U.S. Fish & Wildlife Service

Trempealeau National Wildlife Refuge

Habitat Management Plan

December 2019

American White Pelicans *(Pelecanus erythrothynchos*) in October; Trempealeau National Wildlife Refuge. (Photo credit: L. Palmer, USFWS)

Habitat Management Plans provide long-term guidance for management decisions; set forth goals, objectives, and strategies needed to accomplish refuge purposes; and, identify the Fish and Wildlife Service's best estimate of future needs. These plans detail program planning levels that are sometimes substantially above current budget allocations and as such, are primarily for Service strategic planning and program prioritization purposes. The plans do not constitute a commitment for staffing increases, operational and maintenance increases, or funding for future land acquisition.

The National Wildlife Refuge System, managed by the U.S. Fish and Wildlife Service, is the world's premier system of public lands and waters set aside to conserve America's fish, wildlife, and plants. Since the designation of the first wildlife refuge in 1903, the System has grown to encompass more than 150 million acres, 556 national wildlife refuges and other units of the Refuge System, plus 38 wetland management districts.

Habitat Management Plan
Trempealeau National Wildlife Refuge

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Chapter 1: Introduction

1.1 Scope and Rationale

The Trempealeau National Wildlife Refuge (Trempealeau NWR or Refuge) was established by Executive Order 7437 in 1936 as "a refuge and breeding ground for migratory birds and other wildlife". Trempealeau NWR is managed by the U.S. Fish and Wildlife Service (USFWS) as part of the National Wildlife Refuge System (NWRS or System). The mission of the NWRS is "*to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans".*

In 1997, Congress passed the National Wildlife Refuge System Refuge Improvement Act renewing its vision for the future of the refuge system where:

- Wildlife comes first
- Refuges are anchors for biodiversity and ecosystem-level conservation
- Lands and waters of the System are biologically healthy
- Refuge lands reflect national and international leadership in habitat management and wildlife conservation
- The biological integrity, diversity and environmental health must be maintained, defined in 601 FW 3.
- Monitoring of plant and animal populations is essential
- Growth of the NWRS and conservation of ecosystems across the United States

In 2008 Trempealeau NWR completed a Comprehensive Conservation Plan (CCP), which is designed to guide the management and administration of the Refuge for a period of 15 years while adhering to the NWRS and the Refuge missions and visions (USFWS 2008a). Identified within the CCP are broadly-defined goals and objectives for the management of wildlife and habitats within the Refuge (Appendix A). The following Habitat Management Plan (HMP) serves as a step-down plan from the CCP and provides a more precise guide to the goals, objectives, and strategies for the management of wildlife and habitats at Trempealeau NWR.

The lifespan of this HMP is 15 years and was prepared in accordance with guidance for developing HMPs provided by the USFWS Habitat Management Plans policy (620 FW 1). It also complies with all applicable laws, regulations, and policies governing the management of units of the National Wildlife Refuge System.

1.2 Legal Mandates

As part of the National Wildlife Refuge System, the administration, management and growth of Trempealeau NWR adheres to the following goals that are common to all National Wildlife Refuges (USFWS 2004, Section 601 FW1.8):

- Conserve a diversity of fish, wildlife, and plants and their habitats, including species that are endangered or threatened with becoming endangered.

- Develop and maintain a network of habitats for migratory birds, anadromous and interjurisdictional fish, and marine mammal populations that is strategically distributed and carefully managed to meet important life history needs of these species across their ranges.

- Conserve those ecosystems, plant communities, wetlands of national or international significance, and landscapes and seascapes that are unique, rare, declining, or underrepresented in existing protection efforts.

Trempealeau NWR was established by Executive Order 7437 in 1936 as:

> "…a refuge and breeding ground for migratory birds and other wildlife".

Subsequent property acquisitions to the Refuge added additional purposes. These purposes are:

> "…suitable for-(1) incidental fish and wildlife oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species ..." (Refuge Recreation Act of 1962; 16 U.S.C 460k-460k-4)
>
> "...for the development, advancement, management, conservation, and protection of fish and wildlife resources." (Fish and Wildlife Act of 1956; 16 U.S.C. 742f(a)(4)

Multiple additional laws and executive orders are applicable to the management and administration of Trempealeau NWR and a full listing can be found in Appendix E of the Refuge CCP (USFWS 2008a). Some of the most significant laws and executive orders, as related to this HMP, are:

- The Migratory Bird Treaty Act of 1918
- The Migratory Bird Conservation Act of 1929
- The Fish and Wildlife Coordination Act of 1934 and amended in 1958
- The National Wildlife Refuge System Administration Act of 1966
- The Endangered Species Act of 1973
- Executive Order 11988, Floodplain Management, of 1977
- Executive Order 11990, Protection of Wetlands, of 1977
- Fish and Wildlife Improvement Act of 1978
- Fish and Wildlife Conservation Act of 1980 as amended
- Federal Noxious Weed Act of 1990
- Executive Order 12996, Management and General Use Public Use of the National Wildlife Refuge System, of 1996
- National Wildlife Refuge System Improvement Act of 1997

- Executive Order 13112, Invasive Species, of 1999
- Executive Order 13175, Responsibilities of Federal Agencies to Protect Migratory Birds, of 2001

1.3 Relationship to Other Plans

The wildlife and habitat goals and objectives described in this HMP are consistent with other refuge plans, as well as, regional and national conservation plans. The plans listed below were used to help develop this HMP.

Refuge Plans

Comprehensive Conservation Plan CCP
Passage of the National Wildlife Refuge Improvement Act in 1997 mandated the completion of a Comprehensive Conservation Plan for all Refuges by 2012. Trempealeau NWR completed a CCP in 2008 and it serves as a document that will guide the management and administration of the Refuge until 2023, a period of 15 years. The Trempealeau NWR CCP (USFWS 2008a) identifies the purpose, goals and objectives for the Refuge. The CCP is an all-inclusive plan that guides every aspect of conservation on the Refuge, including wildlife and habitat management, public use, and Refuge operations. As stated above, the HMP is a step-down plan in which the goals and objectives support and further define the wildlife and habitat management goals and objectives of the CCP to achieve the purposes for which Trempealeau NWR was established.

Furbearer Trapping Plan
The Refuge completed a Furbearer Trapping Plan in 1999 (USFWS 1999a). The trapping plan identifies six species that can be legally taken during trapping activities at the Refuge: muskrat (*Ondatra zibethicus*), beaver (*Castor canadensis*), raccoon (*Procyon lotor*), mink (*Mustela vison*), spotted skunk (*Spilogale putorius*), striped skunk (*Mephitis mephitis*), and opossum (*Didelphis virginiana*). Two of these species, muskrat and beaver have the ability to modify habitat conditions through their effects on vegetation as well as their ability to damage Refuge infrastructure such as dikes, levees and water control structures.

Hunting Plan
The Refuge completed a Hunting Plan in 2017 (USFWS 2017a) which will be a chapter within the future TNWR Visitor Service Plan. The Hunting Plan identifies how the Refuge will manage public hunting opportunities on Refuge lands as identified in the Trempealeau National Wildlife Refuge Comprehensive Conservation Plan (CCP) (USFWS 2008a). Included in this plan is a hunt plan for white-tailed deer (*Odocoileus virginianus*). The impacts of the overpopulation of deer on plants within a habitat can extend throughout a whole ecosystem causing declines in abundance and diversity of plants as well as insects, small mammals and canopy-nesting birds (Levy 2006). Over browsing of native species by deer can also increase invasive plant species (Rawinski 2008). Harvest levels of deer will be set in consultation with Wisconsin DNR.

Fire Management Plan
The Refuge completed a Fire Management Plan in 2015 (USFWS 2015a). Revisions within this plan complement new fire interval recommendations. Some of the goals of the 2015 Fire Management Plan include the following:

- The reestablishment of fire as the management tool of choice to maintain and enhance existing fire-adapted communities.
- Reestablishment of historical fire regimes.
- Restoration of fire-adapted communities.

2015 Contaminant Assessment Process Report
In 2015 the Refuge completed a Contaminant Assessment Process Report (USFWS 2015b) that recommended the Refuge work with the Water Resources Branch in the Division of Natural Resources and Conservation Planning to perform a hydrological evaluation to address the data gaps pertaining to how surface and ground waters are entering the Refuge. Understanding the hydrology of the Refuge is important to help understand what risks may exist for the Refuge. In addition, a better understanding of the hydrology will help to manage water levels throughout the Refuge for the benefit of resident and migratory birds. A hydrologic evaluation could include surface and/or groundwater monitoring, bathymetry survey, modeling, or a water budget (USFWS 2015b). When the location, timing, and magnitude of water sources on the Refuge are better understood the contaminant risks to the Refuge will be easier to identify and evaluate. The Water Resources Branch in the Division of Natural Resources and Conservation Planning will discuss options for a hydrologic evaluation with Refuge staff to ensure data collected will benefit Refuge management needs (USFWS 2015b). See Appendix B for summary of 2015 CAP report.

State, Regional and National Plans

Environmental Pool Plans (EPP)
Environmental Pool Plans for Mississippi River Pools 1-10 were completed in 2004 by the Fish and Wildlife Work Group of the River Resources Forum (Fish and Wildlife Work Group 2004), representing a cooperative effort of state and federal agencies to develop common habitat goals and objectives for the Upper Mississippi River. Various recommendations are identified in the EPP for the Refuge, such as prairie restoration and the management of water levels to improve aquatic habitat.

Wisconsin Strategy for Wildlife Species of Greatest Conservation Need
The State Wildlife Grants (SWG) program is administered by the USFWS and it includes the distribution of federal funds to all states and territories for the conservation of wildlife resources of greatest conservation need. Implementation of the SWG program requires each state to complete a plan that guides the actions of the state in allocating SWG funds towards conservation activities. As mandated by participation in the SWG program, the state of Wisconsin completed the Wisconsin Strategy for Wildlife Species of Greatest Conservation Need in 2005 (WDNR 2005). Among the many purposes of this plan, it serves to identify Wisconsin native wildlife species that are most at risk of becoming endangered or threatened, delineates their distribution within the state, identifies the habitats they are associated with,

and identifies actions that can developed to contribute to their conservation. This plan was updated in 2015 (WDNR 2015a) and can be accessed here: https://dnr.wi.gov/topic/wildlifehabitat/actionplan.html

USFWS Region 3 Fish and Wildlife Resource Conservation Priorities
In 2002, the USFWS identified the species considered to be in the greatest need of attention in Region 3 under the full span of USFWS authority (USFWS 2002). This plan also associated each species with ecosystems and habitats, and identified conservation concerns, desired outcomes, conservation obstacles, and conservation strategies associated with each species.

Upper Mississippi River and Great Lakes Region Joint Venture Implementation Plan
The Upper Mississippi River and Great Lakes Joint Venture (UMRGLR JV 2007) Implementation Plan was completed in 2007 (UMRGLR JV 2007). A goal of the UMRGLJV is to provide guidance to wildlife managers so they can implement habitat projects that contribute to regional population objectives. In addition to the UMRGLJV Implementation Plan, UMRGLJV bird-group strategies were crafted for shorebirds (Potter et al. 2007a), landbirds (Potter et al. 2007b), waterbirds (Soulliere et al. 2007a), and waterfowl (Soulliere et al. 2007b). Bird-group strategies identify the type, location, season, and amount of habitat needed for each bird-group in order to contribute to the achievement of population objectives.

USFWS Birds of Conservation Concern
As mandated by the 1988 amendment to the Fish and Wildlife Conservation Act of 1980, in 2008 the USFWS identified species, subspecies and populations of all migratory nongame birds that were likely to become candidate species under the Endangered Species Act of 1973. This document identifies which species fall into this category as well as species that were already candidate species and species that had been recently delisted. Additionally, it identifies bird assemblages for each Bird Conservation Region (BCR). Trempealeau NWR is contained within BCR 23, Prairie Hardwood Transition (USFWS 2008b).

Partners in Flight Bird Conservation Plan
Partners In Flight (PIF) Bird Conservation Plans (BCP) identify species and habitats most in need of conservation, establish objectives for bird populations and habitats within physiographic areas, and make recommendations for needed conservation actions. Trempealeau NWR is encompassed by the PIF Upper Great Lakes Plain physiographic area 16 (Knutson et al. 2001). This area is known as the “driftless area” because it was not glaciated during the Pleistocene. Habitats within the area include broadleaf forests, oak savannas, and a diversity of prairie communities.

Karner Blue Butterfly (Lycaeides melissa samuelis) Recovery Plan (USFWS 2003)
Karner blue butterflies are a Federally Endangered species that is dependent on wild lupine (*Lupinus perennis*), it’s only known larval food plant, and on nectar plants. Wild lupine historically occurred in savanna and barren habitats characterized by dry sandy soils, but only remnants of these types of habitats remain. Wild lupine will also grow in rights-of-ways, airports, military bases, and utility corridors. Although wild lupine grows on the Refuge, Karner blue butterflies have not been recorded on TNWR. The savanna habitat that was historically

present on the Refuge may have supported these butterflies at one time and any restoration of this habitat may support this species. Possible reintroductions of this species following recommendations of the recovery plan may be feasible.

Chapter 2: Background

2.0 Refuge Location and Description

Trempealeau NWR is located within the Mississippi River Valley in Buffalo and Trempealeau Counties of southwestern Wisconsin. The Refuge is adjacent to Navigation Pool 6 of the Mississippi River, directly east, across the river, from the town of Winona, Minnesota (Figure 2.1).

Figure 2.1. Location of Trempealeau NWR, Trempealeau, WI (Source: 2008 TNWR CCP; Figure 1 (USFWS 2008a)).

The Refuge was once a backwater of the Mississippi River but was essentially isolated in the early 1900s by the construction of the Burlington Northern Sante Fe Railroad (BNSFRR) dike and the diversion of the Trempealeau River. About seven miles of the BNSFR dike forms the Refuge's southern boundary and on the east boundary about 2.5 miles of barrier dikes separate Refuge pools from the man-made channel of the Trempealeau River. In addition, a 2.5-mile long Canadian National Railroad (CNRR) dike crosses the Refuge and about three miles of additional interior dikes separate Refuge wetlands into pools (Figure 2.2). Trempealeau NWR includes 6,808 acres, of which about 4,972 acres are wetlands.

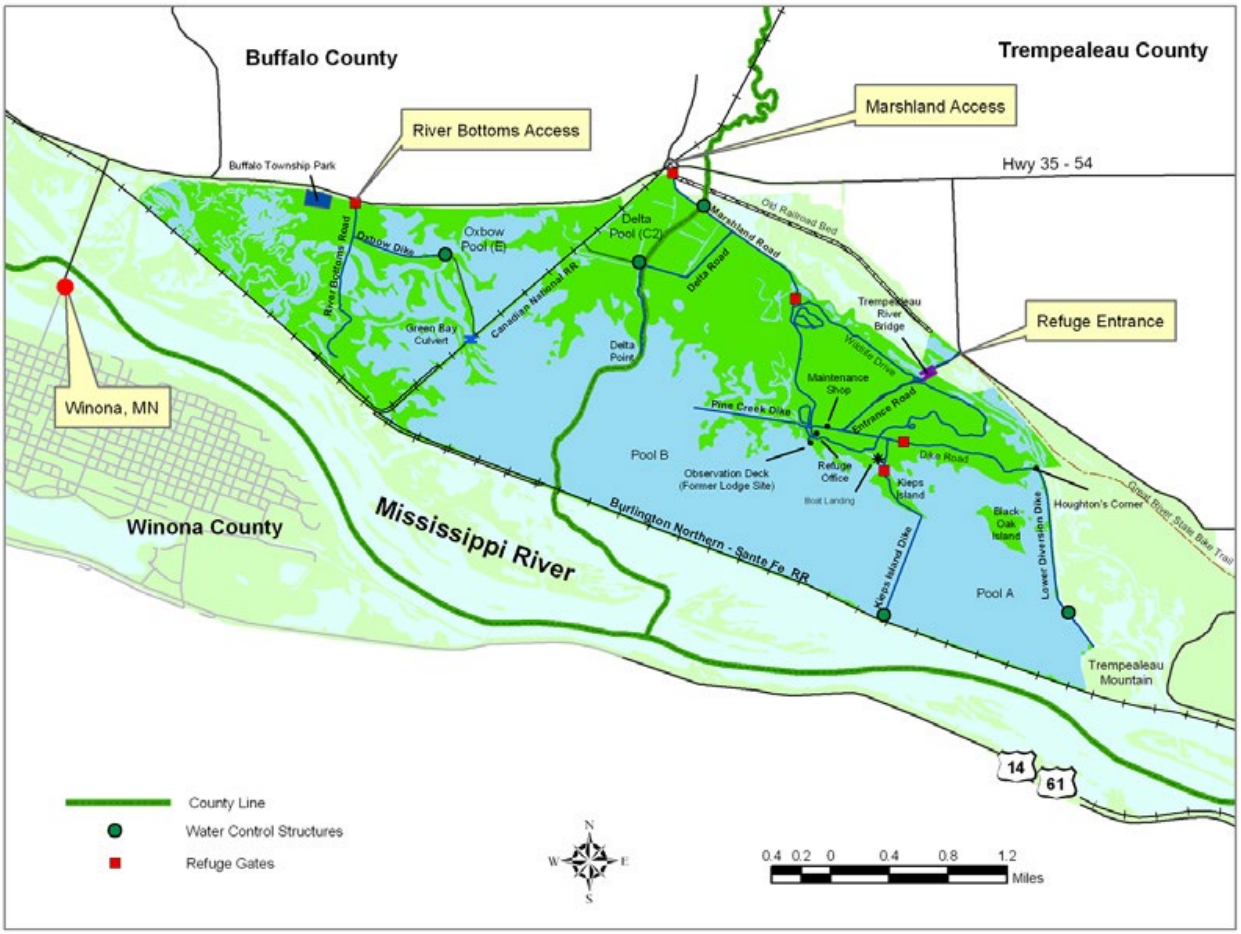

Figure 2.2. Locations of roads, dikes, levees, water control structures, and other infrastructure on Trempealeau NWR, Trempealeau, Wisconsin. This figure does not reflect the updated management unit names. (Source: 2008 TNWR CCP; Figure 9 (USFWS 2008a)).

The original Refuge established by Executive Order 7437 in 1936 comprised 706.9 acres of upland habitats with open areas of former hay, pasture, and cropland. In 1979, substantial aquatic and wetland habitats were added to the Refuge when 4,910 acres were acquired. Subsequent to that, additional acquisitions were made resulting in a current size of 6,808 acres.

2.1 Geographical Setting

Trempealeau National Wildlife Refuge lies within the Upper Mississippi River/Tallgrass Prairie (UMR/TGP) Ecosystem (USFWS n.d.; Figure 2.3). This large, ecologically diverse area encompasses land in the states of Illinois, Iowa, Minnesota, Missouri, and Wisconsin. The UMR/TGP ecosystem is bisected into an east and west portion by the Mississippi River. Other major rivers in this ecosystem include the Minnesota, Chippewa, Black, Wisconsin, Iowa, Rock, Skunk, Des Moines, Illinois, and Kaskaskia.

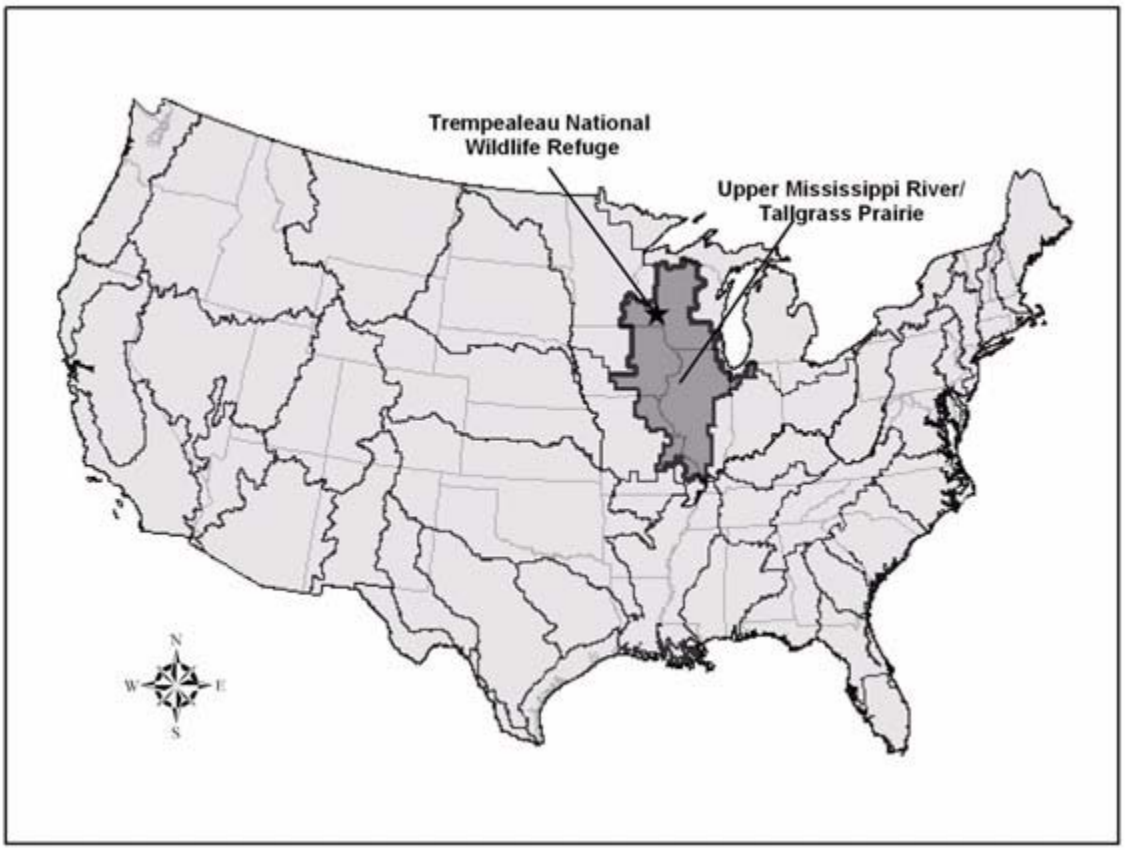

Figure 2.3. Map showing the Upper Mississippi River/Tallgrass Prairie Ecosystem and the location of Trempealeau NWR. (Source: 2008 TNWR CCP; Figure 4 (USFWS 2008a)).

The Trempealeau River, an 81.5-mile-long river (131.2 km), is also located within the UMR/TGP ecosystem. This river is a tributary of the Mississippi River and begins in western Jackson County and flows west and then southwest into the Mississippi River downstream of Winona, Minnesota at Perrot State Park. TNWR lies between the Lower Trempealeau River Watershed (Figure 2.4) and Mississippi River's Pool 6 (WDNR n.d.). The Trempealeau and Mississippi Rivers are the primary surface waters that impact water levels and management in Trempealeau NWR.

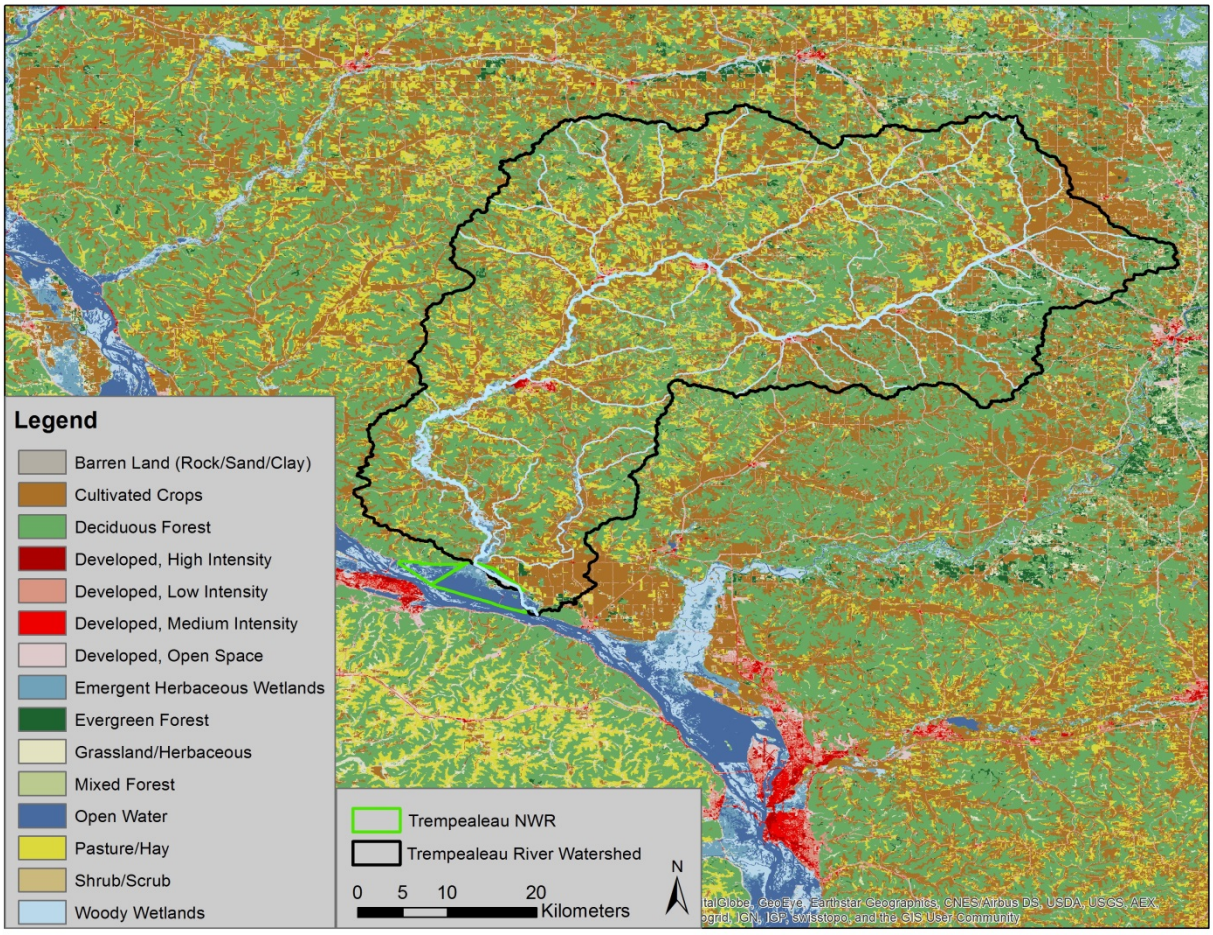

Figure 2.4. Trempealeau River Watershed and surrounding land use. Boundary of Trempealeau NWR is green polygon. (Source: 2015 TNWR CAP; Figure 8 (USFWS 2015b). Map by Steve Choy, Green Bay Ecological Services Field Office).

The Refuge is located within two overlapping ecotypes within the UMR/TGP ecosystem – these include the Driftless Area and the Oak Savanna and Forestland Area. The Driftless Area covers parts of Minnesota, Iowa, Wisconsin, and Illinois. Because it was not subject to glacial drift during the latter part of the Pleistocene epoch, the Driftless Area is characterized by highly dissected uplands with deeply cut valleys. Overlaying the Driftless Area in much of southern and western Wisconsin is a fire-dependent ecotype which once covered more than 30 million acres in the Region. Today, the oak savannas of the Midwest are considered by some to be the world's most threatened communities. Conversion of oak savanna to agricultural lands, elimination of fire, invasion by exotic species, and human development have largely eliminated this ecotype from the UMR/TGP Ecosystem. However, Trempealeau NWR includes some of the last remaining remnants of prairie/oak savanna habitats. The original Refuge included more than 700 acres of rolling native prairie and oak savanna. Unfortunately, due to the spread of invasive species such as black locust (*Robinia pseudo-acacia*) and buckthorn (*Rhamnus cathartica*) a large portion has been converted to forested areas.

Trempealeau National Wildlife Refuge is located within the Upper Midwest and Great Lakes Land Conservation Cooperative (LCC 16; LCCN 2018), the Prairie Hardwood Transition (Bird Conservation Region 23; USFWS 2008b), and the PIF Upper Great Lakes Plain physiographic area 16 (Knutson et al. 2001). Trempealeau NWR lies adjacent to Navigation Pool 6 of the Mississippi River and is strategically located on an important migration corridor, the Mississippi Flyway, providing resting and feeding habitat for thousands of waterfowl and other birds during spring and fall.

2.2 Climate

The Upper Mississippi River Watershed, which includes the Refuge, is characterized by tremendous temperature ranges. Average lows occur in January and February (8-13 degrees Fahrenheit) with extreme temperatures of minus 30 degrees Fahrenheit or lower. July and August have average highs in the lower 80's, with occurrences of extreme temperatures over 100 degrees. Some moderation in temperature extremes within the Upper Mississippi River valley have been observed. This is apparent in the spring when hardwood trees begin leafing out several days earlier than those on the plateaus flanking the valley. Average annual precipitation is about 30 inches. About 80 percent occurs as rain from April through October with the remainder falling as snow from November to March. Winter moisture accumulates and can cause excessive runoff and flooding following the spring break-up.

The U.S. Department of the Interior issued Secretarial Order 3226 in January 2001 requiring Federal agencies under its direction that have land management responsibilities to consider potential climate change impacts as part of long range planning endeavors. According to a report produced by the Wisconsin Initiative on Climate Change Impacts (2011), Wisconsin has become warmer and wetter and scientists project these changes in climate will continue. Changes such as rising air temperatures and changes in the frequencies of extreme weather, such as heavy rains, will have a significant impact on wildlife populations and habitats (Allstadt et al. 2015; Martinuzzi et al. 2016). Projected increases in heavy rain events in the Midwest (Martinuzzi et al. 2016) may increase sediment and nutrient inputs into the Refuge wetlands and adjacent rivers leading to an increase in blue-green algal blooms and a loss of biodiversity in wetlands. Changes in climate are already causing breeding distributions of landbirds to shift substantially at an average velocity of 1.27 km/year (Bateman et al. 2015) and the relationships between plants and pollinators are being disrupted with the early onset of spring (Allstadt et al. 2015). Some native species will no longer thrive in the higher temperatures making way for invasive or non-native species (WICCI 2011). Therefore, our management strategies need to be flexible in order to accommodate any future habitat alterations due to climate change within the Refuge. Climate change impacts have been considered throughout this HMP and incorporated into the habitat goals, objectives and strategies outlined in Chapter 4.

2.3 Historic Perspective

The Upper Mississippi River Valley was substantially influenced by the Pleistocene geologic age. During this period, heavy water flows caused substantial erosion and cut the present deep valley. As flows lessened, sediments composed of sand and gravel were deposited forming the

basis for present Refuge soils. Soils within the Refuge range from alluvial types in the wetlands to finely eroded sands on the steeper uplands. Varying levels of silt overlie sand and gravel sediments in the wetland bottoms. However, isolation of Refuge marshes from adjacent river floodwaters by the barrier dikes has reduced the degree of siltation compared to adjacent Mississippi backwater areas. The 700-acre central upland portion is an area of rolling sand dunes formed from wind-blown material deposited in the valley during a former dry period.

Trempealeau NWR has been described as one of the most important archeological sites in the Midwest. Human use of the area dates back 12,000 years. Dozens of sites and more than 6,000 artifacts have been cataloged from various locations. However, most of these surveys have been conducted in a few areas on the east side of the Refuge. The majority of the Refuge lands have not been surveyed for archeological artifacts and as a result, the locations and extent of archeological resources are unknown. (USFWS 2008a).

In the late 1800s a railroad was constructed along the Mississippi River and forms the Refuge's south boundary. In the early 1900s, a drainage district was formed with the intent of draining the area north of the railroad dike for farming. The district dug a channel diverting the Trempealeau River and Pine Creek into the Mississippi River about three miles downstream of the Trempealeau River's original delta. Dredged material taken from the new channel was placed on the south bank to create barrier dikes to protect adjacent lands from flooding. Attempts to drain and farm within the dikes were largely unsuccessful and the drainage district eventually went bankrupt. Following the completion of Lock and Dam 6 at Trempealeau in the mid-1930s, water levels throughout Pool 6 were raised several feet and stabilized for navigation on the main river channel. Wetlands protected by the railroad and barrier dikes became part of a corporation known as Delta Fish and Fur Farm (Delta FFF).

Trempealeau NWR was established in 1936 when 706.9 acres were set aside by Executive Order 7437 (See CCP, Appendix E). The original Refuge consisted of an upland portion with open areas of former hay, pasture, and cropland. For more than 40 years the Refuge remained small in spite of several attempts to purchase more than 5,000 acres of the surrounding Delta FFF. The Delta FFF yielded a variety of incomes to its owners from farming, timber harvest, commercial fishing, furbearer trapping, and turtle and bait fish harvest. In addition, a group of local sportsmen leased the marshes for waterfowl hunting. Under private ownership the area remained relatively unchanged. Of significance was a major flood in 1965 that breached dikes, inundated Refuge buildings, and caused irreparable damage to wetland plant communities (USFWS 2008a).

In 1975, Dairyland Power Cooperative acquired the Delta FFF. Dairyland wanted to construct a rail loop for a coal off-loading facility near their power generating plant at Alma, Wisconsin. The land they would need was part of the Upper Mississippi River NW&FR. As part of a land exchange Dairyland divested 132 acres of the Delta FFF and sold an additional 4,778 acres to the Service in 1979. This addition, plus other recent acquisitions, has brought Trempealeau NWR to its present 6,808 acres. Additional land acquisitions are being considered that would alleviate issues with the entrance road, allow restoration and protection of bottomland forest

and emergent marshes, and allow the Trempealeau River to move freely within its floodplain regardless of land use issues.

Historical records indicate that the upland areas of the Refuge were once dominated by prairie and oak savanna habitats (Curtis 1959; Figure 2.5). Much of the uplands were converted to agriculture before the Refuge purchased the property in 1936. Under Refuge management in the 1940s through the 1960s, various pine species, black locust, Siberian pea (*Caragana arborescens*), and honeysuckle (*Lonicera spp.*) were planted to reduce soil erosion and provide wildlife habitat in tune with the management practices of the time. In the 1970s, many of the oaks in the savanna were removed because of oak wilt disease. These management practices have resulted in over 85 percent of the upland forests being dominated by non-native tree species. In the past years, nearly all upland forests have been invaded by a dense understory of European buckthorn, limiting growth of native hardwoods, shrubs, and wildflowers. Efforts to control invasive or non-native forest plants have been limited by current funding and staffing levels.

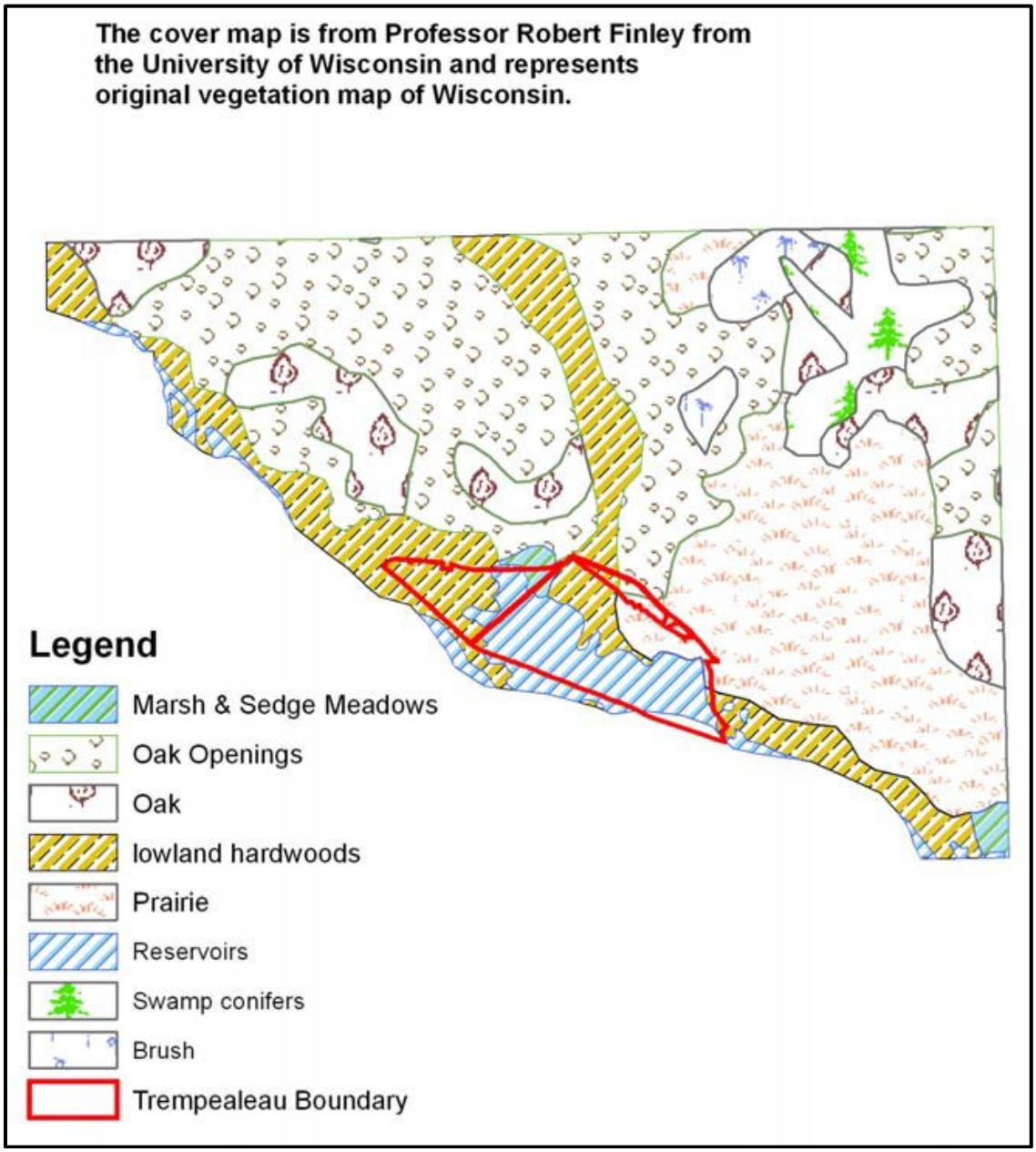

Figure 2.5. Pre-European settlement vegetation map, Trempealeau NWR by Finley. (Source: 2008 TNWR CCP; Figure 14; USFWS 2008a).

Grasslands are fragmented into small units surrounded by forest edge that support populations of species that prey on nestlings or parasitize grassland and forest birds' nests. In addition, black locust saplings increase throughout the prairies each year at an alarming rate. Control of invasive plants, especially black locust is limited by available staff, equipment, and restrictions on chemical use.

Prior to impoundment, much of the old river channels on the western portion of the Refuge were bordered with bottomland hardwoods. Some areas were cleared for farming and then later maintained by the Refuge as grasslands in order to create edge habitat. Now that the importance of bottomland hardwoods (and other habitats) in unfragmented condition is

known, and the difficulty of maintaining these fields using fire is realized, the Refuge has recently begun to restore these areas to bottomland hardwoods. Some restoration has already occurred with planting of seedlings and direct seeding of various trees including swamp white oak (*Quercus bicolor*), hackberry (*Celtis occidentalis*), and green ash (*Fraxinus pennsylvanica*).

As mentioned previously, the Refuge was once a backwater of the Mississippi River but was essentially isolated in the early 1900s by the construction of the Burlington Northern Sante Fe Railroad dike and the diversion of the Trempealeau River. The hydrology was further altered in the 1930s by the construction of Lock and Dam 6 on the Mississippi River. The result is a deeper, relatively stabilized water system. Over time, stable water levels have adversely affected aquatic plant abundance, diversity and distribution. Fish and wildlife dependent on these plant communities have declined. Shorebirds are particularly dependent on mudflats and sandbars during migration, but these habitats have been mostly eliminated by higher water levels. In 1999 a series of dikes and pumps were installed to assist with water level management on about 1,500 acres of the Refuge. The remaining 4,000 acres of wetland are essentially unmanageable, subject to the effects of wind, waves, and rough fish that keep the water too cloudy to be fully productive.

2.4 Current Land Classifications and Refuge Conditions

Using the descriptions within the Wisconsin Natural Communities (WDNR 2015b), NVCS Association Classification (Faber-Langendoen, 2001), and our best professional judgment, we developed a table of the natural communities that have been documented on the Refuge or have the potential to occur (Table 2.1). The Refuge's vegetation types were grouped into the following broad habitat types: grassland, savanna, forest, forested wetland, wetland, and riverine. Figure 2.6 reflect the spatial distribution of these broad habitat classifications. There are eight management units within TNWR (Figure 2.6). Six of the management units are within the wetland areas and are divided by dikes, levees, or railroads. The other two units are the grassland/savanna unit and the Trempealeau River unit. In Figure 2.6 wetland was further broken down into mudflats, shrub carr, emergent marsh, submergent marsh, and open water. The broad habitat classifications will be used to guide us in the selection of resources of concern and the development of goals and objectives in the subsequent chapters.

Table 2.1. Summary of Trempealeau NWR habitat types and communities.

Broad Habitat Type	WI Natural Communities[1]	NVCS Association Classification[2]	Populations and Habitat Attributes	Natural Processes Responsible for these Conditions	Limiting Factors/Threats	State Rank (WI/NVCS)[4]
Grassland	Dry Mesic Prairie	Midwest Dry-mesic Prairie, CEGL002214	Soils either loamy sands or sandy loams; terraces on margins of large river valleys, sandy outwash deposits. Taller species such as big bluestem (*Andropogon gerardii*) and indian-grass (*Sorghastrum nutans*) dominate. Needle grass (*Stipa spartea*) may also be present; herb component is more diverse than in Dry Prairies, including many species that occur in both Dry and Mesic Prairies. Composites and legumes well-represented in undisturbed stands.	Droughty soils, periodic fire	Conversion to agricultural uses or the encroachment of woody vegetation due to the lack of wildfire, fragmentation, invasives (smooth brome, Kentucky bluegrass, and Canada bluegrass, and other forbs including crown vetch, spotted knapweed, sweet clovers, and wild parsnip)	S2
	Mesic Prairie	Central Mesic Tallgrass Prairie, CEGL002203	Rich, moist, well-drained sites, level or gently rolling glacial topography; tall grass, big bluestem (*Andropogon gerardii*) dominates; also little bluestem (*Andropogon scoparius*), indian grass (*Sorghastrum nutans*), porcupine grass (*Stipa spartea*), prairie dropseed (*Sporobolus heterolepis*), and tall switchgrass (*Panicum virgatum*); diverse forbs, prairie docks (*Silphium spp*.), lead plant (*Amorpha canescens*), heath and smooth asters (*Aster ericoides* and *A. laevis*), sand coreopsis (*Coreopsis palmata*), prairie sunflower (*Helianthus laetiflorus*), rattlesnake-master (*Eryngium yuccifolium*), flowering spurge (*Euphorbia corollata*), beebalm (*Monarda fistulosa*), prairie coneflower (*Ratibida pinnata*), spiderwort (*Tradescantia ohioensis*).	Rich moist soils, good drainage and periodic fire	Conversion to agriculture due to highly productive soil types; fire suppression, encroachment of woody species; development	S1
	Wet Prairie	Central Cordgrass Wet Prairie, CEGL002224	Heterogeneous tall grassland community; The dominant graminoids are Canada bluejoint grass (*Calamagrostis canadensis*), cordgrass (*Spartina pectinata*), and prairie muhly (*Muhlenbergia glomerata*), plus several sedge (*Carex spp*.) species including lake sedge (*C. lacustris*), water sedge (*C. aquatilis*), and woolly sedge (*C. lanuginosa*).	Periodic fire.	Drainage, conversion to agriculture, sedimentation, pollution from surrounding ag. Invasive species, grazing, fire suppression	SU

Broad Habitat Type	WI Natural Communities[1]	NVCS Association Classification[2]	Populations and Habitat Attributes	Natural Processes Responsible for these Conditions	Limiting Factors/Threats	State Rank (WI/NVCS)[4]
Savanna	Oak Opening	North-central Bur Oak Openings, CEGL002020	On wet-mesic to dry sites. Oak-dominated savanna community in which there is less than 50% tree canopy coverage and more than one tree per acre. Bur, white, and black oaks are dominant in mature stands, typically as large, open-grown trees with distinctive limb architecture. Shagbark hickory (*Carya ovata*) is sometimes present. American hazelnut is a common understory shrub. The herb layer is similar to those found in oak forests and prairies, with many of the same grasses and forbs present (Curtis 1959).	Frequent low intensity fire	Fire suppression, invasives (exotic buckthorns, honeysuckles, and multiflora rose, spotted knapweed, spurges); grazing, fragmentation, development, deer herbivory	S1
	Oak Woodland	North-central Bur Oak Openings, CEGL002020	Similar land type and structurally intermediate between Oak Openings and Southern Dry Forest. Dominant trees included white oak, bur oak, and black oak, sometimes mixed with red oak and shagbark hickory; less crown spread than in savanna. Herb layer of prairie, oak savanna, and oak forest communities, but also featuring grasses, legumes, composites and other forbs that are best adapted to light conditions of high filtered shade	Frequent low intensity fire	Fire suppression, invasives (exotic buckthorns, honeysuckles, and multiflora rose, spotted knapweed, spurges); grazing, fragmentation, development, deer herbivory; oak wilt; public opposition to pine removal; climate change.	S1
Forest	Southern Dry Forest	Midwestern White Oak - Red Oak Forest, CEGL002068	Dry sites; tree canopy is moderately closed, with typically 70-80% cover, white oak (*Quercus alba*) and black oak (*Quercus velutina*), also red and bur oaks (*Q. rubra* and *Q. macrocarpa*) and black cherry (*Prunus serotina*); shrub layer, brambles (*Rubus spp*.), gray dogwood (*Cornus racemosa*), and American hazelnut (*Corylus americana*); herbaceous species are wild geranium (*Geranium maculatum*), false Solomon's-seal (*Smilacina racemosa*), hog-peanut (*Amphicarpaea bracteata*), and woodland sunflower (*Helianthus strumosus*).	Occasional (prescribed) fire to regenerate	Grazing, deer herbivory impacts regeneration; invasives (buckthorn, honeysuckles). Historically not present. Lack of fire allows intolerant species to shade out oak; introduction of invasive plants and pine plantings; oak wilt; public opposition to pine removal; climate change	S3
Forested Wetland	Floodplain Forest	Silver Maple - Elm - (Cottonwood) Forest, CEGL002586	Lowland hardwood forest along large rivers; canopy dominants, silver maple (*Acer saccharinum*), river birch (*Betula nigra*), green ash (*Fraxinus pennsylvanica*), hackberry (*Celtis occidentalis*), swamp white oak (*Quercus bicolor*), and cottonwood (*Populus deltoides*); understory of nettles (*Laportea canadensis* and *Urtica dioica*), sedges, ostrich fern (*Matteuccia struthiopteris*) and gray-headed coneflower (*Rudbeckia laciniata*), cardinal flower (*Lobelia cardinalis*) and green dragon (*Arisaema dracontium*).	Periodic flooding and scouring, lateral water movement	Hydrology change, impoundment; adjacent agriculture, sedimentation, erosion, pollution; invasive species	S3

Broad Habitat Type	WI Natural Communities[1]	NVCS Association Classification[2]	Populations and Habitat Attributes	Natural Processes Responsible for these Conditions	Limiting Factors/Threats	State Rank (WI/NVCS)[4]
		Bur Oak - Swamp White Oak Mixed Bottomland Forest, CEGL002098	Restricted to river bottoms, low terraces, and low slopes along river floodplains; tree canopy contains bur oak (*Quercus macrocarpa)*, swamp white oak (*Quercus bicolor)*, and shellbark hickory (*Carya laciniosa)*.	Historically this type may have had a woodland structure because of fire	Development and grazing	-
Wetland	Emergent Marsh	Midwest Mixed Emergent Deep Marsh, CEGL002229	Emergent and submergent aquatic vegetation in permanent standing water, pure stands of single species or in various mixtures; cat-tails (*Typha spp*.), bulrushes (particularly *Scirpus acutus*, *S. fluviatilis*, and *S. validus*), bur-reeds (*Sparganium spp*.), giant reed (*Phragmites australis*), pickerel-weed (*Pontederia cordata*), water-plantains (*Alisma spp*.), arrowheads (*Sagittaria spp*.), and larger spikerush (*Eleocharis smallii*).	Permanent standing water; highly dynamic from season to season	Disturbance, development, sedimentation, eutrophication, pollution, invasives	S4
	Submergent Marsh	Midwest Pondweed Submerged Aquatic, CEGL002282	Herbaceous community of aquatic macrophytes occurs in lakes, ponds, and rivers; found in deep water wetlands and flowages that have little moving water present. Submergent macrophytes often occur in deeper water than beds of floating-leaved or emergent species. Dominants include various species of pondweeds (*Potamogeton spp*.) along with waterweed (*Elodea canadensis*), slender naiad (*Najas flexilis*), eel-grass (*Vallisneria americana*), and species of water-milfoil (*Myriophyllum*) and bladderworts (*Utricularia*).	Natural deep-water hydrology, intact shoreline and surrounding wetland	Disturbance of bottom sediments from recreational powerboats; Shoreline development; pollutants, invasive plants	S4
	Shrub Carr	Dogwood - Willow Swamp, CEGL002186	In bands around lakes, ponds, floodplains; glacial lakebeds; tall shrubs such as red-osier dogwood (*Cornus stolonifera*), meadow-sweet (Spiraea alba), and various willows (*Salix discolor, S. bebbiana*, and *S. gracilis*). Canada bluejoint grass (*Calamagrostis canadensis*) is common.	Maintenance of natural hydrologic cycles	Altered hydrology, invasives, sedimentation and pollution; grazing	S4

Broad Habitat Type	WI Natural Communities[1]	NVCS Association Classification[2]	Populations and Habitat Attributes	Natural Processes Responsible for these Conditions	Limiting Factors/Threats	State Rank (WI/NVCS)[4]
Riverine	Large River/Warm-water Rivers	NA	The Trempealeau River borders the TNWR northeast section and is considered a **Large River** under the state's Natural Community Determinations. Land use in the watershed is primarily agricultural, forest, and a mix of wetland and other uses. Trempealeau River exhibits a naturally sandy substrate common to rivers in the Western Coulees and Ridges Ecological Landscape. This river has the potential to support a high-quality Class II trout fishery. However, this section is rated poor for Fish and Aquatic Life and Fish Consumption due to pollutants. Common species found in Trempealeau River include: Redhorse spp (*Moxostoma spp*), freshwater drum (*Aplodinotus grunniens)*, bluegill (*Lepomis macrochirus*), common carp (*Cyprinus carpio*), bass (*Micropterus spp.*), walleye (*Sander vitreus*), northern pike (*Esox lucius*), and gizzard shad (*Dorosoma cepedianum*).	Due to an almost entirely Agricultural watershed there is a heavy load of soil sediment over the sand substrate; runoff from agriculture and a commercial pesticide plant contributes to pollutant load.	The section of the Trempealeau river that borders the Refuge is considered poor and impaired due pollutants, which include total phosphorus and mercury. Impairments include: Contaminated Fish Tissue and Water Quality Use Restrictions (WDNR n.d.).	NA

[1] Wisconsin Department of Natural Resources. 2015b. Wisconsin's Natural Communities. Retrieved from http://dnr.wi.gov/topic/endangeredresources/communities.asp
[2] Faber-Langendoen, D., editor. 2001. Plant communities of the Midwest: Classification in an ecological context. Association for Biodiversity Information, Arlington, VA. 61 pp. + appendix (705 pp.). Retrieved from http://www.natureserve.org/library/plantcommappendix.pdf
[4] State Rankings: S1-critically imperiled, S2-imperiled, S3-rare or uncommon, S4-apparently secure, S5-secure, SU- possibly in peril but status uncertain. Retrieved from http://dnr.wi.gov/topic/NHI/WList.html#GRank

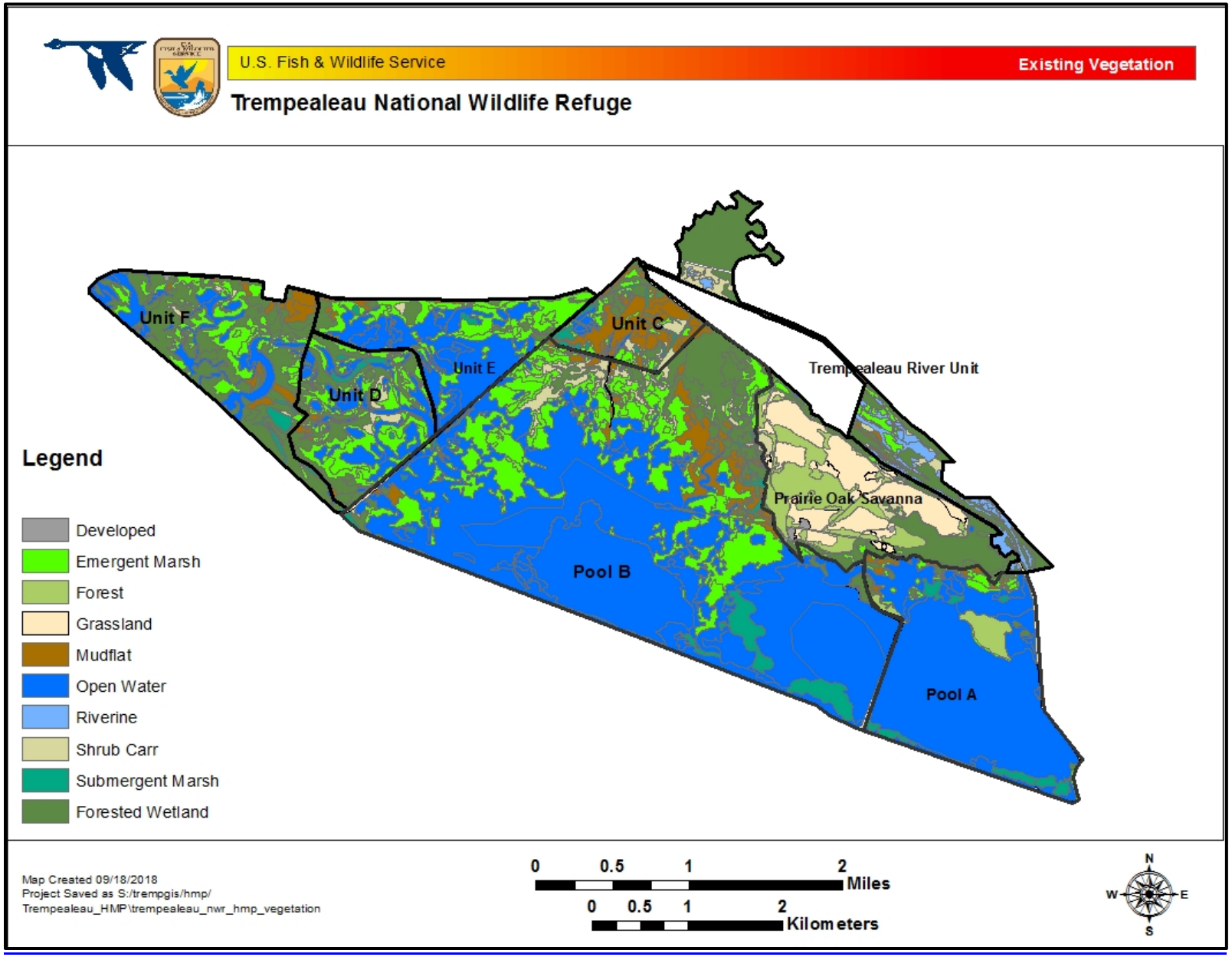

Figure 2.6. Current Trempealeau NWR vegetation map using broad habitat classifications (Source: 2010 USGS vegetation classifications).

