HABITAT MANAGEMENT PLAN

Green Bay and Gravel Island National Wildlife Refuges

October 2017

Cardno
Shaping the Future

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
For
Green Bay and Gravel Island National Wildlife Refuges
Approvals

Action	Signature/Name	Date
Prepared By:	Sadie O'Dell Will Taylor, Dan Salas (Cardino) and Sadie O'Dell (Refuge Biologist)	3/27/2018
Submitted By:	STEVEN LENZ Digitally signed by STEVEN LENZ Date: 2018.03.30 09:57:37 -05'00' Steven J. Lenz (Refuge Manager/Project Leader)	
Reviewed By:	Patricia J. Heglund, PhD (Regional Refuge Biologist)	3/30/18
Reviewed By:	Cathy Nigg Cathy Nigg (Refuge Supervisor)	3/30/18
Approved By:	Charles W. Blair (Regional Refuge Chief)	4-2-18

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EXECUTIVE SUMMARY

This Habitat Management Plan (HMP) provides vision and specific guidance on enhancing and managing habitat for the resources of concern (ROC) at the refuge. The contributions of the refuge to ecosystem- and landscape-scale wildlife and biodiversity conservation, specifically migratory waterfowl, are incorporated into this HMP. The HMP is intended to provide habitat management direction for the next 15 years. The HMP is also needed to ensure that the refuge continues to conserve habitat for migratory birds in the context of climate change, which affects all units of the National Wildlife Refuge System.

This HMP is a step-down plan, tiered from the Gravel Island, Green Bay, Harbor Island, Huron, and Michigan Islands National Wildlife Refuge Comprehensive Conservation Plan (CCP) (USFWS 2012). The CCP process was a multi-year, collaborative planning exercise resulting in the establishment of refuge-specific goals, objectives, and strategies, and this HMP further refines these goals and prescribes specific management actions for their implementation. The HMP builds on and amends the original objectives from the CCP to develop specific goals and strategies related to ROC. Future Inventory and Monitoring Plans and Annual Habitat Work Plans will tier from the HMP and hone in on these goals and strategies.

Green Bay and Gravel Island National Wildlife Refuges (NWR) are managed by the U.S. Fish and Wildlife Service (Service) as part of the National Wildlife Refuge System (NWRS). The island refuges are managed by staff based at Horicon NWR in Mayville, WI. The five islands that make up the Green Bay NWR are located off the tip of Door County peninsula in Lake Michigan between mainland Wisconsin and Michigan. Three islands (Hog, Plum, and Pilot) lie between the tip of the Door Peninsula and Washington Island in Wisconsin waters, while 2015 additions (St. Martin Island and Rocky Island) lie further northeast and within Michigan's border. Spider Island and Gravel Island comprise Gravel Islands NWR. These islands are also located in Lake Michigan, approximately one mile to the east of the Door Peninsula. In 1970, Gravel, Spider, and Hog Island were designated as Wilderness Areas.

The Green Bay and Gravel Island NWR ROC were identified by reviewing the species known to occur within the refuge, as well as those identified in local and regional conservation plans, and analyzing their relation to the biological integrity, diversity, and environmental health (BIDEH) of the habitats present on the refuge. The comprehensive ROC list was then narrowed down by selecting species most likely to represent a suite of habitat needs for other species (i.e., focal or surrogate species). Based on this analysis, the refuge identified 7 priority ROC, including 3 birds, 1 plant, and 3 natural communities. More information on these ROC and their selection is detailed in Chapter 3.

As part of the ROC identification, habitats were also prioritized for future management. Priorities were based on each habitat's ability to be managed effectively to support ROCs. Based on this review, the refuge identified the following priority habitats (ordered from greater to lesser importance): early successional habitat/colonial nesting areas, northern mesic forest, Great Lakes rock shore and alvar. Lastly, the HMP establishes a list of appropriate management actions pertinent to achieving determined priority habitat and ROC goals.

This HMP defines the refuge's important role in providing breeding habitat for colonial nesting birds, as well as migratory stopover habitat. Similarly, the refuges provide a unique landscape context and protection for several rare natural communities and endangered plants. Its location along the Niagara Escarpment and Lake Michigan makes it a major stopover and breeding focal area for many species. The selection of priorities and management actions within this plan reflect the refuge's contribution to these resources.

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ACRONYMS AND ABBREVIATIONS

ABC	American Bird Conservancy
AHWP	Annual Habitat Work Plans
BCR	Bird Conservation Region
BIDEH	Biological Integrity, Diversity, and Environmental Health
CCP	Comprehensive Conservation Plan
DNR	Department of Natural Resources
DOI	U.S. Department of the Interior
FMP	Fire Management Plan
HMP	Habitat Management Plan
IMP	Inventory and Monitoring Plan
LCC	Landscape Conservation Cooperatives
LWCF	Land and Water Conservation Fund
MIDNR	Michigan Department of Natural Resources
NAWMP	North American Waterfowl Management Plan
NABCI	North American Bird Conservation Initiative
NWR	National Wildlife Refuge
NWRS	National Wildlife Refuge System
NVCS	National Vegetation Classification System
PIF	Partners in Flight
ROC	Resources of Concern
ROCSTAR	Resources of Concern Selection Tool for America's Refuges
SHC	Strategic Habitat Conservation
TNC	The Nature Conservancy
UMGL JV	Upper Mississippi and Great Lakes Region Joint Venture
UMVGL	Upper Mississippi Valley and Great Lakes
U.S.	United States
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service
WDNR	Wisconsin Department of Natural Resources

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CHAPTER 1.

INTRODUCTION

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1. INTRODUCTION

1.1 PURPOSE OF GREEN BAY AND GRAVEL ISLAND NATIONAL WILDLIFE REFUGES

Green Bay and Gravel Island National Wildlife Refuges (NWR) are managed by the U.S. Fish and Wildlife Service (Service) as part of the National Wildlife Refuge System (NWRS). The island refuges are managed by staff based at Horicon NWR in Mayville, WI. 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.

Gravel Island NWR was established by Executive Order 1678, dated January 9, 1913…

"…as a preserve and breeding ground for native birds."

Public Law 91-504, October 23, 1970 designated the Gravel Island NWR as a Wilderness Area.

Green Bay NWR was established by Executive Order 1487, February 21, 1912…

"…as a preserve and breeding ground for native birds."

Public Law 91-504, October 23, 1970 designated the Green Bay NWR as a Wilderness Area.

Green Bay NWR, Plum and Pilot Islands Additions were established by Public Land Order 7681, dated October 17, 2007…

"…to protect native and migratory bird habitat and endangered species habitat within the Great Lakes Basin ecosystem."

1.2 REFUGE OVERVIEW

Green Bay NWR

The five islands that make up the Green Bay NWR are located off the tip of Door County peninsula in Lake Michigan between mainland Wisconsin and Michigan (Figure 1-2). Three islands (Hog, Plum, and Pilot) lie between the tip of the Door Peninsula and Washington Island in Wisconsin waters, while 2015 additions (St. Martin Island and Rocky Island) lie further northeast and within Michigan's border. The Nature Conservancy purchased the majority of St. Martin Island in 2013 and 2014 from private landowners and donated it to USFWS for inclusion in the Green Bay NWR in September of 2015. The remainder of the island (51 acres) and the lighthouse are owned and maintained by the Little Traverse Bay Band of Odawa Indians (Figure 1-1). Rocky Island, (26.2 acres) also owned by The Nature Conservancy, was donated at the same time. At over 1,300 acres, St. Martin Island is now the largest island in the refuge.

Figure 1-1. Map of St. Martin Island depicting areas purchased and donated by the Nature Conservancy, as well as areas still owned by the Little Traverse Bay Band of Odawa Indians (TNC 2014).

Plum Island is the next largest at approximately 316 acres while the smaller, Hog and Pilot average around 6 acres. Hog Island provides nesting habitat for colonies of herring gulls, great blue herons, black-crowned night herons, and great egrets. Pilot Island provides nesting habitat for herring gulls and a large colony of nesting double-crested cormorants, hereafter called cormorants (Figure 1-2).

Green Bay NWR contains ecotypes and habitat rare elsewhere in Wisconsin, including the coastal fens and alvars (e.g. limestone barrens). These communities support rare plants such as dwarf lake iris (*Iris lacustris*) and Canada yew (*Taxus canadensis*), making the refuge a unique opportunity for conservation and management (DNR 2014).

Human impact on these islands is evident from historic lighthouse and U.S. Coast Guard (USCG) structures on Plum, Pilot, and St. Martin Islands. The U.S. Coast Guard still maintains active aids to navigation on both Plum and Pilot Islands, and all of these structures are listed on the National Register of Historic Places (USFWS 2013).

Gravel Islands NWR

Spider Island and Gravel Island, 24 and 10 acres respectively, comprise Gravel Islands NWR (Figure 1-2). These islands are also located in Lake Michigan, approximately one mile to the east of the Door Peninsula. Gravel and Spider islands were initially protected in 1913 by an Executive Order with the intent to preserve native bird breeding habitat. Herring gulls and cormorants nest on these islands. Gravel Island supports a large nesting population of Caspian terns, historically the largest colony in the Great Lakes (USFWS 2013).

The small size and relatively low elevation of Spider, Gravel, and Hog Island (Green Bay NWR) make them more susceptible to lake level changes and thus the area of these islands, and the communities on them, will fluctuate depending on conditions. For example Gravel Island rises only 10 feet, at the most, above Lake Michigan (USFWS 2013).

Wisconsin Islands Wilderness

In 1970, the United States Congress designated Gravel, Spider, and Hog islands as the Wisconsin Islands Wilderness. The prime management consideration of the wilderness status was the continued protection of nesting birds by limiting access to the islands during the breeding seasons (O'Dell 2012). For this reason, the wilderness islands are closed to public visitation consistent with the conservation purpose of the refuge. The wilderness designation provides an additional level of protection on the islands and boaters are asked to stay at least a quarter-mile offshore so as not to endanger the nesting areas (Wilderness.net 2015).

Figure 1-2. Locations of Green Bay and Gravel Islands Units.

1.3 SCOPE OF HABITAT MANAGEMENT PLAN

This Habitat Management Plan (HMP) provides decisions regarding the priority resources of concern (ROC) at the refuges and associated specific guidance for enhancing and managing habitat for the ROC across the refuges for the next 15 years.

This HMP is a step-down plan, tiered from the Gravel Island, Green Bay, Harbor Island, Huron, and Michigan Islands NWR Comprehensive Conservation Plan (CCP) (USFWS 2012). The CCP process was a multi-year, collaborative planning exercise resulting in the establishment of refuge-specific goals, objectives, and strategies, and this HMP further refines these goals and prescribes specific management actions for their implementation. In order to avoid duplication yet still function as a stand-alone document, background information relevant to HMP planning, much of which is already detailed in the CCP, is summarized in Chapters 1 and 2 of this HMP. Chapter 3 identifies the resources of concern (ROC) present at the NWR. Chapter 4 refines habitat goals and objectives specific to selected ROC and prescribes management actions that will help the NWR successfully achieve the goals of the CCP.

Like the CCP, the HMP is a science-based, collaborative process that incorporates information from across the community of natural resource professionals, to include scientific input from local field and regional USFWS offices, academic institutions, and various regional conservation partnerships. While the HMP is required for USFWS to effectively meet its refuge stewardship mandates and is limited to directing activities within the NWRs, the USFWS integrates current local or regional initiatives pertinent to identified ROCs to the greatest extent possible.

1.4 MISSION MANDATES

U.S. Fish and Wildlife Service

The USFWS mission is to "work with others to conserve, protect, and enhance fish, wildlife, plants and their habitats for the continuing benefit of the American people," and the Service functions as the primary Federal agency responsible for doing so. Specific responsibilities include enforcing Federal wildlife laws, managing migratory bird populations, restoring nationally significant fisheries, administering the Endangered Species Act, restoring wildlife habitat such as wetlands, and managing the NWRS.

The mission of the NWRS is to "administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans."

Federal Trust Resources Refer to the USFWS's responsibilities, as charged by Congress to the Secretary of the Interior, for the conservation of fish and wildlife as defined by legislation, treaty, or similar authority (e.g., Fish and Wildlife Act, Endangered Species Act, Migratory Bird Conservation Act). The responsibilities to protect and steward interjurisdictional fisheries, listed species, and migratory birds are shared with other Federal agencies and state governments, and the degree to which the Service is involved varies with species and situations.

The National Wildlife Refuge System Administration Act (1966) as amended by the National Wildlife Refuge System Improvement Act (1997) (16 U.S.C. 668dd668ee) defines the NWRS; directs the Secretary of the Interior to maintain the biological integrity, diversity, and environmental

health (BIDEH) of the NWRS; and it authorizes the Secretary to permit any use of a refuge provided such use is compatible with the major purposes for which the refuge was established. The Improvement Act established the legitimacy and appropriateness of the six priority public uses (hunting, fishing, wildlife observation and photography, environmental education, and interpretation) and established a formal process for determining resource conservation and land use compatibility (CCP and HMP development). Although public uses are allowed within the NWRS, in order to fulfil primary habitat function and refuge designation mandates, it is often necessary that the USFWS establish closed areas or otherwise restrict activities that are in conflict with refuge establishment purposes and USFWS stewardship responsibilities for Federal trust resources. The Improvement Act offered a renewed vision for the NWRS where:

- Wildlife comes first.
- Refuges are cornerstones 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.

NWRs are established under a variety of authorities. The purposes of a refuge are specified in, or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or refuge subunit.

1.5 HABITAT MANAGEMENT PLANNING RELATIONSHIP TO OTHER PLANS

In addition to USFWS policies, orders, regulations, and other mandates, further guidance for wildlife habitat management at the Green Bay and Gravel Island NWRs is provided by several refuge-specific, regional, national, and international plans. As a partner in many wildlife- or habitat-focused initiatives, the USFWS strives to incorporate relevant programs and support existing progress to the extent practicable.

U.S. Fish and Wildlife Service Policies

Important guidance for habitat management on refuge lands has already been provided by several key policies outlined by the Service. These policies are included within the Fish and Wildlife Service Manual, which documents re-delegation of the Director's authority, prescribes the policies and procedures for administrative activities and program operations, and steps down our compliance with other requirements, such as statutes, Executive Orders, Departmental directives, and regulations of other agencies (USFWS 2013). Several policies are pertinent to the development of HMPs:

Habitat Management Planning Policy – USFWS 620 FW 1 (2002)

This chapter of the Service Manual establishes Service policy for planning habitat management within the NWRS. The guidance in this chapter applies to the development of HMPs and Annual Habitat Work Plans (AHWP) and discusses their relationship to refuge CCPs. The policy and guidance in this chapter describe strategies and implementation schedules for meeting CCP goals and objectives. We utilize this policy to direct the content and considerations addressed in this HMP.

Biological Integrity, Diversity and Environmental Health Policy – USFWS 601 FW 3 (2001, with Amendment 1, 2006)

The Biological Integrity, Diversity and Environmental Health Policy directs the maintenance and restoration, where appropriate, of the biological integrity, diversity, and environmental health (BIDEH) of the NWRS and thus fosters the implementation of refuge purpose(s) and NWRS mission. It provides guidance for conservation and management of the broad spectrum of fish, wildlife, and habitat resources found on refuges and associated ecosystems. Further, it provides refuge 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 NWRS mission, restore lost or severely degraded components. The role of BIDEH is considered in habitat management planning to the extent that it supports the refuge purpose, goals, and objectives. Elements of BIDEH are also considered when selecting strategies that help us achieve habitat management objectives.

Department of the Interior Secretarial Order 3226 (January 19, 2001) and Order 3289 (September 14, 2009)

Department of the Interior (DOI) Secretarial Order 3289 reiterated Order 3226 (2001), which requires global climate change to be addressed in governmental decision making. This Order ensures that climate change impacts are taken into account when undertaking long-range planning exercises, when setting priorities for research and investigations, when developing multi-year management plans, and/or when making major decisions regarding the potential utilization of resources under DOI purview. To uphold the vision in these Orders, the USFWS Strategic Plan for Responding to Accelerating Climate Change (2010) provides guidance for the consideration of actual and projected climate change impacts to fish and wildlife populations and their habitats in USFWS planning, decision making, consultation and evaluation, management, and restoration efforts.

Department of the Interior Secretarial Order 3356 (September 15, 2017)

This Order continues the Department's efforts to enhance conservation stewardship; increase outdoor recreation opportunities for all Americans, including opportunities to hunt and fish; and improve the management of game species and their habitats for this generation and beyond.

Inventory and Monitoring Policy – USFWS 701 FW 2 (2014)

The USFWS Inventory and Monitoring Policy provides guidance for developing an Inventory and Monitoring Plan (IMP) at a NWR, typically produced following the completion of the HMP. The IMP describes priorities for natural resource surveys, the selection, and design of survey protocols, data storage and analysis, and reporting results. It accommodates all levels of natural resource surveys from the refuge level to participation in landscape, regional, national, and international inventory and monitoring programs, both internal and external to the USFWS. Overall, this policy promotes consistency in the planning and implementation of inventory and monitoring throughout the NWRS.

