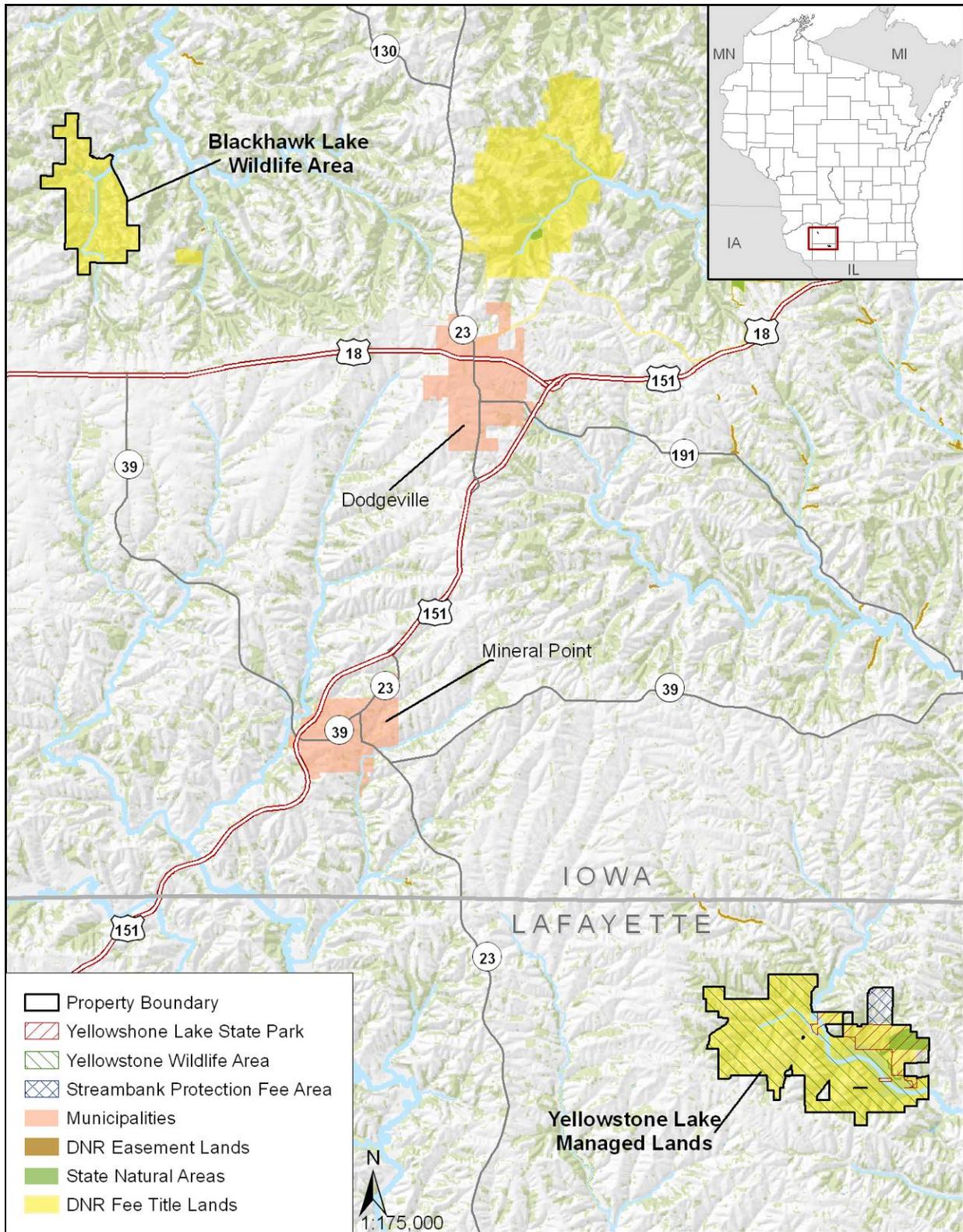


Figure 1. Location of Yellowstone Wildlife Area, Yellowstone Lake State Park, Yellowstone Savanna State Natural Area, Streambank Protection Fee Area, and Blackhawk Lake Wildlife Area

Background on Past Efforts

A few large-scale research and planning efforts have identified YLBL as being ecologically significant. The following are examples of such projects and the significant features identified.

Wisconsin Wildlife Action Plan: Conservation Opportunity Areas

The Wisconsin Wildlife Action Plan (WAP; WDNR 2006a) recognized one Conservation Opportunity Area (COA) relating to the sites covered in this report (see Appendix B): Blackhawk Lake Wildlife Area lies within the larger “Dodgeville and Wyoming Oak Woodland/Savanna” COA. Conservation Opportunity Areas are places in Wisconsin that contain ecological features, natural communities, or Species of Greatest Conservation Need (SGCN) habitat for which Wisconsin has a unique responsibility for protection when viewed from the global, continental, upper Midwest, or state perspective.

Legacy Places

The Land Legacy Report (WDNR 2006b) was designed to identify Wisconsin’s most important conservation and recreation needs for the next 50 years. Yellowstone Lake managed lands were identified as a Legacy Place in acknowledgment of its having a large water body (impoundment), its grassland, savanna, woodland, and marsh habitats, and in particular its recreational potential.

Priority Landscapes for Grassland Bird Management

In 1997, Sample and Mossman identified 26 “priority landscapes” in Wisconsin that represent unique opportunities for landscape-scale grassland management for grassland birds. State-owned lands surrounding Yellowstone Lake were identified as part of the “Yellowstone/Pecatonica River Grasslands and Savanna” priority landscape. Yellowstone Lake managed lands have oak savanna, idle cool- and warm-season grasslands, dry and wet old field habitats, dry and dry-mesic prairie, and upland shrub habitat, all of which can benefit grassland bird species when considered as a whole and within the larger landscape.

Special Management Designations

State Natural Areas

State Natural Areas (SNA) are places on the landscape that protect outstanding examples of native natural communities, significant geological formations, and archaeological sites. Designation confers a significant level of land protection through state statutes, administrative rules, and guidelines. Yellowstone Savanna is a 220-acre SNA that lies within Yellowstone Lake State Park. There are no SNAs within Blackhawk Lake Wildlife Area.

Forest Certification

All DNR-managed lands, including state parks, wildlife areas, and natural areas, are recognized by the Forest Stewardship Council and the Sustainable Forestry Initiative as being responsibly managed (WDNR 2009). This certification emphasizes the state’s commitment to responsibly managing and conserving forestlands, supporting economic activities, protecting wildlife habitat, and providing recreational opportunities.

Southwest Wisconsin Grassland and Stream Conservation Area

The Wisconsin Department of Natural Resources joined with a diverse group of conservation partners, local governments, and landowners in southwestern Wisconsin to establish the "Southwest Wisconsin Grassland and Stream Conservation Area (SWGSCA)." Southwestern Wisconsin has been recognized for many years as one of the best grassland conservation opportunities in the Upper Midwest. The area stands out for its distinct combination of resources: exceptional populations of grassland birds, which are in

serious decline across their range; many scattered remnants of the area's original prairie and savanna that once covered the region; concentrations of rare plants and animals, and spring-fed streams, all set within this expansive rural farming region of open fields, croplands, oak groves, and pastures. Yellowstone Lake managed lands fall within the boundaries of the SWGSCA.

Public Lands

All lands in the study area are owned by the Wisconsin Department of Natural Resources, and are managed by the Bureau of Parks and Recreation, Bureau of Wildlife Management, and Bureau of Endangered Resources.

Regional Ecological Context

“Southwest Savanna” and “Western Coulees & Ridges” Ecological Landscapes

This section is largely reproduced from the Ecological Landscapes of Wisconsin Handbook (WDNR In Prep. a).

The WDNR has mapped the state into areas of similar ecological potential and geography called Ecological Landscapes. The Ecological Landscapes are based on aggregations of smaller ecoregional units (Subsections) from a national system of delineated ecoregions known as the National Hierarchical Framework of Ecological Units (NHFEU) (Cleland et al. 1997). These ecoregional classification systems delineate landscapes of similar ecological pattern and potential for use by resource administrators, planners, and managers.

Yellowstone Wildlife Area, Yellowstone Lake State Park, and Yellowstone Savanna State Natural Area are located in the **Southwest Savanna Ecological Landscape**, while Blackhawk Lake Wildlife Area is located in the **Western Coulees and Ridges Ecological Landscape** (WDNR In Prep. a) (Figure 2).

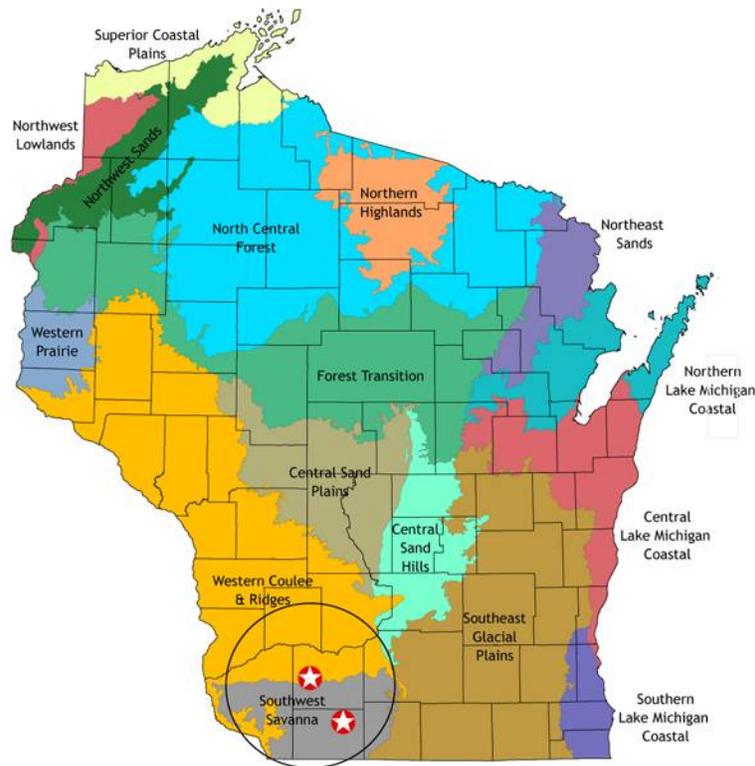


Figure 2. Ecological Landscapes of Wisconsin and the study area.

The **Western Coulee and Ridges Ecological Landscape** is the largest of the 16 Ecological Landscapes. It is located in southwestern and west central Wisconsin within the Driftless Area, a region that escaped glaciation during the last glacial period. The Driftless Area is noted for its steeply dissected terrain, extensive network of streams, and lack of glacial deposits (although glacial outwash materials do occur in

river valleys). Several large rivers including the Wisconsin, Mississippi, Chippewa, Kickapoo and Black flow through or border this Ecological Landscape.

Historical vegetation consisted of southern hardwood forest, oak savanna, and prairie, along with wetlands (forested and open) along rivers and streams. With Euro-American settlement, most of the level land on ridgetops and in valley bottoms was cleared for agriculture. The untillable steep slopes between valley bottom and ridgetop either remained in forest or grew up into oak-dominated forests when early wildfire-suppression policies were instituted.

Current vegetation of the Western Coulee and Ridges Ecological Landscape is a mix of forest (40% of total cover), agriculture, and grassland, with wetlands mostly restricted to the river valleys. The primary forest cover is oak-hickory, while maple-basswood forests are common in cooler, moister areas. Bottomland hardwoods occur in the valley bottoms of major rivers. Relict conifer stands are rare, and are associated with steep-faced outcrops with cool microclimates. This Ecological Landscape has few natural lakes, though oxbows and ponds may be found with large river floodplains. Impoundments have been installed on a number of rivers to create man-made lakes.

The **Southwest Savanna Ecological Landscape** is also located within the Driftless Area of Wisconsin. Although no natural lakes occur in this Ecological Landscape, several large rivers flow through, including the Pecatonica, Galena, and Yellowstone Rivers. Historical vegetation of the **Southwest Savanna Ecological Landscape** consisted primarily of prairie, oak savanna, and oak-dominated forests.

Only 11% of current land cover is classified as timberland in the **Southwest Savanna Ecological Landscape**. Almost three-quarters of the land here is in agricultural crops, with lesser amounts of grasslands, barrens, and urban areas. The major forest types are oak-hickory and maple-basswood. Prairie and oak savanna remnants occur mostly on rocky hilltops and slopes that were untillable; many of these sites are currently pastures. Relict stands of pine occur on bedrock outcroppings along some stream systems.

Regional Biodiversity Needs and Opportunities

Opportunities for sustaining natural communities in the Southwest Savanna and Western Coulees & Ridges Ecological Landscapes were developed in 2005 by the Ecosystem Management Planning Team (EMPT; not published until 2007) and later focused on wildlife Species of Greatest Conservation Need and their habitat in the Wisconsin Wildlife Action Plan (WDNR 2006a). The goal of sustaining natural communities is to manage for natural community types that 1) historically occurred in a given landscape and 2) have a high potential to maintain their characteristic composition, structure, and ecological function over a long period of time (e.g., 100 years). This list can help guide land and water management activities so that they are compatible with the local ecology of the Ecological Landscape while maintaining important components of ecological diversity and function. Based on the EMPT's criteria, these are the most appropriate community types that could be considered for management activities within the Southwest Savanna and Western Coulees & Ridges Ecological Landscape.

There are management opportunities for 28 natural communities in the Southwest Savanna Ecological Landscape. Of these, 6 are considered "major" opportunities (Table 1). Similarly, there are management opportunities for 45 natural communities in the Western Coulees and Ridges Ecological Landscape, 24 of which are considered "major." A "major" opportunity indicates that the natural communities can be sustained in the Ecological Landscape, either because many significant occurrences of the natural community have been recorded in the landscape or major restoration activities are likely to be successful in maintaining the community's composition, structure, and ecological function over a longer period of time. An additional 10 natural communities are considered "important" in the Southwest Savanna

Ecological Landscape and 13 in the Western Coulees and Ridges. An “important” opportunity indicates that although the natural community does not occur extensively or commonly in the Ecological Landscape, one to several occurrences are present and are important in sustaining the community in the state. In some cases, important opportunities may exist because the natural community may be restricted to just one or a few Ecological Landscapes within the state and there may be a lack of opportunities elsewhere.

Table 1. Major Natural Communities Management Opportunities in the Southwest Savanna and Western Coulees & Ridges Ecological Landscape (EMPT 2007 and WDNR 2006a)

	Southwest Savanna	Western Coulees & Ridges
Algific Talus Slope		X
Bedrock Glade		X
Cedar Glade		X
Coldwater streams		X
Coolwater streams		X
Dry Cliff		X
Dry Prairie	X	X
Dry-mesic Prairie	X	X
Emergent Marsh		X
Floodplain Forest		X
Hemlock Relict		X
Mesic Prairie		X
Moist Cliff		X
Oak Barrens		X
Oak Opening	X	X
Oak Woodland	X	X
Pine Relict		X
Sand Prairie		X
Shrub Carr		X
Southern Dry Forest		X
Southern Dry-mesic Forest		X
Southern Mesic Forest		X
Submergent Marsh		X
Surrogate Grasslands	X	X
Warmwater streams	X	X

Rare Species of the Southwest Savanna and Western Coulees & Ridges Ecological Landscape
 Numerous rare species are known from the Southwest Savanna and Western Coulees & Ridges Ecological Landscapes. “Rare” species include all of those species that appear on the WDNR’s NHI Working List (*Wisconsin Natural Heritage Working List*) classified as “Endangered,” “Threatened,” or “Special Concern.” Tables 2 and 3 list the number of species known to occur in these two landscapes based on information stored in the NHI database as of 2012.

Table 2. Listing Status for rare species in the Southwest Savanna Ecological Landscape as of 2012.

Source is the NHI database. Listing Status is based on the Working List published June 2011.

Listing Status	Taxa					Total Fauna	Total Plants	Total Listed
	Mammals	Birds	Herptiles	Fishes	Invertebrates			
State Endangered	0	1	1	2	2	6	9	15
State Threatened	1	4	1	2	3	11	14	25
State Special Concern	3	5	3	1	9	21	17	38
Federally Endangered	0	0	0	0	0	0	0	0
Federally Threatened	0	0	0	0	0	0	1	1
Federal Candidate	0	0	0	0	0	0	0	0

Table 3. Listing Status for rare species in the Western Coulees & Ridges Ecological Landscape as of 2012.

Source is the NHI database. Listing Status is based on the Working List published June 2011.

Listing Status	Taxa					Total Fauna	Total Plants	Total Listed
	Mammals	Birds	Herptiles	Fishes	Invertebrates			
State Endangered	0	6	5	7	17	35	18	53
State Threatened	2	9	2	9	10	32	26	58
State Special Concern	4	13	11	10	74	112	62	174
Federally Endangered	1	0	0	0	3	4	0	4
Federally Threatened	0	0	0	0	0	0	2	2
Federal Candidate	0	0	1	0	2	3	0	3

The Wisconsin Wildlife Action Plan denoted Species of Greatest Conservation Need (SGCN). Species of Greatest Conservation Need are animals that have low and/or declining populations that are in need of conservation action. They include various birds, fish, mammals, reptiles, amphibians, and invertebrates (e.g. dragonflies, butterflies, and freshwater mussels) that may be:

- Already listed as threatened or endangered;
- At risk because of threats to their life history needs or their habitats;
- Stable in number in Wisconsin, but declining in adjacent states or nationally.
- Of unknown status in Wisconsin and suspected to be vulnerable.

There are five vertebrate SGCN significantly associated with the Southwest Savanna Ecological Landscape and 16 vertebrate SGCN significantly associated with the Western Coulees & Ridges Ecological Landscape. This means that the species is (and/or historically was) significantly associated with the Ecological Landscape, and restoration of natural communities this species is associated with in the Ecological Landscape would significantly improve conditions for the species.

