National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science

National Park Service Vegetation Inventory Program

Mississippi National River and Recreation Area, Minnesota

Natural Resource Report NPS/GLKN/NRR—2015/1002





ON THIS PAGE
All photographs collected in Mississippi National River and Recreation Area, Minnesota. From upper left clockwise: Upland tall grass prairie, a hoverfly pollinating nodding beggartick (*Bidens cernua*), tree frog (*Hyla* sp.), moored tow with St. Paul, Minnesota skyline, Vermillion River backwaters on Pool 3, northern water snake (*Nerodia sipedon*).
All photographs by Andrew Strassman (U.S. Geological Survey)

ON THE COVER
Mississippi River side-channel in Pool 3, Mississippi National River and Recreation Area, Minnesota.
Photograph by Andrew Strassman (U.S. Geological Survey)

National Park Service Vegetation Inventory Program

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Natural Resource Report NPS/GLKN/NRR—2015/1002

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Fort Collins, Colorado

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Executive Summary

The National Park Service (NPS) Vegetation Inventory Program (VIP) is an effort to classify, describe, and map existing vegetation of national park units for the NPS Natural Resource Inventory and Monitoring (I&M) Program. The NPS VIP is managed by the NPS Inventory and Monitoring Division and provides baseline vegetation information to the NPS Natural Resource I&M Program. The USGS Upper Midwest Environmental Sciences Center, NatureServe, and NPS Mississippi National River and Recreation Area (MISS) have completed vegetation classification and mapping of MISS for the NPS VIP.

Mappers, ecologists, and botanists collaborated to identify and describe vegetation types within the U.S. National Vegetation Classification (USNVC) and to determine how best to map them by using aerial imagery. The team collected data from 132 vegetation plots within MISS to develop detailed descriptions of USNVC associations. Data from 52 verification sites were also collected to test both the dichotomous key to vegetation associations and the application of vegetation types to a sample set of map polygons. Furthermore, data from 776 accuracy assessment (AA) sites were collected (of which 757 were used to test accuracy of the vegetation-map layer). These data sets led to the identification of 45 vegetation association in the USNVC at MISS.

A total of 45 map classes were developed to map the vegetation and open water of MISS, including the following: 35 map classes represent natural (including ruderal) vegetation in the USNVC, 7 map classes represent cultural vegetation (agricultural and developed) in the USNVC, and 3 map classes represent nonvegetative open-water bodies (non-USNVC). Features were interpreted from viewing color-infrared digital aerial imagery dated September and October 2012 (during peak leaf-phenology change of trees) via digital onscreen three-dimensional stereoscopic workflow systems in geographic information systems (GIS). The interpreted data were digitally and spatially referenced, thus making the spatial-database layers usable in GIS. Polygon units were mapped to either a 0.5 ha or 0.25 ha minimum mapping unit, depending on vegetation type.

A geodatabase containing various feature-class layers and tables shows the locations of USNVC vegetation types (vegetation map), vegetation plot samples, verification sites, AA sites, project boundary extent, and aerial image centers. The feature-class layer and relate tables for the vegetation map provides 4,498 polygons of detailed attribute data covering 21,771.6 ha, with an average polygon size of 4.8 ha; the vegetation map covers the entire administrative boundary for MISS.

Summary reports generated from the vegetation-map layer show map classes representing USNVC natural (including ruderal) vegetation associations apply to 4,012 polygons (89.2% of polygons) and cover 8,938.7 ha (41.1%) of the map extent. Of these polygons, the map layer shows MISS to be 27.5% forest and woodland (5,986.2 ha), 1.6% shrubland (353.6 ha), 11.2% herbaceous vegetation (2,431.8 ha), and 0.8% sparse vegetation (163.9 ha). Map classes representing USNVC cultural types apply to 415 polygons (9.2% of polygons) and cover 7,628.5 ha (35.0%) of the map extent. Map classes representing non-vegetative open-water bodies (non-USNVC) apply to 71 polygons (1.6% of polygons) and cover 5,204.4 ha (23.9%) of the map extent.

A thematic AA study was conducted of map classes representing USNVC natural (including ruderal) vegetation. Results show an overall accuracy of 83.4% (kappa index of 82.6%) based on data from 757 of the 776 AA sites. Most individual map-class themes exceed the NPS VIP standard of 80% with a 90% confidence interval.

The MISS vegetation mapping project delivers many geospatial and vegetation data products in hardcopy and/or digital formats. These products consist of an in-depth project report discussing methods and results, which include descriptions and a dichotomous key to vegetation associations, map classification and map-class descriptions, and a contingency table showing AA results. The suite of products also includes a database of vegetation plots, verification sites, and AA sites; digital pictures of field sites; field data sheets; digital aerial imagery; hardcopy and digital maps; and a geodatabase of vegetation and land cover (map layer), field work locations (vegetation plots, verification sites, and AA sites), aerial imagery index, project boundary, and metadata. All geospatial products are projected in Universal Transverse Mercator, Zone 15, by using the North American Datum of 1983. Information on the NPS VIP and completed park mapping projects are located on the Internet at <http://science.nature.nps.gov/im/inventory/veg>.

Acknowledgments

The success of this project was dependent on the collaborative efforts of several individuals from various organizations. The dedicated people who worked on this project collectively have a wide array of skill and expertise, essential in moving the National Park Service (NPS) Mississippi National River and Recreation Area (MISS) vegetation mapping project to its completion. We wish to acknowledge those individuals who have been vital in making this project a success.

We respectfully thank the NPS Vegetation Inventory Program (VIP) staff for entrusting this project to us, including Karl Brown (NPS VIP Coordinator) for funding the MISS vegetation mapping project, and Tammy Cook (NPS VIP) for giving us guidance when we needed it. We also thank Bill Route and Ulf Gafvert of the NPS Great Lakes Network (GLKN) for their support to complete MISS vegetation mapping project, the last of nine park units within GLKN to receive classification and mapping products from the NPS VIP. Thanks are also in order to the NPS MISS staff, in particular Nancy Duncan and Rory Stierler for hosting this project, with its series of meetings, training sessions, and field efforts. Furthermore, we acknowledge Brian Lubinski, Region 3 pilot for the U.S. Fish and Wildlife Service (USFWS), for his involvement in the collection of digital aerial imagery for the MISS vegetation mapping project.

We also acknowledge our colleagues from within our own offices—the USGS Upper Midwest Environmental Sciences Center (UMESC) and NatureServe. Of the USGS, we acknowledge Janis Ruhser for producing stereo models for three-dimensional (3D) mapping, her assistance in the accuracy assessment (AA) analysis, and reviewing report material; Larry Robinson for managing and collecting the digital aerial imagery with the USFWS regional pilot and for keeping 3D mapping stations functional; JC Nelson for producing the random-site selection for AA and metadata generation of the aerial imagery and the feature class layers within the geodatabase; Enrika Hlavacek for producing the series of map graphics and composition; and Jayme Stone for her help in collecting AA data as the field season came to a close, reviewing report material, and preparing close-out meeting materials. Of NatureServe, we acknowledge Mary Russo for getting classification data into and out of the central database of NatureServe with ease and speed and Don Faber-Langendoen for consulting with us on the vegetation classification. We would like to thank the field crews who sampled the vegetation plots and AA sites, as they collected the invaluable data we needed for so much of the project. Terry Serres was the Lead Ecologist for all of the vegetation plot sampling and Terry Serres and Amelia Krug did the majority of AA site data collection. Special thanks to Macalester College for allowing us repeated access to their Katherine Ordway Natural History Study Area and to Dr. Jerald Dosch and Mike Anderson for helping us understand the history of the site.

This project required the cooperation and assistance of many individuals. Their diligence in working on this diverse project is highly regarded and appreciated because their labors went toward so many aspects of this project—from developing the vegetation classification to creating the spatial geodatabase. We give special thanks to all the private landowners, non-profit organizations, and municipal and State governments that granted this project access to their lands.

Introduction

Mississippi National River and Recreation Area Vegetation Mapping Project

The Mississippi National River and Recreation Area (MISS) vegetation mapping project is an initiative of the National Park Service (NPS) Vegetation Inventory Program (VIP) to classify and map vegetation types of MISS. (Note: "MISS" is also referred to as "park" throughout this report.) The goals of the project are to adequately describe and map vegetation types of the park and to provide the NPS Natural Resource Inventory and Monitoring (I&M) Program, resource managers, and biological researchers with useful baseline vegetation information.

The MISS vegetation mapping project was officially started in spring 2012, with a scoping meeting wherein partners discussed project objectives, goals, and methods. Major collaborators at this meeting included staff from the NPS MISS, the NPS Great Lakes Network (GLKN), NatureServe, and the USGS Upper Midwest Environmental Sciences Center. The Minnesota Department of Natural Resources (DNR) was also in attendance. Common to all NPS VIP projects, the three main components of the MISS vegetation mapping project are as follows: (1) vegetation classification, (2) vegetation mapping, and (3) map accuracy assessment (AA). In this report, each of these fundamental components is discussed in detail.

With the completion of the MISS vegetation mapping project, all nine park units within the NPS GLKN have received vegetation classification and mapping products from the NPS and USGS vegetation programs. Voyageurs National Park and Isle Royale National Park were completed during 1996–2001 (as program pilot projects) and another six park units were completed during 2004–11, including the Apostle Islands National Lakeshore, Grand Portage National Monument, Indiana Dunes National Lakeshore, Pictured Rocks National Lakeshore, Saint Croix National Scenic Riverway, and Sleeping Bear Dunes National Lakeshore.

The National Park Service Vegetation Inventory Program

The NPS VIP is an effort to classify, describe, and map existing vegetation of national park units. Managed by the NPS Inventory and Monitoring Division, the NPS VIP provides baseline vegetation information for the NPS Natural Resource I&M Program. Vegetation layers and associated information support a wide variety of resource assessment, park management, and planning needs. They also provide structure for framing and answering critical scientific questions about vegetation communities and their relation to environmental processes across the landscape.

Program scientists developed procedures for classification, mapping, and AA (The Nature Conservancy [TNC] and Environmental Systems Research Institute [ESRI] 1994a, 1994b, TNC et al. 1994, NatureServe 2004, Lea and Curtis 2010). Ecology and mapping teams worked together to share knowledge and data and to resolve issues regarding classification and mapping procedures. The NPS VIP products meet Federal Geographic Data Committee (FGDC) standards for vegetation classification and metadata and national standards for spatial accuracy and data transfer. Mapping standards include a minimum mapping unit (MMU) of 0.5 ha and a classification accuracy meeting or exceeding 80% (with a 90% confidence level) for map classes representing vegetation types in the

U.S. National Vegetation Classification (USNVC). All geospatial products are projected in Universal Transverse Mercator (UTM) and use the North American Datum of 1983 (NAD 83).

The NPS VIP provides an array of mapping and vegetation data products. Mapping products include aerial imagery sets, spatial databases of vegetation (including metadata), a map classification description or key, hard-copy maps of vegetation, and an AA of the vegetation map. Vegetation products include vegetation classification, a dichotomous field key to vegetation types, formal descriptions and ground photographs of vegetation types, and field data in database format.

More information on the NPS VIP, as well as products of completed park vegetation mapping projects, is on the Internet at <http://science.nature.nps.gov/im/inventory/veg>.

Natural Resource Inventory and Monitoring Program

The NPS Natural Resource I&M Program is a long-term effort to acquire information needed to help maintain ecosystem integrity for all NPS units with significant natural resources. One of the long-term goals of the I&M Program is to produce baseline inventories of biological and geophysical natural resources. The NPS VIP provides detailed vegetation maps based on aerial imagery and meets specified thematic accuracy standards (80%) set by the I&M Program. More information on the I&M Program is available on the Internet at <http://science.nature.nps.gov/im/index.cfm>.

Vegetation Inventory Program Standards

The NPS VIP uses nationally defined standards, some of which are maintained by the FGDC. These include the following:

- National Vegetation Classification Standard (NVCS) (FGDC 2008),
- Spatial Data Transfer Standard (FGDC 1998b),
- Content Standard for Digital Geospatial Metadata (FGDC 1998a),
- United States National Map Accuracy Standards (U.S. Geological Survey 1999), and
- Integrated Taxonomic Information System[1] (U.S. Department of Agriculture).

The National Vegetation Classification Standard and the U.S. National Vegetation Classification

In 1997, the FGDC adopted the Vegetation Classification Standard: FGDC-STD-005-1997 (FGDC 1997). Since then, the classification standard has undergone a major revision, the National Vegetation Classification Standard (NVCS), Version 2: FGDC-STD-005-2008 (Version 2) (FGDC 2008). This revision was an effort to foster a cohesive view among Federal agencies in their approaches to classifying vegetation, thus reducing duplicative efforts among multiple agencies while promoting consistent classification of vegetation resources across regions. Version 2 replaced the original, addressed several issues known with the first version, and included a substantial reorganization of the classification hierarchical structure. The use of a national standard aids

[1] The Integrated Taxonomic Information System can be accessed at <http://www.itis.gov>.

effective resource stewardship by augmenting compatibility and widespread use of the information throughout the NPS and other Federal and State agencies.

The NVCS is a methodology to classify existing vegetation and is a framework to organize a vegetation classification within a hierarchical structure. The USNVC is a vegetation classification that follows the NVCS as a standard to define and organize existing vegetation in the United States. The NVCS is static in its hierarchical structure whereas the USNVC is flexible with its vegetation classification and concepts, yet remains in the structural hierarchy of the NVCS. The NPS VIP uses the USNVC to classify and describe vegetation of national park units to provide a uniform approach in vegetation classification.

In brief, the NVCS separates vegetation into two overriding categories: natural vegetation (including ruderal vegetation) and cultural vegetation. From there, each category is further divided into three main sections: (1) Upper (where physiognomy plays a predominant role), (2) Middle (where both floristics and physiognomy play a significant role), and (3) Lower (where floristics plays a predominant role). Tables 1 and 2 show the hierarchical structures for both natural and cultural vegetation types with examples of vegetation types from the USNVC. Definitions of these various levels are detailed within Section 2 of the NVCS (FGDC 2008); however, because of the emphasis given by the NPS VIP to vegetation types of the floristic levels (alliance and association) and the group level of the NVCS, the following brief definitions are provided.

- An association-level type is the finest level of the NVCS and is "defined on the basis of a characteristic range of species composition, diagnostic species occurrence, habitat conditions and physiognomy" (Jennings et al. 2006, as quoted in FGDC 2008:14). "Associations reflect topo-edaphic climate, substrates, hydrology, and disturbance regimes" (FGDC 2008:14).
- An alliance-level type is hierarchically one level above the association level and is "defined by a characteristic range of species composition, habitat conditions, physiognomy, and diagnostic species, typically at least one of which is found in the uppermost or dominant stratum of the vegetation" (Jennings et al. 2006, as quoted in FGDC 2008:14). "Alliances reflect regional to subregional climate, substrates, hydrology, moisture/nutrient factors, and disturbance regimes" (FGDC 2008:14).
- A group-level type is hierarchically one level above the alliance level (two levels above association level) yet is also the lowest level of the middle section of the NVCS hierarchy. The group level is defined in Table 2.4 of the NVCS as "combinations of relatively narrow sets of diagnostic plant species (including dominants and co-dominants), broadly similar composition, and diagnostic growth forms that reflect biogeographic differences in composition and sub-continental to regional differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes" (FGDC 2008:17).

Table 1. Hierarchy structure of the National Vegetation Classification Standard, Version 2 (FGDC 2008) for natural vegetation with examples from the U.S. National Vegetation Classification.

Level	Example
Upper: Physiognomy plays a predominant role.	
Formation Class	Forest & Woodland (1)
Formation Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Cool Temperate Forest & Woodland (1.B.2)
Middle: Both floristics and physiognomy play a significant role.	
Division	Eastern North American & Great Plains Cool Temperate Forest & Woodland (1.B.2.Na)
Macrogroup	Central Midwest Oak - Hardwood Forest & Savanna (M012)
Group	North-Central Oak - Hickory Forest & Woodland (G649)
Lower: Floristics plays a predominant role.	
Alliance	*Quercus alba* - *Quercus rubra* - *Carya* spp. North-Central Forest (A3323)
Association	*Quercus alba* - *Quercus rubra* - *Carya ovata* Glaciated Forest (CEGL002068)

Table 2. Hierarchy structure of the National Vegetation Classification Standard, Version 2 (FGDC 2008) for cultural vegetation with examples from the U.S. National Vegetation Classification.

Level	Example
Upper: Physiognomy plays a predominant role.	
Cultural Class	Agricultural & Developed Vegetation
Cultural Subclass	Woody Agricultural Vegetation
Cultural Formation	Forest Plantation & Agroforestry
Cultural Subformation	Forest Plantation
Middle: Both floristics and physiognomy play a significant role.	
Cultural Group [optional]	Currently not available
Cultural Subgroup	Currently not available
Lower: Floristics plays a predominant role.	
Cultural Type	Currently not available
Cultural Subtype [optional]	Currently not available

Content Standard for Digital Geospatial Metadata

Metadata are data that describe the content, quality, condition, and other characteristics of other data. As a standard product, the NPS VIP provides FGDC-compliant metadata files for each spatial-data set it produces. In 1998, the FGDC approved the Content Standard for Digital Geospatial Metadata, FGDC-STD-001-1998 (FGDC 1998a). This metadata standard has a common set of terminology and definitions to document digital geospatial data.

Mississippi National River and Recreation Area[2]

MISS is a national park unit of the NPS and follows 116 km of the Mississippi River through the greater Twin Cities metropolitan area in Minnesota (Figure 1). The park administrative boundary (also referred to as the park corridor in this section) is nearly 22,000 ha with almost all area outside of NPS ownership; the park owns and manages a little over 26 ha. The area outside of park ownership is a mix of public and private ownership involving 30 local governments, including cities,

[2] Information within this section was largely compiled from the Web site for MISS at <http://www.nps.gov/miss> or from personal communication with MISS staff.

townships, and counties. The park corridor spans from Dayton, Minnesota, at the confluence with the Crow and Mississippi Rivers, bisects the metropolitan cities of Minneapolis and St. Paul, Minnesota, and continues to the Goodhue County line south of Hastings, Minnesota, within the bottomlands of Mississippi and Vermillion Rivers. The park corridor also extends about 6 km along the Minnesota River from its confluence with the Mississippi River. Other primary rivers flowing into the Mississippi River within the park corridor include the Crow, Rum, and St. Croix Rivers.

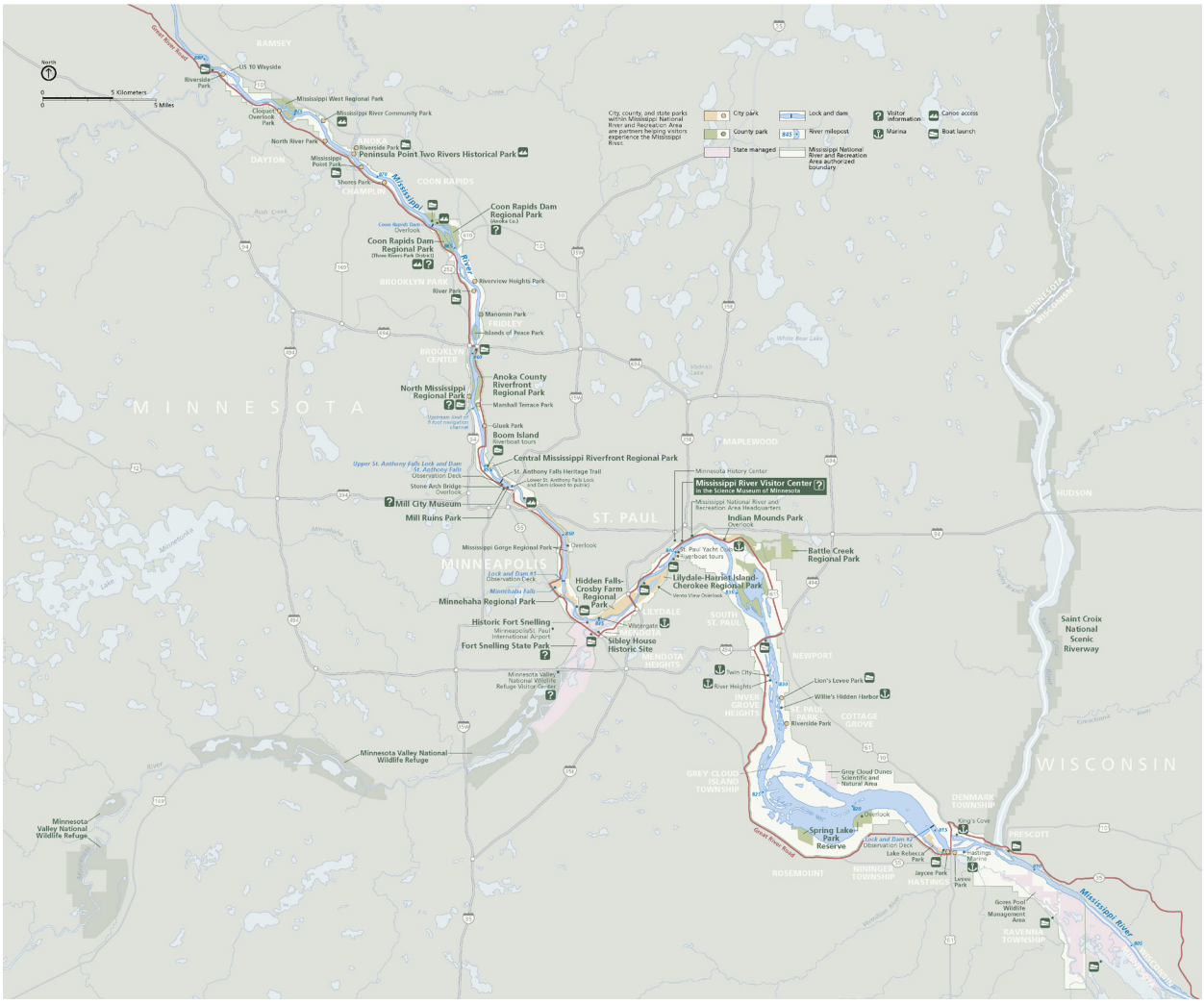


Figure 1. The Mississippi National River and Recreation Area in Minnesota (courtesy of the NPS).

National Park Service Designation and Partnership

MISS was established November 18, 1988, by the U.S. Congress, Public Law 100–696, to protect, preserve, and enhance nationally significant resources in the Mississippi River corridor through the Twin Cities metropolitan area, to coordinate government programs in the corridor, and to provide a management framework to assist the State of Minnesota and its units of local government. The management framework will provide development and implementation of integrated resource management programs for the corridor to ensure orderly public and private development in the area. The U.S. Congress also established a Mississippi River Coordinating Commission to assist Federal,

State, and local authorities in the development and implementation of an integrated resource management plan. This legislation emphasizes the role of the park as a coordinator and advisory organization.

With a multifaceted and complex land ownership within the MISS administrative boundary, the term "partnership park" is easily attributed to MISS. Collaborative relationships with governments, private sector organizations, nonprofits, schools, and individuals are necessary for the park to achieve its goals and purpose. Hamin (2000) explores three case studies of NPS park units ranging from extensive Federal land ownership to "virtually no federal land ownership where achievement of unit goals rests on developing locally collaborative relationships." Hamin includes MISS in the case study reflecting "virtually no federal land ownership" and describes MISS as the star of partnership models for the NPS.

Locks and Dams

Much of the Mississippi River within the park corridor is under the management of the U.S. Army Corp of Engineers (USACE), St. Paul District, and includes four locks and dams for navigation where a 9-foot channel depth is maintained (Figure 2); these four include the Upper St. Anthony Falls Lock and Dam, Lower St. Anthony Falls Lock and Dam, Lock and Dam 1, and Lock and Dam 2. The waters held above each lock and dam are referred to as the pool of the lock and dam; for example, Pool 2 is referred to those waters held by Lock and Dam 2. Even though Lock and Dam 3 is located south of the park boundary, the waters below Lock and Dam 2 are part of Pool 3. The Coon Rapids Dam, which is above the USACE series of locks and dams, was built primarily to generate electric power and is not a lock (Figure 3).



Figure 2. Tow and barge navigation using the 9-foot depth channel maintained by the U.S. Army Corp of Engineers, Pool 2 of the Mississippi River in Minnesota.



Figure 3. The Mississippi River flowing over Coon Rapids Dam, which was built primarily to generate electric power, Coon Rapids Dam Regional Park (Three Rivers Park District), Minnesota.

A Changing Riverine System

The Mississippi River flows 3,782 km from Lake Itasca in northern Minnesota to the Gulf of Mexico in southern Louisiana; it is one of the longest rivers in the world with one of the largest watersheds in the world. The Mississippi River changes the most as it flows through the 116 km stretch of river within the MISS corridor.

Three distinct characteristics describe the river: First, the river enters the park corridor in a rural setting north of the Twin Cities as a free-flowing river, not bound by bluffs, and where prairies at one time came right up to the river's floodplain. Second, the river transitions to a narrow gorge and over the river's only true waterfall, all within the heart of the Twin Cities metropolitan area. And last, the river widens dramatically into a broad floodplain valley starting at the confluence of the Minnesota River and continues through and beyond the southern end of the park corridor.

In the past, glacial deposits and erosion were the primary force shaping the landscape within the park corridor, whereas in contemporary times, human alteration has been a primary shaping source along with other natural influences, such as flooding and erosion. Today, the corridor supports wildlife and fish habitat, outdoor recreation, commercial navigation, hydropower generation, and water supplies. The park offers visitors the opportunity to enjoy and learn of the ecological, cultural, historical, scenic, and scientific values within the corridor.

The Mississippi River enters the park corridor from the northeast as a free-flowing river (Figure 4) curving its way through rural lands consisting mostly of agriculture with remnant prairies and hardwood forests (Figure 5); the river here is designated a Minnesota Wild and Scenic River. In this stretch of free-flowing waters, the floodplain is limited to just beyond the shoreline with occasional islands as the river meanders and braids. As the river flows 21.5 km toward the Coon Rapids Dam, the surrounding landscape becomes increasingly more suburban. Immediately below the Coon Rapids Dam, the river continues with some minor rapids and has a broader floodplain consisting of hardwood and herbaceous wetlands intermingled with some remnant prairie. Yet, again the river quickly returns to a limited floodplain forest with the occasional braided island.



Figure 4. The Mississippi River as a free-flowing river, Mississippi West Regional Park within the Mississippi National River and Recreation Area, Minnesota.



Figure 5. Remnant prairie among hardwood forests, Mississippi West Regional Park within the Mississippi National River and Recreation Area, Minnesota.

Continuing downstream, the surrounding landscape becomes more urbanized. About 10 km south of Coon Rapids Dam, the Mississippi River enters Minneapolis, Minnesota, and develops into a straight and consistently wide channel through the city. Industry dominates the immediate landscape along this stretch of river. A little more than 19 km south of Coon Rapids Dam, the Mississippi River flows over St. Anthony Falls, which is located next to Upper St. Anthony Falls Lock and Dam (Figure 6). This begins the USACE series of 29 locks and dams on the Mississippi River with navigation

beginning about 5.5 km north of St. Anthony Falls. The Lower St. Anthony Falls Lock and Dam is 1 km further down river from St. Anthony Falls.

St. Anthony Falls is the only true waterfall of the entire Mississippi River. It is here also where the only true gorge of the entire Mississippi River begins, and continues for about 13.5 km, passing the Meeker Island Lock and Dam ruins—the first lock and dam ever built on the river—and then passing through Lock and Dam 1 and eventually joining the broad floodplain valley of the Minnesota River. Through the gorge, wooded bluffs sharply reach to 30 m above the river (Figure 7) and span 160 to 320 m across the gorge bluff to bluff. In this stretch of river gorge, the river drops about 34 m in elevation, the largest descent anywhere along the river. Even though the gorge is surrounded by wooded bluffs, it is deep within the interior of the Twin Cities metropolitan area.



Figure 6. St. Anthony Falls Lock and Dam, the first lock and dam series of the Mississippi River, as it bypasses St. Anthony Falls, which is the only true waterfall of the Mississippi River, Twin Cities, Minnesota (courtesy of the NPS).



Figure 7. A wooded bluff on steep incline toward 30 m above the Mississippi River and within the only gorge that the Mississippi River passes through, Twin Cities, Minnesota.

Where the gorge ends and the Mississippi and Minnesota Rivers merge, the valley expands from 320 to over 800 m. Here is where the large and expansive floodplain of the Mississippi River begins and continues through to the Gulf of Mexico. The floodplain within the park corridor includes a plethora of braided river channels and oxbows, backwater lakes and ponds, herbaceous and shrub wetlands, and expansive forests consisting mostly of silver maple (*Acer saccharinum*). The MISS corridor includes a portion of the Minnesota River and floodplain valley prior to its confluence to the Mississippi River. The Minnesota River floodplain consists mainly of a continuous series of backwater lakes, ponds, and wetlands (Figure 8).

The Mississippi River becomes a faster flowing river once it merges with the Minnesota River. As the Mississippi River rounds the St. Paul, Minnesota, area and heads farther south, the floodplain valley becomes even more expansive with the large backwaters of Pool 2 held by Lock and Dam 2 (Figure 9). These backwaters consist not only as expansive open-water lakes, but also as extensive wetlands of aquatic and herbaceous vegetation intermingled with delta-like islands of wetland forests and shrubs. The blufflands to the south and west of this expansive floodplain area rise above the riverine lake 75 m or more, are steeply vertical, and support some of the more pristine oak woodlands

and prairies within the park corridor, such as at the Pine Bend Bluffs Scientific and Natural Area of the Minnesota DNR (Figure 10). To the northeast, the land rises more subtly with a pair of sandy river terraces rising to nearly 35 m above the river, marking the height of the river as glaciers retreated. These dry wind-swept sand terraces provide an environment for grassland prairies.



Figure 8. A portion of the Minnesota River is included in Mississippi National River and Recreation Area, Minnesota, with a floodplain consisting mainly of a series of backwater lakes, ponds, and wetlands.



Figure 9. Spring Lake is part of the large open backwaters of Pool 2 held by Lock and Dam 2 near Hastings, Minnesota, with blufflands in the distance.



Figure 10. Blufflands with pristine oak woodlands and prairies at Pine Bend Bluffs Scientific and Natural Area of the Minnesota Department of Natural Resources near Inver Grove Heights, Minnesota.

Below Lock and Dam 2 near Hastings, Minnesota, the Mississippi River floodplain becomes persistently wide with blufflands lining each side of the valley. The St. Croix River—part of the Saint Croix National Scenic Riverway of the NPS—enters the Mississippi River (Figure 11) about

5.5 km below Lock and Dam 2 and about 6.5 km northwest of where the river leaves the southern boundary of the park corridor. The southern end of the park in the Ravenna Township, Minnesota, consists of a large contiguous floodplain forest with an abundance of backwater river channels, cutoff oxbows, isolated ponds, and the Vermillion River, which resides along the edge of the floodplain valley against the blufflands.



Figure 11. The confluence of the Mississippi and St. Croix Rivers at Prescott, Wisconsin, where the Saint Croix National Scenic Riverway, Minnesota/Wisconsin, and the Mississippi National River and Recreation Area, Minnesota, meet.

Numerous regional and city parks, historical and museum sites, and river access points follow the Mississippi River (Figure 12). The Great River Road National Scenic Byway, which follows the course of the entire Mississippi River, continues along the entire reach of the park corridor. Several trails for biking and walking provide for a closer experience with the park (Figure 13).



Figure 12. East Coon Rapids Dam Visitor Center, one of many locations to visit along the Mississippi National River and Recreation Area, Minnesota.



Figure 13. A hiking trail through an oak-hardwood forest at Spring Lake Park Reserve, Dakota County Parks, Minnesota.

Brief Description of MISS Vegetation

Within the MISS corridor, the forests deep within the riverine floodplain are mostly dominant—and often monotypic—with silver maple (Figure 14) that endures regular flooding. Eastern cottonwood (*Populus deltoides*) and black willow (*Salix nigra*) are other floodplain trees found deep within floodplain forests and occasionally are dominant to silver maple (Figure 15). Forests with less flood water influence within the floodplain and in lowland areas become more dominant with green ash (*Fraxinus pennsylvanica*), American elm (*Ulmus Americana*), common hackberry (*Celtis occidentalis*), and boxelder (*Acer negundo*). As uncommon as they are in the park corridor, red maple (*Acer rubrum*), black ash (*Fraxinus nigra*), eastern tamarack (*Larix laricina*), and gray alder (*Alnus incana*) exist at some small seeps outside of the floodplain.



Figure 14. Dominance of silver maple (*Acer saccharinum*) is typical in floodplain forests of the Mississippi National River and Recreation Area, Minnesota.



Figure 15. Black willow (*Salix nigra*) is an occasional dominant tree in floodplain forests of the Mississippi River within Mississippi National River and Recreation Area, Minnesota.

Sand and mud flats along the Mississippi River host annual forbs that normally scour away every year with floods. More protected floodplain areas, including backwater pools, cutoff oxbows, and even behind man-made structures, support an environment more conducive to persistent herbaceous vegetation (Figure 16), including pondweed species (*Potamogeton* spp.), hornwort species (*Ceratophyllum* spp.), American lotus (*Nelumbo lutea*), American white waterlily (*Nymphaea odorata*), yellow pond-lily (*Nuphar lutea*), watershield (*Brasenia schreberia*), cattail species (*Typha* spp.), bulrush species (*Schoenoplectus* spp.), giant bur-reed (*Sparganium eurycarpum*), rush species (*Juncus* spp.) sedge species (*Carex* spp.), arrowhead species (*Sagittaria* spp.), and rice cutgrass (*Leersia oryzoides*). Several invasive species aggressively persist within the floodplain system, often in dense monotypic stands, including purple loosestrife (*Lythrum salicaria*), common reed (*Phragmites australis*), and reed canarygrass (*Phalaris arundinacea*). Shallow floodplain backwater ponds often thrive in dense cover with knotweed species (*Polygonum* spp.), dock species (*Rumex* spp.), and other wetland forb species (Figure 17). Sandbar willow (*Salix interior*) and false indigo bush (*Amorpha fruticosa*) also have a presence within the floodplain system.



Figure 16. A mix of persistent herbaceous vegetation nestled in a protected area just below the dam of Lock and Dam 2 near Hastings, Minnesota.



Figure 17. A field of knotweed species (*Polygonum* spp.) in a shallow backwater area within the Gores Pool Wildlife Management Area of the Minnesota Department of Natural Resources.

Portions of the Mississippi River floodplain have been built up for cultural use, mainly for industrial purposes. Outside of floodplain and lowland areas, the interface between cultural and natural vegetation becomes much more intricate. In the rural northern portion of the park corridor, there are prairies in restoration and/or protection with much land having been converted to agricultural fields. Protected prairies also exist toward the southern end of the park corridor within State scientific and natural areas (SNA, Minnesota DNR), including Grey Cloud Dunes SNA (Figure 18) and Pine Bend Bluffs SNA. Remnant prairie grasslands within the park corridor are various mixtures of native grass species, including big bluestem (*Andropogon gerardii*), Indiangrass (*Sorghastrum nutans*), little bluestem (*Schizachyrium scoparium*), grama species (*Bouteloua* spp.), switchgrass (*Panicum virgatum*), porcupinegrass (*Hesperostipa spartea*), sand reedgrass (*Calamovilfa longifolia*), sand dropseed (*Sporobolus cryptandrus*), Pennsylvania sedge (*Carex pensylvanica*), and bluejoint (*Calamagrostis canadensis*).

Outside of protected areas, herbaceous vegetation is ruderal and common to fallow and open fields (Figure 19) characterized by smooth brome (*Bromus inermis*), Kentucky bluegrass (*Poa pratensis*), crabgrass species (*Digitaria* spp.), bristlegrass species (*Setaria* spp.), goldenrod species (*Solidago* spp.), thistle species (*Cirsium* spp.), annual ragweed species (*Ambrosia* spp.), knotweed species, and spotted knapweed (*Centaurea stoebe*). These fields also include an inconsistent set of invasive grass and forb species. Some fallow fields host ruderal shrub species along with the herbaceous component, including common buckthorn (*Rhamnus cathartica*), honeysuckle species (*Lonicera* spp.), smooth sumac (*Rhus glabra*), and common prickly-ash (*Zanthoxylum americanum*). Furthermore, cultural vegetation is unprecedented with a diverse cultural influence of agriculture (including tree plantations, grain crops, and improved hay fields), urban and industrial, transportation, and local parks.



Figure 18. A protected prairie at the Grey Cloud Dunes Scientific and Natural Area of the Minnesota Department of Natural Resources near Cottage Grove, Minnesota.



Figure 19. A common mix of ruderal herbaceous vegetation species found within a utility corridor at Coon Rapids Dam Regional Park of Anoka County, Minnesota.

Ruderal upland forests within the complex interface of cultural and natural have tree species that are common to lowland and floodplain locations; these tree species are opportunistic to areas of disturbance, including where mature oak forest communities have been removed. These species include boxelder, green ash, common hackberry, and eastern cottonwood. This complex interface makes for a subtle distinction between upland and wetland forests where they are often in juxtaposition with each other. Other species found in ruderal-type forests include trembling aspen (*Populus tremuloides*), paper birch (*Betula papyrifera*), Siberian elm (*Ulmus pumila*), black cherry (*Prunus serotina*), black locust (*Robinia pseudoacacia*), eastern red-cedar (*Juniperus virginiana*), and pine species (*Pinus* spp.). Ruderal forests are sometimes monotypic with a high density of either trembling aspen or eastern red-cedar.

Mature upland forests and woodlands in the MISS corridor consist of oak species (*Quercus* spp.) and hardwood species. The dry forests and woodlands are standard to bluff and prairie lands and are dominant with bur oak (*Quercus macrocarpa*), which is often a closed-canopy forest but also exist as an open-canopy woodland in the driest settings with both bur oak and northern pin oak (*Q. ellipsoidalis*); some examples can be seen at Pine Bend Bluffs SNA. Dry-mesic forests are dominant with oak and hickory, with white oak (*Quercus alba*) and northern red oak (*Q. rubra*) as the primary oak species and shagbark hickory (*Carya ovata*) as a complementary hardwood species. Mesic forests, usually situated on slopes with northern aspects and near watercourses, are characteristic with sugar maple (*Acer saccharum*), American basswood (*Tilia americana*), and occasionally has a component of northern red oak. (Figure 20).

Further reporting on the vegetation of the park from the MISS vegetation mapping project is provided in various sections of this report, including the appendices.



Figure 20. A mesic hardwood forest on a north-facing slope located at the Hastings Scientific and Natural Area of the Minnesota Department of Natural Resources near Hastings, Minnesota.

Project Overview

General Process

The objective for the Mississippi National River and Recreation Area (MISS) vegetation mapping project was to identify and map existing vegetation types of the park. To accomplish this goal, three main components to the MISS vegetation mapping project were necessary: (1) vegetation classification, (2) vegetation mapping, and (3) map accuracy assessment (AA). Each of these main components is discussed in greater detail within this report; however, as with any vegetation mapping project, several intermediate steps are inherent to the process. Table 3 provides a timeline outlining the sequence of events, which are discussed in the following pages of this report section.

Table 3. Timeline by year and task of the Mississippi National River and Recreation Area, Minnesota vegetation mapping project.

Note: Each year in the table is split into four blocks to better approximate when most of a particular task was performed. These blocks represent January–March, April–June, July–September, and October–December.
[AA, Accuracy Assessment; Clsf, Classification; Recon, Reconnaissance]

Task	2011	2012	2013	2014	2015
Study Plan					
Scoping Meeting					
Vegetation Plots					
Aerial Imagery					
Vegetation Clsf					
Map Clsf Meeting					
Map Recon					
Map/Key Verification					
Mapping					
AA Field					
AA Analysis					
Product Development					
Close-out Meeting					

Study Plan

A detailed study plan was submitted to the NPS VIP August 2011 following much of the "12-Step Guidance for NPS Vegetation Inventories" (version dated November 10, 2010[3]). Staff from the NPS VIP determined that the preliminary planning steps were not needed for the MISS vegetation

[3] Version accessed at http://science.nature.nps.gov/im/inventory/veg/docs/Veg_Inv_12step_Guidance_v1.0.pdf.

mapping project. These steps include 1 and 2, whereby existing data are reviewed and information needed to develop a detailed study plan is compiled. Likewise, Step 10, "Validation of Thematic Accuracy of Map Products" was made exempt by the NPS VIP for the MISS vegetation mapping project.

Although the preliminary steps were made exempt by the NPS VIP, it was worth reviewing an existing vegetation-map layer of MISS. The Minnesota Department of Natural Resources (DNR) has produced a spatial-data layer showing land cover of Minnesota, including the Twin Cities area (Minnesota DNR - Management Information Services Bureau; http://deli.dnr.state.mn.us/). The map layer is based on the Minnesota Land Cover Classification System (MLCCS). More information on the MLCCS can be accessed at http://www.dnr.state.mn.us/mlccs/index.html. This spatial layer has been derived from imagery dated from 1999 to 2007. Although the classification and mapping data provide significant detail to impervious surface for the land cover of the urban interface of MISS, the vegetation portion of the classification is significantly broader than the lower levels (e.g., association, group, macrogroup) defined by the National Vegetation Classification Standard (NVCS). Table 4 provides the MLCCS value domains for Data Element CARTO of the land-cover spatial database.

Table 4. Value domains for the Minnesota Land Cover Classification System for Data Element CARTO within the land-cover spatial database produced by the Minnesota Department of Natural Resources.

(Classification listing from the metadata for Land Cover - Minnesota Land Cover Classification System.)
[Veg, Vegetation]

Code	Name
11	5-10% Impervious
12	11-25% Impervious
13	26-50% Impervious
14	51-75% Impervious
15	76-100% Impervious
21	Short Grasses
22	Agricultural Land
23	Maintained Tall Grass
24	Tree Plantation
31	Forest
32	Wetland Forest
51	Shrubland
52	Wetland Shrubs
61	Tall Grasses
62	Wetland Emergent Veg.
63	Dry Tall Grasses
71	Lichen Scrubland
81	Rock Outcrop
82	Mud Flat
90	Open Water
92	Wetland Open Water

Scoping Meeting

A scoping meeting was held May 17, 2012, at the MISS headquarters in St. Paul, Minnesota. Cooperators discussed the objectives and methods of the MISS vegetation mapping project, received assignments, and were introduced to the vegetation ecology of the park. Individuals from the NPS

MISS, NPS Great Lakes Network, USGS UMESC, NatureServe and the Minnesota DNR met to achieve the following objectives:

- Provide an overview of the NPS VIP and data applications,
- Present the major steps of a mapping project and view examples of final products,
- Learn about landscape, management/science, and specific interests of the park,
- Discuss the project boundary and the minimum mapping unit (MMU) application,
- Discuss plans for data collection and functional and logistical support, and
- Review project schedule.

A representative from the Minnesota DNR presented an overview of the MLCCS and spatial-data layer showing land cover of Minnesota, including the Twin Cities area. Discussion followed on ways the MLCCS might complement the mapping.

Vegetation Sampling Data and Classification

During summer 2012, botanists collected data from 132 vegetation plots for plant community characterization. The sampling data were entered into the NPS PLOTS Database Version 2.0 (NatureServe 2005) for analyses to characterize vegetation associations in the U.S. National Vegetation Classification (USNVC). The plot data were eventually converted to the PLOTS Database Version 3.2 (Colorado Natural Heritage Program [CNHP] 2011) for the NPS. The vegetation analyses provided detailed ecological information to affirm USNVC associations at MISS and document them with local descriptors. NatureServe also produced a dichotomous key to the vegetation associations recognized in the park at that time. The vegetation classification and key were continually refined as additional data from map reconnaissance, verification, and AA were produced. A total of 45 natural (including ruderal) vegetation associations in the USNVC resulted from the MISS vegetation mapping project. Methods and results of vegetation classification are provided in greater detail in the "Vegetation Classification" section of this report.

Digital Aerial Imagery

Digital aerial imagery provides baseline data for mapping vegetation types and other land-cover features. Vertical photographs (photographs taken with the aerial camera pointed straight down at the ground) collected with proper overlap for each flight line permits an interpreter to study the photographs three-dimensionally with a stereoscope (Avery 1978) or, as with the MISS vegetation mapping project, to view stereo models of digital aerial images in three dimensions (3D) using computers. Because ecologic settings are taken into account when mapping vegetation types, viewing the aerial images in 3D helps recognize those ecologic settings.

During the planning stage of the MISS vegetation mapping project, existing aerial imagery of the park were researched to determine if obtaining new imagery was necessary. The findings were that existing imagery sets were not suitable to map vegetation types for the project because they were 1) not current enough, 2) not collected in the fall, and (or) 3) not the resolution needed to properly identify vegetation to the floristic classification levels of the National Vegetation Classification

Standard (NVCS). Therefore, to meet NPS VIP standards, new aerial imagery for the MISS vegetation mapping project would be acquired.

Two sets of aerial imagery were acquired for the MISS vegetation mapping project using a plane-mounted digital camera; a color-infrared (CIR) set funded by the NPS VIP and a true color (TC) set funded by UMESC. The CIR set was acquired as the primary imagery for mapping, collected September 24, 2012, at a pixel resolution of 15.24 cm (centimeter measurement calculated from a standard 6-inch measurement). The TC set was acquired as ancillary imagery for mapping, collected October 12, 2012, at a pixel resolution of 45.72 cm (centimeter measurement calculated from a standard 18-inch measurement)[4]. The goal of fall-dated imagery was to capture leaf-phenology change of hardwood trees; thus, aiding mappers in viewing distinctions between various hardwood-forest types. The CIR imagery captured leaf-phenology close to onset of change, and the TC imagery captured leaf-phenology close to peak change. These imagery sets provided aerial views to conduct both field work and mapping.

The UMESC coordinated the collection of digital aerial imagery for the MISS vegetation mapping project. Several parameters were put in place for this acquisition:

- A suitable pair of images for stereo viewing with 60% forward lap and 30% side lap with the sun angle at least 30 degrees above the horizon,
- A collection time between 10:00 a.m. and 2:00 p.m. local time to avoid long shadows and maintain proper color balance,
- A fall-dated CIR showing peak leaf-phenology change of trees,
- A pixel resolution of 15.24 cm,
- A minimum of 100-m buffer beyond the administrative boundary of the park, and
- A date to capture peak leaf-phenology change that was coordinated with park staff.

The UMESC collaborated with the regional pilot from the Region 3 office of the U.S. Fish and Wildlife Service (St. Paul, Minnesota). This regional office uses a plane-mounted 39-megapixel digital camera (Applanix DSS 439) with 7212 × 5408 pixel sensor—which is considered a medium-format system—that can collect 3-band CIR imagery (in 12-bit format). The camera system employs a sophisticated inertial measurement unit (IMU) and a sensitive global positioning system (GPS) to track the precise location and position of the camera sensor at the instance of exposure. Image processing software uses this positional data to reference each image frame to the surface of the Earth within 1 m (Mostafa et al. 2007).

Table 5 provides baseline information about the digital aerial imagery collected for the MISS vegetation mapping project. The aerial image in Figure 21 shows an individual frame from the CIR aerial imagery set collected at 15.24-cm/pixel resolution. The aerial image in Figure 22 shows an

[4] The TC imagery was acquired at a lower resolution than the CIR imagery to expedite acquisition time from a higher flight elevation. Air traffic controllers of the Federal Aviation Administration restricted aerial flight time and elevation in the vicinity of the Minneapolis–Saint Paul International Airport for the TC imagery collection.

individual frame from the TC aerial imagery set collected at 45.72-cm/pixel resolution. The area captured in the CIR image in Figure 21 is also captured in the TC image in Figure 22; however, the TC image shows considerably more area than the CIR image does. The aerial extent of the CIR frame in Figure 21 is shown with a red-outlined box within the TC frame in Figure 22. The CIR imagery provides a significantly smaller aerial footprint (91 ha per individual frame) than the TC imagery (815 ha per individual frame); however, the number of pixels is the same for both CIR and TC imagery (7212 × 5408 pixels per individual frame), and this gives the CIR a significantly higher image resolution for clearer viewing for interpretation than the TC imagery.

Table 5. Digital aerial imagery sets collected for the Mississippi National River and Recreation Area, Minnesota vegetation mapping project.

Imagery Date	Imagery Type	Pixel Resolution	Footprint (pixels)	Footprint (m)	Area (ha)
9-24-2012	Color infrared	15.24 cm (6 inch)	7212 × 5408	1099 × 824	91
10-12-2012	True Color	45.72 cm (18 inch)	7212 × 5408	3297 × 2473	815



Figure 21. An individual frame from the color-infrared aerial imagery set obtained in September 2012 for the Mississippi National River and Recreation Area, Minnesota vegetation mapping project; the imagery set was collected at 15.24-cm/pixel resolution and covers 91 ha per frame.



Figure 22. An individual frame from the true-color aerial imagery obtained in October 2012 for the Mississippi National River and Recreation Area, Minnesota vegetation mapping project; the imagery set was collected at 45.72-cm/pixel resolution covers 815 ha per frame. The red-outlined box shows the area (91 ha) covered by an individual frame from the color infrared aerial imagery set collected for the project.

Both sets of digital aerial imagery were reviewed to assure that requirements for mapping purposes were met. Upon acceptance, exposures were adjusted for viewing and interpreting purposes. Each set of aerial imagery was then processed for both field and mapping purposes. Processing consisted of producing 1) a two-dimensional (2D) orthorectified mosaic of each imagery set for background display in a geographic information system (GIS), and 2) stereo models to view images in 3D for mapping by using a GIS and specialized 3D computer hardware and software.

Orthorectified Mosaic

Individual image tiles from both CIR and TC digital aerial imagery sets obtained for the MISS vegetation mapping project were converted to Tagged Image File Format (TIFF) format and referenced to the Earth using the GPS and IMU records generated by the camera. Because the IMU records the rotation values from the camera sensor in three directions (roll, pitch, and crab), and the GPS records the horizontal and vertical values from the sensor at the moment of exposure, specific software programs can reference each digital aerial image precisely to a location on the ground. To further increase the fit of the images to the Earth, software programs drape each aerial image over the landscape using digital elevation models (DEM).

Once referenced, or orthorectified, the individual digital aerial images were color balanced and "stitched" together to form a single image mosaic; this was done to both the 15.24-cm/pixel and the 45.72-cm/pixel resolution imagery sets, producing an orthoimage mosaic for each imagery set. Each image mosaic was compressed into Joint Photographic Experts Group (JPEG) 2000 to accommodate computer hardware systems and GIS software with manageable file sizes. Each image mosaic was projected in the Universal Transverse Mercator (UTM), Zone 15, by using the North American Datum of 1983 (NAD 83) and the North American Vertical Datum of 1988 (NAVD 88).

Stereo Models

Digital aerial image tiles were collected with a 60% overlap along flight lines. This allowed for making stereo models for onscreen 3D viewing using a GIS and specialized computer hardware and software. Before aerial imagery can be viewed in 3D, block files must be generated for the stereo models (a block file is a separate georeferencing file that a GIS uses to maintain the alignment of the stereo-pair imagery). These block files establish each aerial image's relation to its adjacent stereo pair, so that the overlap areas are always precisely aligned and the image's overlapping areas can be viewed in stereo. Stereo models use processed but unreferenced, unrectified imagery, since image displacement of features is required for 3D viewing. For the MISS vegetation mapping project, stereo models were produced using LPS Core software (ERDAS, Inc.). For viewing in 3D and map interpretation, the stereo models were imported into Stereo Analyst for ArcGIS (ERDAS, Inc.). This allowed for georeferencing information of the associated block file to be read and the stereo pairs of aerial imagery to display in 3D and in the correct geospatial position. Since the stereo model contains georeferencing information, information delineated on-screen in the GIS by the mapper is also georeferenced as it is drawn. More information on the use of stereo models with specialized stereo viewing equipment for mapping is provided in the "Vegetation Mapping" section of this report.

In addition to orthoimage mosaic sets and stereo models, feature-class layers were produced for both the CIR and TC sets of digital aerial imagery that were obtained for the MISS vegetation mapping project. These feature-class layers provide the center locations of individual aerial images; Figure 23 shows the locations for the CIR set collected at 15.24-cm/pixel resolution, and Figure 24 shows the locations for the TC set collected at 45.72-cm/pixel resolution. These feature classes are incorporated into the geodatabase for the MISS vegetation mapping project. The digital aerial orthoimagery mosaic for both the CIR and the TC sets are also included as a product for the MISS vegetation mapping project.

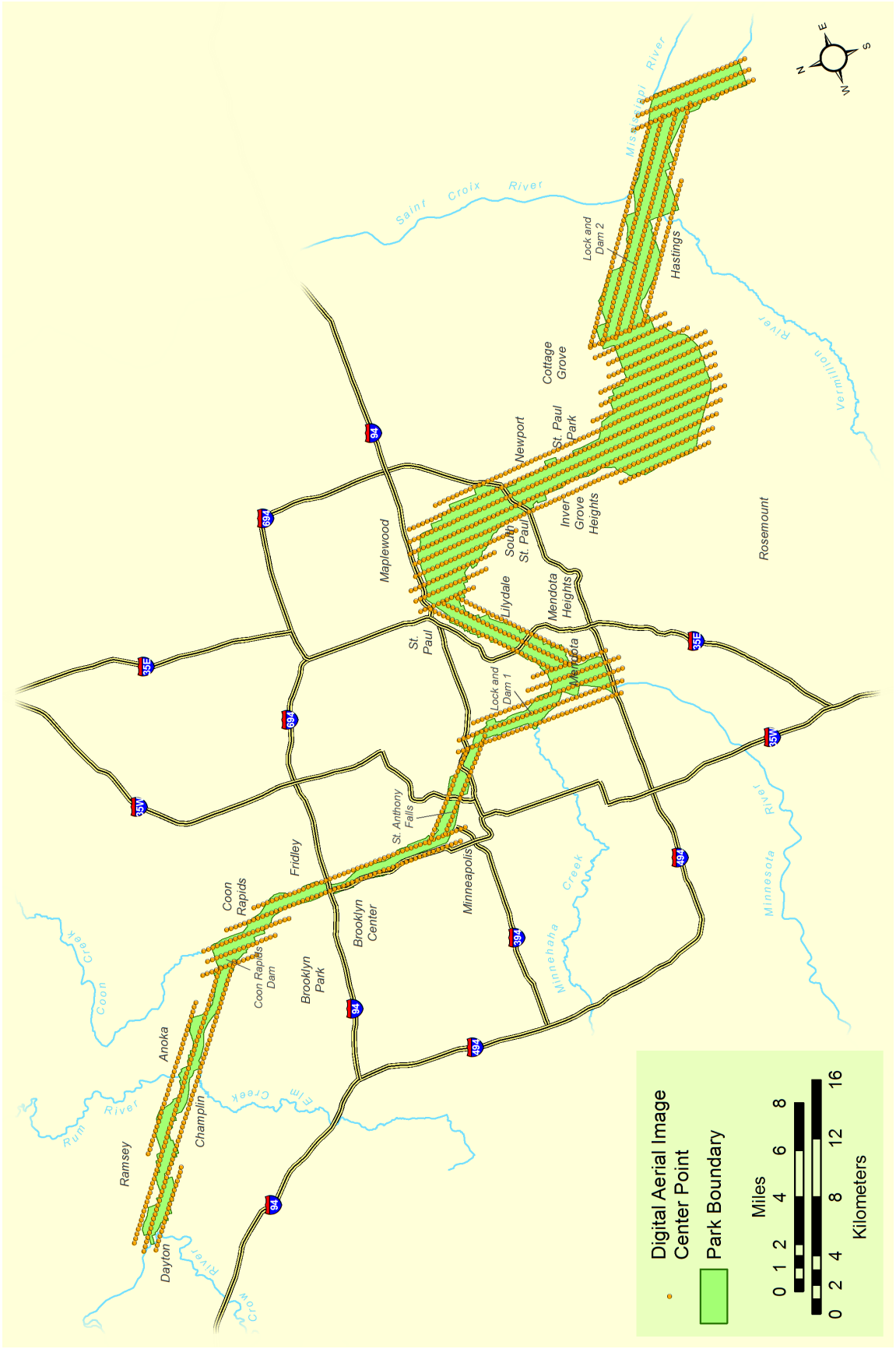


Figure 23. Center locations of color-infrared digital aerial imagery obtained in September 2012 at 15.24-cm/pixel resolution for the Mississippi National River and Recreation Area, Minnesota vegetation mapping project.

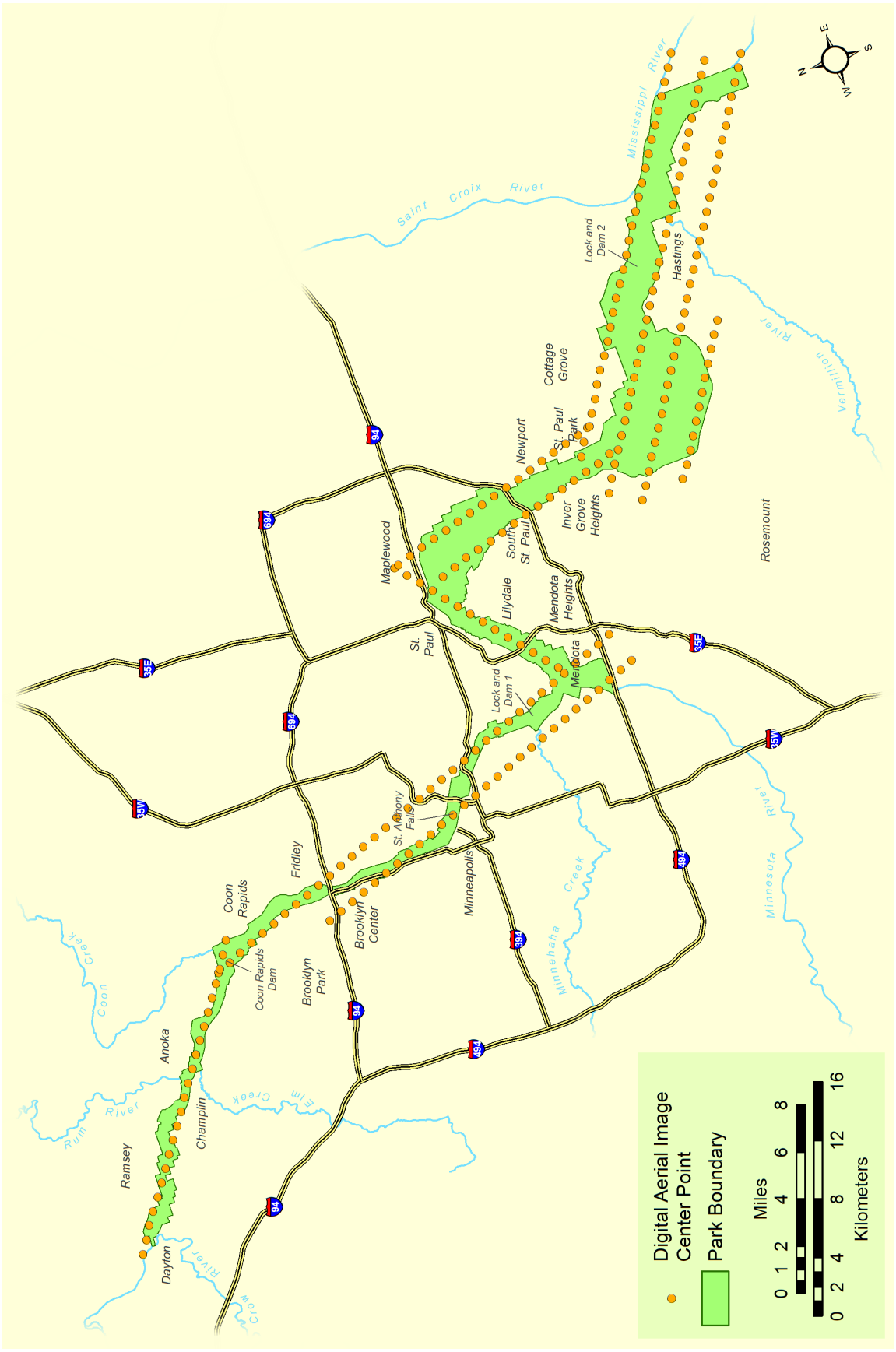


Figure 24. Center locations of true-color digital aerial imagery obtained in October 2012 at 45.72-cm/pixel resolution for the Mississippi National River and Recreation Area, Minnesota vegetation mapping project.

Map Classification, Field Work, and Vegetation Mapping

In May 2013, the classifier and mappers for the MISS vegetation mapping project met to discuss the vegetation classification. This meeting prepared the mappers for field reconnaissance in the park. Two field efforts were completed during the summer of 2013 by the mappers with assistance by the classifier. The purpose of field reconnaissance was to visit the vegetation types in the field, discern their appearances in the aerial images, and establish mapping protocols. Between the first and second field efforts, preliminary maps of select locations were produced by the mappers. During the second field effort, the performance of both the map and dichotomous key to vegetation associations were tested. From the verification results, the map and vegetation key were adjusted accordingly.

The mapping proceeded from fall of 2013 to spring of 2014, with mappers interpreting vegetation and land cover types viewing the CIR and/or the TC digital aerial imagery collected for this project. The mappers viewed the aerial imagery stereoscopically by using computer workstations equipped with both 3D and GIS software. Map conventions based on field work and the vegetation classification helped maintain consistency in mapping. A draft version of the vegetation map (a spatial database layer) was completed in spring of 2014, provided to park staff for review and comment, and then prepared for AA.

A total of 45 map classes were developed to map vegetation and open water of MISS. Of these 45 map classes, 35 represent the USNVC associations identified with this vegetation mapping project. Another seven map classes represent cultural vegetation types (agricultural and developed) in the USNVC and another three map classes represent non-vegetative open water (non-USNVC). The vegetation map layer provides 4,498 polygons of detailed attribute data covering 21,771.6 ha. Methods and results of vegetation mapping are provided in greater detail in the Vegetation Mapping section of this report.

Accuracy Assessment

An AA was performed on the draft version of the vegetation map layer. During the summer of 2014, field crews collected data from 776 stratified and randomly selected sites to evaluate the accuracy of the vegetation map layer for those map classes representing USNVC associations. The AA field data were then compared to the vegetation map data. Results from the AA study show an overall accuracy of 83.4% (kappa index of 82.6%) based on an analysis of data from 757 of the 776 AA sites. The results were tabulated into a contingency matrix. Methods and results of AA are provided in greater detail in the Accuracy Assessment section of this report.

Product Development

Ultimately, a geodatabase containing four feature classes, including the following, was produced: (1) vegetation and land-cover polygons (showing locations of vegetation types and general land-cover features), (2) vegetation points (showing locations of vegetation plots, verification sites, and AA sites), (3) locations of both CIR and TC digital aerial imagery sets obtained for the MISS vegetation mapping project, and (4) project boundary extent (which is the administrative boundary for MISS). Included in the geodatabase are relate tables providing a suite of support information, such as classification crosswalks to detailed sampling data. All geospatial products within this project geodatabase are projected in the UTM, Zone 15, by using NAD 83.

The suite of products produced and compiled for the MISS vegetation mapping project include the project geodatabase described above along with metadata documentation, a vegetation database with all the formal field data collected during this project, field data sheets and digital pictures of field sites, maps and graphics showing a representation of each feature class within the project geodatabase, and this NPS Natural Resource Report.

Close-Out Meeting

The objective of a close-out meeting for any particular NPS VIP vegetation mapping project is for the NPS (at the park unit, network, and national levels) to receive final products from the developers and to be provided briefings on the vegetation mapping project, including summaries of results and demonstration of products. These meetings provide a venue for questions and answers between the recipients and developers; this ultimately enhances the understanding and use of products by the recipients.

At the time of this report, a close-out meeting for the MISS vegetation mapping project is scheduled to take place at MISS in September 2015. In addition to the functions standard to a close-out meeting (as described in previous paragraph), the MISS close-out meeting will include a field workshop where attendees will view firsthand a vegetation plot, a verification site, various AA sites, some classified polygons of the vegetation-map layer, and make use of the descriptions and the dichotomous key to vegetation associations.

Project Boundary Extent

The project boundary extent for the MISS vegetation mapping project coincides with the MISS administrative boundary (Figure 25). The total map extent is 21,771.6 ha. As mentioned previously, a feature-class layer showing the extent of the project boundary was developed and incorporated into the geodatabase for the MISS vegetation mapping project.

Minimum Mapping Units

The NPS VIP standard MMU of 0.5 ha was applied to mapping forest and cultural types. For shrub, herbaceous, and sparsely vegetated types, as well as non-vegetation features, a MMU of 0.25 ha was applied. This smaller MMU was applied because these vegetation types were comparatively rare across the park, the degree of vegetation diversity over small areas was higher, and the isolated patches across MISS were more prevalent. For woodlands, a MMU of 0.5 ha was applied to deciduous woodlands and a MMU of 0.25 ha was applied to conifer woodlands due to the individual circumstances surrounding these woodlands. Also, when vegetation types were found unique to their immediate surroundings (e.g., an herbaceous wetland within an upland forest), mapping below the MMU was allowed.

Classification Organization

Throughout this project report and the final products related to the MISS vegetation mapping project, the vegetation classification provided is from the USNVC, which follows the methodology and organizational hierarchy of the NVCS. The NVCS makes a distinction between natural (including ruderal) and cultural vegetation. Areas with at least 1% vegetation cover are classified and described with the USNVC with one exception—aquatic areas are only included when at least 10% vegetation

cover (emergent or submergent) is present. Areas below these amounts are not described with the USNVC.

Throughout this report, the term "vegetation type" is used to reference vegetation classification units in general, at any level of the classification hierarchy. For example, the *Acer saccharinum* - *Fraxinus pennsylvanica* - *Ulmus americana* Forest Association, *Acer saccharinum* - *Populus deltoides* Floodplain Forest Alliance, and the Silver Maple - Green Ash - Sycamore Floodplain Forest Group are each treated as a vegetation type.

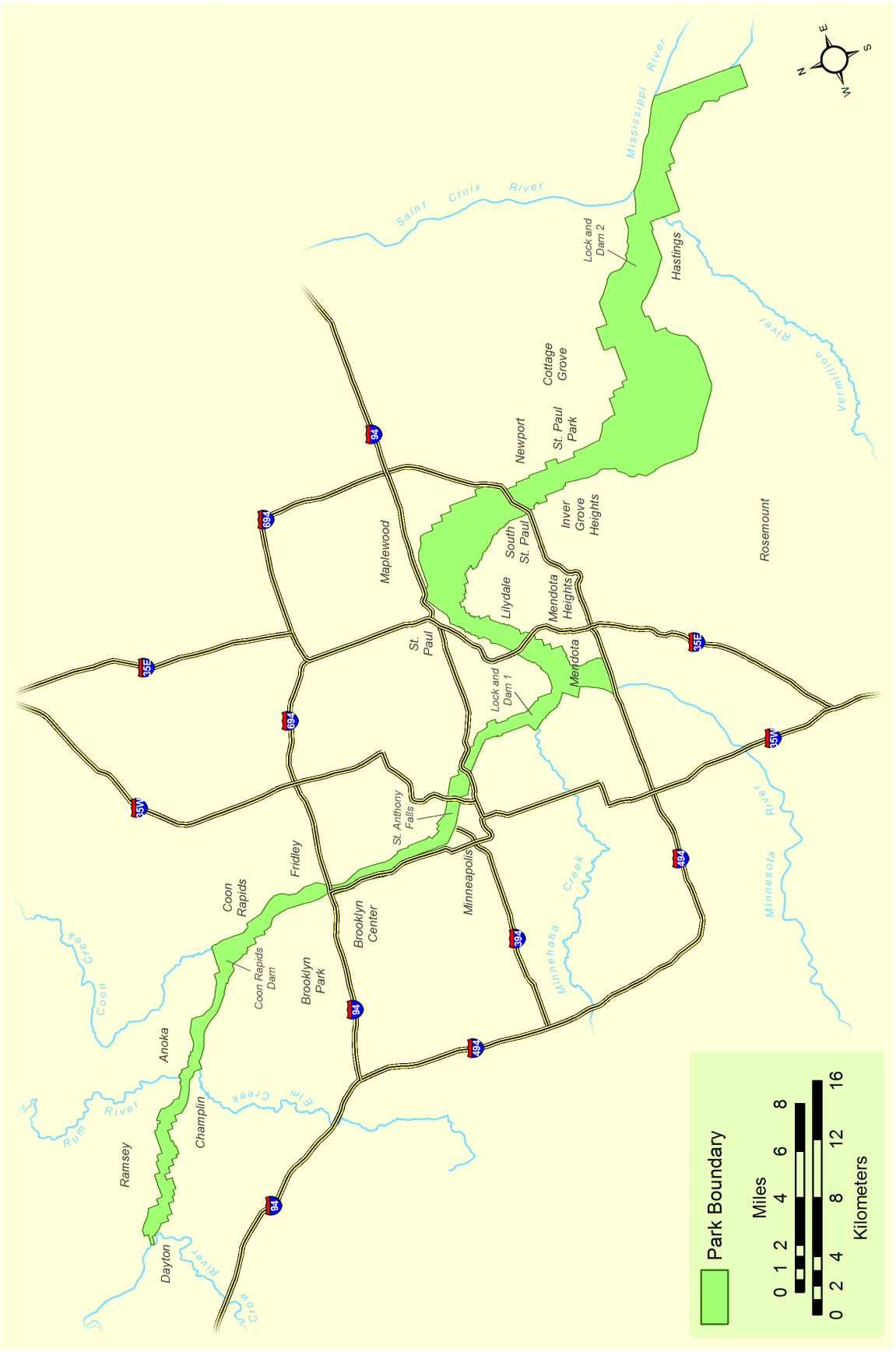


Figure 25. Project boundary for the Mississippi National River and Recreation Area, Minnesota vegetation mapping project.

Vegetation Classification

Methods

Preliminary Classification

The first step in classifying natural (including ruderal) vegetation of Mississippi National River and Recreation Area (MISS) was to prepare a preliminary classification report prior to the May 2012 scoping meeting. That report was generated by reviewing all vegetation associations in the U.S. National Vegetation Classification (USNVC) attributed to the U.S. Department of Agriculture, U.S. Forest Service Sections 222L and 222M. This produced an initial listing that represented a much broader area than the MISS administrative boundary, including many associations that were very unlikely to occur in the park. NatureServe staff reviewed the initial list of vegetation associations and removed the associations thought not exist in the park. The resulting preliminary classification report listed 54 vegetation associations potentially occurring in the park. The list of vegetation associations from the preliminary classification report served as a rough guide to the number and kind of associations the field crew might encounter during vegetation plot sampling and helped estimate how much data the field crews would need to collect to adequately survey and classify the vegetation of the park.

Data Collection Preparation

The protocols for the National Park Service (NPS) Vegetation Inventory Program (VIP) allow for the collection of data from approximately 5 plots, on average, per estimated vegetation association (from the preliminary classification report). The preliminary classification listed 54 possible USNVC associations but actual community diversity was expected to be lower because of the urban/suburban nature of the landscape in and around MISS. Also, several of the items in the preliminary classification were unlikely. It was assumed that about one-half of the vegetation associations would not be found. Thus, using the average of 5 plots per vegetation association, 150 plots were planned to characterize the 30 associations in the USNVC estimated to exist at the park.

Most of the vegetation associations in the preliminary classification were relatively well described across their range but some (e.g., upland forests with different land use histories) were expected to have variable composition from stand to stand, so 4 to 7 plots were targeted for those types. Other associations (e.g., Northern Water-lily Aquatic Wetland, Eastern Reed Marsh) were compositionally simpler; therefore, 1 to 3 plots were targeted for those associations. In addition, to plot data specifically collected for the MISS vegetation mapping project, existing vegetation datasets of the park were also reviewed for potential use to develop the vegetation classification. The Minnesota Department of Natural Resources (DNR) had 35 plots within 1 km of the MISS administrative boundary and they were similar enough to use in the data analysis for MISS (data courtesy of the Minnesota DNR).

All vegetation plots were sampled within the MISS administrative boundary, which encompasses an area of almost 22,000 ha. With an area the size of MISS, the challenge was to find several representatives of each vegetation association that exists in the park without actually seeing the entire area; due to limitations of budget and timeline, a complete census of the park was not feasible. Given the amount of development within and around the project boundaries, the field crew had access to

relatively high-quality publicly available aerial imagery, and with that, the extensive road coverage, the crew was able to quickly assess general vegetation patterns in much of the area. The large amount of private land and the number of individual owners made it infeasible to contact more than a few large private landowners to request access to their property. In the end, access was gained to one private property for plot collection.

Field Sampling

The field sampling methodology was adapted from program standards (NatureServe 2004). Details are provided therein with a general summary here.

Vegetation plots for sampling were placed to represent the character of an entire stand of vegetation as well as possible. Plots were usually located at least 15 m from the boundary of another vegetation type to reduce the variability associated with the transition from one vegetation type to another. This was not possible in the case of small or linear vegetation stands. It was sometimes difficult to determine the boundary of a unique vegetation type because two adjacent stands may be floristically very similar but are separated in the USNVC based on physiognomic criteria (e.g., amount of shrub or tree canopy cover).

Vegetation plots were square or rectangular in shape and were either 100 or 400 m^2, depending on the dominant physiognomy (Table 6). Boundaries of plots were marked with flagging or measuring tapes.

Table 6. Plot sizes used for vegetation plot sampling for the Mississippi National River and Recreation Area, Minnesota vegetation mapping project.

Dominant Physiognomy	Plot size	Plot area
Forest: Trees have their crowns overlapping, usually forming 60-100% cover.	20 x 20 m or 40 x 10 m	400 m^2
Woodland: Open stands of trees with crowns usually not touching. Canopy tree cover 25-60%, OR exceeds shrub, dwarf-shrub, herb, and nonvascular cover.	20 x 20 m or 40 x 10 m	400 m^2
Shrubland: Shrubs greater than 0.5 m tall are dominant, usually forming more than 25% cover OR exceeding tree, dwarf-shrub, herb, and nonvascular cover.	10 x 10 m or 20 x 5 m	100 m^2
Dwarf-shrubland (e.g., heath): Shrubs less than 0.5 m tall are dominant, usually forming more than 25% cover OR exceeds tree, shrub, herb, and nonvascular cover.	10 x 10 m or 20 x 5 m	100 m^2
Herbaceous (e.g., grassland, meadow, marsh): Herbs dominant, usually forming more than 25% cover OR exceeds tree, shrub, dwarf-shrub, and nonvascular cover.	10 x 10 m or 20 x 5 m	100 m^2
Nonvascular (e.g., cliff): Nonvascular cover dominant, usually forming more than 25% cover.	10 x 10 m or 20 x 5 m	100 m^2
Sparse vegetation (e.g., blowout, beach): Less than 10% total vegetation cover.	10 x 10 m or 20 x 5 m	100 m^2

Within each vegetation plot, the vegetation was visually separated into strata. The canopy cover and average height of each stratum was estimated. Within each stratum, all taxa within the plot area were identified, and the foliar cover of each taxon was estimated by using cover classes. (See Table 7 for cover classes and strata.) The diameter at breast height (DBH) of trees greater than 10 cm also was recorded.

Table 7. Cover classes and vegetation strata used during vegetation plot sampling for the Mississippi National River and Recreation Area, Minnesota vegetation mapping project.

Cover scales		Vegetation strata
T	0–1%	T1 Emergent Canopy
P	>1–5%	T2 Main Canopy
1	>5–15%	T3 Subcanopy
2	>15–25%	S1 Tall Shrubs
3	>25–35%	S2 Short Shrubs
4	>35–45%	S3 Dwarf-shrubs
5	>45–55%	H Herbaceous (field layer, including tree seedlings)
6	>55–65%	A1 Floating-leaved aquatics
7	>65–75%	A2 Submerged-leaved aquatics
8	>75–85%	
9	>85–95%	
10	>95%	

Environmental information about the vegetation plot, such as slope, aspect, soil texture, and evidence of disturbance, was recorded. Locational information, including spatial coordinates, was obtained by using a global positioning system (GPS), and written directions to the plot were provided. Digital pictures were collected of the plot to provide additional information and assist in classifying the plot. Field crews took pictures in each cardinal direction from the plot center and at least one other picture that best captured the character of the vegetation. Finally, the field crew gave the plot a provisional classification name. Figure 26 shows an example of a vegetation plot. For an example of a plot form, see "Appendix A: Plot Sampling Form."



Figure 26. Example of a vegetation plot for the Mississippi National River and Recreation Area, Minnesota vegetation mapping project.

Data Analyses, Results, and Discussion

Vegetation Data Analyses

Field teams collected vegetation plot data from July to September of 2012. There were 132 vegetation plots collected for the MISS vegetation mapping project (Figure 27). The plot data were entered into the PLOTS Database Version 2.0 (NatureServe 2005), a Microsoft Access database. For product delivery to the NPS VIP, the set of plot data was converted to the PLOTS Database Version 3.2 (Colorado Natural Heritage Program [CNHP] 2011).

To analyze vegetation patterns and then classify vegetation to associations in the USNVC, the plot data were partitioned into groups using non-metric multi-dimensional scaling (NMS) ordination and Flexible Beta clustering techniques with PC-ORD 5.0 software (McCune and Mefford 1999). Potential groupings of plots were also compared using indicator species.

The analyses proceeded iteratively. Starting with the entire dataset, several groups of vegetation plots were derived based on quantitative analyses. These groups of plots were then examined to see if they matched one or a few USNVC association concept(s). Those that matched were removed, and the process was repeated on the remaining dataset until all plots had been assigned to an association in the USNVC. Some associations were identified early on in the iterative process as a cohesive group of plots separated clearly and differently from the other groups within the larger dataset. Other associations separated much later in the process, indicating less difference between the groups of plots. With several associations, some plots formed a cohesive subgroup that was later merged with other plots to represent the association at MISS. The plots were merged based on the judgment of NatureServe ecologists. Each group of plots that was identified by the quantitative analyses was also examined qualitatively by NatureServe ecologists to see how well the group might fit an existing or potentially new association concept. Based on criteria in the National Vegetation Classification Standard (NVCS, FGDC 2008), dominant canopy species were primarily used to initially place forested vegetation into groups, and the mix of canopy and understory species were used to parse each group of forested vegetation into individual forest associations in the USNVC. To better inform the results of the ordination and cluster analyses, the cover and frequency of all the overstory and understory species in each grouping were calculated. These calculations helped to further characterize and differentiate vegetation associations and were particularly useful for some of the variable forest associations.

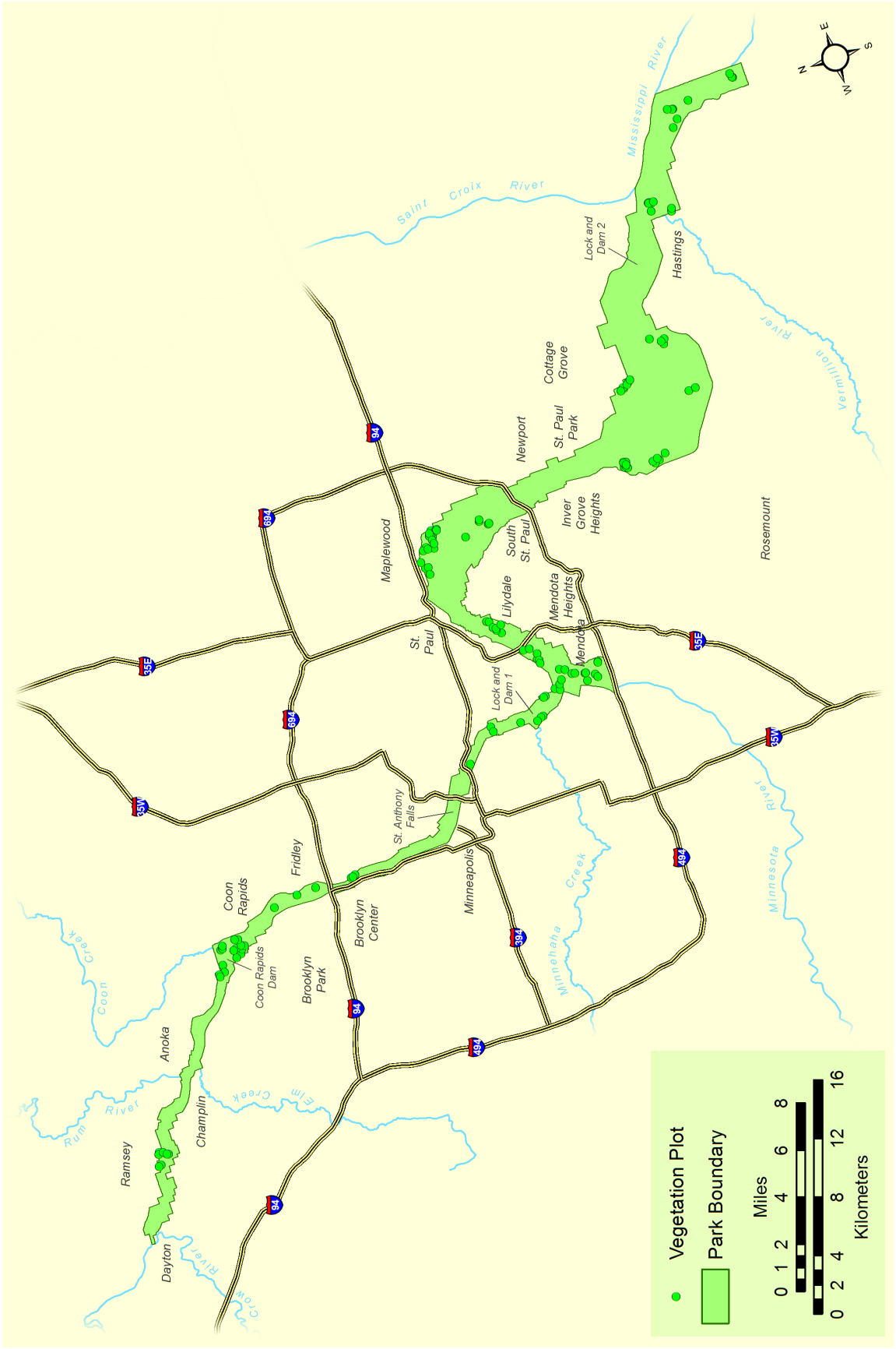


Figure 27. Locations of vegetation plots for the Mississippi National River and Recreation Area, Minnesota vegetation mapping project.

The first groups that split off were those with plots having common species that were found in few other plots or plots that were very strongly dominated by just a few species. These vegetation associations tend to be the most distinct and are often easily identifiable in the field. There were 5 groups of plots that were eventually split into 10 associations after examination of individual plots and further field observations in 2013. These fit into relatively common associations strongly dominated by a few species (7 associations) or uncommon associations dominated by species found in few or no other plots (3 associations). The former included plots dominated by:

- Common reed (*Phragmites australis*) (Eastern Reed Marsh Association),
- Reed canarygrass (*Phalaris arundinacea*) (Reed Canarygrass Eastern Marsh Association),
- Little bluestem (*Schizachyrium scoparium*) (Midwest Dry Sand Prairie Association),
- Sandbar willow (*Salix interior*) (Sandbar Willow Shrubland Association),
- American lotus (*Nelumbo lutea*) (American Lotus Aquatic Wetland Association),
- American white waterlily (*Nymphaea odorata*) (Northern Water-lily Aquatic Wetland Association), and
- Submerged-leaf aquatic plants, including coon's tail (*Ceratophyllum demersum*) and pondweed species (*Potamogeton* spp.) (Midwest Pondweed Submerged Aquatic Wetland Association).

The latter plots had moderate to high cover by species that were rare in the database. These species were characteristic of certain associations that were themselves unusual in the project area. The uncommon characteristic species were:

- Upright sedge (*Carex stricta*) (Upright Sedge Wet Meadow Association),
- Black Ash (*Fraxinus nigra*) in the tree canopy (Red Maple - Ash - Birch Swamp Forest Association), and
- Gray alder (*Alnus incana*) (Gray Alder Swamp Association).

Few plot groupings were equal to just one USNVC association. Of the 31 groups of plots created by the quantitative analytical algorithms, 4 were each equal to 1 association and 5 were combined with other plots into 1 association. The rest were split between multiple groups after examination of individual plots. From past experience with other NPS VIP projects, this is common, but not to this degree. Most groups identified by the quantitative analyses are equal to or subsets of associations. That is, entire groups of plots are typically classified as the same vegetation association. At MISS, most groups of plots were split during qualitative review by NatureServe ecologists. The poor correlation between groups identified by the quantitative analyses and the judgment of NatureServe ecologists is likely a reflection of the disturbed nature of the landscape of the project area. Exotic and native generalist species that respond well to disturbance can be from scarce to abundant across multiple associations. Examples in upland plots were common buckthorn (*Rhamnus cathartica*), exotic honeysuckle species (*Lonicera* spp.), woodbine (*Parthenocissus vitacea*), broadleaf enchanter’s nightshade (*Circaea lutetiana*), and garlic mustard (*Alliaria petiolata*), and in wetland plots reed canarygrass and ground ivy (*Glechoma hederacea*). This suite of characteristic native

species is less distinctive, especially when the invasive species are in the understory of a forest or woodland. The NVCS standards emphasize overstory species and physiognomy for creating units, especially at higher levels of the classification while the quantitative analyses treat all species equally. For example, forests with some similarity in overstory composition and a high cover of common buckthorn, woodbine, and Pennsylvania sedge (*Carex pensylvanica*) in the understory may be clustered by the quantitative analyses based on the abundance of similar understory species. In the USNVC, these would be divided into a disturbed but still recognizable native forest that is dominated with bur oak (*Quercus macrocarpa*) and a heavily disturbed, ruderal forest dominated by common hackberry (*Celtis occidentalis*) and green ash (*Fraxinus pennsylvanica*) with a lesser component of bur oak.

By using the results of NMS and Flexible Beta clustering analyses and the qualitative assessment by ecologists, classification rules were generated to assign vegetation plots to USNVC associations. For example, where upland forests were dominated by deciduous trees and dominated—or nearly dominated—by oak species and/or hickory species (*Carya* spp.), and where northern red oak (*Q. rubra*) and white oak (*Q. alba*) were more abundant than bur oak (*Q. macrocarpa*) and/or northern pin oak (*Q. ellipsoidalis*), vegetation plots were placed in the Midwestern White Oak - Red Oak Forest Association (CEGL002068). These classification rules were formalized, refined, and used to develop a dichotomous key to vegetation associations for the mappers to use during the field reconnaissance and mapping. The classification rules for the MISS vegetation mapping project emphasize the tallest stratum in the vegetation for three reasons: (1) the understory vegetation in the park has been heavily disturbed, (2) the classification rules in the NVCS, and (3) typically, fewer species are in the tallest stratum, and those species have relatively great amounts of cover and relatively significant effect on the conditions within the plot; however, understory species were considered when making classification decisions. Summaries of the plot data for each association (average, minimum, and maximum cover, and frequency for each species in each vegetation stratum) are available in the project vegetation database in the table entitled "_Community_Summary_Data."

Through the analyses of the vegetation plots collected for the MISS vegetation mapping project, 38 groups of plots were eventually classified to vegetation associations in the USNVC. Overall, associations received an average of 4.3 vegetation plots with a frequency range of 1–13 times. Although the crews made a special effort to find uncommon vegetation associations, rare associations still had fewer plots to be adequately characterized. Other associations with few plots were those that naturally have limited variability (e.g., Reed Canarygrass Eastern Marsh or Northern Water-lily Aquatic Wetland). Common associations with the potential for more variation among stands had the most samples. For example, nearly 30% of all plots were classified in four widespread and somewhat variable forest associations.

From the field reconnaissance (summer 2013) to support vegetation mapping and the field site data collected for the accuracy assessment (AA) study (summer 2014), an additional seven USNVC associations were discovered that had not been characterized by the plot data (Table 8). Nearly all of these vegetation associations were well described from a regional perspective or were

compositionally simple, so assigning them to associations in the USNVC was straightforward, even without the sampling data from vegetation plots.

Table 8. List of floristic vegetation types in the U.S. National Vegetation Classification of Mississippi National River and Recreation Area, Minnesota that were identified after the collection of vegetation plots in 2012.

[CEGL, Community Element Global; USNVC, U.S. National Vegetation Classification]

Association Name	USNVC Code
Chinkapin Oak Driftless Bluff Woodland	CEGL002144
Red Oak - Sugar Maple - Elm Forest	CEGL005017
Midwest Hardwood - Conifer Ruderal Forest	CEGL005456
River Mudflats	CEGL002314
Purple Loosestrife Wetland	CEGL006403
Midwest Dry Sandstone Cliff	CEGL002045
Midwest Dry Limestone - Dolostone Cliff	CEGL002291

Three of these seven vegetation associations that were discovered after the plot data analyses (Chinkapin Oak Driftless Bluff Woodland, Midwest Dry Sandstone Cliff, and Midwest Dry Limestone - Dolostone Cliffs) are not extensive within MISS and are found on steep to vertical slopes that were too dangerous to assess. Therefore, these associations were characterized based on less formal field observations and AA data. Interestingly, the Purple Loosestrife Wetland Association was not found in 2012. Where this association was found in 2013 during field reconnaissance for mapping and in 2014 during field data collection for accuracy assessment, the field crew in 2012 had scouted those same areas from a distance and they did not see the characteristic purple flowers that should be visible by the late summer.

Vegetation Classification Results

In all, 45 natural (including ruderal) vegetation associations in the USNVC were identified for the MISS vegetation mapping project. Table 9 lists the vegetation associations and includes the number of times each association was sampled at a vegetation plot or an AA site.

There are two vegetation associations, both cliff associations, with no recorded observations. It was not possible to formally sample these cliff associations largely due to their steep, inaccessible slopes. The lack of significant vascular vegetation, the steep slopes, and the amount of exposed bedrock make identifying these cliffs relatively simple, even without formal samples.

It is also worth noting that there were almost 6 times more AA sites sampled than there were vegetation plots (776 compared to 132). Thus, most field observations of vegetation associations in MISS were from AA sites. Data from AA sites provide important information on distribution and dominant species but do not have the detail of a full vegetation plot.

Table 9. List of vegetation association types in the U.S. National Vegetation Classification of Mississippi National River and Recreation Area, Minnesota.

Note: The number of field observations and whether the type was created based on project data are included. Vegetation associations with likely anthropogenic origin are underlined.
[CEGL, Community Element Global; MISS, Mississippi National River and Recreation Area; Obs, Observations; USNVC, U.S. National Vegetation Classification]

Group	Alliance	Association Name	USNVC Code	Obs	Created at MISS
Forest and Woodland Class					
North-Central Oak - Hickory Forest & Woodland					
	Pinus strobus - *Quercus* spp. Driftless Forest & Woodland				
		Chinkapin Oak Driftless Bluff Woodland	CEGL002144	8	No
	Quercus alba - *Quercus macrocarpa* - *Quercus bicolor* Woodland				
		North-Central Dry-Mesic Oak Woodland	CEGL002142	40	No
	Quercus alba - *Quercus rubra* - *Carya* spp. North-Central Forest				
		Midwestern White Oak - Red Oak Forest	CEGL002068	42	No
North-Central Beech - Maple - Basswood Forest					
	Acer saccharum - *Tilia americana* - *Quercus rubra* Forest				
		North-Central Maple - Basswood Forest	CEGL002062	27	No
		Red Oak - Sugar Maple - Elm Forest	CEGL005017	12	No
Laurentian & Acadian Pine - Oak Forest & Woodland					
	Pinus strobus - *Pinus resinosa* - *Quercus rubra* Forest & Woodland				
		White Pine - Red Oak Forest	CEGL002480	8	No
Northern & Central Native Ruderal Forest					
	Acer negundo - *Fraxinus pennsylvanica* - *Populus tremuloides* Ruderal Forest				
		Midwest Box-elder - Ash Ruderal Forest	CEGL005462	30	Yes
		Midwest Hardwood - Conifer Ruderal Forest	CEGL005456	9	Yes
		Aspen Ruderal Forest	CEGL005454	8	Yes
	Populus deltoides Ruderal Upland Forest Alliance				
		Cottonwood Upland Ruderal Forest	CEGL005455	8	Yes
	Juniperus virginiana - *Pinus virginiana* - *Pinus echinata* Ruderal Forest				
		Midwest Red-cedar Forest	CEGL002593	8	No
Silver Maple - Green Ash - Sycamore Floodplain Forest					
	Acer rubrum - *Fraxinus pennsylvanica* Seasonally Flooded Forest				
		Ash - Elm - Mixed Lowland Hardwood Forest	CEGL002081	45	No
	Acer saccharinum - *Populus deltoides* Floodplain Forest				
		Silver Maple - Elm Forest	CEGL002586	42	No
		Midwestern Cottonwood - Black Willow - Silver Maple Forest	CEGL002018	54	No
Laurentian-Acadian-Allegheny Alkaline Swamp					
	Fraxinus nigra - *Acer rubrum* Saturated Forest				
		Red Maple - Ash - Birch Swamp Forest	CEGL002071	10	No
Northern & Central Native Ruderal Flooded & Swamp Forest					
	Acer negundo - Mixed Hardwoods / *Alliaria petiolata* Ruderal Floodplain Forest				
		Box-elder Ruderal Floodplain Forest	CEGL005033	23	No

Group	Alliance	Association Name	USNVC Code	Obs	Created at MISS
Shrubland and Grassland Class					
Central Great Plains Tallgrass Prairie					
	Andropogon gerardii - *Sorghastrum nutans* Herbaceous				
		Central Mesic Tallgrass Prairie	CEGL002203	35	No
Sand & Gravel Tallgrass Prairie					
	Schizachyrium scoparium - *Bouteloua curtipendula* Gravel & Bluff Herbaceous Vegetation				
		Little Bluestem Bedrock Bluff Prairie	CEGL002245	9	No
		Midwest Dry Gravel Prairie	CEGL002215	8	No
	Schizachyrium scoparium - *Sorghastrum nutans* - *Bouteloua curtipendula* Sand & Gravel Herbaceous				
		Midwest Dry Sand Prairie	CEGL002318	16	No
Northern & Central Ruderal Meadow & Shrubland					
	Dactylis glomerata - *Festuca* spp. - *Solidago canadensis* Mesic Meadow				
		Midwest Forb Old Field	CEGL005459	23	Yes
	Poa compressa - *Solidago nemoralis* - *Centaurea biebersteinii* Dry Meadow & Shrubland				
		Midwest Old Field Grassland	CEGL005457	27	Yes
	Rhamnus cathartica - *Rosa multiflora* - *Elaeagnus umbellata* Ruderal Mesic Shrubland				
		Midwest Old Field Shrubland	CEGL005460	23	Yes
		Buckthorn Shrubland	CEGL005461	3	Yes
Eastern North American Freshwater Marsh					
	Peltandra virginica - *Pontederia cordata* - *Sagittaria* spp. Herbaceous				
		Arrowhead - Rice Cutgrass Marsh	CEGL005240	10	No
	Schoenoplectus tabernaemontani - *Schoenoplectus fluviatilis* - *Typha* spp. Shallow Marsh Herbaceous				
		River Bulrush Marsh	CEGL002221	58	No
		Bulrush - Cattail - Bur-reed Shallow Marsh	CEGL002026	39	No
	Typha angustifolia - *Typha latifolia* - *Schoenoplectus* spp. Deep Marsh Herbaceous				
		Midwest Mixed Emergent Deep Marsh	CEGL002229	3	No
		Midwest Cattail Deep Marsh	CEGL002233	11	No
Northern & Central Shrub Swamp					
	Alnus spp. - *Salix* spp. Lakeshore & Depression Shrubland				
		Gray Alder Swamp	CEGL002381	2	No
Midwest Wet Prairie & Wet Meadow					
	Carex spp. - *Calamagrostis canadensis* Midwest Wet Meadow Herbaceous				
		North-Central Bluejoint Wet Meadow	CEGL005449	2	No
		Lake Sedge Wet Meadow	CEGL002256	6	No
		Upright Sedge Wet Meadow	CEGL002258	2	No
Central Riverine Wetland Vegetation					
	Salix interior Riverwash Shrubland				
		Sandbar Willow Shrubland	CEGL008562	51	No
	Northern & Central Temperate Sparsely Vegetated Riverwash				
		River Mudflats	CEGL002314	16	No
		Riverine Sand Flats	CEGL002049	17	No

Group	Alliance	Association Name	USNVC Code	Obs	Created at MISS
Eastern Temperate Wet Shoreline Vegetation					
	Polygonum spp. Palustrine				
		Riverine Forb Mudflats	CEGL005458	37	Yes
Northern & Central Ruderal Wet Meadow & Marsh					
	Lythrum salicaria Herbaceous				
		Purple Loosestrife Wetland	CEGL006403	14	No
	Phalaris arundinacea Herbaceous				
		Reed Canarygrass Eastern Marsh	CEGL006044	21	No
	Phragmites australis Herbaceous				
		Eastern Reed Marsh	CEGL004141	24	No
Aquatic Vegetation Class					
Eastern North American Freshwater Aquatic Vegetation					
	Nymphaea odorata - *Nuphar* spp. - *Brasenia schreberi* Herbaceous				
		American Lotus Aquatic Wetland	CEGL004323	2	No
		Northern Water-lily Aquatic Wetland	CEGL002562	33	No
	Potamogeton spp. - *Ceratophyllum* spp. - *Elodea* spp. Herbaceous				
		Midwest Pondweed Submerged Aquatic Wetland	CEGL002282	39	No
Open Rock Vegetation Class					
Eastern North American Temperate Cliff					
	Midwest Acidic Cliff				
		Midwest Dry Sandstone Cliff	CEGL002045	0	No
	Midwest Alkaline Cliff				
		Midwest Dry Limestone - Dolostone Cliff	CEGL002291	0	No

Detailed vegetation descriptions were written for each vegetation association derived for the MISS vegetation mapping project and are provided in "Appendix B: Descriptions of Vegetation Associations" (see below in this section for further detail on what is in those descriptions).

Associations near Geographic Limits at MISS

Six vegetation associations were found in three distinct habitats in MISS and are at or near the geographic limit for the association. All six associations are rare within the park, though not rare across their entire range beyond MISS. These associations are grouped by the three distinct habitats.

Wet Meadow Habitat

- North-Central Bluejoint Wet Meadow
- Lake Sedge Wet Meadow
- Upright Sedge Wet Meadow

These three vegetation associations are closely related and are in the same USNVC alliance. The examples in MISS are near the western edge of the rangewide distribution for these associations. They may have been more common within the park in the past but they occur in the same habitat

(wetlands with saturated soils or flooded by shallow water for a few weeks each growing season) as the aggressive exotics reed canarygrass and common reed. These associations, particularly North-Central Bluejoint Wet Meadow and Upright Sedge Wet Meadow, can grade into rich fens in some places. No fens were identified in MISS, though the Minnesota DNR had some plots classified as fens less than 1 mile from the MISS administrative boundary. Field crews noted some widely scattered fen indicators in the same area where these associations were determined. Data from the Minnesota DNR plots were collected in the early 1990s and it is unknown whether the sites have been altered by changes in hydrology or invasion by exotic species.

Woody Swamp Habitat

- Gray Alder Swamp
- Red Maple - Ash - Birch Swamp Forest

These two vegetation associations were found in just a few areas in MISS. They require mucky soil that is saturated for most or all of the growing season. Within the park, these conditions occur in a few locations where groundwater seeps from the base of bluffs. The examples at MISS are at the southern limit of the range of these associations and have species more typical of northern vegetation, including gray alder, paper birch (*Betula papyrifera*) yellow birch (*B. alleghaniensis*), and black ash.

Bluff Prairie Habitat

- Little Bluestem Bedrock Bluff Prairie

This one vegetation association occurs in small patches on the steep bluffs between South St. Paul and Hastings, Minnesota. The examples at MISS are at the northern limit of the range for this association along the Mississippi River and it is unlikely that it was ever found much farther upstream from the Twin Cities since it is limited to river bluffs with thin soil over bedrock. In the absence of fire or some other means to remove woody vegetation, sites where this association occurs will slowly be invaded by shrubs and trees, converting the sites to another vegetation association.

Associations Showing Land-Use History at MISS

The landscape in MISS has a long history of human use and this is evidenced by the vegetation associations identified for the MISS vegetation mapping project and the species commonly present within them. Nearly one-third, or 13 of 45, of the associations identified from this vegetation mapping project likely result from anthropogenic disturbance or from natural ecological processes, such as fire or flood. The USNVC best classifies natural vegetation that lacks a significant amount human disturbance. Thus, this is largely the reason for the nine new ruderal-like associations created for this project that are characterized by disturbance (though one of those associations, Riverine Forb Mudflats, often occurs due to natural flooding disturbance). Vegetation associations at MISS that are likely of anthropogenic origin and that were created based on data from this project are shown in Table 9. The extensive disturbance and the new assemblages of species present difficulties in

classifying these stands. There has not been extensive or region-wide data that represent these vegetation associations, and the recently disturbed stands are often more dynamic in their floristic and physiognomic composition than later successional vegetation.

The more natural, non-ruderal vegetation associations also reflect the land use history of the area, including those associations located at some ongoing vegetation restoration or management sites. Many of these sites had native canopy trees in the mix and in a natural environmental setting absent of recent disturbance. However, the understory vegetation of these sites had only a few species intolerant of not only current land-use disturbance, but also of past disturbance. Within these sites abundant exotic or native species that can tolerate disturbance were found. Other associations were clearly affected by land-management activities, such as clearing shrubs, planting native species, and prescribed fires.

An example of an association with a native canopy with a greatly altered understory is the North-Central Dry-Mesic Oak Woodland. Under the effects of natural ecological processes, the tree canopy in this association was maintained by fire in an open to moderately open state (25–60%) and favored understory species adapted to periodic fire; these species are also commonly found in tallgrass prairies. With a lack of fire, the tree canopy fills in and understory species tolerant of shade, but not tolerant of fire, can invade and become abundant. At MISS, the average tree canopy was about 80%. Common buckthorn was in 12 of the 13 plots of this vegetation association with an average cover of 45% whereas exotic honeysuckle species were in 8 plots and tree species typical of more mesic forests like common hackberry, hophornbeam (*Ostrya virginiana*), and green ash were common as small- or medium-sized trees. A few prairie indicators were present in more open-canopied plots, typically those on drier slopes or those with evident restoration management. Some of these indicators include leadplant (*Amorpha canescens*), American hazelnut (*Corylus americana*), big bluestem (*Andropogon gerardii*), and Indiangrass (*Sorghastrum nutans*).

Examples of associations with significant ongoing land management are some prairie associations in locations where there is clear evidence of management and maintenance by people. Those prairie associations found in these maintained locations include the Central Mesic Tallgrass Prairie, Little Bluestem Bedrock Bluff Prairie, and Midwest Dry Gravel Prairie. Most of these sites showed signs of active management in the form of tree clearing, mowing, or burning (as evidenced by charred vegetation in plots). Most, and possibly all, sites in the Central Tallgrass Prairie association were likely restoration plantings.

In addition to anthropogenic effects on the vegetation, the rivers can have significant effects on several vegetation associations on a year-to-year basis. Forest and shrubland associations are typically stable from year to year, even during floods, because the woody species that are the key to defining them tend to persist through short-term changes. Herbaceous associations are more dynamic during hydrologic changes between years or season. Two of the vegetation associations, River Mudflats and Riverine Sand Flats, are dependent on these changes to create open mineral soil that can be colonized by the annual species that characterize these associations. The effect of significant hydrologic changes on other herbaceous associations was particularly evident in 2014 when record rainfall occurred in early summer, causing major flooding on the Mississippi, Minnesota, and

Vermillion Rivers. Field work after the flooding subsided showed significant changes in the composition of many herbaceous wetlands. A number of stands of what had been wet meadow and shallow marsh associations, (e.g., Reed Canarygrass Eastern Marsh, Eastern Reed Marsh, Arrowhead - Rice Cutgrass Marsh) had greatly reduced cover by perennial species and were dominated by annual species or were mostly covered by dead plants. Other sites had significant scouring or deposition of alluvial material that removed or created sites for these vegetation associations. If conditions remain relatively stable, many of the perennial species that previously dominated those sites may recover, but until they do, the composition of stands will be changed. Future droughts or floods can quickly effect the composition and even location of herbaceous associations.

Descriptions of Vegetation Associations at MISS

All USNVC associations identified with the MISS vegetation mapping project are described in "Appendix B: Descriptions of Vegetation Associations." These descriptions show the position of each vegetation association hierarchically placed in the USNVC and is followed by information about environmental characteristics, vegetation, important species, classification issues, relationship to other classification systems, and distribution. Most fields in the descriptions have a section with information on the range-wide characteristics (prefaced by "Global") and one on the local characteristics (prefaced by "Mississippi National River and Recreation Area"). The global, or range-wide, information applies to the vegetation association across its entire range; this information has been gathered from scientific literature and other field data and is stored in NatureServe's central database. For the descriptive text fields, global information can be thought of as an average or modal expression of a relatively undisturbed stand of the association throughout its range. The local information (listed as "Mississippi National River and Recreation Area") is derived from data from the classification phases of the MISS vegetation mapping project, which consisted mostly of plot data from the plots sampled for this project; however, some information from AA field data and less formal field observations is also included. Vegetation associations without plot data—that is, those associations that were found after the plot sampling was finished—do have descriptions, but any local information is based on general field observations or notes on abundant species drawn from AA field data, not from rigorous vegetation plot data. A dichotomous key to the vegetation associations of MISS is provided in "Appendix C: Dichotomous Key to Vegetation Associations," which can be used in concert with the vegetation descriptions. A listing of plant species identified from the vegetation plot samples and AA sites are provided in "Appendix D: List of Plant Species."

Vegetation Mapping

Methods

Mapping vegetation of the Mississippi National River and Recreation Area (MISS) involved five primary steps: (1) preliminary map classification with a vegetation primer, (2) field reconnaissance, (3) map classification, (4) aerial image interpretation and mapping, and (5) and database development. Although these steps occurred sequentially, they overlap to some degree.

Preliminary Map Classification

Prior to field reconnaissance, mappers needed to become familiar with the vegetation types expected to exist in the park. To accomplish this for MISS, the mappers met with the vegetation classifier and reviewed the vegetation classification and dichotomous key to vegetation associations. During this meeting, the mappers and classifier discussed each vegetation association, what defines it, where it exists in the park, which other associations it is likely to be confused with, and any other aspects of the vegetation associations that could help define their location or signature on the landscape.