Interagency Plans

U.S. Department of the Interior Adaptive Management Guide (Williams et al. 2009)

The planning team used adaptive management principles in the development of this HMP and the refuges will use adaptive management to respond to changing conditions that impair the ability to measure and achieve habitat objectives. It should be noted that although aspects of the U.S. Department of the Interior's (DOI) adaptive management guide were used throughout the entire process of developing this HMP, it is not a required aspect of completing the HMP. As such, the adaptive management process was used as guidance, and Service policy (620 FW 1, 601 FW 3, 701 FW 2) for development of HMPs was the overarching direction used to complete the Green Bay and Gravel Island HMP.

Selecting Surrogate Species for Strategic Habitat Conservation in the Upper Midwest Great Lakes Geography (Powers et al. 2014)

A technical team developed a list of 36 surrogate species across seven broad habitat types within the Upper Midwest and Great Lakes geography using an eight step selection process grounded in the elements of strategic habitat conservation. Population goals are developed for a subset of the species in the list. These species were evaluated during our development of refuge-specific ROC.

USFWS Migratory Bird Program Strategic Plan (2004a)

The Migratory Bird Program Strategic Plan, developed to provide direction for the Service's migratory bird management over the decade 2004–2014, is still useful today. The plan contains a vision and recommendations for the Refuge System's place in bird conservation. It defines strategies for the Service to actively support bird conservation through monitoring, conservation, consultation, and recreation. This HMP, to the extent it is practical, will utilize standard monitoring protocols, habitat assessment and management, and promote nature-based recreation and education to forward the vision of the Migratory Bird Program Strategic Plan.

USFWS North American Waterfowl Management Plan (USFWS 2004b)

The North American Waterfowl Management Plan was originally written in 1986 and envisioned a 15-year effort to achieve landscape conditions that could sustain waterfowl populations. The 2004 revision establishes a new 15-year timeframe for waterfowl conservation in North America by assessing and defining the needs, priorities, and strategies required to guide waterfowl conservation in the 21st century. The species and habitat priority lists were reviewed during our development of refuge-specific ROC.

Partners In Flight Bird Conservation Plan for the Boreal Hardwood Transition (Rosenberg et.al. 2016

This plan outlines objectives for the conservation of bird populations across a variety of habitats within the Boreal Hardwood Transition region. It identifies species of concern based on established assessment criteria. It also proposes science-based management strategies, research, modeling, and monitoring of bird populations within the region. Species identified as priority species in this plan were considered during our development and prioritization of refuge-specific ROC. The 2016 revision present new assessments and tools as well as recommendation

to address continental threats, reverse long-term population declines, and prevent landbirds from becoming at risk over a 10 year timeframe.

Upper Mississippi River and Great Lakes Region Joint Venture (UMRGLJV) Implementation Plan (2007)

This plan intends to integrate bird conservation priorities at the regional, state, and local levels and provide land managers with guidance regarding management for bird habitat. The plan also promotes research, monitoring, and adaptive management strategies to improve existing information on bird populations. It also provides management recommendations to improve habitat for bird-groups of conservation concern. Species identified in the plan were considered during our development and prioritization of refuge-specific ROC.

Upper Mississippi River and Great Lakes Region Joint Venture (UMRGLJV) Conservation Plans

The UMRGLJV developed conservation strategies for landbirds (Potter et al. 2007a), shorebirds (Potter et al. 2007b), waterfowl (Soulliere et al. 2007a), and waterbirds (Wires et al. 2010). These plans are intended to provide step-down conservation plans at the regional scale that provide managers guidance for designing landscapes with increased value to birds. Species and habitats identified in the plan were considered during our development and prioritization of refuge-specific ROC.

Region 3 Coastal Program-Great Lakes Strategic Work Plan; 2017-2021 (USFWS 2017)

This plan is intended to inform and guide the work of the Coastal Program in the Mid-west Region. The Plan steps down the national Coastal Program vision document. The Coastal Program-Great Lakes objective is to maintain or increase the abundance of federal trust species through technical assistance and habitat improvement and protection projects.

State Wildlife Action Plan (WDNR 2005) (MIDNR 2015)

State Wildlife Action Plans represent comprehensive wildlife conservation strategies that are intended to conserve wildlife and their habitats before they become rarer and more expensive to protect. States are required to complete a Wildlife Action Plan to be eligible for funds distributed from the federal government through the Wildlife Conservation and Restoration Program and the State Wildlife Grants Program. Wildlife Action Plans document the distribution and abundance of all species of wildlife within a state and identify those with low and declining populations. Species of Greatest Conservation Need have been identified and were considered during our development and prioritization of refuge-specific ROC.

Refuge-Specific Plans

Comprehensive Conservation Plan (CCP)

The 1997 National Wildlife Refuge Improvement Act required all refuges to complete CCPs by 2012. A CCP is an all-encompassing document that guides biological and public use actions on a NWR for a 15-year period. The Green Bay and Gravel Island CCP was finalized in 2013. As described in Section 1.0, this HMP is a step-down plan of the CCP. Likewise, Inventory and Monitoring, Fire, and Hunting Program Management Plans are also CCP step-down plans and will be further developed and integrated into the CCP/HMP process as it advances.

Inventory and Monitoring Plan (IMP)

An Inventory and Monitoring Plan (IMP) is a required refuge plan that tiers from this HMP and is thus intended to record progress toward the management objectives and strategies developed in the HMP. The IMP provides the framework for the continuous measurement of HMP and CCP goal implementation and monitoring to feed into adaptive management systems. The IMP will be completed as a follow up plan to this HMP.

Wilderness Character Monitoring Reports

A Report on Wilderness Character Monitoring was completed for the Wisconsin Islands Wilderness in 2012 (O'Dell, 2012) and a Summary Update followed in 2016 (Gants et al, 2016). Selected measures for Wisconsin Islands Wilderness were: 1) untrammeled quality, 2) natural quality, 3) undeveloped and 4) solitude or primitive and unconfined recreation.

Fire Management Plan (FMP)

An updated Fire Management Plan for the refuges was completed in 2007. The plan addresses fire management on all units of both refuges.

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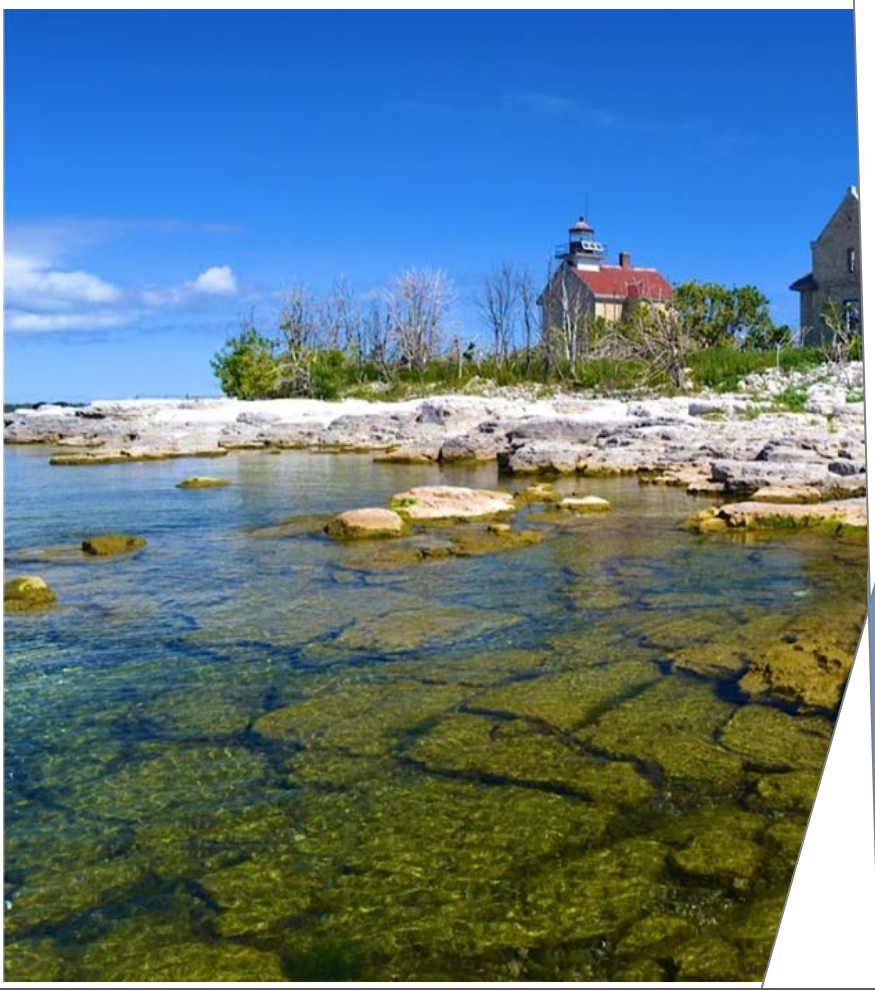

CHAPTER 2.

BACKGROUND

Pilot Island

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2. BACKGROUND

2.1 REFUGE BACKGROUND

Great Lakes Context

The backdrop for the Green Bay and Gravel Islands NWRs is Lake Michigan. Among the five lakes collectively known as The Great Lakes, Lake Michigan is second only to Lake Superior in depth and volume. Besides having a storied history in early exploration of the region and bearing important shipping routes, The Great Lakes are the third largest concentration of fresh water by volume on earth, after the polar ice caps and Lake Baikal in eastern Russia. Lake Michigan, which holds the islands discussed in this HMP, has an average depth of 279 ft. and holds 1,180 cubic miles of water within a surface area of 22,300 square miles (EPA 2015). The landscape it drains is over twice that area, including land mostly in Wisconsin and Michigan, but also small parts of Indiana and Illinois. Despite the vastness of the lake, each of these islands lies no more than a few miles from mainland Wisconsin or Michigan, with shallow channels in between them (USFWS 2013).

Historic Human Influence

Human influence on the Great Lakes islands has varied based on island size, remoteness, and suitability for human purposes. As the Great Lakes region grew more populous, and especially as industrial activity became a dominant economic driver in the upper Midwest, Great Lakes shipping routes were some of the busiest in the world. Lighthouses were one of the first widely recorded human disturbances to some of these islands (Smithsonian 2015). A lighthouse was built on Pilot Island in 1858. Plum Island has several structures built c.1900 including lighthouses and a USCG lifesaving station. Plum Island also has some archaeological spots of interest that are less well-studied including suspected Native American campsites and gardens (USFWS 2013). St. Martin Island contains remnants of 19th century fishing villages, and the northeastern tip of the island still has a standing lighthouse and keeper's quarters (Grimm et al. 2013). While the small size of some of these islands, such as Hog and those of Gravel Island NWR, make significant historical human use less likely, a future cultural survey of the islands is necessary before making further conclusions.

Human use in the region continues to be focused around industry, with Green Bay remaining a regional business hub, but recreation has become a large contributor to the local economy in and around Door County, Wisconsin. Door County including Washington Island, around which several of these islands are clustered, is a summer vacation destination for the region, and a popular launching point for boating, diving, and other leisure-driven purposes. The popularity of Door County and Washington Island in summer and the proximity the islands, along with an increase in recreational kayaking, have led to people getting closer to the islands and their nesting bird colonies than in previous decades. Keeping the wilderness areas protected while maintaining positive public relations is a priority going forward (O'Dell 2012).

Public access to the islands is restricted except for Plum Island, open annually Memorial Day to Labor Day. Visitors are responsible for their own transport via private boat or a local charter boat service allowed under the terms of a USFWS issued Commercial Use Permit. Access is restricted

to a single entrance point on the northeast side of the island to minimize habitat disturbance (USFWS 2013). Access to recently acquired St. Martin Island is restricted as of October 2015, while island specific planning is underway, permits will be required for entry (USFWS 2015). Gravel, Spider, Hog, Pilot, and Rocky islands are protected from human disturbance as breeding bird sanctuaries.

Climate

All of the islands are at approximately 45 degrees north latitude, and are subject to similar weather as what is experienced on mainland Wisconsin or northern Michigan. The growing season is typically short, lasting 70 to 130 days. Late spring freezes are also a relatively common occurrence. Temperatures have been as low as -50 °F and as high as 105 °F, and snowfall has been as high as 140 inches. The area averages around 30 inches of precipitation each year (USFWS 2013).

The U.S. Department of the Interior issued an order 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. In the next century, expected warming trends will be somewhat less along Lake Michigan, as the regional climate is tempered by the large water body. The duration of lake ice cover will likely be shorter by the end of the century, however, and lake levels are expected to drop due to increased evapotranspiration (WICCI 2011). In the last 50 years alone, climate change is estimated to have caused a 4 to 7 inch drop in the Lake Michigan-Huron chain (IJC 2013). For the coming century, climate projection models have indicated a lake level drop from below 1 foot up to 5 feet. This would mean some low-lying islands such as Spider and Gravel could see expanded area. Lower lake levels would likely mean that Hog Island would be connected more frequently to Washington Island via a “land bridge” that forms under low water conditions. This increases the likelihood of predators accessing the island or people walking over and disturbing the nesting bird colonies. The sedge meadow and fen communities on Plum Island would likely diminish in size as their water source is tied directly to lake levels (USFWS 2013). Mountain maple, a common understory shrub on the islands, is expected to lose more than 50% of its suitable habitat in the region under current climate change projections, while other common species such as northern white-cedar (*Thuja occidentalis*), sugar maple (*Acer saccharum*), and paper birch (*Betula papyrifera*) are also expected to decline (Janowiak et al. 2014). The regional effects of climate change projections are discussed further in the Comprehensive Conservation Plan for the islands (USFWS 2013).

2.2 REFUGE ISLANDS OVERVIEW AND HABITATS

The seven islands described here are part of the Grand Traverse chain of islands, stretching from the Door Peninsula of Wisconsin to the Garden Peninsula of Michigan. This chain is part of the Niagara Escarpment, dolomitic limestone that has shifted up and at an angle so the hard, erosion-resistant rock is at the surface. This dolomite forms the base of these refuge islands, and is often exposed, especially in areas near the lake surface, where wind, waves, and ice-action keep vegetation sparse (Dutch 1999). The islands’ location is mapped in Figure 1-2.

Green Bay National Wildlife Refuge currently consists of Hog, Plum, Pilot, Rocky, and St. Martin Islands. Two other islands, Detroit and Poverty Islands, are in the process of being acquired and added to the Green Bay NWR. Hog Island was the lone component of Green Bay NWR, protected since 1912 as a preserve with the purpose of preserving native bird nesting areas, until 2017 when Plum and Pilot Islands were acquired from the U.S. Coast Guard to provide additional habitat for nesting and migrating birds. The USCG continues to maintain the aids to navigation on both Plum and Pilot Islands (USFWS 2013). Public access is prohibited on both Pilot and Hog Islands to further protect native bird nesting areas (USFWS 2013). In 2015, the USFWS acquired approximately 95% of St. Martin Island, 1388 acres, and Rocky Island, 26.2 acres, from The Nature Conservancy. These islands are located further northeast of the other three islands in Michigan waters off the tip of the Garden Peninsula.

Hog Island lies 0.5 miles directly east of Washington Island's Percy Johnson County Park. Hog Island rises approximately 20 feet above lake level and remnant forest exists on the flat top of the island. Paper birch (*B. papyrifera*) and chokecherry (*Prunus virginiana*) dominate the canopy, though these have been thinned due to nesting activity of herring gulls, great blue herons, black-crowned night herons, and great egrets. Red elderberry (*Sambucus racemosa*) has moved into the openings while weedy species such as American black currant (*Ribes americanum*) and fringed bindweed (*Fallopia cilinodis*) dominate the understory. State-listed plant species such as Canada yew (*Taxus canadensis*), Western fescue (*Festuca occidentalis*), and elk sedge (*Carex garberi*) can still be found in the understory. Closer to the water, the vegetation thins out and is replaced by bare limestone ledges (USFWS 2013).