Descriptions of current broad habitat types:

Grassland (Prairie) (357 acres)
Prairie areas make up about 5 percent of the Refuge. Past management efforts have encouraged re-establishment of native grasses such as big bluestem (*Andropogon gerardii Vitman*) and little bluestem (*Schizachyrium scoparium*), switchgrass (*Panicum virgatum*), Indian grass, (*Sorghastrum nutans*), side-oats grama (*Bouteloua curtipendula*), Junegrass (*Koeleria cristata*), and green needlegrass (*Nassella viridula*). In the last two decades, the importance of prairie wildflowers has been recognized including species such as purple prairie clover (*Dalea purpurea*), lupine (*Lupinus perennis*), milkweed (*Asclepias spp*.), prairie larkspur (*Delphinium carolinianum*), goat's rue (*Tephrosia virginiana*), spiderwort (*Tradescantia virginiana*), leadplant (*Amorpha canescens*), and yellow puccoon (*Lithospermum canenscens*). Non-native leafy spurge (*Euphorbia esula)* and cool season grasses such as quackgrass (*Agropyron repens*), smooth brome (*Bromus inermis*), and bluegrass (*Poa pratensis*) occur throughout the grasslands.

Savanna (0 acres but potentially up to 298 acres)
According to Wisconsin's Natural Communities (WDNR 2015b), oak openings and oak woodlands are types of savanna habitat that was once widespread in this area. However, presently no known savanna remnants exist on the Refuge. Small oaks are present within the grasslands, but frequent burning does not allow for growth. Revisions within the 2015 Fire Management Plan (USFWS 2015a) include fire interval recommendations that may allow for more growth. Savanna habitat types such as oak openings and oak woodlands are rapidly disappearing. Restoration is desired but an assessment is needed to determine where and how these habitats can and should be restored (Desired acres = 298). Criteria and guidance provided by the Oak savanna workbook (USFWS, NWRS, Midwest Region, Pauline Drobney et al., Division of Natural Resources and Conservation Planning, *In Prep*), Plant communities of the Midwest (Faber-Langendoen 2001), and Wisconsin's Natural communities (WDNR 2015b), will be used to assess the possibilities of restoration of these imperiled habitats.

Forest (230 acres)
Upland forest at the Refuge is classified as Southern Dry Forest (WDNR 2015b) and covers about 3 percent of the Refuge. Tree canopy for Southern Dry Forest is typically 70-80% cover (WDNR 2015b). The overstory is dominated by red oaks (*Quercus rubra*) and black oaks (*Quercus velutina*), black locust (*Robinia pseudo-acacia*), green ash (*Fraxinus pennsylvanica*), and black cherry (*Prunus serotina*) with a few scattered pine (*Pinus spp.*) plantations. These pine plantations and invasive tree and shrub species degrade much of the upland forests. Removal of these species may contribute to the restoration of savanna habitat (oak woodland) within the Refuge.

Black Oak Island
Included in the forested acreage is Black Oak Island Natural Area, a 46-acre island complex located in Pool A (See Chapter 2, Figure 2.2). The unit was designated a Public Use Natural Area (PUNA) in October, 1986 based on its unique and relatively undisturbed character. The complex includes one large and three small islands covered with mature stands of red and black oaks. Many of the trees are quite large, exceeding 24 inches dbh. Black Oak Island also contains

important archeological resources that are not inventoried and are subject to shoreline erosion and potential theft. However, the islands are accessible only by canoe or kayak and receive very little use by visitors. Regardless, the unit is open to the public for staff-guided wildlife observation, hiking, and photography.

Forested wetland (1,135 acres)
The bottomland hardwood forest (WI natural community = Floodplain Forest; WDNR 2015b) covers about 17 percent of the Refuge and is dominated by silver maple (*Acer saccharinum*), river birch (*Betula nigra*), swamp white oak (*Quercus bicolor*), cottonwood (*Populus deltoides*), willow (*Salix spp*.), and ash (*Fraxinus spp.*). Understory varies but may consist of nettles (Laportea canadensis and Urtica dioica), sedges, ostrich fern (Matteuccia struthiopteris), gray-headed coneflower (Rudbeckia laciniata), cardinal flower (Lobelia cardinalis) and green dragon (Arisaema dracontium). Migratory songbirds, such as the Northern waterthrush (*Parkesia noveboracensis*) can be found in these forested wetlands.

Wetland (4,972 acres)
The 4,972 acres of wetland are categorized further into Mudflats, Shrub Carr, Emergent Marsh, Submergent Marsh, and Open water. Wetlands cover approximately 73 percent of the Refuge.

Mudflats (321 acres; depth = 0-2 inches)
Mudflats comprise about 5 percent of the Refuge. Mudflats are usually bare ground and occur when water is drawn down or at times of low water levels. However, if mudflats are left exposed, plants such as sedges, grasses or native herbs become established. Mudflats are important to migratory shorebirds, such as short-billed dowitchers (*Limnodromus griseus*).

Shrub Carr (148 acres; depth = 0-2 inches)
Shrub carr covers about 2 percent of the Refuge. This wetland community is defined as having less than 25% cover of trees and 50% shrub cover. Principal species within the wetland shrub type are willow (*Salix spp.*), red-osier dogwood (*Cornus stolonifera*), and buttonbush (*Cephalanthus occidentalis*). Shrub carr habitat can also include various sedges and the invasive reed canary grass (*Phalaris arundinacea*). Secretive marsh birds, such as sora (*Porzana Carolina*) can be found in shrub carr habitats.

Emergent Marsh (1,162 acres; depth = 2-24)
Emergent Marsh occupies about 17 percent of the Refuge. The primary emergent species are American lotus (*Nelumbo lutea*), cattail (*Typha latifolia; Typha angustifolia*), burreed (*Sparganium spp.*), sedges (*Carex spp.*), bulrush (*Scirpus spp.*), arrowhead (*Sagittaria spp.*), and phragmites (*Phragmites australis*). Wild rice (*Zizania aquatica*), is abundant, particularly in the western half of the Refuge. During some years wild rice may occupy several hundred acres of the Refuge. This plant is an important fall food plant for migratory birds (Kreitinger et al. 2013) and provides sites for resting, foraging, nesting, and raising broods of migratory and resident waterbirds (Oelke et al. 2018).

Submergent Marsh (201 acres; 24-36 inches)
Submergent marsh occupies about 3 percent of the Refuge. Floating-leaf and submergent aquatics including pickerelweed (*Pontederia cordata L.*), water lily (*Nuphar advena*), pondweeds (*Potamogeton spp.*), waterweed (*Elodea spp.*), coontail (*Ceratophyllum spp.*), and water milfoil (*Myriophyllum spp.*) are present in varying levels of abundance. Submerged vegetation such as coontail (*Ceratophyllum demersum*), sago pondweed (*Potamogeton pectinatus*), and wild celery (*Vallisneria americana*) are the desired species.

Open water (3,140 acres; depth = >36 inches)
Open water occupies 46 percent of the Refuge and provide rafting areas for diving ducks and foraging habitat for pelicans (*Pelecanus erythrothynchos*), cormorants (*Phalacrocorax auritus*), bald eagles (*Haliaeetus leucocephalus*), and other fish-eating birds. The open water areas consist of water greater than 36 inches in depth.

Riverine (83 acres)
The Trempealeau River is the north and east border of the Refuge and empties into the Mississippi at the southeast corner of the Refuge. Trempealeau River land use in the watershed is primarily agricultural, forest, and a mix of wetland and other uses. Trempealeau River exhibits a naturally sandy substrate common to rivers in the Western Coulees and Ridges Ecological Landscape (WDNR 2015d). This river has the potential to support a high-quality Class II trout fishery. However, the section that borders the Refuge is rated poor for Fish and Aquatic Life and Fish Consumption due to pollutants such as phosphorus and mercury (WDNR n.d.).

Developed land (31 acres)
Developed land accounts for less than 1 percent of the Refuge area and includes the headquarters area, maintenance and storage facilities, roads, parking areas, water control structures and new learning center.

Current Refuge conditions

Information in the following section is from the CCP (USFWS 2008a) and where applicable has been updated with the most current information.

Invasive Species
First noted in the mid-1980s, the invasive purple loosestrife (*Lythrum salicaria*) has spread throughout the Refuge and now occurs in some stands that are several acres in size. Other invasive aquatic plants present include Eurasian milfoil (*Myriophyllum spicatum L. var. exalbescens*) and curly-leafed pondweed (*Potamogeton crispus*). In addition, the invasive reed canary grass is present in small patches throughout the Refuge and there are indications that willow may be spreading and occupying areas formerly occupied by emergent and wet meadow species.

Red pine (*Pinus resinosa*) and white pine (*Pinus strobus*) are found on the Refuge and are not indigenous to this particular area of Wisconsin. Scotch pine (*Pinus sylvestris*) and red cedar (*Juniperus virginiana*) are also present and are not native to this area. Recently, nearly all

upland forests have European buckthorn, an invasive species that in many areas form a dense, monotypic understory shading out native hardwood tree and shrub seedlings and wildflowers.

Leafy spurge (*Euphorbia esula*) occurs in grasslands on Trempealeau NWR and was first observed in the mid-1980s. It is now present throughout upland prairie habitats. This plant thrives from its persistent underground root system, defying mowing and burning.

Black locust, a native of the southeastern U.S. was planted on the Refuge in the late 1930s and 1940s to control erosion and provide wildlife cover. The species did well in sandy soil areas and became very invasive due to its aggressive, spreading root system. At present, black locust stands of varying age occupy about 30 percent of the upland area of the Refuge.

Invasive and Exotic Fish and Mollusks
Common carp (*Cyprinus carpio*) have been present in the Refuge pool system for many years. Their numbers tend to fluctuate depending on the severity of winterkills. Bighead carp (*Hypophthalmichthys nobilis*), grass carp (*Ctenopharyngodon idella*), and silver carp (*Hypophthalmichthys molitrix*) have all been documented in the Upper Mississippi River adjacent to or upstream of Trempealeau NWR (USGS 2012) but have not yet been documented in the Refuge pool system. Zebra mussels (*Dreissena polymorpha*), native to Eastern Europe and Western Asia, are now found in the entire Wisconsin portion of the Mississippi River (USGS 2012) but have not yet been found in Trempealeau NWR pools.

Invasive and Exotic Wildlife Species
European starlings (*Strunus vulgaris*) are uncommon on the Refuge during most seasons of the year. There is potential for their early nesting behavior to compete with eastern bluebirds (*Sialia sialis*), tree swallows (Tachycineta bicolor), wood ducks (*Aix sponsa*), American kestrels (*Falco sparverius*), and probably many other species for nest cavities. Mute swans (*Cygnus olor*) are occasionally seen on the Refuge and vicinity.

Environmental Contaminants
In February 1991, sediment samples were collected from several locations in the main Refuge pool. These were borings taken from 0 to 19 feet for bulk chemical testing to determine suitability of sand for dike construction. Samples were analyzed for heavy metals, organochlorine pesticides, and PCBs and were found to be relatively clean. Complete results of the analysis are listed in Appendix A of the January 1994 Corps of Engineers Definite Project Report for the Trempealeau NWR HREP (USACE 1994).

As mentioned earlier, Trempealeau NWR is bordered and bisected by active railroad grades. The BNSFRR in particular is a busy track with trains passing at 20 to 30-minute intervals during working hours. Railroads transport a variety of chemicals, fertilizers, and other materials, some of which would be harmful to fish and wildlife if a derailment occurred adjacent to the Refuge and contaminants entered the wetlands. If there are contaminants in the sediment that are bioavailable to benthic macroinvertebrates, fish foraging on these macroinvertebrates represent an important pathway for contaminant availability in the Refuge foodwebs (USFWS 2015b). Recommendations for evaluating present chemical contaminant levels in the Refuge

are outlined in the 2015 Contaminant Assessment Process (CAP) Report (USFWS 2015b). Also, see Appendix B.

Water Quality

Outbreaks of blue-green algae have been noted in Refuge pools during summer months, turning the water a pea-green color. Studies during July 2002 by USGS researchers from the Upper Mississippi Environmental Sciences Center (UMESC) in La Crosse found that nitrogen concentrations in the Refuge pool were low relative to phosphorus (USFWS 2008a). Low nitrogen levels can limit phytoplankton growth. Phytoplankton such as blue-green algae that can fix atmospheric nitrogen, however, will have a competitive advantage over non-fixing species – hence the huge bloom noted. Refuge pools are shallow and fertile and receive no inflow from adjacent rivers during the winter months. As a result, dissolved oxygen levels become quite low during most winters particularly when snowfall is above normal. Recommendations for long term monitoring of water quality in Refuge pools is outlined in the 2015 Contaminant Assessment Process (CAP) Report (USFWS 2015b) and a summary of this report is provided in Appendix B. By understanding the location, timing, and magnitude of water sources on the Refuge the contaminant risks to the Refuge will be easier to identify, evaluate, and manage.

Fisheries Habitats and Resources

Based on limited population sampling conducted in 1979, 1981, 1984, and 1994, the fishery resource of the Refuge can best be described as mixed but dominated by non-game fish. Carp, buffalo (*Ictiobus spp.*), and bullheads (*Ameiurus spp.*) are the most abundant species and may comprise as much as 85 percent of the standing crop by weight. These species are the most resistant to the partial and often severe winter-kills that occur regularly. Northern pike (*Esox lucius*) and yellow perch (*Perca flavescens*) are the most abundant game species found in Refuge pools. Using a diversity of sampling techniques in 1994, 23 species of fish were recorded (Appendix C of the CCP; USFWS 2008a).

Forage Fish

Little is known about this component of the fish population in Refuge pools. This food base is comprised of young-of-the-year carp and buffalo, gizzard shad (*Dorosoma cepedianum*), and an undetermined number of other species. The importance of Refuge forage fish to many fish-eating birds that frequent the Refuge is substantial. American white pelicans (*Pelecanus erythrothynchos*) and double-crested cormorants (*Phalacrocorax auritus*), for example, arrive in April and are present until late October in numbers often exceeding 500 birds of each species. Hundreds of ring-billed gulls (*Larus delawarensis*) and bald eagles (*Haliaeetus leucocephalus*) roost and feed on the Refuge during both spring and fall migrations. A colony of more than 500 nesting pairs of great blue herons (*Ardea herodias*) and great egrets (*Ardea alba*) is located one mile west of the Refuge and use the Refuge as a major feeding area during breeding season. In short, Trempealeau NWR pools provide an enormous food source for many hundreds of fish-eating birds for 8 to 9 months of the year.

Sport Fish

Trempealeau NWR supports a meager sport fishery with bullheads comprising the majority of the catch by bank fishermen. Limited numbers of northern pike are taken with a few large fish (over 10 pounds) usually reported each year. Other game fish include bass (*Micropterus spp.*), bluegill (*Lepomis macrochirus*), crappie (*Pomoxis spp.*) and yellow perch. Sport fish numbers tend to fluctuate depending on severity of the most recent winterkills.

Threatened and Endangered Fish

No federally listed fish species are known to occur within the Refuge. However, state listed fish species including the American eel (*Anguilla rostrate*; special concern), river redhorse (*Moxostoma carinatum*; threatened) and greater redhorse (*Moxostoma valenciennesi*; threatened) are known to occur in the Trempealeau River. There are also records of the pirate perch (*Aphredoderus sayanus,* special concern) collected on the former Delta FFF in 1947 although the species has not been encountered recently. A fisheries sample report conducted on the Trempealeau River in 2009 (USFWS 2010) by the Wisconsin Department of Natural Resources (WDNR) listed a blue sucker (*Cycleptus elongates*), a state threatened species, was captured, but there are no other records of this species.

Waterfowl

Essentially all diving and dabbling ducks common to the Mississippi Flyway can be seen at Trempealeau NWR during the spring migration. Canada geese (*Branta canadensis*), mallards (*Anas platyrhynchos*), blue-winged teal (Anas discors), and wood ducks are the principal nesting waterfowl. Wood ducks are the most abundant nesting duck on Trempealeau NWR and adjacent Mississippi River backwaters using cavities in bottomland hardwood forest stands for nesting.

Trempealeau NWR is important as a fall waterfowl feeding and resting area for the complex of wetlands occurring in the general area. Neither adjacent Pool 6 within the Upper Mississippi River NW&FR nor state-managed wetlands in Trempealeau Bay include any areas closed to waterfowl hunting. By maintaining only limited waterfowl hunting for disabled persons and restricting human entry and modes of access during fall migration, adequate sanctuary is provided on Trempealeau NWR for large numbers of waterfowl. Diving ducks including ring-necked ducks (*Aythya collaris*) and canvasbacks (*Aythya valisineria*) are attracted to Trempealeau NWR pools during the fall migration. The Upper Mississippi River is an important fall staging area for canvasbacks (Serie et al. 1983) and tundra swans (*Cygnus columbianus*; Thorson et al. 2002). More than two-thirds of the mid-continent population of canvasbacks are believed to pass through the “Upper Miss” and Trempealeau NWR during fall migration. In 2000 it was estimated that approximately 27,000 tundra swans moved through the Upper Mississippi River Valley during fall migration (Thorson et al. 2002) and a recent 10-year (2008-2017) trend analysis indicates a significant increase in abundance over the 2000 population estimate (USFWS 2018). These birds begin to arrive in late October, staging on closed areas within the Upper Mississippi River NW&FR and on Trempealeau NWR, and may stay for a month or more. Peak numbers in excess of 1,000 on the Refuge have been recorded (Stephen Winter, unpublished data).

Waterbirds

American white pelicans began appearing on Trempealeau NWR and vicinity in the mid-1980s. Since then numbers have increased with peaks of up to 1,000 birds recorded. Nesting occurred for the first time in 2007 on Mississippi River Navigation Pool 9. Flocks are assumed to consist of non-breeding adults and sub-adults. Formerly listed as endangered in Wisconsin, double-crested cormorant numbers have rebounded dramatically in the Upper Midwest (Hatch 1995; Weseloh et al. 2002). Until 1985, a small nesting population was maintained on man-made structures located west of Delta Point. This effort was discontinued as cormorant numbers increased and it became obvious that major recruitment was occurring elsewhere. The large flocks that now stage on the Refuge and adjacent Mississippi River backwaters in late summer and fall (Kirsch 1995; Kirsch 1997) are causing consternation among anglers regarding their potential impacts on gamefish numbers. As with pelicans, main food sources within Trempealeau NWR are likely young carp, buffalo, and gizzard shad.

Multiple nesting colonies of great blue herons are present in the Upper Mississippi River valley but declines in the number of nesting colonies on the river have been documented (Thompson 1978; Kirsch et al 2008). Vegetation losses and a decline in suitable foraging habitat are thought to be at least partly responsible for the abandonment of these rookeries (Custer, 2004). For example, of four known rookeries active in 1987 on Pools 4, 5, and 6 of the Winona District, only the Mertes Slough rookery in Pool 6 remains viable. This colony, located only 1 mile upstream of Trempealeau NWR, contained an estimated 600 great blue heron and 100 great egret nests in 2000. Aerial nest counts in 2014 estimated 519 great blue heron nests. Great egrets were not nesting at the time of the aerial survey. Ground nest surveys found four great egret nests later in the season. Aerial nest count surveys have not been conducted at Mertes Slough rookery since the 2014 survey. More recent nest surveys have all been conducted on the ground. In 2018, 310 great blue heron nests were found and no great egret nests. Studies demonstrate that many nesting great blue herons and great egrets that were followed by aircraft traveled from the Mertes Slough rookery to Trempealeau NWR for feeding (Custer, 2004). Other heron species found on the Refuge include the green heron (*Butorides virescens*), black-crowned night heron (*Nycticorax nycticorax*), and least bittern (*Ixobrychus exilis*). Sightings/records of the American bittern (*Botaurus lentiginosus*) on or near the Refuge are extremely rare (Graetz et al 1997).

Central Wisconsin contains the majority of the State's sandhill crane (*Grus Canadensis*) population but expansion of the population to western portions of the state, including Trempealeau County, has occurred since 1995 (Su et al. 2004). At Trempealeau NWR, sandhill crane numbers have increased in recent years with six to 10 nesting pairs on the Refuge. Flocks of up to 30 birds on and near the Refuge are common. Sora (*Porzana Carolina*) and Virginia rails (*Rallus limicola*) are both present during the breeding season (Tyser 1982, 1983; Graetz et al. 1997) and become apparent when wild rice begins to mature. Many birds can be heard calling from stands of wild rice and other emergent vegetation in the western two-thirds of the Refuge from late August into early October. Both species nest on Trempealeau NWR.

Flocks of ring-billed gulls winging their way up through the Mississippi River Valley are a sure sign that spring and flocks of waterfowl are not far behind. These birds move through by the

thousands, but do not nest. Trempealeau NWR provides one of the largest nesting populations of black terns (*Chlidonias niger*) on the Upper Mississippi River (Faber 1990; Graetz et al. 1997). The black tern is a state-listed endangered species in Wisconsin and build their nests on floating vegetation. Nesting pairs peaked in the mid- to late-90s between 60 and 100 pairs. The population bottomed out at 15 pairs during the high water year of 2001. Numbers increased in 2015 with 102 adults detected, but recent flush counts indicate the numbers may be declining again. Flush counts in 2017 indicated there were only 71 pairs and in 2018 only 18 pairs were detected (Adams and Dittmer 2018).

Shorebirds

Shorebird habitat is generally scarce on Trempealeau NWR except during years when drawdowns are conducted on Pool A, exposing mudflats for shorebird foraging. Shorebirds took advantage of the Pool A drawdown in 2000 which coincided with their northward migration in the spring. Twenty-three species of shorebirds used the Refuge during this time. Greater yellowlegs (*Tringa melanoleuca*) and lesser yellowlegs (*Tringa flavipes*) were the first to arrive in mid to late April. Dunlins (*Calidris alpine*) came in the hundreds from early to late May peaking at about a thousand. Unusual species included red knot (*Calidris canutus*), Hudsonian godwit (*Limosa haemastica*) and marbled godwits (*Limosa fedoa*), American avocets (*Recurvirostra americana*), and ruddy turnstones (*Arenaria interpres*). Though the fall migration was less spectacular, a few hundred shorebirds made use of low water levels in the pool. The American woodcock (*Scolopax minor*) is a common migrant and a nesting species on Trempealeau NWR (USFWS 2008a).

Raptors

Bald eagle and osprey (*Pandion haliaetus*) nest on the Refuge. An osprey was first discovered on the Refuge in 1975 and at that time was the only known nest in the area. Since then at least three other nests have appeared within 5 miles west of the Refuge. A pole and nesting platform placed near Kiep's Island has been used in 1998, 1999, 2000, 2001 and 2007, but young were fledged only in 2000 and 2007. There are previous nesting records for the red-shouldered hawk (*Buteo lineatus*), a state-listed threatened species in Wisconsin, on Trempealeau NWR but nests have not been discovered since 2008. However, sightings of this species on the Refuge are becoming more frequent (K. Carlyle, personal communication; eBird 2017). Peregrine falcons (*Falco peregrinus*), a state-listed endangered species in Wisconsin, have nested on bluff outcrops within 2 miles of the Refuge and on man-made structures in towns and cities nearby. This species is observed occasionally at Trempealeau NWR and has been seen taking waterfowl.

Upland Game Birds

Since their reintroduction to southwest Wisconsin in the mid-1980s, wild turkey (*Meleagris gallopavo*) sightings have become more frequent and at present a population of 20-25 birds on the Refuge is estimated. Ruffed grouse (*Bonasa umbellus*) are an uncommon resident of forest edges and shrub habitats on Trempealeau NWR. American woodcock (*Scolopax minor*) also nest on the Refuge.

Passerines

A large and diverse community of breeding and migratory passerines are known to use the Upper Mississippi River Valley and the Refuge (Tyser 1983; Graetz et al. 1997; Knutson and Klass 1997). The most recent bird list for Trempealeau NWR included 143 passerines. The period from late April to mid-May is particularly notable for the diversity and abundance of wood warblers that pass through the Refuge during migration. During the summer, few warblers nest here but many other woodland passerines do, such as multiple woodpecker and vireo species, black-capped chickadee (*Parus atricapillus*), white-breasted nuthatch (*Sitta carolinensis*), and house wren (*Troglodytes aedon*). Grassland birds that breed on the Refuge include eastern meadowlark (*Sturnella magna*), grasshopper sparrow (*Ammodramus savannarum*), dickcissel (*Spiza americana*), and field sparrow (*Spizella pusilla*). Breeding birds of the wetlands include sedge wren (*Cistothorus platensis*), red-winged blackbird (*Agelaius phoeniceus*), and yellow-headed blackbird (*Xanthocephalus xanthocephalus*).

Mammals

A resident white-tail deer (*Odocoileus virginianus*) herd estimated at between 50 and 75 animals occurs on the Refuge and provides both wildlife viewing and hunting opportunities for the public. Since the early 1980s managed hunts including some "antlerless only" seasons have been used to reduce the herd to at or below carrying capacity to protect Refuge habitats. Beaver and muskrats are the most conspicuous of the furbearers. Selected harvest of problem beaver by permittee trapping has been conducted in the past and harvest of muskrats through permittee trapping is allowed with an annual harvest of 1,000 to 1,500 animals. The Refuge and surrounding area seem to support high numbers of raccoons, based on observations of tracks and other sign and numbers of roadkills. The impact of high raccoon populations on nesting waterfowl and other ground-nesting birds on the Refuge is unknown but may be significant. Trappers remove a small number (7-10) of raccoons during the fall season. Coyote (*Canis latrans*) sightings on Trempealeau NWR have become more frequent and other mammals known to occur include mink, otter (*Lutra Canadensis*), striped skunk, weasel (*Mustela spp.*), red fox (*Vulpes fulva*), gray fox (*Urocyon cineroargenteus*), cottontail rabbit, gray squirrel (*Sciurus carolinensis*), fox squirrel (*Sciurus niger*), and a variety of small mammals including ground squirrels, moles, pocket gophers, voles, mice, and shrews. A breeding colony of little brown bats (*Myotis lucifugus*) also occurs on the Refuge and has numbered over 1000 in the past. However, numbers are declining due to mortality caused by white-nose syndrome (E. Adams and H. Kaarakka, personal communication). Fisher (*Martes pennanti*) are expanding their range southward and have been observed on the Refuge recently. Black bears (*Ursus americanus*), gray wolves (*Canis lupis*), and bobcats (*Lynx rufus*) pass through the Refuge on occasion.

Reptiles and Amphibians

According to the Wisconsin Herpetological Society, forty-nine species of reptiles, amphibians and turtles may occur on Trempealeau NWR but only 15 have been recorded to date (Appendix C of CCP; USFWS 2008a). Three of those species are listed as special concern, endangered, or threatened in Wisconsin (WDNR 2015c). The Blanding's turtle (*Emydoidea blandingii*) is listed as a species of special concern, the wood turtle (*Glyptemys insculpta*) is classified as threatened, and the eastern massasauga rattlesnake (*Sistrurus catenatus catenatus*) is listed as endangered.

The Blanding's turtle is frequently observed during the egg-laying season. Frog and toad call surveys have been conducted on the Refuge since 1981 by staff and volunteers. Species recorded include the American toad, green frog, wood frog, leopard frog, chorus frog, spring peeper, eastern gray treefrog and Cope's gray treefrog.

Aquatic Benthic Macroinvertebrates

A lack of benthic macroinvertebrate communities in bottom sediments has been noted in Trempealeau NWR pools. Studies were conducted by USGS to determine if toxic sediment ammonia or fish predation was responsible for the scarcity of aquatic invertebrates. Using comparisons within and outside of fish exclosures, it was concluded that fish predation probably limits invertebrate populations (W. Richardson, personal communication). This is not surprising in view of the large standing crop of black bullheads (*Ameiurus melas*) and brown bullheads (*Ameiurus nebulosus*) in Refuge pools (USFWS 2008a).

Butterflies, Dragonflies, and Damselflies

Monarch butterflies (*Danaus plexippus*), a FWS flagship species for pollinators, are seen every year at the Refuge. The monarch larvae's only food source, milkweed (*Asclepias spp*.), grows in the grasslands and along the roads and trails of the Refuge making the Refuge a great place for monarchs. Besides the monarch, seven other species of butterflies have been recorded by citizen science groups that have been collecting butterfly/dragonfly data on the Refuge since 2013 (D. Jackson, unpublished data; contact Steve Winter, Upper Mississippi River National Wildlife and Fish Refuge Wildlife Biologist, for more information). Although not recorded recently on the Refuge, the Karner blue butterfly (*Lycaeides melissa samuelis*) was once present in this area. Wild lupine, their larval host plant, grows in large patches in the grasslands and therefore reintroductions feasibility should be researched. Citizen science groups have also recorded 30 different species of dragonflies/damselflies on the Refuge (D. Jackson, unpublished data).

Threatened and Endangered Wildlife Species

The bald eagle was recently removed from the federal threatened and endangered species list. Seven bald eagle nesting territories were active in the spring of 2018 on Trempealeau NWR (V. Hirschboeck, personal communication). Bald eagles often pass through in large numbers during migration, particularly during ice break-up in the spring. The eastern massasauga rattlesnake is currently listed as an endangered species in Wisconsin and in 2016 was federally listed as threatened. Formerly, this species was found at numerous sites in bottomland forests and emergent marsh habitats on the Upper Mississippi River NW&FR. It is now known to occur only on state and Refuge lands along the lower Chippewa River near Nelson, Wisconsin and at a site in the Van Loon Bottoms in Pool 7. There are no recent records of the eastern massasauga rattlesnake on Trempealeau NWR, however, former owners of the Delta FFF reported having killed several massasauga prior to 1975 while cutting hay on fields adjacent to what is now Delta Road. For additional federal threatened or endangered species that occur in Wisconsin see https://ecos.fws.gov/ecp0/reports/species-listed-by-state-report?state=WI&status=listed and state threatened or endangered species can be found here https://dnr.wi.gov/files/PDF/pubs/er/ER001.pdf

Chapter 3: Resources of Concern

3.0. Introduction

Resources of concern are the primary focus of this HMP and are central to the work of the NWRS. The FWS's HMP Policy (620 FW 1) defines "resources of concern" as

> *All plant and/or animal species, species groups, or communities specifically identified in Refuge purpose(s), System mission, or international, national, regional, State, or ecosystem conservation plans or acts. For example, waterfowl and shorebirds are resources of concern on a refuge whose purpose is to protect "migrating waterfowl and shorebirds." Federal or State threatened and endangered species on that same Refuge are also resources of concern under terms of the respective threatened and endangered species acts.*

The USFWS is entrusted with conserving and protecting migratory birds, federally listed threatened and endangered species, inter-jurisdictional fishes, and certain marine mammals (i.e. "trust species"). Additionally, each refuge has one or more purposes for which it was established. As a result, management goals and objectives for each refuge is determined by the direction of the refuge purpose(s) and statutory mandates, coupled with species and habitat priorities. Refuges also support other elements of biological diversity including invertebrates, rare plants, unique natural communities, and ecological processes that contribute to biological integrity and environmental health at the refuge, ecosystem, and broader scales (601 FW 3).

Given the multitude of purposes, mandates, policies, and plans that can apply to a refuge, it is necessary to explicitly identify resources of concern and identify those resources for which the refuge is best suited to focus its management activities. The process used by Trempealeau NWR to identify resources of concern and habitat types and communities that represent biological integrity, diversity, and environmental health (BIDEH; 601 FW 3) are described in this chapter. Resources of concern and habitat priorities were then used to develop habitat goals, objectives, and strategies (Chapter 4).

3.1. Comprehensive Resources of Concern

To develop a focused habitat management plan, we first defined the Refuge's comprehensive list of species. A tool was developed to assist in this process, the Resources of Concern Selection Tool for America's Refuges (ROCSTAR; Salas and Pranckus 2015). ROCSTAR was populated with Trempealeau NWR's comprehensive list of species by consulting several plans and lists, including Refuge species lists, national and regional priority documents, state fish and wildlife plans, and Federal and State endangered species lists (Table 3.1). Any species known to occur or that could reasonably occur within the Refuge *and* was included in any of the resources consulted was added to the comprehensive list. The Refuge's comprehensive list included a total of 708 species; 315 birds, 150 plants, 80 fish, 56 insects, 47 mollusca, 33 mammals, 23 herps, 2 crustacean, and 2 arachnids (Appendix C). For the purpose of this document we used available species lists, the ROCSTAR tool, which was used to assist us in

querying the multiple published conservation priority lists of plants, animal, and ecosystems (Table 3.1), and our best professional judgment to select our priority resources of concern. Key ecosystems were also considered because of their importance under the auspices of the Biological Integrity, Diversity, and Ecosystem Health policy (BIDEH; 601 FW 3).

Table 3.1. Plans and lists from which potential resources of concern were identified for each taxa within Trempealeau National Wildlife Refuge.

Taxa Group	Resource																	
	Fed T&E 2015 (USFWS 2015c)	WI State T&E (WDNR 2015c)	WI SWAP (WDNR 2005)	BCR 23 BCC (USFWS 2008b)	FWS R3 BCC (USFWS 2017b)	FWS FY2012- FY2016 Focal Species (USFWS 2011)	Resource Conserv. Priorities, R3 (USFWS 2002)	PIF 16 Upper Great Lakes Plain (Knutson et al. 2001)	UMGL Surrogate Spp (USFWS 2014a)	UMRGLR JV All Bird Implementation Plan (UMRGLR JV 2007)	UMRGLR JV/BCR 23 Priority Spp Waterbirds (Soulliere et al. 2007a)	UMRGLR JV/BCR 23 Priority Spp Shorebird (Potter et al. 2007a)	UMRGLR JV Priority Spp Landbird (Potter et al. 2007b)	UMRGLR JV/BCR 23 Priority Spp Waterfowl (Soulliere et al. 2007b)	American Bird Conservation Watchlist (Rosenberg et al. 2014)	Interjurisdictional Fish, (MICRA 2009)	Partners for Amphibian and Reptile Conservation (PARC 2011)	Xerces Society Redlist (Xerces Society n.d.)
Bird	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Herp	X	X	X				X		X								X	
Fish	X	X	X				X		X							X		
Insect	X	X	X				X		X									X
Mammal	X	X	X				X		X									
Arachnid	X	X	X				X		X									
Crustacean	X	X	X				X		X									
Mollusca	X	X	X				X		X									
Plant	X	X	X															

3.2. Biological Integrity, Diversity, and Environmental Health

The National Wildlife Refuge System Improvement Act of 1997 states that, in administering the System, the Service shall "ensure that the biological integrity, diversity, and environmental health of the System are maintained…" The Service's policy discusses the role of biological integrity, diversity, and environmental health (BIDEH). It also provides managers with an evaluation process to analyze their refuge and recommend the best management direction to prevent further degradation of environmental conditions; and where appropriate and in concert with refuge purposes and System mission, restore lost or degraded components (601 FW 3). The Service defines BIDEH as follows:

- **Biological Integrity** - Biotic composition, structure, and functioning at genetic, organism, and community levels comparable with historic conditions, including the natural biological processes that shape genomes, organisms, and communities.

- **Biological Diversity** - The variety of life and its processes, including the variety of living organisms, the genetic differences between them, and the communities and ecosystems in which they occur.

- **Environmental Health** - Composition, structure, and functioning of soil, water, air, and other abiotic features comparable with historic conditions, including the natural abiotic processes that shape the environment.

As described in the BIDEH policy (601 FW 3), the goal of habitat management on units of the NWRS is to ensure the long-term maintenance and where possible, restoration of healthy populations of native fish, wildlife, plants, and their habitats. In addition to providing habitat for trust species, refuges support other elements of biodiversity including invertebrates, rare plants, unique natural communities, and ecological processes (USFWS 1999b). Where possible, refuge management restores or mimics natural ecosystem processes or functions and thereby maintains biological diversity, integrity, and environmental health.

The native plant community descriptions presented in Chapter 2 (Table 2.1), provide guidance on what conditions constitute biological integrity, diversity and environmental health of Refuge habitats; how those conditions are maintained; how and when it is appropriate to restore degraded conditions, and awareness of external threats to those habitats and ecosystems. Given the continually changing environmental conditions and landscape patterns of the past and present (e.g., rapid development, climate change, sea level rise), relying on natural processes is not always feasible, nor always the best management strategy, for conserving wildlife resources. Uncertainty about the future requires that the Refuge manage within a natural range of variability.

The Trempealeau NWR CCP (USFWS 2008a) includes wildlife and habitat related goals and supporting objectives (Appendix A). However, to comply with BIDEH policy (610 FW 3) and to encourage the successful protection and restoration of BIDEH, we amended some the original objectives from the CCP to add specificity and account for BIDEH in development of the

associated management objectives and strategies. By maintaining existing BIDEH and sustainably managing it over the life of this HMP, we will support the Refuge purpose and habitat needs of priority resources and other benefitting species. These changes and the rationales behind them are summarized in Chapter 4.

3.3. Priority Refuge Resources of Concern

The ROCSTAR comprehensive species list contains many species with a wide array of habitat needs and life history requirements. From this list, we selected and focus our efforts on a few resources of concern. Priority resources of concern are species, species groups, habitat or natural features that represent the spectrum of ecological systems found on the Refuge and that can serve as indicators regarding the success of our management actions or the health of the system.

To guide in the selection of priority resources of concern, we used a series of filters and steps outlined in the Service's Identifying Refuge Resources of Concern and Management Priorities for Refuges: A Handbook (Taylor and Paveglio 2017). The Handbook guides the selection of the ROCs and their associated habitats by considering where we can make the greatest contribution to conservation efforts while taking into account three important considerations: 1) relevance to legal mandates, 2) management significance, and 3) ecological significance. The following filters were applied to select potential ROCs:

- Filter 1: Basic assessment of importance: species were cut if they are not included on any threatened or endangered, conservation need, or other priority lists (ROI=0.0). See Table 3.1 for all plans and lists.
- Filter 2: Cuts were made based on the species' probability of occurrence using range maps and Refuge species lists. Species removed from consideration include those that are unlikely to occur on the Refuge.
- Filter 3: All UMGL Surrogate Species (USFWS 2014a) were added to potential ROC list.
- Filter 4: All Federal T& E species were added to the potential ROC list.
- Filter 5: All State T& E species were added to the potential ROC list.
- Filter 6: species other than birds were eliminated from further consideration if they had a relatively low number of inclusions on priority lists; known occurrence was also taken into consideration again.
- Filter 7: Bird species only present during migration were lumped into transient neotropical and temperate-zone migrants. Species breeding on Refuge are kept. Birds using Refuge habitats during migration only will also benefit from habitat management that benefits resident birds.

In addition to the above filters, we also relied heavily on our own knowledge and experiences (i.e. ease of monitoring, abundance on Refuge, etc.) related to each species. Once potential ROCs are selected each species, group, habitat or feature was scored based on the following;

1) Number of priority rankings or listings in Federal, State, or regional plans
2) Ability to be supported by current or restorable Refuge capabilities

3) Abundance on Refuge
4) Response to habitat management
5) Ability to represent a larger guild or group of species
6) Ability to represent (a) on-Refuge ecological processes, (b) broader ecosystem processes, or (c) their importance in the maintenance or restoration of BIDEH

Based on the scoring results, the Refuge then made an informed decision on the number and type of priority ROC to select. The results of the ROCSTAR scoring evaluation is summarized in Appendix D. Because of the importance of threatened habitats, such as remnant savanna, oak openings and oak woodlands were also selected as resources of concern for the Refuge. In addition, Black Oak Island was selected due to its designation as a Public Use Natural Area. Priority resources of concern selected for the Trempealeau NWR are provided in Table 3.2.

Table 3.2. Selected priority Resources of Concern and reasons for selection for Trempealeau NWR.

Habitat Type	Priority Refuge Resource	Comments on Selection
Grassland	Eastern Meadowlark	JV focal species; UMGL surrogate species; regional conservation priority species. Eastern meadowlarks prefer taller, dense stands of tallgrass vegetation with greater litter depth; easy to monitor; representative of late succession grasslands
	Grasshopper Sparrow	Regional conservation priority species; FWS focal species. Grasshopper sparrows prefer grasslands with shorter, patchier structure; common; easy to monitor
	Monarch Butterfly	UMGL surrogate species; national priority species; flagship species for pollinator and grassland conservation.
Savanna	Oak Opening	Remnant oak openings and oak woodlands (savannas) are unique native habitats with specific plant communities. These habitats are imperiled within the State of Wisconsin. Savanna habitat harbor State and/or Federally listed species. Many of these remaining remnants are degraded and susceptible to further degradation without management.
	Oak Woodland	
	Red-headed Woodpecker	JV focal species; regional conservation priority species; represents savanna species
	Karner Blue Butterfly	UMGL surrogate species; regional conservation priority species; indicator of quality grassland and savanna habitat

Habitat Type	Priority Refuge Resource	Comments on Selection
Forest	Black Oak Island	Designated as a Public Use Natural Area (PUNA) in 1986 as an example of an undisturbed, mature, eastern deciduous forest.
	Wood Thrush	JV focal species; UMGL surrogate species; regional conservation priority species. Represents species that require large blocks of mature deciduous forest.
	American Woodcock	JV focal species; UMGL surrogate species; regional conservation priority species. Represents species that require transitional landscape with shrubs.
	Neotropical and temperate-zone migrants: Canada warbler	Canada warblers are a JV focal species; UMGL surrogate species; and regional conservation priority species. Represents species that use semi-mature, mixed deciduous and conifer forests during migration.
	Northern Long-eared Bat	State and Federal Threatened species; occurs on Refuge.
Forested Wetland	Wood Duck	JV focal species; UMGL surrogate species; regional conservation priority species. Ground gleaner, surface gleaner. Represents species dependent on old growth forests with tree cavities for nesting, mast production, and proximity to water.
	Bald Eagle	FWS focal species; regional conservation priority species. The bald eagle is a federally protected bird. This species is common and is present year round. Bald eagles prefer undisturbed areas with large, mature trees, near open water. As an apex predator, the bald eagle can be used as an indicator of environmental pollutants.
	Neotropical and temperate-zone migrants: Northern waterthrush	The Northern waterthrush is a neotropical migrant, is common during migration, and is easy to monitor. Represents species that use forested wetlands during migration.
Wetland	Black Tern	JV focal species; UMGL surrogate species; regional conservation priority species; FWS focal species. Represents species sensitive to wetland size and quality. Trempealeau NWR provides one of the largest nesting populations of black terns (*Chlidonias niger*). The black tern is a state-listed endangered species (Faber 1990; Graetz et al. 1997) and represent a unique guild of waterbirds (air hawker, surface gleaner). These birds build their nests on floating vegetation.

Habitat Type	Priority Refuge Resource	Comments on Selection
	Mallard	JV focal species; UMGL surrogate species; regional conservation priority species. The mallard requires a grassland/wetland complex for breeding and is representative of other dabbling ducks. Essentially all diving and dabbling ducks common to the Mississippi Flyway can be seen at Trempealeau NWR during the spring migration. Canada geese (*Branta canadensis*), mallards (*Anas platyrhynchos*), blue-winged teal (Anas discors), and wood ducks are the principal nesting waterfowl.
	Sora	JV focal species. The sora represents species using shallow semi-permanent emergent marsh with variable amounts of open water and variable height vegetation. Sora are present at TNWR during the breeding season and are easier to detect than other species that use similar habitat such as the Virginia rail.
	Shorebirds	Shorebirds such as short-billed dowitchers, a JV focal species and a regional conservation priority species, could represent the shorebirds as a PROC. The short-billed dowitcher is common and is easy to monitor. However, the shorebird guild was selected as the PROC in order to cover all shorebirds at Refuge.
	Great Blue Heron	JV focal species; The great blue heron is easily monitored and can be used as surrogate for the other colonial nesting, wading birds that use similar foraging habitats and require or are tolerant of woody cover, including black-crowned night herons and great egrets.
	Pickerel Frog	WI SWAP; WI SC species; Represents native amphibians.
	Blanding's Turtle	WI SWAP; WI SC species. Represents native reptiles; species relies on corridors for movement between suitable wetlands and terrestrial habitats where they lay their eggs.