Description of the Study Area

Location and Size

Yellowstone Lake is a 455-acre man-made lake in Lafayette County surrounded by 5,220 acres of public land, 4,215 of which is State Wildlife Area, 768 of which is State Park, and 237 of which is Streambank Protection Fee Area. Yellowstone Savanna State Natural Area comprises 220 acres within Yellowstone Lake State Park. Blackhawk Lake Wildlife Area is a 5,038 acre property located in Iowa County. Blackhawk Lake is 455 acres, and is also man-made. All acreages are based on Geographical Information System (GIS) acreage derived from ArcSDE/Oracle WDNR Managed Lands (DML) shapefile as of August 2011. See Figure 1 for a map of the study areas.

Ecoregion

Landtype Associations

Nested hierarchically within each Ecological Landscape are NHFEU Subsections which are further divided into Landtype Associations (LTAs) (Cleland et al. 1997). These LTAs are finer scaled polygons (areas of 10,000 – 300,000 acres) that make up each subsection, and are characterized by repeating patterns of characteristic landforms, soil groups, regional climate, and potential vegetation; these are most relevant to this study. Figure 3 shows the distribution of the following LTAs at YLBL:

- **Platteville Savanna (222Le02).** The characteristic landform pattern is sloping, with summits, shoulders, and backslopes of ridges common. Soils are well-drained silty and loamy, with a silt loam surface over calcareous and non-calcareous clayey, sandy, or loamy residuum, or over non-calcareous silty loess. Most areas occur over dolostone, limestone, or sandstone bedrock. This LTA comprises 80% of Yellowstone Lake managed lands (uplands only).
- **Pecatonica Valley (222Le03).** The characteristic landform pattern is sloping, with summits, shoulders, and backslopes of ridges common. They are moderately well-drained, well-drained, poorly drained, or somewhat poorly drained silty soils, with a silt loam surface over calcareous and non-calcareous silty alluvium or loess. This LTA comprises approximately 20% of Yellowstone Lake, and is mostly confined within the boundaries of the lake bed and impoundment.
- **Hills and Valleys - Wisconsin River Drainage (222Lc18).** Soils are well-drained to moderately well-drained silty and loamy, with a silt loam or sandy loam surface over non-calcareous clayey or loamy residuum or over silty loess. Most areas occur over limestone, sandstone, or shale bedrock. This LTA comprises 100% of Blackhawk Lake managed lands.

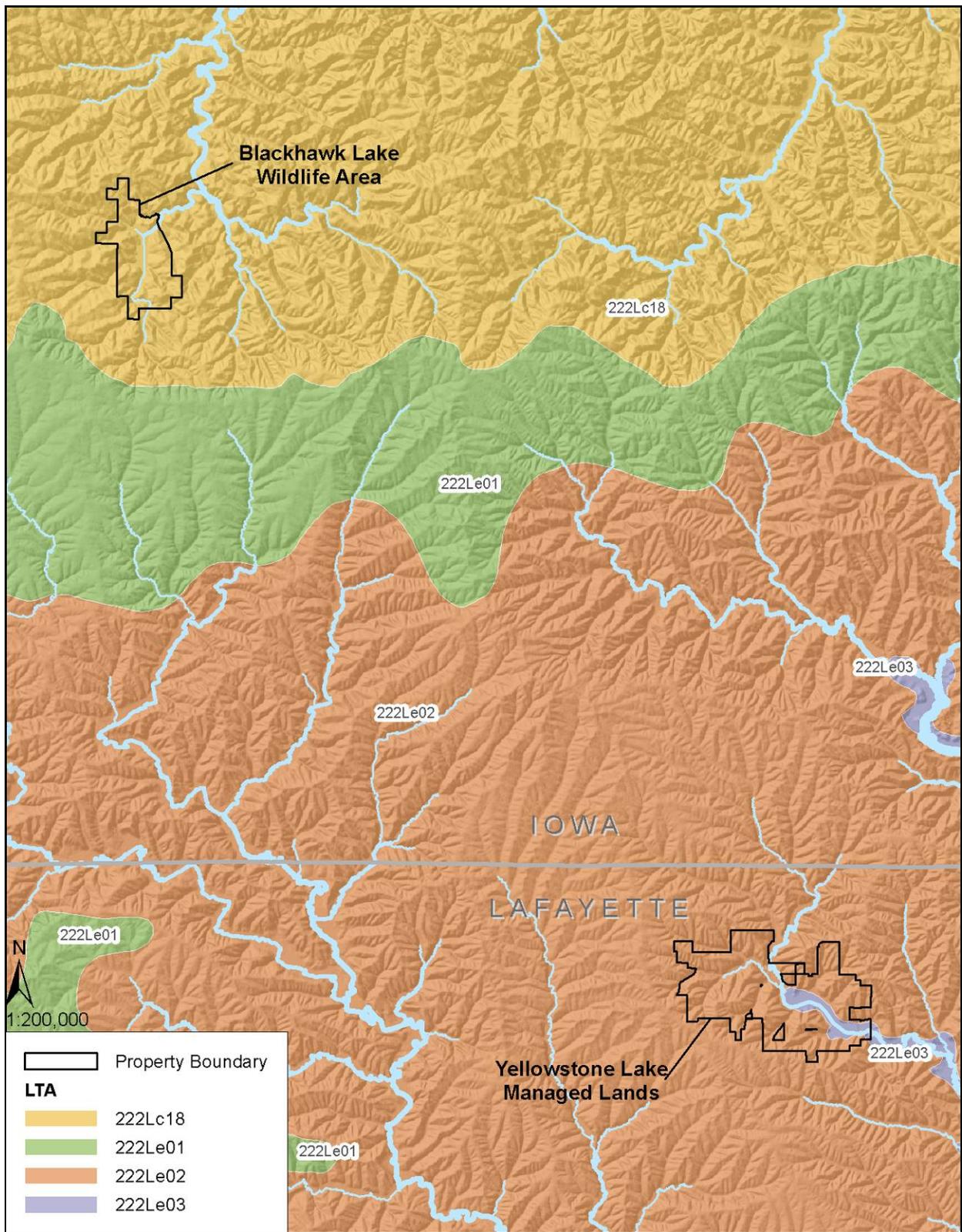


Figure 3. Landtype Associations for Yellowstone Wildlife Area, Yellowstone Lake State Park, Yellowstone Savanna State Natural Area, Streambank Protection Fee Area, and Blackhawk Lake Wildlife Area.

Physical Environment

Geology and Landforms

Blackhawk and Yellowstone Lakes managed lands lie within the Driftless Area of Wisconsin on a vast plateau with broad, rolling ridges and deeply dissected valleys (Watson 1960, Klingelhoets 1962). Dolomitic limestone and sandstone form the main bedrock types underlying the study area, while shale is also minimally influential. Saint Peter sandstone dominates the Yellowstone River valley and associated ridges (approximately half of the site), while the remainder of the site is underlain by Galena limestone (Murdrey et al. 1982). Saint Peter sandstone also underlies about 30% of Blackhawk Lake managed lands, mostly in the southern half, while the remaining area is underlain mostly by limestone. A mantle of loess covers all of the uplands as well as most of the valley slopes and terraces (Watson 1960, Klingelhoets 1962). This loess was probably blown in from the Mississippi River during glacial periods.

The lack of direct, recent glacial influence on the region resulted in a marked absence of lakes. This important aspect of geological history is tied directly to the creation of Blackhawk and Yellowstone Lakes, artificial impoundments on streams installed to provide lakes in a landscape where they do not occur naturally.

Soils

Most soils in the study area are deep, well-drained silt loams (Watson 1960, Klingelhoets 1962). Limestone and sometimes sandstone bedrock lie close to the surface in scattered locations throughout both sites, however, resulting in shallow soils and exposed bedrock (sometimes in the form of cliffs or outcrops). Alluvial deposits occur along stream and river bottoms, yielding poorly-drained soils.

Hydrology

Yellowstone Lake (information from Piening and Threinen 1968a and WDNR 2011a)

Yellowstone Lake and its associated managed lands are within the Yellowstone River Watershed. This watershed is dominated by agriculture (60%), forest (26%) and grassland (11%), and is ranked 'high' for nonpoint source issues affecting streams and groundwater and 'medium' for nonpoint source issues affecting lakes. The watershed can be divided into five subwatersheds: Cannon Creek, McClintock Creek, Steiner Branch, Yellowstone River, and Yellowstone Lake.

In 1954, a 1,200-foot-long earthen dike and 100-foot concrete control structure were installed on the Yellowstone River, creating the 455-acre Yellowstone Lake. The dam structure was designed to raise the level of the Yellowstone River 23 feet behind nearly a quarter of a mile of dike to create an impoundment 1.9 miles wide. This is a shallow, irregular body with generally steep shores except for the gradual slopes of its upstream end and the bay areas of the south shoreline. The original Yellowstone River channel conforms closely with the configurations of the south shoreline.

Four water bodies contribute to Yellowstone Lake's volume: the Yellowstone River, Steiner Branch, and two small spring-fed streams. Steiner Branch is a cool-water Class II and III trout stream, about one-half mile of which is in the Yellowstone Lake Wildlife Area; its mouth is located above Yellowstone Lake. The Yellowstone River is a warm water drainage stream. At least 12 springs occur within Yellowstone Lake managed lands.

Blackhawk Lake (information from Piening and Threinen, 1968b and WDNR 2011b)

Blackhawk Lake is within the Otter and Morrey Creeks Watershed. The streams in this watershed have a high gradient, and most support trout (or did in the past).

Blackhawk Lake is 220 acres, has a maximum depth of 40 feet, and was created by impounding the headwaters of Otter Creek in 1964 as part of a flood control project.

Otter Creek is a tributary to the Wisconsin River. It is a cool-water Class II trout stream for eight miles of its length above Dickinson Creek (Blackhawk Lake not included), and is considered an impaired water. Narveson Creek, a cold-water tributary to Otter Creek, is a spring fed Class II trout fishery, and courses through the northwestern part of the study area. Cave Hollow Creek is a spring-fed, cool-water stream that flows through the southwestern tip of the study area. It has a limestone bedrock bottom as well as limestone bluffs along its banks. Several other unnamed creeks flow into Otter Creek within the study area boundaries.

Vegetation

Historical Vegetation

Data from the original Public Land Surveys are often used to infer forest composition and tree species dominance for large areas in Wisconsin prior to widespread Euro-American settlement. 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 which have been changed functionally (for example, by constructing dams, or suppressing fires). Although data are limited to a specific snapshot in time, they provide valuable insights into Wisconsin's ecological capabilities. Maintaining or restoring some lands to more closely resemble historic systems and including some structural or compositional components of the historic landscape within actively managed lands can help conserve important elements of biological diversity (WDNR In Prep. a). Public Land Surveys for the area comprising YLBL were conducted between 1846 and 1850.

The early vegetation of Wisconsin was mapped by Robert Finley and published in 1976 (Fig. 4; Finley, 1976), and was based on notes and maps from the original Public Land Surveys. Finley's map indicates that Blackhawk Lake was dominated by Oak Opening, while Yellowstone Lake was about 70% oak-dominated forest (white [*Quercus alba*], bur [*Quercus macrocarpa*], and/or black oak [*Quercus velutina*]), 10% Oak Opening, and 10% wetland (marsh, sedge meadow, wet prairie, and/or lowland shrub). Oaks that were noted in the surveyor's notes (Wisconsin Board of Commissioners of Public Lands 1832) at both sites were surprisingly small, ranging from 8-16 inch DBH, and included bur, white, black and northern red [*Quercus rubra*]. Occasional bur oaks were noted at 30-33 inch DBH. Surveyors described the terrain as uneven, rolling, and even "exceedingly hilly," and described the vegetation as thinly timbered. In the central-eastern part of Blackhawk Lake, they even made special note of the absence of undergrowth and grassy areas. All of this information points towards prairie, oak savanna and oak woodland as the dominant cover types.

The Land Economic Inventory of 1939 (Bordner 1939) shows commonalities between the two sites: most areas were actively farmed, and were described as cleared cropland, pasture, or permanent pasture (designated as non-tillable). Stump pastures were scattered throughout, along with occasional areas labeled as "poor land previously cropped." All wooded areas were described as oak-hickory, 6-12 inch DBH, with "medium" to "poor" stand densities, and were mostly small, isolated, and often linear.

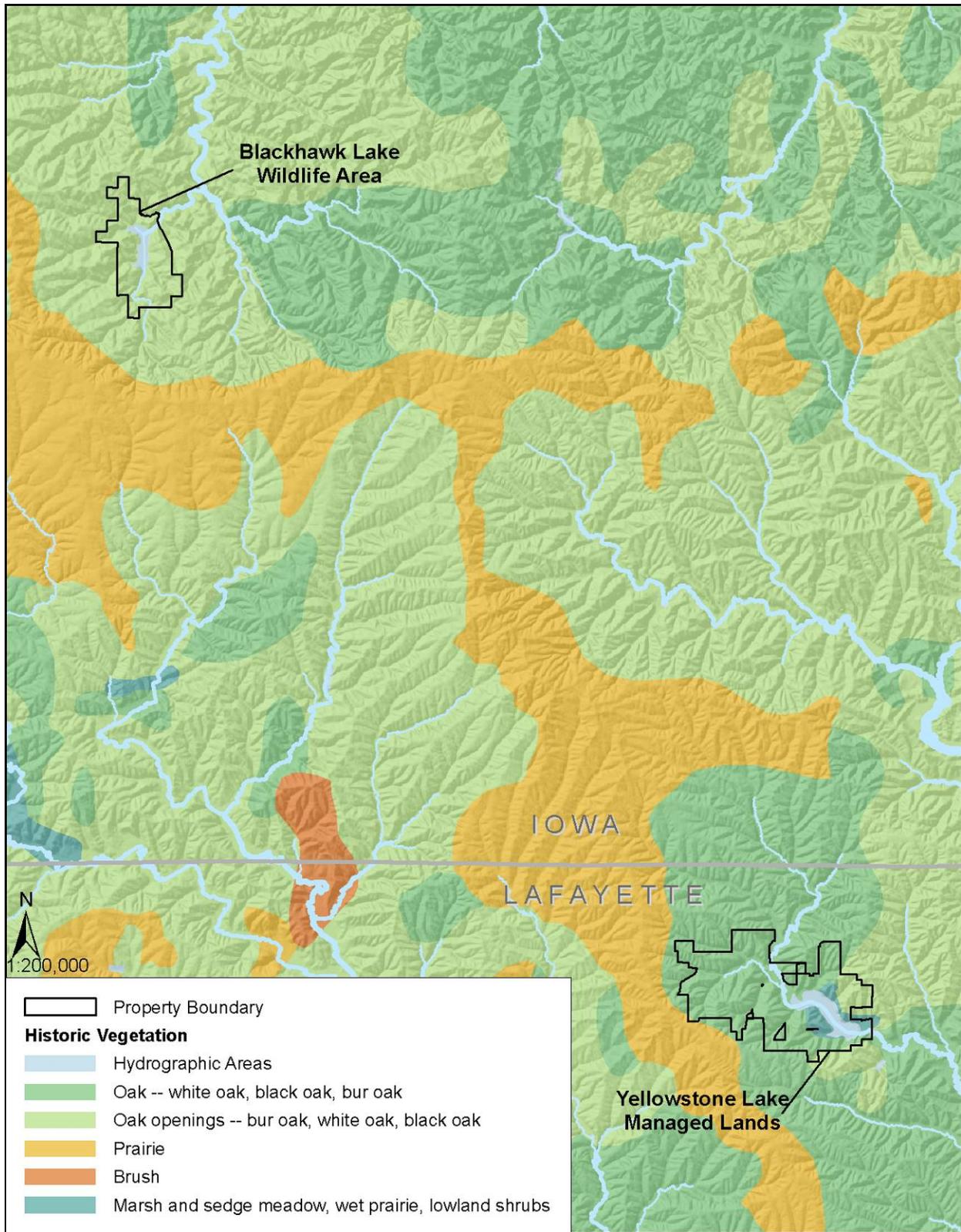


Figure 4. Vegetation for Yellowstone Wildlife Area, Yellowstone Lake State Park, Streambank Protection Fee Area, and Blackhawk Lake Wildlife Area prior to Euro-American settlement. Data are from Finley (1976).

Current Vegetation

Many of the factors that historically impacted vegetation continue to impact the study area today, and include but are not limited to geology, soils, hydrology, and climate. These factors are superseded in most areas, however, by more recent human influences on the land, particularly conversion of land to agriculture, installation of impoundments, fire suppression, and the introduction and spread of non-native invasive species. In general, the hard-working farmers that called these lands home before WDNR purchase plowed the deeper soils on hilltops, logged the wooded areas, and seeded non-native European grasses and legumes throughout to increase forage for grazers, as reflected in current landcover (Fig. 5).