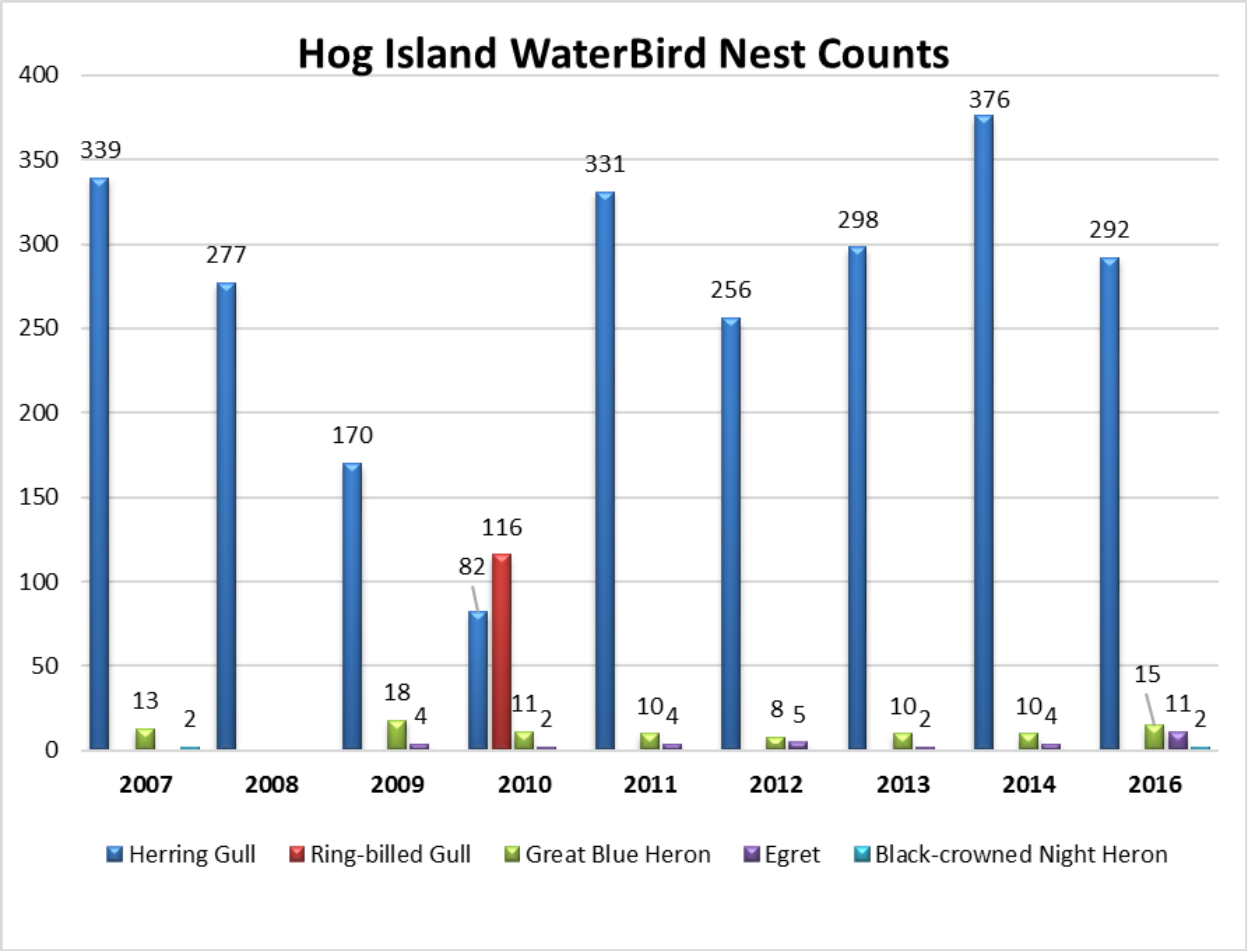

Figure 2-1: Number of nests for waterbird species observed at Hog Island 2007-2016

Pilot Island is slightly larger at 6.4 acres, and is located nearly 3 miles directly east of the tip of Door Peninsula. When first surveyed in the 1970s, the island was covered by a native shrub, white cedar (*Thuja occidentalis*), and paper birch (*B. papyrifera*) community with a healthy Canada yew (*T. canadensis*) understory. In more recent years, nesting colonies of gulls and cormorants have reduced the forest cover to only a few shrubs consisting mostly of red elderberry (*S. racemosa*). The island is now dominated by weedy invasive plants such as catnip (*Nepeta cataria*), bittersweet nightshade (*Solanum dulcamara*), and common mallow (*Malva neglecta*).

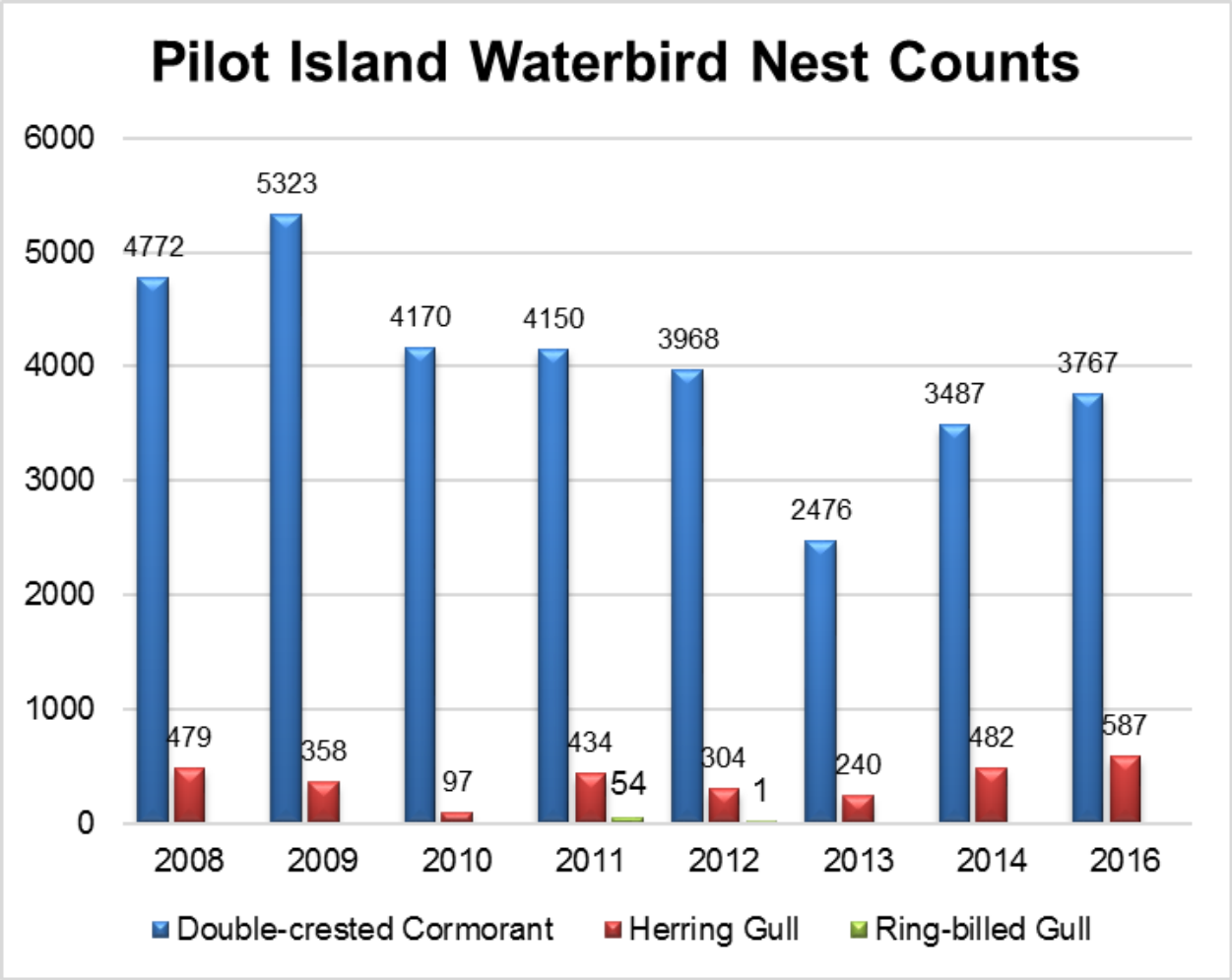

Figure 2-2: Number of nests for waterbird species observed at Pilot Island 2008-2016

Plum Island, approximately 316 acres and peak elevation of 620 MSL feet above the lake, is significantly larger than either Pilot or Hog Island. The vegetative communities are more diverse than the smaller islands. During surveys on the 1970's, WI-DNR reported wonderful old-growth sugar maple (*A. saccharum*) and basswood (*Tilia americana*) forests in the interior of the island, with a dense Canada yew (*T. canadensis*) understory and deer were absent (Huntoon 1977). Through logging and the presence of deer in the 1980s, the forest canopy was opened up and early successional and invasive species have proliferated. Eastern white cedar (*T. occidentalis*) remains dominant on some of the island's bluff communities, and a 15-acre sedge meadow and shallow emergent wetland on the northeastern side of the island are directly connected to the water levels of Lake Michigan, creating a variable wetland community. During low-water periods, a calcareous meadow is exposed, dominated by brook lobelia (*Lobelia kalmia*), rushes (*Juncus* spp.), and St. Johnswort

Dwarf Lake Iris (Horicon NWR staff photo)

(*Hypericum* spp.) The sedge meadow is dominated by Canada blue-joint grass (*Calamagrostis canadensis*) and tussock sedge (*Carex stricta*). Dwarf lake iris (*Iris lacustris*), a federally threatened species, is also found on the northeast side of the island in gravelly, calcareous soils (USFWS 2013).

Owing to its larger size and greater habitat diversity, Plum Island sees high numbers of birds, both breeding on the island and during migration. The American redstart is the most common breeding bird, but many other songbirds use the forest including American woodcock and Northern flicker. During spring and fall migration, many songbirds use the forest, including seven recorded wood warbler species. White-tailed deer are present, and evidence of island gigantism has been found, with the American toad population.

American toad (Anaxyrus americanus) at Green Bay NWR (Horicon NWR staff photo)

The 2015 additions of St. Martin Island and Rocky Island more than quadrupled the size of Green Bay NWR. All but five percent of St. Martin Island, or 1,380 acres, had been owned by The Nature Conservancy before its transfer to the USFWS. The remaining 51 acres remain with the Little Traverse Bay Band of Odawa Indians. The most comprehensive vegetation surveys of St. Martin Island were completed from 2004 – 2013 while the island was owned by The Nature Conservancy. The interior was described as a northern hardwood mix of sugar maple (*A. saccharum*) and paper birch (*B. papyrifera*), with white ash (*Fraxinus americana*), American beech (*Fagus grandifolia*), and red oak (*Quercus rubra*) scattered throughout. Underneath the canopy, a shrub layer is dominated by balsam fir (*Abies balsamea*), mountain maple (*Acer spicatum*), and ironwood (*Carpinus caroliniana*). Surrounding this community is a conifer forest made up of white cedar (*T. occidentalis*) primarily, with lesser numbers of balsam fir (*A. balsamea*) and hemlock (*Tsuga canadensis*). Notably missing from the forest community is an understory of Canada yew (*T. canadensis*), which had been common before white-tailed deer were introduced. Thad Grudzien, a member of the Cranbrook Institute-Oakland University expeditions of 1989-1990, remembers Canada yew being abundant, so there must not have been high populations (or any) white-tailed deer on the island at that time (Judziewicz 2001). This observation was echoed by all biological visitors to the island up through 2006. By 2009, white-tailed deer populations expanded (Smith 2009) to have a tremendous impact on the forest understory vegetation on the island. By 2014, essentially no Canada yew and very little else is able to survive in the understory, except for a few deer-dispersed herbs with burlike fruits such as common hound's tongue (*Cynoglossum boreale*) and stickseed (*Hackelia virginiana*). Neither of these species was documented on the island prior to 2013 (Judziewicz et al. 2016). In 2013, a visit by TNC biologists reported Canada yew as being functionally extirpated from the island due to the result of the unfortunate introduction and subsequent mismanagement of white-tailed deer on the island (Grimm et. al. 2013). Reports from the former island landowner

suggests that the deer were intentionally brought to the island and the herd was managed by local hunters. The Michigan DNR reported 31 bucks (7 points or larger), 9 does, and another 10 deer (a mix of small bucks and does) harvested from the island during the 2009 Michigan firearms gun deer-hunting season (Outdoor News 2009).

Rocky Island, is approximately 26 acres and is located two miles southwest of Michigan's Garden Peninsula (Figure 1- 2) and is in close proximity to Little Summer Islands. The island is identified as an important site for breeding colonial waterbirds in the Great Lakes (Wires 2010). It is narrow with a wooded interior and a cobblestone beach and has hosted large colonies of cormorants, Caspian terns, and common terns in the past. Interestingly, a pig was found on the island in recent years. Thought to have been brought to the island by local fisherman to eliminate nesting cormorants. Nesting colonies of herring and ring-billed gulls have been documented nesting on the island in more recent years.

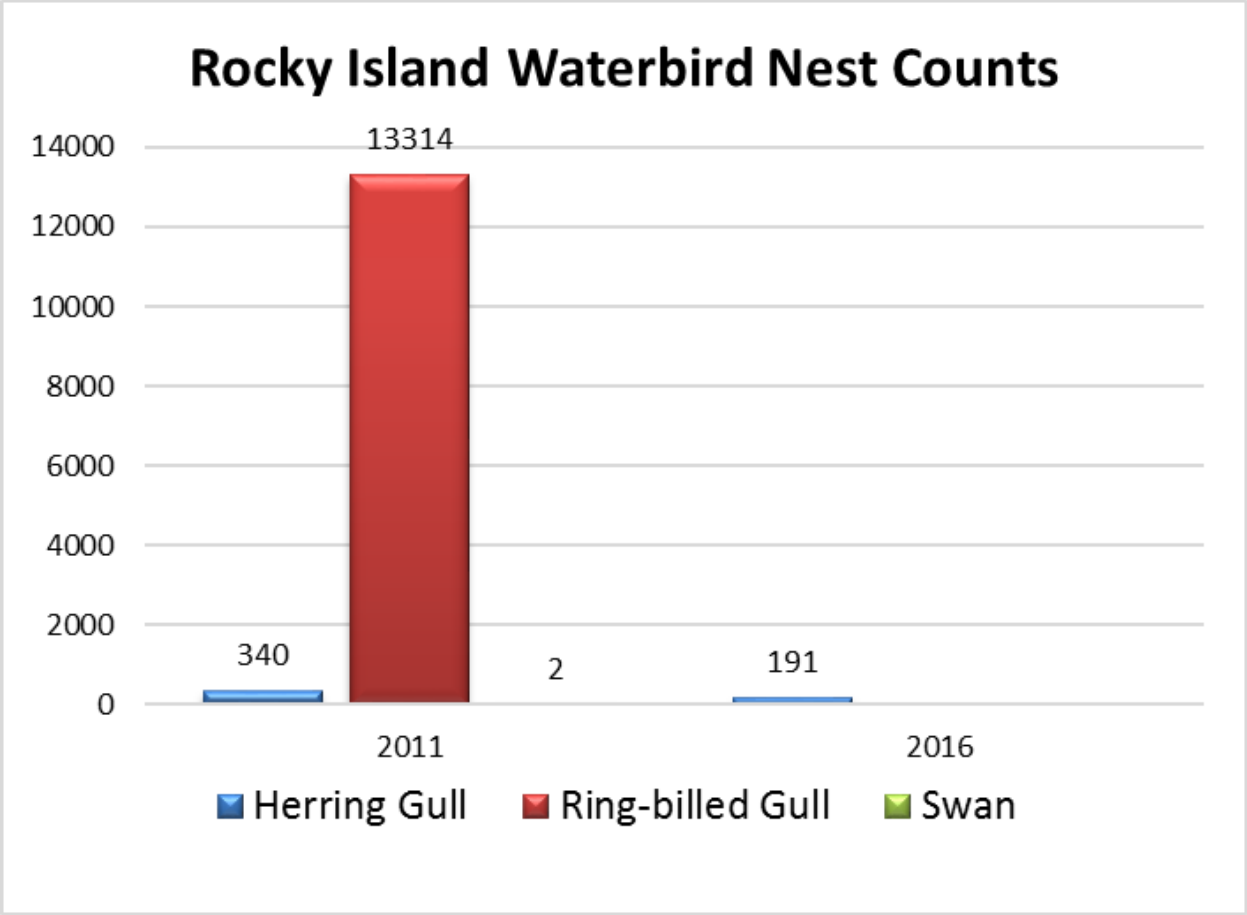

Figure 2-3: Number of nests for waterbird species observed at Rocky Island in 2011 and 2016

Two island parcels, soon to be acquired, are Poverty and Detroit Island. At the time of writing this HMP, the Service is still in the process of completing a land transfer of the majority of 214-acre Poverty Island from Bureau of Land Management and a 150 acre land acquisition on Detroit Island from private ownership to be included the Green Bay NWR (Figure 1-2). The Detroit Island

acquisition will add to 70 acres of already protected lands owned by the WI-DNR and Door County Land Trust. Although not yet owned by the Service, these islands have been included for consideration within this HMP due to the pending acquisitions and similar habitat composition as other islands within the refuge.