Using this information and personal experience, the mappers formed an initial map classification. This map classification with initial mapping conventions, as preliminary as it was, promoted continuity from the classifier to the mapper at the onset of the vegetation mapping process. Additionally, this preliminary step put in the hands of the mappers the foundations of a working map classification, one that would go through many updates and revisions throughout the vegetation mapping process.

Field Reconnaissance

Field reconnaissance efforts were initiated to prepare for mapping vegetation types in MISS. Mappers and classifiers visited the park and compared, with the aid of weatherized field computers, the ground conditions, as determined by the dichotomous key and the classifier, to their signatures (appearances) on the digital color infrared (CIR) aerial imagery set that was obtained for the MISS vegetation mapping. This process was necessary, as Hershey and Befort (1995) explain, because CIR photography (or imagery) is not consistent between image sets to allow a species to be depicted precisely. Sun angle, light intensity, shadow, exposure, and difference in digital post-capture processing can all affect image appearance. Additionally, differences in site history, hydrologic regime, intraspecific variation, and seasonality can all vary the appearance of a single species across a single image. Hence, ground exploration of the aerial imagery is a critical endeavor. Ultimately, the field reconnaissance effort helped correlate imagery signatures of the vegetation with the vegetation classification on the ground (Figure 28).

Field reconnaissance also allowed mappers to become more familiar with the local ecology of vegetation types, which is always important when applying ecologic concepts to mapping. Where mappers discovered limitations to interpreting vegetation types by using digital aerial imagery, environmental models were tested to determine if vegetation types could be consistently separated by environmental elements. In MISS, the history of disturbance (both manmade and natural) that pervades the park prevented models from being a reliable tool for aerial-imagery interpretation.



Figure 28. Field reconnaissance to correlate aerial-image signatures with ground vegetation for the Mississippi National River and Recreation Area, Minnesota vegetation mapping project.

The mappers and classifier performed field reconnaissance during 2013. The field efforts for mapping were done during two separate trips in 2013: one in late July to early August and a second in early September. The mappers and classifier worked as a team, rather than as individuals, to ensure correct assessment of vegetation types and, subsequently, to promote correct classification during mapping. The team became familiar with the vegetation and local ecology as they discussed the structural, floristic, and habitat characteristics of the vegetation encountered in the field and compared the vegetation types to their appearance in the imagery. Through this process, they built an understanding of how to map the vegetation types, established a working map classification with mapping protocols, and helped the classifier to refine the key to associations and the vegetation classification. Most of the natural landscape of MISS was visited by the mappers during the field reconnaissance, and much variability in the vegetation types was found. In some cases, it was determined by the classifier that some vegetation types existed that had not been represented by the vegetation plots. These vegetation types were accordingly added to the vegetation and map classifications.

Orthoimagery mosaic sets of the CIR and true-color (TC) digital aerial imagery obtained for the MISS vegetation mapping project allowed for easy in-field use resulting from their much smaller file sizes, while maintaining the majority of the imagery signature. This imagery was accessed using ArcMap in ArcGIS (Version 10.2, Esri), which also allowed the mapping team to digitally collect notes on vegetation and imagery signatures in the field. Field notes might consist of the map-class assignment, if known. Other notes, to promote proper perspective of species composition (e.g.,

heterogeneous versus monotypic forest stand), might include comments regarding significant species. In addition, estimated tree heights and cover densities were occasionally recorded to give a perspective for applying physiognomic height and density modifiers during mapping.

Verification

Between the first and second field reconnaissance efforts, areas of MISS were mapped with both familiar and novel signatures. During the second field reconnaissance effort, the mappers and classifier visited 52 sites to verify that the mapping was correct and the dichotomous key to vegetation associations functioned correctly. The key to associations, map classification, or mapping conventions were adjusted as needed.

Four separate locations were visited for map verification in MISS. These locations were chosen in an attempt to cover the suite of vegetation types encountered across the park. The CIR digital aerial imagery from September 2012 was interpreted by the mappers, who applied the mapping conventions established from the first field reconnaissance effort.

Specific map verification sites were selected in the field during the second field reconnaissance effort. Locations of the individual map verification sites are shown in Figure 29. The mappers and classifier collected coordinate location information using field computers equipped with global positioning system (GPS) in conjunction with the digital aerial imagery. The dichotomous key to vegetation associations of MISS (an August 2013 draft) was used to determine the vegetation association of the area over a minimum mapping unit (MMU). The vegetation association was compared to the map class assigned by the mapper and an electronic datasheet was completed for each verification site. These data were entered into a feature-class layer with relate tables and incorporated into the geodatabase for the MISS vegetation mapping project. The field data were also imported into the NPS PLOTS Database Version 3.2 (Colorado Natural Heritage Program [CNHP] 2011) for the mapping project.

Map Classification

A map class represents a definable feature (e.g., a vegetation type, a non-vegetated feature, an anthropogenic area) that can be consistently distinguished on aerial imagery and/or by use of an environmental model. The set of map classes that represents all the mapped features defines the map classification. The map classification and protocols that define the mappable features are based on existing classification systems. For the MISS vegetation mapping project, all map classes, except those representing open water types, were linked to the U.S. National Vegetation Classification (USNVC), as identified by NatureServe. For natural (including ruderal) vegetation, map classes were linked to natural types in the USNVC at the finest level, association. For cultural vegetation, map classes were linked to cultural types in the USNVC at the lowest applicable level.

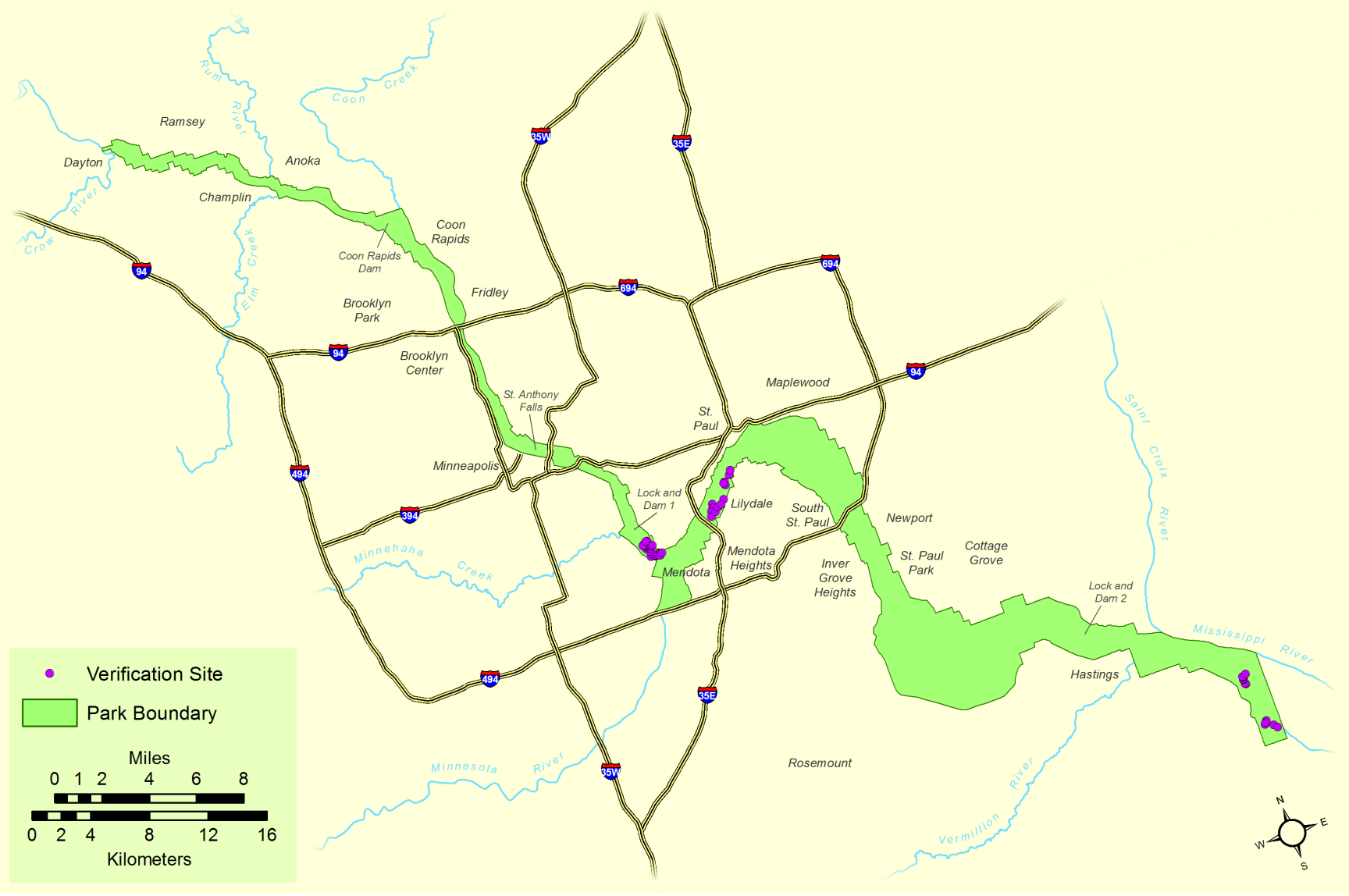


Figure 29. Locations of verification sites for the Mississippi National River and Recreation Area, Minnesota vegetation mapping project.

After a draft of the map classification was developed, a "mapping tree" was created to facilitate the mapping process (Figure 30). A mapping tree is a diagram that divides the map classes into logical groups (e.g., Northern Hardwood Forest, Herbaceous Wetland, Shrub Dominated), then further divides the groups into subgroups (e.g., Grass Dominated, Agriculture, Oak Upland), with a final dichotomous tree of choices between the similar map classes in each subgroup. The choices in a mapping tree are meant to present the mappers with a limited and consistent set of options as they map, remind them of possible alternative map classes to consider, and show them the physiognomic modifier(s) associated with each map class.

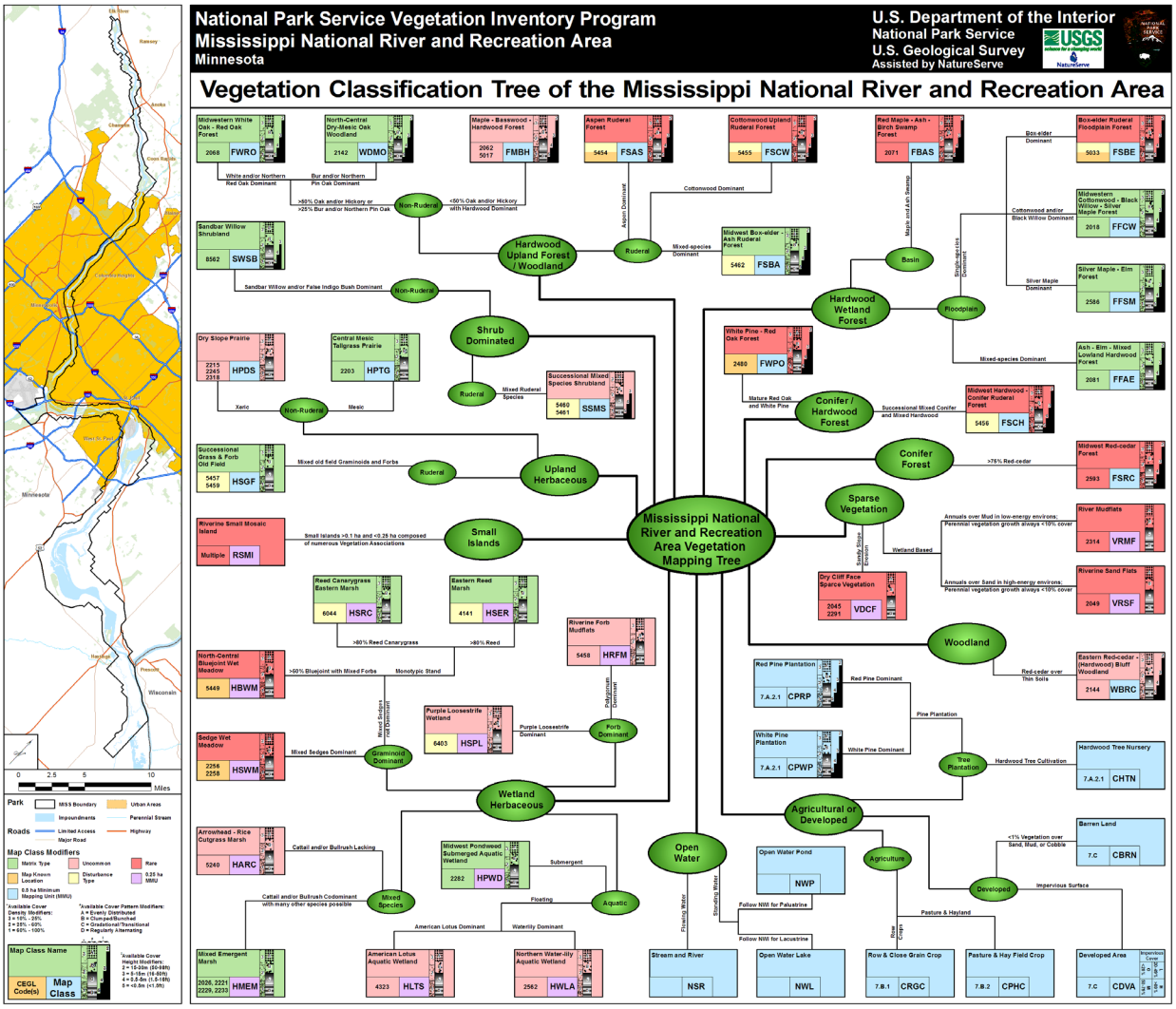


Figure 30. Vegetation-mapping decision tree for the Mississippi National River and Recreation Area, Minnesota vegetation mapping project.

To develop map-class names, for those map classes representing a single vegetation association in the USNVC, the association's common name was used (e.g., North-Central Dry-Mesic Oak Woodland). For those map classes representing more than one association in the USNVC, a comparable name (e.g., the Maple - Basswood - Hardwood Forest map-class for the collective

associations of North-Central Maple - Basswood Forest and the Red Oak - Sugar Maple - Elm Forest) was derived. For those map classes representing cultural vegetation and non-vegetation features, a generic name (e.g., Open Water Lake) was derived.

Throughout the project, the map classification remained fluid. Each field endeavor, including the accuracy assessment (AA) effort, revealed new information that prompted modifications to the map classes and their definitions. Revisions were also made to the map classification as the vegetation classification matured. Furthermore, as aerial images were interpreted, new problems forced redefinition, expansion, conjunction, or minor adjustment to map-class definitions. As individual map classes changed, these changes were consistently reapplied to areas that had already been mapped to ensure consistent mapping across the park.

A map-class code was derived for each map class for ease of assigning information to map polygons. Each map-class code was made using four alpha characters and was to represent an independent map class; each code was to begin with one of the following first alpha characters to represent the major physiognomic characteristic:

- F = Forest (typically >60% tree cover),
- W = Woodland (>25% tree cover),
- S = Shrubland (>25% shrub cover and <25% tree cover),
- H = Herbaceous Vegetation (>10% herbaceous cover and <25% tree and/or <25% shrub cover),
- V = Sparse Vegetation (vegetated are with <10% vegetation cover),
- C = Cultural (agricultural and developed landscapes), and
- N = Non-USNVC (open water with <10% vegetation cover).

The second character was to represent one of two scenarios: the first scenario to denote a successional map-class with an “S” or a floodplain forest with an “F”; the second scenario to denote a significant term in the map-class name. The subsequent two or three alpha characters were to loosely represent the map-class name (e.g., FWPO for White Pine - Red Oak Forest, SSMS for Successional Mixed Species Shrubland, FFAE for Ash - Elm - Mixed Lowland Forest, CRGC for Row & Close Grain Crop).

Codes were also derived for physiognomic modifiers. These modifiers were to provide additional information describing physiognomic characteristics of vegetation within mapped polygons. The physiognomic modifiers used for the MISS vegetation mapping project are listed in Table 10.

An example of codes assigned to a particular mapped polygon might be “WDMO” (map class), “1” (coverage-density modifier), “A” (coverage-pattern modifier), and “2” (height modifier). The “WDMO” map-class code designates the polygon with the Dry-Mesic Oak Forest map class, which represents the *Quercus alba* - *Quercus macrocarpa* - *Quercus rubra* / *Corylus americana* Woodland Association (CEGL002142) in the USNVC. The “1” modifier code indicates that the vegetation has a coverage density of 60–100%, the “A” modifier code indicates that the vegetation has an evenly dispersed pattern, and the “2” modifier code indicates that the average height of trees throughout the

mapped polygon is 15–30 m. This series of map classification and physiognomic information can enhance the interpretation of the map layer for managers and researchers, particularly when other geospatial-data sets are introduced.

Table 10. Physiognomic modifiers assigned to mapped polygons for the Mississippi National River and Recreation Area, Minnesota vegetation mapping project.

[USNVC, U.S. National Vegetation Classification]

Category	Modifier	Meaning
Coverage density (Applied to map classes representing vegetation associations in the USNVC*)	1	Closed Canopy/Continuous (60–100% cover)
	2	Open Canopy/Discontinuous (25–60% cover)
	3	Dispersed-Sparse Canopy (10–25% cover)
Coverage pattern (Applied to map classes representing vegetation associations in the USNVC*)	A	Evenly Dispersed
	B	Clumped/Bunched
	C	Gradational/Transitional
	D	Regularly Alternating
Height (Applied to map classes representing woody terrestrial vegetation associations in the USNVC)	2	15–30 m
	3	5–15 m
	4	0.5–5 m
	5	<0.5 m

*Sparse vegetation types (those with <10% vegetation) do not receive a coverage density modifier.

Aerial Image Interpretation and Mapping

The vegetation of MISS was mapped by staff at the Upper Midwest Environmental Sciences Center (UMESC) using digital-onscreen three-dimensional (3D) mapping systems running geographic information system (GIS) software. The mapping team performed onscreen interpretation of digital imagery that was spatially referenced in GIS. The mapping tree was used to further assist the mapping process and enforce consistent application of the map classification. A draft version of the vegetation map—a spatial-database layer—was then prepared for AA. The vegetation map was then adjusted according to the results from the analysis of the AA to meet accuracy criteria set by the National Park Service (NPS) Vegetation Inventory Program (VIP).

The digital aerial imagery used for the onscreen mapping was obtained on September 24, 2012 (CIR imagery), and on October 12, 2012 (true-color imagery), using a plane-mounted digital camera. (Refer to the "Project Overview" section in this report for more information on the digital aerial imagery collected for the MISS vegetation mapping project.) One individual performed the mapping for the MISS vegetation mapping project while a second performed the quality assurance/quality control (QA/QC). They used systems that incorporated either active or passive stereo method that uses special glasses to produce a 3D image on a liquid-crystal-display monitor for a computer. The stereo models were imported into Stereo Analyst for ArcGIS (ERDAS, Inc.) for 3D viewing and editing.

Mapping occurred from fall of 2013 to spring of 2014. The mapper would map a single flight line and then give this draft work to the second mapper for QA/QC. The second mapper would assess the

draft work for errors in mapping and return it for review and modification. Areas of high complexity could be revised more than once. This QA/QC process ensured that all portions of MISS were examined at least twice and by different individuals.

ArcGIS software was used as the GIS platform for the onscreen digital mapping. Because the 3D images were viewed directly in the GIS environment, vegetation could be mapped directly into ArcGIS. The polygon vector data were stored using an ArcGIS file geodatabase, which was projected in in Universal Transverse Mercator (UTM), Zone 15, by using the North American Datum of 1983 (NAD 83).

Standard image signature characteristics were applied—including texture, color, pattern, and position in the landscape—to guide placement of polygons during mapping. In addition to image signature characteristics, mappers needed to understand the environmental distribution of the vegetation types across the landscape to help them identify those vegetation types and properly place polygon boundaries. For each polygon, the appropriate codes for map classes and physiognomic modifiers were applied.

Many supplemental imagery and data sets were also used by the mappers to visualize and understand the landscape. These layers increased the mappers' ability to understand historical landscape change and use, determine wet and dry areas, and better visualize conifers. The supplemental imagery and data sets included digital aerial imagery and field data from the field reconnaissance efforts, and vegetation plot and verification site data.

The NPS VIP standard MMU of 0.5 ha was applied to mapping forest and cultural types. For shrub, herbaceous, and sparsely vegetated types, as well as non-vegetation features, a MMU of 0.25 ha was applied. This smaller MMU was applied because these vegetation types were comparatively rare across the park, the degree of vegetation diversity over small areas was higher, and the isolated patches across MISS were more prevalent. For woodlands, a MMU of 0.5 ha was applied to deciduous woodlands and a MMU of 0.25 ha was applied to conifer woodlands due to the individual circumstances surrounding these woodlands. Also, when vegetation types were found unique to their immediate surroundings (e.g., an herbaceous wetland within an upland forest), mapping below the MMU was allowed.

Database Development

At this stage, the map layer would have only map-attribute codes assigned to each polygon. To assign meaningful information to each polygon (e.g., map-class names, modifier definitions, and links to USNVC types), a feature-class table and other supportive tables were produced, and ArcGIS was used to relate the tables of polygon information within a geodatabase. A geodatabase provides access to a variety of interrelated data sets, is expandable, and can equip resource managers and researchers with a powerful GIS tool. The geodatabase developed for the MISS vegetation mapping project includes many feature-class layers produced from this project, including the map layer, vegetation sample plots, map verification sites, AA sites, aerial image locations, and project boundary extent. All geospatial products for the MISS vegetation mapping project have been projected in UTM, Zone 15, by using the NAD 83.

Results

Map Classes

After the AA analysis, 45 map classes represent MISS, of which 42 of the 45 are vegetation types in the USNVC. At the time of mapping, 48 map classes existed to map the park, of which 45 map classes represented vegetation types in the USNVC. The AA study showed that confusion in mapping existed between some map classes; these map classes showed accuracy levels <80% (in the 90% confidence interval), as set by the NPS VIP. Map classes with low accuracy were examined for consistent sources of error and then the park was consulted to determine if map classes should be merged to reduce error rates. Most of the map classes with low accuracies were merged with the map class(es) they were most often confused with during the mapping. Various reasons are recognized for where confusion in mapping existed between the map classes, including a breakdown of the mapping tree or ecological mapping conventions, and inconsistent signatures on the imagery across and between map classes. Further details regarding this are provided in the "Accuracy Assessment" section of this report and in individual map-class descriptions in "Appendix E: Descriptions of Map Classes." These descriptions also explain the link between map classes and the types/units they represent. Ground photos showing representations of the map classes are provided where possible.

There are 35 map classes that represent 44 vegetation associations in the USNVC. From this vegetation mapping project, 45 vegetation associations in the USNVC are recognized for MISS; however, 1 association was not directly mapped within the park. This association is not represented by any one map class, because it exists below the MMU across the wetland landscape and is otherwise integrated into other overarching map classes. Of the 35 map classes representing vegetation associations, 27 represent a single association (when it exists above a MMU), 7 represent 2 or more associations mapped together, and 1 represents a mosaic landscape composed of aspects of 19 wetland vegetation associations.

The map classification for the MISS vegetation mapping project is listed in Tables 11 and 12. Table 11 lists the map classification from a map class perspective and shows the vegetation types in the USNVC that are assigned to each map class. Table 12 lists the map classification from a vegetation classification perspective and shows how the map classes relate to the USNVC in hierarchical order. Note, however, that the map classes representing more than one vegetation type appear multiple times in Table 12 and are noted with an asterisk (*).

Table 11. Map classification and crosswalk to vegetation types in the U.S. National Vegetation Classification for the Mississippi National River and Recreation Area, Minnesota vegetation mapping project.

Note: The bold headings within the table (above the map classes) are Groups or Subclasses (except for Open Water) within the U.S. National Vegetation Classification to organize the map classes. All map classes except for those under the Open Water category represent vegetation types within the U.S. National Vegetation Classification.
[CEGL, Community Element Global; USNVC, U.S. National Vegetation Classification]

Map Class Code - Name	Vegetation Association Common Name*	Vegetation Association Scientific Name*	Vegetation Code
North-Central Oak - Hickory Forest & Woodland Group			
WBRC - Eastern Red-cedar - (Hardwood) Bluff Woodland			
	Chinkapin Oak Driftless Bluff Woodland	*Quercus muehlenbergii* - *Quercus* (*alba*, *velutina*) - (*Juniperus virginiana* var. *virginiana*) Driftless Bluff Woodland	CEGL002144
WDMO - North-Central Dry-Mesic Oak Woodland			
	North-Central Dry-Mesic Oak Woodland	*Quercus alba* - *Quercus macrocarpa* - *Quercus rubra* / *Corylus americana* Woodland	CEGL002142
FWRO - Midwestern White Oak - Red Oak Forest			
	Midwestern White Oak - Red Oak Forest	*Quercus alba* - *Quercus rubra* - *Carya ovata* Glaciated Forest	CEGL002068
North-Central Beech - Maple - Basswood Forest Group			
FMBH - Maple - Basswood - Hardwood Forest			
	North-Central Maple - Basswood Forest	*Acer saccharum* - *Tilia americana* / *Ostrya virginiana* - *Carpinus caroliniana* Forest	CEGL002062
	Red Oak - Sugar Maple - Elm Forest	*Quercus rubra* - (*Acer saccharum*, *Quercus alba*) Forest	CEGL005017
Laurentian & Acadian Pine - Oak Forest & Woodland Group			
FWPO - White Pine - Red Oak Forest			
	White Pine - Red Oak Forest	*Pinus strobus* - (*Pinus resinosa*) - *Quercus rubra* Forest	CEGL002480
Northern & Central Native Ruderal Forest Group			
FSRC - Midwest Red-cedar Forest			
	Midwest Red-cedar Forest	*Juniperus virginiana* Midwest Ruderal Forest	CEGL002593
FSBA - Midwest Box-elder - Ash Ruderal Forest			
	Midwest Box-elder - Ash Ruderal Forest	*Acer negundo* - *Celtis occidentalis* - *Fraxinus pennsylvanica* Ruderal Forest	CEGL005462
FSCH - Midwest Hardwood - Conifer Ruderal Forest			
	Midwest Hardwood - Conifer Ruderal Forest	*Fraxinus pennsylvanica* - *Juniperus virginiana* - *Pinus* spp. - *Acer negundo* Ruderal Forest	CEGL005456
FSAS - Aspen Ruderal Forest			
	Aspen Ruderal Forest	*Populus tremuloides* / *Rhamnus cathartica* Ruderal Forest	CEGL005454
FSCW - Cottonwood Upland Ruderal Forest			
	Cottonwood Upland Ruderal Forest	*Populus deltoides* / *Bromus inermis* Ruderal Forest	CEGL005455
Silver Maple - Green Ash - Sycamore Floodplain Forest Group			
FFAE - Ash - Elm - Mixed Lowland Hardwood Forest			
	Ash - Elm - Mixed Lowland Hardwood Forest	*Fraxinus pennsylvanica* - *Celtis occidentalis* - *Tilia americana* - (*Quercus macrocarpa*) Forest	CEGL002081

Map Class Code - Name	Vegetation Association Common Name*	Vegetation Association Scientific Name*	Vegetation Code
FFSM - Silver Maple - Elm Forest			
	Silver Maple - Elm Forest	*Acer saccharinum* - *Fraxinus pennsylvanica* - *Ulmus americana* Forest	CEGL002586
FFCW - Midwestern Cottonwood - Black Willow - Silver Maple Forest			
	Midwestern Cottonwood - Black Willow - Silver Maple Forest	*Populus deltoides* - *Salix nigra* - *Acer saccharinum* Forest	CEGL002018
Laurentian-Acadian-Allegheny Alkaline Swamp Group			
FBAS - Red Maple - Ash - Birch Swamp Forest			
	Red Maple - Ash - Birch Swamp Forest	*Acer rubrum* - *Fraxinus* spp. - *Betula papyrifera* / *Cornus canadensis* Forest	CEGL002071
Northern & Central Native Ruderal Flooded & Swamp Forest Group			
FSBE - Box-elder Ruderal Floodplain Forest			
	Box-elder Ruderal Floodplain Forest	*Acer negundo* Ruderal Floodplain Forest	CEGL005033
Central Great Plains Tallgrass Prairie Group			
HPTG - Central Mesic Tallgrass Prairie			
	Central Mesic Tallgrass Prairie	*Andropogon gerardii* - *Sorghastrum nutans* - (*Sporobolus heterolepis*) - *Liatris* spp. - *Ratibida pinnata* Herbaceous Vegetation	CEGL002203
Sand & Gravel Tallgrass Prairie Group			
HPDS - Dry Slope Prairie			
	Little Bluestem Bedrock Bluff Prairie	*Schizachyrium scoparium* - *Bouteloua curtipendula* Bedrock Bluff Herbaceous Vegetation	CEGL002245
	Midwest Dry Gravel Prairie	*Schizachyrium scoparium* - *Bouteloua curtipendula* Gravel Herbaceous Vegetation	CEGL002215
	Midwest Dry Sand Prairie	*Schizachyrium scoparium* - *Danthonia spicata* - *Carex pensylvanica* - (*Viola pedata*) Herbaceous Vegetation	CEGL002318
Northern & Central Ruderal Meadow & Shrubland Group			
HSGF - Successional Grass & Forb Old Field			
	Midwest Forb Old Field	*Solidago canadensis* - *Coronilla varia* Ruderal Herbaceous Vegetation	CEGL005459
	Midwest Old Field Grassland	*Poa pratensis* - *Bromus inermis* Ruderal Herbaceous Vegetation	CEGL005457
SSMS - Successional Mixed Species Shrubland			
	Midwest Old Field Shrubland	*Lonicera* (x *bella*, *morrowii*, *tatarica*) - *Rhus glabra* - *Zanthoxylum americanum* Ruderal Shrubland	CEGL005460
	Buckthorn Shrubland	*Rhamnus cathartica* Ruderal Shrubland	CEGL005461
Eastern North American Freshwater Marsh Group			
HARC - Arrowhead - Rice Cutgrass Marsh			
	Arrowhead - Rice Cutgrass Marsh	*Sagittaria latifolia* - *Leersia oryzoides* Herbaceous Vegetation	CEGL005240
HMEM - Mixed Emergent Marsh			
	River Bulrush Marsh	*Schoenoplectus fluviatilis* - *Schoenoplectus* spp. Herbaceous Vegetation	CEGL002221
	Bulrush - Cattail - Bur-reed Shallow Marsh	*Schoenoplectus tabernaemontani* - *Typha* spp. - (*Sparganium* spp., *Juncus* spp.) Herbaceous Vegetation	CEGL002026

Map Class Code - Name	Vegetation Association Common Name*	Vegetation Association Scientific Name*	Vegetation Code
	Midwest Mixed Emergent Deep Marsh	*Typha* spp. - *Schoenoplectus acutus* - Mixed Herbs Midwest Herbaceous Vegetation	CEGL002229
	Midwest Cattail Deep Marsh	*Typha* spp. Midwest Herbaceous Vegetation	CEGL002233
Midwest Wet Prairie & Wet Meadow Group			
HBWM - North-Central Bluejoint Wet Meadow			
	North-Central Bluejoint Wet Meadow	*Calamagrostis canadensis* North-Central Wet Meadow	CEGL005449
HSWM - Sedge Wet Meadow			
	Lake Sedge Wet Meadow	*Carex lacustris* Herbaceous Vegetation	CEGL002256
	Upright Sedge Wet Meadow	*Carex stricta* - *Carex* spp. Herbaceous Vegetation	CEGL002258
Central Riverine Wetland Vegetation Group			
SWSB - Sandbar Willow Shrubland			
	Sandbar Willow Shrubland	*Salix interior* Temporarily Flooded Shrubland	CEGL008562
VRMF - River Mudflats			
	River Mudflats	River Mudflats Sparse Vegetation	CEGL002314
VRSF - Riverine Sand Flats			
	Riverine Sand Flats	Riverine Sand Flats - Bars Sparse Vegetation	CEGL002049
Eastern Temperate Wet Shoreline Vegetation Group			
HRFM - Riverine Forb Mudflats			
	Riverine Forb Mudflats	*Polygonum amphibium* - *Sagittaria latifolia* Riverine Herbaceous Vegetation Association	CEGL005458
Northern & Central Ruderal Wet Meadow & Marsh Group			
HSPL - Purple Loosestrife Wetland			
	Purple Loosestrife Wetland	*Lythrum salicaria* Ruderal Herbaceous Vegetation	CEGL006403
HSRC - Reed Canarygrass Eastern Marsh			
	Reed Canarygrass Eastern Marsh	*Phalaris arundinacea* Eastern Ruderal Herbaceous Vegetation	CEGL006044
HSER - Eastern Reed Marsh			
	Eastern Reed Marsh	*Phragmites australis* Eastern North America Temperate Ruderal Herbaceous Vegetation	CEGL004141
Eastern North American Freshwater Aquatic Vegetation Group			
HLTS - American Lotus Aquatic Wetland			
	American Lotus Aquatic Wetland	*Nelumbo lutea* Herbaceous Vegetation	CEGL004323
HWLA - Northern Water-lily Aquatic Wetland			
	Northern Water-lily Aquatic Wetland	*Nymphaea odorata* - *Nuphar* (*microphylla*, *variegata*) Herbaceous	CEGL002562
HPWD - Midwest Pondweed Submerged Aquatic Wetland			
	Midwest Pondweed Submerged Aquatic Wetland	*Potamogeton* spp. - *Ceratophyllum* spp. Midwest Herbaceous Vegetation	CEGL002282
Eastern North American Temperate Cliff Group			
VDCF - Dry Cliff Face Sparse Vegetation			
	Midwest Dry Sandstone Cliff	Sandstone Midwest Dry Cliff Sparse Vegetation	CEGL002045
	Midwest Dry Limestone - Dolostone Cliff	Limestone - Dolostone Midwest Dry Cliff Sparse Vegetation	CEGL002291

Map Class Code - Name	Vegetation Association Common Name*	Vegetation Association Scientific Name*	Vegetation Code
Woody Agricultural Vegetation Cultural Subclass			
CHTN - Hardwood Tree Nursery	Forest Plantation	Not applicable	7.A.2.1
CPRP - Red Pine Plantation	Forest Plantation	Not applicable	7.A.2.1
CPWP - White Pine Plantation	Forest Plantation	Not applicable	7.A.2.1
Herbaceous Agricultural Vegetation Cultural Subclass			
CRGC - Row & Close Grain Crop	Row & Close Grain Crop	Not applicable	7.B.1
CPHC - Pasture & Hay Field Crop	Pasture & Hay Field Crop	Not applicable	7.B.2
Herbaceous & Woody Developed Vegetation Cultural Subclass			
CDVA - Developed Area	Herbaceous & Woody Developed Vegetation	Not applicable	7.C
CBRN - Barren Land	Herbaceous & Woody Developed Vegetation	Not applicable	7.C
Riverine Small Mosaic Island			
RSMI - Riverine Small Mosaic Island	Multiple associations	Multiple associations	Multiple CEGLs
Open Water (Non-USNVC)			
NSR - Stream & River	Not applicable	Not applicable	Not applicable
NWL - Open Water Lake	Not applicable	Not applicable	Not applicable
NWP - Open Water Pond	Not applicable	Not applicable	Not applicable

*Or the classification name of the lowest hierarchical level mapped in the USNVC.

Table 12. Map classification set into the hierarchy of the U.S. National Vegetation Classification for the Mississippi National River and Recreation Area, Minnesota vegetation mapping project.

[CEGL, Community Element Global; USNVC, MMU, minimum mapping unit; U.S. National Vegetation Classification]

Map-class Code	Map-class Name
1 FOREST & WOODLAND CLASS	
1.B.2.Na Eastern North American & Great Plains Cool Temperate Forest & Woodland Division	
M012 Central Midwest Oak Forest, Woodland & Savanna Macrogroup	
G649 North-Central Oak - Hickory Forest & Woodland Group	
A3237 *Pinus strobus* - *Quercus* spp. Driftless Forest & Woodland Alliance	
Quercus muehlenbergii - *Quercus* (*alba*, *velutina*) - (*Juniperus virginiana* var. *virginiana*) Driftless Bluff Woodland Association (CEGL002144)	
WBRC	Eastern Red-cedar - (Hardwood) Bluff Woodland
A3324 *Quercus alba* - *Quercus macrocarpa* - *Quercus bicolor* Woodland Alliance	
Quercus alba - *Quercus macrocarpa* - *Quercus rubra* / *Corylus americana* Woodland Association (CEGL002142)	
WDMO	North-Central Dry-Mesic Oak Woodland

Map-class Code	Map-class Name
A3323 *Quercus alba* - *Quercus rubra* - *Carya* spp. North-Central Forest Alliance	
Quercus alba - *Quercus rubra* - *Carya ovata* Glaciated Forest Association (CEGL002068)	
FWRO	Midwestern White Oak - Red Oak Forest
M882 Central Midwest Mesic Forest Macrogroup	
G021 North-Central Beech - Maple - Basswood Forest Group	
A0220 *Acer saccharum* - *Tilia americana* - *Quercus rubra* Forest Alliance	
Acer saccharum - *Tilia americana* / *Ostrya virginiana* - *Carpinus caroliniana* Forest Association (CEGL002062)	
FMBH*	Maple - Basswood - Hardwood Forest
Quercus rubra - (*Acer saccharum*, *Quercus alba*) Forest Association (CEGL005017)	
FMBH*	Maple - Basswood - Hardwood Forest
M159 Laurentian & Acadian Pine - Oak Forest & Woodland Macrogroup	
G025 Laurentian & Acadian Pine - Oak Forest & Woodland Group	
A4127 *Pinus strobus* - *Pinus resinosa* - *Quercus rubra* Forest & Woodland Alliance	
Pinus strobus - (*Pinus resinosa*) - *Quercus rubra* Forest Association (CEGL002480)	
FWPO	White Pine - Red Oak Forest
M013 Eastern North American Ruderal Forest Macrogroup	
G030 Northern & Central Native Ruderal Forest Group	
A3227 *Juniperus virginiana* - *Pinus virginiana* - *Pinus echinata* Ruderal Forest Alliance	
Juniperus virginiana Midwest Ruderal Forest Association (CEGL002593)	
FSRC	Midwest Red-cedar Forest
A4183 *Acer negundo* - *Fraxinus pennsylvanica* - *Populus tremuloides* Ruderal Forest Alliance	
Acer negundo - *Celtis occidentalis* - *Fraxinus pennsylvanica* Ruderal Forest Association (CEGL005462)	
FSBA	Midwest Box-elder - Ash Ruderal Forest
Fraxinus pennsylvanica - *Juniperus virginiana* - *Pinus* spp. - *Acer negundo* Ruderal Forest Association (CEGL005456)	
FSCH	Midwest Hardwood - Conifer Ruderal Forest
Populus tremuloides / *Rhamnus cathartica* Ruderal Forest Association (CEGL005454)	
FSAS	Aspen Ruderal Forest
A4184 *Populus deltoides* Ruderal Upland Forest Alliance	
Populus deltoides / *Bromus inermis* Ruderal Forest Association (CEGL005455)	
FSCW	Cottonwood Upland Ruderal Forest
1.B.3.Na Eastern North American & Great Plains Flooded & Swamp Forest Division	
M029 Central & Appalachian Floodplain Forest Macrogroup	
G652 Silver Maple - Green Ash - Sycamore Floodplain Forest Group	
A3708 *Acer rubrum* - *Fraxinus pennsylvanica* Seasonally Flooded Forest Alliance	
Fraxinus pennsylvanica - *Celtis occidentalis* - *Tilia americana* - (*Quercus macrocarpa*) Forest Association (CEGL002081)	
FFAE	Ash - Elm - Mixed Lowland Hardwood Forest
A3710 *Acer saccharinum* - *Populus deltoides* Floodplain Forest Alliance	
Acer saccharinum - *Fraxinus pennsylvanica* - *Ulmus americana* Forest Association (CEGL002586)	
FFSM	Silver Maple - Elm Forest
Populus deltoides - *Salix nigra* - *Acer saccharinum* Forest Association (CEGL002018)	
FFCW	Midwestern Cottonwood - Black Willow - Silver Maple Forest
M504 Northern Flooded & Swamp Forest Macrogroup	
G046 Laurentian-Acadian-Allegheny Alkaline Swamp Group	
A0347 *Fraxinus nigra* - *Acer rubrum* Saturated Forest Alliance	
Acer rubrum - *Fraxinus* spp. - *Betula papyrifera* / *Cornus canadensis* Forest Association (CEGL002071)	
FBAS	Red Maple - Ash - Birch Swamp Forest

Map-class Code	Map-class Name
M302 Eastern North American Ruderal Flooded & Swamp Forest Macrogroup	
G552 Northern & Central Native Ruderal Flooded & Swamp Forest Group	
A4099 *Acer negundo* - Mixed Hardwoods / *Alliaria petiolata* Ruderal Floodplain Forest Alliance	
Acer negundo Ruderal Floodplain Forest Association (CEGL005033)	
FSBE	Box-elder Ruderal Floodplain Forest
2 SHRUB & HERB VEGETATION CLASS	
2.B.2.Nb Great Plains Grassland & Shrubland Division	
M054 Great Plains Tallgrass Prairie Macrogroup	
G333 Central Great Plains Tallgrass Prairie Group	
A4057 *Andropogon gerardii* - *Sorghastrum nutans* Herbaceous Alliance	
Andropogon gerardii - *Sorghastrum nutans* - (*Sporobolus heterolepis*) - *Liatris* spp. - *Ratibida pinnata* Herbaceous Vegetation Association (CEGL002203)	
HPTG	Central Mesic Tallgrass Prairie
G151 Sand & Gravel Tallgrass Prairie Group	
A4049 *Schizachyrium scoparium* - *Bouteloua curtipendula* Gravel & Bluff Herbaceous Vegetation Alliance	
Schizachyrium scoparium - *Bouteloua curtipendula* Bedrock Bluff Herbaceous Vegetation Association (CEGL002245)	
HPDS*	Dry Slope Prairie
Schizachyrium scoparium - *Bouteloua curtipendula* Gravel Herbaceous Vegetation Association (CEGL002215)	
HPDS*	Dry Slope Prairie
A4047 *Schizachyrium scoparium* - *Sorghastrum nutans* - *Bouteloua curtipendula* Sand & Gravel Herbaceous Alliance	
Schizachyrium scoparium - *Danthonia spicata* - *Carex pensylvanica* - (*Viola pedata*) Herbaceous Vegetation Association (CEGL002318)	
HPDS*	Dry Slope Prairie
2.B.2.Nc Eastern North American Grassland & Shrubland Division	
M123 Eastern North American Ruderal Grassland & Shrubland Macrogroup	
G059 Northern & Central Ruderal Meadow & Shrubland Group	
A1190 *Dactylis glomerata* - *Festuca* spp. - *Solidago canadensis* Mesic Meadow Alliance	
Solidago canadensis - *Coronilla varia* Ruderal Herbaceous Vegetation Association (CEGL005459)	
HSGF*	Successional Grass & Forb Old Field
A3934 *Poa compressa* - *Solidago nemoralis* - *Centaurea biebersteinii* Dry Meadow & Shrubland Alliance	
Poa pratensis - *Bromus inermis* Ruderal Herbaceous Vegetation Association (CEGL005457)	
HSGF*	Successional Grass & Forb Old Field
A3935 *Rhamnus cathartica* - *Rosa multiflora* - *Elaeagnus umbellata* Ruderal Mesic Shrubland Alliance	
Lonicera (x *bella*, *morrowii*, *tatarica*) - *Rhus glabra* - *Zanthoxylum americanum* Ruderal Shrubland Association (CEGL005460)	
SSMS*	Successional Mixed Species Shrubland
Rhamnus cathartica Ruderal Shrubland Association (CEGL005461)	
SSMS*	Successional Mixed Species Shrubland
2.C.4.Nd Eastern North American Wet Meadow, Marsh & Shrubland Division	
M069 Eastern North American Wet Meadow & Marsh Macrogroup	
G125 Eastern North American Freshwater Marsh Group	
A3669 *Peltandra virginica* - *Pontederia cordata* - *Sagittaria* spp. Herbaceous Alliance	
Sagittaria latifolia - *Leersia oryzoides* Herbaceous Vegetation Association (CEGL005240)	
HARC	Arrowhead - Rice Cutgrass Marsh

Map-class Code	Map-class Name
A3666 *Schoenoplectus tabernaemontani* - *Schoenoplectus fluviatilis* - *Typha* spp. Shallow Marsh Herbaceous Alliance	
Schoenoplectus fluviatilis - *Schoenoplectus* spp. Herbaceous Vegetation Association (CEGL002221)	
HMEM*	Mixed Emergent Marsh
Schoenoplectus tabernaemontani - *Typha* spp. - (*Sparganium* spp., *Juncus* spp.) Herbaceous Vegetation Association (CEGL002026)	
HMEM*	Mixed Emergent Marsh
A1436 *Typha angustifolia* - *Typha latifolia* - *Schoenoplectus* spp. Deep Marsh Herbaceous Alliance	
Typha spp. - *Schoenoplectus acutus* - Mixed Herbs Midwest Herbaceous Vegetation Association (CEGL002229)	
HMEM*	Mixed Emergent Marsh
Typha spp. Midwest Herbaceous Vegetation Association (CEGL002233)	
HMEM*	Mixed Emergent Marsh
G167 Northern & Central Shrub Swamp Group	
A3685 *Alnus* spp. - *Salix* spp. Lakeshore & Depression Shrubland Alliance	
Alnus incana Swamp Shrubland Association (CEGL002381)	
N/A	N/A
G770 Midwest Wet Prairie & Wet Meadow Group	
A4105 *Carex* spp. - *Calamagrostis canadensis* Midwest Wet Meadow Herbaceous Alliance	
Calamagrostis canadensis North-Central Wet Meadow Association (CEGL005449)	
HBWM	North-Central Bluejoint Wet Meadow
Carex lacustris Herbaceous Vegetation Association (CEGL002256)	
HSWM*	Sedge Wet Meadow
Carex stricta - *Carex* spp. Herbaceous Vegetation Association (CEGL002258)	
HSWM*	Sedge Wet Meadow
M880 Eastern North American Wet Shoreline Vegetation Macrogroup	
G755 Central Riverine Wetland Vegetation Group	
A3646 Salix interior Riverwash Shrubland Alliance	
Salix interior Temporarily Flooded Shrubland Association (CEGL008562)	
SWSB	Sandbar Willow Shrubland
A3659 Northern & Central Temperate Sparsely Vegetated Riverwash Alliance	
River Mudflats Sparse Vegetation Association (CEGL002314)	
VRMF	River Mudflats
Riverine Sand Flats - Bars Sparse Vegetation Association (CEGL002049)	
VRSF	Riverine Sand Flats
G756 Eastern Temperate Wet Shoreline Vegetation Group	
A1881 *Polygonum* spp. Palustrine Alliance	
Polygonum amphibium - *Sagittaria latifolia* Riverine Herbaceous Vegetation Association (CEGL005458)	
HRFM	Riverine Forb Mudflats
M303 Eastern North American Ruderal Wet Meadow & Marsh Macrogroup	
G556 Northern & Central Ruderal Wet Meadow & Marsh Group	
A3030 *Lythrum salicaria* Herbaceous Alliance	
Lythrum salicaria Ruderal Herbaceous Vegetation Association (CEGL006403)	
HSPL	Purple Loosestrife Wetland
A1381 *Phalaris arundinacea* Herbaceous Alliance	
Phalaris arundinacea Eastern Ruderal Herbaceous Vegetation Association (CEGL006044)	
HSRC	Reed Canarygrass Eastern Marsh
A1431 *Phragmites australis* Herbaceous Alliance	
Phragmites australis Eastern North America Temperate Ruderal Herbaceous Vegetation Association (CEGL004141)	
HSER	Eastern Reed Marsh

Map-class Code	Map-class Name
5 AQUATIC VEGETATION CLASS	
5.B.2.Na North American Freshwater Aquatic Vegetation Division	
M108 Eastern North American Freshwater Aquatic Vegetation Macrogroup	
G114 Eastern North American Freshwater Aquatic Vegetation Group	
A4064 *Nymphaea odorata* - *Nuphar* spp. - *Brasenia schreberi* Herbaceous Alliance	
Nelumbo lutea Herbaceous Vegetation Association (CEGL004323)	
HLTS	American Lotus Aquatic Wetland
Nymphaea odorata - *Nuphar* (*microphylla*, *variegata*) Herbaceous Association (CEGL002562)	
HWLA	Northern Water-lily Aquatic Wetland
A4066 *Potamogeton* spp. - *Ceratophyllum* spp. - *Elodea* spp. Herbaceous Alliance	
Potamogeton spp. - *Ceratophyllum* spp. Midwest Herbaceous Vegetation Association (CEGL002282)	
HPWD	Midwest Pondweed Submerged Aquatic Wetland
6 OPEN ROCK VEGETATION CLASS	
6.B.1.Na Eastern North American Temperate Cliff, Scree & Rock Vegetation Division	
M111 Eastern North American Cliff & Rock Vegetation Macrogroup	
G106 Eastern North American Temperate Cliff Group	
A3997 Midwest Acidic Cliff Alliance	
Sandstone Midwest Dry Cliff Sparse Vegetation Association (CEGL002045)	
VDCF*	Dry Cliff Face Sparse Vegetation
A3998 Midwest Alkaline Cliff Alliance	
Limestone - Dolostone Midwest Dry Cliff Sparse Vegetation Association (CEGL002291)	
VDCF*	Dry Cliff Face Sparse Vegetation
7 AGRICULTURAL & DEVELOPED VEGETATION CULTURAL CLASS	
7.A Woody Agricultural Vegetation Cultural Subclass	
7.A.2 Forest Plantation & Agroforestry Cultural Formation	
7.A.2.1 Forest Plantation Cultural Subformation	
CHTN	Hardwood Tree Nursery
CPRP	Red Pine Plantation
CPWP	White Pine Plantation
7.B Herbaceous Agricultural Vegetation Cultural Subclass	
7.B.1 Row & Close Grain Crop Cultural Formation	
CRGC	Row & Close Grain Crop
7.B.2 Pasture & Hay Field Crop Cultural Formation	
CPHC	Pasture & Hay Field Crop
7.C Herbaceous & Woody Developed Vegetation Cultural Subclass	
CDVA	Developed Area
CBRN	Barren Land
MOSAIC	
Riverine Mosaic Vegetation (mosaic of riverine USNVC associations each <MMU)	
RSMI	Riverine Small Mosaic Island
NON-USNVC	
Non-Vegetated Water (<1% vegetated)	
NSR	Stream & River
NWL	Open Water Lake
NWP	Open Water Pond

*Map class also represents other vegetation associations.

Summary Report of the Map Layer

A summary report is provided in Table 13 of the spatial-data layer (vegetation map) by individual map class at the most detailed level of polygon attribution (map class with physiognomic modifiers). The table summarizes frequency of occurrence, area, average polygon size, and percent map coverages for each map class. Within the map layer, some polygons might be adjacent to each other and have the same map class, but not the same physiognomic modifiers (thus the polygons are unique to each other by physiognomy, but not by map class). If a summary table was produced of the map layer with the modifier detail simplified to the map classes, it would likely present slightly lower frequencies in number of polygons for some of the map classes as well as for the map layer in its entirety.

Table 13. Frequencies of occurrences and areas for map classes represented in the vegetation-map layer for the Mississippi National River and Recreation Area, Minnesota vegetation mapping project.

Note: Tally results represent the vegetation-map layer at the most detailed level of physiognomic and special modifier attribution. The bold headings within the table (above the map classes) are Groups or Cultural Subclasses (except for Open Water) within the U.S. National Vegetation Classification to organize the map classes. All map classes except for those under the Open Water category represent vegetation types within the U.S. National Vegetation Classification.
[Freq, Frequency; Ha, Hectare; Ave, Average; Poly, Polygon; USNVC, U.S. National Vegetation Classification]

Map Class Code	Map Class Name	Freq Poly	Area (Ha)	Ave (Ha)	% Cover All	% Cover Natural
North-Central Oak - Hickory Forest & Woodland Group						
WBRC	Eastern Red-cedar - (Hardwood) Bluff Woodland	20	46.5	2.3	0.2	0.5
WDMO	North-Central Dry-Mesic Oak Woodland	331	1,066.5	3.2	4.9	11.9
FWRO	Midwestern White Oak - Red Oak Forest	135	394.2	2.9	1.8	4.4
North-Central Beech - Maple - Basswood Forest Group						
FMBH	Maple - Basswood - Hardwood Forest	34	89.6	2.6	0.4	1.0
Laurentian & Acadian Pine - Oak Forest & Woodland Group						
FWPO	White Pine - Red Oak Forest	5	5.8	1.2	0.03	0.07
Northern & Central Native Ruderal Forest Group						
FSRC	Midwest Red-cedar Forest	15	14.8	1.0	0.07	0.17
FSBA	Midwest Box-elder - Ash Ruderal Forest	770	1,541.7	2.0	7.1	17.2
FSCH	Midwest Hardwood - Conifer Ruderal Forest	107	129.7	1.2	0.6	1.5
FSAS	Aspen Ruderal Forest	12	9.6	0.8	0.04	0.11
FSCW	Cottonwood Upland Ruderal Forest	1	3.2	3.2	0.01	0.04
Silver Maple - Green Ash - Sycamore Floodplain Forest Group						
FFAE	Ash - Elm - Mixed Lowland Hardwood Forest	275	901.0	3.3	4.1	10.1
FFSM	Silver Maple - Elm Forest	292	1,222.3	4.2	5.6	13.7
FFCW	Midwestern Cottonwood - Black Willow - Silver Maple Forest	265	506.5	1.9	2.3	5.7
Laurentian-Acadian-Allegheny Alkaline Swamp Group						
FBAS	Red Maple - Ash - Birch Swamp Forest	5	7.5	1.5	0.03	0.08
Northern & Central Native Ruderal Flooded & Swamp Forest Group						
FSBE	Box-elder Ruderal Floodplain Forest	20	47.4	2.4	0.2	0.5
Central Great Plains Tallgrass Prairie Group						
HPTG	Central Mesic Tallgrass Prairie	44	107.0	2.4	0.5	1.2
Sand & Gravel Tallgrass Prairie Group						
HPDS	Dry Slope Prairie	14	47.9	3.4	0.2	0.5

Map Class Code	Map Class Name	Freq Poly	Area (Ha)	Ave (Ha)	% Cover All	% Cover Natural
Northern & Central Ruderal Meadow & Shrubland Group						
HSGF	Successional Grass & Forb Old Field	395	856.6	2.2	3.9	9.6
SSMS	Successional Mixed Species Shrubland	126	140.5	1.1	0.6	1.6
Eastern North American Freshwater Marsh Group						
HARC	Arrowhead - Rice Cutgrass Marsh	15	15.5	1.0	0.07	0.17
HMEM	Mixed Emergent Marsh	218	568.5	2.6	2.6	6.4
Midwest Wet Prairie & Wet Meadow Group						
HBWM	North-Central Bluejoint Wet Meadow	1	0.4	0.4	0.002	0.005
HSWM	Sedge Wet Meadow	3	1.4	0.5	0.007	0.016
Central Riverine Wetland Vegetation Group						
SWSB	Sandbar Willow Shrubland	231	213.1	0.9	1.0	2.4
VRMF	River Mudflats	44	45.8	1.0	0.2	0.5
VRSF	Riverine Sand Flats	128	117.2	0.9	0.5	1.3
Eastern Temperate Wet Shoreline Vegetation Group						
HRFM	Riverine Forb Mudflats	46	52.2	1.1	0.2	0.6
Northern & Central Ruderal Wet Meadow & Marsh Group						
HSPL	Purple Loosestrife Wetland	17	14.3	0.8	0.1	0.2
HSRC	Reed Canarygrass Eastern Marsh	149	194.2	1.3	0.9	2.2
HSER	Eastern Reed Marsh	43	49.0	1.1	0.2	0.5
Eastern North American Freshwater Aquatic Vegetation Group						
HLTS	American Lotus Aquatic Wetland	38	45.3	1.2	0.2	0.5
HWLA	Northern Water-lily Aquatic Wetland	26	147.6	5.7	0.7	1.7
HPWD	Midwest Pondweed Submerged Aquatic Wetland	165	331.7	2.0	1.5	3.7
Eastern North American Temperate Cliff Group						
VDCF	Dry Cliff Face Sparse Vegetation	1	0.8	0.8	0.004	0.009
Woody Agricultural Vegetation Cultural Subclass						
CHTN	Hardwood Tree Nursery	9	31.9	3.5	0.1	0.0
CPRP	Red Pine Plantation	35	33.1	0.9	0.2	0.0
CPWP	White Pine Plantation	8	18.1	2.3	0.1	0.0
Herbaceous Agricultural Vegetation Cultural Subclass						
CRGC	Row & Close Grain Crop	105	717.4	6.8	3.3	0.0
CPHC	Pasture & Hay Field Crop	23	85.6	3.7	0.4	0.0
Herbaceous & Woody Developed Vegetation Cultural Subclass						
CDVA	Developed Area	233	6,697.4	28.7	30.8	0.0
CBRN	Barren Land	2	44.9	22.5	0.2	0.0
Riverine Small Mosaic Island						
RSMI	Riverine Small Mosaic Island	21	3.3	0.2	0.02	0.04
Open Water (Non-USNVC)						
NSR	Stream & River	14	5,001.6	357.3	23.0	0.0
NWL	Open Water Lake	5	128.1	25.6	0.6	0.0
NWP	Open Water Pond	52	74.7	1.4	0.3	0.0
	Totals	4,498	21,771.6	4.8	100.0	41.1

Brief Analysis and Discussion

General Overview of Park Vegetation Map

Collectively the spatial-database layer (vegetation map) produced for the MISS vegetation mapping project is composed of 4,498 polygons covering 21,771.6 ha, with an average polygon size of 4.8 ha. The 35 map classes representing natural (including ruderal) vegetation in the USNVC apply to 89.2% of polygons (4,012 polygons; average size of 2.2 ha) and cover 41.1% of the park (8,938.7 ha). Further broken-down, map classes representing natural vegetation in the USNVC show the park to be 27.5% forest and woodland (5,986.2 ha), 1.6% shrubland (353.6 ha), 11.2% herbaceous cover (2,431.8 ha), and 0.8% sparse vegetation (163.9 ha). Map classes representing cultural vegetation in the USNVC apply to 9.2% of polygons (415 polygons; average size of 18.4 ha) and cover 35.0% of the park (7,628.5 ha). Map classes representing non-vegetative open and flowing water (non-USNVC) apply to 1.6% of polygons (71 polygons; average size of 73.3 ha) and cover 23.9% of the park (5,204.4 ha).

Non-Successional Forest and Woodland

Overall, map classes representing successional forest associations account for 20.5% (925) of the mapped polygons and 8.0% (1,746.4 ha) of the MISS area, whereas map classes representing non-successional forest and woodland associations account for 30.3% (1,362) of the polygons, but 19.5% (4,239.9 ha) of the park area. This demonstrates that non-successional forest and woodland associations are generally found in larger, more homogenous and contiguous blocks with the average area of a successional forest block 1.9 ha compared to 3.1 ha for non-successional forest and woodland map classes. These non-successional forest and woodland coverage figures also discount the value of large blocks of contiguous forest composed of numerous different non-successional map classes.

The major components of the non-successional forest and woodland map classes in MISS are split between three forests: one upland and two floodplain. The upland forests are dominated by the North-Central Dry-Mesic Oak Woodland (WDMO) map class whereas dominance of the floodplain forests is shared between Silver Maple - Elm Forest (FFSM) map class and the Ash - Elm - Mixed Lowland Forest (FFAE) map class. These three map classes dominate the forested landscape at 4.9% (1,066.5 ha), 5.6% (1,222.3 ha), and 4.1% (901.0 ha) of the park area, respectively.

Successional Forest

The successional forest types are dominated by one map-class: Midwest Box-elder - Ash Ruderal Forest (FSBA). This map class covers 7.1% (1,541.7 ha) of MISS. This map class is the most variable in MISS resulting from the inherent ecological variability of the USNVC association composing the map class and the interaction of variable site histories with the available species in each polygon. Forest quality in this map class ranges from highly disturbed forests primarily of young monocultures of successional trees to forests transitioning to non-successional (primarily oak) associations. Additionally, this forest transitions into the FFAE map class when it reaches the floodplain. This transition produces a certain level of confusion in mapping the upland-floodplain interface where a ruderal forest can seamlessly change into a non-successional floodplain forest. Finally, the expected arrival of the emerald ash borer (*Agrilus planipennis*) in the park will significantly modify this map class as mature ash are eliminated and only young ash trees remain.

Shrublands

The two shrub map classes found in MISS, the Successional Mixed Species Shrubland (SSMS) and the Sandbar Willow Shrubland (SWSB), cover 0.6% (140.5 ha) and 1.0% (213.1 ha) of the park, respectively. These two shrub classes present very differently. The SWSB map class is exclusively a wetland map class regularly composed of only sandbar willow (*Salix interior*). The SSMS map class is generally an upland type and composed of both the native sumac species (*Rhus* spp.) and the highly invasive non-native honeysuckle species (*Lonicera* spp.). Both map classes are promoted by occasional disturbance. The SSMS map class in particular warrants further investigation to determine when an area mapped is dominated by native versus non-native shrub species as this will likely influence succession at the site.

Herbaceous Vegetation

Herbaceous-vegetation map classes play a critical role at MISS. Covering 2,431.8 ha (11.2% of the park), these map classes are evenly split between upland (1,011.5 ha, 4.7% of the park), wetland (895.5 ha, 4.1% of the park), and aquatic (524.6 ha, 2.4% of the park) USNVC associations.

The herbaceous uplands are primarily represented by the Successional Grass & Forb Old Field (HSGF) map class (856.6 ha, 3.9% of the park), but also have two important native prairie map classes—the Dry Slope Prairie (HPDS) and the Central Mesic Tallgrass Prairie (HPTG), which cover 47.9 ha (0.2% of the park) and 107.0 ha (0.5% of the park), respectively. The HSGF map class represents a broad array of species (native, naturalized, and invasive), disturbance regimes, and successional directions and cannot be assumed to be a homogenous map class. The HPTG and HPDS prairies are similarly diverse, but this is due to the four different USNVC associations that compose the two map classes; many of the prairies are restored and all will require some form of active management to prevent succession to woody vegetation.

The herbaceous wetland is dominated by the Mixed Emergent Marsh (HMEM) map class, which covers 568.5 ha (2.6% of the park). This map class is composed of four USNVC vegetation associations; these were in three different map classes prior to AA. However, the degree of confusion found between these three map classes during AA indicated that a single map class was more appropriate. As such, HMEM is a large and diverse map class that can have several different USNVC associations within a single polygon. A counterpoint to HMEM is the Reed Canarygrass Eastern Marsh (HSRC) map class, the second-most common herbaceous wetland map class covering 194.2 ha (0.9% of the park). This map class is composed of just one USNVC associations and the polygons in this map class are almost exclusively dominated by just one species, reed canarygrass (*Phalaris arundinacea*). Finally, the herbaceous wetland map classes in the park may vary greatly in appearance and coverage year-to-year depending on the hydrologic cycle due to the dynamic relationship between these map classes and floods and droughts.

The aquatic wetland is dominated by the Midwest Pondweed Submerged Aquatic Wetland (HPWD) map class, which covers 331.7 ha (1.5% of the park), although the Northern Water-lily Aquatic Wetland (HWLA, 147.6 ha, 0.7% of the park) and the American Lotus Aquatic Wetland (HLTS, 45.3, 0.2% of the park) are important map classes of aquatic wetlands. These three map classes need to be looked at together because they occupy the same habitat in the park, seamlessly intergrade with

each other, and vary year-to-year depending on floods and droughts. Additionally, seasonality can greatly affect the appearance of these map classes as the vegetation is often late to emerge in the spring and early to senesce in the fall.

Sparse Vegetation

Sparsely vegetated map classes (non-aquatic vegetation with <10% coverage) are an important part of the landscape in MISS. In particular, the Riverine Mudflats (VRMF) and Riverine Sand Flats (VRSF) map classes cover 45.8 ha (0.2% of the park) and 117.2 ha (0.5% of the park), respectively. These annual, vegetation-dominated map classes are highly dynamic, lasting only a few years unless they are "restored" by some disturbance (primarily flooding). In 2012, the year the imagery was acquired for this project, large floods in the spring were followed by a dry summer and fall. When the imagery was acquired in September 2012, low flow in the Mississippi River exposed large areas of mud and sand. This resulted in a large amount of freshly-scoured habitat and, combined with a low flow in the river in 2013, presented extensive areas of these map classes in the park that were often thoroughly colonized by annual plants.

Open Water

Open water is also a critical part of the landscape in MISS covering 5,204.4 ha (23.9% of the park). Most of this area is the Stream & River (NSR) map class that covers 5,001.6 ha (23.0% of the park, 96.1% of open water). The area represented by the NSR map class is almost exclusively composed of the Mississippi River with the Minnesota River and Vermillion River contributing a much smaller portion of the area mapped.

Cultural Vegetation

A final aspect of MISS that cannot be ignored is the cultural landscape. While there are seven different map classes representing cultural vegetation in the USNVC, only two map classes cover a large area. The first is the Row & Close Grain Crop (CRGC) map class that covers 717.4 ha (3.3% of the park) and is composed of intensive agriculture.

The other is the Developed Area (CDVA) map class that covers 6,697.4 ha (30.8% of the park). This map class is composed of a diverse mix of developed landscapes from mowed picnic areas in parks to parking structure roofs, but a majority of this map class is residential dwellings. Nonetheless, the affect that these impervious surfaces have on the park should not be underestimated.

Map Layer Presentation

A presentation example of the map layer produced for the MISS vegetation mapping project is shown in Figure 31. The finest level of the map (polygons consisting of map classes and physiognomic modifiers) is too detailed to present at a park-wide scale, but insets to the map have been included to show these data; therefore, Figure 31 shows generalized map classes that were aggregated primarily with USNVC Groups for natural (including ruderal) vegetation and with USNVC Cultural Subclasses for cultural vegetation. These categories are the same as the bolded categories provided in Table 11 and Table 13.

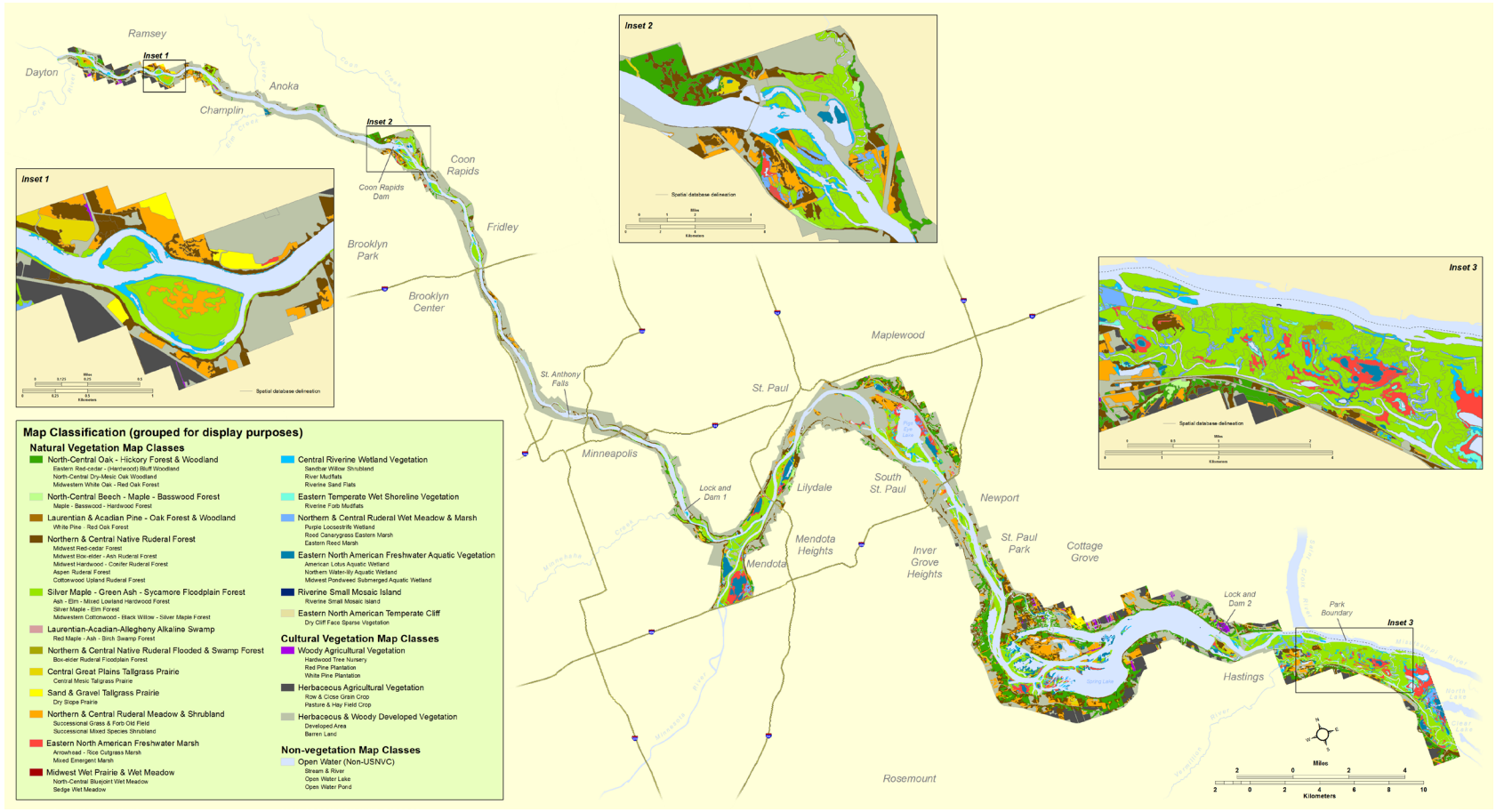


Figure 31. Vegetation of the Mississippi National River and Recreation Area, Minnesota.

Accuracy Assessment

Methods

Purpose

The objective of an accuracy assessment (AA) is to measure the probability that a particular location has been assigned its correct vegetation class. An AA estimates thematic errors in the data, giving users the information needed to determine data suitability for a particular application. At the same time, data producers are able to learn more about the nature of errors in the data. Thus, the two views of an AA are "users' accuracy," which is the probability that the map actually represents what was found on the ground, and "producers' accuracy," which is the probability that an AA site has been mapped correctly. An error in mapping from a users' perspective is one of commission where a map class was mapped that did not exist at the site of assessment. An error in mapping from a producers' perspective is one of omission; for example, a map class was not mapped that existed at the assessment sites. Both producers' and users' accuracies can be obtained from the same set of data by using different analyses. Errors occur when map classes are not the same as the classes observed in the field. A major assumption of AA is that the process of mapping and the process of the assessment (e.g., the application of the classification system) are identical, so that a "false error" is not detected because of procedural differences. The process of AA is based on field observations, and the process of mapping is based on aerial-image interpretation with different perspectives of scale and observation.

Sampling Design

A stratified random sampling approach was used to select AA sites in Mississippi National River and Recreation Area (MISS). All locations within the park administrative boundary, excluding areas specified by park personnel and/or listed as private property, were included in the sampling design. Most map classes representing natural (including ruderal) vegetation associations in the U.S. National Vegetation Classification (USNVC) were included as the individual themes to randomly selected sites. The Dry Cliff Face Sparse Vegetation (VDCF) map class was not included in the sampling; a single polygon of VDCF was mapped and is on private property.

The number of samples needed for each map class (theme) was determined by using National Park Service (NPS) Vegetation Inventory Program (VIP) recommendations (Lea and Curtis 2010), as suggested in the following scenarios.

- Scenario A: The class is abundant. It covers more than 50 ha in total area. The map class receives the maximum sample size of 30.
- Scenario B: The class is relatively abundant. It covers at least 8.33 ha but no more than 50 ha in total area. The map class receives a sample size of 0.6 observations per hectare of the map class (= one observation for every 1.67 ha of map class area). (This ratio allocates observations at a density rate equal to 30 observations per 50 ha).
- Scenario C: The class is relatively rare. It covers less than 8.33 ha in total area. The map class receives 5 observations; the recommended minimum sample size.

For Scenario C, a potential exists for a class to receive less than 5 observations if private land or extremely low total area prohibit site placement.

Where applicable, each sampling site was buffered from the polygon boundary to ensure that the field classification of the observed area (a circular area approximately the size of the minimum mapping unit [MMU]) would not be confused with vegetation types represented in adjacent polygons. Confusion and error could have been attributed to several causes: (1) confusion if the observation area was wholly contained within the map class, (2) positional error caused by global positioning system (GPS) error, and (3) allowable positional error included in the map data. The National Map Accuracy Standard requirement for positional accuracy of 1:24,000-scale products is 12.2 meters (FGDC 1998).

The required buffer distance was calculated with the following formula:

$$\text{Buffer Distance} = \sqrt{R^2 + F^2 + M^2}$$

where R is the radius distance of the observation area, F is the expected (e.g., 90th percentile) GPS error distance, and M is the standard requirement (maximum positional error distance in the map) for positional accuracy.

The MMU that were used to map the park were 0.5 ha and 0.25 ha, depending on the map class. Given these MMU, the radius length of a circular area of 0.5 ha is 40 m and of 0.25 ha is 28 m; these represent the value of R. The value of F is generalized to 15 meters, and the value of M is generalized to 12 meters. Therefore, a buffer distance of either 44 m or 34 m (depending on the MMU designated for a particular map class) was applied to the interior polygon boundaries. For some map-class themes, because they were characteristically shaped as narrow and linear, the buffer needed to be reduced as the target number of AA sites could not otherwise be attained. This was done on a case-by-case basis. The buffer size was reduced incrementally until the target number of sites could be selected for a particular theme; this process promoted the maximum distance in buffer while still attaining the targeted number of sites.

Multiple observations in a polygon were possible, provided they did not overlap in area. In instances where the site selection process was not able to select sites adequately distant from other vegetation polygons, because the vegetation type was in a very small or linear polygon, the hard-copy maps for the field crews included boundary lines that marked the interpreted boundaries between two map classes alongside points demarking locations of the AA sites.

When the number of sites was determined and the buffer applied, random AA site locations were generated for each map class using Hawth's Tools for ArcGIS (Beyer 2004). These AA site coordinates were projected in the Universal Transverse Mercator, Zone 15, by using the North American Datum of 1983 and then provided to the field crews to upload into GPS receivers. The UMESC provided the field crews with 1:16,000-scale hard-copy maps displaying the locations of the

AA sites overlaid on USGS digital raster graphics (DRG). Polygon boundaries were shown only for those areas that were unable to accommodate the required buffer distance.

Field Data Collection

Field observation data were collected by a lead botanist and field assistant (trained in AA procedures by ecologists from Nature Serve and UMESC). This botanist and field assistant (field crew) navigated to the preseleted AA sites using GPS and hard-copy maps. The field crew selected the appropriate vegetation class by using a dichotomous key to the vegetation associations of MISS (draft version 2.21 of January 2014). Field crews assessed an area approximately the size of the MMU for each accuracy assessment site (i.e., a circle with a 40 m radius for an MMU of 0.5 ha, a circle with a 28m radius for an MMU of 0.25 ha, or, if the mapped polygon boundaries could not support a circular MMU, the field crew analyzed an area, specified by polygon boundaries, provided on hard-copy maps). It was important for the crews to assess the area, indicated by point color, on their hard-copy field maps (blue AA site indicated 40m analysis radius [0.5 ha analysis area], red AA site indicated 28m analysis radius [0.25 ha analysis area] and any blue or red site with corresponding polygon boundary lines indicated the analysis size and boundary). In these very narrow polygons (as indicated on the DRG maps with pink boundary lines), the field crews considered the location of the point in relation to polygon boundaries and gave more attention to vegetation occurring along the axis of the polygon.

Within the targeted assessment area, the field crew recorded data, including the GPS coordinate location, dominant and indicator species, environmental data, and pertinent comments. (For an example of a field form, see "Appendix F: Accuracy Assessment Form") The dichotomous key to vegetation associations directed field crews to the vegetation association that best fit the AA site. When the association type was uncertain (e.g., a vegetation type that expressed a variation not supported by the key to associations or an ecotone between two vegetation types), the crews still made a single "best call" but took extra notes on the circumstance. In several instances, an "alternate field call" was recorded, thus providing a second vegetation type to classify a specific site. When two vegetation types were recognized, the crews were instructed to note the vegetation type that contained the most area within the radius of a MMU (for additional field collection details and procedures, see "Appendix G: Accuracy Assessment Field Manual").

Data Analyses

Field data for 776 AA sites were collected and entered into the NPS PLOTS Database Version 2.0 (NatureServe 2005). The AA data set was later converted to the PLOTS Database Version 3.2 (Colorado Natural Heritage Program [CNHP] 2011) for product delivery to the NPS VIP. Of the 776 AA collection sites, 11 were not used because of unresolvable results between mapping and field data, and another 8 were not used as they applied to cultural vegetation[5]. Thus, 757 AA sites were used in the analysis (Figure 32).

[5] At the time of sampling, pine plantations were originally included in the accuracy assessment study. Since then, pine plantations have been moved from the natural to cultural section in the USNVC. The field data for pine plantations remains intact in the vegetation database; however, the data are not part of the accuracy results.

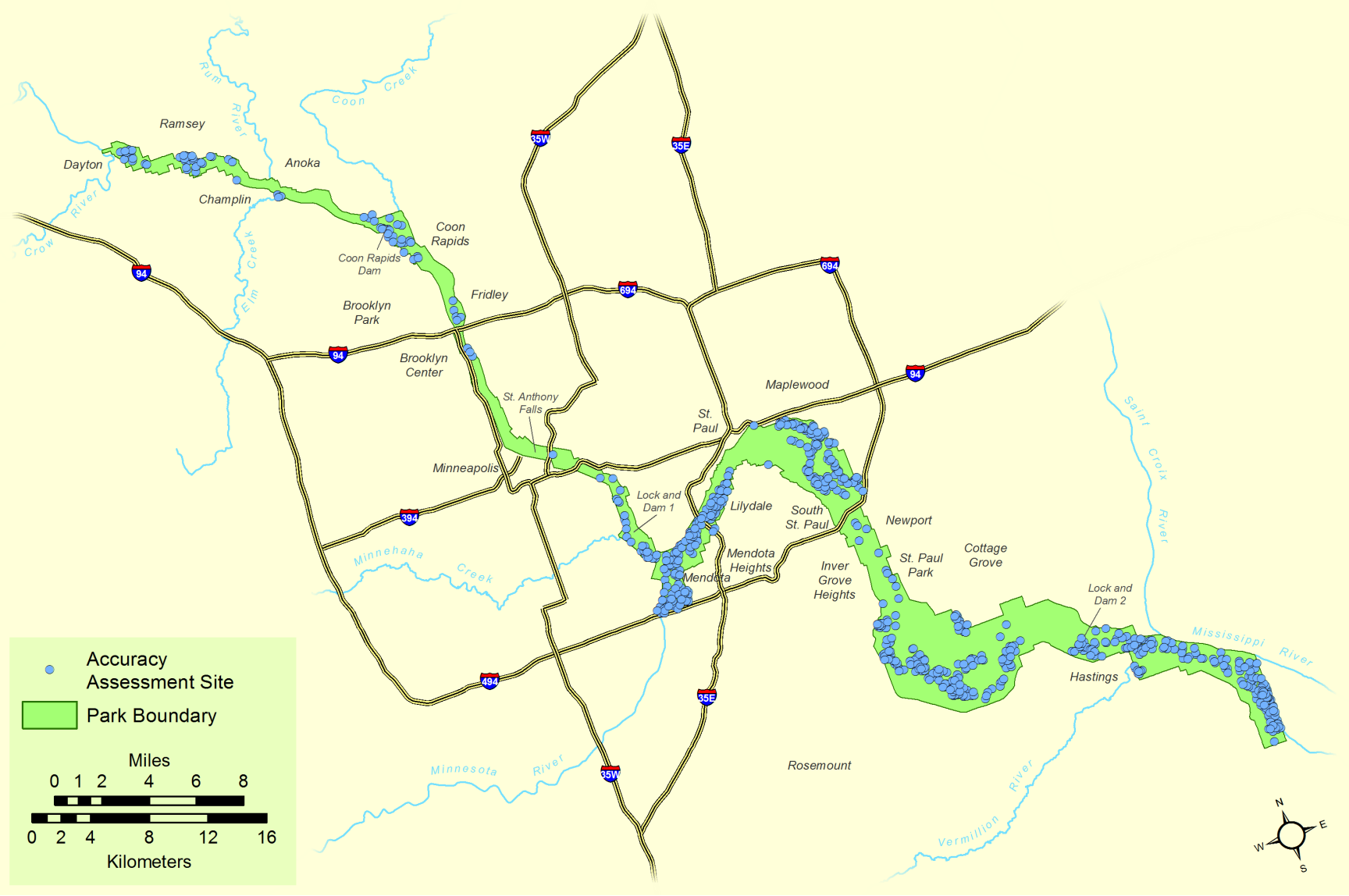


Figure 32. Locations of accuracy assessment sites used to validate the vegetation-map layer for the Mississippi National River and Recreation Area, Minnesota vegetation mapping project.

The database of AA site data was subsequently reviewed for data entry errors. The analysis of map accuracy included the following steps:

- Initial comparative analysis of the field and map data,
- Review of all disagreements and correction of false errors as necessary,
- Individual map-class analysis,
- Final output of results into a contingency matrix, and
- Final output of the analyses and results into a spatial database for use in a geographic information system (GIS).

Initial Comparative Analysis

A spatial join of the AA field-site data and the map-polygon data was prepared. This allowed each AA field-site call (vegetation type) and the corresponding map-polygon call (map class representing vegetation type) to be compared to each other. ArcGIS (Version 10.0, Environmental Systems Research Institute) was used to compare and tabulate the field-site call to the map-polygon call. The comparison accounted for alternate field calls indicated on the field data sheets by accepting map-polygon calls as correct when they matched the alternate calls. The initial comparison revealed that only 69% of the AA sites matched the corresponding polygons.

Review of Disagreements

All mismatches (disagreements) were subsequently reviewed for false errors. A false error is defined as a mismatch between the AA field-site call and the map-polygon call when the mismatch was caused by an accuracy error in the GPS field-site coordinates, by a missing or misapplied field-site call, or by a field-site assessment of an area smaller than the MMU (an inclusion). This review process involved using ArcGIS to locate and view the AA sites, and their corresponding polygons, on a computer screen by using digital aerial imagery and Stereo Analyst (Version 11.0.3, Intergraph Corporation). The field data sheets were also reviewed to gain a fuller sense of the context of the ground data. From this process, it was determined whether an initial disagreement was either a true error or a false error, which would be a match. The following paragraphs explain the process further.

Spatial Error

A spatial error might occur when (1) the GPS device acquired inaccurate field coordinates, or (2) a geospatial error existed within the vegetation map layer (called a “map-layer shift”). These spatial errors could displace the newly acquired field coordinate to an adjacent polygon on the map layer. By selecting sites more than 34 m (0.25 ha MMU vegetation types), 44 m (0.5 ha MMU vegetation types), or 14 m (either 0.25 ha or 0.5 ha narrow or linear vegetation sites that could not accommodate the aforementioned larger buffer sizes) from polygon edges, spatial errors in GPS coordinates were able to be minimized, yet occasionally GPS accuracy could fall outside this parameter.

Questionable Field Call

A field assessment determination might be questioned during the analysis, especially when the perspective from the ground was limited when visual assessments, such as heavy vegetation cover or wet soils, prevented the field crew from walking around the MMU. If the MMU area was diverse,

with more than one map class represented, it was possible to omit or fail to recognize other vegetation types present. These situations were reviewed by checking the aerial imagery for diversity at the site and by inspecting the field data sheets for possible problems.

Inclusion

The area assessed in the field during the AA may fall below the MMU for mapping and so be termed an inclusion. After a review of the aerial imagery, the site in question may have been found to contain vegetation that was an inclusion to the surrounding map class. Certain vegetation features are quite distinct from each other when the aerial imagery was viewed three-dimensionally (e.g., open woodland versus dense forest), which thereby allows easy assessment of site inclusions in the lab. Inclusion can also occur when an area in the field is a valid MMU, but the assessed area overlaps into an adjacent polygon. It is sometimes difficult to determine if the assessed area actually falls within the intended polygon, particularly in the case of smaller polygons adjacent to polygons with similar vegetation types.

Individual Map-Class Analysis

Individual map-class accuracies that fell below standards of the NPS VIP were reviewed to determine which were in confusion with each other. If repeated confusion was evident, a decision needed to be made whether to merge the map classes to gain higher accuracy or to leave the map classes as they were. Certain map classes were left with lower accuracies, because the benefit was determined to be greater for separate map classes with lower accuracies than for merged map classes with higher accuracies. These decisions were made with input from NPS staff at MISS.

Final Output

The results of the final analyses were transferred into a contingency table (matrix), where percentages of users' and producers' accuracies were calculated for each map class. The matrix shows both the frequency of agreement and the placement of disagreements.

AA Spatial Database

For use in a GIS, a feature-class layer was produced of the AA site locations, as well as supporting tables; the layer and tables were incorporated into the geodatabase for the MISS vegetation mapping project. The field data for AA are also included in the PLOTS Database for the project.

Results

Of the 757 sites used in the analysis, the initial comparison revealed only 69% of the AA sites matched the corresponding polygons that represented natural (including ruderal) vegetation associations in the USNVC. Through the review process of correcting false errors and of combining some map classes because of low accuracies, the overall accuracy was eventually increased to 83.36%. A kappa adjustment for chance agreements resulted in an overall accuracy of 82.56%. The contingency matrix for the AA results is provided in "Appendix H: Accuracy Assessment Contingency Table." The matrix shows the accuracy of each map class (along with 90% confidence intervals), with the users' accuracy reflecting errors of inclusion (commission errors) and the producers' accuracy reflecting errors of exclusion (omission errors). The width of each confidence interval has been affected by the sample size used to derive the point estimate.

The overall AA met the accuracy requirement of 80% established by the NPS VIP. The most important factors affecting accuracy were (1) disagreements between mappers and field crews in percent-cover estimates of the strata, (2) difficulties distinguishing red and white oak from bur and pin oak during the mapping, (3) difficulties distinguishing exotic and early successional tree species from native hardwood tree species during the mapping, (4) difficulties distinguishing percent cover of specific exotic and early successional tree species during the mapping, and (5) failure to distinguish percent cover of ruderal/exotic emergent aquatic species in relation to specific wetland herbaceous communities during the mapping. In regard to cover estimates, past experience indicates that estimates in the field are generally lower than estimates from an aerial survey; thus, some mismatches were from a result of two different perspectives.

Some individual map class accuracies did not meet the 80% requirement (taking into account 90% confidence intervals). In general, errors of omission (producers' accuracy) occurred in fewer map classes than did errors of commission (users' accuracy). The following are map classes for which the mapping project did not meet the required rates of accuracy, in terms of either the actual percentage or the confidence intervals.

Users' Accuracy (Errors of Commission)

The users' accuracy for the Northern-Central Dry-Mesic Oak Woodland (WDMO) map class was 63% with a 90% confidence interval of 47–79%. Of the 30 polygons mapped as WDMO, 11 AA sites within those polygons were found to contain different vegetation types, with errors attributed as follows:

- Seven Midwestern White Oak - Red Oak Forest (FWRO) sites were mapped as WDMO, because bur oak (*Quercus macrocarpa*) and/or northern pin oak (*Q. ellipsoidalis*) were misidentified in the tree canopy as white oak (*Q. alba*) and/or northern red oak (*Q. rubra*);
- Two Maple - Basswood - Hardwood Forest (FMBH) sites were mapped as WDMO because the oak component of the canopy was overestimated by the mapper; and
- Two Midwest Hardwood - Conifer Ruderal Forest (FSCH) sites were mapped as WDMO, because the mapper failed to identify the conifer component of the community.

The users' accuracy for the Midwest Box-elder - Ash Ruderal Forest (FSBA) map class was 57% with a 90% confidence interval of 40–73%. Of the 30 polygons mapped as FSBA, 13 AA sites within those polygons were found to contain different vegetation types, with errors attributed as follows:

- Five Midwestern Cottonwood - Black Willow - Silver Maple Forest (FFCW) sites were mapped as FSBA because the amount of cottonwood (*Populus deltoides*) in the tree canopy was either underestimated or misidentified as green ash (*Fraxinus pennsylvanica*) and/or box elder (*Acer negundo*);
- Two Ash - Elm - Mixed Lowland Forest (FFAE) sites were mapped as FSBA because the hydrology of the site was mistaken as upland, instead of wetland, by the mapper;
- Two Cottonwood Upland Ruderal Forest (FSCW) sites were mapped as FSBA because cottonwood was misidentified by the mapper as green ash and/or box elder;

- Two Northern-Central Dry-Mesic Oak Woodland (WDMO) sites were mapped as FSBA because the mapper failed to identify the white oak and/or northern red oak canopy component of the community;
- One Red Maple - Ash - Birch Swamp Forest (FBAS) site was mapped as FSBA because the hydrology of the site was mistaken as upland, instead of wetland, and red maple (*Acer rubrum*) was most likely mistaken as either white oak and/or red oak by the mapper; and
- One Maple - Basswood - Hardwood Forest (FMBH) site was mapped as FSBA, because the mapper failed to identify the white oak and/or red oak and sugar maple (*Acer saccharum*) canopy components of the community.

Producers' Accuracy (Errors of Omission)

The producers' accuracy for the Purple Loosestrife Wetland (HSPL) map class was 46%, with a 90% confidence interval of 20–73%. Of the 13 AA sites classified in the field as HSPL, 7 sites fell within polygons that were mapped as other vegetation types, with errors attributed as follows:

- Four polygons were mapped as Mixed Emergent Marsh (HMEM), because purple loosestrife (*Lythrum salicaria*) was misidentified in the herbaceous stratum as cattail (*Typha* spp.), river bulrush (*Schoenoplectus fluviatilis*), bur-reed (*Sparganium* spp.), or some combination of the three species, along with additional perennial emergent vegetation;
- Two polygons were mapped as River Mudflats (VRMF), because purple loosestrife was misidentified as mixed annual emergent vegetation in the herbaceous stratum; and
- One polygon was mapped as Arrowhead - Rice Cutgrass Marsh (HARC), because purple loosestrife was misidentified in the herbaceous stratum as a combination of arrowhead (*Sagittaria latifolia*) and rice cutgrass (*Leersia oryzoides*).

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Appendix A: Plot Sampling Form

NATIONAL PARK VEGETATION MAPPING PROGRAM: PLOT SURVEY FORM

IDENTIFIERS/LOCATORS

Plot Code__MISS._____ Polygon Code_____

Provisional Community Name_____

State _MN_ Park Name_Mississippi NRRA_____ Park Site Name_____

Quad Name_____ Quad Code_____

Waypoint_____ Field UTM X__ __ __ __ __ __ m E Field UTM Y__ __ __ __ __ __ __ m N

Zone_15_ Datum_____ Error +/-_____ m Elevation _____

Survey Date_____ Surveyors_____

Directions to Plot:

Plot length ___ (m) Plot width ____ (m) Camera _____ # of images _____ Time of First Photo _____

Photos should be at 0, 90, 180, and 270 degrees from the center point and one or more "landscape" photos.

Plot representativeness: - Is the surrounding
~1 hectare area all the same? __yes ___no.
Please draw a map of plot here with plot shape,
where plot photos were taken, potential community
boundary breaks, and important landmarks.

ENVIRONMENTAL DESCRIPTION

Slope _____ (degrees) Aspect_____ (degrees)

Topographic Position

Cowardin System
___Upland
___Riverine
___Palustrine
___Lacustrine

Non-Tidal
___Permanently Flooded
___Semipermanetly Flooded
___Seasonally/Temporarily Flooded
___Saturated
___Seasonally Flooded/Saturated
___Intermittently Flooded

Water Depth
_____ Meters

Environmental Comments:

Ground Surface: *(percent – total should equal 100%)*
___ Bedrock
___ Litter, duff
___ Wood (> 1 cm)
___ Large rocks (cobbles, boulders > 10 cm)
___ Small rocks (gravel, 0.2-10 cm)
___ Sand (0.1-2 mm)
___ Bare soil
___Plant Stems
___ Other:_____

PLOT Code: MISS._____

Soil Texture	Soil Drainage
___ sand ___ loamy sand ___ sandy loam ___ loam	___ Rapidly drained ___ Somewhat rapidly drained
___ silt loam ___ silt ___ clay loam ___ silty clay	___ Moderately well drained ___ Well drained
___ silty clay loam ___ clay ___ peat ___ muck	___ Poorly drained ___ Somewhat poorly drained
	___ Very poorly drained

VEGETATION DESCRIPTION

Leaf phenology (of dominant stratum)	Leaf Type (of dominant stratum)	Physiognomic class	Height Scale for Strata		Cover Scale for Strata	
Trees and Shrubs					P	5%
___Evergreen	___Broad-leaved	___Forest	01	<0.5 m	01	10%
___Cold-deciduous	___Needle-leaved	___Woodland	02	0.5-1m	02	20%
___Drought-deciduous	___Microphyllous	___Shrubland	03	1-2 m	03	30%
___Mixed evergreen - cold-deciduous	___Graminoid	___Dwarf Shrubland	04	2-5 m	04	40%
	___Forb	___Herbaceous	05	5-10 m	05	50%
___Mixed evergreen - drought-deciduous	___Pteridophyte	___Nonvascular	06	10-15 m	06	60%
Herbs		___Sparsely Vegetated	07	15-20 m	07	70%
___Annual			08	20-35 m	08	80%
___Perennial			09	35 - 50 m	09	90%
			10	>50 m	10	100%

Strata	Height Class	Cover Class	Diagnostic species (if known)
T1 Emergent			
T2 Canopy			
T3 Sub-canopy			
S1 Tall shrub			
S2 Short Shrub			
S3 Dwarf-Shrub			
H Herbaceous			
A1 FltngLvdAquatic			
A2 Submrged Aquatic			
N Non-vascular			
V Vine/liana			

please see above table for height and cover scales

Animal Use Evidence

Natural and Anthropogenic Disturbance Comments

Comments

Plot Code_MISS.____________________

Species/percent cover: Starting with the uppermost stratum, list all species with cover class for each species in the stratum. For forests and woodlands, on a separate line below each tree species, list the DBH of all trees above 10 cm diameter. Separate measurements with a comma.

Stratum	Species Name	Cover Class	Stratum	Species Name	Cover Class

Cover Scale for Species: T=<1%; P=1-5%; 01=5-15%; 02=15-25%; 03=25-35%; 04=35-45%; 05=45-55%; 06=55-65%; 07=65-75%; 08=75-85%; 09=85-95%; 10=>95%

Appendix B: Descriptions of Vegetation Associations

U.S. NATIONAL VEGETATION CLASSIFICATION

Associations of
Mississippi National River and Recreation Area

13 January 2015

by

NatureServe

1101 Wilson Blvd., 15th floor
Arlington, VA 22209

P.O. Box 9354
St. Paul, MN 55109

This subset of the International Ecological Classification Standard covers vegetation associations attributed to Mississippi National River and Recreation Area. This classification has been developed in consultation with many individuals and agencies and incorporates information from a variety of publications and other classifications. Comments and suggestions regarding the contents of this subset should be directed to Mary J. Russo, Central Ecology Data Manager, Durham, NC <mary_russo@natureserve.org> and Jim Drake, Regional Vegetation Ecologist, Minneapolis, MN <jim_drake@natureserve.org>.



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[1] NatureServe is an international organization including NatureServe regional offices, a NatureServe central office, U.S. State Natural Heritage Programs, and Conservation Data Centres (CDC) in Canada and Latin America and the Caribbean. Ecologists from the following organizations have contributed the development of the ecological systems classification:

United States
Central NatureServe Office, Arlington, VA; Eastern Regional Office, Boston, MA; Midwestern Regional Office, Minneapolis, MN; Southeastern Regional Office, Durham, NC; Western Regional Office, Boulder, CO; Alabama Natural Heritage Program, Montgomery AL; Alaska Natural Heritage Program, Anchorage, AK; Arizona Heritage Data Management Center, Phoenix AZ; Arkansas Natural Heritage Commission Little Rock, AR; Blue Ridge Parkway, Asheville, NC; California Natural Heritage Program, Sacramento, CA; Colorado Natural Heritage Program, Fort Collins, CO; Connecticut Natural Diversity Database, Hartford, CT; Delaware Natural Heritage Program, Smyrna, DE; District of Columbia Natural Heritage Program/National Capital Region Conservation Data Center, Washington DC; Florida Natural Areas Inventory, Tallahassee, FL; Georgia Natural Heritage Program, Social Circle, GA; Great Smoky Mountains National Park, Gatlinburg, TN; Gulf Islands National Seashore, Gulf Breeze, FL; Hawaii Natural Heritage Program, Honolulu, Hawaii; Idaho Conservation Data Center, Boise, ID; Illinois Natural Heritage Division/Illinois Natural Heritage Database Program, Springfield, IL; Indiana Natural Heritage Data Center, Indianapolis, IN; Iowa Natural Areas Inventory, Des Moines, IA; Kansas Natural Heritage Inventory, Lawrence, KS; Kentucky Natural Heritage Program, Frankfort, KY; Louisiana Natural Heritage Program, Baton Rouge, LA; Maine Natural Areas Program, Augusta, ME; Mammoth Cave National Park, Mammoth Cave, KY; Maryland Wildlife & Heritage Division, Annapolis, MD; Massachusetts Natural Heritage & Endangered Species Program, Westborough, MA; Michigan Natural Features Inventory, Lansing, MI; Minnesota Natural Heritage & Nongame Research and Minnesota County Biological Survey, St. Paul, MN; Mississippi Natural Heritage Program, Jackson, MI; Missouri Natural Heritage Database, Jefferson City, MO; Montana Natural Heritage Program, Helena, MT; National Forest in North Carolina, Asheville, NC; National Forests in Florida, Tallahassee, FL; National Park Service, Southeastern Regional Office, Atlanta, GA; Navajo Natural Heritage Program, Window Rock, AZ; Nebraska Natural Heritage Program, Lincoln, NE; Nevada Natural Heritage Program, Carson City, NV; New Hampshire Natural Heritage Inventory, Concord, NH; New Jersey Natural Heritage Program, Trenton, NJ; New Mexico Natural Heritage Program, Albuquerque , NM; New York Natural Heritage Program, Latham, NY; North Carolina Natural Heritage Program, Raleigh, NC; North Dakota Natural Heritage Inventory, Bismarck, ND; Ohio Natural Heritage Database, Columbus, OH; Oklahoma Natural Heritage Inventory, Norman, OK; Oregon Natural Heritage Program, Portland, OR; Pennsylvania Natural Diversity Inventory, PA; Rhode Island Natural Heritage Program, Providence, RI; South Carolina Heritage Trust, Columbia, SC; South Dakota Natural Heritage Data Base, Pierre, SD; Tennessee Division of Natural Heritage, Nashville, TN; Tennessee Valley Authority Heritage Program, Norris, TN; Texas Conservation Data Center, San Antonio, TX; Utah Natural Heritage Program, Salt Lake City, UT; Vermont Nongame & Natural Heritage Program, Waterbury, VT; Virginia Division of Natural Heritage, Richmond, VA; Washington Natural Heritage Program, Olympia, WA; West Virginia Natural Heritage Program, Elkins, WV; Wisconsin Natural Heritage Program, Madison, WI; Wyoming Natural Diversity Database, Laramie, WY

Canada
Alberta Natural Heritage Information Centre, Edmonton, AB, Canada; Atlantic Canada Conservation Data Centre, Sackville, New Brunswick, Canada; British Columbia Conservation Data Centre, Victoria, BC, Canada; Manitoba Conservation Data Centre. Winnipeg, MB, Canada; Ontario Natural Heritage Information Centre, Peterborough, ON, Canada; Quebec Conservation Data Centre, Quebec, QC, Canada; Saskatchewan Conservation Data Centre, Regina, SK, Canada; Yukon Conservation Data Centre, Yukon, Canada

Latin American and Caribbean
Centro de Datos para la Conservacion de Bolivia, La Paz , Bolivia; Centro de Datos para la Conservacion de Colombia, Cali,Valle, Columbia; Centro de Datos para la Conservacion de Ecuador, Quito, Ecuador; Centro de Datos para la Conservacion de Guatemala, Ciudad de Guatemala , Guatemala; Centro de Datos para la Conservacion de Panama, Querry Heights , Panama; Centro de Datos para la Conservacion de Paraguay, San Lorenzo , Paraguay; Centro de Datos para la Conservacion de Peru, Lima, Peru; Centro de Datos para la Conservacion de Sonora, Hermosillo, Sonora , Mexico; Netherlands Antilles Natural Heritage Program, Curacao , Netherlands Antilles; Puerto Rico-Departmento De Recursos Naturales Y Ambientales, Puerto Rico; Virgin Islands Conservation Data Center, St. Thomas, Virgin Islands.

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1. FOREST & WOODLAND

1.B.2. Cool Temperate Forest & Woodland

1.B.2.Na. Eastern North American & Great Plains Cool Temperate Forest & Woodland

M012. Central Midwest Oak Forest, Woodland & Savanna

G649. North-Central Oak - Hickory Forest & Woodland

Chinkapin Oak Driftless Bluff Woodland

Quercus muehlenbergii - *Quercus* (*alba*, *velutina*) - (*Juniperus virginiana* var. *virginiana*) Driftless Bluff Woodland
Chinkapin Oak - (White Oak, Black Oak) - (Eastern Red-cedar) Driftless Bluff Woodland
Identifier: CEGL002144

USNVC CLASSIFICATION

Division	Eastern North American & Great Plains Cool Temperate Forest & Woodland (1.B.2.Na.)
Macrogroup	Central Midwest Oak Forest, Woodland & Savanna (M012)
Group	North-Central Oak - Hickory Forest & Woodland (G649)
Alliance	Eastern White Pine - Oak species Driftless Forest & Woodland Alliance (A3237)
Association	Chinkapin Oak Driftless Bluff Woodland

ELEMENT CONCEPT

Global Summary: This chinquapin oak woodland type occurs primarily on bluffs of large rivers in the midwestern United States. Stands occur in scattered areas along steep southwest-facing bluffs or slopes, particularly on the Mississippi River. Presumably the underlying soils and bedrock have a calcareous influence. Stands contain an open tree layer, with *Quercus muehlenbergii* (chinkapin oak) as the characteristic dominant, and *Quercus alba* (white oak)*, Quercus velutina* (black oak)*, Quercus macrocarpa* (bur oak), and *Juniperus virginiana* (eastern red-cedar) as common associates. *Cornus racemosa* (gray dogwood) may be common in the shrub layer. The ground layer may contain a dry to dry-mesic prairie flora, but little is known about this type and few stands are available for characterization.

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This dry to dry-mesic woodland or forest is uncommon in the riverway. It is found on steep bluffs, nearly always with bedrock exposures or shallow soil. Stands can stretch above the steep valley slopes to the shallow-sloped or flat bluff tops but do not extend very far from the steep slopes.
Global Environment: Stands occur in scattered areas along steep, southwest-facing bluffs or slopes, particularly on the Mississippi River. Presumably the underlying soils and bedrock have a calcareous influence.

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This association typically has a canopy with mostly deciduous or a mixture of deciduous and evergreen trees. There are a few stands that are nearly all evergreen trees in the canopy, in which case the canopy is short trees. *Juniperus virginiana* (eastern red-cedar) is dominant in either the tree canopy or sub-canopy or, very rarely, both. Common deciduous canopy trees are *Quercus alba* (white oak)*, Quercus macrocarpa* (bur oak)*, Quercus ellipsoidalis* (northern pin oak)*, Juglans nigra* (black walnut), and *Tilia americana* (American basswood) (this last mostly on flat benches or bluff-topes). Common shrubs are *Rhamnus cathartica* (common buckthorn) and *Zanthoxylum americanum* (common pricklyash).
Global Vegetation: Stands contain an open tree layer, with *Quercus muehlenbergii* (chinkapin oak) as the characteristic dominant, and *Quercus alba* (white oak)*, Quercus velutina* (black oak)*, Quercus macrocarpa* (bur oak), and *Juniperus virginiana* (eastern red-cedar) as common associates. *Cornus racemosa* (gray dogwood) may be common in the shrub layer. The ground layer may contain a dry to dry-mesic prairie flora, but little is known about this type, and few stands are available for characterization.

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Tree (canopy)	Broad-leaved deciduous tree	*Juniperus virginiana* (eastern red-cedar)*, Quercus macrocarpa* (bur oak)
Tree subcanopy	Broad-leaved deciduous tree	*Juniperus virginiana* (eastern red-cedar)
Short shrub/sapling	Broad-leaved deciduous shrub	*Rhamnus cathartica* (common buckthorn)*, Zanthoxylum americanum* (common pricklyash)

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Global

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Quercus muehlenbergii* (chinkapin oak)

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: *Juniperus virginiana, Quercus macrocarpa*
Global: *Cornus racemosa*, *Juniperus virginiana*, *Quercus alba*, *Quercus macrocarpa*, *Quercus muehlenbergii*, *Quercus velutina*

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Vulnerable: *Panax quinquefolius* (G3G4, under collection pressure)

CONSERVATION STATUS RANK

Global Rank & Reasons: G2G3 (17-Mar-2000). This type has a relatively restricted range, occurring in small patches on large bluffs along big rivers. Further evidence from Iowa concerning its status there is needed to more firmly establish the rank of this type.

CLASSIFICATION

Status: Standard
Classification Confidence: 3 - Weak
Mississippi National River and Recreation Area Comments: Examples at MISS are likely near the northern limit of the association range and that combined with the extensive history of human use of the area likely results in stands having somewhat different character than the "average" stand of this association. For example, *Quercus muehlenbergii* (chinkapin oak) is absent from this association at MISS while it is common further south.
Global Comments: This association is similar in some respects to limestone glades farther south, such as ~*Quercus muehlenbergii - Juniperus virginiana / Schizachyrium scoparium - Manfreda virginica* Wooded Herbaceous Vegetation (CEGL005131)$$, and may represent the more northern equivalent of this type. This type is poorly defined and may currently only consist of small inclusions on steep slopes, especially on Mississippi River bluffs. In Wisconsin, this type is almost of historic note only, occurring now in a few locations where cedar glades or bedrock bluff prairies also occur. A single occurrence of good quality in Grant County along the Mississippi River is now being managed to maintain its woodland character (E. Epstein pers. comm. 1999). In northeastern Iowa, stands of this type can be codominated by *Juniperus virginiana* var. *virginiana* (eastern red-cedar) and contain an understory dominated by prairie flora with a more open canopy grading into flora more typical of dry forests as the canopy becomes more closed. Type may have varied from more open savanna or glade-like conditions to more closed-canopy conditions.