3.4. Relationship between Refuge Habitats and Priority Resources of Concern

To aid in management of Refuge habitats for the priority resources, we must know their specific habitat requirements (Table 3.3). Those habitat requirements are often shared with other species. Therefore, each priority resource was chosen, in part, because managing for them would also benefit many of the other resources of concern on the comprehensive list. Some of those benefitting species are listed in Table 3.4.

Table 3.3. Priority Resources of Concern for Trempealeau NWR.

Priority Refuge Resource	Habitat Types	Key Habitat Relationships[1]			
		Vegetative Composition	Vegetative Structure	Patch Size	Special Considerations (Trempealeau NWR comments)
Eastern Meadowlark	Grassland	Native tallgrass and shortgrass prairie species	Prefers open grassland with medium density, high litter layer, with some forb content and a few shrubs.	Males have multipurpose territories; in Wisconsin they vary from 1.2 to 6.1 ha but commonly 2.8–3.2 ha	Nests on ground; prefers large grasslands; limit woody vegetation; do not burn annually
Grasshopper Sparrow		Open grasslands and prairies with patches of bare ground. Dry prairies.	Prefers short vegetation with areas of bare ground and clumps of taller dense vegetation.	More likely to occupy large tracts of habitat than small fragments; in Wisconsin male breeding territories averaged 0.85 ha (*n* = 73; Wiens 1969)	Avoid disturbing during the breeding season (mid-April to late August); spp. avoids spring-burned areas; limit woody vegetation; leave adjacent untreated areas for fledglings
Monarch Butterfly		Upland and lowlands; open areas with abundant nectar sources.	Dependent on milkweed (*Asclepias*) which can be found in open fields, gardens, parks. Often found along woodland edges and open areas where milkweeds are prevalent and abundant nectar sources are common.	Found throughout North America. Overwinter in Mexico and southern California.	Upper Midwest Great Lakes geography surrogate species; national priority species; flagship species for pollinator and grassland conservation.
Oak Opening	Savanna	Oak dominated savanna community	Oak-dominated savanna community in which there is less than 50% tree canopy coverage and more than one tree per acre (Curtis 1959). The herb layer is similar to those found in oak forests and prairies, with many of the same grasses and forbs present.	N/A	Historically occurred; remnant areas may still exist on Refuge.
Oak Woodland		Intermediate between the oak savannas (especially oak openings) and the oak forests (especially southern dry forest)	Oak limb architecture differs from oak opening (not wide spreading) and there is greater crown closure, approximately 50% to 95%.	N/A	Historically occurred; remnant areas may still exist on Refuge.

Priority Refuge Resource	Habitat Types	Key Habitat Relationships[1]			
		Vegetative Composition	Vegetative Structure	Patch Size	Special Considerations (Trempealeau NWR comments)
Red-headed Woodpecker		Deciduous woodland; disturbed areas	Occupies oak savanna and other open upland sites with scattered trees.	Size of summer territories (3.1–8.5 ha) are larger than winter territories (0.17 ha to 0.6 ha but can be as large as 1 ha).	Require dead limbs or snags at a density of = 1.5/0.04 ha (Hudson and Bollinger 2013). Prescribed fire also promotes spp. by providing snags and dead limbs, limiting forest succession, and eliminating invasives. Average DBH of nest tree = 56-59 cm (Ingold 1994; Rodewald et al, 2005); dead limbs with nest cavities averaged 20-cm in diameter (Rodewald et al. 2005).
Karner Blue Butterfly		Open barrens, savannas and prairies that contain wild lupine	Dependent on wild lupine, *Lupinus perennis L.* (*Fabaceae*), which historically occurs in savanna and barrens habitats typified by dry sandy soils.	Found where wild lupine is abundant.	Adults are present from late May through late June and again from late July through late August; eggs overwinter on wild lupine. Suitable habitat = 405-810 lupine stems/acre (USFWS 2003).
Black Oak Island	Forest	Undisturbed, mature, eastern deciduous forest	The island complex includes one large and three small islands covered with mature stands of red and black oaks. Many of the trees are large, exceeding 24 inches dbh.	N/A	The islands are accessible only by canoe or kayak and receive very little use by visitors. However, biological integrity may be threatened by invasive plants. Shoreline erosion is also a problem.
Wood Thrush		Mature deciduous and mixed forests	Prefers upland, moist forests with large trees, diverse tree communities, moderate undergrowth, and ample leaf litter.	Territory size ranges between 0.08–4.0 ha	Recent declines may be due to habitat fragmentation in both breeding and wintering grounds. Habitat fragmentation increases exposure to nest predators and may reduce food sources.
American Woodcock		Forests, forest edges, old fields, and wet meadows	Prefers clearings for singing grounds and roosting, young second-growth hardwoods for nesting and brood rearing, and moist shrubby sites for feeding.	Usually solitary; displaying males are loosely clustered on singing grounds. May also form small clusters in winter at night.	Nests and forages on ground in young forests; vulnerable to poisoning by pesticides and heavy metals.

Priority Refuge Resource	Habitat Types	Key Habitat Relationships[1]			
		Vegetative Composition	Vegetative Structure	Patch Size	Special Considerations (Trempealeau NWR comments)
Neotropical and temperate-zone migrants		Deciduous, coniferous, and mixed forests	Dry and humid forests, swamps, and forest edge with well-developed understories.	N/A	Negatively affected by decreases in shrub understory and increases in invasives. Habitat loss, fragmentation, and degradation of habitats on breeding and wintering grounds may contribute to long-term declines.
Northern Long-eared Bat		Caves, buildings, tree bark for roosting; caves and mines for hibernation; forested hillsides and ridges, and small ponds or streams for foraging	Summer habitat may include day roosts in buildings, under tree bark or shutters. May co-hibernate with other species. Foraging habitat includes forested hillsides and ridges, and small ponds or streams.	Colonial hibernators; roosts alone in summer or females may form small colonies; roosts in tall trees or snags during day and caves or rock shelters at night; switch roosts frequently. Summer home range is highly variable (Owen et al. 2003; Broders et al. 2006).	Forest dwelling bat; management should promote increasing roosting and foraging habitat. Avoid impacts to known maternity roost trees and tree removal within 150 feet of known maternity roost trees during the summer maternity period, June 1- July 31 (federal guidance); in Wisconsin June 1 until Aug 15 is recommended (WDNR 2012).
Wood Duck	Forested Wetland	Flooded shrubland, water-tolerant trees, small areas of open water, emergent plants; oak (*Quercus* spp) mast is the preferred food source	Nests in living or dead deciduous trees that are more than one foot in diameter with cavities that are found in scrub/shrub wetland with overhead cover of downed timber; dense stands of emergent plants; shallow wetland types in close proximity	Not territorial: female home range before incubation is ~367 ha (Hartke and Hepp 2004).	Wetland drainage, agriculture, and logging are threats to habitat.
Bald Eagle		Lakes, reservoirs, rivers, marshes, and coasts	Nest in forested areas adjacent to large bodies of water; for perching they prefer tall, mature coniferous or deciduous trees	0.5-2 km^2; territorial during breeding season	Top avian predator

Priority Refuge Resource	Habitat Types	Key Habitat Relationships[1]			
		Vegetative Composition	Vegetative Structure	Patch Size	Special Considerations (Trempealeau NWR comments)
Neotropical and temperate-zone migrants		Deciduous, coniferous, and mixed forests	Dry and humid forests, swamps, and forest edge with well-developed understories.	N/A	Negatively impacted by decreases in shrub understory and increases in invasives. Habitat loss, fragmentation, and degradation of habitats on breeding and wintering grounds may contribute to long-term declines. Decreases in wetland habitat may affect population size; vulnerable to poisoning by pesticides and other contaminants.
Black Tern	Wetland	Marshes and marsh complexes	Prefers shallow freshwater marshes with emergent vegetation.	Semi-colonial nesters; ~2 m territory defended around individual nests	Prefers large wetland with lots of emergent vegetation; water levels should be kept stable during breeding
Mallard		Opportunistic use of shallow wetlands, ponds, and flooded basins, alluvial plains, and agricultural fields	Little consistency in which wetland type selected, often used in proportion to availability. Vegetated and fertile wetlands with some open water preferred	> 5 acres during migration; Breeding home range includes nest site, feeding areas, and sites where male waits for female to join him during incubation recesses	Extremely flexible species and quickly adapts to changes in landscape, precipitation, and temperature Uses a diverse suite of specific habitat requirements based upon life stage
Sora		Freshwater wetlands	Prefers shallow to intermediate freshwater wetlands dominated by emergent vegetation	Distance between nests range 1.2-30 m	Decreases in wetland habitat due to urban and agricultural development may affect population. Soras migrate at night.
Short-billed Dowitcher		Shallow freshwater, mud flats, and flooded agricultural fields.	Migrants will stop on freshwater ponds with muddy margins.	During migration feeds, rests in large flocks; breeding territory size unknown	Lack information on population trends; nests on ground.
Great Blue Heron		Freshwater habitats, grasslands and agricultural fields.	Forage in freshwater habitats, grasslands and agricultural fields. Colonies are usually located within 2 to 4 miles of feeding areas. Breeding colonies are often in isolated swamps or on islands, and near lakes and ponds bordered by forests.	Colony breeders; feeding territories average 0.6 ha (Bayer 1978)	Social birds that nest in colonies but forage on their own or in loose flocks.

Priority Refuge Resource	Habitat Types	Key Habitat Relationships[1]			
		Vegetative Composition	Vegetative Structure	Patch Size	Special Considerations (Trempealeau NWR comments)
Pickerel Frog		Riparian habitats along streams and rivers	Prefers slow-moving, cold water streams with dense vegetation	Not given	Spends most of the active season, late March to early November, foraging on land in riparian habitats; can remain semi-active in winter under water.
Blanding's Turtle		Grassy marshes, mesic prairies, slow-moving rivers, and shallow lakes and ponds; vast marshes that border large rivers	Found in wetland complexes in shallow, slow-moving waters with abundant aquatic vegetation and soft muddy bottoms over firm substrates; adjacent uplands of moist but well-drained sandy or loamy soil	Not given; can move up to several miles throughout the active season to optimize foraging or when moving between wetlands, nesting and overwintering sites	Prefers shallow water with abundant vegetation during the active season and deeper water, typically at least 0.9 m (3 ft) at its deepest, for overwintering. Road mortality and habitat fragmentation are significant threats.

[1]Sources: Wisconsin Department of Natural Resources. 2018. Available: http://www.dnr.state.mn.us/rsg/profile.html?action=elementDetail&selectedElement=AFCJC04010
Poole, A., editor. 2005. The Birds of North America Online. Ithaca, NY: Cornell Laboratory of Ornithology. Available: http://bna.birds.cornell.edu/bna
Powell, H., editor. 2010. All about birds. Ithaca, NY: Cornell Laboratory of Ornithology. Available: https://www.allaboutbirds.org
Wisconsin Department of Natural Resources. 2015. Wisconsin's endangered resources. Available: http://dnr.wi.gov/topic/endangeredresources/

Table 3.4. Priority resources of concern and other benefiting species on Trempealeau NWR

Resource of Concern	Life History Requirement	Habitat	Habitat Structure*	Other Benefitting Resources
Eastern Meadowlark	Whole life	Grassland	Occurs in open grassland with medium density, high litter layer, with some forb content and a few shrubs; they need at least 6 acres in which to establish a territory; nests on ground and cup nest is concealed by dense vegetation.	Henslow's Sparrow Bell's Vireo Bobolink Upland Sandpiper Dickcissel Lark Sparrow Northern Harrier American Badger 13-lined ground squirrel Rusty patched bumble bee Regal Fritillary Brittle Prickly-pear Prairie Fame-flower Prairie Bush-clover
Grasshopper Sparrow	Migration, nesting, brood rearing, foraging		Occurs in open grassland with patches of bare ground; short vegetation with areas of bare ground and clumps of taller dense vegetation; nests on ground and nest is concealed by overhanging grasses	
Monarch Butterfly	Breeding, larval and adult (nectar) foraging		Dependent on milkweed (*Asclepias*) its only known larval food plant; adults feed on nectar plants. Monarchs can be found wherever there is milkweed, such as open fields, gardens, parks.	
Oak Opening	NA	Savanna	Oak-dominated savanna community in which there is less than 50% tree canopy coverage.	Northern Flicker Orchard Oriole Eastern Bluebird Yellow-throated vireo Scarlet tanager Tufted titmouse Blue-gray gnatcatcher
Oak Woodland	NA		Limb architecture of its trees differs from oak opening (not wide spreading) and there is greater crown closure, approximately 50% to 95%.	
Red-headed Woodpecker	Whole life		Occurs in oak savanna and other open upland sites with scattered trees; nests in dead trees or dead limbs of live trees	
Karner Blue Butterfly	Breeding, larval and adult (nectar) foraging		Dependent on wild lupine, *Lupinus perennis L.* (*Fabaceae*), its only known larval food plant, adults feed on nectar plants. Wild lupine historically occurred in savanna and barrens habitats typified by dry sandy soils.	
Black Oak Island	NA	Forest	Mature stands of red and black oaks.	Canada Warbler Black-billed Cuckoo Eastern Whip-poor-will Golden-winged Warbler Blue-winged Warbler Cerulean Warbler Pine Warbler Big Brown Bat Little Brown Myotis Eastern Pipistrelle
Wood Thrush	Migration, nesting, brood rearing, foraging		Occurs mostly in upland, moist forests with large trees, diverse tree communities, moderate undergrowth, and ample leaf litter; nests in areas of semi-dense saplings	
American Woodcock	Migration, nesting, brood rearing, foraging		Need clearings for singing grounds and roosting, young second-growth hardwoods for nesting and brood rearing, and moist shrubby sites for feeding.	

Resource of Concern	Life History Requirement	Habitat	Habitat Structure*	Other Benefitting Resources
Neotropical and temperate-zone migrants	Migration, foraging		Found during migration in both dry and humid forests, swamps, and forest edge.	
Northern Long-eared Bat	Whole life		Summer habitat may include day roosts in buildings, under tree bark or shutters, or caves during the night. Hibernation sites are often in mines or caves, and they may co-hibernate with other species. Foraging habitat includes forested hillsides and ridges, and small ponds or streams.	
Wood Duck	Whole life	Forested Wetland	Occur in wooded swamps, marshes, streams, beaver ponds, and small lakes; stick to wet areas with trees or extensive cattails; cavity nester	Northern Waterthrush Red-shouldered Hawk Peregrine Falcon Osprey Prothonotory Warbler Louisiana Waterthrush Wood Turtle Eastern Massasaugua Willow Flycatcher
Bald Eagle	Migration, nesting, brood rearing, foraging		Prefers forest stands that are mature or old growth with many tall trees; nests in tall trees near water.	
Neotropical and temperate-zone migrants	Migration, foraging		Found during migration in both dry and humid forests, swamps, and forest edge.	
Black Tern	Migration, nesting, brood rearing, foraging	Wetland	Occur in shallow freshwater marshes and semipermanent wetlands; colonial nesters; floating nests are in semi-open stands of emergent vegetation	Common Tern Caspian Tern Forster's Tern (migration) Rusty Blackbird
Mallard	Whole life		Occur in a wide variety of habitats for feeding and nesting but ideal habitat conditions consist of both a diverse wetland complex and upland cover; nests on ground in areas with tall, dense vegetation near water	Blue-winged Teal American Black Duck All Dabbling ducks Fish
Sora	Migration, nesting, brood rearing, foraging		Breeds in shallow wetlands with lots of emergent vegetation; floating nests.	American Bittern Virginia Rail King Rail Least Bittern
Shorebirds	Migration, foraging		Stopover sites include shallow water interspersed with sparsely vegetated mudflat areas, undisturbed resting areas, and abundant invertebrates	All migratory Shorebirds, such as the Short-billed Dowitcher and Solitary Sandpiper
Great Blue Heron	Whole life		Occur in both freshwater and saltwater habitats; also forage in grasslands and agricultural fields; breed in colonies or "heronries"; build stick nests high off the ground; breeding colonies are located within 2 to 4 miles of feeding areas	Great Egret Black-crowned Night-heron Yellow-crowned Night-heron Sandhill Cranes American White Pelican Trumpeter Swan

Resource of Concern	Life History Requirement	Habitat	Habitat Structure*	Other Benefitting Resources
Pickerel Frog	Whole life		Overwinters in cold water streams, seepage pools or spring holes; active from late March to early November; moves to warmer water ponds to breed and lay eggs from April through mid-June; adults spend most of the active season foraging on land in riparian habitats along streams and rivers.	Blanchard's Cricket Frog Northern Leopard Frog American Bullfrog
Blanding's Turtle	Whole life		Occur in shallow, slow-moving waters with abundant vegetation, such as grassy marshes, mesic prairies, slow-moving rivers, and shallow lakes and ponds; marshes that border large rivers are ideal habitat for this species; adults prefer shallow water during the active season and all age classes prefer deeper water for overwintering.	Wood Turtle Smooth Softshell Turtle False Map Turtle

Sources:

Poole, A., editor. 2005. The Birds of North America Online. Ithaca, NY: Cornell Laboratory of Ornithology. Available: http://bna.birds.cornell.edu/bna

Powell, H., editor. 2010. All about birds. Ithaca, NY: Cornell Laboratory of Ornithology. Available: https://www.allaboutbirds.org

Wisconsin Department of Natural Resources. 2015. Wisconsin's endangered resources. Available: http://dnr.wi.gov/topic/endangeredresources/

3.5. Priority Habitats and Relationship to Resources of Concern

Because personnel and funding resources are limited, management activities must be prioritized to ensure that the most important resource needs are met. The habitat types within the Refuge were prioritized based on information including current vegetation, management capability, and conservation needs of priority resources of concern.

Habitat types on the Refuge can be categorized into six broad categories:

- Prairie
- Savanna
- Forest
- Forested wetland
- Wetland
- Riverine

Using the criteria presented in the Handbook (Taylor and Paveglio 2017), Refuge habitats were categorized into Priority I and II Habitats using the following factors:

Priority I Habitats:

- Can be managed to provide the greatest conservation benefit to priority species, especially those specifically identified in the Refuge purpose.
- Offer the greatest contribution to (1) maintenance/restoration of biological integrity, diversity, and environmental health; (2) represent important ecological and ecosystem processes not well represented within the landscape (including the broader ecoregion of which the Refuge is a part) and; (3) address conservation needs of the Refuge System resources of concern.
- Habitat condition or other factors suggest an urgent need for active management.

Priority II Habitats

- Too limited in extent to make a meaningful difference.
- Outside the management authority or jurisdiction of the Refuge.
- Does not require active management to maintain their present condition.

Table 3.5 lists the broad habitat categories according to the Refuges priority for management and provides the reasons for the rankings and how they benefit the Refuges' priority resources.

Table 3.5. Priority I and II habitat types in Trempealeau NWR. perspective

Priority I Habitat (High)	**Reasons for Ranking and Comments**	**Limiting Factors/Threats**
Wetland	• Our ability to manage the wetland and the infrastructure is already in place. • Enabling legislation requires management of the wetlands. • Wetlands are important at a larger scale along Mississippi River for migratory birds. • With the construction of the lock and dam systems shallow water areas have become scarce and therefore TNWR is an important area. • If we didn't manage the wetlands we would quickly lose infrastructure and the ability to manage these wetlands.	• Climate change • More frequent and severe flooding • Beavers • Inability to modify railroad dikes limits infrastructure changes • Not enough infrastructure to make an impact on water levels • No way to quantify what is coming into the system and no way to successfully reduce water levels to needed levels.
Savanna	• Globally rare • BIDEH • Need to restore what we have • Historically savanna was present in this area, it is now highly degraded, if we did not manage this habitat it would quickly convert to forested shrubland	• Lack of fire • Diseases (oak wilt) • Invasive plants
Grassland	• TNWR is one of the last areas with large tracts of grassland, and there are some rare species that are endemic to these areas, such as Karner blue butterflies, rusty patch bumblebees, and brittle prickly pear • Grasslands are becoming increasingly rare, so all acres are important. • If we did not manage this habitat it would quickly convert to forested shrubland	• Lack of fire • Invasive species
Priority II Habitat (Low)	**Reasons for Ranking and Comments**	**Limiting Factors/Threats**
Forested Wetland	• Highly degraded • Changes in landscape hydrology will make it hard to restore or keep these habitats	• Inability to manage under current hydrological conditions.
Forest	• Forest on TNWR are highly degraded and not easy to manage • Forest management knowledge and plant stock is lacking • Forests are probably not the historic habitat for this area; most likely these forests are converted grassland/savanna habitats.	• Invasive plants • Lack of knowledge • Understory management is difficult • Diseases or pest species such as Emerald ash borer
Riverine	• No management capability	• Inability to manage this watershed • Siltation • Loss of flood storage • Development along Trempealeau River is out of our control

3.6. Conflict Resolution

Due to the diversity of goals, purposes, mandates, and conservation priorities of the National Wildlife Refuge System it is not unreasonable to expect conflicting management priorities at a specific refuge. Balancing the types and proportion of habitats as well as their management needs requires special consideration and a process for determining the best course of action. Those considerations are reflected in the objectives and strategies developed in this HMP (Chapter 4).

3.7. Adaptive Management

Priority species and their respective habitat attributes were used to develop habitat objectives, but these refuge habitat management objectives must be achievable. Many factors, such as the lack of resources, existing habitat conditions, species response to habitat manipulations, climatic changes, or invasive species, may reduce or eliminate the ability of the Refuge to achieve objectives. Although these factors were considered during the development of management objectives, conditions may change over the next 15 years and beyond.

In some instances, a refuge may be able to employ the use of adaptive management principles as outlined in the U.S. Department of the Interior Adaptive Management (AM)Technical Guide (Williams et. al 2009). However, these instances will be rare (Knutson et al. 2017). The U.S. Department of the Interior AM Technical Guide defines adaptive management as "…*a decision process that promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process*" (Williams et al. 2009).

Specific management areas that maximize the Refuge's biological benefits were identified where the application of true adaptive management may be prudent. The topics below may require accelerated iteration and alteration of management actions based upon comparisons between predicted and observed results that require changes to management actions outside of the anticipated 5-year Wildlife and Habitat review process (620 FWS 1):

- Water management capabilities in wetland habitat management
- Invasive species control

Regardless of whether true adaptive management is employed, or habitats are simply monitored to measure the effectiveness of our management actions, the Refuge is committed to ensuring that management actions and any changing conditions can be detected and responded to adequately and efficiently. In order to achieve this the Refuge will establish and maintain an inventory and monitoring program in accordance with 701 FW 2.

Chapter 4: Habitat Goals, Objectives, and Strategies

4.0 Introduction

The Trempealeau NWR CCP (2008) was written to help ensure that management and administration of the Refuge meet the mission of the Refuge System, the purpose for which the Refuge was established, and the goals for the Refuge. Therefore, the 2008 CCP contains broad statements of the desired future conditions of the Refuge. The 2008 CCP goals and objectives for Trempealeau NWR were developed with the intention that an HMP would be written as a step-down plan in which objective, goals and strategies would be further developed to support the goals and objectives of the CCP. Therefore, some of the 2008 CCP goals and objectives (Appendix A) were refined for this HMP to help clarify management direction, move strategies to their correct location, or add specificity such that objectives are specific, measurable, achievable, results-oriented, and time specific (SMART).

During the development of the HMP, we reviewed the CCP goals and objectives to determine if they were still representative of existing Refuge conditions, current Service policies, and desired future management. CCP goals and objectives were also reviewed to determine if they meet the criteria defined in the Service's Writing Goals and Objectives Handbook (USFWS 2004). Some CCP objectives were not included in this HMP as they were no longer relevant. Table 4.1 summarizes the CCP objective amendments for this HMP. The revised objectives provide improved specificity and bring objectives into compliance with Service policy but do not change the intent of the CCP objectives. The development of the HMP goals and objectives satisfy the needs outlined in the CCP goals and objectives (USFWS 2008a).

Table 4.1. Crosswalk between the goals and objectives identified in the Trempealeau NWR CCP and the objectives developed for this HMP.

CCP Goals and Objectives	Change between CCP and HMP	HMP Goal or Objective	Rationale
Goal 1: Landscape Goal **Goal 2: Wildlife and Habitat**	CCP goals are very broad; HMP goals are given for each broad habitat type within the Refuge.	All HMP Goals	A goal for each broad habitat type helped staff identify top priority communities and their associated species.
Objective 1.4 Natural Area Management	Strategy; rewritten as an objective and updated to meet SMART criteria	Objective 4.4.9	Updated to meet SMART objective criteria and better define management of the Black Oak Island Public Use Natural Area.
Objective 2.1 Forest Management	Updated to separate upland forest (southern dry forest) from bottomland forest (forested wetland) and to meet SMART criteria.	Objectives 4.4.1 through 4.4.8	The CCP forest objective was written for both upland and bottomland forests. HMP objectives separate forests into upland (southern dry forest) and bottomland forest (forested wetland) to better define management actions and PROCs.

CCP Goals and Objectives	Change between CCP and HMP	HMP Goal or Objective	Rationale
Objective 2.2 Wetland Management	Updated to meet SMART criteria	Objectives 4.1.1, through 4.1.10	The CCP wetland objective was written for all wetland types within Refuge. HMP objectives provide specific desired future conditions for each wetland type to better define management actions and PROCs.
Objective 2.3 Grassland Management	Updated to separate grassland and savanna and to meet SMART criteria	Objectives 4.2.1 through 4.3.4	The CCP grassland objective was written for all grasslands within Refuge. HMP objectives provide more specificity about the desired future condition for grassland and savanna habitats to better define management actions and PROCs.
Objective 2.4 Invasive Plants and Animals	Strategy; removed as an objective	N/A	Incorporated into habitat objectives and updated to meet SMART objectives.
Objective 2.5 Monitor and Investigate Fish, Wildlife and Plants and their Habitats	Strategy; removed as an objective	ALL	Incorporated into habitat objectives as a strategy and updated to meet SMART objectives. Also see IMP.
Objective 2.6 Threatened and Endangered Species Management	Removed as an overall objective and incorporated into habitat strategies; PROC objectives written for any T&E's known to be present on Refuge	ALL	Incorporated into all habitat objectives as a strategy and PROC objectives written to meet SMART objectives
Objective 2.7 Deer Management	Species specific management for deer; removed as objective	N/A	See Hunt Plan.
Objective 2.8 Furbearer Management	Species specific management; removed as objective	N/A	See Furbearer Trapping Plan.

Trempealeau NWR's CCP (USFWS 2008a) identifies the Refuge's wildlife and habitat goal as:

> *Our habitat management will support diverse and abundant native fish, wildlife, and plants.*

To clarify, the wildlife and habitat management goals from the Refuge CCP were redefined for each broad habitat type, Grassland, Savanna, Forest, Forested Wetland, Wetland, and Riverine. Both the HMP goals and objectives follow these broad habitat types. In Table 4.2 we present

the current acres by habitat type and the HMP target acres that are defined in this chapter. In Figure 4.1 we illustrate the target number of acres within the management units (See Chapter 2, Figure 2.6 for illustration of existing acres by habitat type). See Appendix E; Table E.1 for a table listing existing and target acres by broad habitat type within each management unit. All acreages detailed in this HMP are approximations. We used 2010 USGS vegetation classifications to tally habitat acreages. The Refuge is actively engaged in land acquisition and therefore acreages may change over time. Acreages will be updated during the 5-year wildlife and habitat review to reflect new acquisitions and increased understanding of habitat distribution.

Table 4.2. Existing and HMP target acres for Trempealeau National Wildlife Refuge.

Broad Habitat Type(s)	Sub-habitat types	Existing acres*	Number of Desired Acres (HMP)	Difference between existing and desired number of acres
Forest		**230**	**152**	-78
Forested Wetland		**1135**	**1041**	-94
Savanna		**0**	**298**	298
Grassland		**357**	**231**	-126
Wetland (total)		**4972**	**4972**	0
Wetland types	*Moist Soils/Mudflats: Mudflats*	**321**	**357**	*36*
	Moist Soils/Mudflats: Shrub Carr	**148**	**148**	*0*
	Emergent Marsh	**1162**	**1909**	*747*
	Submergent Marsh	**201**	**1753**	*1552*
	Open water	**3140**	**805**	*-2335*
Riverine		**83**	**83**	0
Developed		**31**	**31**	0
	Total	**6808**	**6808**	

*Acreage calculations are from resource grade data by GIS mapping; not official survey acres.

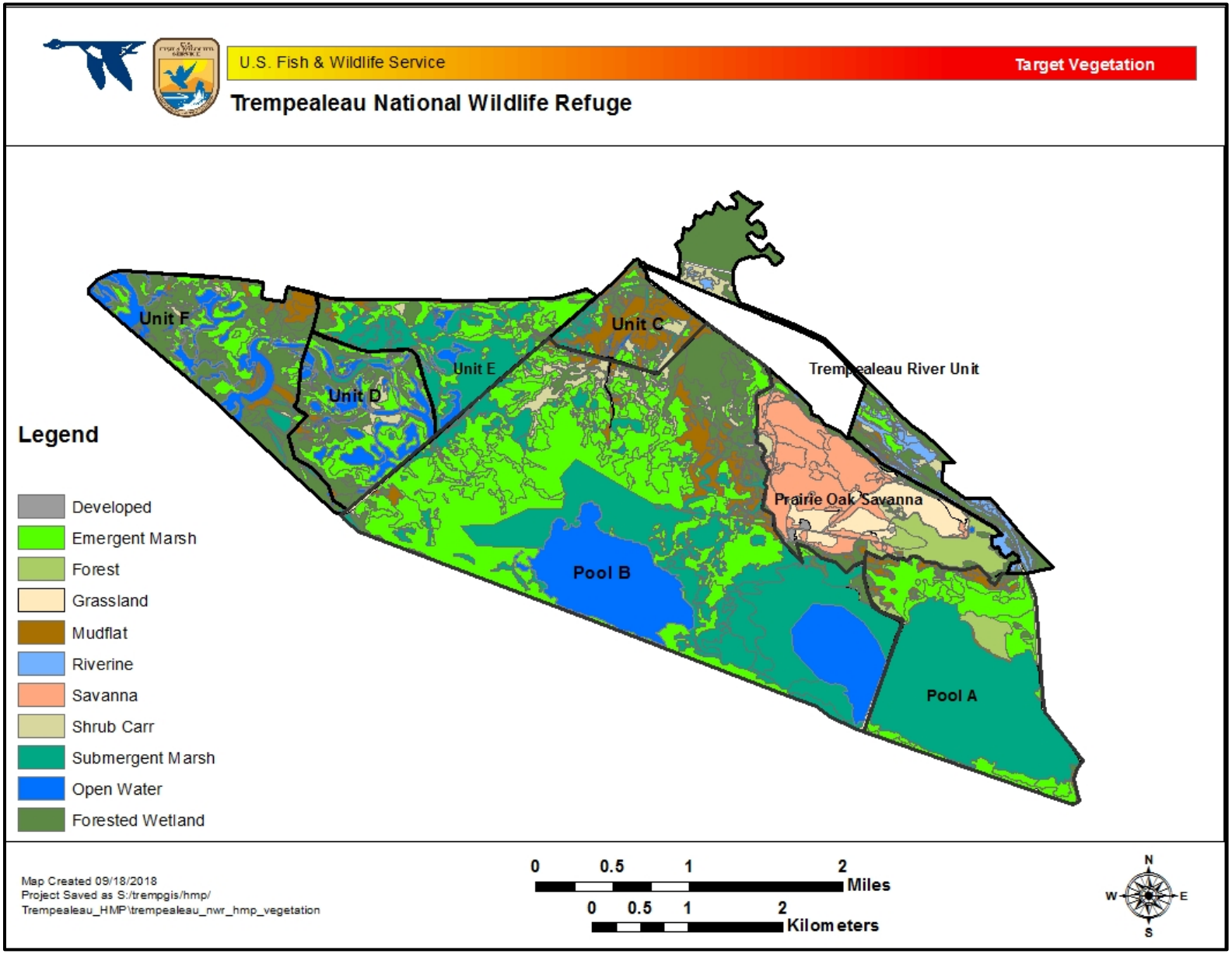

Figure 4.1. Trempealeau National Wildlife Refuge management units and HMP target habitat conditions (Source: 2010 USGS vegetation classifications).

Management strategies identify the tools and techniques that can be used to achieve the habitat objectives outlined in this chapter. The management strategies identified for each habitat objective were selected after reviewing previous and current Refuge practices, consultation with other refuges' biologists, and evaluating the feasibility of implementing these strategies with the current resources and staff. Many factors, (i.e. accessibility, weather, staffing) will affect which strategies are implemented from year to year and will be reflected in Annual Habitat Work Plans. Management strategies are listed in this chapter along with links to additional or supporting documents. Additional information regarding management tools and strategies are further defined in Appendix F.

4.1 Wetland Management (Priority I)

ROCs: Black Tern, Mallard, Sora, Shorebirds, Great Blue Heron, Pickerel Frog, and Blanding's Turtle

Wetland Goal: Restore, enhance, and manage Refuge wetlands to provide high quality, diverse habitat for waterfowl, shorebirds, and other wetland-dependent species.

Objective 4.1.1. Water Budget: Understand water use and water movement on the Refuge to better protect water resources and the wildlife that rely on them. Within one year, complete a hydrological investigation to determine water use, inputs, outputs, timing, magnitude and duration of flooding, and impoundment capacity. Within 5 years of the signing of this HMP, and with the help of the regional refuge hydrologist, design a water management plan to restore natural wetland vegetation zones and support the provision of all stages of wetland conditions for the benefit of wetland-dependent wildlife year-round.

Rationale: Several water control structures and pumps have been installed to help manage the water levels at TNWR. However, completing pumped drawdowns of Refuge pools has been challenging due to groundwater discharge into the Refuge pools and water levels in pools have been consistently too high to meet management objectives of the Refuge (USFWS 2008a). The quantity of water entering the Refuge pools from various sources of water has been unknown (i.e. seepage though the dikes along the Trempealeau and Mississippi rivers, groundwater discharge from underlying shallow aquifers, and inputs from historic artesian wells, etc.) Also, the potential to manage the pools by gravity alone has not been assessed by the water level in the pools over time to the adjacent rivers. Wetlands are dynamic systems that cannot be easily duplicated with engineered facilities (Weller 1981). With the help of the regional hydrologist draft a water management plan that provides guidance for staff who wish to manage the wetlands as a complex (i.e. forested wetland, mudflats, shrub carr, emergent marsh, submergent marsh, and open water). The goal of the plan should be to restore natural wetland vegetation zones and provide all stages of wetland conditions for the benefit of wetland-dependent wildlife year-round. A Water Resource and Inventory Assessment (WRIA; USFWS *In Prep*) is presently being drafted for TNWR and should be available in 2020. This assessment provides baseline hydrological information for the Refuge on the

water budget and the water levels and includes recommendations to guide further hydrological investigation.

Strategies:

- Work with FWS hydrologist
  - to investigate hydrology and determine water input and structure capacity
  - to write a water management plan. The hydrologic evaluation could include:
    - surface and/or groundwater monitoring (quantity and quality)
    - bathymetry survey
    - modeling
  - Develop a basic water budget
    - Understand where seepage is entering the Refuge through the Trempealeau River dike
    - Identify the location of artesian wells and determine if they are major sources of water to the Refuge
    - Measure the groundwater levels in the surficial aquifers

Objective 4.1.2. Refuge water quality: Within 5 years of the signing of this HMP, initiate work to improve the water quality of Refuge pools by reducing the total phosphorus concentration, turbidity, and cyanobacterial harmful algal blooms for the benefit of migratory waterfowl and to improve the recreational experience on the Refuge. Over the life of the plan, the goal is to reduce total phosphorus concentration in Refuge pools from 260 µg/L to 40 µg/L and reduce turbidity from 30 NTU to 20 NTU if possible.

Rationale: Substantial harmful algal blooms have occurred frequently in the TNWR pools. Harmful algal blooms increase turbidity and reduce light availability, which can inhibit the growth of submersed aquatic vegetation. The mean growing season turbidity level in Refuge pools was 30 NTU in 2017 (as measured by the Wisconsin DNR; Shawn Giblin, WDNR Water Quality Specialist, personal communication), which is higher than the 20 NTU turbidity threshold suggested by the Upper Mississippi River Conservation Committee as inhibiting submersed aquatic vegetation growth (Moore et al. 2010). In addition, harmful algal blooms can cause the formation of chemicals that are toxic to humans, pets, and wildlife. Harmful algal blooms also impact the visual aesthetics and cause bad odors which would reduce the quality of visitor experiences to the Refuge. Within the Refuge pools, “heavy” algal blooms have been occurring for decades, e.g. The 1987 Annual Narrative Report for Trempealeau NWR (USFWS 1988). The phosphorus concentration in the water column is a well-known factor contributing to harmful algal blooms (Paerl and Otten 2013). Total phosphorus concentration in the Refuge pools during the mean growing season was 260 µg/L in 2017 (as measured by the Wisconsin DNR; Shawn Giblin, WDNR water Quality Specialist, personal communication), which far exceeds the Wisconsin water quality standard of 40 µg/L “to

protect fish and aquatic life uses" (Wisconsin Administrative Code NR 102; WDNR 2010a)

Strategies:

- Long term monitoring of dissolved oxygen, major plant nutrients, suspended material, turbidity, pH, temperature, sedimentation and contaminants
- Reduce the amount of water entering the Refuge from the Trempealeau River as seepage through the dikes and leakage through the water control structures
- Understand rough fish population management and its potential effects on water quality in the Refuge pools
- Sample surface water flowing into the Refuge at Buffalo Township Park to confirm the hypothesis that it is an insignificant source of phosphorus.
- When possible complete drawdowns of the Refuge pools
- Explore other options (including off-refuge strategies) for water quality improvement

Subobjective 4.1.2.1. Trempealeau River: Within five years, work with partners in the Trempealeau River watershed to initiate work on a watershed plan that includes a total maximum daily load (TMDL) for phosphorus and sediment loads in the lower Trempealeau River. Reduce the total phosphorus concentration of the Trempealeau River from 380 to 100 µg/L to meet the Wisconsin water quality standard (Wisconsin Administrative Code NR 102; WDNR 2010a). Within 5 years of the signing of this HMP, have an approved watershed plan, including a TMDL aimed at improving the water quality and biological integrity of the Trempealeau River as it flows into and through TNWR for the benefit of fresh water fish, such as, but not limited to, bluegill, largemouth bass, and shorthead redhorse.

Rationale: The Trempealeau River is the only river within the boundaries of the Refuge. Although, the Refuge borders Pool 6 of the Mississippi River, this section of the Mississippi River is not within the Refuge boundaries. Regardless, FWS has limited authority and management capability of riverine systems. Most management on the Trempealeau River, if required, is done by the Wisconsin Department of Natural Resources. However, management is needed to address the high sediment loads transported from upstream agricultural lands and the pool water quality within the river and Refuge pools. With the assistance of USFWS hydrologists, USFWS La Crosse Fish and Wildlife Conservation Office, WDNR, and other partners in the watershed, develop a water quality management plan to address these issues.

The lower Trempealeau River has an exceptionally high total phosphorus concentration (380 µg/L in 2016; WDNR 2017) even though the phosphorus concentration has been decreasing over the past 40 years (WDNR 2018) and is listed as impaired for fish and aquatic life due to phosphorus levels (WDNR 2019). The Trempealeau River may be the primary source of phosphorus to the Refuge pools, and watershed efforts to reduce the

phosphorus concentrations in the Trempealeau River would improve the water quality of the Refuge pools as well.

The Trempealeau River has experienced 74% decrease in the total suspended sediment (TSS) concentration over the past 40 years, but still has a moderately high sediment load, with a mean TSS concentration of 41.1 mg/L in 2016 (WDNR 2018). The sediment loads from the Trempealeau River could cause sedimentation in the wetlands adjacent to the river.

Strategies:

- Explore possibility to work with other FWS offices (FWS Hydrologists) or partners such as La Crosse Fish & Wildlife Conservation Office, Universities, and/or state and private agencies to help write the Trempealeau River section of the water management plan, collect baseline fisheries data, assist with river restoration, and/or design research projects
  - Use applied research to address any questions that arise regarding resources of concern, T&E species or other issues such as invasive species management
  - Compile any existing fisheries and/or water quality data that were conducted on Trempealeau River

Objective 4.1.3a. Wetlands with water level control: Provide an annual average of 2,154 acres of wetland vegetation types (mudflats, shrub carr, emergent marsh, submergent marsh, and open water) in Refuge impoundments where water control is possible for the benefit of waterfowl, shorebirds, and other wetland-dependent species.

Rationale: TNWR has three impoundments where water level control is possible; Pool A (857 acres), Unit C (201 acres), and the third one is divided into three units; Unit D (341 acres), Unit E (424 acres), and Unit F (331 acres).

Objective 4.1.3b. Wetlands with little or no water level control: Protect, enhance, and maintain ecological integrity, on a 10-year average, the 2,818 acres of isolated backwaters and wetlands that have little to no water level control. These areas provide mudflats, shrub carr, emergent marsh, submergent marsh, and open water for the benefit of migratory birds, reptiles, amphibians, and other wetland-dependent species.

Rationale: Wetlands with little or no water level control include, Pool B, additional wetlands in the Trempealeau River unit, and small isolated ponds within the Prairie Oak Savanna unit. Pool B is the largest impoundment on the Refuge (2,715 acres). However, it is difficult to manage with the present water control structures. The Trempealeau River unit includes ~69 acres of wetlands and is influenced by land use practices outside of the Refuge boundaries throughout the Trempealeau River watershed. The Prairie Oak Savanna Unit contains ~34 acres of wetlands that also have no water level control structures.

***Sub-Objective 4.1.3.1. Moist soil/mudflats*:** Annually, provide approximately 357 acres (present acres = 321) of moist soil/mudflats primarily for shorebirds, waterfowl, and wading birds along edges of Pools A and B and Units C and F (See Figure 4.1 and Appendix E). Moist soil/mudflats will exhibit the following characteristics at times of peak migration (April – May and August – October): a mix of shallow water (<6 inches water), mudflats with sparse vegetation (< 10% cover emergent), and mudflats with no vegetation. In pools where water level control is possible, drawdown would begin in March, to prepare for May's peak spring shorebird migration and will continue through the fall until freeze-up.

Rationale: Moist Soil/Mudflats are scarce within the Refuge but with proper water and shoreline vegetation management, 357 acres of mudflats could be available for shorebirds and other waterbirds. A better understanding of the hydrology, natural water input, and structural capacity of impoundments will make it easier for Refuge staff to control water depths using the available water control structures. Management, such as biological control or physical removal of vegetation, is also needed along wetland shorelines to provide exposed, moist soil, mudflats that will attract foraging migratory shorebirds such as short-billed dowitchers. Loafing waterfowl such as mallards and blue-winged teal and waders such as great blue herons and great egrets can also be found using these areas.

Sub-Objective 4.1.3.2. Shrub Carr: Annually, support and maintain the ecological integrity of 148 acres (present acres = 148) of moist soil/shrub carr habitat primarily for secretive marshbirds and migratory songbirds, but also for the benefit of wading birds. Moist soil/shrub carr areas should have the following characteristics: water depths of 0-2 inches; < 20% invasive species, < 25% cover of trees, and at least 50% shrub cover. These areas are dominated by woody vegetation less than 6 m (20 feet) tall (Cowardin et al. 1979). Principal species within the wetland shrub type are willow, red-osier dogwood, and buttonbush. Shrub carr habitat can also include various sedge species and Canada bluejoint grass is common.

Rationale: Presently 148 acres of shrub carr habitat exists on the Refuge and provides habitat for migratory songbirds and secretive marsh birds, such as resident soras looking for seeds. Shrub Carr can persist for a very long time if natural hydrologic cycles are maintained (WDNR 2015b) and are tolerant of a wide variety of water levels (WICCI 2011). However, proper water and vegetation management is necessary to maintain these areas and keep them free of invasives, such as reed canary grass and purple loosestrife.

***Sub-Objective 4.1.3.3. Emergent marsh*:** Annually, at times of peak migration (spring: late March – May, and fall: August – October) provide approximately 1,909 acres of emergent marsh habitat primarily for the benefit of waterfowl and waterbirds, but also for the benefit of reptiles and amphibians. Presently approximately 1,162 acres of emergent marsh exist within the Refuge but in areas where water level control is possible a total of 1,909 acres could be available. Emergent marsh areas will exhibit the following characteristics: < 20%

invasive species; water depths of 2-24; a diversity of emergent vegetation such as American lotus, cattail, burreed, sedges, bulrush, arrowhead, and wild rice.

Rationale: Emergent marshes are dominated by erect, rooted, aquatic plants such as cattail, bulrush, phragmites, arrowhead, pickerelweed, and wild rice (WDNR 2015d) and is the desired wetland condition for many of the Refuge wetlands. Presently approximately 1,162 acres of emergent marsh exist within the Refuge. A better understanding of the hydrology, natural water input, and structural capacity will make it easier for Refuge staff to control water depths using the available water control structures that will allow emergent vegetation to persist and possibly increase to 1,909 acres (~773 ha). These shallow water zones with aquatic vegetation such as American lotus, cattail, burreed, sedges, bulrush, arrowhead, phragmites, and wild rice, provide quality foraging and staging habitats for many birds, such as, mallards, a Refuge ROC, but also benefit of other dabbling ducks, waterfowl, and wading birds. In addition, emergent vegetation within this habitat thrives on and protects water quality by absorbing nutrients that can cause algal blooms, while also producing oxygen and stabilizing wetland bottoms (WICCI 2011; WDNR 2015b). The aquatic plants in this habitat can also serve as spawning grounds for fish and amphibians (e.g. Pickerel frog, *Lithobates palustris*), as shelter for a variety of species (e.g. Blanding's turtle), and nesting habitat for birds, such as black terns (WDNR 2015b).

***Sub-Objective 4.1.3.4. Submergent marsh*:** Within 5 years of the signing of this HMP, provide approximately 1,753 acres of submergent marsh primarily for the benefit of waterfowl and waterbirds, but also for the benefit of reptiles and amphibians. Presently, only approximately 201 acres of submergent marsh exist within the Refuge but in areas where water level control is possible a total of 1,753 acres could be available. Submergent marsh will exhibit the following characteristics: water depths of 24-36 inches, < 20% invasive species; a diversity of submerged vegetation such as coontail, sago pondweed, and wild celery.

Rationale: Submergent marsh is also a desired wetland condition for much of the Refuge wetlands. Submergent marshes are usually adjacent or integrated with emergent marshes but occur in deeper water and are dominated by submersed or floating species of plants, such as coontail, sago pondweed, and wild celery. Wild celery is a favorite food plant of many waterfowl that stop at TNWR in large numbers during migration periods. Presently only approximately 201 acres within the Refuge wetlands are classified as submergent marsh but ultimately, through restoration and management the Refuge could increase it to 1,753 acres. Submergent marshes, like emergent marshes, protect water quality and produce oxygen (WICCI 2011; WDNR 2015b). The aquatic plants also serve as spawning grounds for fish and amphibians (e.g. Pickerel frog) and as shelter for a variety of species (e.g. Blanding's turtle) (WDNR 2015b).

***Subobjective 4.1.3.5. Open water*:** Annually, provide approximately 805 acres of open water primarily for foraging and rafting waterfowl and waterbirds. Presently 3,140 acres of

open water exists in the Refuge but in areas where water level control is possible many of these acres can be converted to emergent and submergent marsh. Maintain stable or declining water levels June through August to accommodate over-water nesting species, especially black terns. Water depths of open water should be >36 inches.

Rationale: Presently 3,140 acres of open water exists in the Refuge, but the desired acres are 805. Deeper water affords water column foraging for diving ducks, as well as space for molting and staging waterfowl. However, with proper water management much of the open water areas can be converted to emergent and submergent marsh. An increase in these habitat types will reduce turbidity, erosion of banks, and increase absorption of nutrients, as well as provide additional forage, shelter, and nesting habitat for resident and migratory species.

WETLAND PROC OBJECTIVES:

Objective 4.1.4. Shorebirds: Annually, when conditions allow, lower water elevation to provide approximately 357 acres (144.5 ha) of moist soil/mudflat habitat along edges of pools (See Figure 4.1) primarily for the benefit of migratory shorebirds, such as Short-billed Dowitchers, but also for the benefit of waterfowl, and wading birds. Water levels will be managed to provide optimal foraging depths for migrating shorebirds (0-2 inches at the mud/water interface; Potter et al. 2007a). These moist soil/mudflats have the potential to provide 36,000 shorebird energy-days during migration (April – May and August – October) under ideal conditions. However, because annual conditions may not provide ideal conditions across all acres, a lesser sum of 18,000 shorebird energy-days was chosen as the target.

Shorebird Energy-Day Calculation Information

Target shorebird energy-days were estimated using a daily ration model as outlined in Loesch et al. (2000). This model was also used in the shorebird UMRGLR-JV to calculate habitat objectives (Potter et al. 2007a). Daily ration models are one approach to estimating habitat requirements for targeted populations of migrating waterfowl (Goss-Custard et al. 2003; Williams et al. 2014) and Loesch et al. (2000) reasoned that this approach could also be used for shorebirds. The energy-days calculated in this example are for a guild of birds (shorebirds) and not for a particular species. The model uses "existing metabolic rate" (EMR) of an average sized shorebird (45g) and assumes managed shorebird habitat can provide about 20 kg of benthic invertebrates per hectare (Loesch et al. 2000). Obviously, the number of invertebrates will vary by year, location, quality of habitat, management practices, and other factors. Therefore, actual invertebrate numbers should be verified. The model also assumes shorebirds are eating chironomids and extrapolates that the average shorebird requires 8 g of invertebrate forage per day during migration (Kersten and Piersma 1987; Loesch et al. 2000). Consequently, assuming shorebirds stop-over in fall and spring for a total of ten days (Potter et al. 2007a; Loesch et al. 2000) an average shorebird would require 0.004 ha (40 m^2) of foraging habitat (Loesch et al. 2000). Using these assumptions of this daily ration model we determined that under ideal conditions the Refuge could potentially support

36,000 (number rounded down) bird energy-days during spring and fall migration (See Appendix H for calculation and notes related to this model). By maintaining and providing moist soil/mudflat habitat within the Refuge they will be contributing to the UMRGLR JV shorebird habitat protection/maintenance and restoration/enhancement objectives for Wisconsin and BCR 23 (wet mudflat/moist soil plants protection/maintenance goal = 1,052 ha; restoration/enhancement goal = 964 ha; Potter et al. 2007a, Table 11 and 12).