Gravel Island National Wildlife Refuge consists of Gravel Island and Spider Island, both being part of the Wisconsin Islands Wilderness. Gravel Island is approximately 10 acres and low-lying, reaching only 10 feet above lake level. It hosts a large nesting colony of Caspian terns as well as herring and ring-billed gulls. There is no permanent vegetation on the island due to the semi-regular wave and ice action. During low water years, some plant species are able to grow including American sea rocket (*Cakile edentula var. lacustris*), a state special concern plant.

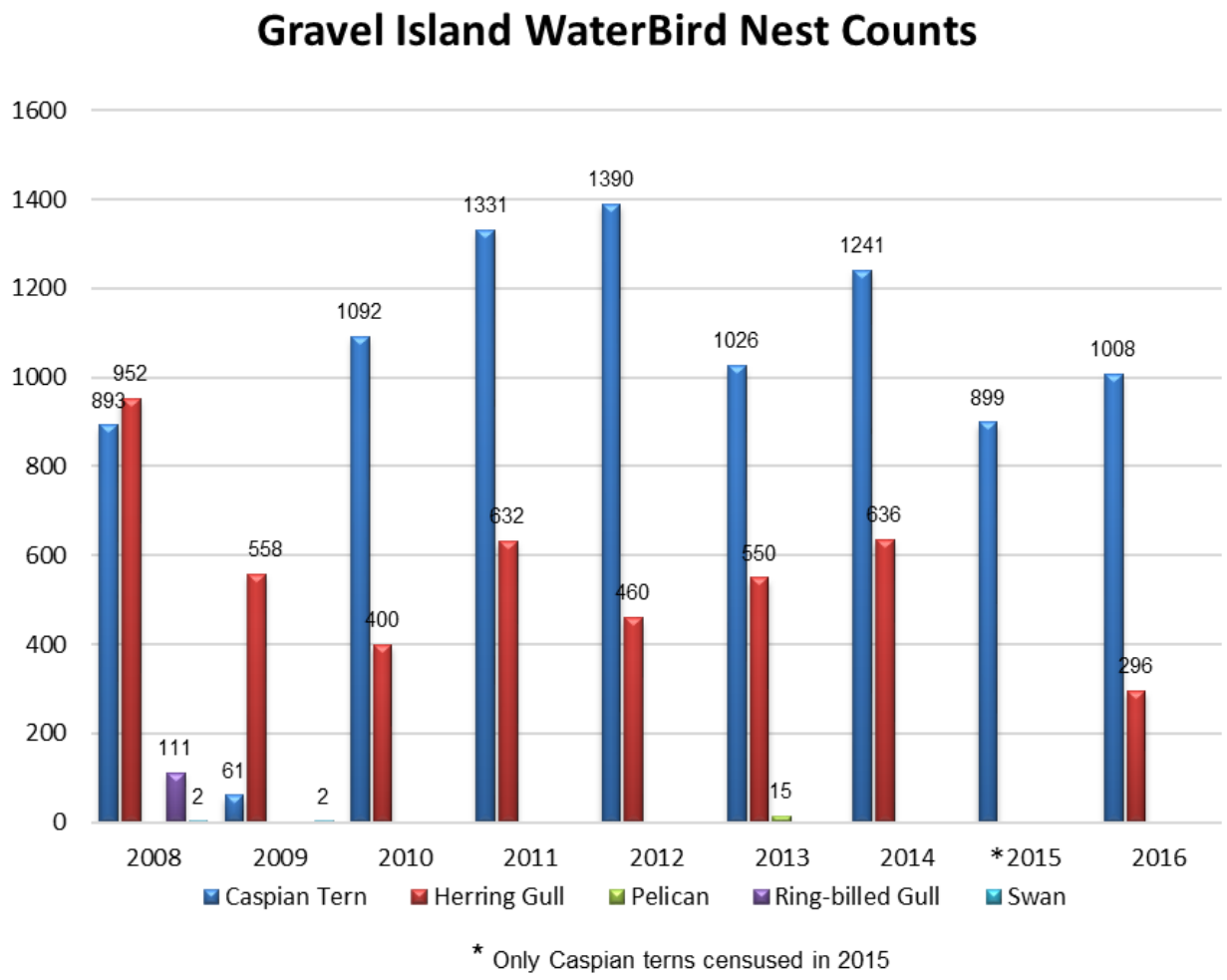

Figure 2-4: Number of nests for waterbird species observed at Gravel Island 2008-2016

Spider Island is approximately 24 acres and rises 14 feet above Lake Michigan. A 1905 survey mentioned a community of eastern white cedar (*T. occidentalis*), paper birch (*B. papyrifera*), and tamarack (*Larix laricina*) growing on the island with a rich understory of native herbaceous species. With the growing population of gulls, herons, and cormorants, the island has nearly no

remnant of its former forest. The most common species on Spider Island are now in the herbaceous layer and non-native: common mallow (*Malva neglecta*), tumble mustard (*Sisymbrium altissimum*), and wormseed mustard (*Erysimum cheiranthoides*). The open and low nature of Spider Island does provide suitable habitat for migrating shorebirds and waterfowl, which have been observed feeding and resting in and around the shallow pools created by the fissured dolomite (USFWS 2013). Spider Island is identified as an important site for breeding colonial waterbirds in the Great Lakes (Wires 2010).

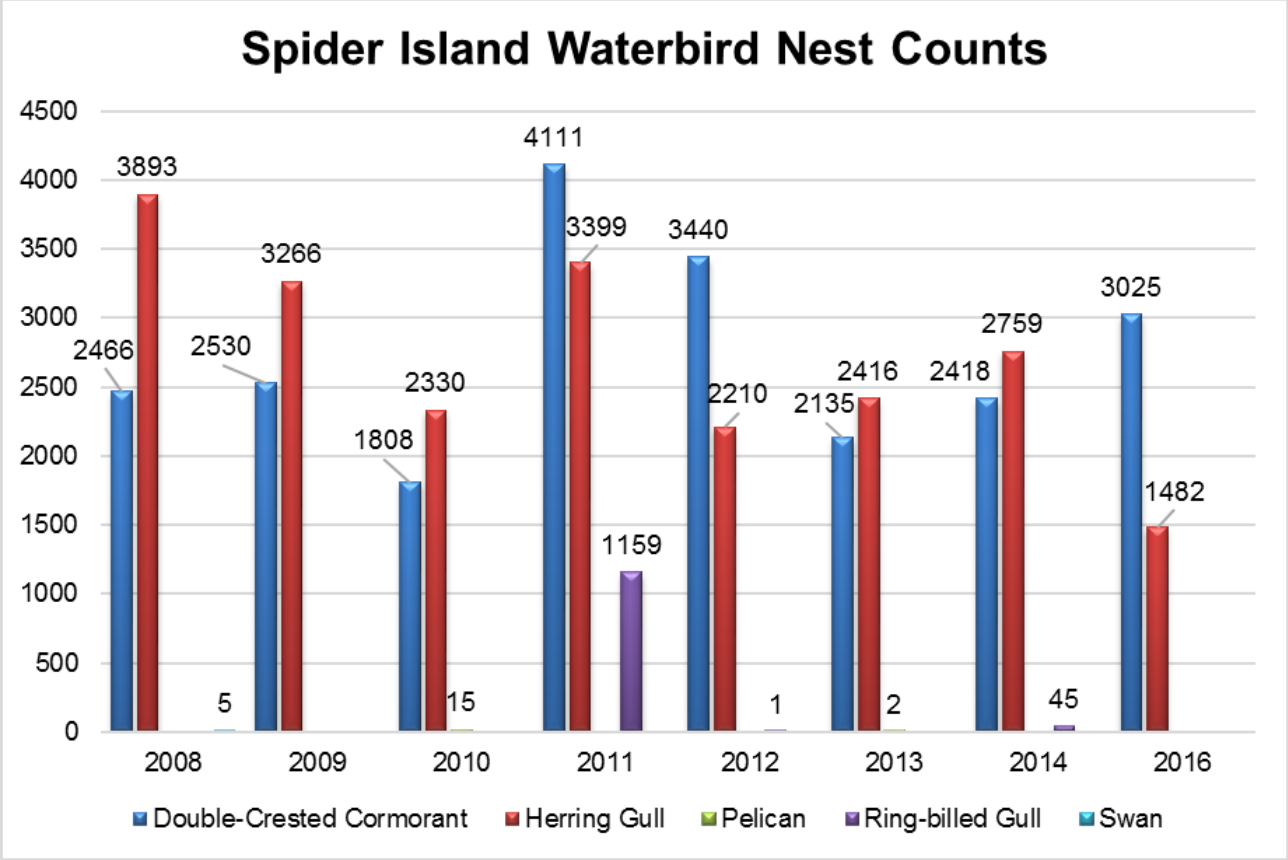

Figure 2-5: Number of nests for waterbird species observed at Spider Island 2008-2016

2.3 CHANGES FROM HISTORIC CONDITION AND CURRENT ISSUES

Historic Land Use

The smaller Great Lakes islands are unique in that their history of human disturbance is limited compared to the nearby mainland. None of the seven islands that make up the Green Bay and Gravel Island NWRs have been continuously inhabited, farmed, or logged in recent human history. The most lasting reminders of anthropogenic change are the lighthouses and associated USCG buildings on Plum, Pilot, and St. Martin Islands. St. Martin was the only island to experience permanent residents, a few small fishing communities through the 1800s, though the population of the 1,300 acre island reached a peak of about 100 people. Subsistence gardening and logging

seemed to take place, and not on a large scale (Door County Pulse 2013). Plum Island and St. Martin Island were selectively logged in the 1980s, most of the old growth hardwoods are absent and the resulting forest landscape is dominated by a third-growth forest of sugar maple (*A. saccharum*), beech (*F. grandifolia*), paper birch (*B. papyrifera*); leaving brushy and weedy species to proliferate on the forest floor. In the coming decades, climate change is expected to make the Great Lakes region more susceptible to new exotic and invasive species that formerly could not sustain a presence in the area (USFWS 2013).

Contaminants

Elevated levels of toxic chemicals on the Great Lakes food chain have coincided with poor health, reproductive impairments, and other physiological problems for species such as the herring gull, ring –billed gull, cormorant, Caspian tern, common tern, and black-crowned night heron (Ryckman et al.) Problems such as reduced hatching success, eggshell thinning, and abnormal adult behavior during nesting were first observed in the 1960-1970's. Early studies by the USFWS Patuxent Research Center established that bird species of the Green Bay and Gravel Islands NWR were heavily contaminated with various organochlorines, such as DDE, dieldrin, and polychlorinated biphenyls (PCBs) (Haseltine et al. 1981) (Heinz et. al 1983). To track progress toward clean-up efforts and ecosystem restoration, a series of investigations was undertaken in 1987-88 to measure contaminant concentrations in trust species, including cormorants, herring gulls, as well as a variety of waterfowl on refuge islands. PCB's and DDT were detected in all locations and concentrations were high, especially for fish-eating birds (Dale, Stromborg 1993). These studies led to similar investigations on the effects of contaminants on cormorant reproductive success and a bill deformities (Larson et.al 1996). Contaminants still pose a threat to many species in the Great Lakes. The refuge islands are one of the few places in Lake Michigan/Green Bay where historic data documenting contaminant impacts on trust resources exists.

Disease

Avian botulism has been a significant cause of mortality in birds living on the Great Lakes since the 1960's One of the largest outbreaks occurred in Lake Michigan in 1963-1964, resulting in the death of 12,000 birds (Brand et. al 1983), with periodic outbreaks of botulism continuing. The outbreaks have become more common and widespread in recent years. Recent research found that warm waters and algae, both of which have become more frequent, tended to precede bird die offs, likely because they promoted the growth of botulism toxin-producing bacteria. Many lakes have been warming with a changing climate, and clearer water caused by exotic zebra mussels provides more sunlight for algae to grow thicker mats. Those conditions create the low-oxygen environments where botulism toxin- producing bacteria thrive. These changes help explain increased bird die offs since the 1960's (Prince, 2018). Bird mortality events due to avian botulism has been documented on /and around the refuge islands in recent years.

Newcastle Disease Virus (NDV) can be substantial mortality factor for refuge waterbirds, especially for juvenile cormorants at refuge breeding colonies. In the Great Lakes and the Upper Midwest, a widespread epidemic occurred in 1992 and caused high mortality of over 20,000 juvenile cormorants in breeding colonies (Glaser et al. 1999). The disease mostly impacts cormorants but also American white pelicans, and ring-billed gulls. Mortality events have been

documented on both Spider and Pilot Island, most recently in 2010 and again on Pilot Island in 2016. In both cases, mortality numbers of 100-500 cormorants, mostly juveniles, were estimated (S. ODell personal communication, 2016). The possible transmission of this virus from free-ranging birds to domestic poultry is a concern. Repeated epizootics in cormorants suggest NDV is well established as a persistent threat to cormorants on refuge islands.

Exotic Species

More than 160 exotic invasive species are established in the Great Lakes (Ricciardi 2011) and several; like the zebra mussel, alewife, sea lamprey, directly and indirectly impact fisheries and fish-eating birds (Mills et al 1993). The introduction of invasive fish has altered food chains in the Great Lakes (Ludwig 2013). For example, the availability of alewives and other exotic fish such as round gobies have been implicated as one of the factors leading to the increase in cormorant populations (Weseloh and Collier 1995) (MIDNR 2005))

Non-indigenous plants such as common reed (*Phragmites australis)* and purple loosestrife *(Lythrum salicaria)* have substantial impacts on coastal wetlands and lakeshores. Recent funding and support from USFWS Coastal Management Program has allowed refuge staff to begin eradicating and/or controlling large Phragmites infestations and other invasive species on both Plum and St. Martin Islands.

The mute swan is an exotic species whose aggressive breeding behavior has the potential to impact breeding birds on refuge islands (Petrie and Francis 2003). Refuge staff work in cooperation with the local USDA APHIS Wildlife Services in staff to monitor mute swans in the Door County area and to remove any nesting mute swans from refuge islands.

Double-crested Cormorants

Although cormorants were listed as endangered species in 1972 and were only delisted in 1999, populations have strongly recovered since then, and cormorants are now a target for control in Wisconsin and Michigan (Pritzl & Peeters 2008). After suffering dramatic population declines mid-century due to bioaccumulation in the food supply of DDE and PCBs the cormorant began a rapid recovery in the mid-to-late 1970s. In 1972, the cormorant was added to the Migratory Bird Treaty Act as a protected species. No longer could fishermen or government agencies destroy nests or shoot cormorants. The introduction of alewives and rainbow smelt into the upper Great Lakes is also thought to have allowed for the

Double-crested Cormorant Colony on Spider Island. (Horicon NWR staff photo)

expansion that has produced an estimated 30,000 cormorant nests in the region as of 2001 (MDNR 2005). Cormorants nest in dense colonies, using any standing vegetation that allows them to perch and dry their wings after feeding. Due to the primarily sedentary nature of the cormorant colony, compared to gulls which are often in flight during the day, guano accumulates quickly in areas where cormorants gather. The acidic nature of the guano eventually makes the soil inhospitable for the native vegetation. Woody vegetation has rapidly decreased in these areas of concentration, such as at Spider and Pilot Islands where nesting bird colonies have destroyed a white cedar (*T. occidentalis*), tamarack (*Larix laricina*), and paper birch (*B. papyrifera*) canopy (USFWS 2013).

In 2006, then-Governor Doyle of Wisconsin signed legislation directing the DNR to create a program of cormorant control (Pritzl and Peeters 2008). An environmental assessment regarding cormorant control recommended that on islands such as Plum and Hog Islands, where native trees and shrubs still dominate the landscape, cormorant control methods be used to protect these habitats (USFWS 2009). Prior to this, in 2003, the Service established a Public Resource Depredation Order (PRDO) that authorized the U.S. Department of Agriculture Wildlife Services, state wildlife agencies, and tribes in 24 states to kill cormorants directly, oil their eggs, and destroy nests when they significantly impact fish, vegetation, or other birds. This authorization has been used at Green Bay NWR's Hog Island to destroy nests/eggs to prevent the establishment of a permanent colony on the island. The vegetation of the island is relatively healthy and a cormorant colony would cause substantial damage to vegetation and habitat for co-nesting species of great blue herons, black-crowned night herons, and great egrets. Larger colonies of cormorants at Spider Island and Pilot Island have been left unmanaged to protect sensitive island habitat for native colonial nesting waterbirds. Spider and Pilot Islands are two of very few islands in the Great Lakes Region that do not experience some form of cormorant management.

Data collected by the refuge illustrates the effectiveness of cormorant control in preventing nesting success and colonization. An eleven year data set maintained by the refuge (Figure 2-6) shows the nest counts of two islands without cormorant control (Spider and Pilot) compared to one island with cormorant control implemented (Hog). Based on this dataset, the refuge has documented the success of nest destruction in preventing colonization of cormorants in high quality and sensitive forest habitats of some islands.