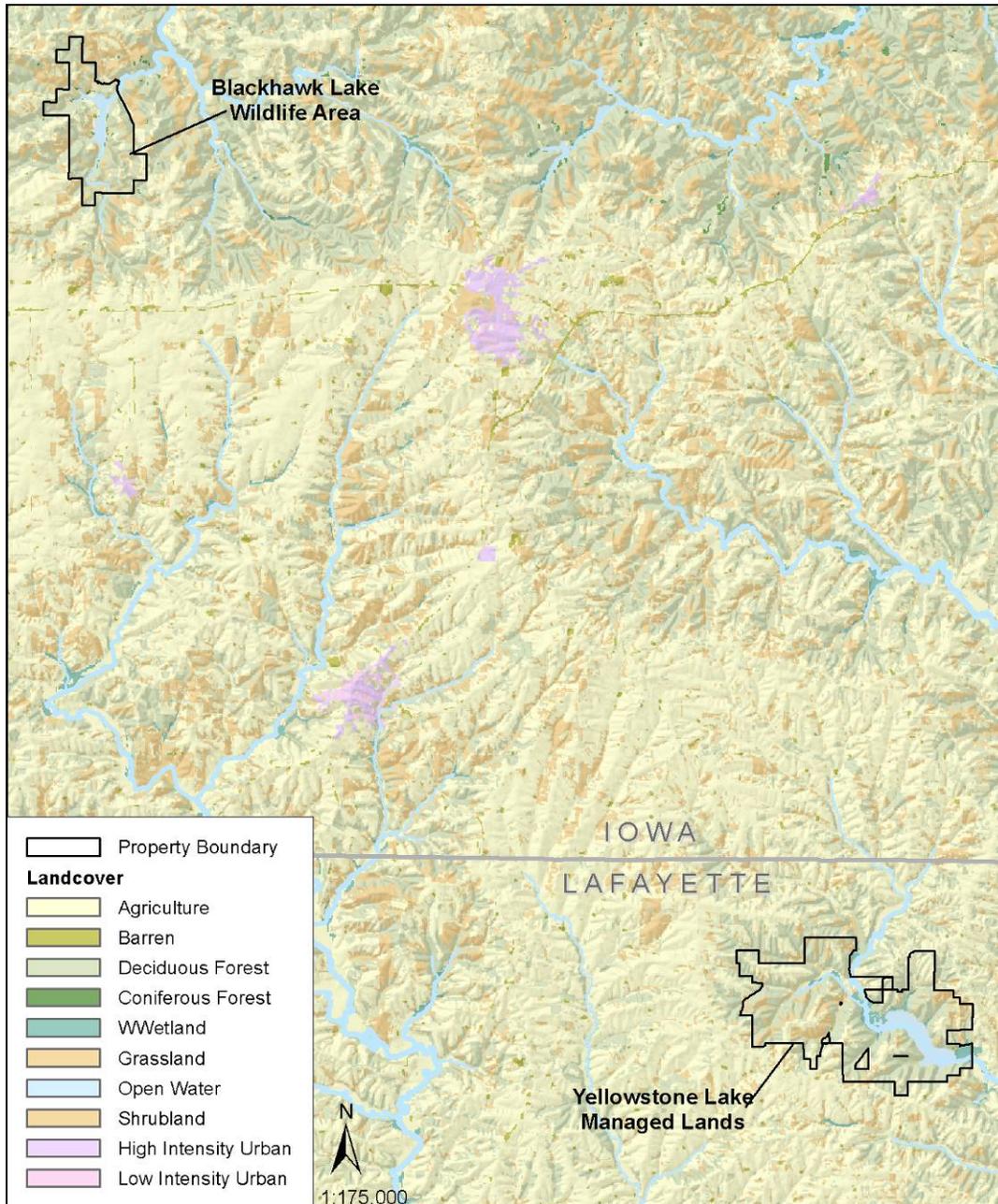
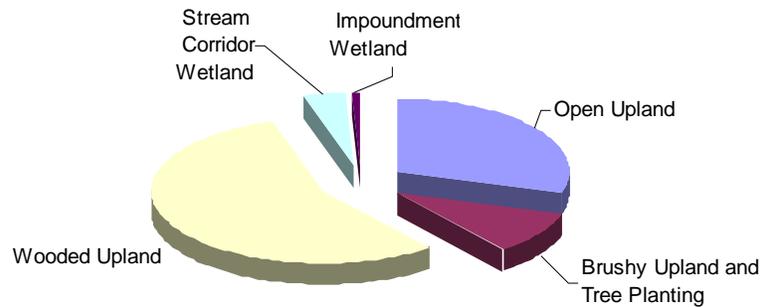


Figure 5. Landcover for Yellowstone Wildlife Area, Yellowstone Lake State Park, Yellowstone Savanna State Natural Area, Streambank Protection Fee Area, and Blackhawk Lake Wildlife Area. From WDNR Wisland GIS coverage (WDNR 1993)

Today, four general land cover types dominate Yellowstone and Blackhawk Lakes: open upland, brushy upland, wooded upland, and wetland. Details of these cover types vis-à-vis their relict native plant communities and condition following such a rich agricultural past are discussed in below.

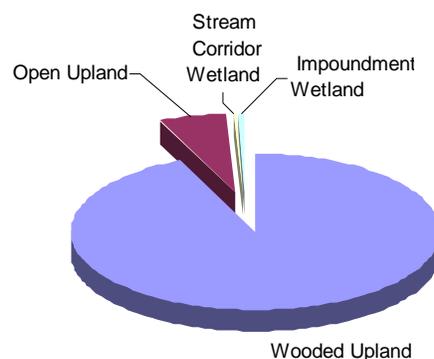
At Yellowstone Lake, wooded uplands comprise approximately 56% (3,000+ acres) of the area, grassy uplands comprise approximately 30% (1,600+ acres), brushy uplands and old fields planted to trees (400+ acres and 120+ acres, respectively) comprise approximately 10%, and wetlands comprise about 5% (250+ acres; Fig. 6). Wooded areas at Yellowstone Lake occur naturally in ravines and on north- and east-facing slopes. They consist of mostly young second-growth southern dry-mesic forest and overgrown oak savanna with depauperate ground layers and abundant non-native invasive species, though some higher quality wooded blocks have remained relatively intact. Occasional tiny Pine Relicts (0.5 acres or less) occur here as well, and 72 acres of pine plantation are scattered throughout the property (WisFIRS). At Yellowstone Lake, about one-half of the area occupied by open uplands is currently under cultivation, while the remaining half is mostly old field or is actively being hayed. In places where soils were too shallow for plowing, remnant Dry Prairie occurs, albeit in a degraded state; non-native weedy and invasive plants, and woody invaders often dominate. Low-quality wetlands (Southern Sedge Meadow and Shrub-carr) occur naturally along narrow stream corridors at Yellowstone Lake and in association with springs, and unnaturally in the form of emergent marsh at impoundments.

Figure 6. Cover Types of Yellowstone Lake Managed Lands (2010 NAIP and 2011 NHI field surveys)



At Blackhawk Lake, wooded uplands comprise approximately 94% (over 4,000 acres) of the area, grassy uplands comprise approximately 5% (over 250 acres), and wetlands comprise less than 1% (Fig. 7).

Figure 7. Cover Types of Blackhawk Lake Wildlife Area (WisFIRS, 2010 NAIP and 2010 NHI field surveys)



Wooded uplands at Blackhawk Lake consist of degraded Oak Woodland, second-growth Dry-mesic/Mesic Forest, scattered low-quality Pine Relicts, overgrown former prairie/savanna, frequent black walnut plantations, and about 90 acres of pine plantation. Only two small blocks of Dry/Dry-mesic Forest (10 acres each) are of good-quality. A striking testament to the widespread extent of historic oak savanna here are the numerous massive (24-36 inch DBH, occasionally up to 48 inches) open-grown bur and white oaks throughout the property. Open uplands consist of severely degraded remnant Dry and Sand Prairie, and former croplands planted to prairie or old field. A one-acre Sand Prairie remnant shows good floral diversity and integrity. Small areas of degraded wetland (Southern Sedge meadow and Shrub-carr) occur naturally along creeks and intermittent streams, and unnaturally in the form of emergent marsh at impoundments.

The most significant natural community types for these two properties are described in detail below:

Prairie

All deep-soil prairies at both properties were plowed in the past for farm land. Dry Prairie remnants that survive today are on shallow rocky soils, often on steep south- and west-facing slopes, while sand prairies can occur on sandy soils on level or gently rolling terrain. These remnants are small and generally highly degraded due to past grazing, fire suppression, and invasion of woody and non-native species (especially Eurasian honeysuckle [*Lonicera* spp.], common buckthorn [*Rhamnus cathartica*], autumn-olive [*Elaeagnus umbellata*], spotted knapweed [*Centaurea biebersteinii*], bird's-foot trefoil [*Lotus corniculatus*], smooth brome [*Bromus inermis*], and Kentucky bluegrass [*Poa pratensis*]).

At the northeast end of Yellowstone Lake, a small (8-acre) low-quality Dry Prairie on a steep southwest-facing slope is protected within Yellowstone Savanna State Natural Area. Many species characteristic of Dry Prairie are present here, including side-oats grama (*Bouteloua curtipendula*), little blue-stem (*Schizachyrium scoparium*), Indian grass (*Sorghastrum nutans*), false boneset (*Kuhnia eupatorioides*), lead-plant (*Amorpha canescens*), and prairie tickseed (*Coreopsis palmata*). The site is being heavily invaded by brush (30-70% cover), including showy bush honeysuckle (*Lonicera X bella*), smooth sumac (*Rhus glabra*), gray dogwood (*Cornus foemina*), common prickly-ash (*Zanthoxylum americanum*), and black locust (*Robinia pseudoacacia*). A rare plant was discovered growing on this prairie in 2010. Other conservative prairie species found here include cream wild indigo (*Baptisia bracteata*), purple prairie-clover (*Dalea purpurea*), and prairie rosinweed (*Silphium integrifolium*). Another small dry prairie remnant at the southeast end of Yellowstone Lake is nearly gone¹ due to heavy woody invasion: Eurasian honeysuckle, gray dogwood, bur oak, quaking aspen (*Populus tremuloides*), eastern red-cedar (*Juniperus virginiana*), yellow-bud hickory (*Carya cordiformis*), and black walnut (*Juglans nigra*), along with numerous other native and non-native trees and shrubs, create 80% cover here. The few prairie species that are hanging on include violet wood-sorrel (*Oxalis violacea*), hoary puccoon (*Lithospermum canescens*), prairie violet (*Viola pedatifida*), and even some that are conservative, including prairie phlox (*Phlox pilosa*), yellow-pimpernel (*Taenidia integerrima*) and golden Alexander's (*Zizia aurea*).

At Blackhawk Lake, a one-acre Sand Prairie with exceptional floral diversity lies in the central eastern part of the property, west of the southernmost parking area on Plank Road (Fig. 8). This prairie is dominated by little blue-stem, big bluestem (*Andropogon gerardii*), common spiderwort (*Tradescantia ohioensis*), and goat's-rue (*Tephrosia virginiana*). Other species that are characteristic of dry prairie that occur here include panic grasses (*Panicum* spp.), Muhlenberg's sedge (*Carex muhlenbergii*), poverty oat grass (*Danthonia spicata*), flowering spurge (*Euphorbia corollata*), round-headed bush-clover (*Lespedeza capitata*), and stiff goldenrod (*Solidago rigida*). This diverse little prairie remnant is greatly threatened by its surroundings: old field/hay field that is loaded with non-native invasives (spotted knapweed, white [*Melilotus albus*] and yellow sweet clovers [*Melilotus officinalis*], wild parsnip

¹ This prairie was historically much larger and now is reduced to less than one-tenth of an acre.

[*Pastinaca sativa*], bird's-foot trefoil, smooth brome, quackgrass [*Elytrigia repens*]), and encroaching woody species. About 500 meters north of this prairie lies another tiny Sand Prairie remnant that is dominated by the non-native yellow bedstraw (*Galium verum*), but is notable for its abundance of wild lupine (*Lupinus perennis*) – unusual in this part of the state.



Fig. 8. Good quality Sand Prairie at Blackhawk Lake. Note abundant spider-wort and goat's-rue. Photo by Amy Staffen.

Southern Dry-mesic and Mesic Forest

Southern Dry-mesic Forests are common throughout Yellowstone Lake, particularly in areas with topographical variation and deeper silt loams. Their canopy dominants are northern red oak, bur oak, white oak, shagbark hickory (*Carya ovata*) and American basswood (*Tilia americana*). Rich Southern Mesic Forests lie within the deeper, shadier coves and ravines, and contain high amounts of sugar maple (*Acer saccharum*) and American basswood. While some of the dry-mesic forests are still in the early stages of recovering from past logging, large canopy oaks remain in many other areas, though the diversity of subcanopy trees, shrubs, and native ground layer species characteristic of primary, undisturbed forest are diminished in number or are absent altogether. Evidence of sustained and often heavy past grazing is apparent in the dominance of shrubs such as common prickly-ash and multiflora rose (*Rosa multiflora*), along with a low-diversity native ground layer. Non-native invasive species such as Eurasian honeysuckle and garlic mustard (*Alliaria petiolata*) are also common in these forests. A good-quality Southern Dry-mesic Forest (113 acres) lies on moderate to steep north- to east-facing slopes and ravines overlooking Yellowstone Lake for 1.5 to 2 miles, extending 300-900 feet inland where it abruptly transitions to younger, lower quality forest (Fig. 9). Small inclusions of eastern white pine (*Pinus strobus*) relict on sandstone outcrops are also present. This forest has extremely high species richness (121 native plant species) due to variable slope, aspect, soils, and moisture regime. The forest is dominated by northern red oak, bur oak, and American basswood (up to 36 inch DBH, averaging 18-24 inches) with lesser amounts of shagbark hickory, big-tooth aspen (*Populus grandidentata*), and white oak. The ground layer includes characteristic species such as large-flowered bellwort (*Uvularia grandiflora*), Jack-in-the-pulpit (*Arisaema triphyllum*), broad-leaf enchanter's-nightshade (*Circaea lutetiana*), common lady fern (*Athyrium filix-femina*), cluster-leaf tick-trefoil (*Desmodium glutinosum*), and zigzag goldenrod (*Solidago flexicaulis*), as well as spring ephemerals such as blue cohosh (*Caulophyllum thalictroides*), Dutchman's-breeches (*Dicentra cucullaria*), small white fawn-lily (*Erythronium albidum*), false rue

anemone (*Isopyrum biternatum*), and yellow forest violet (*Viola pubescens*). Garlic mustard is very problematic in some areas of this forest.

In the few hardwood forest areas at Blackhawk Lake where logging did not occur, or only minimally, typical forest canopy species include bur, white and northern red oak, shagbark hickory, and American basswood. Dominance of shade-tolerant species in the subcanopy (northern red and sugar maple, American basswood, elms [*Ulmus* spp.], ironwood [*Ostrya virginiana*], musclewood [*Carpinus caroliniana*]) is the norm, as are moderate to abundant non-native invasives, especially Eurasian honeysuckle, common buckthorn, multiflora rose and garlic mustard.



Two forested blocks on the property are exceptional in their relatively intact structure, native ground layer diversity, and lack of serious non-native invasive species issues, though neither block meets the criteria for mapping in the NHI database in terms of size and quality: 1) A ten-acre fair- to good-quality Southern Dry Forest with high restoration potential lies in the northeastern part of Blackhawk Lake along Plank Road (due south of the impoundment and Enger Cemetery); it is unique on the property for its marked lack of non-native invasives and rich ground flora. Bur oaks (14-18-inch DBH) create 65-75% canopy cover here, while maples and American basswood create up to 95% subcanopy cover. Despite this heavy shading, the ground flora persists (60+ species), dominated by wild-ginger (*Asarum canadense*), calico aster (*Aster lateriflorus*), broad-leaf enchanter's-nightshade, cleavers (*Galium aparine*), and Virginia creeper (*Parthenocissus quinquefolia*). The flora is richest on the north-facing slope, is less diverse on the steeper northeast-facing slope, and is much brushier on the steep, rocky, northwest-facing slope, with more abundant Pennsylvania sedge (*Carex pennsylvanica*) and early meadow-rue (*Thalictrum dioicum*). Other common species here include red baneberry (*Actaea rubra*), maidenhair fern (*Adiantum pedatum*), sharp-lobed hepatica (*Anemone acutiloba*), poke milkweed (*Asclepias exalta*), blue cohosh, limber honeysuckle (*Lonicera dioica*), zigzag and elm-leaved goldenrods (*Solidago ulmifolia*), and early meadow-rue. 2) Another ten-acre block of good- to fair-quality Southern Dry-mesic Forest with high restoration potential lies in the southwestern part of Blackhawk Lake, west of Union Valley Road on a steep, southeast-facing slope overlooking Cave Hollow Creek (within Forestry Recon Stand 12, Compartment 3). WisFIRS dates the stand origin at 1931. This block of forest is distinct for its relative lack of non-native invasives (a very small amount of garlic mustard was found in this block of forest) and good structure. Canopy cover here is 80% from northern red oak (8-14 inch DBH) and shagbark hickory (12 inch DBH). Black walnut, wild black cherry (*Prunus serotina*) and scattered eastern red-cedar create 50-60% cover in the subcanopy. Saplings of black walnut and American elm (*Ulmus americana*) combine with common prickly-ash, red raspberry (*Rubus idaeus*), and prickly wild gooseberry (*Ribes cynosbati*) to create 15% shrub-layer cover, though this cover increases to almost 100% at the top and base of the slope. Several sandstone outcrops and inclusions create pockets of dry forest, where 14-inch DBH black oaks replace northern red as the canopy dominant. The most common ground layer species are wild sarsaparilla (*Aralia nudicaulis*) and hairy sweet cicely (*Osmorhiza claytonii*). Other typical species that occur here include Jack-in-the-pulpit, large-flowered bellwort, common lady fern, zigzag goldenrod, elm-leaved goldenrod, tinker's-weed (*Triosteum perfoliatum*), and rattlesnake fern

(*Botrychium virginianum*). The spring ephemeral Virginia spring-beauty (*Claytonia virginica*) was also noted here.

Oak Savanna (Oak Woodland, Oak Opening, Oak Barrens)

Yellowstone Savanna State Natural Area contains a fair- to good-quality remnant oak savanna that is currently undergoing restoration (Fig. 14); it is situated along a southwest-northeast-trending ravine. Although the understory has lost some native species due to past grazing, plowing, and lack of fire, the oak structure remains relatively intact. Large bur oaks (18-24 inch DBH) are scattered throughout the ravine, with northern red oak, white oak and shagbark hickory the dominant canopy species. Smaller (12 inch DBH) wild black cherry, American basswood, and American elm dominate the subcanopy. As one moves upslope from the ravine, a transition is evident as the moderately closed canopy (typical of Oak Woodland) slowly opens and provides a more park-like appearance (typical of Oak Opening) with large oaks and other savanna indicator species (e.g., eastern figwort [*Scrophularia marilandica*]). The groundcover is weedy with garlic mustard, white snakeroot (*Eupatorium rugosum*), bog clearweed (*Pilea fontana*), and common blackberry (*Rubus alleghaniensis*).

A striking testament to the widespread extent of historic oak opening at Blackhawk Lake are the numerous massive (24-36 inch DBH, occasionally up to 48 inches) open-grown bur and white oaks throughout the property. As with the hardwood forests, however, native woody succession is in advanced stages in former savanna sites, non-native invasive species are abundant, and the ground layers are very low in native diversity. Where soils are sandy, black oak replaces bur and northern red oak, and pressure from natural succession and non-native invasives is less pronounced, although Pennsylvania sedge dominates the ground layer in these areas.