Objective 4.1.5. Sora: Annually, lower water elevation to provide 148 acres of shrub carr habitat and 1,909 acres of emergent marsh (See Figure 4.1) to benefit secretive marshbirds, such as sora rails. Breeding soras prefer shallow (5-40 cm), shoreward portions of wetlands with an abundance of emergent vegetation (Soulliere et al. 2007a). Minimum optimal habitat required to support a pair of soras is 4.9 acres with densities of breeding sora ranging from 0.24-3.9 birds/acre (Soulliere et al. 2007a). Therefore, if all shrub carr and emergent marsh areas were available, and of high quality, for sora nesting the Refuge could potentially support approximately 420 sora pairs.

Objective 4.1.6: Mallard: Annually, provide approximately 1,909 acres of emergent marsh habitats on the Refuge for the benefit of fall migrating dabbling ducks, breeding secretive marshbirds, wading birds, overwater nesting birds, and herptiles. This habitat is characterized by water depths ranging from 2 to 24 inches interspersed with mixed stands of cattail, bulrush, phragmites, arrowhead, pickerelweed, and wild rice (60-80% emergent plant cover). These emergent marsh habitats are expected to support fall migrations of dabbling ducks, such as mallards, with an annual target of 500,000 duck energy-days (DED).

Mallard Energy-Day Calculation Information

Fall migration targets for mallards (dabbling ducks) in emergent marsh habitat (UMRGLR JV community category = shallow semi-permanent marsh, hemi-marsh; Soulliere et al. 2007b) were estimated using a daily ration model as described in Soulliere et al. (2007b). Daily ration models are one approach to estimating habitat requirements for targeted populations of migrating waterfowl (Goss-Custard et al. 2003; Williams et al. 2014). We used the daily energy needs of a mallard (1493 kJ/day) using forage available in a shallow semi-permanent marsh, hemi marsh that provides 985,332 kJ/ha (Soulliere et al. 2007b). This daily ration model determined that the Refuge could potentially provide habitat to support 500,000 (number rounded down) duck energy-days during migration. This equates to supporting approximately 17,857 mallards (500,000 duck use-days or DUDs) for 28 days (Bellrose and Crompton 1970). See Appendix I for calculation and notes related to this model. By maintaining and providing additional emergent marsh habitat the Refuge will be contributing to the UMRGLR JV waterfowl habitat protection/maintenance and restoration/enhancement objectives for Wisconsin and BCR 23 (shallow semi-permanent marsh, hemi-marsh protection/maintenance goal = 54,082 ha; restoration/enhancement goal = 1,286 ha; Soulliere et al. 2007b, Table 12 and 13).

Objective 4.1.7. Black Terns: Annually, provide approximately 1,909 acres of emergent marsh, 1,753 acres of submergent marsh, and 805 acres of open water habitat for the benefit of black terns. Black terns presently nest on the Refuge on floating plant material or mats within bur-reed (Sparganium sp.), bulrush (Scirpus sp.), water lily (Nymphaea sp. or Nuphar sp.), and cattail (Typha sp.) (Faber 1990, Custer et al. 1998). They typically nest semi-colonially in loose groups of about 20 pairs but also nest singly or in groups as high as 200 pairs (Soulliere et al. 2007a). Flush count surveys were conducted on the Refuge from 2015 to 2018 with numbers of birds flushed decreasing from 102 in 2015 to 18 in 2018. According to Souilliere et al. (2007a) the minimum number of acres of optimal habitat required for each 40-bird colony is 49 acres (~20 ha). Therefore, if all emergent and submergent marsh areas were available, and of high quality, for black tern nesting the Refuge could support 74 black tern nests.

Objective 4.1.8. Great Blue Heron: Annually provide 2,414 acres of wetland habitat (mudflat, shrub carr, and emergent marsh) for the benefit of foraging colonial wading birds, such as the great blue heron. Great blue herons nest in a colony one mile west of the Refuge at Mertes Slough. In 2018, 310 great blue heron nests were found at this site. However, up to 600 great blue herons have nested in this colony (unpublished data; 2000 aerial survey). Primary foraging locations of great blue herons, where they eat fish, amphibians, reptiles, small mammals, insects, and other birds, are located on average between 1 to 4 miles from their colony sites (Vennesland and Butler 2011). The Refuge will continue to be a foraging site for the 300-600 great blue herons and other colonial breeding wading birds.

Objective 4.1.9. Pickerel Frog: Annually, provide approximately 3,662 acres of wetland habitat (1,909 acres of emergent marsh, 1,753 acres of submergent marsh) for the benefit of pickerel frogs. Pickerel frogs occur on the Refuge and are a Species of Special Concern in Wisconsin. Within 5 years of the signing of this HMP, conduct surveys to determine persistence on Refuge using methods described by the North American Amphibian Monitoring Program (USGS 2015) or the Wisconsin Frog and Toad Survey (Paloski et al 2014). Pickerel frogs prefer cool streams and other wet areas in woodlands but in summer, they may be found feeding in fields away from water. They spend their winters burrowed in the mud beneath ponds or streams. Adult pickerel frogs eat insects, spiders, and other small invertebrates and the tadpoles eat algae and plant matter (AmphibiaWeb 2019). Breeding season in Wisconsin runs from April to June (Paloski et al. 2014) and the female lays an egg mass of 700 - 3,000 eggs in shallow water attached to submerged vegetation (MDNR 2019). Management practices that restore wetland hydrology and maintain upland habitats adjacent to wetlands will benefit Pickerel frogs.

Objective 4.1.10. Blanding's Turtle: Annually, provide approximately 3,662 acres of wetland habitat (1,909 acres of emergent marsh, 1,753 acres of submergent marsh) for the benefit of Blanding's turtles. Blanding's turtles occur on the Refuge, but numbers are unknown. Within 5 years of the signing of this HMP, conduct surveys to determine the estimated population size on Refuge using methods described by Congdon and Keinath (2006). Blanding's turtles require a combination of wetland and terrestrial habitats and in

Wisconsin are typically active March through early November (WDNR 2014). According to Ross and Anderson (1990) Blanding's turtles mean home range size is 0.8 ha (1.98 acres) for males and 0.6 ha (1.48 acres) for females. Permanent aquatic areas, vernal pools, and temporary wetlands are needed for long-term residence and foraging, whereas terrestrial areas with well-drained soils and minimal vegetation cover is needed for nesting and migration corridors (Congdon and Keinath 2006). Therefore, management practices that restore natural wetland hydrology, provide a diversity of wetland vegetation, and maintain upland habitats adjacent to wetlands will benefit Blanding's turtles (Kingsbury and Gibson 2012; WDNR 2014).

Wetland Management Rationale: Construction of a series of locks and dams on the Mississippi River in the 1930s created a deeper, relatively stable water system, especially during the summer. Although flooding was not a serious problem at TNWR because of barrier dikes, the seasonal low water cycle, so important to aquatic plants dependent on mud flats and sandbars for their reproduction, was virtually eliminated. With stable and higher water levels, wind and wave action gradually eliminated aquatic plant beds, particularly in the lower Refuge pools. Additionally, rough fish, primarily common carp, are present throughout the pool system. Carp have a major impact on aquatic plant growth by rooting out plants and suspending sediments while feeding. Climate change is also contributing to changes in wetland conditions with higher temperatures, variable precipitation, and more frequent and intense storms (WICCI 2011). These changes can alter the wetland hydrology and increase erosion, sedimentation, and nutrient runoff. Environmental changes such as longer growing seasons, elevated CO_2 levels, sedimentation, and excess of nutrients (WICCI 2011) are contributing to an increase in invasive reed canary grass and non-native phragmites in Refuge wetlands. In addition, purple loosestrife has become prevalent at TNWR, crowding out native species and posing a threat to wetland ecology.

Wetlands provide critical habitat for a host of migrating waterfowl, wading birds, fish-eating birds and songbirds. Of the 370 species of birds occurring in Wisconsin, 39% rely on wetlands to meet some portion of their life needs (Hale 1982). Wetlands also play an essential role in the healthy functioning of ecosystems by providing flood storage, sediment and nutrient filtering, and groundwater recharge. TNWR is over 70% wetlands and this habitat is a high priority habitat for the Refuge that supports both migratory and resident wildlife species.

Providing a mix of wetland habitat types is critical to achieving high species diversity within the Refuge. All the wetland communities within the Refuge provide critical habitat for several of the PROCs within the Refuge. Moist soil unit management mimics the natural seasonal inundation and drying cycle that was historically prevalent in the riparian landscape around the Refuge. TNWR uses a combination of water level management and invasive species control to enhance habitat available for shorebirds, waterfowl, wading birds, and herptiles during their peak spring and fall migration and breeding periods while maintaining essential habitat for other freshwater species of management concern.

Strategies:

- Evaluate contaminant levels in the Refuge as recommended in the 2015 Contaminant Assessment Process Report (USFWS 2015b). See Appendix B
- Construct a water control structure in the former "Green Bay culvert"
- Improve water control structure in River Bottoms Road dike
- Refer to WDNR's Blanding's Turtle (*Emydoidea blandingii*) Species Guidance (WDNR 2014) and PARC's Habitat Management Guidelines for Amphibians and Reptiles of the Midwestern United States (Kingsbury and Gibson 2012) for management recommendations and guidelines
- Early detection, rapid response (EDRR; DOI 2016a) methods may be used to determine when management actions are needed to keep invasive plant species cover less than 20% of total area
- Remove purple loosestrife using biological controls (See Appendix F)
    - Raise pots of defoliating beetles or find suitable nursery sites for annual release at sites on the Refuge. Use volunteers for beetle release when available
- Limit rodent damage to trees, dikes, and water control structures by allowing trapping of furbearers, such as beaver and muskrats, as outlined in the Refuge's Furbearer Trapping Plan (USFWS 1999a)
- Explore collaboration with other FWS offices or partners such as USFWS Ecological Services Field Office, Migratory Birds, La Crosse Fish & Wildlife Conservation Office, Universities, and/or state and private agencies to collect baseline inventory data, assist with restoration, and/or design research projects
- Develop or use existing protocols to assist in the implementation of baseline inventories
- Use applied research to address any questions that arise regarding resources of concern, T&E species or other issues such as invasive species management
- Conduct an archeological inventory of the archeological resources present at sensitive sites within Refuge

4.2 Savanna Management (Priority I)

ROCs: Red-headed Woodpecker, Karner Blue Butterfly, Oak Openings, and Oak Woodlands

Savanna Goal: Restore and manage remnant savanna habitats within TNWR to optimize native species diversity and composition.

Objective 4.2.1. Savanna: Within two years of the signing of this HMP, evaluate habitats surrounding present grasslands for potential oak savanna restoration for the benefit of PROC species such as red-headed woodpeckers and Karner blue butterflies. Wisconsin DNR describes oak savannas as plant communities that have a partial tree canopy with open areas dominated by herbaceous vegetation and includes the community types Oak Woodland and Oak Openings (WDNR 2015b). Our goal is to manage for approximately 160 acres of Oak Woodlands with >50% oak canopy and approximately 138 acres of Oak Openings with an oak canopy of <50% and 2 or more mature oaks per acre. Newly

established oak savanna will be managed for native, uneven aged oaks with canopy covering <50% of the total savanna area. Ultimately, per acre, the desired conditions include an average of 2 or more open branching, mature oaks, with dbh 10 inches or greater and a variety of younger aged oaks with dbh ranging from 5 to 10 inches that provide a canopy cover providing highly filtered shade averaging approximately 50% across the unit. The herbaceous component will be similar to those found in the surrounding grasslands, with many of the same grasses and forbs present. However, shade loving species such as boneset (*Eupatorium sessilifolium*), violet bush-clover (*Lespedeza violacea*), woodland sunflower (*Helianthus strumosus*), eastern shooting-star (*Primula meadia*), yellow-pimpernel (*Smyrnium integerrimum*) and purple milkweed (*Asclepias purpurascens*) may also be present (WDNR 2015d). In addition, for the benefit of Karner blue butterflies, increase or maintain the desired lupine density to or at, 405-810 lupine stems/acre (USFWS 2003).

SAVANNA PROC OBJECTIVES:

Objective 4.2.2. Red-headed woodpecker: Restore and maintain through periodic fire 298 acres of oak savanna habitat, consisting of 160 acres of oak woodland and 138 acres of oak openings (See Figure 4.1). Red-headed woodpeckers prefer nesting habitat that consists of open grassland with scattered or clumps of trees and snags at a density of 1.5/0.04 ha. Average DBH of nest tree = 56-59 cm (22-23 inches; Ingold 1994; Rodewald et al, 2005) and dead limbs on live trees with nest cavities averaged 20-cm (~8 inches) in diameter (Rodewald et al. 2005). By restoring and managing oak savanna habitat within TNWR the Refuge will be contributing to the Mississippi Great Lakes Joint Venture (UMGLJV) red-headed woodpecker population goal of up to 0.05 birds/acre (Potter et al. 2007b). Therefore, if all 298 acres of oak savanna were available and of high quality for red-headed woodpecker nesting the Refuge could potentially support 15 red-headed woodpecker pairs.

Objective 4.2.3. Karner Blue Butterfly: Evaluate the feasibility of translocating Karner blue butterflies to the Refuge following the guidelines of the Karner Blue Butterfly Recovery Plan (USFWS 2003) and the Wisconsin Statewide Karner Blue Butterfly Habitat Conservation Plan (WDNR 2010b). Wild lupine, the only host plant for Karner blue caterpillars, will be maintained through prescribed fire at intervals that will allow for the development of healthy populations of lupine and forbs (USFWS 2003). See Fire Management Plan (USFWS 2015a). Suitable habitat for Karner blue butterflies includes 405-810 lupine stems/acre (USFWS 2003) and a diversity of nectar resources from spring through fall for adult Karner blues and other pollinators. Translocation of Karner blues on the Refuge may contribute to the Karner Blue Recovery Plan objective of restoring viable metapopulations (approximately 3,000 first or second brood adults) of Karner blues across the species extant range so that it can be reclassified from endangered to threatened (USFWS 2003).

Savanna Management Rationale: Oak savannas share a similar status with tallgrass prairies, however, it is the most threatened plant community in the Midwest and among the most threatened in North America (Nuzzo 1986). Intact examples of oak savanna vegetation are now so rare that less than 500 acres are listed in the Natural Heritage Inventory as having a plant

assemblage similar to the original oak savanna. This is less than 0.01% of the original 5.5 million acres (Henderson 1995). Conversion of oak savanna to agricultural lands, elimination of fire, invasion by exotic species, and human development have largely eliminated this ecotype. According to Curtis (1959) oak savanna was present within the borders of what is now the Trempealeau National Wildlife Refuge (See Chapter 2, Figure 2.5). However, an assessment is needed to determine the locations of oak savanna remnants and determine if these remnants are candidates for restoration. Figure 4.1. is a map of the areas where savanna restoration may be feasible. We believe there is the potential to restore nearly 300 acres of degraded oak woodland to savanna (pers. comm. Vickie Hirschboeck, former refuge manager, retired).

A number of species would benefit from the restoration of oak savannas at TNWR including red-headed woodpeckers and Karner blue butterflies. Red-headed woodpeckers occur on the Refuge and are a species of special concern in Wisconsin. They prefers open habitats with a few trees and snags for nesting (Powell 2010).

The Karner blue butterfly was listed as federally endangered in 1992 and systematic statewide surveys for this species in Wisconsin have been conducted since 1990 (USFWS 2003). However, inspection of the Karner Blue Recovery Plan (USFWS 2003) indicates that surveys have not been conducted in Trempealeau County. Once surveys are conducted and it is determined that Karner blue butterflies are present, the Refuge could become part of the West Central Driftless Recovery Unit (USFWS 2003). Karner blue butterflies rely on wild lupine (*Lupinus perennis*) as its only larval food plant and wild lupine is present in large patches at TNWR. Karner blue recovery efforts have been ongoing in Wisconsin since 1990 but not at TNWR. Translocation to the Refuge may be feasible if populations do not already exist. Management and recovery efforts for Karner Blue butterflies will follow the guidelines outlined in Karner Blue Butterfly Recovery Plan (USFWS 2003) and the Wisconsin Statewide Karner Blue Butterfly Habitat Conservation Plan (WDNR 2010b).

Decisions on management tools, locations and restoration related to oak savanna require continuous discussions, monitoring, and creativity to meet the needs of wildlife resources and achieve the criteria outlined in the objectives. Guidance provided by the Oak Savanna Workbook (USFWS *In Prep*), Plant communities of the Midwest (Faber-Langendoen 2001), Wisconsin's Natural communities (WDNR 2015b), and Refuge staff's best professional judgment and experience are just some of the "tools" that will be used to help guide management decisions. Remnants of oak savanna on the Refuge are most likely highly degraded and are invaded by noxious weeds and shade loving woody trees and shrubs. Therefore, restoring these habitats will require intensive and frequent management such as, the removal of woody species followed by herbicide treatments to control resprouting and frequent fire and mowing followed by herbicide to deplete the seed banks and allow native grasses and forbs to dominate the understory. In addition, we want to provide quality habitat for breeding red-headed woodpeckers and Karner blue butterflies. For those species we want to make sure our savanna provides snags for nesting birds and lupine for breeding butterflies and other pollinators. Managing savannas for historic structural characteristics and native species composition will help to conserve this imperiled habitat for a diversity of wildlife but more importantly, for the ecological integrity of the savanna ecosystem.

Strategies:

- Determine feasibility of restoration at sites following guidance in the Oak Savanna Workbook (USFWS *In Prep*)
- Release crowns of 10% oak seedlings in units by pruning random trees to single stems after August 1. Protect these trees from fire by mowing/trimming around them before burn, until the stems are large enough to withstand fire damage
- Manage oak wilt by avoiding damage to oaks and surrounding soils until after August 1
- Plant at least two acres of oaks and other hardwood seedlings where natural regeneration is insufficient to restore oak savanna that will provides a canopy cover of highly filtered shade averaging approximately 50% across the unit
    - Emphasize bur oaks over red and black oaks to minimize loss from oak wilt
- Revise, if needed, the Fire Management Plan to incorporate the desired future condition for savanna and the monitoring that will be used to indicate the need for management
- Apply a combination of treatments (fire, mechanical, and chemical) at the appropriate time based on the needs of the unit (e.g. species of woody or invasive plants that require treatment, life history of the woody or invasive plant, severity of the infestation, etc.) to maximize native plant diversity (See Appendix F)
- Use prescribed fire when indicated by monitoring to control encroachment by cool season exotic grasses, forbs and woody shrubs. Modify existing firebreaks where necessary to incorporate timber stands targeted for restoration to oak savanna
- Vary season and frequency of fire to develop uneven age stands of oaks based on monitoring data and the ecology of the species you want to favor or reduce
- Protect snags and cavity trees
- Remove invasive plants with a combination of mechanical techniques, chemical application, biological controls (See Appendix F)
    - Reduce leafy spurge infestation to 10% or less of prairie by expanding flea beetle release program
        - In late June collect flea beetles from leafy spurge and move them to units burned in spring of that year
    - Black locust and crown vetch will be removed from savanna units wherever found
- Monitor and maintain wild lupine component of all grassland/savanna units to provide for expansion of Karner blue butterfly range. Goal is to provide 405-810 lupine stems/acre (USFWS 2003)
- Conduct an archeological inventory of the archeological resources present at sensitive sites within Refuge

4.3 Grassland Management (Priority I)

PROC's: eastern meadowlark, grasshopper sparrow, and monarch butterfly

Grassland Goal: Restore, enhance, and protect the presence, diversity, and species richness of Refuge grassland habitats to benefit grassland birds and Neotropical migrants.

Objective 4.3.1. Grassland: Annually, maintain, enhance, and manage approximately 130 acres of grasslands in the Prairie Oak Savanna Unit to provide breeding and migratory stopover needs of Refuge priority resources, including but not limited to eastern meadowlark, grasshopper sparrow, and monarch butterfly. Floral structure and composition will exhibit the following conditions:

- Presently TNWR has 256 acres of grassland within the Prairie Oak Savanna Unit (See Appendix E). The desired number of grassland acres are 130. The remaining 126 acres will be evaluated for potential oak savanna reconstruction (see objective 4.2.1)
- Cover dominated by native grass species ($\geq$50%) and native forbs (>10%)
    - 25% cool season grasses and
    - 75% warm season grasses and
    - $\geq$ 30 species of forbs
- Litter depth with a range of 0-7.5 cm (0-3 in)
- Vegetation height-density range from 5-35 cm (Samples and Mossman 1997; Hull 2002)
- Less than 10% woody cover
- Less than 30% invasive species
    - Leafy spurge will occupy an average of <10 % of the species composition and will be interspersed with native plants, never becoming monotypic
    - Black locust and crown vetch will be removed from grassland units wherever found

GRASSLAND PROC OBJECTIVES:

Objective 4.3.2. Eastern Meadowlark: Support an estimated breeding population of 0.32 pairs/acre of eastern meadowlark (Potter et al. 2007). Multipurpose territories for feeding, mating, and rearing of young range between 2.8 and 3.2 ha (Hull et al. 2019). Breeding habitat should include areas of dense grasses of moderate height (12.5-35 cm), low shrub coverage (<5%), low forb coverage, a well-developed litter layer ($\leq$13 cm), and the availability of suitable perches (Hull 2000; Hull et al. 2019).

Objective 4.3.3. Grasshopper Sparrow: Support an estimated breeding population of 0.0364 to 0.162 pairs/acre (Johnson and Schwartz 1993) of grasshopper sparrows. Grasshopper sparrow breeding territory size ranges from 0.3 ha to 1.7 ha (Wiens 1969). They require a minimum of 8-30 ha of contiguous shrub free, dry grassland for nesting and foraging (Dechant et al. 1998). Suitable habitat is characterized by large areas of contiguous grassland of intermediate height (VOR = 5-20 cm; Sample and Mossman 1997), moderately deep litter cover with areas of bare soil, and low shrub density (Dechant et al. 1998).

Objective 4.3.4. Monarch Butterfly: Develop, restore, enhance and manage grassland habitat that supports breeding monarch butterflies, a FWS flagship species. Provide milkweed and flowering plants before the monarchs arrive in late May (Howard 2019). In established prairie habitats, provide a diversity of nectar resources from spring through fall for adult monarchs and other pollinators. Plant only source-identified and locally adapted seeds of milkweed to establish the goal of about 250 milkweed stems/acre (table S3.1 in Thogmartin et al. 2017).

Grassland Management Rationale: Tallgrass prairies are one of the most threatened natural communities in the Midwest (WDNR 2015b) and are a high priority habitat at TNWR. Over 99% of Wisconsin's tallgrass prairies have been lost to agriculture and development (WDNR, 2015b). The remnant tallgrass prairies on the Refuge may soon be the only examples in southern Wisconsin. Therefore, it is essential that we actively manage TNWR prairies and any remaining remnant prairies not only for their inherent ecological integrity and diversity, but to protect endemic flora and fauna, and to benefit grassland-dependent wildlife, such as but not limited to, the eastern meadowlark, grasshopper sparrow, and monarch butterfly.

The absence of trees is generally the optimum state for maximum development and health of grassland systems. Grasses dominate the vegetative biomass of tallgrass prairies, but forbs dominate the species composition. The most represented families of forbs are the composite (aster), legume, milkweed, carrot, and rose families. Over 400 species of native vascular plants are characteristic of Wisconsin's grasslands. Detailed descriptions of Wisconsin's grassland plant communities can be found in the classic text by Curtis (1959). An inventory done within the TNWR grasslands in 2007 found 241 species of plants, including brittle prickly pear (*opuntia fragilis*; state threatened), prairie bush-clover (*lespedeza leptostachya*; federally threatened and state endangered), and prairie fame-flower (*phemeranthus rugospermus*; state species of concern) (unpublished data). Verification of the presence and locations of these species are needed.

Wisconsin grasslands also have diverse and specialized fauna, especially among invertebrates, herptiles, and birds. TNWR hosts a number of grassland specific species, such as grasshopper sparrows, eastern meadowlarks, and monarch butterflies. Grassland birds prefer a range of vegetation structures. For example, the grasshopper sparrow prefers grasslands with shorter, patchier structure while the eastern meadowlark prefers taller, dense stands of tallgrass vegetation with greater litter depth (Hull 2002; Dechant 2002). Providing a mixture of tall and shorter stature sites will allow for the coexistence of both species.

Historically, tall grass prairies were maintained through fire and grazing as well as a highly variable climate (Anderson 2006). Historic fire intervals were estimated at about five to ten years (Wright and Bailey 1980). However, recent literature suggests fire frequencies in the tallgrass regions of Minnesota and Wisconsin were between two and three years but were highly dependent on the climate (Dickmann and Cleland 2002). In the absence of fire and grazing from the landscape invasive species invade the prairies. TNWR is no exception, as evidenced by the presence of black locust and buckthorn in most of the Refuge's prairies. In

addition, adjacent forests are also becoming infested with invasive species and provide a continual seed source of some of the invasive species present in the grasslands. Increasing CO2, warmer temperatures, earlier springs, reduced snowpack, and an increase in flood events will only increase plant productivity and areal expansion of invasive species (WICCI 2011). In addition, as environmental conditions become less predictable and there are more frequent and prolonged droughts and/or storms, local conditions may not allow for the application of controlled fires at the right time.

The main management tool to maintain a diverse prairie is fire and prescribed burning has been an important part of prairie management on TNWR. About 357 acres are burned on a rotational system during the spring months under prescriptions in the Refuge's Fire Management Plan (USFWS 2015a). At TNWR grasslands are typically burned on a 3-5-year rotation (USFWS 2015a). This is consistent with the literature that suggests after six years, native and restored prairies become dense, grass-dominated stands with increased litter depth (Olechnowski et al. 2009, Naugle et al. 2000) and are more susceptible to invasive species including trees and shrubs (Naugle et al. 2000). However, there is some recent literature on pollinators that indicates a 3-year interval may be too often to support healthy populations (Brown et al. 2017). Grassland stand health and vigor will deplete due to increased litter accumulation (Naugle et. al 2000) and therefore, TNWR prairies may need management intervention between years two and eight post fire, when litter accumulation is great enough to carry a fire and the dominance of woody or invasive species is greater than 25% of the unit (Olechnowski et al. 2009). The TNWR fire plan (USFWS 2015a) incorporates the desired habitat conditions and annual monitoring of the plant assemblages within management units that will better inform annual treatment schedules.

Strategies:

- Reduce or remove invasive plants with a combination of mechanical techniques, chemical application, biological controls (See Appendix F)
    - Reduce leafy spurge infestation to 10% or less of prairie by expanding flea beetle release program
        - In late June collect flea beetles from leafy spurge and move them to units burned in spring of that year
- Develop fire prescriptions that maintain <10% areal coverage of woody plants in a unit and promote growth of warm season native grasses and forbs
- Apply a combination of treatments (fire, mechanical, and chemical) at the appropriate time based on the needs of the unit (e.g. species of woody or invasive plants that require treatment, life history of the woody or invasive plant, severity of the infestation, etc.) to maximize native plant diversity and early successional stages of prairie systems
- Follow fire Management Plan that accommodates new management guidelines (USFWS 2015a)
- Delay mowing until late August (3-5 year rotations depending on the condition of the unit)

- Create barriers to invasive plant introduction by managing roadside weeds with mowing and chemicals and creating a vehicle cleaning station for any vehicle that will go off main Refuge roads
- Promote, plant, and monitor a mix of pollinator specific plants, including milkweed and goldenrod, timed to accommodate all life stages of monarch butterflies
- Conduct pollinator-friendly management practices, such as prescribed burns, October 1-May 1
- Decrease "edge" habitat by removing all pine plantings from within or adjacent to prairie units
- Explore collaboration with other FWS offices or partners such as USFWS Ecological Services Field Office, Migratory Birds, Universities, and/or state and private agencies to collect baseline inventory data, assist with restoration, and/or design research projects
    - Develop or use existing protocols to assist in collection of baseline inventories
- Use applied research to address any questions that arise regarding resources of concern, T&E species or other issues such as invasive species management
- Conduct an archeological inventory of the archeological resources present at sensitive sites within Refuge

4.4 Forest Management (Priority II)
PROCs: Forested Wetland: Wood Duck and Bald Eagle; Southern Dry Forest: Wood Thrush, American Woodcock, and Northern Long-eared Bat; Both: neotropical and temperate-zone migrants

Forest Goal: Enhance and restore historic species diversity and structure to Refuge southern dry forest and forested wetland habitats to meet the needs of migrating birds and other forest-dependent wildlife. Restore historic hydrologic conditions of forested wetlands to support older age class trees for the benefit of wetland dependent cavity nesting waterfowl and tree nesting raptors.

Objective 4.4.1. Forested Wetland: Manage approximately 1,041 acres of forested wetland for the benefit of cavity nesting waterfowl, migratory songbirds, bald eagles, and other wetland forest species. Desired conditions include:

- >50% canopy cover (dominated by silver maple but also river birch, green ash, hackberry, swamp white oak and cottonwood)
- Understory
    - Shrub and sapling layer <25% cover (species such as buttonbush and American elder (*Sambucus canadensis*) are common
    - Understory may also include nettles, sedges, ostrich fern, gray-headed coneflower, cardinal flower and green dragon

    - Vines such as Virginia creeper (*Parthenocissus quinquefolia*), grapes (*Vitis* spp.), Canada moonseed (*Menispermum canadense*), and poison-ivy (*Toxicodendron radicans*) are also common
- Flooding during growing season will be limited to <30 total days
- Invasive and non-natives species will comprise <10% of total species abundance.
    - European buckthorn will occupy <10% of canopy
    - Tartarian Honey suckle and Chinese elm will occupy <1% of total plants in the shrub layer
- Currently, approximately 1,135 acres of forested wetland occur on the Refuge, but 94 acres will be evaluated for potential oak savanna restoration (see Objective 4.2.1)

FORESTED WETLAND PROC OBJECTIVES:

Objective 4.4.2. Wood duck: Annually, manage and protect 1,041 acres of forested wetland for the benefit of cavity nesting wetland species such as wood ducks. Wood ducks prefer mature hardwood forests in close proximity to wetlands (<2 km). Species nests primarily in tree cavities of trees with diameter (dbh) >25 cm and are not territorial (Soulliere 2007b). According to Soulliere et al. (2007b) the minimum optimal habitat required for each wood duck pair is 1.2 acres. In Wisconsin naturally occurring nest cavities densities range from 0.263 to 0.372 cavities/acre (Soulliere 1985; Denton et al. 2012). Therefore, if suitable wood duck breeding habitat and nest cavities are available the Refuge has the potential to support approximately 274-387 breeding pairs.

Objective 4.4.3. Bald Eagle: Annually, protect the seven existing bald eagle nests on the Refuge and monitor for any additional nests. A 200-meter buffer around nests will be kept free of human disturbance and all large mature trees near water will be retained as possible roosting or nesting habitat.

Objective 4.4.4. Migratory songbirds: Annually, protect and manage high quality habitats, primarily forested wetland (1,041) and southern dry forests (152 acres) within Trempealeau NWR for the benefit of transient neotropical and temperate-zone migrants, such as Canada warblers and northern waterthrush. TNWR will support diverse ($N \geq 35$ species) and abundant populations of transient neotropical and temperate-zone migrants who stop over enroute to their breeding grounds.

Forested Wetland Rationale: Trempealeau NWR lies within the Mississippi Flyway and is an important stopover site for many species of birds (Knutson and Klaas 1997, 1998; Urich et al. 2002; Kirsch et al. 2013). Kirsch et al. 2013 observed 35 species of transient neotropical (N=26) and temperate-zone (N=9) migrants within the Upper Mississippi River area during spring migration (mid-April to end of May). Neotropical and temperate-zone migrants spend up to one-third of each year migrating (Mehlman et al. 2005) and the greatest constraint during migration is the acquisition of adequate food to replenish fat stores (Moore et al. 1995). During spring migration, the 1,041-1,135 acres of forested wetland, as well as the 152-230 acres of southern dry forest, within the Refuge provide foraging opportunities, shelter, and protection from predators so that these migrants can replenish their fat stores before heading to their

breeding grounds. However, climate change has the potential to alter the suitable climate space favored by individual species and their habitats, change resource availability, increase habitat disturbance, change phenology, and alter migration routes or stop migration for some species altogether (Moore 2011). Management will focus on providing high quality forest habitats and their associated food resources (i.e. aquatic, aerial, and terrestrial insects) as species respond to climate change.

Presently forested wetland habitat covers 17% of the Refuge. Before impoundment, forested wetlands lined most of the old river channels. These wetland forests, once abundant, were either cleared for farming or destroyed by prolonged flooding when Lock and Dam 6 went into operation. Little of the forested wetland is regenerating and large, old trees suitable for bald eagle nesting, great blue heron rookeries, or wood duck nesting cavities are becoming less abundant.

A Forest Management Plan is needed due to much of the existing forest habitat on the Refuge being degraded by invasive species. The wetland forest habitats of TNWR are a low priority habitat and will require management actions in order to maintain and keep from degrading. Resident birds such as wood duck and bald eagles, as well as migratory songbirds would benefit from management that decreases the dominance of invasive species. These forests can be managed to support the needs of migratory and resident species.

Strategies:

- Within 5 years of the signing of the HMP, develop a Forest Management Plan
    - Consult with forester to write management prescriptions for the existing 1,135 acres of forested wetland. HMP target forested wetland acreage is 1,041 (See Table 4.1)
    - Determine feasibility of restoration of 94 acres of forested edge to savanna (Oak Woodland; see Savanna objective) following guidance in the Oak Savanna Workbook (USFWS In Prep)
    - Explore possibility to work with other FWS offices or partners, Universities, and/or state and private agencies to collect information on forest regeneration and restoration
- A better understanding of the hydrology within the forested wetland areas will make it easier for Refuge staff to make informed decisions about how to manage the water depths in these areas. A water budget (See Objective 4.1.1) is needed to achieve appropriate water depths and limit inundation duration using the available water control structures (see Objective 4.1.1)
- Within forested wetland areas manage hydrology to limit flooding to <30 days during the growing season
    - Protect swamp white oak and cottonwoods in Unit C by lowering water level to below the root mass during the growing season to avoid prolonged flooding when conditions allow
- Management actions may include:
    - Maintain canopy cover >50% to discourage reed canary grass.
    - Removal of invasive plants from understory

        - Remove black locust and European buckthorn using a combination of mechanical techniques and chemical applications. Retreat resprouts with mowing and chemicals for minimum of 5 years
    - Use prescribed fire where feasible
        - Remove hanging fuels from burn units to allow burning; followed by fall burning; then prescription burning according to Fire Management Plan (USFWS 2015a)
    - Protect all snags and cavity trees
        - Snags and dying trees near known bat roost locations should be protected from June 1 through August 15 when bats may have flightless pups at the roost
        - Surveys need to be conducted and any roost sites discovered protected following the 4(d) Rule for the Northern Long-Eared Bat (2016) that is under authority of section 4(d) of the Endangered Species Act of 1973 (https://www.govinfo.gov/content/pkg/FR-2016-01-14/pdf/2016-00617.pdf#page=1)
    - Manage oak wilt by avoiding damage to oaks and surrounding soils until after August 1
- Apply a combination of treatments (fire, mechanical, and chemical) at the appropriate time based on the needs of the unit (e.g. species of woody or invasive plants that require treatment, life history of the woody or invasive plant, severity of the infestation, etc.) to maximize native plant diversity (See Appendix F)
- Conduct an archeological inventory of the archeological resources present at sensitive sites within Refuge
- Collect long-term data on neotropical and temperate-zone migrant species presence, diversity and abundance in floodplain and upland forest. Annual monitoring of species diversity and abundance of migrants will provide information regarding species distributional changes, species turnover (as distributions change the Refuge may lose some species but gain others), and changes in abundance due to climate change, land use, and other environmental changes

Objective 4.4.5. Southern Dry Forest: Annually, manage approximately 152 acres of southern dry forest for the benefit of migratory and ground-nesting birds and roosting bats, such as wood thrush, American woodcock, migratory songbirds, and northern long-eared bat. Desired conditions include:

- Moderately closed canopy (70-80% cover) with overstory dominated by oaks
    - Mature trees should be >50 feet tall with smaller oak saplings in the understory for the benefit of wood thrush (Powell 2010) and American woodcock (Potter 2007)
- Well-developed shrub layer dominated by dogwoods and hazelnut

- Herbaceous species should include, wild geranium, false Solomon's-seal, hog-peanut, and woodland sunflower
- Invasive and non-natives species will comprise <10% of total species abundance
    - Black locust, Chinese elm, and European buckthorn combined will occupy <10% of the canopy
    - Tartarian Honeysuckle will occupy <1% of total plants in the shrub layer
- Currently, approximately 230 acres of southern dry forest occurs on the Refuge, but 78 acres will be evaluated for potential oak savanna restoration (see Objective 4.2.1)

SOUTHERN DRY FOREST PROC OBJECTIVES:

Objective 4.4.6. Wood Thrush: Annually manage and protect 152 acres of southern dry forest habitat for the benefit of breeding wood thrush. Wood thrush prefer the interior portions of mature upland forests and approximately 7 acres are required to support a pair of wood thrushes (Potter et al. 2007). Therefore, if southern dry forested habitat within the Refuge were considered suitable for wood thrush the Refuge could potentially support 0.14 wood thrush pairs/acre or 22 wood thrush pairs.

Objective 4.4.7. American Woodcock: Annually, manage and protect 152 acres of southern dry forest for the benefit of breeding American woodcock. Preferred nesting and brooding habitat is within young to mid-age hardwood stands where an abundance of earthworms are available for foraging woodcock (Kelley et al. 2008; McAuley et al 2013). The American Woodcock Conservation Plan indicates that habitat managed for woodcock should support 0.5-1 woodcock/acre (Kelley et al. 2008). Therefore, if all southern dry forested habitat within the Refuge were considered suitable for American woodcock the Refuge could potentially support 76-152 woodcock.

Objective 4.4.8. Northern Long-eared Bat: Annually, manage and protect the 152 acres of southern dry forest (see Objective 4.4.2) and the 1,041 acres of forested wetland (see objective 4.4.1.) habitats for the benefit of northern long-eared bats, a state and federal threatened species. Habitat requirements include resources for roosting, foraging and drinking (Taylor 2006). Northern long-eared bats are forest dwelling bats that roost singly or in colonies during the summer in cavities, underneath bark, crevices, or hollows of both live and dead trees (typically ≥3 inches dbh) (USFWS 2014b; Whalen and Krusac 2014). Bats move frequently between roost trees and do not show a preference for the type of tree (Taylor 2006; DOI 2016b). However, trees in the early stages of decay and with more bark cover will provide more roosting opportunities. Therefore, management should provide forested habitat that consists of mixed-species, mixed-aged trees with multiple snags or dying trees and some open areas. Female home range size varies from approximately 45 to 28 acres depending on reproductive status (Owen et al. 2003; WDNR 2013) but the females may form small maternity colonies of up to 30 bats in late spring (Caceres and Barclay 2000, Owen et. al. 2002). Northern long-eared bats occur on the Refuge, but numbers are unknown (USFWS 2008a).

Southern Dry Forest Rationale: Presently southern dry forests covers approximately 3% of TNWR. Southern dry forest habitat is not a historic habitat for this area and with proper management some of these areas will be converted to oak savanna (See Table 4.2 and Figure 4.1). However, southern dry forests serve a purpose on the Refuge and support migratory and resident species such wood thrush (*Hylocichla mustelina*), American woodcock, northern long-eared bat (*Myotis septentrionalis*), and migratory songbirds. Forest ecosystems generally require less intensive management than other habitat types. However, if left unchecked these habitats will quickly be degraded. A number of factors including invasion by exotic species, oak wilt, and agriculture has altered forests on the Refuge. The forest canopy in many areas is dominated by black locust, and the native shrub component which should include species such as dogwoods, hazel, viburnums and others, has been replaced by European buckthorn, black locust, Siberian pea, and Tartarian honeysuckle. Therefore, to help determine how the forests at TNWR should be managed a forest management plan is needed. The forest habitats of TNWR are a low priority habitat but they will require management actions in order to maintain and keep from degrading. The forest management plan will identify management prescriptions such as commercial harvest, plantings, fire, and invasive plant control that will increase the biological integrity, diversity, and environmental health of these forests. Due to limited staff and knowledge of forest management, a forester will be consulted to conduct the surveys and to write prescriptions for all forest stands.

Strategies:

- Within 5 years of the signing of the HMP, develop a Forest Management Plan
  - Consult with forester to write management prescriptions for the existing 230 acres of southern dry forest. HMP target forest acreage is 152 acres of southern dry forest (See Table 4.1)
  - Determine feasibility of restoration of 78 acres of forested edge to savanna (Oak Woodland; see Savanna objective) following guidance in the Oak Savanna Workbook (USFWS In Prep)
  - Promote hardwood transition in southern dry forest areas by removing interior pine/invasives around good quality oak/cherry (release crowns)
    - Commercial harvest of merchantable pine and black locust (w/chemical treatment of locust)
  - Explore possibility to work with other FWS offices or partners, Universities, and/or state and private agencies to collect information on forest regeneration and restoration
- Management actions may include:
  - Maintain canopy cover >50% to discourage reed canary grass
  - Removal of invasive plants from understory
    - Remove black locust and European buckthorn using a combination of mechanical techniques and chemical applications. Retreat resprouts with mowing and chemicals for minimum of 5 years
  - Use prescribed fire where feasible

        - Remove hanging fuels from burn units to allow burning; followed by fall burning; then prescription burning according to Fire Management Plan (USFWS 2015a)
    - Protect all snags and cavity trees.
        - Snags and dying trees near known bat roost locations should be protected from June 1 through August 15 when bats may have flightless pups at the roost
        - Surveys need to be conducted and any roost sites discovered protected following the 4(d) Rule for the Northern Long-Eared Bat (2016) that is under authority of section 4(d) of the Endangered Species Act of 1973 (https://www.govinfo.gov/content/pkg/FR-2016-01-14/pdf/2016-00617.pdf#page=1)
    - Manage oak wilt by avoiding damage to oaks and surrounding soils until after August 1
- Apply a combination of treatments (fire, mechanical, and chemical) at the appropriate time based on the needs of the unit (e.g. species of woody or invasive plants that require treatment, life history of the woody or invasive plant, severity of the infestation, etc.) to maximize native plant diversity (See Appendix F)
- Conduct an archeological inventory of the archeological resources present at sensitive sites within Refuge
- Collect long-term data on neotropical and temperate-zone migrant species presence, diversity and abundance in floodplain and upland forest. Annual monitoring of species diversity and abundance of migrants will provide information regarding species distributional changes, species turnover (as distributions change the Refuge may lose some species but gain others), and changes in abundance due to climate change, land use, and other environmental changes

Objective 4.4.9. Black Oak Island. Maintain and protect the ecological condition and archaeological artifacts of Black Oak Island Natural Area/Archeological sites. Within the first five years following the approval of the HMP conduct baseline inventories on Black Oak Island for the purpose of determining management direction that will keep invasive plant species cover less than 5% of the total area. Inventories will also outline any protection and restoration measures needed due to the presence of archeological resources. In addition, sensitive sites throughout Refuge should be inventoried to determine the locations and extent of archeological resources that will also need consideration when determining management actions.

Black Oak Island Rationale: In 1986, Black Oak Island was designated a Public Use Natural Area (PUNA) as an example of undisturbed, mature, eastern deciduous forest. A PUNA is a relatively undisturbed ecosystem that is available for public use with certain restrictions to protect the area. Activities such as hiking, bird watching, hunting, fishing, wildlife observation, and photography are permitted if they are compatible with objectives. Camping, picnicking,

swimming, uncontrolled hiking, and consumptive use of nonrenewable resources are prohibited on the islands (USFWS 1982).

The Service's Refuge Manual (USFWS 1982), Section 8 RM 11 (Appendix G) provides guidance for management, administration, and visitor use of Public Use Natural Areas and lists the following objectives of the designations:

- Assure preservation of a variety of significant natural areas for public use which, when considered together, illustrate the diversity of the NWRS natural environments.
- Preserve those environments that are essentially unmodified by human activity for future use.

In public use natural areas, as in designated research areas or wilderness, natural processes are allowed to predominate without human intervention. However, under certain circumstances, deliberate manipulation may be used to maintain the unique features for which the natural area was established. Due to the introduction of invasive plants, such as European buckthorn, some of the biological characteristics on which Black Oak Island Public Use Natural Area was designated may be threatened and management to control invasive species may be needed. Therefore, to ensure the future integrity of the area, monitoring of current habitat conditions and the changes since the area was designated need to be conducted for the appropriate management actions to be determined.

Strategies:

- Before any management is conducted on Black Oak Island or other sensitive sites within Refuge, policy 614 FW1 (Overview of Managing Cultural Resources) and 614 FW3 (Compliance with Section 106 of the National Historic Preservation Act) will be consulted and applicable activities will be approved by the Regional Historic Preservation Officer (RHPO), presently James Myster
- Conduct an archeological inventory of the archeological resources present on Black Oak Island and other sensitive sites within Refuge
- Black Oak Island Public Use Natural Area:
    - Protect archeological resources on Islands
    - Determine if further shoreline protection is needed to prevent erosion of artifacts from Black Oak Island
    - Determine if is necessary to close unsupervised access to Black Oak Island
    - Conduct vegetation survey on Islands. Survey should document:
        - Habitat cover type(s)
        - Comprehensive species inventory
        - Degree of degradation by invasive species or other source
    - Early detection, rapid response (EDRR; DOI 2016a) or Forest Invasive Inventory (Booker et al. 2017) methods may be used to determine when management actions are needed to keep invasive plant species cover less than 5% of total area
    - Remove invasive plants from Black Oak Island using methods approved by RHPO (See Appendix F for invasive species management strategies)

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Appendix A: Trempealeau NWR CCP Wildlife and Habitat Goals, Objectives, Strategies

Note: The text provided in this appendix is taken directly from the Trempealeau NWR CCP (USFWS 2008a) goals, objectives and strategies and are provided here for reference. The HMP goals and objectives provided in Chapter 4 are consistent with the vision and direction provided in the 2008 CCP.

CCP Landscape Goal (Goal 1 in CCP)
We will strive to maintain and improve the scenic and wild character, and environmental health of the Refuge.

Objective 1.4: Natural Area Management
By 2010 develop a management plan, including a habitat survey and archeological resource inventory and protection for Black Oak Island.

Strategies:
- By 2010 develop a Management Plan for Black Oak Island.
- Map vegetation on Black Oak Island.
- Remove all invasive plants from Black Oak Island.
- Solicit an archeologist to inventory and document archeological resources present on Black Oak Island.
- Determine if further shoreline protection is needed to prevent erosion of artifacts from Black Oak Island.
- Protect archeological resources on Black Oak Island by increasing law enforcement surveillance and closing the island to unsupervised public access.

CCP Wildlife and Habitat Goal (Goal 2 in CCP)
Our habitat management will support diverse and abundant native fish, wildlife, and plants.

Objective 2.1: Forest Management
By 2010 develop a Habitat Management Plan incorporating forest management. By 2015 enhance 50 acres of upland hardwood forest; and 500 acres of floodplain hardwood forest in three separate blocks. Remove all Scotch pine and selectively thin all pine plantings by 50 percent.

Strategies:
- 2.1.1. Survey upland forest stands for archeological resources.
- 2.1.2. Continue restoration of River Bottoms Road sites by planting new age classes of swamp white oak seedlings every 3 years until natural regeneration is occurring.

- 2.1.3. At River Bottoms Road sites inter-plant other native seedlings as available, focusing on mast-producing species. Coordinate seed collection from local floodplain sites and seedling production with Army Corps of Engineers foresters.
- 2.1.4. Annually treat 5 acres each of upland and floodplain forest using mechanical and chemical means as appropriate, to remove black locust and European buckthorn. Black locust and European buckthorn will occupy <10 percent of the canopy in upland forest and <20 percent in floodplain forest.
- 2.1.5. Work with Army Corps of Engineers foresters to identify stands and prescriptions for timber sales. Permit commercial harvest of black locust and pine.
- 2.1.6. By 2010, clear down timber from burn units by permitting firewood cutting.
- 2.1.7. Protect swamp white oak in pool C2 by lowering water level during the growing season to avoid prolonged flooding.
- 2.1.8. With others, seek research on floodplain forest regeneration and restoration of forest habitats to benefit cavity dependent species.