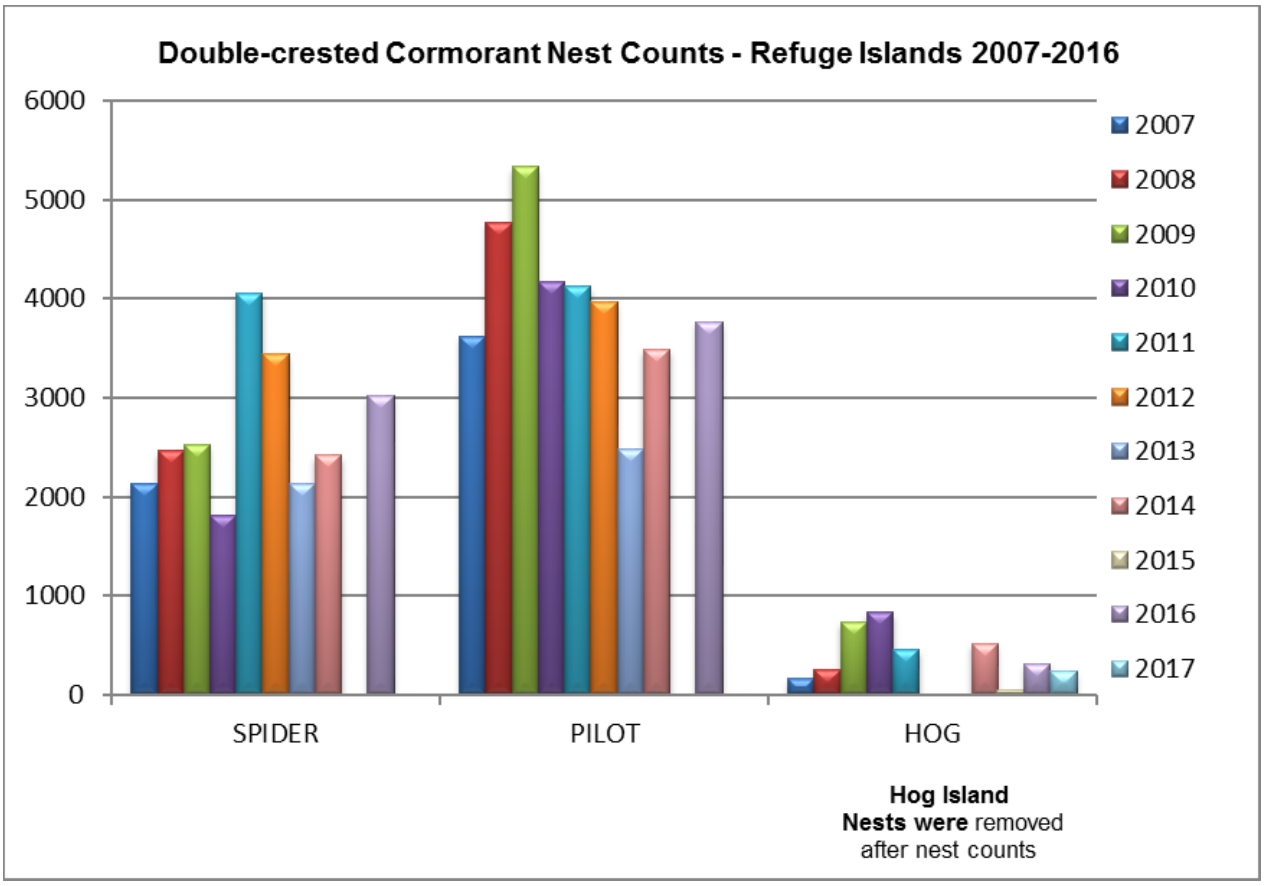

Figure 2-6: Number of double-crested cormorant nests observed on refuge islands 2007-2016

In May 2016, the Public Resource Depredation Order was vacated when a federal judge ruled in favor of the plaintiffs in a lawsuit filed by Public Employees for Environmental Responsibility. The authority for authorizing lethal take of depredating cormorants then reverted back to the issuance of depredation permits pursuant to 50 C.F.R. § 21.41. Unfortunately, much of the supporting NEPA analyses for the issuance of permits was based on an inadequate EA issued in 2014. Without adequate NEPA documentation, the USFWS stopped issuing depredation permits until an appropriate NEPA review could be completed. As a result, cormorants successfully nested on Hog Island in 2016 and 2017.

The USFWS finalized an Environmental Assessment (EA) for Issuing Depredation Permits for Double-crested Cormorant Management in October of 2017. In the EA, the USFWS proposes to make decisions on depredation permit applications for the annual take of up to 51,571 double-crested cormorants, across 37 central and eastern States and the District of Columbia. The USFWS will allocate the maximum allowable take across three managed subpopulations: Atlantic, Mississippi/Central, and Florida. The scope of the new EA is limited to applications for depredation permits for managing cormorants near aquaculture facilities, alleviating human health and safety concerns, protecting threatened and endangered species, and reducing property damage.

Permits may also be issued if there is convincing evidence that cormorants are adversely affecting species of conservation concern or rare and declining plant communities on a local scale.

Approved management strategies for DCCO include lethal and non-lethal methods. Egg oiling, which allows the birds to remain at the nest site, eliminates the viability of eggs. Nest destruction has been used to discourage adult DCCOs from remaining at their roosting site. Lastly, targeted shooting of adult DCCOs can be used to lower the population, but more immediately it discourages the colony from nesting at that particular site (USDA 2012). In accordance with the 2017 EA, non-lethal methods are required as the initial approach before implementing lethal measures.

Refuge staff plan to continue cormorant management on Hog Island and monitor the impacts of management activities on cormorants and non-target species. New management techniques will be considered as new information becomes available on the best methods to eliminate or significantly reduce the continued need for killing or removal of birds, or destroying eggs/nests. Local population density of breeding cormorants and movement between sites, especially in response to human disturbance will likely determine the future need for cormorant management on refuge islands. Refuge staff will continue to coordinate and work cooperatively with the Wisconsin Cormorant Coordination Group (WDNR, USDA WS, and USFWS) to exchange information on cormorant management.

White-tailed Deer

White-tailed deer have also had an impact on the landscape, and can cause similar habitat-altering changes. Deer were introduced on Plum Island and St. Martin Island in the last few decades, and species such as Canada yew (*T. canadensis*) have been decimated as a result. Canada yew was historically important in this community, and was documented as being abundant on the Grand Traverse Islands in vegetation surveys in the 1970s, though some of these same reports warned of imminent collapse of the yew population if white-tailed deer herbivory were allowed to continue at high levels (WDNR 1978). These findings were echoed by more recent surveys of St. Martin Island, in which Canada yew was determined to be functionally extirpated from the island, and would remain so until white-tailed deer were removed from the landscape (Epstein et al. 2002). Besides the Canada yew, plants sensitive to deer herbivory include northern white-cedar (*T. occidnetalis*) and eastern hemlock (*Tsuga canadensis*), two common tree species on the islands, as well as spring ephemerals and orchids on the forest floor. Wisconsin DNR deer management guidelines concur that deer populations can negatively affect forest regeneration, especially impacting preferred species such as eastern hemlock, northern white cedar, and Canada yew (WDNR 1998). Effects can be seen in the absence of saplings in an area even though adults of the species are present, or in browse-lines, where trees and shrubs are browsed at heights easily reached by deer. With no resident predators, deer that reside on the island reproduce quickly and have had measurable impact on forest vegetation (WDNR 2015).

Coffey Swamp, overbrowsed by deer. Washington Island (E. Judziewicz)

Following decades of milder winters on average in the 1990s and 2000s, the deer population has reached a historically high level (DNR 2014). White-tailed deer densities may be as high as 2-4 times greater than pre-European settlement, and Canada yew populations do not seem to persist in areas with this population level. In a study with approximately 2-6 white-tailed deer per square kilometer, scattered populations of Canada yew were browsed beyond their ability to maintain themselves (Windels and Flaspohler 2013). According to information from the Wisconsin DNR, overwintering deer densities in Door County may be over 10 deer per square kilometer (DNR 2015). Some of the most persistent Canada yew populations exist on Great Lakes islands that have no deer population. Though hunting may not be able to dramatically effect deer densities on the mainland, removing deer from these sensitive island refuges is possible and likely to have an impact. Recent deer culling efforts at the Apostle Islands National Lakeshore, have shown results indicating a positive correlation between white-tailed deer removal and Canada yew regrowth, providing a remnant population of yew exists (Windels and Flaspohler 2014).

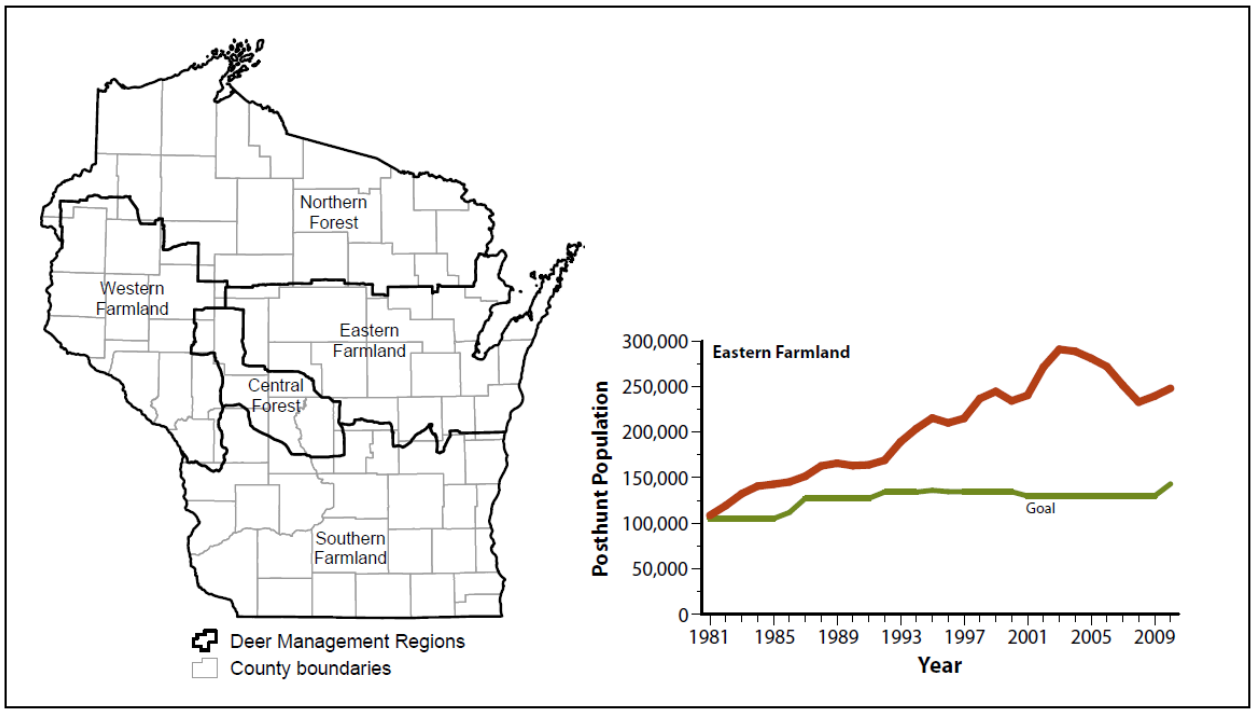

Figure 2-7 White-tailed deer population size in relation to population goal in the eastern farmland deer management region, 1981 - 2009. Credit: DNR 2014.

Deer are often considered a keystone herbivore; affecting community structure and modifying the distribution patterns and abundance of many other species. Migratory birds such as the Canada warbler use these islands to forage. Too many deer endanger the flora and fauna of the forest including valuable forest understory and healthy forest regeneration to the detriment of migratory breeding and migratory birds using these islands. In order to allow for the northern mesic forest community to maintain its biological integrity, especially regarding regeneration of natural and formerly dominant species, a reduction or elimination of the deer population from the forested islands is considered necessary. The vegetation on these islands is exceptionally sensitive to deer browse, very few deer could cause long-term impacts to species composition and forest regeneration.

The eradication of deer from St. Martin Island is proposed due to the remote location of the island. The goal for Plum Island is to eliminate and/or keep deer numbers as low as possible, with the expectation that deer will eventually colonize the island on their own due to the proximity of the island to the mainland and larger Washington Island. Limited deer hunting has been allowed on Plum Island since 1982, and by permit only since acquisition by the USFWS. A nuisance deer control plan for St. Martin Island and a Hunt Plan for Plum Island are currently being developed to document methods for intensive control of deer aiming to eradicate the existing population and to limit or control any long-term re-establishment (USFWS 2013, pers. comm. refuge staff 2015).

2.4 CURRENT REFUGE CONDITIONS AND RESOURCES

Multiple planning efforts or classifications exist that help to frame natural resources management opportunities and challenges on a broader scale. This HMP planning effort took the following into consideration:

Great Lakes Basin Ecosystem

The Green Bay and Gravel Island NWRs are located within the Great Lakes Basin Ecosystem, a system shared with Canada and 8 states. The ecosystem is made up of the world's largest freshwater body, which holds 18 percent of the world's supply of freshwater, and has a drainage basin of 228,000 square miles. Major biological concerns within the ecosystem include the impact of invasive species, aquatic and terrestrial habitat loss, and contaminants. Human activities including commercial navigation, industrial development, and waste disposal, drinking water extraction, recreation, and other uses that affect natural resources within the ecosystem.

Landscape Conservation Cooperative (LCC) Context

Both Green Bay and Gravel Island National Wildlife Refuges are part of the Upper Midwest and Great Lakes (UMGL) LCC. The mission of the UMGL LCC is to build a network of knowledge on climate change impacts to fish, wildlife, and other natural resources, while identifying conservation and management strategies that prepare for these and other changes across the region.

Bird Conservation Region (BCR)

The regional planning efforts completed by the North American Bird Conservation Initiative (NABCI) in 1999 created a series of regional conservation planning units that span international boundaries. The Green Bay and Gravel Island National Wildlife Refuges are located in BCR 12 – Boreal Hardwood Transition – that extends from southern Ontario, across northern Minnesota, Wisconsin, and Michigan. This region is characterized by coniferous and northern hardwood forests, nutrient-poor soils, and numerous clear lakes, bogs, and river flowage.

Partners in Flight (PIF) Physiographic Area

Partners in Flight (PIF) has created 99 physiographic areas that link conservation areas by natural environmental characteristics. The Green Bay and Gravel Island National Wildlife Refuges fall within the Boreal Hardwood Transition Physiographic Area 12. Historic vegetation types in this area include aspen-birch, maple-mixed hardwood, and white-red-jack pine communities.

Upper Mississippi River and Great Lakes Region Joint Venture (UMRGLJV)

The Green Bay and Gravel Islands National Wildlife Refuges occur within the UMRGLJV, which includes all of Indiana, Michigan, Wisconsin, plus portions of seven other states. Through various partnerships, the UMRGLJV seeks to coordinate the development and implementation of bird conservation goals, decision tools, and management strategies across the region.

2.5 LAND CLASSIFICATION AND PLANT COMMUNITIES

The National Wildlife Refuge System adopted the National Vegetation Classification Standard (NVCS) which was developed by The Nature Conservancy and the Natural Heritage Network as a standard for classifying plant communities (Natureserve 2013). The classification contains hierarchical levels of community specificity. The narrowest level within the classification is the

Association. Table 2-1 lists the NVCS Associations presumed within the various broad scale habitats of the refuge. The list presented in Table 2-1 was developed by the HMP planning team based on refuge staff experience and input and subsequent review of known plant communities in the region. Through this information gathering, the HMP planning team identified the presented list of broad habitats, NVCS associations, corresponding Wisconsin natural plant communities, and descriptions. The spatial distribution of these plant community and habitat classifications is presented in Figures 2-7 to 2-15.