A 15-acre moderate-quality Oak Woodland lies in the northwest part of the Blackhawk Lake property on a west- and southwest-facing slope (part of Forest Recon Compartment 1, Stand 33). Although not high enough quality for entry into the NHI database, it merits mention here because it will be undergoing a timber harvest in the near future, and shows potential for Oak Opening/Oak Woodland restoration. The stand originated in 1934 (WisFIRS), and is dominated by 11- to 15-inch DBH white, bur and northern red oak that create a filtered canopy. Pole-sized oak, yellow-bud hickory and white birch (*Betula papyrifera*) are densely stocked in the subcanopy, while beaked hazelnut (*Corylus cornuta*), common prickly-ash, multiflora rose, common blackberry and prickly wild gooseberry create a moderate to dense shrub layer. Some conservative species that are typical of Oak Woodland persist here, and include golden Alexanders, poke milkweed, Virginia wild-rye (*Elymus virginicus*), and tinker's-weed. In some places, especially to the north, garlic mustard is common.

Pine Relict and Cliff Communities

At Yellowstone Lake, tiny Pine Relicts with eastern white pine are found in association with sandstone outcrops south of the lake, within a matrix of Southern Dry-mesic Forest. Typical herbs here include American starflower (*Trientalis borealis*), Canada mayflower (*Maianthemum canadense*), and bracken fern (*Pteridium aquilinum*). Moist, mossy cliffs on sandstone outcrops occur at the southeast end of the lake within a mesic forest matrix.

Three small Pine Relicts (0.5, 0.8 and 2 acres) were surveyed at Blackhawk Lake, all of which were ranked as fair to poor quality. This low quality is a result of past grazing, abundance of shade-tolerant species, and invasion by weed natives and non-native invasives (especially garlic mustard, spotted knapweed, autumn-olive, and common blackberry). All of the Pine Relicts are associated with picturesque sandstone outcrops and short, dry cliffs (5-20 feet high), and often afford lovely views of the surrounding landscape. Interestingly, the dominant pine species are different at each of the three subsites: red pine (*Pinus resinosa*) at one, eastern white pine at another, and jack pine (*Pinus banksiana*) at the third. Both black and white oaks also figure prominently in the canopy of these pine relicts. Low shrubs create the dominant ground cover, and are typified by huckleberry (*Gaylussacia baccata*), velvet-leaf blueberry (*Vaccinium myrtilloides*), and northern bush-honeysuckle (*Diervilla lonicera*). Common ground layer herbs include poverty oat grass, Pennsylvania sedge, and Canada mayflower.

Surrogate Grassland

At Yellowstone Lake, about one-half of the area occupied by open uplands is currently under cultivation, while the remaining half is mostly old field or is actively being hayed, with small acreages that have been converted to prairie.

More than 200 acres of former cropland have been converted to prairie, old field, and hay field at Blackhawk Lake; 75 acres remain under sharecrop agreement. The prairie plantings are well-established, have sufficient native grass cover to sustain regular and hot prescribed burns, and harbor a good diversity of native prairie species, though some would not have occurred historically in this part of the state (most notably prairie dock). These grassland sites are also relatively free of non-native invasives, though they loom everywhere within their vicinity: along mowed field roads, in adjacent old fields/hay fields, and in the shade of Colorado blue spruces planted in lines within the grasslands. Apart from the “usual suspects” that typically invade grasslands in southwestern Wisconsin, another non-native plant was noted as behaving extremely aggressively in a prairie planting west of Plank Road: perennial pea-vine (*Lathyrus latifolius*); monitoring of the spread of this plant is recommended. The old fields at Blackhawk Lake are dominated by smooth brome, timothy (*Phleum pratense*), quackgrass, Canadian goldenrod (*Solidago canadensis*), wild parsnip, spotted knapweed, and bird’s-foot trefoil; their open character is frequently threatened by woody invaders such as autumn-olive, Eurasian honeysuckle, common buckthorn and multiflora rose.

Rare Species and High Quality Natural Communities

Rare species and high-quality examples of native communities have been documented in the four townships within which YLBL is located (T04N R04E, T03N R04E, T06N R02E, T07N R02E). Table 4 shows the rare species and high-quality natural communities currently known in those four townships.

Table 4. Documented rare species and high-quality natural communities of the four townships (T04N R04E, T03N R04E, T06N R02E, T7N R02E) within which Yellowstone Wildlife Area, Yellowstone Lake State Park, Yellowstone Savanna State Natural Area, and Blackhawk Lake Wildlife Area are located.

For explanation of state and global ranks, and state status, see Appendix A. State status, tracking status, and ranks based on June 1, 2011 working list.

Common Name	Scientific Name	Last Observed Date	State Rank	Global Rank	State Status	SGC N	Tracked by NHI
Animals							
Acadian flycatcher	<i>Empidonax vireescens</i>	2011	S3B	G5	THR	x	Y
American bullfrog	<i>Bufo americanus</i>	2010	S3S4	G5	SC/H		W
Bald eagle	<i>Haliaeetus leucocephalus</i>	2010	S4B,S4N	G5	SC/P	x	Y
Bell's vireo	<i>Vireo bellii</i>	1991	S2B	G5	THR	x	Y
Big brown bat	<i>Eptesicus fuscus</i>	2011	S2S4	G5	THR		Y
Black-billed cuckoo	<i>Coccyzus erythrophthalmus</i>	2011	S3S4B	G5	SC/M	x	W
Blanding's turtle	<i>Emydoidea blandingii</i>	1990	S3S4	G4	THR	x	Y
Blue-winged warbler	<i>Vermivora pinus</i>	2011	S4B,S4N	G5	SC/M	x	W
Bobolink	<i>Dolichonyx oryzivorus</i>	2011	S3S4B	G5	SC/M	x	W
Brown thrasher	<i>Toxostoma rufum</i>	2011	S3S4B	G5	SC/M	x	W
Dickcissel	<i>Spiza americana</i>	2011	S3B	G5	SC/M	x	W
Eastern meadowlark	<i>Sturnella magna</i>	2011	S3S4B	G5	SC/M	x	W
Field sparrow	<i>Spizella pusilla</i>	2011	S3S4B	G5	SC/M	x	W
Grasshopper sparrow	<i>Ammodramus savannarum</i>	2011	S3B	G5	SC/M	x	W
Henslow's sparrow	<i>Ammodramus henslowii</i>	2011	S2S3B	G4	THR	x	Y
Highland dancer	<i>Argia plana</i>	2008	S2S3B	G5	SC/N	x	Y
Least flycatcher	<i>Empidonax minimus</i>	2011	S4B,S4N	G5	SC/M	x	W
Big Brown Bat	<i>Eptesicus fuscus</i>	2001	S2S4	G5	THR		Y
Eastern Pipistrelle	<i>Perimyotis subflavus</i>	1946	S1S3	G5	THR		Y
Little brown bat	<i>Myotis lucifugus</i>	2011	S2S4	G5	THR		Y
Northern cricket frog	<i>Acris crepitans</i>	2008	S1	G5	END	x	Y
Northern leopard frog	<i>Lithobates pipiens</i>	2010	S4?	G5	SC/H		W
Ornate Box Turtle	<i>Terrapene ornata</i>	2007	S1	G5	END	x	Y
Pickerel frog	<i>Lithobates palustris</i>	2011	S3?	G5	SC/H	x	Y
Red-headed woodpecker	<i>Melanerpes erythrocephalus</i>	2011	S3B	G5	SC/M	x	W
Vesper sparrow	<i>Pooecetes gramineus</i>	2011	S3S4B	G5	SC/M	x	W

Western meadowlark	<i>Sturnella neglecta</i>	1997	S2B	G5	SC/M	x	Y
Willow flycatcher	<i>Empidonax traillii</i>	2011	S4B,S4 N	G5	SC/M	x	W
Wood thrush	<i>Hylocichla mustelina</i>	2011	S4B,S4 N	G5	SC/M	x	W
Yellow-billed cuckoo	<i>Coccyzus americanus</i>	2011	S3B	G5	SC/M	x	W
Yellow-breasted chat	<i>Icteria virens</i>	2010	S2B	G5	SC/M	x	Y
Bird rookery	Bird Rookery	2010	SU	G5	SC		Y
Plants							
American gromwell	<i>Lithospermum latifolium</i>	2010	S4	G4	SC	NA	W
Great Indian-plantain	<i>Cacalia muhlenbergii</i>	2010	S3	G4	SC	NA	W
Great water-leaf	<i>Hydrophyllum appendiculatum</i>	2010	S2S3B	G5	SC	NA	Y
Hill's thistle	<i>Cirsium hillii</i>	2001	S3	G3	THR	NA	Y
Lobed Spleenwort	<i>Asplenium pinnatifidum</i>	1989	S1	G4	THR	NA	Y
Nodding Pogonia	<i>Triphora trianthophora</i>	1962	S2	G3G4	THR	NA	Y
October lady's-tresses	<i>Spiranthes ovalis var. erostellata</i>	2010	S1	G5?T4 ?	SC	NA	Y
Prairie fame-flower	<i>Phemeranthus rugospermus</i>	2011	S3	G3G4	SC	NA	Y
Prairie Indian-Plantain	<i>Cacalia tuberosa</i>	2006	S3	G4G5	THR	NA	Y
Prairie Turnip	<i>Pediomelum esculentum</i>	1929	S3	G5	SC	NA	Y
Purple Milkweed	<i>Asclepias purpurascens</i>	2001	S3	G5?	END	NA	Y
Putty Root	<i>Aplectrum hyemale</i>	1972	S2S3	G5	SC	NA	Y
Short's rock-cress	<i>Arabis shortii</i>	2010	S1S2	G5	SC	NA	Y
Yellow gentian	<i>Gentiana alba</i>	2010	S4	G4	THR	NA	Y
Yellow Giant Hyssop	<i>Agastache nepetoides</i>	1987	S3	G5	THR	NA	Y
Natural Communities							
Dry prairie		2010	S3	G3	NA	NA	Y
Emergent marsh		2010	S4	G4	NA	NA	Y
Moist cliff		1976	S4	GNR	NA	NA	Y
Oak opening		2010	S1	G1	NA	NA	Y
Pine relict		1976	S2	G4	NA	NA	Y
Southern dry-mesic forest		2010	S3	G4	NA	NA	Y

Management Opportunities and Considerations for Biodiversity Conservation

Landscape Level Opportunities and Considerations

Wildlife Action Plan Conservation Opportunity Area

Conservation Opportunity Areas (COAs) are places in Wisconsin that contain ecological features, natural communities, or Species of Greatest Conservation Need habitat for which Wisconsin has a unique responsibility for protection when viewed from the global, continental, upper Midwest, or state perspective. Blackhawk Lake Wildlife Area lies within the larger “Dodgeville and Wyoming Oak Woodland/Savanna” COA, an opportunity identified as having continental significance.

Altered Ecological Processes

The vegetation that historically occurred at YLBL developed within a complex environment comprised of both elements that are relatively static over ecological time (e.g., soils, underlying landforms) and dynamic ecological processes (e.g., hydrological cycles, nutrient cycles, wildfires). Many of the dynamic ecological processes that shaped these landscapes have been altered by humans.

The hydrology of Otter Creek and the Yellowstone River was dramatically altered with the installation of impoundments and creation of Blackhawk and Yellowstone Lakes. The negative impacts of impoundments on animal communities are well-documented, and should be mitigated to the extent possible and practical. Dams affect aquatic species and habitats by fragmenting them into disjunct segments, preventing the movements of some species between different stretches of the water bodies. Water below impoundments is warmer and of diminished quality, negatively affecting the aquatic macroinvertebrate communities, increasing the growth of periphyton, and diminishing the quality and quantity of fish habitat. Impoundments typically have organically rich bottom sediments, resulting in algal blooms and periods of dissolved oxygen depletion near the bottom. Surveys conducted by WDNR in 1999 and 2000 at Blackhawk Lake revealed that the bottom discharge structure was ineffective, as evidenced by significantly higher temperatures below the dam and lower dissolved oxygen levels at the bottom (WDNR 2002). This study also documented that the macroinvertebrate community was “very good” above the lake and “fair” below the lake.

Another ecological process that has been altered is how fire interacts with the natural communities and rare species of Yellowstone and Blackhawk Lakes. For all of the natural communities (excluding cliffs, aquatic communities, and Southern Mesic Forest in protected coves), fire was a critical process in their development and the species that depend on them (Kozlowski and Ahlgren 1974). Without regular fire, native woody species can invade and dominate these communities. Fire is also important for removing excess thatch in prairies, which can limit the growth and reproduction of native plants (McDaniel 2000). In woodlands, fire facilitates seedling establishment (Rouse 1986), controls tree species that are not adapted to fire (Abrams 1992), and prevents smothering of short-statured plants through the removal of leaf litter (Richard Henderson, personal communication). Re-introducing fire into an area should be done with consideration of all of the species currently using the habitat and how the fire may impact the amount and quality of habitat available.

Non-Native Invasive Species

Many non-native invasive plants, animals and pathogens, both terrestrial and aquatic, are present at YLBL and in the surrounding landscape. Non-native invasive species thrive in newly disturbed areas, but also may invade and compromise high-quality natural areas. They establish quickly, tolerate a wide range

of conditions, are easily dispersed, and are free of the diseases, predators, and competitors that kept their populations in check in their native range.

In terrestrial settings, non-native invasive plants out-compete and even kill native plants by monopolizing light, water, and nutrients, by altering soil chemistry and, in the case of garlic mustard, by altering mycorrhizal relationships. In situations where non-native invasive plants become dominant, they may even alter ecological processes by limiting one's ability to use prescribed fire (a striking example being common buckthorn), by modifying hydrology (e.g., reed canary grass [*Phalaris arundinacea*] can alter surface flow and clog culverts), and by limiting tree regeneration and ultimately forest composition (WDNR In prep.b). In addition to the threats on native communities and native species diversity, terrestrial non-native invasive species negatively impact forestry (by reducing tree regeneration, growth and longevity), recreation (by degrading wildlife habitat and limiting access), agriculture, and human health (plants that cause skin rashes or blisters).

Similarly to terrestrial invasives, aquatic invasives are successful because they originate in other regions or continents, thus lacking natural checks and balances. Early and abundant growth of aquatic plants not only overwhelms native plants, it may disrupt aquatic predator-prey relationships by fencing out larger fish, and may limit important aquatic food plants for waterfowl. The die-off of non-native plants in summer can cause oxygen depletion in water bodies, and decaying plants can contribute to nutrient loading and algal blooms.

The high recreational usage of Blackhawk and Yellowstone Lakes has contributed to the introduction and spread of non-native invasive species throughout the properties. Campgrounds, trails, the lakes, and other high-use areas are typical entry points for non-native invasive species that are introduced by visitors' footwear, clothing, vehicle tires, boats, and recreational equipment. Once established, these invasives may continue to spread along natural corridors (e.g., waterways) and along human-made corridors (e.g., trails and roads). They even have the potential to invade remote high-quality natural areas via vectors such as wind, water, and wildlife. Non-native invasive species may also be spread inadvertently through management activities such as timber operations and roadside mowing, especially if Best Management Practices aren't followed.

Non-native invasive species that are widespread at YLBL and pose the greatest immediate threat to native species diversity, rare species habitats, or high-quality natural communities are listed in Table 5. Although resources for complete control of widespread invasives may be lacking, containment (i.e., limiting further spread) may be considered as an alternative action.

Table 5. Widespread non-native invasive species currently known at Blackhawk Lake Wildlife Area, Yellowstone Lake State Park, Yellowstone Wildlife Area, and Yellowstone Savanna State Natural Area, and Streambank Protection Fee Area.

Common Name	Latin Name	Upland Habitats		Wetlands	Aquatic	Abundance Comments
		Open	Wooded			
Plants						
Autumn-olive	<i>Eleagnus angustifolia</i>	X				Uncommon at Yellowstone Lake, common at Blackhawk Lake.
Canada thistle	<i>Cirsium arvense</i>	X	X	X		Common throughout.
Common buckthorn	<i>Rhamnus cathartica</i>		X			Moderate to common.
Curly-leaf pondweed	<i>Potamogeton crispus</i>				X	Present at both lakes.
Eurasian bush honeysuckles	<i>Lonicera</i> spp.	X	X			Common to abundant.
Eurasian water-milfoil	<i>Myriophyllum spicatum</i>				X	Common at both lakes.
Garlic mustard	<i>Alliaria petiolata</i>		X			Common to abundant.
Kentucky bluegrass	<i>Poa pratensis</i>	X		X		Abundant in remnant dry prairies and old fields.
Multiflora rose	<i>Rosa multiflora</i>	X	X			Common.
Narrow-leaved cattail	<i>Typha angustifolia</i>			X		Abundant at impoundments.
Purple loosestrife	<i>Lythrum salicaria</i>			X		Common at Yellowstone Lake impoundment.
Reed canary grass	<i>Phalaris arundinacea</i>			X		Abundant at impoundments & stream corridor sedge meadows.
Russian-olive	<i>Eleagnus umbellata</i>	X				Noted in southwest part of Yellowstone Lake WA & at State Park campground.
Smooth brome	<i>Bromus inermis</i>	X				Abundant in remnant dry prairies and old fields.
Spotted knapweed	<i>Centaurea biebersteinii</i>	X				Moderate to common.
Watercress	<i>Nasturtium officinalis</i>				X	Abundant in unnamed creek, northwest Blackhawk Lake property.
Wild parsnip	<i>Pastinaca sativa</i>	X		X		Common.
Yellow and white sweet clover	<i>Melilotus officinalis</i> & <i>M. alba</i>	X				Common to abundant.
Animals						
Chinese mystery snail	<i>Cipangopaludina chinensis</i>				X	Present at Blackhawk Lake.
Common carp	<i>Cyprinus carpio</i>				X	Abundant at Yellowstone Lake.
European earthworms	Families of <i>Acanthodrilidae</i> , <i>Lumbricidae</i> , and <i>Megascolecidae</i>	X	X			Comprehensive surveys not done. Clear evidence of invasion at Blackhawk Lake.
rusty crayfish	<i>Orconectes rusticus</i>				X	Present at Yellowstone Lake.