This type may have once occurred in southeastern Minnesota in Houston County. Smith (2008, p. 384) describes a site there where *Quercus muehlenbergii* (chinkapin oak) once occurred, as follows: "The site is on a dry southwest-facing hillside...the soil is calcareous and coarse textured, derived from Prairie du Chien dolomite (a limestone). At the time of the discovery [1899] the habitat was apparently open and prairie-like, or possibly savanna-like, with a few scattered trees or oak grubs...The site has since grown into a substantial forest....chinquapin oak is missing."
Global Similar Associations:
- *Quercus muehlenbergii - (Juniperus virginiana* var. *virginiana)* Unglaciated Bluff Woodland (CEGL004267)
- *Quercus muehlenbergii - Cercis canadensis / Packera obovata - Lithospermum canescens* Woodland (CEGL006231)
- *Quercus muehlenbergii - Juniperus virginiana / Schizachyrium scoparium - Manfreda virginica* Wooded Herbaceous Vegetation (CEGL005131) occurs farther south.

Global Related Concepts:
- Cedar Glade (Faber-Langendoen 2001) =
- Inland Oak Opening (Chapman et al. 1989) >

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This association was found widely scattered on bluffs downriver of the confluence of the Minnesota and Mississippi Rivers to Spring Lake Regional Park.
Global Range: This chinkapin oak woodland type occurs primarily on bluffs of large rivers in the midwestern United States, ranging from Iowa and Illinois to Michigan and Wisconsin.
Nations: US
States/Provinces: IA:S3, IL?, MN, WI:S4
TNC Ecoregions: 46:C, 47:C, 48:C
USFS Ecoregions (1994/95): 222Lc:CCC, 251:P
Federal Lands: NPS (Effigy Mounds, Mississippi, Saint Croix)

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ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: WBRC - Eastern Red-cedar - (Hardwood) Bluff Woodland
Mississippi National River and Recreation Area Inventory Notes: This association was not identified during plot sampling. It was found later in the project and so is described based on field reconnaissance notes and Accuracy Assessment data. As such, it lacks comprehensive species lists and detailed information on vegetation strata.
Mississippi National River and Recreation Area Plots and Observation Points: No plots in MISS.
Local Description Authors: J. Drake
Global Description Authors: D. Faber-Langendoen
References: Chapman et al. 1989, Epstein pers. comm., Faber-Langendoen 2001, Hop et al. 2005, INAI unpubl. data, Midwestern Ecology Working Group n.d., WNHI 2011, WNHI unpubl. data, White and Madany 1978

North-Central Dry-Mesic Oak Woodland

Quercus alba - *Quercus macrocarpa* - *Quercus rubra* / *Corylus americana* Woodland
White Oak - Bur Oak - Northern Red Oak / American Hazelnut Woodland
Identifier: CEGL002142

USNVC CLASSIFICATION

Division	Eastern North American & Great Plains Cool Temperate Forest & Woodland (1.B.2.Na.)
Macrogroup	Central Midwest Oak Forest, Woodland & Savanna (M012)
Group	North-Central Oak - Hickory Forest & Woodland (G649)
Alliance	White Oak - Bur Oak - Swamp White Oak Woodland Alliance (A3324)
Association	North-Central Dry-Mesic Oak Woodland

ELEMENT CONCEPT

Global Summary: This white oak - bur oak woodland is found in the northern prairie-forest border of the midwestern United States. Stands occur on flat, gently rolling or hilly landscapes subject to fires of low frequency and variable intensity. Canopy cover ranges from 30-80%. The tree layer is dominated by *Quercus alba* (white oak) and *Quercus macrocarpa* (bur oak) on drier soils (or even *Quercus ellipsoidalis* (northern pin oak) or *Quercus velutina* (black oak)) and occasionally codominated by *Quercus rubra* (northern red oak) on more mesic soils. The ground layer is codominated by shrubs and tree grubs, forbs and graminoids. Shrub cover is usually high (30-50%) with some stands forming impenetrable thickets. Typical shrubs include *Corylus americana* (American hazelnut) and *Cornus foemina* (stiff dogwood). Dominant herbs include *Andropogon gerardii* (big bluestem)*, Carex pensylvanica* (Pennsylvania sedge)*, Desmodium glutinosum* (pointedleaf ticktrefoil), and *Geranium maculatum* (spotted geranium). This community is maintained by a fire regime that is frequent enough to prevent full canopy closure and sapling establishment of fire-sensitive tree species, but infrequent enough to allow saplings of fire-tolerant tree species to reach fire-resistant size.

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This community was found on flat to steep slopes (0-45 degrees). Slopes were south- or west-facing. Soils were sandy loam or loamy sand and well-drained. The unvegetated ground surface was predominantly bare soil (avg. 32%) and litter (avg. 46%). Rocks and bedrock were sometimes present but all together averaged only 4% cover and were never more than 25% cover.
Global Environment: Stands occur on level to rolling topography on well-drained outwash plains and coarse-textured end moraines, as well as on moderately fire-protected slopes in the Driftless Area. The pH varies from 6.1-7.3. Soils are excessively to moderately well-drained (dry to dry-mesic). Textures range from loams to sandy loams, and include silt loams (loess-derived) close to bedrock in the Driftless Area. This community may develop on a slope of any aspect so long as the topography encourages infrequent but occasional fire. On shallow-to-bedrock slopes, a lower fire frequency is required to maintain oak woodland on south-facing slopes. This is because the combination of shallow soils and high evapotranspiration slows the rate of canopy closure by slowing the rate at which trees grow to canopy size. Soils range from coarse-grained sandy loams to fine-grained loams and silt loams. The effect of topography on the fire regime, rather than soil texture/water-holding capacity, plays the important dynamic role in forming and maintaining dry-mesic oak woodland structure (Grimm 1984, MNNHP 1993). More mesic soils favor increased presence of *Quercus rubra* (northern red oak).

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This community is nominally a woodland but at MISS the canopy physiognomy ranges from closed woodland (50%) to forest (90%) and is usually the latter (avg. canopy cover is 78%). *Quercus macrocarpa* (bur oak) is usually the dominant tree but a few stands have more *Quercus ellipsoidalis* (northern pin oak). Some stands can be dominated by a combination of *Celtis occidentalis* (common hackberry) and *Fraxinus pennsylvanica* (green ash) but *Quercus macrocarpa* (bur oak) and/or *Quercus ellipsoidalis* (northern pin oak) are still common in the canopy. The tree subcanopy ranges from 0-70% and averages 22% cover. *Celtis occidentalis* (common hackberry) and *Quercus macrocarpa* (bur oak) are the most common trees. The shrub strata are moderately to well developed in most stands. Twenty-eight shrub species and six woody vines were found in the shrub strata as well as small trees. *Rhamnus cathartica* (common buckthorn) is the most abundant shrub with nearly continuous canopy in a few stands. *Prunus virginiana* (chokecherry)*, Zanthoxylum americanum* (common pricklyash)*, Ribes missouriense*

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(Missouri gooseberry), *Rubus occidentalis* (black raspberry), *Lonicera* x*bella* (Bell's honeysuckle), and *Lonicera tatarica* (Tatarian honeysuckle) were common. The vines *Parthenocissus vitacea* (woodbine) and *Vitis riparia* (riverbank grape) were in most stands. The ground layer was composed largely of woody vines, tree seedlings, and the herbaceous species *Carex pensylvanica* (Pennsylvania sedge) and *Circaea lutetiana* (broadleaf enchanter's nightshade).

Global Vegetation: There are three main structural layers: tree canopy, tall-shrub and herbaceous. Tree densities for stems greater than 10 cm dbh may historically have been between 50-200 stems per hectare (Bowles et al. 1994). The tree layer is composed predominantly of *Quercus alba* (white oak) and *Quercus macrocarpa* (bur oak), with *Quercus ellipsoidalis* (northern pin oak) or *Quercus velutina* (black oak) more common on dry sites, and occasional codominance by *Quercus rubra* (northern red oak), *Carya* spp. (hickory), and *Populus* spp. (poplar) (MNNHP 1993). *Sassafras albidum* (sassafras) can become an important tree layer component in the eastern end of the oak woodland range.

This community may include portions of stands also described as brushland (Grimm 1984, MNNHP 1993) or barrens (Bowles and McBride 1994, White 1994a). Shrub cover is usually high (30-50%) with some stands forming impenetrable thickets. Typical shrubs include *Corylus americana* (American hazelnut) and *Cornus foemina* (stiff dogwood). Throughout the range of the type, dominant herbs include *Andropogon gerardii* (big bluestem), *Carex pensylvanica* (Pennsylvania sedge), *Desmodium glutinosum* (pointedleaf ticktrefoil), *Geranium maculatum* (spotted geranium), and many others. These brushlands are dominated by woody species capable of reaching overstory size, but nearly all woody individuals are found in a shrubby state because intense fires are frequent enough to preclude them from reaching overstory size. Other barrens have been described to have scattered woody individuals of canopy size (White 1994a).

This community may also include stands described as "closed savanna" or "closed woodland" (Packard 1988, Swink and Wilhelm 1994). These stands experience low-intensity but moderately frequent fires that preclude the establishment of fire-sensitive tree saplings of species such as *Acer saccharum* (sugar maple), *Tilia americana* (American basswood) and *Fagus grandifolia* (American beech), but allow the establishment and growth to canopy size of moderately fire-tolerant tree saplings such as *Quercus rubra* (northern red oak) and even *Acer nigrum* (black maple). Shrub cover is quite low in this subtype due to the high frequency of low-intensity fire. Fuel loads for fires in this community are provided by several cool-season sedges and grasses such as *Carex rosea* (rosy sedge), *Carex pensylvanica* (Pennsylvania sedge), *Elymus villosus* (hairy wildrye), and *Elymus hystrix* (eastern bottlebrush grass) (Wilhelm 1991).

Macroclimate, as expressed in relative moisture stress levels, is hypothesized to play an important role in species composition variation from east to west in the Oak Woodlands region. Although an oak woodland in Minnesota and Michigan may have soils of the same water-holding capacity, plants in the Minnesota site will experience more drought stress due to macroclimate than the Michigan site. Thus, species that compete best in high-moisture stress situations will require a more open canopy to compete in an eastern oak woodland than they will in a western oak woodland of similar soil type. Conversely, species that compete best in lower moisture stress situations will require a more closed canopy to compete in a western oak woodland than they will in an eastern oak woodland. For example, *Hamamelis virginiana* (American witchhazel), a species which competes well only under low moisture stress conditions, readily invades unburned woodland in Michigan, but is found only in more shaded ravine situations in Wisconsin (B. Pruka pers. obs.) and Minnesota (MNNHP 1993).

Quercus alba (white oak) is the most common overstory tree in dry-mesic oak woodland (Bowles et al. 1994). *Quercus rubra* (northern red oak) becomes important in more mesic soils where it can successfully compete with *Quercus alba* (white oak) (Nowacki et al. 1990). *Quercus rubra* (northern red oak) is a successful gap-colonizer species, and woodlands codominated by it are more likely to be located adjacent to nearby dry-mesic and mesic forests (Kline and Cottam 1979). The catastrophic nature of many woodland fires promotes the presence of woody invaders such as *Populus tremuloides* (quaking aspen), *Populus grandidentata* (bigtooth aspen), and *Fraxinus americana* (white ash) (Kline and Cottam 1979, MNNHP 1993).

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Tree (canopy)	Broad-leaved deciduous tree	*Quercus macrocarpa* (bur oak)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Rhamnus cathartica* (common buckthorn)
Short shrub/sapling	Broad-leaved deciduous shrub	*Rhamnus cathartica* (common buckthorn)
Herb (field)	Vine/Liana	*Parthenocissus vitacea* (woodbine), *Vitis riparia* (riverbank grape)
Herb (field)	Forb	*Circaea lutetiana* (broadleaf enchanter's nightshade)
Herb (field)	Graminoid	*Carex pensylvanica* (Pennsylvania sedge)

Global: Information not available.

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CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: *Quercus macrocarpa*
Global: Information not available.

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Information not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G4 (22-Jun-1998). Most former examples of this community have been eliminated by cultivation, grazing, or conversion to forest due to fire suppression (Curtis 1959, Grimm 1984). Most of the remaining examples are relatively small. Minnesota appears to have the most acreage left.

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Mississippi National River and Recreation Area Comments: At MISS, this community ranges from a woodland to closed forest physiognomy and is dominated by *Quercus macrocarpa* (bur oak). In stands with a closed canopy, the growth form of the older trees and the presence of woodland or prairie species indicate that most stands formerly had a more open canopy and so all *Quercus macrocarpa*-dominated stands are included in this woodland class. Many stands at MISS now have a preponderance of *Rhamnus cathartica* (common buckthorn) or other invasive shrubs in the understory.
Global Comments: This type typically covers dry to dry-mesic stands, but some mesic stands could also be placed here. Traditionally, partially canopied communities with a canopy cover of 10-50% have been classified as savanna, while communities with greater than 50% canopy cover have been classified as forest (Curtis 1959). Recent studies (Pruka 1994, Faber-Langendoen et al. unpubl.) suggest that there is enough turnover in understory composition along this broad canopy continuum to merit the subdivision of partially canopied communities into two communities: savanna (10-30% canopy) and woodland (30-80% canopy) (Anderson 1991, MNNHP 1993, Packard 1993, Pruka 1994). Forest communities in this region generally have >80% canopy cover. This distinction, however, is not clean. For example, in the Driftless area, drier oak forests on loess are typically treated as part of the dry-mesic white oak - red oak forest, ~*Quercus alba - Quercus rubra - Carya ovata* Glaciated Forest (CEGL002068)$$ because of the finer soils that, despite slope and aspect, are more nutrient rich and moist. The driest stands would have been maintained by fire and best fit into this woodland type (H. Dunevitz pers. comm. 2000). This type may occur in Missouri and southern Iowa. Stands in southern Iowa and northern Missouri are currently placed in ~*Quercus alba - (Carya ovata) / Carex pensylvanica* Glaciated Woodland (CEGL002134)$$.
Global Similar Associations:

- *Quercus alba - (Carya ovata) / Carex pensylvanica* Glaciated Woodland (CEGL002134) is a similar type but found in southern Iowa, central Illinois and northern Missouri.
- *Quercus alba - Quercus velutina - Quercus palustris / Carex pensylvanica* Woodland (CEGL005054) Oak woodlands in southeastern Michigan and southwestern Ontario are currently treated as a separate, more eastern woodland type found on the Great Lakes Lakeplain. More information is needed on this distribution.
- *Quercus ellipsoidalis - (Quercus macrocarpa)* Forest (CEGL002077) a northern oak forest has a more-or-less closed canopy (canopy >80%). It is found on nutrient-poor, drought-prone soils that preclude establishment of more nutrient-demanding trees such as *Acer saccharum* (sugar maple). Northern oak forests occur on sites protected from intense fires; otherwise they would be converted to oak woodland or *Corylus americana* (American hazelnut) shrubland. Even though the canopy is generally closed, the canopy architecture of oaks allows enough sunlight to penetrate to the oak forest understory such that oak forests and oak woodlands share many understory species in common. Oak forests are dominated by shrubs that are taller, since the shrubs are not consumed by intense fires. These taller shrubs produce enough shade to reduce the herbaceous component of oak forests in comparison to oak woodlands. Some understory species common in oak woodlands appear unable to compete with the shade of shrubs and saplings in oak forests.
- *Quercus macrocarpa - (Quercus alba, Quercus velutina) / Andropogon gerardii* (CEGL002020)
- *Quercus macrocarpa - (Quercus ellipsoidalis) / Schizachyrium scoparium - Koeleria macrantha* Wooded Herbaceous Vegetation (CEGL002160) northern oak barrens has a wider canopy cover range (10-80%) and is found on sites where fire is more frequent. *Quercus macrocarpa* (bur oak) is of greater importance, shrub cover is generally lower, and graminoid cover is much higher. Understory species shared with dry-mesic oak woodlands but more common in oak openings tend to be those that are less shade-tolerant or more drought-tolerant.
- *Quercus macrocarpa / Corylus americana - Amelanchier alnifolia* Woodland (CEGL000556) dry oak woodland is somewhat related. Both communities have canopies of 30-80%, but opening woodlands are found on loamier soils and dominated by *Quercus alba* (white oak), *Quercus macrocarpa* (bur oak), and *Quercus rubra* (northern red oak) (reaching dominance on more mesic stands only). Dry oak woodlands are found on droughty, sandy soils and are dominated by *Quercus ellipsoidalis* (northern pin oak), *Quercus velutina* (black oak), and *Quercus alba* (white oak). Their highly droughty, low-fertility soils lead to low fuel loads that often allow for only low-intensity fires. Woody individuals which survive the sapling stage generally reach canopy size as the intensities of fire in this community are rarely high enough to kill overstory trees (Anderson 1991). Many understory species are

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shared in common between dry-mesic oak woodlands and dry oak woodlands. Understory species that are either unique to or more common in dry oak woodlands are those that compete well only in acidic, low-nutrient sandy soils or those that compete well only under more droughty conditions. Conversely, species unique to or more common in dry-mesic oak woodlands tend to be more competitive under lower moisture stress conditions and/or prefer more alkaline conditions.

- *Quercus velutina / Carex pensylvanica* Forest (CEGL002078) a northern oak forest has a more-or-less closed canopy (canopy >80%). It is found on nutrient-poor, drought-prone soils that preclude establishment of more nutrient-demanding trees such as *Acer saccharum* (sugar maple). Northern oak forests occur on sites protected from intense fires; otherwise they would be converted to oak woodland or *Corylus americana* (American hazelnut) shrubland. Even though the canopy is generally closed, the canopy architecture of oaks allows enough sunlight to penetrate to the oak forest understory such that oak forests and oak woodlands share many understory species in common. Oak forests are dominated by shrubs that are taller, since the shrubs are not consumed by intense fires. These taller shrubs produce enough shade to reduce the herbaceous component of oak forests in comparison to oak woodlands. Some understory species common in oak woodlands appear unable to compete with the shade of shrubs and saplings in oak forests.

Global Related Concepts:

- Oak Woodland-Brushland (Big Woods Section) (MNNHP 1993) <
- Oak Woodland-Brushland (Southeast Section) (MNNHP 1993) <
- Southern Mesic Woodland White Oak-Bur Oak Subtype (Faber-Langendoen 2001) =

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This association was found primarily between the confluence of the Minnesota and Mississippi Rivers and Hastings and in Coon Rapids Regional Park.

Global Range: This white oak - bur oak woodland is found in the northern prairie-forest border of the midwestern United States, ranging from southeastern Minnesota and Wisconsin south to northeastern Iowa and northern Illinois, and possibly further east in the prairie peninsula.

Nations: US

States/Provinces: IA, IL, IN, MN, WI:S1

TNC Ecoregions: 35:C, 36:?, 46:C, 47:C, 48:C

USFS Ecoregions (1994/95): 212Je:P??, 212Jf:P??, 222Jj:CCC, 222Kf:CCC, 222Kg:CCC, 222Lc:CCC, 222Lf:CCC, 222Mb:CCC, 222Md:CCC, 222Me:CCC, 251Aa:C??, 251Ci:CCC

Federal Lands: NPS (Indiana Dunes, Mississippi, Saint Croix)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: WDMO - North-Central Dry-Mesic Oak Woodland

Mississippi National River and Recreation Area Inventory Notes:

Mississippi National River and Recreation Area Plots and Observation Points: MISS.005, MISS.008, MISS.010, MISS.029, MISS.039, MISS.040, MISS.041, MISS.044, MISS.046, MISS.085, MISS.095, MISS.120, DNR.0665

Local Description Authors: J. Drake

Global Description Authors: B.W. Pruka, J. Drake and D. Faber-Langendoen

References: Anderson 1983, Anderson 1991, Bowles and McBride 1994, Bowles et al. 1994, Chapman 1984, Chapman et al. 1994, Curtis 1959, Faber-Langendoen 2001, Faber-Langendoen et al. n.d., Grimm 1984, Hop et al. 2009, INAI unpubl. data, Kline and Cottam 1979, Leitner et al. 1991, MNNHP 1993, Midwestern Ecology Working Group n.d., Minnesota DNR 2005a, Minnesota DNR 2005c, Nowacki et al. 1990, Packard 1988, Packard 1993, Pfannmuller 1991, Pruka 1994, Schwegman and McClain 1985, Swink and Wilhelm 1994, WNHI 2011, WNHI unpubl. data, White 1994a, White and Madany 1978, Wilhelm 1991

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Midwestern White Oak - Red Oak Forest

Quercus alba - *Quercus rubra* - *Carya ovata* Glaciated Forest
White Oak - Northern Red Oak - Shagbark Hickory Glaciated Forest
Identifier: CEGL002068

USNVC CLASSIFICATION

Division	Eastern North American & Great Plains Cool Temperate Forest & Woodland (1.B.2.Na.)
Macrogroup	Central Midwest Oak Forest, Woodland & Savanna (M012)
Group	North-Central Oak - Hickory Forest & Woodland (G649)
Alliance	White Oak - Northern Red Oak - Hickory species North-Central Forest Alliance (A3323)
Association	Midwestern White Oak - Red Oak Forest

ELEMENT CONCEPT

Global Summary: This oak forest community is widespread in the north-central United States. Stands occur primarily on glaciated, rolling topography on a wide variety of soils that have a dry-mesic moisture condition. The canopy is variable but typically closed (>80%). *Quercus alba* (white oak) and *Quercus rubra* (northern red oak) are the leading dominants, but *Quercus ellipsoidalis* (northern pin oak), *Quercus macrocarpa* (bur oak), *Quercus velutina* (black oak), and *Carya ovata* (shagbark hickory) can also be codominant. Typical associates include *Juglans nigra* (black walnut) and, more south or east, *Carya alba* (mockernut hickory) and *Carya glabra* (pignut hickory). The subcanopy contains *Ostrya virginiana* (hophornbeam), *Prunus serotina* (black cherry), *Sassafras albidum* (sassafras), and, increasingly, *Acer rubrum* (red maple) or *Acer saccharum* (sugar maple). The shrub layer is quite variable but can include *Cornus alternifolia* (alternateleaf dogwood), *Cornus florida* (flowering dogwood) (southward), *Cornus foemina* (stiff dogwood), *Corylus americana* (American hazelnut) (northward), *Parthenocissus quinquefolia* (Virginia creeper), *Ribes cynosbati* (eastern prickly gooseberry), and *Zanthoxylum americanum* (common pricklyash). The herbaceous layer includes *Amphicarpaea bracteata* (American hogpeanut), *Anemone virginiana* (tall thimbleweed), *Symphyotrichum cordifolium (= Aster cordifolius* var. *sagittifolius)* (common blue wood aster), *Botrychium virginianum* (rattlesnake fern), *Brachyelytrum erectum* (bearded shorthusk), *Circaea lutetiana* ssp. *canadensis* (broadleaf enchanter's nightshade), *Desmodium glutinosum* (pointedleaf ticktrefoil), *Galium concinnum* (shining bedstraw), *Geranium maculatum* (spotted geranium), *Osmorhiza claytonii* (Clayton's sweetroot), *Sanicula odorata* (clustered blacksnakeroot), and *Maianthemum racemosum* (feathery false lily of the valley).

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This community occurs on dry-mesic settings on a variety of landscapes from flat uplands to steep valley slopes. Soils are mostly loam, sandy loam, and loamy sand. The ground surface is mostly covered by leaf litter with a moderate amount of bare ground and a minor amount of downed wood.
Global Environment: This community is found primarily on glaciated, rolling topography on a wide variety of soils that have a dry-mesic moisture condition. It is also found in the unglaciated Driftless Area of the upper Midwest.

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This community has a moderately closed to dense (50-90%) tree canopy. *Quercus alba* (white oak) and *Quercus rubra* (northern red oak) are the most common tree canopy species though some disturbed stands may be dominated by early successional species such as *Populus tremuloides* (quaking aspen), *Populus deltoides* (eastern cottonwood), *Fraxinus pennsylvanica* (green ash), and *Celtis occidentalis* (common hackberry). The tree subcanopy ranges from 0-70% (avg. 22%) and can have a variety of species but *Quercus rubra* (northern red oak), *Tilia americana* (American basswood), *Ulmus americana* (American elm), and *Prunus serotina* (black cherry) are commonly found. The shrub layers are usually rich with small trees, shrubs, and climbing vines. *Acer saccharum* (sugar maple) is not in many plots but can be very abundant in a few stands. Frequently encountered species are *Rhamnus cathartica* (common buckthorn), *Vitis riparia* (riverbank grape), *Parthenocissus vitacea* (woodbine), *Rubus occidentalis* (black raspberry), and *Smilax tamnoides* (bristly greenbrier). A wide variety of forbs and graminoids can be found in the ground layer. Few have significant cover on their own but together they had 5-70% (avg 40%) cover. Some of the more common species are *Amphicarpaea bracteata* (American hogpeanut), *Carex pensylvanica* (Pennsylvania sedge), *Desmodium glutinosum* (pointedleaf ticktrefoil), *Galium triflorum* (fragrant bedstraw), *Geum canadense* (white avens), and *Osmorhiza claytonii* (Clayton's sweetroot), along with tree seedlings.
Global Vegetation: The canopy is variable but typically closed (>80%). *Quercus alba* (white oak) and *Quercus rubra* (northern red oak) are the leading dominants, but *Quercus ellipsoidalis* (northern pin oak), *Quercus macrocarpa* (bur oak), *Quercus velutina* (black oak), and *Carya ovata* (shagbark hickory) can also be codominant. In Minnesota, *Quercus ellipsoidalis* (northern pin oak) replaces *Quercus velutina* (black oak) in the east-central part of the state (e.g., Washington County). Typical associates include *Juglans nigra* (black walnut), and more south or east, *Carya alba* (mockernut hickory) and *Carya glabra* (pignut hickory). The subcanopy contains *Ostrya virginiana* (hophornbeam), *Prunus serotina* (black cherry), *Sassafras albidum* (sassafras), and, increasingly, *Acer rubrum* (red maple) or *Acer saccharum* (sugar maple). The shrub layer is quite variable but can include *Cornus alternifolia* (alternateleaf dogwood), *Cornus florida* (flowering dogwood) (southward), *Cornus foemina* (stiff dogwood), *Corylus americana* (American hazelnut) (northward), *Parthenocissus quinquefolia* (Virginia creeper), *Ribes cynosbati* (eastern prickly gooseberry), and *Zanthoxylum americanum* (common pricklyash). The herbaceous layer includes *Amphicarpaea bracteata* (American hogpeanut), *Anemone virginiana* (tall thimbleweed), *Symphyotrichum cordifolium (= Aster sagittifolius)* (common blue wood aster), *Botrychium*

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virginianum (rattlesnake fern), *Brachyelytrum erectum* (bearded shorthusk), *Circaea lutetiana* ssp. *canadensis (= Circaea quadrisulcata)* (broadleaf enchanter's nightshade), *Desmodium glutinosum* (pointedleaf ticktrefoil), *Galium concinnum* (shining bedstraw), *Geranium maculatum* (spotted geranium), *Osmorhiza claytonii* (Clayton's sweetroot), *Sanicula odorata (= Sanicula gregaria)* (clustered blacksnakeroot), and *Maianthemum racemosum (= Smilacina racemosa)* (feathery false lily of the valley) (Curtis 1959, Nelson 1985, MNNHP 1993, Anderson 1996).

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Tree (canopy)	Broad-leaved deciduous tree	*Quercus alba* (white oak), *Quercus rubra* (northern red oak)
Tree subcanopy	Broad-leaved deciduous tree	*Quercus rubra* (northern red oak), *Ulmus americana* (American elm)
Short shrub/sapling	Broad-leaved deciduous shrub	*Prunus virginiana* (chokecherry), *Rhamnus cathartica* (common buckthorn)
Herb (field)	Vine/Liana	*Parthenocissus vitacea* (woodbine), *Vitis riparia* (riverbank grape)
Herb (field)	Forb	*Desmodium glutinosum* (pointedleaf ticktrefoil), *Osmorhiza claytonii* (Clayton's sweetroot)
Herb (field)	Graminoid	*Carex pensylvanica* (Pennsylvania sedge)

Global: Information not available.

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: *Quercus alba, Quercus rubra*
Global: Information not available.

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Vulnerable: *Panax quinquefolius* (G3G4, under collection pressure)

CONSERVATION STATUS RANK

Global Rank & Reasons: G4? (3-Oct-1996). Many sites have been cleared, logged, and grazed. It is not clear how many high quality, large tracts exist.

CLASSIFICATION

Status: Standard
Classification Confidence: 1 - Strong
Mississippi National River and Recreation Area Comments: This association was found between downtown Minneapolis and Hastings.
Global Comments: This type rarely has any other oak species in it beyond *Quercus alba* (white oak), *Quercus rubra* (northern red oak), *Quercus velutina* (black oak), and occasional *Quercus macrocarpa* (bur oak) or *Quercus ellipsoidalis* (northern pin oak), unlike stands farther south with southern oak species. This type is primarily found on glaciated terrain, including Wisconsinan through Kansan, but its distribution may extend beyond that. Where stands have either *Acer rubrum* (red maple) or *Acer saccharum* (sugar maple) at >20% canopy coverage or basal area, they should be placed in *~Quercus rubra - (Acer saccharum, Quercus alba)* Forest (CEGL005017)$$, an oak-maple type. Also compare to *~Quercus alba - Quercus rubra - Carya ovalis / Acer saccharum / Polystichum acrostichoides* Forest (CEGL007233)$$ of the southeastern states.
Global Similar Associations:
- *Quercus alba - Quercus rubra - Carya (alba, ovata) / Cornus florida* Acidic Forest (CEGL002067) is an unglaciated white oak-red oak type
- *Quercus alba - Quercus rubra - Carya ovalis / Acer saccharum / Polystichum acrostichoides* Forest (CEGL007233)
- *Quercus alba - Quercus rubra - Quercus muehlenbergii / Cercis canadensis* Forest (CEGL002070) is an unglaciated white oak-red oak type
- *Quercus alba - Quercus rubra - Quercus prinus - Acer saccharum / Lindera benzoin* Forest (CEGL002059) is a red oak-white oak-maple type; generally more mesic or more maple-dominated.
- *Quercus prinus - Quercus (alba, coccinea, velutina) / Viburnum acerifolium - (Kalmia latifolia)* Forest (CEGL005023)
- *Quercus prinus - Quercus* spp. / *Vaccinium arboreum - (Kalmia latifolia, Styrax grandifolius)* Forest (CEGL007700)
- *Quercus rubra - (Acer saccharum, Quercus alba)* Forest (CEGL005017) is a red oak-white oak-maple type; generally more mesic or more maple-dominated.
- *Quercus rubra - Quercus alba - (Quercus velutina, Acer rubrum) / Viburnum acerifolium* Forest (CEGL002462)

Global Related Concepts:
- Dry - Fresh Hickory Deciduous Forest Type (Lee et al. 1998) <
- Dry - Fresh Oak - Hickory Deciduous Forest Type (Lee et al. 1998) <
- Dry-Mesic Forest (Nelson 1985) >
- Dry-Mesic Southern Forest - White Oak (Red Oak)-Hickory (Chapman et al. 1989) >

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- Oak Forest (Big Woods Section) Mesic Subtype (MNNHP 1993) <
- Oak Forest (Southeast Section) Mesic Subtype (MNNHP 1993) <
- Oak-Hickory Forests (Anderson 1996) =
- Southern Dry-Mesic Forest (Curtis 1959) =
- Southern Dry-Mesic Forest White Oak-Red Oak Subtype (Faber-Langendoen 2001) =

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This association is abundant and found throughout most of the MISS project area, though it is most common in the central portion of the area and is uncommon in the floodplain-dominated area of Gore's Pool WMA.
Global Range: This oak forest community is widespread in the north-central United States, ranging from Ohio west to Minnesota, south to Iowa, and east to Indiana.
Nations: CA, US
States/Provinces: IA:S4, IL, IN, MI, MN, MO, OH, ON, WI:S3
TNC Ecoregions: 35:C, 36:C, 37:C, 38:C, 44:C, 45:C, 46:C, 47:C, 48:C, 49:C
USFS Ecoregions (1994/95): 212Fb:PPP, 212Jj:P??, 212Ka:P??, 221Ea:CCC, 221Ec:CCC, 221Ee:CCC, 221Ef:CCC, 221Eg:CCC, 221Fa:CCC, 221Fb:CCP, 221Fc:CCC, 222Aa:CCC, 222Ak:CCC, 222Ao:CCC, 222Aq:CCC, 222Fe:CCC, 222Ga:CCC, 222Gb:CCC, 222Gc:CCC, 222Ha:CCC, 222Hb:CCC, 222Hf:CCC, 222Id:CCP, 222If:CCC, 222Ja:CCC, 222Jb:CCC, 222Jg:CCC, 222Jh:CCC, 222Ji:CCC, 222Jj:CCC, 222Ke:CCC, 222Kf:CCC, 222Kg:CCC, 222Kh:CCC, 222Kj:CCC, 222Lb:CCC, 222Lc:CCC, 222Qb:CCC, 251Be:CCC, 251Cb:CCC, 251Cc:CCC, 251Cd:CCC, 251Ce:CCC, 251Cf:CCC, 251Cg:CCC, 251Cj:CCC, 251Ck:CCC, 251Dc:CCC, 251Dd:CCC, 251De:CCC, 251Df:CCC, 251Dh:CCP
Federal Lands: NPS (Cuyahoga Valley, Effigy Mounds, Indiana Dunes, Mississippi, Saint Croix); USFS (Finger Lakes)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: FWRO - Midwestern White Oak - Red Oak Forest
Mississippi National River and Recreation Area Inventory Notes:
Mississippi National River and Recreation Area Plots and Observation Points: DNR.4618, DNR.4922, MISS.001, MISS033, MISS.037, MISS038, MISS.083, MISS.102, MISS.106, MISS.125
Local Description Authors: J. Drake
Global Description Authors: D. Faber-Langendoen
References: Abrams 1992, Anderson 1996, Chapman et al. 1989, Curtis 1959, Faber-Langendoen 2001, Homoya et al. 1988, Hop et al. 2005, Hop et al. 2009, INAI unpubl. data, Kost et al. 2007, Lee et al. 1998, MNNHP 1993, Midwestern Ecology Working Group n.d., Minnesota DNR 2005a, Nelson 1985, Nelson 2010, ONHD unpubl. data, WNHI 2011, WNHI unpubl. data, White and Madany 1978

M882. Central Midwest Mesic Forest

G021. North-Central Beech - Maple - Basswood Forest

North-Central Maple - Basswood Forest

Acer saccharum - *Tilia americana* / *Ostrya virginiana* - *Carpinus caroliniana* Forest
Sugar Maple - American Basswood / Hophornbeam - American Hornbeam Forest
Identifier: CEGL002062

USNVC CLASSIFICATION

Division	Eastern North American & Great Plains Cool Temperate Forest & Woodland (1.B.2.Na.)
Macrogroup	Central Midwest Mesic Forest (M882)
Group	North-Central Beech - Maple - Basswood Forest (G021)
Alliance	Sugar Maple - American Basswood - Northern Red Oak Forest Alliance (A0220)
Association	North-Central Maple - Basswood Forest

ELEMENT CONCEPT

Global Summary: This maple - basswood forest is found in the north-central United States. Stands occur on flat to steep slopes on loamy soils derived from glacial till or, less commonly, loess. The soils are well-drained, fertile, and deep. The tree canopy of this community is moderately dense to dense and greatly affects the composition of the understory. *Acer saccharum* (sugar maple) and *Tilia americana* (American basswood) are the most prevalent tree species. Other common tree species include *Carpinus caroliniana* (American hornbeam), *Carya cordiformis* (bitternut hickory), *Carya ovata* (shagbark hickory), *Fraxinus pennsylvanica* (green ash), *Juglans nigra* (black walnut), *Ostrya virginiana* (hophornbeam), *Quercus alba* (white oak), *Quercus rubra* (northern red oak), and *Ulmus* spp. (elm). The scattered shrub layer contains species such as *Cornus alternifolia* (alternateleaf dogwood), *Ribes* spp. (gooseberry), *Sambucus* spp. (elderberry), and *Zanthoxylum americanum* (common pricklyash). Spring ephemerals are a distinctive

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part of the herbaceous layer. Common herbaceous species include *Anemone quinquefolia* (wood anemone), *Claytonia* spp. (springbeauty), *Dicentra cucullaria* (dutchman's breeches), *Erythronium* spp. (fawnlilly), *Polygonatum pubescens* (hairy Solomon's seal), *Sanicula odorata (= Sanicula gregaria)* (clustered blacksnakeroot), *Trillium grandiflorum* (white trillium), and *Uvularia grandiflora* (largeflower bellwort).

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This community is found on level to steeply sloping sites but 6 of the 8 plots with measured slopes were >25 degrees and were on ravine slopes directly above the Mississippi River. All plots had a northerly or easterly aspect. Soils were loams and clay. The ground surface is covered mostly by leaf litter with lesser amounts of bare soil. Downed wood is fairly common in this community.

Global Environment: This community is found on flat to steep slopes on loamy soils derived from glacial till or, less commonly, loess (Curtis 1959). The soils are well-drained, fertile, and deep (MNNHP 1993).

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: The tree canopy of this mesic forest community is typically 15-20 m tall and dense (70-100% cover). It is dominated by *Acer saccharum* (sugar maple), and *Tilia americana* (American basswood). *Carya cordiformis* (bitternut hickory), *Quercus rubra* (northern red oak), *Fraxinus pennsylvanica* (green ash), and *Ulmus* spp. (elm) are often present in the canopy. Some disturbed sites can have significant amounts of *Populus deltoides* (eastern cottonwood) above a subcanopy of *Acer saccharum* (sugar maple) and *Tilia americana* (American basswood). The subcanopy is open to closed (20-70%). *Acer saccharum* (sugar maple) is the most consistent and abundant component of the subcanopy across all sites. *Tilia americana* (American basswood), *Ostrya virginiana* (hophornbeam), *Ulmus americana* (American elm), and *Ulmus rubra* (slippery elm) are other common associates in the subcanopy. The tall and short shrub strata can both be absent to dense (0-80%). They both nearly always contain small *Acer saccharum* (sugar maple), *Rhamnus cathartica* (common buckthorn), and *Parthenocissus vitacea* (woodbine). *Acer saccharum* (sugar maple) is the most abundant. Other species often in the shrub layers are *Ribes cynosbati* (eastern prickly gooseberry), *Tilia americana* (American basswood), *Vitis riparia* (riverbank grape) *Zanthoxylum americanum* (common pricklyash), *Staphylea trifolia* (American bladdernut), and *Toxicodendron rydbergii* (western poison ivy). The herbaceous stratum is highly variable in cover and diversity. Cover averaged 23% and varied from 5-60%. Eighty-five species, including tree species, were found in the herbaceous stratum in the 10 plots at MISS. Seedlings of *Acer saccharum* (sugar maple), *Tilia americana* (American basswood), and *Celtis occidentalis* (common hackberry) are in most plots. *Asarum canadense* (Canadian wildginger), *Arisaema triphyllum* (Jack in the pulpit), *Hydrophyllum virginianum* (eastern waterleaf), *Solidago flexicaulis* (zigzag goldenrod), and *Carex pensylvanica* (Pennsylvania sedge) are in most plots, as well.

Global Vegetation: The tree canopy of this community is moderately dense to dense and greatly affects the composition of the understory. Only shade-tolerant species are able to persist (Curtis 1959). *Acer saccharum* (sugar maple) and *Tilia americana* (American basswood) are the most prevalent tree species. Other common tree species include *Carpinus caroliniana* (American hornbeam), *Carya cordiformis* (bitternut hickory), *Carya ovata* (shagbark hickory), *Fraxinus pennsylvanica* (green ash), *Juglans nigra* (black walnut), *Ostrya virginiana* (hophornbeam), *Quercus alba* (white oak), *Quercus rubra* (northern red oak), and *Ulmus* spp. (elm). The scattered shrub layer contains species such as *Cornus alternifolia* (alternateleaf dogwood), *Ribes* spp. (gooseberry), *Sambucus* spp. (elderberry), and *Zanthoxylum americanum* (common pricklyash). Spring ephemerals are a distinctive part of the herbaceous layer. Common herbaceous species include *Anemone quinquefolia* (wood anemone), *Claytonia* spp. (springbeauty), *Dicentra cucullaria* (dutchman's breeches), *Erythronium* spp. (fawnlilly), *Polygonatum pubescens* (hairy Solomon's seal), *Sanicula odorata (= Sanicula gregaria)* (clustered blacksnakeroot), *Trillium grandiflorum* (white trillium), and *Uvularia grandiflora* (largeflower bellwort) (Curtis 1959, MNNHP 1993). In more disturbed examples of this association such as those found at Effigy Mounds National Monument in Iowa, *Laportea canadensis* (Canadian woodnettle) can range from moderate to very dense and can almost exclusively dominate the understory in some examples.

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Tree (canopy)	Broad-leaved deciduous tree	*Acer saccharum* (sugar maple), *Tilia americana* (American basswood)
Tree subcanopy	Broad-leaved deciduous tree	*Acer saccharum* (sugar maple), *Tilia americana* (American basswood), *Ostrya americana* (hophornbeam)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Acer saccharum* (sugar maple)
Short shrub/sapling	Broad-leaved deciduous shrub	*Acer saccharum* (sugar maple), *Rhamnus cathartica* (common buckthorn

Global: Information not available.

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: *Acer saccharum*

Global: Information not available.

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OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Vulnerable: *Rhus aromatica* var. *arenaria* (G5T3Q)

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G4 (3-Mar-2000). These rich mesic hardwood forests are poorly protected throughout their range. They were once the matrix forests over large parts of the upper Midwest, and now occur primarily in small (<1000 acres) fragments, many of which have been logged or grazed.

CLASSIFICATION

Status: Standard
Classification Confidence: 1 - Strong
Mississippi National River and Recreation Area Comments:
Global Comments: This type may be in Indiana [see Lindsey et al. (1969), p. 532-533 at Ecology Cove Dune State Park]. Pure basswood stands in the western part of range are placed in *~Tilia americana - (Quercus macrocarpa) / Ostrya virginiana* Forest (CEGL002012)$$. Stands in northwestern Wisconsin probably should go with *~Acer saccharum - Tilia americana / Ostrya virginiana / Lonicera canadensis* Forest (CEGL002458)$$. Compare with *~Acer saccharum - Acer nigrum - Tilia americana - Quercus rubra / Ostrya virginiana* Forest (CEGL002061)$$ in the central Midwest.
Global Similar Associations:
- *Acer saccharum - Acer nigrum - Tilia americana - Quercus rubra / Ostrya virginiana* Forest (CEGL002061)
- *Acer saccharum - Carya cordiformis / Asimina triloba* Floodplain Forest (CEGL005035)
- *Acer saccharum - Tilia americana / Ostrya virginiana / Lonicera canadensis* Forest (CEGL002458)
- *Tilia americana - (Quercus macrocarpa) / Ostrya virginiana* Forest (CEGL002012)

Global Related Concepts:
- *Acer* Forest (Cahayla-Wynne and Glenn-Lewis 1978) <
- *Tilia* Forest (Cahayla-Wynne and Glenn-Lewis 1978) <
- Maple-Basswood Forest (Big Woods Section) (MNNHP 1993) <
- Maple-Basswood Forest (Southeast Section) (MNNHP 1993) <
- Southern Mesic Forest (Curtis 1959) >
- Southern Mesic Forest Maple-Basswood Southern Subtype (Faber-Langendoen 2001) =

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This association was found between downtown Minnespolis and Hastings SNA.
Global Range: This maple - basswood forest is found in the north-central United States, ranging from northern Illinois west to South Dakota.
Nations: US
States/Provinces: IA:S4?, IL, IN, MN, SD:S2, WI:S3
TNC Ecoregions: 35:C, 36:C, 44:C, 45:C, 46:C, 47:C, 48:C
USFS Ecoregions (1994/95): 212Hd:CCC, 212Jl:CCC, 212Kb:CCC, 212Nc:CCC, 222Ga:CCC, 222Hf:CCC, 222Jj:CCC, 222Ke:CCC, 222Kf:CCC, 222Kg:CCC, 222Kh:CCC, 222Kj:CCC, 222Lc:CCC, 222Ld:CCC, 222Le:CCC, 222Lf:CCC, 222Ma:CCC, 222Mb:CCC, 222Mc:CCC, 222Md:CCC, 222Me:CCC, 251Aa:CCC, 251Ba:CCC, 251Bb:CCC, 251Be:CCC, 251Cf:CCC, 251De:CCC, 251Df:CCC
Federal Lands: NPS (Effigy Mounds, Indiana Dunes, Mississippi, Saint Croix)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: FMBH - Maple - Basswood - Hardwood Forest
Mississippi National River and Recreation Area Inventory Notes:
Mississippi National River and Recreation Area Plots and Observation Points: DNR5645, DNR8319, MISS.063, MISS.065, MISS.071, MISS.091, MISS.099, MISS.122, MISS.123, MISS.126
Local Description Authors: J. Drake
Global Description Authors: J. Drake
References: Cahayla-Wynne and Glenn-Lewis 1978, Curtis 1959, Daubenmire 1936, Faber-Langendoen 2001, Grimm 1984, Hop et al. 2005, Hop et al. 2009, INAI unpubl. data, Lindsey et al. 1969, MNNHP 1993, Midwestern Ecology Working Group n.d., Minnesota DNR 2005a, Minnesota DNR 2005c, SDNHP unpubl. data, WNDD unpubl. data, WNHI 2011, WNHI unpubl. data, White and Madany 1978

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Red Oak - Sugar Maple - Elm Forest

Quercus rubra - (*Acer saccharum*, *Quercus alba*) Forest
Northern Red Oak - (Sugar Maple, White Oak) Forest
Identifier: CEGL005017

USNVC CLASSIFICATION

Division	Eastern North American & Great Plains Cool Temperate Forest & Woodland (1.B.2.Na.)
Macrogroup	Central Midwest Mesic Forest (M882)
Group	North-Central Beech - Maple - Basswood Forest (G021)
Alliance	Sugar Maple - American Basswood - Northern Red Oak Forest Alliance (A0220)
Association	Red Oak - Sugar Maple - Elm Forest

ELEMENT CONCEPT

Global Summary: This community is found in the northern prairie-forest border region of the United States and farther east to Ohio. Tree canopy dominance is variable, but *Quercus rubra* (northern red oak) is always present with at least moderate (20%) cover. Other associates may include *Acer saccharum* (sugar maple), *Acer rubrum* (red maple), *Quercus alba, Tilia americana* (American basswood), and *Ulmus americana* (American elm). The subcanopy and sapling layers often contain *Prunus virginiana* (chokecherry) or *Prunus serotina* (black cherry). This type is poorly understood, but may represent a successional type in the prairie-forest border region shifting from oak dominance to maple, basswood and elm dominance. The type is restricted to the central midwestern region and extreme southern Ontario, and is not found in northern Minnesota, northern Wisconsin, northern Michigan, or central Ontario.

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This deciduous forest is typically found on moderate to steep slopes, often with talus or bedrock exposures. The unvegetated surface is mostly bare soil and leaf litter.
Global Environment: The oak stands generally are found on either mesic sites protected from fire or on drier slopes, where, historically, fires could sweep through, but where fire protection is creating more mesic conditions.

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: The tree canopy is moderately dense to dense in this forest. *Quercus rubra* (northern red oak) and *Quercus alba* (white oak) are co-dominant with *Acer saccharum* (sugar maple) and *Tilia americana* (American basswood) with secondary associates such as *Celtis occidentalis* (common hackberry), *Fraxinus pennsylvanica* (green ash), and *Ulmus* spp. (elm). *Ostrya virginiana* (hophornbeam) is common in the tree subcanopy.
Global Vegetation: The vegetation is comprised of a closed-canopy tree layer. The major tree dominant is *Quercus rubra* (northern red oak). Other common associates include *Acer saccharum* (sugar maple), *Acer rubrum* (red maple), *Quercus alba* (white oak), *Tilia americana* (American basswood), and *Ulmus americana* (American elm). The subcanopy and sapling layers often contain *Ostrya virginiana* (hophornbeam), *Prunus virginiana* (chokecherry) or *Prunus serotina* (black cherry) and, in the eastern part of the association's range, *Cornus florida* (flowering dogwood) and *Lindera benzoin* (northern spicebush). The understory can contain many common herbs of dry-mesic to mesic deciduous forests such as *Actaea pachypoda* (white baneberry), *Allium tricoccum* (ramp), *Aralia nudicaulis* (wild sarsaparilla), *Arisaema triphyllum* (Jack in the pulpit), *Desmodium* spp. (ticktrefoil), and *Maianthemum canadense* (Canada mayflower).

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Tree (canopy)	Broad-leaved deciduous tree	*Acer saccharum* (sugar maple), *Quercus alba* (white oak), *Quercus rubra* (northern red oak), *Tilia americana* (American basswood)
Tree subcanopy	Broad-leaved deciduous tree	*Ostrya virginiana* (hophornbeam)

Global: Information not available.

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Information not available.

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Information not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G4? (14-Aug-2009). This association is relatively common throughout its range. It can arise from logging or other anthropogenic disturbance.

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CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Mississippi National River and Recreation Area Comments:
Global Comments: This type is only moderately well understood; current stands represent both mesic stands protected from fire and somewhat more dry-mesic stands as a successional type shifting from oak dominance to maple, basswood, and elm dominance. The type concept is restricted to south of Province 212 (Bailey et al. 1994), and north of the limits of glaciation. Stands in Ohio may differ from those further west. See also Kline and Cottam (1979) where a white oak - maple forest type is described in the prairie - forest border. Stands in southern Indiana need to be compared with other red oak - maple types.
Global Similar Associations:
- *Quercus alba - Quercus rubra - Carya ovata* Glaciated Forest (CEGL002068) is typically found in dry-mesic sites with a mixed oak canopy, typically with *Quercus alba* as a significant component.
- *Quercus rubra - Acer saccharum - (Betula alleghaniensis)* Forest (CEGL002461) is another red oak type, but is generally north of the prairie-forest border in Province 212.
- *Quercus rubra - Quercus alba - (Quercus velutina, Acer rubrum) / Viburnum acerifolium* Forest (CEGL002462) is another red oak type, in Province 212.

Global Related Concepts:
- Southern Dry-Mesic Forest Mesic Red Oak Subtype (Faber-Langendoen 2001) =

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This association was found between downtown Minneapolis and Hastings SNA.
Global Range: This community is found in the northern prairie-forest border and central midwestern region of the United States, ranging from western Ohio and southern Michigan, west to southern Minnesota and Iowa.
Nations: CA, US
States/Provinces: IA?, IL, IN, MI, MN, OH, ON, WI
TNC Ecoregions: 36:C, 44:C, 45:C, 48:C, 49:C
USFS Ecoregions (1994/95): 221Fa:CCC, 222Aq:CCC, 222Fd:CCC, 222Ga:CCC, 222Ha:CCC, 222Hb:CCC, 222Hc:CCC, 222Jb:CCC, 222Jc:CCC, 222Jg:CCC, 222Jj:CCC, 222Kg:CCC, 222Lb:CCC, 222Lc:CCC, 222Lf:CCC, 222M:CP, 251Cf:CCC, 251Ci:CCC, 251Cj:CCC, 251Dc:CCC, 251De:CCC, 251Dg:CCC
Federal Lands: NPS (Indiana Dunes, Mississippi)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: FMBH - Maple - Basswood - Hardwood Forest
Mississippi National River and Recreation Area Inventory Notes: This association was not identified during plot sampling. It was found later in the project and so is described based on field reconnaissance notes and Accuracy Assessment data. As such, it lacks comprehensive species lists and detailed information on vegetation strata.
Mississippi National River and Recreation Area Plots and Observation Points: No plots at MISS.
Local Description Authors: J. Drake
Global Description Authors: D. Faber-Langendoen, mod. J. Drake
References: Bailey et al. 1994, Faber-Langendoen 2001, Homoya et al. 1988, Hop et al. 2009, INAI unpubl. data, Kline and Cottam 1979, Kost et al. 2007, Midwestern Ecology Working Group n.d., ONHD unpubl. data, WNHI 2011, WNHI unpubl. data, White and Madany 1978

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M159. Laurentian & Acadian Pine - Oak Forest & Woodland

G025. Laurentian & Acadian Pine - Oak Forest & Woodland

White Pine - Red Oak Forest

Pinus strobus - (*Pinus resinosa*) - *Quercus rubra* Forest
Eastern White Pine - (Red Pine) - Northern Red Oak Forest
Identifier: CEGL002480

USNVC CLASSIFICATION

Division	Eastern North American & Great Plains Cool Temperate Forest & Woodland (1.B.2.Na.)
Macrogroup	Laurentian & Acadian Pine - Oak Forest & Woodland (M159)
Group	Laurentian & Acadian Pine - Oak Forest & Woodland (G025)
Alliance	Eastern White Pine - Red Pine - Northern Red Oak Forest & Woodland Alliance (A4127)
Association	White Pine - Red Oak Forest

ELEMENT CONCEPT

Global Summary: This white pine - oak forest occurs in the central Great Lakes region of the United States and Canada, where it occurs on dry to dry-mesic sites with well-drained sandy loams or coarser soils, typically on morainal slopes. *Pinus strobus* (eastern white pine) is the dominant component of the overstory, often forming a supercanopy above the hardwood canopy. *Quercus rubra* (northern red oak) is an important canopy species, along with *Acer saccharum* (sugar maple), and *Quercus alba* (white oak) in central Minnesota, and, farther eastward, *Fraxinus americana* (white ash), *Quercus velutina* (black oak), and occasional *Fagus grandifolia* (American beech). Northern stands may contain *Acer rubrum* (red maple), *Betula papyrifera* (paper birch), *Pinus resinosa* (red pine), *Pinus strobus* (eastern white pine), *Populus grandidentata* (bigtooth aspen), and *Populus tremuloides* (quaking aspen), along with *Abies balsamea* (balsam fir) in the understory. The shrub and vine layer in the southern part of the range contains *Cornus foemina* (stiff dogwood), *Corylus americana* (American hazelnut), *Parthenocissus quinquefolia* (Virginia creeper), and *Vaccinium angustifolium* (lowbush blueberry), and, farther north, *Corylus cornuta* (beaked hazelnut), *Diervilla lonicera* (northern bush honeysuckle), *Gaultheria procumbens* (eastern teaberry), *Vaccinium angustifolium* (lowbush blueberry), and *Viburnum acerifolium* (mapleleaf viburnum). Typical herbs in the southern part of the range include *Amphicarpaea bracteata* (American hogpeanut), *Aralia nudicaulis* (wild sarsaparilla), *Carex pensylvanica* (Pennsylvania sedge), and *Geranium maculatum* (spotted geranium); farther north, they include *Eurybia macrophylla (= Aster macrophyllus)* (bigleaf aster), *Maianthemum canadense* (Canada mayflower), *Oryzopsis asperifolia* (roughleaf ricegrass), *Polygala paucifolia* (gaywings), *Polygonatum pubescens* (hairy Solomon's seal), *Pteridium aquilinum* (western brackenfern), and *Trientalis borealis* (starflower). Mosses include *Ptilidium pulcherrimum*.

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This dry-mesic forest was is found on moderate to steep slopes, often but not exclusively on south or west facing slopes. Soils are usually well drained and sandy. The unvegetated surface is approximately half leaf litter and half bare ground with a few rocks present on some sites.
Global Environment: Sites are found on dry-mesic to mesic sites with well-drained sandy loams or coarser soils, typically on morainal slopes and ridges.

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This is a mixed conifer-deciduous forest, though some small areas may be nearly all conifers. The tree canopy is closed (avg. 70%) and tall compared to other forests at MISS. *Pinus strobus* (eastern white pine) is dominant to co-dominant and sometimes is significantly taller than the deciduous trees. *Quercus alba* (white oak) and *Quercus rubra* (northern red oak) are the most abundant deciduous trees. *Betula papyrifera* (paper birch) is an unusual tree at MISS that was found fairly often in this forest. The shrub layer is usually well-developed (avg. 70%) with species such as *Ribes missouriense* (Missouri gooseberry), *Rhamnus cathartica* (common buckthorn), *Prunus virginiana* (chokecherry), and exotic *Lonicera* spp. (honeysuckle). The herbaceous stratum is moderately well developed (avg. 40%) and contains many of the grasses and forbs common to dry-mesic forests at MISS, such as *Ageratina altissima* (white snakeroot), *Aralia nudicaulis* (wild sarsaparilla), *Arisaema triphyllum* (Jack in the pulpit), *Carex pensylvanica* (Pennsylvania sedge), *Circaea lutetiana* (broadleaf enchanter's nightshade), *Maianthemum racemosum* (feathery false lily of the valley), and the woody vine *Parthenocissus vitacea* (woodbine).
Global Vegetation: *Pinus strobus* (eastern white pine) is the dominant component of the overstory, often forming a supercanopy above the hardwood canopy. *Quercus rubra* (northern red oak) is an important canopy species, along with *Acer saccharum* (sugar maple) and *Quercus alba* (white oak) in central Minnesota, and, farther eastward, *Fraxinus americana* (white ash), *Quercus velutina* (black oak), and occasional *Fagus grandifolia* (American beech). Northern stands may contain *Acer rubrum* (red maple), *Betula papyrifera* (paper birch), *Pinus resinosa* (red pine), *Pinus strobus* (eastern white pine), *Populus grandidentata* (bigtooth aspen), and *Populus tremuloides* (quaking aspen), along with *Abies balsamea* (balsam fir) in the understory. The shrub and vine layer in the southern part of the range contains *Cornus foemina* (stiff dogwood), *Corylus americana* (American hazelnut), *Parthenocissus quinquefolia* (Virginia creeper), and *Vaccinium angustifolium* (lowbush blueberry), and, farther north, *Corylus cornuta* (beaked hazelnut), *Diervilla lonicera* (northern bush honeysuckle), *Gaultheria procumbens* (eastern teaberry), *Vaccinium angustifolium*

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(lowbush blueberry), and *Viburnum acerifolium* (mapleleaf viburnum). Typical herbs in the southern part of the range include *Amphicarpaea bracteata* (American hogpeanut), *Aralia nudicaulis* (wild sarsaparilla), *Carex pensylvanica* (Pennsylvania sedge), and *Geranium maculatum* (spotted geranium); farther north, they include *Eurybia macrophylla (= Aster macrophyllus)* (bigleaf aster), *Maianthemum canadense* (Canada mayflower), *Oryzopsis asperifolia* (roughleaf ricegrass), *Polygala paucifolia* (gaywings), *Polygonatum pubescens* (hairy Solomon's seal), *Pteridium aquilinum* (western brackenfern), and *Trientalis borealis* (starflower). Mosses include *Ptilidium pulcherrimum*, among others (Eyre 1980, MNNHP 1993, Chambers et al. 1997).

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Tree (canopy)	Broad-leaved deciduous tree	*Pinus strobus* (eastern white pine), *Quercus alba* (white oak), *Quercus rubra* (northern red oak)
Short shrub/sapling	Broad-leaved deciduous shrub	*Prunus virginiana* (chokecherry), *Rhamnus cathartica* (common buckthorn)
Herb (field)	Forb	*Ageratina altissima* (white snakeroot), *Parthenocissus vitacea* (woodbine)
Herb (field)	Graminoid	*Carex pensylvanica* (Pennsylvania sedge)

Global: Information not available.

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: *Pinus strobus, Quercus alba, Quercus rubra*
Global: Information not available.

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Vulnerable: *Panax quinquefolius* (G3G4, under collection pressure)

CONSERVATION STATUS RANK

Global Rank & Reasons: G4 (13-Nov-2006). This association occurs in the Great Lake states region of the U.S. and in Ontario, Canada. More than 50 EOs are known from the U.S. portion of the range, and more are expected in Ontario. Currently the majority of reported EOs are ranked either A or B. Further review is needed of current assignment of EORANK to EOs of this type. Many stands are relatively large in size and total acreage well exceeds 10,000 acres. Both oaks and white pine have been extensively logged and cleared for agriculture throughout the range of this type. Although a number of EOs are in protected areas, little is known about the degree to which management is focused on the maintenance of this association. The type is dependent on fire disturbances and relatively dry substrates, and is dominated by oaks and white pine that are fairly resilient to both natural and anthropogenic disturbances.

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Mississippi National River and Recreation Area Comments: Linkage of the vegetation found at Mississippi National River and Recreation Area to this global association is somewhat unclear. The global association has a range generally north of MISS. The MISS vegetation may link better to CEGL002481, though currently that association is limited to sand plains, not ravine settings like at MISS.
Global Comments: Distinction between this type and *~Pinus strobus - Quercus alba / (Corylus americana, Gaylussacia baccata)* Forest (CEGL002481)$$, which is found on sands, needs clarification. Compare also with *~Pinus strobus - Quercus (rubra, velutina) - Fagus grandifolia* Forest (CEGL006293)$$ in the East. Type may have a boreal variant (see Voyageurs NP and descriptions from central Ontario (Chambers et al. 1997). If Minnesota White Pine-Hardwood Forest (especially north-central subtype) is primarily a sandplain type, all of it should be placed with CEGL002481. In Wisconsin, this type grades into the pure evergreen white pine type, *~Pinus strobus / Acer spicatum - Corylus cornuta* Forest (CEGL002445)$$.
Global Similar Associations:
- *Pinus resinosa - Pinus strobus / Corylus cornuta* Forest (CEGL002479)
- *Pinus strobus - Quercus (rubra, velutina) - Fagus grandifolia* Forest (CEGL006293) is possibly an Eastern region version of the same type.
- *Pinus strobus - Quercus alba / (Corylus americana, Gaylussacia baccata)* Forest (CEGL002481) is a sandplain type in the sandplains of central MN, WI, and MI.
- *Pinus strobus / Acer spicatum - Corylus cornuta* Forest (CEGL002445)
- *Quercus rubra - Quercus alba - (Quercus velutina, Acer rubrum) / Viburnum acerifolium* Forest (CEGL002462)

Global Related Concepts:
- Dry - Fresh White Pine - Oak Mixed Forest Type (Lee et al. 1998) =
- Dry-Mesic Northern Forest - White Pine (Red Pine)-Oak (Chapman et al. 1989) =
- Northern Dry-Mesic Forest White Pine-Red Oak Subtype (Faber-Langendoen 2001) =

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- White Pine - Hardwood Forest (North-Central Section) (MNNHP 1993) <
- White Pine - Northern Red Oak - Red Maple: 20 (Eyre 1980) =
- White Pine-White Birch-Red Oak-Largetooth Aspen-Bracken Fern (Chambers et al. 1997) =

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This association was observed only in Battle Creek Regional Park and Pine Bend Bluff SNA.
Global Range: This white pine - oak forest community occurs in the central Great Lakes region of the United States and Canada, where it occurs on dry to dry-mesic sites. Stands range from east-central Minnesota east to Michigan and Ontario.
Nations: CA, US
States/Provinces: MI:S3, MN, ON, QC:S4?, WI:S3
TNC Ecoregions: 46:C, 47:C, 48:C, 64:C
USFS Ecoregions (1994/95): 212Eb:CCC, 212Hb:CCP, 212He:CCC, 212Hi:CCC, 212Hj:CCC, 212Hl:CCC, 212Hm:CCP, 212Ho:CCC, 212Hp:CCP, 212Hq:CCP, 212Hr:CCP, 212Ht:CCP, 212Hu:CCP, 212Hv:CCC, 212Hw:CCC, 212Ja:CCP, 212Jb:CCC, 212Jc:CCP, 212Jf:CCP, 212Jj:CCP, 212Jl:CCP, 212Jm:CCC, 212Jn:CCP, 212Jr:CCC, 212Ka:CCP, 212Kb:CCC, 212Mb:CPP, 212Na:CPP, 212Nb:CPP, 212Nc:CPP, 212Oa:CCC, 212Oc:CCC, 222Jd:CCC, 222Je:CCC, 222Jg:CCC, 222Lc:CCC, 222Lf:CCC, 222Mc:CCC, 222Md:CCC
Federal Lands: NPS (Mississippi, Pictured Rocks, Saint Croix, Sleeping Bear Dunes); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Huron, Huron-Manistee, Manistee, Nicolet, Ottawa)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: FWPO - White Pine - Red Oak Forest
Mississippi National River and Recreation Area Inventory Notes:
Mississippi National River and Recreation Area Plots and Observation Points: DNR.4622, MISS.007, MISS.108
Local Description Authors: J. Drake
Global Description Authors: D. Faber-Langendoen
References: CDPNQ unpubl. data, Chambers et al. 1997, Chapman et al. 1989, Eyre 1980, Faber-Langendoen 2001, Farrand and Bell 1982, Hop et al. 2010c, Kost et al. 2007, Lee et al. 1998, MNNHP 1993, Midwestern Ecology Working Group n.d., Minnesota DNR 2005a, Minnesota DNR 2005c, WNHI 2011, WNHI unpubl. Data

M013. Eastern North American Ruderal Forest

G030. Northern & Central Native Ruderal Forest

Midwest Red-cedar Forest

Juniperus virginiana Midwest Ruderal Forest
Eastern Red-cedar Midwest Ruderal Forest
Identifier: CEGL002593

USNVC CLASSIFICATION

Division	Eastern North American & Great Plains Cool Temperate Forest & Woodland (1.B.2.Na.)
Macrogroup	Eastern North American Ruderal Forest (M013)
Group	Northern & Central Native Ruderal Forest (G030)
Alliance	Eastern Red-cedar - Virginia Pine - Shortleaf Pine Ruderal Forest Alliance (A3227)
Association	Midwest Red-cedar Forest

ELEMENT CONCEPT

Global Summary: This semi-natural red-cedar forest type is expected to be found in locally disturbed areas in the central and upper midwestern United States. Stands typically occur in old fields and other disturbed places. The vegetation may vary in structure from open-canopy woodland (particularly as it invades herbaceous old fields) to dense, closed-canopy forest. *Juniperus virginiana* (eastern red-cedar) is the leading tree dominant. Other associates have not been well-described, but may include *Rhus typhina* (staghorn sumac).

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This community occurs in a variety of settings, typically in old farm fields, pastures, or abandoned industrial lots. Slope is usually flat to moderate. Soils tend towards sandy.
Global Environment: Stands typically occur in old fields and other disturbed places.

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VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: The open to moderately closed canopy of this short forest is often dominated by *Juniperus virginiana* (eastern red-cedar) but can include significant deciduous trees, typically *Fraxinus pennsylvanica* (green ash). Other early successional trees that may occur include *Populus deltoides* (eastern cottonwood) and *Ulmus* spp. (elm).. The predominant canopy is short (5-10 m). Young *Juniperus virginiana* (eastern red-cedar) and other canopy trees are usually common in the understory but some sites, usually those undergoing restoration management, have *Quercus macrocarpa* (bur oak) or other *Quercus* spp. (oak). The understory is dominated by species typical of ruderal fields, including shrubs such as *Zanthoxylum americanum* (common pricklyash), *Rhamnus cathartica* (common buckthorn), and invasive *Lonicera* spp. (honeysuckle) and herbaceous speices such as *Poa pratensis* (Kentucky bluegrass) and *Bromus inermis* (smooth brome).
Global Vegetation: The vegetation may vary in structure from open-canopy woodland (particularly as it invades herbaceous old fields) to dense, closed-canopy forest. *Juniperus virginiana* (eastern red-cedar) is the leading tree dominant. Other associates have not been well-described, but may include *Rhus typhina* (staghorn sumac).

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Juniperus virginiana* (eastern red-cedar), *Fraxinus pennsylvanica* (green ash)

Global:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Juniperus virginiana* (eastern red-cedar)

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: *Juniperus virginiana*
Global: Information not available.

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Information not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNA (invasive) (15-Jan-1999). Although not planted, this type invades sites where human disturbances, such as agricultural plowing followed by abandonment, roadcuts, or other soil disturbances, have removed the natural vegetation.

CLASSIFICATION

Status: Standard
Classification Confidence: 3 - Weak
Mississippi National River and Recreation Area Comments: The canopy of this community can range from pure coniferous to mixed coniferous-deciduous.
Global Comments: The range of this type is north of ~*Juniperus virginiana* var. *virginiana* - *(Quercus* spp.) Forest (CEGL007124)$$, which, in the Midwest is expected to go no further north than in the Ozarks and Interior Low Plateau (and possibly the Western Allegheny Plateau).
Global Similar Associations:
- *Juniperus virginiana* var. *virginiana* - (*Quercus* spp.) Ruderal Forest (CEGL007124)

Global Related Concepts:
- Dry - Fresh Red Cedar Coniferous Forest Type (Lee et al. 1998) =

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This association was observed on the northern and southern portions of MISS, north of the Coon Rapids Dam and in Gray Cloud SNA and Gore's Pool WMA.
Global Range: This semi-natural red cedar forest type is expected to be found in locally disturbed areas in the central and upper midwestern United States.
Nations: CA, US
States/Provinces: IA, MN, ON:S4
TNC Ecoregions: 35:P, 36:P, 46:P, 48:P
USFS Ecoregions (1994/95): 222M:CC, 251:P
Federal Lands: NPS (Mississippi)

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ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: FSRC - Midwest Red-cedar Forest
Mississippi National River and Recreation Area Inventory Notes:
Mississippi National River and Recreation Area Plots and Observation Points: MISS.061, MISS092
Local Description Authors: J. Drake
Global Description Authors: D. Faber-Langendoen
References: INAI unpubl. data, Lee et al. 1998, Midwestern Ecology Working Group n.d.

Midwest Box-elder - Ash Ruderal Forest

Acer negundo - Celtis occidentalis - Fraxinus pennsylvanica Ruderal Forest
Box-elder - Common Hackberry - Green Ash Ruderal Forest
Identifier: CEGL005462

USNVC CLASSIFICATION

Division	Eastern North American & Great Plains Cool Temperate Forest & Woodland (1.B.2.Na.)
Macrogroup	Eastern North American Ruderal Forest (M013)
Group	Northern & Central Native Ruderal Forest (G030)
Alliance	Box-elder - Green Ash - Quaking Aspen Ruderal Forest Alliance (A4183)
Association	Midwest Box-elder - Ash Ruderal Forest

ELEMENT CONCEPT

Global Summary: Information not available.

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This community was sampled four times in the park. Plot sites ranged from flat to moderately steeply sloped. Sites are not flooded even during high water events. Soils range from silty clay to sands but are always at least moderately well drained due to soil coarseness, slope, or both. This forest community occurs on sites with a history of disturbance and may have trash or other evidence of previous human development or occupation. When this community occurs on slopes, it is often steep enough to have exposed bedrock and/or talus. The ground surface averages nearly half bare ground and about ¼ litter and ¼ bedrock or rock fragments.
Global Environment: Information not available.

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This community occurs on upland sites where disturbance has allowed the generalist trees that dominate the canopy to become established. *Acer negundo* (boxelder) is the most consistently abundant tree but *Celtis occidentalis* (common hackberry), *Fraxinus pennsylvanica* (green ash), *Ulmus rubra* (slippery elm), and sometimes *Fraxinus nigra* (black ash) are also common to co-dominant. The tree canopy tends toward the open end of the range for forest communities and can even have a woodland character (40-60%) from restoration management activities, treefall due to the steep slopes, or other disturbances. The tree subcanopy and shrub strata are vigorous where the canopy is more open. Common subcanopy components include the canopy trees, *Prunus serotina* (black cherry), and large *Rhamnus cathartica* (common buckthorn) and *Cornus alternifolia* (alternateleaf dogwood). The shrub stratum has young individuals of the canopy trees, *Rhamnus cathartica* (common buckthorn), *Cornus alternifolia* (alternateleaf dogwood), *Ribes* spp. (gooseberry) *Rubus* spp. (blackberry), and *Lonicera* x*bella* (Bell's honeysuckle). The ground layer tends to be open with few consistently abundant species. Tree seedlings, *Circaea lutetiana* (broadleaf enchanter's nightshade), *Carex pensylvanica* (Pennsylvania sedge), *Symphyotrichum* spp. (aster), *Alliaria petiolata* (garlic mustard), *Arctium minus* (lesser burdock), *Thalictrum dioicum* (early meadow-rue), and *Impatiens capensis* (jewelweed) are usually present. The woody vines *Parthenocissus vitacea* (woodbine) and *Vitis riparia* (riverbank grape) are common.
Global Vegetation: Information not available.

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Tree (canopy)	Broad-leaved deciduous tree	*Acer negundo* (boxelder), *Celtis occidentalis* (common hackberry), *Fraxinus pennsylvanica* (green ash)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Rhamnus cathartica* (common buckthorn)
Short shrub/sapling	Broad-leaved deciduous shrub	*Rhamnus cathartica* (common buckthorn)
Herb (field)	Vine/Liana	*Parthenocissus vitacea* (woodbine), *Vitis riparia* (riverbank grape)

Global: Information not available.

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CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: *Acer negundo, Celtis occidentalis, Fraxinus pennsylvanica*
Global: Information not available.

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Information not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNA (ruderal) (30-Dec-2013).

CLASSIFICATION

Status: Standard
Classification Confidence: 3 - Weak
Mississippi National River and Recreation Area Comments: This association was identified based on information collected during the vegetation mapping project at MISS. It lacks characterization based on data from a larger region and thus lacks information in the "Global" fields of this description.
The tree canopy of this community is typically dominated by species also found in disturbed floodplains/terraces. There is a great deal of overlap between the two communities in all strata, though the floodplain/terrace forest tends to have more of a few floodplain species like *Acer saccharinum* (silver maple) as well as a denser tree canopy and correspondingly less dense tree subcanopy and shrub strata. This community is never flooded and usually on slopes vs. temporarily/intermittently flooded terraces for the disturbed floodplain/terrace community.
Global Comments:
Global Related Concepts: Information not available.

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This association was observed throughout the project area.
Global Range: This association has been identified only in east-central Minnesota but is almost certainly much more widespread in the upper Midwestern United States.
Nations: US
States/Provinces: MN
TNC Ecoregions: 46
USFS Ecoregions (1994/95): 222M:CC
Federal Lands: NPS (Mississippi)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: FSBA - Midwest Box-elder - Ash Ruderal Forest
Mississippi National River and Recreation Area Inventory Notes: Mississippi National River and Recreation Area Plots and Observation Points: MISS.045, MISS.064, MISS.075, MISS.093
Local Description Authors: J. Drake
Global Description Authors: Information not available.
References: Midwestern Ecology Working Group n.d.

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Midwest Hardwood - Conifer Ruderal Forest

Fraxinus pennsylvanica - *Juniperus virginiana* - *Pinus* spp. - *Acer negundo* Ruderal Forest
Green Ash - Eastern Red-cedar - Pine species - Box-elder Ruderal Forest
Identifier: CEGL005456

USNVC CLASSIFICATION

Division	Eastern North American & Great Plains Cool Temperate Forest & Woodland (1.B.2.Na.)
Macrogroup	Eastern North American Ruderal Forest (M013)
Group	Northern & Central Native Ruderal Forest (G030)
Alliance	Box-elder - Green Ash - Quaking Aspen Ruderal Forest Alliance (A4183)
Association	Midwest Hardwood - Conifer Ruderal Forest

ELEMENT CONCEPT

Global Summary: Information not available.

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This semi-natural forest or woodland is found on a variety of settings but all with a history of significant disturbance. Soils range from sandy to loamy. Most of these sites were disturbed for agricultural or urban development and so are on relatively flat areas. Remnants of development such as building foundations, or walls, fences, and roads are in some sites.
Global Environment: Information not available.

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This forest can be variable in composition and physiognomy from woodland to closed forest and from short canopy trees to moderately tall. The unifying characteristics are a history of extensive disturbance and dominance by exotic and native generalist species in all strata. Species on a site may have been planted at some point in the past. Abundant trees can be *Acer negundo* (boxelder)*, Fraxinus pennsylvanica* (green ash)*, Juniperus virginiana* (eastern red-cedar)*, Picea* spp. (spruce) (planted), *Pinus resinosa* (red pine) (planted), *Pinus strobus* (eastern white pine) (planted), *Pinus sylvestris* (Scotch pine), and *Prunus serotina* (black cherry). The canopy is typically uneven in height. The understory varies greatly with the amount of tree canopy and history of site use. Common shrubs are *Rhamnus cathartica* (common buckthorn), exotic *Lonicera* spp. (honeysuckle), and *Zanthoxylum americanum* (common pricklyash). The ground layer can be dominated by grasses, especially *Bromus inermis* (smooth brome) and *Poa pratensis* (Kentucky bluegrass) where the tree canopy is open, or a variety of weedy forbs.
Global Vegetation: Information not available.

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Tree (canopy)	Broad-leaved deciduous tree	*Acer negundo* (boxelder), *Fraxinus pennsylvanica* (green ash), *Juniperus virginiana* (eastern red-cedar), *Pinus* spp. (pine)
Herb (field)	Graminoid	*Bromus inermis* (smooth brome), *Poa pratensis* (Kentucky bluegrass)

Global: Information not available.

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Information not available.

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Information not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNA (ruderal) (30-Dec-2013).

CLASSIFICATION

Status: Standard
Classification Confidence: 3 - Weak
Mississippi National River and Recreation Area Comments: This association was identified based on information collected during the vegetation mapping project at MISS. It lacks characterization based on data from a larger region and thus lacks information in the "Global" fields of this description.

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Global Comments:
Global Related Concepts: Information not available.

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This association was observed at scattered locations in the project area. It was most common north of the confluence with the Rum River but was also observed at Crosby Farm Park and Hastings SNA,
Global Range: This community is described only from east-central Minnesota but is likely to occur elsewhere in the Midwest.
Nations: US
States/Provinces: MN
TNC Ecoregions: 46
USFS Ecoregions (1994/95): 222M:CC
Federal Lands: NPS (Mississippi)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: FSCH - Midwest Hardwood - Conifer Ruderal Forest
Mississippi National River and Recreation Area Inventory Notes: This association was not identified during plot sampling. It was found later in the project and so is described based on field reconnaissance notes and Accuracy Assessment data. As such, it lacks comprehensive species lists and detailed information on vegetation strata.
Mississippi National River and Recreation Area Plots and Observation Points: No plots in MISS.
Local Description Authors: J. Drake
Global Description Authors:
References: Midwestern Ecology Working Group n.d.

Aspen Ruderal Forest

Populus tremuloides / *Rhamnus cathartica* Ruderal Forest
Quaking Aspen / Common Buckthorn Ruderal Forest
Identifier: CEGL005454

USNVC CLASSIFICATION

Division	Eastern North American & Great Plains Cool Temperate Forest & Woodland (1.B.2.Na.)
Macrogroup	Eastern North American Ruderal Forest (M013)
Group	Northern & Central Native Ruderal Forest (G030)
Alliance	Box-elder - Green Ash - Quaking Aspen Ruderal Forest Alliance (A4183)
Association	Aspen Ruderal Forest

ELEMENT CONCEPT

Global Summary: Information not available.

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This community is composed largely of invasive or generalist species and can occur on a variety of upland habitats. The unvegetated cover on the ground is about 2:1 litter to bare ground.
Global Environment: Information not available.

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This community has a moderately open to closed canopy which is usually 5-15 m tall. *Populus tremuloides* (quaking aspen), or rarely *Betula papyrifera* (paper birch), is the dominant species. Other common canopy species are *Quercus ellipsoidalis* (northern pin oak), *Quercus rubra* (northern red oak), and *Populus deltoides* (eastern cottonwood). The subcanopy is sparse and often difficult to distinguish from the canopy and tall shrub strata. The most common species in it are *Betula papyrifera* (paper birch), *Prunus serotina* (black cherry), and *Rhamnus cathartica* (common buckthorn). The tall shrub stratum is moderately open to moderately closed but the short shrub stratum is closed to dense. *Rhamnus cathartica* (common buckthorn) is the most consistently abundant shrub with lesser amounts of *Ribes missouriense* (Missouri gooseberry), *Prunus serotina* (black cherry), *Parthenocissus vitacea* (woodbine), *Vitis riparia* (riverbank grape), *Zanthoxylum americanum* (common pricklyash), and exotic *Lonicera* spp. (*L. tatarica* (Tatarian honeysuckle), *L. morrow* (Morrow's honeysuckle), and *L.* x*bella* ((Bell's honeysuckle)), among others. The herbaceous stratum is not as dense as the shrubs but is also characterized by generalist or weedy species. *Amphicarpaea bracteata* (American hogpeanut), *Galium triflorum* (fragrant bedstraw), *Circaea lutetiana* (broadleaf enchanter's nightshade), *Carex pensylvanica* (Pennsylvania sedge), *Actaea rubra, Ageratina altissima* (white snakeroot), and *Desmodium glutinosum* (pointedleaf ticktrefoil) are typical.
Global Vegetation: Information not available.

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MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Populus tremuloides* (quaking aspen)
Tall shrub	Broad-leaved deciduous shrub	*Rhamnus cathartica* (common buckthorn)
Short shrub	Broad-leaved deciduous shrub	*Rhamnus cathartica* (common buckthorn)

Global: Information not available.

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: *Populus tremuloides*
Global: Information not available.

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Information not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNA (ruderal) (30-Dec-2013).

CLASSIFICATION

Status: Standard
Classification Confidence: 3 - Weak
Mississippi National River and Recreation Area Comments: This association was identified based on information collected during the vegetation mapping project at MISS. It lacks characterization based on data from a larger region and thus lacks information in the "Global" fields of this description. The concept of this association includes ruderal woodlands and forests in which *Populus tremuloides* (quaking aspen) and *Betula papyrifera* (paper birch) are dominant or co-dominant. This can occur in a variety of settings including former industrial sites and old agricultural fields.
Global Comments:
Global Related Concepts: Information not available.

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This uncommon association was observed only south of the confluence of the Minnesota and Mississippi River near 35E, at Battle Creek Regional Park, the Ordway Field Station, and Hastings SNA.
Global Range: This community is described only from east-central Minnesota but is likely to occur elsewhere in the Midwest.
Nations: US
States/Provinces: MN
TNC Ecoregions: 46
USFS Ecoregions (1994/95): 222M:CC
Federal Lands: NPS (Mississippi)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: FSAS - Aspen Ruderal Forest
Mississippi National River and Recreation Area Inventory Notes:
Mississippi National River and Recreation Area Plots and Observation Points: MISS.002, MISS.104, MISS.130, DNR.662
Local Description Authors: J. Drake
Global Description Authors: Information not available.
References: Midwestern Ecology Working Group n.d.

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Cottonwood Upland Ruderal Forest

Populus deltoides / *Bromus inermis* Ruderal Forest
Eastern Cottonwood / Smooth Brome Ruderal Forest
Identifier: CEGL005455

USNVC CLASSIFICATION

Division	Eastern North American & Great Plains Cool Temperate Forest & Woodland (1.B.2.Na.)
Macrogroup	Eastern North American Ruderal Forest (M013)
Group	Northern & Central Native Ruderal Forest (G030)
Alliance	Eastern Cottonwood Ruderal Upland Forest Alliance (A4184)
Association	Cottonwood Upland Ruderal Forest

ELEMENT CONCEPT

Global Summary: Information not available.

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This upland woodland community was sampled once in the park. It occurs on disturbed, upland sites with well drained soils. The plot site was a former gravel pit with well drained silt loam soil and hilly, uneven topography. Litter covered most of the ground surface and there was a small amount of bare ground.
Global Environment: Information not available.

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This woodland community occurs on disturbed upland sites where the dominant tree, *Populus deltoides* (eastern cottonwood), colonizes open ground and forms an open to closed woodland canopy. Because these are among the first trees to become established in an area, the canopy can range from short to tall (3-30 m), depending on how old the stand is. *Populus deltoides* (eastern cottonwood) is the most abundant species but other trees may be in the stand in the canopy or subcanopy. These include *Acer negundo* (boxelder), *Juniperus virginiana* (eastern red-cedar), *Fraxinus pennsylvanica* (green ash), and *Ulmus americana* (American elm). The shrub stratum is open and includes *Salix humilis* var. *humilis* (prairie willow), and young trees. The herbaceous layer is dense and dominated by *Bromus inermis* (smooth brome) and *Poa pratensis* (Kentucky bluegrass) with small amounts of *Equisetum hyemale* (scouringrush horsetail), *Verbascum thapsus* (common mullein), *Viola* spp. (violet), *Solidago gigantea* (giant goldenrod), *Galium boreale* (northern bedstraw), and *Taraxacum officinale* (common dandelion).
Global Vegetation: Information not available.

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Tree (canopy)	Broad-leaved deciduous tree	*Populus deltoides* (eastern cottonwood)
Tree subcanopy	Broad-leaved deciduous tree	*Juniperus virginiana* (eastern red-cedar)
Herb (field)	Graminoid	*Bromus inermis* (smooth brome), *Poa pratensis* (Kentucky bluegrass)

Global: Information not available.

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: *Populus deltoides*
Global: Information not available.

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Information not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNA (ruderal) (30-Dec-2013).

CLASSIFICATION

Status: Standard
Classification Confidence: 3 - Weak
Mississippi National River and Recreation Area Comments: This association was identified based on information collected during the vegetation mapping project at MISS. It lacks characterization based on data from a larger region and thus lacks information in the "Global" fields of this description.
Global Comments:
Global Related Concepts: Information not available.

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OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This uncommon community was found only at Mississippi West Regional Park and Coon Rapids Dam Regional Park.
Global Range: This community is described only from east-central Minnesota but is likely to occur elsewhere in the Midwest.
Nations: US
States/Provinces: MN
TNC Ecoregions: 46
USFS Ecoregions (1994/95): 222M:CC
Federal Lands: NPS (Mississippi)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: FSCW - Cottonwood Upland Ruderal Forest
Mississippi National River and Recreation Area Inventory Notes: This community was only seen once during plot sampling, at Mississippi West Regional Park, but is presumed to occur elsewhere in the park on disturbed former industrial or agricultural areas.
Mississippi National River and Recreation Area Plots and Observation Points: MISS.058
Local Description Authors: J. Drake
Global Description Authors: Information not available.
References: Midwestern Ecology Working Group n.d.

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1.B.3. Temperate Flooded & Swamp Forest

1.B.3.Na. Eastern North American & Great Plains Flooded & Swamp Forest

M029. Central & Appalachian Floodplain Forest

G652. Silver Maple - Green Ash - Sycamore Floodplain Forest

Ash - Elm - Mixed Lowland Hardwood Forest

Fraxinus pennsylvanica - *Celtis occidentalis* - *Tilia americana* - (*Quercus macrocarpa*) Forest
Green Ash - Common Hackberry - American Basswood - (Bur Oak) Forest
Identifier: CEGL002081

USNVC CLASSIFICATION

Division	Eastern North American & Great Plains Flooded & Swamp Forest (1.B.3.Na.)
Macrogroup	Central & Appalachian Floodplain Forest (M029)
Group	Silver Maple - Green Ash - Sycamore Floodplain Forest (G652)
Alliance	Red Maple - Green Ash Seasonally Flooded Forest Alliance (A3708)
Association	Ash - Elm - Mixed Lowland Hardwood Forest

ELEMENT CONCEPT

Global Summary: This ash - elm lowland hardwood forest community type is found in the northern tallgrass region of the midwestern United States. Stands occur in stream and river valleys, on low plateaus, and along lake margins. The sites often occur on terraces that flood only occasionally, and usually for just a few days in spring. They may have seasonally high (within the rooting zone) water tables, but these do not persist into the growing season. The mineral soils are deep, fertile, and moderately well-drained to poorly drained. This community is dominated by deciduous trees that can tolerate the saturated soil conditions. The tree canopy is typically closed, and often has a mixture of several tree species. Among the most abundant are *Celtis occidentalis* (common hackberry), *Fraxinus pennsylvanica* (green ash), and *Tilia americana* (American basswood). *Quercus macrocarpa* (bur oak) is often abundant in the prairie-forest border region. Other common tree species include *Acer saccharinum* (silver maple), *Acer negundo* (boxelder), *Ulmus americana* (American elm), *Betula papyrifera* (paper birch), and *Populus tremuloides* (quaking aspen). The shrub layer is patchy and composed of both upland and lowland shrubs. The herbaceous layer contains a variety of herbs.

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This wet-mesic forest occurs most commonly on floodplains that are not frequently scoured or inundated by floodwaters. This includes floodplain terraces, floodplains of small streams, and sometimes basins that are wet but not flooded for most of the growing season. Soils are usually alluvial and range from sandy loam to silt. The unvegetated surface is composed of bare ground (avg. 52%), leaf litter (avg. 33%), and downed wood (avg. 10%). This association has the second highest average cover of downed wood at MISS, just behind another common floodplain forest, the Silver Maple – Elm Forest (CEGL002586).

Global Environment: This community is found in stream and river valleys, on low plateaus, and along lake margins. The sites often occur on terraces that flood only occasionally, and usually for just a few days in spring. They may have seasonally high (within the rooting zone) water tables, but these do not persist into the growing season. The mineral soils are deep, fertile, and moderately well-drained to poorly drained (Kurmis et al. 1986, MNNHP 1993, Minnesota DNR 2005b).

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: The canopy of this forest type is typically dense (avg. 79%) and combined with the tree subcanopy (avg. 25%) they form a nearly complete tree canopy. Some combination of *Acer negundo* (boxelder), *Acer saccharinum* (silver maple), *Celtis occidentalis* (common hackberry), *Fraxinus pennsylvanica* (green ash), *Tilia americana* (American basswood), and *Ulmus americana* (American elm) dominate the canopy, though *Acer negundo* (boxelder) and *Acer saccharinum* (silver maple) alone are not >50% cover. The tree subcanopy consists of similar species. *Fraxinus nigra* (black ash), *Populus deltoides* (eastern cottonwood), and *Quercus macrocarpa* (bur oak) are present in some stands. The shrub canopy is variable (avg. 35%) and largely composed of exotic or generalist native species including *Lonicera tatarica* (Tatarian honeysuckle), *Rhamnus cathartica* (common buckthorn), *Ribes* spp. (gooseberry), *Rubus* spp. (blackberry), and *Zanthoxylum americanum* (common pricklyash). The herbaceous stratum is moderate to closed (avg. 39%). A wide variety of species were found in the ground layer. *Glechoma hederacea* (ground ivy) and *Laportea canadensis* (Canadian woodnettle) were the most common but many others can be present, such as *Alliaria petiolata* (garlic mustard), *Ageratina altissima* (white snakeroot), *Galium triflorum* (fragrant bedstraw), *Hackelia virginiana* (beggarslice), *Leersia virginica* (whitegrass), and *Rudbeckia laciniata* (cutleaf coneflower). Seedlings of *Celtis occidentalis* (common hackberry) are also common. Woody vines are common on the forest floor or climbing on other plants, these include *Parthenocissus vitacea* (woodbine), *Toxicodendron rydbergii* (western poison ivy), and *Vitis riparia* (riverbank grape).

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Global Vegetation: This community is dominated by deciduous trees that can tolerate the saturated soil conditions. The tree canopy is typically closed and often has a mixture of several tree species. Among the most abundant are *Celtis occidentalis* (common hackberry), *Fraxinus pennsylvanica* (green ash), and *Tilia americana* (American basswood). *Quercus macrocarpa* (bur oak) is often abundant in the prairie-forest border region. Other common tree species include *Acer saccharinum* (silver maple), *Acer negundo* (boxelder), *Ulmus americana* (American elm), *Betula papyrifera* (paper birch), and *Populus tremuloides* (quaking aspen). The shrub layer is patchy and composed of both upland and lowland shrubs. The herbaceous layer contains a variety of upland herbs. (MNNHP 1993).

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Tree (canopy)	Broad-leaved deciduous tree	*Acer negundo* (boxelder), *Acer saccharinum* (silver maple), *Celtis occidentalis* (common hackberry), *Fraxinus pennsylvanica* (green ash), *Tilia americana* (American basswood), *Ulmus americana* (American elm)
Short shrub/sapling	Broad-leaved deciduous shrub	*Rhamnus cathartica* (common buckthorn), *Zanthoxylum americanum* (common pricklyash)
Herb (field)	Forb	*Glechoma* hederacea (ground ivy), *Laportea canadensis* (Canadian woodnettle)

Global: Information not available.

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Information not available.

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Information not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G4? (3-Oct-1996).

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Mississippi National River and Recreation Area Comments: Stands of this vegetation often show evidence of significant disturbance, due to periodic flooding or anthropogenic causes or both. This is reflected in the floristic composition which is dominated by early successional and/or exotic species in every stratum.
Global Comments: Ground layer composition of this type needs better characterization. In the northern tallgrass prairie region, this type concept overlaps with *~Tilia americana - (Quercus macrocarpa) / Ostrya virginiana* Forest (CEGL002012)$$, but, unlike that type, this type is generally found on terraces within the floodplain. See also *~Fraxinus pennsylvanica - Ulmus americana - (Acer negundo, Tilia americana)* Great Plains Forest (CEGL005400)$$. A similar type is defined for stands in Missouri (*~Fraxinus pennsylvanica - Celtis* spp. - *Quercus* spp. - *Platanus occidentalis* Bottomland Forest (CEGL002410)$$).
Global Similar Associations:
- *Fraxinus pennsylvanica - Celtis* spp. - *Quercus* spp. - *Platanus occidentalis* Bottomland Forest (CEGL002410)
- *Fraxinus pennsylvanica - Ulmus americana - (Acer negundo, Tilia americana)* Great Plains Forest (CEGL005400)
- *Platanus occidentalis - Fraxinus pennsylvanica - Ulmus americana / Cornus sericea* Forest (CEGL006901)
- *Tilia americana - (Quercus macrocarpa) / Ostrya virginiana* Forest (CEGL002012)

Global Related Concepts:
- Ash-Elm-Trillium (Kurmis et al. 1986) =
- Lowland Hardwood Forest (MNNHP 1993) =

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This common association was found throughout the park but was most common on the Minnesota River and downriver to Hastings and north of downtown Minneapolis where there is a broader floodplain.
Global Range: This ash-elm lowland hardwood forest community type is found in the northern tallgrass region of the midwestern United States.
Nations: US
States/Provinces: MN:S4, ND:S3, WI?
TNC Ecoregions: 35:C, 46:C, 47:C

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USFS Ecoregions (1994/95): 212Kb:CCC, 212Mb:CCC, 212Na:CCC, 212Nb:CCP, 212Nc:CCC, 222Lc:CCC, 222Lf:CCC, 222Ma:CCC, 222Mb:CCC, 222Mc:CCC, 222Me:CCC, 222Na:CCC, 251Aa:CCC, 251Ab:CCC, 251Ba:CCC, 251Bb:CCC
Federal Lands: NPS (Mississippi, Saint Croix); USFS (Chippewa)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: FFAE - Ash - Elm - Mixed Lowland Hardwood Forest
Mississippi National River and Recreation Area Inventory Notes:
Mississippi National River and Recreation Area Plots and Observation Points: DNR.0659, DNR.6692, MISS.016, MISS.017, MISS.047, MISS.051, MISS.055, MISS.067, MISS.078, MISS.094, MISS.096
Local Description Authors: J. Drake
Global Description Authors: J. Drake, mod. D. Faber-Langendoen
References: Ewing 1924, Kurmis et al. 1986, MNNHP 1993, Midwestern Ecology Working Group n.d., Minnesota DNR 2005a, Minnesota DNR 2005b, NDNHI unpubl. data, WNHI 2011

Silver Maple - Elm Forest

Acer saccharinum - *Fraxinus pennsylvanica* - *Ulmus americana* Forest
Silver Maple - Green Ash - American Elm Forest
Identifier: CEGL002586

USNVC CLASSIFICATION

Division	Eastern North American & Great Plains Flooded & Swamp Forest (1.B.3.Na.)
Macrogroup	Central & Appalachian Floodplain Forest (M029)
Group	Silver Maple - Green Ash - Sycamore Floodplain Forest (G652)
Alliance	Silver Maple - Eastern Cottonwood Floodplain Forest Alliance (A3710)
Association	Silver Maple - Elm Forest

ELEMENT CONCEPT

Global Summary: This silver maple - green ash - elm - cottonwood forest is found throughout the midwestern United States and parts of the eastern United States. Stands occur on medium to large, regularly flooded floodplains. The canopy cover is more-or-less closed and dominated by *Acer saccharinum* (silver maple), *Fraxinus pennsylvanica* (green ash), *Ulmus americana* (American elm), and *Populus deltoides* (eastern cottonwood). Associated species may include *Ulmus rubra* (slippery elm), *Acer negundo* (boxelder), *Salix nigra* (black willow), *Celtis occidentalis* (common hackberry), and *Carya cordiformis* (bitternut hickory). More southward, *Platanus occidentalis* (American sycamore) and *Betula nigra* (river birch) may occur. The shrub and sapling layer is often open (<25% cover). Species that may be present include *Sambucus canadensis* (American black elderberry), *Rubus occidentalis* (black raspberry), or *Lindera benzoin* (northern spicebush). Woody and herbaceous vines can be prominent, including among the woody vines *Parthenocissus quinquefolia* (Virginia creeper), *Toxicodendron radicans* (eastern poison ivy), and *Vitis riparia* (riverbank grape). Herbaceous vine species include *Apios americana* (groundnut), *Amphicarpaea bracteata* (American hogpeanut), and *Echinocystis lobata* (wild cucumber). Herbaceous grasses, forbs, and ferns dominate the ground layer, including *Symphyotrichum lateriflorum (= Aster lateriflorus)* (calico aster), *Boehmeria cylindrica* (smallspike false nettle), *Erythronium americanum* (dogtooth violet), *Solidago gigantea* (giant goldenrod), *Cinna arundinacea* (sweet woodreed), *Leersia virginica* (whitegrass), *Elymus virginicus* (Virginia wildrye), *Impatiens pallida* (pale touch-me-not), *Laportea canadensis* (Canadian woodnettle), *Matteuccia struthiopteris* (ostrich fern), *Onoclea sensibilis* (sensitive fern), *Pilea pumila* (Canadian clearweed), *Urtica dioica* (stinging nettle), and others. A variety of exotics may be present, including *Lysimachia* spp. (yellow loosestrife), *Microstegium vimineum* (Nepalese browntop), *Polygonum cuspidatum* (Japanese knotweed), *Rosa multiflora* (multiflora rose), and *Lonicera japonica* (Japanese honeysuckle).

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This forest was found on floodplains that are subject to significant flooding every few years. This forest is often immediately adjacent to the main river channel but can extend well back from the channel where the river valley is broad. Sites that are not flooded for several years will begin to succeed to other wet-mesic forests. Soils are alluvial and range from fine sand to silt. Most of the unvegetated ground surface is composed of bare sand (18%) and bare mineral soil (avg. 44%), which reflects the frequency of scouring and deposition due to flooding. Downed wood (avg. 13%), is more abundant in this community than any other in the park and plant litter is fairly common (avg. 25%). Some of this is from plants in the immediate vicinity and some is due to flood debris that becomes stranded during flood events.
Global Environment: This community occurs on terraces of medium to larger rivers. Soils may be well-drained and sandy, more loamy on infrequently flooded bottomlands and levees, or deep silts on stabilized sites of terraces along larger rivers. It appears to be favored by deposition of deep sandy sediments by low-energy floodwaters. The community may form small linear patches among other floodplain associations or be locally extensive. The structure and composition of the type is influenced by the flooding regime. Floods leave river-deposited debris on the forest floor, ice scars on trees, and abandoned channels that retain water at or above the level of the main river channel.

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VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This deciduous forest generally has a tall tree canopy that is moderately closed to closed (avg. 86%). *Acer saccharinum* (silver maple) is the single most abundant tree. *Populus deltoides* (eastern cottonwood) can be common to co-dominant and in some stands most of the *Populus deltoides* (eastern cottonwood) are taller than the *Acer saccharinum* (silver maple). *Fraxinus pennsylvanica* (green ash) and *Ulmus americana* (American elm) are also common but are either roughly equal in height to the main canopy of *Acer saccharinum* (silver maple) or shorter. The tree subcanopy is absent to moderate (avg. 12%) and contains similar species as the tree canopy with the exception of little to no *Populus deltoides* (eastern cottonwood) and more *Acer negundo* (boxelder). There are few shrubs and the herbaceous stratum ranges from non-existent where recent deposition or scouring has removed it to very dense in stands that have escaped severe floods for several years and where sufficient light penetrates the canopy. Common species, some of which can form dense patches, include *Laportea canadenssi, Leersia virginica* (whitegrass), *Glechoma hederacea* (ground ivy), and *Pilea pumila* (Canadian clearweed), *Acer saccharinum* (silver maple) seedlings can be dense on sites where the herbaceous layer was removed by flooding and after a good seed year.
Global Vegetation: The canopy cover is more-or-less closed and dominated by *Acer saccharinum* (silver maple), *Fraxinus pennsylvanica* (green ash), *Ulmus americana* (American elm), and *Populus deltoides* (eastern cottonwood). Associated species may include *Ulmus rubra* (slippery elm), *Acer negundo* (boxelder), *Salix nigra* (black willow), *Celtis occidentalis* (common hackberry), and *Carya cordiformis* (bitternut hickory). More southward, *Platanus occidentalis* (American sycamore) and *Betula nigra* (river birch) may occur. The shrub and sapling layer is often open (<25% cover). Species that may be present include *Sambucus canadensis* (American black elderberry), *Rubus occidentalis* (black raspberry), or *Lindera benzoin* (northern spicebush). Woody and herbaceous vines can be prominent, including among the woody vines *Parthenocissus quinquefolia* (Virginia creeper), *Toxicodendron radicans* (eastern poison ivy), and *Vitis riparia* (riverbank grape). Herbaceous vine species include *Apios americana* (groundnut), *Amphicarpaea bracteata* (American hogpeanut), and *Echinocystis lobata* (wild cucumber). Grasses, forbs, and ferns dominate the ground layer, including various combinations of *Symphyotrichum lateriflorum (= Aster lateriflorus)* (calico aster), *Boehmeria cylindrica* (smallspike false nettle), *Chasmanthium latifolium* (Indian woodoats), *Cryptotaenia canadensis* (Canadian honewort), *Erythronium americanum* (dogtooth violet), *Solidago gigantea* (giant goldenrod), *Cinna arundinacea* (sweet woodreed), *Leersia virginica* (whitegrass), *Elymus virginicus* (Virginia wildrye), *Helianthus* sp., *Impatiens capensis* (jewelweed), *Impatiens pallida* (pale touch-me-not), *Laportea canadensis* (Canadian woodnettle), *Matteuccia struthiopteris* (ostrich fern), *Menispermum canadense* (common moonseed), *Onoclea sensibilis* (sensitive fern), *Pilea pumila* (Canadian clearweed), *Polygonum virginianum* (jumpseed), *Rudbeckia laciniata* (cutleaf coneflower), *Verbesina alternifolia* (wingstem), *Urtica dioica* (stinging nettle), and others. A variety of exotics may be present, including *Lysimachia* spp. (yellow loosestrife), *Microstegium vimineum* (Nepalese browntop), *Glechoma hederacea* (ground ivy), *Polygonum cuspidatum* (Japanese knotweed), *Rosa multiflora* (multiflora rose), and *Lonicera japonica* (Japanese honeysuckle). Anderson (1996) notes that *Celtis occidentalis* (common hackberry), *Gleditsia triacanthos* (honeylocust), and *Aesculus glabra* (Ohio buckeye) may be more common along the calcareous streams of western Ohio.

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Tree (canopy)	Broad-leaved deciduous tree	*Acer saccharinum* (silver maple)
Herb (field)	Forb	*Glechoma hederacea* (ground ivy), *Laportea canadensis* (Canadian woodnettle), *Pilea pumila* (Canadian clearweed)
Herb (field)	Graminoid	*Leersia virginica* (whitegrass)

Global

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer saccharinum* (silver maple)
Herb (field)	Vine/Liana	*Parthenocissus quinquefolia* (Virginia creeper), *Toxicodendron radicans* (eastern poison ivy)
Herb (field)	Graminoid	*Leersia virginica* (whitegrass)

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: *Acer saccharinum*
Global: *Acer negundo*, *Acer saccharinum*, *Alliaria petiolata*, *Conium maculatum*, *Elymus virginicus*, *Glechoma hederacea*, *Humulus japonicus*, *Populus deltoides*, *Urtica dioica* ssp. *gracilis*

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: This common association was found throughout the park but was most common on the Minnesota River and downriver to Hastings and north of downtown Minneapolis where there is a broader floodplain.
Global: Invasive/Exotic: *Alliaria petiolata* (High/Medium), *Conium maculatum* (Medium/Low), *Glechoma hederacea* (Low), *Humulus japonicus* (Medium/Low), *Lonicera japonica* (High/Medium), *Microstegium vimineum* (High/Medium), *Polygonum cuspidatum* (High/Medium), *Rosa multiflora* (Medium/Low); **Other Plants**: *Matteuccia struthiopteris* (G5)

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CONSERVATION STATUS RANK

Global Rank & Reasons: G4? (3-Oct-1996). There has been significant conversion of stands to agriculture, hydrologic modifications due to river dams, etc., and siltation caused by modified flooding regimes.