Objective 2.2 Wetland Management

Working with others and through a more aggressive Refuge program, seek a continuous improvement in the quality of water flowing into and out of the Refuge in terms of long-term monitoring of dissolved oxygen, major plant nutrients, suspended material, turbidity, pH, temperature, sedimentation and contaminants. By 2022, develop and maintain infrastructure to allow management of 5,500 acres of wetlands as described below:

- Two out of every 5 years, provide an average of 275 acres of moist soil/mudflat habitat primarily for shorebirds, waterfowl, and wading birds.
- By 2022, provide an average of 2,750 acres of emergent marsh habitats on the Refuge. This habitat will be characterized by water depths ranging from 3 to 30 inches interspersed with stands of cattail, bulrush, phragmites, arrowhead, pickerelweed, water lily and American lotus. Submerged aquatic plants such as coontail and sago pondweed will usually be present. Emergent marsh habitat will be apportioned among the Refuge pools as follows:
    - Pool A –250 acres,
    - Pool B – 1,050 acres,
    - Pool C1 –500 acres,
    - Pool C2– 150 acres,
    - Pool D –300 acres,
    - Pool E –300 acres,
    - Pool F – 200 acres.
- Continue to provide approximately 1,550 acres of deepwater marsh habitat among Refuge pools. This habitat will generally consist of open water greater than 30 inches in depth. Submerged vegetation such as coontail, sago pondweed, and wild celery is desired. These habitats will provide open water rafting areas for diving ducks and

foraging habitat for pelicans, cormorants, Bald Eagles, and other fish-eating birds. Deepwater habitat would be distributed among Refuge pools roughly as follows:

- Pool A –350 acres,
- Pool B – 1,000 acres,
- Pool D – 150 acres,
- Pool F –50 acres

Strategies:

- 2.2.1. By 2010, write a Habitat Management Plan that includes strategies for managing water levels in each impoundment.
- 2.2.2. Once every 5 years when funding for pumping is available, reduce water levels in Pool A by pumping to expose 50 percent (350 acres) of the bottom. Drawdown would begin in May, coinciding with shorebird migration, and continue through the fall until freeze-up. Low water conditions would create conditions for a partial kill of rough fish. Water levels would return to full pool over the winter through dike and groundwater seepage.
- 2.2.3. Once every 5 years when funding for pumping is available (alternating with Pool A), reduce water elevations in Pool E when wild rice has reached the floating leaf stage in late May or early June. Maintain water level as low as possible through late August, and then gradually restore levels to maximize food availability for waterfowl, rails, and wading birds.
- 2.2.4. Avoid prolonged flooding of swamp white oaks in Unit C2 by lowering water level below the root mass of these trees during the growing season.
- 2.2.5. Maintain stable or declining water levels in pools B and E, June through August to accommodate over-water nesting species, especially Black Terns.
- 2.2.6. Construct a dike with a spillway and water control structure between Delta Point and Pine Creek dike. Raise and widen Delta and Pine Creek roads to serve as dikes for a new sub-impoundment C1 totaling about 375 acres.
- 2.2.7. Construct a water control structure in the former “Green Bay culvert” thereby creating impoundment D, about 450 acres.
- 2.2.8. Construct a water control structure in River Bottoms Road dike to create impoundment F of about 450 acres. Raise and widen River Bottoms Road south of its junction with Oxbow dike.
- 2.2.9. Subdivide C2 into three manageable units.
- 2.2.10. When conditions allow, drawdown Pool B using gravity flow through Pool A into the Trempealeau River. Once every 7 years pump Pool B as low as possible with existing pumps to improve aquatic plant growth.
- 2.2.11. Hire one permanent seasonal tractor operator to perform annual maintenance of dikes, pumps and water control structures.
- 2.2.12. Hire a Private Lands Biologist (shared half time with Winona District) to fully implement the Partners for Wildlife Program in the Trempealeau and Buffalo River Watersheds to improve water quality entering the Refuge.
- 2.2.13. Construct five islands each, in the eastern portion of Pools A and B. Material for the islands would be dredged from within each pool or from the

Mississippi River and pumped through the BNSFRR dike. In addition to providing nesting habitat for various species, islands would break wind and wave energy and decrease turbidity.

- 2.2.14. Continuously monitor water quality at six locations using dataloggers.
- 2.2.15. When feasible, use commercial fishing and winter drawdowns to reduce populations of rough fish in pools A and B.
- 2.2.16. Work with USGS and the National Weather Service to re-establish a permanent weather station.
- 2.2.17. Continue to stress the importance of water quality in public information and interpretation, and environmental education programs.

Objective 2.3 Grassland Management

Maintain existing 335 acres of prairie and by 2022 restore 100 acres of prairie /oak savanna habitat. Prairie component will have native cool and warm season grasses and wild flowers typical of undisturbed sand prairie in western Wisconsin. Oak savanna will comprise 20 to 40 percent of the prairie area with an open canopy of native, uneven aged oaks.

Strategies:

- 2.3.1. Use prescribed fire as described in the approved Fire Management Plan (USFWS, 2008) to control encroachment by cool season exotic grasses, forbs and woody shrubs. Modify existing firebreaks where necessary to incorporate timber stands targeted for restoration to oak savanna.
- 2.3.2. Expand flea beetle release program to reduce leafy spurge in all prairie/oak savanna habitats. Leafy spurge will occupy <10 percent of any prairie/oak savanna unit by 2022.
- 2.3.3. Annually, convert a minimum of 5 acres of black locust to prairie using mechanical and chemical means as appropriate. Use commercial harvest to remove merchantable trees where practical. If necessary, plant native grasses and forbs to enhance restoration.
- 2.3.4. Remove understory of invasive shrubs from oak savanna habitats. By 2022, invasive plants will occupy <10 percent of oak savannas.
- 2.3.5. By 2022, plant at least 2 acres of oaks and other hardwood seedlings where natural regeneration is insufficient to restore oak savanna. Emphasize bur oaks over red and black oaks to minimize further losses from oak wilt.
- 2.3.6. By 2022, decrease “edge” habitat by removing all pine plantings from within prairie units.
- 2.3.7. Hire a permanent, full-time seasonal biological technician to oversee prairie/oak savanna restoration including monitoring and invasive plant control.
- 2.3.8. Use volunteers and school groups to collect and redistribute native grass and wildflower seed.
- 2.3.9. Develop interpretive and education programs on prairies and invasive plants.

Objective 2.4 Invasive Plants and Animals

Reduce abundance of invasive and non-indigenous plants as specified in Table 2 (see Chapter 4, Pg. 63 of 2008 CCP). If conditions allow, once every 5 years prior to drawdown of Pool A, remove invasive carp and other rough fish using commercial fishing.

Strategies:

- 2.4.1. Conduct an inventory and prepare baseline maps of invasive plant infestations, and to undertake mechanical removal of invasive plants.
- 2.4.2. As part of a Habitat Management Plan, write an invasive plant control and management step-down plan (Integrated Pest Management Plan) that identifies priority areas and methods of control. Emphasize mechanical and biological control.
- 2.4.3. Seek seasonal staff and funding to accelerate current control and applied research through interagency partnerships, volunteer programs, and public education.
- 2.4.4. Continue to work with the Department of Agriculture, other agencies, the state, and other refuges in securing insects for release on the Refuge and on private lands within the Trempealeau and Buffalo River watersheds.
- 2.4.5. Seek grants, cost-sharing, or special funding opportunities for invasive plant removal.
- 2.4.6. Conduct public information efforts including media, brochures, signs, and programs to increase awareness of the threats posed by invasive plants and what citizens can do to minimize the introduction or spread of invasive species.
- 2.4.7. Build a GIS database of invasive plants and update it every 3 years.
- 2.4.8. If conditions allow, permit commercial fishing for rough fish in Pool A prior to each drawdown.
- 2.4.9. Monitor all pools for invasive fish, aquatic plants and mollusks.
- 2.4.10. Investigate feasibility of implementing an exchange program for gardeners with loosestrife planted in ornamental gardens.
- 2.4.11. Secure outside funding to set up rearing cages on private lands and begin distribution of beetles to landowners within the Trempealeau and Buffalo River Watersheds.
- 2.4.12. Continue to serve as a source of flea beetles for other agencies and landowners who have infestations of leafy spurge.
- 2.4.13. Explore the installation of fish barriers at all water control structures.
- 2.4.14. Determine the distribution of reed canary grass and phragmites and investigate methods of control.

Objective 2.5 Monitor and Investigate Fish, Wildlife and Plants and their Habitats
By 2010 update the Wildlife Inventory Plan to include all federal and state listed species, species of regional conservation concern, furbearers, and deer. Increase partnerships with agencies and universities and encourage applied research on the Refuge.

Strategies:

- 2.5.1. Engage other experts and partners to develop and implement a Wildlife Inventory Plan that includes all federal and state listed species, regional conservation species, furbearers, and deer. Also include "species of greatest conservation need" as identified in the Wisconsin Comprehensive Wildlife Conservation Plan.
- 2.5.2. Work with partners, volunteers, students and staff to store, summarize and, as appropriate, analyze survey data annually.
- 2.5.3. Continue to work with universities, states, USGS, and the COE to share data on species and habitats.
- 2.5.4. Participate in formal coordination meetings with USGS to share biological data, monitoring and monitoring expertise.
- 2.5.6. Foster partnerships with colleges and universities to encourage graduate research projects.
- 2.5.7. Continue to use volunteers to complete certain surveys like waterbird counts, and deer surveys.
- 2.5.8. By 2010, complete a Habitat Management Plan that integrates monitoring results with habitat management actions.
- 2.5.9. Working with partners, develop a Herptile Management Plan by 2010.

Objective 2.6 Threatened and Endangered Species Management
Continue to monitor Bald Eagle use of the Refuge. Complete an evaluation of state-listed species using the Refuge.

Strategies:

- 2.6.1. Consider the needs of threatened, endangered, and candidate species in all habitat and public use management decisions.
- 2.6.2. Continue to consult with the Service's Ecological Services Office on all actions which may affect listed species.
- 2.6.3. In the Wildlife Inventory Plan address monitoring for all listed or candidate species, and other species of management concern to help preclude listing.
- 2.6.4. In the Habitat Management Plan, identify steps needed to ensure populations of listed or candidate species are sustained in support of delisting or to preclude listing.
- 2.6.5. Continue to monitor Bald Eagle nesting and success.
- 2.6.6. Close 100-meter radius around active Bald Eagle nests to public entry February 1 to July 1.

- 2.6.7. Where feasible, protect large nest trees from prolonged flooding and erosion.
- 2.6.8. Work with Wisconsin DNR to assess the potential for reintroduction of Massasagua rattlesnakes.
- 2.6.9. Increase education and outreach targeting threatened and endangered species and their needs.
- 2.6.10. Work with partners to assess the potential for reintroduction of Karner blue butterflies.

Objective 2.7 Deer Management

By 2010, update the Wildlife Inventory Plan and Habitat Management Plan to include management and monitoring of white-tailed deer and related browse impacts. Base harvest levels of deer on annual population monitoring and evaluation of habitat quality.

Strategies:

- 2.7.1. Update Wildlife Inventory Plan to include white-tailed deer monitoring, including fawn counts.
- 2.7.2. Include monitoring of browse impacts in Habitat Management Plan.
- 2.7.3. With partners, investigate the most current, efficient and appropriate technologies and protocols to monitor browse and herd size.
- 2.7.4. Investigate funding mechanisms and partnerships to contract aerial, forward looking infra-red (FLIR) surveys to count deer once every 5 years.
- 2.7.5. Model percent change in browse impacts over time.
- 2.7.6. Encourage research by universities and partner agencies on deer-habitat interactions including implications to invasive plant abundance.
- 2.7.7. Work closely with Wisconsin DNR to coordinate information exchange, planning, and management of CWD on nearby lands.
- 2.7.8. Continue to use a managed public hunt of white-tailed deer to maintain acceptable levels of browse.
- 2.7.9. Update the Hunt Plan to include white-tailed deer hunting.
- 2.7.10. Seek expert advice to model white-tailed deer population dynamics to determine appropriate harvest levels.
- 2.7.11. Base sex and age ratio of harvest requirements on population modeling and advice from Wisconsin DNR.
- 2.7.12. Update Visitor Service Plan to improve safety and require all pedestrians to wear blaze orange during the gun hunt.
- 2.7.13. Investigate options for closing the Refuge to non-hunting visitors during key hunting times.
- 2.7.14. Improve signage and develop a Refuge-specific hunting safety brochure.
- 2.7.15. Continue issuing over-the-counter permits for late season archery.
- 2.7.16. Continue to operate a check station on opening weekend.

- 2.7.17. Require mandatory reporting of hunter success or loss of 1 year hunting privileges.
- 2.7.18. Continue to follow Wisconsin guidelines for season dates and times.

Objective 2.8 Furbearer Management

Update the Furbearer Management Plan by 2009 and continue to manage muskrat, beaver, and raccoon populations at levels where damage to dikes and interference with water management and bird banding operations is limited.

Strategies:

- 2.8.1. Work with public to update Furbearer Management Plan by 2009.
- 2.8.2. Update Wildlife Inventory Plan to include muskrats, beavers, and otters.
- 2.8.3. Use harvest data to determine appropriate harvest levels to minimize damage to dikes and structures.
- 2.8.4. As needed adjust trapping activities to avoid conflicts with other hunts or Refuge management.
- 2.8.5. Remove problem animals from banding sites as needed to meet banding objectives.
- 2.8.6. Work with Wisconsin Trapping Association to provide training for all trappers using the Refuge. Encourage communication and cooperation among trappers.

Appendix B: Contaminant Assessment Summary

The following summary and contaminant assessment recommendations from the Trempealeau National Wildlife Refuge 2015 Contaminant Assessment Process (CAP) Report (USFWS 2015a) are included here for reference. The 2015 CAP should be referenced for further information.

Summary of 2015 CAP (USFWS 2015a)

The 2015 Contaminant Assessment Process (CAP) for the Trempealeau National Wildlife Refuge (NWR or Refuge) evaluated existing information to identify existing and potential contaminant issues that may affect Refuge resources. This CAP also provides recommendations for further evaluations and actions to be considered with Refuge management goals and objectives. The CAP did not identify any known or documented contaminant issues at the Refuge. However, based on the information evaluated there are several potential contaminant risks for the Refuge which should be considered for further evaluation and/or actions.

Several land use practices could be sources for contaminants presenting a risk to the Refuge including railway and highway transportation, silica sand mining, agriculture, and industry. These land uses could introduce contaminants into the system via surface waters, groundwater, or in the air.

The greatest risk of contaminant introduction to the Refuge is railway and highway transportation due to the direct and short pathway to the Refuge. As opposed to other potential sources (e.g. silica sand mines) that rely on surface and groundwater pathways, which do not have direct connections to the Refuge under most conditions, railways and highways have direct connections because of their proximity (immediately adjacent) to the Refuge. The Refuge is bounded on three sides by railways and a state highway used to transport multiple goods including silica sands, crude oil, and grains. A train derailment or tractor-trailer crash could involve chemicals spills that could result in an immediate introduction of contaminants to the Refuge or into surface waters. Additionally, railways and highways can be a conduit for contaminants to enter surface waters through runoff events or groundwater through infiltration. Contaminants may include heavy metals (e.g. copper and lead), salts, or oils.

Silica sand mining has seen a substantial increase in the past decade in counties surrounding Trempealeau NWR. Normal mining practices at silica sand mines may introduce contaminants into the air, surface waters or ground water. “Fugitive dust particles” may be released during mining activities into the air. Wastewater maintained in storage ponds could be introduced into surface or ground waters if best management practices are not followed. In addition, contaminants could also enter surface or ground waters through unintended releases from storm water runoff, dewatering practices, and unintended reintroduction through wells. Contaminants of most concern are flocculants (e.g. DADMAC and polyacrylamide) used in the separation process.

Agricultural land use may also pose a risk for contaminants to enter surface or ground waters depending upon the land use practices being employed. Contaminants (e.g. nutrients, pesticides, and suspended sediments) can enter the surface waters following rain events if the

contaminant has recently been applied or they could enter the ground water following normal rain events or if the contaminants were over-applied. Best management practices (e.g. buffer strips, no tiles) can all reduce the risk from contaminants entering surface and ground waters.

The Refuge is located immediately across the river from Winona, MN and upstream of La Crosse, WI. Both cities have significant industrial development that releases contaminants into the air at minimal levels. The industries are monitored and permitted through the Environmental Protection Agency for the release of contaminants into the air. While individual businesses release minimal contaminant levels into the air, the cumulative impacts from all of the industries are unknown.

There are two rivers bordering the Refuge through which contamination of surface water from railways and highways, silica sand mines or agricultural practices may influence the Refuge. The Trempealeau River borders the eastern side of the Refuge emptying into Pool 6 of the Mississippi River which borders the southern side of the Refuge. Through the construction of the BNSFR dike, including closing the culverts and bridges that used to exist and construction of the barrier dikes that diverted the Trempealeau River, the Refuge wetlands became essentially isolated from the Mississippi and Trempealeau Rivers. However, there may be some exchange of water by way of seepage through the berms along both rivers. The Refuge also discharges into the Trempealeau River through a gravity controlled structure located in the Lower Diversion Dike. Additionally, water from the Trempealeau and Mississippi Rivers may enter the Refuge if there is significant flooding and the Lower Diversion Dike and the gates on the Marshland Road inlet structures are opened to equalize the pressure on the BNSFR dike. Influence from the Mississippi and Trempealeau Rivers as pathways of contaminant risk is currently not well understood.

In addition to the two rivers influence from groundwater is also not well understood. The surrounding bedrock and aquifer have characteristics that would suggest a high susceptibility to groundwater influence. The influence would most likely be in the form of groundwater discharge because of the Refuge's location along the Mississippi River. Rivers, especially those that are large in size, are often the areas where groundwater upwells back into the surface water system.

Understanding the hydrology of the Refuge is important to help understand what risks there are to the Refuge. Railway and highway transportation poses the most significant risk to the Trempealeau and Mississippi Rivers through the possibility of spills and the introduction of contaminants (e.g. salts, oils, and heavy metals) through runoff. Silica sand mines may introduce contaminants into the Trempealeau River through flooding events or runoff if best management practices are not employed. Additionally, the mines may introduce contaminants into the groundwater through unintended releases or if best management practices are not employed. The risk from the silica sand mines appears minimal as a majority of the mines are located a considerable distance upstream of the Trempealeau River. Any accidental contamination of the river would most likely be significantly diluted by the time it reaches the Refuge. Influence from groundwater contamination is unknown but expected to be minimal if mines are being implemented according to current regulatory practices. In the event a mine

does not employ best management practices, the ground and surface waters would be at a higher risk to contamination creating a higher risk to the Refuge. Agricultural land uses are also a contaminant source that does not appear to be a significant risk to the Refuge. Certain agricultural practices (e.g. nutrient and pesticide application) may introduce contaminants into the groundwater through infiltration or in surface waters of the Trempealeau or Mississippi Rivers. The types of agricultural land use (e.g. hay pastures, row crops, or animal feedlots) may also significantly affect the risk to the Refuge because of the amounts and types of contaminants that are used for each land use.

While all of these land uses may contaminant the Trempealeau or Mississippi Rivers or groundwater, the lack of understanding towards hydrologic connectivity between surface and ground waters to the Refuge limits the ability to fully determine risks to the Refuge. If there is no or limited connectivity to both rivers contamination in the rivers would pose a nominal risk to the Refuge. If there is significant connectivity between the Refuge and both rivers then any contamination of the rivers would pose a more significant risk to the Refuge. The same would be true for groundwater. An increase in connectivity would increase the risk to the Refuge if the groundwater was contaminated.

Presently, there is little sediment, water, and biota contaminant data available for Trempealeau NWR that would help evaluate if contaminants from the land uses are currently or have previously entered the Refuge system. Sediment samples were collected from three locations within the Refuge in 1991 and were tested for a suite of contaminants including heavy metals, PCBs, and organochlorine pesticides. The results, presented in Appendix A of the January 1994 Corps of Engineers Definite Project Report for the Trempealeau NWR HREP (USACE 1994), indicated that concentrations were low in the samples taken. In a July 2002 study by the USGS Upper Mississippi Environmental Sciences Center indicated that nitrogen concentrations were low relative to phosphorus concentrations in Refuge pools. There are no other known studies evaluating chemical contaminant levels in the Refuge.

Recommendations for further evaluations or actions include:

<u>Hydrologic Evaluation</u>

To address the data gaps pertaining to how surface and ground waters are entering the Refuge system this CAP recommends:

- A hydrologic evaluation for the Refuge to determine the primary source water supplies to the Refuge. A hydrologic evaluation could include:
    - Surface and/or groundwater monitoring (quantity and/or quality),
    - Bathymetry surveys,
    - Modeling, and/or
    - A water budget

When the location, timing, and magnitude of water sources on the Refuge are better understood the contaminant risks to the Refuge will be easier to identify and evaluate. The Water Resources Branch in the Division of Natural Resources and Conservation Planning will discuss options for a hydrologic evaluation with the Refuge Manager in the summer of 2016 to ensure data collected will benefit Refuge management needs.

Baseline Contaminant Evaluation

To address the data gaps pertaining to existing contaminant concentrations on the Refuge this CAP recommends:

- A baseline contaminant assessment for water and sediment be performed. The contaminant data currently available is dated (24 years old) or limited (nitrogen and phosphorus only). An assessment should include:
    - Strategic sampling at locations most likely to be impacted by contaminants (e.g. near railroad berms)
    - An analysis for contaminants most likely to be present and posing a risk to resources (e.g. heavy metals and current use pesticides)
    - An analysis in media most likely to be a pathway for exposure (e.g. sediments for benthic biota and water for pelagic biota).
- An assessment for contaminants associated with frac sand mines (DADMAC and acrylamide) in water samples.

Having a hydrologic evaluation completed prior to sampling is recommended to help identify areas to sample. However, an evaluation of legacy contaminants near railways and highways can be completed prior to a hydrological evaluation due to the immediate proximity of these sources as potential contaminant pathways. Information from a baseline contaminant assessment will be beneficial in identifying if there currently exists a risk to resources from contaminants and assist in applying mitigation strategies and restoration projects to address areas of contamination. Ecological Services can assist the Refuge in developing a sampling design to guide the collection of sediment, water, and/or biota samples for analysis of contaminants that may be present in the Refuge. Ecological Services can also assist in the evaluation of the resulting analytical data.

Spill Planning and Response

With the significant risk posed by spills to the Refuge this CAP recommends that the Trempealeau NWR continues to be involved with spill planning and response for the Upper Mississippi. The Environmental Protection Agency along with industry partners and response agencies including the U.S. Fish and Wildlife Service is preparing a Geographic Response Plan for Pools 5, 5a, and 6 of the Upper Mississippi River. The plan is expected to be completed by the spring of 2016. It will guide responders to important, sensitive environmental areas and improve timeliness and effectiveness of response efforts. The Service will recommend to the U.S. Environmental Protection Agency and the Upper Mississippi River Hazardous Spills Group (facilitated by the Upper Mississippi River Basin Association) that Trempealeau NWR be included in a spill response exercise scenario in order to further prepare emergency responders and resource managers to minimize spill-related impacts to Refuge resources in the event of a spill of oil or hazardous substances.

Exposure to Lead from Past Hunting Activities

Deer hunting is important for the Refuge to manage over-browsing and reduce disease while also being important for wildlife-dependent recreation. The Trempealeau NWR allows special gun hunts to help control deer numbers. In a study conducted by the USFWS (Warner et al., 2014), results indicated over a third of the bald eagles that were found dead in the Midwest Region had lead concentrations in livers consistent with lead poisoning and discarded offal piles

from deer shot with lead ammunition could potentially be the source of the lead exposure. In response, some Refuges will conduct a pilot program to encourage the use of non-lead shot for hunting. As a part of the monitoring the Refuge may consider studies evaluating potential lead exposure in pools, wetlands, and upland areas given the number of bald eagles that feed in the area.

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Appendix C: ROCSTAR Comprehensive list of species for Trempealeau NWR

The following table is a comprehensive list of species generated from the Trempealeau NWR ROCSTAR (Resources of Concern Selection Tool for America's Refuges; Salas and Pranckus 2015) Any species known to occur or that could reasonably occur on the Refuge *and* was included in any of the resources consulted was added to the comprehensive list. Please see section 3.3 for description of the selection process used to select the Resources of Concern (ROC). Please see the ServCat record 57138 for original and complete Trempeleau NWR ROCSTAR.

This large excel table is only included in the PDF version of this report.

Trempealeau NWR
ROCSTAR: Resources of Concern Selection Tool for Americas Refuges
Comprehensive List of Refuge Resources of Concern:

								T & E		SWAP	FWS					PIF	LCC	UMRGLR JV BIRD PLANS												
Common Name	*Scientific Name*	Taxa Group	Group/Order	Broad Habitat	Harvested species	CCP NWR Spp	Species documented in range	Fed T&E 2013	WI State T&E, 2015	WI SWAP, 2011	BCR 23 BCC	FWS R3 BCC 2012	FWS FY2012- FY2016 Focal Species	Regional Conserv. Priority List UMR GRL, 2002	PIF 16 Upper Great Lakes Plain, 2001	UMGL Surogate Spp 2014	UMRGLR JV All Bird Implementation Plan, 2007	UMRGLR JV/BCR 23 Priority Spp Waterbirds 2007	UMRGLR JV/BCR 23 Priority Spp Shorebird 2007	UMRGLR JV Priority Spp Landbird 2007	UMRGLR JV/BCR 23 Priority Spp Waterfowl 2007	ABC Watchlist 2007	INTERJURISDICTIONAL FISH, 2009	PARC	Xerces	Total Number of Plans	Ratio of inclusion	Global Rank	WI RANK
LANDBIRDS																														
Golden-winged warbler	*Vermivora chrysoptera*	Bird	Landbird	Shr		X	y		SC	X	X	X (f)	f	UMR	X (I)	Shr	X(f)			X (f)		Red				11	0.9	G4	S3S4B
Wood Thrush	*Hylocichla mustelina*	Bird	Landbird	For		X	y		SC	X		X	f	UMR	X (IIC)	For	X(f)			X (f)		Yellow				10	0.8	G5	S4B
Henslow's Sparrow	*Ammodramus henslowii*	Bird	Landbird	Gra		X	y		T	X	X	X (f)	f	UMR	X (I)	Gra	X(f)					Red				10	0.8	G4	S2S3B
Cerulean Warbler	*Setophaga cerulea*	Bird	Landbird	For		X	y		T	X		X	f	UMR	X (I)		X(f)			X (f)		Yellow				9	0.8	G4	S2S3B
Red-headed Woodpecker	*Melanerpes erythrocephalus*	Bird	Landbird	For, Gra		X	y		SC	X	X	X		UMR	X (I)		X(f)			X (f)		Yellow				9	0.8	G5	S3B
Canada Warbler	*Cardellina canadensis*	Bird	Landbird	Shr, For		X	y		SC	X	X	X		UMR	X	For	X(f)					Yellow				9	0.8	G5	S3S4B
Blue-winged Warbler	*Vermivora cyanoptera*	Bird	Landbird	Shr, For		X	y		SC	X	X	X		UMR	X (I)		X(f)			X (f)		Yellow				9	0.8	G5	S4B
Prothonotary Warbler	*Prothonotary citrea*	Bird	Landbird	For, Rip		X	y		SC	X		X		UMR	X (I)		X(f)			X (f)		Yellow				8	0.7	G5	S3B
Bobolink	*Dolichonyx orizivorus*	Bird	Landbird	Gra		X	y		SC	X	X	X	f	UMR	X (I)	Gra										8	0.7	G5	S3S4B
Short-eared Owl	*Asio flammeus*	Bird	Landbird	Gra		X	y		SC	X	X (nb)	X		UMR	X (IIC)		X			X						8	0.7	G5	S1B
Bell's Vireo	*Vireo bellii*	Bird	Landbird	Gra, Shr		X	y		T	X		X		UMR	X (I)		X			X		Red				8	0.7	G5	S2B
Olive-sided Flycatcher	*Contopus cooperi*	Bird	Landbird	For		X	y		SC	X		X		UMR			X(f)			X (f)		Yellow				7	0.6	G4	S2B
Louisiana Waterthrush	*Parkesia motacilla*	Bird	Landbird	For, Rip		X	y		SC	X		X		UMR	X (IIC)		(f, h)			X (f)						7	0.6	G5	S3B
Dickcissel	*Spiza americana*	Bird	Landbird	Gra		X	y		SC	X	X	X		UMR	X (I)		X									7	0.6	G5	S3B
Rusty Blackbird	*Euphagus carolinus*	Bird	Landbird	Pal, Rip		X	y		SC	X	X (nb)	X	f	UMR								Yellow				7	0.6	G4	SNA
Willow Flycatcher	*Empidonax traillii*	Bird	Landbird	Pal, Shr		X	y		SC	X	X (ss)	X			X		X(f)					Yellow (SW sp)				7	0.6	G5	S4B
Kirtland's Warbler	*Setophaga kirtlandii*	Bird	Landbird	Shr			y	E	E	X		E					X(f)			X (f)		Red				7	0.6	G1	S1B
Eastern Whip-poor-will	*Antrostomus vociferus*	Bird	Landbird	For		X	y		SC	X		X		UMR	X		(f, h)									6	0.5		
Black-billed Cuckoo	*Coccyzus erythropthalmus*	Bird	Landbird	For		X	y		SC	X	X	X		UMR	X (I)											6	0.5	G5	S3S4B
Kentucky Warbler	*Geothlypis formosus*	Bird	Landbird	For			y		T	X		X			X (I)		X(f)					Red/Y				6	0.5	G5	S1S2?B
Bald Eagle	*Haliaeetus leucocephalus*	Bird	Landbird	For, Rip		X	y		SC	X	X (d)	X (f)	f	UMR												6	0.5	G5	S4B,S4N
Le Conte's Sparrow	*Ammodramus leconteii*	Bird	Landbird	Pal, Gra		X	y		SC	X		X		UMR		Pal						Yellow				6	0.5	G4	S2S3B
Peregrine Falcon	*Falco peregrinus*	Bird	Landbird	Rip		X	y		E	X	X (d)	X		UMR	X											6	0.5	G4	S1S2B
Brown Thrasher	*Toxostoma rufum*	Bird	Landbird	Shr		X	y		SC	X	X	X			X (IIA)	Shr										6	0.5	G5	S3S4B
Worm-eating Warbler	*Helmitheros vermivorum*	Bird	Landbird	For			y		E	X		X		UMR			X									5	0.4	G5	S1B
Connecticut Warbler	*Oporornis agilis*	Bird	Landbird	For			y		SC	X				UMR			(f, h)			X (f)						5	0.4	G4	S2S3B
Acadian Flycatcher	*Empidonax virescens*	Bird	Landbird	For, Rip			y		T	X		X		UMR	X (I)											5	0.4	G5	S3B
Field Sparrow	*Spizella pusilla*	Bird	Landbird	Gra		X	y		SC	X		X		UMR	X (I)											5	0.4	G5	S3S4B
Eastern Meadowlark	*Sturnella magna*	Bird	Landbird	Gra		X	y		SC	X				UMR		Gra	(f, h)									5	0.4	G5	S3S4B
Loggerhead Shrike	*Lanius ludovicianus*	Bird	Landbird	Gra, Shr		X	y		E	X		X		UMR	X											5	0.4	G4	S1B
Black-throated Blue Warbler	*Setophaga caerulescens*	Bird	Landbird	For		X	y		SC	X							(f, h)			X (f)						4	0.3	G5	S3B
Veery	*Catharus fuscescens*	Bird	Landbird	For		X	y		SC	X							(f, h)			X (f)						4	0.3	G5	S3S4B
Red-shouldered Hawk	*Buteo lineatus*	Bird	Landbird	For, Rip, Riv		X	y		T	X				UMR	Rip & Riv											4	0.3	G5	S3S4B,S1N
Northern Harrier	*Circus cyaneus*	Bird	Landbird	Pal, Gra		X	y		SC	X				UMR	X (IIC)											4	0.3	G5	S3B,S2N
Nelson's Sparrow	*Ammodramus nelsoni*	Bird	Landbird	Pal, Gra			y		SC	X		X										Yellow				4	0.3	G5	S1B
Barn Owl	*Tyto alba*	Bird	Landbird	Dev, For, Gra			y		SC	X				UMR												3	0.3	G5	SNA
Northern Goshawk	*Accipiter gentilis*	Bird	Landbird	For		X	y		SC	X				UMR												3	0.3	G5	S2B,S2N
Yellow-billed Cuckoo	*Coccyzus americanus*	Bird	Landbird	For		X	y		SC	X					X											3	0.3	G5	S3B
Hooded Warbler	*Setophaga citrina*	Bird	Landbird	For			y		T	X					X											3	0.3	G5	S2S3B
Western Meadowlark	*Sturnella neglecta*	Bird	Landbird	Gra		X	y		SC	X				UMR												3	0.3	G5	S2B
Northern Bobwhite	*Colinus virginianus*	Bird	Landbird	Gra, Shr	X	X	y		SC	X					X											3	0.3	G5	S2S3B
Red Crossbill	*Loxia curvirostra*	Bird	Landbird	For			y		SC	X																2	0.2	G5	S2?B
Yellow-throated Warbler	*Setophaga dominica*	Bird	Landbird	For		X	y?		E	X																2	0.2	G5	S1?B
Spruce Grouse	*Falcipennis canadensis*	Bird	Landbird	For	X		y		T	X																2	0.2	G5	S2B,S1S2
Least Flycatcher	*Empidonax minimus*	Bird	Landbird	For		X	y		SC	X																2	0.2	G5	S4B
Osprey	*Pandion haliaetus*	Bird	Landbird	For, Rip		X	y		SC	X																2	0.2	G5	S4B
Lark Sparrow	*Chondestes grammacus*	Bird	Landbird	Gra		X	y		SC	X																2	0.2	G5	S3B
Vesper Sparrow	*Pooecetes gramineus*	Bird	Landbird	Gra		X	y		SC	X																2	0.2	G5	S3S4B
Sharp-tailed Grouse	*Tympanuchus phasianellus*	Bird	Landbird	Gra			y		SC	X																2	0.2	G4	S1B,S2N
Greater Prairie-Chicken	*Tympanuchus cupido*	Bird	Landbird	Gra			no?		T	X					X (I)		X(f)			X (f)		Red				6	0.5	G4	S1B,S2N
Grasshopper Sparrow	*Ammodramus savannarum*	Bird	Landbird	Gra			y		SC			X	f	UMR	X											5	0.4	G5	S3B

								T & E		SWAP	FWS				PIF	LCC	UMRGLR JV BIRD PLANS												
Common Name	*Scientific Name*	Taxa Group	Group/Order	Broad Habitat	Harvested species	CCP NWR Spp	Species documented in range	Fed T&E 2013	WI State T&E, 2015	WI SWAP, 2011	BCR 23 BCC	FWS R3 BCC 2012	FWS FY2012- FY2016 Focal Species	Regional Conserv. Priority List UMR GRL, 2002	PIF 16 Upper Great Lakes Plain, 2001	UMGL Surogate Spp 2014	UMRGLR JV All Bird Implementation Plan, 2007	UMRGLR JV/BCR 23 Priority Spp Waterbirds 2007	UMRGLR JV/BCR 23 Priority Spp Shorebird 2007	UMRGLR JV Priority Spp Landbird 2007	UMRGLR JV/BCR 23 Priority Spp Waterfowl 2007	ABC Watchlist 2007	INTERJURISDICTIONAL FISH, 2009	PARC	Xerces	Total Number of Plans	Ratio of inclusion	Global Rank	WI RANK
Yellow-breasted Chat	*Icteria virens*	Bird	Landbird	Shr		X	y		SC						X		(f, h)			X (f)						4	0.3	G5	S2B
Painted Bunting	*Passerina ciris*	Bird	Landbird	Shr, For			no?					X	f									Yellow				3	0.3		
Prairie Warbler	*Setophaga discolor*	Bird	Landbird	Gra			y?					X		UMR								Yellow				3	0.3	G5	
Cape May Warbler	*Setophaga tigrina*	Bird	Landbird	For		X	y		SC								(f, h)			X (f)						3	0.3	G5	S3B
Northern Flicker	*Colaptes auratus*	Bird	Landbird	Gra, For		X	y					X		UMR		Gra										3	0.3		
Marsh Wren	*Cistothorus palustris*	Bird	Landbird	Pal		X	y				X	X			X (IIC)											3	0.3	G5	
Sedge Wren	*Cistothorus platensis*	Bird	Landbird	Pal		X	y					X		UMR	X (IIC)											3	0.3		
Bewick's Wren (bewickii ssp.)	*Thryomanes bewickii bewickii*	Bird	Landbird	Shr, For			no					X		UMR	X											3	0.3		
Swainson's Hawk	*Buteo swainsoni*	Bird	Landbird	Gra		X	y					X		UMR												2	0.2		
Baird's Sparrow	*Ammodramus bairdii*	Bird	Landbird	Gra			no					X										Red				2	0.2		
Chestnut-collared Longspur	*Calcarius ornatus*	Bird	Landbird	Gra			no?					X										Yellow				2	0.2		
Smith's Longspur	*Calcarius pictus*	Bird	Landbird	Gra			no?					X										Yellow				2	0.2		
Bachman's Sparrow	*Peucaea aestivalis*	Bird	Landbird	Gra			no					X										Red				2	0.2	G3	
Orchard Oriole	*Icterus spurius*	Bird	Landbird	Gra, Shr		X	y					X		UMR												2	0.2		
Boreal Chickadee	*Poecile hudsonicus*	Bird	Landbird	For			no?		SC	X																2	0.2	G5	S2S3B
Swainson's Warbler	*Limnothlypis swainsonii*	Bird	Landbird	For			no?					X		UMR												2	0.2		
Bay-breasted Warbler	*Setophaga castanea*	Bird	Landbird	For		X	y										X			X						2	0.2		
Long-eared Owl	*Asio otus*	Bird	Landbird	Gra, For		X	y		SC					UMR												2	0.2	G5	S2B
Chimney Swift	*Chaetura pelagica*	Bird	Landbird	Dev, For		X	y										(f, h)									1	0.1		
Common Nighthawk	*Chordeiles minor*	Bird	Landbird	Dev, Gra		X	y		SC																	1	0.1	G5	S2S3B
Swamp Sparrow	*Melospiza georgiana*	Bird	Landbird	Pal		X	y								X (IIA)											1	0.1		
Merlin	*Falco columbarius*	Bird	Landbird	For, Gra		X	y		SC																	1	0.1	G5	S3B, S2N
Evening Grosbeak	*Coccothraustes verpertinus*	Bird	Landbird	For		X	y		SC																	1	0.1	G5	S2S3B
White-winged Crossbill	*Loxia leucoptera*	Bird	Landbird	For			y		SC																	1	0.1	G5	SU
Purple Martin	*Progne subis*	Bird	Landbird	Pal, Rip		X	y		SC																	1	0.1	G5	S2S3B
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	Bird	Landbird	Gra, Rip		X	y								X (IIA)											1	0.1		
Baltimore Oriole	*Icterus galbula*	Bird	Landbird	For		X	y								X											1	0.1		
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	Bird	Landbird	Pal		X	y		SC																	1	0.1	G5	S3
Sprague's Pipit	*Anthus spragueii*	Bird	Landbird	Gra			no?						f													1	0.1		
Wilson's Warbler	*Cardellina pusilla*	Bird	Landbird	Shr, For			y		SC																	1	0.1	G5	SUB
Mourning Warbler	*Oporornis philadelphia*	Bird	Landbird	Shr, Rip		X	y								X											1	0.1		
Pine Warbler	*Setohoaga pinus*	Bird	Landbird	For			y									For										1	0.1		
Blackburnian Warbler	*Setophaga fusca*	Bird	Landbird	For		X	y								X											1	0.1		
Ruby-crowned Kinglet	*Regulus calendula*	Bird	Landbird	For		X	y		SC																	1	0.1	G5	S2S3B
Burrowing Owl	*Athene cunicularia*	Bird	Landbird	Gra			no?						f													1	0.1		
Great Gray Owl	*Strix nebulosa*	Bird	Landbird	For			y		SC																	1	0.1	G5	SNA
Swainson's Thrush	*Catharus ustulatus*	Bird	Landbird	For		X	y		SC																	1	0.1	G5	S2B
Yellow-bellied Flycatcher	*Empidonax flaviventris*	Bird	Landbird	For, Rip			y		SC																	1	0.1	G5	S3S4B
Yellow-throated Vireo	*Vireo flavifrons*	Bird	Landbird	For		X	y								X											1	0.1		
White-eyed Vireo	*Vireo griseus*	Bird	Landbird	Shr			y								X											1	0.1		
Philadelphia Vireo	*Vireo philadelphicus*	Bird	Landbird	For		X	y		SC																	1	0.1	G5	SUB
Cooper's Hawk	*Accipiter cooperii*	Bird	Landbird	For		X	y																			0	0.0		
Sharp-shinned Hawk	*Accipiter striatus*	Bird	Landbird	For		X	y																			0	0.0		
Golden Eagle	*Aquila chrysaetos*	Bird	Landbird	For, Gra		X	y																			0	0.0		
Red-tailed Hawk	*Buteo jamaicensis*	Bird	Landbird	Gra		X	y																			0	0.0		
Rough-legged Hawk	*Buteo lagopus*	Bird	Landbird	Gra		X	y																			0	0.0		
Broad-winged Hawk	*Buteo platypterus*	Bird	Landbird	For		X	y																			0	0.0		
Horned Lark	*Eremophila alpestris*	Bird	Landbird	Dev, Gra		X	y																			0	0.0		
Belted Kingfisher	*Ceryl alcyon*	Bird	Landbird	Rip		X	y																			0	0.0		
Cedar Waxwing	*Bombycilla cedrorum*	Bird	Landbird	Shr		X	y																			0	0.0		
Bohemian Waxwing	*Bombycilla garrulus*	Bird	Landbird	Shr		X	y																			0	0.0		
Northern Cardinal	*Cardinalis cardinalis*	Bird	Landbird	Dev, Shr		X	y																			0	0.0		
Indigo Bunting	*Passerina cyanea*	Bird	Landbird	Shr		X	y																			0	0.0		
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	Bird	Landbird	For		X	y																			0	0.0		
Turkey Vulture	*Cathartes aura*	Bird	Landbird	For, Gra		X	y																			0	0.0		

								T & E		SWAP	FWS				PIF	LCC	UMRGLR JV BIRD PLANS													
Common Name	*Scientific Name*	Taxa Group	Group/Order	Broad Habitat	Harvested species	CCP NWR Spp	Species documented in range	Fed T&E 2013	WI State T&E, 2015	WI SWAP, 2011	BCR 23 BCC	FWS R3 BCC 2012	FWS FY2012- FY2016 Focal Species	Regional Conserv. Priority List UMR GRL, 2002	PIF 16 Upper Great Lakes Plain, 2001	UMGL Surogate Spp 2014	UMRGLR JV All Bird Implementation Plan, 2007	UMRGLR JV/BCR 23 Priority Spp Waterbirds 2007	UMRGLR JV/BCR 23 Priority Spp Shorebird 2007	UMRGLR JV Priority Spp Landbird 2007	UMRGLR JV/BCR 23 Priority Spp Waterfowl 2007	ABC Watchlist 2007	INTERJURISDICTIONAL FISH, 2009	PARC	Xerces	Total Number of Plans	Ratio of inclusion	Global Rank	WI RANK
Brown Creeper	*Certhia americana*	Bird	Landbird	For		X	y																			0	0.0		
Rock Pigeon	*Columba livia*	Bird	Landbird	Dev		X	y																			0	0.0		
American Crow	*Corvus brachyrhynchos*	Bird	Landbird	Dev, For, Shr	X	X	y																			0	0.0		
Common Raven	*Corvus corax*	Bird	Landbird	For		X	y																			0	0.0		
Blue Jay	*Cyanocitta cristata*	Bird	Landbird	For		X	y																			0	0.0		
Mourning Dove	*Zenaida macroura*	Bird	Landbird	Dev, Shr	X	X	y																			0	0.0		
Lapland Longspur	*Calcarius lapponicus*	Bird	Landbird	Gra		X	y																			0	0.0		
Dark-eyed junco	*Junco hyemalis*	Bird	Landbird	Gra, Shr		X	y																			0	0.0		
Song Sparrow	*Melospiza melodia*	Bird	Landbird	Gra, Shr		X	y																			0	0.0		
Savannah Sparrow	*Passerculus sandwichensis*	Bird	Landbird	Gra		X	y																			0	0.0		
Fox Sparrow	*Passerella iliaca*	Bird	Landbird	For, Shr		X	y																			0	0.0		
Eastern Towhee	*Pipilo erythrophthalmus*	Bird	Landbird	Gra, Shr		X	y																			0	0.0		
Snow Bunting	*Plectrophenax nivalis*	Bird	Landbird			X	y																			0	0.0		
American Tree Sparrow	*Spizella arborea*	Bird	Landbird	Gra, Shr		X	y																			0	0.0		
Clay-colored Sparrow	*Spizella pallida*	Bird	Landbird	Gra, Shr		X	y																			0	0.0		
Chipping Sparrow	*Spizella passerina*	Bird	Landbird	Gra, Shr		X	y																			0	0.0		
White-throated Sparrow	*Zonotrichia albicollis*	Bird	Landbird	Shr		X	y																			0	0.0		
White-crowned Sparrow	*Zonotrichia leucophrys*	Bird	Landbird	Shr		X	y																			0	0.0		
American Kestrel	*Falco sparverius*	Bird	Landbird	Gra		X	y																			0	0.0		
Common Redpoll	*Carduelis flammea*	Bird	Landbird	Gra, Shr		X	y																			0	0.0		
Hoary Redpoll	*Carduelis hornemanni*	Bird	Landbird	Gra, Shr		X	y																			0	0.0		
Pine Siskin	*Carduelis pinus*	Bird	Landbird	For, Shr		X	y																			0	0.0		
American Goldfinch	*Carduelis tristis*	Bird	Landbird	Gra, Shr		X	y																			0	0.0		
Purple Finch	*Carpodacus purpureus*	Bird	Landbird	Shr		X	y																			0	0.0		
Pine Grosbeak	*Pinicola enucleator*	Bird	Landbird	For		X	y																			0	0.0		
Cliff Swallow	*Hirundo pyrrhonota*	Bird	Landbird	Rip		X	y																			0	0.0		
Barn Swallow	*Hirundo rustica*	Bird	Landbird	Dev, Gra, Rip		X	y																			0	0.0		
Bank Swallow	*Riparia riparia*	Bird	Landbird	Rip		X	y																			0	0.0		
Tree Swallow	*Tachycineta bicolor*	Bird	Landbird	Rip		X	y																			0	0.0		
Red-winged Blackbird	*Agelaius phoeniceus*	Bird	Landbird	Gra, Pal		X	y																			0	0.0		
Brewer's Blackbird	*Euphagus cyanocephalus*	Bird	Landbird	Gra, Pal		X	y																			0	0.0		
Brown-headed Cowbird	*Molthrus ater*	Bird	Landbird	Dev, For, Shr		X	y																			0	0.0		
Common Grackle	*Quiscalus quiscula*	Bird	Landbird	Dev, For, Shr		X	y																			0	0.0		
Northern Shrike	*Lanius excubitor*	Bird	Landbird	Gra, Shr		X	y																			0	0.0		
Gray Catbird	*Dumetella carolinensis*	Bird	Landbird	Shr		X	y																			0	0.0		
Northern Mockingbird	*Mimus polyglottos*	Bird	Landbird	Shr		X	y																			0	0.0		
American Pipit	*Anthus rubescens*	Bird	Landbird	Gra		X	y																			0	0.0		
Tufted Titmouse	*Baeolophus bicolor*	Bird	Landbird	For		X	y																			0	0.0		
Black-capped Chickadee	*Parus atricapillus*	Bird	Landbird	For, Shr		X	y																			0	0.0		
Common Yellowthroat	*Geothlypis trichas*	Bird	Landbird	Gra, Pal		X	y																			0	0.0		
Black and White Warbler	*Mniotilta varia*	Bird	Landbird	For		X	y																			0	0.0		
Northern Parula	*Parula americana*	Bird	Landbird	For		X	y																			0	0.0		
Ovenbird	*Seiurus aurocapilla*	Bird	Landbird	For		X	y																			0	0.0		
Northern Waterthrush	*Seiurus noveboracensis*	Bird	Landbird	For, Rip		X	y																			0	0.0		
Yellow Warbler	*Setohoaga petechia*	Bird	Landbird	Rip, Shr		X	y																			0	0.0		
Yellow-rumped Warbler	*Setophaga coronata*	Bird	Landbird	For, Rip, Shr		X	y																			0	0.0		
Magnolia Warbler	*Setophaga magnolia*	Bird	Landbird	For		X	y																			0	0.0		
Palm Warbler	*Setophaga palmarum*	Bird	Landbird	For, Gra		X	y																			0	0.0		
Chestnut-sided Warbler	*Setophaga pensylvanica*	Bird	Landbird	For, Rip, Shr		X	y																			0	0.0		
American Redstart	*Setophaga ruticilla*	Bird	Landbird	For		X	y																			0	0.0		
Blackpoll Warbler	*Setophaga striata*	Bird	Landbird	For		X	y																			0	0.0		
Black-throated Green Warbler	*Setophaga virens*	Bird	Landbird	For		X	y																			0	0.0		
Bachman's Warbler	*Vermivora bachmanii*	Bird	Landbird	For			no?																			0	0.0		
Tennessee warbler	*Vermivora peregrina*	Bird	Landbird	For		X	y																			0	0.0		
Nashville Warbler	*Vermivora ruficapilla*	Bird	Landbird	For		X	y																			0	0.0		