Early detection and rapid control of new and/or small infestations, however, may be considered for higher prioritization in an invasive species management strategy (Boos et al. 2010). A number of non-native invasive species are, in fact, new or are not yet widespread at Yellowstone and Blackhawk Lakes, or are known in the vicinity (Table 6); monitoring for these species and rapid response to small infestations represent high-impact actions.

Table 6. New or not-widespread non-native invasive species at Blackhawk Lake Wildlife Area, Yellowstone Lake State Park, Yellowstone Wildlife Area, Yellowstone Savanna State Natural Area, and Streambank Protection Fee Area.

Common Name	Latin Name	Upland Habitats		Wetlands	Aquatic	Abundance Comments
		Open	Wooded			
Plants						
Big-leaf lupine	<i>Lupinus polyphyllus</i>	X				Planted (?) in old field south of Cave Hollow Rd at Blackhawk Lake.
Japanese hedge parsley	<i>Torilis japonica</i>		X			Known in vicinity of Blackhawk Lake.
Japanese knotweed	<i>Polygonum cuspidatum</i>	X	X	X	X	Small patch being managed, T6N R2E Section 5.
Perennial pea	<i>Lathyrus latifolius</i>	X				Behaving aggressively in old fields at Blackhawk Lake.
Yellow bedstraw	<i>Galium verum</i>	X				Behaving aggressively on remnant sand prairie at Blackhawk Lake.

For recommendations on controlling specific invasive species consult with DNR staff, refer to websites on invasive species, such as that maintained by the DNR (<http://dnr.wi.gov/invasives>) and by the Invasive Plants Association of Wisconsin (<http://www.ipaw.org>), and seek assistance from local invasive species groups:

- Southwestern Wisconsin Weed Management Area (Grant, Crawford, Lafayette, Iowa, Richland, Dane, Sauk Counties). Contact: Mark Horn, (608)836-0054, mark.horn@monarda.biz.
- Citizen-based lake monitoring groups coordinated through WDNR and UW-Extension.

Also refer to invasive species Best Management Practices (BMPs) for forestry, recreation, urban forestry, and rights-of-way, which were developed by the Wisconsin Council on Forestry (<http://council.wisconsinforestry.org/>).

Following are details on a few key species:

Oak Wilt

Oak wilt is caused by a fungus, *Ceratocystis fagacearum*, that effects water movement within oak trees, often killing the trees. The fungus was thought to be native, but the most recent science suggests that it is not (J. Cummings Carlson, WDNR, personal communication). It has been in the state for at least 100 years and is widespread throughout the southern part of the state. Oak wilt is often not a major concern for woodland or barrens restoration areas where open canopy conditions are favored, and dead oak trees can make long-lasting wildlife cavity trees. It can, however, have significant impacts to forested stands with a heavy oak component.

European Earthworms

The invasion of forests by European earthworms of the families *Acanthodrilidae*, *Lumbricidae*, and *Megascolodidae* is a concern throughout Wisconsin. While native earthworms were absent from much of Wisconsin after the last glaciation, non-native invasive earthworms have been introduced since widespread Euro-American settlement, primarily as discarded fishing bait (Hendrix and Bohlen 2002, Hale et al. 2005). Non-native earthworms can have dramatic impacts on forest floor properties by greatly reducing organic matter (Hale et al. 2005), microbial biomass (Groffman et al. 2004), nutrient availability (Bohlen et al. 2004, Suarez et al. 2004), and fine-root biomass (Groffman et al. 2004). These physical changes in the forest floor reduce densities of tree seedlings and rare herbs (Gundale 2002) and can favor non-native invasive plants (Kourtev et al. 1999). In a study of 51 Northern Wisconsin forest stands,

Wiegmann (2006) found that shifts in ground layer plant community composition due to non-native earthworms were more severe in stands with high white-tailed deer densities.

Striking evidence of an earthworm invasion front was discovered during community surveys in a mesic forest on the eastern shore of Blackhawk Lake (Fig. 10). It is most likely that the earthworms in this forest were discarded by individuals fishing on the lake, stressing the importance of educating anglers on the proper disposal of live bait. Few people realize that worms can swim, much less that they are invasive.



Figure 10. Non-native invasive earthworms at Blackhawk Lake Wildlife Area. Invasion front is marked with arrows. Note marked diminishment of leaf litter and vegetation on the lake-side (right side) of the photograph, clear indicators of earthworm activity. *Photo by Amy Staffen.*

Wisconsin's Statewide Forest Strategy

Wisconsin's Statewide Forest Assessment (WDNR 2010b) was based on Wisconsin's Forest Sustainability Framework (Wisconsin Council on Forestry 2008), and was designed to assess the current state of Wisconsin's public and private forests and analyze the sustainability of our forested ecosystems. Wisconsin's Statewide Forest Strategy (WDNR 2010c) contains a collection of strategies and actions designed to address the management and landscape priorities identified in the Statewide Forest Assessment. The strategies are broad guides intended to focus the actions of the forestry community.

All three of these documents include topics related to biological diversity in Wisconsin's forests, and provide information useful for department master planning and management activities. The following

strategies (Table 7), organized using their number in the Statewide Forest Strategy document, are particularly pertinent to the YLBL planning efforts in regard to opportunities to maintain or enhance biological diversity (WDNR 2010c).

Table 7. Statewide Forest Strategies pertinent to Blackhawk Lake Wildlife Area, Yellowstone Lake State Park, Yellowstone Wildlife Area, Yellowstone Savanna State Natural Area, and Streambank Protection Fee Area.

Strategy Number	Strategy
11	Encourage the management of under-represented forest communities.
12	Improve all forested communities with a landscape management approach that considers the representation of all successional stages.
13	Increase forest structure and diversity.
14	Encourage the use of disturbance mechanisms to maintain diverse forest communities.
15	Maintain the appropriate forest types for the ecological landscape while protecting forest health and function.
18	Encourage the forestry community to be engaged in deer management issues with an understanding of the long term significance of deer impacts on sustainable forestry.
19	Adapt forest management practices to sustainably manage forests with locally high deer populations.
22	Strive to prevent infestations of invasive species before they arrive.
23	Work to detect new (invasive species) infestations early and respond rapidly to minimize impacts to forests.
24	Control and manage existing (invasive species) infestations.
25	Rehabilitate, restore, or adapt native forest habitats and ecosystems.
29	Attempt to improve the defenses of the forest and increase the resilience of natural systems to future climate change impacts.
30	Intentionally accommodate (climate) change and enable forest ecosystems to adaptively respond.

High Conservation Value Forests

The Wisconsin DNR manages 1.5 million acres that are certified by the Forest Stewardship Council (FSC) (FSC 2009) and the Sustainable Forest Initiative (SFI). Forest certification requires forests to be managed using specified criteria for ecological, social, and economic sustainability. Principle 9 of the *Draft 7 FSC-US Forest Management Standard* concerns the maintenance of High Conservation Value Forests (HCVF). High Conservation Value Forests are defined as possessing one or more of the following:

- Contain globally, regionally, or nationally significant concentrations of biodiversity values, including rare, threatened, or endangered species and their habitats.

- Globally, regionally, or nationally significant large landscape level forests, contained within, or containing the management unit, where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance.
- Are in or contain rare, threatened, or endangered ecosystems.
- Provide basic services of nature in critical situations (e.g., watershed protection, erosion control).
- Are fundamental to meeting basic needs of local communities (e.g., subsistence, health).
- Are critical to local communities’ traditional cultural identity (areas of cultural, ecological, economic, or religious significance identified in cooperation with such local communities).

Community Level Opportunities and Considerations

The Wisconsin Wildlife Action Plan (WAP) (WDNR 2006a) identifies 37 natural communities for which there are “Major” or “Important” opportunities for protection, restoration, or management in the **Western Coulees & Ridges** Ecological Landscapes. Thirteen of these natural communities are present on **Blackhawk Lake** managed lands (Table 8).

Table 8. Major and Important Opportunities of Western Coulees & Ridges Ecological Landscape.

<u>Major Opportunity</u>	<u>Important Opportunity</u>
Southern Dry Forest	Southern Sedge Meadow
Southern Dry-Mesic Forest	
Pine Relict	
Oak Barrens	
Shrub Carr	
Dry Prairie	
Sand Prairie	
Surrogate Grasslands	
Emergent Marsh	
Dry Cliff	
Coldwater Stream	
Coolwater Stream	

The Wisconsin Wildlife Action Plan (WAP) (WDNR 2006a) also identifies 17 natural communities for which there are “Major” or “Important” opportunities for protection, restoration, or management in the **Southwest Savanna** Ecological Landscapes. Eleven of these natural communities are present on **Yellowstone Lake** managed lands (Table 9).

Table 9. Major and Important Opportunities of Southwest Savanna Ecological Landscape.

<u>Major Opportunity</u>	<u>Important Opportunity</u>
Dry Prairie	Coolwater streams
Oak Opening	Moist Cliff
Oak Woodland	Pine Relict
Surrogate Grasslands	Southern Dry Forest
Warmwater streams	Southern Dry-mesic Forest
	Southern Mesic Forest

Although all of the above communities have been identified at YLBL, only some are high quality, or have medium to high restoration potential. These include:

Dry Prairie and Sand Prairie

Prairie once occupied approximately 2.1 million acres in Wisconsin. Now, approximately 2,000 acres remain – less than 0.1% (Leach and Givnish 1999). Of these, only those prairies that occurred at the wet and dry ends of the soil spectrum survived. Virtually all deep-soil Mesic Prairies were converted to agricultural or residential uses. The surviving remnants are highly degraded due to fire suppression, over-grazing, and invasion of native woody species and non-native invasive species. Wisconsin has more Dry Prairies than any other state because of the many steep-sided bluffs in the extensive Driftless Area, the rough terrain of the kettle interlobate moraine, and the north-south orientation of several major river valleys such as the Mississippi, the Chippewa, and the St. Croix (WDNR 2006b). These topographic attributes provide suitable sites for the development and persistence of this prairie type.

A small remnant Dry Prairie lies within Yellowstone Savanna State Natural Area, and supports a number of conservative and rare plant species. At Blackhawk Lake, a one-acre Sand Prairie with exceptional floral diversity lies in the central eastern part of the property, west of the southernmost parking area on Plank Road. Degraded remnants of these types are found elsewhere on both of the properties. Woody species control, non-native invasive species control, and prescribed fire are needed to restore and maintain these small but diverse remnant grasslands.

A primary site with an opportunity to protect and manage Dry Prairie and associated flora and fauna is Yellowstone Savanna (Figs. 13 and 14).

Oak Savanna (Oak Opening, Oak Woodland, Oak Barrens)

Oak savannas were historically common in Wisconsin but are now rare throughout the state. Restoration of these globally rare natural communities is critical to the survival of many rare plants and animals that depend on them. Yellowstone and Blackhawk Lakes managed lands offer opportunities to restore prairies, Oak Openings, Oak Woodlands, and Oak Barrens (Blackhawk Lake only) on a landscape scale and within a matrix of other habitats.

Historically, Oak Openings were abundant in Wisconsin, covering approximately 5.5 million acres (Curtis 1959) south of the Tension Zone. Review of historical literature indicates that Oak Openings once supported an exceptionally diverse flora, about 25% of the entire native flora of Wisconsin (Leach and Givnish 1999). Of the about 75,000 acres (Hoffman 2009) of Oak Opening remaining in Wisconsin, many of these are highly degraded or have succeeded to closed-canopy oak forests. The few extant remnants are mostly on drier sites, with the mesic and wet-mesic Oak Openings almost totally destroyed by conversion to agricultural or residential uses and by the encroachment of other woody plants due to fire suppression. Oak Woodland once occupied approximately 1.4 million acres (Curtis 1959) in pre-widespread Euro-American settlement Wisconsin; today, it is extraordinarily rare – only about 140,000 acres remain in the state (Hoffman 2009). Most of these remnants are highly degraded and have converted to closed-canopy oak forest. Oak Barrens historically occupied approximately 1.8 million acres in Pre-European Settlement Wisconsin (Richard Henderson, personal communication), but is now reduced to approximately 95,000 acres (Hoffman 2009; includes both pine and oak barrens).

Opportunities exist at YLBL to restore Oak Openings, Oak Woodlands, and Oak Barrens (Blackhawk Lake only), and to increase their connectivity. Such actions would also improve habitat for many plants and animals that are specialists of grassland, savanna, woodland, and barrens. Typical oak savanna restorations in Wisconsin require aggressive and intensive management for a period of 15 or more years. This reflects the highly degraded state of most sites, and the time and effort required to effectively restore system structure and function. Be aware that limited short-term efforts could result in merely a structural restoration with no ecosystem functionality, and may be considered wasteful. Also bear in mind that many former Oak Woodlands are now closed-canopy forests that provide critical habitat for numerous bird species. Ecological restoration that converts closed-canopy forests to Oak Woodland may benefit some savanna specialist species at the expense of other species. As with all ecological restoration opportunities, sufficient resources must be available to ensure success of the project before the difficult decision of limiting habitat for some species in favor of other species is made. At Yellowstone Savanna State Natural Area, reference to the “Oak Savanna Management Guide” in the WDNR State Natural Area Handbook should be made.

An opportunity to contribute to the science of oak savanna restoration exists at Yellowstone Lake Wildlife Area, where research on the effects of fire and grazing on woody species and native flora is ongoing (Harrington and Kathol 2009, Hedtcke et al. 2009). Early findings suggest that rotational grazing of Scottish highland cattle may add a new and useful tool to the ‘restoration toolbox’ for oak savanna restoration. Most notably, the cattle were observed forcing themselves into dense shrub thickets to forage, areas where fire simply cannot penetrate due to limited ground fuels (Harrington and Kathol 2008); impenetrable thickets such as these are typical in abandoned upland pastures in southwest Wisconsin. Since the impacts of fire versus grazing were often assimilar (e.g., grazing was better at controlling *Rubus* species than fire, but fire better controls *Ribes* species better), the researchers suggest that the two be implemented as complimentary practices (Harrington and Kathol 2009). Scottish highland cattle grazing is also feasible from an animal husbandry perspective, as the nutritional content and digestibility of savanna shrubs at Yellowstone Lake was found to be satisfactory for supporting cattle (as long as dry matter intake is not limited; Hedtcke et al. 2009). Given the promising results of these two-year studies, continued long-term research is encouraged.

A primary site with an opportunity to protect and manage oak savanna and associated flora and fauna is Yellowstone Savanna (Figure 13).

Southern Dry-mesic Forest: An Opportunity for Older Forest Management

The Southern Dry-mesic Forest along the south shore of Yellowstone Lake offers an opportunity to protect and restore a high-quality ecosystem, as well as to manage for older forest and, eventually, old-growth forest. This forest has extremely high species richness (121 native plant species), including rare species and spring ephemerals. WisFIRS reconnaissance data indicate that these stands are over 100 years old, as is evidenced by the large diameters of the dominant canopy species: the northern red oak, bur oak, and American basswood here average 18-24 inches DBH, and many achieve girths of 36 inches. This forest is described further as a primary site (“Yellowstone Forest”).

Older forests (greater than 100-120 years old) in Wisconsin are rare and declining, largely due to timber harvesting and conversion to other land uses (WDNR 2010b). The WDNR has identified a need to conserve, protect, and manage old-growth forests (WDNR 2004, WDNR 1995) and old-growth management is a component of Forest Certification.

Old-growth stands are sometimes characterized by a multi-layered, uneven age and size class structure; a high degree of compositional and structural patchiness and heterogeneity; and significant amounts of coarse woody debris and tip-up mounds (WDNR In Prep. a). The structural diversity provided by old-growth and older forests that support unique assemblages of plants, birds, and other animals. Old-growth forest management is one important facet of providing the diverse range of habitats needed for sustainable forest management (WDNR 2010b).

Older forests can provide habitat for many rare and declining species in the state, including a number of rare birds species, and all of Wisconsin’s summer resident forest bats.

Species or Taxa Level Opportunities and Considerations

Wildlife Action Plan Priority Communities and Conservation Actions

The Wisconsin Wildlife Action Plan identifies ecological priorities in each Ecological Landscape. Ecological priorities are the natural communities in each Ecological Landscape that are most important to the Species of Greatest Conservation Need. Note that these Ecological Priorities include all of the natural communities that we have determined to provide the best opportunities for management at YLBL from an ecological/biodiversity perspective.

The Wildlife Action Plan also describes Priority Conservation Actions that make effective use of limited resources and address multiple species with each action. Implementing these actions and avoiding activities that may preclude successful implementation of these actions in the future would greatly benefit the SGCN at YLBL. Priority Conservation Actions identified in the Wisconsin Wildlife Action Plan (WDNR 2006b) for the Southwest Savanna and Western Coulees & Ridges Ecological Landscapes that apply to YLBL include:

- Sand prairie and oak barrens restoration and maintenance.
- Grassland bird and wildlife management.
- Restoration and protection of spring-fed cold water streams.
- Preservation of cliff communities, along with cave and bat hibernacula.
- Restoration of rare grassland and oak savanna communities.
- Rare prairie species restoration and management (e.g., Henslow's sparrow, loggerhead shrike, Bell's vireo, prairie bush clover, regal fritillary butterfly, other rare invertebrates, and the Blanchard's cricket frog).
- Protection of pine relicts.

Grassland Bird Conservation

Biologists and birders are concerned about population declines of many grassland bird species. Since the North American Breeding Bird Survey (BBS) began in 1966, grassland birds have declined more steeply than any other group of birds in North America and the Midwest (Sample and Mossman 1997; Askins et al. 2007). In 1997, Sample and Mossman identified 26 “priority landscapes” in Wisconsin that represent unique opportunities for landscape-scale grassland management for grassland birds. State-owned lands surrounding Yellowstone Lake were identified as part of the “Yellowstone/Pecatonica River Grasslands and Savanna” priority landscape. Yellowstone Lake managed lands have oak savanna, idle cool- and warm-season grasslands, dry and wet old field habitats, dry and dry-mesic prairie, and upland shrub habitat, all of which can benefit grassland bird species when considered as a whole and within the larger landscape.