CLASSIFICATION

Status: Standard

Classification Confidence: 2 - Moderate

Mississippi National River and Recreation Area Comments:

Global Comments: This type (CEGL002586) includes stands where *Acer saccharinum* (silver maple) represents the majority of trees (>50% cover or basal area?). This type is most clearly expressed on medium to larger rivers, but occurs on higher flooded terraces. Compare with *~Populus deltoides - Salix nigra - Acer saccharinum* Forest (CEGL002018)$$ (which also occurs on medium to large rivers but on more recently scoured sand bars and the inner most active part of the floodplain) and *~Fraxinus pennsylvanica - Celtis occidentalis - Tilia americana - (Quercus macrocarpa)* Forest (CEGL002081)$$ (which occurs on the terraces of small to large river terraces). To some degree this type is more northern, separable from the more southern type *~Acer saccharinum - Celtis laevigata - Carya illinoinensis* Forest (CEGL002431)$$, but this distinction is not yet well resolved. In the southern parts of its range, this type may overlap with *~Platanus occidentalis - Acer saccharinum - Juglans nigra - Ulmus rubra* Forest (CEGL007334)$$, but that type is generally a higher terrace, small stream type. Compare this type with SAF cover type 62 (Eyre 1980). In Minnesota stands with less than either 50% cottonwood or silver maple and not in northwestern Minnesota tend to occur here (i.e., a mixed floodplain forest), as do silver maple stands with a supercanopy of cottonwoods. In southwestern Minnesota, stands with swamp white oak belong with *~Quercus macrocarpa - Quercus bicolor - Carya laciniosa / Leersia* spp. *- Cinna* spp. Forest (CEGL002098)$$. *Fraxinus pennsylvanica* is a typical codominant in this type. In Wisconsin, this type may better be named *Acer saccharinum - Fraxinus pennsylvanica - Betula nigra* Forest (E. Epstein pers. comm. 1999).

Global Similar Associations:

- *Acer (rubrum, saccharinum) - Fraxinus* spp. *- Ulmus americana* Forest (CEGL005038) grades into this community in backwater swamps.
- *Acer saccharinum - (Populus deltoides) / Matteuccia struthiopteris - Laportea canadensis* Forest (CEGL006147) is somewhat more northern, lacking *Platanus* and *Betula nigra*.
- *Acer saccharinum - Acer negundo / Ageratina altissima - Laportea canadensis - (Elymus virginicus)* Forest (CEGL006217)
- *Acer saccharinum - Betula nigra / Cephalanthus occidentalis* Forest (CEGL007810)
- *Acer saccharinum - Celtis laevigata - Carya illinoinensis* Forest (CEGL002431) is more southern.
- *Acer saccharinum* Temporarily Flooded Forest [Placeholder] (CEGL007304)
- *Fagus grandifolia - Quercus* spp. *- Acer rubrum - Juglans nigra* Forest (CEGL005014) in the eastern part of its range on the mesic side.
- *Fraxinus nigra - Acer saccharinum* Upper Great Lakes Floodplain Forest (CEGL005488)
- *Fraxinus pennsylvanica - Ulmus americana - (Acer negundo, Tilia americana)* Great Plains Forest (CEGL005400)
- *Fraxinus pennsylvanica - Ulmus* spp. *- Celtis occidentalis* Forest (CEGL002014)
- *Platanus occidentalis - Acer saccharinum - Juglans nigra - Ulmus rubra* Forest (CEGL007334) may overlap in southern parts of the range of CEGL002586.
- *Populus deltoides - Salix nigra - Acer saccharinum* Forest (CEGL002018) grades into this community on the wetter side.
- *Quercus macrocarpa - Quercus bicolor - Carya laciniosa / Leersia* spp. *- Cinna* spp. Forest (CEGL002098)

Global Related Concepts:

- Floodplain Forest Silver Maple Subtype (MNNHP 1993) **<**
- Floodplain Forest Silver Maple Subtype (Faber-Langendoen 2001) **=**
- Floodplain Forest Swamp White Oak Subtype (MNNHP 1993) **<**
- Silver Maple - American Elm: 62 (Eyre 1980) **>**
- Silver Maple Floodplain Forest (Fike 1999) **>**
- Silver maple-American elm-cottonwood floodplain forest (CAP pers. comm. 1998) **?**
- Southern Floodplain Forest (Chapman et al. 1989) **>**
- Wet Bottomland Forest (Nelson 1985) **>**

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This association is widespread in the park. It is most common where the floodplain is broad and flat, particularly on the banks of the river from Fort Snelling State Park and further downriver, on most islands in MISS, and is very widespread in Gore's Pool WMA.

Global Range: This association is found throughout the midwestern United States and in the mid-Atlantic region of the eastern United States, ranging from Delaware, New Jersey, and Pennsylvania west to Minnesota, and south to Arkansas.

Nations: CA, US

States/Provinces: AR, DE, IA:SU, IL, IN, KY, MI, MN, MO, NJ, NY, OH, ON, PA, QC?, TN, WI:S3, WV:S3S4

TNC Ecoregions: 35:C, 36:C, 37:C, 38:C, 40:?, 42:C, 43:P, 44:C, 45:C, 46:C, 47:C, 48:C, 49:C, 50:C, 60:C, 61:C, 62:C

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USFS Ecoregions (1994/95): 212Fc:CCC, 212Hb:CCC, 212He:CCC, 212Hm:CCC, 212Ht:CCP, 212Hv:CCC, 212Hw:CCP, 212Hx:CCP, 212Hy:CCP, 212Ja:CCC, 212Je:CCC, 212Jf:CCC, 212Jj:CC?, 212Jl:CCC, 212Js:CCC, 212Ka:CC?, 212Kb:CCC, 212Mb:CPP, 212Na:CC?, 212Nb:CCP, 212Nc:CCC, 212Nd:CCC, 221Bd:CCC, 221Da:CCC, 221Db:CCC, 221Ea:CCC, 221Ec:CCC, 221Ed:CCC, 221Ef:CCC, 221Fa:CCC, 222Aj:CCC, 222An:CCC, 222Ap:CCC, 222Aq:CCC, 222Ch:CCC, 222Db:CCC, 222Dc:CCP, 222De:CCC, 222Df:CCP, 222Ei:CPP, 222Ek:CPP, 222El:CPP, 222Em:CPP, 222Fa:CCP, 222Fb:CCC, 222Fc:CCP, 222Fd:CCP, 222Fe:CCP, 222Ff:CCP, 222Ga:CCC, 222Gb:CCC, 222Gc:CCC, 222Gd:CCP, 222Ge:CCC, 222Ha:CCC, 222Hb:CCC, 222Hc:CCC, 222Hf:CCC, 222If:CCC, 222Jb:CCC, 222Jh:CCC, 222Ji:CCC, 222Jj:CCC, 222Ka:CCC, 222Kb:CCC, 222Kd:CCC, 222Kf:CCC, 222Kg:CCC, 222Kh:CCC, 222Kj:CCP, 222Lc:CCC, 222Ld:CCC, 222Lf:CCC, 222Ma:CCC, 222Mb:CCC, 222Mc:CCC, 222Md:CCC, 222Me:CCC, 232Ac:CCC, 234Aa:CC?, 234Am:CCC, 234An:CCC, 251Ba:CCC, 251Be:CCC, 251Cc:CCC, 251Cd:CCC, 251Cf:CCC, 251Dd:CCP, 251De:CCC, 251Df:CCC, 251Dg:CCC, 251Dh:CCC, 251Eb:CCC, M221Cb:CCC
Federal Lands: NPS (Appalachian Trail [Lower New England], Buffalo River, Cuyahoga Valley, Delaware Water Gap, Effigy Mounds, Indiana Dunes, Mississippi, New River Gorge, Saint Croix, Upper Delaware); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Huron-Manistee, Huron?, Manistee, Nicolet?, Ozark?, Wayne); USFWS (Erie)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: FFSM - Silver Maple - Elm Forest
Mississippi National River and Recreation Area Inventory Notes:
Mississippi National River and Recreation Area Plots and Observation Points: DNR.3263, DNR.3264, DNR.4928, DNR.6108, DNR.6690, MISS.018, MISS.020, MISS.022, MISS.056, MISS.113, MISS.129
Local Description Authors: J. Drake
Global Description Authors: D. Faber-Langendoen, mod. L.A. Sneddon, E. Largay, S.C. Gawler
References: Anderson 1996, CAP pers. comm. 1998, CDPNQ unpubl. data, Chapman et al. 1989, Coxe 2009, Edinger et al. 2002, Eyre 1980, Faber-Langendoen 2001, Fike 1999, Homoya et al. 1988, Hop et al. 2005, Hop et al. 2009, INAI unpubl. data, Kost et al. 2007, MNNHP 1993, Midwestern Ecology Working Group n.d., Minnesota DNR 2005a, Nelson 1985, Nelson 2010, ONHD unpubl. data, Perles et al. 2007, Perles et al. 2008, Podniesinski and Wagner 2002, TDNH unpubl. data, Vanderhorst et al. 2007, WNHI 2011, WNHI unpubl. data, WPC and TNC 2002, WVNHP unpubl. data b, Walton et al. 1996, White and Madany 1978, Zimmerman 2011k, Zimmerman et al. 2012

Midwestern Cottonwood - Black Willow - Silver Maple Forest

Populus deltoides - *Salix nigra* - *Acer saccharinum* Forest
Eastern Cottonwood - Black Willow - Silver Maple Forest
Identifier: CEGL002018

USNVC CLASSIFICATION

Division	Eastern North American & Great Plains Flooded & Swamp Forest (1.B.3.Na.)
Macrogroup	Central & Appalachian Floodplain Forest (M029)
Group	Silver Maple - Green Ash - Sycamore Floodplain Forest (G652)
Alliance	Silver Maple - Eastern Cottonwood Floodplain Forest Alliance (A3710)
Association	Midwestern Cottonwood - Black Willow - Silver Maple Forest

ELEMENT CONCEPT

Global Summary: This cottonwood - black willow - silver maple forest is characteristic of the fronts and banks of most major rivers and large streams throughout the Central Forest Region, extending into the northern forest particularly within the Mississippi, Ohio, and Missouri River systems. It develops on bare, moist soil on recently formed sand bars, front-land ridges, and well-drained flats, along with *Salix interior* (sandbar willow), *Eragrostis hypnoides* (teal lovegrass), *Leptochloa panicea* ssp. *brachiata (= Leptochloa filiformis)* (mucronate sprangeltop), *Lipocarpha micrantha (= Hemicarpha micrantha)* (smallflower halfchaff sedge), *Rumex maritimus* (golden dock), *Potentilla paradoxa* (Paradox cinquefoil), and *Bidens* spp. (beggarticks). This natural community can also be found well-drained ridges in the first bottoms. Soils are formed in alluvium, are deep, medium-textured, and with adequate or excessive moisture available for vegetation during the growing season. The tree canopy is tall (to 30 m) and dominated by *Populus deltoides* (eastern cottonwood), *Salix nigra* (black willow), and *Acer saccharinum* (silver maple), although *Fraxinus pennsylvanica* (green ash), *Acer negundo* (boxelder), *Platanus occidentalis* (American sycamore), and *Ulmus americana* (American elm) are also commonly encountered. Tree diversity is limited due to the dynamics of flooding and resultant deposition and scouring of sediments. In earlier successional stages, the subcanopy can be strongly dominated by *Salix nigra* (black willow). The shrub layer is conspicuously absent in many parts of the range. Herbaceous growth can be thick and lush but is often patchy and sparse due to frequent inundation. Species most often encountered in the ground layer include *Carex* spp. (sedge), *Leersia oryzoides* (rice cutgrass), *Bidens* spp. (beggarticks), and Asteraceae spp.

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This forest community develops on bare soil in floodplains on moist, well-drained alluvial soil. It is most commonly found adjacent to the active river channel on sandy soil, though it can be on finer soils. Most of the ground surface was plant litter (avg. 51%) and downed wood (8%) with most of the rest being bare soil (19%)

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and bare sand (7%). Flooding is necessary for the establishment and maintenance of this community. Flood duration is usually a few days to a few weeks though the water may be several feet above the forest floor during those times.
Global Environment: This community colonizes newly deposited substrates adjacent to rivers, lakes, streams, and in frequently flooded, low, wet depressions in floodplains. Dynamic substrate availability caused by frequent flooding encourages the establishment and maintenance of this community type. Frequent flooding contributes to a highly unstable ecosystem where substrate availability is constantly changing due to excessive water depth, scouring, and sediment deposition. The dynamic forces of flowing water maintain this early-successional forest type. Flooding is seasonal (early spring/late fall).

Soils are somewhat poorly drained to poorly drained (occasionally moderately well-drained), slowly to moderately permeable, and formed in silty, loamy, sandy, or clayey alluvial materials. Characteristic topography is undulating narrow to broad linear ridges and natural levees along sloughs, overflow channels, and intermediate terrain between ridges and depressions in river floodplains. Prominent physical properties include low organic matter and subsequent light color and acidic pH. Soils which support this floodplain forest are developed in sandy to clayey alluvial sediments deposited by large rivers on bottomlands. These soils are deep and moderately to extremely acidic with little or no horizon development. Major soil orders which support this natural community include Entisols and Inceptisols. In Illinois, soils which commonly support this floodplain forest include the Medway, Ware, Bowdre, Cairo, and Gorham Series. Other bottomland soils which can also support this forest include the Millington, Confrey, Ambraw, Wallkill, Birds, Bonnie, Wastenaw, Petrolia, Propolis, Blackroar, Otter Beaucoup, Sawmill, Colo, Calco, Fults, McFain, Cape, Bungay, Karnak, Titus, Shiloh, Darwin, Wabash Jacob, and Booker Series. Bedrock is deeply buried by alluvium deposited during floods. Rock units were formed during the Cenozoic Era. Twenty percent consists of Tertiary marine deposits (lignitic sandy and argillaceous deposits). The remaining rock consists of equal amounts of Quaternary marine deposits of glacial outwash. Bedrock is deeply buried by alluvium deposited during floods. Rock units were formed during the Cenozoic Era. Twenty percent consists of Tertiary marine deposits (lignitic sandy and argillaceous deposits). The remaining rock consists of equal amounts of Quaternary marine deposits of glacial outwash.

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: The canopy of this floodplain forest is usually moderately closed to closed but can be moderately open (avg. 77%). Older stands often have among the tallest canopy of any forest at MISS. *Populus deltoides* (eastern cottonwood) is the single most abundant canopy tree, though *Salix nigra* (black willow) can be abundant in some stands. Both these species require open areas to establish so, in the absence of significant disturbance to the canopy, they are absent or uncommon in the other vegetation strata. *Acer saccharinum* (silver maple) is common to co-dominant while *Acer negundo* (boxelder) and *Fraxinus pennsylvanica* (green ash) are frequently present in low amounts. The tree subcanopy is sparse to moderate (avg. 37%) and is composed of floodplain species that can tolerate moderate amounts of shade, such as *Acer negundo* (boxelder)*, Acer saccharinum* (silver maple)*, Fraxinus pennsylvanica* (green ash), and *Ulmus americana* (American elm). The shrub stratum is generally open (avg. 30%) and composed of a mix of shrubs, small trees, and climbing vines. Some of the more common of these are exotic *Lonicera* spp. (honeysuckle), *Rhamnus cathartica* (common buckthorn)*, Ribes* spp. (gooseberry), and *Vitis riparia* (riverbank grape). The herbaceous stratum can be nearly absent to dense (avg. 42%). Dry, sandy conditions, a dense tree canopy, and recent severe flooding tend to result in low herbaceous cover while sites with finer soils, a more open tree canopy, and less recent floods can have dense ground cover. Seedlings of canopy and sub-canopy trees, with the exception of *Populus deltoides* (eastern cottonwood), are commonly present but not dominant. *Alliaria petiolata* (garlic mustard)*, Circaea lutetiana* (broadleaf enchanter's nightshade)*, Laportea canadensis* (Canadian woodnettle)*, Leersia virginica* (whitegrass), and the woody vines *Parthenocissus vitacea* (woodbine) and *Vitis riparia* (riverbank grape) are all common and may be locally abundant.
Global Vegetation: This community is dominated by broadleaf deciduous trees. Canopy closure is complete, or nearly so, with few shrubs and limited tree species found in the type. The tree canopy is tall (to 30 m) and dominated by *Populus deltoides* (eastern cottonwood)*, Salix nigra* (black willow), and *Acer saccharinum* (silver maple), although *Fraxinus pennsylvanica* (green ash)*, Acer negundo* (boxelder), and *Ulmus americana* (American elm) are also commonly encountered. Tree diversity is limited due to the dynamics of flooding and deposition/scouring of sediments. The subcanopy can be strongly dominated by *Salix nigra* (black willow). The shrub layer is conspicuously absent in many parts of the range. Herbaceous growth can be thick and lush but is often patchy and sparse due to frequent inundation. Species most often encountered in the ground layer include *Carex* spp. (sedge), *Leersia oryzoides* (rice cutgrass)*, Bidens* spp. (beggarticks), and Asteraceae spp. (TNC 1995a). Cottonwood trees can exceed 30 m in height with massive trunks which fork into stout branches when growing on sites protected from prolonged severe flooding. Thick "dog hair" stands of cottonwood and willow occur on newly formed sand bars. This is an early-successional forest exhibiting rapid growth.

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Tree (canopy)	Broad-leaved deciduous tree	*Populus deltoides* (eastern cottonwood)
Tree subcanopy	Broad-leaved deciduous tree	*Acer negundo* (boxelder), *Ulmus americana* (American elm)
Short shrub/sapling	Broad-leaved deciduous shrub	*Rhamnus cathartica* (common buckthorn)

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Global

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Populus deltoides* (eastern cottonwood), *Salix nigra* (black willow)
Tree subcanopy	Broad-leaved deciduous tree	*Salix nigra* (black willow)
Herb (field)	Forb	*Bidens aristosa* (bearded beggarticks), *Spermacoce glabra* (smooth false buttonweed), *Symphyotrichum lanceolatum* var. *lanceolatum* (white panicle aster), *Symphyotrichum lateriflorum* var. *lateriflorum* (calico aster)
Herb (field)	Graminoid	*Carex typhina*, *Leersia oryzoides* (rice cutgrass)

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: *Populus deltoides*
Global: Information no available.

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information no available.
Global: Vulnerable: *Macrochelys temminckii* (G3G4), *Vermivora bachmanii* (GH)

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G4 (22-Jun-1998). The current range of this community is much smaller than the presettlement range due to extensive logging, ditching, draining, and land clearing for conversion to croplands. The reduced waterflows and channelization of rivers decreases the frequency of natural floods necessary for the scouring and deposition of new substrates that favor cottonwood regeneration.

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Mississippi National River and Recreation Area Comments:
Global Comments: The name of the community has had *Acer saccharinum* (silver maple) added to it to highlight the distinction between this and *~Populus deltoides - Salix nigra / Mikania scandens* Forest (CEGL007346)$$. Kentucky occurrences are intermediate between the two. This type does not occur in Nebraska, where *Salix nigra* (black willow) is a very uncommon tree species. In fact it is thought to have been incorrectly reported as more widespread in the state because it can be confused with *Salix amygdaloides* (peachleaf willow) (G. Steinauer pers. comm. 2000). In floodplains with a history of agricultural activity, this type can also be found re-establishing on abandoned fields.
Global Similar Associations:
- *Acer saccharinum - Fraxinus pennsylvanica - Ulmus americana* Forest (CEGL002586)
- *Populus deltoides - Salix nigra / Mikania scandens* Forest (CEGL007346) occurs in the southeastern United States.
- *Populus deltoides - Salix nigra* Woodland (CEGL004919)
- *Salix nigra* Forest (CEGL002103) is a *Salix nigra*-dominated community.
- *Salix nigra* Temporarily Flooded Shrubland (CEGL003901) is a *Salix nigra*-dominated community.

Global Related Concepts:
- *Populus deltoides - Salix nigra / Leersia* community (Voigt and Mohlenbrock 1964) =
- *Populus deltoides - Salix nigra* Forest (TNC 1995a) =
- Black Willow: 95 (Eyre 1980) >
- Cottonwood-Dogwood Floodplain Woodland (Steinauer and Rolfsmeier 2000) =
- Cottonwood: 63 (Eyre 1980) >
- Eastern Broadleaf Forests: 98: Northern Floodplain Forest (*Populus-Salix-Ulmus*) (Küchler 1964) >
- Eastern Broadleaf and Needleleaf Forests (Küchler 1964) >
- Floodplain Forest (MNNHP 1993) >
- Floodplain Forest Cottonwood-Willow Subtype (Faber-Langendoen 2001) =
- Palustrine: Palustrine Forested Wetland (Cowardin et al. 1979) <
- Riparian Forest (Evans 1991) >
- Terrestrial: Forest: Hardwood (TNC 1985) >
- UNESCO FORMATION CODE: I.B.3d (UNESCO 1973) >
- Wet Bottomland Forest (Nelson 1985) >

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This association is widespread in the park. It is most common where the floodplain is broad and flat, particularly on the banks of the river from Fort Snelling State Park and further downriver, on most islands in MISS, and is very widespread in Gore's Pool WMA.

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Global Range: This cottonwood - black willow - silver maple forest is characteristic of the fronts and banks of most major rivers and streams throughout the Central Forest Region, extending into the northern forest particularly within the Mississippi, Ohio, and Missouri River systems, extending from Ohio west to Minnesota, southward to Oklahoma, and east to Kentucky.
Nations: US
States/Provinces: AR?, IA:SU, IL, IN, KS:SU, KY, MN, MO, NE:S2, OH, OK, WI:S3, WY
TNC Ecoregions: 35:C, 36:C, 37:C, 38:P, 39:?, 42:C, 43:C, 44:C, 46:C, 48:C, 49:C
USFS Ecoregions (1994/95): 221Fa:CCC, 222Ad:CP?, 222Ae:CP?, 222C:CP, 222D:CP, 222E:CP, 222F:CP, 222G:CP, 222H:CP, 222I:CP, 222Jj:CCC, 222K:CC, 222Lf:CCC, 222Mb:CCC, 222Me:CCC, 231A:PP, 231B:PP, 231E:PP, 231F:PP, 231G:PP, 232B:PP, 232C:PP, 234A:PP, 251Ba:CCC, 251Bb:CCC, 251Cd:CC?, 251Cg:CCC, 251D:CP
Federal Lands: NPS (Cuyahoga Valley, Effigy Mounds?, Fort Larned, Indiana Dunes, Mississippi, Saint Croix); USFS (St. Francis?)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: FFCW - Midwestern Cottonwood - Black Willow - Silver Maple Forest
Mississippi National River and Recreation Area Inventory Notes:
Mississippi National River and Recreation Area Plots and Observation Points: MISS.011, MISS.014, MISS.031, MISS.035, MISS.050, MISS.074, MISS.076, MISS.098, MISS.110, MISS.115, MISS.116, MISS.124
Local Description Authors: J. Drake
Global Description Authors: M. Guetersloh, mod. D. Faber-Langendoen
References: Braun 1950, Bruner 1931, Cogan 2007b, Collins et al. 1981, Cowardin et al. 1979, Evans 1991, Evans et al. 2009, Eyre 1980, Faber-Langendoen 2001, Galloway 1963, Galloway 1964, Hefley 1937, Hoagland 2000, Homoya et al. 1988, Hop et al. 2005, Hop et al. 2009, INAI unpubl. data, Küchler 1964, Lauver et al. 1999, MNNHP 1993, Midwestern Ecology Working Group n.d., Minnesota DNR 2005a, Minnesota DNR 2005b, Nelson 1985, Nelson 2010, ONHD unpubl. data, Rogers 1953, SAF 1967, Steinauer and Rolfsmeier 2000, TNC 1985, TNC 1995a, UNESCO 1973, Voigt and Mohlenbrock 1964, WNDD unpubl. data, WNHI 2011, WNHI unpubl. data, Ware and Penfound 1949, White and Madany 1978, Zanoni et al. 1979

M504. Northern Flooded & Swamp Forest

G046. Laurentian-Acadian-Allegheny Alkaline Swamp

Red Maple - Ash - Birch Swamp Forest

Acer rubrum - *Fraxinus* spp. - *Betula papyrifera* / *Cornus canadensis* Forest
Red Maple - Ash species - Paper Birch / Bunchberry Dogwood Forest
Identifier: CEGL002071

USNVC CLASSIFICATION

Division	Eastern North American & Great Plains Flooded & Swamp Forest (1.B.3.Na.)
Macrogroup	Northern Flooded & Swamp Forest (M504)
Group	Laurentian-Acadian-Allegheny Alkaline Swamp (G046)
Alliance	Black Ash - Red Maple Saturated Forest Alliance (A0347)
Association	Red Maple - Ash - Birch Swamp Forest

ELEMENT CONCEPT

Global Summary: This red maple swamp forest type is found in the northern parts of the Great Lakes region of the United States and in adjacent Canada. Stands are typically found on muck and shallow peat on lakeplains and floodplains. The canopy structure is variable, with cover ranging from open (25-60%) to closed (60-100%). Common canopy dominants include *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Betula papyrifera* (paper birch), *Fraxinus nigra* (black ash), *Fraxinus pennsylvanica* (green ash), and occasional *Larix laricina* (tamarack), *Pinus strobus* (eastern white pine), and *Ulmus americana* (American elm) (at least historically). *Pinus strobus* (eastern white pine) may form a patchy supercanopy above the hardwood canopy. Common shrubs include *Alnus incana* (gray alder). *Toxicodendron vernix* (poison sumac) may be common in parts of the range. Other associates include *Ilex verticillata* (common winterberry), *Ribes* spp. (gooseberry), and *Rubus idaeus* ssp. *strigosus (= Rubus strigosus)* (grayleaf red raspberry). The herbaceous layer contains *Carex stipata* (awlfruit sedge), *Impatiens capensis* (jewelweed), *Mitella nuda* (naked miterwort), *Onoclea sensibilis* (sensitive fern), *Osmunda cinnamomea* (cinnamon fern), *Osmunda claytoniana* (interrupted fern), *Saxifraga pensylvanica* (eastern swamp saxifrage), and others. A seepage swamp subtype can occur where steep sandy slopes and gravelly slopes merge with a river or stream terrace. The ground layer can be exceptionally diverse, with characteristic seepage species including *Angelica atropurpurea* (purplestem angelica), *Carex bromoides* (brome-like sedge), *Hydrocotyle americana* (American marshpennywort), *Poa paludigena* (bog bluegrass), *Saxifraga pensylvanica* (eastern swamp saxifrage), and *Symplocarpus foetidus* (skunk cabbage).

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ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This wetland forest was sampled four times in the park. The conditions that allow this community to form are rare in MISS and all known examples are small. This forest is found at the base of bluffs where water seepage causes the soil to be saturated for all or nearly all the growing season. Soils are mucky. Sites are usually flat or have shallow slopes. The ground surface is almost half covered by plant litter and half bare ground with little else.
Global Environment: Stands are typically found on muck and shallow peat on lakeplains and floodplains (MNNHP 1993).

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: The canopy of this wetland forest is moderately open (avg. 60%) and dominated by *Fraxinus nigra* (black ash). *Acer negundo* (boxelder), *Acer saccharinum* (silver maple), *Betula alleghaniensis* (yellow birch), and *Fraxinus pennsylvanica* (green ash) can occur, also. There is very little tree subcanopy. The shrub layer is open (avg. 18%) and contains small *Fraxinus nigra* (black ash), *Cornus sericea* (redosier dogwood), and *Rhamnus cathartica* (common buckthorn). One site is known to have significant *Alnus incana* (gray alder). The herbaceous layer is typically lush (avg. 60%) and diverse with species such as *Carex lacustris* (hairy sedge), *Impatiens capensis* (jewelweed), *Myosotis laxa* (bay forget-me-not), *Phalaris arundinacea* (reed canarygrass), and *Symplocarpus foetidus* (skunk cabbage) dominating stands.
Global Vegetation: The canopy structure is variable, with cover ranging from open (25-60%) to closed (60-100%). Common canopy dominants include *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Betula papyrifera* (paper birch), *Fraxinus nigra* (black ash), *Fraxinus pennsylvanica* (green ash), and occasional *Larix laricina* (tamarack), *Pinus strobus* (eastern white pine), and *Ulmus americana* (American elm) (at least historically). *Pinus strobus* (eastern white pine) may form a patchy supercanopy above the hardwood canopy. Common shrubs include *Alnus incana* (gray alder), and *Toxicodendron vernix* (poison sumac) may be common in parts of the range. Other associates include *Ilex verticillata* (common winterberry), *Ribes* spp. (gooseberry), and *Rubus idaeus* ssp. *strigosus (= Rubus strigosus)* (grayleaf red raspberry). The herbaceous layer contains *Carex stipata* (awlfruit sedge), *Impatiens capensis* (jewelweed), *Mitella nuda* (naked miterwort), *Onoclea sensibilis* (sensitive fern), *Osmunda cinnamomea* (cinnamon fern), *Osmunda claytoniana* (interrupted fern), *Saxifraga pensylvanica* (eastern swamp saxifrage), and others (MNNHP 1993, Wovcha et al. 1995). A seepage swamp subtype can occur where steep sandy slopes and gravelly slopes merge with a river or stream terrace. The ground layer can be exceptionally diverse, with characteristic seepage species including *Angelica atropurpurea* (purplestem angelica), *Carex bromoides* (brome-like sedge), *Hydrocotyle americana* (American marshpennywort), *Poa paludigena* (bog bluegrass), *Saxifraga pensylvanica* (eastern swamp saxifrage), and *Symplocarpus foetidus* (skunk cabbage) (MNNHP 1993, Wovcha et al. 1995).

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Tree (canopy)	Broad-leaved deciduous tree	*Fraxinus nigra* (black ash)
Herb (field)	Forb	*Impatiens capensis* (jewelweed), *Symplocarpus foetidus* (skunk cabbage)

Global: Information no available.

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: *Fraxinus nigra*
Global: Information no available.

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information no available.
Global: Vulnerable: *Dryopteris crinalis* (G3), *Poa paludigena* (G3)

CONSERVATION STATUS RANK

Global Rank & Reasons: G4 (3-Oct-1996). In Wisconsin, where the type is ranked S2, few high-quality occurrences have been documented (E. Epstein pers. comm. 1999).

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Mississippi National River and Recreation Area Comments: Examples of this community at MISS are small and so have a greater edge-to-interior ratio than larger communities do. Still, the conditions in this community are typically distinct from the surrounding vegetation which makes it relatively easy to identify.
Global Comments: Hydrology of this type may be a combination of seasonally flooded and saturated. This type can arise as a result of logging cedar swamps, or where hydrology has been altered (E. Epstein pers. comm. 1999). *Fraxinus nigra* (black ash) is less than 50% of the cover; if greater, then see the *Fraxinus nigra* type (CEGL002105). If *Larix laricina* (tamarack) is at least 25% of the canopy, then see *~Larix laricina - Acer rubrum / (Rhamnus alnifolia, Vaccinium corymbosum*) Forest (CEGL005232)$$ or *~Larix laricina / Alnus incana* Forest (CEGL002471)$$.

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Global Similar Associations:

- *Fraxinus nigra* - Mixed Hardwoods - Conifers / *Cornus sericea / Carex* spp. Forest (CEGL002105) This type is dominated by *Fraxinus nigra* and is more northern in distribution.
- *Larix laricina - Acer rubrum / (Rhamnus alnifolia, Vaccinium corymbosum)* Forest (CEGL005232) This type contains significant *Larix laricina* (generally at least 25%, and more typically over 50% cover) and *Acer rubrum* (at least 25%). May overlap in concept.
- *Larix laricina / Alnus incana* Forest (CEGL002471) This type is a rich swamp, with *Larix laricina* (tamarack) as the dominant (generally >50% cover).
- *Symplocarpus foetidus* - Mixed Forbs Wet Meadow (CEGL002385)

Global Related Concepts:

- Mixed Hardwood Swamp (MNNHP 1993) ><
- Mixed Hardwood Swamp Seepage Subtype (MNNHP 1993) <
- Northern Hardwood Swamp Red Maple-Ash-Birch Subtype (Faber-Langendoen 2001) =
- Southern Swamp (Chapman et al. 1989) >

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This uncommon association was found in seven small areas in the park, all but one at the base of steep bluffs. These areas were all between Minnehaha Falls Park and Ordway Field Station.
Global Range: This red maple swamp forest type is found in the northern parts of the Great Lake states region of the United States and in adjacent Canada, ranging from Minnesota east to Michigan and Ontario.
Nations: CA, US
States/Provinces: MI, MN, ON, QC?, WI:S2?
TNC Ecoregions: 35:C, 45:P, 46:C, 47:C, 48:C
USFS Ecoregions (1994/95): 212He:CCP, 212Hl:CCP, 212Hm:CCP, 212Hn:CCP, 212Ho:CCP, 212Hp:CCP, 212Hq:CCP, 212Hr:CCP, 212Hs:CCP, 212Ht:CCP, 212Hu:CCP, 212Hv:CCC, 212Hw:CCP, 212Hx:CCP, 212Hy:CCP, 212Ia:CCC, 212Ja:CPP, 212Jb:CPP, 212Jc:CPP, 212Jl:CPP, 212Jn:CPP, 212Jo:CPP, 212Kb:CCC, 212La:CPP, 212Mb:CPP, 212Na:CCP, 212Nb:CCP, 212Nc:CCC, 222Jc:CCC, 222Jg:CCC, 222Mc:CCC, 222Md:CCC, 222Na:CCC
Federal Lands: NPS (Apostle Islands, Isle Royale, Mississippi, Saint Croix, Sleeping Bear Dunes); USFS (Chequamegon-Nicolet?, Chequamegon?, Chippewa, Huron-Manistee, Huron?, Manistee, Nicolet?, Ottawa)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: FBAS - Red Maple - Ash - Birch Swamp Forest
Mississippi National River and Recreation Area Inventory Notes:
Mississippi National River and Recreation Area Plots and Observation Points: DNR.6013, DNR.6014, MISS.006, MISS.105
Local Description Authors: J. Drake
Global Description Authors: D. Faber-Langendoen
References: CDPNQ unpubl. data, Chapman et al. 1989, Epstein pers. comm., Faber-Langendoen 2001, Hop et al. 2010a, Kost et al. 2007, MNNHP 1993, Midwestern Ecology Working Group n.d., Minnesota DNR 2005a, TNC 1999b, WNHI 2011, WNHI unpubl. data, Wovcha et al. 1995

M302. Eastern North American Ruderal Flooded & Swamp Forest

G552. Northern & Central Native Ruderal Flooded & Swamp Forest

Box-elder Ruderal Floodplain Forest

Acer negundo Ruderal Floodplain Forest
Box-elder Ruderal Floodplain Forest
Identifier: CEGL005033

USNVC CLASSIFICATION

Division	Eastern North American & Great Plains Flooded & Swamp Forest (1.B.3.Na.)
Macrogroup	Eastern North American Ruderal Flooded & Swamp Forest (M302)
Group	Northern & Central Native Ruderal Flooded & Swamp Forest (G552)
Alliance	Box-elder - Mixed Hardwoods / Garlic Mustard Ruderal Floodplain Forest Alliance (A4099)
Association	Box-elder Ruderal Floodplain Forest

ELEMENT CONCEPT

Global Summary: This semi-open to closed-canopy ruderal forest is found on disturbed sites in floodplains in the southern, eastern, and midwestern United States. Stands occur on large rivers in the active floodplain and on sandbars, and may form farther from the riverfront following disturbance. Occurrences are mostly on higher floodplain terraces with less rocky soils which were used for

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agriculture or habitation. They are typically temporarily flooded in the spring. These ruderal forests are dominated by *Acer negundo* (boxelder). Other characteristic species include *Platanus occidentalis* (American sycamore), *Celtis laevigata* (sugarberry), *Acer rubrum* (red maple), *Liriodendron tulipifera* (tuliptree), *Robinia pseudoacacia* (black locust), *Liquidambar styraciflua* (sweetgum), *Acer saccharinum* (silver maple), *Ulmus alata* (winged elm), *Ulmus rubra* (slippery elm), *Carya cordiformis* (bitternut hickory), *Fraxinus pennsylvanica* (green ash), *Juglans nigra* (black walnut), *Carpinus caroliniana* (American hornbeam), *Morus rubra* (red mulberry), and *Populus deltoides* (eastern cottonwood). The shrub and herb layers range from sparse to relatively lush, and the vine component often is heavy. The herb layer consists of a mixture of weedy exotics and native floodplain species, including *Rhamnus cathartica* (common buckthorn) and various invasive *Lonicera* species (honeysuckle).

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This wet-mesic forest was found on level to gently sloping ground on floodplains or in basins that are saturated or flooded for a few to several weeks during the growing season. On floodplains, this forest is usually on terraces or other sites that do not get significant scouring and deposition most years. This forest results from some kind of disturbance but it is nearly always anthropogenic disturbance such as logging, agricultural or urban development, or hydrologic alteration. The ground surface is mostly bare ground (avg. 73%) with some plant litter (avg. 15%) and downed wood (avg. 8%).

Global Environment: Stands occur on disturbed sites in large rivers in the active floodplain and on sandbars, and may form farther from the riverfront following disturbance. Occurrences are mostly on higher floodplain terraces with less rocky soils which were used for agriculture or habitation. They are typically temporarily flooded in the spring and have sandy soils. In Kentucky, these forests may also occur in old fields within floodplains.

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This forest has a moderately closed to closed tree canopy (avg. 75%). The dominant species, *Acer negundo* (boxelder), is a short tree but associated trees can be taller which tends to result in a tree canopy of varying height across a stand. The growth form and general height of *Acer negundo* (boxelder) may also blur any distinction with a tree sub-canopy. *Acer negundo* (boxelder) has at least 60% cover in the tree canopy and is often prominent in lower vegetation strata. Common associates are *Acer saccharinum* (silver maple), *Celtis occidentalis* (common hackberry), *Fraxinus pennsylvanica* (green ash), *Populus deltoides* (eastern cottonwood), and *Ulmus americana* (American elm). The shrub stratum is well represented (avg. 55% cover) and composed mostly of *Rhamnus cathartica* (common buckthorn) and young individuals of the canopy trees, generally with the exception of *Populus deltoides* (eastern cottonwood). The herbaceous stratum also tends to be well developed (avg. 60%). A variety of mostly exotic or native generalist species can be present in addition to seedlings of canopy trees but *Alliaria petiolata* (garlic mustard), *Circaea lutetiana* (broadleaf enchanter's nightshade), *Geum canadense* (white avens), *Glechoma hederacea* (ground ivy), *Laportea canadensis* (Canadian woodnettle), *Leersia virginica* (whitegrass), *Impatiens* spp. (touch-me-not), and *Phalaris arundinacea* (reed canarygrass) are some of the more common species. The woody vines *Parthenocissus vitacea* (woodbine) and *Vitis riparia* (riverbank grape) are usually present climbing in one or more strata.

Global Vegetation: These ruderal forests (sometimes woodlands) are dominated by *Acer negundo* (boxelder). Other characteristic species include *Platanus occidentalis* (American sycamore), *Celtis laevigata* (sugarberry), *Acer rubrum* (red maple), *Liriodendron tulipifera* (tuliptree), *Robinia pseudoacacia* (black locust), *Liquidambar styraciflua* (sweetgum), *Acer saccharinum* (silver maple), *Ulmus alata* (winged elm), *Ulmus rubra* (slippery elm), *Carya cordiformis* (bitternut hickory), *Fraxinus pennsylvanica* (green ash), *Juglans nigra* (black walnut), *Carpinus caroliniana* (American hornbeam), *Morus rubra* (red mulberry), and *Populus deltoides* (eastern cottonwood). The shrub and herb layers range from sparse to relatively lush, and the vine component often is heavy. *Lindera benzoin* (northern spicebush) may be dominant in the shrub layer. The herb layer consists of a mixture of weedy exotics and native floodplain species, including *Ageratina altissima* (white snakeroot), *Alliaria petiolata* (garlic mustard), *Boehmeria cylindrica* (smallspike false nettle), *Carex grayi* (Gray's sedge), *Cryptotaenia canadensis* (Canadian honewort), *Glechoma hederacea* (ground ivy), *Lysimachia nummularia* (creeping jenny), *Mertensia virginica* (Virginia bluebells), *Polygonum virginianum* (jumpseed), *Prunella vulgaris* (common selfheal), *Urtica dioica* ssp. *dioica*(stinging nettle), and *Verbesina alternifolia* (wingstem). The range, dynamics, and variability of this type are complicated by the "weedy" nature of *Acer negundo* (boxelder), e.g., in Kentucky, *Acer negundo* (boxelder) may be dominant in old fields, with *Dichanthelium clandestinum* and *Carex* spp. in the ground layer. Elsewhere in the Midwest, logged and grazed stands of *Fraxinus pennsylvanica* (green ash) and *Ulmus americana* (American elm) may be dominated by *Acer negundo* (boxelder).

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Tree (canopy)	Broad-leaved deciduous tree	*Acer negundo* (boxelder)
Tree subcanopy	Broad-leaved deciduous tree	*Acer negundo* (boxelder)
Short shrub/sapling	Broad-leaved deciduous shrub	*Rhamnus cathartica* (common buckthorn)
Herb (field)	Forb	*Alliaria petiolata* (garlic mustard), *Glechoma hederacea* (ground ivy)

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Global

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Acer negundo* (boxelder)

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: *Acer negundo*

Global: *Acer negundo*, *Acer saccharinum*, *Ageratina altissima*, *Boehmeria cylindrica*, *Carex grayi*, *Lindera benzoin*, *Liquidambar styraciflua*, *Mertensia virginica*, *Platanus occidentalis*, *Prunella vulgaris*, *Robinia pseudoacacia*, *Ulmus americana*, *Verbesina alternifolia*

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information no available.

Global: Invasive/Exotic: *Alliaria petiolata* (High/Medium), *Glechoma hederacea* (Low), *Lysimachia nummularia* (Medium/Low), *Urtica dioica* ssp. *dioica*

CONSERVATION STATUS RANK

Global Rank & Reasons: GNA (ruderal) (28-Mar-2014). As currently defined, this is a broad-ranging ruderal community type.

CLASSIFICATION

Status: Standard

Classification Confidence: 2 - Moderate

Mississippi National River and Recreation Area Comments: This association can have a similar composition to *Fraxinus pennsylvanica - Celtis occidentalis - Tilia americana - (Quercus macrocarpa)* Forest, CEGL002081, but is dominated by *Acer negundo* (boxelder), presumably reflecting a history of more extensive disturbace. The canopy composition can be the same as *Acer negundo - Celtis occidentalis - Fraxinus pennsylvanica* Ruderal Forest, CEGL005462, but this latter community is not on sites flooded or saturated at some point during most growing seasons. Due to the weedy, generalist nature of many species in both communities it can be very difficult to differentiate sites on the drier edges of floodplains or other wetlands.

Global Comments: The range, dynamics, and variability of this type is complicated by the "weedy" nature of *Acer negundo* (boxelder). For example, disturbed stands in former *Fraxinus pennsylvanica - Ulmus americana - Celtis (occidentalis, laevigata)* Temporarily Flooded Forest Alliance (A.286) often become dominated by *Acer negundo* (boxelder). And in the upper Midwest *Acer negundo* (boxelder)-dominated stands are treated as part of *~Fraxinus pennsylvanica - (Ulmus americana) / Symphoricarpos occidentalis* Forest (CEGL002088)$$. Thus, some consistency is needed in the application of this type across its range. In Arkansas, these forests can be pure *Acer negundo* (boxelder) or have *Acer rubrum* (red maple) and *Platanus occidentalis* (American sycamore) as associates (T. Foti pers. comm. 1999). Composition is variable. Where *Acer negundo* (boxelder) occurs in natural habitats in the Southeast, it should be placed in *~Acer negundo - (Platanus occidentalis, Populus deltoides)* Forest (CEGL004690)$$, e.g., along the Arkansas River in Arkansas (D. Zollner pers. comm. 1999). In Missouri, natural stands would probably be combined with *~Betula nigra - Platanus occidentalis* Forest (CEGL002086)$$ (M. Leahy pers. comm. 1999). In Kentucky, this may be found at the Licking River impoundment (Cave Run Lake).

Global Similar Associations:

- *Acer negundo - (Platanus occidentalis, Populus deltoides)* Forest (CEGL004690)
- *Betula nigra - Platanus occidentalis* Forest (CEGL002086)
- *Fraxinus nigra - Acer saccharinum* Upper Great Lakes Floodplain Forest (CEGL005488)
- *Fraxinus pennsylvanica - (Ulmus americana) / Symphoricarpos occidentalis* Forest (CEGL002088)
- *Fraxinus pennsylvanica - Ulmus americana - (Acer negundo, Tilia americana)* Great Plains Forest (CEGL005400)
- *Fraxinus pennsylvanica - Ulmus* spp. - *Celtis occidentalis* Forest (CEGL002014)
- *Platanus occidentalis - Acer saccharinum - Juglans nigra - Ulmus rubra* Forest (CEGL007334)

Global Related Concepts:

- *Acer negundo* Forest (Harrison 2004) =
- *Acer negundo* riparian woodland (Vanderhorst 2001b) =
- Bottomland Hardwood Forest (Smith 1996a) >
- Riparian Forest (Evans 1991) >

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This association was found only between Lock and Dam #1 and the 494 bridge.

Global Range: This *Acer negundo* (boxelder) ruderal floodplain forest is found sporadically on floodplains in the southern, eastern, and midwestern United States, ranging from New York and New Jersey west to Minnesota (and possibly southeastern South Dakota), south to Louisiana and possibly Texas, and east to Georgia. It occurs in the Piedmont region in Pennsylvania and in the Coastal Plain and Piedmont regions in New Jersey and Delaware.

Nations: CA?, US

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States/Provinces: AL, AR, DC, DE:S3, GA, IA, KY, LA, MD, MN, MO, MS, NJ, NY, OK, PA, QC?, SC, SD?, TN, TX?, VA, WV
TNC Ecoregions: 31:?, 32:P, 36:P, 38:C, 39:C, 40:C, 41:P, 42:C, 43:C, 44:C, 46, 50:C, 53:C, 56:?, 57:?, 58:?, 59:C, 61:C, 62:C
USFS Ecoregions (1994/95): 221Bc:CCC, 221Ha:CC?, 221Hc:CC?, 221Hd:CC?, 221He:CC?, 221Ja:CP?, 221Jb:CP?, 221Jc:CP?, 222An:CCC, 222Ca:CC?, 222Cb:CC?, 222Cd:CC?, 222Ce:CC?, 222Cf:CC?, 222Cg:CCC, 222Ch:CC?, 222Ea:CCP, 222Eb:CCP, 222Ec:CCP, 222Ed:CCP, 222Ee:CCP, 222Ef:CCP, 222Eg:CCC, 222Eh:CCP, 222Ei:CCP, 222Ej:CCP, 222Ek:CCP, 222En:CCP, 222Eo:CCC, 222Fa:CP?, 222Fb:CP?, 222Fc:CP?, 222Fd:CP?, 222Ff:CP?, 222M:CC, 231Ba:CCC, 231Bb:CCP, 231Bc:CCP, 231Bd:CCP, 231Be:CCP, 231Bf:CCP, 231Bg:CCP, 231Bh:CCC, 231Bi:CCC, 231Bj:CCP, 231Bk:CCP, 231Bl:CCP, 231Ca:CCP, 231Cb:CCP, 231Cc:CCP, 231Cd:CCC, 231Ce:CCP, 231Cf:CCP, 231Cg:CCP, 231Da:CCP, 231Db:CCP, 231Dc:CCP, 231Dd:CCP, 231De:CCP, 231Ea:CC?, 231Eb:CCP, 231Ec:CC?, 231Ed:CCP, 231Ee:CCP, 231Ef:CCP, 231Eg:CCP, 231Eh:CCP, 231Ei:CCP, 231Ej:CCP, 231Ek:CCP, 231El:CCP, 231Em:CCP, 231En:CCP, 231Fa:C??, 231Fb:C??, 231Ga:CCC, 231Gb:CCC, 231Gc:CCC, 232Ac:CCC, 232Ad:CC?, 232Bb:CCC, 232Bd:CCC, 234Aa:CCC, 234Ab:CCC, 234Ac:CCC, 234Ad:CCC, 234Ae:CCC, 234Af:CCC, 234Ag:CCC, 234Ah:CCC, 234Ai:CCC, 234Aj:CCC, 234Ak:CCC, 234Al:CCC, 234Am:CCC, 234An:CCC, M221Be:CCC, M221Cb:CCC
Federal Lands: NPS (Antietam, Bluestone, Buffalo River, C&O Canal, Chickamauga-Chattanooga, George Washington Parkway, Harpers Ferry, Manassas, Mississippi, Monocacy, Natchez Trace, National Capital-East, New River Gorge, Ozark Riverways, Saratoga, Shiloh, Vicksburg); USFS (Daniel Boone, St. Francis); USFWS (Little River, National Conservation Training Center)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: FSBE - Box-elder Ruderal Floodplain Forest
Mississippi National River and Recreation Area Inventory Notes:
Mississippi National River and Recreation Area Plots and Observation Points: MISS.009, MISS.042
Local Description Authors: J. Drake
Global Description Authors: E. Largay and S.C. Gawler, mod. D. Faber-Langendoen
References: Blair 1938, CDPNQ unpubl. data, Campbell pers. comm., Chastain et al. 2006, Coxe 2009, Edinger et al. 2002, Edinger et al. 2007, Evans 1991, Evans et al. 2009, Fleming et al. 2001, Foti pers. comm., Harrison 2004, Harrison 2011, INAI unpubl. data, LNHP 2009, Lea 2004, Lea et al. 2013, Leahy pers. comm., NRCS 2004a, Nigh et al. 2000, Nordman et al. 2011, Patterson and DeSelm 1989, Schotz pers. comm., Smith 1996a, Southeastern Ecology Working Group n.d., TDNH unpubl. data, Vanderhorst 2001b, Vanderhorst et al. 2007, Vanderhorst et al. 2008, WVNHP unpubl. data b, Zollner pers. comm.

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2. SHRUB & HERB VEGETATION

2.B.2. Temperate Grassland & Shrubland

2.B.2.Nb. Great Plains Grassland & Shrubland

M054. Great Plains Tallgrass Prairie

G333. Central Great Plains Tallgrass Prairie

Central Mesic Tallgrass Prairie

Andropogon gerardii - *Sorghastrum nutans* - (*Sporobolus heterolepis*) - *Liatris* spp. - *Ratibida pinnata* Herbaceous Vegetation
Big Bluestem - Indiangrass - (Prairie Dropseed) - Blazingstar species - Pinnate Prairie Coneflower Herbaceous Vegetation
Identifier: CEGL002203

USNVC CLASSIFICATION

Division	Great Plains Grassland & Shrubland (2.B.2.Nb.)
Macrogroup	Great Plains Tallgrass Prairie (M054)
Group	Central Great Plains Tallgrass Prairie (G333)
Alliance	Big Bluestem - Indiangrass Herbaceous Alliance (A4057)
Association	Central Mesic Tallgrass Prairie

ELEMENT CONCEPT

Global Summary: This mesic tallgrass prairie grassland community is found primarily in the glaciated central midwestern United States. Stands occur on silty clay loams and silty loams. Soils are typically derived from deep (>100 cm) silty clay and silt loam glacial till or unaltered loess, except for those in the Driftless Area. Soil drainage is intermediate, and nutrient content is high. The pH ranges from slightly acidic to circumneutral. Topography varies from level to moderately sloping on uplands of glacial outwash and till plains. This is a tallgrass mixed herbaceous community dominated by perennial C4 bunch and sod grasses. Trees are infrequent to absent. The height of the dominant plants ranges from 0.5-2.0 m. Cover is high, typically 85-95%. Forb species composition varies more than grass composition from site to site. *Andropogon gerardii* (big bluestem), *Symphyotrichum ericoides (= Aster ericoides)* (white heath aster), *Dalea candida* (white prairie clover), *Eryngium yuccifolium* (button eryngo), *Helianthus pauciflorus* ssp. *pauciflorus* (stiff sunflower), *Liatris pycnostachya* (prairie blazing star), *Liatris spicata* (dense blazing star), *Ratibida pinnata* (pinnate prairie coneflower), *Rosa carolina* (Carolina rose), *Schizachyrium scoparium* (little bluestem), *Sporobolus heterolepis* (prairie dropseed), *Oligoneuron rigidum (= Solidago rigida)* (stiff goldenrod), and *Sorghastrum nutans* (Indiangrass) are abundant throughout this community's range. *Amorpha canescens* (leadplant), a subshrubby species, and *Salix humilis* (prairie willow) are also typically present.

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This grassland association was on flat to moderately sloping sites with deep soil. Soils are usually sandy loam or loam. Most examples in the park had clear signs of management, usually fire or mowing. Given the general climate of the area and the disruption of the natural fire regime, all sites likely need management to preclude succession to shrub- or tree-dominated vegetation. Many sites have thick litter buildup (avg. 56%) with bare ground occupying most of the rest of the ground surface (23%).

Global Environment: Soils are characteristically deep (>100 cm) silty clay loams and silty loams, which occur in the glaciated portions of the Midwest. Soils are derived from glacial till or unaltered loess, or are in the Driftless Area. Soil drainage is intermediate and nutrient content is high. The pH ranges from slightly acidic to circumneutral. Topography varies from level to moderately sloping on uplands of glacial outwash and till plains.

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This grassland community is characterized by native tallgrass species with little to no shrub or tree cover taller than the grasses. Average cover by herbaceous species in mid- to late summer is 78%. *Andropogon gerardii* (big bluestem), *Panicum virgatum* (switchgrass), and *Sorghastrum nutans* (Indiangrass) are the most abundant native tallgrasses. In wet-mesic sites, *Calamagrostis canadensis* (bluejoint) and *Spartina pectinata* (prairie cordgrass) can be common. Native mid and short graminoids can be common, too, including *Carex* spp. (sedge), *Bouteloua curtipendula* (sideoats grama), *Koeleria macrantha* (prairie Junegrass), and *Schizachyrium scoparium* (little bluestem). The exotic grasses *Bromus inermis* (smooth brome) and *Poa pratensis* (Kentucky bluegrass) are often present and can be dominant in degraded examples. Many forbs, native or exotic, can occur in this association. Most do not have high cover, though some do, especially *Ambrosia artemisiifolia* (annual ragweed), *Artemisia ludoviciana* (white sagebrush), *Coronilla varia* (purple crownvetch), *Euthamia graminifolia* (flat-top goldentop), *Monarda fistulosa* (wild bergamot), *Solidago canadensis* (Canada goldenrod), and *Solidago speciose* (showy goldenrod). Other

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common forbs are *Achillea millefolium* (common yarrow), *Asclepias syriaca* (common milkweed), *Erigeron strigosus* (prairie fleabane), *Lespedeza capitata* (roundhead lespedeza), *Oligoneuron rigidum* (stiff goldenrod), *Rudbeckia hirta* (blackeyed Susan), and *Symphyotrichum ericoides* (white heath aster). Shrubs and small trees typically have <25% cover but short shrubs that are significantly shorter than the tallgrass species, such as *Rosa* spp. (rose) and *Rubus* spp. (blackberry) and shrubs that have been mowed or burned recently and have not recovered their taller stature, such as *Lonicera* spp. (honeysuckle), and *Rhus* spp. (sumac), may have >25% cover below the taller herbaceous canopy.

Global Vegetation: This is a tallgrass mixed herbaceous community dominated by perennial C4 bunch and sod grasses. Trees are rare to absent. The height of the dominant plants ranges from 0.5-2.0 m. Cover is high, 85-95% is typical. Ninety-five percent of the plant species are perennial. Forb species composition varies more than grass composition from site to site. *Andropogon gerardii* (big bluestem), *Symphyotrichum ericoides (= Aster ericoides)* (white heath aster), *Dalea candida* (white prairie clover), *Eryngium yuccifolium* (button eryngo), *Helianthus pauciflorus* ssp. *pauciflorus* (stiff sunflower), *Ratibida pinnata* (pinnate prairie coneflower), *Rosa carolina* (Carolina rose), *Schizachyrium scoparium* (little bluestem), *Sporobolus heterolepis* (prairie dropseed), *Oligoneuron rigidum (= Solidago rigida)* (stiff goldenrod), and *Sorghastrum nutans* (Indiangrass) are abundant throughout this community's range. *Amorpha canescens* (leadplant), a subshrub species, and *Salix humilis* (prairie willow) are also typically present. In Ohio and Minnesota, introduced *Poa pratensis* (Kentucky bluegrass) has been noted as replacing native grasses when this community is grazed. This may occur in other states as well.

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Herb (field)	Forb	*Monarda fistulosa* (wild bergamot), *Solidago canadensis* (Canada goldenrod)
Herb (field)	Graminoid	*Andropogon gerardii* (big bluestem), *Panicum virgatum* (switchgrass), *Sorghastrum nutans* (indiangrass)

Global

Stratum	Lifeform	Species
Short shrub/sapling	Dwarf-shrub	*Rosa carolina* (Carolina rose)
Herb (field)	Forb	*Eryngium yuccifolium* (button eryngo), *Helianthus pauciflorus* ssp. *pauciflorus* (stiff sunflower), *Symphyotrichum ericoides* (white heath aster)
Herb (field)	Graminoid	*Andropogon gerardii* (big bluestem), *Schizachyrium scoparium* (little bluestem), *Sorghastrum nutans* (Indiangrass), *Sporobolus heterolepis* (prairie dropseed)

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: *Andropogon gerardii, Panicum virgatum, Sorghastrum nutans*
Global: *Andropogon gerardii*, *Eryngium yuccifolium*, *Liatris pycnostachya*, *Schizachyrium scoparium*, *Silphium laciniatum*, *Sorghastrum nutans*, *Sporobolus heterolepis*

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: *Poa pratensis* (Medium)
Global: Invasive/Exotic: *Poa pratensis* (Medium)

CONSERVATION STATUS RANK

Global Rank & Reasons: G1G2 (23-Mar-2000). This community has nearly been eliminated from its former range. Most former sites have been converted to cropland, pasture, or development. Others are succeeding to forest or woodland in the absence of fire. Many remaining sites are along rights-of-way (roads, railroads, utilities) and long term viability is problematic.

CLASSIFICATION

Status: Standard
Classification Confidence: 1 - Strong
Mississippi National River and Recreation Area Comments: Most, if not all, of the examples of this community in the park are partially or fully restored prairies, based on signs or reports from local land managers. The restored prairies, even if clearly planted relatively recently and possibly lacking much diversity beyond the presumed seed mix, are included in this association at MISS.
Global Comments: Note, in Iowa, the Southern Mesic Prairie includes the northeastern part of the state (Iowan Surface). In Ohio this type is found at Castalia Prairie. Characteristic forb of this type in the central part of its range (but absent from Ohio and Michigan) is *Silphium laciniatum*. Relation to tallgrass prairie in Kentucky needs review. Nebraska historically had much more loess tallgrass prairie, *~Andropogon gerardii - Sorghastrum nutans - Hesperostipa spartea* Loess Hills Herbaceous Vegetation (CEGL002025)$$, but virtually all of that has been plowed up. Remaining sites are either on heavily eroded loess sites or glacial till sites that are difficult to plow, blurring what distinction there might have been between these two types (G. Steinauer pers. comm. 2000, Steinauer and Rolfsmeier 2000). In Minnesota, this type may have been historically relatively uncommon in the southeast part of the state. Few occurrences remain today(Minnesota DNR 2005b).

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Global Similar Associations:
- *Andropogon gerardii - Sorghastrum nutans - Hesperostipa spartea* Loess Hills Herbaceous Vegetation (CEGL002025)
- *Andropogon gerardii - Sporobolus heterolepis* Western Foothills Herbaceous Vegetation (CEGL001465)
- *Schizachyrium scoparium - Sorghastrum nutans - Bouteloua curtipendula* Gravel Herbaceous Vegetation (CEGL005176)

Global Related Concepts:
- Mesic Prairie (Nelson 1985) >
- Mesic Prairie (Faber-Langendoen 2001) =
- Mesic Prairie (Central Section) (MNNHP 1993) ><
- Mesic Prairie (Southeast Section) (MNNHP 1993) <
- Mesic, impeded drainage type (White and Glenn-Lewin 1984) <
- Wet-mesic, unimpeded drainage type (White and Glenn-Lewin 1984) <

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This association was found at scattered locations throughout the park but nearly all large examples were between the Battle Creek Regional Park and Spring Lake Regional Park.
Global Range: This mesic tallgrass prairie grassland community is found primarily in the glaciated central midwestern United States, ranging from western Ohio and Michigan west to east-central Minnesota, south to northern Missouri, and east to Indiana.
Nations: US
States/Provinces: IA:S1, IL, IN, KS:S2?, MI:S1, MN, MO, NE, OH, WI:S1
TNC Ecoregions: 35:C, 36:C, 44:C, 45:C, 46:C, 48:C
USFS Ecoregions (1994/95): 222D:C?, 222E:C?, 222Fd:C??, 222Ga:CCC, 222Gb:CCC, 222Ge:CCC, 222Ha:CCC, 222Hb:CCC, 222He:CCC, 222Hf:CCC, 222If:CCC, 222Jh:CCC, 222Ji:CCC, 222Jj:CCC, 222Ka:CCC, 222Kc:CCC, 222Ke:CCC, 222Kf:CCC, 222Kg:CCC, 222Kh:CCC, 222Ki:CCC, 222Kj:CCC, 222Lc:CCC, 222Le:CCC, 222Lf:CCC, 222Me:CCC, 251Bd:CCC, 251Ca:CCC, 251Cb:CCC, 251Cc:CCC, 251Cd:CCP, 251Ce:CCP, 251Cf:CCC, 251Ch:CCC, 251Ci:CCC, 251Cj:CCC, 251Ck:CCP, 251Cm:CC?, 251Cp:CCC, 251Cq:CCC, 251Da:CCP, 251Db:CCP, 251Dc:CCC, 251Dd:CCC, 251De:CCC, 251Df:CCP, 251Dg:CCC, 251Dh:CCC
Federal Lands: NPS (Effigy Mounds, Mississippi)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: HPTG - Central Mesic Tallgrass Prairie
Mississippi National River and Recreation Area Inventory Notes:
Mississippi National River and Recreation Area Plots and Observation Points: DNR.0663, DNR.4923, DNR.6868, MISS.023, MISS.036, MISS.043, MISS.057, MISS.100, MISS.131
Local Description Authors: J. Drake
Global Description Authors: J. Drake, D. Faber-Langendoen, and D. M. Ambrose
References: Betz 1978, Boettcher and Bragg 1989, Chapman et al. 1989, Curtis 1959, Faber-Langendoen 2001, Freckmann 1966, Homoya et al. 1988, Hop et al. 2005, INAI unpubl. data, Kost et al. 2007, Lauver et al. 1999, MNNHP 1993, McClain 1986, Midwestern Ecology Working Group n.d., Minnesota DNR 2005a, Minnesota DNR 2005b, Nelson 1985, Nelson 2010, ONHD unpubl. data, Risser 1988, Rolfsmeier and Steinauer 2010, Schroeder 1982, Smith 1981, Steinauer and Rolfsmeier 2000, WNHI 2011, WNHI unpubl. data, White 1981, White and Glenn-Lewin 1984, White and Madany 1978

G151. Sand & Gravel Tallgrass Prairie

Little Bluestem Bedrock Bluff Prairie

Schizachyrium scoparium - Bouteloua curtipendula Bedrock Bluff Herbaceous Vegetation
Little Bluestem - Sideoats Grama Bedrock Bluff Herbaceous Vegetation
Identifier: CEGL002245

USNVC CLASSIFICATION

Division	Great Plains Grassland & Shrubland (2.B.2.Nb.)
Macrogroup	Great Plains Tallgrass Prairie (M054)
Group	Sand & Gravel Tallgrass Prairie (G151)
Alliance	Little Bluestem - Sideoats Grama Gravel & Bluff Herbaceous Vegetation Alliance (A4049)
Association	Little Bluestem Bedrock Bluff Prairie

ELEMENT CONCEPT

Global Summary: This little bluestem bluff prairie community occurs primarily in the Driftless Area of the upper midwestern United States. Stands occur on very thin soils on limestone ridges and steep hillsides, usually with a southwestern aspect. These dry prairie soils occupy the highest position on the moisture catena and may be less than 10 cm deep over extensive areas. The vegetation is dominated by grasses or, locally, low shrubs. Grasses are less than 1 m tall. *Schizachyrium scoparium* (little bluestem)*, Bouteloua curtipendula* (sideoats grama)*, Sporobolus heterolepis* (prairie dropseed), and *Andropogon gerardii* (big bluestem) are abundant

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grasses across this community's range. Forbs that are common include *Amorpha canescens* (leadplant), *Symphyotrichum sericeum (= Aster sericeus)* (western silver aster), *Dalea purpurea* var. *purpurea* (purple prairie clover), *Dichanthelium linearifolium* (slimleaf panicgrass), *Euphorbia corollata* (flowering spurge), and *Solidago nemoralis* (gray goldenrod). Species that do best toward the east include *Minuartia michauxii* var. *michauxii* (Michaux's stitchwort), *Asclepias verticillata* (whorled milkweed), and *Geum triflorum* (old man's whiskers), while those that do best along the Mississippi River include *Symphyotrichum oblongifolium (= Aster oblongifolius)* (aromatic aster), *Bouteloua hirsuta* (hairy grama), and *Scutellaria parvula* var. *missouriensis (= Scutellaria parvula* var. *leonardii)* (Leonard's skullcap). In addition, *Muhlenbergia cuspidata* (plains muhly) and *Pediomelum esculentum* (large Indian breadroot) are restricted to the Driftless Area. This community is structurally very stable and not very dependent on fire. Moisture conditions on these sites are so severe that trees and most woody species cannot grow.

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This community was on moderate to steep slopes with thin soil and are usually facing south or west. Scattered bedrock exposures are common. These dry conditions limit the growth of woody species, though fire or other disturbance is required to remove woody species periodically.
Global Environment: This community occurs on very thin soils on limestone ridges and steep hillsides, usually with a southwest aspect. The low water storage capacity of the soil, the strong insolation of southwest slopes, and exposure to high winds make these sites prone to high desiccation. It is likely that these prairies receive significant quantities of water from condensation rather than precipitation. The organic content of the soil acts as a sponge to hold the condensate.

These dry prairie soils occupy the highest position on the moisture catena. The runoff of rainwater is very rapid on the slopes. There is continual movement of soil particles so the soil remains very thin except where dissolution pockets occur in the underlying limestone. The soil may be less than 10 cm deep over extensive areas. Both water retention and nutrient content in the actual soils are very good, but the thinness of the layers means that the total available quantity of either is quite limited. There is great uniformity from prairie to prairie in many of the soil chemical properties. The average pH is 7.8. The soil groups are Brunizem and Melanized Rendzina (Curtis 1959, MNNHP 1993).

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This midgrass prairie has moderate cover by herbaceous species and few woody species in high quality examples. Midgrass, shortgrass, and tallgrass species can all be common, though tallgrasses rarely dominate. *Bouteloua curtipendula* (sideoats grama), *Bouteloua hirsuta* (hairy grama), *Schizachyrium scoparium* (little bluestem), and *Sorghastrum nutans* (Indiangrass) are all typical of this community and *Muhlenbergia cuspidata* (plains muhly) and *Sporobolus heterolepis* (prairie dropseed) were locally common on some plots. Many forbs can be present but few have high cover. *Asclepias tuberosa* (butterfly milkweed), *Campanula rotundifolia* (bluebell bellflower), *Dalea purpurea* (purple prairie clover), *Erigeron strigosus* (prairie fleabane), and *Scutellaria parvula* (small skullcap) were found in most plots. Shrubs and small trees were rare but will increase in the absence of fire or other disturbance that removes them.
Global Vegetation: The vegetation is dominated by grasses or, locally, low shrubs. Trees may be present, but tree canopy cover is less than 10%. Grasses are less than 1 m tall. *Schizachyrium scoparium* (little bluestem), *Bouteloua curtipendula* (sideoats grama), *Sporobolus heterolepis* (prairie dropseed), and *Andropogon gerardii* (big bluestem) are abundant grasses across this community's range. Forbs that are common include *Amorpha canescens* (leadplant), *Symphyotrichum sericeum (= Aster sericeus)* (western silver aster), *Dalea purpurea* var. *purpurea* (purple prairie clover), *Dichanthelium linearifolium* (slimleaf panicgrass), *Euphorbia corollata* (flowering spurge), and *Solidago nemoralis* (gray goldenrod) (Curtis 1959, MNNHP 1993). There is a high degree of uniformity among different stands of this community in Wisconsin. The greatest differences are between those prairies on the Mississippi River and those in Dane County and other more eastern locations (Umbanhowar 1992). Although noticeable, these differences are minor and reflect slight changes in importance along an east-west gradient. Species that do best toward the east include *Minuartia michauxii* var. *michauxii* (Michaux's stitchwort), *Asclepias verticillata* (whorled milkweed), and *Geum triflorum* (old man's whiskers), while those that do best along the Mississippi River include *Symphyotrichum oblongifolium (= Aster oblongifolius)* (aromatic aster), *Bouteloua hirsuta* (hairy grama), and *Scutellaria parvula* var. *missouriensis (= Scutellaria parvula* var. *leonardii)* (Leonard's skullcap). In addition, *Muhlenbergia cuspidata* (plains muhly) and *Pediomelum esculentum* (large Indian breadroot) are restricted to the Driftless Area.

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Andropogon gerardii* (big bluestem), *Bouteloua curtipendula* (sideoats grama), *Schizachyrium scoparium* (little bluestem), *Sorghastrum nutans* (Indiangrass), *Sporobolus heterolepis* (prarie dropseed)

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Global

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Amorpha canescens* (leadplant)
Herb (field)	Forb	*Dalea purpurea* var. *purpurea* (purple prairie clover), *Euphorbia corollata* (flowering spurge), *Solidago nemoralis* (gray goldenrod), *Symphyotrichum sericeum* (western silver aster)
Herb (field)	Graminoid	*Andropogon gerardii* (big bluestem), *Bouteloua curtipendula* (sideoats grama), *Dichanthelium linearifolium* (slimleaf panicgrass), *Schizachyrium scoparium* (little bluestem), *Sporobolus heterolepis* (prairie dropseed)

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: *Bouteloua curtipendula*, *Dalea purpurea*, *Dichanthelium linearifolium*, *Euphorbia corollata*, *Schizachyrium scoparium*, *Solidago nemoralis*, *Sporobolus heterolepis*, *Symphyotrichum sericeum*

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Invasive/Exotic: *Ambrosia artemisiifolia* ()

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G4 (23-Mar-2000). There have been 341 occurrences documented: 239 in Minnesota (where the community is ranked S3), 57 in Iowa (S2?), 43 in Wisconsin (S3), and 2 in Illinois (S1,S1). The community occurs in 12 ecoregional subsections. There are probably fewer than 10,000 acres rangewide. Sizes of 334 occurrences total 2690 acres. This community is found on very thin soils on limestone ridges and steep hillsides, usually with a southwestern aspect. Lack of fire permits invasion by more woody vegetation.

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Mississippi National River and Recreation Area Comments:
Global Comments:
Global Similar Associations:

- *Schizachyrium scoparium - Bouteloua curtipendula - Muhlenbergia cuspidata - Symphyotrichum sericeum* Alkaline Herbaceous Vegetation (CEGL002403)
- *Schizachyrium scoparium - Sorghastrum nutans - Clinopodium arkansanum* Alkaline Herbaceous Vegetation (CEGL005179)
- *Schizachyrium scoparium - Sorghastrum nutans - Tradescantia bracteata* Alkaline Bedrock Herbaceous Vegetation (CEGL005280)

Global Related Concepts:

- Dry Prairie (Southeast Section) Bedrock Bluff Subtype (MNNHP 1993) =
- Dry Prairie Bedrock Bluff Subtype (Faber-Langendoen 2001) =

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This rare association was found only in Spring Lake Regional Park in a few areas.
Global Range: This little bluestem bluff prairie community occurs primarily in the Driftless Area of the upper midwestern United States, particularly in southern Wisconsin, northern Illinois, northeastern Iowa, and southeastern Minnesota. Range extent probably approaches 150,000 square km.
Nations: US
States/Provinces: IA:S2?, IL:S1, MN:S3, WI:S3
TNC Ecoregions: 36:C, 46:C, 47:C
USFS Ecoregions (1994/95): 222Ka:CCC, 222Ke:CCC, 222Kh:CCC, 222Lb:CCC, 222Lc:CCC, 222Ld:CCC, 222Le:CCC, 222Lf:CCC, 222Md:CCC, 222Me:CCC, 251Ch:CCC, 251Da:CCC
Federal Lands: NPS (Mississippi, Saint Croix)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: HPDS - Dry Slope Prairie
Mississippi National River and Recreation Area Inventory Notes: All plots attributed to this community were sampled by the MN DNR in the 1980s. Accuracy assessment points attributed to this type may not truly reflect this community due to an error in

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application of the vegetation key. Due to time since sampling and the urban development and vegetation succession that has occurred since then, this type is likely very rare or possibly eliminated from the park.
Mississippi National River and Recreation Area Plots and Observation Points: DNR.0661, DNR.0664, DNR.8316
Local Description Authors: J. Drake
Global Description Authors: J. Drake, D. Faber-Langendoen, and D. M. Ambrose
References: Curtis 1959, Faber-Langendoen 2001, INAI unpubl. data, MNNHP 1993, Midwestern Ecology Working Group n.d., Minnesota DNR 2005a, Minnesota DNR 2005b, Umbanhowar 1992, WNHI 2011, WNHI unpubl. data, White and Madany 1978

Midwest Dry Gravel Prairie

Schizachyrium scoparium - *Bouteloua curtipendula* Gravel Herbaceous Vegetation
Little Bluestem - Sideoats Grama Gravel Herbaceous Vegetation
Identifier: CEGL002215

USNVC CLASSIFICATION

Division	Great Plains Grassland & Shrubland (2.B.2.Nb.)
Macrogroup	Great Plains Tallgrass Prairie (M054)
Group	Sand & Gravel Tallgrass Prairie (G151)
Alliance	Little Bluestem - Sideoats Grama Gravel & Bluff Herbaceous Alliance (A4049)
Association	Midwest Dry Gravel Prairie

ELEMENT CONCEPT

Global Summary: This bluestem dry gravel prairie is found in the upper midwestern region of the United States. Stands occur on steep, gravelly slopes, usually facing south or southwest. These slopes can be kames, eskers, river terraces, or hills. Soils are gravelly, well to excessively drained, and often excessively aerated. Sites at the bottom of a slope have more soil accumulation, more soil moisture, and are generally more fertile. This community is dominated by grasses or, locally, by low shrubs. Trees may be present but their canopy cover is less than 10%. Grasses are typically less than 1 m tall. *Bouteloua curtipendula* (sideoats grama), *Schizachyrium scoparium* (little bluestem), *Sorghastrum nutans* (Indiangrass), *Sporobolus heterolepis* (prairie dropseed), and *Hesperostipa spartea (= Stipa spartea)* (porcupinegrass) dominate this community. There is considerable variation in the composition of the forb component.

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This community was found on moderate to steep slopes on sandy or gravelly soils. The slopes were on all aspects, though drier south and west aspects seem to inhibit the spread of woody species.
Global Environment: This community occurs on steep, gravelly slopes, usually facing south or southwest. These slopes can be kames, eskers, river terraces, or hills. Soils are gravelly, well- to excessively drained, and often excessively aerated. Sites at the bottom of a slope have more soil accumulation, more soil moisture, and are generally more fertile (White and Madany 1978).

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This midgrass community has moderate cover by herbaceous species and low shrub and tree cover, in high quality examples. Typical native dominants are *Hesperostipa spartea* (porcupinegrass) and *Schizachyrium scoparium* (little bluestem). *Poa pratensis* (Kentucky bluegrass) can dominate degraded stands. Other common graminoids are *Andropogon gerardii* (big bluestem), *Bouteloua curtipendula* (sideoats grama), *Carex pensylvanica* (Pennsylvania sedge), *Dichanthelium oligosanthes* (Heller's rosette grass), and *Poa compressa* (Canada bluegrass). Many forb species can be present but few are abundant. Typical species include *Ambrosia psilostachya* (Cuman ragweed), *Hedeoma hispida* (rough false pennyroyal), *Helianthemum bicknellii* (hoary frostweed), *Lithospermum incisum* (narrowleaf stoneseed), *Mirabilis hirsuta* (hairy four o'clock), *Penstemon grandifloras* (large beardtongue), and *Symphyotrichum ericoides* var. *ericoides* (white heath aster). *Amorpha canescens* (leadplant) is a common native shrubs. Trees and shrubs can become more common in the prolonged absence of fire or management activity. *Juniperus virginiana* (eastern red-cedar) often invades these prairies but *Prunus* spp. (cherry), *Quercus macrocarpa* (bur oak), *Rhus* spp. (sumac), *Zanthoxylum americanum* (common pricklyash), and other species can invade over time.
Global Vegetation: This community is dominated by grasses or, locally, by low shrubs. Trees may be present but their canopy cover is less than 10%. Grasses are typically less than 1 m tall. *Bouteloua curtipendula* (sideoats grama), *Schizachyrium scoparium* (little bluestem), *Sorghastrum nutans* (Indiangrass), *Sporobolus heterolepis* (prairie dropseed), and *Hesperostipa spartea (= Stipa spartea)* (porcupinegrass) dominate this community. There is considerable variation in the composition of the forb component (White and Madany 1978).

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Bouteloua curtipendula* (sideoats grama), *Hesperostipa spartea* (porcupinegrass), *Schizachyrium scoparium* (little bluestem)

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Global

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Bouteloua curtipendula* (sideoats grama), *Hesperostipa spartea* (porcupinegrass), *Schizachyrium scoparium*, *Sorghastrum nutans* (Indiangrass), *Sporobolus heterolepis* (prairie dropseed)

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: *Bouteloua curtipendula*, *Hesperostipa spartea*, *Muhlenbergia cuspidata*, *Schizachyrium scoparium*, *Sorghastrum nutans*, *Sporobolus heterolepis*

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Vulnerable: *Astragalus tennesseensis* (G3, an outlier species that previously occurred in this community (it was last reported in the 1800s); it has been reintroduced on one site in Indiana.); **Invasive/Exotic**: *Ambrosia artemisiifolia* (This field has not been reviewed.)

CONSERVATION STATUS RANK

Global Rank & Reasons: G3 (6-Feb-2007). There are probably fewer than 200 occurrences of this community rangewide. It is reported from Indiana (where it is ranked S1), Illinois (S1), Wisconsin (S3), Minnesota (S2), and Iowa (S2?). It is restricted to steep, gravelly slopes, usually facing south or southwest. Currently there are 172 occurrences documented. Occurrences of this community are often heavily grazed.

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Mississippi National River and Recreation Area Comments:
Global Comments: Indicator species need to be identified to better determine how distinctive this gravel prairie type is from other dry prairies. *Cirsium hillii* (Hill's thistle) may be a good one, at least in Minnesota. In addition *Hesperostipa comata (= Stipa comata)* (needle and thread) and *Bouteloua gracilis* (blue grama) are typically absent from this type compared to ~*Schizachyrium scoparium* - *Bouteloua* spp. - *Hesperostipa spartea* Gravel Herbaceous Vegetation (CEGL002499)$$ (R. Dana pers. comm. 1999).
Global Similar Associations:
- *Schizachyrium scoparium* - *Bouteloua* spp. - *Hesperostipa spartea* Gravel Herbaceous Vegetation (CEGL002499) found further north and west in the tallgrass prairie region.
- *Schizachyrium scoparium* - *Carex tonsa* var. *rugosperma* - *Carex muehlenbergii* - *Lithospermum caroliniense* - *Opuntia humifusa* Herbaceous Vegetation (CEGL005099)
- *Schizachyrium scoparium* - *Sorghastrum nutans* - *Bouteloua curtipendula* Gravel Herbaceous Vegetation (CEGL005176)
- *Schizachyrium scoparium* - *Sorghastrum nutans* - *Bouteloua curtipendula* Herbaceous Vegetation (CEGL002214)

Global Related Concepts:
- Dry Prairie (Central Section) Sand - Gravel Subtype (MNNHP 1993) <
- Dry Prairie (Southeast Section) Sand - Gravel Subtype (MNNHP 1993) <
- Dry Prairie Gravel Hill Subtype (Faber-Langendoen 2001) =

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This rare association was found in a few occurrences in Spring Lake Regional Park, Gray Cloud Dunes SNA, Minnehaha Park, and Ordway Field Station. All known examples are small.
Global Range: This bluestem dry gravel prairie is found in the upper midwestern region of the United States, ranging from northern Indiana west to Iowa and east-central Minnesota.
Nations: US
States/Provinces: IA:S2?, IL, IN:S1, MN, WI:S3
TNC Ecoregions: 35:C, 36:C, 45:C, 46:C, 47:C, 48:C
USFS Ecoregions (1994/95): 212Jd:CCC, 212Kb:CCC, 212Mb:C??, 212Nc:CCC, 222Hf:CCC, 222Ke:CCC, 222Kf:CCC, 222Kh:CCC, 222Lb:CCC, 222Lc:CCC, 222Lf:CCC, 222Ma:CCC, 222Mb:CCC, 222Mc:CCC, 222Md:CCC, 251Ba:CCC, 251Bb:CCC, 251Bd:CCC, 251Be:CCC, 251Cf:CCC, 251Dc:CCC
Federal Lands: NPS (Mississippi)

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ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: HPDS - Dry Slope Prairie

Mississippi National River and Recreation Area Inventory Notes: All observed examples of this community at MISS are small and being encroached on by woody species from adjacent forests. Some current oak woodlands likely were this community before the natural fire regime was modified.

Mississippi National River and Recreation Area Plots and Observation Points: DNR.4619, DNR.4620, DNR.4621, DNR.6867, DNR.8317

Local Description Authors: J. Drake

Global Description Authors: J. Drake, D. Faber-Langendoen, and D. M. Ambrose

References: Faber-Langendoen 2001, Homoya et al. 1988, INAI unpubl. data, MNNHP 1993, Midwestern Ecology Working Group n.d., Minnesota DNR 2005a, Minnesota DNR 2005b, WNHI 2011, WNHI unpubl. data, White and Madany 1978

Midwest Dry Sand Prairie

Schizachyrium scoparium - *Danthonia spicata* - *Carex pensylvanica* - (*Viola pedata*) Herbaceous Vegetation
Little Bluestem - Poverty Oatgrass - Pennsylvania Sedge - (Bird's-foot Violet) Herbaceous Vegetation
Identifier: CEGL002318

USNVC CLASSIFICATION

Division	Great Plains Grassland & Shrubland (2.B.2.Nb.)
Macrogroup	Great Plains Tallgrass Prairie (M054)
Group	Sand & Gravel Tallgrass Prairie (G151)
Alliance	Little Bluestem - Indiangrass – Sideoats Grama Sand & Gravel Herbaceous Alliance (A4047)
Association	Midwest Dry Sand Prairie

ELEMENT CONCEPT

Global Summary: This dry sand prairie community is widespread throughout the midwestern region of the United States and adjacent Canada. Stands occur on steep slopes, sandy outwash, sandy lake plains, and alluvial deposits. They may occur on sand ridges (including inland dunes and sandy areas of coarse-textured end moraines), where, particularly if blowouts have occurred, they may resemble sand barrens. Soils are well-drained to excessively drained, coarse-textured sands, loamy sands, and sandy loams. Gravels are very minor. Graminoids dominate the herbaceous layer, which can be open to closed. Dominant species include *Carex pensylvanica* (Pennsylvania sedge), *Danthonia spicata* (poverty oatgrass), *Koeleria macrantha* (prairie Junegrass), *Schizachyrium scoparium* (little bluestem), and *Hesperostipa spartea (= Stipa spartea)* (porcupinegrass). Other graminoids include *Bouteloua hirsuta* (hairy grama), *Digitaria cognata (= Leptoloma cognatum)* (fall witchgrass) and *Dichanthelium acuminatum* var. *fasciculatum (= Dichanthelium lanuginosum)* (western panicgrass). In more open dune-like habitats *Calamovilfa longifolia* (prairie sandreed) may be present. A wide variety of forbs are present including *Asclepias verticillata* (whorled milkweed), *Ambrosia psilostachya* (Cuman ragweed), *Artemisia frigida* (prairie sagewort), *Pseudognaphalium obtusifolium (= Gnaphalium obtusifolium)* (rabbit-tobacco), *Euphorbia corollata* (flowering spurge), *Hieracium longipilum* (hairy hawkweed), *Lechea tenuifolia* (narrowleaf pinweed), *Liatris aspera* (tall blazing star), *Liatris cylindracea* (Ontario blazing star), *Nuttallanthus canadensis (= Linaria canadensis)* (Canada toadflax), *Lithospermum canescens* (hoary puccoon), *Lupinus perennis* (sundial lupine), *Oenothera rhombipetala* (fourpoint evening primrose), *Polygala polygama* (racemed milkwort), *Packera plattensis (= Senecio plattensis)* (prairie groundsel), *Solidago nemoralis* (gray goldenrod), *Tephrosia virginiana* (Virginia tephrosia) and *Viola pedata* (birdfoot violet). *Hudsonia tomentosa* (woolly beachheather), and other sand barrens species, are more often restricted to local disturbances such as blowouts or slipfaces.

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This community was found on sites with sandy soils and gentle to moderate slopes. Some sites had been planted/restored recently. Litter accumulation was not high, presumably because these sites are not as productive as grasslands on finer-textured soils that retain water better. The surface of the ground was mostly a mixture of bare sand (avg. 20%), bare soil (avg. 20%), and litter (avg. 30%).

Global Environment: Stands can occur on steep slopes, sandy outwash, sandy lakeplains, and alluvial deposits. They may occur on sand ridges (including inland dunes and sandy areas of coarse-textured end moraines), where, particularly if blowouts have occurred, they may resemble sand barrens. Soils are well-drained to excessively drained, coarse-textured sands, loamy sands, and sandy loams. Gravels are very minor. They generally lack a dark A horizon, have brownish, yellowish, grayish, or reddish thin B horizons, and no mottling (Curtis 1959, White and Madany 1978, Homoya et al. 1985, Chapman et al. 1989, MNNHP 1993).

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This community is dominated by native graminoids approximately 1 m or shorter. Total cover by herbaceous species is moderate to high (avg. 65%). Forbs and exotic grasses can dominate in more degraded stands. *Schizachyrium scoparium* (little bluestem) is common to dominant in nearly every stand. Other native species that are often present and can be co-dominant include *Andropogon gerardii* (big bluestem), *Bouteloua curtipendula* (sideoats grama), *Bouteloua gracilis* (blue grama), and *Koeleria macrantha* (prairie Junegrass). The exotic grasses *Bromus inermis* (smooth brome) and *Poa pratensis* (Kentucky bluegrass) are often present and can dominate degraded sites. Forb diversity tends to be somewhat lower

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than in richer, more productive grasslands. Common forbs include *Ambrosia artemisiifolia* (annual ragweed), *Berteroa incana* (hoary alyssum), *Lespedeza capitata* (roundhead lespedeza), *Linaria vulgaris* (butter and eggs), *Monarda fistulosa* (wild bergamot), *Oligoneuron rigidum* (stiff goldenrod), and *Solidago* spp. (goldenrod). Shrubs and trees are rare or absent in higher quality stands but can become more common with prolonged lack of fire or management activities to remove them. *Juniperus virginiana* (eastern red-cedar), *Lonicera* spp. (honeysuckle), *Rhus* spp. (sumac), *Rubus* spp. (blackberry), and *Zanthoxylum americanum* (common pricklyash) are typical of these invaded sites.

Global Vegetation: Graminoids dominate the herbaceous layer, which can be open to closed. Dominant species include *Carex pensylvanica* (Pennsylvania sedge), *Danthonia spicata* (poverty oatgrass), *Koeleria macrantha* (prairie Junegrass), *Schizachyrium scoparium* (little bluestem), and *Hesperostipa spartea (= Stipa spartea)* (porcupinegrass). Other graminoids include *Bouteloua hirsuta* (hairy grama), *Digitaria cognata (= Leptoloma cognatum)* and *Dichanthelium acuminatum* var. *fasciculatum (= Dichanthelium lanuginosum)* (western panicgrass). In more open dune-like habitats *Calamovilfa longifolia* (prairie sandreed) may be present. A wide variety of forbs are present, including *Asclepias verticillata* (whorled milkweed), *Ambrosia psilostachya* (Cuman ragweed), *Artemisia frigida* (prairie sagewort), *Pseudognaphalium obtusifolium (= Gnaphalium obtusifolium)* (rabbit-tobacco), *Euphorbia corollata* (flowering spurge), *Hieracium longipilum* (hairy hawkweed), *Lechea tenuifolia* (narrowleaf pinweed), *Liatris aspera* (tall blazing star), *Liatris cylindracea* (Ontario blazing star), *Nuttallanthus canadensis (= Linaria canadensis)* (Canada toadflax), *Lithospermum canescens* (hoary puccoon), *Lupinus perennis* (sundial lupine), *Oenothera rhombipetala* (fourpoint evening primrose), *Polygala polygama* (racemed milkwort), *Packera plattensis (= Senecio plattensis)* (prairie groundsel), *Solidago nemoralis* (gray goldenrod), *Tephrosia virginiana* (Virginia tephrosia), and *Viola pedata* (birdfoot violet). *Hudsonia tomentosa* (woolly beachheather), and other sand barrens species, are more often restricted to local disturbances such as blowouts or slipfaces (Curtis 1959, White and Madany 1978, Homoya et al. 1985, Chapman et al. 1989, MNNHP 1993).

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Schizachyrium scoparium* (little bluestem)

Global: Information not available.

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: *Schizachyrium scoparium*
Global: Information not available.

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Vulnerable: *Talinum rugospermum* (G3G4)

CONSERVATION STATUS RANK

Global Rank & Reasons: G2G3 (22-Jun-1998). Although the community has a fairly broad distribution, few occurrences have been documented, and most remnants are probably very disturbed, low quality examples. This community is ranked S1S2 or S2 in 5 states, and occurs in at least one more state, possibly several more. It is extirpated from Missouri. Many occurrences have been converted to agriculture, or disturbed by grazing and/or fire suppression.

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Mississippi National River and Recreation Area Comments:
Global Comments: Separation of this type from sand barrens, ~*Schizachyrium scoparium - Carex tonsa* var. *rugosperma - Carex muehlenbergii - Lithospermum caroliniense - Opuntia humifusa* Herbaceous Vegetation (CEGL005099)$$, may be difficult, and they may represent a temporal sequence after exposure of sandy substrates, either by wind or human clearing. In general sand barrens occur on more dune-like habitats or on formerly plowed sand prairies, and sands may still move. Sand prairies occur on more stable sandy soils. A proposed descriptive revision to the name of this type, presuming it is combined with CEGL005099, is *Schizachyrium scoparium - Koeleria macrantha - (Aristida* spp.) - *Carex (umbellata, muehlenbergii) - Viola pedata* Herbaceous Vegetation (Prairie-Forest Border Ecoregional Planning Team pers. comm. 1999). Potential diagnostic species for sand prairies may be *Lithospermum canescens* (hoary puccoon) and *Viola pedata* (birdfoot violet). Potential diagnostic species for sand barrens are *Cyperus lupulinus* ssp. *lupulinus (= Cyperus filiculmis)* (Great Plains flatsedge), *Cyperus schweinitzii* (Schweinitz's flatsedge), *Carex muehlenbergii* (Muhlenberg's sedge), *Lithospermum caroliniense* (Carolina puccoon), *Opuntia humifusa* (devil's-tongue), and *Sporobolus cryptandrus* (sand dropseed). In Minnesota, the dry-mesic stands of this type may better fit with ~*Schizachyrium scoparium - Sorghastrum nutans - Andropogon gerardii - Lespedeza capitata* Sand Herbaceous Vegetation (CEGL002210)$$. In Illinois distinction of sand prairie and sand hill prairie needs review, but for now they are combined into this type [see also CEGL005099]. In Indiana *Koeleria macrantha* (prairie Junegrass) and *Hesperostipa spartea (= Stipa spartea)* (porcupinegrass) may be common (Jackson 1979).

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Global Similar Associations:

- *Corylus americana - Salix humilis / Schizachyrium scoparium* Shrubland (CEGL005072)
- *Pteridium aquilinum - Bromus kalmii* Herbaceous Vegetation (CEGL005142)
- *Schizachyrium scoparium - Carex tonsa* var. *rugosperma - Carex muehlenbergii - Lithospermum caroliniense - Opuntia humifusa* Herbaceous Vegetation (CEGL005099) This type is more typical on disturbed sand prairies.
- *Schizachyrium scoparium - Hesperostipa spartea - Bouteloua (curtipendula, gracilis)* Sand Herbaceous Vegetation (CEGL005204)
- *Schizachyrium scoparium - Sorghastrum nutans - Andropogon gerardii - Lespedeza capitata* Sand Herbaceous Vegetation (CEGL002210)
- *Schizachyrium scoparium - Sorghastrum nutans - Aristida lanosa - Polypremum procumbens* Herbaceous Vegetation (CEGL002397)

Global Related Concepts:

- Dry Prairie (Central Section) Barrens Subtype (MNNHP 1993) ><
- Dry Prairie (Southeast Section) Barrens Subtype (MNNHP 1993) ><
- Dry Sand Prairie (Nelson 1985) >
- Dry Sand Prairie (Faber-Langendoen 2001) =

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This association was found in Gray Cloud Dunes SNA with some smaller examples in and near Mississippi West Regional Park.

Global Range: This dry sand prairie community is widespread throughout the midwestern region of the United States and adjacent Canada, extending from Indiana, Michigan and southern Ontario, west to Iowa and east-central Minnesota.

Nations: CA, US

States/Provinces: IA:S2?, IL, IN, MI:S2, MN, MO, ON, WI

TNC Ecoregions: 35:C, 36:C, 44:C, 46:C, 47:C, 48:C, 64:C

USFS Ecoregions (1994/95): 212Hq:CCC, 212Hr:CCP, 212Ht:CCP, 212Hu:CCC, 212Hv:CCP, 212Hx:CCC, 212Hy:CCP, 212Ka:CCC, 222Ge:CCC, 222Jb:CCC, 222Jh:CCC, 222Ji:CCC, 222Jj:CCC, 222Kb:CCC, 222Ke:CCC, 222Kg:CCC, 222Lb:CCC, 222Lc:CCC, 222Lf:CCC, 222Me:CCC, 234Ac:???, 251Be:CCC, 251Cc:CCC, 251Cf:CCC, 251Ch:CCC, 251Da:CCC, 251Df:CCC, 251Dg:CCC, 251Dh:CCC

Federal Lands: NPS (Mississippi, Saint Croix); USFS (Huron, Huron-Manistee, Manistee)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: HPDS - Dry Slope Prairie

Mississippi National River and Recreation Area Inventory Notes:

Mississippi National River and Recreation Area Plots and Observation Points: MISS.027, MISS.028, MISS.060

Local Description Authors: J. Drake

Global Description Authors: D. Faber-Langendoen

References: Chapman et al. 1989, Curtis 1959, Faber-Langendoen 2001, Homoya et al. 1985, Homoya et al. 1988, INAI unpubl. data, Jackson 1979, Kost et al. 2007, MNNHP 1993, Midwestern Ecology Working Group n.d., Minnesota DNR 2005a, Minnesota DNR 2005b, Nelson 1985, Nelson 2010, WNHI 2011, WNHI unpubl. data, White and Madany 1978

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2.B.2.Nc. Eastern North American Grassland & Shrubland

M123. Eastern North American Ruderal Grassland & Shrubland

G059. Northern & Central Ruderal Meadow & Shrubland

Midwest Forb Old Field

Solidago canadensis - *Coronilla varia* Ruderal Herbaceous Vegetation
Canada Goldenrod - Purple Crown-vetch Ruderal Herbaceous Vegetation
Identifier: CEGL005459

USNVC CLASSIFICATION

Division	Eastern North American Grassland & Shrubland (2.B.2.Nc.)
Macrogroup	Eastern North American Ruderal Grassland & Shrubland (M123)
Group	Northern & Central Ruderal Meadow & Shrubland (G059)
Alliance	Orchardgrass - Fescue species - Canada Goldenrod Mesic Meadow Alliance (A1190)
Association	Midwest Forb Old Field

ELEMENT CONCEPT

Global Summary: Information not available.

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This ruderal community was found on a variety of soils but is usually on flat to moderately sloping sites. The ground is mostly bare soil (avg. 72%) with some plant litter (avg. 13%). The common factor affecting this community is a history of extensive disturbance from agricultural or urban development activities that result in a site strongly dominated by exotic or weedy native forbs.
Global Environment: Information not available.

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This community is characterized by a moderately open to dense herbaceous stratum (avg. cover 85%) dominated by exotic and weedy native forbs. There may be shrubs and trees present but they are either very short or have less than 25% cover. Common herbaceous species vary depending on past site use, seed sources, and other factors but forbs often include *Ambrosia artemisiifolia* (annual ragweed), *Arctium minus* (lesser burdock), *Berteroa incana* (hoary alyssum), *Cirsium arvense* (Canada thistle), *Conyza canadensis* (Canadian horseweed), *Coronilla varia* (purple crownvetch), *Galium aparine* (stickywilly), *Melilotus officinalis* (yellow sweetclover), *Monarda fistulosa* (wild bergamot), *Rudbeckia hirta* (blackeyed Susan), *Solidago canadensis* (Canada goldenrod), *Trifolium pratense* (red clover), and *Verbascum thapsus* (common mullein). Graminoids can be common and often include *Bromus inermis* (smooth brome), *Panicum capillare* (witchgrass), *Poa pratensis* (Kentucky bluegrass), *Setaria viridis* (green bristlegrass), and others. The shrubs and small trees than can be present are usually exotic or generalist native species, much like the herbaceous layer. *Acer negundo* (boxelder) and *Populus deltoides* (eastern cottonwood) can be present, typically as short trees, along with the shrubs *Lonicera* spp. (honeysuckle), *Rhamnus cathartica* (common buckthorn), *Rubus* spp. (blackberry), and *Zanthoxylum americanum* (common pricklyash).
Global Vegetation: Information not available.

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area: Information not available.

Global: Information not available.

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Information not available.

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Information not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNA (ruderal) (30-Dec-2013).

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CLASSIFICATION

Status: Standard
Classification Confidence: 3 - Weak
Mississippi National River and Recreation Area Comments: This association was identified based on information collected during the vegetation mapping project at MISS. It lacks characterization based on data from a larger region and thus lacks information in the "Global" fields of this description.
Global Comments:
Global Related Concepts: Information not available.

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This association is mostly found downriver from confluence of the Minnesota and Mississippi Rivers to the northern end of Gore's Pool WMA on areas that are rarely or never flooded.
Global Range: Information not available.
Nations: US
States/Provinces: MN
TNC Ecoregions: 46
USFS Ecoregions (1994/95): 222M:CC
Federal Lands: NPS (Mississippi)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: HSGF - Successional Grass & Forb Old Field
Mississippi National River and Recreation Area Inventory Notes:
Mississippi National River and Recreation Area Plots and Observation Points: MISS.0003, MISS.004, MISS.132
Local Description Authors: J. Drake
Global Description Authors: Information not available.
References: Midwestern Ecology Working Group n.d.

Midwest Old Field Grassland

Poa pratensis - *Bromus inermis* Ruderal Herbaceous Vegetation
Kentucky Bluegrass - Smooth Brome Ruderal Herbaceous Vegetation
Identifier: CEGL005457

USNVC CLASSIFICATION

Division	Eastern North American Grassland & Shrubland (2.B.2.Nc.)
Macrogroup	Eastern North American Ruderal Grassland & Shrubland (M123)
Group	Northern & Central Ruderal Meadow & Shrubland (G059)
Alliance	Canada Bluegrass - Gray Goldenrod - Spotted Knapweed Dry Meadow & Shrubland Alliance (A3934)
Association	Midwest Old Field Grassland

ELEMENT CONCEPT

Global Summary: Information not available.

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This association occurs on a variety of landforms, slopes, and soil types. The common factor to all sites is a history of significant anthropogenic disturbance, often including planting of exotic species. Sites were found on flat to steep slopes and mostly on medium-textured soils but coarse or fine soils are possible. Sites range from wet-mesic to dry-mesic. Dead plants, both standing and in the form of litter on the ground, are common. Plant litter had an average of 73% cover and bare ground only 5% cover.
Global Environment: Information not available.

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This association is characterized by strong dominance by exotic grasses <1 m tall. The herbaceous stratum is moderate to dense (avg. 80%) and may have scattered trees and shrubs above it but those lifeforms have <25% cover. This association often results from planting or the spread of planted species from nearby areas. Most sites are dominated by the perennials *Bromus inermis* (smooth brome) or *Poa pratensis* (Kentucky bluegrass). *Elymus repens* (quackgrass) was abundant on a few sites. Annual grasses can be abundant or even dominant in some stands, among these *Digitaria* spp. (crabgrass), *Setaria* spp. (bristlegrass) are the most common. Forb cover ranges from very sparse to high, but is always less than the grass cover. Common forbs tend to be exotic or weedy natives, including *Ambrosia artemisiifolia* (annual ragweed), *Asclepias verticillata* (whorled milkweed), *Berteroa incana* (hoary alyssum), *Centaurea biebersteinii* (spotted knapweed), *Cirsium arvense*

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(Canada thistle), *Coronilla varia* (purple crownvetch), *Melilotus officinalis* (yellow sweetclover), *Rudbeckia hirta* (blackeyed Susan), *Solidago canadensis* (Canada goldenrod), *Trifolium* spp. (clover), and *Verbascum thapsus* (common mullein). Shrubs and trees that are present reflect the open, often disturbed nature of the sites and include *Lonicera* spp. (honeysuckle), *Prunus virginiana* (chokecherry), *Rhus* spp. (sumac), *Rubus* spp. (blackberry), and *Ulmus pumila* (Siberian elm).
Global Vegetation: Information not available.

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Bromus inermis* (smooth brome), *Poa pratensis* (Kentucky bluegrass)

Global: Information not available.

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: *Bromus inermis*, *Poa pratensis*
Global: Information not available.

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Information not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNA (ruderal) (30-Dec-2013).

CLASSIFICATION

Status: Standard
Classification Confidence: 3 - Weak
Mississippi National River and Recreation Area Comments: This association was identified based on information collected during the vegetation mapping project at MISS. It lacks characterization based on data from a larger region and thus lacks information in the "Global" fields of this description. It is certain to be common in the upper Midwest.
Global Comments:
Global Related Concepts: Information not available.

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This common association is found in open, upland sites with a history of extensive disturbance throughout the park from the confluence with the Crow River south to Hastings. Gore's Pool WMA is, in general, too wet to support this association.
Global Range: Information not available.
Nations: US
States/Provinces: MN
TNC Ecoregions: 46
USFS Ecoregions (1994/95): 222M:CC
Federal Lands: NPS (Mississippi)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: HSGF - Successional Grass & Forb Old Field
Mississippi National River and Recreation Area Inventory Notes:
Mississippi National River and Recreation Area Plots and Observation Points: MISS.015, MISS.025, MISS.048, MISS.052, MISS.053, MISS.059
Local Description Authors: J. Drake
Global Description Authors:
References: Midwestern Ecology Working Group n.d.

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Midwest Old Field Shrubland

Lonicera (x *bella*, *morrowii*, *tatarica*) - *Rhus glabra* - *Zanthoxylum americanum* Ruderal Shrubland
(Bell's Honeysuckle, Morrow's Honeysuckle, Tatarian Honeysuckle) - Smooth Sumac - Common Prickly-ash Ruderal Shrubland
Identifier: CEGL005460

USNVC CLASSIFICATION

Division	Eastern North American Grassland & Shrubland (2.B.2.Nc.)
Macrogroup	Eastern North American Ruderal Grassland & Shrubland (M123)
Group	Northern & Central Ruderal Meadow & Shrubland (G059)
Alliance	Common Buckthorn - Multiflora Rose - Autumn Olive Ruderal Mesic Shrubland Alliance (A3935)
Association	Midwest Old Field Shrubland

ELEMENT CONCEPT

Global Summary: Information not available.

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This association occurs on a variety of landforms, slopes, and soil types. The common factor to all sites is a history of significant anthropogenic disturbance, often including planting of exotic species. Sites were found on flat to steep slopes and mostly on medium-textured soils but coarse or fine soils are possible. Sites range from wet-mesic to dry-mesic and were found on the floodplain, on valley slopes, and on flat uplands away from the floodplain. The ground cover was mostly litter (avg. 46%) with some bare sand (14%).
Global Environment: Information not available.

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This association has a tall to short shrub layer (1-5 m tall) with at least 25% cover but this can range to nearly 100%. Tree cover is sparse (<25%) and herbaceous cover can be variable but tends to be dense (avg. 70%). The most abundant shrubs are exotic or weedy native species, particularly *Lonicera xbella* (Bell's honeysuckle), *Lonicera japonica* (Japanese honeysuckle), *Lonicera tatarica* (Tatarian honeysuckle), *Rhus glabra* (smooth sumac), *Rhus hirta* (staghorn sumac), *Rhus typhina* (staghorn sumac), and *Zanthoxylum americanum* (common pricklyash). *Rubus* spp. (blackberry) and *Ribes* spp. (gooseberry) can be common low shrubs. These can occur in varying proportions from relatively even mixes to nearly monospecific stands. The herbaceous stratum mirrors the ruderal nature of the shrub layer and is usually dominated by grasses. *Bromus inermis* (smooth brome) and *Poa pratensis* (Kentucky bluegrass) are often dominant though native grasses can be present or common. *Achillea millefolium* (common yarrow), *Ageratina altissima* (white snakeroot), *Ambrosia artemisiifolia* (annual ragweed), *Asclepias syriaca* (common milkweed), *Centaurea biebersteinii* (spotted knapweed), *Conyza canadensis* (Canadian horseweed), *Monarda fistulosa* (wild bergamot), *Solidago canadensis* (Canada goldenrod), and *Solidago gigantea* (giant goldenrod) are typical components of the forb cover.
Global Vegetation: Information not available.

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Lonicera xbella* (Bell's honeysuckle), *Lonicera japonica* (Japanese honeysuckle), *Lonicera tatarica* (Tatarian honeysuckle), *Rhus glabra* (smooth sumac), *Rhus hirta* (staghorn sumac), *Rhus typhina* (staghorn sumac), *Zanthoxylum americanum* (common pricklyash)
Short shrub/sapling	Broad-leaved deciduous shrub	*Lonicera xbella* (Bell's honeysuckle), *Lonicera japonica* (Japanese honeysuckle), *Lonicera tatarica* (Tatarian honeysuckle), *Rhus glabra* (smooth sumac), *Rhus hirta* (staghorn sumac), *Rhus typhina* (staghorn sumac), *Zanthoxylum americanum* (common pricklyash)
Herb (field)	Graminoid	*Bromus inermis* (smooth brome), *Poa pratensis* (Kentucky bluegrass)

Global: Information not available.

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Information not available.

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OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Information not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNA (ruderal) (30-Dec-2013).