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Ruffed Grouse	*Bonasa umbellus*	Bird	Landbird	For, Shr	X	X	y																			0	0.0		
Wild Turkey	*Meleagris gallopava*	Bird	Landbird	For, Shr	X	X	y																			0	0.0		
Ring-necked Pheasant	*Phasianus colchicus*	Bird	Landbird	Gra		X	y																			0	0.0		
Pileated Woodpecker	*Dryocopus pileatus*	Bird	Landbird	For		X	y																			0	0.0		
Red-bellied Woodpecker	*Melanerpes carolinus*	Bird	Landbird	For		X	y																			0	0.0		
Black-backed Woodpecker	*Picoides arcticus*	Bird	Landbird	For			no?																			0	0.0	G5	
Downy Woodpecker	*Picoides pubescens*	Bird	Landbird	For		X	y																			0	0.0		
Yellow-bellied Sapsucker	*Sphyrapicus varius*	Bird	Landbird	For		X	y																			0	0.0		
Golden-crowned Kinglet	*Regulus satrapa*	Bird	Landbird	For, Shr		X	y																			0	0.0		
Red-breasted Nuthatch	*Sitta canadensis*	Bird	Landbird	For		X	y																			0	0.0		
White-breasted Nuthatch	*Sitta carolinensis*	Bird	Landbird	For		X	y																			0	0.0		
Northern Saw-whet Owl	*Aegolius acadicus*	Bird	Landbird	For		X	y																			0	0.0		
Boreal Owl	*Aegolius funereus*	Bird	Landbird	For			no?																			0	0.0		
Great-horned Owl	*Bubo virginianus*	Bird	Landbird	For, Gra		X	y																			0	0.0		
Barred Owl	*Falco sparverius*	Bird	Landbird	For, Gra		X	y																			0	0.0		
Snowy Owl	*Nyctea scandica*	Bird	Landbird	Gra		X	y																			0	0.0		
Eastern Screech Owl	*Otus asio*	Bird	Landbird	For		X	y																			0	0.0		
European Starling	*Strunus vulgaris*	Bird	Landbird	Dev		X	y																			0	0.0		
Blue-gray Gnatcatcher	*Polioptila caerulea*	Bird	Landbird	For		X	y																			0	0.0		
Scarlet Tanager	*Piranga olivacea*	Bird	Landbird	For		X	y																			0	0.0		
Ruby-throated Hummingbird	*Archilochus colubris*	Bird	Landbird	For, Gra		X	y																			0	0.0		
House Wren	*Troglodytes aedon*	Bird	Landbird	Dev, For, Shr		X	y																			0	0.0		
Winter Wren	*Troglodytes troglodytes*	Bird	Landbird	For		X	y																			0	0.0		
Hermit Thrush	*Catharus guttatus*	Bird	Landbird	For		X	y																			0	0.0		
Gray-cheeked Thrush	*Catharus minimus*	Bird	Landbird	For		X	y																			0	0.0		
Eastern Bluebird	*Sialisa sialis*	Bird	Landbird	Gra, Shr		X	y																			0	0.0		
American Robin	*Turdus migratorius*	Bird	Landbird	Dev, For, Gra		X	y																			0	0.0		
Eastern Wood-pewee	*Contopus virens*	Bird	Landbird	For		X	y																			0	0.0		
Alder Flycatcher	*Empidonax alnorum*	Bird	Landbird	For, Rip		X	y																			0	0.0		
Great Crested Flycatcher	*Myiarchus citrinus*	Bird	Landbird	For, Rip		X	y																			0	0.0		
Eastern Phoebe	*Sayornis phoebe*	Bird	Landbird	Dev, For, Rip		X	y																			0	0.0		
Eastern Kingbird	*Tyrannus tyrannus*	Bird	Landbird	Gra, Rip, Shr		X	y																			0	0.0		
Western Kingbird	*Tyrannus verticalis*	Bird	Landbird	Gra, Rip, Shr			no?																			0	0.0		
Warbling Vireo	*Vireo gilvus*	Bird	Landbird	For		X	y																			0	0.0		
Red-eyed Vireo	*Vireo olivaceus*	Bird	Landbird	For		X	y																			0	0.0		
Blue-headed Vireo	*Vireo solitarius*	Bird	Landbird	For		X	y																			0	0.0		
WATERBIRDS																													
Black Rail	*Laterallus jamaicensis*	Bird	Waterbird	Pal			no					X	f	UMR	X (I)		X	m				Red				7	0.6		
Least Bittern	*Ixobrychus exilis*	Bird	Waterbird	Pal		X	y		SC			X		UMR			X	b/m								5	0.4	G5	S2S3B
Black-crowned Night-heron	*Nycticorax nycticorax*	Bird	Waterbird	Pal, Rip		X	y		SC			X		UMR			X(f)	b/w								5	0.4	G5	S2B
Black Tern	*Chlidonias niger*	Bird	Waterbird	Riv, Lac, Pal		X	y		E	X	X	X	f	UMR	X (IIC)	Pal	X(f)	b								10	0.8	G4	S2B
Whooping Crane	*Grus americana*	Bird	Waterbird	Pal			y	NEP	SC	X		E		UMR	X (I)		X	M				Red				9	0.8	G1	SXB
Yellow Rail	*Coturnicops noveboracensis*	Bird	Waterbird	Pal			y		T	X	X	X	f	UMR			X(f)	B/m				Red				9	0.8	G4	S1B
King Rail	*Rallus elegans*	Bird	Waterbird	Pal		X	y		SC	X		X (f)	f	UMR	X		X(f)	b				Yellow				9	0.8	G4	S1B
Common Tern	*Sterna hirundo*	Bird	Waterbird	Riv, Lac, Bar		X	y		E	X	X	X	akes pc	UMR		Lac	X (f)	b/m								9	0.8	G5	S1B,S2N
American Bittern	*Botaurus lentiginosus*	Bird	Waterbird	Pal		X	y		SC	X	X	X		UMR			X	b								7	0.6	G4	S3B
Forster's Tern	*Sterna forsteri*	Bird	Waterbird	Lac		X	y		E	X				UMR	X			b/m								5	0.4	G5	S1B
Horned Grebe	*Podiceps auritus*	Bird	Waterbird	Riv, Lac		X	y		SC	X	X (nb)	X						M								5	0.4	G5	S4N
Yellow-crowned Night-heron	*Nyctanassa violacea*	Bird	Waterbird	Pal		X	y		T	X							X	b/m								4	0.3	G5	S1B
Great Egret	*Ardea alba*	Bird	Waterbird	Pal		X	y		T	X								b/m								3	0.3	G5	S2B
Snowy Egret	*Egretta thula*	Bird	Waterbird	Pal		X	y?		SC	X								b/m								3	0.3	G5	SNA
Red-necked Grebe	*Podiceps grisegena*	Bird	Waterbird	Riv, Lac		X	y?		E	X								B/m								3	0.3	G5	S1B
Caspian Tern	*Hydroprogne caspia*	Bird	Waterbird	Riv, Lac, Bar		X	y		E	X								b/m								3	0.3	G5	S1B,S2N
Common Loon	*Gavia immer*	Bird	Waterbird	Riv, Lac		X	y		SC					UMR		Lac		B/M								4	0.3	G5	S3S4B
Pied-billed Grebe	*Podilymbus podiceps*	Bird	Waterbird	Lac, Pal		X	y				X	X					X	B								4	0.3		

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American White Pelican	*Pelecanus erythrorhynchos*	Bird	Waterbird	Riv, Lac, Pal		X	y		SC						X			b/m								3	0.3	G4	S3B
Common Moorhen	*Gallinula chloropus*	Bird	Waterbird	Pal	X	X	y		SC					UMR				B/m								3	0.3	G5	S3
Great Blue Heron	*Ardea herodias*	Bird	Waterbird	Pal, Rip		X	y		SC									b/w								2	0.2	G5	S4B
Thayer's Gull	*Larus glaucoides*	Bird	Waterbird	Riv, Lac			y?											w				Yellow				2	0.2		
Great Black-backed Gull	*Larus marinus*	Bird	Waterbird	Lac, Dev			y?		SC									w								2	0.2	G5	SNA
Least Tern, Interior	*Sternula antillarum*	Bird	Waterbird	Riv, Bar		X	y?					E										Red				2	0.2		
Double-crested Cormorant	*Phalacrocorax auritus*	Bird	Waterbird	Riv, Lac		X	y							UMR				B/w/M								2	0.2		
Western Grebe	*Aechmophorus occidentalis*	Bird	Waterbird	Riv, Lac		X	y?		SC									b/m								2	0.2	G5	SNA
American Coot	*Fulica americana*	Bird	Waterbird	Riv, Lac, Pal	X	X	y		SC									B/m								2	0.2	G5	S3S4B
Sora	*Porzana carolina*	Bird	Waterbird	Pal	X	X	y										X	B/m								2	0.2	G5	
Cattle Egret	*Bubulcus ibis*	Bird	Waterbird	Dev, Gra		X	y?											b/m								1	0.1		
Green Heron	*Butorides virescens*	Bird	Waterbird	Pal, Rip		X	y											b								1	0.1		
Little Blue Heron	*Egretta caerulea*	Bird	Waterbird	Pal		X	y?											b/m								1	0.1		
Red-throated Loon	*Gavia stellata*	Bird	Waterbird	Riv, Lac		X	no?											m								1	0.1		
Sandhill Crane	*Grus canadensis*	Bird	Waterbird	Pal		X	y											B/M								1	0.1		
Herring Gull	*Larus argentatus*	Bird	Waterbird	Riv, Lac, Dev		X	y											b/w/m								1	0.1		
Ring-billed Gull	*Larus delawarensis*	Bird	Waterbird	Riv, Lac, Dev		X	y											B/w								1	0.1		
Iceland Gull	*Larus glaucoides*	Bird	Waterbird	Riv, Lac			y?											w								1	0.1		
Glaucous Gull	*Larus hyperboreus*	Bird	Waterbird	Lac, Dev			y?											w								1	0.1		
Bonaparte's Gull	*Larus philadelphia*	Bird	Waterbird	Riv, Lac		X	y											w/m								1	0.1		
Franklin's Gull	*Leucophaeus pipixcan*	Bird	Waterbird	Pal		X	y											m								1	0.1		
Parasitic Jaeger	*Stercorarius parasiticus*	Bird	Waterbird	Lac		X	y?											m								1	0.1		
Sabine's Gull	*Xema sabini*	Bird	Waterbird	Riv, Lac			y?											m								1	0.1		
Eared Grebe	*Podiceps nigricollis*	Bird	Waterbird	Riv, Lac, Pal			y											b								1	0.1		
Virginia Rail	*Rallus limicola*	Bird	Waterbird	Pal	X	X	y											B/m								1	0.1		
Lesser Black-backed Gull	*Larus fuscus*	Bird	Waterbird	Lac, Dev			y?																			0	0.0		
White-faced Ibis	*Plegadis chihi*	Bird	Waterbird	Lac, Pal		X	y																			0	0.0		
Glossy Ibis	*Plegadis falcinellus*	Bird	Waterbird	Lac, Pal		X	y																			0	0.0		
White Ibis	*Plegadis falcinellus*	Bird	Waterbird	Lac, Pal		X	y																			0	0.0		
WATERFOWL																													
American Black Duck	*Anas rubripes*	Bird	Waterfowl	Pal	X	X	y		SC				f		X (IIC)		X(f)				b/N					5	0.4	G5	S2S3
Lesser Scaup	*Aythya affinis*	Bird	Waterfowl	Riv, Lac	X	X	y		SC	X			f	UMR		Lac	X(f)				N					7	0.6	G5	S3N
Trumpeter Swan	*Cygnus buccinator*	Bird	Waterfowl	Riv, Lac, Pal		X	y		SC	X				UMR	X (I)						B/N	Yellow				6	0.5	G4	S4B
Redhead	*Aythya americana*	Bird	Waterfowl	Riv, Lac	X	X	y		SC	X					X (IIC)		X (s)				b/N					5	0.4	G5	S2B
Wood Duck	*Aix sponsa*	Bird	Waterfowl	Pal, For, Rip, Riv	X	X	y							UMR	Rip & Riv		(f, h)				B/n					4	0.3		
Blue-winged Teal	*Anas discors*	Bird	Waterfowl	Lac, Riv, Pal	X	X	y		SC							Pal	X (f, s)				B/N					4	0.3	G5	S3S4B
Mallard	*Anas platyrhynchos*	Bird	Waterfowl	Pal, Gra	X	X	y							UMR		Pal	X (f, s)				B/N					4	0.3		
Canvasback	*Aythya valisineria*	Bird	Waterfowl	Riv, Lac	X	X	y		SC	X				UMR			X(f)				N					5	0.4	G5	S2N
Northern Pintail	*Anas acuta*	Bird	Waterfowl	Pal	X	X	y						f				X				n					3	0.3		
Canada Goose, Miss Flyway	*Branta canadensis*	Bird	Waterfowl	Riv, Lac, Dev	X	X	y							UMR			X				B/N					3	0.3		
Common Goldeneye	*Bucephala clangula*	Bird	Waterfowl	Riv, Lac	X	X	y		SC								X (s)				N					3	0.3	G5	S2S3?B
American Wigeon	*Anas americana*	Bird	Waterfowl	Lac, Riv, Pal	X	X	y										X (s)				n					2	0.2		
Greater Scaup	*Aythya marila*	Bird	Waterfowl	Lac	X	X	y						f								N					2	0.2		
Hooded Merganser	*Lophodytes cucullatus*	Bird	Waterfowl	Riv, Lac, Pal, Rip	X	X	y								X						N					2	0.2		
Ruddy Duck	*Oxyura jamaicensis*	Bird	Waterfowl	Riv, Lac, Pal	X	X	y		SC												B/N					2	0.2	G5	S2N, S3B
Green-winged Teal	*Anas crecca*	Bird	Waterfowl	Pal	X	X	y														b/n					1	0.1		
Gadwall	*Anas strepera*	Bird	Waterfowl	Pal, Gra	X	X	y														b/n					1	0.1		
Ring-necked Duck	*Aythya collaris*	Bird	Waterfowl	Riv, Lac, Rip	X	X	y														b/N					1	0.1		
Bufflehead	*Bucephala albeola*	Bird	Waterfowl	Riv, Lac	X	X	y														n					1	0.1		
Long-tailed Duck	*Clangula hyemalis*	Bird	Waterfowl	Lac	X		y?														n					1	0.1		
Tundra Swan	*Cygnus columbianus*	Bird	Waterfowl	Riv, Lac		X	y										(f, h)									1	0.1		
Mute swan	*Cygnus olor*	Bird	Waterfowl	Riv, Lac	n	X	y?														B/N					1	0.1		
Northern Shoveler	*Anas clypeata*	Bird	Waterfowl	Pal	X	X	y																			0	0.0		
Cinnamon Teal	*Anas cyanoptera*	Bird	Waterfowl	Lac, Riv, Pal		X	y																			0	0.0		
Eurasian Wigeon	*Anas penelope*	Bird	Waterfowl	Lac, Riv, Pal		X	y																			0	0.0		

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Greater White-fronted Goose	*Anser albifrons*	Bird	Waterfowl	Pal	X		y																			0	0.0		
Atlantic brant	*Branta bernicla*	Bird	Waterfowl	Lac	X		y?																			0	0.0		
Snow Goose, Greater	*Chen caerulescens*	Bird	Waterfowl	Pal	X	X	y																			0	0.0		
White-winged Scoter	*Melanitta fusca*	Bird	Waterfowl	Lac	X	X	y?																			0	0.0		
Black Scoter	*Melanitta nigra*	Bird	Waterfowl	Lac	X		y?																			0	0.0		
Surf Scoter	*Melanitta perspicillata*	Bird	Waterfowl	Lac	X	X	y?																			0	0.0		
Common Merganser	*Mergus merganser*	Bird	Waterfowl	Riv, Lac	X	X	y																			0	0.0		
Red-breasted Merganser	*Mergus serrator*	Bird	Waterfowl	Riv, Lac	X	X	y																			0	0.0		
Common Eider	*Somateria mollissima*	Bird	Waterfowl	Lac			y?																			0	0.0		
SHOREBIRDS																													
Piping Plover (Great Lakes pop.)	*Charadrius melodus*	Bird	Shorebird	Bar			no	E	E	X		E		UMR	X (I)	& Oper	X(f)	M/B (f), 4								9	0.8		
Red Knot (roselaari ssp.)	*Calidris canutus*	Bird	Shorebird	Pal		X	y?				X (nb)	X	f				X	M, 3				Yellow				6	0.5		
Red Knot (rufa ssp.)	*Calidris canutus*	Bird	Shorebird	Pal		X	y?				X (nb, c	X	f				X	M, 3				Yellow				6	0.5		
Upland Sandpiper	*Bartramia longicauda*	Bird	Shorebird	Gra		X	y		T	X	X	X	f	UMR	X (I)	Gra	X(f)	m/b (f),	X (f)							11	0.9	G5	S2B
American Woodcock	*Scolopax minor*	Bird	Shorebird	For, Pal, Shr	X	X	y		SC	X			f	UMR	X, IIIB	Shr	X(f)	M/B (f),	X (f)							9	0.8	G5	S3S4B
Hudsonian Godwit	*Limosa haemastica*	Bird	Shorebird	Gra, Pal		X	y?		SC	X	X (nb)	X	f	UMR			X	M, 4				Yellow				9	0.8	G4	S2S3N
Buff-breasted Sandpiper	*Calidris subruficollis*	Bird	Shorebird	Pal			y		SC	X	X (nb)	X	f	UMR			X	M, 4				Red				9	0.8	G4	S3N
Marbled Godwit	*Limosa fedoa*	Bird	Shorebird	Pal		X	y?		SC	X	X (nb)	X (f)	f	UMR			X	M, 3				Yellow				9	0.8	G5	S2S3N
Short-billed Dowitcher	*Limnodromus griseus*	Bird	Shorebird	Pal		X	y		SC	X	X (nb)	X		UMR			X(f)	M (f), 4								7	0.6	G5	S4N
Whimbrel	*Numenius phaeopus*	Bird	Shorebird	Pal			y?		SC	X	X (nb)	X		UMR			X	M, 3								7	0.6	G5	S2S3N
Wilson's Phalarope	*Phalaropus tricolor*	Bird	Shorebird	Pal		X	y		SC	X				UMR	X (I)		X(f)	M (f), 4								6	0.5	G5	S1B
Solitary Sandpiper	*Tringa solitaria*	Bird	Shorebird	Pal		X	y		SC	X	X (nb)	X					X (c)	m/b, 4								6	0.5	G5	S4N
Dunlin	*Calidris alpina*	Bird	Shorebird	Pal		X	y		SC	X			f				(f, h)	M (f), 4								5	0.4	G5	S4N
American Golden Plover	*Pluvialis dominica*	Bird	Shorebird	Gra		X	y		SC	X							X(f)	M (f), 4								4	0.3	G5	S3N
Piping Plover (Great Plains pop.)	*Charadrius melodus*	Bird	Shorebird	Bar			no?			X		E		UMR												4	0.3		
Sanderling	*Calidris alba*	Bird	Shorebird	Pal		X	y										X (f, c)	M (f), 4				Yellow				3	0.3		
Stilt Sandpiper	*Calidris himantopus*	Bird	Shorebird	Pal		X	y?							UMR				M, 4				Yellow				3	0.3		
Semipalmated Sandpiper	*Calidris pusilla*	Bird	Shorebird	Pal		X	y					X	f					M, 4								3	0.3		
Semipalmated Plover	*Charadrius semipalmatus*	Bird	Shorebird	Pal		X	y											M, 4				Yellow				2	0.2		
Killdeer	*Charadrius vociferus*	Bird	Shorebird	Gra, Pal		X	y										(f, h)	M/B (f), 5								2	0.2		
Ruddy Turnstone	*Arenaria interpres*	Bird	Shorebird	Pal		X	y										X (c)	M, 4								2	0.2		
White-rumped Sandpiper	*Calidris fuscicollis*	Bird	Shorebird	Pal		X	y?											M, 4				Yellow				2	0.2		
Western Sandpiper	*Calidris mauri*	Bird	Shorebird	Pal		X	y											M, 3				Yellow				2	0.2		
Pectoral Sandpiper	*Calidris melanotos*	Bird	Shorebird	Pal		X	y											M, 4				Red				2	0.2		
Wilson's Snipe	*Gallinago delicata*	Bird	Shorebird	Pal	X	X	y										(f, h)	M/b (f), 4								2	0.2		
Long-billed Curlew	*Numenius americanus*	Bird	Shorebird	Pal			no						f									Yellow				2	0.2		
Lesser Yellowlegs	*Tringa flavipes*	Bird	Shorebird	Pal		X	y					X						M, 5								2	0.2		
Greater Yellowlegs	*Tringa melanoleuca*	Bird	Shorebird	Pal		X	y							UMR				M, 5								2	0.2		
Black-bellied Plover	*Pluvialis squatarola*	Bird	Shorebird	Pal		X	y											M, 4								1	0.1		
Black-necked Stilt	*Himantopus mexicanus*	Bird	Shorebird	Pal		X	y		SC																	1	0.1	G5	SNA
American Avocet	*Recurvirostra americana*	Bird	Shorebird	Pal		X	y?											m								1	0.1		
Spotted Sandpiper	*Actitis macularius*	Bird	Shorebird	Pal		X	y											M/B, 4								1	0.1		
Baird's Sandpiper	*Calidris bairdii*	Bird	Shorebird	Pal		X	y											M, 4								1	0.1		
Least Sandpiper	*Calidris minutilla*	Bird	Shorebird	Pal		X	y											M, 5								1	0.1		
Long-billed Dowitcher	*Limnodromus scolopaceus*	Bird	Shorebird	Pal		X	y											M, 5								1	0.1		
Red-necked Phalarope	*Phalaropus lobatus*	Bird	Shorebird	Pal			y?											M, 3								1	0.1		
Willet	*Tringa semipalmata*	Bird	Shorebird	Pal			y											M, 3								1	0.1		
MAMMAL																													
Gray wolf	*Canis lupus*	Mammal	Carnivora	For	X	X	y		SC	X				UMR												3	0.6	G4G5	S4
Northern Long-eared Bat	*Myotis septentrionalis*	Mammal	Chiroptera	For		X	y	T	T	X																3	0.6	G1G2	S1S2
Silver-haired Bat	*Lasionycteris noctivagans*	Mammal	Chiroptera	For		X	y		SC	X																2	0.4	G5	S2S4
Red Bat	*Lasiurus borealis*	Mammal	Chiroptera	For		X	y		SC	X																2	0.4	G5	S3
Hoary Bat	*Lasiurus cinerus*	Mammal	Chiroptera	For		X	y		SC	X																2	0.4	G5	S3
Woodland Vole / Pine Vole	*Microtus pinetorum*	Mammal	Rodentia	For		X	y		SC	X																2	0.4	G5	S2
Prairie Vole	*Microtus ochrogaster*	Mammal	Rodentia	Gra		X	y		SC	X																2	0.4	G5	S2

								T & E		SWAP	FWS				PIF	LCC	UMRGLR JV BIRD PLANS												
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Franklin's Ground Squirrel	*Spermophilus franklinii*	Mammal	Rodentia	Gra		X	y		SC	X															2	0.4	G5	S2
Water Shrew	*Sorex palustris*	Mammal	Soricomorpha	Rip			y?		SC	X															2	0.4	G5	S3
Elk or Wapiti	*Cervus elaphus*	Mammal	Artiodactyla	Gra, For			no		SC																1	0.2	G5	SNA
Puma / Cougar / Mountain Lion	*Felis concolor*	Mammal	Carnivora	For			no?		SC																1	0.2	G5	SNA
Least Weasel	*Mustela nivalis*	Mammal	Carnivora	For, Rip	X	X	y		SC																1	0.2	G5	SU
Big Brown Bat	*Eptesicus fuscus*	Mammal	Chiroptera	Gra, Shr, For		X	y		T																1	0.2	G5	S2S4
Little Brown Myotis	*Myotis lucifugus*	Mammal	Chiroptera	For		X	y		T																1	0.2	G3	S2S4
Eastern Pipistrelle	*Pipistrellus subflavus*	Mammal	Chiroptera	Sub, For		X	y		T																1	0.2	G3	S1S3
Western Harvest Mouse	*Reithrodontomys megalotis*	Mammal	Rodentia	Gra, Pal		X	y		SC																1	0.2	G5	SU
Least Shrew	*Cryptotis parva*	Mammal	Soricomorpha	Gra Shr			y?																		1	0.2	G5	SH
White-tailed Deer	*Odocoileus virginianus*	Mammal	Artiodactyla	For	X	X	y																		0	0.0		
Coyote	*Canis latrans*	Mammal	Carnivora	For	X	X	y																		0	0.0		
Fox, Gray	*Urocyon cineroargenteus*	Mammal	Carnivora	For	X	X	y																		0	0.0		
Fox, Red	*Vulpes fulva*	Mammal	Carnivora	For	X	X	y																		0	0.0		
Bobcat	*Lynx rufus*	Mammal	Carnivora	For	X	X	y																		0	0.0		
Skunk, Striped	*Mephitis mephitis*	Mammal	Carnivora	For, Gra	X	X	y																		0	0.0		
Skunk, Spotted	*Spilogale putorius*	Mammal	Carnivora	For, Gra	X	X	y																		0	0.0		
Otter, River	*Lutra canadensis*	Mammal	Carnivora	For, Rip	X	X	y																		0	0.0		
Short-tailed Weasel	*Mustela erminea*	Mammal	Carnivora	For, Rip	X	X	y																		0	0.0		
Long-tailed Weasel	*Mustela frenata*	Mammal	Carnivora	For, Rip	X	X	y																		0	0.0		
Mink	*Mustela vison*	Mammal	Carnivora	For, Rip	X	X	y																		0	0.0		
American Badger	*Taxida taxus*	Mammal	Carnivora	Gra	X	X	y																		0	0.0		
Raccoon	*Procyon lotor*	Mammal	Carnivora	For	X	X	y																		0	0.0		
American Black Bear	*Ursus americanus*	Mammal	Carnivora	For	X	X	y																		0	0.0		
Beaver	*Castor canadensis*	Mammal	Rodentia	Rip, Riv	X	X	y																		0	0.0		
Muskrat	*Ondatra zibethicus*	Mammal	Rodentia	Rip, Riv	X	X	y																		0	0.0		
AMPHIBIANS																													
Four-toed Salamander	*Hemidactylium scutatum*	Herp	Amphibian	For, Pal			y		SC	X														B	3	0.5	G5	S3?
Common Mudpuppy	*Necturus maculosus maculosus*	Herp	Amphibian	Lac, Riv		X	y		SC	X														C	3	0.5	G5	
Blanchard's Cricket Frog	*Acris crepitans blanchardi*	Herp	Amphibian	Lac, Rip, Riv		X	y		E	X															2	0.3	G5	S1
Pickerel Frog	*Lithobates palustris*	Herp	Amphibian	Lac, Rip, Riv		X	y		SC	X															2	0.3	G5	S3?
American Bullfrog	*Lithobates catesbeianus*	Herp	Amphibian	Lac, Rip, Riv		X	y?		SC																1	0.2	G5	S3S4
Northern Leopard Frog	*Lithobates pipiens*	Herp	Amphibian	Lac, Rip, Riv			y		SC																1	0.2		
Blue-spotted Salamander	*Ambystoma laterale*	Herp	Amphibian	For		X	y																	C	1	0.2		
REPTILES																													
Eastern Massasauga	*Sistrurus catenatus catenatus*	Herp	Reptile	For, Pal		X	y	C	E	X				UMR										A	5	0.8	G4T3T	S1
Timber Rattlesnake	*Crotalus horridus*	Herp	Reptile	For, Bar		X	y		SC	X				UMR										B	4	0.7	G4	S2S3
Wood Turtle	*Glyptemys insculpta*	Herp	Reptile	For, Riv		X	y		T	X														B	3	0.5	G4	S2
Blanding's Turtle	*Emydoidea blandingii*	Herp	Reptile	Pal		X	y		SC	X														A	3	0.5	G4	S3S4
Prairie Ringneck Snake	*Diadophis punctatus arnyi*	Herp	Reptile	For		X	y		SC	X															2	0.3	G5T5	S2S3
Gray Ratsnake (Carolinian pop in C	*Pantherophis spiloides*	Herp	Reptile	For, Pal			y		SC	X															2	0.3	G5T5	S3
Slender Glass Lizard	*Ophisaurus attenuatus*	Herp	Reptile	Gra			y?		E	X															2	0.3	G5	S1
Six-lined (Prairie) Racerunner	*Aspidoscelis sexlineata*	Herp	Reptile	Gra, Bar		X	y		SC	X															2	0.3	G5	S2S3
Gophersnake (Bullsnake)	*Pituophis catenifer*	Herp	Reptile	Gra, Shr, For			y		SC	X															2	0.3	G5	S2S3
Smooth Softshell	*Apalone mutica*	Herp	Reptile	Lac, Riv		X	y		SC	X															2	0.3	G5	S3
North American Racer	*Coluber constrictor*	Herp	Reptile	Rip, Bar, Gra			y		SC	X															2	0.3	G5	S2
Five-lined Skink	*Eumeces fasciatus*	Herp	Reptile	Bar, For			y?		SC																1	0.2		
Eastern Hog-nosed Snake	*Heterodon platirhinos*	Herp	Reptile	Gra, For		X	y		SC																1	0.2	G5	
Smooth Greensnake	*Opheodrys vernalis*	Herp	Reptile	Gra, Pal			y?																	B	1	0.2	G5	
False Map Turtle	*Graptemys pseudogeographica*	Herp	Reptile	Lac, Riv, Pal		X	y		SC																1	0.2	G5	S3?
Common Snapping Turtle	*Chelydra serpentina*	Herp	Reptile	Lac, Riv, Pal		X	y																		0	0.0	G5	
INSECTS																													
Little White (Ghost) Tiger Beetle	*Cicindela lepida*	Insect	Coleoptera	Bar			y?		SC	X															2	0.3	G3G4	S1
Fox Small Squaregilled Mayfly	*Cercobrachys fox*	Insect	Ephemeropta	Riv			y		SC	X															2	0.3	G3G4	S2S3
A Common Burrowing Mayfly	*Hexagenia rigida*	Insect	Ephemeropta	Riv			y		SC	X															2	0.3	G5	S2?

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Pecatonica River Mayfly	*Acanthametropus pecatonica*	Insect	Ephemeropta				y		E	X																2	0.3	G2G4	S1
Ojibwe Small Square-gilled Mayfly	*Brachycercus ojibwe*	Insect	Ephemeropta				y		SC	X																2	0.3	G3	S2S3
Wisconsin Small Square-gilled May	*Cercobrachys lilliei*	Insect	Ephemeropta				y		SC	X																2	0.3	G2	S1S2
A Brush-legged Mayfly	*Homoeoneuria ammophila*	Insect	Ephemeropta				y		SC	X																2	0.3	G4	S2?
A Cleft-footed Minnow Mayfly	*Metretopus borealis*	Insect	Ephemeropta				y		SC	X																2	0.3	G5	S1S2
Karner Blue	*Lycaeides melissa samuelis*	Insect	Lepidoptera	Gra, Sav			y?	E	SC	X				UMR		Gra									CI	6	1.0	G5T2	S3
Ottoe Skipper	*Hesperia ottoe*	Insect	Lepidoptera	Gra			y		SC	X				UMR											V	4	0.7	G3G4	S1
Frosted Elfin	*Callophrys irus*	Insect	Lepidoptera	For, Sav			y?		T	X															I	3	0.5	G3	S1
Regal fritillary	*Speyeria idalia*	Insect	Lepidoptera	Gra			y		E	X															V	3	0.5	G3	S1
Persius Duskywing	*Erynnis persius*	Insect	Lepidoptera	Sav			y?		SC	X															I	3	0.5	G5T1T3	S3
Phyllira Tiger Moth	*Grammia phyllira*	Insect	Lepidoptera	Bar, Gra			y?		SC	X																2	0.3	G4	S2
Columbine Duskywing	*Erynnis lucilius*	Insect	Lepidoptera	For, Sav			y		SC	X																2	0.3	G4	S2S3
Blazing Star Stem Borer	*Papaipema beeriana*	Insect	Lepidoptera	Gra			y?		SC	X																2	0.3	G2G3	S2S3
Gray copper	*Lycaena dione*	Insect	Lepidoptera	Gra, Rip			y		SC	X																2	0.3	G5	S2?
Midwestern Fen Buckmoth	*Hemileuca nevadensis*	Insect	Lepidoptera	Pal			y?		SC	X																2	0.3	G5T3T4	S3
Cobweb Skipper	*Hesperia metea*	Insect	Lepidoptera	Sav			y?		SC	X																2	0.3	G4G5	S2
Phlox Moth	*Schinia indiana*	Insect	Lepidoptera	Sav			y?		E	X																2	0.3	G2G4	S2S3
Mottled Duskywing	*Erynnis martialis*	Insect	Lepidoptera	Sav, Shr			y?		SC	X																2	0.3	G3	S2
Swamp Darner	*Epiaeschna heros*	Insect	Odonata	For, Pal			y?		SC	X																2	0.3	G5	S2S3
Lemon-faced Emerald	*Somatochlora ensigera*	Insect	Odonata	For, Rip, Riv			y?		SC	X																2	0.3	G4	S2S3
Slender Bluet	*Enallagma traviatum*	Insect	Odonata	Lac			y?		SC	X																2	0.3	G5	S1S3
Pygmy snaketail	*Ophiogomphus howei*	Insect	Odonata	Lac, Riv			y?		T	X																2	0.3	G3	S4
White-spangled Skimmer	*Libellula cyanea*	Insect	Odonata	Pal			y?		SC	X																2	0.3	G5	S2
Royal River Cruiser	*Macromia taeniolata*	Insect	Odonata	Rip, Riv			y?		SC	X																2	0.3	G5	S2S3
Sand Snaketail	*Ophiogomphus smithi*	Insect	Odonata	Riv			y		SC	X																2	0.3	G2G3	S2
Extra-striped snaketail	*Ophiogomphus anomalus*	Insect	Odonata	Riv			y?		E	X																2	0.3	G4	S2S3
Stone's Locust	*Melanoplus stonei*	Insect	Orthoptera	Bar, Sav			y?		SC	X																2	0.3	G4G5	S1S2
Speckled Rangeland Grasshopper	*Arphia conspersa*	Insect	Orthoptera	For, Gra			y?		SC	X																2	0.3	G5	S2
Short-winged Grasshopper	*Dichromorpha viridis*	Insect	Orthoptera	For, Gra			y?		SC	X																2	0.3	G5	S2S3
Spotted-winged Grasshopper	*Orphulella pelidna*	Insect	Orthoptera	Gra, Pal			y?		SC	X																2	0.3	G5	S2S3
Ash-brown Grasshopper	*Trachyrhachys kiowa*	Insect	Orthoptera	Gra, Shr			y?		SC	X																2	0.3	G5	S2
Huckleberry Spur-throat Grasshop	*Melanoplus fasciatus*	Insect	Orthoptera	Sav, Shr			y?		SC	X																2	0.3	G5	S2
Quadrate Sallfly	*Haploperla orpha*	Insect	Plecoptera				y?		SC	X																2	0.3	G4	S2S3
Red-Tailed Prairie Leafhopper	*Aflexia rubranura*	Insect	Hemiptera	Gra			no?		E	X																2	0.3	G2	S2?
Prairie Leafhopper	*Polyamia dilata*	Insect	Hemiptera	Gra			no?		T	X																2	0.3	GNR	S2
Whitney Underwing	*Catocala whitneyi*	Insect	Lepidoptera	Gra, Sav			no?		SC	X																2	0.3	G3G4	S3
Mottled Darner	*Aeshna clepsydra*	Insect	Odonata	Lac, Rip			no?		SC	X																2	0.3	G4	S2S3
Spatterdock Darner	*Rhionaeschna mutata*	Insect	Odonata	Lac, Pal			no?		T	X																2	0.3	G4	S1
Smokey rubyspot	*Hetaerina titia*	Insect	Odonata	Riv			no?		SC	X																2	0.3	G5	S1S2
Sphagnum Sprite	*Nehalennia gracilis*	Insect	Odonata	For, Pal			no?		SC	X																2	0.3	G5	S2S3
Forcipate Emerald	*Somatochlora forcipata*	Insect	Odonata	For, Rip, Riv			no?		SC	X																2	0.3	G5	S2S3
Ringed boghaunter	*Williamsonia lintneri*	Insect	Odonata	Aqu, Pal			no?		SC	X																2	0.3	G3	S3
Saint Croix Snaketail	*Ophiogomphus susbehcha*	Insect	Odonata	Riv			no?		E	X																2	0.3	G2	S2
A Giant Casemaker Caddisfly	*Banksiola dossuaria*	Insect	Trichoptera	Riv			y?		SC	X																2	0.3	G5	S2S3
Slaty Skimmer	*Libellula incesta*	Insect	Odonata	For, Pal, Riv			no?		SC	X																2	0.3	G5	S2S3
A Purse Casmaker Caddisfly	*Ochrotrichia riesi*	Insect	Trichoptera	Riv			y?		SC	X																2	0.3	G3G4	S1S3
Dusted Skipper	*Atrytonopsis hianna*	Insect	Lepidoptera	Gra, Sav			y?		SC																	1	0.2	G4G5	S2S3
Juniper hairstreak	*Callophrys gryneus*	Insect	Lepidoptera	Bar, Gra			y		SC																	1	0.2	G5	S3
Gorgone checkerspot	*Chlosyne gorgone*	Insect	Lepidoptera	Gra, Sav			y		SC																	1	0.2	G5T5	S3
Monarch Butterfly	*Danaus plexippus*	Insect	Lepidoptera	Gra			y								Gra ; Nat'l Priority											1	0.2		
Pronghorned Clubtail	*Gomphus graslinellus*	Insect	Odonata	Lac, Riv			y		SC																	1	0.2	G5	S2S3
Great Spreadwing	*Archilestes grandis*	Insect	Odonata	Pal, Rip, Riv			no?		SC																	1	0.2	G5	S2S3
Blue-legged Grasshopper	*Melanoplus flavidus*	Insect	Orthoptera	Bar, Gra			y?		SC																	1	0.2	G4	S2?
ARACHNIDS																													
A Jumping Araneae	*Paradamoetas fontana*	Arachnid	Araneae				y?		SC	X																2	0.4	GNR	S1S2

								T & E		SWAP	FWS				PIF	LCC	UMRGLR JV BIRD PLANS												
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A Jumping Araneae	*Phidippus pius*	Arachnid	Araneae				no?		SC																	1	0.2		GNR
FISH																													
Crystal Darter	*Crystallaria asprella*	Fish		Riv			no?		E	X				UMR									X			4	0.7	G3	S1
Ozark Minnow	*Notropis nubilus*	Fish		Riv			no?		T	X													X			3	0.5	G5	S2
Walleye	*Sander vitreus*	Fish		Lac, Rip, Riv	X	X	y							UMR	Rip & Riv								X			3	0.5	G5	
Pirate perch	*Aphredoderus sayanus*	Fish		Lac, Pal, Riv			y		SC														X			2	0.3	G5	S3
Mud Darter	*Etheostoma asprigene*	Fish		Pal, Riv			y		SC														X			2	0.3	G4G5	S3
Least Darter	*Etheostoma microperca*	Fish		Lac, Pal, Riv			no?		SC	X																2	0.3	G5	S3
Smallmouth bass	*Micropterus dolomieu*	Fish		Lac, Rip, Riv	X		y								Rip & Riv								X			2	0.3		
Weed Shiner	*Notropis texanus*	Fish		Lac, Pal, Riv			y		SC														X			2	0.3	G5	S3
Pugnose minnow	*Opsopoeodus emiliae*	Fish		Lac, Pal, Riv			y		SC														X			2	0.3	G5	S3
Brook trout, Heritage strains	*Salvelinus fontinalis*	Fish		Lac, Rip, Riv	X		y							UMR	Rip & Riv											2	0.3		
Shovelnose Sturgeon	*Scaphirhynchus platorynchus*	Fish		Riv	X		y							UMR									X			2	0.3	G4	
Paddlefish	*Polyodon spathula*	Fish		Lac, Rip, Riv			y		T	X				UMR	Rip & Riv								X			5	0.8	G4	S2
Lake sturgeon	*Acipenser fulvescens*	Fish		Lac, Riv	X		y		SC	X				UMR	Rip & Riv								X			5	0.8	G3G4	S3
River redhorse	*Moxostoma carinatum*	Fish		Rip, Riv			y		T	X					Rip & Riv								X			4	0.7	G4	S2
American Eel	*Anguilla rostrata*	Fish		Lac, Riv			y		SC	X													X			3	0.5	G4	S2
Greater redhorse	*Moxostoma valenciennesi*	Fish		Lac, Riv			y?		SC	X													X			3	0.5	G4	S3
Goldeye	*Hiodon alosoides*	Fish		Lac, Riv, Pal			y		E	X													X			3	0.5	G5	S2
Bluntnose Darter	*Etheostoma chlorosoma*	Fish		Pal, Riv			y		E	X													X			3	0.5	G5	S1
Black Buffalo	*Ictiobus niger*	Fish		Pal, Riv			y		T	X													X			3	0.5	G5	S2
Skipjack herring	*Alosa chrysochloris*	Fish		Riv			y		E	X													X			3	0.5	G5	S1
Rock bass	*Ambloplites rupestris*	Fish		Lac, Rip, Riv	X		y																X			1	0.2		
Black bullhead	*Ameiurus melas*	Fish		Lac, Pal, Riv	X	X	y																X			1	0.2	G5	
Freshwater drum	*Aplodinotus grunniens*	Fish		Lac, Riv		X	y																X			1	0.2	G5	
River carpsucker	*Carpiodes carpio*	Fish		Lac, Riv	X		y																X			1	0.2	G5	
Highfin carpsucker	*Carpiodes velifer*	Fish		Riv			ext																X			1	0.2		
White Sucker	*Catostomus commersoni*	Fish		Riv	X	X	y																X			1	0.2	G5	
Cisco	*Coregonus artedi*	Fish		Lac			ext								Rip & Riv											1	0.2		
Grass carp	*Ctenopharyngodon idella*	Fish		Lac, Pal, Riv	n		y																X			1	0.2	G5	
Common carp	*Cyprinus carpio*	Fish		Lac, Pal, Riv	X	X	y																X			1	0.2	G5	
Gizzard shad	*Dorosoma cepedianum*	Fish		Lac, Riv			y																X			1	0.2	G5	
Northern pike	*Esox lucius*	Fish		Lac, Riv	X		y																X			1	0.2	G5	
Muskellunge	*Esox masquinongy*	Fish		Lac, Riv	X		y																X			1	0.2		
Banded Darter	*Etheostoma zonale*	Fish		Riv			y																X			1	0.2		
Brassy Minnow	*Hybognathus hankinsoni*	Fish		Riv			y																X			1	0.2	G5	
Northern hogsucker	*Hypentelium nigricans*	Fish		Riv			y																X			1	0.2		
Silver carp	*Hypophthalmichthys molitrix*	Fish		Riv	n		y																X			1	0.2	G5	
Bighead carp	*Hypophthalmichthys nobilis*	Fish		Riv	n		y																X			1	0.2	G5	
Chestnut Lamprey	*Ichthyomyzon castaneus*	Fish		Lac, Riv			y																X			1	0.2	G4	
Blue catfish	*Ictalurus furcatus*	Fish		Riv			ext																X			1	0.2	G5	
Channel catfish	*Ictalurus punctatus*	Fish		Riv	X	X	y																X			1	0.2	G5	
Smallmouth buffalo	*Ictiobus bubalus*	Fish		Riv	X	X	y																X			1	0.2	G5	
Bigmouth buffalo	*Ictiobus cyprinellus*	Fish		Pal, Riv	X	X	y																X			1	0.2	G5	
Spotted Gar	*Lepisosteus oculatus*	Fish		Lac, Riv			y																X			1	0.2	G5	
Longnose gar	*Lepisosteus osseus*	Fish		Lac, Riv		X	y																X			1	0.2	G5	
Shortnose gar	*Lepisosteus platostomus*	Fish		Lac, Pal, Riv		X	y																X			1	0.2	G5	
Bluegill	*Lepomis macrochirus*	Fish		Lac, Riv	X	X	y																X			1	0.2	G5	
Silver Chub	*Macrhybopsis storeriana*	Fish		Riv			y		SC																	1	0.2	G5	S3
Spotted bass	*Micropterus punctulatus*	Fish		Riv	X		y																X			1	0.2		
Largemouth bass	*Micropterus salmoides*	Fish		Lac, Riv	X		y																X			1	0.2	G5	
Spotted Sucker	*Minytrema melanops*	Fish		Riv			y																X			1	0.2		
White bass	*Morone chrysops*	Fish		Lac, Riv	X	X	y																X			1	0.2	G5	
Silver redhorse	*Moxostoma anisurum*	Fish		Lac, Riv			y																X			1	0.2		
Golden Redhorse	*Moxostoma erythrurum*	Fish		Lac, Riv	X	X	y																X			1	0.2	G5	

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Shorthead Redhorse	*Moxostoma macrolepidotum*	Fish		Lac, Riv	X	X	y																X			1	0.2	G5	
River Shiner	*Notropis blennius*	Fish		Riv		X	y																X			1	0.2	G5	
Tadpole Madtom	*Noturus gyrinus*	Fish		Pal			y																X			1	0.2		
Rainbow trout	*Oncorhynchus mykiss*	Fish		Riv	X		y																X			1	0.2		
Yellow perch	*Perca flavescens*	Fish		Lac	X	X	y																X			1	0.2		
Blackside Darter	*Percina maculata*	Fish		Riv			y																X			1	0.2		
River Darter	*Percina shumardi*	Fish		Riv			y																X			1	0.2	G5	
White crappie	*Pomoxis annularis*	Fish		Lac, Riv	X	X	y																X			1	0.2	G5	
Black crappie	*Pomoxis nigromaculatus*	Fish		Lac, Riv	X	X	y																X			1	0.2	G5	
Brown trout	*Salmo trutta*	Fish		Riv	X		y																X			1	0.2		
Sauger	*Stizostedion canadense*	Fish		Riv	X		y																X			1	0.2	G5	
Western Sand Darter	*Ammocrypta clara*	Fish		Riv			y		SC	X													X			3	0.5	G3	S3
Blue Sucker	*Cycleptus elongatus*	Fish		Riv			y		T	X													X			3	0.5	G3G4	S2
Black Redhorse	*Moxostoma duquesnii*	Fish		Riv			y		E	X													X			3	0.5	G5	S1
Pallid Shiner	*Hybopsis (Notropis) amnis*	Fish		Riv			y		E	X													X			3	0.5	G4	S1
Gilt Darter	*Percina evides*	Fish		Riv			y		T	X													X			3	0.5	G4	S2S3
Starhead Topminnow	*Fundulus dispar*	Fish		Lac, Riv, Pal			y		E	X																2	0.3	G4	S2
Redfin Shiner	*Lythrurus umbratilis*	Fish		Riv			y		T	X																2	0.3	G5	S2
Shoal Chub	*Macrhybopsis hyostoma*	Fish		Riv			y		T	X																2	0.3	G5	S2
Yellow bullhead	*Ameiurus natalis*	Fish		Lac, Pal, Riv	X	X	y																			0	0.0		
Brown bullhead	*Ameiurus nebulosus*	Fish		Lac, Pal, Riv	X	X	y																			0	0.0		
Goldfish	*Carassius auratus*	Fish		Lac	n		y																			0	0.0	G5	
Green sunfish	*Lepomis cyanellus*	Fish		Lac, Riv	X	X	y																			0	0.0		
Pumpkinseed	*Lepomis gibbosus*	Fish		Lac, Riv	X	X	y																			0	0.0		
Orange-spotted sunfish	*Lepomis humilis*	Fish		Lac, Riv	X	X	y																			0	0.0		
Yellow Bass	*Morone mississippiensis*	Fish		Lac, Riv	X		y																			0	0.0		
Flathead catfish	*Pylodictis olivaris*	Fish		Lac, Riv	X		y																			0	0.0	G5	
CRUSTACEAN																													
Prairie Crayfish	*Procambarus gracilis*	Crustacean	Crayfish	For, Gra, Pal			y		SC	X																2	0.4	G5	S2?
Rusty crayfish	*Orconectes rusticus*	Crustacean	Crayfish		n		y																			0	0.0		
MUSSELS																													
Snuffbox	*Epioblasma triquetra*	Mollusca	Mussel	Riv			no?	E	E	X				UMR		Rip & Riv Surr										5	1.0	G3	S1
Winged Mapleleaf	*Quadrula fragosa*	Mollusca	Mussel	Riv			no?	E	E	X																3	0.6	G1	S1
Higgins' eye pearlymussel	*Lampsilis higginsi*	Mollusca	Mussel	Rip, Riv			y	E	E	X				UMR		Rip & Riv										5	1.0	G1	S1
Spectaclecase	*Cumberlandia monodonta*	Mollusca	Mussel	Riv			y	E	E	X				UMR												4	0.8	G3	S1
Bullhead	*Plethobasus cyphyus*	Mollusca	Mussel	Riv			y?	E	E	X				UMR												4	0.8	G3	S1
Rock Pocketbook	*Arcidens confragosus*	Mollusca	Mussel	Riv			y		T	X				UMR												3	0.6	G4	S1S2
Elktoe	*Alasmidonta marginata*	Mollusca	Mussel	Riv			y		SC					UMR												2	0.4	G4	S3
Monkeyface	*Quadrula metanevra*	Mollusca	Mussel	Riv			y		T	X				UMR												3	0.6	G4	S2
Mapleleaf	*Quadrula quadrula*	Mollusca	Mussel	Riv	X		y		SC	X				UMR												3	0.6	G5	S3
Salamander mussel	*Simpsonaias ambigua*	Mollusca	Mussel	Riv			y		T	X				UMR												3	0.6	G3	S2
Pistolgrip (Buckhorn)	*Tritogonia verrucosa*	Mollusca	Mussel	Riv			y		T	X				UMR												3	0.6	G4G5	S2
Flat Floater	*Anodonta suborbiculata*	Mollusca	Mussel	Riv			y		SC	X																2	0.4	G5	S2S3
Purple Wartyback	*Cyclonaias tuberculata*	Mollusca	Mussel	Riv			y?		E	X																2	0.4	G5	S2
Black Sandshell	*Ligumia recta*	Mollusca	Mussel	Riv			y		SC					UMR												2	0.4	G5	S3
Washboard	*Megalonaias nervosa*	Mollusca	Mussel	Riv			y		SC					UMR												2	0.4	G5	S3
Round pigtoe	*Pleurobema sintoxia*	Mollusca	Mussel	Riv			y		SC					UMR												2	0.4	G4G5	S3
Fat Pocketbook	*Potamilus capax*	Mollusca	Mussel	Riv			y	E						UMR												2	0.4		
Butterfly	*Ellipsaria lineolata*	Mollusca	Mussel	Riv			y		E	X																2	0.4	G4G5	S2
Elephant-ear	*Elliptio crassidens*	Mollusca	Mussel	Riv			y		E	X																2	0.4	G5	S1
Ebonyshell	*Fusconaia ebena*	Mollusca	Mussel	Riv			y		E	X																2	0.4	G4G5	S1
Ellipse	*Venustaconcha ellipsiformis*	Mollusca	Mussel	Riv			no?		T	X																2	0.4	G4	S3
Yellow sandshell	*Lampsilis teres anodontoides*	Mollusca	Mussel	Riv			y?		E	X																2	0.4	G5	S1
Pink Papershell	*Potamilus ohiensis*	Mollusca	Mussel	Riv			y		SC	X																2	0.4	G5	S3
Wartyback	*Quadrula nodulata*	Mollusca	Mussel	Riv			y		T	X																2	0.4	G4	S1S2