Yellowstone and Blackhawk Lake managed lands provide breeding habitat for 17 grassland bird species. Habitat for these birds at YLBL is made up of a mix of old field, cropland, planted prairie, retired pasture, oak savanna, and sedge meadow.

Grassland bird habitat is most effectively maintained as large landscapes of continuous grassland, uninterrupted by hedgerows, with the cover of woody plants less than 5% (Sample and Mossman 1997). Hedgerows fragment grasslands and provide habitat/movement corridors for predators of grassland birds. Structural diversity within the grassland, including shrubs, short and tall grass, amount of residual herbaceous duff, a mix of grasses and forbs, and a management rotation of type, intensity, and frequency, is also important.

Herptile Conservation

Yellowstone and Blackhawk Lakes were identified as supporting or having potential for restoring habitat for rare herptiles. The variety of aquatic, wetland, and upland habitats are well-suited to serve the habitat needs of a number of herptile species.

Yellowstone Lake presents an opportunity to protect and manage for several rare frog species that prefer springs, spring-fed creeks, ponds, lakes, and a variety of habitats along and adjacent to streams and rivers, including marshes, fens, sedge meadows, low prairies, and exposed mud flats. Water bodies are most productive for one particular species when they support emergent, submergent and/or floating vegetation in the littoral zone, thus aquatic plant introduction activities such as those conducted recently by UW-Platteville students at Yellowstone Lake could be beneficial.



Fig. 11. Spring-fed creek at Blackhawk Lake provides important habitat for frogs. *Photo by Jeff Lorch.*

Although no rare reptiles were documented at Blackhawk Lake, the oak savanna and Sand Prairie habitats show potential for supporting rare reptile species. Traditional restoration techniques for these community types (removal of successional woody species and non-native invasives, application of prescribed fire) could benefit these prairie/savanna reptiles. Although management that mimics natural disturbance regimes is needed to

restore and maintain these fire-dependant habitats, the poor dispersal abilities of many herptiles needs to be taken into account when planning habitat management and species recovery.

Although Blackhawk Lake provides excellent habitat for mudpuppies (*Necturus maculosus*), they may not be present since it is not a natural lake and movement past the dam would be difficult. However, Otter Creek is a fairly large creek and a tributary of the Wisconsin River, increasing its potential for mudpuppies. It is possible that mudpuppies living upstream of the lake were able to colonize the impoundment. The deep pool formed as the creek flows under Plank Road also provides good habitat that might support a small population of mudpuppies.

Bat Conservation

By feeding on insects, bats are an important component of healthy ecosystems. Opportunities to promote bat habitat at YLBL include providing resources for roosting, foraging, and drinking.

The Driftless Area of Wisconsin, in which YLBL lie, is particularly rich in known and potential bat hibernacula sites. At Yellowstone Lake State Park, there are roughly 30 bat houses installed in which over 3,000 little brown bats roost. Bats may also roost under loose, peeling bark and in crevices and cavities of trees. Often these attributes are found in older forests with snags of varying decay level, size, and height. Artificial bat boxes such as those that have been erected at Yellowstone Lake State Park can provide an important supplement to natural roost sites; the Wisconsin Bat Program has created a bat house handbook which includes designs for multiple bat houses as well as information on mounting and maintaining bat houses.

Foraging is done in small to medium forest openings or gaps, in other natural and artificial openings such as ponds, and along roads or water courses (Taylor 2006). Maintaining diverse forest flora and reducing non-native plant abundance is important for promoting invertebrate prey diversity and thus promoting foraging opportunities for bats (WDNR 2006a).

Maintaining high-water quality and access to water is important for protecting bat populations. Wide buffers (generally wider than those recommended in Best Management Practices for water quality [WDNR 2010d]) around water, including rivers, streams, and wet meadows, are important for bats and other wildlife species using these areas (Taylor 2006).

Hibernaculum disturbance, habitat degradation, and wind-turbine mortality are threats that affect all bat species found in Wisconsin. An emerging threat to Wisconsin's bats, White-Nose Syndrome (WNS) has been called the "most precipitous wildlife decline in the past century in North America" by Bat Conservation International and has devastated bat populations in the eastern United States since 2006 (*White-nose Syndrome*). It has recently been discovered that the fungus (*Geomyces destructans*) is the causal agent of White-Nose Syndrome (Lorch et al. 2011). Due to the emerging threats that bat populations face in Wisconsin, more information in the form of surveys (acoustic and roost) are needed to more accurately describe the bats that use YLBL.

Primary Sites: Site-specific Opportunities for Biodiversity Conservation

Two ecologically important sites were identified on Yellowstone Lake managed lands; none were identified at Blackhawk Lake Wildlife Area (Figure 12). These Primary Sites were delineated because they generally encompass the best examples of 1) rare and representative natural communities, 2) documented occurrences of rare species populations, and/or 3) opportunities for ecological restoration or connections. These sites warrant high protection and/or restoration consideration during the development of the property master plan. This report is meant to be considered along with other information when identifying opportunities for various management designations during the master planning process.

Descriptions for each of the Primary Sites can be found in Appendix D. Information provided in the summary paragraphs includes location information, a site map, a brief summary of the natural features present, the site's ecological significance, and management considerations.

Yellowstone and Blackhawk Lakes Managed Lands Primary Sites

- YLBL01** Yellowstone Forest
- YLBL02** Yellowstone Savanna

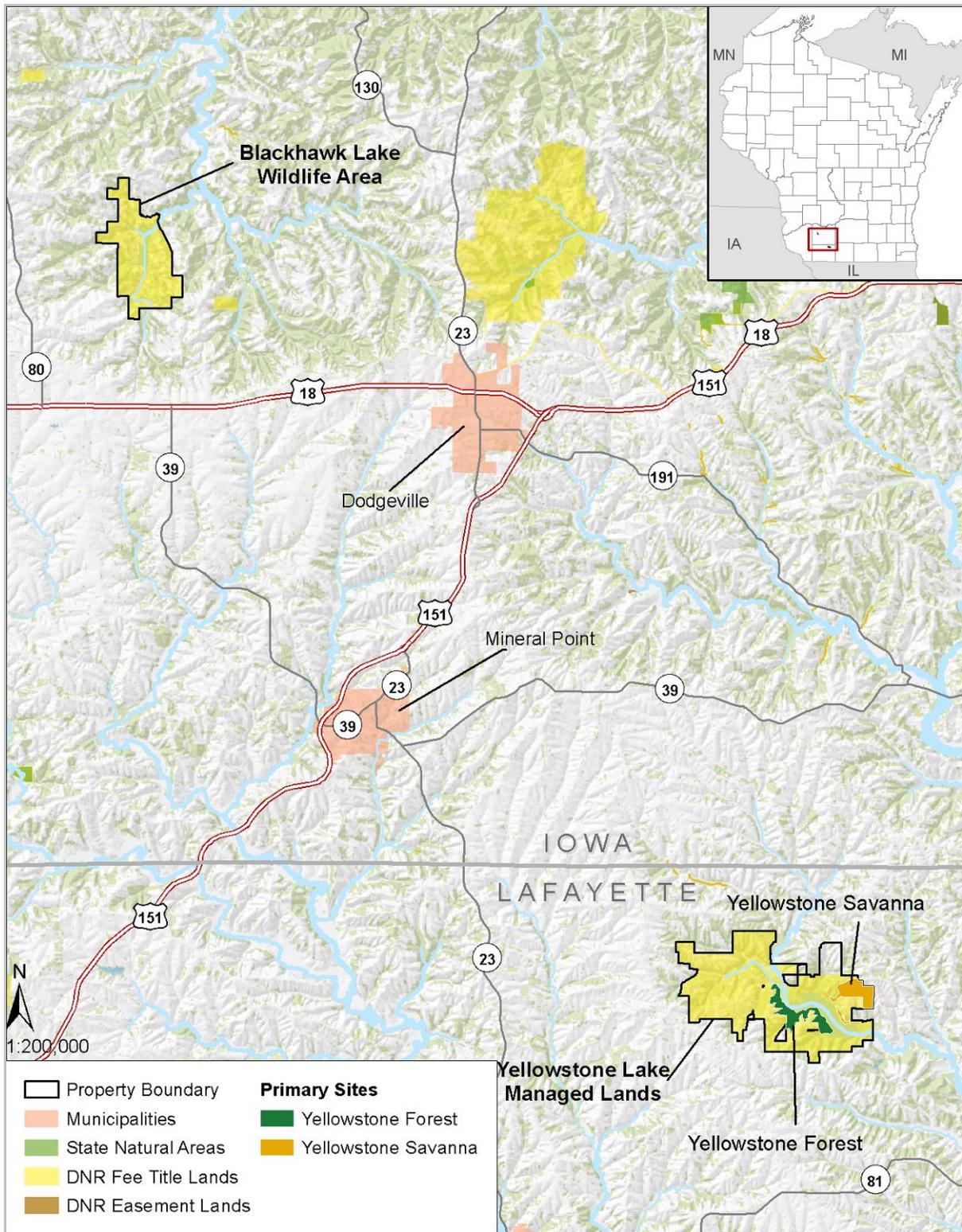


Figure 12. Primary Sites of Yellowstone Wildlife Area, Yellowstone Lake State Park, Streambank Protection Fee Area, and Blackhawk Lake Wildlife Area

Future Needs

This project was designed to provide a rapid assessment of the biodiversity values for YLBL managed lands. Although the report should be considered adequate for master planning purposes, additional efforts could help to inform future adaptive management efforts, along with providing useful information regarding the natural communities and rare species contained in YLBL managed lands.

- Continued non-native invasive species monitoring and control is needed. Public lands throughout Wisconsin are facing major management problems because of serious infestations of highly invasive non-native species. Some of these species are easily dispersed by humans and vehicles; others are spread by birds, mammals, insects, water, or wind. In order to protect the important biodiversity values of YLBL, a comprehensive non-native invasive species monitoring and control plan will be needed for detecting and rapidly responding to new non-native invasive threats.
- Locations and likely habitats should be identified for conducting additional rare plant surveys during appropriate seasons.
- Surveys for reptiles should be conducted in remnant prairie and oak savanna areas at Yellowstone Lake managed lands.
- Surveys for small mammals should be conducted at all YLBL properties.
- Bat roost monitoring should be considered at all YLBL properties. Monitoring a colony of bats is simple and counts can be completed by volunteers in the evening. More information about bat roosts and roost monitoring can be obtained by contacting the Wisconsin Bat Program in the Bureau of Endangered Resources or by visiting the Wisconsin Bat Monitoring Program website (<http://wiatri.net/inventory/bats>).

Glossary

Ecological Landscape - landscape units developed by the WDNR to provide an ecological framework to support natural resource management decisions. The boundaries of Wisconsin's sixteen Ecological Landscapes correspond to ecoregional boundaries from the National Hierarchical Framework of Ecological Units, but sometimes combine subsections to produce a more manageable number of units.

element - the basic building blocks of the Natural Heritage Inventory. They include natural communities, rare plants, rare animals, and other selected features such as colonial bird rookeries, bat hibernacula, and mussel beds. In short, an element is any biological or ecological entity upon which we wish to gather information for conservation purposes.

element occurrence - an Element Occurrence (EO) is an area of land and/or water in which a rare species or natural community is, or was, present. An EO should have practical conservation value for the Element as evidenced by potential continued (or historic) presence and/or regular recurrence at a given location. For species, the EO often corresponds with the local population, but when appropriate may be a portion of a population (e.g., a single nest territory or long distance dispersers) or a group of nearby populations (e.g., metapopulation). For communities, the EO may represent a stand or patch of a natural community or a cluster of stands or patches of a natural community. Because they are defined on the basis of biological information, EOs may cross jurisdictional boundaries.

Landtype Association (LTA) - a level in the National Hierarchical Framework of Ecological Units (see next entry) representing an area of 10,000 – 300,000 acres. Similarities of landform, soil, and vegetation are the key factors in delineating LTAs.

natural community - an assemblage of plants and animals, in a particular place at a particular time, interacting with one another, the abiotic environment around them, and subject to primarily natural disturbance regimes. Those assemblages that are repeated across a landscape in an observable pattern constitute a community type. No two assemblages, however, are exactly alike.

periphyton - algae, bacteria, other associated microorganisms, and non-living organic matter attached to any submerged surface.

representative - native plant species that would be expected to occur in native plant communities influenced primarily by natural disturbance regimes in a given landscape - e.g., see Curtis (1959).

SGCN (or “Species of Greatest Conservation Need”) – native wildlife species with low or declining populations that are most at risk of no longer being a viable part of Wisconsin's fauna (from the “Wisconsin Wildlife Action Plan,” WDNR 2006).

Species List

The following is a list of species referred to by common name in the report text.

Common Name	Scientific Name
Animals	
emerald ash borer	<i>Agilus planipennis</i>
earthworm family	<i>Acanthodrilidae</i>
earthworm family	<i>Lumbricidae</i>
earthworm family	<i>Megascloedidae</i>
mudpuppy	<i>Necturus maculosus</i>
Plants	
American basswood	<i>Tilia americana</i>
American elm	<i>Ulmus americana</i>
American starflower	<i>Trientalis borealis</i>
ash	<i>Fraxinus spp.</i>
autumn-olive	<i>Elaeagnus umbellata</i>
beaked hazelnut	<i>Corylus cornuta</i>
big blue-stem	<i>Andropogon gerardii</i>
big-tooth aspen	<i>Populus grandidentata</i>
bird's-foot trefoil	<i>Lotus corniculatus</i>
black locust	<i>Robinia pseudoacacia</i>
black oak	<i>Quercus velutina</i>
black walnut	<i>Juglans nigra</i>
blue cohosh	<i>Caulophyllum thalictroides</i>
bog clearweed	<i>Pilea fontana</i>
bracken fern	<i>Pteridium aquilinum</i>
broad-leaf enchanter's-nightshade	<i>Circaea lutetiana</i>
bur oak	<i>Quercus macrocarpa</i>
calico aster	<i>Aster lateriflorus</i>
Canada mayflower	<i>Maianthemum canadense</i>
Canadian goldenrod	<i>Solidago canadensis</i>
cleavers	<i>Galium aparine</i>

cluster-leaf tick-trefoil	<i>Desmodium glutinosum</i>
common blackberry	<i>Rubus allegheniensis</i>
common buckthorn	<i>Rhamnus cathartica</i>
common lady fern	<i>Athyrium filix-femina</i>
common prickly-ash	<i>Zanthoxylum americanum</i>
common spiderwort	<i>Tradescantia ohiensis</i>
cream wild indigo	<i>Baptisia bracteata</i>
Dutchman's-breeches	<i>Dicentra cucullaria</i>
early meadow-rue	<i>Thalictrum dioicum</i>
eastern figwort	<i>Scrophularia marilandica</i>
eastern red-cedar	<i>Juniperus virginiana</i>
eastern white pine	<i>Pinus strobus</i>
elm-leaved goldenrod	<i>Solidago ulmifolia</i>
elms	<i>Ulmus spp.</i>
Eurasian honeysuckles	<i>Lonicera spp.</i>
false boneset	<i>Kuhnia eupatorioides</i>
false rue anemone	<i>Isopyrum biternatum</i>
flowering spurge	<i>Euphorbia corollata</i>
garlic mustard	<i>Alliaria petiolata</i>
goat's-rue	<i>Tephrosia virginiana</i>
golden Alexander's	<i>Zizia aurea</i>
gray dogwood	<i>Cornus foemina</i>
great Indian-plantain	<i>Cacalia muhlenbergii</i>
hairy sweet cicely	<i>Osmorhiza claytonii</i>
hoary puccoon	<i>Lithospermum canescens</i>
huckleberry	<i>Gaylussacia baccata</i>
ironwood	<i>Ostrya virginiana</i>
jack pine	<i>Pinus banksiana</i>
Jack-in-the-pulpit	<i>Arisaema triphyllum</i>
Kentucky bluegrass	<i>Poa pratensis</i>
large-flowered bellwort	<i>Uvularia grandiflora</i>
late figwort	<i>Scrophularia marilandica</i>
lead-plant	<i>Amorpha canescens</i>

limber honeysuckle	<i>Lonicera dioica</i>
little blue-stem	<i>Schizachyrium scoparium</i>
maidenhair fern	<i>Adiantum pedatum</i>
Muhlenberg's sedge	<i>Carex muhlenbergii</i>
multiflora rose	<i>Rosa multiflora</i>
musclewood	<i>Carpinus caroliniana</i>
northern bush-honeysuckle	<i>Diervilla lonicera</i>
northern red oak	<i>Quercus rubra</i>
panic grasses	<i>Panicum spp.</i>
Pennsylvania sedge	<i>Carex pensylvanica</i>
perennial pea-vine	<i>Lathyrus latifolius</i>
poke milkweed	<i>Asclepias exaltata</i>
poverty oat grass	<i>Danthonia spicata</i>
prairie phlox	<i>Phlox pilosa</i>
prairie rosinweed	<i>Silphium integrifolium</i>
prairie tickseed	<i>Coreopsis palmata</i>
prairie violet	<i>Viola pedatifida</i>
prickly wild gooseberry	<i>Ribes cynosbati</i>
purple prairie-clover	<i>Dalea purpurea</i>
quackgrass	<i>Elytrigia repens</i>
quaking aspen	<i>Populus tremuloides</i>
rattlesnake fern	<i>Botrychium virginianum</i>
red baneberry	<i>Actaea rubra</i>
red pine	<i>Pinus resinosa</i>
red raspberry	<i>Rubus idaeus</i>
reed canary grass	<i>Phalaris arundinacea</i>
round-headed bush-clover	<i>Lespedeza capitata</i>
shagbark hickory	<i>Carya ovata</i>
sharp-lobed hepatica	<i>Anemone acutiloba</i>
showy bush honeysuckle	<i>Lonicera X bella</i>
side-oats grama	<i>Bouteloua curtipendula</i>
small white fawn-lily	<i>Erythronium albidum</i>
smooth brome	<i>Bromus inermis</i>

smooth sumac	<i>Rhus glabra</i>
spotted knapweed	<i>Centaurea biebersteinii</i>
stiff goldenrod	<i>Solidago rigida</i>
sugar maple	<i>Acer saccharum</i>
timothy	<i>Phleum pratense</i>
tinker's-weed	<i>Triosteum perfoliatum</i>
velvet-leaf blueberry	<i>Vaccinium myrtilloides</i>
violet wood-sorrel	<i>Oxalis violacea</i>
Virginia creeper	<i>Parthenocissus quinquefolia</i>
Virginia spring-beauty	<i>Claytonia virginica</i>
Virginia wild-rye	<i>Elymus virginicus</i>
white birch	<i>Betula papyrifera</i>
white oak	<i>Quercus alba</i>
white snakeroot	<i>Eupatorium rugosum</i>
white sweet-clover	<i>Melilotus albus</i>
wild black cherry	<i>Prunus serotina</i>
wild lupine	<i>Lupinus perennis</i>
wild parsnip	<i>Pastinaca sativa</i>
wild sarsaparilla	<i>Aralia nudicaulis</i>
wild-ginger	<i>Asarum canadense</i>
yellow bedstraw	<i>Galium verum</i>
yellow forest violet	<i>Viola pubescens</i>
yellow Indian grass	<i>Sorghastrum nutans</i>
yellow sweet-clover	<i>Melilotus officinalis</i>
yellow-bud hickory	<i>Carya cordiformis</i>
yellow-pimpernel	<i>Taenidia integerrima</i>
zigzag goldenrod	<i>Solidago flexicaulis</i>

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Additional Resources

Numerous online resources are available for learning more about the rare species, natural communities, and ecological concepts contained within this report. These are just a few of the resources that we recommend.