CLASSIFICATION

Status: Standard
Classification Confidence: 3 - Weak
Mississippi National River and Recreation Area Comments: This association was identified based on information collected during the vegetation mapping project at MISS. It lacks characterization based on data from a larger region and thus lacks information in the "Global" fields of this description.
Global Comments:
Global Related Concepts: Information not available.

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This uncommon association was found in a few scattered locations throughout the park from the confluence with the Crow River to Hastings, including on some of the sandier islands in the northern part of the park. Gore's Pool WMA is, in general, too wet to support this association.
Global Range: Information not available.
Nations: US
States/Provinces: MN
TNC Ecoregions: 46
USFS Ecoregions (1994/95): 222M:CC
Federal Lands: NPS (Mississippi)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: SSMS - Successional Mixed Species Shrubland
Mississippi National River and Recreation Area Inventory Notes:
Mississippi National River and Recreation Area Plots and Observation Points: DNR.6726, MISS.024, MISS.026, MISS.066, MISS.084
Local Description Authors: J. Drake
Global Description Authors: Information not available.
References: Midwestern Ecology Working Group n.d.

Buckthorn Shrubland

Rhamnus cathartica Ruderal Shrubland
Common Buckthorn Ruderal Shrubland
Identifier: CEGL005461

USNVC CLASSIFICATION

Division	Eastern North American Grassland & Shrubland (2.B.2.Nc.)
Macrogroup	Eastern North American Ruderal Grassland & Shrubland (M123)
Group	Northern & Central Ruderal Meadow & Shrubland (G059)
Alliance	Common Buckthorn - Multiflora Rose - Autumn Olive Ruderal Mesic Shrubland Alliance (A3935)
Association	Buckthorn Shrubland

ELEMENT CONCEPT

Global Summary: This non-native invasive shrubland is widespread throughout the northeastern and midwestern United States. It tends to form dense, often even-aged thickets, crowding and shading out native shrubs and herbs. In an open site, *Rhamnus cathartica* (common buckthorn) establishment is followed by lateral crown spread. This extension continues until branches touch adjacent shrubs. The large leaves and continuous canopy create dense shade. Even-aged thickets are common in both wetlands and in woodland understories. In fire-adapted ecosystems, the lack of vegetation under buckthorn prohibits fires.

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This association was sampled once in the park but was noted during field reconnaissance in subsequent years. It was found on a mesic to wet-mesic site that may be flooded or saturated in very wet years and was noted on wetter sites that are saturated for at least part of the growing season. The ground was mostly bare (72% cover) with some leaf litter (20%).

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Global Environment: *Rhamnus cathartica* (common buckthorn) is tolerant of many soil types, including well-drained sand, clay, poorly drained calcareous, neutral or alkaline, wet or dry.

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This association has at least 25% shrub cover but the dominant species, *Rhamnus cathartica* (common buckthorn), tends to form dense stands over time. As the shrub cover increases, less light is available for shorter shrubs and herbaceous species and these layers are often depauperate. Typical species present in the ground stratum range from *Acer saccharum* (sugar maple), *Fraxinus pennsylvanica* (green ash), *Fraxinus nigra* (black ash), and *Quercus rubra* (northern red oak) seedlings on mesic sites to *Caltha palustris* (yellow marsh marigold), *Impatiens pallida* (pale touch-me-not), *Symplocarpus foetidus* (skunk cabbage), and *Typha angustifolia* (narrowleaf cattail) on wetter sites.
Global Vegetation: *Rhamnus cathartica* (common buckthorn) tends to form dense, often even-aged thickets, crowding and shading out native shrubs and herbs. In an open site, its establishment is followed by lateral crown spread. This extension continues until branches touch adjacent shrubs. The large leaves and continuous canopy create dense shade. Even-aged thickets are common in both wetlands and in woodland understories (Converse 1985). In fire-adapted ecosystems, the lack of vegetation under buckthorn prohibits fires.

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Rhamnus cathartica* (common buckthorn)
Short shrub/sapling	Broad-leaved deciduous shrub	*Rhamnus cathartica* (common buckthorn)

Global: Information not available.

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: *Rhamnus cathartica*
Global: Information not available.

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Information not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNA (invasive) (30-Dec-2013).

CLASSIFICATION

Status: Standard
Classification Confidence: 3 - Weak
Mississippi National River and Recreation Area Comments:
Global Comments: *Rhamnus cathartica* (common buckthorn) is commonly known as common or European buckthorn, and is native to Europe. It appears to prefer lightly shaded conditions, and is often found in open oak woods and edges of woodlands. But here we describe it as a distinct type when found in open settings, where it forms the canopy layer. Wieseler (1999) states that "*R. cathartica* was introduced to North America as an ornamental shrub, for fencerows, and wildlife habitat. Introduction of buckthorn was based on its hardiness and ability to thrive in a variety of soil and light conditions." Converse (1985) states that "*R. cathartica* has been cultivated for hedges (Wyman 1971), forestry uses, and wildlife habitat. This species is also used in shelter-belt planting (Hubbard 1974). Naturalized habitats include pastures, fencerows, roadsides, and slopes of ravines."
Global Related Concepts: Information not available.

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This uncommon association was found only near Battle Creek Regional Park. There was formerly a stand in the northern part of Gore's Pool WMA but it was subjected to restoration management and the shrubs were removed.
Global Range: *Rhamnus cathartica* (common buckthorn) has spread extensively since being introduced in mid 1800s and its range extends in Canada from Nova Scotia in the northeast to Saskatchewan in the northwest, and south in the U.S. to northeastern Kansas, and eastward to North Carolina. The degree to which the plant community occurs throughout this range needs review.
Nations: CA, US
States/Provinces: CT, DE, IA, IL, IN, KS, KY, MA, MB, MD, ME, MI, MN, MO, NC, ND, NE, NH, NJ, NS, NY, OH, ON, PA, QC, RI, SD, SK, TN, VA, VT, WI, WV
TNC Ecoregions: 46
USFS Ecoregions (1994/95): 222M:CC
Federal Lands: NPS (Mississippi)

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ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: SSMS - Successional Mixed Species Shrubland

Mississippi National River and Recreation Area Inventory Notes: The site where the plot was taken during this project was subject to restoration management and most of the *Rhamnus cathartica* (common buckthorn) was removed. Without continued management, *Rhamnus cathartica* (common buckthorn) will likely become abundant and possibly dominant in the future.

Rhamnus cathartica (common buckthorn) is extremely common in upland and wet-mesic forests at MISS but appears to rarely form thick stands away from a forest canopy. Some of this may be due to efforts to control/eliminate this invasive species.

Mississippi National River and Recreation Area Plots and Observation Points: MISS.087

Local Description Authors: J. Drake

Global Description Authors: D. Faber-Langendoen

References: Archibold et al. 1997, Converse 1985, Gale 2000, Heneghan et al. 2002, Heneghan et al. 2004, Heneghan et al. 2006, Midwestern Ecology Working Group n.d.

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2.C.4. Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland

2.C.4.Nd. Eastern North American Wet Meadow, Marsh & Shrubland

M069. Eastern North American Wet Meadow & Marsh

G125. Eastern North American Freshwater Marsh

Arrowhead - Rice Cutgrass Marsh

Sagittaria latifolia - *Leersia oryzoides* Herbaceous Vegetation
Broadleaf Arrowhead - Rice Cutgrass Herbaceous Vegetation
Identifier: CEGL005240

USNVC CLASSIFICATION

Division	Eastern North American Wet Meadow, Marsh & Shrubland (2.C.4.Nd.)
Macrogroup	Eastern North American Wet Meadow & Marsh (M069)
Group	Eastern North American Freshwater Marsh (G125)
Alliance	Green Arrow Alum - Pickerelweed - Arrowhead species Herbaceous Alliance (A3669)
Association	Arrowhead - Rice Cutgrass Marsh

ELEMENT CONCEPT

Global Summary: This arrowhead marsh type is found in the midwestern United States mostly along larger floodplains such as the upper Mississippi River and its larger tributaries. Stands occur in semipermanently flooded wetlands dominated by *Sagittaria latifolia* (broadleaf arrowhead) and/or *Leersia oryzoides* (rice cutgrass). In examples of this type, *Leersia oryzoides* (rice cutgrass) typically occurs in more shallow areas or where the water recedes enough to allow it to establish, but not inhibit, *Sagittaria latifolia* (broadleaf arrowhead). Other emergent aquatic species such as *Potamogeton* spp. (pondweed) and *Ceratophyllum demersum* (coon's tail) are also often present. Although this type can occur naturally, many examples along major waterways can be impacted by dams and/or impoundments. Examples of this community may become monospecific stands of either *Sagittaria latifolia* (broadleaf arrowhead) or *Leersia oryzoides* (rice cutgrass), especially in areas above dams along major rivers where the environment can be more lacustrine in nature. More information is needed to determine the range of this type outside of the upper Midwest.

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This herbaceous wetland occurs on sites that are flooded most or all of the growing season, except in exceptionally dry year. Stands can occur on lakes or on river backwaters where the current is not usually strong. Water depth rarely exceeds 0.5 m. Water (avg. 32%), plant litter (avg. 14% and bare soil (avg. 14%) constituted the unvegetated ground cover.
Global Environment: Stands occur in semipermanently flooded wetlands.

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This association is dominated by emergent herbaceous species generally shorter than 1 m above the water. Cover is moderate to high (avg. 69%). *Leersia oryzoides* (rice cutgrass) was the most abundant species in most stands but a variety of other low to tall emergent species can be present to co-dominant, including *Cyperus esculentus* (yellow nutsedge), *Eragrostis hypnoides* (teal lovegrass), *Lythrum salicaria* (purple loosestrife), *Polygonum amphibium* (water knotweed), *Sagittaria latifolia* (broadleaf arrowhead), *Sagittaria rigida* (sessilefruit arrowhead), *Schoenoplectus fluviatilis* (river bulrush), *Schoenoplectus tabernaemontani* (softstem bulrush), and *Typha angustifolia* (narrowleaf cattail). Shrubs and trees were absent or very rare.
Global Vegetation: Stands are dominated by *Sagittaria latifolia* (broadleaf arrowhead) and *Leersia oryzoides* (rice cutgrass), often with other emergent aquatic species. Little is known about the dynamics, naturalness, or composition of this association.

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Leersia oryzoides* (rice cutgrass)

Global: Information not available.

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Information not available.

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OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Information not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (16-Jun-1998).

CLASSIFICATION

Status: Standard
Classification Confidence: 3 - Weak
Mississippi National River and Recreation Area Comments:
Global Comments: This type can occur naturally but many examples, especially areas of monospecific or nearly monospecific stands, may be caused by dams or impoundments. Separating natural occurrences from semi-natural ones may be difficult, especially on rivers that have been permanently altered due to dams. Also, this type could be considered a subtype of a more broadly defined shallow marsh type, ~*Schoenoplectus tabernaemontani* - *Typha* spp. - (*Sparganium* spp., *Juncus* spp.) Herbaceous Vegetation (CEGL002026)$$.
Global Similar Associations:

- *Sagittaria cuneata* - *Sagittaria longiloba* Herbaceous Vegetation (CEGL004525) This type contains some southern U.S. species not found in the Midwest.
- *Schoenoplectus tabernaemontani* - *Typha* spp. - (*Sparganium* spp., *Juncus* spp.) Herbaceous Vegetation (CEGL002026) This is a broadly defined shallow marsh type that may include CEGL005240 as a subtype.

Global Related Concepts: Information not available.

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This uncommon association was found in a few locations in protected areas of the Mississippi River or lakes on the floodplain. These sites were between Crosby Farm Park and Gore's Pool WMA.
Global Range: This type is found in the midwestern United States. Its range outside of major rivers in the upper Midwest needs further review.
Nations: US
States/Provinces: IA, IL, MN, MT?, SD, WI
TNC Ecoregions: 26:C, 34:P, 35:P, 36:P, 46:C, 47:C
USFS Ecoregions (1994/95): 222K:C?, 222L:CC, 222M:CC, 251B:PP, 251C:PP, 331E:??
Federal Lands: NPS (Effigy Mounds, Mississippi, Saint Croix)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: HARC - Arrowhead - Rice Cutgrass Marsh
Mississippi National River and Recreation Area Inventory Notes: In one of the field seasons for this project, 2014, there was extensive high flooding in May and June, in particular. The composition and location of aquatic or emergent wetlands, in particular, were affected in the floodplains of the Minnesota, Mississippi, and Vermillion Rivers. Plant growth was delayed or plants were killed, scouring and deposition of alluvium altered habitat, etc.
Mississippi National River and Recreation Area Plots and Observation Points: DNR.4924, DNR.6688, DNR.6689, MISS.032, MISS.103, MISS.112
Local Description Authors: J. Drake
Global Description Authors: D. Faber-Langendoen
References: Hop et al. 2005, INAI unpubl. data, Midwestern Ecology Working Group n.d., Minnesota DNR 2005a, Minnesota DNR 2005b

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River Bulrush Marsh

Schoenoplectus fluviatilis - *Schoenoplectus* spp. Herbaceous Vegetation
River Bulrush - Clubrush species Herbaceous Vegetation
Identifier: CEGL002221

USNVC CLASSIFICATION

Division	Eastern North American Wet Meadow, Marsh & Shrubland (2.C.4.Nd.)
Macrogroup	Eastern North American Wet Meadow & Marsh (M069)
Group	Eastern North American Freshwater Marsh (G125)
Alliance	Softstem Bulrush - River Bulrush - Cattail species Shallow Marsh Herbaceous Alliance (A3666)
Association	River Bulrush Marsh

ELEMENT CONCEPT

Global Summary: This community is found throughout the central and upper midwestern United States where it is found along large rivers and lakeshores. Sites are subject to seasonal flooding that typically draws down by late summer. The diagnostic dominant is *Schoenoplectus fluviatilis (= Scirpus fluviatilis)* (river bulrush), which often forms almost mono-dominant patches. Other marsh associates include *Typha angustifolia* (narrowleaf cattail), *Typha latifolia* (broadleaf cattail), *Schoenoplectus tabernaemontani (= Scirpus tabernaemontani)* (softstem bulrush), and *Sparganium eurycarpum* (broadfruit bur-reed).

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This emergent herbaceous wetland was typically in backwater lakes and channels on the Mississippi or Minnesota Rivers. These sites are flooded or saturated in the spring or after heavy summer rains nearly every year. Water may remain through most of the growing season or draw-down by early summer. Soils are alluvial and fine textured. The unvegetated ground is mostly litter (50%) and bare ground (32%) with a little water (3%).
Global Environment: Sites are subject to seasonal flooding that typically draws down by late summer.

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: Emergent wetland species dominate this community. Many sites have very dense vegetation and the dominant species, *Schoenoplectus fluviatilis* (river bulrush), can form thick stands. These can be nearly monotypic in the tall emergent category but under that canopy shorter species can still have moderate cover. *Polygonum amphibium* (water knotweed) and *Sagittaria latifolia* (broadleaf arrowhead) are present in most stands. Heavy flooding or sustained low water can result in a reduction in cover by *Schoenoplectus fluviatilis* (river bulrush) and allow other species to spread into the open spaces. Most of the diversity in this community is in openings in the tall emergent canopy. Here, other species found in shallow marshes can be found, including *Bidens cernua* (nodding beggartick), *Eleocharis quinqueflora* (fewflower spikerush), *Leersia oryzoides* (rice cutgrass), *Stachys tenuifolia* (smooth hedgenettle), *Sium suave* (hemlock waterparsnip), *Symphyotrichum lanceolatum* (white panicle aster), *Typha* spp. (cattail), and *Xanthium strumarium* (rough cocklebur). Shrubs and trees are unusual and tend to be concentrated near the drier edge of this community.
Global Vegetation: The diagnostic dominant is *Schoenoplectus fluviatilis (= Scirpus fluviatilis)* (river bulrush), which often forms almost mono-dominant patches. Other marsh associates include *Typha angustifolia* (narrowleaf cattail), *Typha latifolia* (broadleaf cattail), *Schoenoplectus tabernaemontani (= Scirpus tabernaemontani)* (softstem bulrush), and *Sparganium eurycarpum* (broadfruit bur-reed). It may be that the type includes dominance by a variety of *Scirpus* spp. within the region, including *Scirpus fluviatilis* (river bulrush), *Schoenoplectus tabernaemontani (= Scirpus tabernaemontani)*, and *Schoenoplectus acutus (= Scirpus acutus)* (hardstem bulrush).

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Herb (field)	Forb	*Schoenoplectus fluviatilis* (river bulrush)

Global: Information not available.

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: *Schoenoplectus fluviatilis*
Global: Information not available.

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Information not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G4 (26-Jan-2000). In the northern tallgrass prairie these marshes can be heavily degraded due to heavy siltation, nutrient enrichment, and plowed floodplains (R. Dana pers. comm. 1999). In the Mississippi River floodplains, extensive stands once occurred, but they are now subject to very altered hydrologic regimes (since the 1930s) (E. Epstein pers. comm. 1999).

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CLASSIFICATION

Status: Standard
Classification Confidence: 3 - Weak
Mississippi National River and Recreation Area Comments:
Global Comments: This type is weakly defined, often being treated as part of a mixed emergent marsh type. And it may be that the type includes dominance by a variety of *Scirpus* spp. within the region, including *Scirpus fluviatilis* (river bulrush)*, Schoenoplectus tabernaemontani (= Scirpus tabernaemontani)* (softstem bulrush), and *Schoenoplectus acutus (= Scirpus acutus)* (hardstem bulrush). Further work is needed to characterize its extent and composition. But its potentially extensive nature along major rivers and dependence on flooding may make it a good indicator of natural flooding regimes. In the northern tallgrass prairie and Mississippi River floodplains these marshes can be heavily degraded due to heavy siltation, nutrient enrichment, and plowed floodplains (R. Dana, E. Epstein pers. comm. 1999).
Global Related Concepts:
- Deep Marsh River Bulrush Subtype (Faber-Langendoen 2001) =
- Freshwater Marsh (Nelson 1985) >
- Marsh: Bulrush: Mineral substrate (W7) (Harris et al. 1996) =
- Mixed Emergent Marsh (Prairie Section) (MNNHP 1993) >

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This association is found where the river floodplain is broad and flat. This occurs on the Minnesota River and on the Mississippi River from the confluence of those two rivers to the southern end of the project area. It forms large stands near Gun Club Lake and in Gore's Pool WMA.
Global Range: This community is found throughout the central and upper midwestern United States where it is found along large rivers and lakeshores, ranging from Ohio west to Manitoba and south to Iowa.
Nations: CA, US
States/Provinces: IA, IL, IN, MB:S3, MN, MO, OH, WI
TNC Ecoregions: 35:C, 36:C, 37:P, 44:P, 46:C, 48:C
USFS Ecoregions (1994/95): 212Ja:PPP, 222Ab:C??, 222Ak:C??, 222Gc:CCC, 222Kg:CCC, 222Md:CCC, 251Aa:C??, 251Cd:CC?, 251Cf:CCC, 251Ck:CCC
Federal Lands: NPS (Effigy Mounds, Mississippi)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: HMEM - Mixed Emergent Marsh
Mississippi National River and Recreation Area Inventory Notes: In one of the field seasons for this project, 2014, there was extensive high flooding in May and June, in particular. The composition and location of aquatic or emergent wetlands, in particular, were affected in the floodplains of the Minnesota, Mississippi, and Vermillion Rivers. Plant growth was delayed or plants were killed, scouring and deposition of alluvium altered habitat, etc.
Mississippi National River and Recreation Area Plots and Observation Points: DNR.4925, MISS.049, MISS.079, MISS.114
Local Description Authors: J. Drake
Global Description Authors: D. Faber-Langendoen
References: Epstein pers. comm., Faber-Langendoen 2001, Greenall 1996, Harris et al. 1996, Homoya et al. 1988, Hop et al. 2005, INAI unpubl. data, MNNHP 1993, Midwestern Ecology Working Group n.d., Minnesota DNR 2005a, Minnesota DNR 2005b, Nelson 1985, Nelson 2010, ONHD unpubl. data, WNHI 2011, WNHI unpubl. data, White and Madany 1978

Bulrush - Cattail - Bur-reed Shallow Marsh

Schoenoplectus tabernaemontani - *Typha* spp. - (*Sparganium* spp., *Juncus* spp.) Herbaceous Vegetation
Softstem Bulrush - Cattail species - (Bur-reed species, Rush species) Herbaceous Vegetation
Identifier: CEGL002026

USNVC CLASSIFICATION

Division	Eastern North American Wet Meadow, Marsh & Shrubland (2.C.4.Nd.)
Macrogroup	Eastern North American Wet Meadow & Marsh (M069)
Group	Eastern North American Freshwater Marsh (G125)
Alliance	Softstem Bulrush - River Bulrush - Cattail species Shallow Marsh Herbaceous Alliance (A3666)
Association	Bulrush - Cattail - Bur-reed Shallow Marsh

ELEMENT CONCEPT

Global Summary: This shallow marsh mixed emergent community ranges broadly over the midwestern United States and adjacent Canada. It is found in basin-like depressions, backwater areas of floodplains, and shallow margins of lakes or ponds. Soils are shallow to deep, very poorly drained, consisting of peats, mucks, or mineral materials, often found in alluvium. Vegetation varies from zones

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dominated by tall emergents 1-2 m tall to those with hydrophytic annual and perennial forbs <1 m tall. In the tall emergent zone, *Schoenoplectus tabernaemontani (= Scirpus tabernaemontani)* (softstem bulrush), *Schoenoplectus fluviatilis (= Scirpus fluviatilis)* (river bulrush), *Schoenoplectus acutus (= Scirpus acutus)* (hardstem bulrush), *Typha angustifolia* (narrowleaf cattail), and *Typha latifolia* (broadleaf cattail) may dominate, mixed with a variety of other herbaceous species, such as *Leersia oryzoides* (rice cutgrass), *Eleocharis palustris* (common spikerush), *Juncus* spp. (rush), and *Sparganium* spp. (bur-reed). The hydrophytic annual and perennial forb zone is dominated by *Alisma subcordatum* (American water plantain), *Alisma triviale* (northern water plantain), *Sagittaria latifolia* (broadleaf arrowhead), *Sparganium eurycarpum* (broadfruit bur-reed), *Pontederia cordata* (pickerelweed), along with *Bacopa rotundifolia* (disk waterhyssop) and *Heteranthera limosa* (blue mudplantain). Occasional floating-leaved aquatics are sometimes present, including *Azolla caroliniana* (Carolina mosquitofern), *Lemna* spp. (duckweed) (duckweed), *Spirodela polyrrhiza* (common duckmeat), and *Utricularia macrorhiza* (common bladderwort).

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This mixed shallow marsh was found in shallow basin wetlands, on the edges of lakes, ponds, and in protected parts of the Mississippi and Minnesota Rivers. These sites are flooded or saturated for part or most of nearly every year and water may remain for the entire growing season in some sites. Water rarely exceeds 0.5 m for long periods. The unvegetated surface is nearly entirely water (avg. 80%).

Global Environment: This community ranges broadly over the midwestern United States. It is found in basin-like depressions, backwater areas of floodplains and shallow margins of lakes or ponds. Soils are shallow to deep, very poorly drained, consisting of peats, mucks, or mineral materials, often found in alluvium (Lauver et al. 1999).

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This association is dominated by emergent herbaceous species in a shallow marsh setting but can be variable in terms of height, canopy cover, and dominant species. Vegetation can be scattered, especially on the deep water edge of this community, to very dense and can be moderately tall to tall (1-2 m). Common or dominant species are similarly variable - *Sagittaria latifolia* (broadleaf arrowhead), *Sparganium eurycarpum* (broadfruit bur-reed), *Schoenoplectus tabernaemontani* (softstem bulrush), *Typha angustifolia* (narrowleaf cattail), *Typha latifolia* (broadleaf cattail), and *Typha ×glauca* are typical. Other species that can be present or abundant include *Cyperus odoratus* (fragrant flatsedge), *Leersia oryzoides* (rice cutgrass), *Lysimachia* spp. (yellow loosestrife), *Lythrum salicaria* (purple loosestrife), *Polygonum amphibium* (water knotweed), and *Xanthium strumarium* (rough cocklebur). Floating-leaved species are often scattered in this association. Typical species are *Ceratophyllum demersum* (coon's tail), *Lemna* spp. (duckweed), *Nelumbo lutea* (American lotus), *Potamogeton* spp. (pondweed), and *Spirodela polyrrhiza* (common duckmeat),

Global Vegetation: Vegetation varies from zones dominated by tall emergents 1-2 m tall to those with hydrophytic annual and perennial forbs <1 m tall. In the tall emergent zone, *Schoenoplectus tabernaemontani (= Scirpus tabernaemontani)* (softstem bulrush), *Schoenoplectus fluviatilis (= Scirpus fluviatilis)* (river bulrush), *Schoenoplectus acutus (= Scirpus acutus)* (hardstem bulrush), *Typha angustifolia* (narrowleaf cattail), and *Typha latifolia* (broadleaf cattail) may dominate, mixed with a variety of other herbaceous species, such as *Leersia oryzoides* (rice cutgrass), *Eleocharis palustris* (common spikerush), *Juncus* spp. (rush), and *Sparganium* spp. (bur-reed). The hydrophytic annual and perennial forb zone is dominated by *Alisma subcordatum* (American water plantain), *Alisma triviale* (northern water plantain), *Pontederia cordata* (pickerelweed), *Sagittaria latifolia* (broadleaf arrowhead), and *Sparganium eurycarpum* (broadfruit bur-reed), along with *Bacopa rotundifolia* (disk waterhyssop) and *Heteranthera limosa* (blue mudplantain). Other species that may dominate locally include *Polygonum pensylvanicum (= Polygonum bicorne)* (Pennsylvania smartweed), *Polygonum amphibium* var. *emersum (= Polygonum coccineum)* (longroot smartweed), and *Polygonum lapathifolium* (longroot smartweed). Occasional floating-leaved aquatics are sometimes present, including *Azolla caroliniana* (Carolina mosquitofern), *Lemna* spp. (duckweed), *Spirodela polyrrhiza* (common duckmeat), and *Utricularia macrorhiza* (common bladderwort) (Eggers and Reed 1987, Steinauer and Rolfsmeier 2000).

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Herb (field)	Forb	*Sagittaria latifolia* (broadleaf arrowhead), *Sparganium eurycarpum* (broadfruit bur-reed), *Schoenoplectus tabernaemontani* (softstem bulrush), *Typha angustifolia* (narrowleaf cattail), *Typha latifolia* (broadleaf cattail), *Typha ×glauca*

Global: Information not available.

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: Information not available.

Global: Information not available.

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.

Global: Information not available.

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CONSERVATION STATUS RANK

Global Rank & Reasons: G4G5 (22-Jun-1998).

CLASSIFICATION

Status: Standard
Classification Confidence: 3 - Weak
Mississippi National River and Recreation Area Comments:
Global Comments: This is a very broadly defined type that intergrades between wet meadows and deep marshes. Shaw and Fredine (1971) (in Eggers and Reed 1987) define shallow marsh as "soils that are saturated to inundated by standing water up to 15 cm in depth, throughout most of the growing season." Depending on the local topographic context, the type may or may not be extensive. Any number of types could be separated within this coarsely defined type, but it is not yet clear how best to make such distinctions (e.g., the forb-dominated portions, such as *Pontederia cordata* (pickerelweed) or *Sagittaria latifolia* (broadleaf arrowhead)). [See e.g., ~*Sagittaria latifolia - Leersia oryzoides* Herbaceous Vegetation (CEGL005240)$$.] See also Lee et al. (1998), who separate out a *Sparganium eurycarpum* (broadfruit bur-reed) type. Taxonomically, *Schoenoplectus tabernaemontani* (softstem bulrush) is equivalent to former *Scirpus validus* (Kartesz 1999). In Minnesota, *Schoenoplectus acutus (= Scirpus acutus)* (hardstem bulrush) may be the more common bulrush (R. Dana pers. comm. 1999). *Eleocharis* spp. (spikerush) can also be typical of this type. Dominant and characteristic plants should always be described from stands to allow for adequate characterization. In Nebraska, the pond marsh extends to south-central Nebraska (Steinauer and Rolfsmeier 2000).
Global Similar Associations:
- *Sagittaria latifolia - Leersia oryzoides* Herbaceous Vegetation (CEGL005240)
- *Schoenoplectus acutus - (Schoenoplectus fluviatilis)* Freshwater Herbaceous Vegetation (CEGL002225)
- *Typha* spp. - *Schoenoplectus acutus* - Mixed Herbs Midwest Herbaceous Vegetation (CEGL002229) This is the deep marsh equivalent of this type.
- *Typha* spp. - *Schoenoplectus* spp. - Mixed Herbs Great Plains Herbaceous Vegetation (CEGL002228)

Global Related Concepts:
- *Scirpus validus* herbaceous association (Hoagland 1997) **?**
- Bur-reed Mineral Shallow Marsh Type (Lee et al. 1998) **<**
- Bur-reed Organic Shallow Marsh Type (Lee et al. 1998) **<**
- Freshwater Marsh (Nelson 1985) **>**
- Inland Emergent Marsh (Chapman et al. 1989) **>**
- Mixed Emergent Marsh (Forest Section) (MNNHP 1993) **>**
- Pond Marsh (Steinauer and Rolfsmeier 2003) **>**
- Pond Marsh (Steinauer and Rolfsmeier 1997) **>**
- Pond Marsh (Steinauer and Rolfsmeier 2000) **>**
- Shallow Marsh (Faber-Langendoen 2001) **=**
- Spike Rush Organic Shallow Marsh Type (Lee et al. 1998) **<**

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This association is found where the river floodplain is broad and flat. This occurs on the Minnesota River and on the Mississippi River from the confluence of those two rivers to the southern end of the project area.
Global Range: This shallow marsh mixed emergent community ranges broadly over the midwestern United States and adjacent Canada, from Ohio and Ontario west to Manitoba, south to Oklahoma and northern Arkansas, and east to Indiana.
Nations: CA, US
States/Provinces: AR, DC?, IA, IL, IN, KS:S1S2, MB:S4?, MI, MN, MO, ND:S3, NE, NM, OH, OK, ON, PA, QC, SD, SK, VA, WI:S4, WY
TNC Ecoregions: 26:C, 33:C, 34:C, 35:C, 36:C, 37:C, 38:C, 39:C, 40:P, 42:P, 44:C, 45:C, 46:C, 47:C, 48:C, 49:C, 50:C
USFS Ecoregions (1994/95): 212Hb:CC?, 212Hm:CCC, 212Hs:CCC, 212Hv:CCC, 212Ib:C??, 212Ja:CCP, 212Jb:CC?, 212Jc:CCP, 212Jd:CCC, 212Je:CC?, 212Jf:CC?, 212Jj:CC?, 212Jk:CC?, 212Jl:CC?, 212Jm:CC?, 212Ka:CP?, 212Kb:CPP, 212La:CPP, 212Lb:CPP, 212Lc:CPP, 212Ld:CPP, 212Ma:CPP, 212Mb:CPP, 212Na:CPP, 212Nb:CPP, 212Nc:CPP, 212Nd:CPP, 221Ea:CCC, 221Ec:CCC, 221Ed:CCP, 221Ef:CCC, 221Fa:CCC, 221He:CCC, 222Ak:CC?, 222An:CCC, 222Ao:CCP, 222Db:CCC, 222Ga:CCC, 222Gb:CCC, 222Ha:CCC, 222Hc:CCC, 222Hf:CCC, 222Ji:CCC, 222Jj:CCC, 222Kf:CCC, 222Kg:CCC, 222Md:CCC, 222Na:CPP, 232Ad:CCC, 251Aa:CP?, 251Cc:CCC, 251Cd:CC?, 251Cf:CCC, 251Cj:CCC, 251Co:CCC, 251Dg:CCC, 332E:PP
Federal Lands: NPS (Buffalo River, C&O Canal, Cuyahoga Valley, Effigy Mounds, Indiana Dunes, Isle Royale, Mississippi, National Capital-East, Prince William, Saint Croix); USFS (Chequamegon-Nicolet?, Chequamegon?, Chippewa?, Nicolet?, Ottawa?, Wayne); USFWS (Erie)

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ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: HMEM - Mixed Emergent Marsh
Mississippi National River and Recreation Area Inventory Notes: In one of the field seasons for this project, 2014, there was extensive high flooding in May and June, in particular. The composition and location of aquatic or emergent wetlands, in particular, were affected in the floodplains of the Minnesota, Mississippi, and Vermillion Rivers. Plant growth was delayed or plants were killed, scouring and deposition of alluvium altered habitat, etc.
Mississippi National River and Recreation Area Plots and Observation Points: DNR.4926, MISS.030
Local Description Authors: J. Drake
Global Description Authors: D. Faber-Langendoen
References: Baalman 1965, CDPNQ unpubl. data, Chapman et al. 1989, Eggers and Reed 1987, Faber-Langendoen 2001, Greenall 1996, Hoagland 1997, Hoagland 2000, Homoya et al. 1988, Hop et al. 2005, Hop et al. 2009, INAI unpubl. data, Kartesz 1999, Lauver et al. 1999, Lee et al. 1998, MNNHP 1993, Midwestern Ecology Working Group n.d., Minnesota DNR 2005a, Minnesota DNR 2005b, Muldavin et al. 2000a, NDNHI unpubl. data, NHNM unpubl. data, Nelson 1985, Nelson 2010, ONHD unpubl. data, Rolfsmeier and Steinauer 2010, Shaw and Fredine 1971, Steinauer and Rolfsmeier 1997, Steinauer and Rolfsmeier 2000, Steinauer and Rolfsmeier 2003, TNC 1999b, WNDD unpubl. data, WNHI 2011, WNHI unpubl. data, White and Madany 1978

Midwest Mixed Emergent Deep Marsh

Typha spp. - *Schoenoplectus acutus* - Mixed Herbs Midwest Herbaceous Vegetation
Cattail species - Hardstem Bulrush - Mixed Herbs Midwest Herbaceous Vegetation
Identifier: CEGL002229

USNVC CLASSIFICATION

Division	Eastern North American Wet Meadow, Marsh & Shrubland (2.C.4.Nd.)
Macrogroup	Eastern North American Wet Meadow & Marsh (M069)
Group	Eastern North American Freshwater Marsh (G125)
Alliance	Narrowleaf Cattail - Broadleaf Cattail - Bulrush species Deep Marsh Herbaceous Alliance (A1436)
Association	Midwest Mixed Emergent Deep Marsh

ELEMENT CONCEPT

Global Summary: This deep freshwater marsh community is found in glacial potholes, river valleys, ponds, and on lake plains throughout the midwestern and parts of the eastern United States. These marshes have hydric soils and are flooded with water levels ranging from several centimeters to more than 1 m for a significant part of the growing season. Soils that support this community can be mineral or organic but are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part. This deepwater emergent marsh community is dominated by perennial, coarse-leaved graminoid vegetation. A typical example of this marsh contains a mosaic of emergents, submergents, and floating-leaved plants interspersed with areas of open water. Occurrences may contain extensive areas of open water, but the vegetation covers at least 3% of the surface. *Typha latifolia* (broadleaf cattail)*, Typha angustifolia* (narrowleaf cattail), and *Schoenoplectus acutus (= Scirpus acutus)* (hardstem bulrush) dominate this dynamic ecosystem. Sedges are also common (e.g., *Carex lupuliformis* (false hop sedge) and *Carex hyalinolepis* (shoreline sedge) in the eastern part of the range), and a diverse assemblage of grasses, floating-leaved aquatics, and submerged aquatics are present. Vegetative diversity and density are highly variable in response to water depth, water chemistry, and natural forces.

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This emergent wetland association was found in shallow basin wetlands, on the edges of lakes, ponds, and in protected parts of the Mississippi and Minnesota Rivers. These sites are flooded or saturated for most or all of nearly every year. Water is often 0.5 m deep or deeper for long periods.
Global Environment: These highly productive wetlands are found in glacial potholes, river valleys, ponds, and on lakeplains. They are characterized by continuous inundation and are considered a deep marsh. Water depth averages 0.3-0.6 m, ranging from several centimeters to more than one meter for a significant part of the growing season. Seasonal flooding during winter and spring or flooding during heavy rains help maintain these marshes by causing water exchange which replenishes freshwater and circulates nutrients and organic debris. Soils can be mineral or organic but are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part. Vegetative diversity and density are highly variable in response to water depth, water chemistry, and natural forces. This community is characterized by continuous inundation and is considered a deep marsh. Water levels may reach 2 m, and there may be large areas of open water (Niering 1985).

Soils can be mineral or organic but are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part (Mitsch and Gosselink 1993). Soil types listed are those which could support this community in Illinois. They include Lawson - Sawmill - Darwin, Haymond - Petrolia - Karnak, Martinsville - Sciotoville, Alford - Wellston, Hosmer - Zanesville - Berks, Grantsburg - Zanesville - Wellston, Houghton - Palms - Muskego; fine-fine/silty-coarse-silty (some evic-coprogenous), mixed montmorillonitic, mesic; Cumulic Hapludolls, Cumulic Haplaquolls, Typic Hapladalfs, Aquic Fragiudalfs, Ultic Hapludalfs, Typic Fragiudalfs, Typic Dystrochrepts, Terrice Medisaprists, Typic Medisaprists, Limnic Medisaprists; Alfisols, Mollisols, Inceptisols, Entisols (Fehrenbacher et al. 1982). The geologic substrate is Paleozoic rock deeply buried by alluvium.

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VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This association can have open to dense herbaceous vegetation cover. Patches of open water are present in most examples and the emergent vegetation often gets more scattered in deeper water. Dominant species range from moderate to tall (1-2 m) and often change with water depth within a stand and the amount of flooding a site has experienced recently. *Sagittaria latifolia* (broadleaf arrowhead), *Schoenoplecus* spp. (bulrush), *Sparganium eurycarpum* (broadfruit bur-reed), *Typha angustifolia* (narrowleaf cattail), and *Typha latifolia* (broadleaf cattail) are all common, though *Typha* spp. (cattail) is never strongly dominant. Floating-leaved species are nearly always present, especially *Lemna* spp. (duckweed), *Spirodela polyrrhiza* (common duckmeat), and *Wolffia* spp. (watermeal).

Global Vegetation: This deepwater emergent marsh community is dominated by perennial herbaceous vegetation with graminoid leaves. A typical example of this marsh contains a mosaic of emergents, submergents, and floating-leaved plants interspersed with areas of open water (Harris et al. 1996). Various kinds of emergents may dominate a marsh depending on the water depth. Quite often the vegetation arranges itself in belts (wetland zonation), with a particular species or range of species occupying specific depths from the shoreline to deep open water. Marshes may display areas of open water, but vegetation dominates (>30% cover). *Typha latifolia* (broadleaf cattail), *Typha angustifolia* (narrowleaf cattail), and *Schoenoplectus acutus (= Scirpus acutus)* (hardstem bulrush) dominate this dynamic ecosystem. Sedges are also common (e.g., *Carex lupuliformis* (false hop sedge) and *Carex hyalinolepis* (shoreline sedge) in the eastern part of the range). A diverse assemblage of grasses, floating-leaved aquatics, and submerged aquatics are present (TNC 1995a). Emergent marshes exhibit differences in vegetative composition and physiognomy in response to water depth and substrate aggradation. In Ohio, *Schoenoplectus tabernaemontani* (softstem bulrush) is most common and *Schoenoplectus acutus* (hardstem bulrush) is rare (it is more common in Ohio fens).

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area: Information not available.

Global Stratum	Lifeform	Species
Herb (field)	Graminoid	*Carex hyalinolepis* (shoreline sedge), *Phragmites australis* (common reed), *Schoenoplectus acutus* (hardstem bulrush), *Typha latifolia* (broadleaf cattail)
Floating aquatic	Aquatic herb (floating & submergent)	*Lemna minor*, *Nelumbo lutea* (American lotus)

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Information not available.

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Vulnerable: *Calephelis muticum* (G3), *Cryptobranchus alleganiensis* (G3G4); **Invasive/Exotic**: *Lythrum salicaria* (High, an aggressive exotic species which threatens this community in Canada, the Northeast, and more recently in the Midwest), *Phragmites australis* (High); **Other Plants**: *Schoenoplectus californicus* (G5, occasionally found in this community)

CONSERVATION STATUS RANK

Global Rank & Reasons: G4? (26-Jan-2000). This type is subject to many forms of human impact, particularly draining for farmland.

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Mississippi National River and Recreation Area Comments: This association was not identified during plot sampling. It was found later in the project and so is described based on field reconnaissance notes and Accuracy Assessment data. As such, it lacks comprehensive species lists and detailed information on vegetation strata.
Global Comments: This community type is very broadly defined. It can be highly dynamic from one season to the next, and species composition and density are very dependent on water regime and sometimes the mineral content of water and soil (Niering 1985). Deep marsh is defined as having water depths of 15 cm to over 1 m throughout all or most of the growing season (Shaw and Fredine 1971, in Eggers and Reed 1987). The concept and distribution of this community in the Southeast needs reassessment; it should be compared to ~*Typha latifolia* Southern Herbaceous Vegetation (CEGL004150)$$, particularly in the Mississippi alluvial plain of Missouri (M. Leahy pers. comm. 1999). Many of the presettlement occurrences of this community have been drained and converted to cropland or destroyed by siltation, which greatly accelerates the natural successional process from shallow inundation to moist soil. *Lythrum salicaria* (purple loosestrife) is an aggressive exotic species that threatens this community in Canada, the Northeast, and more recently in the Midwest. Stands in Province 212 may deserve to be recognized as a separate northern type, but further data are needed.
Global Similar Associations:
- *Schoenoplectus acutus - Typha latifolia - (Schoenoplectus tabernaemontani)* Sandhills Herbaceous Vegetation (CEGL002030)
- *Schoenoplectus acutus* Herbaceous Vegetation (CEGL001840)
- *Schoenoplectus tabernaemontani - Typha* spp. - (*Sparganium* spp., *Juncus* spp.) Herbaceous Vegetation (CEGL002026)

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- *Typha (angustifolia, latifolia) - (Schoenoplectus* spp.) Eastern Herbaceous Vegetation (CEGL006153)
- *Typha latifolia - Caltha palustris* Herbaceous Vegetation (CEGL006245)
- *Typha latifolia* Southern Herbaceous Vegetation (CEGL004150)
- *Typha* spp. Midwest Herbaceous Vegetation (CEGL002233)

Global Related Concepts:
- Deep Marsh Mixed Emergent Subtype (Faber-Langendoen 2001) =
- Freshwater Marsh (Steinauer and Rolfsmeier 2000) =
- Freshwater Marsh (Steinauer and Rolfsmeier 2003) >
- Freshwater Marsh (Nelson 1985) >
- Inland Emergent Marsh (Chapman et al. 1989) >
- Marsh: Mixed: Mineral Substrate (W5) (Harris et al. 1996) >
- Marsh: Mixed: Organic Substrate (W10) (Harris et al. 1996) >
- Mixed Emergent Marsh (Forest Section) (MNNHP 1993) ><
- Palustrine Emergent Wetland (Cowardin et al. 1979) <
- Palustrine: Herbaceous Wetland: Riparian (TNC 1985) >
- Palustrine: Palustrine Emergent Wetland (Cowardin et al. 1979) <
- Pond Marsh (Steinauer and Rolfsmeier 2003) >
- UNESCO FORMATION CODE: V.A. (UNESCO 1973) >

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This uncommon association was found only near Pig's Eye Lake and Lake Rebecca Park.
Global Range: This community is found in glacial potholes, river valleys, ponds, and on lakeplains throughout the midwestern and parts of the eastern United States, ranging from Ohio and Ontario west to North Dakota, south to Nebraska and east to Alabama.
Nations: CA, US
States/Provinces: AL, IA:S4, IL, IN, KY, MI, MN, MO, ND, NE, OH, ON, SD, TN, WI:S4, WY
TNC Ecoregions: 35:C, 36:C, 37:P, 43:C, 44:P, 46:C, 47:C, 48:C, 50:?
USFS Ecoregions (1994/95): 212He:CCC, 212Hi:CCC, 212Hj:CCP, 212Ho:CCC, 212Hq:CCP, 212Ht:CCC, 212Hv:CCC, 212Hw:CCC, 212Ib:C??, 212Ja:CPP, 212Jb:CP?, 212Jc:CP?, 212Jf:CPP, 212Jj:CPP, 212Jl:CPP, 212Jm:CPP, 212Jn:CP?, 212Jo:CP?, 212Ka:CPP, 212Mb:CPP, 212Na:CCP, 212Nb:CCP, 212Nc:CCC, 212Nd:CC?, 222A:CP, 222D:CP, 222E:CP, 222G:CP, 222Ha:CCC, 222Hb:CCC, 222Ia:CCC, 222Jc:CCC, 222Jg:CCC, 222Jh:CCC, 222Ji:CCC, 222Jj:CCC, 222Kd:CCC, 222Ke:CCC, 222Kf:CCC, 222Kg:CCC, 222Kj:CCC, 222Mc:CCC, 222Md:CCC, 222Me:CCC, 222Na:CCC, 234A:PP, 251Aa:CCC, 251Ab:CCC, 251Bb:CCC, 251Bd:CCC, 251Be:CCC, 251Cb:CCC, 251Cf:CCC, 251Cg:CCC, 251Ch:CCC, 251Cm:CCC, 251Cp:CCC, 251Dg:CCC, 251Eb:CCC
Federal Lands: NPS (Isle Royale, Mississippi, Pictured Rocks, Sleeping Bear Dunes); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Huron, Huron-Manistee, Nicolet, Ottawa?)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: HMEM - Mixed Emergent Marsh
Mississippi National River and Recreation Area Inventory Notes: This association was not identified during plot sampling. It was found later in the project and so is described based on field reconnaissance notes and Accuracy Assessment data. As such, it lacks comprehensive species lists and detailed information on vegetation strata.

In one of the field seasons for this project, 2014, there was extensive high flooding in May and June, in particular. The composition and location of aquatic or emergent wetlands, in particular, were affected in the floodplains of the Minnesota, Mississippi, and Vermillion Rivers. Plant growth was delayed or plants were killed, scouring and deposition of alluvium altered habitat, etc.
Mississippi National River and Recreation Area Plots and Observation Points: No plots in MISS.
Local Description Authors: J. Drake
Global Description Authors: M. Guetersloh, mod. D. Faber-Langendoen
References: Benyus 1989, Chapman et al. 1989, Cowardin et al. 1979, Duncan and Duncan 1988, Eggers and Reed 1987, Faber-Langendoen 2001, Faircloth 1971, Fehrenbacher et al. 1982, Harris et al. 1996, Homoya et al. 1988, Hop et al. 2010c, INAI unpubl. data, Illinois Nature Preserve Commission 1973, MNNHP 1993, Midwestern Ecology Working Group n.d., Minnesota DNR 2005a, Minnesota DNR 2005b, Mitsch and Gosselink 1993, Mohlenbrock 1959, NDNHI unpubl. data, Nelson 1985, Nelson 2010, Niering 1985, ONHD unpubl. data, Rolfsmeier and Steinauer 2010, Schotz pers. comm., Shaw and Fredine 1971, Steinauer and Rolfsmeier 2000, Steinauer and Rolfsmeier 2003, TDNH unpubl. data, TNC 1985, TNC 1995a, TNC 1999b, UNESCO 1973, WNDD unpubl. data, WNHI 2011, WNHI unpubl. data, Wharton 1978, Wharton 1989, White and Madany 1978, Whitley et al. 1990

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Midwest Cattail Deep Marsh

Typha spp. Midwest Herbaceous Vegetation
Cattail species Midwest Herbaceous Vegetation
Identifier: CEGL002233

USNVC CLASSIFICATION

Division	Eastern North American Wet Meadow, Marsh & Shrubland (2.C.4.Nd.)
Macrogroup	Eastern North American Wet Meadow & Marsh (M069)
Group	Eastern North American Freshwater Marsh (G125)
Alliance	Narrowleaf Cattail - Broadleaf Cattail - Bulrush species Deep Marsh Herbaceous Alliance (A1436)
Association	Midwest Cattail Deep Marsh

ELEMENT CONCEPT

Global Summary: This community type is found in deep marshes throughout the midwestern United States and Canada. The vegetation is dominated by relatively pure stands of *Typha* spp., either *Typha latifolia* (broadleaf cattail) or *Typha angustifolia* (narrowleaf cattail) or both. Many associates could occur. This type may simply be a less diverse variation of ~*Typha* spp. - *Schoenoplectus acutus* - Mixed Herbs Midwest Herbaceous Vegetation (CEGL002229)$$, or is a ruderal type resulting from human disturbance to wetlands.

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This emergent wetland was sampled once in the park. It was found in backwater channels and floodplain lakes that are connected to the main rivers only during very high floods. Soils are fine-textured alluvium. Water is present most or all of the growing season and may up to 1 m deep for several weeks but is often shallower.
Global Environment: These wetlands are found in glacial potholes, river valleys, ponds, and on lakeplains. They are characterized by continuous inundation and are considered a deep marsh. Water depth averages 0.3-0.6 m, ranging from several centimeters to more than one meter for a significant part of the growing season.

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: Tall emergent herbaceous species dominate; the most abundant species may be 2-3 m tall on favorable sites. Total vegetation cover is often dense but may be patchy, especially on the deep-water side of stands. *Typha angustifolia* (narrowleaf cattail), *Typha x glauca,* and *Typha latifolia* (broadleaf cattail) are strongly dominant with at least 80% cover. Other emergents include *Lythrum salicaria* (purple loosestrife), *Polygonum amphibium* (water knotweed), *Phalaris arundinacea, Sagittaria latifolia* (broadleaf arrowhead), and *Schoenoplectus fluviatilis* (river bulrush). Floating-leaved species are usually present and can have moderate cover beneath the taller *Typha* spp. (cattail) canopy. *Ceratophyllum demersum* (coon's tail), *Lemna* spp. (duckweed), *Nymphaea odorata* (American white waterlily), and *Spirodela polyrrhiza* (common duckmeat) are all typical floating-leaved components.
Global Vegetation: This deepwater emergent marsh community is dominated by perennial, coarse-leaved graminoid vegetation. Stands may vary from a mosaic of emergents, submergents, and floating-leaved plants interspersed with areas of open water to dense stands of emergents (Harris et al. 1996). They may display substantial areas of open water, but vegetation covers at least 30% of the surface. The vegetation is dominated by relatively pure stands of *Typha* spp., either *Typha latifolia* (broadleaf cattail) or *Typha angustifolia* (narrowleaf cattail) or both. Many associates could occur.

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Typha angustifolia* (narrowleaf cattail), *Typha x glauca, Typha latifolia* (broadleaf cattail)

Global: Information not available.

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Information not available.

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Information not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (3-Oct-1996).

CLASSIFICATION

Status: Standard

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Classification Confidence: 2 - Moderate
Mississippi National River and Recreation Area Comments:
Global Comments: This type extends throughout the eastern forest regions and the tallgrass prairie province, but not further west. It is unclear whether a separate *Typha*-dominated type is needed in addition to the mixed *Typha* - *Scirpus* type (e.g., ~*Typha* spp. - *Schoenoplectus acutus* - Mixed Herbs Midwest Herbaceous Vegetation (CEGL002229)$$), as well as separate *Scirpus*-dominated types (e.g., ~*Schoenoplectus acutus* - *(Schoenoplectus fluviatilis)* Freshwater Herbaceous Vegetation (CEGL002225)$$). Pure *Typha* stands, depending on site conditions, are also perceived as degraded examples of the mixed type. In western Minnesota, where *Typha* spp. form pure stands, the species may be *Typha angustifolia* (narrowleaf cattail) or *Typha x glauca* in culturally disturbed marshes, and *Typha latifolia* (broadleaf cattail) (mixed with other species, especially Carices) in more undisturbed marshes (R. Dana pers. comm. 1999). Elsewhere, *Typha angustifolia* (narrowleaf cattail) is thought to be more typical of undisturbed marshes.
Global Similar Associations:
- *Schoenoplectus acutus* - *(Schoenoplectus fluviatilis)* Freshwater Herbaceous Vegetation (CEGL002225)
- *Typha (angustifolia, latifolia)* - *(Schoenoplectus* spp.) Eastern Herbaceous Vegetation (CEGL006153)
- *Typha latifolia* - *Caltha palustris* Herbaceous Vegetation (CEGL006245)
- *Typha* spp. - *Schoenoplectus acutus* - Mixed Herbs Midwest Herbaceous Vegetation (CEGL002229)
- *Typha* spp. Great Plains Herbaceous Vegetation (CEGL002389)

Global Related Concepts:
- Cattail Marsh (MNNHP 1993) =
- Cattail Mineral Shallow Marsh Type (Lee et al. 1998) <
- Cattail Organic Shallow Marsh Type (Lee et al. 1998) <
- Deep Marsh Cattail Subtype (Faber-Langendoen 2001) =
- Freshwater Marsh (Steinauer and Rolfsmeier 2003) >
- Freshwater Marsh (Nelson 1985) >
- Inland Emergent Marsh (Chapman et al. 1989) >

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This association is found in a few locations throughout the park. It ws found in Coon Rapids Dam Regional Park, Crosby Farm Park, Lillydale Regional Park, Lake Rebecca Park, and Pine Bend Bluff SNA.
Global Range: This community type is found in deep marshes throughout the midwestern United States, from Ohio and Ontario west to North Dakota, south to Kansas, and east to Indiana.
Nations: CA, US
States/Provinces: IA:S5, IL, IN, KS:SU, MI, MN:S5, MO, ND, NE, OH:S5, ON, SD, WI:S4, WY
TNC Ecoregions: 32:C, 35:C, 36:C, 37:C, 38:C, 44:C, 45:C, 46:C, 47:C, 48:C, 49:C
USFS Ecoregions (1994/95): 212Ha:CPP, 212Hb:CPP, 212He:CPP, 212Hh:CPP, 212Hi:CPP, 212Hj:CPP, 212Hk:CPP, 212Hl:CPP, 212Hm:CPP, 212Hn:CPP, 212Ho:CPP, 212Hp:CPP, 212Hq:CPP, 212Hr:CPP, 212Hs:CPP, 212Ht:CPP, 212Hv:CPP, 212Hw:CPP, 212Hx:CPP, 212Hy:CPP, 212Ib:C??, 212Ja:CPP, 212Jb:CPP, 212Jc:CPP, 212Jf:CPP, 212Jj:CPP, 212Jk:CPP, 212Jl:CPP, 212Jm:CPP, 212Jn:CPP, 212Jo:CPP, 212Jr:CPP, 212Ka:CCP, 212Kb:CCC, 212La:CPP, 212Mb:CPP, 212Na:CPP, 212Nb:CPP, 212Nc:CPP, 221Ec:CCC, 221Eg:CCC, 221Fa:CCC, 222Am:CCC, 222Ge:CCC, 222Ha:CCC, 222Jc:CCC, 222Jh:CCC, 222Ji:CCC, 222Jj:CCC, 222Kf:CCC, 222Kg:CCC, 222Mb:CCC, 222Mc:CCC, 222Md:CCC, 222Me:CCC, 251Aa:CCC, 251Ba:CCC, 251Bb:CCC, 251Bd:CCC, 251Be:CCC, 251Cc:CCC, 251Cf:CCC, 251Cg:CCC, 251Dc:CCC, 251Dg:CCC, 251Ea:CCC, 251Ed:CCC, 255Aa:CCC
Federal Lands: NPS (Cuyahoga Valley, Indiana Dunes, Mississippi, Saint Croix, Voyageurs); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Hiawatha, Nicolet, Ottawa?, Superior?)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: HMEM - Mixed Emergent Marsh
Mississippi National River and Recreation Area Inventory Notes: In one of the field seasons for this project, 2014, there was extensive high flooding in May and June, in particular. The composition and location of aquatic or emergent wetlands, in particular, were affected in the floodplains of the Minnesota, Mississippi, and Vermillion Rivers. Plant growth was delayed or plants were killed, scouring and deposition of alluvium altered habitat, etc.
Mississippi National River and Recreation Area Plots and Observation Points: MISS.062
Local Description Authors: J. Drake
Global Description Authors: D. Faber-Langendoen
References: Chapman et al. 1989, Faber-Langendoen 2001, Harris et al. 1996, Homoya et al. 1988, Hop et al. 1999, Hop et al. 2009, INAI unpubl. data, Lauver et al. 1999, Lee et al. 1998, MNNHP 1993, Midwestern Ecology Working Group n.d., Minnesota DNR 2005a, Minnesota DNR 2005b, NDNHI unpubl. data, Nelson 1985, Nelson 2010, ONHD unpubl. data, Rolfsmeier and Steinauer 2010, Steinauer and Rolfsmeier 2003, WNDD unpubl. data, WNHI 2011, WNHI unpubl. data, White and Madany 1978

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G167. Northern & Central Shrub Swamp

Gray Alder Swamp

Alnus incana Swamp Shrubland
Gray Alder Swamp Shrubland
Identifier: CEGL002381

USNVC CLASSIFICATION

Division	Eastern North American Wet Meadow, Marsh & Shrubland (2.C.4.Nd.)
Macrogroup	Eastern North American Wet Meadow & Marsh (M069)
Group	Northern & Central Shrub Swamp (G167)
Alliance	Alder species - Willow species Lakeshore & Depression Shrubland Alliance (A3685)
Association	Gray Alder Swamp

ELEMENT CONCEPT

Global Summary: This alder swamp community is widespread in the midwestern and northeastern United States and southern Canada. Stands occur on shores, edges of beaver meadows in stream floodplains, swales associated with small streams in peatlands, or upland forests. Soils are well-decomposed peat, muck or mineral soils. The hydrology is typically seasonally flooded, with most sites remaining saturated. The vegetation is dominated by tall shrubs, 2-8 m in height, with a moderately open to dense shrub canopy. There is an understory of shorter shrubs and herbaceous species. The density of the understory varies inversely with the tall-shrub canopy. The overstory is usually overwhelmingly dominated by *Alnus incana* (gray alder), but in the more southeastern portions of this type's range, *Alnus serrulata* (hazel alder) can occur with *Alnus incana* (gray alder). Where alder is not as dominant, other shrubs, such as *Cornus sericea* (redosier dogwood), *Ilex verticillata* (common winterberry), *Rubus idaeus* (American red raspberry), *Salix* spp. (willow), *Spiraea alba* (white meadowsweet), *Spiraea tomentosa* (steeplebush), and *Viburnum* spp., can be found. At the southern range limit of this type in West Virginia, shrub layers may by be dominated or codominated by the Central Appalachian endemic *Ilex collina*. The herbaceous layer contains species such as *Symphyotrichum lanceolatum* var. *lanceolatum (= Aster simplex)* (white panicle aster), *Symphyotrichum puniceum (= Aster puniceus)* (purplestem aster), *Calamagrostis canadensis* (bluejoint), *Caltha palustris* (yellow marsh marigold), *Carex lacustris* (hairy sedge), *Carex prairea* (prairie sedge), *Carex trisperma* (threeseeded sedge), *Doellingeria umbellata (= Aster umbellatus)* (parasol whitetop), *Eupatorium maculatum* (spotted joepyeweed), *Glyceria melicaria* (melic mannagrass), *Glyceria striata* (fowl mannagrass), *Impatiens capensis* (jewelweed), *Lycopus uniflorus* (northern bugleweed), *Onoclea sensibilis* (sensitive fern), *Osmunda cinnamomea* (cinnamon fern), *Rubus pubescens* (dwarf red blackberry), *Scirpus atrovirens* (green bulrush), *Symplocarpus foetidus* (skunk cabbage), *Thelypteris palustris* (eastern marsh fern), *Typha* spp. (cattail), and *Viola* spp. (violet). Mosses include *Climacium dendroides* and *Sphagnum* spp. Where the tall-shrub canopy is open, graminoids can become dense. Scattered trees are found in many stands, including *Acer rubrum* (red maple), *Fraxinus nigra* (black ash), and *Thuja occidentalis* (northern white cedar).

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This association was found at one site at the base of the river bluffs where water seepage maintains saturated soil conditions through most or all of the growing season. The site is close to the river and may flood in the spring of many years. The soil is mucky and deep.

Global Environment: Sites are typically along streams, lakeshores, edges of beaver meadows, swales associated with small streams in peatlands or upland forests, or near seeps. Most have little to no slope, but some sites are on moderate slopes. Hydrologic conditions can range from temporarily flooded to seasonally flooded, or even saturated, but are typically seasonally flooded/saturated. The water ranges from non-stagnant, nutrient-rich, and often slightly calcareous (Curtis 1959) to rather stagnant and nutrient-poor where over acidic bedrock or till. Soils are wet, often mucks or peats (Anderson 1982, Chapman et al. 1989). In the upper Midwest, this community is found on Precambrian Shield bedrock that is overlaid with sandy loam soils, which are moderately well-drained and deep (>60 cm). In northeastern Minnesota stands can occur on northeast- and south-facing slopes that are moderate to steep, with slopes ranging from 4 to 45% (Ohmann and Ream 1971). The climate is highly variable, with temperature extremes between -46° and 38°C and 58-91 cm precipitation.

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This association has a variable tall shrub canopy with scattered trees and a moderate herbaceous stratum. Shrubs are 2-5 m tall and range from dense in the center of the stand to scattered on the edges. *Alnus incana* (gray alder) is the only abundant shrub. Scattered trees, mostly *Fraxinus nigra* (black ash), are on the edges of this community. The herbaceous layer underneath the dense shrubs is patchy but on the edges where the shrub cover is lower there is more herbaceous cover. *Carex lacustris* (hairy sedge), *Myosotis laxa* (bay forget-me-not), and *Phalaris arundinacea* (reed canarygrass) are common where shrub cover is moderate to sparse while *Symplocarpus foetidus* (skunk cabbage) is common under the more dense shrub canopy.

Global Vegetation: The vegetation is dominated by tall shrubs, 2-8 m in height, with a moderately open to dense shrub canopy. There is an understory of shorter shrubs and herbaceous species. The density of the understory varies inversely with the tall-shrub canopy. The overstory is usually overwhelmingly dominated by *Alnus incana* (gray alder), but in the more southeastern portions of this type's range, *Alnus serrulata* (hazel alder) can occur with *Alnus incana* (gray alder). Where alder is not as dominant, other shrubs,

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such as *Cornus sericea* (redosier dogwood), *Ilex verticillata* (common winterberry), *Rubus idaeus* (American red raspberry), *Salix* spp. (willow), *Spiraea alba* (white meadowsweet), *Spiraea tomentosa* (steeplebush), and *Viburnum* spp., can be found. The herbaceous layer contains species such as *Symphyotrichum lanceolatum* var. *lanceolatum (= Aster simplex)* (white panicle aster), *Symphyotrichum puniceum (= Aster puniceus)* (purplestem aster), *Calamagrostis canadensis* (bluejoint), *Caltha palustris* (yellow marsh marigold), *Carex lacustris* (hairy sedge), *Carex prairea* (prairie sedge), *Carex trisperma* (threeseeded sedge), *Doellingeria umbellata (= Aster umbellatus)* (parasol whitetop), *Eupatorium maculatum* (spotted joepyeweed), *Impatiens capensis* (jewelweed), *Lycopus uniflorus* (northern bugleweed), *Onoclea sensibilis* (sensitive fern), *Osmunda cinnamomea* (cinnamon fern), *Rubus pubescens* (dwarf red blackberry), *Scirpus atrovirens* (green bulrush), *Symplocarpus foetidus* (skunk cabbage), *Thelypteris palustris* (eastern marsh fern), *Typha* spp. (cattail), and *Viola* spp. Mosses include *Climacium dendroides* and *Sphagnum* spp. Where the tall-shrub canopy is open, the graminoids can become dense. Scattered trees are found in many stands, including *Acer rubrum* (red maple), *Fraxinus nigra* (black ash), and *Thuja occidentalis* (northern white cedar) (Curtis 1959, Anderson 1982, MNNHP 1993, Harris et al. 1996, Sperduto 2000b, Thompson and Sorenson 2000, Gawler 2002). Where stands border on saturated conditions with peaty soils, peatland species such as *Chamaedaphne calyculata* (leatherleaf), *Rhododendron canadense* (rhodora), and *Sphagnum* spp. may be present.

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Alnus incana* (gray alder)
Short shrub/sapling	Broad-leaved deciduous shrub	*Alnus incana* (gray alder)
Herb (field)	Forb	*Symplocarpus foetidus* (skunk cabbage)
Herb (field)	Graminoid	*Carex lacustris* (hairy sedge)

Global

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Alnus incana* (gray alder)

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: *Alnus incana*
Global: *Alnus incana*

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Vulnerable: *Ilex collina* (G3, Southern Blue Ridge endemic), *Polemonium vanbruntiae* (G3G4)

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (23-Jun-2006). This association is widely distributed and considered secure in many states.

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Mississippi National River and Recreation Area Comments:
Global Comments: Type has a very broad distribution, and there may be a need to separate a northern (more boreal) type from a southern (more temperate) type, or perhaps an enriched versus lower-nutrient type, based on floristic differences. Hydrology may be quite variable, ranging from temporarily flooded to semipermanently flooded. In Ohio, this association sometimes merges with *Alnus serrulata* (hazel alder) stands in *~Alnus serrulata* Swamp Shrubland (CEGL005082)$$; that association is distinguished by somewhat more southern associates, including *Rhododendron viscosum, Lindera benzoin* (northern spicebush), *Peltandra virginica* (green arrow arum), etc.. With increasing tree canopy cover, this association can be similar to *Larix laricina* (tamarack) forest types, *Thuja occidentalis* (northern white cedar) saturated forest types, and *Fraxinus nigra - Acer rubrum* saturated forest types.
Global Similar Associations:
- *Alnus incana - Cornus (amomum, sericea) / Clematis virginiana* Shrubland (CEGL006062)
- *Alnus incana* ssp. *rugosa - Nemopanthus mucronatus / Sphagnum* spp. Shrubland (CEGL006158)
- *Alnus serrulata* Swamp Shrubland (CEGL005082)

Global Related Concepts:
- *Alnus incana - Sambucus canadensis* shrub community (Darlington 1943) <
- *Alnus incana - Viburnum cassinoides* shrub community (Darlington 1943) <
- *Alnus incana* ssp. *rugosa* tall shrub thicket (Fortney et al. 2005) =
- *Alnus rugosa* shrub (Walbridge and Lang 1982) =
- *Alnus rugosa* tall shrub community (Walbridge 1982) =
- *Alnus rugosa* tall shrub community (Robinette 1966) =
- *Alnus rugosa* thicket community (Fortney 1975) =
- Alder - Ninebark Wetland (Fike 1999) >
- Alder Mineral Thicket Swamp Type (Lee et al. 1998) <

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- Alder Organic Thicket Swamp Type (Lee et al. 1998) <
- Alder Shrub Swamp (Anderson and Schwegman 1991) =
- Alder Shrub Thicket (Gawler 2002) >
- Alder Swamp (MNNHP 1993) =
- Alder Thicket (Faber-Langendoen 2001) =
- Alder Thicket (Curtis 1959) =
- Thicket Swamp: Speckled Alder / Bluejoint Grass type , W35 (Harris et al. 1996) =

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This very uncommon association was noted at one place, in Ordway Field Station.

Global Range: This alder swamp shrubland is widespread in the midwestern and northeastern United States and southern Canada, ranging from Maine west to Manitoba, south to Iowa, and east to New York and perhaps northern New Jersey.

Nations: CA, US

States/Provinces: IA:S3?, IL, IN?, MA, MB?, ME, MI:S5, MN:S5, ND:S2?, NH:S3S4, NJ?:S2S4, NY, OH, ON, PA, QC:S4S5, VT, WI:S4, WV:S3

TNC Ecoregions: 34:C, 35:C, 46:C, 47:C, 48:C, 60:C, 61:C, 62:C, 63:C, 64:C

USFS Ecoregions (1994/95): 212Cb:CCC, 212Da:CCC, 212Db:CCC, 212Dc:CCC, 212Fc:CCC, 212Ha:CCP, 212Hb:CCP, 212He:CCP, 212Hh:CCP, 212Hi:CCC, 212Hj:CCP, 212Hk:CCP, 212Hl:CCC, 212Hm:CCP, 212Hn:CCP, 212Ho:CCC, 212Hp:CCP, 212Hq:CCC, 212Hr:CCP, 212Hs:CCP, 212Ht:CCC, 212Hv:CCP, 212Hw:CCC, 212Hy:CCP, 212Ia:CCC, 212Ib:CCC, 212Ja:CCP, 212Jb:CCP, 212Jc:CCP, 212Je:CCP, 212Jf:CCC, 212Jj:CCP, 212Jk:CCP, 212Jl:CCP, 212Jm:CCP, 212Jn:CCP, 212Jo:CCP, 212Jr:CCC, 212Ka:CCP, 212Kb:CCC, 212La:CCC, 212Lb:CCC, 212Mb:CPP, 212Na:CCC, 212Nb:CCP, 212Nc:CCC, 221Ae:CCC, 221Ak:CCP, 221Al:CCP, 221Bc:CCC, 222Je:CCC, 222Lb:CCC, 222Lc:CCC, 222Mc:CCC, 222Md:CCC, 222Na:CCC, 251Aa:CCC, 251Ab:CCC, M212Aa:CCC, M212Ac:CCC, M212Ae:CCC, M212Af:CCC, M212B:CC, M212C:CC, M212D:CP

Federal Lands: NPS (Acadia, Apostle Islands, Appalachian Trail [Lower New England], Appalachian Trail [Northern Appalachians], Cuyahoga Valley, Grand Portage, Isle Royale, Mississippi, Pictured Rocks, Saint Croix, Saratoga, Sleeping Bear Dunes, Upper Delaware, Voyageurs); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Huron, Huron-Manistee, Manistee, Nicolet, Ottawa, Superior); USFWS (Aroostook, Assabet River, Carlton Pond, Moosehorn?, Nulhegan Basin, Rachel Carson?)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: N/A

Mississippi National River and Recreation Area Inventory Notes: There were no plots sampled in the project area but this community was observed in one area on the Ordway Field Station. The community is distinct enough that identification was possible without the need of detailed plots.

Mississippi National River and Recreation Area Plots and Observation Points: No plots in MISS.

Local Description Authors: J. Drake

Global Description Authors: D. Faber-Langendoen, mod. S.C. Gawler

References: Anderson 1982, Anderson and Schwegman 1991, Breden et al. 2001, Byers et al. 2007, CDPNQ unpubl. data, Chapman et al. 1989, Curtis 1959, Darlington 1943, DeMeo et al. 1998, Edinger et al. 2002, Edinger et al. 2007, Faber-Langendoen 2001, Fike 1999, Fortney 1975, Fortney et al. 2005, Gawler 2002, Gawler and Cutko 2010, Greenall 1996, Harris et al. 1996, Homoya et al. 1988, Hop et al. 1999, Hop et al. 2010a, Hop et al. 2010b, Hop et al. 2010c, INAI unpubl. data, Kost et al. 2007, Lee et al. 1998, Lubinski et al. 2003, MNNHP 1993, Midwestern Ecology Working Group n.d., Minnesota DNR 2003, Minnesota DNR 2005a, NDNHI unpubl. data, NRCS 2004a, ONHD unpubl. data, Ohmann and Ream 1971, Perles et al. 2008, Rentch unpubl. data 2003, Robinette 1966, Sperduto 2000b, Sperduto and Nichols 2004, Swain and Kearsley 2001, TNC 1999b, Thompson and Sorenson 2000, WNDD unpubl. data, WNHI 2011, WNHI unpubl. data, Walbridge 1982, Walbridge and Lang 1982, White and Madany 1978

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G770. Midwest Wet Prairie & Wet Meadow

North-Central Bluejoint Wet Meadow

Calamagrostis canadensis North-Central Wet Meadow
Bluejoint North-Central Wet Meadow
Identifier: CEGL005449

USNVC CLASSIFICATION

Division	Eastern North American Wet Meadow, Marsh & Shrubland (2.C.4.Nd.)
Macrogroup	Eastern North American Wet Meadow & Marsh (M069)
Group	Midwest Wet Prairie & Wet Meadow (G770)
Alliance	Sedge species - Bluejoint Midwest Wet Meadow Herbaceous Alliance (A4105)
Association	North-Central Bluejoint Wet Meadow

ELEMENT CONCEPT

Global Summary: This wet meadow vegetation is widespread in the midwestern United States. Stands occur on the floodplains of small streams, in poorly drained depressions, beaver meadows, levees and lakeshores. Soils are typically mineral soil or well-decomposed peat, with a thick root mat. Water regime varies between temporarily and seasonally flooded. Graminoid cover is typically dense and can form hummocky microtopography. *Calamagrostis canadensis* (bluejoint) is dominant, often occurring in almost pure stands or with tall sedges, such as *Carex aquatilis* (water sedge), *Carex lacustris* (hairy sedge), and *Carex stricta* (upright sedge). *Agrostis gigantea (= Agrostis alba)* (redtop), *Glyceria grandis* (American mannagrass), *Poa palustris* (fowl bluegrass), *Poa compressa* (Canada bluegrass), *Scirpus cyperinus* (woolgrass), and *Typha latifolia* (broadleaf cattail) are sometimes abundant. Forbs include *Campanula aparinoides* (marsh bellflower), *Epilobium leptophyllum* (bog willowherb), *Eupatorium maculatum* (spotted joepyeweed), *Eupatorium perfoliatum* (common boneset), *Impatiens capensis* (jewelweed), *Iris versicolor* (harlequin blueflag), *Polygonum amphibium* (water knotweed), and *Comarum palustre (= Potentilla palustris)* (purple marshlocks). Scattered shrubs, such as *Viburnum nudum* (possumhaw), *Viburnum dentatum* (southern arrowwood), *Spiraea alba* (white meadowsweet), *Cornus amomum* (silky dogwood), or *Alnus serrulata* (hazel alder), may be present. *Phalaris arundinacea* (reed canarygrass) and/or *Lythrum salicaria* (purple loosestrife) may be present, especially in disturbed examples.

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This association was found on the periphery of a lake in the floodplain of the Mississippi River. The area was also near the base of the river bluffs and may receive groundwater seepage during the year. The site had wet soil and is probably saturated for significant parts of the growing season in most year. It may be flooded briefly by a rise in the level of the lake most years but is not likely flooded by the main river except in high flood stages. The unvegetated surface had abundant litter and some bare ground but no open water.
Global Environment: Stands occur on the floodplains of small streams, in poorly drained depressions, beaver meadows, levees and lakeshores. Soils are typically mineral soil or well-decomposed peat or peat silt loam with a thick root mat. Water regime varies between temporarily and seasonally flooded.

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This community had a dense herbaceous stratum approximately 1 m tall. There was no single dominant but several common species including *Asclepias* spp., *Carex lacustris* (hairy sedge), *Eupatorium* spp. (joepyeweed), *Poa palustris* (fowl bluegrass), *Spartina pectinata* (prairie cordgrass), and *Typha latifolia* (broadleaf cattail) were present.
Global Vegetation: Graminoid cover is typically dense and can form hummocky microtopography. *Calamagrostis canadensis* (bluejoint) is dominant, often occurring in almost pure stands or with tall sedges, such as *Carex aquatilis* (water sedge), *Carex lacustris* (hairy sedge), and *Carex stricta* (upright sedge). *Agrostis gigantea (= Agrostis alba)* (redtop), *Glyceria grandis* (American mannagrass), *Poa palustris* (fowl bluegrass), *Poa compressa* (Canada bluegrass), *Scirpus cyperinus* (woolgrass), and *Typha latifolia* (broadleaf cattail) are sometimes abundant. Forbs include *Campanula aparinoides* (marsh bellflower), *Epilobium leptophyllum* (bog willowherb), *Eupatorium maculatum* (spotted joepyeweed), *Eupatorium perfoliatum* (common boneset), *Iris versicolor* (harlequin blueflag), *Polygonum amphibium* (water knotweed), and *Comarum palustre (= Potentilla palustris)* (purple marshlocks). Scattered shrubs, such as *Viburnum nudum* (possumhaw), *Viburnum dentatum* (southern arrowwood), *Spiraea alba* (white meadowsweet), or *Cornus amomum* (silky dogwood) may be present. *Lythrum salicaria* (purple loosestrife) may be present, especially in disturbed examples.

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MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area: Information not available.

Global

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Calamagrostis canadensis* (bluejoint)

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: *Calamagrostis canadensis*

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Information not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G4G5 (5-Jul-2013). This type is common in the north-central parts of the midwestern United States.

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Mississippi National River and Recreation Area Comments: This herbaceous wetland had no plots in the park and was identified based on one field observation for a small site in Cherokee Regional Park near Pickerel Lake. The attribution of this association to MISS and the characterization of the community within the park is thus somewhat shaky.
Global Comments: This type can grade into sedge meadows. A guideline of <50% sedges may be suggested as a criterion for the definition of this type compared to sedge meadow types. Harris et al. (1996) suggest that the bluejoint meadow type is drier than sedge meadows and less peaty than shore fens.
Global Similar Associations:
- *Calamagrostis canadensis - Carex* spp. Laurentian & Northeast Wet Meadow (CEGL005448)
- *Calamagrostis canadensis - Doellingeria umbellata - Spartina pectinata* Herbaceous Vegetation (CEGL006427)
- *Calamagrostis canadensis - Scirpus* spp. - *Dulichium arundinaceum* Herbaceous Vegetation (CEGL006519)
- *Carex stricta - Carex* spp. Herbaceous Vegetation (CEGL002258) Dominance of sedges versus grasses is much higher.
- *Carex utriculata - Carex lacustris - (Carex vesicaria, Carex stricta)* Herbaceous Vegetation (CEGL002257)
- *Phalaris arundinacea* Eastern Ruderal Herbaceous Vegetation (CEGL006044)
- *Phalaris arundinacea* Western Herbaceous Vegetation (CEGL001474)
- *Phleum pratense - (Calamagrostis canadensis)* Ruderal Herbaceous Vegetation (CEGL005249)

Global Related Concepts:
- Bluejoint Meadow (Faber-Langendoen 2001) **>**
- Palustrine Persistent Emergent Wetland (PEM1) (Cowardin et al. 1979) **?**

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This association was found in one place, on the southwestern edge of Pickerel Lake in Lillydale Regional Park.
Global Range: This wet meadow vegetation is common in the north-central parts of the midwestern United States.
Nations: CA?, US
States/Provinces: MB?, MN, ON?, QC?, WI
TNC Ecoregions: 45:C, 46:C, 48:C
USFS Ecoregions (1994/95): 222M:CC
Federal Lands: NPS (Mississippi, Saint Croix?)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: HBWM - North-Central Bluejoint Wet Meadow
Mississippi National River and Recreation Area Inventory Notes: This association was not identified during plot sampling. It was found later in the project and so is described based on field reconnaissance notes and Accuracy Assessment data. As such, it lacks comprehensive species lists and detailed information on vegetation strata.

In one of the field seasons for this project, 2014, there was extensive high flooding in May and June, in particular. The composition and location of aquatic or emergent wetlands, in particular, were affected in the floodplains of the Minnesota, Mississippi, and Vermillion Rivers. Plant growth was delayed or plants were killed, scouring and deposition of alluvium altered habitat, etc.
Mississippi National River and Recreation Area Plots and Observation Points: No plots in MISS.
Local Description Authors: J. Drake

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Global Description Authors: D. Faber-Langendoen
References: CDPNQ unpubl. data, Cowardin et al. 1979, Eastern Ecology Working Group n.d., Faber-Langendoen 2001, Harris et al. 1996, Midwestern Ecology Working Group n.d., Minnesota DNR 2005a, WNHI 2011, WNHI unpubl. data

Lake Sedge Wet Meadow

Carex lacustris Herbaceous Vegetation
Lake Sedge Herbaceous Vegetation
Identifier: CEGL002256

USNVC CLASSIFICATION

Division	Eastern North American Wet Meadow, Marsh & Shrubland (2.C.4.Nd.)
Macrogroup	Eastern North American Wet Meadow & Marsh (M069)
Group	Midwest Wet Prairie & Wet Meadow (G770)
Alliance	Sedge species - Bluejoint Midwest Wet Meadow Herbaceous Alliance (A4105)
Association	Lake Sedge Wet Meadow

ELEMENT CONCEPT

Global Summary: This broad-leaved wet sedge meadow type occurs in the upper central midwestern region of the United States. Stands occur on floodplains, shallow bays of lakes and streams, and upland depressions. Soils are mineral or well-decomposed peat. Flooding is variable but typically is seasonal. The vegetation is dominated by tall sedges. Shrubs may have up to 25% cover. *Carex lacustris* (hairy sedge) forms almost mono-dominant stands. Occasionally other emergents, such as *Typha latifolia* (broadleaf cattail) or *Sagittaria* spp. (arrowhead), may codominate. In Wisconsin this type is common in the northwest, where it typically intermingles with tall shrubs, especially *Salix* spp. (e.g., *Salix petiolaris* (meadow willow)). Common herbaceous associates at low cover include *Doellingeria umbellata (= Aster umbellatus)* (parasol whitetop), *Calamagrostis canadensis* (bluejoint), *Carex stricta* (upright sedge), *Solidago canadensis* (Canada goldenrod), *Polygonum sagittatum* (arrowleaf tearthumb), *Verbena hastata* (swamp verbena), *Impatiens capensis* (jewelweed), *Eupatorium maculatum* (spotted joepyeweed), and *Muhlenbergia glomerata* (spiked muhly).

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This shallow herbaceous wetland was found in shallow basins on the floodplains of the Mississippi, Vermillion, and Minnesota Rivers. These basins were separated from the main river channels by natural levees and floodplain forests. Soils were fine-textured and contained noticeable decomposed organic matter. Sites were saturated through most or all of the growing season and were likely flooded for parts of most years. Bare soil made up most of the unvegetated ground surface (avg. 60%) with some plant litter present (avg. 22%),
Global Environment: Stands occur on floodplains, shallow bays of lakes and streams, and upland depressions. Soils are mineral or well-decomposed peat. Flooding is variable but typically is seasonal.

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This vegetation type is dominated by tall or medium-tall (1-2 m), coarse-leaved herbaceous species. Trees are absent or nearly so but shrubs 1-3 m tall can have up to 30% cover. *Carex lacustris* (hairy sedge) is the most common species and dominates many stands. *Acorus americanus* (sweetflag), *Polygonum amphibium* (water knotweed), *Sagittaria latifolia* (broadleaf arrowhead), *Schoenoplectus fluviatilis* (river bulrush), and *Typha latifolia* (broadleaf cattail) are common and can be abundant. The exotic grasses *Phalaris arundinacea* (reed canarygrass) and *Phragmites australis* (common reed) can be dominant in degraded examples. *Sicyos angulatus* (oneseed bur cucumber) can be abundant, particularly late in the growing season. Other herbaceous species that may be present are *Amaranthus tuberculatus* (roughfruit amaranth), *Bidens* spp. (beggarticks), *Leersia oryzoides* (rice cutgrass), *Stachys tenuifolia* (smooth hedgenettle), and *Vernonia fasciculata* (prairie ironweed). Floating-leaved species may be present on wetter sites. *Amorpha fruticosa* (desert false indigo), *Cornus sericea* (redosier dogwood), and *Salix interior* (sandbar willow) are typical shrubs.
Global Vegetation: The vegetation is dominated by tall sedges. Shrubs may have up to 25% cover. *Carex lacustris* (hairy sedge) forms almost mono-dominant stands. Occasionally other emergents, such as *Typha latifolia* (broadleaf cattail) or *Sagittaria* spp. (arrowhead), may codominate. In Wisconsin this type is common in the northwest, where it typically intermingles with tall shrubs, especially *Salix* spp. (e.g., *Salix petiolaris* (meadow willow)). Common herbaceous associates at low cover include *Doellingeria umbellata (= Aster umbellatus)* (parasol whitetop), *Calamagrostis canadensis* (bluejoint), *Carex stricta* (upright sedge), *Solidago canadensis* (Canada goldenrod), *Polygonum sagittatum* (arrowleaf tearthumb), *Verbena hastata* (swamp verbena), *Impatiens capensis* (jewelweed), *Eupatorium maculatum* (spotted joepyeweed), and *Muhlenbergia glomerata* (spiked muhly) (E. Epstein pers. comm. 1999).

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MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Carex lacustris* (hairy sedge)

Global

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Carex lacustris* (hairy sedge)

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: *Carex lacustris*
Global: *Carex lacustris*

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Vulnerable: *Polemonium vanbruntiae* (G3G4)

CONSERVATION STATUS RANK

Global Rank & Reasons: G4G5 (3-Oct-1996).

CLASSIFICATION

Status: Standard
Classification Confidence: 3 - Weak
Mississippi National River and Recreation Area Comments: This association can have as little as 25% *Carex* spp. cover at MISS. The floristic composition can be variable between years if large changes in the hydrology of these sites occur (droughts or floods).
Global Comments: Further characterization of this type is needed to determine whether it is a good type. Currently, it is more or less excluded from the Great Plains, western tallgrass prairie region, but otherwise eastward across the Laurentian region, and into the north-central parts of the East. As such, it blurs the traditional distinction in the Great Lakes between northern sedge meadows and southern or prairie sedge meadows. Possibly, northern parts of the range should be removed and treated with *~Carex utriculata - Carex lacustris - (Carex vesicaria, Carex stricta)* Herbaceous Vegetation (CEGL002257)$$. It may represent a mono-dominant variant of a more broadly defined mixed broad-leaved sedge type (e.g., Bakowsky and Lee 1996). *Carex stricta* (upright sedge), by contrast, is a narrow-leaved sedge. Apparently in Ohio, stands can be very large, especially in northeastern Ohio. *Carex hyalinolepis* (shoreline sedge) can also occur over large areas in Ohio (Greg Schneider pers. comm. 1996). Charles Umbanhowar should be consulted for examples of this type in southeastern Minnesota.
Global Similar Associations:
- *Carex stricta - Carex* spp. Herbaceous Vegetation (CEGL002258) a narrow-leaved sedge type.
- *Carex utriculata - Carex lacustris - (Carex vesicaria, Carex stricta)* Herbaceous Vegetation (CEGL002257) a more northern coarse-sedge type.

Global Related Concepts:
- Sedge Meadow Lake Sedge Subtype (Faber-Langendoen 2001) =
- Wet Meadow (MNNHP 1993) >

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This association was found in three areas in the park. It was found in one small stand near Pickerel Lake and in two areas of Gore's Pool WMA.
Global Range: This broad-leaved wet sedge meadow type occurs in the north-central region of the United States, extending into Manitoba, Canada.
Nations: CA, US
States/Provinces: IA:SU, IL, IN, MB:SU, MN, OH, WI
TNC Ecoregions: 35:C, 46:C, 47:C, 48:C, 59:C, 61:C
USFS Ecoregions (1994/95): 212Hb:CPP, 212Ja:CPP, 212Jb:CP?, 212Jc:CP?, 212Je:CP?, 212Jf:CPP, 212Jj:CP?, 212Jk:CP?, 212Jl:CPP, 212Jm:CPP, 212Ka:CCP, 212Kb:CCC, 212Mb:CPP, 212Na:CCC, 212Nb:CCP, 212Nc:CCC, 221Aa:CCP, 221Ai:CCC, 221Bc:CCC, 222Jg:CCC, 222Ke:CCC, 222Kf:CCC, 222Lc:CCC, 222Lf:CCC, 222Mb:CCC, 222Mc:CCC, 222Md:CCC, 222Me:CCC, 222Na:CCC, 251Aa:CCC
Federal Lands: NPS (Cuyahoga Valley, Minute Man, Mississippi, Saratoga); USFS (Chippewa, Monongahela); USFWS (Canaan Valley)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: HSWM - Sedge Wet Meadow
Mississippi National River and Recreation Area Inventory Notes: In one of the field seasons for this project, 2014, there was extensive high flooding in May and June, in particular. The composition and location of aquatic or emergent wetlands, in particular,

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were affected in the floodplains of the Minnesota, Mississippi, and Vermillion Rivers. Plant growth was delayed or plants were killed, scouring and deposition of alluvium altered habitat, etc.
Mississippi National River and Recreation Area Plots and Observation Points: MISS.127, MISS.128
Local Description Authors: J. Drake
Global Description Authors: D. Faber-Langendoen, mod. S.C. Gawler
References: Bakowsky and Lee 1996, Epstein pers. comm., Faber-Langendoen 2001, Greenall 1996, Homoya et al. 1988, INAI unpubl. data, MNNHP 1993, Midwestern Ecology Working Group n.d., Minnesota DNR 2005a, ONHD unpubl. data, WNHI 2011, WNHI unpubl. data, White and Madany 1978

Upright Sedge Wet Meadow

Carex stricta - *Carex* spp. Herbaceous Vegetation
Upright Sedge - Sedge species Herbaceous Vegetation
Identifier: CEGL002258

USNVC CLASSIFICATION

Division	Eastern North American Wet Meadow, Marsh & Shrubland (2.C.4.Nd.)
Macrogroup	Eastern North American Wet Meadow & Marsh (M069)
Group	Midwest Wet Prairie & Wet Meadow (G770)
Alliance	Sedge species - Bluejoint Midwest Wet Meadow Herbaceous Alliance (A4105)
Association	Upright Sedge Wet Meadow

ELEMENT CONCEPT

Global Summary: This wet sedge meadow community is found in the southern Great Lakes region and parts of the central midwestern United States. Sites occur in stream valleys, along lake margins, and in depressions and channels in glacial outwash. Soils include wet mineral soils, muck, or shallow peat (<0.5 m), with the water table below the surface for most of the growing season. The vegetation is dominated by sedges and grasses, but the shrub component can be high as 25%. Dominant plants include *Calamagrostis canadensis* (bluejoint) and *Carex stricta* (upright sedge). Associated graminoids include *Carex aquatilis* (water sedge), *Carex pellita (= Carex lanuginosa)* (woolly sedge), *Carex bebbii* (Bebb's sedge), *Carex lacustris* (hairy sedge), *Eleocharis* spp. (spikerush), *Juncus* spp. (rush), *Phalaris arundinacea* (reed canarygrass) (common in more degraded examples), and *Typha latifolia* (broadleaf cattail). Typical forbs include *Anemone canadensis* (Canadian anemone), *Asclepias incarnata* (swamp milkweed), *Symphyotrichum lanceolatum* var. *lanceolatum (= Aster simplex)* (white panicle aster), *Equisetum arvense* (field horsetail), *Eupatorium maculatum* (spotted joepyeweed), *Eupatorium perfoliatum* (common boneset), *Iris versicolor* (harlequin blueflag), *Lycopus americanus* (American water horehound), and *Solidago canadensis* (Canada goldenrod).

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This herbaceous wetland occurs on soil that is saturated for most or all of the growing season and may be flooded for brief periods in some years. The soil was fine-textured alluvium with noticeable decomposed organic matter. The site is near a floodplain lake but may also receive sub-surface seepage from the base of nearby river bluffs. The unvegetated surface was 30% plant litter and 35% bare soil.
Global Environment: Sites occur in stream valleys, along lake margins, and in depressions and channels in glacial outwash. Soils include wet mineral soils, muck, or shallow peat (<0.5 m), with the water table below the surface for most of the growing season (Chapman et al. 1989, MNNHP 1993).

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: Medium-tall (0.5-1 m) sedges dominate the nearly continuous herbaceous stratum in this community. *Carex stricta* (upright sedge) is the dominant species with *Carex lacustris* (hairy sedge), *Phragmites australis* (common reed), and *Typha latifolia* (broadleaf cattail) as associated graminoids. Several forbs occur in this community that were noted only here or in one other plot in the park. These were *Epilobium leptophyllum* (bog willowherb), *Eupatorium maculatum* (spotted joepyeweed), *Eupatorium perfoliatum* (common boneset), *Lathyrus palustris, Lysimachia thyrsiflora,* and *Thelypteris palustris* (eastern marsh fern).
Global Vegetation: The vegetation is dominated by sedges and grasses, but the shrub component can be high as 25%. Dominant plants include *Calamagrostis canadensis* (bluejoint) and *Carex stricta* (upright sedge). Associated graminoids include *Carex aquatilis* (water sedge), *Carex pellita (= Carex lanuginosa)* (woolly sedge), *Carex bebbii* (Bebb's sedge), *Carex lacustris* (hairy sedge), *Eleocharis* spp. (spikerush), *Juncus* spp. (rush), *Phalaris arundinacea* (reed canarygrass) (common in more degraded examples), and *Typha latifolia* (broadleaf cattail). Typical forbs include *Anemone canadensis* (Canadian anemone), *Asclepias incarnata* (swamp milkweed), *Symphyotrichum lanceolatum* var. *lanceolatum (= Aster simplex)* (white panicle aster), *Equisetum arvense* (field horsetail), *Eupatorium maculatum* (spotted joepyeweed), *Eupatorium perfoliatum* (common boneset), *Iris versicolor* (harlequin blueflag), *Lycopus americanus* (American water horehound), and *Solidago canadensis* (Canada goldenrod) (Curtis 1959, Chapman et al. 1989, MNNHP 1993).

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MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Carex stricta* (upright sedge)

Global: Information not available.

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: *Carex stricta*
Global: Information not available.

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Other Plants: *Eleocharis wolfii* (G3G5)

CONSERVATION STATUS RANK

Global Rank & Reasons: G4? (3-Oct-1996).

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Mississippi National River and Recreation Area Comments: The site classified to this community has some fen indicators but it was judged not enough to place this is a fen community. The species present were marginal and the larger area around this site is heavily dominated by *Phragmites australis* (common reed)*, Phalaris arundinacea* (reed canarygrass), and *Lythrum salicaria* (purple loosestrife), among other invasive species. It is possible this is a fen site but that it is very degraded, possibly due to alterations in the hydrology, invasion by exotic species, or both.
Global Comments: This type may have some fen characteristics, but stands dominated by *Carex stricta* (upright sedge) with fen associates are better placed in *~Carex stricta - Valeriana edulis - Parnassia palustris* Herbaceous Vegetation (CEGL005241)$$, whose concept is strongly based on northeastern Iowa stands (Leoschke and Pearson 1987). The northern limits of this type are not clear with respect to *~Carex utriculata - Carex lacustris - (Carex vesicaria, Carex stricta)* Herbaceous Vegetation (CEGL002257)$$. Wet meadow stands in the northern parts of Michigan, Wisconsin, and Minnesota are usually placed in CEGL002257, and, although they are more typically dominated by coarse sedges (*Carex rostratae* (beaked sedge)*, Carex lacustris* (hairy sedge)*, Carex vesicaria* (blister sedge)), they can occasionally have dominance by *Carex stricta* (upright sedge)) (Harris et al. 1996, W12). As a result ecoregion distribution of this type needs review. Ontario stands may have some *Carex lasiocarpa* (woollyfruit sedge) in this type.
Global Similar Associations:
- *Calamagrostis canadensis - Carex* spp. Laurentian & Northeast Wet Meadow (CEGL005448)
- *Calamagrostis canadensis* North-Central Wet Meadow (CEGL005449)
- *Carex lacustris* Herbaceous Vegetation (CEGL002256)
- *Carex* spp. - *(Carex pellita, Carex vulpinoidea)* Herbaceous Vegetation (CEGL005272)
- *Carex stricta - Carex vesicaria* Herbaceous Vegetation (CEGL006412)
- *Carex stricta - Valeriana edulis - Parnassia palustris* Herbaceous Vegetation (CEGL005241) This is the fen equivalent of the sedge meadow type.
- *Carex utriculata - Carex lacustris - (Carex vesicaria, Carex stricta)* Herbaceous Vegetation (CEGL002257) This types is typically dominated by coarse sedges, but occasionally by *Carex stricta*.
- *Chamaedaphne calyculata / Carex oligosperma / Sphagnum* spp. Dwarf-shrubland (CEGL005091)
- *Cornus sericea - Salix (bebbiana, discolor, petiolaris) / Calamagrostis stricta* Shrubland (CEGL002187)

Global Related Concepts:
- Narrow-leaved Sedge Mineral Meadow Marsh Type (Lee et al. 1998) <
- Narrow-leaved Sedge Mineral Shallow Marsh Type (Lee et al. 1998) <
- Sedge Meadow Tussock Sedge Subtype (Faber-Langendoen 2001) =
- Wet Meadow (MNNHP 1993) >

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This association was found in only one small stand near Gun Club Lake in Fort Snelling State Park.
Global Range: This wet sedge meadow community is found in the southern Great Lakes region of the United States and Canada, and parts of the central Midwest, ranging from Indiana and Ontario, west to Minnesota and Iowa.
Nations: CA, US
States/Provinces: IA:S3, IL:S2, IN, MI:S3, MN, ND:S2S3, ON, WI:S3
TNC Ecoregions: 26:C, 35:C, 36:C, 45:C, 46:C, 47:C, 48:C

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USFS Ecoregions (1994/95): 212Hb:CCC, 212Hl:CCC, 212Hm:CCP, 212Hn:CCP, 212Ho:CCC, 212Hp:CCP, 212Hq:CCP, 212Hr:CCP, 212Ht:CCP, 212Hv:CCC, 212Hw:CCC, 212Hx:CCP, 212Hy:CCC, 212Ib:CPP, 212Ja:CCP, 212Jb:CC?, 212Jc:CCP, 212Je:CCP, 212Jf:CCC, 212Jj:CCP, 212Jk:CCC, 212Jl:CCP, 212Jm:CCC, 212Ka:CPP, 212Mb:CPP, 212Na:CPP, 212Nb:CPP, 212Nc:CPP, 222Ha:CPP, 222Hb:CPP, 222Ja:CCP, 222Jb:CCC, 222Jg:CCC, 222Jh:CCC, 222Ji:CCC, 222Jj:CCC, 222Ka:CCC, 222Kb:CCC, 222Kd:CCC, 222Ke:CCC, 222Kf:CCC, 222Kg:CCC, 222Kh:CCC, 222Ki:CCC, 222Kj:CCC, 222Lb:CCC, 222Lc:CCC, 222Le:CCC, 222Lf:CCC, 222Me:CCC, 251Aa:CCC, 251Ab:CCC, 251Bb:CCC, 251Bd:CCC, 251Ca:CCC, 251Cc:CCC, 251Cf:CCC, 251Ch:CCC, 251Dc:CCC, 251Dd:CCP, 251Dg:CCC, 251Dh:CCP
Federal Lands: NPS (Indiana Dunes, Mississippi, Saint Croix, Sleeping Bear Dunes); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Huron, Huron-Manistee, Manistee, Nicolet)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: HSWM - Sedge Wet Meadow
Mississippi National River and Recreation Area Inventory Notes: This community is known from one site in Fort Snelling State Park near Gun Club Lake. The area likely gets some seepage from the nearby bluffs but is also connected hydrologically to Gun Club Lake and, during very high floods, such as in 2014, to the Minnesota River. The Minnesota DNR mapped this area as Calcareous Fen (Southeastern) in the mid 1990s but it is currently strongly dominated by *Phragmites australis* (common reed)*, Phalaris arundinacea* (reed canarygrass), and other weedy species with patches of native vegetation remaining, including the site where this was mapped.

In one of the field seasons for this project, 2014, there was extensive high flooding in May and June, in particular. The composition and location of aquatic or emergent wetlands, in particular, were affected in the floodplains of the Minnesota, Mississippi, and Vermillion Rivers. Plant growth was delayed or plants were killed, scouring and deposition of alluvium altered habitat, etc.
Mississippi National River and Recreation Area Plots and Observation Points: MISS.082
Local Description Authors: J. Drake
Global Description Authors: D. Faber-Langendoen
References: CDPNQ unpubl. data, Chapman et al. 1989, Curtis 1959, Faber-Langendoen 2001, Harris et al. 1996, Homoya et al. 1988, Hop et al. 2009, INAI unpubl. data, Kost et al. 2007, Lee et al. 1998, Leoschke and Pearson 1987, MNNHP 1993, Midwestern Ecology Working Group n.d., Minnesota DNR 2005a, NDNHI unpubl. data, WNHI 2011, WNHI unpubl. data, White and Madany 1978

M880. Eastern North American Wet Shoreline Vegetation

G755. Central Riverine Wetland Vegetation

Sandbar Willow Shrubland

Salix interior Temporarily Flooded Shrubland
Sandbar Willow Temporarily Flooded Shrubland
Identifier: CEGL008562

USNVC CLASSIFICATION

Division	Eastern North American Wet Meadow, Marsh & Shrubland (2.C.4.Nd.)
Macrogroup	Eastern North American Wet Shoreline Vegetation (M880)
Group	Central Riverine Wetland Vegetation (G755)
Alliance	Sandbar Willow Riverwash Shrubland Alliance (A3646)
Association	Sandbar Willow Shrubland

ELEMENT CONCEPT

Global Summary: This willow shrubland community is found scattered along rivers and streams at lower elevations in parts of the midwestern United States, the Mississippi River Alluvial Plain, and the Appalachians. This type represents an early-successional stage of temporarily flooded riparian vegetation that occurs most commonly on alluvial sands. The substrate may also contain silts, clays, and/or gravels. The canopy is dominated by *Salix interior* (sandbar willow), which can form dense stands up to 4 m tall. There are often areas where the shrub layer is absent. Seedlings and small saplings of *Populus deltoides* (eastern cottonwood) or *Platanus occidentalis* (American sycamore) may be present. The herbaceous cover is sparse to moderate, but rarely exceeds 30%. Species present include *Polygonum lapathifolium* (longroot smartweed)*, Eupatorium* spp. (joepyeweed), *Schoenoplectus americanus (= Scirpus americanus)* (chairmaker's bulrush), and *Xanthium strumarium* (rough cocklebur). The composition of this community, especially the herbaceous layer, varies from year to year with succession or renewed disturbance.

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This wetland shrubland was found on sites that are flooded briefly in most growing seasons but are not flooded or saturated for extended periods. Many examples are along the main channels of the Mississippi River but it can occur on floodplain lakes and old channels not connected to the main river except in high floods. Soils are alluvial and mostly sandy and well drained. The unvegetated surface is 41% bare soil, 15% sand, and 3% downed wood.

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Global Environment: This community is found on recently deposited or disturbed alluvial material. The parent material is alluvial sand, although silt, clay, or gravel may be present. Soil development is poor to absent.

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This association is characterized by a moderate to dense canopy (avg. (66%) of tall shrubs, the tallest often 3-5 m tall and sometimes up to 8 m, with a sparse to moderate herbaceous stratum (avg. 26%) and trees absent or scattered (avg. 8%). *Salix interior* (sandbar willow) is the most abundant species and often forms nearly a monotypic shrub canopy. *Salix nigra* (black willow) and *Populus deltoides* (eastern cottonwood) can form a very sparse canopy over the shrubs or be mixed with them as sapling and seedlings, along with *Acer saccharinum* (silver maple) or other *Salix* spp. (willow) trees. *Amorpha fruticosa* (desert false indigo), *Cornus sericea* (redosier dogwood) and *Salix eriocephala* (Missouri River willow) can occasionally be present. Due to the growth form of the dominant shrubs and small trees, enough light penetrates to the ground to allow a significant herbaceous layer to develop unless the shrubs are very dense. Where the shrub cover is moderate or open (<50%), the herbaceous stratum can be dense. Many species are found in the herbaceous stratum, among the more common are *Calystegia sepium* (hedge false bindweed), *Carex lacustris* (hairy sedge), *Equisetum hyemale* (scouringrush horsetail), *Laportea canadensis* (Canadian woodnettle), *Leersia oryzoides* (rice cutgrass), *Lythrum salicaria* (purple loosestrife), *Phalaris arundinacea* (reed canarygrass), *Phragmites australis* (common reed), *Polygonum* spp. (knotweed), *Sagittaria latifolia* (broadleaf arrowhead), *Schoenoplectus fluviatilis* (river bulrush), *Sicyos angulatus* (oneseed bur cucumber), *Stachys tenuifolia* (smooth hedgenettle), and *Symphyotrichum lanceolatum* (white panicle aster).

Global Vegetation: This community is dominated by shrubs, generally between 2 and 4 m tall. The most abundant of these is *Salix interior* (sandbar willow). Saplings of *Populus deltoides* (eastern cottonwood) or *Platanus occidentalis* (American sycamore) are also frequently found in the shrub layer. This stratum can have moderate to high stem density in overall composition of the community. The species in the shrub layer do not form a closed canopy, this allows significant light to reach the ground layer. Patches are also frequently found where the shrub layer is absent. The herbaceous cover is sparse to moderate, but rarely exceeds 30%. Older stands and places with less competition from the shrubs may have greater herbaceous cover. The composition of the herbaceous layer can vary greatly; species that are often found in this community include *Polygonum lapathifolium* (longroot smartweed), *Eupatorium* spp. (joepyeweed), *Schoenoplectus americanus (= Scirpus americanus)* (chairmaker's bulrush), and *Xanthium strumarium* (rough cocklebur).

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Salix interior* (sandbar willow)
Short shrub/sapling	Broad-leaved deciduous shrub	*Salix interior* (sandbar willow)

Global: Information not available.

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: *Salix interior*
Global: Information not available.

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Information not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G4G5 (30-Sep-2001). This type is moderately widespread and common throughout its range.

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Mississippi National River and Recreation Area Comments:
Global Comments: This type represents an earlier-seral stage of temporarily flooded riparian alluvial shrubland.
Global Similar Associations:
- *Salix exigua* Temporarily Flooded Shrubland (CEGL001197) is a related type from further west dominated by a different nominal *Salix* species.
- *Salix interior* - *Salix eriocephala* Sandbar Shrubland (CEGL005078) of the Great Lakes States/Provinces.

Global Related Concepts:
- *Salix exigua* Temporarily Flooded Shrubland (Kittel and Lederer 1993) =
- Gravel Bar Type (Dale and Kuroda 1979) ><
- P4B3cI2a. *Salix exigua* (Foti et al. 1994) =
- Sandbar Willow Shrubland (Steinauer and Rolfsmeier 2003) >

OTHER COMMENTS

Other Comments:

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ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This association was found in many places where the floodplain was broad and well developed. It occurred along the edge of channels and some floodplain lakes on the Minnesota River and on the Mississippi River from the confluence of those two rivers to the southern end of the project area.

Global Range: This sandbar willow shrubland community is found along rivers and streams at lower elevations in parts of the midwestern United States and parts of the Appalachians, ranging sporadically from South Dakota, Nebraska, Iowa, and Illinois south to Oklahoma and Arkansas, and northeast at least to Kentucky. The species ranges north into Canada (Kartesz 1999), but there is no information indicating that it forms stands worthy of recognition as a community anywhere northeast of Kentucky.

Nations: US

States/Provinces: AR, IA, KY?, MN, NE, OK, TN?, WI?