Table 2-1. Plant Communities of Green Bay and Gravel Islands NWRs

Broad Habitat Type	WI Natural Community[1]	NVCS Alliance Class[2]	Populations and Habitat Attributes	Natural Processes Responsible	Limiting Factors/ Threats	Global Rank	State Rank
Northern Forest	Northern Mesic Forest	Maple – Yellow Birch Northern Hardwoods Forest, CEGL002457	This forest community is dominated by deciduous trees with scattered conifers in some stands. *Acer saccharum* is a dominant throughout the range of this community. It may form nearly pure stands (Flaccus and Ohmann 1964, Hansen et al. 1973). Other common canopy trees include *Acer rubrum*, *Betula alleghaniensis*, *Fraxinus americana*, and *Tilia americana*. Conifers, such as *Abies balsamea*, *Picea glauca*, *Pinus strobus*, *Thuja occidentalis*, and *Tsuga canadensis*, can be found in some stands. The shrub layer is sparse; however, it can be moderately developed where the tree canopy is not fully closed. Typical shrubs include *Acer spicatum*, *Corylus cornuta*, *Lonicera canadensis*, and *Taxus canadensis*. The herbaceous stratum includes *Clintonia borealis*, *Lycopodium* spp., *Maianthemum canadense*, *Osmorhiza claytonii*, *Streptopus lanceolatus* (= *Streptopus roseus*), and *Viola* spp. (Chambers et al. 1997).	Rich moist soils, good drainage; natural gaps due to windthrow; periodic but infrequent fire	Fire suppression; browsing pressure from white-tailed deer inhibit forest regeneration; woody species	G4	S4

Broad Habitat Type	WI Natural Community[1]	NVCS Alliance Class[2]	Populations and Habitat Attributes	Natural Processes Responsible	Limiting Factors/ Threats	Global Rank	State Rank
Northern Forest	Northern Mesic Forest	Northern White-cedar – Yellow Birch Forest, CEGL002450	The canopy of this community is dominated by *Thuja occidentalis* and a variety of hardwoods, most typically *Betula alleghaniensis*, *Betula papyrifera*, and *Populus tremuloides*, but occasionally *Acer rubrum*, *Acer saccharum* and *Fraxinus nigra*. Associated conifers include *Abies balsamea*, *Picea glauca*, and rarely *Tsuga canadensis*. The understory usually contains a well-developed shrub/sapling layer, including *Abies balsamea*, *Acer spicatum*, *Corylus cornuta*, *Diervilla lonicera*, *Linnaea borealis*, *Ribes triste*, *Rubus pubescens*, and *Taxus canadensis*. Herbaceous species include *Aralia nudicaulis*, *Eurybia macrophylla* (= *Aster macrophyllus*), *Clintonia borealis*, *Coptis trifolia*, *Cornus canadensis*, *Dryopteris carthusiana*, *Galium triflorum*, *Gymnocarpium dryopteris*, *Lycopodium* spp., *Maianthemum canadense*, *Mitella nuda*, *Onoclea sensibilis*, and *Trientalis borealis*. Diagnostic features include the mixed dominance of *Thuja occidentalis* and hardwoods, particularly *Betula alleghaniensis*, in an essentially upland site type.	Natural gaps due to windthrow allow for regeneration; periodic but infrequent	Fire suppression; browsing pressure from white-tailed deer inhibit forest regeneration; woody invasive species; Double-crested Cormorant colonies	G2	S1

Broad Habitat Type	WI Natural Community[1]	NVCS Alliance Class[2]	Populations and Habitat Attributes	Natural Processes Responsible	Limiting Factors/ Threats	Global Rank	State Rank
Great Lakes Rock Shore & Coastal Wetlands	Great Lakes Alkaline Rockshore	Great Lakes Limestone – Dolostone Bedrock Shore, CEGL002506	These lakeshores are characterized by a zonal gradation of plant communities, changing in response to distance from the lake. Typical species found in protected bedrock cracks of the splash/scrape zone include *Juncus balticus*, *Argentina anserina* (= *Potentilla anserina*), and *Populus balsamifera*. The more inland vegetated zone contains patchy vegetation. Common species include *Clinopodium arkansanum* (= *Calamintha arkansana*), *Deschampsia caespitosa*, *Dasiphora fruticosa* ssp. *floribunda* (= *Pentaphylloides floribunda*), *Dichanthelium acuminatum* var. *lindheimeri* (= *Panicum lindheimeri*), and species from the previous zone. A variety of mosses, including *Campylium stellatum*, are common throughout this zone. In the most inland zone, on sand accumulations or cobble ridges on the bedrock, scattered trees and shrubs are common, including *Abies balsamea*, *Picea glauca*, *Populus balsamifera*, and *Thuja occidentalis* (Albert et al. 1995).	Wind, waves, and ice action; lake water levels	Altered hydrology, disturbance, invasives	G3	S2

Broad Habitat Type	WI Natural Community[1]	NVCS Alliance Class[2]	Populations and Habitat Attributes	Natural Processes Responsible	Limiting Factors/ Threats	Global Rank	State Rank
Great Lakes Rock Shore & Coastal Wetlands	Alvar	Juniper Alvar Shrubland, CEGL005212	This rare community consists of areas of thin discontinuous soil overlying horizontal beds of limestone or dolomite in the vicinity of Great Lakes shorelines. They are characterized by relatively low tree cover and a distinctive biota which includes elements of rock pavement, prairie, savanna and boreal forest communities. Among these are regional endemics, some very rare. This community type is much more common and better-developed in Michigan and Ontario than in Wisconsin. Small coniferous and deciduous trees (cedar, fir, pine, oak, aspen, birch) are scattered among an assemblage of species that can include big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), Indian-grass (*Sorghastrum nutans*), and wood lily (*Lilium philadelphicum*), as well as shoreline plants such as silverweed (*Potentilla anserina*) and dwarf lake iris (*Iris lacustris*). *Oligoneuron album* (= *Solidago ptarmicoides*), and *Carex umbellata*. Less than 50% of the ground surface is exposed limestone bedrock, which is usually covered with lichens, mosses, and algae (Reschke et al. 1998).	Wind, waves, and ice action; lake water levels	Altered hydrology, invasive species, Double-crested Cormorant colonies	G3	S1

Broad Habitat Type	WI Natural Community[1]	NVCS Alliance Class[2]	Populations and Habitat Attributes	Natural Processes Responsible	Limiting Factors/ Threats	Global Rank	State Rank
Early Successional & Transitional Habitat	Surrogate Grasslands	N/A	Surrogate grasslands include agricultural habitats such as hayfields, small grains (oats, wheat, and barley), row crops (corn, soybeans, and potatoes), fallow fields, old fields, pastures, and set-aside fields (e.g., CRP) planted to non-native cool-season grasses (such as smooth brome, timothy, red-top, orchard-grass, bluegrass, and quack-grass) or native warm-season grasses (such as big bluestem, little bluestem, Indiangrass, switchgrass, and sideoats grama). Examples of other surrogate prairie grasslands include young conifer plantations, orchards, parks, golf courses, airports, roadsides, cut-over or burned-over forests, and mossed bogs (bogs from which sphagnum moss has been removed commercially). Surrogate grasslands also include other idle grasslands, such as those on public or private lands managed for wildlife. Usually, idle grasslands are composed of non-native grasses and forbs, but they also can be plantings of one or several native prairie species, but fall far short of the rich species diversity of the original prairie.	Human disturbance (maintenance of developed areas); invasive species	Further disturbance; altered hydrology; invasive species	GNR	SNR

Broad Habitat Type	WI Natural Community[1]	NVCS Alliance Class[2]	Populations and Habitat Attributes	Natural Processes Responsible	Limiting Factors/ Threats	Global Rank	State Rank
Early Successional & Transitional Habitat	Shore Fen	Great Lakes Sedge Rich Shore Fen, CEGL005115	These 'marly flats' contain a rich assemblage of calciphilic plants. Herbaceous species dominate parts of these areas. The dominant graminoid is *Calamagrostis canadensis*, but *Carex viridula* and *Lobelia kalmii* are key diagnostics of this type. Other diagnostic species include *Cladium mariscoides*, *Hypericum kalmianum*, *Dichanthelium acuminatum* var. *lindheimeri* (= *Panicum lindheimeri*), *Argentina anserina* (= *Potentilla anserina*), and *Triglochin maritima*. Scattered shrubs, such as *Dasiphora fruticosa* ssp. *floribunda* (= *Pentaphylloides floribunda*) or *Myrica gale*, may be present, but shrub cover is less than 25% (Minc and Albert 1998). In Wisconsin, in coastal estuaries of Lake Superior, common associates include *Cladium mariscoides*, *Carex livida*, and *Triglochin maritima*. *Carex exilis* is codominant at several sites (E. Epstein pers. comm. 1999).	Human disturbance; Invasive species; lake water levels affecting wetland area	Further disturbance; altered hydrology; invasive species	S2	GNR