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Fawnsfoot	*Truncilla donaciformis*	Mollusca	Mussel	Riv			y		T	X																2	0.4	G5	S1S2
Threeridge	*Amblema plicata*	Mollusca	Mussel	Riv	X		y							UMR												1	0.2		
Pimpleback	*Quadrula pustulosa pustulosa*	Mollusca	Mussel	Riv	X		y							UMR												1	0.2	G5	
Asian clam	*Corbicula fluminea*	Mollusca	Mussel	Riv	n		y																			0	0.0		
Zebra mussel	*Dreissena polymorpha*	Mollusca	Mussel	Riv	n		y																			0	0.0		
SNAILS																													
Bright Glyph	*Glyphyalinia wheatleyi*	Mollusca	Snail	For			no?		SC	X																2	0.4	G5	S1
Bronze Pinecone	*Strobilops aeneus*	Mollusca	Snail	For			no?		SC	X																2	0.4	G5	S1
Flanged Valvata	*Valvata winnebagoensis*	Mollusca	Snail	Aqu			no?		SC	X																2	0.4	G2	SU
Deep-throat vertigo	*Vertigo nylanderi*	Mollusca	Snail	For, Pal			no?		SC	X																2	0.4	G3G4	S1S2
Dull Gloss	*Zonitoides limatulus*	Mollusca	Snail	For, Pal			no?		SC	X																2	0.4	G4G5	S1S2
Cherrystone Drop	*Hendersonia occulta*	Mollusca	Snail	Bar, For			y?		T	X																2	0.4	G4	S2S3
Wing Snaggletooth	*Gastrocopta procera*	Mollusca	Snail	Bar, Gra			y		T	X																2	0.4	G5	S3
Sterki's granule	*Guppya sterkii*	Mollusca	Snail	For			y?		SC	X																2	0.4	G5	S2S3
Eightfold Pinecone	*Strobilops affinis*	Mollusca	Snail	For			y		SC	X																2	0.4	G4	S3
Broad□banded Forestsnail	*Allogona profunda*	Mollusca	Snail	For			y?		SC																	1	0.2	G5	S2S3
Domed disc	*Discus patulus*	Mollusca	Snail	.			no?		SC																	1	0.2	G5	SU
Smooth coil	*Helicodiscus singleyanus*	Mollusca	Snail	Bar, Gra			y		SC																	1	0.2	G5	S2?
Ribbed Striate	*Striatura exigua*	Mollusca	Snail	.			y		SC																	1	0.2	G5	S2S3
Trumpet vallonia	*Vallonia parvula*	Mollusca	Snail	.			y?		SC																	1	0.2	G4	S2?
Crested vertigo	*Vertigo cristata*	Mollusca	Snail	.			no?		SC																	1	0.2	G5	S3
Tapered vertigo	*Vertigo elatior*	Mollusca	Snail	For, Pal			y?		SC																	1	0.2	G5	S3
Cross Vertigo	*Vertigo modesta*	Mollusca	Snail	.			no?		SC																	1	0.2	G5	S1
Honey vertigo	*Vertigo tridentata*	Mollusca	Snail	Gra			y?		SC																	1	0.2	G5	S3
PLANTS																													
Northern Monkshood	*Aconitum noveboracense*	Plant		Bar, For			y	T	T																	2	0.7	G3	S2
Prairie Bush□clover	*Lespedeza leptostachya*	Plant		Gra			y	T	E																	2	0.7	G3	S2
Musk□root	*Adoxa moschatellina*	Plant		Bar, For			y		T																	1	0.3	G5	S2
Roundstem foxglove	*Agalinis gattingeri*	Plant		For, Gra, Sav			y		T																	1	0.3	G4	S2
Swamp Agrimony	*Agrimonia parviflora*	Plant		For, Pal		X	y		SC																	1	0.3	G5	S1S2
Carolina Anemone	*Anemone caroliniana*	Plant		Bar, Gra			y		E																	1	0.3	G5	S1
Early Anemone	*Anemone multifida var. hudsoniana*	Plant		Bar, Gra			y		E																	1	0.3	G5T5	S1
Puttyroot	*Aplectrum hyemale*	Plant		For			y		SC																	1	0.3	G5	S2S3
Short's Rock□cress	*Arabis shortii*	Plant		For			y		SC																	1	0.3	G5	S1S2
Rock Stitchwort	*Arenaria stricta ssp. Dawsonensi*	Plant		Bar, Gra			y		SC																	1	0.3	G5	S1
Shinners' Three□awned Grass	*Aristida dichotoma*	Plant		Bar, Gra			y?		SC																	1	0.3	G5	S1
Great Indian-plantain	*Arnoglossum muehlenbergii*	Plant		For, Gra			y?		SC																	1	0.3		
Prairie Indian□plantain	*Arnoglossum plantagineum*	Plant		Gra			y?		SC																	1	0.3	G4G5	S3
Dragon Wormwood	*Artemisia dracunculus*	Plant		Bar, Gra			y		SC																	1	0.3	G5	S2
Prairie Sagebrush	*Artemisia frigida*	Plant		Bar, Gra			y		SC																	1	0.3	G5	S2
Woolly Milkweed	*Asclepias lanuginosa*	Plant		Bar, Gra			y		T																	1	0.3	G4?	S1
Dwarf Milkweed	*Asclepias ovalifolia*	Plant		Sav			y?		T																	1	0.3	G5?	S3
Purple milkweed	*Asclepias purpurascens*	Plant		Sav		X	y		E																	1	0.3	G5?	S3
Sullivant's milkweed	*Asclepias sullivantii*	Plant		Gra			y?		T																	1	0.3	G5	S2S3
Lobed Spleenwort	*Asplenium pinnatifidum*	Plant		Bar			no?		T																	1	0.3	G4	S1
Ground□plum	*Astragalus crassicarpus*	Plant		Gra		X	y		E																	1	0.3	G5	S2
Yellow Wild□indigo	*Baptisia tinctoria*	Plant		Sav		X	y		SC																	1	0.3	G5	S1
Twining Screwstem	*Bartonia paniculata*	Plant		Gra, Pal			y?		SC																	1	0.3	G5	S1
Clustered Poppy-mallow	*Callirhoe triangulata*	Plant		Gra			y		SC																	1	0.3	G3	S2
Larger Water-starwort	*Callitriche heterophylla*	Plant		Rip, Riv		X	y		T																	1	0.3	G5	S1
Oklahoma Grass□pink	*Calopogon oklahomensis*	Plant		For, Gra			y?		SC																	1	0.3	G3	SH
Yellow Evening Primrose	*Calylophus serrulatus*	Plant		Bar, Gra		X	y		SC																	1	0.3	G5	S2
Wild Hyacinth	*Camassia scilloides*	Plant		Gra			no?		E																	1	0.3	G4G5	S2
Dry Woods Sedge	*Carex artitecta*	Plant		Bar, For			y?		SC																	1	0.3	G5	S1
Rocky Mountain Sedge	*Carex backii*	Plant		Bar, For, Rip, Sav			y		SC																	1	0.3	G4	S1

								T & E		SWAP	FWS				PIF	LCC	UMRGLR JV BIRD PLANS													
Common Name	*Scientific Name*	Taxa Group	Group/Order	Broad Habitat	Harvested species	CCP NWR Spp	Species documented in range	Fed T&E 2013	WI State T&E, 2015	WI SWAP, 2011	BCR 23 BCC	FWS R3 BCC 2012	FWS FY2012- FY2016 Focal Species	Regional Conserv. Priority List UMR GRL, 2002	PIF 16 Upper Great Lakes Plain, 2001	UMGL Surogate Spp 2014	UMRGLR JV All Bird Implementation Plan, 2007	UMRGLR JV/BCR 23 Priority Spp Waterbirds 2007	UMRGLR JV/BCR 23 Priority Spp Shorebird 2007	UMRGLR JV Priority Spp Landbird 2007	UMRGLR JV/BCR 23 Priority Spp Waterfowl 2007	ABC Watchlist 2007	INTERJURISDICTIONAL FISH, 2009	PARC	Xerces	Total Number of Plans	Ratio of inclusion	Global Rank	WI RANK
Carey's Sedge	*Carex careyana*	Plant		For			y		T																	1	0.3	G4G5	S1
Fescue sedge	*Carex festucacea*	Plant		Gra, Pal, Rip			y		SC																	1	0.3	G5	S2
Smooth sheath Sedge	*Carex laevivaginata*	Plant		Pal		X	y		E																	1	0.3	G5	S1
Long's Sedge	*Carex longii*	Plant		Pal			y?		SC																	1	0.3	G5	S1
False Hop Sedge	*Carex lupuliformis*	Plant		Pal			y?		E																	1	0.3	G4	S2
Intermediate Sedge	*Carex media*	Plant		For			y?		E																	1	0.3	G5T5?	S2
Drooping Sedge	*Carex prasina*	Plant		For, Pal			y		SC																	1	0.3	G4	S3
Schweinitz's Sedge	*Carex schweinitzii*	Plant		For, Pal			y?		E																	1	0.3	G3G4	S1
Straw Sedge	*Carex straminea*	Plant		Bar, Gra, Rip, Pal			y?		SC																	1	0.3	G5	S1
Torrey's Sedge	*Carex torreyi*	Plant		Gra, Sav			y		SC																	1	0.3	G4	S1
Spreading Chervil	*Chaerophyllum procumbens*	Plant		For		X	y		SC																	1	0.3	5T3T4	S1
Hill's Thistle	*Cirsium hillii*	Plant		Gra, Sav			y		T																	1	0.3	G3	S3
Narrow leaved Dayflower	*Commelina erecta var. deamiana*	Plant		Bar, Gra			y		SC																	1	0.3	G5T5	S1
Autumn Coral-root	*Corallorhiza odontorhiza*	Plant		For			y?		SC																	1	0.3		
Arrow headed Rattle box	*Crotalaria sagittalis*	Plant		Bar, Gra			y		SC																	1	0.3	G5	S1
Hazel Dodder	*Cuscuta coryli*	Plant		Gra, Pal, Rip			y?		SC																	1	0.3	G5?	S1
Rope Dodder	*Cuscuta glomerata*	Plant		Gra, Pal		X	y		SC																	1	0.3	G5	S1
Field Dodder	*Cuscuta pentagona*	Plant		Gra, Pal			y?		SC																	1	0.3	G5	S1
Smartweed Dodder	*Cuscuta polygonorum*	Plant		For, Pal		X	y		SC																	1	0.3	G5	S1
Small White Lady's-slipper	*Cypripedium candidum*	Plant		Gra, Pal			y		T																	1	0.3	G4	S3
Showy Lady's-slipper	*Cypripedium reginae*	Plant		For, Pal			y?		SC																	1	0.3		
Laurentian Bladder Fern	*Cystopteris laurentiana*	Plant		For			y?		SC																	1	0.3	G3	S2
Silky Prairie clover	*Dalea villosa var. villosa*	Plant		Gra, Rip			y		SC																	1	0.3	G5	S2
Mullein Foxglove	*Dasistoma macrophylla*	Plant		For, Sav			y?		SC																	1	0.3	G4	S1
Hoary Tick trefoil	*Desmodium canescens*	Plant		For, Sav			y		SC																	1	0.3	G5	S1
Beak Grass	*Diarrhena obovata*	Plant		For, Rip			y		E																	1	0.3	G4G5	S2
Wilcox's Panic Grass	*Dichanthelium (=Panicum) wilcoxia*	Plant		Bar, Gra			y?		SC																	1	0.3	G5	S1
Water-purslane	*Didiplis diandra*	Plant		Lac, Rip, Riv			y?		SC																	1	0.3	G5	S1
Buttonweed	*Diodia teres var. teres*	Plant		Bar, Gra			y?		SC																	1	0.3	G5T5	S1
Glade Fern	*Diplazium pycnocarpon*	Plant		For			y?		SC																	1	0.3	G5	S2
Jeweled Shooting Star	*Dodecatheon amethystinum*	Plant		Bar, For			y		SC																	1	0.3	G4	S1S2
Pale Purple Coneflower	*Echinacea pallida*	Plant		Gra			no?		T																	1	0.3	G4	S3
Erect Burhead	*Echinodorus rostratus*	Plant		Aqu, Lac, Pal			no?		SC																	1	0.3	G5	SH
Yerba de tajo	*Eclipta prostrata*	Plant		Rip		X	y		SC																	1	0.3	G5	SH
Flat stemmed Spike rush	*Eleocharis compressa*	Plant		Gra, Pal		X	y		SC																	1	0.3	G4	S2
Engelmann's spike rush	*Eleocharis engelmannii*	Plant		Pal, Rip			y?		SC																	1	0.3	G4G5Q	S1
Robbins' Spike rush	*Eleocharis robbinsii*	Plant		Lac			no?		SC																	1	0.3	G4G5	S3
Marsh Horsetail	*Equisetum palustre*	Plant		Pal			y		SC																	1	0.3	G5	S2
Upland Boneset	*Eupatorium sessilifolium var. brittoi*	Plant		For, Sav			y		SC																	1	0.3		
Cluster Fescue	*Festuca paradoxa*	Plant		Gra, Pal			no?		SC																	1	0.3	G5	SH
Wild Licorice	*Glycyrrhiza lepidota*	Plant		Gra, Rip			y?		SC																	1	0.3	G5	S1
Limestone Oak Fern	*Gymnocarpium robertianum*	Plant		For, Pal			y?		SC																	1	0.3	G5	S1S2
Kentucky Coffee tree	*Gymnocladus dioicus*	Plant		For		X	y		SC																	1	0.3	G5	S2
Azure Bluets	*Houstonia caerulea*	Plant		Gra, Sav		X	y		SC																	1	0.3	G5	S2
Rock Clubmoss	*Huperzia porophila*	Plant		Bar, For			y		SC																	1	0.3	G4	S3
Green violet	*Hybanthus concolor*	Plant		For			no?		SC																	1	0.3	G5	SH
Great Water leaf	*Hydrophyllum appendiculatum*	Plant		For			y?		SC																	1	0.3	G5	S2S3
Shrubby St. John's wort	*Hypericum prolificum*	Plant		For, Gra, Pal		X	y		SC																	1	0.3	G5	S1
Round-fruited St. John's-wort	*Hypericum sphaerocarpum*	Plant		Gra, Pal		X	y		T																	1	0.3	G5	S1S2
Purple Rocket	*Iodanthus pinnatifidus*	Plant		For, Pal			y?		SC																	1	0.3	G5	S1
Twinleaf	*Jeffersonia diphylla*	Plant		For			y?		SC																	1	0.3	G5	S3
Butternut	*Juglans cinerea*	Plant		For, Rip			y		SC																	1	0.3		
Violet Bush clover	*Lespedeza violacea*	Plant		Bar, For			y?		SC																	1	0.3	G5	S2
Slender Bush clover	*Lespedeza virginica*	Plant		Gra, Sav			y?		T																	1	0.3	G5	S2
Silver Bladderpod	*Lesquerella ludoviciana*	Plant		Gra			y?		T																	1	0.3	G5	S1

								T & E		SWAP	FWS				PIF	LCC	UMRGLR JV BIRD PLANS												
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Dotted Blazing Star	*Liatris punctata var. nebraskana*	Plant		Gra			y?		E																	1	0.3	G5T3T5	S2S3
American Gromwell	*Lithospermum latifolium*	Plant		For			y?		SC																	1	0.3	G4	S4
Three-flowered Melic Grass	*Melica nitens*	Plant		For			y?		SC																	1	0.3	G5	S1
Small Forget-me-not	*Myosotis laxa*	Plant		Rip, Riv			y		SC																	1	0.3	G5	S2
Glade Mallow	*Napaea dioica*	Plant		For, Gra, Rip			y		SC																	1	0.3	G4	S3
Prairie False-dandelion	*Nothocalais (=Microseris) cuspidat*	Plant		Gra			y		SC																	1	0.3	G5	S2
Yellow Water Lily	*Nuphar advena*	Plant		Lac, Riv		X	y		SC																	1	0.3	G5T5	S1
Brittle Prickly-pear	*Opuntia fragilis*	Plant		Bar, Gra			y		T																	1	0.3	G4G5	S3
Clustered Broomrape	*Orobanche fasciculata*	Plant		Bar, Gra			y		T																	1	0.3	G4	S1
One-flowered Broomrape	*Orobanche uniflora*	Plant		Gra, For, Rip, Shr			y?		SC																	1	0.3	G5	S3
Prairie Ragwort	*Packera plattensis*	Plant		Gra			y?		SC																	1	0.3	G5	S3
American Ginseng	*Panax quinquefolius*	Plant		For			y?		SC																	1	0.3	G3G4	S4
American Feverfew	*Parthenium integrifolium*	Plant		Gra			y?		SC																	1	0.3	G5	S3S4
Silvery Scurf Pea	*Pediomelum argophyllum*	Plant		Gra			y?		SC																	1	0.3	G5	S1
Prairie Turnip	*Pediomelum esculentum*	Plant		Gra			y?		SC																	1	0.3	G5	S3
Purple-stem Cliff-brake	*Pellaea atropurpurea*	Plant		Bar			no?		SC																	1	0.3	G5	S2
Hairy Beardtongue	*Penstemon hirsutus*	Plant		Gra, Sav		X	y		SC																	1	0.3	G4	S1
Pale beard tongue	*Penstemon pallidus*	Plant		Gra, Sav			y?		SC																	1	0.3	G5	S1
Arrow-leaved Sweet-coltsfoot	*Petasites sagittatus*	Plant		Pal, Shr			no?		T																	1	0.3	G5	S3
Broad Beech Fern	*Phegopteris hexagonoptera*	Plant		For			y?		SC																	1	0.3	G5	S2
Prairie Fame-flower	*Phemeranthus (=Talinum) rugospe*	Plant		Bar, Gra			y		SC																	1	0.3	G3G4	S3
Cleft Phlox	*Phlox bifida ssp. stellaria*	Plant		Sav			y?		SC																	1	0.3	G5?T3	S1
Tubercled Rein-orchid	*Platanthera flava var. herbiola*	Plant		For, Gra, Pal, Rip			y		T																	1	0.3	G4T4Q	S2
Hooker's Orchid	*Platanthera hookeri*	Plant		For			y		SC																	1	0.3	G4	S2
Sycamore	*Platanus occidentalis*	Plant		For, Pal		X	y		SC																	1	0.3	G5	S2
Bog Bluegrass	*Poa paludigena*	Plant		For, Pal			y?		SC																	1	0.3	G3	S3
Woodland Bluegrass	*Poa sylvestris*	Plant		For, Rip			y?		SC																	1	0.3	G5	S1
Wolf's Bluegrass	*Poa wolfii*	Plant		For			y		SC																	1	0.3	G4	S1
Pink Milkwort	*Polygala incarnata*	Plant		Gra			y?		E																	1	0.3	G5	S1
Christmas Fern	*Polystichum acrostichoides*	Plant		For			y?		SC																	1	0.3	G5	S2
Prairie Parsley	*Polytaenia nuttallii*	Plant		Gra, Sav			y		T																	1	0.3	G5	S2
Water-thread Pondweed	*Potamogeton diversifolius*	Plant		Pal		X	y		SC																	1	0.3	G5	S2
Spotted Pondweed	*Potamogeton pulcher*	Plant		Pal, Rip		X	y		E																	1	0.3	G5	S1
Rough Rattlesnake-root	*Prenanthes aspera*	Plant		Gra			y		E																	1	0.3	G4?	S1
Nodding Rattlesnake-root	*Prenanthes crepidinea*	Plant		For, Sav, Rip			y?		E																	1	0.3	G4	S1
Bird's-eye Primrose	*Primula mistassinica*	Plant		Bar			y?		SC																	1	0.3	G5	S3
Catfoot	*Pseudognaphalium micradenium*	Plant		Sav			y?		SC																	1	0.3	4G5T3	S1
Cliff Cudweed	*Pseudognaphalium obtusifolium va*	Plant		Bar, Rip			y?		T																	1	0.3	G5T2	S2
Wafer-ash	*Ptelea trifoliata*	Plant		Gra, For, Rip, Sav			y		SC																	1	0.3	G5	S2
Chinquapin Oak	*Quercus muehlenbergii*	Plant		Rip, Sav			y?		SC																	1	0.3	G5	S1S2
Pin Oak	*Quercus palustris*	Plant		Pal, Rip		X	y		SC																	1	0.3	G5	S1
Lanced-leaved Buckthorn	*Rhamnus lanceolata ssp. glabrata*	Plant		Shr			y?		SC																	1	0.3	G5T4T5	S1
Virginia Meadow-beauty	*Rhexia virginica*	Plant		Gra, Rip			no?		SC																	1	0.3	G5	S3
Lapland Azalea	*Rhododendron lapponicum*	Plant		Bar			no?		E																	1	0.3	G5	S1
Hairy wild petunia	*Ruellia humilis*	Plant		Gra, Sav		X	y		E																	1	0.3	G5	S2
Long-lobe Arrowhead	*Sagittaria calycina*	Plant		Rip, Riv			y		SC																	1	0.3	G5	S1
Silky Willow	*Salix sericea*	Plant		Bar, Rip			y?		SC																	1	0.3	G5	SH
Slender Bulrush	*Schoenoplectus heterochaetus*	Plant		Rip			y?		SC																	1	0.3	G5	S1
Tall Nut-rush	*Scleria triglomerata*	Plant		Sav			y?		SC																	1	0.3	G5	S2S3
Heart-leaved Skullcap	*Scutellaria ovata ssp. ovata*	Plant		For			y		SC																	1	0.3	G5T5	S3
Small Skullcap	*Scutellaria parvula var. parvula*	Plant		Bar, Gra			y		E																	1	0.3	G4T4	S1
Maryland Senna	*Senna marilandica*	Plant		Gra, Rip, Sav			no?		SC																	1	0.3	G5	S1
Snowy Campion	*Silene nivea*	Plant		For, Gra, Rip			y?		SC																	1	0.3	G4?	S2
Shadowy Goldenrod	*Solidago sciaphila*	Plant		Bar			y?		SC																	1	0.3	G3G4	S4
October Lady's-tresses	*Spiranthes ovalis var. erostellata*	Plant		For, Gra, Sav			y?		SC																	1	0.3	G5?T4?	S1

								T & E		SWAP	FWS				PIF	LCC	UMRGLR JV BIRD PLANS													
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Slick-seed Wild-bean	*Strophostyles leiosperma*	Plant		Bar, Gra			y		SC																	1	0.3	G5	S2
Canadian Yew	*Taxus canadensis*	Plant		For			y?		SC																	1	0.3	G5	S4
Waxleaf Meadowrue	*Thalictrum revolutum*	Plant		Gra, Shr		X	y		SC																	1	0.3	G5	S2
Hairy‐jointed Meadow‐parsnip	*Thaspium chapmanii*	Plant		Sa v			y?		E																	1	0.3	G5	S1
Purple Meadow‐parsnip	*Thaspium trifoliatum var. flavum*	Plant		For, Gra			y?		SC																	1	0.3	G5T5	S2
Snow Trillium	*Trillium nivale*	Plant		For			y?		T																	1	0.3	G4	S3
Nodding Pogonia	*Triphora trianthophora*	Plant		For			y?		SC																	1	0.3	G3G4	S2
Sand Violet	*Viola sagittata var. ovata*	Plant		Bar			no?		E																	1	0.3	G5T5	S2
Oregon Woodsia	*Woodsia oregana ssp. cathcartiana*	Plant		Bar			no?		SC																	1	0.3	G5T5	S1
White Camas	*Zigadenus elegans var. glaucus*	Plant		Bar, Gra, Sav			y		SC																	1	0.3	G5T4T5	S2S3

Appendix D: ROCSTAR: Resources of Concern Selection Tool for Americas Refuges

ROCSTAR: Resources of Concern Selection Tool for Americas Refuges

From the Handbook: Now you must selectively reduce this table to those species and plant communities that will be managed to fulfill obligations to refuge purposes, Refuge System resources of concern, and biological integrity, diversity, and environmental health...We suggest using the following filters to help you select the appropriate focal resources: site capabilities, limiting factors, response to management or restoration, best science, and professional judgment. Also consider ecological or ecosystem processes within the refuge and surrounding landscape and importance for the maintenance and restoration of biological integrity, diversity, and environmental health when selecting focal resources.

Step 5. Identify Priority Refuge Resources of Concern

1. Select guilds and/or groups or community types of significance that utilize the broad habitat type noted within the BIDEH table (Step 3).
2. For each broad habitat type representing BIDEH within Step 3, select a number of "potential priority refuge ROC's" that help achieve refuge purpose AND rank moderate to high in regional priority rankings.
3. Select initial "potential priority refuge ROC's" from each group, guild, or significant community type to populate the scoring matrix below.
4. Score filters for each species and/or community based on available data, literature, professional judgment, and scoring definitions on the tab titled "Scoring Definitions and Scales".
5. Evaluate scoring to narrow down and select priority refuge ROC's. Be sure to consider the varying needs of different guilds, time of year, habitat availability, and biological capabilities. Select numerous species or guilds as necessary to evaluate future management and monitoring.

* Assumes that the filter of Refuge and Trust resources (Steps 1 and 2 have been applied. Can be done tracked in Step 4. Comprehensive ROC)

PRAIRIE

Species - Grassland	Ratio of priority rankings or listings in Federal, State, or regional plans	Ability to be supported by current or restorable refuge capabilities? (See scoring scale A)	Abundance on Refuge (See scoring scale B)	Responds well to habitat management? (See scoring scale C)	Ability to represent a larger guild or group of species? (See scoring scale D)	Ability to represent on-refuge ecological processes, or broader ecosystem processes? (See scoring scale E)	Scoring
First picks:							
Henslow's Sparrow	10	3	1	1	7	5	4.70
Eastern Meadowlark	5	7	5	7	10	7	**6.75**
Upland Sandpiper	10	3	1	3	7	3	4.70
Bell's Vireo	7	5	5	5	3	3	4.80
Other options:							
Bobolink	7	7	1	7	5	7	5.80
Hudsonian Godwit	7	1	1	3	1	1	2.50
Short-eared Owl	7	7	1	3	3	5	4.60
Dickcissel	5	10	5	4	3	1	4.95
Le Conte's Sparrow	5	7	1	3	3	3	3.90
Grasshopper Sparrow	5	7	10	10	7	7	**7.50**
Kirtland's Warbler	5	1	1	5	1	1	2.40
Weight	*0.2*	*0.2*	*0.15*	*0.15*	*0.15*	*0.15*	*1.00*

SAVANNA

Species – Savanna	Ratio of priority rankings or listings in Federal, State, or regional plans	Ability to be supported by current or restorable refuge capabilities? (See scoring scale A)	Abundance on Refuge (See scoring scale B)	Responds well to habitat management? (See scoring scale C)	Ability to represent a larger guild or group of species? (See scoring scale D)	Ability to represent on-refuge ecological processes, or broader ecosystem processes? (See scoring scale E)	Scoring
First picks:							
Red-headed Woodpecker	7	10	7	10	10	10	**8.95**
Other options:							
Northern Flicker	3	10	7	10	10	5	7.40
Weight	*0.2*	*0.2*	*0.15*	*0.15*	*0.15*	*0.15*	*1.00*

WETLANDS

Species - Wetlands	Ratio of priority rankings or listings in Federal, State, or regional plans	Ability to be supported by current or restorable refuge capabilities? (See scoring scale A)	Abundance on Refuge (See scoring scale B)	Responds well to habitat management? (See scoring scale C)	Ability to represent a larger guild or group of species? (See scoring scale D)	Ability to represent on-refuge ecological processes, or broader ecosystem processes? (See scoring scale E)	Scoring
First picks:							
Black Tern	10	10	10	7	8	8.5	**9.03**
Mallard	3	10	10	10	10	7	**8.15**
American Bittern	5	10	5	3	7	7	**6.30**
Short-billed Dowitcher	5	5	3	5	10	7	**5.75**
Rusty Blackbird	5	7	3	3	3	1	**3.90**
Other options:							
Whooping Crane	7	3	1	3	1	5	**3.50**
King Rail	7	7	1	3	7	5	**5.20**
Blue-winged Teal	3	10	7	7	10	10	**7.70**
Common Tern	7	3	1	3	7	1	**3.80**
Lesser Scaup	5	5	7	7	7	3	**5.60**
Common Loon	3	7	1	1	1	3	**2.90**
Le Conte's Sparrow	5	7	1	3	3	3	**3.90**
Trumpeter Swan	5	7	3	5	1	5	**4.50**
American Black Duck	5	7	3	5	7	1	**4.80**
Yellow Rail	7	0	0	0	0	0	**1.40**
Least Bittern	5	5	1	3	7	3	**4.10**
Black-crowned Night-heron	5	7	1	3	1	1	**3.30**
Hudsonian Godwit	7	1	1	3	3	1	**2.80**
Marbled Godwit	7	3	1	3	3	3	**3.50**
American Godwit	7	0	0	0	0	0	**1.40**
Buff-breasted Sandpiper	7	3	1	5	3	3	**3.80**
Whimbrel	5	3	1	5	3	3	**3.40**
Red Knot	5	3	1	5	3	3	**3.40**
Solitary Sandpiper	5	3	1	5	3	3	**3.40**
Wilson's Phalarope	5	3	1	5	3	3	**3.40**
Willow Flycatcher	5	7	3	7	1	7	**5.10**
Louisiana Waterthrush	5	7	7	7	5	7	**6.30**
Peregrine Falcon	5	5	1	1	1	3	**2.90**
Weight	*0.2*	*0.2*	*0.15*	*0.15*	*0.15*	*0.15*	*1.00*

FOREST

Species - Forest	Ratio of priority rankings or listings in Federal, State, or regional plans	Ability to be supported by current or restorable refuge capabilities? (See scoring scale A)	Abundance on Refuge (See scoring scale B)	Responds well to habitat management? (See scoring scale C)	Ability to represent a larger guild or group of species? (See scoring scale D)	Ability to represent on-refuge ecological processes, or broader ecosystem processes? (See scoring scale E)	Scoring
First picks:							
Wood Thrush	10	7	3	7	7	5	**6.70**
Canada Warbler	7	7	1	1	7	7	**5.20**
Golden-winged Warbler	10	7	3	5	7	3	**6.10**
American Woodcock	7	7	10	10	3	3	**6.70**
Other options:							
Pine Warbler	1	3	3	3	3	3	**2.60**
Brown Thrasher	5	10	10	10	10	3	**7.95**
Eastern Whip-poor-will	5	5	1	7	1	3	**3.80**
Black-billed Cuckoo	5	5	5	5	5	7	**5.30**
Blue-winged Warbler	7	10	1	10	7	3	**6.55**
Cerulean Warbler	7	1	5	5	10	10	**6.10**
Prothonotary Warbler	7	1	3	5	7	7	**4.90**
Olive-sided Flycatcher	5	0	0	0	0	0	**1.00**
Louisiana Waterthrush	5	7	7	7	5	7	**6.30**
Eastern Whip-poor-will	5	5	1	7	1	3	**3.80**
Black-billed Cuckoo	5	5	5	5	5	7	**5.30**
Bald Eagle	5	10	10	5	7	10	**7.80**
Kentucky Warbler	5	1	1	3	0	0	**1.80**
Red-headed Woodpecker	7	10	7	10	10	10	**8.95**
Northern Waterthrush	1	10	7	10	10	10	**7.75**
Weight	*0.2*	*0.2*	*0.15*	*0.15*	*0.15*	*0.15*	*1.00*

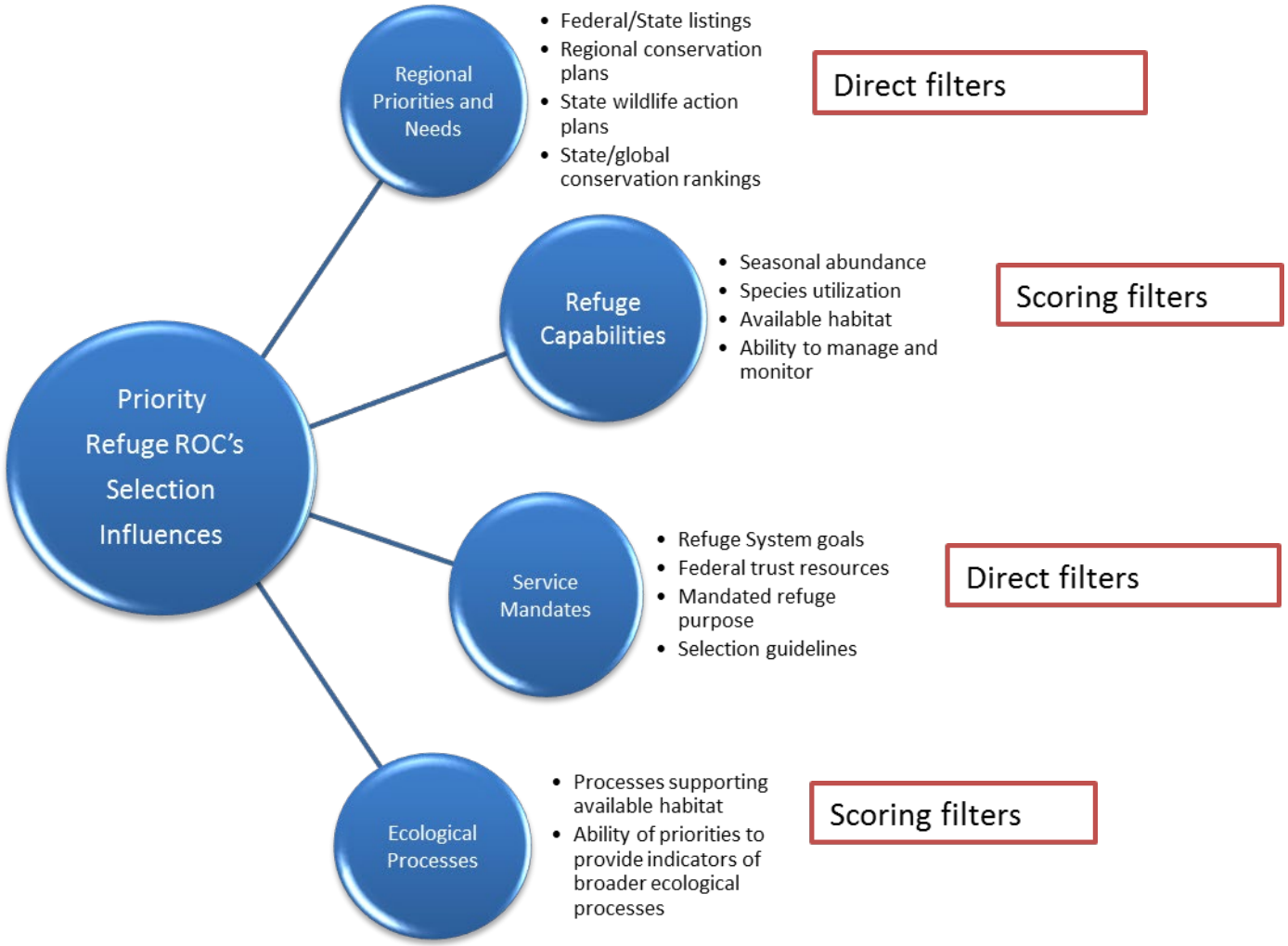
FORESTED WETLANDS

Species – Forested Wetlands	Ratio of priority rankings or listings in Federal, State, or regional plans	Ability to be supported by current or restorable refuge capabilities? (See scoring scale A)	Abundance on Refuge (See scoring scale B)	Responds well to habitat management? (See scoring scale C)	Ability to represent a larger guild or group of species? (See scoring scale D)	Ability to represent on-refuge ecological processes, or broader ecosystem processes? (See scoring scale E)	Scoring
First picks:							
Red-shouldered Hawk	3	1	1	5	7	7	**3.80**
Wood Duck	3	10	10	10	7	7	**7.70**
Prothonotary Warbler	7	1	3	5	7	7	**4.90**
Louisiana Waterthrush	5	7	7	7	5	7	**6.30**
Bald Eagle	5	10	10	5	7	10	**7.80**
Other options:							
Brown Thrasher	7	7	10	10	3	3	**6.70**
Northern Waterthrush	1	10	7	10	10	10	**7.75**
Weight	*0.2*	*0.2*	*0.15*	*0.15*	*0.15*	*0.15*	*1.00*

Summary of Filter Scoring Criteria* and Determining Factors Used in Value Assignments

Scoring Criteria	# of priority rankings or listings in Federal, State, or regional plans	Ability to be supported by current or restorable refuge capabilities? (See scoring scale A)	Abundance on Refuge (See scoring scale B)	Responds well to habitat management? (See scoring scale C)	Ability to represent a larger guild or group of species? (See scoring scale D)	Ability to represent (a) on-refuge ecological processes, (b) broader ecosystem processes, or (c) their importance in the maintenance or restoration of BIDEH? (See scoring scale E)
Summary of determining factors and likely information sources.	Based on summary listings in the Potential ROC list developed for the refuge.	Based on knowledge of refuge habitats and conditions required for migratory and/or breeding habitat preferences found in literature.	Based on abundance and breeding listings in the Potential ROC list developed for the refuge.	Based on knowledge of refuge habitats and conditions required for migratory and/or breeding habitat preferences found in literature.	Based on knowledge of other birds of similar guilds and habitat requirements based on professional judgment or in literature.	Based on knowledge of species relation to ecological processes that support refuge habitats (soils, hydrology, disturbance regimes), broader ecosystem processes (watershed impacts, climate change), or the importance of the species in evaluating the maintenance or restoration of BIDEH based on professional judgment or in literature.

*Based on filters described in Step 5: Identify Priority Refuge Resources of Concern, pages 18-19 of Identifying ROC's Handbook.


Priority Refuge ROC's Selection Influences
Regional Priorities and Needs
Federal/State listings
Regional conservation plans
State wildlife action plans
State/global conservation rankings
Direct filters
Refuge Capabilities
Seasonal abundance
Species utilization
Available habitat
Ability to manage and monitor
Scoring filters
Service Mandates
Refuge System goals
Federal trust resources
Mandated refuge purpose
Selection guidelines
Direct filters
Ecological Processes
Processes supporting available habitat
Ability of priorities to provide indicators of broader ecological processes
Scoring filters

Conservation Plan List Ratio of Inclusion

0.8 - 1.0	10
0.6 - 0.79	7
0.4 - 0.59	5
.2 - 0.39	3
0.0 - 0.19	1

Scoring Scale A - Assign values based on literature review, professional judgment, and definitions provided.

Strongly Able	10	Current refuge habitat(s) provide a variety of forage, breeding, and migratory requirements during all or part of the species life history.
Somewhat Able	7	Current refuge habitat(s) (or conditions practically restored or enhanced) provide some forage, breeding, and migratory requirements during all or part of the species life history.
Limited Ability	5	Current refuge habitat(s) provide occasional or limited forage, breeding, and migratory requirements during a portion of the species life history. Significant restoration or enhancement would be necessary to increase supporting habitat ability.
Inconclusive/Uncertain	3	Current literature available or working knowledge of species poses a significant degree of uncertainty in terms of the refuge habitat(s) ability to provide forage, breeding, and migratory requirements during all or part of the species life history.
Clearly Unable	1	Current literature available and/or working knowledge of species indicates that refuge habitat(s) have limited or no ability to provide substantial forage, breeding, and migratory requirements during all or part of the species life history.

Scoring Scale B - Assign values based on refuge I&M records and professional judgment.

Birds		**Fish, Plants, Herps, and Other Native Wildlife**	
Common throughout breeding season	10	Common throughout refuge	10
Common during migration only	7	Common along portions of refuge	7
Occasional during breeding	5	Occasional/Uncommon throughout refuge	5
Occasional during migration	3	Occasional/Uncommon along portions of refuge	3
Uncommon/rare	1	Rare or no local records.	1

Scoring Scale C - Assign values based on literature review, professional judgment, and definitions provided.

Strongly Able	10	Species is documented or (based on professional judgment) is known to respond positively to habitat management**. Suitable habitat management actions are practical for the refuge to implement and can be monitored easily.
Somewhat Able	7	Species response to management** actions is less documented, but (based on professional judgment) is likely to respond positively to habitat management. Suitable habitat management actions are practical for the refuge to implement, but may require additional or detailed I&M efforts to ensure response is documented.
Limited Ability	5	Species response to management** actions is less documented and (based on professional judgment) is less likely to respond positively to habitat management. Species may have generalist habitat requirements or be difficult to evaluate with I&M. Suitable habitat management actions are either difficult for the refuge to implement, or monitor a direct response.
Inconclusive/Uncertain	3	Species response is not clearly documented and (based on refuge I&M or professional judgment) is uncertain as to whether it can have a reliable response to habitat management**.
Clearly Unable	1	Species response to management** actions is documented or (based on professional judgment) is not likely to respond positively to habitat management. Species may have generalist habitat requirements or be difficult to evaluate with I&M. Suitable habitat management actions are either difficult for the refuge to implement, or monitor a direct response.

** Management may include preservation, protection, restoration, enhancement, or other specific conservation measures taken to sustain a particular habitat or species requirement.

Scoring Scale D - Assign values based on literature review, professional judgment, and definitions provided.

Strongly Able	10	Species is documented or (based on refuge I&M or professional judgment) likely to represent (focal, umbrella, indicator, or keystone) other species. Species known to share a suite of habitat requirements with other species, guilds, or groups utilizing the refuge.
Somewhat Able	7	Species is not clearly documented, but (based on refuge I&M or professional judgment) may potentially represent (focal, umbrella, indicator, or keystone) other species. Species likely shares a suite of habitat requirements with other species, guilds, or groups utilizing the refuge.
Limited Ability	5	Species is not clearly documented and (based on refuge I&M or professional judgment) is less likely to represent (focal, umbrella, indicator, or keystone) other species. Species is either a) very specific, or b) a generalist in terms of habitat requirements related to other species, guilds, or groups utilizing the refuge.
Inconclusive/Uncertain	3	Species is not clearly documented and (based on refuge I&M or professional judgment) is uncertain as to whether it can represent (focal, umbrella, indicator, or keystone) other species.
Clearly Unable	1	Species is documented (or based on refuge I&M or professional judgment) to be unable represent (focal, umbrella, indicator, or keystone) other species. Due to a lack of similar guilds or groups available or very specific habitat requirements.

Scoring Scale E - Assign values based on literature review, professional judgment, and definitions provided.

Strongly Able	10	Species is documented or (based on refuge I&M or professional judgment) likely to strongly act as an indicator of both: on-refuge ecological processes AND broader landscape ecosystem processes.
Somewhat Able	7	Species is documented or (based on refuge I&M or professional judgment) likely to strongly act as an indicator of either: on-refuge ecological processes OR broader landscape ecosystem processes.
Limited Ability	5	Species is documented or (based on refuge I&M or professional judgment) somewhat likely to act as an indicator of either: on-refuge ecological processes OR broader landscape ecosystem processes.
Inconclusive/Uncertain	3	Species is documented or (based on refuge I&M or professional judgment) less likely or uncertain to act as an indicator of either: on-refuge ecological processes OR broader landscape ecosystem processes.
Clearly Unable	1	Species is documented or (based on refuge I&M or professional judgment) not likely to act as an indicator of either: on-refuge ecological processes OR broader landscape ecosystem processes.

Appendix E: Existing and Target Habitat Conditions

Table E.1. Trempealeau NWR existing and HMP target habitat conditions within habitat management units.

Management Unit	Unit size (acres)	Broad Habitat Type(s)	sub-habitat types	Existing acres*	Target condition (HMP)	Difference between target and existing
Pool A	936	Forest		**42**	**42**	0
		Forested Wetland		**20**	**20**	0
		Savanna		**0**	**0**	0
		Grassland		**17**	**17**	0
		Wetland (total)		**857**	**857**	0
		Wetland types	*Moist Soils/Mudflats: Mudflats*	***15***	***41***	*26*
			Moist Soils/Mudflats: Shrub Carr	***0***	***0***	*0*
			Emergent Marsh	***38***	***228***	*190*
			Submergent Marsh	***37***	***588***	*551*
			Open water	***767***	***0***	*-767*
		Riverine		**0**	**0**	0
		Developed		**0**	**0**	0
Pool B	2,993	Forest		**1**	**1**	0
		Forested Wetland		**238**	**238**	0
		Savanna		**0**	**0**	0
		Grassland		**38**	**38**	0
		Wetland (total)		**2715**	**2715**	0
		Wetland types	*Moist Soils/Mudflats: Mudflats*	***120***	***120***	*0*
			Moist Soils/Mudflats: Shrub Carr	***66***	***66***	*0*
			Emergent Marsh	***582***	***1149***	*567*
			Submergent Marsh	***105***	***867***	*762*
			Open water	***1842***	***513***	*-1329*

Management Unit	Unit size (acres)	Broad Habitat Type(s)	sub-habitat types	Existing acres*	Target condition (HMP)	Difference between target and existing
		Riverine		**0**	**0**	0
		Developed		**1**	**1**	0
Unit C	246	Forest		**0**	**0**	0
		Forested Wetland		**34**	**34**	0
		Savanna		**0**	**0**	0
		Grassland		**11**	**11**	0
		Wetland (total)		**201**	**201**	0
		Wetland types	*Moist Soils/Mudflats: Mudflats*	***108***	***108***	*0*
			Moist Soils/Mudflats: Shrub Carr	***15***	***15***	*0*
			Emergent Marsh	***39***	***39***	*0*
			Submergent Marsh	***25***	***36***	*11*
			Open water	***14***	***3***	*-11*
		Riverine		**0**	**0**	0
		Developed		**0**	**0**	0
Unit D	468	Forest		**0**	**0**	0
		Forested Wetland		**119**	**119**	0
		Savanna		**0**	**0**	0
		Grassland		**8**	**8**	0
		Wetland (total)		**341**	**341**	0
		Wetland types	*Moist Soils/Mudflats: Mudflats*	***10***	***10***	*0*
			Moist Soils/Mudflats: Shrub Carr	***16***	***16***	*0*
			Emergent Marsh	***175***	***175***	*0*
			Submergent Marsh	***11***	***11***	*0*
			Open water	***129***	***129***	*0*
		Riverine		**0**	**0**	0

Management Unit	Unit size (acres)	Broad Habitat Type(s)	sub-habitat types	Existing acres*	Target condition (HMP)	Difference between target and existing
		Developed		**0**	**0**	0
Unit E	474	Forest		**0**	**0**	0
		Forested Wetland		**38**	**38**	0
		Savanna		**0**	**0**	0
		Grassland		**12**	**12**	0
		Wetland (total)		**424**	**424**	0
		Wetland types	*Moist Soils/Mudflats: Mudflats*	***11***	***11***	0
			Moist Soils/Mudflats: Shrub Carr	***2***	***2***	0
			Emergent Marsh	***153***	***153***	0
			Submergent Marsh	***4***	***232***	228
			Open water	***254***	***26***	-228
		Riverine		**0**	**0**	0
		Developed		**0**	**0**	0
Unit F	647	Forest		**0**	**0**	0
		Forested Wetland		**302**	**302**	0
		Savanna		**0**	**0**	0
		Grassland		**12**	**12**	0
		Wetland (total)		**331**	**331**	0
		Wetland types	*Moist Soils/Mudflats: Mudflats*	***43***	***43***	*0*
			Moist Soils/Mudflats: Shrub Carr	***5***	***5***	*0*
			Emergent Marsh	***133***	***133***	*0*
			Submergent Marsh	***18***	***18***	*0*
			Open water	***132***	***132***	*0*
		Riverine		**0**	**0**	0
		Developed		**2**	**2**	0

Management Unit	Unit size (acres)	Broad Habitat Type(s)	sub-habitat types	Existing acres*	Target condition (HMP)	Difference between target and existing
Prairie Oak Savanna	663	Forest		**186**	**108**	-78
		Forested Wetland		**159**	**65**	-94
		Savanna		**0**	**298**	298
		Grassland		**256**	**130**	-126
		Wetland (total)		**34**	**34**	0
		Wetland types	*Moist Soils/Mudflats: Mudflats*	**0**	**10**	10
			Moist Soils/Mudflats: Shrub Carr	**13**	**13**	0
			Emergent Marsh	**18**	**8**	-10
			Submergent Marsh	**1**	**1**	0
			Open water	**2**	**2**	0
		Riverine		**0**	**0**	0
		Developed		**28**	**28**	
Trempealeau River Watershed	381	Forest		**1**	**1**	0
		Forested Wetland		**225**	**225**	0
		Savanna		**0**	**0**	0
		Grassland		**3**	**3**	0
		Wetland (total)		**69**	**69**	0
		Wetland types	*Moist Soils/Mudflats: Mudflats*	**14**	**14**	0
			Moist Soils/Mudflats: Shrub Carr	**31**	**31**	0
			Emergent Marsh	**24**	**24**	0
			Submergent Marsh	**0**	**0**	0
			Open water	**0**	**0**	0
		Riverine		**83**	**83**	0
		Developed		**0**	**0**	0

*Acreage calculations are from resource grade data by GIS mapping; not official survey acres.