TNC Ecoregions: 26:C, 27:C, 32:?, 33:?, 35:C, 36:C, 37:C, 38:C, 39:C, 40:P, 42:C, 46:C, 47:C

USFS Ecoregions (1994/95): 222An:CCP, 222L:CC, 222M:CC, 231G:CC, 234A:CC, 251Aa:CCC, 251B:CP, 251C:CC, 251D:CC, 251E:CC, 251F:CP, 311A:??, 315C:??, 315D:??, 331B:PP, 331C:PP, 331F:PP, 331G:P?, 331H:P?, 331I:P?, 331J:P?, 332C:??, 332E:??, M222Aa:PPP

Federal Lands: NPS (Effigy Mounds, Mississippi, Saint Croix)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: SWSB - Sandbar Willow Shrubland

Mississippi National River and Recreation Area Inventory Notes:

Mississippi National River and Recreation Area Plots and Observation Points: MISS.077, MISS.080, MISS.090, MISS.097, MISS.111, MISS.119

Local Description Authors: J. Drake

Global Description Authors: M. Pyne

References: Bellah and Hulbert 1974, Dale and Kuroda 1979, Foti et al. 1994, Hansen et al. 1989, Hansen et al. 1995, Hoagland 2000, Hop et al. 2005, Kartesz 1999, Kittel and Lederer 1993, Minnesota DNR 2003, Minnesota DNR 2005a, Rolfsmeier and Steinauer 2010, Shelford 1954, Southeastern Ecology Working Group n.d., Steinauer 1989, Steinauer and Rolfsmeier 2000, Steinauer and Rolfsmeier 2003, TDNH unpubl. data, Wilson 1970

River Mudflats

River Mudflats Sparse Vegetation

River Mudflats Sparse Vegetation

Identifier: CEGL002314

USNVC CLASSIFICATION

Division	Eastern North American Wet Meadow, Marsh & Shrubland (2.C.4.Nd.)
Macrogroup	Eastern North American Wet Shoreline Vegetation (M880)
Group	Central Riverine Wetland Vegetation (G755)
Alliance	Northern & Central Temperate Sparsely Vegetated Riverwash Alliance (A3659)
Association	River Mudflats

ELEMENT CONCEPT

Global Summary: This river mudflats community is found throughout the upper and central midwestern region of the United States and adjacent Canada, and probably more widely. It extends south at least as far as the Ozark and Ouachita Mountains of Arkansas. Stands occur in riverine areas that flood in the spring, but dry out later in the season, exposing wet, muddy sediments on which plant species subsequently grow. Substrates include silt and clay. The composition and structure of the vegetation are influenced by the flooding regime. Vegetation of this type has not been characterized. Stands in south-central Illinois and east-central Missouri contain the characteristic, and rare, *Boltonia decurrens* (claspingleaf doll's daisy).

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This association is found along the Mississippi, Minnesota, and Vermillion Rivers and some tributaries. The action of the current is necessary to create and maintain this community so most stands are near the main channels of these rivers. Sites are flooded for part of almost every growing season and can remain underwater for several weeks but are exposed at some point during the growing season long enough for plant to germinate. Soil is fine-textured alluvium. Most stands are within a few feet of the river level but in years of high flooding, new stands can be created several feet above the river level in late summer.

Global Environment: Stands occur in riverine areas that flood in the spring, but dry out later in the season, exposing wet, muddy sediments on which plant species subsequently grow. Substrates include silt and clay. The composition and structure of the vegetation are influenced by the flooding regime.

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VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This community can have a highly variable composition, even at a given site from year to year or even in the course on one year, depending on the duration of flooding, time since the site was exposed, soil texture, local seed sources, and other factors. The effect of extended submersion followed by exposure and drying of the soil combined with the physical effects of scouring and deposition of the substrate prevents long-lived perennial species – aquatic, wetland, or upland – from becoming common. Soon after the water recedes, the site will be bare or nearly bare. Annual, and sometimes biennial, species can go through their life-cycles before the next flood cycle. Some sites remain with very little vegetation cover but, by late summer, some sites can have very dense growth. Possible species include *Amaranthus tuberculatus* (roughfruit amaranth), *Bidens cernua* (nodding beggartick), *Bidens frondosa* (devil's beggartick), *Cyperus odoratus* (fragrant flatsedge), *Cyperus esculentus* (yellow nutsedge), *Echinochloa muricata* (rough barnyardgrass), *Eragrostis hypnoides* (teal lovegrass), *Lindernia dubia* (yellowseed false pimpernel), and seedlings of *Acer saccharinum* (silver maple) and *Populus deltoides* (eastern cottonwood). Perennials will typically become more abundant the less often a site is subject to significant flooding every year.
Global Vegetation: Vegetation of this type has not been characterized. Stands in south-central Illinois and east-central Missouri contain the characteristic and rare *Boltonia decurrens* (claspingleaf doll's daisy) (W. McClain pers. comm. 1996).

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area: Information not available.

Global: Information not available.

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: *Boltonia decurrens*

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: **Vulnerable**: *Boltonia decurrens* (G2G3)

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (3-Oct-1996).

CLASSIFICATION

Status: Standard
Classification Confidence: 3 - Weak
Mississippi National River and Recreation Area Comments: This is a highly dynamic vegetation type. The composition and appearance of stands can change from year to year and during the same growing season depending on degree of flooding and other factors. New sites can be created by high flood levels scouring away existing perennial vegetation or depositing silt and mud in new areas or by sustained drought which causes river levels to drop and expose areas that are usually under water.
Global Comments: River mudflats are currently separated from lake mudflats, ~Lake Mudflats Sparse Vegetation (CEGL002313)$$. This type represents both the open, sparsely vegetated river mudflats as well as the more vegetated phases. As such, the type may overlap in concept with ~*Polygonum amphibium* Permanently Flooded Herbaceous Vegetation [Placeholder] (CEGL002002)$$, ~*Polygonum* spp. - Mixed Forbs Herbaceous Vegetation (CEGL002430)$$, and other herbaceous mudflat communities that occur on similar substrates, but are not regularly flooded.
Global Similar Associations:
- Lake Mudflats Sparse Vegetation (CEGL002313)
- *Polygonum amphibium* Permanently Flooded Herbaceous Vegetation [Placeholder] (CEGL002002)
- *Polygonum* spp. - Mixed Forbs Herbaceous Vegetation (CEGL002430)

Global Related Concepts:
- Cobble Beach (Chapman et al. 1989) >
- River Beach (MNNHP 1993) =
- River Mud Flats (Faber-Langendoen 2001) =

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This association was found along the main river channels and in some protected areas on the Minnesota River and the Mississippi River from the confluence of those two rivers to the southern end of the project area.
Global Range: The river mudflat community type is found throughout the upper and central midwestern region of the United States and adjacent Canada, and probably more widely. Currently, it ranges from Minnesota and Manitoba east to Michigan and Ontario, and south to Illinois and Indiana. It extends south at least as far as the Ozarks and Ouachitas of Arkansas.
Nations: CA, US

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States/Provinces: AR, IA, IL, IN, MA, MB:S3, MI, MN, MO, NH, ON, QC, VT:S3, WI
TNC Ecoregions: 35:C, 36:C, 38:C, 39:C, 46:C, 47:P, 48:C, 61:C, 64:C
USFS Ecoregions (1994/95): 212Ea:CCP, 212Ec:CCC, 212Ed:CCP, 212Ee:CCP, 212Jn:CPP, 212Mb:C??, 212Na:CP?, 212Nb:CPP, 212Nc:CP?, 221Af:CCC, 222Ha:PPP, 222Ji:PPP, 222M:CC, 251Aa:P??, 251Ba:P??
Federal Lands: NPS (Effigy Mounds, Mississippi)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: VRMF - River Mudflats
Mississippi National River and Recreation Area Inventory Notes: This association did not have any plots in the park and was described based on field reconnaissance notes. Full species lists will not be available.

In one of the field seasons for this project, 2014, there was extensive high flooding in May and June, in particular. The composition and location of aquatic or emergent wetlands, in particular, were affected in the floodplains of the Minnesota, Mississippi, and Vermillion Rivers. Plant growth was delayed or plants were killed, scouring and deposition of alluvium altered habitat, etc.
Mississippi National River and Recreation Area Plots and Observation Points: No plots at MISS.
Local Description Authors: J. Drake
Global Description Authors: D. Faber-Langendoen
References: CDPNQ unpubl. data, Chapman et al. 1989, Faber-Langendoen 2001, Greenall 1996, Homoya et al. 1988, Hop et al. 2005, MNNHP 1993, McClain pers. comm., Midwestern Ecology Working Group n.d., Minnesota DNR 2005a, Nelson 2010, Swain and Kearsley 2001, Thompson and Sorenson 2000, WNHI unpubl. data, White and Madany 1978

Riverine Sand Flats

Riverine Sand Flats - Bars Sparse Vegetation
Riverine Sand Flats - Bars Sparse Vegetation
Identifier: CEGL002049

USNVC CLASSIFICATION

Division	Eastern North American Wet Meadow, Marsh & Shrubland (2.C.4.Nd.)
Macrogroup	Eastern North American Wet Shoreline Vegetation (M880)
Group	Central Riverine Wetland Vegetation (G755)
Alliance	Northern & Central Temperate Sparsely Vegetated Riverwash Alliance (A3659)
Association	Riverine Sand Flats

ELEMENT CONCEPT

Global Summary: This community ranges from the western Great Plains to the eastern parts of the midwestern United States and Canada. It is a sparsely vegetated community that occurs along river shorelines, islands, pointbars, and flats. These sandbars form when receding floodwaters deposit sand and lesser amounts of clay, silt, and cobbles in the stream bed. Soils are often undeveloped due to the ephemeral nature of the stands. Drainage depends on depth above the water level. Herbaceous species shared in Missouri and Nebraska include *Cyperus* spp. (*Cyperus erythrorhizos* (redroot flatsedge)*, Cyperus odoratus* (fragrant flatsedge)*, Cyperus squarrosus* (bearded flatsedge)*), Eragrostis hypnoides* (teal lovegrass)*, Eragrostis trichodes* (sand lovegrass)*, Leptochloa fusca* ssp. *fascicularis (= Leptochloa fascicularis)* (bearded sprangletop)*, Polygonum* spp. (including *Polygonum lapathifolium* (longroot smartweed)*), Rorippa sinuata* (spreading yellowcress)*, Sporobolus cryptandrus* (sand dropseed), and *Xanthium strumarium* (rough cocklebur).

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This association is found mostly along the Mississippi River. The soils along the Minnesota and Vermillion Rivers tend to be finer-textured, though some examples can be found on those rivers. The action of the current is necessary to create and maintain this community so most stands are near the main channels of these rivers. Sites are flooded for part of almost every growing season and can remain underwater for several weeks but are exposed at some point during the growing season long enough for plant to germinate. Soil is medium- to coarse-textured alluvial sand. Most stands are within a few feet of the river level but in years of high flooding, new stands can be created several feet above the river level in late summer. The unvegetated surface is mostly sand but can have gravel, large rocks, and driftwood or other flood debris.
Global Environment: This community is a sparsely vegetated community that occurs along river shorelines, islands, pointbars, and flats. These sandbars form when receding floodwaters deposit sand and lesser amounts of clay, silt, gravel, and cobbles in the stream bed. Soils are often undeveloped due to the ephemeral nature of the stands. Drainage depends on depth above the water level (Nelson 1985, Steinauer and Rolfsmeier 2000).

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This community can have a highly variable composition, even at a given site from year to year or even in the course on one year, depending on the duration of flooding, time since the site was exposed, soil texture, local seed sources, and other factors. The effect of extended submersion followed by exposure and drying of the soil combined with the physical effects of scouring and deposition of the substrate prevents long-lived perennial species, aquatic, wetland,

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or upland, from becoming common. Soon after the water recedes, the site will be bare or nearly bare. Annual, and sometimes biennial, species can go through their life-cycles before the next flood cycle. Because the soils are typically well-drained and not very fertile, total vegetation cover is rarely high, even by the end of the growing season. Common species are *Amaranthus arenicola* (sandhill amaranth), *Cyperus esculentus* (yellow nutsedge), *Eragrostis hypnoides* (teal lovegrass), *Lindernia dubia* (yellowseed false pimpernel), *Mollugo verticillata* (green carpetweed), small *Salix interior* (sandbar willow) (nearly always spreading from adjacent shrublands), and seedlings of *Acer saccharinum* (silver maple) and *Populus deltoides* (eastern cottonwood).

Global Vegetation: Vegetation is very sparse, highly dynamic and irregular in structure because of constantly changing conditions on the river. Herbaceous species shared in Missouri and Nebraska include *Cyperus* spp. (*Cyperus erythrorhizos* (redroot flatsedge), *Cyperus odoratus* (fragrant flatsedge), *Cyperus squarrosus* (bearded flatsedge)), *Eragrostis hypnoides* (teal lovegrass), *Eragrostis trichodes* (sand lovegrass), *Leptochloa fusca* ssp. *fascicularis (= Leptochloa fascicularis)* (bearded sprangletop), *Polygonum* spp. (including *Polygonum lapathifolium* (longroot smartweed)), *Rorippa sinuata* (spreading yellowcress), *Sporobolus cryptandrus* (sand dropseed), and *Xanthium strumarium* (rough cocklebur). Other species listed for Nebraska and Missouri alone can be found in Nelson (1985) and Steinauer and Rolfsmeier (2000). Woody cover is generally absent in the first year of establishment but can increase if the site does not flood. A broader description including other Midwest and Great Plains sites is needed. Given the dynamic nature of the habitat and lack of information from across the range of this type, it is not clear which species are most constant in the Great Plains.

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area: Information not available.

Global

Stratum	Lifeform	Species
Herb (field)	Forb	*Polygonum lapathifolium* (longroot smartweed)
Herb (field)	Graminoid	*Cenchrus longispinus* (mat sandbur), *Eragrostis trichodes* (sand lovegrass), *Sporobolus cryptandrus* (sand dropseed)

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: *Cyperus erythrorhizos*, *Cyperus odoratus*, *Cyperus squarrosus*, *Eragrostis hypnoides*, *Eragrostis trichodes*, *Leptochloa fusca* ssp. *fascicularis*, *Polygonum lapathifolium*, *Rorippa sinuata*, *Sporobolus cryptandrus*, *Xanthium strumarium*

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Vulnerable: *Vitis rupestris* (G3)

CONSERVATION STATUS RANK

Global Rank & Reasons: G4G5 (22-Jun-1998).

CLASSIFICATION

Status: Standard
Classification Confidence: 3 - Weak
Mississippi National River and Recreation Area Comments: This is a highly dynamic vegetation type. The composition and appearance of stands can change from year to year and during the same growing season depending on degree of flooding and other factors. New sites can be created by high flood levels scouring away existing perennial vegetation or depositing sand in new areas or by sustained drought which causes river levels to drop and expose areas that are usually under water.
Global Comments: This type will need to be separated into at least a Great Plains versus a Midwest type. The current description is based primarily on work available in Missouri (Nelson 1985) and Nebraska (Steinauer and Rolfsmeier 2000). See also ~Great Plains Riverine Gravel Flats Sparse Vegetation (CEGL005223)$$.
Global Similar Associations:
- Great Plains Riverine Gravel Flats Sparse Vegetation (CEGL005223)
- Ozark Riverine Cobble - Gravel Flats Sparse Vegetation (CEGL007012)
- *Salix exigua* / Mesic Graminoids Shrubland (CEGL001203)

Global Related Concepts:
- Annual mudflat (Currier 1982) =
- River Beach Sand Subtype (MNNHP 1993) =
- Sand Bar (Nelson 1985) =
- Sandbar/Mudflat (Steinauer and Rolfsmeier 2000) =
- Sandbar/Mudflat (Steinauer and Rolfsmeier 2003) =

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This association was found mostly north of downtown Minneapolis but had several scattered occurrences south of there throughout the project area.

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Global Range: This community is found from the western Great Plains to the eastern parts of the midwestern United States and Canada, ranging from Indiana northwest to Saskatchewan, and south to Kansas.
Nations: CA, US
States/Provinces: IL, IN, KS:SU, MB:S3, MN, MO:S3, ND, NE:S5, ON, QC, SK?, WY
TNC Ecoregions: 26:C, 36:C, 37:C, 38:C, 46:C, 47:C, 48:C, 64:C
USFS Ecoregions (1994/95): 212Mb:CPP, 212Na:CPP, 212Nb:CPP, 212Nc:CPP, 222Ad:CC?, 222Ae:CC?, 222Af:CC?, 222Ak:CC?, 222Ap:CCC, 222Md:CCC, 251Cg:CCC, 251D:CC, 331:C, 332C:CC, 332E:CC
Federal Lands: NPS (Fort Laramie, Fort Union Trading Post, Mississippi, Ozark Riverways, Saint Croix, Scotts Bluff, Theodore Roosevelt); USFS (Chippewa)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: VRSF - Riverine Sand Flats
Mississippi National River and Recreation Area Inventory Notes: In one of the field seasons for this project, 2014, there was extensive high flooding in May and June, in particular. The composition and location of aquatic or emergent wetlands, in particular, were affected in the floodplains of the Minnesota, Mississippi, and Vermillion Rivers. Plant growth was delayed or plants were killed, scouring and deposition of alluvium altered habitat, etc.
Mississippi National River and Recreation Area Plots and Observation Points: MISS.118
Local Description Authors: J. Drake
Global Description Authors: D. Faber-Langendoen
References: CDPNQ unpubl. data, Chastain et al. 2006, Currier 1982, Greenall 1996, Homoya et al. 1988, Lauver et al. 1999, MNNHP 1993, Midwestern Ecology Working Group n.d., Minnesota DNR 2003, Minnesota DNR 2005a, Nelson 1985, Nelson 2010, Nigh et al. 2000, Rolfsmeier and Steinauer 2010, Salas and Pucherelli 2002a, Steinauer and Rolfsmeier 2000, Steinauer and Rolfsmeier 2003, TNC 1998e, TNC n.d.b, Von Loh et al. 2000, WNDD unpubl. data, White and Madany 1978

G756. Eastern Temperate Wet Shoreline Vegetation

Riverine Forb Mudflats

Polygonum amphibium - *Sagittaria latifolia* Riverine Herbaceous Vegetation
Water Knotweed - Broadleaf Arrowhead Riverine Herbaceous Vegetation
Identifier: CEGL005458

USNVC CLASSIFICATION

Division	Eastern North American Wet Meadow, Marsh & Shrubland (2.C.4.Nd.)
Macrogroup	Eastern North American Wet Shoreline Vegetation (M880)
Group	Eastern Temperate Wet Shoreline Vegetation (G756)
Alliance	Smartweed species Palustrine Alliance (A1881)
Association	Riverine Forb Mudflats

ELEMENT CONCEPT

Global Summary: Information not available.

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This association is found along the Mississippi, Minnesota, and Vermillion Rivers and some tributaries in areas protected from constant exposure to currents. This can include lakes or depressions in the floodplain as well as backwater areas of the main rivers. Stands are often flooded for a few to several weeks each year but will not persist in the face of repeated exposure to strong currents and deposition and scouring. Soil is rich fine-textured alluvium which can encourage lush vegetative growth.
Global Environment: Information not available.

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This forb-dominated wetland usually forms dense, low herbaceous stands. However, it occurs mostly in floodplains and is subject to periodic severe flooding which can kill some of the existing plants and open up the herbaceous canopy. In the absence of repeated disturbance, the herbaceous stratum fills in the open areas, first with annuals or short-lived perennials and eventually with perennials. Shrubs are not common but can have up to 25% cover in some stands. Trees are widely scattered or absent. *Polygonum amphibium* (water knotweed) is the most common species in this community and can form nearly solid canopies 0.5-1 m high. *Sagittaria latifolia* (broadleaf arrowhead) and other low forbs can be abundant under this canopy. *Schoenoplectus fluviatilis* (river bulrush) and *Sagittaria latifolia* (broadleaf arrowhead) are very common but do not have more than 50% cover. The perennials *Carex lacustris* (hairy sedge), *Leersia oryzoides* (rice cutgrass), *Phalaris arundinacea* (reed canarygrass), *Phragmites australis* (common reed), *Sparganium eurycarpum* (broadfruit bur-reed), *Stachys tenuifolia* (smooth hedgenettle), and *Typha* spp. (cattail), and the annuals/biennials *Amaranthus tuberculatus* (roughfruit amaranth), *Bidens cernua* (nodding beggartick), *Bidens frondosa* (devil's beggartick), *Calystegia sepium* (hedge false bindweed), *Eragrostis hypnoides* (teal lovegrass), *Polygonum pensylvanicum* (Pennsylvania smartweed), *Sicyos angulatus* (oneseed bur cucumber), and *Xanthium*

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strumarium (rough cocklebur) can all be found in this community. Woody species include *Salix interior* (sandbar willow) and small to large floodplain trees.
Global Vegetation: Information not available.

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Herb (field)	Forb	*Polygonum amphibium* (water knotweed), *Sagittaria latifolia* (broadleaf arrowhead)

Global: Information not available.

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: *Polygonum amphibium*
Global: Information not available.

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Information not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (30-Dec-2013).

CLASSIFICATION

Status: Standard
Classification Confidence: 3 - Weak
Mississippi National River and Recreation Area Comments: This association was identified based on information collected during the vegetation mapping project at MISS. It lacks characterization based on data from a larger region and thus lacks information in the "Global" fields of this description.
Global Comments:
Global Related Concepts: Information not available.

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This association was found along the main river channels and in some protected areas on the Minnesota River and the Mississippi River from the confluence of those two rivers to the southern end of the project area. The largest concentration was on the fine-textured alluvium of the Mississippi and Vermillion Rivers in Gore's Pool WMA.
Global Range: Information not available.
Nations: US
States/Provinces: MN
TNC Ecoregions: 46
USFS Ecoregions (1994/95): 222M:CC
Federal Lands: NPS (Mississippi)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: HRFM - Riverine Forb Mudflats
Mississippi National River and Recreation Area Inventory Notes: This association was not identified during plot sampling. It was found later in the project and so is described based on field reconnaissance notes and Accuracy Assessment data. As such, it lacks comprehensive species lists and detailed information on vegetation strata.

In one of the field seasons for this project, 2014, there was extensive high flooding in May and June, in particular. The composition and location of aquatic or emergent wetlands, in particular, were affected in the floodplains of the Minnesota, Mississippi, and Vermillion Rivers. Plant growth was delayed or plants were killed, scouring and deposition of alluvium altered habitat, etc.
Mississippi National River and Recreation Area Plots and Observation Points: No plots in MISS.
Local Description Authors: J. Drake
Global Description Authors: Information not available.
References: Midwestern Ecology Working Group n.d.

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M303. Eastern North American Ruderal Wet Meadow & Marsh

G556. Northern & Central Ruderal Wet Meadow & Marsh

Purple Loosestrife Wetland

Lythrum salicaria Ruderal Herbaceous Vegetation
Purple Loosestrife Ruderal Herbaceous Vegetation
Identifier: CEGL006403

USNVC CLASSIFICATION

Division	Eastern North American Wet Meadow, Marsh & Shrubland (2.C.4.Nd.)
Macrogroup	Eastern North American Ruderal Wet Meadow & Marsh (M303)
Group	Northern & Central Ruderal Wet Meadow & Marsh (G556)
Alliance	Purple Loosestrife Herbaceous Alliance (A3030)
Association	Purple Loosestrife Wetland

ELEMENT CONCEPT

Global Summary: This association consists of wetlands heavily invaded by *Lythrum salicaria* (purple loosestrife) with few or no species indicating the former more native association analog. *Lythrum* makes up at least 75% of the vegetation cover and may approach 100%. The sparse associates include common wetland plants such as *Impatiens capensis* (jewelweed), *Onoclea sensibilis* (sensitive fern), *Thelypteris palustris* (eastern marsh fern), *Carex stricta* (upright sedge), and *Typha* spp. (cattail). Shrubs are sparse or absent.

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This association is found in the floodplains of the Mississippi, Minnesota, and Vermillion Rivers on the edges of lakes and river channels and in depressions. Sites are flooded or saturated for at least a few weeks in most years but are not under water for the majority of the growing season. Soils range from fine silt to moderately coarse sand.
Global Environment: Information not available.

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This vegetation type is strongly dominated (>80%) by *Lythrum salicaria* (purple loosestrife). No other species is in a high proportion of stands but *Eragrostis hypnoides* (teal lovegrass), *Eleocharis* spp. (spikerush), *Leersia oryzoides* (rice cutgrass), *Sagittaria latifolia* (broadleaf arrowhead), *Sparganium eurycarpum* (broadfruit bur-reed), and *Typha* spp. (cattail) can be found in some stands. The herbaceous stratum is typically 1-1.5 m tall and dense though extensive flooding or drought can cause openings. Stems from previous years are typically present and make the vegetation more dense than just the standing live plants, especially early in the growing season. Shrubs can have up to 25% cover but trees are absent or rare.
Global Vegetation: *Lythrum salicaria* (purple loosestrife) makes up at least 75% of the vegetation cover and may approach 100%. The sparse associates include common wetland plants such as *Impatiens capensis* (jewelweed), *Onoclea sensibilis* (sensitive fern), *Thelypteris palustris* (eastern marsh fern), *Carex stricta* (upright sedge), and *Typha* spp. (cattail). Shrubs are sparse or absent.

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Herb (field)	Forb	*Lythrum salicaria* (purple loosestrife)

Global

Stratum	Lifeform	Species
Herb (field)	Forb	*Lythrum salicaria* (purple loosestrife)

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: *Lythrum salicaria*
Global: *Lythrum salicaria*

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: *Lythrum salicaria* (High, state-level noxious weed)
Global: Invasive/Exotic: *Lythrum salicaria* (High, State-level noxious weed)

CONSERVATION STATUS RANK

Global Rank & Reasons: GNA (invasive) (7-Dec-2005). This community represents vegetation which has invaded native wetlands. It is not a conservation priority and does not receive a conservation rank.

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CLASSIFICATION

Status: Standard
Classification Confidence: 3 - Weak
Mississippi National River and Recreation Area Comments:
Global Comments: This association is reserved for areas strongly dominated by *Lythrum salicaria* (purple loosestrife) and consequently without a suite of associated species that indicate the native community that formerly occupied the site.
Global Related Concepts: Information not available.

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This associations was found at scattered locations from Pickerel Lake in Lillydale Regional Park down to the northern part of Gore's Pool WMA. It was most concentrated on the many small islands and shallow marshes in the river near Lower Gray Cloud Island
Global Range: This association is known from the Midwest and northeastern U.S.
Nations: US
States/Provinces: MA, MN, NY
TNC Ecoregions: 46:C, 48:C, 61:C
USFS Ecoregions (1994/95): 221Aa:CCP, 221Ae:CCC, 221Ai:CCC, 221Bc:CCC, 222Ib:CCC, 222Ic:CCC, 222M:CC
Federal Lands: NPS (Minute Man, Mississippi, Saratoga?); USFWS (Iroquois, Montezuma)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: HSPL - Purple Loosestrife Wetland
Mississippi National River and Recreation Area Inventory Notes: This association was not identified during plot sampling. It was found later in the project and so is described based on field reconnaissance notes and Accuracy Assessment data. As such, it lacks comprehensive species lists and detailed information on vegetation strata.

In one of the field seasons for this project, 2014, there was extensive high flooding in May and June, in particular. The composition and location of aquatic or emergent wetlands, in particular, were affected in the floodplains of the Minnesota, Mississippi, and Vermillion Rivers. Plant growth was delayed or plants were killed, scouring and deposition of alluvium altered habitat, etc.
Mississippi National River and Recreation Area Plots and Observation Points: No plots in MISS.
Local Description Authors: J. Drake
Global Description Authors: S.C. Gawler
References: Eastern Ecology Working Group n.d., Edinger et al. 2002, Edinger et al. 2007, Gawler et al. 2005, NRCS 2004a

Reed Canarygrass Eastern Marsh

Phalaris arundinacea Eastern Ruderal Herbaceous Vegetation
Reed Canarygrass Eastern Ruderal Herbaceous Vegetation
Identifier: CEGL006044

USNVC CLASSIFICATION

Division	Eastern North American Wet Meadow, Marsh & Shrubland (2.C.4.Nd.)
Macrogroup	Eastern North American Ruderal Wet Meadow & Marsh (M303)
Group	Northern & Central Ruderal Wet Meadow & Marsh (G556)
Alliance	Reed Canarygrass Herbaceous Alliance (A1381)
Association	Reed Canarygrass Eastern Marsh

ELEMENT CONCEPT

Global Summary: This association is found throughout the northeastern United States and Canada, but its distribution as a natural type is complicated elsewhere. *Phalaris arundinacea* (reed canarygrass) is native to the United States and Canada but is now more widely distributed and abundant because of local introductions from both local and European populations. The introduced strains may be more aggressive ecotypes than native strains. Stands are found in both minerotrophic basin wetlands as well as rivershores. *Phalaris arundinacea* (reed canarygrass) has been widely used as a forage and hay crop, especially in marshes and floodplains, and it is used for wildlife food and for shoreline and ditch stabilization. Stands are dominated by *Phalaris arundinacea* (reed canarygrass), a 0.5- to 2-m tall perennial grass, which tends to occur in monocultures or associated with *Calamagrostis canadensis* (bluejoint). Associates in the glaciated Northeast include *Viburnum nudum* (possumhaw), *Alnus incana* (gray alder) or *Alnus serrulata* (hazel alder), *Viburnum dentatum* (southern arrowwood), and *Agrostis gigantea* (redtop). In Central Appalachian bottomland old fields, characteristic associates include *Verbesina alternifolia* (wingstem) (which may be codominant), *Solidago rugosa* (wrinkleleaf goldenrod), *Boehmeria cylindrica* (smallspike false nettle), and *Euthamia graminifolia* (flat-top goldentop), along with exotic species such as *Glechoma hederacea* (ground ivy), *Coronilla varia* (purple crownvetch), *Rosa multiflora* (multiflora rose), and *Elaeagnus umbellata* (autumn olive). Midwest associates include species characteristic of wet meadows. *Phalaris arundinacea* (reed canarygrass)

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can displace native species over time. Further work is required to resolve the natural versus introduced nature of this type in the Southeast before a description can be completed.

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This wet meadow association is most common in the floodplains of the Mississippi, Minnesota, and Vermillion Rivers on the edges of lakes and river channels and in depressions. Smaller stands can occur in wet depression away from the floodplains, as well. Sites are flooded or saturated for a few weeks in most years but are not under water for the majority of the growing season. Soils range from fine silt to moderately coarse sand.
Global Environment: Stands are found in both minerotrophic basin wetlands as well as rivershores. The dominant species has been widely used as a forage and hay crop, especially in marshes and floodplains, and it is used for wildlife food and for shoreline and ditch stabilization (Barnes 1999).

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This vegetation has a moderate to very dense herbaceous layer approximately 1 m tall. Shrubs and trees can be present but do not have more than 25% cover. *Phalaris arundinacea* (reed canarygrass) is strongly dominant, with at least 80% cover. No other species is found with high frequency but *Boehmeria cylindrica* (smallspike false nettle)*l, Carex lacustris* (hairy sedge)*, Cirsium arvense* (Canada thistle)*, Impatiens capensis* (jewelweed)*, Scirpus atrovirens* (green bulrush)*,* and other wet-meadow species can occur. Severe flooding, such as happened in 2014, can kill some of the perennial vegetation in stands of this association, favoring a higher proportion of annuals for a few years until *Phalaris arundinacea* (reed canarygrass) recovers. *Salix interior* (sandbar willow) is the most common shrub found in this vegetation.
Global Vegetation: Stands are dominated by *Phalaris arundinacea* (reed canarygrass), a 0.5- to 2-m tall perennial grass that is native to the United States and Canada, but which has also been introduced from European strains. The introduced strains may be more aggressive ecotypes than native strains (Barnes 1999). It tends to occur in monocultures or associated with *Calamagrostis canadensis* (bluejoint) or, less commonly, with a mixture of forbs equaling the graminoid cover. Associates in the glaciated Northeast include *Viburnum nudum* (possumhaw)*, Salix* spp. (willow), *Alnus incana* (gray alder) or *Alnus serrulata* (hazel alder)*, Viburnum dentatum* (southern arrowwood)*, Poa palustris* (fowl bluegrass)*, Mentha arvensis, Leersia virginica* (whitegrass)*, Lythrum salicaria* (purple loosestrife), and *Agrostis gigantea* (redtop). In Central Appalachian bottomland old fields, characteristic associates include *Verbesina alternifolia* (wingstem) (which may be codominant), *Solidago rugosa* (wrinkleleaf goldenrod)*, Boehmeria cylindrica* (smallspike false nettle), and *Euthamia graminifolia* (flat-top goldentop), along with exotic species such as *Glechoma hederacea* (ground ivy)*, Coronilla varia* (purple crownvetch)*, Rosa multiflora* (multiflora rose), and *Elaeagnus umbellata* (autumn olive). Midwest associates include species characteristic of wet meadows. *Phalaris arundinacea* (reed canarygrass) can displace native species over time (Apfelbaum and Sams 1987, Barnes 1999, and references therein). Further work is required to resolve the natural versus introduced nature of this type in the Southeast.

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Phalaris arundinacea* (reed canarygrass)

Global

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Phalaris arundinacea* (reed canarygrass)

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: *Phalaris arundinacea*
Global: *Phalaris arundinacea*

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Invasive/Exotic: *Coronilla varia* (High), *Elaeagnus umbellata* (High), *Glechoma hederacea* (Low), *Phalaris arundinacea* (High), *Rosa multiflora* (Medium/Low)

CONSERVATION STATUS RANK

Global Rank & Reasons: GNA (invasive) (1-Dec-1997). *Phalaris arundinacea* (reed canarygrass) is native to the United States and Canada but is now more widely distributed and abundant because of local introductions from both local and European populations (Apfelbaum and Sams 1987). It can invade a variety of habitats.

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Mississippi National River and Recreation Area Comments:
Global Comments: Type has a broad distribution; in fact, it is widespread throughout temperate areas of the northern hemisphere. It is native to the United States and Canada, but is now more widely distributed and abundant because of local introductions from both local and European populations (Apfelbaum and Sams 1987). It can invade a variety of habitats, suggesting that little unites these

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stands apart from the dominance of *Phalaris arundinacea* (reed canarygrass). However, that may be the only reasonable way to describe this type. This vegetation is documented from Shady Valley TNC Preserve, Johnson County, Tennessee, where it occupies channelized streams, impoundments, and fen restoration sites. In these examples, characteristic associates include *Juncus effusus* (common rush), *Carex lurida* (shallow sedge), *Carex gynandra* (nodding sedge), and *Alnus serrulata* (hazel alder).

Global Similar Associations:
- *Calamagrostis canadensis* - *Carex* spp. Laurentian & Northeast Wet Meadow (CEGL005448)
- *Calamagrostis canadensis* North-Central Wet Meadow (CEGL005449)
- *Phalaris arundinacea* Western Herbaceous Vegetation (CEGL001474)

Global Related Concepts:
- *Phalaris arundinacea* temporarily flooded grasslands (Metzler and Barrett 2001) **>**
- Bluejoint - Reed Canary Grass Marsh (Fike 1999) **>**
- Bottomland old fields (Vanderhorst 2001a) **=**
- Palustrine Persistent Emergent Wetland (PEM1) (Cowardin et al. 1979) **?**
- Reed canary grass riverine grassland (Perles et al. 2004) **?**
- SNE low-energy riverbank community (Rawinski 1984a) **?**
- Semi-Natural (MNNHP 1993) **>**
- Shallow Emergent Marsh (Thompson 1996) **?**
- Southern New England nutrient-poor streamside/lakeside marsh (Rawinski 1984a) **?**
- Southern New England nutrient-rich streamside/lakeside marsh (Rawinski 1984a) **?**

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This association was widespread in Gore's Pool WMA and had small occurrences in Coon Rapids Dam Regional Park, Pickerel Lake, Battle Creek Regional Park, and Pine Bend Bluffs SNA.
Global Range: This association is found throughout the northeastern United States and Canada, but its distribution as a natural type is complicated elsewhere. It currently ranges from Virginia north to Vermont, east to Minnesota and south to Tennessee.
Nations: CA, US
States/Provinces: CT, DE, IA, IN, MA, MD, ME, MN, NH, NJ, NY, OH, ON, PA, QC, RI, TN, VA, VT, WI?, WV
TNC Ecoregions: 46:C, 47:C, 48:C, 49:C, 50:C, 51:C, 59:C, 60:C, 61:C, 62:C
USFS Ecoregions (1994/95): 212Fc:CCC, 212G:CP, 221Aa:CCC, 221Bc:CCC, 221Bd:CCC, 221Da:CCC, 221Fa:CCC, 222Ib:CCC, 222Ic:CCC, 222Jj:CCC, 222L:CC, 222M:CC, M221Ac:CCC, M221Ad:CCC, M221Bb:CCC, M221Bf:CCC, M221Dc:CCC
Federal Lands: NPS (Allegheny Portage Railroad, Appalachian Trail [Central Appalachians], Appalachian Trail [Lower New England], C&O Canal, Catoctin Mountain, Cuyahoga Valley, Delaware Water Gap, Effigy Mounds, Eisenhower, Gettysburg, Harpers Ferry, Indiana Dunes, Mississippi, Saint Croix, Saratoga, Saugus Iron Works, Upper Delaware); USFWS (Assabet River?, Erie, Great Meadows?, Great Swamp, Iroquois, Montezuma, Oxbow, Parker River, Rachel Carson?)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: HSRC - Reed Canarygrass Eastern Marsh
Mississippi National River and Recreation Area Inventory Notes: In one of the field seasons for this project, 2014, there was extensive high flooding in May and June, in particular. The composition and location of aquatic or emergent wetlands, in particular, were affected in the floodplains of the Minnesota, Mississippi, and Vermillion Rivers. Plant growth was delayed or plants were killed, scouring and deposition of alluvium altered habitat, etc.
Mississippi National River and Recreation Area Plots and Observation Points: MISS.012, MISS.019, MISS.21, MISS.088
Local Description Authors: J. Drake
Global Description Authors: D. Faber-Langendoen, mod. S.C. Gawler
References: Apfelbaum and Sams 1987, Barnes 1999, CDPNQ unpubl. data, Cowardin et al. 1979, Coxe 2009, Edinger et al. 2002, Edinger et al. 2007, Fike 1999, Hop et al. 2005, Hop et al. 2009, Largay and Sneddon 2008, MNNHP 1993, Metzler and Barrett 2001, Metzler and Barrett 2006, Midwestern Ecology Working Group n.d., NRCS 2004a, ONHD unpubl. data, Perles et al. 2004, Perles et al. 2006c, Perles et al. 2006d, Perles et al. 2007, Perles et al. 2008, Rawinski 1984a, Sperduto 2000a, Swain and Kearsley 2001, TDNH unpubl. data, TNC and WPC 2004, Thompson 1996, Thompson and Sorenson 2000, Vanderhorst 2001a, Vanderhorst and Streets 2006, Zimmerman 2011h, Zimmerman et al. 2012

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Eastern Reed Marsh

Phragmites australis Eastern North America Temperate Ruderal Herbaceous Vegetation
Common Reed Eastern North America Temperate Ruderal Herbaceous Vegetation
Identifier: CEGL004141

USNVC CLASSIFICATION

Division	Eastern North American Wet Meadow, Marsh & Shrubland (2.C.4.Nd.)
Macrogroup	Eastern North American Ruderal Wet Meadow & Marsh (M303)
Group	Northern & Central Ruderal Wet Meadow & Marsh (G556)
Alliance	Common Reed Herbaceous Alliance (A1431)
Association	Eastern Reed Marsh

ELEMENT CONCEPT

Global Summary: This reed marsh type is found across the east-temperate regions of the United States and Canada. Stands occur in semipermanently flooded marshes, ditches, impoundments, etc., that have often been disturbed by human activity. The vegetation is variable, as *Phragmites australis* (common reed) will often invade into existing natural or semi-natural communities present on the site. Once firmly established, this community is usually strongly dominated by *Phragmites australis* (common reed), with few or no other vascular plants present.

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This association is most common in the floodplains of the Mississippi, Minnesota, and Vermillion Rivers on the edges of lakes and river channels and in depressions. Smaller stands can be found in wet depressions away from the floodplains, as well. Sites are flooded or saturated for at least a few weeks in most years but are not under water for the majority of the growing season. Soils range from fine silt to moderately coarse sand. The unvegetated surface was mostly plant litter (avg. 55%) with some bare ground (avg. 25%).
Global Environment: Stands occur in semipermanently flooded marshes, ditches, impoundments, etc. that have often been disturbed by human activity.

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This herbaceous wetland typically has moderate to very dense cover by tall (2-3 m) grasses. *Phragmites austrails* (common reed) is strongly dominant (>80% cover) with few other species occurring regularly. A variety of species typical of emergent wetlands can be found including *Calystegia sepium* (hedge false bindweed), *Impatiens capensis* (jewelweed), *Polygonum amphibium* (water knotweed), *Sagittaria latifolia* (broadleaf arrowhead), *Schoenoplectus fluviatilis* (river bulrush), and *Typha* spp. (cattail). Shrubs can have up to 25% cover but are often shorter than the *Phragmites australis* (common reed). *Amorpha fruticosa* (desert false indigo) and *Cornus racemosa* (gray dogwood) were sometimes present to common in this association.
Global Vegetation: The vegetation is often variable, as *Phragmites australis* (common reed) will often invade into existing natural or semi-natural communities present on the site. Once firmly established, this community is usually strongly dominated by *Phragmites australis* (common reed), with few or no other vascular plants present.

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Phragmites australis* (common reed)

Global

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Phragmites australis* (common reed)

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: *Phragmites australis*
Global: *Phragmites australis*

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Information not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNA (invasive) (23-Nov-1997). Although almost always occurring as a naturalized type that arises from human disturbance, some stands in northern Minnesota and further north in Canada may be native. If so, they should be tracked as a separate type.

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CLASSIFICATION

Status: Standard
Classification Confidence: 1 - Strong
Mississippi National River and Recreation Area Comments:
Global Comments: This is not a native community but is the result of the invasion of alien *Phragmites australis* (common reed) into natural or semi-natural vegetation. The vegetation has variable hydrology and, unless *Phragmites* is clearly dominant, is often treated as part of other marsh and meadow types. The geographic distribution of the type is arbitrarily limited to Bailey's Humid Temperate Domain in eastern North America (Bailey 1997, 1998). Stands in northern Minnesota and farther north in Canada may represent native stands. If so, they should be tracked as a different type. Tidal vegetation of the Gulf Coast of Louisiana and Texas dominated by *Phragmites australis* (common reed) is classified in ~*Sagittaria lancifolia* Tidal Freshwater Marsh Alliance (A1987)$$.
Global Similar Associations:
- *Phragmites australis* Tidal Ruderal Herbaceous Vegetation (CEGL004187)
- *Phragmites australis* Western North America Temperate Ruderal Herbaceous Vegetation (CEGL001475)

Global Related Concepts:
- *Phragmites australis* community (Metzler and Barrett 1992) **?**
- *Phragmites australis* temporarily flooded grasslands (Metzler and Barrett 2001) **>**
- *Phragmites australis* tidal marsh association (Clancy 1993b) **?**
- Inland Emergent Marsh (Chapman et al. 1989) **>**
- Semi-Natural (MNNHP 1993) **>**
- Semi-Natural (Faber-Langendoen 2001) **>**
- Southern New England nutrient-poor streamside/lakeside marsh (Rawinski 1984a) **?**
- Southern New England nutrient-rich streamside/lakeside marsh (Rawinski 1984a) **?**

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This association was found in protected backwaters and lakes in the floodplain in Fort Snelling State Park, Battle Creek Regional Park, Pig's Eye Lake, and Gore's Pool WMA,
Global Range: This reed marsh type is found across the east-temperate regions of the United States and Canada, ranging from Maine west to the eastern Dakotas and Manitoba, south to Texas and east to Florida.
Nations: CA, US
States/Provinces: AL, AR, CT, DE, FL, GA, IA, IN, LA, MA, MD, ME, MI, MN, MS, NC, NH, NJ:S5, NY, OH, ON, PA:S5, QC, RI, SC, TX, VA, VT, WI, WV
TNC Ecoregions: 31:C, 39:P, 40:C, 41:C, 42:C, 47:C, 48:C, 52:P, 53:C, 55:C, 56:C, 57:C, 59:C, 60:C, 61:C, 62:C
USFS Ecoregions (1994/95): 212C:CP, 212Fc:CCC, 212Ho:CCC, 212Hw:CCC, 221Aa:CCP, 221Ab:CCC, 221Ae:CCC, 221Ai:CCC, 221Bc:CCC, 221Da:CCC, 222Ic:CCC, 222Jj:CCC, 222M:CC, 231Fb:CCC, 232Ab:CCC, 232Ac:CCC, 232Ch:CCC, 232Dc:CCC, 232E:CC, 232G:CC, 234A:PP, 255Dc:CCC, M212:C, M221:P
Federal Lands: NPS (Appalachian Trail [Central Appalachians], Appalachian Trail [Lower New England], Assateague Island, Boston Harbor Islands, Cape Cod, Cuyahoga Valley, Indiana Dunes, Minute Man, Mississippi, Padre Island, Saint Croix, Saratoga, Sleeping Bear Dunes, Upper Delaware, Voyageurs); USFWS (Alligator River, Aransas, Bon Secour, Brazoria, Cape May, E.B. Forsythe, Great Dismal Swamp, Great Meadows, Great Swamp, Matagorda Island, Monomoy, Montezuma, Oxbow, Parker River, Prime Hook, Supawna Meadows)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: HSER - Eastern Reed Marsh
Mississippi National River and Recreation Area Inventory Notes: In one of the field seasons for this project, 2014, there was extensive high flooding in May and June, in particular. The composition and location of aquatic or emergent wetlands, in particular, were affected in the floodplains of the Minnesota, Mississippi, and Vermillion Rivers. Plant growth was delayed or plants were killed, scouring and deposition of alluvium altered habitat, etc.
Mississippi National River and Recreation Area Plots and Observation Points: MISS.13, MISS.81
Local Description Authors: J. Drake
Global Description Authors: D. Faber-Langendoen
References: Bailey 1997, Bailey 1998, Bell et al. 2002, Brock et al. 2007, CDPNQ unpubl. data, Chapman et al. 1989, Clancy 1993b, Coxe 2009, Edinger et al. 2002, Edinger et al. 2007, Eichelberger 2011f, Faber-Langendoen 2001, Gawler et al. 2005, Harris et al. 1996, Homoya et al. 1988, Hop et al. 1999, Hop et al. 2009, INAI unpubl. data, Largay and Sneddon 2010, MNNHP 1993, Metzler and Barrett 1992, Metzler and Barrett 2001, Metzler and Barrett 2006, NRCS 2004a, NatureServe 2009, Nelson 1986, ONHD unpubl. data, Perles et al. 2008, Rawinski 1984a, Schafale and Weakley 1990, Schotz pers. comm., Sneddon et al. 2010, Southeastern Ecology Working Group n.d., Swain and Kearsley 2001, TNC 1995c, Zimmerman et al. 2012

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5. AQUATIC VEGETATION

5.B.2. Temperate & Boreal Freshwater Aquatic Vegetation

5.B.2.Na. North American Freshwater Aquatic Vegetation

M108. Eastern North American Freshwater Aquatic Vegetation

G114. Eastern North American Freshwater Aquatic Vegetation

American Lotus Aquatic Wetland

Nelumbo lutea Herbaceous Vegetation
American Lotus Herbaceous Vegetation
Identifier: CEGL004323

USNVC CLASSIFICATION

Division	North American Freshwater Aquatic Vegetation (5.B.2.Na.)
Macrogroup	Eastern North American Freshwater Aquatic Vegetation (M108)
Group	Eastern North American Freshwater Aquatic Vegetation (G114)
Alliance	American White Waterlily - Pond-lily - Watershield Herbaceous Alliance (A4064)
Association	American Lotus Aquatic Wetland

ELEMENT CONCEPT

Global Summary: The American lotus type occurs in natural wetlands or artificial impoundments across the eastern United States and southern Ontario. Stands are essentially monospecific *Nelumbo lutea* (American lotus) communities. This association may be divided as more information becomes available. In Wisconsin, this type is located primarily in the backwaters and impoundments of the Mississippi River and along the deep marshes of the lower Wolf River system. In the Central Appalachians this association includes mixed or monospecific *Nelumbo lutea* (American lotus) communities of natural wetlands or artificial impoundments, sometimes with scattered *Cephalanthus occidentalis*. Other floating-leaved aquatic plant species, such as *Nuphar lutea* ssp. *advena* (yellow pond-lily) and *Nymphaea odorata* (American white waterlily), may be present, as may emergent species such as *Schoenoplectus tabernaemontani (= Scirpus tabernaemontani)* (softstem bulrush)*, Pontederia cordata* (pickerelweed)*, Juncus effusus* (common rush)*, Typha latifolia* (broadleaf cattail)*, Eichhornia crassipes* (common water hyacinth) (alien), *Hydrocotyle* spp. (marshpennywort), and floating aquatics, such as *Salvinia minima* (water spangles)*, Spirodela* spp. (duckmeat), *Lemna* spp. (duckweed), and *Azolla caroliniana* (Carolina mosquitofern). The hydrology of this association is highly variable; the hydrologic placement is debatable.

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This association is found in permanently flooded sites with water typically 1-2 m deep. It is found in lakes and ponds on the floodplains and in protected backchannels.
Global Environment: Stands are found in natural wetlands or artificial impoundments. In Wisconsin, this type is located primarily in the backwaters and impoundments of the Mississippi River and along the deep marshes of the lower Wolf River system (E. Epstein pers. comm. 2003). The hydrology of this association in the Central Appalachian region is highly variable; thus, the hydrologic placement is debatable (Central Appalachian Ecoregional Planning Team pers. comm. 1998).

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This association has few species. The dominant, *Nelumbo lutea* (American lotus)*,* can form a scattered to dense canopy, often with a stratum of submergent aquatic plants below it. *Nymphaea odorata* (American white waterlily) and non-rooted floating-leaved species (*Lemna* spp. (duckweed) and *Spirodela polyrrhiza* (common duckmeat)) can be common. Submergent species include *Ceratophyllum demersum* (coon's tail), and *Potamogeton* spp. (pondweed). Emergent species are rare to absent.
Global Vegetation: Stands are essentially monospecific *Nelumbo lutea* (American lotus) communities. This association may be divided as more information becomes available. In the Central Appalachian region, mixed or monospecific *Nelumbo lutea* (American lotus) communities of natural wetlands or artificial impoundments sometimes contain scattered *Cephalanthus occidentalis*. Other floating-leaved aquatic plant species, such as *Nuphar lutea* ssp. *advena* (yellow pond-lily) and *Nymphaea odorata* (American white waterlily), may be present, as may emergent species such as *Schoenoplectus tabernaemontani (= Scirpus tabernaemontani)* (softstem bulrush)*, Pontederia cordata* (pickerelweed)*, Juncus effusus* (common rush)*, Typha latifolia* (broadleaf cattail)*, Eichhornia crassipes* (common water hyacinth) (alien), *Hydrocotyle* spp. (marshpennywort), and floating aquatics, such as *Salvinia minima* (water spangles)*, Spirodela* spp. (duckmeat), *Lemna* spp. (duckweed), and *Azolla caroliniana* (Carolina mosquitofern) (Central Appalachian Ecoregional Planning Team pers. comm. 1998).

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MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Herb (field)	Forb	*Nelumbo lutea* (American lotus)

Global: Information not available.

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: *Nelumbo lutea*
Global: Information not available.

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Information not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G4? (15-Oct-2002). Although natural stands may be relatively rare, this type may also occur in cultural impoundments. The dominant species in stands of this vegetation is widespread across the eastern United States and adjacent Canada. This is not a rare or imperiled vegetation type, even though its occurrence is poorly documented. Stands may occur in natural lakes and ponds or in artificial impoundments.

CLASSIFICATION

Status: Standard
Classification Confidence: 1 - Strong
Mississippi National River and Recreation Area Comments:
Global Comments: It is unclear whether natural stands (ponds) can be separated from ruderal stands (cultural impoundments that are invaded by *Nelumbo lutea* (American lotus)), complicating the classification and the assessment of the rarity of this type. This type is relatively uncommon in Wisconsin, but several of the occurrences are quite large (hundreds of acres) and reasonably well protected (E. Epstein pers. comm. 2003).
Global Related Concepts:

- *Nelumbo lutea* Permanently Flooded - Tidal Herbaceous Vegetation (Coulling 2002) =
- *Nelumbo lutea* Permanently Flooded - Tidal Herbaceous Vegetation [Provisional] (VDNH 2003) =
- *Nelumbo lutea* Semipermanently Flooded - Tidal Herbaceous Vegetation (Fleming et al. 2007b) =
- American Lotus Floating-leaved Shallow Aquatic Type (Lee et al. 1998) =
- Freshwater Marsh (Nelson 1985) >
- IID6a. Natural Impoundment Pond (Allard 1990) >
- Inland Emergent Marsh (Chapman et al. 1989) >
- Piedmont/Mountain Semipermanent Impoundment (Schafale and Weakley 1990) >
- Submergent/Floating Vascular Vegetation (Smith 1996a) >
- Tidal Freshwater and Oligohaline Aquatic Bed (Fleming et al. 2001) >
- Water lily emergent vegetation (CAP pers. comm. 1998) **?**

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This association was found in only two places in the park, Pickerel Lake and Pig's Eye Lake.
Global Range: This type is found locally across many parts of the eastern/southeastern United States, from Kentucky and Virginia northeast to Ontario and Wisconsin, south to Texas, and east to Georgia.
Nations: CA, US
States/Provinces: AL, AR, GA, IA, IL?, IN, KY, LA, MI, MO?, MS, NC, NE:S1?, OK, ON, SC, TN, TX, VA:SU
TNC Ecoregions: 31:C, 32:P, 36:C, 37:P, 38:C, 39:C, 40:P, 41:C, 42:C, 43:C, 44:C, 46:C, 48:C, 51:?, 52:P, 53:C, 56:P, 57:P, 58:?, 59:C
USFS Ecoregions (1994/95): 222Ab:CCC, 222Ag:CCC, 222Ah:CCC, 222An:CCC, 222Ch:CCC, 222Db:CCC, 222Ka:CCC, 222Kb:CCC, 222Ke:CCC, 222Kf:CCC, 222Kh:CCC, 222Lb:CCC, 222Lc:CCC, 222Ld:CCC, 222Le:CCC, 222M:CC, 231Ga:CCC, 231Gb:CCC, 231Gc:CCC, 232:C, 234Aa:CCC, 234Ac:CCC, 234Ad:CCC, 234Af:CCC, 234Ag:CCC, 234Ai:CCC, 234Al:CCC, 234Am:CCC, 234An:CCC, 251Df:CCC, 255Dc:CCC, M221Ad:CCC, M222Aa:CCC, M222Ab:CCC, M231Aa:CCC, M231Ab:CCC, M231Ac:CCC, M231Ad:CCC
Federal Lands: DOD (Fort Benning); NPS (Effigy Mounds, Mississippi, Natchez Trace); USFS (Kisatchie, Ouachita, Ouachita (Coastal Plain)?, Ouachita (Mountains), Ozark); USFWS (Aransas?, Big Lake, Brazoria, Eufaula, McFaddin, Reelfoot)

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ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: HLTS - American Lotus Aquatic Wetland
Mississippi National River and Recreation Area Inventory Notes: In one of the field seasons for this project, 2014, there was extensive high flooding in May and June, in particular. The composition and location of aquatic or emergent wetlands, in particular, were affected in the floodplains of the Minnesota, Mississippi, and Vermillion Rivers. Plant growth was delayed or plants were killed, scouring and deposition of alluvium altered habitat, etc.
Mississippi National River and Recreation Area Plots and Observation Points: MISS.069
Local Description Authors: J. Drake
Global Description Authors: A.S. Weakley
References: ALNHP 2002, Allard 1990, Blair 1938, Blair and Hubbell 1938, CAP pers. comm. 1998, Chapman et al. 1989, Coulling 2002, Epstein pers. comm., Fleming and Coulling 2001, Fleming and Patterson 2011a, Fleming et al. 2001, Fleming et al. 2007b, Hoagland 2000, Homoya et al. 1988, Hop et al. 2005, INAI unpubl. data, LNHP 2009, Lee et al. 1998, McAlister and McAlister 1995, Nelson 1985, Nelson 2010, Penfound 1953, Rolfsmeier and Steinauer 2010, Schafale 2012, Schafale and Weakley 1990, Schotz pers. comm., Smith 1996a, Southeastern Ecology Working Group n.d., TDNH unpubl. data, VDNH 2003, White and Madany 1978

Northern Water-lily Aquatic Wetland

Nymphaea odorata - *Nuphar* (*microphylla*, *variegata*) Herbaceous Vegetation
American White Water-lily - (Yellow Pond-lily, Variegated Yellow Pond-lily) Herbaceous Vegetation
Identifier: CEGL002562

USNVC CLASSIFICATION

Division	North American Freshwater Aquatic Vegetation (5.B.2.Na.)
Macrogroup	Eastern North American Freshwater Aquatic Vegetation (M108)
Group	Eastern North American Freshwater Aquatic Vegetation (G114)
Alliance	American White Waterlily - Pond-lily - Watershield Herbaceous Alliance (A4064)
Association	Northern Water-lily Aquatic Wetland

ELEMENT CONCEPT

Global Summary: This water-lily aquatic wetland type occurs throughout the upper midwestern region of the United States and adjacent Canada. Stands occur in open, slow-moving water on lakes and streams, often less than 0.5 m deep. The substrate is variable, from muck to sedimentary peat. Emergent vegetation cover is less than 25% and floating-leaved aquatics cover at least 25% of the surface. Typical dominants vary from stand to stand but include *Nymphaea odorata* (American white waterlily)*, Nuphar microphylla (= Nuphar lutea* ssp. *pumila)* (yellow pond-lily), and *Nuphar variegata (= Nuphar lutea* ssp. *variegata)* (varigated yellow pond-lily). Other dominants may include *Brasenia schreberi* (watershield) and *Potamogeton amplifolius* (largeleaf pondweed). A variety of emergent species can occur in this community.

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This association is found in permanently flooded sites with water typically 1-2 m deep. It is found in lakes and ponds on the floodplains and in protected backchannels and in some ponds away from the floodplain.
Global Environment: Stands occur in open, slow-moving water on lakes and streams, often less than 0.5 m deep. The substrate is variable, from muck to sedimentary peat (Harris et al. 1996)

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This association is common but was found with only one dominant species in the floating-leaved plants stratum - *Nymphaea odorata* (American white waterlily). This species could be scattered to dense. Only the non-rooted floating-leaved species *Lemna* spp. (duckweed), *Spirodela polyrrhiza* (common duckmeat), and *Wolffia* spp. (watermeal) were common on the water surface. Submergent species were usually abundant and included *Ceratophyllum demersum* (coon's tail)*, Elodea canadensis* (Canadian waterweed)*, Heteranthera dubia* (grassleaf mudplantain)*, Myriophyllum sibiricum* (shortspike watermilfoil)*, Myriophyllum spicatum*, and *Potamogeton* spp. (pondweed).
Global Vegetation: Emergent vegetation cover is less than 25% and floating-leaved aquatics cover at least 25% of the surface. Typical dominants vary from stand to stand but include *Nymphaea odorata* (American white waterlily)*, Nuphar microphylla (= Nuphar lutea* ssp. *pumila)* (yellow pond-lily), and *Nuphar variegata (= Nuphar lutea* ssp. *variegata)* (varigated yellow pond-lily). Other dominants may include *Brasenia schreberi* (watershield) and *Potamogeton amplifolius* (largeleaf pondweed). A variety of emergent species can occur within this type (Harris et al. 1996).

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MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Herb (field)	Forb	*Nymphaea odorata* (American white waterlily)

Global

Stratum	Lifeform	Species
Floating aquatic	Aquatic herb (floating & submergent)	*Nuphar microphylla* (yellow pond-lily), *Nuphar variegata* variegated yellow pond-lily), *Nymphaea odorata* (American white waterlily)

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: *Nymphaea odorata*
Global: *Nuphar microphylla*, *Nuphar variegata*, *Nymphaea odorata*

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Information not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (3-Oct-1996).

CLASSIFICATION

Status: Standard
Classification Confidence: 3 - Weak
Mississippi National River and Recreation Area Comments:
Global Comments: This type is not well-characterized across its range. Further review is needed in the United States. Depending on spatial scale, it conceptually overlaps both submergent and emergent aquatic types.
Global Related Concepts:

- Inland Emergent Marsh (Chapman et al. 1989) **>**
- Lake Bed (MNNHP 1993) **>**
- Open water marsh: floating-leaved plants (W4) (Harris et al. 1996) **=**
- Pond-lily Formation (Pound and Clements 1900) **?**
- Sandhills Aquatic Wetland (Steinauer and Rolfsmeier 2003) **>**
- Sandhills Open Water Marsh (Steinauer and Rolfsmeier 2000) **>**
- Sandhills Open Water Marsh (Steinauer and Rolfsmeier 1997) **>**
- Submerged Aquatic Northern Water Lily Subtype (Faber-Langendoen 2001) **=**
- Water Lily - Bullhead Lily Floating-leaved Shallow Aquatic Type (Lee et al. 1998) **=**
- Water lily Association (Pool 1914) **?**

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This association was widespread in floodplain lakes and protected backchannels on the Minnesota River and the Mississippi River from the confluence of those two rivers to the southern end of the project area.
Global Range: This water-lily aquatic wetland type occurs throughout the upper midwestern region of the United States and adjacent Canada.
Nations: CA, US
States/Provinces: MB:S2, MI, MN, NE?:S2, NY, ON, QC:S5?, WI
TNC Ecoregions: 46:C, 47:C, 48:C
USFS Ecoregions (1994/95): 212Hi:CCC, 212Hl:CCP, 212Hm:CCP, 212Hn:CCP, 212Ho:CCC, 212Hp:CCP, 212Hq:CCP, 212Hr:CCP, 212Hs:CCP, 212Ht:CCP, 212Hv:CCP, 212Hw:CCC, 212Hx:CCP, 212Hy:CCP, 212Ia:CCC, 212Ib:CCP, 212Ja:CPP, 212Jb:CPP, 212Jc:CPP, 212Jl:CPP, 212Jn:CPP, 212Jo:CPP, 212La:CPP, 212Mb:CPP, 212Na:CPP, 212Nb:CPP, 212Nc:CPP, 221B:CC, 222Jb:CCC, 222Je:CCC, 222M:CC, M212:C
Federal Lands: NPS (Apostle Islands, Grand Portage, Isle Royale, Mississippi, Pictured Rocks, Sleeping Bear Dunes, Voyageurs); USFS (Chippewa, Huron, Huron-Manistee, Manistee?, Ottawa, Superior?)

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ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: HWLA - Northern Water-lily Aquatic Wetland
Mississippi National River and Recreation Area Inventory Notes: In one of the field seasons for this project, 2014, there was extensive high flooding in May and June, in particular. The composition and location of aquatic or emergent wetlands, in particular, were affected in the floodplains of the Minnesota, Mississippi, and Vermillion Rivers. Plant growth was delayed or plants were killed, scouring and deposition of alluvium altered habitat, etc.
Mississippi National River and Recreation Area Plots and Observation Points: MISS.034, MISS.068, MISS.072, MISS.073
Local Description Authors: J. Drake
Global Description Authors: D. Faber-Langendoen
References: CDPNQ unpubl. data, Chapman et al. 1989, Edinger et al. 2002, Faber-Langendoen 2001, Greenall 1996, Harris et al. 1996, Hop et al. 1999, Hop et al. 2010a, Hop et al. 2010b, Hop et al. 2010c, Lee et al. 1998, MNNHP 1993, Midwestern Ecology Working Group n.d., Pool 1914, Pound and Clements 1900, Rolfsmeier and Steinauer 2010, Steinauer and Rolfsmeier 1997, Steinauer and Rolfsmeier 2000, Steinauer and Rolfsmeier 2003, TNC 1999b, WNHI unpubl. data

Midwest Pondweed Submerged Aquatic Wetland

Potamogeton spp. - *Ceratophyllum* spp. Midwest Herbaceous Vegetation
Pondweed species - Hornwort species Midwest Herbaceous Vegetation
Identifier: CEGL002282

USNVC CLASSIFICATION

Division	North American Freshwater Aquatic Vegetation (5.B.2.Na.)
Macrogroup	Eastern North American Freshwater Aquatic Vegetation (M108)
Group	Eastern North American Freshwater Aquatic Vegetation (G114)
Alliance	Pondweed species - Hornwort species - Waterweed species Herbaceous Alliance (A4066)
Association	Midwest Pondweed Submerged Aquatic Wetland

ELEMENT CONCEPT

Global Summary: This broadly defined submerged aquatic or open marsh type is found throughout the midwestern region of the United States and adjacent Canada. Based on information in the northern parts of the Midwest, several vegetation subgroups can be recognized that may be separate associations. Subgroup A is a shallow (<50 cm), sparsely vegetated, open water marsh found on sand, or organic and mineral material trapped in rocky bottoms. Stands are often exposed to wave action and found in oligotrophic lakes. Dominant plants often have basal rosettes that are resistant to wave action. Typical species include *Elatine minima* (small waterwort), *Eriocaulon aquaticum* (sevenangle pipewort), *Gratiola aurea* (golden hedgehyssop), *Isoetes tenella (= Isoetes echinospora)* (spiny-spore quillwort), *Isoetes lacustris (= Isoetes macrospora)* (lake quillwort), *Juncus pelocarpus* (brownfruit rush), and *Lobelia dortmanna* (Dortmann's cardinalflower). Subgroup B is a shallow (<50 cm) open water marsh with emergent cover <25% and floating-leaved aquatics >25%. Substrate is a mineral soil (often sand), boulders, or a mixture of sedimentary peat and fine mineral soil. Stands can be exposed to waves or are in stream channels. Stands may often be dominated by a single species. Typical dominants include *Eleocharis acicularis* (needle spikerush), *Myriophyllum* spp. (watermilfoil), *Potamogeton amplifolius* (largeleaf pondweed), *Potamogeton gramineus* (variableleaf pondweed), *Potamogeton praelongus* (whitestem pondweed), *Potamogeton robbinsii* (Robbins' pondweed), *Sparganium fluctuans* (floating bur-reed), and *Utricularia macrorhiza (= Utricularia vulgaris)* (common bladderwort). Subgroup C includes open water marsh with emergent cover <25% and floating leaved aquatics >25%. Substrate is sedimentary peat and stands are often found in sheltered bays of lakes and streams that do not have high wave energy. Stands may often be dominated by a single species. Typical dominants include *Ceratophyllum demersum* (coon's tail), *Elodea canadensis* (Canadian waterweed), *Lemna* spp. (duckweed), *Myriophyllum sibiricum* (shortspike watermilfoil), *Myriophyllum verticillatum* (whorl-leaf watermilfoil), *Potamogeton natans* (floating pondweed), *Stuckenia pectinata (= Potamogeton pectinatus)* (sago pondweed), *Potamogeton richardsonii* (Richardson's pondweed), *Potamogeton zosteriformis* (flatstem pondweed), *Ranunculus aquatilis* (white water crowfoot), *Utricularia macrorhiza (= Utricularia vulgaris)* (common bladderwort), and *Vallisneria americana* (American eelgrass).

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This association is found in permanently flooded sites with water typically 1-2 m deep. It is found in lakes and ponds on the floodplains and in protected backchannels and in some ponds away from the floodplain.
Global Environment: Curtis (1959) [see also Swindale and Curtis (1957)] noted that the major environmental controls on submerged aquatic vegetation are water depth (as it relates to light intensity), water chemistry, water movement, and nature of the substrate. Various combinations of these factors can interact in a variety of ways to influence the local composition of the community. As a result, a single lake may contain a number of relatively homogeneous stands, each with a different species makeup, which depends on depth, nature of adjoining shoreline, degree of protection from waves, etc. Water chemistry may be one of the few constants. Assessment of water conductivity and alkalinity are two measured parameters that can provide some understanding of the influence of water chemistry on species composition.

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VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: This association has a moderate to dense submerged aquatic vegetation layer with little or no (<10%) cover by emergent or rooted floating-leaved herbaceous species. *Ceratophyllum demersum* (coon's tail), *Potamogeton crispus* (curly pondweed), *Potamogeton foliosus* (leafy pondweed), *Potamogeton perfoliatus* (claspingleaf pondweed), *Potamogeton zosteriformis* (flatstem pondweed), and *Stuckenia pectinata* (sago pondweed), alone or in combination, can be dominants in this community. The non-rooted floating-leaved species *Lemna* spp. (duckweed), *Spirodela polyrrhiza* (common duckmeat), and *Wolffia* spp. (watermeal) could be common on the water surface.

Global Vegetation: Based on information in the northern parts of the Midwest, several vegetation subgroups can be recognized that may be separate associations. Subgroup A is a shallow (<50 cm), sparsely vegetated, open-water marsh found on sand, or organic and mineral material trapped in rocky bottoms. Stands are often exposed to wave action and found in oligotrophic lakes. Dominant plants often have basal rosettes that are resistant to wave action. Typical species include *Elatine minima* (small waterwort), *Eriocaulon aquaticum* (sevenangle pipewort), *Gratiola aurea* (golden hedgehyssop), *Isoetes tenella (= Isoetes echinospora)* (spiny-spore quillwort), *Isoetes lacustris (= Isoetes macrospora)* (lake quillwort), *Juncus pelocarpus* (brownfruit rush), and *Lobelia dortmanna* (Dortmann's cardinalflower) (Curtis 1959, Harris et al. 1996). Subgroup B is a shallow (<50 cm), open-water marsh with emergent cover <25% and floating-leaved aquatics >25%. Substrate is a mineral soil (often sand), boulders, or a mixture of sedimentary peat and fine mineral soil. Stands can be exposed to waves or are in stream channels. Stands may often be dominated by a single species. Typical dominants include *Eleocharis acicularis* (needle spikerush), *Myriophyllum* spp. (watermilfoil), *Potamogeton amplifolius* (largeleaf pondweed), *Potamogeton gramineus* (variableleaf pondweed), *Potamogeton praelongus* (whitestem pondweed), *Potamogeton robbinsii* (Robbins' pondweed), *Sparganium fluctuans* (floating bur-reed), and *Utricularia macrorhiza (= Utricularia vulgaris)* (common bladderwort). Subgroup C includes open-water marsh with emergent cover <25% and floating-leaved aquatics >25%. Substrate is sedimentary peat, and stands are often found in sheltered bays of lakes and streams that do not have high wave energy. Stands may often be dominated by a single species. Typical dominants include *Ceratophyllum demersum* (coon's tail), *Elodea canadensis* (Canadian waterweed), *Lemna* spp. (duckweed), *Myriophyllum sibiricum* (shortspike watermilfoil), *Myriophyllum verticillatum* (whorl-leaf watermilfoil), *Potamogeton natans* (floating pondweed), *Stuckenia pectinata (= Potamogeton pectinatus)* (sago pondweed), *Potamogeton richardsonii* (Richardson's pondweed), *Potamogeton zosteriformis* (flatstem pondweed), *Ranunculus aquatilis* (white water crowfoot), *Utricularia macrorhiza (= Utricularia vulgaris)* (common bladderwort), and *Vallisneria americana* (American eelgrass) (Curtis 1959, Harris et al. 1996).

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area:

Stratum	Lifeform	Species
Herb (field)	Forb	*Ceratophyllum demersum* (coon's tail), *Potamogeton crispus* (curly pondweed), *Potamogeton foliosus* (leafy pondweed), *Potamogeton perfoliatus* (claspingleaf pondweed), *Potamogeton zosteriformis* (flatstem pondweed), *Stuckenia pectinata* (sago pondweed)

Global: Information not available.

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: *Ceratophyllum demersum, Potamogeton crispus, Potamogeton foliosus, Potamogeton perfoliatus, Potamogeton zosteriformis, Stuckenia pectinata*

Global: Information not available.

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.

Global: Information not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (3-Oct-1996).

CLASSIFICATION

Status: Standard

Classification Confidence: 3 - Weak

Mississippi National River and Recreation Area Comments:

Global Comments: This type is based on information in the more northern parts of the range. However, it may need to be split into a boreal/sub-boreal type (subgroup A above) and a Midwestern type (subgroups B and C), and even within the Midwest there may be substantial differences between western and eastern stands (Robert Dana pers. comm. 1999). In Wisconsin, Subgroup A is considered distinctive, and could be ranked an S3 type. It is locally common there in deep, hard-bottomed seepage lakes of the Northern Highlands Pitted Outwash subsection (212Jm of Keys et al. 1995) (E. Epstein pers. comm. 1999).

Global Similar Associations:

- *Stuckenia pectinata - Ruppia maritima* Herbaceous Vegetation (CEGL002004) Prairie pothole type.

Global Related Concepts:

- Bladderwort Submerged - Floating-leaved Shallow Aquatic Type (Lee et al. 1998) <

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- Bur-reed Mixed Shallow Aquatic Type (Lee et al. 1998) <
- Lake Bed (MNNHP 1993) ><
- Open water marsh: floating-leaved plants (W4) (Harris et al. 1996) ><
- Pondweed Mixed Shallow Aquatic Type (Lee et al. 1998) <
- Pondweed Submerged Shallow Aquatic Type (Lee et al. 1998) <
- River Bed (MNNHP 1993) <
- Stonewort Submerged Shallow Aquatic Type (Lee et al. 1998) <
- Submerged Aquatic Northern Pondweed Subtype (Faber-Langendoen 2001) <
- Submerged Aquatic Pondweed Subtype (Faber-Langendoen 2001) <
- Water Stargrass Submerged Shallow Aquatic Type (Lee et al. 1998) <
- Waterweed Submerged Shallow Aquatic Type (Lee et al. 1998) <

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This widespread association was found throughout MISS on lakes in or out of the floodplain and in areas of the river protected from direct exposure to the current.
Global Range: This pondweed submerged aquatic type is found widely throughout the midwestern United States and adjacent Canada, ranging from Ohio and Ontario west to North Dakota and south to Iowa.
Nations: CA, US
States/Provinces: IA:SU, IL, IN, MI:S4, MN, ND, OH, ON, SD, WI, WY
TNC Ecoregions: 35:C, 36:C, 44:C, 45:C, 46:C, 47:C, 48:C, 49:C, 50:C
USFS Ecoregions (1994/95): 212Hb:CCP, 212Hi:CCC, 212Ho:CCC, 212Hs:CCC, 212Hv:CCC, 212Hw:CCC, 212Ia:CCC, 212Ib:CCP, 212Ja:CCP, 212Jb:CCP, 212Jc:CCP, 212Je:CCP, 212Jf:CCP, 212Jj:CCP, 212Jl:CCP, 212Jm:CCC, 212Ka:CPP, 212La:CPP, 212Mb:C??, 221Ef:CCC, 221Fc:CCC, 221He:CCC, 222Ao:CPP, 222Ch:CPP, 222Gc:CPP, 222Ha:CCC, 222Jg:CCC, 222Jh:CCC, 222Ji:CCC, 222Jj:CCC, 222Kf:CCC, 222L:CC, 222M:CC, 251Aa:???, 251Ba:???
Federal Lands: NPS (Apostle Islands, Cuyahoga Valley, Effigy Mounds, Grand Portage, Indiana Dunes, Isle Royale, Mississippi, Pictured Rocks, Saint Croix, Sleeping Bear Dunes, Voyageurs); USFS (Chequamegon, Chequamegon-Nicolet, Nicolet, Shawnee, Superior?)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: HPWD - Midwest Pondweed Submerged Aquatic Wetland
Mississippi National River and Recreation Area Inventory Notes: In one of the field seasons for this project, 2014, there was extensive high flooding in May and June, in particular. The composition and location of aquatic or emergent wetlands, in particular, were affected in the floodplains of the Minnesota, Mississippi, and Vermillion Rivers. Plant growth was delayed or plants were killed, scouring and deposition of alluvium altered habitat, etc.
Mississippi National River and Recreation Area Plots and Observation Points: MISS.070
Local Description Authors: J. Drake
Global Description Authors: D. Faber-Langendoen
References: Chapman et al. 1989, Curtis 1959, Faber-Langendoen 2001, Harris et al. 1996, Homoya et al. 1988, Hop et al. 1999, Hop et al. 2005, Hop et al. 2009, Hop et al. 2010a, Hop et al. 2010b, Hop et al. 2010c, INAI unpubl. data, Keys et al. 1995, Kost et al. 2007, Lee et al. 1998, MNNHP 1993, Midwestern Ecology Working Group n.d., NDNHI unpubl. data, ONHD unpubl. data, Swindale and Curtis 1957, TNC 1999b, WNDD unpubl. data, White and Madany 1978, Wilcox and Meeker 1991, Zartman and Pittillo 1998

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6. OPEN ROCK VEGETATION

6.B.1. Temperate & Boreal Cliff, Scree & Other Rock Vegetation

6.B.1.Na. Eastern North American Temperate Cliff, Scree & Rock Vegetation

M111. Eastern North American Cliff & Rock Vegetation

G106. Eastern North American Temperate Cliff

Midwest Dry Sandstone Cliff
Sandstone Midwest Dry Cliff Sparse Vegetation
Sandstone Midwest Dry Cliff Sparse Vegetation
Identifier: CEGL002045

USNVC CLASSIFICATION

Division	Eastern North American Temperate Cliff, Scree & Rock Vegetation (6.B.1.Na.)
Macrogroup	Eastern North American Cliff & Rock Vegetation (M111)
Group	Eastern North American Temperate Cliff (G106)
Alliance	Midwest Acidic Cliff Alliance (A3997)
Association	Midwest Dry Sandstone Cliff

ELEMENT CONCEPT

Global Summary: This dry sandstone cliff community is found throughout the central and upper midwestern United States and adjacent southern Canada. Stands occur as steep to vertical rock exposures of sandstone bedrock. Aspect is variable, but stands are best developed on south- and west-facing slopes. Vegetation is restricted to shelves, cracks and crevices in the rock, generally averaging less than 20%. Mosses and lichens are common, including crustose lichens. In the Ozarks and Interior Low Plateau, scattered occurrences of woody species, such as *Juniperus virginiana* (eastern red-cedar), *Quercus stellata* (black oak), *Vaccinium arboreum* (farkleberry), and *Vaccinium pallidum (= Vaccinium vacillans)* (Blue Ridge blueberry), are found. In the Ozarks and Interior Low Plateau, the herbaceous layer contains the ferns *Asplenium bradleyi* (Bradley's spleenwort), *Asplenium pinnatifidum* (lobed spleenwort), *Cheilanthes lanosa* (hairy lipfern), *Dennstaedtia punctilobula* (eastern hayscented fern), and *Dryopteris marginalis* (marginal woodfern). In Minnesota and Wisconsin the dry cliffs include forbs, such as *Aquilegia canadensis* (red columbine), *Campanula rotundifolia* (bluebell bellflower), *Solidago hispida* (hairy goldenrod), *Solidago sciaphila* (shadowy goldenrod) (Driftless area endemic), *Toxicodendron radicans* (eastern poison ivy), *Selaginella rupestris* (northern selaginella), *Silene antirrhina* (sleepy silene), and *Tradescantia ohiensis* (bluejacket), and the ferns *Asplenium trichomanes* (maidenhair spleenwort), *Pellaea atropurpurea* (purple cliffbrake), *Pellaea glabella* (smooth cliffbrake), *Polypodium virginianum (= Polypodium vulgare)* (rock polypody), and *Woodsia* spp. (cliff fern). The nonvascular layer in Missouri includes the mosses *Brothera leana, Polytrichum* spp., and *Rhodobryum roseum*, and the lichens, *Pleopsidium chlorophanum (= Acarospora chlorophana), Cladonia mateocyatha, Cladonia strepsilis*, and *Dermatocarpon miniatum*.

ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This association is poorly documented at MISS but occurs where steep to vertical sandstone bedrock is exposed. These cliffs or bluffs are at least 3 m tall. Soil development is limited to ledges and cracks.
Global Environment: Stands occur as steep to vertical rock exposures of sandstone bedrock, occasionally with dolostone interbedded. Aspect is variable, but stands are best developed on south- and west-facing slopes (Nelson 1985, MNNHP 1993). The geologic formations in Missouri include Channel Sands, St. Peter, Lamotte, Roubidoux, and Gunter formations (M. Leahy pers. comm. 1999).

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: Little is known of these cliff communities at MISS. Vascular plant growth is very sparse and limited to cracks and ledges where soil can accumulate. Non-vascular plants can be abundant.
Global Vegetation: Vegetation is restricted to shelves, cracks and crevices in the rock, generally averaging less than 20%. In the Ozarks and Interior Low Plateau, scattered occurrences of woody species, such as *Juniperus virginiana* (eastern red-cedar), *Quercus stellata, Vaccinium arboreum* (farkleberry), and *Vaccinium pallidum (= Vaccinium vacillans)* (Blue Ridge blueberry), are found. In the Ozarks and Interior Low Plateau, the herbaceous layer contains the ferns *Asplenium bradleyi* (Bradley's spleenwort), *Asplenium pinnatifidum* (lobed spleenwort), *Cheilanthes lanosa* (hairy lipfern), *Dennstaedtia punctilobula* (eastern hayscented fern), and *Dryopteris marginalis* (marginal woodfern). In Minnesota and Wisconsin the dry cliffs include forbs, such as *Aquilegia canadensis* (red columbine), *Campanula rotundifolia* (bluebell bellflower), *Solidago hispida* (hairy goldenrod), *Solidago sciaphila* (shadowy

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goldenrod) (Driftless Area endemic), *Toxicodendron radicans* (eastern poison ivy), *Selaginella rupestris* (northern selaginella), *Silene antirrhina* (sleepy silene), and *Tradescantia ohiensis* (bluejacket), and the ferns *Asplenium trichomanes* (maidenhair spleenwort), *Pellaea atropurpurea* (purple cliffbrake), *Pellaea glabella* (smooth cliffbrake), *Polypodium virginianum (= Polypodium vulgare)* (rock polypody), and *Woodsia* spp. (cliff fern). The nonvascular layer in Missouri includes the mosses *Brothera leana, Polytrichum* spp., and *Rhodobryum roseum*, and the lichens *Pleopsidium chlorophanum (= Acarospora chlorophana), Cladonia mateocyatha, Cladonia strepsilis*, and *Dermatocarpon miniatum* (White and Madany 1978, Homoya et al. 1985, Nelson 1985, MNNHP 1993, Anderson 1996). On some Driftless Area cliffs along major rivers, odd groupings of species can occur, e.g., *Dasiphora fruticosa* ssp. *floribunda (= Pentaphylloides floribunda)* (shrubby cinquefoil), *Ledum groenlandicum* (bog Labrador tea), and *Photinia melanocarpa (= Aronia melanocarpa)* (black chokeberry). Also, the endemic *Pseudognaphalium obtusifolium* ssp. *saxicola (= Gnaphalium saxicola)* (rabbit-tobacco) occurs exclusively on dry sandstone cliffs in the Driftless Area (E. Epstein pers. comm. 1999).

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area: Information not available.

Global: Information not available.

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: Information not available.
Global: Information not available.

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area:
Global: Vulnerable: *Pseudognaphalium obtusifolium* ssp. *saxicola* (G5T2)

CONSERVATION STATUS RANK

Global Rank & Reasons: G4G5 (2-Mar-2000). Although the cliffs may be relatively common, sites may lack adequate buffers above and below the cliffs.

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Mississippi National River and Recreation Area Comments: This association at MISS is classified based on steep slopes, exposed sandstone bedrock, and little to no vascular plant cover. The understanding of the plants, both vascular and non-vascular, commonly occurring on this association is very poor.
Global Comments: This type could be split into an Ozark/Interior Low Plateau sandstone cliff type and a more northern Midwest sandstone cliff type. Relation of this type to stands in the southeast needs to be resolved. Cliffs are defined as vertical exposures of rock at least 3 m tall. The distinction between open (dry) vs. shaded (moist) may be more important that bedrock type, at least on a local or State level. Curtis (1959) comments that in an effort to group the Wisconsin cliff data into meaningful categories, sites were separated by rock type (dolomite, sandstone, igneous) and exposure (shaded, exposed). He found that type of rock was far less important than exposure. For example, the shaded sandstone community had an index of similarity (based on presence/absence) of 64% with the shaded limestone community, but an index of 29% with the exposed sandstone community. As a result, he lumped the bedrock types together, but this produced some of the lowest indices of homogeneity among stands (approx. 35%) of any type in Wisconsin, though this may also reflect differences among northern and southern Wisconsin cliffs, as well as bedrock type and exposure (Curtis 1959, Table IV-2). In order to continue such comparisons regionwide, it will be necessary to continue grouping types by the combination of bedrock, pH, and exposure. Some cliffs contain multiple types of rocks, typically sandstone mixed with limestone or dolostone. This may complicate assignment of the cliff to a single rock type. In Ohio, Anderson (1996) provides several references to lichen composition on sandstone cliffs. In Kansas, sandstone cliffs occur in the Dakota sandstone region (extending into Nebraska), along several creeks/rivers in eastern Kansas, and in the Chautauqua Hills area in southeastern Kansas (Chris Lauver pers. comm. 1998).
Global Similar Associations:
- Appalachian - Alleghenian Sandstone Dry Cliff Sparse Vegetation (CEGL006435)
- *Juniperus virginiana / Corydalis sempervirens* Cliff Sparse Vegetation (CEGL006422)
- Limestone - Dolostone Midwest Dry Cliff Sparse Vegetation (CEGL002291)
- Sandstone Midwest Moist Cliff Vegetation (CEGL002287)

Global Related Concepts:
- Dry Acid Cliff (Chapman et al. 1989) >
- Dry Cliff (Southeast Section) (MNNHP 1993) >
- Exposed Rock Cliffs (Curtis 1959) >
- Open Cliff Sandstone Subtype (Faber-Langendoen 2001) =
- Sandstone Dry Cliff (Steinauer and Rolfsmeier 2000) =

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OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This uncommon association is found in a few small locations from downtown Minneapolis to Spring Lake Regional Park. There are a few tall sandstone cliffs, notably near Crosby Farm Park and Indian Mounds Park.
Global Range: This dry sandstone cliff community is found throughout the central and upper midwestern United States and adjacent Canada, ranging from Ohio and Ontario west to Minnesota, south to Kansas, and east to Indiana.
Nations: CA, US
States/Provinces: AR, IA:S3?, IL:S5, IN, KS:SU, MI, MN, MO:S3, NE:S4, OH, ON, WI:S4
TNC Ecoregions: 26:C, 36:C, 37:C, 38:C, 39:C, 44:C, 46:C, 48:C, 60:C
USFS Ecoregions (1994/95): 212Hi:CPP, 212Ja:CPP, 212Jn:CPP, 212Jr:CPP, 222Aa:CCC, 222Ac:CCC, 222Aj:CCC, 222Ak:CCC, 222Aq:CCC, 222Dc:CCP, 222De:CCC, 222Df:CCC, 222Dh:CCP, 222Di:CCP, 222Ga:CCC, 222Gb:CCC, 222Gc:CCC, 222Hf:C??, 222Ka:CCC, 222Lc:CCC, 222M:CC, 251Cj:CCC, 251Dd:CCC, M221:?
Federal Lands: NPS (Mississippi, Saint Croix); USFS (Hiawatha, Ozark?, Shawnee, Wayne)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: VDCF - Dry Cliff Face Sparse Vegetation
Mississippi National River and Recreation Area Inventory Notes: This association was not identified during plot sampling. It was found later in the project and so is described based on field reconnaissance notes. As such, it lacks species lists and detailed information on vegetation strata.
Mississippi National River and Recreation Area Plots and Observation Points: No plots in MISS.
Local Description Authors: J. Drake
Global Description Authors: D. Faber-Langendoen
References: Anderson 1996, Chapman et al. 1989, Curtis 1959, Epstein pers. comm., Faber-Langendoen 2001, Homoya et al. 1985, Homoya et al. 1988, INAI unpubl. data, Lauver et al. 1999, Leahy pers. comm., MNNHP 1993, Midwestern Ecology Working Group n.d., Minnesota DNR 2005a, Minnesota DNR 2005c, Nelson 1985, Nelson 2010, Rolfsmeier and Steinauer 2010, Steinauer and Rolfsmeier 2000, WNHI 2011, WNHI unpubl. data, White and Madany 1978

Midwest Dry Limestone - Dolostone Cliff

Limestone - Dolostone Midwest Dry Cliff Sparse Vegetation
Limestone - Dolostone Midwest Dry Cliff Sparse Vegetation
Identifier: CEGL002291

USNVC CLASSIFICATION

Division	Eastern North American Temperate Cliff, Scree & Rock Vegetation (6.B.1.Na.)
Macrogroup	Eastern North American Cliff & Rock Vegetation (M111)
Group	Eastern North American Temperate Cliff (G106)
Alliance	Midwest Alkaline Cliff Alliance (A3998)
Association	Midwest Dry Limestone - Dolostone Cliff

ELEMENT CONCEPT

Global Summary: This limestone - dolostone cliff community type is found throughout the midwestern United States and adjacent Canada. Stands occur as steep to vertical rock exposures of limestone bedrock. Aspect is variable, but stands are best developed on south- and west-facing slopes. Vegetation is restricted to shelves, cracks and crevices in the rock, generally averaging less than 20%, and typically consisting of vines and ferns. In the Ozarks and Interior Plateau region, ferns include *Cheilanthes feei* (slender lipfern), *Argyrochosma dealbata (= Notholaena dealbata)* (powdery false cloak fern), *Pellaea atropurpurea* (purple cliffbrake), and *Pellaea glabella* (smooth cliffbrake). Herbaceous forbs and graminoids include *Aquilegia canadensis* (red columbine), *Hedyotis nigricans (= Houstonia nigricans), Mentzelia oligosperma* (chickenthief), *Muhlenbergia cuspidata* (plains muhly), *Sedum pulchellum* (widowscross), and *Solidago rugosa* ssp. *aspera (= Solidago drummondii)* (wrinkleleaf goldenrod). Lichens include *Placidium lachneum (= Dermatocarpon lachneum), Lecanora muralis* and *Psora russellii*. In Ohio, stands contain the ferns *Pellaea atropurpurea* (purple cliffbrake), and *Pellaea glabella* (smooth cliffbrake), and the forbs *Aquilegia canadensis* (red columbine), *Arabis laevigata* (smooth rockcress), *Heuchera americana* (American alumroot), *Hydrangea arborescens* (wild hydrangea), and *Sedum ternatum* (woodland stonecrop). Scattered woody plants across the range include *Celastrus scandens* (American bittersweet), *Juniperus virginiana* (eastern red-cedar), *Parthenocissus quinquefolia* (Virginia creeper), *Physocarpus opulifolius* (common ninebark), *Quercus prinus* (chestnut oak) (southward), and *Toxicodendron radicans* (eastern poison ivy) *(= Rhus radicans)*, and farther north, *Taxus canadensis* (Canada yew), *Thuja occidentalis* (northern white cedar), and *Tsuga canadensis* (eastern hemlock).

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ENVIRONMENTAL DESCRIPTION

Mississippi National River and Recreation Area Environment: This association is poorly documented at MISS but occurs where steep to vertical limestone bedrock is exposed. These cliffs or bluffs are at least 3 m tall. Soil development is limited to ledges and cracks.

Global Environment: Stands occur as steep to vertical rock exposures of limestone bedrock. Aspect is variable, but stands are best developed on south- and west-facing slopes. Soils are either absent or, along ledges and shelves, very shallow. The cliffs drain very rapidly, and can become very dry in summer (Nelson 1985).

VEGETATION DESCRIPTION

Mississippi National River and Recreation Area Vegetation: Little is known of these cliff communities at MISS. Vascular plant growth is very sparse and limited to cracks and ledges where soil can accumulate. Non-vascular plants can be abundant.

Global Vegetation: Vegetation is restricted to shelves, cracks and crevices in the rock, generally averaging less than 20%, and typically consisting of vines and ferns. In the Ozarks and Interior Plateau region, ferns include *Cheilanthes feei* (slender lipfern), *Argyrochosma dealbata (= Notholaena dealbata)* (powdery false cloak fern), *Pellaea atropurpurea* (purple cliffbrake), and *Pellaea glabella* (smooth cliffbrake). Herbaceous forbs and graminoids include *Aquilegia canadensis* (red columbine), *Hedyotis nigricans (= Houstonia nigricans), Mentzelia oligosperma* (chickenthief), *Muhlenbergia cuspidata* (plains muhly), *Sedum pulchellum* (widowscross), and *Solidago rugosa* ssp. *aspera (= Solidago drummondii)* (wrinkleleaf goldenrod). Lichens include *Placidium lachneum (= Dermatocarpon lachneum), Lecanora muralis* and *Psora russellii*. In Ohio, stands contain the ferns *Pellaea atropurpurea* (purple cliffbrake) and *Pellaea glabella* (smooth cliffbrake), and the forbs *Aquilegia canadensis* (red columbine), *Arabis laevigata* (smooth rockcress), *Heuchera americana* (American alumroot), *Hydrangea arborescens* (wild hydrangea), and *Sedum ternatum* (woodland stonecrop). Scattered woody plants across the range include *Celastrus scandens* (American bittersweet), *Juniperus virginiana* (eastern red-cedar), *Parthenocissus quinquefolia* (Virginia creeper), *Physocarpus opulifolius* (common ninebark), *Quercus prinus* (chestnut oak) (southward), and *Toxicodendron radicans* (eastern poison ivy) *(= Rhus radicans)*, and farther north, *Taxus canadensis* (Canada yew), *Thuja occidentalis* (northern white cedar), and *Tsuga canadensis* (eastern hemlock) (Curtis 1959, Nelson 1985, MNNHP 1993, Anderson 1996).

MOST ABUNDANT SPECIES

Mississippi National River and Recreation Area: Information not available.

Global: Information not available.

CHARACTERISTIC SPECIES

Mississippi National River and Recreation Area: Information not available.

Global: Information not available.

OTHER NOTEWORTHY SPECIES

Mississippi National River and Recreation Area: Information not available.

Global: Information not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G4G5 (2-Mar-2000). In Missouri many sites have been quarried (M. Leahy pers. comm. 1999). This issue should be examined range-wide. Other sites lack adequate buffers above and below the cliffs. Finally, rock-climbing can be disruptive to vegetation (Larson et al. 1999a).

CLASSIFICATION

Status: Standard

Classification Confidence: 2 - Moderate

Mississippi National River and Recreation Area Comments: This association at MISS is classified based on steep slopes, exposed limestone bedrock, and little to no vascular plant cover. The understanding of the plants, both vascular and non-vascular, commonly occurring on this association is very poor.

Global Comments: Definitions of cliff types remain problematic. A minimum height of 3 m may be practical. Curtis (1959) in Wisconsin suggested that substrate was of secondary importance compared to moisture (shading vs. open) in determining floristic patterns. Furthermore some cliffs are a combination of layers of sandstone, shale and limestone or dolostone, making classification problematic. The combination of moisture and substrate is retained here, but a more systematic rangewide comparison of cliff floras is needed. Tim Nigh (pers. comm. 1996) has suggested that the Missouri type could be named "*Aquilegia canadensis* - *Solidago rugosa* ssp. *aspera (= Solidago drummondii)* - *Pellaea atropurpurea* Cliff." Ozark, southern Illinois, and Indiana cliffs may be better placed into a Southeastern/Interior Low Plateau type, separate from an upper Midwest type. Limestone cliffs along the Niagara Escarpment in central Ontario/Bruce Peninsula may be different from those in southern Ontario (Wasyl Bakowsky pers. comm. 1998) and from other Great Lakes limestone cliffs. A series of studies in Ontario's cliffs have led to a series of surprising biological discoveries, including a rich snail fauna, unusual cyanobacteria, and old growth *Thuja occidentalis* (northern white cedar) stands on the cliffs (Larson and Kelly 1991, Larson et al. 1999a, Larson et al. 1999b) [see also ~*Thuja occidentalis* Cliff Woodland (CEGL002451)$$]. In Kansas, limestone cliffs are particularly common in glaciated northeastern Kansas, on the western side of the Missouri River and perhaps other major rivers/creeks, and probably in the Osage Cuestas. Chalk breaks in west-central Kansas along the Smoky Hill River and

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associated terrain are cliff-like and probably need to be separated from the eastern cliffs (Lauver pers. comm. 1998). In Ohio, where limestone cliffs are found particularly in western Ohio, Lake Erie Islands, and unglaciated bluegrass region, Anderson (1996) cites a number of studies that describe the nonvascular vegetation. In Illinois see Winterringer and Vestal (1956).

Global Similar Associations:
- *Juniperus ashei* Ozark Clifftop Woodland (CEGL004672)
- Limestone - Dolostone Great Lakes Shore Cliff Sparse Vegetation (CEGL002504)
- Limestone - Dolostone Midwest Moist Cliff Vegetation (CEGL002292)
- *Pellaea atropurpurea* Cliff Sparse Vegetation (CEGL006527)
- Sandstone Midwest Dry Cliff Sparse Vegetation (CEGL002045)

Global Related Concepts:
- Canada Bluegrass Carbonate Open Cliff Type (Lee et al. 1998) <
- Cliff Communities (Anderson 1996) >
- Cliffbrake - Lichen Carbonate Open Cliff Type (Lee et al. 1998) <
- Dry Cliff (Southeast Section) (MNNHP 1993) >
- Dry Non-Acid Cliff (Chapman et al. 1989) >
- Exposed Rock Cliffs (Curtis 1959) >
- Open Carbonate Cliff Rim Type (Lee et al. 1998) <

OTHER COMMENTS

Other Comments:

ELEMENT DISTRIBUTION

Mississippi National River and Recreation Area Range: This uncommon association is found in a few small locations from downtown Minneapolis to Spring Lake Regional Park.

Global Range: This limestone/dolostone cliff community type is found throughout the midwestern United States and adjacent Canada, from Ohio and Ontario, west to Minnesota, south to Kansas, and possibly Arkansas, and east to Indiana.

Nations: CA, US

States/Provinces: IA:S4, IL, IN, KS:SU, MI, MN, MO:S5, OH, ON

TNC Ecoregions: 36:C, 37:C, 38:C, 44:C, 45:C, 46:C, 48:C

USFS Ecoregions (1994/95): 212Jn:CCC, 222Ac:CCC, 222Ad:CCC, 222Ae:CCC, 222Af:CCC, 222Ag:CCC, 222Ah:CCC, 222Ak:CCC, 222Am:CCC, 222Ap:CCC, 222Aq:CCC, 222Df:CCC, 222Di:CCP, 222Ek:CCC, 222Fd:CCC, 222Fe:CCC, 222Hc:CCC, 222Hf:CCP, 222Lc:CCC, 222Lf:CCC, 222Md:CCC, 251Ce:CCC

Federal Lands: NPS (Mississippi, Ozark Riverways); USFS (Shawnee)

ELEMENT SOURCES

Mississippi National River and Recreation Area Map Code: VDCF - Dry Cliff Face Sparse Vegetation

Mississippi National River and Recreation Area Inventory Notes: This association was not identified during plot sampling. It was found later in the project and so is described based on field reconnaissance notes. As such, it lacks species lists and detailed information on vegetation strata.

Mississippi National River and Recreation Area Plots and Observation Points: No plots in MISS.

Local Description Authors: J. Drake

Global Description Authors: D. Faber-Langendoen

References: Anderson 1996, Chapman et al. 1989, Chastain et al. 2006, Curtis 1959, Homoya et al. 1988, INAI unpubl. data, Larson and Kelly 1991, Larson et al. 1999a, Larson et al. 1999b, Lauver et al. 1999, Lee et al. 1998, MNNHP 1993, Midwestern Ecology Working Group n.d., Minnesota DNR 2005a, Minnesota DNR 2005c, Nelson 1985, Nelson 2010, ONHD unpubl. data, TDNH unpubl. data, White and Madany 1978, Winterringer and Vestal 1956

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Appendix C: Dichotomous Key to Vegetation Associations

Explanation and Use of the Key

This is a dichotomous field key to vegetation associations (plant communities) of Mississippi National River and Recreation Area (MISS). The vegetation associations are based on the U.S. National Vegetation Classification (USVCS) and were identified from field data collected for the MISS vegetation mapping project of the National Park Service Vegetation Inventory Program. For each vegetation association provided in the key, the USNVC association name is given, followed by the Community Global Element (CEGL) code.

For best results, all assessments of plant communities in the field should be done on an area of 5,000 m^2 (i.e., a 40-m radius around a point or a rectangle of 50 by 100 m) or 2500 m^2 (28 m radius around a point or a square 50 m by 50 m) and of uniform vegetation (a single vegetation community). "Appendix B: Descriptions of Vegetation Associations" in the project report for the MISS vegetation mapping project is recommended to complement this key to determine correct assessment of types.

The term "dominance" means greater than 50% relative cover within a given stratum unless otherwise noted. When the term "total canopy cover" is used, it is in reference to the absolute canopy cover. All other cover values refer to relative canopy cover; e.g., if total cover of the tree canopy is 40%, then a notation of >25% cover of sugar maple (*Acer saccharum*) refers to 25% of the 40% total cover.