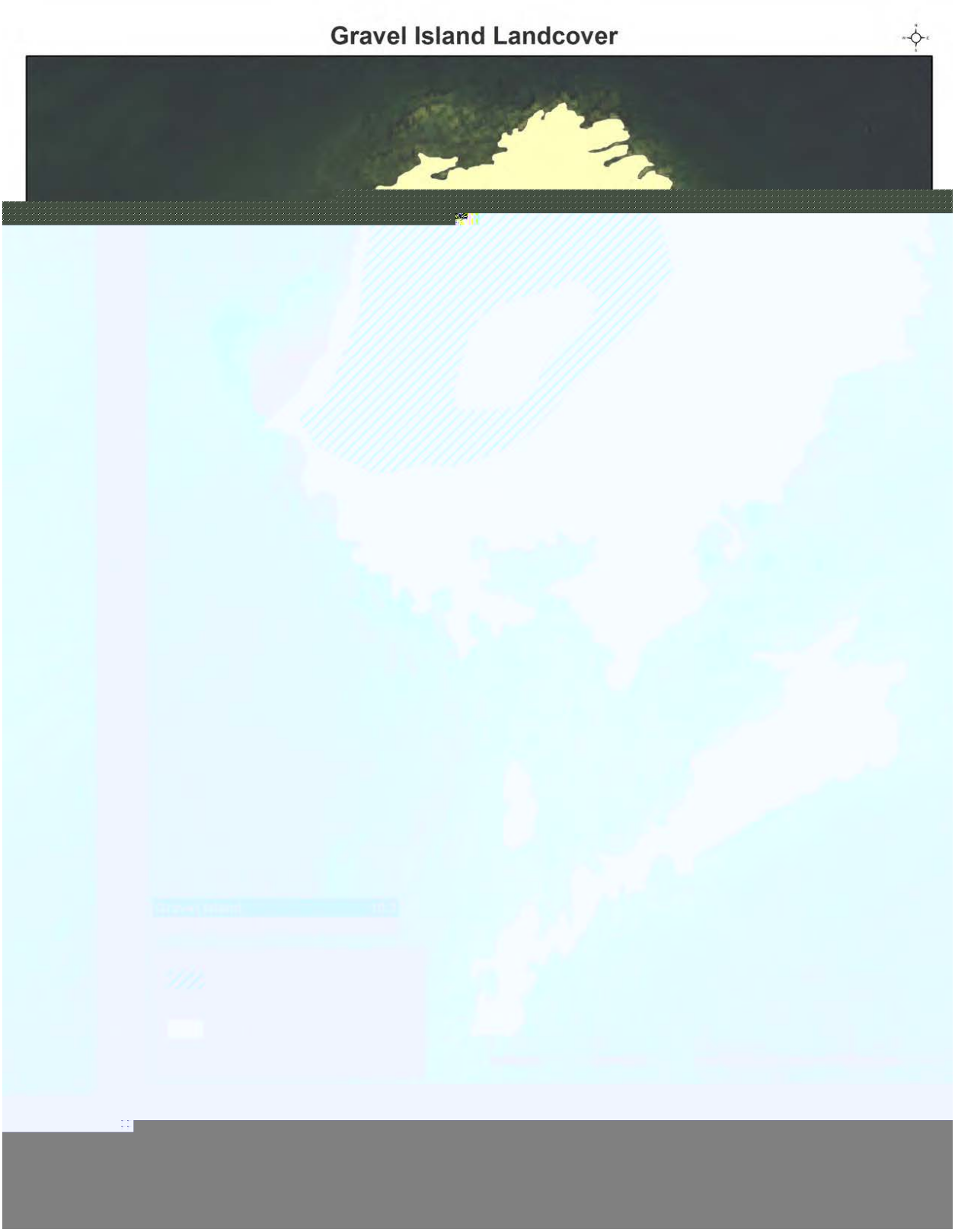

Figure 2-7. Habitat Classification Map of Gravel Island NWR: Gravel Island Unit

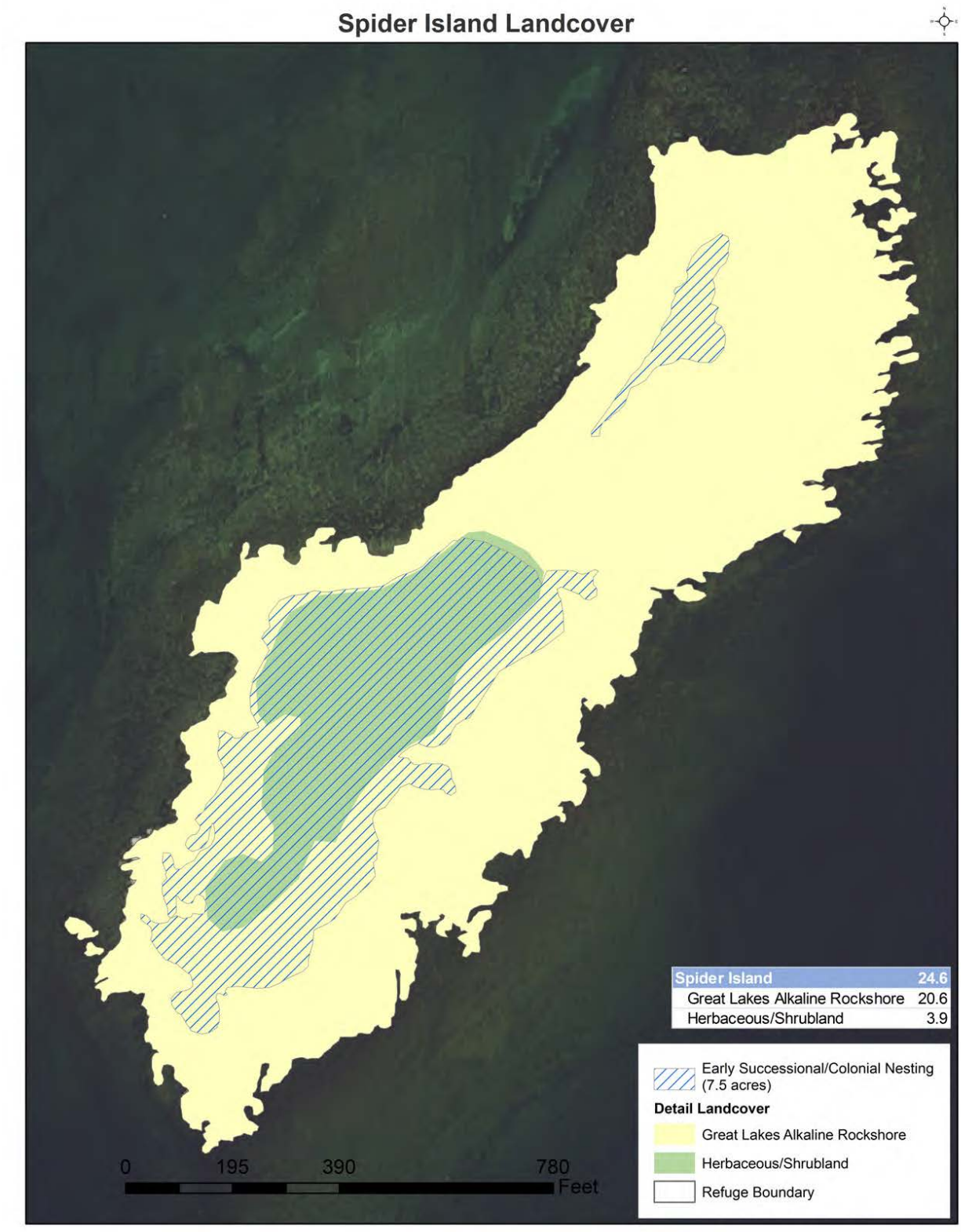

Figure 2-8. Habitat Classification Map of Gravel Island NWR: Spider Island Unit

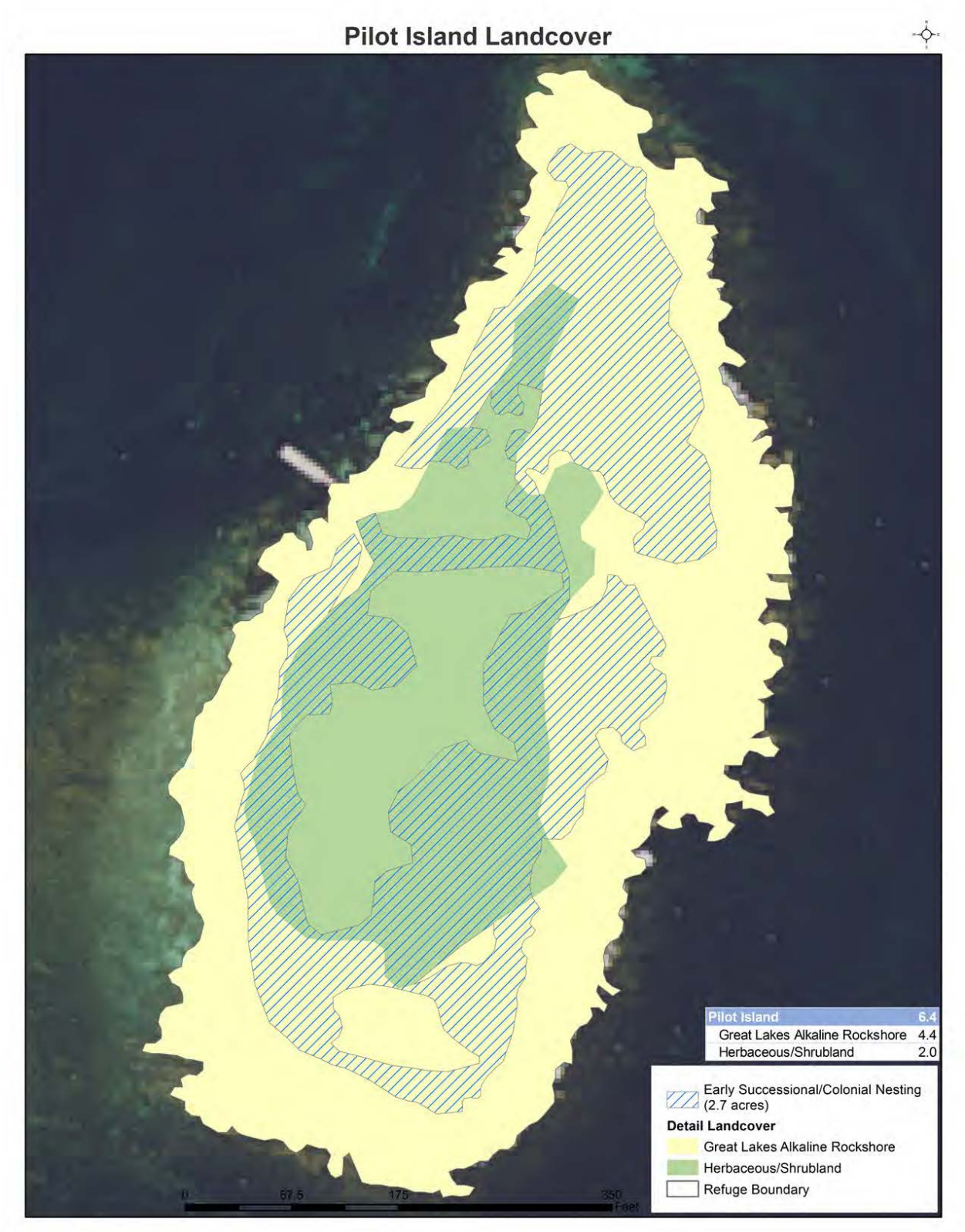

Figure 2-9. Habitat Classification Map of Green Bay NWR: Pilot Island Unit

Figure 2-10. Habitat Classification Map of Green Bay NWR: Hog Island Unit

Figure 2-11. Habitat Classification Map of Green Bay NWR: Plum Island Unit

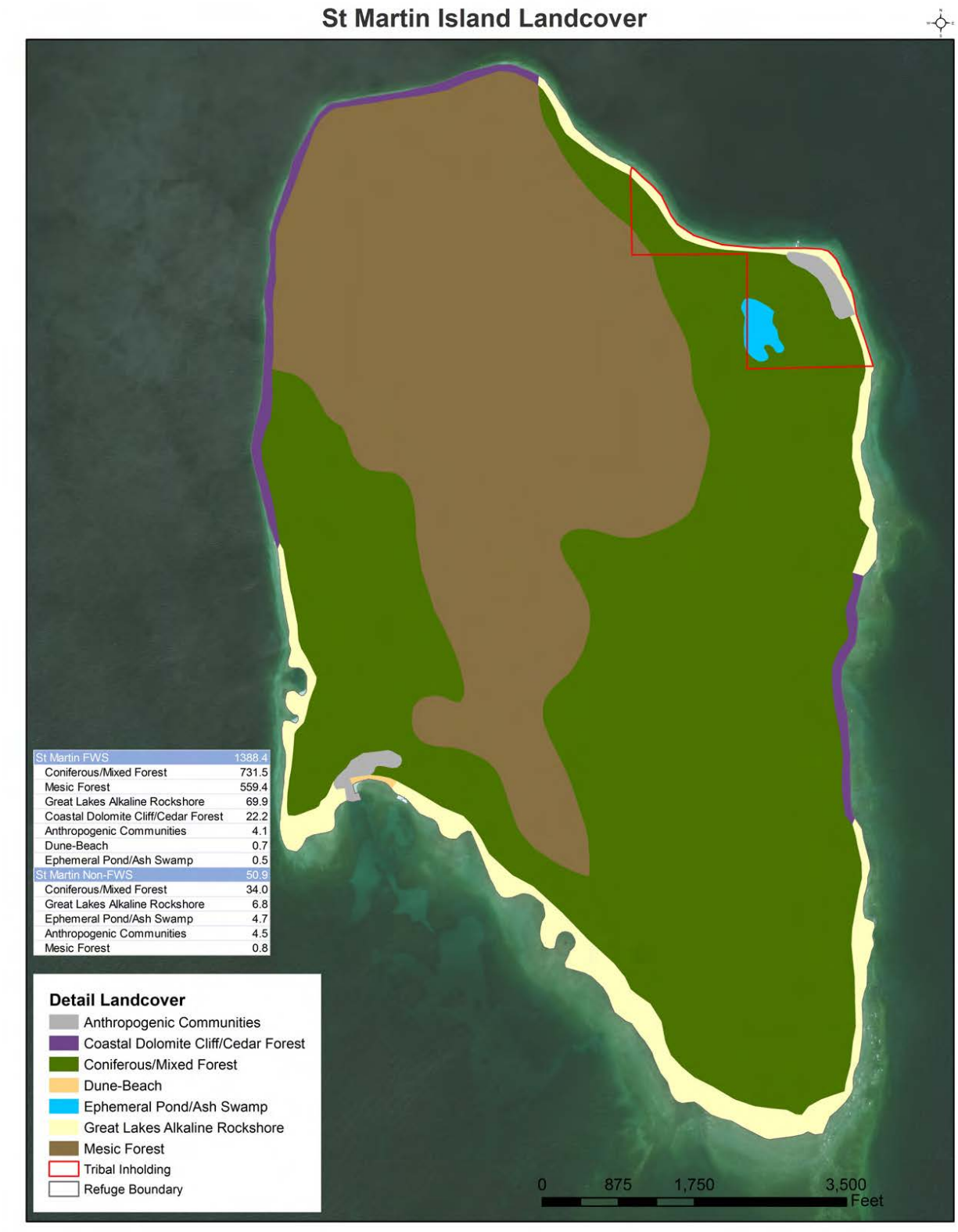

Figure 2-12. Habitat Classification Map of Green Bay NWR: St. Martin Island Unit

Figure 2-13. Habitat Classification Map of Green Bay NW: Rocky Island Unit

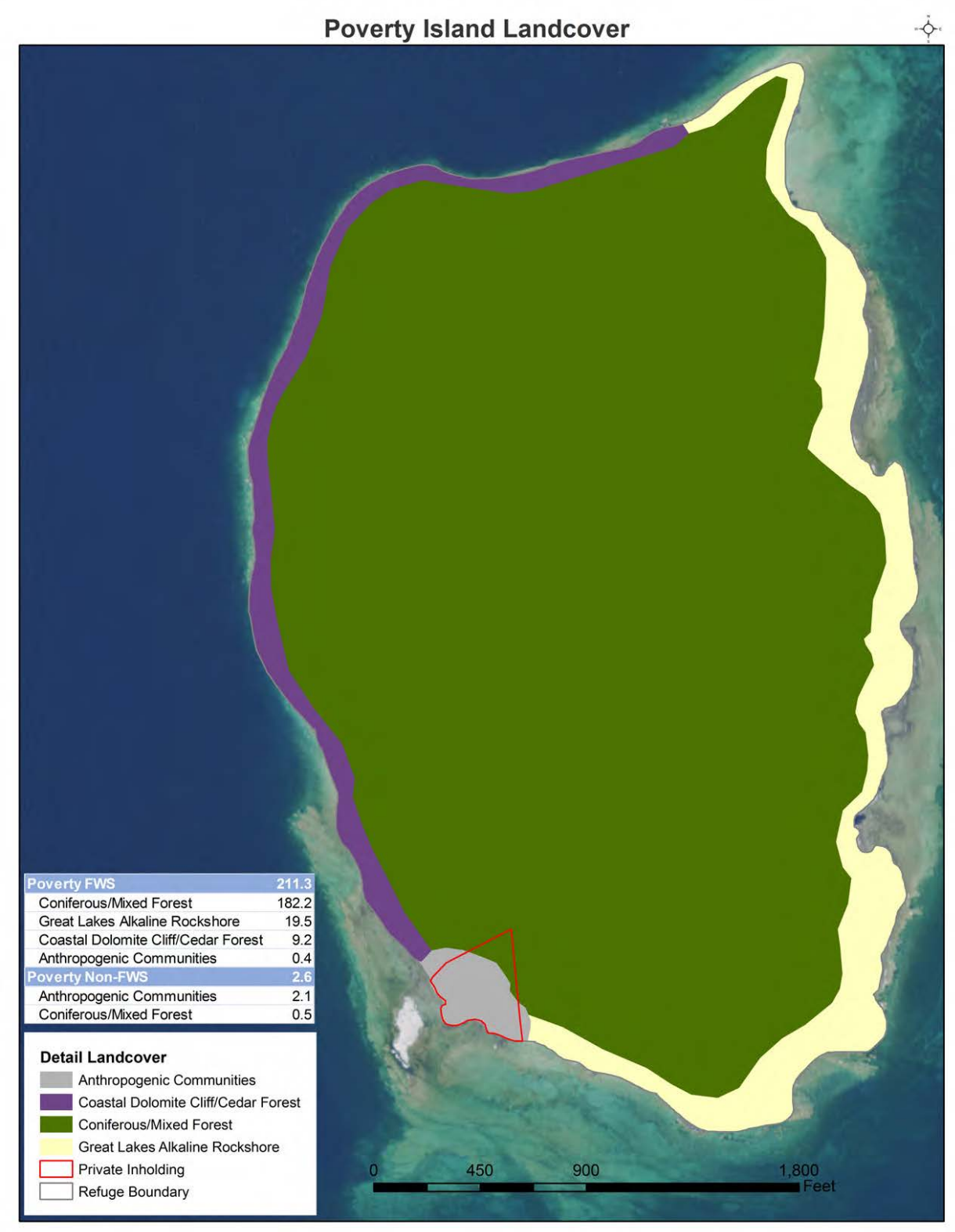

Figure 2-14. Habitat Classification Map of Poverty Island (Future Acquisition/Green Bay NWR)

Figure 2-15. Habitat Classification Map of Poverty Island (Future Acquisition/Green Bay NWR)

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CHAPTER 3.

RESOURCES OF CONCERN

Herring Gull Colony

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3. RESOURCES OF CONCERN

3.1 INTRODUCTION

Defining Resources of Concern

Resources of Concern (ROCs) are the focal point of a HMP. The 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 a resource 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 a resource of concern under terms of the respective endangered species acts."

The USFWS is entrusted by Congress to conserve and protect migratory birds, federally listed threatened and endangered species, inter-jurisdictional fish, and certain marine mammals (trust species) for the benefit of the American people. Each refuge also has its own specified purpose(s) for which it was created that guides its management goals and objectives. Within these purposes, refuges support other elements of biological diversity such as locally rare plant, invertebrate, and vertebrate species, natural communities, and the ecological processes that contribute to the biological integrity and environmental health at the refuge, ecosystem, and broader scales (601 FW 3).

Importance of Defining Resources of Concern to Guide Refuge Activities

Identifying ROCs allows us to identify property and management-scale management objectives aimed at maintaining, increasing, and/or improving the habitats required by trust resources and populations identified in the refuges' purpose. The ROC process facilitates a targeted approach to identifying priority areas and/or gaps in management that may require additional resources such as information (data collection and monitoring) or staff and equipment. Species respond to habitat management differently; therefore identifying ROC allows us to focus management activities at an appropriate level that yields the greatest benefit to trust resources, complementing biological integrity, diversity, and environmental health (BIDEH) and the refuge's purpose.

The first step of developing a focused habitat management strategy is to define a refuge's comprehensive list of ROCs in light of the multiple mandates, purposes, policies, and regional/national plans applicable to that management unit. The following details the development of the ROCs at the Green Bay and Gravel Island National Wildlife Refuges.

3.2 IDENTIFICATION OF REFUGE RESOURCES OF CONCERN

National and regional conservation plans relevant to the Green Bay and Gravel Island National Wildlife Refuges were identified and used in ROC selection. A comprehensive list of species known to use the District was compiled by season and relative abundance (Appendix D). Each species' conservation significance was then quantified as the number of conservation plans which

included that species. The comprehensive list of ROCs was then narrowed down by selecting species most likely to represent a suite of habitat needs for other species (i.e., surrogate species) using the process later defined in section 3.4.1. We refer to this subset of ROCs as priority resources. The comprehensive list of ROCs was then narrowed down by selecting species most likely to represent a suite of habitat needs for other species (i.e., surrogate species) using the process later defined in Section 3.4.1. We refer to this subset of ROCs as priority resources.

Refuge Purposes and Resources of Concern

As discussed in Chapter 2, the Green Bay and Gravel Island National Wildlife Refuges were established to provide preserves and breeding areas for native birds. When Pilot and Plum Islands were added in 2007, the mission was expanded to include migratory bird and endangered species habitat within the Great Lakes Basin. Refuge habitats are distributed across three primary types: northern forest, Great Lakes rock shore and coastal wetlands, and early successional and transitional habitat. Within these broad categories are relatively rare or endemic communities in the region at large, adding to their significance. The maps in Figures 2-7 to 2-15 show the approximate current distribution of these habitat types on the refuge islands.

The Green Bay National Wildlife Refuge includes five islands ranging from Hog Island at only 6 acres to the 2015 acquisition of St. Martin Island at over 1,300 acres. The differences in size lead to diverse community types on the islands. Gravel Island is mostly dolomitic limestone outcrop with thin soil, and lake water levels can significantly impact the exposed area and where vegetation can establish. Pilot and Hog are slightly higher but contain similar bedrock and soil characteristics. It is this open habitat that attracts native nesting birds such as herring gulls and Caspian terns to establish colonies. Larger islands such as Plum and St. Martin have higher ground over hundreds of acres, allowing forest communities to grow and dominate the interior.

Green Bay NWR was established in 1912 under Executive Order 1487, while Plum and Pilot Islands were added in 2007 per Public Land Order 7681 for further protection of native and migratory birds and endangered species habitat in the region. In 1970, Hog, Gravel, and Spider Island were further protected through designation as a federally protected Wilderness Area.

Gravel Island NWR is comprised of two smaller islands, Gravel (10.3 acres) and Spider (24.6 acres), both of which host nesting colonies of native birds. Gravel Islands NWR was established in 1913 per Executive Order 1678 for the preservation of native bird breeding grounds.

The focus at Green Bay and Gravel Island NWRs has been to employ biological policies and science to conserve the unique natural communities present on these islands and the breeding grounds of native birds. In doing so, these refuges help achieve the core mission of the Service, which is to “administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.”

Management is unique at the islands. Other than invasive species control at Plum and St. Martin Islands and a pollinator enhancement project on Plum Island, no active management of the vegetation (habitat) is currently proposed. Cormorant and white-tailed deer management are the only other management actions proposed and deemed critical for the maintenance of ROC on the islands. Wilderness Islands shall be managed to protect wilderness characteristics (ODell

2012). If management is done on wilderness islands, the following should be considered: a *Minimum Tool Analysis* should be conducted and no work should be done on any wilderness islands that would adversely disturb nesting colonial waterbirds. Invasive plant management on these islands could be done late in the season, after fledging

Refuge System and USFWS Resources of Concern

USFWS Trust Resources

While the designated purpose is the foremost determinant of a particular unit's management, managing trust resources is also a priority for all Service lands. Trust resources relevant to the Green Bay and Gravel Island National Wildlife Refuges are:

Migratory Birds

A list of all species of migratory birds protected by the Migratory Bird Treaty Act (16 U.S.C. 703–711) and subject to the regulations on migratory birds is contained in subchapter B of title 50 CFR §10.13. The USFWS Division of Migratory Bird Management also maintains lists of priority bird species of concern at national, regional, and ecoregional (Bird Conservation Region) scales (USFWS 2004a). The primary sources of information used to identify potential migratory bird species of concern include:

- State and Federal Listed Species
- USFWS FY 2012-FY 2016 Focal Species (USFWS 2012a)
- USFWS Region 3 Birds of Conservation Concern (USFWS 2012a)
- USFWS Birds of Conservation Concern (USFWS 2008)
- Partners in Flight Landbird Conservation Plan 2016 (Rosenberg et al. 2016)
- Upper Midwest Great Lakes Regional Conservation Priority List (USFWS 2002)
- Upper Midwest Great Lakes LCC Surrogate Species List (Powers et al. 2014)
- Upper Mississippi and Great Lakes Region Joint Venture Conservation Plans (UMRGLR JV 2007)

Wetlands

Wetlands provide habitat for approximately one-third of all federally listed species and for migratory waterfowl. The Emergency Wetlands Resources Act of 1986 (Pub. L. 99–645 (100 Stat. 3582), approved November 10, 1986, authorizes the purchase of wetlands by Land and Water Conservation Fund (LWCF). It requires the Secretary of the Interior to establish a National Wetlands Priority Conservation Plan, which requires the states to include wetlands in their Comprehensive Outdoor Recreation Plans. LWCF funds have played a limited role for wetland acquisition in the refuge. Most refuge lands been procured through funding from the Migratory Bird Hunting Stamp Act [16 U.S.C. 718(c)], grants from the state Outdoor Heritage Fund, and donations.