1. Bureau of Endangered Resources' Animals, Plants, and Communities Web Pages

Information for plants, animals, and natural communities on the Wisconsin Working List, as well as Species of Greatest Conservation Need from the Wisconsin Wildlife Action Plan. For reptiles and amphibians, information for more common species is also provided here. At this time, the level of detail available varies among species; some have detailed factsheets while others have only a short paragraph or a map. These pages will continue to evolve as more information becomes available and are the Bureau of Endangered Resources' main source of information for species and communities. dnr.wi.gov/org/land/er/biodiversity/

2. Wisconsin Natural Heritage Inventory Working List

The Wisconsin Natural Heritage Working List contains species known or suspected to be rare in the state and natural communities native to Wisconsin. It includes species legally designated as "Endangered" or "Threatened" as well as species in the advisory "Special Concern" category. This Web page offers a printable pdf file and a key to the Working List for use in conjunction with the information provided in #1 above. dnr.wi.gov/org/land/er/wlist/

3. Ecological Landscapes of Wisconsin Handbook

Wisconsin's 16 Ecological Landscapes have unique combinations of physical and biological characteristics such as climate, geology, soils, water, or vegetation. This handbook will contain a chapter for each of these landscapes with detailed information about their ecology, socioeconomics, and ecological management opportunities. An additional introductory chapter will compare the 16 landscapes in numerous ways, discuss Wisconsin's ecology on the statewide scale, and introduce important concepts related to ecosystem management in the state. The full handbook is in development as of this writing, and chapters will be made available online as they are published. Currently, a set of Web pages provide brief Ecological Landscape descriptions, numerous maps, and other useful information, including management opportunities for natural communities and Species of Greatest Conservation Need. dnr.wi.gov/landscapes/

4. The Wisconsin Wildlife Action Plan

This plan is the result of a statewide effort to identify native Wisconsin animal species of greatest conservation need. The plan also presents priority conservation actions to protect the species and their habitats. The plan itself is available online, and there are several online tools to explore the data within the plan. The Web pages are closely integrated with the pages provided in items #1 and #3 above. The Wildlife Action Plan Web pages are quite numerous, so we recommend the following links as good starting points for accessing the information.

- the plan itself: dnr.wi.gov/org/land/er/wwap/
- explore Wildlife Action Plan data: dnr.wi.gov/org/land/er/wwap/explore/
- Wildlife Action Plan Implementation: dnr.wi.gov/org/land/er/wwap/implementation/

5. **Wisconsin's Biodiversity as a Management Issue - A Report to Department of Natural Resources Managers**

This now out-of-print report presents a department strategy for conserving biological diversity. It provides department employees with an overview of the issues associated with biodiversity and provides a common point of reference for incorporating the conservation of biodiversity into our management framework. The concepts presented in the report are closely related to the material provided in this report, as well as the other resources listed in this section.

dnr.wi.gov/org/es/science/publications/rs915_95.htm

6. **Wisconsin's Statewide Forest Strategy**

Wisconsin's Statewide Forest Strategy is a collection of many strategies and actions designed to address major issues and priority topics over the next five to ten years. It provides a long-term, comprehensive, coordinated approach for investing resources to address the management and landscape priorities identified in the Statewide Forest Assessment. Several of the strategies contain issues related to biodiversity and ecosystem management.

dnr.wi.gov/forestry/assessment/strategy/overview.htm

7. **2010 Wisconsin's Statewide Forest Assessment**

The goal of this project was to assess the "state of affairs" of Wisconsin's public and private forests and analyze the sustainability of our forested ecosystems. The Statewide Forest Assessment helps to explain trends, identify issues, and present an updated view of the status of forests in Wisconsin. The first chapter deals with biological diversity in Wisconsin's forests, and the major conclusions from this assessment were used to develop the strategies in # 6 above.

dnr.wi.gov/forestry/assessment/strategy/assess.htm

Appendix A

Natural Heritage Inventory Overview and General Methodology

This biotic inventory and analysis was conducted by the Wisconsin Natural Heritage Inventory (NHI) program. The Wisconsin NHI program is part of the Wisconsin DNR's Bureau of Endangered Resources and a member of an international network of Natural Heritage programs representing all 50 states, as well as portions of Canada, Latin America, and the Caribbean. These programs share standardized methods for collecting, processing, and managing data for rare species, natural communities, and certain other natural features (e.g., bird rookeries). NatureServe, an international non-profit organization, coordinates the network. This appendix provides a general overview of the methodology we use for these projects. Please see the NatureServe Web site for more detailed information about standard methods used by the Heritage Network (www.NatureServe.org) for locating, documenting, and ranking rare species and natural community occurrences.

General Process Used when Conducting Biotic Inventories for Master Planning

The Wisconsin NHI Program typically uses a "coarse filter-fine filter" approach to conducting biotic inventory projects for master planning. This approach begins with a broad assessment of the natural communities and aquatic features present, along with their relative quality and condition. The area's landforms, soils, topography, hydrology, current land uses, and the surrounding matrix are also evaluated using Geographic Information Systems (GIS) and other electronic and hardcopy data sources. Data that describe conditions for the area prior to Euro-American settlement are often used during this step and at other times to further understand the ecological capabilities of the area. Often, we consult with local managers, biologists, or others familiar with the ecology of the area when preparing for an inventory project. The goals for this step are to identify the important ecological attributes and biological processes present, as well as to focus our inventory efforts.

The level of survey intensity varies based on the size and ecological complexity of the property or group of properties, as well as the resources available. For larger properties such as state forests, biotic inventory efforts typically take more than one year. Ideally, taxa surveys are conducted following a coarse-filter analysis that sometimes include extensive natural community surveys. There is often time for "mop-up work" during the year following the completion of the main survey effort, whereby additional surveys are conducted for areas that could not be reached the first year or for which new information has become available. For smaller properties, a "Rapid Ecological Assessment" often takes the place of a full-scale biotic inventory. The level of effort for these projects varies based on the needs of the study area, although surveys are almost always completed during one field season. Coarse filter work for rapid assessments is often done based on GIS data, aerial photos, data acquired from previous efforts, and information from property managers and others knowledgeable about the area.

Taxa-specific surveys can be costly and intensive and sometimes must be completed during a very narrow period of time. For example, bird surveys must be completed within an approximately one-month time window. For this and several other reasons, ***our surveys cannot locate every rare species occurrence within a given area.*** Therefore, it is important to use resources as efficiently as possible, making every effort to identify the major habitats present in the study area from the start. This approach concentrates inventory efforts on those sites most likely to contain target species to maximize efficient use of resources. Communication among biologists during the field season can help identify new areas of interest or additional priorities for surveys. The goal is to locate species populations with the highest conservation value whenever possible.

After all of the data are collected, occurrences of rare species, high-quality natural communities, and certain other features are documented, synthesized, and incorporated into the NHI Database. The NHI program refers to this process as “mapping” the data and uses a tabular and spatial database application designed specifically for the Heritage Network. Other secondary databases are also used by the Wisconsin NHI Program for storing additional species and community information such as species lists, GPS waypoints, photos, and other site documentation.

Once the data mapping and syntheses are completed, the NHI Program evaluates data from the various department biologists, contractors, and other surveyors. This information is examined along with many other sources of spatial and tabular information including topographic maps, various types of aerial photography, digital soil and wetland maps, hydrological data, forest reconnaissance data, and land cover data. Typically, GPS waypoints and other spatial information from the various surveys are superimposed onto these maps for evaluation by NHI biologists.

In addition to locating important rare species populations and high-quality natural community occurrences, the major products culminating from all of this work are the “Primary Sites.” These areas contain relatively undisturbed, high-quality, natural communities; provide important habitat for rare species; offer opportunities for restoration; could provide important ecological connections; or some combination of the above factors. The sites are meant to highlight, based on our evaluation, the best areas for conserving biological diversity for the study area. They often include important rare species populations, High Conservation Value Forests, or other ecologically important areas.

The final report describes the Primary Sites, as well as rare or otherwise notable species, and other ecological opportunities for conserving or enhancing the biological diversity of the study area. The report is intended for use by department master planning teams and others and strives to describe these opportunities at different scales, including a broad, landscape context that can be used to facilitate ecosystem management.

Select Tools Used for Conducting Inventory

The following are descriptions of standard tools used by the NHI Program for conducting biotic inventories. Some of these may be modified, dropped, or repeated as appropriate to the project.

File Compilation: Involves obtaining existing records of natural communities, rare plants and animals, and aquatic features for the study area and surrounding lands and waters from the NHI Database. Other databases with potentially useful information may also be queried, such as: forest reconnaissance data; the DNR Surface Water Resources series for summaries of the physical, chemical, and biological characteristics of lakes and streams (statewide, by county); the Milwaukee Public Museum's statewide Herp Atlas; the Wisconsin Breeding Bird Atlas; other NHI “atlas” and site databases; museum/herbarium collections for various target taxa; soil surveys; geological surveys; and the department's fish distribution database.

Additional data sources are sought out as warranted by the location and character of the site, and the purpose of the project. Manual files maintained within the Bureau of Endangered Resources, including the State Natural Area files, often contain information on a variety of subjects relevant to the inventory of natural features for an area.

Literature Review: Field biologists involved with a given project consult basic references on the natural history and ecology of the area, as well as any documented rare species. This sometimes broadens and/or sharpens the focus of the inventory efforts.

Target Elements: Lists of target elements including natural communities, rare plants and animals, and aquatic features are developed for the study area. Field inventory is then scheduled for the times when these elements are most identifiable or active. Inventory methods follow accepted scientific standards for each taxon.

Compilation of Maps and Other Spatial Data: USGS 7.5 minute topographic quadrangles, most often in digital form, serve along with aerial photos as the base maps for field survey and often yield useful clues regarding access, extent of area to be surveyed, developments, and the presence and location of special features. These are used in conjunction with numerous GIS layers, which are now a basic resource tool for the efficient and comprehensive planning of surveys and the analysis of their results.

WDNR wetland maps consist of aerial photographs upon which all wetlands down to a scale of 2 or 5 acres have been delineated. Each wetland polygon is classified based on characteristics of vegetation, soils, and water depth. These polygons have been digitized for most counties, and the resulting GIS layers can be superimposed onto other maps.

Ecoregion GIS layers are useful for comprehensive projects covering large geographic areas such as counties, national and state forests, and major watersheds. These maps integrate basic ecological information on climate, landforms, geology, soils, and vegetation. Ecological Landscapes provide the broad framework most often used in Wisconsin; however smaller units, including Landtype Associations, can be very helpful for evaluating ecoregions at finer scales.

Aerial photographs: These provide information on a study area not available from maps, paper files, or computer printouts. Examination of both current and historical photos, taken over a period of decades, can be especially useful in revealing changes in the environment over time. The Wisconsin NHI Program uses several different types of both color and black and white air photos. Typically, these are in digital format, although paired photos in print format can be valuable for stereoscopic viewing. High-resolution satellite imagery is often cost-prohibitive but is available for some portions of the state and is desirable for certain applications.

Original Land Survey Records: The surveyors who laid out the rectilinear Town-Range-Section grid across the state in the mid-nineteenth century recorded trees by species and size at all section corners and along section lines. Their notes also included general impressions of vegetation, soil fertility, and topography, and note aquatic features, wetlands, and recent disturbances such as windthrow and fire. As these surveys typically occurred prior to extensive settlement of the state by Europeans, they constitute a valuable record of conditions prior to extensive modification of the landscape by European technologies and settlement patterns. The tree data are available in GIS format as raw points or interpreted polygons, and the notes themselves can provide helpful clues regarding the study area's potential ecological capabilities.

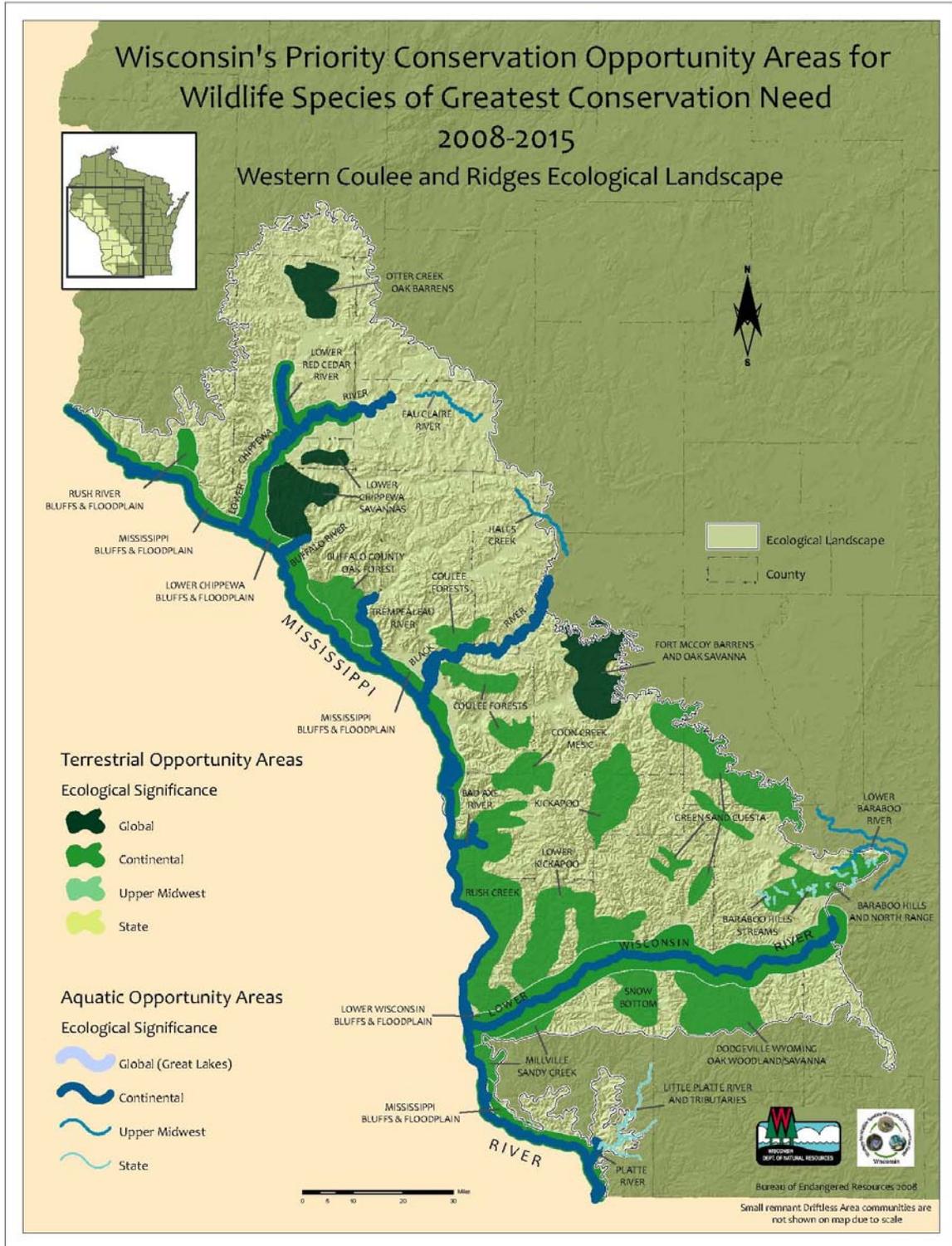
Interviews: Interviews with scientists, naturalists, land managers or others knowledgeable about the area to be surveyed often yield invaluable information.

Global Positioning Systems (GPS): Small, portable GPS units are now a routine piece of field equipment used for virtually all NHI survey work. Collecting coordinates (waypoints) facilitates mapping and makes it easy to quickly communicate specific locations among biologists. Often waypoints are paired with photos and/or other information and stored in a waypoint tracking database.

Aerial Reconnaissance: Fly-overs are desirable for large sites, and for small sites where contextual issues are especially important. When possible, this should be done both before and after ground level work. Flights are scheduled for those times when significant features of the study area are most easily identified and

differentiated. They are also useful for observing the general lay of the land, vegetation patterns and patch sizes, aquatic features, infrastructure, and disturbances within and around the site.