GENERAL KEY

1A. Absence of standing water, saturated soils, and/or peat soil. Mineral soil not saturated throughout most of the growing season. Upland soils and vegetation prevalent. Wetlands absent or limited to occasional vernal pools; **does not** include floodplain sites that flood frequently. **2**

1B. Wetland soils and vegetation prevalent. Presence of standing water or saturated mineral, muck, or organic soils; **includes** floodplain sites that flood frequently. **22**

UPLAND

2A. Total tree canopy >25%. Forest or woodland. **3**

2B. Total tree canopy <25%. Dominated by shrubs or herbaceous vegetation. **13**

UPLAND FORESTS

3A. Tree canopy >75% deciduous hardwood species. **4**

3B. Tree canopy <75% deciduous hardwood species. **10**

4A. Tree canopy >75% exotic trees, early successional native trees, and trees planted in rows, usually boxelder (*Acer negundo*), paper birch (*Betula papyrifera*), common hackberry (*Celtis occidentalis*), green ash (*Fraxinus pennsylvanica*), eastern red-cedar (*Juniperus virginiana*), planted pines (*Pinus* spp.), quaking aspen (*Populus tremuloides*), eastern cottonwood (*Populus deltoides*), black cherry (*Prunus serotina*), black walnut (*Juglans nigra*), and Siberian elm (*Ulmus pumila*). **8**

4B. Tree canopy <75% exotic trees, early successional native trees, and trees planted in rows, boxelder (*Acer negundo*), paper birch (*Betula papyrifera*), common hackberry (*Celtis occidentalis*), green ash (*Fraxinus pennsylvanica*), eastern red-cedar (*Juniperus virginiana*), planted pines (*Pinus* spp.), quaking aspen (*Populus tremuloides*), eastern cottonwood (*Populus deltoides*), black cherry (*Prunus serotina*), black walnut (*Juglans nigra*), and Siberian elm (*Ulmus pumila*). **5**

5A. Tree canopy >20% northern red oak (*Quercus rubra*) and white oak (*Quercus alba*) AND >25% sugar maple (*Acer saccharum*) and American basswood (*Tilia americana*). Sites usually on mesic (north-facing) slopes with thin to moderately deep soil. Bedrock exposures and talus are often present. ..... ***Quercus rubra* - (*Acer saccharum*, *Quercus alba*) Forest (CEGL005017)**

5B. Tree canopy <20% northern red oak (*Quercus rubra*) and white oak (*Quercus alba*) OR <25% sugar maple (*Acer saccharum*) and American basswood (*Tilia americana*). **6**

6A. Tree canopy >50% oaks (*Quercus* spp.) and/or hickories (*Carya* spp.). **7**

6B. Tree canopy <50% oaks (*Quercus* spp.) and/or hickories (*Carya* spp.); dominants are sugar maple (*Acer saccharum*) and American basswood (*Tilia americana*), rarely with a supercanopy of eastern cottonwood (*Populus deltoides*). .....***Acer saccharum* - *Tilia americana* / *Ostrya virginiana* - *Carpinus caroliniana* Forest (CEGL002062)**

7A. Tree canopy dominated by white oak (*Quercus alba*) and/or northern red oak (*Quercus rubra*), sometimes with hickories (*Carya* spp.)..... ..... ***Quercus alba* - *Quercus rubra* - *Carya ovata* Glaciated Forest (CEGL002068)**

7B. Tree canopy dominated by bur oak (*Quercus macrocarpa*) and/or northern pin oak (*Quercus ellipsoidalis*)..... ***Quercus alba* - *Quercus macrocarpa* - *Quercus rubra* / *Corylus americana* Woodland (CEGL002142)**

8A. Tree canopy >50% quaking aspen (*Populus tremuloides*), black cherry (*Prunus serotina*), and paper birch (*Betula papyrifera*), sometimes with eastern cottonwood (*Populus deltoides*) and oaks (*Quercus* spp.)..... ***Populus tremuloides* / *Rhamnus cathartica* Ruderal Forest (CEGL005454)**

8B. Tree canopy <50% quaking aspen (*Populus tremuloides*), black cherry (*Prunus serotina*), and paper birch (*Betula papyrifera*). **9**

9A. Tree canopy >60% eastern cottonwood (*Populus deltoides*); tree canopy <60% absolute cover; ground layer is typically strongly herbaceous; site NOT on a floodplain or terrace that is regularly flooded. ..... ***Populus deltoides* / *Bromus inermis* Ruderal Forest (CEGL005455)**

9B. Tree canopy dominated by a combination of box elder (*Acer negundo*), hackberry (*Celtis occidentalis*), eastern cottonwood (*Populus deltoides*), Siberian elm (*Ulmus pumila*), black locust (*Robinia pseudoacacia*), and green ash (*Fraxinus pennsylvanica*) AND silver maple (*Acer saccharinum*) <5%; site NOT on a floodplain or terrace that is regularly flooded; tree canopy can be short in young stands..... ..***Acer negundo* - *Celtis occidentalis* - *Fraxinus pennsylvanica* Ruderal Forest (CEGL005462)**

10A. Sites on or immediately adjacent to steep bluffs; bedrock exposures common; conifer component of tree canopy >50% eastern red-cedar (*Juniperus virginiana*). ***Quercus muehlenbergii* - *Quercus* (*alba*, *velutina*) - (*Juniperus virginiana* var. *virginiana*) Driftless Bluff Woodland (CEGL002144)**

10B. Sites not as above. **11**

11A. Canopy >75% conifers; tree canopy >50% eastern red-cedar (*Juniperus virginiana*). ***Juniperus virginiana* Midwest Ruderal Forest (CEGL002593)**

11B. Canopy <75% conifers. **12**

12A. Canopy conifers not planted in rows; conifer component >50% eastern white pine (*Pinus strobus*); deciduous tree component dominated by white oak (*Quercus alba*) and northern red oak (*Quercus rubra*). ***Pinus strobus* - (*Pinus resinosa*) - *Quercus rubra* Forest (CEGL002480)**

12B. Deciduous component of canopy dominated by hickories (*Carya* spp.), green ash (*Fraxinus pennsylvanica*), and oaks (*Quercus* spp.); sites often on obviously disturbed or managed areas; canopy sometimes 25–60% absolute cover. ***Fraxinus pennsylvanica* - *Juniperus virginiana* - *Pinus* spp. - *Acer negundo* Ruderal Forest (CEGL005456)**

UPLAND SHRUBLANDS

13A. Shrubs generally taller than herbaceous species have >25% total cover. **14**

13B. Shrubs generally taller than herbaceous species have <25% total cover. **15**

14A. Shrub canopy >50% exotic honeysuckles (*Lonicera* x *bella, L. tatarica*, *L. morrowi*), smooth sumac (*Rhus glabra*), and prickly ash (*Zanthoxylum americanum*). ***Lonicera* (x *bella*, *morrowi*, *tatarica*) - *Rhus glabra* - *Zanthoxylum americanum* Ruderal Shrubland (CEGL005460)**

14B. Shrub canopy >50% common buckthorn (*Rhamnus cathartica*). ***Rhamnus cathartica* Ruderal Shrubland (CEGL005461)**

UPLAND HERBACEOUS

15A. >10% total vegetation cover. **16**

15B. <10% total vegetation cover, sites on cliffs. **21**

16A. Herbaceous canopy >25% native grasses; typically big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), grama (*Bouteloua curtipendula, B. hirsuta, B. gracilis*), Indiangrass (*Sorghastrum nutans*), switchgrass (*Panicum virgatum*), porcupinegrass (*Hesperostipa spartea*), bluejoint (*Calamagrostis canadensis*), and possibly others. **17**

16B. Herbaceous canopy <25% native grasses; typically big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), grama (*Bouteloua curtipendula, B. hirsuta*), Indiangrass (*Sorghastrum nutans*), switchgrass (*Panicum virgatum*), porcupinegrass (*Hesperostipa spartea*), bluejoint (*Calamagrostis canadensis*), and possibly others. **20**

17A. Of the native grasses, >50% big bluestem (*Andropogon gerardii*), Indiangrass (*Sorghastrum nutans*), bluejoint (*Calamagrostis canadensis*), and switchgrass (*Panicum virgatum*). ....***Andropogon gerardii* - *Sorghastrum nutans* - (*Sporobolus heterolepis*) - *Liatris* spp. - *Ratibida pinnata* Herbaceous Vegetation (CEGL002203)**

17B. Of the native grasses, <50% big bluestem (*Andropogon gerardii*), Indiangrass (*Sorghastrum nutans*), bluejoint (*Calamagrostis canadensis*), and switchgrass (*Panicum virgatum*). **18**

18A. Sites are usually strongly dominated by graminoids with relatively few forbs; of the native grasses, little bluestem (*Schizachyrium scoparium*) is the most common but other species of sandy soils can be common including sand reedgrass (*Calamovilfa longifolia*), sand dropseed (*Sporobolus cryptandrus*), and, in more mesic sites, big bluestem (*Andropogon gerardii*); sites on deep sandy soils often with a south or west aspect; stands can be large. ....***Schizachyrium scoparium* - *Danthonia spicata* - *Carex pensylvanica* - (*Viola pedata*) Herbaceous Vegetation (CEGL002318)**

18B. Graminoid-dominated but forb-rich; of the native grasses, sideoats grama (*Bouteloua curtipendula*), plains muhly (*Muhlenbergia cuspidata*), porcupine grass (*Hesperostipa spartea*), and prairie dropseed (*Sporobolus heterolepis*) are dominant; sites on coarse-textured, usually gravelly soils or thin soils over bedrock; stands always small..... **19**

19A. Sites on coarse-textured usually gravelly soils; of the native graminoids, sideoats grama (*Bouteloua curtipendula*), porcupine grass (*Hesperostipa spartea*), and Pennsylvania sedge (*Carex pensylvanica*) are dominant. .....***Schizachyrium scoparium* - *Bouteloua curtipendula* Gravel Herbaceous Vegetation (CEGL002215)**

19B. Sites on thin soils over bedrock; of the native grasses, sideoats grama (*Bouteloua curtipendula*), big bluestem (*Andropogon gerardii*), plains muhly (*Muhlenbergia cuspidata*), and little bluestem (*Schizachyrium scoparium*) are dominant.....***Schizachyrium scoparium* - *Bouteloua curtipendula* Bedrock Bluff Herbaceous Vegetation (CEGL002245)**

20A. Herbaceous canopy >40% Kentucky bluegrass (*Poa pratensis*), smooth brome (*Bromus inermis*), crabgrass (*Digitaria* spp.), bristlegrass (*Setaria* spp.). ....***Poa pratensis* - *Bromus inermis* Ruderal Herbaceous Vegetation (CEGL005457)**

20B. >50% exotic or generalist native forbs. Dry or dry-mesic sites. Species vary widely depending on past land use, management practices, and site conditions; common species include goldenrods (*Solidago* spp.), thistles (*Cirsium* spp.), annual ragweed (A*mbrosia artemisiifolia*), great ragweed (*Ambrosia trifida*), knotweed (*Polygonum* spp.), and spotted knapweed (*Centaurea stoebe*). ....***Solidago canadensis* - *Coronilla varia* Ruderal Herbaceous Vegetation (CEGL005459)**

SPARSE VEGETATION

21A. Sites on sandstone cliffs. .....**Sandstone Midwest Dry Cliff Sparse Vegetation (CEGL002045)**

21B. Sites on limestone/dolostone cliffs. ....**Limestone - Dolostone Midwest Dry Cliff Sparse Vegetation (CEGL002291)**

WETLANDS

22A. Total tree canopy > 25%. Forest or woodland. **23**
22B. Total tree canopy < 25%. Shrubland, herbaceous vegetation, or sparsely vegetated. **27**

WETLAND FORESTS

23A. Tree canopy >60% box elder (*Acer negundo*). ..... ***Acer negundo* Ruderal Floodplain Forest (CEGL005033)**
23B. Tree canopy <60% box elder (*Acer negundo*). **24**

24A. Tree canopy >50% cottonwood (*Populus deltoides*) and willow (*Salix* spp.) trees. ..... ***Populus deltoides - Salix nigra - Acer saccharinum* Forest (CEGL002018)**
24B. Tree canopy <50% cottonwood (*Populus deltoides*) and willow (*Salix* spp.) trees. **25**

25A. Canopy >50% silver maple (*Acer saccharinum*). ..... ***Acer saccharinum - Fraxinus pennsylvanica - Ulmus americana* Forest (CEGL002586)**
25B. Canopy <50% silver maple (*Acer saccharinum*). **26**

26A. Canopy >50% black ash (*Fraxinus nigra*), paper birch (*Betula papyrifera*), and yellow birch (*Betula alleghaniensis*); sites on muck soils. ..... ***Acer rubrum - Fraxinus* spp. - *Betula papyrifera* / *Cornus canadensis* Forest (CEGL002071)**
26B. Canopy >50% green ash (*Fraxinus pennsylvanica*), American basswood (*Tilia americana*), silver maple (*Acer saccharinum*), box elder (*Acer negundo*), American elm (*Ulmus americana*), and hackberry (*Celtis occidentalis*), sometimes black walnut (*Juglans nigra*); sites on terraces or upper floodplains. ..... ***Fraxinus pennsylvanica - Celtis occidentalis - Tilia americana - (Quercus macrocarpa) Forest (CEGL002081)**

WETLAND SHRUBLAND

27A. Total shrub canopy >25%. **28**
27B. Total shrub canopy <25%. **29**

28A. Shrub canopy >50% gray alder (*Alnus incana*). ..... ***Alnus incana* Swamp Shrubland (CEGL002381)**
28B. Shrub canopy >50% sandbar willow (*Salix interior*) and false indigo bush (*Amorpha fruticosa*). ..... ***Salix interior* Temporarily Flooded Shrubland (CEGL008562)**

WETLAND HERBACEOUS

29A. >10% total vegetation cover, including submergent aquatic species. **30**
29B. <10% total vegetation cover, including submergent aquatic species; sites along rivers and streams. **50**

30A. >10% perennial herbaceous species. **32**
30B. <10% perennial herbaceous species. **31**

31A. Sites in river floodplains on sand/gravel bars. **Riverine Sand Flats - Bars Annual Vegetation (CEG002049)**
31B. Sites in river floodplains on silt/mud flats. **River Mudflats Annual Vegetation (CEGL002314)**

32A. >10% total canopy cover by emergent herbaceous species. **33**
32B. <10% total canopy cover by emergent herbaceous species; submergent and/or rooted floating-leaved aquatic species >10% cover. **48**

33A. >80% cattail (*Typha* spp.). ***Typha* spp. Midwest Herbaceous Vegetation (CEGL002233)**
33B. <80% cattail (*Typha* spp.). **34**

34A. >80% reed canary grass (*Phalaris arundinacea*) relative to native species. ***Phalaris arundinacea* Eastern Ruderal Herbaceous Vegetation (CEGL006044)**
34B. <80% reed canary grass (*Phalaris arundinacea*) relative to native species. **35**

35A. >80% common reed (*Phragmites australis*) relative to native species. ***Phragmites australis* Eastern North America Temperate Ruderal Herbaceous Vegetation (CEGL004141)**
35B. <80% common reed (*Phragmites australis*) relative to native species. **36**

36A. >80% purple loosestrife (*Lythrum salicaria*) relative to native species. ***Lythrum salicaria* Ruderal Herbaceous Vegetation (CEGL006403)**
36B. <80% purple loosestrife (*Lythrum salicaria*) relative to native species. **37**

37A. >25% cover by sedges (*Carex* spp.) **38**
37B. <25% cover by sedges (*Carex* spp.) **39**

38A. Of the sedges (*Carex* spp.), hairy sedge (*Carex lacustris*) >50%. ***Carex lacustris* Herbaceous Vegetation (CEGL02256)**
38B. Of the sedges (*Carex* spp.), hairy sedge (*Carex lacustris*) <50%; >50% upright sedge (*Carex stricta*). ***Carex stricta* - *Carex* spp. Herbaceous Vegetation (CEGL02258)**

39A. Herbaceous cover >50% rice cutgrass (*Leersia oryzoides*) and arrowhead (*Sagittaria* spp.). ***Sagittaria latifolia* - *Leersia oryzoides* Herbaceous Vegetation (CEGL005240)**
39B. Herbaceous cover <50% rice cutgrass (*Leersia oryzoides*) and arrowhead (*Sagittaria* spp.). **40**

40A. Herbaceous cover >50% bluejoint (*Calamagrostis canadensis*), common boneset (*Eupatorium perfoliatum*), spotted joepyeweed (*Eupatorium maculatum*), geranium (*Geranium* spp.), waterhorehound (*Lycopus* spp.), goldenrod (*Solidago* spp.), jewelweed (*Impatiens capensis*), and hairy sedge (*Carex lacustris*). ..... ***Calamagrostis canadensis* North Central Wet Meadow (CEGL005449)**

40B. Herbaceous cover <50% bluejoint (*Calamagrostis canadensis*), common boneset (*Eupatorium perfoliatum*), spotted joepyeweed (*Eupatorium maculatum*), jewelweed (*Impatiens capensis*), and hairy sedge (*Carex lacustris*). **41**

41A. Herbaceous cover >50% river bulrush (*Schoenoplectus fluviatilis*). ..... ***Schoenoplectus fluviatilis* - *Schoenoplectus* spp. Herbaceous Vegetation (CEGL002221)**

41B. Herbaceous cover <50% river bulrush (*Schoenoplectus fluviatilis*). **42**

42A. Herbaceous cover >50% perennial wetland knotweeds (*Polygonum* spp.), typically water knotweed (*Polygonum amphibium*); sites with less vegetation cover by perennials may have a high proportion of annuals, especially later in the growing season. ..... ***Polygonum amphibium* - *Sagittaria latifolia* Riverine Herbaceous Vegetation (CEGL005458)**

42B. Herbaceous cover <50% perennial wetland knotweeds (*Polygonum* spp.). **43**

43A. Herbaceous cover >80% exotic or weedy species, typically purple loosestrife (*Lythrum salicaria*), reed canary grass (*Phalaris arundinacea*), common reed (*Phragmites australis*), dock (*Rumex* spp.), vervain (*Verbena* spp.), and ragweed (*Ambrosia* spp.). **44**

43B. Herbaceous cover <80% exotic or weedy species, typically purple loosestrife (*Lythrum salicaria*), reed canary grass (*Phalaris arundinacea*), common reed (*Phragmites australis*), dock (*Rumex* spp.), vervain (*Verbena* spp.), and ragweed (*Ambrosia* spp.). **47**

44A. Most abundant species is common reed (*Phragmites australis*). ..... ***Phragmites australis* Eastern North America Temperate Ruderal Herbaceous Vegetation (CEGL004141)**

44B. Most abundant species is NOT common reed (*Phragmites australis*). **45**

45A. Most abundant species is reed canary grass (*Phalaris arundinacea*). ..... **Phalaris arundinacea Eastern Ruderal Herbaceous Vegetation (CEGL006044)**

45B. Most abundant species is NOT reed canary grass (*Phalaris arundinacea*). **46**

46A. Most abundant species is purple loosestrife (*Lythrum salicaria*). ..... ***Lythrum salicaria* Ruderal Herbaceous Vegetation (CEGL006403)**

46B. >50% generalist native forbs. Wet or wet-mesic sites. Species vary widely depending on past land use, management practices, and site conditions; common species include dock (*Rumex* spp.), ragweed (*Ambrosia* spp.), vervain (*Verbena* spp.), arrowhead (*Sagittaria* spp.), knotweed (*Polygonum* spp.), and others. ..... ***Polygonum amphibium* - *Sagittaria latifolia* Riverine Herbaceous Vegetation (CEGL005458)**

47A. Shallow marshes dominated by one or more of a variety of emergent hydrophytic herbaceous species. Common species are bur-reed (*Sparganium* spp.), rush (*Juncus* spp.), cattail (*Typha* spp.), rice cut-grass (*Leersia oryzoides*), arrowhead (*Sagittaria* spp.), and sometimes duckweed (*Lemna* spp.); sites are flooded or saturated for nearly all of the growing season but water is usually <0.5 m deep. ..... ***Schoenoplectus tabernaemontani* - *Typha* spp. - (*Sparganium* spp., *Juncus* spp.) Herbaceous Vegetation (CEGL002026)**

47B. Deep marshes dominated by emergent herbaceous wetland species, typically cattail (*Typha* spp.) and hardstem bulrush (*Schoenoplectus acutus*); small floating-leaved plants such as watermeal (*Wolffia* spp.), common duckmeat (*Spirodella polyrrhiza*), and duckweed (*Lemna* spp.) are common as are open patches of water; water is often >0.5 m deep. .... ***Typha* spp. - *Schoenoplectus acutus* - Mixed Herbs Midwest Herbaceous Vegetation (CEGL002229)**

48A. >10% total cover of rooted floating-leaved species (not including non-rooted species such as watermeal (*Wolffia* spp.), common duckmeat (*Spirodella polyrrhiza*), and duckweed (*Lemna* spp.)..... **49**

48B. <10% total cover of rooted floating-leaved species, submergent species >10% total cover; dominants are pondweed (*Potamogeton* spp.) and/or hornwort (*Ceratophyllum* spp.). .... ***Potamogeton* spp. - *Ceratophyllum* spp. Midwest Herbaceous Vegetation (CEGL002282)**

49A. Aquatic herbaceous cover >50% American lotus (*Nelumbo lutea*). .... ***Nelumbo lutea* Herbaceous Vegetation (CEGL004323)**

49B. Aquatic herbaceous cover >50% yellow pond-lily (*Nuphar lutea*), American white waterlily (*Nymphaea odorata*), and/or watershield (*Brasenia schreberia*). ..... ***Nymphaea odorata* - *Nuphar* (*microphylla*, *variegata*) Herbaceous Vegetation (CEGL002562)**

50A. Most or all of site covered by water..... **OPEN WATER** (not a vegetation class)

50B. Most or all of site NOT covered by water. **51**

51A. Site on sand/gravel substrate..... **Riverine Sand Flats - Bars Annual Vegetation (CEGL002049)**

51B. Site on mud/silt substrate. ..... **River Mudflats Annual Vegetation (CEGL002314)**

Appendix D: List of Plant Species

Explanation of the Species List

Plant taxa were identified and documented from vegetation plots and accuracy assessment sites collected for the Mississippi National River and Recreation Area (MISS) vegetation mapping project. Plant taxa, along with other sample data, were entered into the National Park Service (NPS) PLOTS Database, Version 2.0 (NatureServe 2005) for subsequent analyses to characterize vegetation associations in the U.S. National Vegetation Classification and to make assessment of the vegetation map accuracy. These data were eventually converted to the PLOTS Database, Version 3.2 (Colorado Natural Heritage Program [CNHP] 2011) for the NPS. Table D-1 is an export of all plant taxa generated from the PLOTS Database for this project. This list includes taxa identified to the genus, species, and subspecies level. This list is not intended to be comprehensive list of every taxon at MISS. The plant taxa list is organized alphabetically by scientific name. Nomenclature follows the PLANTS database managed by the U.S. Department of Agriculture, which can be accessed at <http://plants.usda.gov>.

Table D-1. Plant species list of Mississippi National River and Recreation Area, Minnesota.

Scientific Name	Common Name	Family
Abutilon theophrasti	velvetleaf	Malvaceae
Acer	maple	Aceraceae
Acer ginnala	Amur maple	Aceraceae
Acer negundo	boxelder	Aceraceae
Acer platanoides	Norway maple	Aceraceae
Acer rubrum	red maple	Aceraceae
Acer saccharinum	silver maple	Aceraceae
Acer saccharum	sugar maple	Aceraceae
Achillea millefolium	common yarrow	Asteraceae
Acorus americanus	sweetflag	Acoraceae
Actaea rubra	red baneberry	Ranunculaceae
Adiantum pedatum	northern maidenhair	Pteridaceae
Aesculus glabra	Ohio buckeye	Hippocastanaceae
Agastache foeniculum	blue giant hyssop	Lamiaceae
Agastache scrophulariifolia	purple giant hyssop	Lamiaceae
Ageratina	snakeroot	Asteraceae
Ageratina altissima	white snakeroot	Asteraceae
Ageratina altissima var. *altissima*	white snakeroot	Asteraceae
Agrimonia gryposepala	tall hairy agrimony	Rosaceae
Agrimonia striata	roadside agrimony	Rosaceae
Alisma	water plantain	Alismataceae
Alisma triviale	northern water plantain	Alismataceae
Alliaria petiolata	garlic mustard	Brassicaceae
Alnus incana	gray alder	Betulaceae
Alnus incana ssp. *rugosa*	speckled alder	Betulaceae
Alopecurus aequalis	shortawn foxtail	Poaceae
Amaranthus	pigweed	Amaranthaceae
Amaranthus arenicola	sandhill amaranth	Amaranthaceae
Amaranthus cannabinus	tidalmarsh amaranth	Amaranthaceae
Amaranthus hybridus	slim amaranth	Amaranthaceae
Amaranthus rudis	tall amaranth	Amaranthaceae
Amaranthus tuberculatus	roughfruit amaranth	Amaranthaceae
Ambrosia artemisiifolia	annual ragweed	Asteraceae
Ambrosia trifida	great ragweed	Asteraceae

Scientific Name	Common Name	Family
Amelanchier	serviceberry	Rosaceae
Ammannia coccinea	valley redstem	Lythraceae
Amorpha	false indigo	Fabaceae
Amorpha canescens	leadplant	Fabaceae
Amorpha fruticosa	desert false indigo	Fabaceae
Amphicarpaea bracteata	American hogpeanut	Fabaceae
Anaphalis margaritacea	western pearly everlasting	Asteraceae
Andropogon gerardii	big bluestem	Poaceae
Anemone	anemone	Ranunculaceae
Anemone canadensis	Canadian anemone	Ranunculaceae
Anemone cylindrica	candle anemone	Ranunculaceae
Anemone quinquefolia	wood anemone	Ranunculaceae
Anemone virginiana	tall thimbleweed	Ranunculaceae
Anethum graveolens	dill	Apiaceae
Angelica	angelica	Apiaceae
Angelica atropurpurea	purplestem angelica	Apiaceae
Antennaria	pussytoes	Asteraceae
Antennaria neglecta	field pussytoes	Asteraceae
Antennaria plantaginifolia	woman's tobacco	Asteraceae
Apios americana	groundnut	Fabaceae
Apocynum	dogbane	Apocynaceae
Apocynum cannabinum	Indianhemp	Apocynaceae
Aquilegia canadensis	red columbine	Ranunculaceae
Arabis microphylla	littleleaf rockcress	Brassicaceae
Aralia nudicaulis	wild sarsaparilla	Araliaceae
Aralia racemosa	American spikenard	Araliaceae
Arctium minus	lesser burdock	Asteraceae
Arisaema triphyllum	Jack in the pulpit	Araceae
Artemisia	sagebrush	Asteraceae
Artemisia absinthium	absinthium	Asteraceae
Artemisia biennis	biennial wormwood	Asteraceae
Artemisia campestris	field sagewort	Asteraceae
Artemisia dracunculus	tarragon	Asteraceae
Artemisia frigida	prairie sagewort	Asteraceae
Artemisia ludoviciana	white sagebrush	Asteraceae
Artemisia serrata	sawtooth wormwood	Asteraceae
Artemisia vulgaris	common wormwood	Asteraceae
Asarum canadense	Canadian wildginger	Aristolochiaceae
Asclepias	milkweed	Asclepiadaceae
Asclepias exaltata	poke milkweed	Asclepiadaceae
Asclepias incarnata	swamp milkweed	Asclepiadaceae
Asclepias syriaca	common milkweed	Asclepiadaceae
Asclepias tuberosa	butterfly milkweed	Asclepiadaceae
Asclepias verticillata	whorled milkweed	Asclepiadaceae
Asclepias viridiflora	green comet milkweed	Asclepiadaceae
Asparagus officinalis	garden asparagus	Liliaceae
Aster	aster	Asteraceae
Astragalus canadensis	Canadian milkvetch	Fabaceae
Athyrium filix-femina	common ladyfern	Dryopteridaceae
Avena sativa	common oat	Poaceae
Bacopa rotundifolia	disk waterhyssop	Scrophulariaceae
Baptisia alba var. *macrophylla*	largeleaf wild indigo	Fabaceae

Scientific Name	Common Name	Family
Baptisia bracteata	longbract wild indigo	Fabaceae
Barbarea vulgaris	garden yellowrocket	Brassicaceae
Berberis thunbergii	Japanese barberry	Berberidaceae
Berteroa incana	hoary false madwort	Brassicaceae
Berula erecta	cutleaf waterparsnip	Apiaceae
Betula alleghaniensis	yellow birch	Betulaceae
Betula papyrifera	paper birch	Betulaceae
Bidens	beggarticks	Asteraceae
Bidens cernua	nodding beggartick	Asteraceae
Bidens connata	purplestem beggarticks	Asteraceae
Bidens coronata	crowned beggarticks	Asteraceae
Bidens discoidea	small beggarticks	Asteraceae
Bidens frondosa	devil's beggartick	Asteraceae
Bidens tripartita	threelobe beggarticks	Asteraceae
Boehmeria	false nettle	Urticaceae
Boehmeria cylindrica	smallspike false nettle	Urticaceae
Boltonia asteroides	white doll's daisy	Asteraceae
Boltonia asteroides var. *recognita*	white doll's daisy	Asteraceae
Botrychium oneidense	bluntlobe grapefern	Ophioglossaceae
Bouteloua curtipendula	sideoats grama	Poaceae
Bouteloua gracilis	blue grama	Poaceae
Brachyelytrum erectum	bearded shorthusk	Poaceae
Brasenia schreberi	watershield	Cabombaceae
Brassica nigra	black mustard	Brassicaceae
Brassica oleracea	cabbage	Brassicaceae
Bromus ciliatus	fringed brome	Poaceae
Bromus inermis	smooth brome	Poaceae
Bromus tectorum	cheatgrass	Poaceae
Calamagrostis	reedgrass	Poaceae
Calamovilfa longifolia	prairie sandreed	Poaceae
Caltha palustris	yellow marsh marigold	Ranunculaceae
Calystegia sepium	hedge false bindweed	Convolvulaceae
Calystegia sepium ssp. *americana*	hedge false bindweed	Convolvulaceae
Campanula rapunculoides	rampion bellflower	Campanulaceae
Campanula rotundifolia	bluebell bellflower	Campanulaceae
Campanulastrum americanum	American bellflower	Campanulaceae
Cannabis sativa	marijuana	Cannabaceae
Caragana arborescens	Siberian peashrub	Fabaceae
Cardamine bulbosa	bulbous bittercress	Brassicaceae
Cardamine pensylvanica	Pennsylvania bittercress	Brassicaceae
Carduus nutans	nodding plumeless thistle	Asteraceae
Carex	sedge	Cyperaceae
Carex amphibola	eastern narrowleaf sedge	Cyperaceae
Carex aquatilis	water sedge	Cyperaceae
Carex arctata	drooping woodland sedge	Cyperaceae
Carex bebbii	Bebb's sedge	Cyperaceae
Carex blanda	eastern woodland sedge	Cyperaceae
Carex brevior	shortbeak sedge	Cyperaceae
Carex brunnescens	brownish sedge	Cyperaceae
Carex caroliniana	Carolina sedge	Cyperaceae
Carex crawfordii	Crawford's sedge	Cyperaceae
Carex eburnea	bristleleaf sedge	Cyperaceae

Scientific Name	Common Name	Family
Carex gracillima	graceful sedge	Cyperaceae
Carex hystericina	bottlebrush sedge	Cyperaceae
Carex intumescens	greater bladder sedge	Cyperaceae
Carex lacustris	hairy sedge	Cyperaceae
Carex muehlenbergii	Muhlenberg's sedge	Cyperaceae
Carex normalis	greater straw sedge	Cyperaceae
Carex oligocarpa	richwoods sedge	Cyperaceae
Carex oligosperma	fewseed sedge	Cyperaceae
Carex pelocarpa	duskyseed sedge	Cyperaceae
Carex pensylvanica	Pennsylvania sedge	Cyperaceae
Carex projecta	necklace sedge	Cyperaceae
Carex radiata	eastern star sedge	Cyperaceae
Carex retrorsa	knotsheath sedge	Cyperaceae
Carex rosea	rosy sedge	Cyperaceae
Carex sprengelii	Sprengel's sedge	Cyperaceae
Carex stipata	owlfruit sedge	Cyperaceae
Carex stricta	upright sedge	Cyperaceae
Carex utriculata	Northwest Territory sedge	Cyperaceae
Carpinus caroliniana	American hornbeam	Betulaceae
Carya cordiformis	bitternut hickory	Juglandaceae
Carya ovalis	red hickory	Juglandaceae
Catalpa speciosa	northern catalpa	Bignoniaceae
Caulophyllum thalictroides	blue cohosh	Berberidaceae
Celastrus scandens	American bittersweet	Celastraceae
Celtis occidentalis	common hackberry	Ulmaceae
Centaurea biebersteinii	spotted knapweed	Asteraceae
Cerastium	mouse-ear chickweed	Caryophyllaceae
Ceratophyllum	hornwort	Ceratophyllaceae
Ceratophyllum demersum	coon's tail	Ceratophyllaceae
Chamaecrista fasciculata	sleepingplant	Fabaceae
Chamaesyce	sandmat	Euphorbiaceae
Chamaesyce geyeri	Geyer's sandmat	Euphorbiaceae
Chamaesyce glyptosperma	ribseed sandmat	Euphorbiaceae
Chelidonium majus	celandine	Papaveraceae
Chelone glabra	white turtlehead	Scrophulariaceae
Chenopodium	goosefoot	Chenopodiaceae
Chenopodium album	lambsquarters	Chenopodiaceae
Chenopodium berlandieri	pitseed goosefoot	Chenopodiaceae
Chenopodium pratericola	desert goosefoot	Chenopodiaceae
Chenopodium rubrum	red goosefoot	Chenopodiaceae
Chenopodium simplex	mapleleaf goosefoot	Chenopodiaceae
Cicuta maculata	spotted water hemlock	Apiaceae
Cimicifuga arizonica	Arizona bugbane	Ranunculaceae
Cinna arundinacea	sweet woodreed	Poaceae
Cinna latifolia	drooping woodreed	Poaceae
Circaea lutetiana	broadleaf enchanter's nightshade	Onagraceae
Cirsium	thistle	Asteraceae
Cirsium arvense	Canada thistle	Asteraceae
Cirsium discolor	field thistle	Asteraceae
Cirsium nuttallii	Nuttall's thistle	Asteraceae
Cirsium vulgare	bull thistle	Asteraceae
Clematis virginiana	devil's darning needles	Ranunculaceae

Scientific Name	Common Name	Family
Convolvulus	bindweed	Convolvulaceae
Conyza	horseweed	Asteraceae
Conyza canadensis	Canadian horseweed	Asteraceae
Coptis	goldthread	Ranunculaceae
Coreopsis palmata	stiff tickseed	Asteraceae
Cornus	dogwood	Cornaceae
Cornus alternifolia	alternateleaf dogwood	Cornaceae
Cornus amomum	silky dogwood	Cornaceae
Cornus racemosa	gray dogwood	Cornaceae
Cornus rugosa	roundleaf dogwood	Cornaceae
Cornus sericea	redosier dogwood	Cornaceae
Coronilla varia	purple crownvetch	Fabaceae
Corydalis caseana	Sierra fumewort	Fumariaceae
Corylus americana	American hazelnut	Betulaceae
Cryptotaenia canadensis	Canadian honewort	Apiaceae
Cuscuta	dodder	Cuscutaceae
Cuscuta pentagona	fiveangled dodder	Cuscutaceae
Cyperus	flatsedge	Cyperaceae
Cyperus erythrorhizos	redroot flatsedge	Cyperaceae
Cyperus esculentus	chufa flatsedge	Cyperaceae
Cyperus lupulinus	Great Plains flatsedge	Cyperaceae
Cyperus odoratus	fragrant flatsedge	Cyperaceae
Cyperus strigosus	strawcolored flatsedge	Cyperaceae
Cystopteris bulbifera	bulblet bladderfern	Dryopteridaceae
Cystopteris fragilis	brittle bladderfern	Dryopteridaceae
Dalea candida	white prairie clover	Fabaceae
Dalea purpurea	violet prairie clover	Fabaceae
Dalea villosa	silky prairie clover	Fabaceae
Danthonia spicata	poverty oatgrass	Poaceae
Datura stramonium	jimsonweed	Solanaceae
Daucus carota	Queen Anne's lace	Apiaceae
Decodon verticillatus	swamp loosestrife	Lythraceae
Delphinium carolinianum	Carolina larkspur	Ranunculaceae
Desmodium	ticktrefoil	Fabaceae
Desmodium canadense	showy ticktrefoil	Fabaceae
Desmodium cuspidatum	largebract ticktrefoil	Fabaceae
Desmodium glutinosum	pointedleaf ticktrefoil	Fabaceae
Desmodium illinoense	Illinois ticktrefoil	Fabaceae
Desmodium paniculatum	panicledleaf ticktrefoil	Fabaceae
Dicentra cucullaria	dutchman's breeches	Fumariaceae
Dichanthelium	rosette grass	Poaceae
Dichanthelium boreale	northern panicgrass	Poaceae
Dichanthelium oligosanthes	Heller's rosette grass	Poaceae
Diervilla lonicera	northern bush honeysuckle	Caprifoliaceae
Digitaria	crabgrass	Poaceae
Digitaria cognata	Carolina crabgrass	Poaceae
Digitaria sanguinalis	hairy crabgrass	Poaceae
Dioscorea	yam	Dioscoreaceae
Dioscorea villosa	wild yam	Dioscoreaceae
Dryopteris carthusiana	spinulose woodfern	Dryopteridaceae
Dryopteris cristata	crested woodfern	Dryopteridaceae
Dryopteris intermedia	intermediate woodfern	Dryopteridaceae

Scientific Name	Common Name	Family
Echinacea purpurea	eastern purple coneflower	Asteraceae
Echinochloa	cockspur grass	Poaceae
Echinochloa crus-galli	barnyardgrass	Poaceae
Echinochloa muricata	rough barnyardgrass	Poaceae
Echinochloa walteri	coast cockspur grass	Poaceae
Echinocystis lobata	wild cucumber	Cucurbitaceae
Eleocharis	spikerush	Cyperaceae
Eleocharis intermedia	matted spikerush	Cyperaceae
Eleocharis ovata	ovate spikerush	Cyperaceae
Eleocharis palustris	common spikerush	Cyperaceae
Elodea canadensis	Canadian waterweed	Hydrocharitaceae
Elodea nuttallii	western waterweed	Hydrocharitaceae
Elymus	wildrye	Poaceae
Elymus canadensis	Canada wildrye	Poaceae
Elymus hystrix	eastern bottlebrush grass	Poaceae
Elymus repens	quackgrass	Poaceae
Elymus riparius	riverbank wildrye	Poaceae
Elymus virginicus	Virginia wildrye	Poaceae
Epilobium leptophyllum	bog willowherb	Onagraceae
Equisetum arvense	field horsetail	Equisetaceae
Equisetum fluviatile	water horsetail	Equisetaceae
Equisetum hyemale	scouringrush horsetail	Equisetaceae
Equisetum laevigatum	smooth horsetail	Equisetaceae
Equisetum pratense	meadow horsetail	Equisetaceae
Equisetum sylvaticum	woodland horsetail	Equisetaceae
Eragrostis	lovegrass	Poaceae
Eragrostis hypnoides	teal lovegrass	Poaceae
Eragrostis pectinacea	tufted lovegrass	Poaceae
Eragrostis spectabilis	purple lovegrass	Poaceae
Erechtites hieraciifolia	American burnweed	Asteraceae
Erigeron	fleabane	Asteraceae
Erigeron annuus	eastern daisy fleabane	Asteraceae
Erigeron philadelphicus	Philadelphia fleabane	Asteraceae
Erigeron strigosus	prairie fleabane	Asteraceae
Eriochloa villosa	hairy cupgrass	Poaceae
Eriogonum strictum	Blue Mountain buckwheat	Polygonaceae
Eryngium yuccifolium	button eryngo	Apiaceae
Erysimum	wallflower	Brassicaceae
Euonymus atropurpurea	eastern wahoo	Celastraceae
Eupatorium altissimum	tall thoroughwort	Asteraceae
Eupatorium maculatum	spotted joepyeweed	Asteraceae
Eupatorium perfoliatum	common boneset	Asteraceae
Eupatorium purpureum	sweetscented joe pye weed	Asteraceae
Euphorbia	spurge	Euphorbiaceae
Euphorbia corollata	flowering spurge	Euphorbiaceae
Euphorbia cyparissias	cypress spurge	Euphorbiaceae
Euphorbia davidii	David's spurge	Euphorbiaceae
Euphorbia esula	leafy spurge	Euphorbiaceae
Eurybia macrophylla	bigleaf aster	Asteraceae
Euthamia graminifolia	flat-top goldentop	Asteraceae
Fernaldia	fernaldia	Apocynaceae
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Scientific Name	Common Name	Family
Fragaria	strawberry	Rosaceae
Fragaria vesca	woodland strawberry	Rosaceae
Fragaria virginiana	Virginia strawberry	Rosaceae
Frangula alnus	glossy buckthorn	Rhamnaceae
Fraxinus	ash	Oleaceae
Fraxinus americana	white ash	Oleaceae
Fraxinus nigra	black ash	Oleaceae
Fraxinus pennsylvanica	green ash	Oleaceae
Froelichia floridana	plains snakecotton	Amaranthaceae
Galium	bedstraw	Rubiaceae
Galium aparine	stickywilly	Rubiaceae
Galium asprellum	rough bedstraw	Rubiaceae
Galium boreale	northern bedstraw	Rubiaceae
Galium concinnum	shining bedstraw	Rubiaceae
Galium trifidum	threepetal bedstraw	Rubiaceae
Galium triflorum	fragrant bedstraw	Rubiaceae
Gaura biennis	biennial beeblossom	Onagraceae
Gentiana alba	plain gentian	Gentianaceae
Gentiana andrewsii	closed bottle gentian	Gentianaceae
Geranium	geranium	Geraniaceae
Geranium maculatum	spotted geranium	Geraniaceae
Geum	avens	Rosaceae
Geum aleppicum	yellow avens	Rosaceae
Geum canadense	white avens	Rosaceae
Geum macrophyllum	largeleaf avens	Rosaceae
Geum triflorum	old man's whiskers	Rosaceae
Glechoma hederacea	ground ivy	Lamiaceae
Gleditsia triacanthos	honeylocust	Fabaceae
Glyceria	mannagrass	Poaceae
Gnaphalium	cudweed	Asteraceae
Grindelia squarrosa	curlycup gumweed	Asteraceae
Gymnocladus dioicus	Kentucky coffeetree	Fabaceae
Hackelia virginiana	beggarslice	Boraginaceae
Helenium autumnale	common sneezeweed	Asteraceae
Helianthemum bicknellii	hoary frostweed	Cistaceae
Helianthus	sunflower	Asteraceae
Helianthus annuus	common sunflower	Asteraceae
Helianthus grosseserratus	sawtooth sunflower	Asteraceae
Helianthus hirsutus	hairy sunflower	Asteraceae
Helianthus maximiliani	Maximilian sunflower	Asteraceae
Helianthus pauciflorus	stiff sunflower	Asteraceae
Helianthus strumosus	paleleaf woodland sunflower	Asteraceae
Helianthus tuberosus	Jerusalem artichoke	Asteraceae
Heliopsis helianthoides	smooth oxeye	Asteraceae
Hepatica nobilis var. *acuta*	sharplobe hepatica	Ranunculaceae
Hepatica nobilis var. *obtusa*	roundlobe hepatica	Ranunculaceae
Heracleum maximum	common cowparsnip	Apiaceae
Hesperis matronalis	dames rocket	Brassicaceae
Hesperostipa spartea	porcupinegrass	Poaceae
Heteranthera dubia	grassleaf mudplantain	Pontederiaceae
Heterotheca stenophylla var. *angustifolia*	stiffleaf false goldenaster	Asteraceae
Heterotheca villosa	hairy false goldenaster	Asteraceae

Scientific Name	Common Name	Family
Heuchera	alumroot	Saxifragaceae
Hibiscus laevis	halberdleaf rosemallow	Malvaceae
Hieracium aurantiacum	orange hawkweed	Asteraceae
Hieracium longipilum	hairy hawkweed	Asteraceae
Hordeum	barley	Poaceae
Hordeum jubatum	foxtail barley	Poaceae
Hydrophyllum virginianum	eastern waterleaf	Hydrophyllaceae
Hypericum ascyron	great St. Johnswort	Clusiaceae
Hypericum perforatum	common St. Johnswort	Clusiaceae
Hypericum punctatum	spotted St. Johnswort	Clusiaceae
Impatiens	touch-me-not	Balsaminaceae
Impatiens capensis	jewelweed	Balsaminaceae
Impatiens pallida	pale touch-me-not	Balsaminaceae
Iris versicolor	harlequin blueflag	Iridaceae
Juglans cinerea	butternut	Juglandaceae
Juglans nigra	black walnut	Juglandaceae
Juncus	rush	Juncaceae
Juncus tenuis	poverty rush	Juncaceae
Juniperus virginiana	eastern redcedar	Cupressaceae
Koeleria macrantha	prairie Junegrass	Poaceae
Lactuca	lettuce	Asteraceae
Lactuca biennis	tall blue lettuce	Asteraceae
Lactuca serriola	prickly lettuce	Asteraceae
Laportea canadensis	Canadian woodnettle	Urticaceae
Larix laricina	tamarack	Pinaceae
Lathyrus	pea	Fabaceae
Lathyrus palustris	marsh pea	Fabaceae
Lathyrus sativus	white pea	Fabaceae
Lathyrus venosus	veiny pea	Fabaceae
Leersia	cutgrass	Poaceae
Leersia oryzoides	rice cutgrass	Poaceae
Leersia virginica	whitegrass	Poaceae
Lemna	duckweed	Lemnaceae
Lemna minor	common duckweed	Lemnaceae
Lemna trisulca	star duckweed	Lemnaceae
Lemna turionifera	turion duckweed	Lemnaceae
Leonurus cardiaca	common motherwort	Lamiaceae
Lepidium	pepperweed	Brassicaceae
Lepidium densiflorum	common pepperweed	Brassicaceae
Lepidium virginicum	Virginia pepperweed	Brassicaceae
Lespedeza capitata	roundhead lespedeza	Fabaceae
Leucanthemum vulgare	oxeye daisy	Asteraceae
Liatris aspera	tall blazing star	Asteraceae
Liatris ligulistylis	Rocky Mountain blazing star	Asteraceae
Liatris punctata	dotted blazing star	Asteraceae
Liatris pycnostachya	prairie blazing star	Asteraceae
Ligustrum vulgare	European privet	Oleaceae
Lilium	lily	Liliaceae
Linaria vulgaris	butter and eggs	Scrophulariaceae
Lindernia dubia	yellowseed false pimpernel	Scrophulariaceae
Lithospermum canescens	hoary puccoon	Boraginaceae
Lithospermum caroliniense	Carolina puccoon	Boraginaceae

Scientific Name	Common Name	Family
Lonicera	honeysuckle	Caprifoliaceae
Lonicera ×bella	Bell's honeysuckle	Caprifoliaceae
Lonicera dioica	limber honeysuckle	Caprifoliaceae
Lonicera morrowii	Morrow's honeysuckle	Caprifoliaceae
Lonicera tatarica	Tatarian honeysuckle	Caprifoliaceae
Lotus corniculatus	birdfoot deervetch	Fabaceae
Lupinus perennis	sundial lupine	Fabaceae
Lycopus americanus	American water horehound	Lamiaceae
Lycopus uniflorus	northern bugleweed	Lamiaceae
Lycopus virginicus	Virginia water horehound	Lamiaceae
Lycopus ×sherardii	waterhorehound	Lamiaceae
Lysimachia	yellow loosestrife	Primulaceae
Lysimachia ciliata	fringed loosestrife	Primulaceae
Lysimachia hybrida	lowland yellow loosestrife	Primulaceae
Lysimachia nummularia	creeping jenny	Primulaceae
Lysimachia thyrsiflora	tufted loosestrife	Primulaceae
Lysimachia vulgaris	garden yellow loosestrife	Primulaceae
Lythrum alatum	winged lythrum	Lythraceae
Lythrum salicaria	purple loosestrife	Lythraceae
Maianthemum	mayflower	Liliaceae
Maianthemum canadense	Canada mayflower	Liliaceae
Maianthemum racemosum	feathery false lily of the valley	Liliaceae
Maianthemum stellatum	starry false lily of the vally	Liliaceae
Maianthemum trifolium	threeleaf false lily of the valley	Liliaceae
Malus	apple	Rosaceae
Matteuccia	ostrich fern	Dryopteridaceae
Matteuccia struthiopteris	ostrich fern	Dryopteridaceae
Medicago	alfalfa	Fabaceae
Medicago lupulina	black medick	Fabaceae
Medicago sativa	alfalfa	Fabaceae
Melilotus	sweetclover	Fabaceae
Melilotus alba	white sweetclover	Fabaceae
Melilotus officinalis	yellow sweetclover	Fabaceae
Menispermum canadense	common moonseed	Menispermaceae
Mentha arvensis	wild mint	Lamiaceae
Mimulus ringens	Allegheny monkeyflower	Scrophulariaceae
Mirabilis nyctaginea	heartleaf four o'clock	Nyctaginaceae
Mollugo	carpetweed	Molluginaceae
Mollugo verticillata	green carpetweed	Molluginaceae
Monarda didyma	scarlet beebalm	Lamiaceae
Monarda fistulosa	wild bergamot	Lamiaceae
Monotropa uniflora	Indianpipe	Monotropaceae
Morus alba	white mulberry	Moraceae
Morus rubra	red mulberry	Moraceae
Muhlenbergia	muhly	Poaceae
Muhlenbergia frondosa	wirestem muhly	Poaceae
Muhlenbergia racemosa	marsh muhly	Poaceae
Muhlenbergia schreberi	nimblewill	Poaceae
Myosotis	forget-me-not	Boraginaceae
Myosotis laxa	bay forget-me-not	Boraginaceae
Myosoton aquaticum	giantchickweed	Caryophyllaceae
Myriophyllum sibiricum	shortspike watermilfoil	Haloragaceae

Scientific Name	Common Name	Family
Myriophyllum spicatum	spike watermilfoil	Haloragaceae
Nasturtium microphyllum	onerow yellowcress	Brassicaceae
Nasturtium officinale	watercress	Brassicaceae
Nelumbo lutea	American lotus	Nelumbonaceae
Nepeta cataria	catnip	Lamiaceae
Nuphar lutea ssp. *pumila*	yellow pond-lily	Nymphaeaceae
Nuphar lutea ssp. *variegata*	varigated yellow pond-lily	Nymphaeaceae
Nymphaea odorata	American white waterlily	Nymphaeaceae
Oenothera	evening-primrose	Onagraceae
Oenothera biennis	common evening primrose	Onagraceae
Oenothera clelandii	Cleland's evening-primrose	Onagraceae
Oligoneuron rigidum	stiff goldenrod	Asteraceae
Oligoneuron rigidum var. *rigidum*	stiff goldenrod	Asteraceae
Onoclea sensibilis	sensitive fern	Dryopteridaceae
Onosmodium molle	softhair marbleseed	Boraginaceae
Osmorhiza claytonii	Clayton's sweetroot	Apiaceae
Osmorhiza longistylis	longstyle sweetroot	Apiaceae
Osmunda cinnamomea	cinnamon fern	Osmundaceae
Osmunda claytoniana	interrupted fern	Osmundaceae
Ostrya virginiana	hophornbeam	Betulaceae
Oxalis	woodsorrel	Oxalidaceae
Oxalis stricta	common yellow oxalis	Oxalidaceae
Packera aurea	golden ragwort	Asteraceae
Panicum	panicgrass	Poaceae
Panicum capillare	witchgrass	Poaceae
Panicum virgatum	switchgrass	Poaceae
Parietaria	pellitory	Urticaceae
Parietaria pensylvanica	Pennsylvania pellitory	Urticaceae
Paronychia virginica	yellow nailwort	Caryophyllaceae
Parthenocissus quinquefolia	Virginia creeper	Vitaceae
Parthenocissus vitacea	woodbine	Vitaceae
Paspalum setaceum	thin paspalum	Poaceae
Pastinaca sativa	wild parsnip	Apiaceae
Penstemon grandiflorus	large beardtongue	Scrophulariaceae
Penthorum sedoides	ditch stonecrop	Crassulaceae
Petasites frigidus	arctic sweet coltsfoot	Asteraceae
Phalaris arundinacea	reed canarygrass	Poaceae
Phleum pratense	timothy	Poaceae
Phlox	phlox	Polemoniaceae
Phlox austromontana	mountain phlox	Polemoniaceae
Phragmites australis	common reed	Poaceae
Phryma leptostachya	American lopseed	Verbenaceae
Phyla lanceolata	lanceleaf fogfruit	Verbenaceae
Physalis	groundcherry	Solanaceae
Physalis heterophylla	clammy groundcherry	Solanaceae
Physalis longifolia	longleaf groundcherry	Solanaceae
Physalis virginiana	Virginia groundcherry	Solanaceae
Physostegia virginiana	obedient plant	Lamiaceae
Picea abies	Norway spruce	Pinaceae
Picea glauca	white spruce	Pinaceae
Picea pungens	blue spruce	Pinaceae
Pilea	clearweed	Urticaceae

Scientific Name	Common Name	Family
Pilea fontana	lesser clearweed	Urticaceae
Pilea pumila	Canadian clearweed	Urticaceae
Pinus banksiana	jack pine	Pinaceae
Pinus ponderosa	ponderosa pine	Pinaceae
Pinus resinosa	red pine	Pinaceae
Pinus strobus	eastern white pine	Pinaceae
Pinus sylvestris	Scotch pine	Pinaceae
Pinus virginiana	Virginia pine	Pinaceae
Plantago	plantain	Plantaginaceae
Plantago major	common plantain	Plantaginaceae
Plantago patagonica	woolly plantain	Plantaginaceae
Plantago rugelii	blackseed plantain	Plantaginaceae
Poa nemoralis ssp. *interior*	inland bluegrass	Poaceae
Poa palustris	fowl bluegrass	Poaceae
Poa pratensis	Kentucky bluegrass	Poaceae
Polanisia dodecandra	redwhisker clammyweed	Capparaceae
Polygonatum biflorum	smooth Solomon's seal	Liliaceae
Polygonum	knotweed	Polygonaceae
Polygonum amphibium	water knotweed	Polygonaceae
Polygonum arenastrum	oval-leaf knotweed	Polygonaceae
Polygonum convolvulus	black bindweed	Polygonaceae
Polygonum convolvulus var. *convolvulus*	black bindweed	Polygonaceae
Polygonum hydropiper	marshpepper knotweed	Polygonaceae
Polygonum lapathifolium	curlytop knotweed	Polygonaceae
Polygonum pensylvanicum	Pennsylvania smartweed	Polygonaceae
Polygonum perfoliatum	Asiatic tearthumb	Polygonaceae
Polygonum persicaria	spotted ladysthumb	Polygonaceae
Polygonum punctatum	dotted smartweed	Polygonaceae
Polygonum punctatum var. *confertiflorum*	dotted smartweed	Polygonaceae
Polygonum punctatum var. *punctatum*	dotted smartweed	Polygonaceae
Polygonum sagittatum	arrowleaf tearthumb	Polygonaceae
Polygonum scandens var. *scandens*	climbing false buckwheat	Polygonaceae
Polygonum virginianum	jumpseed	Polygonaceae
Populus deltoides	eastern cottonwood	Salicaceae
Populus grandidentata	bigtooth aspen	Salicaceae
Populus tremuloides	quaking aspen	Salicaceae
Portulaca oleracea	little hogweed	Portulacaceae
Potamogeton	pondweed	Potamogetonaceae
Potamogeton amplifolius	largeleaf pondweed	Potamogetonaceae
Potamogeton crispus	curly pondweed	Potamogetonaceae
Potamogeton foliosus	leafy pondweed	Potamogetonaceae
Potamogeton perfoliatus	claspingleaf pondweed	Potamogetonaceae
Potamogeton zosteriformis	flatstem pondweed	Potamogetonaceae
Potentilla	cinquefoil	Rosaceae
Potentilla argentea	silver cinquefoil	Rosaceae
Potentilla arguta	tall cinquefoil	Rosaceae
Potentilla norvegica	Norwegian cinquefoil	Rosaceae
Potentilla paradoxa	Paradox cinquefoil	Rosaceae
Potentilla recta	sulphur cinquefoil	Rosaceae
Potentilla simplex	common cinquefoil	Rosaceae
Prenanthes alba	white rattlesnakeroot	Asteraceae
Prunella vulgaris	common selfheal	Lamiaceae

Scientific Name	Common Name	Family
Prunus americana	American plum	Rosaceae
Prunus nigra	Canadian plum	Rosaceae
Prunus pensylvanica	pin cherry	Rosaceae
Prunus serotina	black cherry	Rosaceae
Prunus virginiana	chokecherry	Rosaceae
Psathyrostachys juncea	Russian wildrye	Poaceae
Pseudocrossidium obtusulum	pseudocrossidium moss	Pottiaceae
Pseudognaphalium obtusifolium	rabbittobacco	Asteraceae
Pseudognaphalium obtusifolium ssp. *obtusifolium*	rabbittobacco	Asteraceae
Pteridium aquilinum	western brackenfern	Dennstaedtiaceae
Pycnanthemum virginianum	Virginia mountainmint	Lamiaceae
Quercus alba	white oak	Fagaceae
Quercus ellipsoidalis	northern pin oak	Fagaceae
Quercus macrocarpa	bur oak	Fagaceae
Quercus rubra	northern red oak	Fagaceae
Ranunculus	buttercup	Ranunculaceae
Ranunculus abortivus	littleleaf buttercup	Ranunculaceae
Ranunculus arvensis	corn buttercup	Ranunculaceae
Ranunculus recurvatus	blisterwort	Ranunculaceae
Raphanus sativus	cultivated radish	Brassicaceae
Ratibida columnifera	upright prairie coneflower	Asteraceae
Ratibida pinnata	pinnate prairie coneflower	Asteraceae
Rhamnus cathartica	common buckthorn	Rhamnaceae
Rhus glabra	smooth sumac	Anacardiaceae
Rhus hirta	staghorn sumac	Anacardiaceae
Ribes	currant	Grossulariaceae
Ribes americanum	American black currant	Grossulariaceae
Ribes cynosbati	eastern prickly gooseberry	Grossulariaceae
Ribes missouriense	Missouri gooseberry	Grossulariaceae
Riccia fluitans		Ricciaceae
Ricciocarpos		Ricciaceae
Robinia pseudoacacia	black locust	Fabaceae
Rorippa	yellowcress	Brassicaceae
Rorippa nasturtium-aquaticum	watercress	Brassicaceae
Rorippa palustris ssp. *hispida*	hispid yellowcress	Brassicaceae
Rosa acicularis	prickly rose	Rosaceae
Rosa arkansana	prairie rose	Rosaceae
Rosa blanda	smooth rose	Rosaceae
Rubus	blackberry	Rosaceae
Rubus allegheniensis	Allegheny blackberry	Rosaceae
Rubus idaeus	American red raspberry	Rosaceae
Rubus idaeus ssp. *strigosus*	grayleaf red raspberry	Rosaceae
Rubus laciniatus	cutleaf blackberry	Rosaceae
Rubus occidentalis	black raspberry	Rosaceae
Rubus pubescens	dwarf red blackberry	Rosaceae
Rubus wheeleri	Wheeler's blackberry	Rosaceae
Rubus wisconsinensis	Wisconsin blackberry	Rosaceae
Rudbeckia hirta	blackeyed Susan	Asteraceae
Rudbeckia laciniata	cutleaf coneflower	Asteraceae
Ruellia brittoniana	Britton's wild petunia	Acanthaceae
Rumex altissimus	pale dock	Polygonaceae
Rumex crispus	curly dock	Polygonaceae

Scientific Name	Common Name	Family
Rumex obtusifolius	bitter dock	Polygonaceae
Rumex orbiculatus	greater water dock	Polygonaceae
Sagittaria	arrowhead	Alismataceae
Sagittaria calycina	hooded arrowhead	Alismataceae
Sagittaria graminea	grassy arrowhead	Alismataceae
Sagittaria latifolia	broadleaf arrowhead	Alismataceae
Sagittaria montevidensis	giant arrowhead	Alismataceae
Sagittaria rigida	sessilefruit arrowhead	Alismataceae
Salix	willow	Salicaceae
Salix ×rubens	hybrid crack willow	Salicaceae
Salix amygdaloides	peachleaf willow	Salicaceae
Salix babylonica	Weeping willow	Salicaceae
Salix bebbiana	Bebb willow	Salicaceae
Salix cascadensis	cascade willow	Salicaceae
Salix discolor	pussy willow	Salicaceae
Salix eriocephala	Missouri River willow	Salicaceae
Salix glauca	grayleaf willow	Salicaceae
Salix humilis var. *humilis*	prairie willow	Salicaceae
Salix interior	sandbar willow	Salicaceae
Salix nigra	black willow	Salicaceae
Salix pentandra	laurel willow	Salicaceae
Salix petiolaris	meadow willow	Salicaceae
Sambucus nigra	black elderberry	Caprifoliaceae
Sambucus nigra ssp. *canadensis*	American black elderberry	Caprifoliaceae
Sambucus racemosa	red elderberry	Caprifoliaceae
Sanguinaria	bloodroot	Papaveraceae
Sanguinaria canadensis	bloodroot	Papaveraceae
Sanicula	sanicle	Apiaceae
Sanicula marilandica	Maryland sanicle	Apiaceae
Sanicula odorata	clustered blacksnakeroot	Apiaceae
Schizachyrium scoparium	little bluestem	Poaceae
Schoenoplectus	bulrush	Cyperaceae
Schoenoplectus fluviatilis	river bulrush	Cyperaceae
Schoenoplectus tabernaemontani	softstem bulrush	Cyperaceae
Scirpus	bulrush	Cyperaceae
Scirpus atrovirens	green bulrush	Cyperaceae
Scirpus cyperinus	woolgrass	Cyperaceae
Scrophularia	figwort	Scrophulariaceae
Scrophularia lanceolata	lanceleaf figwort	Scrophulariaceae
Scrophularia marilandica	carpenter's square	Scrophulariaceae
Scutellaria galericulata	marsh skullcap	Lamiaceae
Scutellaria lateriflora	blue skullcap	Lamiaceae
Senecio	ragwort	Asteraceae
Setaria	bristlegrass	Poaceae
Setaria faberi	Japanese bristlegrass	Poaceae
Setaria pumila	yellow bristlegrass	Poaceae
Setaria viridis	green bristlegrass	Poaceae
Sicyos angulatus	oneseed burr cucumber	Cucurbitaceae
Silene csereii	Balkan catchfly	Caryophyllaceae
Silene latifolia	bladder campion	Caryophyllaceae
Silene latifolia ssp. *alba*	bladder campion	Caryophyllaceae
Silene suksdorfii	Suksdorf's silene	Caryophyllaceae

Scientific Name	Common Name	Family
Silphium	rosinweed	Asteraceae
Silphium laciniatum	compassplant	Asteraceae
Silphium perfoliatum	cup plant	Asteraceae
Sisymbrium loeselii	small tumbleweed mustard	Brassicaceae
Sium suave	hemlock waterparsnip	Apiaceae
Smilax ecirrata	upright carrionflower	Smilacaceae
Smilax herbacea	smooth carrionflower	Smilacaceae
Smilax lasioneura	Blue Ridge carrionflower	Smilacaceae
Smilax tamnoides	bristly greenbrier	Smilacaceae
Solanum dulcamara	climbing nightshade	Solanaceae
Solanum nigrum	black nightshade	Solanaceae
Solidago	goldenrod	Asteraceae
Solidago arguta	Atlantic goldenrod	Asteraceae
Solidago canadensis	Canada goldenrod	Asteraceae
Solidago flexicaulis	zigzag goldenrod	Asteraceae
Solidago gigantea	giant goldenrod	Asteraceae
Solidago missouriensis	Missouri goldenrod	Asteraceae
Solidago nemoralis	gray goldenrod	Asteraceae
Solidago speciosa	showy goldenrod	Asteraceae
Sonchus	sowthistle	Asteraceae
Sonchus arvensis	field sowthistle	Asteraceae
Sonchus asper	spiny sowthistle	Asteraceae
Sorbus aucuparia	European mountain ash	Rosaceae
Sorbus decora	northern mountain ash	Rosaceae
Sorghastrum nutans	Indiangrass	Poaceae
Sparganium	bur-reed	Sparganiaceae
Sparganium eurycarpum	broadfruit bur-reed	Sparganiaceae
Spartina pectinata	prairie cordgrass	Poaceae
Spiraea alba	white meadowsweet	Rosaceae
Spirodela polyrrhiza	common duckmeat	Lemnaceae
Sporobolus cryptandrus	sand dropseed	Poaceae
Sporobolus heterolepis	prairie dropseed	Poaceae
Stachys palustris	marsh hedgenettle	Lamiaceae
Stachys pilosa	hairy hedgenettle	Lamiaceae
Stachys tenuifolia	smooth hedgenettle	Lamiaceae
Staphylea trifolia	American bladdernut	Staphyleaceae
Stellaria	starwort	Caryophyllaceae
Stellaria media	common chickweed	Caryophyllaceae
Strophostyles helvula	trailing fuzzybean	Fabaceae
Strophostyles leiosperma	slickseed fuzzybean	Fabaceae
Stuckenia	pondweed	Potamogetonaceae
Stuckenia pectinatus	sago pondweed	Potamogetonaceae
Symphoricarpos albus	common snowberry	Caprifoliaceae
Symphoricarpos occidentalis	western snowberry	Caprifoliaceae
Symphyotrichum	aster	Asteraceae
Symphyotrichum ciliolatum	Lindley's aster	Asteraceae
Symphyotrichum cordifolium	common blue wood aster	Asteraceae
Symphyotrichum dumosum var. *dumosum*	rice button aster	Asteraceae
Symphyotrichum ericoides	white heath aster	Asteraceae
Symphyotrichum laeve	smooth blue aster	Asteraceae
Symphyotrichum lanceolatum	white panicle aster	Asteraceae
Symphyotrichum lateriflorum	calico aster	Asteraceae

Scientific Name	Common Name	Family
Symphyotrichum novae-angliae	New England aster	Asteraceae
Symphyotrichum ontarione	bottomland aster	Asteraceae
Symphyotrichum oolentangiense	skyblue aster	Asteraceae
Symphyotrichum pilosum	hairy white oldfield aster	Asteraceae
Symphyotrichum sericeum	western silver aster	Asteraceae
Symplocarpus foetidus	skunk cabbage	Araceae
Syringa vulgaris	common lilac	Oleaceae
Taraxacum officinale	common dandelion	Asteraceae
Taxus canadensis	Canada yew	Taxaceae
Teucrium canadense	Canada germander	Lamiaceae
Thalictrum	meadow-rue	Ranunculaceae
Thalictrum dasycarpum	purple meadow-rue	Ranunculaceae
Thalictrum dioicum	early meadow-rue	Ranunculaceae
Thalictrum thalictroides	rue anemone	Ranunculaceae
Thelypteris palustris	eastern marsh fern	Thelypteridaceae
Thlaspi arvense	field pennycress	Brassicaceae
Tilia americana	American basswood	Tiliaceae
Torilis japonica	erect hedgeparsley	Apiaceae
Toxicodendron radicans	eastern poison ivy	Anacardiaceae
Toxicodendron rydbergii	western poison ivy	Anacardiaceae
Tradescantia occidentalis	prairie spiderwort	Commelinaceae
Tradescantia ohiensis	bluejacket	Commelinaceae
Tragopogon dubius	yellow salsify	Asteraceae
Trichostema austromontanum	San Jacinto bluecurls	Lamiaceae
Trifolium	clover	Fabaceae
Trifolium arvense	rabbitfoot clover	Fabaceae
Trifolium hybridum	alsike clover	Fabaceae
Trifolium pratense	red clover	Fabaceae
Trifolium repens	white clover	Fabaceae
Trillium	trillium	Liliaceae
Trillium cernuum	whip-poor-will flower	Liliaceae
Triosteum aurantiacum	orangefruit horse-gentian	Caprifoliaceae
Triosteum perfoliatum	feverwort	Caprifoliaceae
Typha	cattail	Typhaceae
Typha ×glauca	hybrid cattail	Typhaceae
Typha angustifolia	narrowleaf cattail	Typhaceae
Typha latifolia	broadleaf cattail	Typhaceae
Ulmus	elm	Ulmaceae
Ulmus americana	American elm	Ulmaceae
Ulmus pumila	Siberian elm	Ulmaceae
Ulmus rubra	slippery elm	Ulmaceae
Urtica dioica	stinging nettle	Urticaceae
Utricularia	bladderwort	Lentibulariaceae
Uvularia grandiflora	largeflower bellwort	Liliaceae
Uvularia sessilifolia	sessileleaf bellwort	Liliaceae
Vallisneria americana	American eelgrass	Hydrocharitaceae
Verbascum thapsus	common mullein	Scrophulariaceae
Verbena	vervain	Verbenaceae
Verbena hastata	swamp verbena	Verbenaceae
Verbena stricta	hoary verbena	Verbenaceae
Verbena urticifolia	white vervain	Verbenaceae
Vernonia fasciculata	prairie ironweed	Asteraceae

Scientific Name	Common Name	Family
Veronica arvensis	corn speedwell	Scrophulariaceae
Veronica serpyllifolia	thymeleaf speedwell	Scrophulariaceae
Veronica verna	spring speedwell	Scrophulariaceae
Veronicastrum	veronicastrum	Scrophulariaceae
Veronicastrum virginicum	Culver's root	Scrophulariaceae
Viburnum lantana	wayfaringtree	Caprifoliaceae
Viburnum lentago	nannyberry	Caprifoliaceae
Viburnum opulus	European cranberrybush	Caprifoliaceae
Viburnum opulus var. *americanum*	American cranberrybush	Caprifoliaceae
Viburnum rafinesquianum	downy arrowwood	Caprifoliaceae
Vicia americana	American vetch	Fabaceae
Vicia villosa	winter vetch	Fabaceae
Viola	violet	Violaceae
Viola canadensis	Canadian white violet	Violaceae
Viola cucullata	marsh blue violet	Violaceae
Viola pedatifida	prairie violet	Violaceae
Viola pubescens	downy yellow violet	Violaceae
Viola sororia	common blue violet	Violaceae
Vitis riparia	riverbank grape	Vitaceae
Wolffia	watermeal	Lemnaceae
Wolffia borealis	northern watermeal	Lemnaceae
Wolffia columbiana	Columbian watermeal	Lemnaceae
Woodsia	cliff fern	Dryopteridaceae
Xanthium strumarium	rough cockleburr	Asteraceae
Zanthoxylum americanum	common pricklyash	Rutaceae
Zea mays	corn	Poaceae
Zizia aurea	golden zizia	Apiaceae

Appendix E: Descriptions of Map Classes

Explanation of Map-Class Descriptions

This appendix to the main report of the Mississippi National River and Recreation Area (MISS) vegetation mapping project provides descriptions of the 45 map classes used to map MISS for the National Park Service (NPS) Vegetation Inventory Program (VIP). Of these 45 map classes, 42 represent vegetation types in the U.S. National Vegetation Classification (USNVC) whereas 3 map classes represent non-vegetative open-water bodies (non-USNVC). Of the 42 map classes representing USNVC types, 15 are forest or woodland map classes, 16 are shrub or herbaceous map classes, 3 are sparse vegetation over rocks, sand, or mud map classes, 1 is a mosaic map class of mixed riverine vegetation, and 7 cultural map classes of agricultural or developed lands.

For those map classes representing vegetation associations in the USNVC, "Appendix B: Descriptions of Vegetation Associations" and "Appendix C: Dichotomous Key to Vegetation Associations" should be used to complement the map-class descriptions in this appendix.

Each map-class description provides the formal map-class code and name used for mapping. For map classes that represent just one vegetation association in the USNVC, the association common name provided by NatureServe is used as the map-class name, with the exception of the Eastern Red-cedar - (Hardwood) Bluff Woodland (WBRC) map class. Because chinquapin oak (*Quercus muehlenbergii*) is absent from this association in the park, the map-class name focuses on the eastern red-cedar (*Juniperus virginiana*) that dominates these sites. For map classes that represent more than one vegetation association, cultural vegetation, or a non-vegetation feature, a comparable or generic name for the map class were derived.

At the beginning of each map-class description, the USNVC classification name(s) and code(s) the map class represents is provided, with the exception of non-vegetated open water bodies. Each map class is described with a focus on how it presents in the MISS landscape, noting that this may not reflect how the various USNVC types present across their range. Descriptions are from a mapping, rather than an ecological, perspective, but ecological concepts relevant to the mapping effort were integrated into the map-class description. Full ecological descriptions of each vegetation association are available in "Appendix B: Descriptions of Vegetation Associations."

Throughout the map-class descriptions, "MMU" refers to minimum mapping unit and "AA" refers to accuracy assessment. Hardwood trees refer to all deciduous tree species. Tree species, such as northern red oak (*Quercus rubra*), eastern red-cedar (*Juniperus virginiana*), and green ash (*Fraxinus pennsylvanica*), are to be assumed to be of heights >5 m, unless otherwise specified (e.g., shrub-height trees) in the description. The term "tree species" includes general references to trees as conifers and hardwoods. Furthermore, unless otherwise noted, the herbaceous types have >10% herbaceous cover and <25% total tree and shrub canopy closure; shrubland types have >25% shrub canopy closure and <25% tree canopy closure, woodlands have >25% tree canopy closure, and forests typically have >60% tree canopy closure.

Along with text descriptions of the map classes, ground pictures are provided when possible to visually depict the vegetation types and non-vegetation features that the map classes represent. It is

worth noting that the pictures are a partial representation; capturing all variations within a map class would not be possible.

Map classes are sorted to match the order in which the vegetation they represent is presented in the USNVC. Map classes that represent non-vegetative open-water bodies are not included in the USNVC. Map-classification codes, names, and their crosswalk to vegetation types in the USNVC, are listed in Table E-1. Table E-2 shows the map classification set within the hierarchy of the USNVC. In Table E-2, map classes that represent more than one vegetation association are noted with an asterisk (*). Of note, these map classes may represent vegetation associations in more than one location in the USNVC. The map classification is listed alphabetically by map-class code in Table E-3 at the end of this appendix.

Minimum Mapping Units

The NPS VIP standard minimum mapping unit (MMU) of 0.5 ha was applied to mapping forest and cultural types. For shrub, herbaceous, and sparsely vegetated types, as well as non-vegetation features, a MMU of 0.25 ha was applied. This smaller MMU was applied because these vegetation types were comparatively rare across the park, the degree of vegetation diversity over small areas was higher, and the isolated patches across MISS were more prevalent. For woodlands, a MMU of 0.5 ha was applied to deciduous woodlands and a MMU of 0.25 ha was applied to conifer woodlands due to the individual circumstances surrounding these woodlands. Also, when vegetation types were found unique to their immediate surroundings (e.g., an herbaceous wetland within an upland forest), mapping below the MMU was allowed.

No Map Class

There is one vegetation association in the USNVC that was not defined by any one map class. This association was found to always be below the MMU and is the *Alnus incana* Swamp Shrubland Association (CEGL002381).

Small patches of CEGL002381 were found in isolated wetlands and backwaters around the park, but only rarely and always in patches well below the MMU. It is realistic to expect small clumps (inclusions) of CEGL002381 to be possible in any of the wetland map-classes in the park. As with each vegetation associations that is represented by the various map classes described in this appendix, CEGL002381 is described as well in “Appendix B: Descriptions of Vegetation Associations” and is also included in “Appendix C: Dichotomous Key to Vegetation Associations.”

Table E-1. Map classification and crosswalk to vegetation types in the U.S. National Vegetation Classification for the Mississippi National River and Recreation Area, Minnesota vegetation mapping project.

Note: The bold headings within the table (above the map classes) are Groups or Cultural Subclasses (except for Open Water) within the U.S. National Vegetation Classification to organize the map classes. All map classes except for those under the Open Water category represent vegetation types within the U.S. National Vegetation Classification.
[CEGL, Community Element Global; USNVC, U.S. National Vegetation Classification]

Map Class Code - Name	Vegetation Association Common Name*	Vegetation Association Scientific Name*	Vegetation Code
North-Central Oak - Hickory Forest & Woodland Group			
WBRC - Eastern Red-cedar - (Hardwood) Bluff Woodland			
	Chinkapin Oak Driftless Bluff Woodland	*Quercus muehlenbergii* - *Quercus* (*alba*, *velutina*) - (*Juniperus virginiana* var. *virginiana*) Driftless Bluff Woodland	CEGL002144
WDMO - North-Central Dry-Mesic Oak Woodland			
	North-Central Dry-Mesic Oak Woodland	*Quercus alba* - *Quercus macrocarpa* - *Quercus rubra* / *Corylus americana* Woodland	CEGL002142
FWRO - Midwestern White Oak - Red Oak Forest			
	Midwestern White Oak - Red Oak Forest	*Quercus alba* - *Quercus rubra* - *Carya ovata* Glaciated Forest	CEGL002068
North-Central Beech - Maple - Basswood Forest Group			
FMBH - Maple - Basswood - Hardwood Forest			
	North-Central Maple - Basswood Forest	*Acer saccharum* - *Tilia americana* / *Ostrya virginiana* - *Carpinus caroliniana* Forest	CEGL002062
	Red Oak - Sugar Maple - Elm Forest	*Quercus rubra* - (*Acer saccharum*, *Quercus alba*) Forest	CEGL005017
Laurentian & Acadian Pine - Oak Forest & Woodland Group			
FWPO - White Pine - Red Oak Forest			
	White Pine - Red Oak Forest	*Pinus strobus* - (*Pinus resinosa*) - *Quercus rubra* Forest	CEGL002480
Northern & Central Native Ruderal Forest Group			
FSRC - Midwest Red-cedar Forest			
	Midwest Red-cedar Forest	*Juniperus virginiana* Midwest Ruderal Forest	CEGL002593
FSBA - Midwest Box-elder - Ash Ruderal Forest			
	Midwest Box-elder - Ash Ruderal Forest	*Acer negundo* - *Celtis occidentalis* - *Fraxinus pennsylvanica* Ruderal Forest	CEGL005462
FSCH - Midwest Hardwood - Conifer Ruderal Forest			
	Midwest Hardwood - Conifer Ruderal Forest	*Fraxinus pennsylvanica* - *Juniperus virginiana* - *Pinus* spp. - *Acer negundo* Ruderal Forest	CEGL005456
FSAS - Aspen Ruderal Forest			
	Aspen Ruderal Forest	*Populus tremuloides* / *Rhamnus cathartica* Ruderal Forest	CEGL005454
FSCW - Cottonwood Upland Ruderal Forest			
	Cottonwood Upland Ruderal Forest	*Populus deltoides* / *Bromus inermis* Ruderal Forest	CEGL005455
Silver Maple - Green Ash - Sycamore Floodplain Forest Group			
FFAE - Ash - Elm - Mixed Lowland Hardwood Forest			
	Ash - Elm - Mixed Lowland Hardwood Forest	*Fraxinus pennsylvanica* - *Celtis occidentalis* - *Tilia americana* - (*Quercus macrocarpa*) Forest	CEGL002081

Map Class Code - Name	Vegetation Association Common Name*	Vegetation Association Scientific Name*	Vegetation Code
FFSM - Silver Maple - Elm Forest			
	Silver Maple - Elm Forest	*Acer saccharinum* - *Fraxinus pennsylvanica* - *Ulmus americana* Forest	CEGL002586
FFCW - Midwestern Cottonwood - Black Willow - Silver Maple Forest			
	Midwestern Cottonwood - Black Willow - Silver Maple Forest	*Populus deltoides* - *Salix nigra* - *Acer saccharinum* Forest	CEGL002018
Laurentian-Acadian-Allegheny Alkaline Swamp Group			
FBAS - Red Maple - Ash - Birch Swamp Forest			
	Red Maple - Ash - Birch Swamp Forest	*Acer rubrum* - *Fraxinus* spp. - *Betula papyrifera* / *Cornus canadensis* Forest	CEGL002071
Northern & Central Native Ruderal Flooded & Swamp Forest Group			
FSBE - Box-elder Ruderal Floodplain Forest			
	Box-elder Ruderal Floodplain Forest	*Acer negundo* Ruderal Floodplain Forest	CEGL005033
Central Great Plains Tallgrass Prairie Group			
HPTG - Central Mesic Tallgrass Prairie			
	Central Mesic Tallgrass Prairie	*Andropogon gerardii* - *Sorghastrum nutans* - (*Sporobolus heterolepis*) - *Liatris* spp. - *Ratibida pinnata* Herbaceous Vegetation	CEGL002203
Sand & Gravel Tallgrass Prairie Group			
HPDS - Dry Slope Prairie			
	Little Bluestem Bedrock Bluff Prairie	*Schizachyrium scoparium* - *Bouteloua curtipendula* Bedrock Bluff Herbaceous Vegetation	CEGL002245
	Midwest Dry Gravel Prairie	*Schizachyrium scoparium* - *Bouteloua curtipendula* Gravel Herbaceous Vegetation	CEGL002215
	Midwest Dry Sand Prairie	*Schizachyrium scoparium* - *Danthonia spicata* - *Carex pensylvanica* - (*Viola pedata*) Herbaceous Vegetation	CEGL002318
Northern & Central Ruderal Meadow & Shrubland Group			
HSGF - Successional Grass & Forb Old Field			
	Midwest Forb Old Field	*Solidago canadensis* - *Coronilla varia* Ruderal Herbaceous Vegetation	CEGL005459
	Midwest Old Field Grassland	*Poa pratensis* - *Bromus inermis* Ruderal Herbaceous Vegetation	CEGL005457
SSMS - Successional Mixed Species Shrubland			
	Midwest Old Field Shrubland	*Lonicera* (x *bella*, *morrowii*, *tatarica*) - *Rhus glabra* - *Zanthoxylum americanum* Ruderal Shrubland	CEGL005460
	Buckthorn Shrubland	*Rhamnus cathartica* Ruderal Shrubland	CEGL005461
Eastern North American Freshwater Marsh Group			
HARC - Arrowhead - Rice Cutgrass Marsh			
	Arrowhead - Rice Cutgrass Marsh	*Sagittaria latifolia* - *Leersia oryzoides* Herbaceous Vegetation	CEGL005240
HMEM - Mixed Emergent Marsh			
	River Bulrush Marsh	*Schoenoplectus fluviatilis* - *Schoenoplectus* spp. Herbaceous Vegetation	CEGL002221
	Bulrush - Cattail - Bur-reed Shallow Marsh	*Schoenoplectus tabernaemontani* - *Typha* spp. - (*Sparganium* spp., *Juncus* spp.) Herbaceous Vegetation	CEGL002026

Map Class Code - Name	Vegetation Association Common Name*	Vegetation Association Scientific Name*	Vegetation Code
	Midwest Mixed Emergent Deep Marsh	*Typha* spp. - *Schoenoplectus acutus* - Mixed Herbs Midwest Herbaceous Vegetation	CEGL002229
	Midwest Cattail Deep Marsh	*Typha* spp. Midwest Herbaceous Vegetation	CEGL002233
Midwest Wet Prairie & Wet Meadow Group			
HBWM - North-Central Bluejoint Wet Meadow			
	North-Central Bluejoint Wet Meadow	*Calamagrostis canadensis* North-Central Wet Meadow	CEGL005449
HSWM - Sedge Wet Meadow			
	Lake Sedge Wet Meadow	*Carex lacustris* Herbaceous Vegetation	CEGL002256
	Upright Sedge Wet Meadow	*Carex stricta* - *Carex* spp. Herbaceous Vegetation	CEGL002258
Central Riverine Wetland Vegetation Group			
SWSB - Sandbar Willow Shrubland			
	Sandbar Willow Shrubland	*Salix interior* Temporarily Flooded Shrubland	CEGL008562
VRMF - River Mudflats			
	River Mudflats	River Mudflats Sparse Vegetation	CEGL002314
VRSF - Riverine Sand Flats			
	Riverine Sand Flats	Riverine Sand Flats - Bars Sparse Vegetation	CEGL002049
Eastern Temperate Wet Shoreline Vegetation Group			
HRFM - Riverine Forb Mudflats			
	Riverine Forb Mudflats	*Polygonum amphibium* - *Sagittaria latifolia* Riverine Herbaceous Vegetation Association	CEGL005458
Northern & Central Ruderal Wet Meadow & Marsh Group			
HSPL - Purple Loosestrife Wetland			
	Purple Loosestrife Wetland	*Lythrum salicaria* Ruderal Herbaceous Vegetation	CEGL006403
HSRC - Reed Canarygrass Eastern Marsh			
	Reed Canarygrass Eastern Marsh	*Phalaris arundinacea* Eastern Ruderal Herbaceous Vegetation	CEGL006044
HSER - Eastern Reed Marsh			
	Eastern Reed Marsh	*Phragmites australis* Eastern North America Temperate Ruderal Herbaceous Vegetation	CEGL004141
Eastern North American Freshwater Aquatic Vegetation Group			
HLTS - American Lotus Aquatic Wetland			
	American Lotus Aquatic Wetland	*Nelumbo lutea* Herbaceous Vegetation	CEGL004323
HWLA - Northern Water-lily Aquatic Wetland			
	Northern Water-lily Aquatic Wetland	*Nymphaea odorata* - *Nuphar* (*microphylla*, *variegata*) Herbaceous	CEGL002562
HPWD - Midwest Pondweed Submerged Aquatic Wetland			
	Midwest Pondweed Submerged Aquatic Wetland	*Potamogeton* spp. - *Ceratophyllum* spp. Midwest Herbaceous Vegetation	CEGL002282
Eastern North American Temperate Cliff Group			
VDCF - Dry Cliff Face Sparse Vegetation			
	Midwest Dry Sandstone Cliff	Sandstone Midwest Dry Cliff Sparse Vegetation	CEGL002045
	Midwest Dry Limestone - Dolostone Cliff	Limestone - Dolostone Midwest Dry Cliff Sparse Vegetation	CEGL002291
Woody Agricultural Vegetation Cultural Subclass			

Map Class Code - Name	Vegetation Association Common Name*	Vegetation Association Scientific Name*	Vegetation Code
CHTN - Hardwood Tree Nursery			
	Forest Plantation	Not applicable	7.A.2.1
CPRP - Red Pine Plantation			
	Forest Plantation	Not applicable	7.A.2.1
CPWP - White Pine Plantation			
	Forest Plantation	Not applicable	7.A.2.1
Herbaceous Agricultural Vegetation Cultural Subclass			
CRGC - Row & Close Grain Crop			
	Row & Close Grain Crop	Not applicable	7.B.1
CPHC - Pasture & Hay Field Crop			
	Pasture & Hay Field Crop	Not applicable	7.B.2
Herbaceous & Woody Developed Vegetation Cultural Subclass			
CDVA - Developed Area			
	Herbaceous & Woody Developed Vegetation	Not applicable	7.C
CBRN - Barren Land			
	Herbaceous & Woody Developed Vegetation	Not applicable	7.C
Riverine Small Mosaic Island			
RSMI - Riverine Small Mosaic Island			
	Multiple associations	Multiple associations	Multiple CEGLs
Open Water (Non-USNVC)			
NSR - Stream & River			
	Not applicable	Not applicable	Not applicable
NWL - Open Water Lake			
	Not applicable	Not applicable	Not applicable
NWP - Open Water Pond			
	Not applicable	Not applicable	Not applicable

*Or the classification name of the lowest hierarchical level mapped in the USNVC.

Table E-2. Map classification set into the hierarchy of the U.S. National Vegetation Classification for the Mississippi National River and Recreation Area, Minnesota vegetation mapping project.

[CEGL, Community Element Global; USNVC, MMU, minimum mapping unit; U.S. National Vegetation Classification]

Map-class Code	Map-class Name
1 FOREST & WOODLAND CLASS	
1.B.2.Na Eastern North American & Great Plains Cool Temperate Forest & Woodland Division	
M012 Central Midwest Oak Forest, Woodland & Savanna Macrogroup	
G649 North-Central Oak - Hickory Forest & Woodland Group	
A3237 *Pinus strobus* - *Quercus* spp. Driftless Forest & Woodland Alliance	
Quercus muehlenbergii - *Quercus* (*alba*, *velutina*) - (*Juniperus virginiana* var. *virginiana*) Driftless Bluff Woodland Association (CEGL002144)	
WBRC	Eastern Red-cedar - (Hardwood) Bluff Woodland
A3324 *Quercus alba* - *Quercus macrocarpa* - *Quercus bicolor* Woodland Alliance	
Quercus alba - *Quercus macrocarpa* - *Quercus rubra* / *Corylus americana* Woodland Association (CEGL002142)	
WDMO	North-Central Dry-Mesic Oak Woodland
A3323 *Quercus alba* - *Quercus rubra* - *Carya* spp. North-Central Forest Alliance	
Quercus alba - *Quercus rubra* - *Carya ovata* Glaciated Forest Association (CEGL002068)	
FWRO	Midwestern White Oak - Red Oak Forest
M882 Central Midwest Mesic Forest Macrogroup	
G021 North-Central Beech - Maple - Basswood Forest Group	
A0220 *Acer saccharum* - *Tilia americana* - *Quercus rubra* Forest Alliance	
Acer saccharum - *Tilia americana* / *Ostrya virginiana* - *Carpinus caroliniana* Forest Association (CEGL002062)	
FMBH*	Maple - Basswood - Hardwood Forest
Quercus rubra - (*Acer saccharum*, *Quercus alba*) Forest Association (CEGL005017)	
FMBH*	Maple - Basswood - Hardwood Forest
M159 Laurentian & Acadian Pine - Oak Forest & Woodland Macrogroup	
G025 Laurentian & Acadian Pine - Oak Forest & Woodland Group	
A4127 *Pinus strobus* - *Pinus resinosa* - *Quercus rubra* Forest & Woodland Alliance	
Pinus strobus - (*Pinus resinosa*) - *Quercus rubra* Forest Association (CEGL002480)	
FWPO	White Pine - Red Oak Forest
M013 Eastern North American Ruderal Forest Macrogroup	
G030 Northern & Central Native Ruderal Forest Group	
A3227 *Juniperus virginiana* - *Pinus virginiana* - *Pinus echinata* Ruderal Forest Alliance	
Juniperus virginiana Midwest Ruderal Forest Association (CEGL002593)	
FSRC	Midwest Red-cedar Forest
A4183 *Acer negundo* - *Fraxinus pennsylvanica* - *Populus tremuloides* Ruderal Forest Alliance	
Acer negundo - *Celtis occidentalis* - *Fraxinus pennsylvanica* Ruderal Forest Association (CEGL005462)	
FSBA	Midwest Box-elder - Ash Ruderal Forest
Fraxinus pennsylvanica - *Juniperus virginiana* - *Pinus* spp. - *Acer negundo* Ruderal Forest Association (CEGL005456)	
FSCH	Midwest Hardwood - Conifer Ruderal Forest
Populus tremuloides / *Rhamnus cathartica* Ruderal Forest Association (CEGL005454)	
FSAS	Aspen Ruderal Forest
A4184 *Populus deltoides* Ruderal Upland Forest Alliance	
Populus deltoides / *Bromus inermis* Ruderal Forest Association (CEGL005455)	
FSCW	Cottonwood Upland Ruderal Forest

Map-class Code	Map-class Name
1.B.3.Na Eastern North American & Great Plains Flooded & Swamp Forest Division	
M029 Central & Appalachian Floodplain Forest Macrogroup	
G652 Silver Maple - Green Ash - Sycamore Floodplain Forest Group	
A3708 *Acer rubrum* - *Fraxinus pennsylvanica* Seasonally Flooded Forest Alliance	
Fraxinus pennsylvanica - *Celtis occidentalis* - *Tilia americana* - (*Quercus macrocarpa*) Forest Association (CEGL002081)	
FFAE	Ash - Elm - Mixed Lowland Hardwood Forest
A3710 *Acer saccharinum* - *Populus deltoides* Floodplain Forest Alliance	
Acer saccharinum - *Fraxinus pennsylvanica* - *Ulmus americana* Forest Association (CEGL002586)	
FFSM	Silver Maple - Elm Forest
Populus deltoides - *Salix nigra* - *Acer saccharinum* Forest Association (CEGL002018)	
FFCW	Midwestern Cottonwood - Black Willow - Silver Maple Forest
M504 Northern Flooded & Swamp Forest Macrogroup	
G046 Laurentian-Acadian-Allegheny Alkaline Swamp Group	
A0347 *Fraxinus nigra* - *Acer rubrum* Saturated Forest Alliance	
Acer rubrum - *Fraxinus* spp. - *Betula papyrifera* / *Cornus canadensis* Forest Association (CEGL002071)	
FBAS	Red Maple - Ash - Birch Swamp Forest
M302 Eastern North American Ruderal Flooded & Swamp Forest Macrogroup	
G552 Northern & Central Native Ruderal Flooded & Swamp Forest Group	
A4099 *Acer negundo* - Mixed Hardwoods / *Alliaria petiolata* Ruderal Floodplain Forest Alliance	
Acer negundo Ruderal Floodplain Forest Association (CEGL005033)	
FSBE	Box-elder Ruderal Floodplain Forest
2 SHRUB & HERB VEGETATION CLASS	
2.B.2.Nb Great Plains Grassland & Shrubland Division	
M054 Great Plains Tallgrass Prairie Macrogroup	
G333 Central Great Plains Tallgrass Prairie Group	
A4057 *Andropogon gerardii* - *Sorghastrum nutans* Herbaceous Alliance	
Andropogon gerardii - *Sorghastrum nutans* - (*Sporobolus heterolepis*) - *Liatris* spp. - *Ratibida pinnata* Herbaceous Vegetation Association (CEGL002203)	
HPTG	Central Mesic Tallgrass Prairie
G151 Sand & Gravel Tallgrass Prairie Group	
A4049 *Schizachyrium scoparium* - *Bouteloua curtipendula* Gravel & Bluff Herbaceous Vegetation Alliance	
Schizachyrium scoparium - *Bouteloua curtipendula* Bedrock Bluff Herbaceous Vegetation Association (CEGL002245)	
HPDS*	Dry Slope Prairie
Schizachyrium scoparium - *Bouteloua curtipendula* Gravel Herbaceous Vegetation Association (CEGL002215)	
HPDS*	Dry Slope Prairie
A4047 *Schizachyrium scoparium* - *Sorghastrum nutans* - *Bouteloua curtipendula* Sand & Gravel Herbaceous Alliance	
Schizachyrium scoparium - *Danthonia spicata* - *Carex pensylvanica* - (*Viola pedata*) Herbaceous Vegetation Association (CEGL002318)	
HPDS*	Dry Slope Prairie
2.B.2.Nc Eastern North American Grassland & Shrubland Division	
M123 Eastern North American Ruderal Grassland & Shrubland Macrogroup	
G059 Northern & Central Ruderal Meadow & Shrubland Group	
A1190 *Dactylis glomerata* - *Festuca* spp. - *Solidago canadensis* Mesic Meadow Alliance	
Solidago canadensis - *Coronilla varia* Ruderal Herbaceous Vegetation Association (CEGL005459)	
HSGF*	Successional Grass & Forb Old Field

Map-class Code	Map-class Name
A3934 *Poa compressa* - *Solidago nemoralis* - *Centaurea biebersteinii* Dry Meadow & Shrubland Alliance	
Poa pratensis - *Bromus inermis* Ruderal Herbaceous Vegetation Association (CEGL005457)	
HSGF*	Successional Grass & Forb Old Field
A3935 *Rhamnus cathartica* - *Rosa multiflora* - *Elaeagnus umbellata* Ruderal Mesic Shrubland Alliance	
Lonicera (x *bella*, *morrowii*, *tatarica*) - *Rhus glabra* - *Zanthoxylum americanum* Ruderal Shrubland Association (CEGL005460)	
SSMS*	Successional Mixed Species Shrubland
Rhamnus cathartica Ruderal Shrubland Association (CEGL005461)	
SSMS*	Successional Mixed Species Shrubland
2.C.4.Nd Eastern North American Wet Meadow, Marsh & Shrubland Division	
M069 Eastern North American Wet Meadow & Marsh Macrogroup	
G125 Eastern North American Freshwater Marsh Group	
A3669 *Peltandra virginica* - *Pontederia cordata* - *Sagittaria* spp. Herbaceous Alliance	
Sagittaria latifolia - *Leersia oryzoides* Herbaceous Vegetation Association (CEGL005240)	
HARC	Arrowhead - Rice Cutgrass Marsh
A3666 *Schoenoplectus tabernaemontani* - *Schoenoplectus fluviatilis* - *Typha* spp. Shallow Marsh Herbaceous Alliance	
Schoenoplectus fluviatilis - *Schoenoplectus* spp. Herbaceous Vegetation Association (CEGL002221)	
HMEM*	Mixed Emergent Marsh
Schoenoplectus tabernaemontani - *Typha* spp. - (*Sparganium* spp., *Juncus* spp.) Herbaceous Vegetation Association (CEGL002026)	
HMEM*	Mixed Emergent Marsh
A1436 *Typha angustifolia* - *Typha latifolia* - *Schoenoplectus* spp. Deep Marsh Herbaceous Alliance	
Typha spp. - *Schoenoplectus acutus* - Mixed Herbs Midwest Herbaceous Vegetation Association (CEGL002229)	
HMEM*	Mixed Emergent Marsh
Typha spp. Midwest Herbaceous Vegetation Association (CEGL002233)	
HMEM*	Mixed Emergent Marsh
G167 Northern & Central Shrub Swamp Group	
A3685 *Alnus* spp. - *Salix* spp. Lakeshore & Depression Shrubland Alliance	
Alnus incana Swamp Shrubland Association (CEGL002381)	
N/A	N/A
G770 Midwest Wet Prairie & Wet Meadow Group	
A4105 *Carex* spp. - *Calamagrostis canadensis* Midwest Wet Meadow Herbaceous Alliance	
Calamagrostis canadensis North-Central Wet Meadow Association (CEGL005449)	
HBWM	North-Central Bluejoint Wet Meadow
Carex lacustris Herbaceous Vegetation Association (CEGL002256)	
HSWM*	Sedge Wet Meadow
Carex stricta - *Carex* spp. Herbaceous Vegetation Association (CEGL002258)	
HSWM*	Sedge Wet Meadow
M880 Eastern North American Wet Shoreline Vegetation Macrogroup	
G755 Central Riverine Wetland Vegetation Group	
A3646 Salix interior Riverwash Shrubland Alliance	
Salix interior Temporarily Flooded Shrubland Association (CEGL008562)	
SWSB	Sandbar Willow Shrubland
A3659 Northern & Central Temperate Sparsely Vegetated Riverwash Alliance	
River Mudflats Sparse Vegetation Association (CEGL002314)	
VRMF	River Mudflats
Riverine Sand Flats - Bars Sparse Vegetation Association (CEGL002049)	
VRSF	Riverine Sand Flats

Map-class Code	Map-class Name
G756 Eastern Temperate Wet Shoreline Vegetation Group	
A1881 *Polygonum* spp. Palustrine Alliance	
Polygonum amphibium - *Sagittaria latifolia* Riverine Herbaceous Vegetation Association (CEGL005458)	
HRFM	Riverine Forb Mudflats
M303 Eastern North American Ruderal Wet Meadow & Marsh Macrogroup	
G556 Northern & Central Ruderal Wet Meadow & Marsh Group	
A3030 *Lythrum salicaria* Herbaceous Alliance	
Lythrum salicaria Ruderal Herbaceous Vegetation Association (CEGL006403)	
HSPL	Purple Loosestrife Wetland
A1381 *Phalaris arundinacea* Herbaceous Alliance	
Phalaris arundinacea Eastern Ruderal Herbaceous Vegetation Association (CEGL006044)	
HSRC	Reed Canarygrass Eastern Marsh
A1431 *Phragmites australis* Herbaceous Alliance	
Phragmites australis Eastern North America Temperate Ruderal Herbaceous Vegetation Association (CEGL004141)	
HSER	Eastern Reed Marsh
5 AQUATIC VEGETATION CLASS	
5.B.2.Na North American Freshwater Aquatic Vegetation Division	
M108 Eastern North American Freshwater Aquatic Vegetation Macrogroup	
G114 Eastern North American Freshwater Aquatic Vegetation Group	
A4064 *Nymphaea odorata* - *Nuphar* spp. - *Brasenia schreberi* Herbaceous Alliance	
Nelumbo lutea Herbaceous Vegetation Association (CEGL004323)	
HLTS	American Lotus Aquatic Wetland
Nymphaea odorata - *Nuphar* (*microphylla*, *variegata*) Herbaceous Association (CEGL002562)	
HWLA	Northern Water-lily Aquatic Wetland
A4066 *Potamogeton* spp. - *Ceratophyllum* spp. - *Elodea* spp. Herbaceous Alliance	
Potamogeton spp. - *Ceratophyllum* spp. Midwest Herbaceous Vegetation Association (CEGL002282)	
HPWD	Midwest Pondweed Submerged Aquatic Wetland
6 OPEN ROCK VEGETATION CLASS	
6.B.1.Na Eastern North American Temperate Cliff, Scree & Rock Vegetation Division	
M111 Eastern North American Cliff & Rock Vegetation Macrogroup	
G106 Eastern North American Temperate Cliff Group	
A3997 Midwest Acidic Cliff Alliance	
Sandstone Midwest Dry Cliff Sparse Vegetation Association (CEGL002045)	
VDCF*	Dry Cliff Face Sparse Vegetation
A3998 Midwest Alkaline Cliff Alliance	
Limestone - Dolostone Midwest Dry Cliff Sparse Vegetation Association (CEGL002291)	
VDCF*	Dry Cliff Face Sparse Vegetation

Map-class Code	Map-class Name
7 AGRICULTURAL & DEVELOPED VEGETATION CULTURAL CLASS	
7.A Woody Agricultural Vegetation Cultural Subclass	
7.A.2 Forest Plantation & Agroforestry Cultural Formation	
7.A.2.1 Forest Plantation Cultural Subformation	
CHTN	Hardwood Tree Nursery
CPRP	Red Pine Plantation
CPWP	White Pine Plantation
7.B Herbaceous Agricultural Vegetation Cultural Subclass	
7.B.1 Row & Close Grain Crop Cultural Formation	
CRGC	Row & Close Grain Crop
7.B.2 Pasture & Hay Field Crop Cultural Formation	
CPHC	Pasture & Hay Field Crop
7.C Herbaceous & Woody Developed Vegetation Cultural Subclass	
CDVA	Developed Area
CBRN	Barren Land
MOSAIC	
Riverine Mosaic Vegetation (mosaic of riverine USNVC associations each <MMU)	
RSMI	Riverine Small Mosaic Island
NON-USNVC	
Non-Vegetated Water (<1% vegetated)	
NSR	Stream & River
NWL	Open Water Lake
NWP	Open Water Pond

*Map class also represents other vegetation associations.

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NWP – Open Water Pond E-69

WBRC – Eastern Red-cedar - (Hardwood) Bluff Woodland

The Eastern Red-cedar - (Hardwood) Bluff Woodland (WBRC) map class represents the *Quercus muehlenbergii* - *Quercus* (*alba*, *velutina*) - (*Juniperus virginiana* var. *virginiana*) Driftless Bluff Woodland Association (CEGL002144) in the USNVC. This map class is rare and spatially limited having only been found in four locations along the edge of Pool 3 and along the Vermillion River floodplain. As a rare type, it makes up a correspondingly small 0.2% of the park, represented by only 20 polygons covering 46.5 ha.

Generally associated with calcareous bedrock, such as the limestone bluffs in the images below, this map class was found on thin soils on steep to very steep slopes. Requiring at least 50% of the canopy to be eastern red-cedar (*Juniperus virginiana*), hardwoods were often rare or completely absent. Canopy cover varied, but was rarely a true woodland (<60% canopy cover) and commonly had a closed canopy (100%); this is likely due to changes in fire regime over the past century.

The AA results for this map class were mixed and AA sites were too rare to reliably assess how well this map class was mapped owing to the combined rarity of the map class and access restrictions on private land. The AA results do indicate that the WBRC map class was occasionally confused with the Midwest Hardwood - Conifer Ruderal Forest (FSCH) map class when the site was too successional in nature.



Images showing two examples of the WBRC map class in MISS and the direct association with exposed bedrock on top of thin, calcareous soils.

WDMO – North-Central Dry-Mesic Oak Woodland

The North-Central Dry-Mesic Oak Woodland (WDMO) map class represents the *Quercus alba* - *Quercus macrocarpa* - *Quercus rubra* / *Corylus americana* Woodland Association (CEGL002142) in the USNVC. Found throughout the park, and often in very large blocks, this map class was a major component of the upland forests. Despite being classified as a woodland in the USNVC and having historically been an open woodland or savannah, most of the WDMO in the park has become a closed canopy forest. The exception to this are sites where fire has been reintroduced or undergrowth is mechanically removed. The WDMO map class covers 1,066.5 ha in the park, which is 4.9% of the park area, but it is also 32.3% of the upland forest in the park making it a very significant component of the landscape. Only the Midwest Box-elder - Ash Ruderal Forest (FSBA) is larger than WDMO in upland coverage (46.7% of the upland forest) and FSBA represents a much more anthropogenically influenced landscape.

The WDMO map class is defined by the dominance of bur and/or northern pin oak (*Quercus macrocarpa* and *Q. ellipsoidalis*) over other tree species. In many instances, areas of this forest were strongly dominated by bur and/or northern pin oak though mixing with northern hardwoods, other species of oak, and ruderal hardwoods species also occurred. Generally found in warmer and drier topographic positions in the park, this map class was historically associated with prairies and savannahs.

The AA results for the WDMO map class are somewhat lower than desired, but this is a very common and broad association. Occasionally, areas mapped as the Maple - Basswood - Hardwood Forest (FMBH) map class and the Midwest Hardwood - Conifer Ruderal Forest (FSCH) turned out to have sufficient bur and/or northern pin oak to be classified as WDMO and instances of five different map classes (FMBH, FSCH, and three others) were found within areas mapped as WDMO. This was caused by underestimating or over estimating the coverage of oak at the AA site. However, the major cross-confusion was with the Midwestern White Oak - Red Oak Forest (FWRO) map class. This occurred when the ratio of bur and/or northern pin to white and northern red oak (*Q. alba* and *Q. rubra*) was misinterpreted. While grouping the WDMO and FWRO map classes together would have provided a slightly more accurate map, it was determined that these two map classes should remain separate owing to the different management needed and broad coverage of each within the park.



The above images show the various phases of WDMO in MISS starting in the upper left moving clockwise: actively managed WDMO with an open woodland form, abundant prairie grasses and forbs, and good oak recruitment; a less actively managed WDMO that still maintains a woodland character, but is losing the prairie grasses and forbs and has reduced oak recruitment; a closed-canopy WDMO being invaded by buckthorn with minimal oak recruitment; a fully invaded WDMO with a closed buckthorn canopy and little recruitment of any other vegetation.

FWRO – Midwestern White Oak - Red Oak Forest

The Midwestern White Oak - Red Oak Forest (FWRO) map class represents the *Quercus alba* - *Quercus rubra* - *Carya ovata* Glaciated Forest Association (CEGL002068) in the USNVC. Occurring throughout the park, FWRO is most commonly presented as a large-patch late-successional closed-canopy forest. Often, FWRO was woven into the low areas and protected north slopes with WDMO present on the hilltops and more exposed, warmer and drier slopes. Several high-quality examples of this forest were found in the park, including the two examples below, which exhibited a wealth of spring ephemeral vegetation. The FWRO map class is common at the park and it covers 394.2 ha (1.8%).

This map class is defined by the dominance or codominance of white and northern red oak (*Quercus alba*, *Q. rubra*) over other tree species. Within the park, the instances of northern red oak dominated FWRO were much more common than instances of white oak dominated FWRO, though this difference was found to be impossible to determine from the project imagery set. Occasionally, more mixed versions of FWRO occurred and this was generally in areas where the WDMO map class occurred; these forests would often have red and white oak mixed with bur and/or northern pin oak (*Q. macrocarpa* and *Q. ellipsoidalis*). Generally found in more sheltered, mesic topographic positions in the park, the FWRO map class was historically associated with northern hardwood forests.

The AA results for FWRO were slightly lower than desired, but this is a very common and variable association. There were two sources of error. The first source of error happened when the ratio of mesic oaks to hardwoods was misjudged—patches of FMBH in polygons of FWRO and patches of FWRO in polygons of FMBH. This problem was relatively uncommon. The second source of error happened when the ratio of bur and/or northern pin oak to white and northern red oak was misinterpreted, and thus, confused FWRO and WDMO. While grouping the FWRO and WDMO map classes together would have provided a slightly more accurate map, it was determined that these two map classes should remain separate owing to the different management needed and broad coverage of each within the park.



Two examples of the FWRO map class in MISS. These images show the closed-canopy of red and white oak over an open forest floor with varying degrees of herbaceous vegetation; the left image shows the potential for extensive coverage of spring ephemeral flowers while the right image shows the more typical duff layer.

FMBH – Maple - Basswood - Hardwood Forest

The Maple - Basswood - Hardwood Forest (FMBH) map class represents two forest associations in the USNVC: the *Acer saccharum* - *Tilia americana* / *Ostrya virginiana* - *Carpinus caroliniana* Forest Association (CEGL002062) and the *Quercus rubra* - (*Acer saccharum*, *Quercus alba*) Forest Association (CEGL005017). This map class represents a broad array of forests that are dominated by native, non-successional hardwoods, and lacking oaks. Ground cover at these sites varied from nearly absent to exceptionally dense and diverse, primarily based upon site history. Relatively uncommon in the park, only 89.6 ha of FMBH were mapped in the park accounting for only 0.4% of the park's area.

This map class is defined by the dominance of northern hardwoods, specifically sugar maple (*Acer saccharum*) and basswood (*Tilia americana*) over other species. Occasional oaks are common within this forest, but should never be dominant over the northern hardwoods species.

Originally, the two USNVC associations found in FMBH, CEGL002062 and CEGL005017, were mapped separately. However, only one instance of CEGL005017 was found in the park and AA results determined that it fit better as CEGL002062. It was determined that these two associations should be mapped together. Otherwise, results for this map class were good. There was only occasional confusion with the WDMO and FWRO map classes when the ratio of oaks to northern hardwoods was misjudged. Additionally, there was rare confusion with successional hardwood map classes and with wetland forest map classes when degree of disturbances and landscape position were misjudged, respectively.



The images above depict four different varieties of the FMBH forest in MISS, clockwise from the upper left: a FMBH with no leaf-litter and greatly reduced herbaceous cover resulting from invasive earthworms; a FMBH showing the expected duff layer and rich herbaceous layer; a FMBH with a graminoid understory suggesting a history of grazing; and a FMBH on a steep hill with an inset jewelweed (*Impatiens capensis*) seep.

FWPO – White Pine - Red Oak Forest

The White Pine - Red Oak Forest (FWPO) map class represents the *Pinus strobus* - (*Pinus resinosa*) - *Quercus rubra* Forest Association (CEGL002480) in the USNVC. This is the rarest natural forest type in the park. Defined by a natural (non-planted) mixed pine and oak regeneration on dry, sandy soils, only five sites were mapped in the park covering just 5.8 ha (0.03%).