Appendix F: Habitat Management Strategy Descriptions

The following appendix identifies the management tools or strategies used for invasive species management that could be utilized by managers to achieve the habitat objectives outlined in Chapter 4. These strategies were identified through literature review, consultation with other biologists, and feasibility of utilization on Trempealeau NWR. The information in this appendix should be used as a reference when making invasive species management decisions. Many techniques mentioned in Chapter 4 were based on resources already available online and the links are provided here. These online resources should be referenced for further information and direction when applying these strategies.

Invasive Species Management

Prevention Strategies

Actions to prevent invasive species introductions into and within a region are far more cost effective and environmentally desirable than actions undertaken after invasive species establishment (Leung et al. 2002). In addition to Refuge staff actively treating and controlling invasive species, there are other areas in which invasive species management strategies can be considered or incorporated into habitat management:

Working with Partners

Working with partners is one of the most effective way to manage invasive species on a refuge. Control efforts on the refuge will have little long-term impact if the surrounding lands and waters are infested with invasive species. Working with partners on invasive species management is important to USFWS. A detailed summary of invasive species related partnerships and funding sources is available online at http://www.fws.gov/invasives/partnerships.html. Where possible, refuge habitat management should consider the support available through partnerships and resources listed here.

Incorporate Invasive Species Prevention in All Habitat Management Activities

Field activities for habitat management can introduce invasive species and create disturbances favorable to species introductions. Some considerations for prevention include:

- Minimize ground disturbance and restore disturbed areas.
- Require mulch, sand, gravel, dirt, and other construction materials to be certified as free of noxious weed seeds.
- Avoid stockpiles of weed-infested materials.
- Inspect vehicles, machinery, and gear (hand tools, clothing, hats, socks, shoes, gloves, jackets, etc.) before and after conducting activities
- Remove any contaminated material (plants, animals, and mud) from personal gear in a designated area
- Clean and sanitize sensitive equipment every time it has been exposed to substrates that may harbor invasive species or use dedicated field gear for each site with unique

invasive species risks.

- When loaning equipment or vehicles, make an expectation that the equipment is loaned out clean and returned clean.
- Where possible, take reasonable steps to avoid transit through areas of high density, or small isolated populations of invasive species.
- Minimize the number of entry points to a project site.

Invasive Species Management

Controlling and managing invasive species is a strategy for maintaining the biological integrity and diversity of all habitats when prevention has failed. In 2015, NWRS invasive species representatives (strike team, invasive species, and IPM coordinators) from all eight regions and headquarters jointly refined a conceptual model depicting the phases of strategic and adaptive invasive plant management (Figure E.1.). The model was first developed by Region 8 to help focus regional support for invasive plant management. Although focused on invasive plants, the model can be applied in theory to other taxa. In general, the model outlines an iterative approach of invasive species management that includes prioritization, inventorying, management, and monitoring.

Potential management strategies for prioritizing control efforts for established invasive species and controlling invasive species are generally described in the sections below. Prior to the initiation of invasive species control efforts, the refuge manager must understand the biology of the species to be controlled. When invasive species become established, a number of resources are available to assist refuge managers with selecting species-specific strategies for invasive species management. Some good sources of management information include:

- National Invasive Species Information Center: http://invasivespeciesinfo.gov/index.shtml
- Center for Invasive Species and Ecosystem Health: http://www.invasive.org/
- USGS Invasive Species Program: http://biology.usgs.gov/invasive/
- Midwest Invasive Plant Network (MIPN): http://mipn.org/
- Weeds Gone Wild: http://www.nps.gov/plants/alien/index.htm

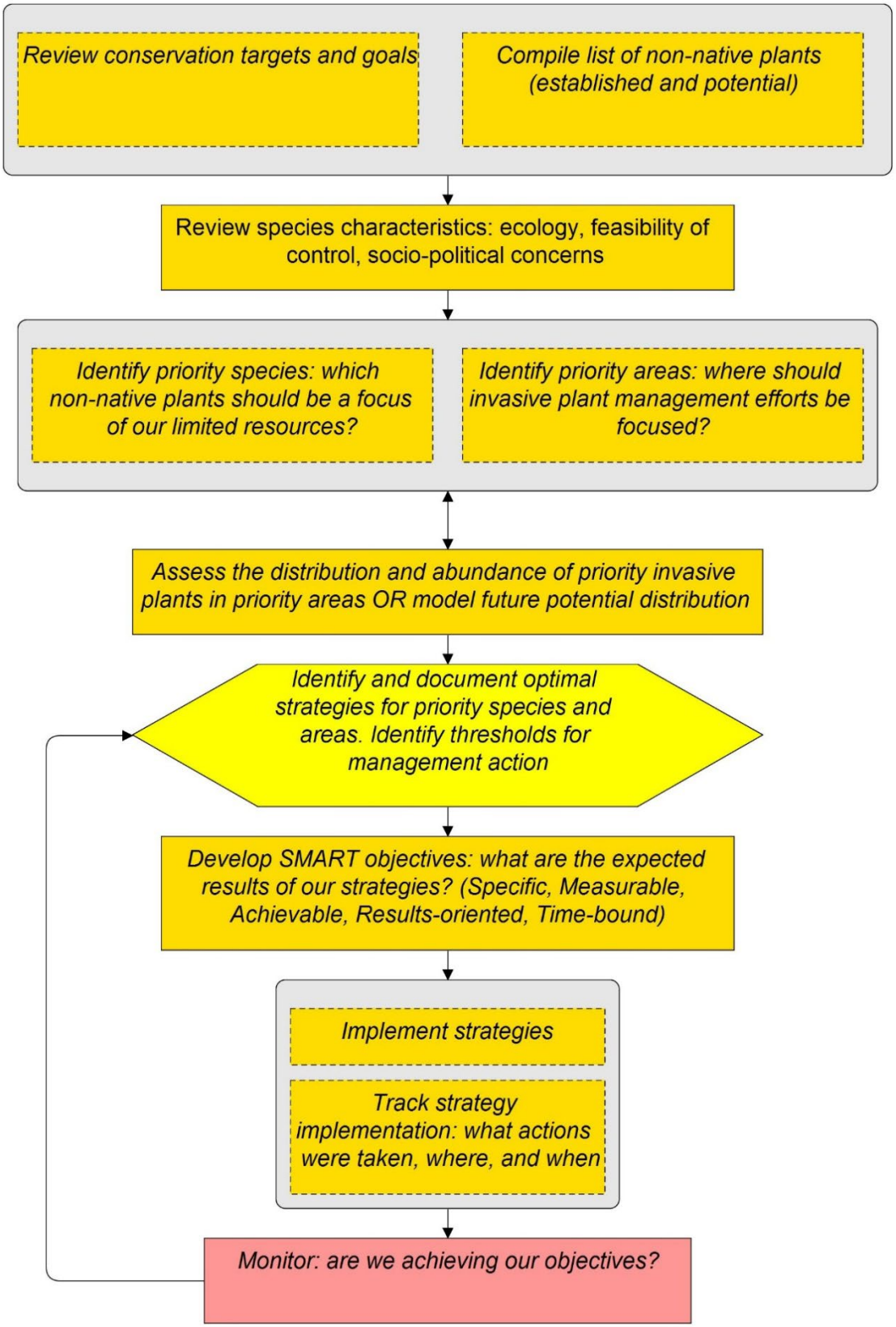


Figure F.1. Phases of strategic and adaptive invasive plant management.

Early Detection and Rapid Response (EDRR)
Where prevention is not possible, early detection and rapid response is the next best strategy for new invasions. The Department of Interior released a general framework for EDRR efforts in 2016 (DOI 2016).

- See: https://www.doi.gov/sites/doi.gov/files/National%20EDRR%20Framework.pdf

This approach to invasive species control is based on the well-documented phases of invasion (Rawlins et al. 2011 and depicted in Figure E.2. below), with the goal of recognizing invasions in their early phase and eradicating infestations before they grow too large to eradicate. Success will depend, in part, on participation by all refuge staff, researchers, and volunteers to report and respond to invasions.

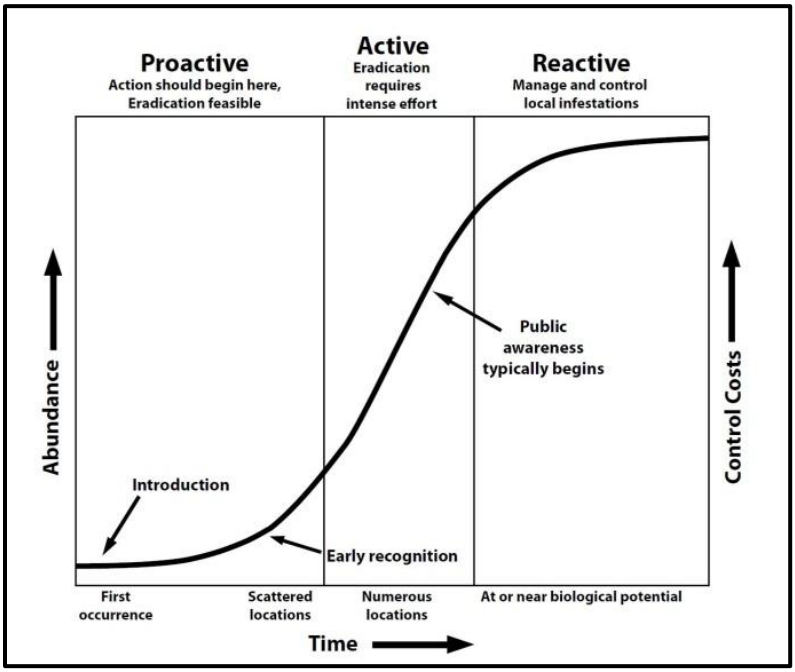


Figure F.2. Phases of invasive species invasion and control (from Rawlins et al. 2011).

Tools and resources for early detection and distribution mapping have been developed and are readily available online from a number of sources. One such source of information includes EDDMapS (Early Detection and Distribution Mapping System) developed by The University of Georgia - Center for Invasive Species and Ecosystem Health. This site includes mapping tools, species distribution maps, and other spatial datasets that inform invasive species distribution:

- EDDMapS: https://www.eddmaps.org/

When small infestations are spotted, they should be eradicated as soon as possible. The site must then be monitored for several years to ensure the control was effective.

Prioritizing Invasive Species Control Efforts

The first step in prioritizing invasive species control efforts is to set clear management objectives and then compare a suite of management alternatives against those objectives. Once measureable objectives and management alternatives have been selected then prioritization can occur.

There are a number of ranking tools to assist land managers with the daunting task of prioritizing their invasive plant control efforts. The *Fulfilling the Promise* National Invasive Species Management Strategy Team recommends using the following order of priority to determine appropriate actions:

1. Smallest scale of infestation
2. Poses greatest threat to land management objectives
3. Greatest ease of control.

The following ranking systems are available for prioritizing invasive plant species control:

- Morse, L.E., J.M. Randall, N. Benton, R. Hiebert, and S. Lu. 2004. An Invasive Species Assessment Protocol: Evaluating Non-Native Plants for Their Impact on Biodiversity. Version 1. NatureServe, Arlington, Virginia. Available online at: http://www.natureserve.org/library/invasiveSpeciesAssessmentProtocol.pdf
- Hiebert, R.D. and J. Stubbendieck. 1993. Handbook for Ranking Exotic Plants for Management and Control. National Park Service. Natural Resources Report NPS/NRMWRO/NRR-93/08. Denver, Colorado. Available online at: http://especes-envahissantes-outremer.fr/pdf/methode_hierarchisation_hiebert.pdf
- APRS Implementation Team. 2000. Alien plants ranking system version 5.1. Jamestown, ND: Northern Prairie Wildlife Research Center Online. (Version 30SEP2002).
- Zimmerman, C., M. Jordan, G. Sargis, H. Smith, K. Schwager. 2011. An Invasive Plant Management Decision Tool. Version 1.1. The Nature Conservancy, Arlington, Virginia. Available online at: http://greatlakesresilience.org/sites/default/files/library_reference_2011_TheNatureConservancy_IPMDAT.pdf

Categories of treatment control are adapted from guidance outlined in The Nature Conservancy's Invasive Plant Management Decision Analysis Tool Report (Zimmerman et al. 2011). This recommended approach contains three potential control options: eradication, containment, and suppression.

- Eradication attempts to eliminate all individuals and the seed bank from an area with the low likelihood of needing to address the species again in the future.
- A containment/reduction approach prevents infestations of invasive species from spreading to uninfested areas and (where possible) seeks to reduce population sizes to a level suitable for eradication.
- Suppression attempts to reduce an invasive plant population in size, abundance, and/or

reproductive output below the threshold needed to maintain a species or ecological process.

"Eradication is considered successful when no plants are recovered from the initial infested area for three consecutive years" (Zimmerman et al. 2011). Eradication is practical only for small-scale infestations, generally identified in the introduction phase. Rejmánek and Pitcairn (2002) recommend infestations of < 1 ha (2.47 acres) be considered for eradication in California.

According to Zimmerman et al. (2011), containment may involve methods that prevent reproduction and dispersal, treating the perimeter of a large infestation, and/or eliminating small satellite infestations. "Containment is most effective with species that spread slowly, move short distances, and for which effective barriers can be established" (Hulme 2006). Reduction seeks to eliminate any occurrences within the area and/or prevent the invasive species from spreading into the project area from the surrounding landscape. Similar techniques and management thresholds are at work for either focus of this approach.

The timeframe of a suppression effort may vary depending on the invasive plant and desired conservation outcome. Zimmerman et al. (2011) cites several examples where suppression is best suited:

1. Areas targeted for planting desired species in order to establish and become competitive.
2. Interim competition pressure on desired species needs to be reduced so that they may persist.
3. Areas where suppression helps maintain conditions for rare or listed species.

Restore Altered Habitats and Reintroduce Native Plants

Restoration is critically important because the conditions responsible for the initial invasion will expose the site to a resurgence of the invasive species, as well as a secondary invasion of one or more different species. Furthermore, restoration of a disturbed area before the initial invasion may preclude the need for further control efforts. The goal is to conserve and promote natural processes that will inherently suppress potential pest populations (DOI 2007).

If funding or personnel are not available to restore highly disturbed areas in a timely manner, consider planting a cover crop for several years to stabilize the site prior to reintroducing native plants. This will prevent more invasive seeds from entering the environment until the site can be restored. Native plants can then be established by direct seeding or planting with less competition from invasives in the seed bank. When practical, local genotypes of native species should be used.

Biological Control

Biological control is the use of animals or disease organisms that feed upon or parasitize the invasive species target. Usually, the control agent is imported from the invasive species' home country, and artificially high numbers of the control agent are fostered and maintained. There

are also “conservation” or “augmentation” biological control methods where populations of biological agents already in the environment (usually native) are maintained or enhanced to target an invasive species. The advantages of this method are that it avoids the use of chemicals and can provide relatively inexpensive and permanent control over large areas. Appropriate control agents do not exist for all invasive species. Petitions must be submitted to, and approved by, the USDA Technical Advisory Group on weed biological control before any proposed biological control agent can be released in the United States.

Detailed discussion of the application and impacts of biological controls on Service lands is available at:
http://www.fws.gov/invasives/staffTrainingModule/methods/biological/impacts.html

Physical Control
Physical (also referred to as mechanical or manual) removal of invasive organisms can be effective against some herbaceous plants, shrubs and saplings, and aquatic organisms. This is particularly effective for plants that are annuals or have a taproot. Care should be taken to minimize soil disturbance to prevent creating conditions ideal for weed seed germination. Repeated cutting over a growing period is needed for effective control of many invasive plant species. Care should be taken to properly remove and dispose of any plant parts that can re-sprout. Treatments should be timed to prevent seed set and re-sprouting. The following methods are available: hand-pulling, pulling with hand tools (weed wrench, etc.), mowing, brush-hogging, weed-eating, stabbing (cutting roots while leaving in place), girdling (removing cambium layer), mulching, tilling, smothering (black plastic or other), and flooding.

Mowing can be used to reduce plant height and deplete energy reserves of invasive and robust plants. Repeated mowing within a growing season is often necessary to successfully control invasive plants. This can be logistically difficult in a habitat that is managed for various resources of concern. However, mowing can be effective when combined with other strategies, such as chemical treatment, spring flooding, and disking. Timing of mowing should be scheduled to maximize above ground energy reserves and to prevent seed dispersal (late summer). Mowing may also increase plant diversity by creating space (light) for other species to germinate.

The advantages of mechanical treatment are low cost for equipment and supplies and minimal damage to neighboring plants and the environment. The disadvantages are higher costs for labor and inability to control large areas. For many invasive species, mechanical treatments alone are not effective, especially for mature plants or well-established plants. Mechanical treatments are most effective when combined with herbicide treatments (e.g. girdle and herbicide treatment).

Detailed discussion of the application and impacts of physical controls on Service lands is available at:
http://www.fws.gov/invasives/staffTrainingModule/methods/physical/impacts.html

Herbicides

Invasive and robust plants in impoundments can be managed using herbicides approved for use in wetlands. Methods of application include spot-treatment using back pack or ATV mounted sprayer, or aerial application. Spot-treated is more targeted (avoiding neighboring plants), but can be very labor intensive when treating large areas. Aerial application is less labor-intense, but is not as target-specific, and requires extensive planning to execute. Herbicides are applied during various times of the growing season depending on plant species and overall goal. For long term control, herbicide application is typically combined with other methods, such as mowing, burning, and flooding.

There are a wide variety of chemicals that are toxic to plant and animal species. They may work in different ways and be very target specific, or affect a wide range of species. Herbicides may be "pre-emergent," that is, applied prior to germination to prevent germination or kill the seedling, or "post-emergent" and may have various modes of action (auxin mimic, amino acid inhibitor, mitosis inhibitor, photosynthesis inhibitor, lipid biosynthesis inhibitor). Products may come in granular, pelleted, dust or liquid forms. Liquid herbicides are commonly diluted to an appropriate formula and mixed with other chemicals that facilitate mixing, application, or efficacy. Common application methods include foliar spray, basal bark, hack and squirt, injection, and cut stump. The timing of applications is critical to achieve good control, as the growth stage at which an organism will be most effectively controlled varies with different species.

The advantages are that the right chemicals, applied correctly, can produce desired results over a large area for a reasonable cost. The disadvantages are that the chemicals may affect non-target species at the site (including the applicator) and/or contaminate surface or groundwater. Proper planning includes using the most target-specific, least hazardous (humans and the environment), and most effective chemical for the job. Additionally, one should research minimum effective dosage, as the chemical labels often give higher than necessary concentrations. Herbicides often are most effective when used in combination with mechanical methods described above.

Attention to protective gear, licensing requirements and other regulations is essential. In the U.S. Fish and Wildlife Service, all pesticide and other chemical applications (including adjuvants designed to enhance effectiveness) are covered by Service and departmental regulations, and a Pesticide Use Proposal (PUP) is required for all pesticide applications.

Prescribed Fire

Fire can either suppress or encourage any given plant species, so great care must be taken to understand the ecosystem and the life histories of the native and invasive plants before using this tool. This tool is most successful when it is used to mimic natural fire regimes. Proper timing of prescribed burns is essential for controlling target invasive species. The most effective fires for invasive plant control occur just prior to flower or seed set, or at the young sapling/seedling stage. Invasive plants are well adapted to disturbance, often surviving fire and rapidly spreading through a disturbed landscape. Studies in northeastern successional habitats

have generally shown that fire alone will not remove invasive shrubs. Additional herbicide and/or cutting treatments are necessary (Patterson 2003).

This tool requires a good deal of pre-planning (including permitting) and requires a trained crew available on short notice during the burn window. Spot burning using a propane torch can be a good method to control small infestations of invasive plants. It can be advantageous where it is too wet or where there is too little fuel to carry a prescribed fire.

There are several principles that should be considered when employing prescribed fire to control woody plants:

- Plant mortality is strongly tied to death of "growth points" (i.e. meristems/buds), which are more sensitive to heat damage when actively growing, and when tissue moisture is high (Miller 2000). Therefore, applying fire during spring, when target plants are mobilizing water/nutrients and breaking dormancy of leaf/flower buds, or during fall cold-acclimation periods, is more likely to kill growth points than prescribed fire during dormant periods.
- Concentrations of metabolic compounds, i.e. sugars, salts, lignins, vary seasonally, and have been shown to relate to seasonal effects on shrubs. Consequently, timing of treatments may be more important than the type (cutting versus burning) in controlling invasive plants. To reduce biomass, fires should be applied during periods of low below-ground carbohydrate storage (i.e. immediately after spring flushing and growth) and should be followed with a second growing season treatment (such as mowing, herbicide, or more prescribed fire) before total non-structural carbohydrate (TNC) levels are replenished. Repeated burning (several consecutive years) during the low point of a plant's TNC cycle can amplify the negative effects of the treatment (Richburg and Patterson 2003, 2004).

Deer Control

Invasive plant problems often are exacerbated by white-tailed deer over browsing native species, and when deer numbers rise above the carrying capacity, biodiversity declines (Rawinski 2008). Hunting should be used to reduce the deer population wherever necessary and logistically feasible. Hunting must be regulated (e.g., hunting methods, timing of seasons, hunting pressure) and harvests monitored to prevent negative impact to long-term survival of deer populations. Deer control must be conducted in combination with other invasive plant control measures as deer control alone will not be effective if the invasive plants are already established.

More details on the impacts of white-tailed deer specific to forest ecosystems and invasive plants can be found in Rawinski (2008) and elsewhere.

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Appendix G: Refuge Manual, Section 8 RM 10 & 11

Policy regarding Public Use Natural Areas (611 FW 2) has not been written yet but once written will be based on old Refuge Manual (RM) chapters 8 RM 10 and 11 (USFWS 1982). Until these chapters are superseded by a Service Manual chapter the Refuge System still considers these chapters in effect. Chapter 10 is specific to Research Natural Areas and Chapter 11 is specific to Public Use Natural Areas. Some information applies to both designations.

These chapters of the 1982 Service Refuge Manual are only available as a PDF and will be inserted into the PDF version of the final HMP.

10. Research Natural Area Management

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10. Research Natural Area Management

10.1 Policy. The Service recognizes the importance of preserving plant and animal communities in a natural state for research purposes. The Service cooperates with other public and private agencies and organizations to identify, classify, and establish Research Natural Areas (RNA). Cooperation is necessary to ensure that different ecological types are represented as part of a comprehensive network of RNAs across varied land ownerships.

10.2 Objectives. Activities on RNAs are limited to research, study, observation, monitoring, and educational activities that are non-destructive, non-manipulative, and maintain unmodified conditions. The objectives of RNAs are as follows:

A. To participate in the national effort to preserve adequate examples of all major ecosystem types or other outstanding physical or biological phenomena;

B. To provide research and educational opportunities for scientists and others in the observation, study, and monitoring of the environment; and

C. To contribute to the national effort to preserve a full range of genetic and behavioral diversity for native plants and animals, including endangered or threatened species.

10.3 Authority. Designation and management of RNAs is delegated to the Director by the National Wildlife Refuge System Administration Act of 1966. RNAs are administratively designated, modified, or abrogated by the Director.

10.4 Definition. RNAs on National Wildlife Refuges are part of a national network of reserved areas under various ownerships. This network is the result of a designation system recognized by other Federal land administering agencies and the Federal Committee on Ecological Reserves. RNAs are intended to represent the full array of North American ecosystems; biological communities, habitats, and phenomena; and geological and hydrological formation and conditions. They are areas where natural processes are allowed to predominate without human intervention. However, under certain circumstances, deliberate manipulation is used to maintain unique features that the RNA was established to protect.

10.5 Forms. A Natural Area Information Form (Exhibit 1) is used to nominate areas for designation as RNAs.

10.6 Procedure for Designation. Every RNA must be documented by an approved Natural Area Information Form. The form will be submitted by the refuge manager to the regional and Washington offices sequentially for signature. Signed copies will be returned to and filed at the field station and

regional office. Before initiating the RNA nomination, refuge managers should review the publication, "A Directory of Research Natural Areas on Federal Lands of the United States of America," (1977), by the Federal Committee on Ecological Reserves, for more information.

10.7 Categorization. RNAs are categorized according to the following:

A. Biological features.

(1) An ecological community significantly illustrating characteristics of a physiographic province or a biome.

(2) A biota of relative stability maintaining itself under prevailing natural conditions, such as a climax community.

(3) An ecological community significantly illustrating the process or succession and restoration to a climax condition following a naturally caused disruptive change.

(4) A habitat supporting a vanishing, rare, or restricted species.

(5) A relic flora or fauna persisting from an earlier period.

(6) A seasonal haven for concentrations of native animals or a vantage point for observing concentrated populations such as a constricted migration route.

B. Physical features.

(1) Outstanding geological formations or features significantly illustrating geologic processes.

(2) Significant fossil evidence.

(3) Any site containing significant evidence illustrating important scientific discoveries.

C. Management criteria. Two types of natural areas are recognized according to management criteria:

(1) The floral and faunal sere is allowed to advance towards climax;

(2) Vegetation succession is maintained at a desired seral stage that would otherwise advance towards climax. Such areas would normally be established where the primary purpose of the area is dependent upon a particular successional stage.

D. Classification system. Presently, there is no national classification system that describes all ecological characters that may exist on a natural area. To ensure some uniformity of a classification-identification system, the classification systems outlined in "A Directory of Research National Areas on Federal Lands of the United States of America," should be used.

10.8 Management. RNAs must be reasonably protected from any influence that could alter or disrupt the characteristic phenomena for which the area was established.

A. Identification. Boundaries should be marked in the field when necessary to ensure the integrity of the area. As a minimum, all corners or turning points should be marked with a galvanized pipe driven in the ground and the location of each pipe documented. Avoid signs or marks that tend to attract sightseers, recreationists, or casual visitors. Special closures may be necessary to protect such areas from actual or potential harm resulting from public use. An area may be closed pursuant to 50 CFR 25.21.

B. Use.

(1) Publicity. Professional groups of scientists and educators at the national, State, and university level should be informed of the location and availability for use of RNAs. Listing in natural area directories, such as "A Directory of Research Natural Areas on Federal Lands in the United States of America" is required.

(2) Recreation. Picnicking, camping, collecting plants, gathering nuts and herbs, picking berries, hunting, fishing, trapping and other public uses which contribute to modification of a Research Natural Area should be discontinued or expressly prohibited if such uses threaten serious impairment of research or education values.

(3) Research. Scientific use of RNAs by responsible scientists and educators is encouraged, providing their activities will not impair or threaten the features of the area. Minimal disruptive procedures may be permitted. Collection of duplicate specimens should be stopped once adequate materials have been deposited in appropriate scientific institutions. (See 4 RM 6 for guidelines to follow on research proposals.)

(4) Education. Generally, educational use should be at the college level. However, lower levels of educational institutions are

not excluded from use. Non-research educational use will be permitted only where it does not conflict with research use.

C. Fences. Natural area boundaries should not be fenced unless necessary for protection against livestock or excessive human use. If fencing is necessary, construction of fences should not restrict free movement of wild animals.

D. Physical improvements. Generally, no permanent physical improvements such as roads, fences, or buildings are permitted within a natural area. However, temporary facilities needed for research, such as instrument or personnel shelters, may be installed with the approval of the refuge manager. In all cases, these shelters or structures will be removed and the area restored to its original state upon the conclusion of the research project.

E. Vegetation management. The refuge manager may initiate management practices only where necessary to preserve vegetation and only as stated in a plan approved by the regional director. These management practices may include grazing, control of excessive animal populations, prescribed burning, and the use of chemicals for plant, insect, and disease control.

F. Wildlife management. Wildlife populations ideally should be controlled by natural processes and no interference with normal cycles and fluctuations should be tolerated. Under some circumstances predator removal and other disruptions of community relation may have created conditions under which certain species multiply beyond normal limits and thereby pose a disruptive threat. When this happens, control of such populations may be necessary by artificial means.

G. Mineral entry. Natural areas should be withdrawn from mineral and oil entry, unless these can be accomplished without disturbing the features for which the RNA was established.

H. Management plan. Use of each natural area will be governed by a natural area management plan which is compatible with established refuge objectives. (See 4 RM 3, Management Planning.) The management plan should address:

-- Criteria followed in its selection;
-- Use objectives and restrictions;
-- Management objectives and maintenance details, especially those that will influence or interfere with established ecological processes; and,
-- Protection objectives and practices.

10.9 Modification and disestablishment procedures.

A. Modification procedures. Any modification of the approved boundary lines must be submitted through the regional office for approval by the Director. The memorandum should be submitted explaining why the boundary change is being recommended and what effects the change might have on the natural area.

B. Disestablishment procedures. Disestablishment procedures are initiated if an area is no longer useful for its established purposes. Ideally, such areas should be replaced by designating a similar area that properly fulfills the objectives of the original area. Disestablished or replacement areas will be registered with the Federal Committee on Ecological Reserves.

Disestablishment is requested by memorandum through the regional office to the Director. The request explains why disestablishment is being recommended, why restoration efforts are not feasible, and whether a suitable replacement area is available.

1. Name of Natural Area _____

2. Administering Agency _____

3. Supervising Field Unit _____

4. State and County _____

5. Latitude and Longitude _____

6. Primary type on area: _____

7. Other important types represented on area:

   a. Botanic _____

   b. Zologic _____

   c. Geologic _____

   d. Aquatic _____

8. Acreage _____

9. Elevation and Topography _____

10. Management practices which may be used to maintain are: _____

11. For information contact: _____

This form should be filled out in accordance with the instructions on the accompanying information sheet.

Instructions

Please use a typewriter to fill out the attached form.

1. Each natural area should have a name. If an area under your supervision does not now have a name, please suggest one. A name based on some important feature of the natural area might be appropriate.

2. Place the name of the administering agency in this space, i.e., Bureau of Land Management, U.S. Fish and Wildlife Service, U.S. Forest Service, National Park Service, etc.

3. Indicate the name of the supervising field unit in this space, i.e., Custer National Forest, Yellowstone National Park, Monomoy National Wildlife Refuge, BLM District Office, etc.

4. List the State and county in which the natural area is located, not the State and county of the administering field unit headquarters. If the area is in parts of two or more counties, list each.

5. Give the latitude and longitude of the approximate center of the natural area.

6. Under item 6 indicate the primary type on the natural area by number and name (see pages 89-104 of Research Natural Areas, 1968), e.g., SAF-45, Pitch pine, or A-26, Saline Lake. Following the type name, write the number of acres on the area represented by that type. While some areas may have several important types, usually one will be more important than the rest. This primary type is the only one which should be indicated under item 6.

7. Other important types on the natural area should be indicated under the appropriate headings, a-d, by type number and name. Following the type name, write the number of acres on the area represented by that type. Each type listed under item 7 should be an important one. An entry need not be made for all or even most of the subheadings (7a-d).

8. Indicate the total acreage of the natural area.

9. Give the maximum and minimum elevation of the natural area and a brief description of the topography, i.e., level, rolling, mountainous, etc.

10. Give the name and address of the unit to contact for information concerning use, policies, availability, etc., of the natural area.

11. Public Use Natural Area Management

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11. Public Use Natural Area Management

11.1 Policy. The Service recognizes the importance of preserving plant and animal communities in a natural state and assigns a high level of importance to maintaining for public use selected areas that are representative of the natural character of the National Wildlife Refuge System (NWRS).

11.2 Objectives. Public Use Natural Areas (PUNAs) are designated to:

A. Assure the preservation of a variety of significant natural areas for public use which, when considered together, illustrate the diversity of the NWRS natural environments; and

B. Preserve these environments that are essentially unmodified by human activity for future use.

11.3 Authority. Designation and management of PUNAs is delegated to the Director by the National Wildlife Refuge System Administration Act. PUNAs are administratively designated, modified, or disestablished by the Director.

11.4 Definition. A PUNA is a relatively undisturbed ecosystem or subecosystem that is available for use by the public with certain restrictions for protecting the area. Such an area must possess exceptional value or quality in illustrating or interpreting an element of the natural heritage of our Nation. The designation, PUNA, is fostered only by the NWRS. It is separate and distinct from the Research Natural Area (RNA) designation system.

11.5 Forms. A PUNA Submission form (Exhibit 1) is used to nominate areas for designation as PUNAs.

11.6 Procedure for designation. Every PUNA must be documented by an approved PUNA submission form. The form will be submitted by the refuge manager to the regional and Washington offices sequentially for signature. Signed copies will be returned and filed at the field station and regional office.

11.7 Categorization. PUNAs are categorized according to the same features that are used to categorize RNAs. These categories are discussed in 8 RM 10, Research Natural Area Management.

11.8 Management. PUNAs must be reasonably protected from any influence that could disrupt the conditions that maintain and perpetuate those ecological and geological phenomena which the area was intended to exemplify.

A. Identification. Boundaries should be marked in the field, when appropriate, to ensure integrity of the area. As a minimum, all corners or turning points should be marked with a galvanized pipe

driven into the ground and the location of each pipe documented. Signs delineating these areas should clearly inform the public of the location of regulations concerning use of the areas. Travel is restricted to designated foot trails. Point of access interpretive media should describe the ecological significance of the area.

B. Use.

(1) Publicity. Publicity of the area should be oriented towards the general public. In addition, the existence of these areas should be made known to professional groups interested in research and education. Preparation of a leaflet describing the site, rules of use, and directions to the area is appropriate. The wording "Public use natural area" should not be used in the leaflet or at the trail entrance since the title is subject to misinterpretation by the general public. The given name should be used instead, such as "Dancy Bottoms Natural Area".

(2) Recreation. (See 50 CFR 26.31-34.) Recreational use on a PUNA should be limited to activities that are compatible with maintenance of resource integrity and significance. Recreational uses could include a self-guided interpretive foot trail, nonmotorized canoe or tour boat, or access point with appropriate interpretive media. Conducted walks, tours, or programs by refuge personnel or qualified individuals should be encouraged. Incidental uses such as berrypicking, hunting, fishing, and trapping may be permitted where they do not interfere with the objectives of the PUNA. Camping, picnicking, swimming, uncontrolled hiking, and consumptive use of nonrenewable resources are prohibited.

(3) Research. Scientific use of PUNAs by responsible scientists and educators is encouraged, providing their activities will not impair or threaten the features of the area. Minimal disruptive procedures such as collection of some soil, plant and animal specimens may be permitted. If a collection permit is issued, a voucher sample should be deposited with the Service. Collection of duplicate specimens should be stopped once adequate materials have been deposited in appropriate herbaria. (See 4 RM 6 for guidelines to follow on research proposals.)

(4) Education. Both research and non-research educational use of the PUNA are encouraged.

C. Fences. Boundaries of PUNAs should not be fenced unless necessary for protection against livestock or excessive human use. If fencing is necessary, construction of fences will not restrict free movement of wild animals.

D. Physical Improvements. Guidelines for physical improvements on PUNAs are the same as on RNAs. (See 8 RM 10, Research Natural Areas.)

E. Vegetation management. Guidelines for vegetation management on PUNAs are the same as on RNAs. (See 8 RM 10.)

F. Wildlife management. Guidelines for wildlife management on PUNAs are the same as on RNAs. (See 8 RM 10.)

G. Mineral entry. Guidelines for mineral entry on PUNAs are the same as on RNAs. (See 8 RM 10.)

H. Management plan. Guidelines for management plans for PUNAs are the same as those for RNAs. (See 8 RM 10.)

11.9 Modification and disestablishment procedures. These procedures are the same for PUNAs as for RNAs. (See 8 RM 10.)

1. Refuge Name _____

2. Name of Area _____

3. State and County _____

4. Latitude and Longitude _____

5. Township, Range, and Section _____

6. Primary theme(s) on area: _____

_____

_____

7. Other important themes represented on area:

_____

_____

_____

8. Classification for 19-- Objectives: Grasslands _____ Woodlands _____
Tundra _____ Desert _____ Wetlands _____

9. Reclassified

10. Within or Adjoining _____ Wilderness Area
_____ Research Natural Area

11. Type of Public Use activities permitted:

_____

_____

_____

12. Acreage _____

13. Elevation and Topography _____

_____

14. Enclosures _____

This form should be filled out in accordance with the following instructions.

INSTRUCTIONS

1. Enter refuge name and supervising office, if supervised by another field station.

2. If are has no formal or local name, enter "No Name."

3. Enter location by State and county.

4. Latitude and longitude should be used for area(s) of less than 10 acres.

5. Township, range, and section should be nearest 1/4 of 1/4 Section of areas of more than 10 acres. Enclose letter size map showing location etc., and pertinent photographs.

6. Enter primary theme(s) from the following classification system. Give brief description of each theme.

Land Ecosystems

Tundra
Boreal forest (just south of Arctic tundra)
Pacific forest
Dry coniferous forest and woodland
Eastern deciduous forest
Grassland (steppe)
Chaparral
Deserts
Tropical region
Special ecosystem (bogs, balds, lava flows, etc.)
Special interest species (rare, and relict, i.e., confined habitat, etc.)

Aquatic Ecosystem

Marine environments
Habitats of special interest (bird and mammal colonies)
Estuaries, Salt marshes and wetlands
Streams
Underground waters with distinctive animal life
Lakes, ponds, fresh marshes and wetlands
Freshwaters species and special interest (rare, relict species)

7. Enter other theme(s). Same as in No. 6. Give brief description of each theme.

8. Check classification used for identifying area when submitting refuge outputs during 19-- refuge objective setting process (objective for 19--).

9. If this area is the result of the reclassification of a Research Natural Area (either whole or in part), enter its name.

10. Enter name(s) of Wilderness or Research Natural Areas that this area is within or adjoins.

11. Enter existing and planned public use activities. List primary uses first.

12. Enter acreage or description of area.

13. Enter significant topographic data.

14. Enclose letter size map showing location of area and any roads, trails, etc., or other proposed or designated areas in the vicinity.

Forms should be submitted to Regional Office for forwarding to Central Office, Branch of Resource Management, Division of Refuge Management, who will review for the Director's approval.

Appendix H: Shorebird energy-days calculations

Model background:

Loesch et al. 2000 was cited in the Shorebird JV (Potter et al. 2007a) and used to calculate JV shorebird habitat objectives (See pages 24-25). *Note: the JV indicates this paper is from 2006 but it was actually published in the peer reviewed USDA Forest Service Proceedings in 2000.*

Loesch et al. (2000) model:

$$\textbf{Foraging habitat} = IM_{migration} * \textbf{Duration} * \textbf{Forage Density}^{-1} * \textbf{Population}$$

JV (Potter et al. 2007) interpreted the model as:

$$\textbf{FORAGING HABITAT} = \textbf{ABUNDANCE} * \textbf{USE DAYS} * \textbf{ENERGY REQUIREMENT} * \textbf{FORAGE DENSITY}^{-1}$$

Note: USE DAYS in JV model is referring to length of stay of migrants or the same as Duration in Loesch model. Also Population in Loesch model and ABUNDANCE in JV model are both referring to estimated number of birds using an area (or energy-days).

We solved equation to calculate Population/Abundance (energy-days):

$$\textbf{Population} = (\textbf{Foraging habitat} * \textbf{Forage Density}) * (IM_{migration} * \textbf{Duration})^{-1}$$

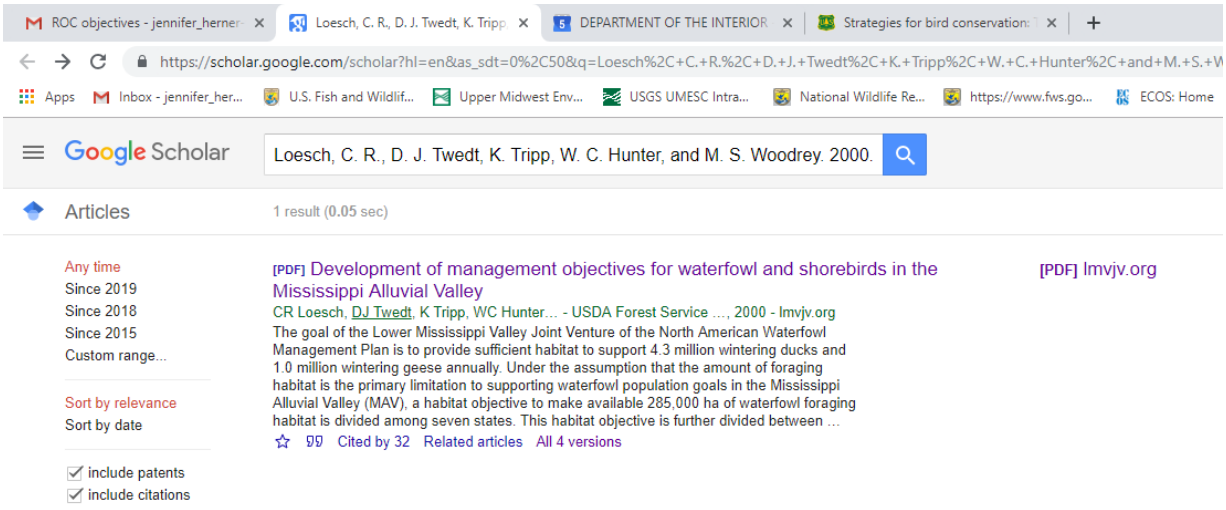
$IM_{migration}$ **(IM = invertebrate mass)/ENERGY REQUIREMENT** = daily food requirements during migration, in units of grams per day
Duration/USE DAYS = length of stay of migrants, in days
Forage density = available prey biomass per unit area, in grams per square meter
Population/ABUNDANCE = number of birds habitat can support (energy-days)
Foraging habitat = the number of moist soil/mudflat available, in square meters

Shorebird model sources:
Loesch, C. R., D. J. Twedt, K. Tripp, W. C. Hunter, and M. S. Woodrey. 2000. Development of management objectives for waterfowl and shorebirds in the Mississippi Alluvial Valley. USDA Forest Service Proceedings RMRS-P-16: 8-11. https://www.fs.fed.us/rm/pubs/rmrs_p016.pdf
Also online here: http://www.birds.cornell.edu/pifcapemay/loesch.htm

Potter, B. A., R. J. Gates, G. J. Soulliere, R. P. Russell, D. A. Granfors, and D. N. Ewert. 2007a. Upper Mississippi River and Great Lakes Region Joint Venture Shorebird Habitat Conservation Strategy. U. S. Fish and Wildlife Service, Fort Snelling, MN. 101pp.

Loesch et al. 2000 info:
The USDA Forest Service Proceedings are peer reviewed. See first link included in the citation. The Preface of the proceedings document reads: "All of them have been peer reviewed, accepted for inclusion, and modified through an intensive editorial process to ensure that this publication is a worthy and useful product of the PIF planning process."

Google scholar info Loesch et al. 2000:



Cited 32 times.
See:
https://scholar.google.com/scholar?hl=en&as_sdt=0%2C50&q=Loesch%2C+C.+R.%2C+D.+J.+Twedt%2C+K.+Tripp%2C+W.+C.+Hunter%2C+and+M.+S.+Woodrey.+2000.+Development+of+management+objectives+for+waterfowl+and+shorebirds+in+the+Mississippi+Alluvial+Valley.+USDA+Forest+Service+Proceedings+RMRS-P-16%3A+8-11.++https%3A%2F%2Fwww.fs.fed.us%2Frm%2Fpubs%2Frmrs_p016.pdf&btnG=
Journals listed include:

- Biological Conservation
- Wetlands
- Waterbirds
- Condor
- Avian Conservation and Ecology
- Journal of Fish and Wildlife Management

CALCULATION

Objective 6.2: Moist Soils/Mudflats (water depth = 0-2 inches): Annually, when conditions allow, lower water elevation to provide approximately **357 acres (144.5 ha)** of moist soil/mudflat habitat along edges of pools primarily for the benefit of migratory shorebirds…

Equation: **Population = (Foraging habitat*Forage Density)*($IM_{migration}$*Duration)$^{-1}$**

Foraging habitat = 357 acres = 144.5 ha = **1,445,000 m^2**
Available habitat at Refuge with proper water management

Forage Density = 2g/m^2
"*Chironomids are the primary food source for these birds, and about **2 g** of these and other benthic invertebrates are available to foraging shorebirds in **each square meter** of habitat*." – from Loesch et al. 2000 and also used in Potter et al. 2007a.

$IM_{migration}$ = 8 g/bird/day
"*The average mass of one of these shorebirds is 45 g. The daily food requirements (for maintenance plus needed fat gain) of this average-sized bird is about **8 g***" – Loesch et al 2000.

Duration = 10 days
Table 7 in Potter et al. 2007a lists "Duration at stops (days)" at stopovers in UMRGLR for a number of different shorebirds. The table indicates Short-billed dowitcher's will stay at stopover sights 1-5 days, but has 2 stopover sights. The range of duration of stay is 1-10 days. I used 10 days for my estimate in order to estimate max energy days of refuge.

Calculation:
(1,445,000 m^2 * 2g/m^2) * (8 g/bird/day * 10 days)$^{-1}$ = **36,125 bird energy-days**

Other notes from Loesch et al. 2000 and simplified calculation:
Over the duration of an assumed 10-day migration period, each shorebird would require 40 m^2 (0.004 ha) of managed foraging habitat. The numbers work out the same using this information. **144.5ha/0.004ha = 36,125 birds**

Appendix I: Duck energy-days calculations

Duck (mallard) energy-days were estimated using a daily ration model. This model calculates duck energy days (DED) using the formula: DED = (Hectares * Total Energy available per hectare)/DER. The UMRGLR-JV reported the energy available per hectare for five wetland community types (Table 11 of Soulliere et al. 2007) and DER is the daily energy requirement for a species as defined in Table 10 of Soulliere et al. 2007. See Table B.1 for calculations. JV community type descriptions are listed in this Appendix. All calculations used the UMRGLR-JV information to calculate energy-days for mallards. Note that "Total Energy available per hectare" has the potential to vary by year, location, management practices, and other factors. To make this model stronger actual "Total Energy available per hectare" numbers could be verified.

Table I.1: Calculation of energy days for migrating Mallards and other benefitting species.

			Species	Mallard	Wood Duck	Blue-winged Teal	Tundra Swan	Canvasback	Lesser Scaup
			DER (kJ)**	1,493	952	713	5,492	1,496	1,099
JV wetland habitat types***	Refuge Total Acres	Hectares	Total Energy available per hectare (kJ/ha)*	DED: Duck Energy-Days Formula: (Hectares X Total Energy available per hectare) / DER					
Wet mudflat / moist soil plants	357	144.53	3,629,321			735,711			
Shallow semi-permanent marsh, hemi marsh	1,909	772.87	985,332	510,072	799,935				
Deep-water marsh	1,753	709.72	1,367,540				176,724		
Marsh with associated shrub/ forest	148	59.92	1,415,238						
Extensive open water	805	325.91	1,603,169					349,258	475,423

DUDs can be calculating by referring to the JV waterfowl document, Appendix G (Soulliere et al. 2007) and looking up "estimated duration of stay (use-days) for waterfowl occurring in the Upper Mississippi River and Great Lakes JV region during the non-breeding season. DED/estimated duration of stay (fall) = numbers of ducks (DUD)

*See JV waterfowl Table 11 (Soulliere et al. 2007)
**DER = Daily energy requirement (JV waterfowl Table 10; Soulliere et al. 2007)

*****JV wetland community type descriptions (JV waterfowl Table 8; Soulliere et al. 2007)**:
Wet mudflat / moist-soil plants = non-forested wetland with dynamic hydrology and areas of exposed mudflat; summer growth of annual seed-producing plants (moist-soil species) is typically flooded in fall and spring.
Shallow semi-permanent marsh, hemi-marsh = marsh <1 m deep with herbaceous cover and persistent standing water most years; typically, a mosaic of emergent vegetation and open water.
Deep water marsh = open water 0.5–1.5 m deep mixed with areas and borders of emergent vegetation; submergent vegetation common in openings.
Marsh with associated shrub/forest = mixed emergent marsh and open water with nearby shrub or forest; typically, marsh and woody cover is <0.1 km apart; often a riparian system.
Extensive open water = open water areas of the Great Lakes, large rivers, and inland lakes with water depth 1–9 m.

Source:
Soulliere, G. J., B. A. Potter, J. M. Coluccy, R. C. Gatti., C. L. Roy, D. R. Luukkonen, P. W. Brown, and M. W. Eichholz. 2007. Upper Mississippi River and Great Lakes Region Joint Venture Waterfowl Habitat Conservation Strategy. U.S. Fish and Wildlife Service, Fort Snelling, Minnesota, USA.

Table I.2: JV waterfowl wetland habitat communities with associated Refuge categories and ROCs

Habitat descriptions (JV waterfowl Table 8):	**=**	**HMP Wetland habitat description**	**ROCs**
Wet mudflat / moist-soil plants	**=**	Moist Soils/Mudflats (water depth = 0-2 inches)	**Shorebirds** (Short-billed Dowitcher)
Shallow semi-permanent marsh, hemi-marsh	**=**	Emergent marsh (water depth = 2-24 inches)	**Mallard**
Deep water marsh	**=**	Submergent marsh (water depth = 24-36 inches)	Black Tern, Wood Duck
Marsh with associated shrub/forest	**=**	Moist Soils/Shrub Carr (water depth = 0-2 inches)	Great Blue Heron, Sora
Extensive open water	**=**	Open water (water depth = >36 inches)	Black Tern, Wood Duck