Appendix B



Wisconsin's Priority Conservation Opportunity Areas for Wildlife Species of Greatest Conservation Need 2008-2015

Southwest Savanna Ecological Landscape



Terrestrial Opportunity Areas

Ecological Significance

- Global
- Continental
- Upper Midwest
- State

Aquatic Opportunity Areas

Ecological Significance

- Global (Great Lakes)
- Continental
- Upper Midwest
- State

- Ecological Landscape
- County



Bureau of Endangered Resources 2008

Appendix C

Wisconsin Natural Heritage Working List Explanation

The Wisconsin Natural Heritage Working List contains species known or suspected to be rare in the state and natural communities native to Wisconsin. It includes species legally designated as "Endangered" or "Threatened" as well as species in the advisory "Special Concern" category. Most of the species and natural communities on the list are actively tracked and we encourage data submissions on these species. This list is meant to be dynamic - it is updated as often as new information regarding the biological status of species becomes available. See the Endangered Resources Program web site for the most recent Natural Heritage Inventory Working List (<http://dnr.wi.gov/org/land/er/wlist/>).

Key

Scientific Name: Scientific name used by the Wisconsin Natural Heritage Inventory Program.

Common Name: Standard, contrived, or agreed upon common names.

Global Rank: Global element rank. See the rank definitions below.

State Rank: State element rank. See the rank definitions below.

US Status: Federal protection status in Wisconsin, designated by the Office of Endangered Species, U.S. Fish and Wildlife Service through the U.S. Endangered Species Act. LE = listed endangered; LT = listed threatened; XN = non-essential experimental population(s); LT,PD = listed threatened, proposed for de-listing; C = candidate for future listing.

WI Status: Protection category designated by the Wisconsin DNR. END = endangered; THR = threatened; SC = Special Concern.

WDNR and federal regulations regarding Special Concern species range from full protection to no protection. The current categories and their respective level of protection are 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 WDNR; SC/M = fully protected by federal and state laws under the Migratory Bird Act.

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

Global & State Element Rank Definitions

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 factors making it vulnerable to extinction throughout its range; in terms of occurrences, in the range of 21 to 100.

G4 = Apparently globally secure, though it may be quite rare in parts of its range, especially at the periphery.

G5 = Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.

GH = Of historical occurrence throughout its range, i.e., formerly part of the established biota, with the expectation that it may be rediscovered.

GU = Possibly in peril range-wide, but their status is uncertain. More information is needed.

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

G? = Not ranked.

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 (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extirpation from the state.

S2 = Imperiled in Wisconsin because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extirpation from the state.

S3 = Rare or uncommon in Wisconsin (21 to 100 occurrences).

S4 = Apparently secure in Wisconsin, with many occurrences.

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

SA = Accidental (occurring only once or a few times) or casual (occurring more regularly although not every year); a few of these species (typically long-distance migrants such as some birds and butterflies) may have even bred on one or more of the occasions when they were recorded.

SE = An exotic established in the state; may be native elsewhere in North America.

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.

SN = Regularly occurring, usually migratory and typically non-breeding species for which no significant or effective habitat conservation measures can be taken in Wisconsin. This category includes migratory birds and bats that pass through twice a year or, may remain in the winter (or, in a few cases, the summer) along with certain lepidoptera which regularly migrate to Wisconsin where they reproduce, but then completely die out every year with no return migration. Species in this category are so widely and unreliably distributed during migration or in winter that no small set of sites could be set aside with the hope of significantly furthering their conservation.

SZ = Not of significant conservation concern in Wisconsin, invariably because there are no definable occurrences in the state, although the taxon is native and appears regularly in the state. An SZ rank will generally be used for long-distance migrants whose occurrence during their migrations are too irregular (in terms of repeated visitation to the same locations), transitory, and dispersed to be reliably identified, mapped, and protected. Typically, the SZ rank applies to a non-breeding population.

SR = Reported from Wisconsin, but without persuasive documentation which would provide a basis for either accepting or rejecting the report. Some of these are very recent discoveries for which the program hasn't yet received first-hand information; others are old, obscure reports that are hard to dismiss because the habitat is now destroyed.

SRF = Reported falsely (in error) from Wisconsin but this error is persisting in the literature.

SU = Possibly in peril in the state, but their status is uncertain. More information is needed.

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 non-breeding 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 non-breeding (N) status of the taxon in question. (e.g. S2B,S5N).

APPENDIX D

Primary Sites of Yellowstone Wildlife Area, Yellowstone Lake State Park, Yellowstone Savanna State Natural Area, Streambank Protection Fee Area, and Blackhawk Lake Wildlife Area²

Two ecologically important sites were identified on Yellowstone Lake WDNR-managed lands; none were identified at Blackhawk Lake Wildlife Area. These Primary Sites were delineated because they generally encompass the best examples of 1) rare and representative natural communities, 2) documented occurrences of rare species populations, and/or 3) opportunities for ecological restoration or connections. These sites warrant high protection and/or restoration consideration during the development of the property master plan. This report is meant to be considered along with other information when identifying opportunities for various management designations during the master planning process.

Information provided in the summary paragraphs includes location information, a site map, a brief summary of the natural features present, the site's ecological significance, and management considerations.

² A list of species referred to by common name is found at the end of this appendix.

YLBL01. YELLOWSTONE FOREST

Location

Property:	Yellowstone Wildlife Area
County:	Lafayette
Landtype Association:	Platteville Savanna (222Le02)
Approximate Size (acres):	290

Description of Site

Yellowstone Forest (Fig. 1) comprises approximately 290 acres of mostly Southern Dry-mesic Forest that lies on the south shore of Yellowstone Lake within Yellowstone Wildlife Area. Small inclusions of eastern white pine relict on sandstone outcrops are also present, as are pockets of rich Southern Mesic Forest that lie within the deeper, shadier coves and ravines. The site lies on moderate to steep north- to east-facing slopes and ravines overlooking Yellowstone Lake for 1.5 to 2 miles, extending 300-900 feet inland where it abruptly transitions to younger, lower quality forest. This forest has extremely high species diversity (121 native plant species) due to variable slope, aspect, soils, and moisture regime. The forest is dominated by northern red oak (*Quercus rubra*), bur oak (*Q. macrocarpa*), and American basswood (*Tilia americana*; up to 36 inch DBH, averaging 18-24 inches) with lesser amounts of shagbark hickory (*Carya ovata*), big-tooth aspen (*Populus grandidentata*), and white oak (*Quercus alba*). The ground layer includes characteristic species such as large-flowered bellwort (*Uvularia grandiflora*), Jack-in-the-pulpit (*Arisaema triphyllum*), common lady fern (*Athyrium filix-femina*), zigzag goldenrod (*Solidago flexicaulis*), blue cohosh (*Caulophyllum thalictroides*), Dutchman's-breeches (*Dicentra cucullaria*), and small white fawn-lily (*Erythronium albidum*).

Significance of Site

An opportunity exists at Yellowstone Forest to manage for Older Forest and, eventually, Old-Growth Forest. Older forests (greater than 100-120 years old) in Wisconsin are rare and declining, largely due to timber harvesting, conversion to other land uses, pests, invasive species, herbivory, and the lack of seed sources (WDNR 2010). These older forests offer unique habitat, including compositional, structural, and functional attributes. Wisconsin's Statewide Forest Strategy (2010) identifies the need to improve all forested communities with a landscape management approach that considers the representation of all successional stages, which includes older forest and old-growth forest. WisFIRS reconnaissance data indicate that stands in Yellowstone Forest (particularly those closest to the lake) are over 100 years old, evidenced by the large diameters of the dominant canopy species, structural diversity, and abundant coarse woody debris.

Management Considerations

Long-term development and maintenance of older forest composition, structure and function within a minimally manipulated environment should be a major consideration for this site (for further guidance, see WDNR In prep). The core area of high-quality forest at Yellowstone Forest is relatively large in size, but has a high degree of edge due to a somewhat linear shape. The boundaries of the Primary Site include the contiguous younger, lower quality forest that lies further inland to create a buffer and reduce edge. This buffer area should be managed to achieve the same structure and composition as those of the core area, primarily by allowing natural succession to occur unimpeded.

Monitoring and control of garlic mustard (*Alliaria petiolata*) may represent the single most important management need, as it can outcompete native ground layer species and also limit regeneration of canopy trees. Exotic bush honeysuckle is also present. Caution should be used when applying prescribed fire to this site to ensure that the flame height and temperature are kept low and that ravines and rich slopes are excluded.

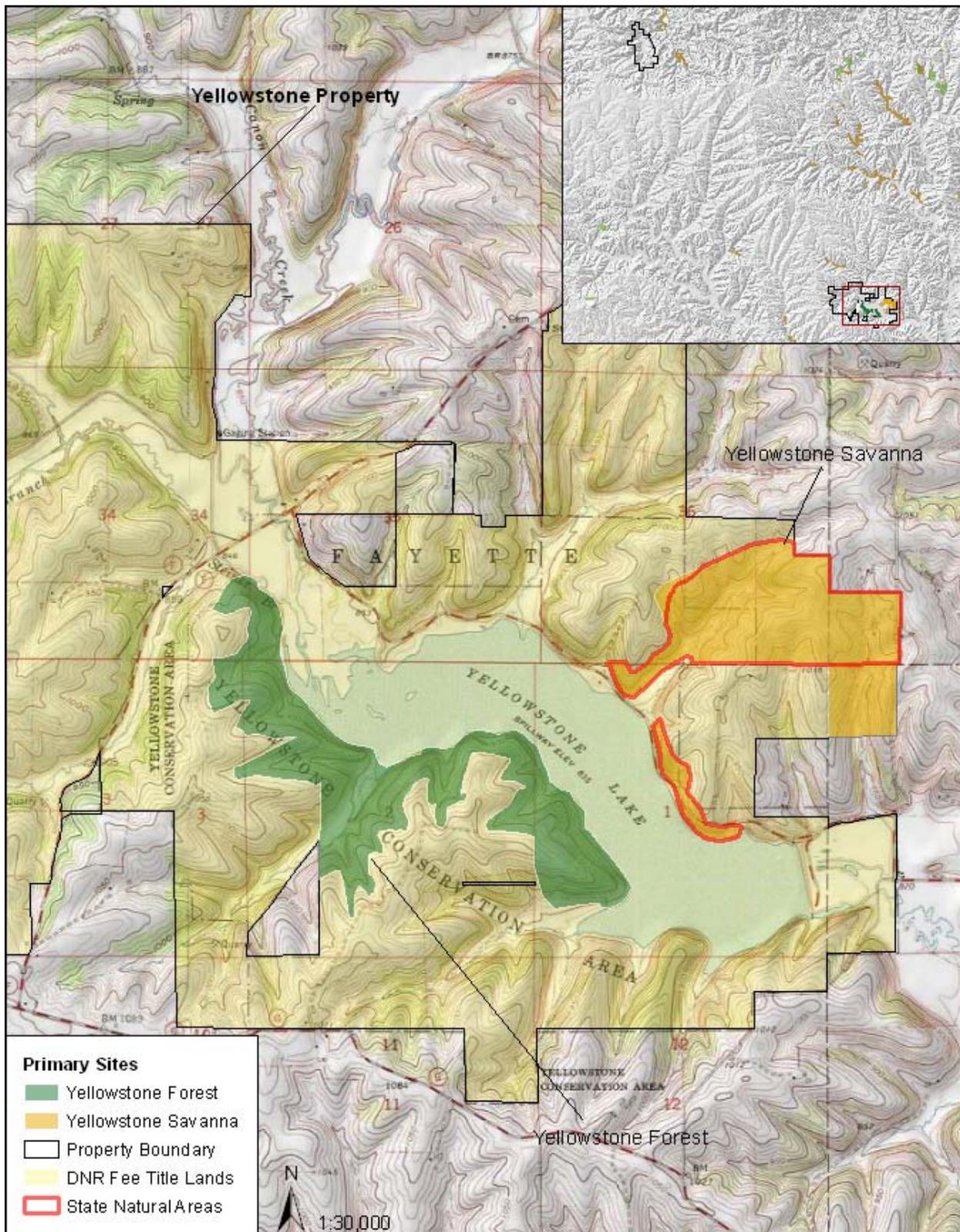


Figure 1. Yellowstone Forest and Yellowstone Savanna Primary Sites

YLBL02. YELLOWSTONE SAVANNA

Location

Properties:	Yellowstone State Park, Yellowstone Savanna State Natural Area
County:	Lafayette
Landtype Association:	Platteville Savanna (222Le02)
Approximate Size (acres):	240

Description of Site

Yellowstone Savanna (Fig. 1) comprises approximately 240 acres east of Yellowstone Lake, and lies within Yellowstone Savanna State Natural Area and Yellowstone State Park. The site harbors remnant Dry Prairie and Oak Opening, which are buffered by old field. The fair- to good-quality remnant Oak Opening is currently undergoing restoration. It is situated along a southwest-northeast-trending ravine, and is about 10 acres in area. Although the understory has lost some native species due to past grazing, plowing, and lack of fire, the oak structure remains relatively intact. Large bur oaks (18-24 inch DBH) are scattered throughout the ravine, with northern red oak, white oak and shagbark hickory the dominant canopy species. Smaller (12 inch DBH) wild black cherry (*Prunus serotina*), American basswood, and American elm (*Ulmus americana*) dominate the subcanopy. As one moves upslope from the ravine, a transition is evident as the moderately closed canopy (typical of Oak Woodland) slowly opens and provides a more park-like appearance (typical of Oak Opening) with large oaks and other savanna indicator species (e.g., eastern figwort [*Scrophularia marilandica*]). The groundcover is weedy with garlic mustard, white snakeroot (*Eupatorium rugosum*), bog clearweed (*Pilea fontana*), and common blackberry (*Rubus alleghaniensis*).

The remnant Dry Prairie is small (eight acres), and lies on a steep southwest-facing slope. Many species characteristic of Dry Prairie are present here, including side-oats grama (*Bouteloua curtipendula*), little bluestem (*Schizachyrium scoparium*), Indian grass (*Sorghastrum nutans*), false boneset (*Kuhnia eupatorioides*), leadplant (*Amorpha canescens*), and prairie tickseed (*Coreopsis palmata*). Other conservative prairie species found here include cream wild indigo (*Baptisia bracteata*), purple prairie clover (*Dalea purpurea*), and rosinweed (*Silphium integrifolium*).

Significance of Site

Historically, Oak Openings were abundant in Wisconsin, covering approximately 5.5 million acres (Curtis 1959) south of the Tension Zone. Review of historical literature indicates that Oak Openings once supported an exceptionally diverse flora, about 25% of the entire native flora of Wisconsin (Leach and Givnish 1999). Of the about 75,000 acres (Hoffman 2009) of Oak Opening remaining in Wisconsin, many of these are highly degraded or have succeeded to closed-canopy oak forests. Prairie once occupied approximately 2.1 million acres in Wisconsin. Now, approximately 2,000 acres remain – less than 0.1% (Leach and Givnish 1999). Of these, only those prairies that occurred at the wet and dry ends of the soil spectrum survived. Both of these community types support specialist animal species that are equally rare. Yellowstone Savanna State Natural was designated in 2002.

Management Considerations

The remnant Dry Prairie is being heavily invaded by brush (30-70% cover), including Eurasian honeysuckle (*Lonicera X bella*), smooth sumac (*Rhus glabra*), gray dogwood (*Cornus foemina*), common prickly-ash (*Zanthoxylum americanum*), and black locust (*Robinia pseudoacacia*). Removal of these must be a priority if this prairie is to survive, along with consistent follow-up measures. Control of non-native invasive species including wild parsnip (*Pastinaca sativa*) and sweet clover (*Melilotus* spp) is also a priority, along with application of regular fire.



Fig. 14. Yellowstone Savanna Primary Site. Photo by Ryan O'Connor.

Species List

List of species referred to by common name in Appendix D.

Plants	
Common Name	Scientific Name
American basswood	<i>Tilia americana</i>
American elm	<i>Ulmus americana</i>
American gromwell	<i>Lithospermum latifolium</i>
big-tooth aspen	<i>Populus grandidentata</i>
black locust	<i>Robinia pseudoacacia</i>
blue cohosh	<i>Caulophyllum thalictroides</i>
bog clearweed	<i>Pilea fontana</i>
broad-leaf enchanter's-nightshade	<i>Circaea lutetiana</i>
burr oak	<i>Quercus macrocarpa</i>
cluster-leaf tick-trefoil	<i>Desmodium glutinosum</i>
common blackberry	<i>Rubus allegheniensis</i>
common lady fern	<i>Athyrium filix-femina</i>
common prickly-ash	<i>Zanthoxylum americanum</i>
cream wild indigo	<i>Baptisia bracteata</i>
Dutchman's-breeches	<i>Dicentra cucullaria</i>
eastern figwort	<i>Scrophularia marilandica</i>
false boneset	<i>Kuhnia eupatorioides</i>
false rue anemone	<i>Isopyrum biternatum</i>
garlic mustard	<i>Alliaria petiolata</i>
gray dogwood	<i>Cornus foemina</i>
Jack-in-the-pulpit	<i>Arisaema triphyllum</i>
large-flowered bellwort	<i>Uvularia grandiflora</i>
lead-plant	<i>Amorpha canescens</i>
little blue-stem	<i>Schizachyrium scoparium</i>
Muhlenberg's cacalia	<i>Cacalia muhlenbergii</i>
northern red oak	<i>Quercus rubra</i>
prairie rosinweed	<i>Silphium integrifolium</i>
prairie tickseed	<i>Coreopsis palmata</i>

purple prairie-clover	<i>Dalea purpurea</i>
shagbark hickory	<i>Carya ovata</i>
Short's rock-cress	<i>Arabis shortii</i>
showy bush honeysuckle	<i>Lonicera X bella</i>
side-oats grama	<i>Bouteloua curtipendula</i>
small white fawn-lily	<i>Erythronium albidum</i>
smooth sumac	<i>Rhus glabra</i>
white oak	<i>Quercus alba</i>
white snakeroot	<i>Eupatorium rugosum</i>
wild black cherry	<i>Prunus serotina</i>
yellow Indian grass	<i>Sorghastrum nutans</i>
zigzag goldenrod	<i>Solidago flexicaulis</i>

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