While very rare in park, AA results are consistent with good mapping. All five of the sites mapped as FWPO were found to be mapped correctly and no new instances of FWPO were discovered during the AA process.





The images above show two FWPO forests in MISS. Note the natural placement and regeneration of both oak species (*Quercus* spp.) and eastern white pine (*Pinus* strobus) within these forests.

FSRC – Midwest Red-cedar Forest

The Midwest Red-cedar Forest (FSRC) map class represents a single disturbance-oriented forest association in the USNVC: the *Juniperus virginiana* Midwest Ruderal Forest Association (CEGL002593). This map class represents successional woodlands and forests dominated eastern red-cedar (*Juniperus virginiana*). Relatively rare in the park, only 15 polygons of this map class were found and they covered 14.8 ha (0.07%).

This map class is defined by the simple and often exclusive dominance of eastern red-cedar. In most instances of these sites there is a very low diversity of vegetation resulting from the past use of the area as pastures and farm fields.

The AA results indicate that FSRC was mapped very well. These sites were never confused with any other map classes and no new instances of FSRC were discovered during the AA process.



Two examples of the FSRC map class in MISS with the left image having a much more woodland-like appearance compared to the dense, closed-canopy forest in the right image.

FSBA – Midwest Box-elder - Ash Ruderal Forest

The Midwest Box-elder - Ash Ruderal Forest (FSBA) map class represents the *Acer negundo* - *Celtis occidentalis* - *Fraxinus pennsylvanica* Ruderal Forest Association (CEGL005462) in the USNVC. While this is just one association in the USNVC, the range of ruderal woodlands and forests represented by this map class is probably the broadest of any map class in the park. This map class is not only the most common forest map class, but also the most common map class that represents natural vegetation in the park. The FSBA map class covers 1,541.7 ha in the park (7.1%), but accounts for 46.7% of the total upland forest cover in the park.

This map class is defined by its similar history of disturbance; often a random assortment of ruderal tree, shrub, and herbaceous species; relatively young age; and upland location. Additionally, this map class can be found in any upland topographic position, can be monocultures or a mix of any of the trees that define the CEGL005462 association with other species, and can have a very diverse array of often advantageous or non-native shrub and herbaceous species.

While very common across the landscape of the park, AA results indicate that FSBA was potentially mapped too aggressively. Instances of other map classes being found in FSBA polygons were limited to the Midwest Hardwood - Conifer Ruderal Forest (FSCH) map class (dependent on % conifer). However, instances of other map classes being found in FSBA polygons were prevalent, but non-specific, and ranged across forest types, both upland and wetland.



Various combinations of FSBA found around MISS showing aspects of wet or dry habitat, open- or closed-canopy, and young or mature forests. From the upper left: a wet, open-canopy, mature FSBA; a dry, open-canopy, mature FSBA; a mesic, closed-canopy, mature FSBA; and a wet-mesic closed-canopy, young FSBA.

FSCH – Midwest Hardwood - Conifer Ruderal Forest

The Midwest Hardwood - Conifer Ruderal Forest (FSCH) map class represents the *Fraxinus pennsylvanica* - *Juniperus virginiana* - *Pinus* spp. - *Acer negundo* Ruderal Forest Association (CEGL005456) in the USNVC. This map class generally consists of ruderal forests on dry, calcareous slopes with a history of agriculture (often specifically grazing). This is due to the general unpalatability of eastern red-cedar (*Juniperus virginiana*) to grazing animals. When grazing was stopped on lands overrun by eastern red-cedar, other hardwood species would colonize these sites resulting in the mixed woodlands and forests that make up this map class. Covering 129.7 ha in the park (0.6%), the FSCH map class is relatively uncommon.

This map class is defined by the successional nature of the vegetation combined with the mixture of eastern red-cedar and successional hardwoods; occasionally, other conifer species such as Scotch and jack pine (*Pinus sylvestris* and *P. banksiana*) and Norway spruce (*Picea abies*) were present in this forest. It is found throughout the park, but generally confined to abandoned farm fields, field edges, and formerly grazed slopes.

The AA results for this map class indicate that FSCH was potentially mapped too aggressively. Instances of other map classes being found in FSCH polygons were inconsistent and mainly limited to WDMO (when eastern red-cedar cover was underestimated). However, instances of other map classes being found in FSCH polygons were prevalent, but non-specific, and ranged across forest types, both upland and wetland. This resulted from overestimating the relative dominance of eastern red-cedar to the other vegetation at the site, which would then dictate the map class.



Two examples of FSCH in MISS: left is a FSCH composed of red pine (*Pinus resinosa*) and mixed hardwoods; right is and a FSCH composed of eastern red-cedar (*Juniperus virginiana*) and mixed hardwoods.

FSAS – Aspen Ruderal Forest

The Aspen Ruderal Forest (FSAS) map class represents the *Populus tremuloides* / *Rhamnus cathartica* Ruderal Forest Association (CEGL005454) in the USNVC. This map class represents small, rare patches of trembling aspen (*Populus tremuloides*) regeneration that are scattered around the park and is defined by areas with a dominance of trembling aspen. Only 12 examples of this forest are mapped in the park covering 9.6 ha (0.04%).

The AA results indicate that FSAS was mapped completely as no new instances of the map class were found during the AA process. However, some polygons may not contain a majority of trembling aspen and will have other species mixed in, which pushes these areas towards the WDMO or FSCH map classes.



Two examples of FSAS forests in MISS; a younger version is on the left and a more mature version is on the right. Note that the bark is not peeling from the trees as it would on paper birch (*Betula papyrifera*) by this size.

FSCW – Cottonwood Upland Ruderal Forest

The Cottonwood Upland Ruderal Forest (FSCW) represents the *Populus deltoides* / *Bromus inermis* Ruderal Forest Association (CEGL005455) in the USNVC. This map class represents one location in the park where a forest of eastern cottonwood (*Populus deltoides*) is growing on dry upland soils with no apparent hydrologic connection or inundation regime; this concept also defines the map class. This one site covers 3.2 ha (0.01%) in the park making it the rarest forest in the park.

The AA results indicate that FSCW was mapped correctly, but not aggressively enough. The mapping team was told that all instances of FSCW in the park were known, but AA found four more instances of this map class. Because the mapping team was not specifically looking for any additional occurrences of FSCW across the landscape, it is likely there are more instances to be found of this interesting ruderal forest.





Two examples of the FSCW map class in MISS showing the clearly non-floodplain setting of the forest. Despite having no connection to a floodplain, the presence of cottonwood indicates ready access to a perennial water source.

FFAE – Ash - Elm - Mixed Lowland Hardwood Forest

The Ash - Elm - Mixed Lowland Hardwood Forest (FFAE) map class represents the *Fraxinus pennsylvanica* - *Celtis occidentalis* - *Tilia americana* - (*Quercus macrocarpa*) Forest Association (CEGL002081) in the USNVC. Found in floodplains throughout the park, this type is surpassed only by the Silver Maple Elm (FFSM) in prevalence in the lowland forest category. This common lowland forest makes up more than 901 ha or about 4.1% of the park.

This map class is defined by a broad mix of hardwood trees including green ash (*Fraxinus pennsylvanica*), silver maple (*Acer saccharinum*), box elder (*Acer negundo*), American elm (*Ulmus americana*), American basswood (*Tilia Americana*), and hackberry (*Celtis occidentalis*) with no single species being a dominant. Often, this map class will have two or three co-dominant species, but neither silver maple nor boxelder may ever be dominant. This map class is almost always closed canopy, but may be more open in disturbed version.

The AA indicates FFAE was accurately mapped and the map consistently represents this association across the landscape. There is occasional and inconsistent confusion with both upland and wetland map classes: confused upland map classes include Maple - Basswood - Hardwood Forest (FMBH) and Midwest Box-elder - Ash Ruderal Forest (FSBA); confused floodplain map classes include Silver Maple - Elm Forest (FFSM) and Box-elder Floodplain Forest (FSBE). The confusion exists at very low levels.



Two examples of the FFAE forest in MISS showing the broad mix of species and diverse herbaceous layer that is generally present. Additionally, the forest on the right shows the well-developed vine layer often present in this forest.

FFSM – Silver Maple - Elm Forest

The Silver Maple - Elm Forest (FFSM) map class represents the *Acer saccharinum* - *Fraxinus pennsylvanica* - *Ulmus americana* Forest Association (CEGL002586) in the USNVC. Found on floodplains throughout the park and covering 1222.3 ha, FFSM was the most prevalent lowland forest class, making up 5.6% of the park.

This map class is defined by a dominance of silver maple (*Acer saccharinum*), with silver maple often making up at least 50%, but often 80% or more of the overstory trees in this forest type. Heavy dominance by silver maple was an excellent indicator of this type. Often, other floodplain trees, such as Easter cottonwood (*Populus deltoides*), black willow (*Salix nigra*), green ash (*Fraxinus pennsylvanica*), and American elm (*Ulmus americana*) were present in the forest. This forest was occasionally characterized by a super-canopy of tall cottonwood overtopping a canopy of mature silver maple, but the silver maple characterizes the forest. Due to regular scouring and occasional extended flooding, this forest often had a very "open" feel despite their dense canopies. This map class occurs on temporarily flooded soils of floodplains along major rivers and smaller streams throughout the park.

The AA results indicate that the FFSM map class was mapped exceptionally well. There was only rare confusion with Ash - Elm - Mixed Lowland Forest (FFAE) and Midwestern Cottonwood - Black Willow - Silver Maple Forest (FFCW) map classes.



Four different images of the FFSM map class. The top left shows the results of recent flood inundation and scouring; the right two showcase the open understory and rich herbaceous layer often found in this map class; the lower left provides a view of the generally dense, closed canopy of this map class.

FFCW – Midwestern Cottonwood - Black Willow - Silver Maple Forest

The Midwestern Cottonwood - Black Willow - Silver Maple Forest (FFCW) map class represents the *Populus deltoides* - *Salix nigra* - *Acer saccharinum* Forest Association (CEGL002018) in the USNVC. This map class was the third most common of the lowland forest types in the park. With 506.5 ha mapped representing 2.3% of the park's area. While FFSM was the matrix lowland forest at MISS and combined with FFAE it often made up large swaths of the floodplain forest, FFCW was often represented by smaller polygons. Above Pool 2 FFCW was almost always composed exclusively of cottonwood, whereas in Pools 2 and 3 FFCW was more often mixed cottonwoods and willows or was entirely dominated by black willow.

This map class is defined by a forest dominated by cottonwood (*Populus deltoides*) and black willow (*Salix nigra*), sometimes mixed together but often as more monotypic stands. Associate trees can include silver maple (*Acer saccharinum*), boxelder (*Acer negundo*), green ash (*Fraxinus pennsylvanica*), and American elm (*Ulmus americana*), but these species are seldom prevalent and generally occur towards ecotones with other forest types. In the park, FFCW was most often mapped on islands or banks fronting the main channel of the Mississippi River, but could also be found in backwater areas, often in proximity to emergent vegetation beds.

The AA results indicate that the FFCW map class was mapped well. It was rarely confused with Silver Maple - Elm Forest (FFSM) and Sandbar Willow Shrubland (SWSB) map classes by the mappers. However, the line between upland and floodplain was not always consistent. Several polygons of Midwest Box-elder - Ash Ruderal Forest (FSBA) and Midwest Hardwood - Conifer Ruderal Forest (FSCH), both upland forests map classes, turned out to be FFCW at the AA sites.





While often a mixed forest of cottonwood (*Populus deltoides*) and black willow (*Salix nigra*), these two images present different extremes of the FFCW map class. The left image is almost entirely black willow while the right image is almost entirely eastern cottonwood.

FBAS – Red Maple - Ash - Birch Swamp Forest

The Red Maple - Ash - Birch Swamp Forest (FBAS) map class represents the *Acer rubrum* - *Fraxinus* spp. - *Betula papyrifera* / *Cornus canadensis* Forest Association (CEGL002071) in the USNVC. This rare lowland forest class was mapped at only five locations making up just 7.5 ha and representing a mere 0.03% of the park. All mapped locations were within Pool 2. One of these polygons represented a fairly extensive 3.2 ha forest, whereas two of these polygons were between 1.0 and 2.0 ha, and the remaining two polygons barely topped the 0.5 ha MMU.

This map class is defined by the dominance of black ash over other tree species in an open canopied forest on a poorly drained muck substrate. A mix of other hardwood swamp trees were associated with the black ash with yellow birch (*Betula alleghaniensis*) and green ash (*Fraxinus pennsylvanica*) being the most common.

The AA results indicate that FBAS map class was mapped very well, though possibly too conservatively. Two additional instances of FBAS were discovered: one in Maple - Basswood - Hardwood Forest (FMBH) map class and one in Midwest Box-elder - Ash Ruderal Forest (FSBA) map class.



Two images from the FBAS map class. The left image shows a closed-canopy, shrub-dominated version. The right image shows an open-canopy, graminoid-dominated version.

FSBE – Box-elder Ruderal Floodplain Forest

The Box-elder Ruderal Floodplain Forest (FSBE) map class represents the *Acer negundo* Ruderal Floodplain Forest Association (CEGL005033) in the USNVC. This map class was found in lowland areas of Pools 2 and 3, primarily in areas that had likely experienced a fair amount of disturbance in the past. The greatest concentration of FSBE (one-half of those mapped) polygons are found near Pig's Eye Lake, southeast of downtown St. Paul, Minnesota. With only 20 polygons mapped covering 47.4 ha, FSBE was fairly rare and represented just 0.2% of the park.

This map class was defined by a heavy dominance of boxelder (*Acer negundo*). FSBE requires at least 60% dominance by boxelder, but 80% or greater dominance was common. Occasionally, various other hardwood floodplain species occurred at these sites, but never at coverage levels high enough to challenge the boxelder dominance. This map class is also characterized by a closed canopy with few or no gaps.

The AA results indicate that the FSBE map class was mapped very well. It was occasionally confused with Ash - Elm - Mixed Hardwood Lowland Forest (FFAE) and rarely with Midwestern Cottonwood - Black Willow - Silver Maple Forest (FFCW) map classes.



Two images from the FSBE map class in MISS. The left image shows a mature FSBE while the right shows a younger FSBE. Both are nearly completely composed of boxelder (*Acer negundo*).

HPTG – Central Mesic Tallgrass Prairie

The Central Mesic Tallgrass Prairie (HPTG) map class represents the *Andropogon gerardii* - *Sorghastrum nutans* - (*Sporobolus heterolepis*) - *Liatris* spp. - *Ratibida pinnata* Herbaceous Vegetation Association (CEGL002203) in the USNVC. Instances of this map class are spread throughout the park due to restoration and replanting efforts, though it is still relatively uncommon. Generally found in more mesic environments, HPTG covers 107 ha (0.5%) of the park.

This map class is dominated by a mix of native prairie grasses and forbs, especially focused on warm-season grasses. Because of active management (fire, mowing, or other brush control), the HPTG map class generally had a small amount or no shrub and tree cover. The mixture of grasses to forbs varied from site to site with some sites displaying a high diversity while other sites were almost exclusively composed of three to four species of prairie grass.

The AA results indicate that the HPTG map class was mapped very well. There was only occasional confusion with the drier-site Dry Slope Prairie (HPDS) and the more successional and non-native-species dominated Successional Grass & Forb Old Field (HSGF).



Four views of the HPTG map class progression upper left clockwise from spring through early fall.

HPDS – Dry Slope Prairie

The Dry Slope Prairie (HPDS) map class represents three uncommon dry, mixed-grass prairies in the USNVC: the *Schizachyrium scoparium - Bouteloua curtipendula* Gravel Herbaceous Vegetation Association (CEGL002215), the *Schizachyrium scoparium - Bouteloua curtipendula* Bedrock Bluff Herbaceous Vegetation Association (CEGL002245), and the *Schizachyrium scoparium - Danthonia spicata - Carex pensylvanica* - (*Viola pedata*) Herbaceous Vegetation Association (CEGL002318). Initially, there was interest in mapping these three associations apart, but field work concluded that they often co-occur, intergrade, and share enough characteristics to make them impossible to reliably split for this project. Additionally, this map class is very limited in the park—1 of the 14 locations consisted of 37 ha of the total 47.9 ha (0.2% of the park).

This map class is defined by short native grasses and forbs growing on thin and dry soils. Found on hillsides, bluff tops, and rocky out-crops, this map class is generally devoid of trees and shrubs as a result of limited soil and water, though some examples are slowly succumbing to tree and shrub invasion.

The AA results indicate that the HPDS map class was mapped very well. There was only occasional confusion with the more mesic Central Mesic Tallgrass Prairie (HPTG) map class and the more successional and non-native-species dominated Successional Grass & Forb Old Field (HSGF).



Four different views of the HPDS map class in MISS. These images present views of CEGL002215 (upper left) and CEGL002318 (upper right and both lower). Images from CEGL002245 were not obtained during the field season due to access issues.

HSGF – Successional Grass & Forb Old Field

The Successional Grass & Forb Old Field (HSGF) map class represents two ruderal herbaceous associations in the USNVC: the *Poa pratensis* - *Bromus inermis* Ruderal Herbaceous Vegetation Association (CEGL005457) and the *Solidago canadensis* - *Coronilla varia* Ruderal Herbaceous Vegetation Association (CEGL005459). These two vegetation associations freely mix and, depending on the time of year and characteristics of the season, one field can start the season as one association and end it as the other association. This map class is very common in the park, and was also used to capture the vegetation in fallow fields, pastures, and parts of road and utility right-of-ways. This map class covers 856.6 ha (3.9%) in the park.

This map class represents the broad swath of native and non-native successional grass and forb species found in old fields. Often, these sites are kept open due to occasional management (right-of-ways) or past land-use practices that preclude the colonization by woody species.

The AA results indicate that the HSGF map class was mapped very well, though possibly too conservatively. Instances of HSGF were found to occur in the Central Mesic Tallgrass Prairie (HPTG), Dry Slope Prairie (HPDS), and Successional Mixed Species Shrubland (SSMS) map classes suggesting this successional vegetation is even more prevalent on the landscape than what was mapped.



Selections of the HSGF map class from MISS. The top images show graminoid dominated sites compared to the forb dominated sites on the bottom; the sites on the left depict spring vegetation while the right depict fall vegetation. While this is not a single site, the degree of variation at a single site across the season and across years can be substantial.

SSMS – Successional Mixed Species Shrubland

The Successional Mixed Species Shrubland (SSMS) map class represents two ruderal upland shrub associations in the USNVC: the *Lonicera* (x *bella*, *morrowii*, *tatarica*) - *Rhus glabra* - *Zanthoxylum americanum* Ruderal Shrubland Association (CEGL005460) and *Rhamnus cathartica* Ruderal Shrubland Association (CEGL005461). While these two associations can represent relatively different positions in the landscape, the signatures in the imagery and species tended to mix. This map class is very common in the park, and covers 140.5 ha (0.6%); several extensive polygons were mapped.

This map class is defined by the native and non-native shrub species that colonize old fields after abandonment, prairies that lack management, and forests clearing. Often, these sites become so densely populated with shrubs that all other species are excluded from the site.

The AA results indicate that the SSMS map class was mapped well. Rarely, this map class was confused with Midwest Hardwood - Conifer Ruderal Forest (FSCH) map class when the relative density of trees was underestimated. Occasional confusion with the Successional Grass & Forb Old Field (HSGF) map class occurred when relative density of shrubs was overestimated. A more consistent confusion with the Sandbar Willow Shrubland (SWSB) map class occurred when the line between upland and wetland shrubs was not apparent or wet depressions occurred in otherwise dry field environments.



Two examples of the very varied SSMS map class. The left image shows an area that was historically an oak forest invaded by buckthorn (*Rhamnus cathartica*) forming CEGL005461. The right image shows an area where fire suppression has transformed a dry prairie into a hill of sumac (*Rhus glabra*) forming CEGL005460.

HARC – Arrowhead - Rice Cutgrass Marsh

The Arrowhead - Rice Cutgrass Marsh (HARC) map class represents the *Sagittaria latifolia* - *Leersia oryzoides* Herbaceous Vegetation Association (CEGL005240) in the USNVC. All instances of HARC were found in Pools 2 and 3, with the majority of the polygons less than 1.0 ha. This class is rare with just 15 polygons mapped covering 15.5 ha representing only 0.07% of the park.

This map class is defined by a dominance of rice cutgrass (*Leersia oryzoides*) and/or arrowhead species (*Sagittaria* spp.). It is found in shallow ponds and backwater areas that are flooded for most of the growing season, but only where floodwater does not have strong current. Other herbaceous, emergent vegetation were sometimes found in this class, but in limited amounts. The HARC map class areas dominated by arrowhead are usually in deeper water, whereas areas where rice cutgrass is prevalent tend to have shallower water.

The AA indicates that the HARC map class was mapped well, though the sample size is small and precludes drawing definitive conclusions. HARC was rarely confused with a variety of different map classes. The River Mudflats (VRMF), Reed Canarygrass Eastern Marsh (HSRC), and Purple Loosestrife Wetland (HSPL) map classes were occasionally mapped as HARC, whereas HARC was rarely mistaken for the Mixed Emergent Marsh (HMEM) map class and Riverine Forb Mudflats (HRFM) map classes.



The HARC map class at MISS can be found in both isolated wetlands (left) and along the main-stem Mississippi River (right).

HMEM – Mixed Emergent Marsh

The Mixed Emergent Marsh (HMEM) map class represents four herbaceous associations in the USNVC:

- *Schoenoplectus tabernaemontani* - *Typha* spp. - (*Sparganium* spp., *Juncus* spp.) Herbaceous Vegetation Association (CEGL002026),
- *Schoenoplectus fluviatilis* - *Schoenoplectus* spp. Herbaceous Vegetation Association (CEGL002221),
- *Typha* spp. - *Schoenoplectus acutus* - Mixed Herbs Midwest Herbaceous Vegetation Association (CEGL002229), and
- *Typha* spp. Midwest Herbaceous Vegetation Association (CEGL002233).

Together these four associations combine to cover 568.5 ha covering 2.6% of the park. Most of the HMEM is concentrated in Pools 2 and 3, with just a few small polygons upriver of Pool 2, mostly under 2.0 ha in size.

Initially, mappers attempted to separate these four associations into three marsh wetland map classes. The Bulrush - Cattail - Bur-reed Shallow Marsh (CEGL002026) and the Midwest Mixed Emergent Deep Marsh (CEGL002229) were initially combined as one map class because it was assumed that they would have the most overlap from both an ecological and signature standpoint. Mappers expected that, through a combination of topographic location, apparent hydrologic influence, and signature, these four marsh wetland associations would separate consistently into the three map classes. However, during the analysis process for AA it became apparent that the associations overlapped widely and were easily confused with one another. Several factors were assumed to contribute to this confusion:

- Insufficient hydrologic information to reliably assess hydrologic regime and hydrologic changes due to higher water levels present during sampling than at time of aerial imagery collection;
- Inconsistent and co-mingled signatures of component species;
- Insufficient field data to reliably discern between the various wetland types, due to the inherent accessibility issues in sampling wetlands that were encountered during field reconnaissance; and
- A vegetation makeup that was more heterogeneous across the landscape than was initially documented.

After consultation with staff at MISS, the AA team concluded that these emergent-marsh vegetation associations needed to be grouped into one map class that consistently represents all the marsh wetland types and allow future field work and mapping efforts to detail the vegetative makeup of each individual occurrence.

The HMEM map class is defined by a very wide expression of emergent vegetation types growing in deep to shallow marsh settings. It can include areas that are heavily dominated by a single species,

such as with River Bulrush Marsh (CEGL002221) or Midwest Cattail Deep Marsh (CEGL002233), and also areas that encompass a diverse range of species in both shallow and deep marshes, such as with Bulrush - Cattail - Bur-reed Shallow Marsh (CEGL002026) or the Midwest Mixed Emergent Deep Marsh (CEGL002229).

Originally mapped and tested during the AA process as three separate map-classes, these map classes were grouped together based upon the consistent confusion among the map classes. After these were grouped, this map class shows consistent, if only occasional, confusion with most of the wetland herbaceous map classes. Because three separate map classes were merged to form this map class, some areas of the HMEM map class are particularly large, with the largest, in Gore's Pool Wildlife Management Area (WMA), just over 52 ha.



Examples of the four different vegetation associations found in the HMEM map class in MISS, from the upper left clockwise: the Bulrush - Cattail - Bur-reed Shallow Marsh (CEGL002026); the River Bulrush Marsh (CEGL002221); the Midwest Mixed Emergent Deep Marsh (CEGL002229); and the Midwest Cattail Deep Marsh (CEGL002233).

HBWM – North-Central Bluejoint Wet Meadow

The North-Central Bluejoint Wet Meadow (HBWM) map class represents the *Calamagrostis canadensis* North-Central Wet Meadow Association (CEGL005449) in the USNVC. It was represented by only one mapped polygon in the park, which at just 0.4 hectares makes up only 0.002% of the park.

The single polygon was found on the west end of Pickerel Lake near the Pool and Yacht Club parking lot. It was at the base of a bluff and may have received some groundwater seepage, and was unlikely to be flooded by the Mississippi River except in a very high-water event, but might receive brief flooding when water in Pickerel Lake rise. The area was dominated by a wide array of forbs along with hairy sedge (*Carex lacustris*) with a few grasses and some dogwood species (*Cornus* spp.) and willow species (*Salix* spp.) shrubs. Some of the more dominant forbs were joe-pye weed species (*Eupatorium* spp.), milkweed species (*Asclepias* spp.), and goldenrod species (*Solidago* spp.).

The sample size of AA is simply too small to draw many conclusions. The one instance mapped as the HBWM map class was correct and another instance of HBWM was found mapped as the Riverine Forb Mudflats (HRFM) map class. However, the ability to conclude anything more on a map class this rare is limited.



The one occurrence mapped of the HBWM map class in MISS.

HSWM – Sedge Wet Meadow

The Sedge Wet Meadow (HSWM) map class represents two similar sedge wet meadows in the USNVC: the *Carex lacustris* Herbaceous Vegetation Association (CEGL002256) and the *Carex stricta* - *Carex* spp. Herbaceous Vegetation Association (CEGL002258). With only three polygons mapped totaling only 1.4 ha, this very rare class made up only 0.007% of the park.

Two of the polygons were along shallow banks of the Vermillion River in Gore's Pool WMA. These polygons contained lake sedge (*Carex lacustris*) growing away from the water with a variety of other vegetation, much of it annual, such as beggarticks species (*Bidens* spp.), cocklebur (*Xanthium strumarium*), and spikerush species (*Eleocharis* spp.) mixed in and growing closer to the water. These polygons reflect the Lake Sedge Wet Meadow (CEGL002256). The other polygon was near Gun Club Lake near Fort Snelling and was also the location of a vegetation plot. This was in more of a basin setting and with dominance by upright sedge (*Carex stricta*) mixed with forbs and grasses reflects the Upright Sedge Wet Meadow (CEGL002258).

The AA sample size for the HSWM map class is simply too small to draw any conclusions. Only one HSWM location was assessed during the AA process and it was determined to be correct; no other instances of HSWM were encountered during the AA process.



A small example of the rare HSWM map class along the Vermillion River in MISS. This site was the Lake Sedge Wet Meadow (CEGL002256).

SWSB – Sandbar Willow Shrubland

The Sandbar Willow Shrubland (SWSB) map class represents the *Salix interior* Temporarily Flooded Shrubland Association (CEGL008562) in the USNVC. This fairly common class makes up 213.1 ha or about 1% of the park. While it occurred throughout the park, the areas with the most SWSB mapped were in Gore's Pool WMA, south of Hastings, Minnesota, and in the vicinity of Grey Cloud Island, Minnesota. The SWSB map class tends to be a fairly small-patch type with the largest polygon mapped only 4.2 ha in size and the majority of mapped polygons between 0.5 and 2.0 ha.

This map class is defined by dominance of sandbar willow (*Salix interior*) on areas that receive periodic, but not usually prolonged, flooding and scouring. It is common on riverbanks, sandbars and sand flats, but can also be found growing in muck. It is generally composed of moderately-dense to dense sandbar willow cover with occasional floodplain trees with cottonwood (*Populus deltoides*), silver maple (*Acer saccharinum*), and black willow (*Salix nigra*) being the most common.

The AA results indicate that the SWSB map class was mapped well. It was occasionally confused with upland successional shrubs (SSMS) and in a separate instance the relative density of willow was determined to be too low compared to common reed (*Phragmites australis*) and an area was determined to be the Eastern Reed Marsh (HSER) map class. More important were the occurrences of mappable areas of SWSB within the Midwestern Cottonwood - Black Willow - Silver Maple Forest (FFCW) (confusion between black willow and sandbar willow), Successional Mixed Species Shrubland (SSMS) (confusion between upland and wetland), and Mixed Emergent Marsh (HMEM) and HSER (under estimation of RD willow) map classes.



Two examples of the SWSB map class at MISS. The left image provides an example of a backwater version over muck whereas the right image provides an example of one along the main-stem of the Mississippi River colonizing a sandbar.

VRMF – River Mudflats

The River Mudflats (VRMF) map class represents the River Mudflats Sparse Vegetation Association (CEGL002314) in the USNVC. This is classified as a sparse vegetation type, indicating that it cannot have >10% vegetation cover; however, this rule was not always applicable in MISS. Occurring along the larger streams and rivers of the park where silt and mud are deposited, the VRMF map class is rather common along the waterways in the park, but it rarely occurs at above the MMU of 0.25 ha. Very obvious in appearance, given the landscape position and lack of vegetation, this map class is also exceedingly ephemeral. With 44 polygons mapped making up 45.8 ha, this uncommon map class made up 0.2% of the park. Needing a fairly wide floodplain, this class is most common in the south (Gore's Pool area) and becomes less common in the northern part of the park, with no polygons mapped above Lock and Dam 1. This is a small-patch type with no polygons above 3.0 ha and the vast majority at around or below 1.0 ha in size.

This class is characterized by a highly variable composition of annual plants that could change from year to year and across the season, even at the same site, depending on flooding regime, soil deposition, and seed bank. While this map class is listed as a sparse vegetation type (<10% vegetated), variable conditions can lead to expressions that range from very sparse to fairly lush vegetation, though always composed of annual plant species.

Because of the regular scouring of these mud and silt habitats and the high-mobility of the substrates, they should be expected to occur in a dynamic nature along the waterways of MISS.

The AA results indicate that the VRMF map class was mapped well. Occasionally, the cover of perennial vegetation was sufficient to classify an area as the Riverine Forb Mudflats (HRFM), Mixed Emergent Marsh (HMEM), or Purple Loosestrife Wetland (HSPL) map class, indicating that succession progressed quickly in this dynamic map class. Additionally, patches of VRMF were found in Riverine Sand Flats (VRSF) map class (confusion of sand for mud) and once in the Arrowhead - Rice Cutgrass Marsh (HARC) map class (over-estimation of the RD of perennial vegetation).



Two examples of the VRMF map class in MISS showing the potential for both very sparse and very dense coverage by annual plants, but the lack of perennial plants.

VRSF – Riverine Sand Flats

The Riverine Sand Flats (VRSF) map class represents the Riverine Sand Flats - Bars Sparse Vegetation Association (CEGL002049) in the USNVC. This is classified as a sparse vegetation type, indicating that it cannot have >10% vegetation cover; however, this rule was not always applicable in MISS. Occurring along the larger streams and rivers of MISS where sand and gravel are deposited, the VRSF map class is rather common along the large waterways in the park, with many small examples below the 0.25 ha MMU found in the park. Very obvious in appearance, given the landscape position and lack of vegetation, this map class is also exceedingly ephemeral. Unlike the River Mudflats (VRMF) map class, which was limited to the southern part of the park, this class occurred throughout the park, often in thin bands stretching along shorelines or around islands. The majority of 128 mapped polygons were between 0.25 and 2.0 ha. This fairly common class was mapped over 117.2 ha and made up 0.5% of the park.

This map class is characterized by very low vegetation cover on sandy or gravelly substrates (usually near the main channel) that receive frequent river scouring. Vegetation is extremely variable and ephemeral. Because of the regular scouring of these sand and gravel habitats and the high mobility of the substrates, this map class should be expected to occur in a dynamic nature along the waterways of MISS.

The AA results indicate that the VRSF map class was mapped very well. Occasionally, areas of VRMF were mapped as VRSF, and, on a single occasion, an area of the Mixed Emergent Marsh (HMEM) map class was taken to be VRSF (underestimation of perennial vegetation cover), but no unmapped instances of VRSF were found.



Two examples of the VRSF map class in MISS showing the commonly sparse coverage by annual plants and general lack of perennial plants.

HRFM – Riverine Forb Mudflats

The Riverine Forb Mudflats (HRFM) map class represents the *Polygonum amphibium* - *Sagittaria latifolia* Riverine Herbaceous Vegetation Association (CEGL005458) in the USNVC. Mapped over 52.2 ha with 46 polygons, this somewhat-common class composed a little more than 0.2% of the park. Almost all mapped polygons occur within Pool 3, mostly within Gore's Pool WMA.

This class is characterized by wetlands heavily dominated with water smartweed (*Polygonum amphibium*). It occurs in shallow backwater lakes and depressions, which usually receive at least a few weeks of flooding each year, but are protected from strong currents or scouring. Small amounts of other emergent vegetation, such as broad leaf arrowhead (*Sagittaria latifolia*), river bulrush (*Schoenoplectus fluviatilis*), and cattail species (*Typha* spp.), as well as a myriad of annual wetland forbs, along with scattered wetland shrubs and floodplain forest trees, may also be present in this map class.

The AA results indicate that the HRFM map class was mapped rather well, but suggest a more dynamic relationship between this map class and other similar map classes that this one might succeed into. The most common point of confusion was with the Mixed Emergent Marsh (HMEM) map class, a map class that allows for a somewhat similar mix of species in different ratios. Another consistent point of confusion was with Purple Loosestrife Wetland (HSPL) map class, which is a map class known to occupy similar habitat in the park. The instances of confusion with other map classes suggest that the quick-growing and vigorous vegetation of HRFM may have swamped the signature of the actual dominant vegetation at the site.



Two examples of the variable HRFM map class. The left image shows a site dominated by water knotweed (*Polygonum amphibium*) with invading river bulrush (*Schoenoplectus fluviatilis*). The right image shows the common progression of vegetation often noted at sites with HRFM: a ring of HMEM followed by a ring of HARC followed by a center of HRFM. The central ring in the right image is mostly blooming nodding beggartick (*Bidens cernua*).

HSPL – Purple Loosestrife Wetland

The Purple Loosestrife Wetland (HSPL) map class represents the *Lythrum salicaria* Ruderal Herbaceous Vegetation Association (CEGL006403) in the USNVC. Composed of the highly invasive purple loosestrife (*Lythrum salicaria*), a species that readily colonizes disturbed floodplains and wetlands and that will also invade adjacent uplands, this vegetation association forms large monocultures on islands in the Mississippi River, though it has been somewhat controlled by the introduction of various biocontrol measures. Only 17 polygons of this type were mapped, covering about 14.3 ha, with all mapped polygons occurring on the small islands below Grey Cloud Island, Minnesota, or near Pig's Eye Lake southeast of St. Paul, Minnesota. This fairly rare type makes up just 0.1% of the park.

The HSPL map class was characterized by a heavy dominance of purple loosestrife (*Lythrum salicaria*) on banks, islands, and other areas that experience flooding for at least a few weeks in most years, but are not inundated for the entire growing season. Purple loosestrife cover is high, often exceeding 80%, and there are often dead stems from the previous year's growth mixed in. While purple loosestrife is the dominant vegetation, grasses, other emergent vegetation, and annual vegetation may also be present. Fairly few large polygons of this type exist in the park, but numerous small (<0.25 hectare MMU) patches are scattered in wetlands throughout the park.

The AA results indicate that the HSPL map class was mapped well with only a little confusion with the Mixed Emergent Marsh (HMEM) map class, which commonly contained purple loosestrife. However, AA results also indicate that HSPL was mapped too conservatively with examples of HSPL found within polygons of the River Mudflats (VRMF), Arrowhead - Rice Cutgrass Marsh (HARC), and especially HMEM map classes.



An example of the typical pattern of the HSPL map class in MISS where disturbed river shore is quickly invaded and smothered by purple loosestrife (*Lythrum salicaria*).

HSRC – Reed Canarygrass Eastern Marsh

The Reed Canarygrass Eastern Marsh (HSRC) map class represents the *Phalaris arundinacea* Eastern Ruderal Herbaceous Vegetation Association (CEGL006044) in the USNVC. The HSRC map class was used for wet meadows that were dominated (>80% cover) with reed canarygrass (*Phalaris arundinacea*). Covering 194.2 ha, this fairly common class made up 0.9% of the park. The HSRC map class was found throughout the park with the largest concentrations found in basin settings or areas where the floodplain is widest. With the exception of a handful of sites over 10 ha, most sites were small with the majority being under 1.0 ha in size.

The HSRC map class captures nearly monotypic stands of reed canarygrass wherein the relative dominance of reed canarygrass to other herbaceous vegetation is >80%. The HSRC map class was often prolific within floodplain zones that receive annual or better inundation and was also found in many basin settings. Scattered trees were often present, but they contributed <25% total cover. Likewise, scattered water-tolerant shrubs were often present, but they contributed <25% total cover.

The AA results are good for the HSRC map class, but indicate it was likely mapped too aggressively. Several instances of the Riverine Forb Mudflats (HRFM) and Mixed Emergent Marsh (HMEM) map classes were found in areas mapped as HSRC. By comparison, examples of HSRC were only found in the HRFM, HMEM, and Arrowhead - Rice Cutgrass Marsh (HARC) map classes, one time each.



Two examples of the HSRC map class in MISS showing the lush green monoculture of reed canarygrass (*Phalaris arundinacea*) in spring and the characteristic golden seed head in fall.

HSER – Eastern Reed Marsh

The Eastern Reed Marsh (HSER) map class represents the *Phragmites australis* Eastern North America Temperate Ruderal Herbaceous Vegetation Association (CEGL004141) in the USNVC. With 43 polygons mapped over 49 ha, this was a somewhat uncommon class that composed a little over 0.2% of the park. Most examples of HSER in the park were found in three locations: lower Gores Pool WMA; around Pig's Eye Lake; and in the wetlands along the Minnesota River.

At MISS, the HSER map class was mapped where common reed (*Phragmites australis*) was essentially monotypic (>80% relative dominance to other emergent vegetation). Reed canarygrass (*Phalaris arundinacea*) and cattail species (*Typha* spp.), two vegetation species indicative of disturbed wetlands, were commonly found within the HSER map class, but never in great quantity.

The AA results indicate that the HSER map class was mapped very well. There was only the rare confusion with the Sandbar Willow Shrubland (SWSB) map class when the relative dominance of sandbar willow (*Salix interior*) was either overestimated or underestimated.



Two examples of the HSER map class in MISS showing the dense rank monoculture of common reed (*Phragmites australis*) that excludes almost all other plants.

HLTS – American Lotus Aquatic Wetland

The American Lotus Aquatic Wetland (HLTS) map class represents the *Nelumbo lutea* Herbaceous Vegetation Association (CEGL004323) in the USNVC. With 38 polygons mapped over 45.3 ha, this type was rare and represents only 0.2% of the park. The HLTS map class was mapped in the park from the Minnesota River south to the end of the park, with the greatest concentration of lotus being in the waters around Grey Cloud Island, Minnesota. Usually present in fairly small patches, most mapped polygons measured <1.0 ha in total coverage.

The HLTS map class was found in floodplain lakes and ponds and in protected river backwaters. In this map class, American lotus (*Nelumbo lutea*) was the dominant vegetation. Ranging from sparse to very dense, lotus beds at MISS usually had low species diversity other than lotus and sometimes water lily (*Nymphaea odorata*) and submergent vegetation, as well as non-rooted duckweed species (*Lemna* spp.), could be found in lotus beds.

The AA results indicate that the HLTS map class was mapped well, if too aggressively. No new instances of HLTS were discovered during AA. However, instances of the Northern Water-lily Aquatic Wetland (HWLA) and the Midwest Pondweed Submerged Aquatic Wetland (HPWD) map class were found in areas mapped as HLTS. This does not mean that American lotus was absent from these locations, but that American lotus was not the dominant vegetation at the site. Reasons for this could include: lotus die-off due to flooding, disease, and other factors; underestimation of the amount of submergent vegetation (HPWD); water lily, algae, or duckweed obscured by American lotus; and potentially lotus-root harvesting for culinary use and sale.



Two examples of the HLTS map class in MISS showing an example in Pickerel Lake (left) and a second along the main-stem of the Mississippi River.

HWLA – Northern Water-lily Aquatic Wetland

The Northern Water-lily Aquatic Wetland (HWLA) map class represents the *Nymphaea odorata* - *Nuphar* (*microphylla*, *variegata*) Herbaceous Association (CEGL002562) in the USNVC. Present from the Minnesota River and south to the end of the park, with 26 polygons representing 147.6 ha, HWLA was somewhat common, making up 0.7% of the park. HWLA is a larger-patch map class than the American Lotus Aquatic Wetland (HLTS) map class, with the largest polygon in Gun Club Lake (near Fort Snelling) measuring over 60 ha.

The HWLA map class at MISS represents areas of permanently flooded riverine backwaters, lakes, ponds, or basins with muck or sandy bottoms that contain yellow pond-lily (*Nuphar lutea*), watershield (*Brasenia schreberi*), and/or American white waterlily (*Nymphaea odorata*); American white waterlily was the species prominently sampled at MISS. Rooted, floating aquatics may also occur in this map class with submersed aquatic species or nonrooted floating species (*Lemna* spp., *Wolffia* spp.) generally present based upon the site specifics.

The AA results indicate that the HLTS map class was mapped well, but too conservatively. No instances of HWLA were mapped incorrectly; however, instances of HWLA within polygons of HLTS were discovered at several locations. This is likely the result of areas of mixed lily and American lotus (*Nelumbo lutea*) where the coverage of the more robust lotus was overestimated, while the coverage of lily underestimated.



Two examples of the HWLA map class in MISS showing the emergence of the vegetation in spring when the leaves are often above the water and the vegetation in late summer when it is generally laying on the water surface.

HPWD – Midwest Pondweed Submerged Aquatic Wetland

The Midwest Pondweed Submerged Aquatic Wetland (HPWD) map class represents the *Potamogeton* spp. - *Ceratophyllum* spp. Midwest Herbaceous Vegetation Association (CEGL002282) in the USNVC. With 165 polygons covering 331.7 ha, this map class was common and made up 1.5% of the park. While there were a few polygons >10 ha, this was a mostly small-patch type with most polygons being <1.0 ha.

The HPWD map class at MISS captures areas that are permanently or semipermanently flooded wherein submergent vegetation such as pondweed species (*Potamogeton* spp.), coon's tail (*Ceratophyllum demersum*), waterweed species (*Elodea* spp.), and watermilfoil species (*Myriophyllum* spp.) contribute >10% cover, with floating-leaved aquatic vegetation contributing <10% cover, and with herbaceous emergent vegetation contributing <10% cover. At the park, the HPWD map class was restricted to the slow-moving sections or still parts of rivers, such as backwater lakes and permanent ponds, and lakes. Submergent species could be present singly or in many combinations. Duckweed species (*Lemna* spp.) and other non-rooted floating aquatic plants were sometimes present on the water's surface. Often after late spring, and especially in late summer and early fall, filamentous algal mats could become very common in this map class, but they are not specifically part of the vegetation association.

The AA results indicate that the HPWD map class was mapped well. No instances of HPWD mapped incorrectly were discovered during AA. However, instances mapped as the American Lotus Aquatic Wetland (HLTS) map class were rarely determined to be HPWD. This is likely the result of areas of mixed submergent vegetation and American lotus (*Nelumbo lutea*) where the coverage of the more robust lotus was overestimated, whereas the coverage of the mixed submergent vegetation was discounted.



Two examples of the HPWD map class in MISS. The green algal mat prominent in both images is not specifically part of this map class, but is almost always found in this map class after late spring. Note the family of North American river otter (*Lontra canadensis*) enjoying the pond at left.

VDCF – Dry Cliff Face Sparse Vegetation

The Dry Cliff Face Sparse Vegetation (VDCF) map class represents two rare dry cliff face associations in the USNVC: the Sandstone Midwest Dry Cliff Sparse Vegetation Association (CEGL002045) and the Limestone - Dolostone Midwest Dry Cliff Sparse Vegetation Association (CEGL002291). In the vegetation map, this map class is confined to a single polygon covering 0.8 ha (0.004% of the park), but more areas exist. These instances of this map class can appear to cover a large area from the ground, but due to their near-vertical presentation on the map (plan view), their area was never large enough to map.

The one instance of the VDCF map class in the park that was large enough to map was not safe enough to assess during the AA process. As such, while VDCF is a map class that would normally be surveyed during AA, no AA data was collected.



Two images of the VDCF map class in MISS along the Mississippi River. Despite being occasionally inundated by the river, this map class is otherwise very dry and completely inaccessible. The site shown above was not mapped because the horizontal footprint of near-vertical surface is well below the minimum mapping unit.

CHTN – Hardwood Tree Nursery

The Hardwood Tree Nursery (CHTN) map class represents planted hardwood nursery trees of the Forest Plantation Cultural Subformation under the Agricultural & Developed Vegetation Cultural Class in the USNVC. This map class represents nine hardwood tree nurseries within the park covering 31.9 ha (0.1% of the park). These sites, both municipal and commercial, represent a variety of species of hardwood trees, planted in rows, with the intention that the tree will be removed and replanted before mature.

Because the CHTN map class is a cultural vegetation map class, it was not assessed for accuracy.



A view of the CHTN map class at Donie Galloway Riverside Park in MISS.

CPRP – Red Pine Plantation

The Red Pine Plantation (CPRP) map class represents planted red pines of the Forest Plantation Cultural Subformation under the Agricultural & Developed Vegetation Cultural Class in the USNVC. This map class represents 35 red pine plantations within MISS covering 33.1 ha (0.2% of the park).

When the MISS vegetation mapping project began, red pine plantations were classified as *Pinus resinosa* Planted Forest (CEGL007177) in the USNVC. Since then, due to changes in the USNVC, red pine plantations were reclassified into the Cultural portion of the USNVC and CEGL007177 no longer exists. Because of this, the CPRP map class was initially assessed for accuracy, unlike other agricultural and developed map classes. However, results are not reported because all plantation map classes were removed from the final accuracy assessment.



An example of the CPRP map class in MISS that shows the results of limited or no management for an extended period of time.

CPWP – White Pine Plantation

The White Pine Plantation (CPWP) map class represents planted white pines of the Forest Plantation Cultural Subformation under the Agricultural & Developed Vegetation Cultural Class in the USNVC. This map class represents eight white pine plantations within MISS covering 18.1 ha (0.1% of the park).

When the MISS vegetation mapping project began, white pine plantations were classified as *Pinus strobus* Planted Forest (CEGL007178) in the USNVC. Since then, due to changes in the USNVC, white pine plantations were reclassified into the Cultural portion of the USNVC and CEGL007178 no longer exists. Because of this, the CPWP map class was initially assessed for accuracy, unlike other agricultural and developed map classes. However, results are not reported because all plantation map classes were removed from the final accuracy assessment.



An example of the CPWP map class in MISS that shows the results of limited or no management for an extended period of time.

CRGC – Row & Close Grain Crop

The Row & Close Grain Crop (CRGC) map class represents the Row & Close Grain Crop Cultural Formation of the Agricultural & Developed Vegetation Cultural Class in the USNVC. This map class represents close-grown crops grown within MISS—mostly soybeans and corn. This map class is very common in the more rural portions of the park and near the boundary of the park. In total, 717.4 ha (3.3% of the park) was mapped as the CRGC map class, though this area may fluctuate year to year as crop fields rotate in to pasture (Pasture & Hay Field Crop [CPHC] map class) and pastures back into production.

Because the CRGC map class is a cultural vegetation map class, it was not assessed for accuracy.



Images of a cornfield and a soybean field in MISS that show how the CCGC map class can present and change from year to year.

CPHC – Pasture & Hay Field Crop

The Pasture & Hay Field Crop (CPHC) map class represents the Pasture & Hay Field Crop Cultural Formation of the Agricultural & Developed Vegetation Cultural Class in the USNVC. This map class represents grass crops either harvested for hay or used for pasturing animals. This map class is generally found in the more rural portions of the park and near the boundary of the park. In total, 85.6 ha (0.4% of the park) was mapped as the CPHC map class, though this area may fluctuate year to year as pastures are brought back into production while other crop fields are planted back to pasture to rest.

Because the CPHC map class is a cultural vegetation map class, it was not assessed for accuracy.

No images of CPHC were captured in MISS.

CDVA – Developed Area

The Developed Area (CDVA) map class represents, in part, the Herbaceous & Woody Developed Vegetation Cultural Subclass of the Agricultural & Developed Vegetation Cultural Class in the USNVC. The Barren Land (CBRN) map class also represents, in part, the Herbaceous & Woody Developed Vegetation Cultural Subclass. The CDVA map class is the most common map class in the park covering 6,697.4 ha (30.8% of the park). Often found in large, contiguous blocks; the urban centers of the park are a defining feature on the landscape. Within the CDVA map class are four modifiers: open space, low intensity, medium intensity, and high intensity. These four modifiers are based up the percent of impervious surface in the site with open space <20% (377.4 ha; 5.6%), Low Intensity 20-49% (1626.0 ha; 24.3%), Medium Intensity 50-79% (2965.1 ha; 44.3%), and High Intensity >80% (1728.9 ha; 25.8%).

Because the CDVA map class is a cultural vegetation map class, it was not assessed for accuracy.



Four examples of the CDVA map class in MISS. These range from an entirely vegetated golf course to an entirely impervious-surface stockyard. Clockwise from the upper left these images represent the open space, low intensity, medium intensity, and high intensity modifiers.

CBRN – Barren Land

The Barren Land (CBRN) map class represents, in part, the Herbaceous & Woody Developed Vegetation Cultural Subclass of the Agricultural & Developed Vegetation Cultural Class in the USNVC. The Developed Area (CDVA) map class also represents, in part, the Herbaceous & Woody Developed Vegetation Cultural Subclass. This map class is defined by areas actively undergoing development or modification that leaves large areas denuded of vegetation (which will not be planted to a crop). Two instances of this map class covering 44.9 ha (0.2% of the park) and are within a quarry.

Because the CBRN map class is a cultural vegetation map class, it was not assessed for accuracy.

No images of CBRN were captured in MISS.

RSMI – Riverine Small Mosaic Island

The Riverine Small Mosaic Island (RSMI) map class was created to address the conditions inherent in small, diverse islands found within the Mississippi River. These island groups represent genuine and important landscapes in the river, but do not properly fit into a single map class. By definition, areas mapped as the RSMI map class are not composed of or dominated by a single vegetation association, but are composed of a mosaic of numerous, often disparate, vegetation associations, which precludes the mapping of the area as any other vegetation type.

Locations mapped as the RSMI map class will contain two or more of the following vegetation associations:

- *Fraxinus pennsylvanica* - *Celtis occidentalis* - *Tilia americana* - (*Quercus macrocarpa*) Forest (CEGL002081),
- *Acer saccharinum* - *Fraxinus pennsylvanica* - *Ulmus americana* Forest (CEGL002586),
- *Populus deltoides* - *Salix nigra* - *Acer saccharinum* Forest (CEGL002018),
- *Acer negundo* Ruderal Floodplain Forest (CEGL005033),
- *Schoenoplectus fluviatilis* - *Schoenoplectus* spp. Herbaceous Vegetation (CEGL002221),
- *Schoenoplectus tabernaemontani* - *Typha* spp. - (*Sparganium* spp., *Juncus* spp.) Herbaceous Vegetation (CEGL002026),
- *Typha* spp. - *Schoenoplectus acutus* - Mixed Herbs Midwest Herbaceous Vegetation (CEGL002229),
- *Typha* spp. Midwest Herbaceous Vegetation (CEGL002233),
- *Salix interior* Temporarily Flooded Shrubland (CEGL008562),
- *Polygonum amphibium* - *Sagittaria latifolia* Riverine Herbaceous Vegetation Association (CEGL005458),
- *Lythrum salicaria* Ruderal Herbaceous Vegetation (CEGL006403),
- *Phalaris arundinacea* Eastern Ruderal Herbaceous Vegetation (CEGL006044),
- *Phragmites australis* Eastern North America Temperate Ruderal Herbaceous Vegetation (CEGL004141),
- *Sagittaria latifolia* - *Leersia oryzoides* Herbaceous Vegetation (CEGL005240),
- River Mudflats Sparse Vegetation (CEGL002314),
- Riverine Sand Flats - Bars Sparse Vegetation (CEGL002049),
- *Nelumbo lutea* Herbaceous Vegetation (CEGL004323),
- *Nymphaea odorata* - *Nuphar* (*microphylla*, *variegata*) Herbaceous (CEGL002562), and
- *Potamogeton* spp. - *Ceratophyllum* spp. Midwest Herbaceous Vegetation (CEGL002282).

Twenty-one examples of the RSMI map class were found in the park covering 3.3 ha (0.02% of the park). Most of these were found in the Spring Lake area with a few more found farther down river. These islands are being actively built and eroded by the river and it is likely they will fluctuate in size, grow, join other islands, or completely disappear over time.

Because the RSMI map class is a mosaic vegetation map class composed of numerous associations all well below the minimum mapping unit, it was not assessed for accuracy.



An example of the RSMI map class in MISS along the main-stem Mississippi River. While not apparent in this image, this is a sand spit <10 m across and about 500 m long with parts of the vegetation associations of CEGL002049, CEGL002026, CEGL002221, CEGL006044, CEGL008562, CEGL002081, and CEGL002586. No association ever covered more than 25% of the spit and that coverage was composed of numerous independent areas.

NSR – Stream & River

The Stream and River (NSR) map class is not classified in the USNVC and encompasses open-water streams and rivers. Wetland vegetation—aquatic and/or emergent—may be present (usually in shallow waters close to shorelines), but it should contribute <1% cover; however, small areas (below the size of a MMU) of wetland vegetation having >10% cover—including herbaceous vegetation, shrubs, and trees—may be present especially when the changeable nature of vegetation on the Mississippi River is considered. These small vegetation areas are either captured as inclusions of NSR or in the RSMI map class.

The NSR map class was used extensively throughout MISS. Streams that were too narrow to map were mapped as inclusions of the map classes used for the surrounding lands. The rivers and streams mapped as the NSR map class in MISS include the following: Mississippi River, Minnesota River, Vermillion River, Crow River, Rum River, Elm Creek, Coon Creek, and Battle Creek. The Saint Croix River is not mapped because this river is covered by the Saint Croix National Scenic Riverway Vegetation Mapping Project map, which joins to the Mississippi River.

Because of the central position of the Mississippi River in MISS, the NSR map class is the second-most common map class in the park behind the Developed Area (CDVA) map class. Covering 5,001.6 ha, this map class accounts for 23.0% of the park.

Because the NSR map class is an open-water map class, it was not assessed for accuracy.



Two images of the Mississippi River in MISS comparing the free-flowing Mississippi River above the Coon Rapids Dam and the impounded Mississippi River above Lock and Dam 2 (Pool 2). The Mississippi River and its interconnected backwaters and tributaries compose the NSR map class.

NWL – Open Water Lake

The Open Water Lake (NWL) map class is not classified in the USNVC and captures open-water lakes that are >8 ha in area and have <1% cover of wetland vegetation present. Open-water ponds that were <8 ha were mapped as the Open Water Pond (NWP) map class. Open-water lakes are deep, such that vegetation is unable to take root. Wetland vegetation—aquatic and/or emergent—may be present (usually in shallow waters close to shorelines), but it should contribute <10% cover; however, small areas (below the size of a MMU) of wetland vegetation having >10% cover—including herbaceous vegetation, shrubs, and trees—may be present. These small vegetation areas would be included as part of NWL. When they are distinct from the immediate surroundings, wetland vegetation types occurring in areas less than the size of the standard MMU were mapped. The shores of open water lakes are an example of such an environment.

Because the NWL map class requires such a low vegetation cover in combination with a large area of deep, open water, only five water bodies in the park were classified as NWL: Pickerel Lake, Rebecca Lake, Mud Hen Lake and one water body that is hydrologically connected to Mud Hen Lake, and the flooded sand mine on Lower Grey Cloud Island. These lakes cover 128.1 ha and account for 0.6% of MISS.

Because the NWL map class is an open water map class, it was not assessed for accuracy.



An image of the flooded sand mine on Grey Cloud Island showing the large expanse of unvegetated water characteristic of the NWL map class in MISS.

NWP – Open Water Pond

The Open Water Pond (NWP) map class is not classified in the USNVC and captures open-water ponds that are <8 ha in area and have <1% cover of wetland vegetation present. Open-water lakes that were >8 ha were mapped as the Open Water Lake (NWL) map class. Open-water ponds are usually deep enough such that vegetation is unable to take root, managed to prevent the growth of vegetation, or otherwise disturbed so that vegetation is not growing. Wetland vegetation—aquatic and/or emergent—may be present (usually in shallow waters close to shorelines), but it should contribute <10% cover. However, small areas (below the size of a MMU) of wetland vegetation having >10% cover—including herbaceous vegetation, shrubs, and trees—may be present. These small vegetation areas would be mapped as inclusions of NWP. When they are distinct from the immediate surroundings, wetland vegetation types occurring in areas less than the size of the standard MMU were mapped. Open-water ponds are an example of such an environment. The NWP map class was used throughout MISS.

Usually, shallow ponds within MISS were the result of manmade impoundments and generally hosted significant amounts of vegetation, unless they were managed to maintain open water. Within the park, 52 water bodies are mapped as NWP.

Although the NWP map class is uncommon, examples of it are scattered throughout MISS and cover 74.7 ha, or approximately 0.3% of the park.

Because the NWP map class is an open water map class, it was not assessed for accuracy.



The pond at Doris Kemp Park, Minneapolis, in MISS (classified as the NWP map class) showing the active management needed to maintain an unvegetated water body, here.

Table E-3. Map classification listing, sorted alphabetically by map-class code, used for the Mississippi National River and Recreation Area, Minnesota vegetation mapping project.

Map-class Code	Map-class Name
CBRN	Barren Land
CDVA	Developed Area
CHTN	Hardwood Tree Nursery
CPHC	Pasture & Hay Field Crop
CPRP	Red Pine Plantation
CPWP	White Pine Plantation
CRGC	Row & Close Grain Crop
FBAS	Red Maple - Ash - Birch Swamp Forest
FFAE	Ash - Elm - Mixed Lowland Hardwood Forest
FFCW	Midwestern Cottonwood - Black Willow - Silver Maple Forest
FFSM	Silver Maple - Elm Forest
FMBH	Maple - Basswood - Hardwood Forest
FSAS	Aspen Ruderal Forest
FSBA	Midwest Box-elder - Ash Ruderal Forest
FSBE	Box-elder Ruderal Floodplain Forest
FSCH	Midwest Hardwood - Conifer Ruderal Forest
FSCW	Cottonwood Upland Ruderal Forest
FSRC	Midwest Red-cedar Forest
FWPO	White Pine - Red Oak Forest
FWRO	Midwestern White Oak - Red Oak Forest
HARC	Arrowhead - Rice Cutgrass Marsh
HBWM	North-Central Bluejoint Wet Meadow
HLTS	American Lotus Aquatic Wetland
HMEM	Mixed Emergent Marsh
HPDS	Dry Slope Prairie
HPTG	Central Mesic Tallgrass Prairie
HPWD	Midwest Pondweed Submerged Aquatic Wetland
HRFM	Riverine Forb Mudflats
HSER	Eastern Reed Marsh
HSGF	Successional Grass & Forb Old Field
HSPL	Purple Loosestrife Wetland
HSRC	Reed Canarygrass Eastern Marsh
HSWM	Sedge Wet Meadow
HWLA	Northern Water-lily Aquatic Wetland
NSR	Stream & River
NWL	Open Water Lake
NWP	Open Water Pond
RSMI	Riverine Small Mosaic Island
SSMS	Successional Mixed Species Shrubland
SWSB	Sandbar Willow Shrubland
VDCF	Dry Cliff Face Sparse Vegetation
VRMF	River Mudflats
VRSF	Riverine Sand Flats
WBRC	Eastern Red-cedar - (Hardwood) Bluff Woodland
WDMO	North-Central Dry-Mesic Oak Woodland

Appendix F: Accuracy Assessment Form

NATIONAL PARK VEGETATION MAPPING PROGRAM: ACCURACY ASSESSMENT POINT FORM

IDENTIFIERS/LOCATORS

Field Point Code _MISS._____ Database Point Code (for office use)_____

State _MN_ Park Name _Mississippi NRRA_____ Park Site Name _____

Survey Date _____/_____/____ Surveyors _____

Field UTM X ___ ___ ___ ___ ___ ___ m E Field UTM Y ___ ___ ___ ___ ___ ___ ___ m N

GPS Error _____ m UTM Zone _15_ Datum _NAD83___.

If GPS coordinates are intentionally offset from AA Point, provide the azimuth and estimated distance to the point below AND the reason for not getting to the listed coordinates.

Camera _____. Number of Images _____. [Photo of Page 1 of Form, then N, E, S, W, then 1+ representative of MMU]

Time of First Photo _____. Photo Numbers _____.

ENVIRONMENTAL DESCRIPTION

Slope _____ Aspect_____

Topographic Position

Environmental Comments (Characteristics that affect vegetation –e.g., if site is a wetland, indicate type of hydrology, e.g., seepage wetland, temporarily flooded stream bottom, seasonally flooded pond, etc.; topographic position, landform, evidence of natural and human disturbance, etc.):

Unvegetated Surface: *(total should add to 100%)*

___ Bedrock
___ Litter, duff
___ Wood (> 1 cm)
___ Large rocks (cobbles, rocks > 10 cm)
___ Small rocks (gravel, 0.2-10 cm)
___ Sand (0.1-2 mm)
___ Bare soil
___Plant Stems
___Water
___ Other:_____

Sketch of Assessment Area

(aerial view or transect view or both): indicate north arrow, where GPS positions were collected, whether an offset point was needed, locations and bearings of photopoints, plot orientation, roads, trails, as well as distinctive features of the vegetation, e.g., transitions to different vegetation types, or landscape features , etc. Use the symbols in the key below for GPS points and photos. *Site need not be circular if constrained by map guidelines.*

⊗	GPS position
○→	Photo # and direction

MISS.

VEGETATION DESCRIPTION

Stratum	Height	Strata Cover Class	Dominant species	Species Cover Class
Tree Canopy	_____	_____	_____	
Sub-canopy	_____	_____	_____	
Shrub	_____	_____	_____	
Dwarf-shrub	_____	_____	_____	
Herbaceous	_____	_____	_____	
Non-vascular	_____	_____	_____	
Floating-leaved	_____	_____	_____	
Submergent	_____	_____	_____	

Primary Veg Association Code and Name (from vegetation key) CELG00_____

_____

Secondary Veg Association Code and Name (from vegetation key) CEGL00_____

_____

Fit (does MMU key easily to an association?): **H M L**

Your **confidence** in determination: **H M L**

Provide additional comments about problems or ease applying the key at this site, rationale for choice of association, if there was doubt, etc.

Strata and Species Cover Scale:		Strata Height Scale:	
P	5%	01	<0.5 m
01	10%	02	0.5-1 m
02	20%	03	1-2 m
03	30%	04	2-5 m
04	40%	05	5-10 m
05	50%	06	10-15 m
06	60%	07	15-20 m
07	70%	08	20-35 m
08	80%	09	35-50 m
09	90%		
10	100%		

Appendix G: Accuracy Assessment Field Manual

FIELD MANUAL FOR ACCURACY ASSESSMENT SAMPLING

NPS VEGETATION INVENTORY PROGRAM

MISSISSIPPI NATIONAL RIVER AND RECREATION AREA
SUMMER 2014

Prepared for
U.S. Department of the Interior
U.S. Geological Survey and
National Park Service

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A. THE BASIC FRAMEWORK FOR VEGETATION DESCRIPTION

Vegetation Physiognomy, Floristics, and Environment

The U.S. National Vegetation Classification (USNVC) is a vegetation classification that integrates floristic and physiognomic criteria, along with some environmental criteria, to define vegetation units. At higher levels (the formation units) physiognomy is the primary criteria - as indicated by the physiognomy (outward appearance) and structure of dominant growth forms. Physiognomy plays a role in defining and organizing units, which are evaluated at multiple levels within the USNVC hierarchy. At lower levels (i.e., the alliance and association), floristic composition is the primary criteria. Environmental factors such as macroclimate are used at higher levels, while more local site factors, such as hydrology or substrate, are used at lower levels. The field sampling design emphasizes collecting data on all three sets of criteria. Field teams gather data on 1) dominant species, 2) dominant growth forms, and 3) environmental factors. Physiognomic and structural information are needed for the dominant and uppermost layers of vegetation. Location and environmental data are needed to confirm or explain floristic classification decisions.

Floristic information is the leading criteria for the alliance and association units that are being used to check the vegetation map at Mississippi National River and Recreation Area (NRRA). These units are based on total species composition of a stand, as represented by a sampling unit. Thus, floristics and physiognomy must be described across all strata (or layers) of vegetation. Dominant species information is collected across these layers to confirm the classification of the site.

Cover Of Species, Including By Strata

In addition to the simple presence of growth forms and species in a plot, we need a measure of their abundance or dominance. The USNVC gives consideration both to the presence and the abundance of species and growth forms. Cover is the most widely accepted measure of species abundance or dominance because a) it can be applied to all species, whether aquatic, herb, grass, shrub, or tree, b) it is relatively easy to estimate in the field, and c) it is a reliable and accurate measure for the purposes of classification.

Because the USNVC is an integrated physiognomic-floristic hierarchy, information on species cover should be collected within the context of its vertical strata. In this way, we can link major species dominants to the dominant growth forms, and we can assess diagnostic species patterns in the different layers of vegetation. In addition, older data sets that only contain information on a single stratum (e.g., only tree layer data) can still be compared to the cover data of that stratum.

Environmental Factors

Although primary classification decisions are based on floristic composition and physiognomy, final decisions about vegetation classes are often made in the context of information on environmental or local site factors. Indeed, habitat features are often valuable in making decisions about the diagnostic value of species and they are useful in completing descriptions of vegetation types and using those descriptions to answer management or research questions (i.e. value as habitat to certain species or suitability for trails). They may help explain the vegetation pattern or provide additional criteria for keys to vegetation types. For this reason, we recommend a variety of ecological or habitat factors be collected, including at minimum, slope, elevation and aspect, topographic position, and evidence of

disturbances. Wherever possible, we provide picklists to ensure consistency. The information is rarely technical in nature, thus facilitating their collection in the field.

B. PROJECT AND PLOT DESCRIPTION OVERVIEW

This section provides field teams with general instructions and guidelines for teams conducting field work for a given project area. It gives the "how-to" in deciding on collecting data. Detailed, field-by-field coding conventions are provided for each of the primary data forms.

Field Sampling Strategy

Field sites are pre-selected by the mapping team. Sampling will be done after navigating to the pre-selected AA points. Once at the site, the field crew should make sure to consider an area equal to the minimum mapping unit (MMU) when making classification decisions. The minimum mapping unit for MISS is 0.5 ha (~1.2 acres) for most map units and 0.25 ha (~0.6 acres) for some. **The mapping team will not map vegetation units smaller than that and thus it is critical that the AA field team does not consider smaller vegetation units, either.** Once the field team is at the correct site and has scouted out an area equal to the MMU they will begin to collect field data.

It is helpful to remember that map classes are not necessarily the same thing as vegetation associations. Map polygons are drawn and AA points are selected based on map classes. The field crew will assess the vegetation at an AA point and assign it to a vegetation association. At MISS, many, but not all, map classes equal vegetation associations. In most cases, this difference will not be important, or even apparent, to the field crews. One possible result of the difference that will affect the crews is that AA points may include more than one vegetation association. If a map class is composed of two similar vegetation associations, an AA point may be chosen that falls entirely within that single map class but on the border of two vegetation associations. In this event, field crews should not move the AA point but should record data as normal and note that two vegetation associations are present, or that the site is intermediate between two and they are not confident only one fits the site best (accomplished by recording both a primary and secondary best fit vegetation association name and corresponding 4-digit code on the datasheet).

Recognizing Strata and Growth Forms

A comprehensive vegetation description requires information on physiognomy, floristics, and environment. To standardize the collection of physiognomic information, we collect information on the main strata of vegetation, including a list of species by those strata. Because of the importance of using a standard approach to sampling vegetation strata, we discuss this issue in some detail here, to ensure that subsequent discussions of field data collection are clear. A stratum is a layer of vegetation that includes all plant growth forms that occur within it. Plants are assigned to strata based on their predominant position or height in the stand, not by their taxonomy or mature growth form. Consequently, a tree species that has both seedlings and saplings in a plot will be listed in several strata. In describing the vegetation physiognomy of a plot for classification purposes, it is only necessary to capture the main features of the often-complex stand conditions, rather than to describe the layering in the greatest possible detail.

In terrestrial environments, four basic vegetation strata should be recognized whenever they are present: tree, shrub, herb, and moss (sensu Fosberg 1961; the ground layer of mosses, liverworts, lichens, and algae). In aquatic environments, floating, and submerged strata should be recognized where present. These six strata are needed to convey both the vertical distribution of overall cover and the predominant growth forms. Additionally, they may be used to convey the abundance of each species in each stratum so as to provide a more detailed record of vegetation composition by strata. The six strata are defined as follows (see Figure G-1 for an example):

Tree stratum: includes tall trees (single-stemmed woody plants, generally more than 5 m in height at maturity under optimal growing conditions). Very tall shrubs with tree-like form may also be included here, as may other growth forms, such as lianas and epiphytes, and their contribution to the stratum can be further specified using the "growth form" field.

Shrub stratum: includes shrubs (multiple-stemmed woody plants, generally less than 5 m in height at maturity under optimal growing conditions) and shorter trees (saplings). As with the tree stratum, other growth forms present in this stratum may also be included; however, herbaceous growth forms should be excluded, as their stems often die back annually and do not have as consistent a height as woody growth forms. Where dwarf-shrubs (i.e. shrubs < 0.5 m) form a distinct stratum (either as part of a series of strata, as in a forest, or as the top stratum of more open vegetation, such as tundra or xeric shrublands), they should be treated as a low version of the shrub stratum (or short shrub substratum). In many vegetation types, dwarf-shrubs may simply occur as one growth form component of the herb stratum (see below).

Herb stratum (also referred to as field or ground stratum): includes herbs (plants without woody stems and often dying back annually), often in association with low creeping semi-shrubs, dwarf-shrubs, vines, and non-woody brambles (such as raspberries), as well as tree seedlings <1 m tall. Where herbs are entirely absent, it is still possible to recognize this stratum if other very low woody or semi-woody growth forms are present.

Nonvascular stratum (also referred to as moss, bryoid, or ground stratum): is defined entirely by mosses, lichens, liverworts, and alga. Ground-creeping vines, prostrate shrubs and herbs should be treated in the herb stratum.

Floating aquatic stratum: includes rooted or drifting plants that float on the water surface (e.g., duckweed, water-lily).

Submerged aquatic stratum: includes rooted or drifting plants that by-and-large remain submerged in the water column or on the aquatic bottom (e.g., pondweed). The focus is on the overall strata arrangement of these aquatic plants. Note that emergent plants growth forms in a wetland should be placed in the strata listed above (e.g., cattail or sedges would be placed in the herb stratum, bald cypress or black ash in the tree stratum).

Epiphytes, vines, and lianas are best not treated as separate strata; rather they are treated within the strata defined above.

Within each basic woody stratum, we separate out substrata (See Strata and Substrata, pg. G-16).

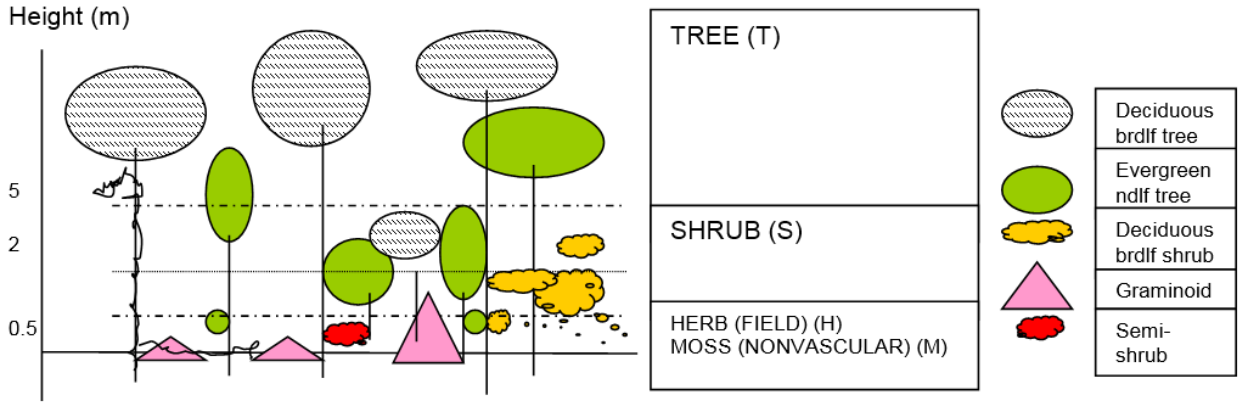


Figure G-1. Major strata (layers) recognized in terrestrial vegetation. Shown here are typical strata found in forests. Additional strata found in stands of aquatic vegetation are floating aquatic and submerged aquatic.

Measuring Species Abundance and Strata Using Cover

Cover is a meaningful attribute for nearly all plant growth forms and allows their abundances to be evaluated in comparable terms. Percent cover can be defined generically as "the vertical projection of the crown or shoot area to the ground surface expressed as … percent of the reference area" (Mueller-Dombois and Ellenberg 1974). For the National Park Service (NPS) Vegetation Inventory Program (VIP), percent cover based on crown or shoot area is applied as canopy cover. Canopy cover is the percentage of ground covered by a vertical projection of the outermost perimeter of the natural spread of foliage of plants. Small openings within the canopy are included.

Canopy cover is the preferred method of collecting cover because it better estimates the "area that is directly influenced by the individuals of each species" (Daubenmire 1968), is easier than foliar cover to estimate from aerial imagery, and is more likely to correlate with satellite image analysis. A classification based on canopy cover is better suited for mapping vegetation than one based on foliar cover. Cover should always be estimated on an absolute basis, i.e., the actual proportion of the sampled area (e.g., if the total tree stratum cover is 50%, and red oak constitutes half of that, its cover should be recorded as 25% (the proportion of the whole plot it covers) not 50% (the proportion of the tree canopy it covers.

C. ACCURACY ASSESSMENT FORM

The Basics

Accuracy Assessment sites are not marked by defined boundaries. Accuracy Assessment sites are picked in advance by the mapping team. Field teams navigate to the point, scout out the area briefly to get a feel for what it is like, and record some general data to characterize it on an Accuracy Assessment Form.

Getting There

Depending on the project the team may have a variety of base maps to work with to locate the plots. In NPS VIP projects, field teams will have, at a minimum, an aerial image with the AA points that they need to visit/sample. Polygons interpreted from aerial imagery will not be on the maps unless

the boundary of the polygon is within the standard AA point radius (40 m for 0.5 ha and 28 m for 0.25 ha). The team navigates to each selected area using road and trail maps, the aerial image, and GPS. The point maps have roads and trails highlighted on them to help the team as well.

Before leaving... check that the team has all the materials needed to complete the field work (See Section D: Checklists for Field Teams).

Every morning... check the GPS receiver to make sure it is set to NAD 83, the batteries are charged, a sufficient amount of replacement batteries are brought along, and the storage memory is sufficient for the day's work. Check the camera to ensure there is space for the day's work. If you are using a digital camera, verify that batteries and memory are sufficient for the day's work.

Location of the plot… navigate to the exact coordinates of the target AA point. If it is not practical or safe to get to the exact coordinates, get as close as possible, record the UTM coordinates of your position and then record the offset. The offset should be recorded as a direction (azimuth) and distance from the UTM coordinates where you are standing to the target point you were originally aiming for.

Once There - The Basic Procedures for Field Data Collection

Determine and record the plot location

Using the GPS receiver, field teams determine the UTM coordinates and record them under the **UTM X** and **UTM Y** blanks on the vegetation plot form. They also record the GPS error. If the team cannot get a GPS reading with sufficient accuracy (~10 m), they should mark the location they were at as precisely as they can on the aerial image maps they have. They can use these to estimate UTMs later. Note on the form that it was necessary to resort to this method.

Identifiers/Locators

Complete the information for any fields that are not already completed. The AA point code is pre-determined by the mapping group and should be recorded on the form.

Taking vegetation photographs

Teams should take at least 6 photos of each AA point. The first photo is of the AA field form after, at a minimum, the AA point number and UTM coordinates have been written down. The next four photos should be in the four cardinal directions (N, E, S, W), starting with north. Since the photos taken in the cardinal directions may not capture the feel of the area, take at least one additional photo that best represents the sample area.

Record Environmental Description

Environmental information for AA points is relatively simple. Record the slope angle, slope direction, topographic position, and environmental factors affecting the vegetation of the area.

Complete Vegetation Description

Substrata (e.g., canopy tree and subcanopy tree, tall shrub and short shrub) are standard for the NPS VIP and these are nested within the basic strata.

Provide the prevailing height of each stratum.

Having decided on the strata, record the species information in the following manner:

1. Begin by simply listing the dominant 1-4 species observed in each of the main layers.
2. Collect any unknown dominant species (see details below), label each bag or sheet containing the specimen with the plot code and a unique identifier corresponding to the code on the form (e.g. *Carex* #1, Fern #2).
3. When the list appears complete, begin estimating cover. For each stratum
   a. Estimate total cover of the substratum (Tree Canopy, Herbaceous, etc.);
   b. Estimate individual species covers for the substratum (i.e., *Quercus rubra* in the Tree Canopy);
   c. Add up species covers within the stratum, and compare to total stratum cover and sort out any discrepancies, recognizing that overlap can occur between species and layers and that you are only recording cover of dominant species (i.e., cover of minor species will not appear on the data sheet).
4. Check your list of species to be sure that they are clear. Whenever possible, use the species names that match the taxonomic authority for your project.

Some guidance on estimating cover

The cover of the stratum is the total vertical projection of the canopy cover of all species collectively on the ground, not the sum of the individual covers of all species in the stratum. Therefore, the total cover of the stratum will never exceed 100% (whereas, adding up the individual cover of species within the stratum could well exceed 100% since species usually overlap in their cover).

Plants are assigned to strata based on their predominant position or height in the stand, not by their taxonomy or mature growth form. Consequently, a tree species that has both seedlings and saplings in a plot could be listed in several strata.

Epiphytes and lianas are handled by listing them in the strata in which they occur. Thus, they may also be listed on the field form in more than one stratum.

The herb stratum (or field stratum) includes all low woody, semi-woody plants, or creeping vines, where these overlap in height with the herbs. This is a compromise between strata based strictly on height versus growth form. Field teams may find it helpful to create a checklist of dwarf-shrubs, semi-woody shrubs, or vines that are to be recorded along with herbaceous plants as part of the herb stratum.

The nonvascular stratum (sometimes called moss, bryoid, or ground stratum) is reserved strictly for cryptogams (mosses, lichens, liverworts, algae, and bacteria), even where herbs or woody plants may be reduced to very short heights.

Collecting Specimens

Field teams should have sufficient botanical expertise to identify most species encountered in the project area. If this is not possible, an expert taxonomist should be identified early in the project. A

large backlog of unidentified pressed specimens should be avoided, as storing and curating large numbers of specimens becomes inefficient. If the team cannot identify a plant to species, they should record it on the form as "unknown species 1," "unknown species 2," "unknown *Carex* sp. 1," etc. They can record associated cover class and other data for the unknown as they would for any other species. They can then do one of two things:

a. If they need the species identified right away because it appears to be dominant or diagnostic (they'll be seeing it all over the place or it's much more common in this particular vegetation type than in others), they can take a sample of the species with as much of the plant as possible, especially intact flower or fruiting parts, if present. Place the sample in a bag or on a sheet and label the bag or sheet with the plot code and the name used on the data form (e.g., Carex sp.1). A member of the team should then try to key it out.
b. If specimens must be saved for identification beyond a few days, they must be dried and pressed but mounting is unnecessary unless they are to be housed in a herbarium. Aquatic plants should be handled as follows: place a mounting sheet at the bottom of a deep tray of water. Suspend the plant in the basin and arrange it as needed, then carefully remove from the basin. Place between blotters to dry. Mark the pressed specimen with the plot code and the name used on the data form.

If possible, store specimens in a cool, dry place. Bagged specimens will keep fresh longer in the refrigerator or ice chest until pressed or identified. A judgment must be made early on regarding species that should be identified in the field versus those that can wait. Common plants recurring in many plots are best keyed in the field, whereas those encountered rarely or at very low cover may be keyed later, when manuals are likely to be readily accessible. A quick prioritization of what to key and what to press may be made based on the recurrence of the species in samples and on the cover-class estimate of the species in a particular plot. Field teams should mark the specimen tag with its cover class estimate and any notes helpful in identification such as "tall shrub" or "wetland plant", as well as its unique identifying number for the vegetation sample. If pressed specimens begin to build up, teams should let their project supervisor know. They can take steps to have some of them identified.

Classifying the AA Point

Once all data have been collected at an AA point, the field team needs to provide a classification name for the vegetation. Field teams will have a vegetation key to work through to decide on the classification. Typically, physiognomy and floristics will both be important to place a community within the USNVC. If there is confusion about how to classify the AA point or if the vegetation key does not work well, that should be noted on the AA Form. Additionally, if the vegetation key does not work well at a specific site; the AA crew should still record a best fit vegetation association based on the field key, again, noting that the vegetation type assigned to the site is the "best-fit" but does not necessarily fit well.

Before Leaving…

Before heading off, be sure to check the forms over to be sure all of the categories have been completed. In particular:

Look over the various strata categories and be sure there are cover values for all strata.
Look over the dominant species lists to be sure none were missed that were called out or observed.
Review the descriptive fields that summarize the overall impression of the stand (environmental comments, unvegetated surface, fit, confidence and classification comments). If these haven't been filled out, now is a good time.
Check the equipment list to be sure nothing is left behind and all flagging has been cleaned up.

LOCATION INFORMATION

Field Point Code
Record the unique code for the AA point from the AA point map. For the NPS VIP, standard park name acronyms are used. Code indicates the specific plot within the vegetation polygon. For Mississippi NRRA, the codes are MISS.###.

Database Point Code
This will be assigned during data entry, if needed. This should be left blank in the field.

State
Provide State name or code (e.g., Minnesota or MN)

Park Name
This field will be Mississippi NRRA for this project.

Park Site Name
Assign a provisional project site name to describe more precisely where the data were collected. It should represent a nearby and identifiable feature on the topographic map or the name of the local park or refuge where the point is located.

Survey Date
Record the date the survey was taken; month, day, year.

Surveyors
Record the names of surveyors, with team leader listed first. The team leader is the person most responsible for the quality of the data recorded on the form and the first person to which questions about the data will be addressed.

Field UTM X
Record UTM X coordinates, using GPS if at all possible. If you can't get a GPS reading, estimate coordinates from a topo map and note on the form that this method was used.

Field UTM Y
Record UTM Y coordinates, using GPS if at all possible. If you can't get a GPS reading, estimate coordinates from a topo map and note on the form that this method was used.

GPS Error
Note the error in the GPS reading.

UTM Zone
Record the GPS zone for this point. For the MISS project, this is UTM Zone 15.

Datum
Record the name of the datum used when collecting this location information. For the MISS project, this should always be NAD 83.

Camera
Record the camera model

Number of Images
Record the number of images taken of the plot.

Time of First Photo
Time the first photo was taken.

Photo Numbers
Record the series of numbers used by the camera for the photos of the AA site.

ENVIRONMENTAL DESCRIPTION

Slope
Measure the slope in degrees using a clinometer or estimate using a compass that contains a slope-measuring device.

Aspect
Measure the slope aspect using a compass (be sure to correct for the magnetic declination). Note: all compasses should be pre-set to an average declination for the park and thus, readings from the compasses carried by the field teams may be directly noted.

Topographic Position
Select a single topographic position of the plot from the picklist

1. INTERFLUVE (crest, summit, ridge). Linear top of ridge, hill, or mountain; the elevated area between two fluves (drainageways) that sheds water to the drainageways.
2. HIGH SLOPE (shoulder slope, upper slope, convex creep slope). Geomorphic component that forms the uppermost inclined surface at the top of a slope. Includes the transition zone from backslope to summit. Surface is dominantly convex in profile and erosional in origin.

3. HIGH LEVEL area above surrounding landscape.
4. MIDSLOPE (transportational midslope, middle slope). Intermediate slope position.
5. BACKSLOPE (dipslope). Subset of midslopes that are steep, linear, and may include cliff segments (fall faces).
6. STEP IN SLOPE (ledge, terracette). Nearly level shelf interrupting a steep slope, rock wall, or cliff face.
7. LOWSLOPE (lower slope, foot slope, colluvial footslope). Inner gently inclined surface at the base of a slope. Surface profile is generally concave and a transition between midslope or backslope, and toeslope.
8. TOESLOPE (alluvial toeslope). Outermost gently inclined surface at base of a slope. In profile, commonly gentle and linear and characterized by alluvial deposition.
9. LOW LEVEL (terrace). Valley floor or shoreline representing the former position of an alluvial plain, lake, or shore.
10. CHANNEL WALL (bank). Sloping side of a channel.
11. CHANNEL BED (narrow valley bottom, gully, arroyo, wash). Bed of single or braided watercourse commonly barren of vegetation and formed of modern alluvium.
12. BASIN FLOOR (depression). Nearly level to gently sloping, bottom surface of a basin.

Environmental Comments

Enter any additional noteworthy comments on the environmental setting. This field can be used to describe stand history such as fire events (date since last fire or evidence of severity), evidence of hydrologic regime, as well as other disturbance or stand regeneration factors.

Unvegetated Surface

Estimate ground or surface cover to the nearest percentage by each category, including woody stem basal area (Table G-1). For surface features not provided on this list, use the "other" category, and note the feature. Cover estimates should sum to 100%. In cases where moss, lichen, sand or litter thinly covers the rock, ignore the less significant cover and record the total cover of rock. Else, if they form a dense mat on these surfaces, or if they occur directly on the soil (or, as in a bog, the moss covers the entire surface layer), include them as part of a nonvascular category for the ground or surface layer. This nonvascular cover should also be included in the total cover of moss and lichen when recording the percent cover of the non-vascular strata (see within Table G-1 below). Rock and sand definitions are from Brady and Weil (2002).

Table G-1. Percent value descriptions to record unvegetated surface values within an accuracy assessment site.

Value	Description
Percent Bedrock	Percent of surface that is exposed bedrock
Percent Rock (Gravel/Pebble, Cobble, Stones/Boulders)	Percent of surface that is exposed gravel/pebble (2–75 mm), cobble (75–256 mm) and stone/boulder (>256 mm).
Percent Wood	Percent of surface that is wood
Percent Litter	Percent of surface that is litter
Percent Bare Soil	Percent of surface that is bare mineral soil
Percent Water	Percent of surface that is water
Percent Sand	Percent of surface that is occupied by aeolian or alluvial sand deposits (0.05 mm to 2.0 mm)
Percent Nonvascular	Percent of soil surface that is occupied by lichens, moss, or bacteria that may
Percent Live Stem	Percent of surface that is occupied by living stems (tree trunks, etc.)
Other	

VEGETATION DESCRIPTION

Stratum, Stratum Height, Stratum Cover

List all of the strata that are present, and record the average height and its total cover (Table G-2). You should use the Height Scale and Cover Scale below (which also provides the recommended accuracy of absolute values).

Table G-2. Value scales for strata to record total cover and average height within an accuracy assessment site.

Cover Scale for Strata		Height Scale for Strata	
P	>1-5%	01	<0.5 m
1	>5-15%	02	0.5-1m
2	>15-25%	03	1-2 m
3	>25-35%	04	2-5 m
4	>35-45%	05	5-10 m
5	>45-55%	06	10-15 m
6	>55-65%	07	15-20 m
7	>65-75%	08	20-35 m
8	>75-85%	09	35 - 50 m
9	>85-95%	10	>50 m
10	>95%		

Individual Species Cover

For each stratum, list the dominant species and their cover values. For Accuracy Assessment points, you will list only the dominant species, and perhaps any additional species that you consider to be diagnostic or characteristic. Cover values should still be assigned to the listed species (for this project, “dominant” is typically species with > 10% cover, though this can be less in sparse strata, often including the Herb stratum).

Strata and Substrata

Main Strata

Tree stratum: includes tall trees (single-stemmed woody plants, generally more than 5 m in height (and 10 cm dbh) or greater at maturity under optimal growing conditions). Very tall shrubs with tree-like form may also be included here, as may other growth forms, such as lianas and epiphytes, and their contribution to the stratum can be further specified using the "growth form" field.

Shrub stratum: includes shrubs (multiple-stemmed woody plants, generally less than 5 m in height at maturity under optimal growing conditions) and shorter trees (saplings). As with the tree stratum, other growth forms present in this stratum may also be included (however, herbaceous growth forms should be excluded, as their stems often die back annually and do not have as consistent a height as woody growth forms). Where dwarf-shrubs (i.e. shrubs < 0.5 m) form a distinct stratum (either as part of a series of strata, as in a forest, or as the top stratum of more open vegetation, such as xeric shrublands), they should be treated as a low version (down to 0.2 m) of the shrub stratum (or short shrub substratum). In many vegetation types, a number of low woody plants may simply occur as one growth form component of the herb stratum (see below).

Herb stratum: (or field stratum) includes herbs (plants without woody stems and often dying back annually), regardless of height, often in association with low creeping semi-shrubs, dwarf-shrubs, creeping vines, and non-woody brambles (such as raspberries), as well as tree or shrub seedlings. Herbs are treated here regardless of height because many herbs grow anew each year, and their height is more dynamic than woody species. As noted below, individual growth forms can be recognized within this stratum. Where herbs are entirely absent, it is still possible to recognize this stratum if other very low woody or semi-woody growth forms are present.

Moss stratum: (or nonvascular stratum): is defined entirely by mosses, lichens, liverworts, and alga. Ground-creeping vines, prostrate shrubs and herbs should be treated in the herb stratum.

Floating aquatic stratum: includes rooted or drifting plants that float on the water surface (e.g., duckweed, water-lily).

Submerged aquatic stratum: includes rooted or drifting plants that by-and-large remain submerged in the water column or on the aquatic bottom (e.g., pondweed). The focus is on the overall strata arrangement of these aquatic plants. Note that emergent plants growth forms in a wetland should be placed in the strata listed above (e.g., cattail or sedges would be placed in the herb stratum, whereas the duckweed would be in the floating aquatic stratum).

Epiphytes, vines and lianas are not treated as separate strata; rather they are treated within the strata defined above.

Sub-Strata

It is desirable to recognize additional distinctions within the main strata. These substrata are to be used in conjunction with the main strata, that is, the main strata (see above) should always be described along with any substrata. Here we provide a set of substrata.

Tree Stratum (T):

Tree Canopy: the main layer of tree canopy, composed of trees whose crowns from the upper predominant canopy; includes dominant, co-dominant trees

Subcanopy: trees greater than 5 m in height that do not reach the main canopy; they may form a distinct secondary layer or may consist of suppressed trees that are wholly beneath the main canopy.

Shrub/Sapling Stratum (S):

Shrub: 0.01-5 m tall shrubs

Dwarf-shrubs: Shrubs that will never exceed <0.5 m in height

Herb (Field) Stratum (H):

No recommendations are made for dividing this dynamic stratum.

Moss (Nonvascular) Stratum (M):

This stratum is not divided into substrata.

Floating Stratum:

No recommendations are made for dividing this dynamic stratum.

Submergent Stratum:

No recommendations are made for dividing this dynamic stratum.

Primary Veg Assoc Name

This is the vegetation class that best fits the AA point, based on the vegetation key. Provide both the code and name of the association.

Secondary Veg Assoc Name

If the vegetation of the area at the AA point seems intermediary between two types, record the second best fit in this field. Provide both the code and name of the association.

Fit

Rated as HIGH, MEDIUM, or LOW – Record both how easily the vegetation at the AA point keyed to a vegetation community AND how confident is the field crew that the vegetation types they keyed the site to actually fits the vegetation at the site. Vegetation at a site may fit the key well but the final classification may not match the community well or vice versa. IF you chose MEDIUM or LOW, record how well the key worked to classify the vegetation around the AA point. It is especially important to note any difficulties or questions encountered in classifying the point, either due to confusion with the vegetation key or disturbance/heterogeneity around the AA point.

D. CHECKLISTS FOR FIELD TEAMS

Planning for the Day

1. Safety and sustenance issues (plenty of food, water, proper clothing, first-aid kit)
2. Field communications: Develop plan with other team(s), if necessary, for check-in time re: plot types and contingencies for duplication problems
3. Check on GPS (batteries, memory available, waypoints for priority samples logged using spreadsheet?)
4. Check on digital camera (memory, batteries)
5. Check list for all other field equipment
6. Plan day's mission before departure for day using hardcopy AA point map with flagged points

Planning for the Week

1. Check for all appropriate maps, aerial imagery (if available), and AA point maps.
2. Develop an estimate of reasonable expectations of plots to choose for each team broken up by day and based on an estimate of individual team's travel logistics for the week.
3. Develop plan for the week to sample all AA points in work area.
4. Balance points two and three above with the expected work schedule of the teams and ensure adequate time off and reduce over-time concerns.
5. Check for all necessary information for AA point maps for the zone and blank field forms.
6. Communication with management team and field teams.
    a. Update list of sampled points
    b. All uncertainties dealt with (e.g., not able to get to some points, problems with interpreting PI information, personnel issues, problems in interpreting classification/key, park-related logistics).
7. Organization of field teams:
    a. Gather Q.C.'ed field forms (allow time for Q.C. and resolving questions about the forms)
    b. Obtain all plants not identified (allow time for plant I.D.)
    c. Were there any questions about the polygons visited during the week?
    d. What was accomplished, what was not accomplished?
    e. Pass on the developments and questions to the management team on a regular basis. Don't let them build up too long.

Materials checklist

- AA point maps
- road / trail maps
- compass
- GPS receiver (checked daily to ensure that it is set correctly (to NAD 83)
- clinometer
- camera and batteries/memory card (allow at least 6 exposures per plot)
- baggies
- pens / permanent markers

- accuracy assessment forms, including some on waterproof paper
- classification report for the project
- vegetation key
- loupe/magnifier for identifying plants
- botanical manuals

Formula to calculate tree heights

(Distance to tree) x tangent (angle to top of tree) + height above ground of observer. When on a slope, make sure to take into account the difference in height of where you are standing and where the tree emerges from the ground. The results are less affected by small errors in reading the angle the closer you are to 45 degrees. Try to choose a convenient distance for multiplication (i.e., 5 m, 10 m, 20 m) that will also result in an angle to the top of the tree around 45 degrees.

Example: If you are 10 m from the tree you are measuring and the clinometer reads 67 degrees and your eye is 1.5 m above the ground, the tree height = 10 m x 2.3553 + 1.5 m = 25.05 m tall.

Table of angles (degrees) and their tangents is provided in Table G-3 below.

Table G-3. Table of angles (degrees) and their tangents.

Angle	Tangent	Angle	Tangent	Angle	Tangent
0	0.0000	30	0.5773	60	1.7317
1	0.0175	31	0.6008	61	1.8037
2	0.0349	32	0.6248	62	1.8804
3	0.0524	33	0.6493	63	1.9622
4	0.0699	34	0.6744	64	2.0499
5	0.0875	35	0.7001	65	2.1440
6	0.1051	36	0.7265	66	2.2455
7	0.1228	37	0.7535	67	2.3553
8	0.1405	38	0.7812	68	2.4745
9	0.1584	39	0.8097	69	2.6044
10	0.1763	40	0.8390	70	2.7467
11	0.1944	41	0.8692	71	2.9033
12	0.2125	42	0.9003	72	3.0767
13	0.2309	43	0.9324	73	3.2698
14	0.2493	44	0.9656	74	3.4862
15	0.2679	45	1.0000	75	3.7306
16	0.2867	46	1.0354	76	4.0091
17	0.3057	47	1.0722	77	4.3295
18	0.3249	48	1.1105	78	4.7023
19	0.3443	49	1.1502	79	5.1418
20	0.3639	50	1.1916	80	5.6679
21	0.3838	51	1.2347	81	6.3095
22	0.4040	52	1.2798	82	7.1099
23	0.4244	53	1.3269	83	8.1372
24	0.4452	54	1.3762	84	9.5045
25	0.4663	55	1.4279	85	11.4157
26	0.4877	56	1.4823	86	14.2780
27	0.5095	57	1.5396	87	19.0404
28	0.5317	58	1.6001	88	28.5437
29	0.5543	59	1.6640	89	56.9168

Appendix H: Accuracy Assessment Contingency Table

Explanation of the Contingency Table

The accuracy assessment contingency table (or matrix) for the Mississippi National River and Recreation Area vegetation-map layer is an array of numbers set out in rows and columns to compare results of vegetation types represented on the map layer to vegetation types as verified on the ground. Map-class codes for this project are used in the matrix to identify vegetation types for ease of comparison during the analysis and are listed at the side of each row and the top of each column. A condensed table between the map classes and codes to the vegetation types is provided within this appendix. This table shows the various vegetation types assigned to the map-class codes that are used to label vegetation types in this contingency table. For a comprehensive crosswalk between map classes and vegetation types, refer to the main report section or "Appendix E: Descriptions of Map Classes."

The columns represent vegetation associations in the U.S. National Vegetation Classification (USNVC). These columns tabulate the producer's accuracy by showing errors of exclusion (omission errors) present in the map. The rows represent the map classes listed by their respective map-class codes. These rows tabulate the users' accuracy by showing errors of inclusion (commission errors) present in the map. (Again, refer to the crosswalk for map class-names and links to vegetation types.) Following the contingency table is a table showing the calculations for the kappa index, which provides for an adjustment for chance agreements.

The following contingency matrix is formatted to a letter-size page (8.5" x 11") in landscape orientation.

National Park Service Vegetation Inventory Program
Mississippi National River and Recreation Area

		FIELD SAMPLES - REFERENCE DATA																															COMISSION			
	MAP CODES	FMBH	WBRC	FWRO	WDMO	FWPO	FSRC	FSCH	FSBA	FSAS	FSCW	FBAS	FFAE	FFSM	FFCW	FSBE	HPTG	HPDS	HSGF	SSMS	VRMF	VRSF	SWSB	HBWM	HSWM	HRFM	HMEM	HARC	HSRC	HSER	HSPL	HPWD	HWLA	HLTS	TOTAL	USERS' ACCUR-ACY	90% Confidence Intervals	
																																					-	+
MAP DATA - PREDICTION DATA	FMBH	19		1	1			1				1	2																						25	76%	60%	92%
	WBRC		2		1																														3	67%	5%	128%
	FWRO	3		25	2																														30	83%	70%	96%
	WDMO	2		7	19			2																											30	63%	47%	79%
	FWPO					5																													5	100%	90%	110%
	FSRC						8																												8	100%	94%	106%
	FSCH		2		2			19	2		1				1					1														28	68%	52%	84%
	FSBA	1			2				17		2	1	2		5																				30	57%	40%	73%
	FSAS				1			1		4																									6	67%	27%	107%
	FSCW										3																								3	100%	83%	117%
	FBAS											5																							5	100%	90%	110%
	FFAE												28	1		1																			30	93%	84%	102%
	FFSM													30																					30	100%	98%	102%
	FFCW										1			1	27									1											30	90%	79%	101%
	FSBE												3		1	20																			24	83%	69%	98%
	HPTG																24	2	4																30	80%	66%	94%
	HPDS																	19	2																21	90%	78%	103%
	HSGF																2		27																29	93%	84%	103%
	SSMS																		3	25			2												30	83%	70%	96%
	VRMF																				13					1	2				2				18	72%	52%	92%
	VRSF																				4	24					1								29	83%	69%	96%
	SWSB																			2			27							1					30	90%	79%	101%
	HBWM																							1											1	100%	50%	150%
	HSWM																								1										1	100%	50%	150%
	HRFM																							1		22	5	1	1						30	73%	58%	88%
	HMEM																						1			1	80	2	1		4				89	90%	84%	96%
	HARC																				1							5	1		1				8	63%	28%	97%
	HSRC																									6	4		20						30	67%	51%	82%
	HSER																						1				2			26					29	90%	79%	101%
	HSPL																										2				6				8	75%	44%	106%
	HPWD																															30			30	100%	98%	102%
	HWLA																																30		30	100%	98%	102%
	HLTS																															2	5	20	27	74%	58%	90%
OMISSION	TOTAL	25	4	33	28	5	8	23	19	4	7	7	35	32	34	21	26	21	36	28	18	24	32	2	1	30	96	8	23	27	13	32	35	20	757	Total Samples		
	PRODUCERS' ACCURACY	76%	50%	76%	68%	100%	100%	83%	89%	100%	43%	71%	80%	94%	79%	95%	92%	90%	75%	89%	72%	100%	84%	50%	100%	73%	83%	63%	87%	96%	46%	94%	86%	100%	757			
	90% Confidence Interval -	60%	-4%	62%	52%	90%	94%	67%	75%	88%	5%	36%	67%	85%	67%	85%	82%	78%	62%	78%	52%	98%	72%	-33%	50%	58%	77%	28%	73%	88%	20%	85%	75%	98%	Total Samples Correct			
	90% Confidence Interval +	92%	104%	90%	84%	110%	106%	98%	104%	113%	81%	107%	93%	102%	92%	105%	103%	103%	88%	101%	92%	102%	96%	133%	150%	88%	90%	97%	101%	104%	73%	102%	97%	103%	631			
		OVERALL ACCURACY = 83.36% KAPPA INDEX = 82.56% KAPPA INDEX LOWER 90% CONFIDENCE LEVEL = 80.23% KAPPA INDEX UPPER CONFIDENCE LEVEL = 84.90%																																				

Code	P(row 1)	P(col i)	P(chance i)
FMBH	0.033025	0.033025	0.001091
WBRC	0.003963	0.005284	0.000021
FWRO	0.039630	0.043593	0.001728
WDMO	0.039630	0.036988	0.001466
FWPO	0.006605	0.006605	0.000044
FSRC	0.010568	0.010568	0.000112
FSCH	0.036988	0.030383	0.001124
FSBA	0.039630	0.025099	0.000995
FSAS	0.007926	0.005284	0.000042
FSCW	0.003963	0.009247	0.000037
FBAS	0.006605	0.009247	0.000061
FFAE	0.039630	0.046235	0.001832
FFSM	0.039630	0.042272	0.001675
FFCW	0.039630	0.044914	0.001780
FSBE	0.031704	0.027741	0.000880
HPTG	0.039630	0.034346	0.001361
HPDS	0.027741	0.027741	0.000770
HSGF	0.038309	0.047556	0.001822
SSMS	0.039630	0.036988	0.001466
VRMF	0.023778	0.023778	0.000565
VRSF	0.038309	0.031704	0.001215
SWSB	0.039630	0.042272	0.001675
HBWM	0.001321	0.002642	0.000003
HSWM	0.001321	0.001321	0.000002
HRFM	0.039630	0.039630	0.001571
HMEM	0.117569	0.126816	0.014910
HARC	0.010568	0.010568	0.000112
HSRC	0.039630	0.030383	0.001204
HSER	0.038309	0.035667	0.001366
HSPL	0.010568	0.017173	0.000181
HPWD	0.039630	0.042272	0.001675
HWLA	0.039630	0.046235	0.001832
HLTS	0.035667	0.026420	0.000942
P(chance)	Total	1.000000	0.045558

P(correct)	0.833554
P(chance)	0.045558

Kappa	0.825609
90%CI -	0.802262
90%CI+	0.848956

Code	Map-class Name	NVCS Codes
FMBH	Maple - Basswood - Hardwood Forest	CEGL002062, CEGL005017
WBRC	Eastern Red-cedar - (Hardwood) Bluff Woodland	CEGL002144
FWRO	Midwestern White Oak - Red Oak Forest	CEGL002068
WDMO	North-Central Dry-Mesic Oak Woodland	CEGL002142
FWPO	White Pine - Red Oak Forest	CEGL002480
FSRC	Midwest Red-cedar Forest	CEGL002593
FSCH	Midwest Hardwood - Conifer Ruderal Forest	CEGL005456
FSBA	Midwest Box-elder - Ash Ruderal Forest	CEGL005462
FSAS	Aspen Ruderal Forest	CEGL005454
FSCW	Cottonwood Upland Ruderal Forest	CEGL005455
FBAS	Red Maple - Ash - Birch Swamp Forest	CEGL002071
FFAE	Ash - Elm - Mixed Lowland Hardwood Forest	CEGL002081
FFSM	Silver Maple - Elm Forest	CEGL002586
FFCW	Midwestern Cottonwood - Black Willow - Silver Maple Forest	CEGL002018
FSBE	Box-elder Ruderal Floodplain Forest	CEGL005033
HPTG	Central Mesic Tallgrass Prairie	CEGL002203
HPDS	Dry Slope Prairie	CEGL002215, CEGL002245, CEGL002318
HSGF	Successional Grass & Forb Old Field	CEGL005457, CEGL005459
SSMS	Successional Mixed Species Shrubland	CEGL005460, CEGL005461
VRMF	River Mudflats	CEGL002314
VRSF	Riverine Sand Flats	CEGL002049
SWSB	Sandbar Willow Shrubland	CEGL008562
HBWM	North-Central Bluejoint Wet Meadow	CEGL005449
HSWM	Sedge Wet Meadow	CEGL002256, CEGL002258
HRFM	Riverine Forb Mudflats	CEGL005458
HMEM	Mixed Emergent Marsh	CEGL002026, CEGL002221, CEGL002229, CEGL002233
HARC	Arrowhead - Rice Cutgrass Marsh	CEGL005240
HSRC	Reed Canarygrass Eastern Marsh	CEGL006044
HSER	Eastern Reed Marsh	CEGL004141
HSPL	Purple Loosestrife Wetland	CEGL006403
HPWD	Midwest Pondweed Submerged Aquatic Wetland	CEGL002282
HWLA	Northern Water-lily Aquatic Wetland	CEGL002562
HLTS	American Lotus Aquatic Wetland	CEGL004323

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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