Threatened and Endangered Species

The Endangered Species Act (16 U.S.C. 1531–1544, December 28, 1973, as amended 1976-1982, 1984 and 1988) states in Sec. 8A.(a) that:

> "The Secretary of the Interior… is designated as the Management Authority and the Scientific Authority for purposes of the Convention and the respective functions

of each such Authority shall be carried out through the United States Fish and Wildlife Service."

The act also requires all Federal departments and agencies to conserve threatened and endangered species and to utilize their authorities in furtherance of the purposes of this Act.

Federal threatened or endangered species were identified for inclusion in this HMP by reviewing the Federal threatened and endangered species list and relevant recovery plans for listed species (see http://ecos.fws.gov/ecos/indexPublic.do).

3.3 BIOLOGICAL INTEGRITY, DIVERSITY, AND ENVIRONMENTAL HEALTH

Defining 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 diversity, integrity, and environmental health (commonly referred to by its acronym 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 severely degraded components (601 FW 3). The Service defines BIDEH as follows:

- 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.
- 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.
- 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.

Identifying BIDEH within the Refuge

The Service will manage for priority species with habitat needs that exist along a continuum of vegetation and hydrologic regimes within habitat types present on the refuge. The Service has reviewed historic information regarding habitats, management changes, and species use within the refuge authorized boundaries. The planning team has reviewed relevant literature describing requirements of selected priority species and ecosystem processes that regulate natural communities to assess current and future potential conservation status for the refuge. The following resources were used to describe baseline environmental, abiotic, and biotic conditions on the refuge:

- Reports and associated data on site history and capabilities
- Maps and aerial imagery of existing and historical vegetation types
- Wisconsin Natural Heritage Program (Epstein, E.J., E.J. Judziewicz, and E.A. Spencer. 2002) and National Vegetation Classification System (NVCS) natural community descriptions

- Status and trend information for potential species of concern as documented in regional and local assessments and reports, or from refuge staff observations

Based on a review of the existing and historical data listed above, a list of habitat types that contain elements of BIDEH was developed to evaluate processes that influence the ecological and biological integrity of habitat types within the refuge (see Table 2-1). Table 2-1 also crosswalks the refuge-specific habitat types developed by the HMP planning team with Wisconsin and NVCS classifications.

Maintaining and Restoring BIDEH

Owing to their remote location and difficulty to access, the Green Bay and Gravel Island NWRs have not experienced the intense human development or disturbance that mainland refuges have seen. Despite this, they still have seen impacts related to their coastal history and previous navigational use. Plum, Pilot, and St. Martin Islands have historically seen small communities and construction associated with U.S. Coast Guard lighthouses and other structures. Selective logging has also taken place on the larger islands with substantial forest cover. These activities provided vectors for invasive species introduction. White-tailed deer have been introduced to the islands both through naturally-occurring and human–based introductions. A more broad-scale disturbance to the area, as mentioned previously in Chapter 2, will be climate change and cycles in Lake Michigan water levels. Forecasted trends may push some of the dominant forest species out of the area, and expose or submerge additional shoreline or land cover. More details of historic habitat alteration within the refuges are provided in the CCP (USFWS 2012) and Chapter 2.

The diverse and sensitive habitats on the refuges and their remote nature require proactive conservation and management of natural resources to maintain or restore BIDEH and meet refuge purposes. The Green Bay and Gravel Island CCP (USFWS 2013) include wildlife- and habitat-related goals and supporting objectives. However, in order to be in compliance with BIDEH policy (610 FW 3) and to encourage the effective protection and restoration of BIDEH, this HMP has amended these original objectives from the CCP to add specificity and account for BIDEH in development of associated management strategies in Chapter 4. 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 rationale behind them are outlined in Chapter 4.

3.4 PRIORITY DISTRICT RESOURCES OF CONCERN

Priority Resources of Concern Selection

The potential ROC table (Appendix D) contains a comprehensive list of species with a broad array of habitat needs that occur within the Green Bay NWRs. This list was refined and reduced to identify priority species representing the spectrum of habitat needs for species included in Appendix A. The Service selected priority species using the Service's Identifying Refuge Resources of Concern Handbook (referred to as "the Handbook") (Paveglio and Taylor 2010), as well as aspects of Strategic Habitat Conservation (SHC), which is an iterative process developed by the Service to support strategic decisions for habitat conservation for species on landscape-level scales (USFWS 2008). The selection process outlined within the Handbook and SHC guidance uses a focal resource concept (i.e., surrogate species approaches).

To assist the HMP planning team in identifying ROC specific to the refuges, Cardno developed the Resources of Concern Selection Tool for America's Refuges (ROCSTAR). The ROCSTAR tool was developed to assist national wildlife refuges, waterfowl production areas, wetland management districts, and other conservation lands in identifying priority resources for management and monitoring. This tool is intended to assist managers and planners in completing the selection process outlined within the Handbook. The ROCSTAR tool allows the planning team to review the applicable filters required when considering priority ROC selection. It also provides a decision support framework that allows users to compare various resources and their ability to address the selection considerations outlined in the Handbook (Paveglio and Taylor 2010), and also incorporates aspects of the surrogate species concept as described in Caro (2010) and USFWS (2012b). The tool results in a series of resource scorings sorted by habitat type. Based on the scoring results, the planning team can then make an informed decision on the number and type of priority ROCs to select for each habitat type managed on the refuges. The results of the ROCSTAR scoring evaluation is summarized in Appendix E.

The Handbook guides the selection of refuge priority ROC by considering which resources best address the following considerations, including the resources':

- Relevance to Legal Mandates
- Management Significance
- Ecological Significance

Relevant Legal Mandates:

Candidate priority resources were evaluated for their ability to be managed in order to fulfill the refuge purpose and associated Service policies and mandates. Specifically,

Contribution to refuge purpose – Achieving refuge purposes and managing for trust resources as well as BIDEH can be addressed through habitat requirements of focal species, i.e., species that may represent guilds that are associated with important attributes or conditions within habitat types. The use of focal species is particularly valuable in addressing Service trust resources such as migratory birds. By selecting focal species, we can document our refuge-specific contribution to migratory bird conservation.

Contribution to Refuge System – The conservation of priority species within the refuges has an important role in supporting the mission of the NWRS. By selecting priority species that can be used as a measure of our management success, we can use these species in developing our inventory and monitoring program in order to evaluate management and communicate the success and challenges of management with others. In doing so, we will aid in providing long-term support for the NWRS.

Management Significance:

Candidate priority resources were evaluated for their management significance to the refuges. A species was considered significant to management on the refuges if it had the following characteristics: 1) species have a direct application to key management decisions or effectiveness of past management activities, 2) species are reliant on habitat management to provide suitable or improved conditions, 3) management and protection of the species or its habitat is recognized as important (i.e. presence in regional conservation plans and lists noted previously) by

managers, researchers, policy makers and the public. Evaluating management significance is important because data on the species and its habitats can help inform management decisions and progress toward refuges' goals. Specifically,

Habitat requirements of priority species – Habitat suitability and availability may limit the capability of the refuges to support or manage for a priority species of concern. The following species-specific factors were evaluated:

- Historic habitat use and abundance on the refuges
- Connectedness and species utilization of habitat types
- Environmental conditions including soils, hydrology, disturbance patterns, contaminants, predation, and invasive species
- Specific life history needs, such as habitat needs for breeding, migrating, and overwintering stages of avian species.

Habitat management for selected priority species – Observations and institutional knowledge of Green Bay and Gravel Island NWR personnel were used to determine the feasibility for the refuge to support a particular species throughout specific seasons (e.g., breeding, migration, overwintering).

The need for management and protection of the priority species is recognized – Chapter 1 highlighted numerous national, regional, and state conservation plans used to identify conservation priorities for the refuges. Species on the comprehensive ROC list were initially ranked based on the sum of conservation plans in which they were found. Some species ranked high on conservation plans, but were only incidental or did not occur on the refuges, and consequently were not included in the priority species selection since they presumably could not be effectively managed for.

Contribution to inventory and monitoring – Candidate priority species are to be evaluated for their potential contribution to the development of the refuges inventory and monitoring program. Priority species must be able to provide indicators of habitat management by responding to our management actions through increased use, improved breeding, presence/absence, or by another measure.

Ecological Significance:

Candidate priority resources were evaluated through a series of planning team meetings, literature reviews, and an interagency partner review for their ecological significance to the refuges. Ecological significance was defined as a species 1) having a strong, defensible link to overall ecological function of the landscape or be strongly associated with a critical resource of the refuges, 2) sensitive to larger landscape or habitat changes so that it can act as an indicator of potential change, and 3) status of the species or its habitat is representative of other priority species, ecological processes or biological organizations. Evaluating the ecological significance of candidate priority species helps ensure that management and monitoring activities associated with priority species and their habitats contribute to the BIDEH of the refuges. Priority resources can be used as an indicator of BIDEH based on their presence, absence, abundance, or relative well-being in a given habitat niche. In doing so, it serves as a marker of overall health of its required habitat type.

Using these criteria, the planning team refined the list of potential ROC during the development of the HMP based on continued review of the criteria previously described. For the Green Bay and Gravel Island NWRs, a total of seven priority ROCs were selected. A list of these communities and species as well as their general habitat requirements can be found in Table 3-1. Discussion of the priority ROCs can be found following the table.

Table 3-1 Habitat Requirements for Green Bay and Gravel Islands NWRs Resources of Concern

Priority Refuge Resource	Habitat Types	Key Habitat Relationships			
		Vegetative Composition	Vegetative Structure	Patch Size	Special Considerations
Bald eagle (*Haliaeetus leucocephalus*)	Northern Mesic Forest	Large mature coniferous or deciduous trees	Mature and old-growth forest with relatively open canopy; close (usually <2 km) to water with suitable foraging opportunities; some form of habitat discontinuity or edge	1–2 km2 is a typical territory size	Top avian predator, immatures prefer undisturbed areas, indicator for bioaccumulation of contaminants. (Buehler 2000)
Northern Mesic Forest		Dominated by canopy of sugar maple, yellow birch, red oak, and eastern hop hornbeam. The understory is rich in spring ephemerals and includes trilliums, sedges, wild leek, and false Solomon's seal. Historically, Canada yew was a dominant understory species before white-tailed deer populations were introduced/increased.	Windthrow of mature trees common; tall canopy associates create multi-layered canopy; tall shrub layer often well developed	N/A	Forests dominated by northern white cedar were historically common within this Ecological Landscape, particularly on dolomite outcrops. (Epstein et al. 2002) Logging eliminated older trees and are dominated by regenerating stands of sugar maple beech, white birch, and aspen. Very few Canada yew remain due to the introduction of deer on the islands

Priority Refuge Resource	Habitat Types	Key Habitat Relationships			
		Vegetative Composition	Vegetative Structure	Patch Size	Special Considerations
Great Lakes Beach	Great Lakes Alkaline Rock Shore and Alvar (Includes coastal wetland component)	Plants endemic to the shores of the Great Lakes, such as seaside spurge and American sea-rocket, are characteristic of some of the Lake Michigan beaches, especially during low water periods. Native associates may include silverweed, Baltic rush, and water horehound.	Occurs in association with active dune systems. The beaches of the Great Lakes are extremely dynamic features, strongly influenced by water level changes and storm events.	N/A	Significant populations of rare plants are known from several of these sites. (Epstein et al. 2002)
Great Lakes Alkaline Rockshore		White cedar forests dominate near the coasts where dolomite is the bedrock, understory climbing fumitory and one flowered cancer root Shrubs are ninebark and shrubby cinquefoil; herbs silverweed, Arctic primrose, grass-leaved goldenrod, brook lobelia, gentians, grasses-of-Parnassus, Indian paint-brush, low calamint, dwarf-lake iris, and many sedges and rushes.	Creviced, wave-splashed, nearly horizontal dolomite ledges; may be either inundated or exposed during a given year (Epstein et al. 2002)		Rare land snails are found in the dolomite cliffs along with dwarf lake iris.
Dwarf Lake Iris (*Iris lacustris*)		Found growing under white cedar, although white spruce, balsam fir, and aspen are also frequently present as well as gay wings, white starry false solomon seal, and Indian paintbrush.	Old beach ridges or behind open dunes. On sand or in thin soil over limestone-rich gravel or bedrock with partial sun. Semi-open Great Lakes shorelines with cool moist lakeshore air.	N/A	Fluctuating water levels of the Great Lakes play a vital role in opening up new habitat for dwarf lake iris. (Dwarf Lake Iris 2015, Chittenden 2016)

Priority Refuge Resource	Habitat Types	Key Habitat Relationships			
		Vegetative Composition	Vegetative Structure	Patch Size	Special Considerations
Black-crowned Night-heron	Early Successional Transitional Habitat / Colonial Nesting Bird Areas	Enormous variety; willow, hackberry, poison ivy, elderberry, Phragmites.	Wide variety of nesting habitat and vegetation with proximity to foraging habitat Good vegetative cover essential	Not given	Indicative of other colonial nesting birds. Indicates early/mid successional growth, as they respond to vegetation changes brought on by breeding bird activity. Nest colony site selection may be related to predator avoidance. (Hothem et al. 2010)
Caspian Tern		Sparse vegetation on sandy soils; nest placement may be near rocks, driftwood or tall annual weeds. (Bent 1921, Cuthbert and Wires 1999)	Flat rocky islands, beaches, and sandy shores littered with driftwood, are typical breeding habitat for this species. Favors protected waters such as bays, lagoons, lakes etc. for foraging	Not given	The Caspian tern nests on freshwater and coastal islands, beaches, and shorelines isolated from human disturbance (Cuthbert and Wires 1999, Strong et al 2004, Audubon 2002)

Priority Refuge Resources and Relation to Refuge BIDEH

Wildlife

The *Bald eagle* is a federally protected bird that prefers undisturbed areas with large, mature trees, almost always near open water capable of supporting fish or waterfowl populations. Mature pine trees are often favored for nesting, especially those that are taller than surrounding trees. Bald eagles can be used as indicators of environmental pollutants due to position at the top of the food chain, and the presence of mature forest with mixed structure especially in the northern mesic forest community.

Black-crowned night heron will use a variety of habitat, but is often found in or around shallow marsh with shrubby groves adjacent. Though vegetation and community type seem to vary, two essentials that reappear are adequate cover, often early- to mid-successional communities, and sufficient foraging area nearby. On the refuges black-crowned night herons are indicative of other colonial nesters, such as great blue herons and great egrets, and the habitat structure required for their breeding populations. Black-crowned night herons are listed as a Species of Special Concern in Wisconsin.

The *Caspian tern* nests in colonies, typically on islands with little to no vegetation and often sandy or rocky substrate, among driftwood or other debris. Distance from human disturbance seems to be required. On the refuge, Caspian terns are indicative of colonial nesting birds, such as herring and ring-billed gulls, cormorants, American white pelicans, and common terns, nesting on the gravelly shoreline communities common on the islands. Caspian terns are listed as Endangered in Wisconsin and Threatened in Michigan.

Dwarf lake iris is a federally and state threatened plant in Wisconsin and Michigan. It grows in partially open habitat on the islands, rooting in thin soil or sand over the limestone bedrock, or alvar communities. The species will associate with northern white cedar and some other northern conifer species that grow on the outskirts of the islands. Dwarf lake iris responds to opening of habitat along the edges of the woody communities due to lake level fluctuations and wave action.

Natural Communities

Northern Mesic Forest communities are typically dominated by sugar maple *(A. saccharum*), eastern hemlock (*T. canadadensis*), with yellow birch (*Betula allegheniensis*) and basswood and red oak (*Quercus rubra*), with some areas having successional stands of white birch (*B. papyrifera*), quaking aspen (*Populus tremuloides*), and big-toothed aspen (*Populus grandidentata*). The moderating effects of Lake Michigan (cool summers, mild winters) favor the persistence of southern and eastern species on the islands beech-sugar maple forest. Minor components include basswood (*Tilia americana*), white ash (*Fraxinus americana*), red maple (*Acer rubrum*), and hop-hornbeam (*Ostrya virginiana*) (Judziewicz et al. 2016). Forest understories usually have a well-developed shrub layer of alders (*Alnus sp*.) and mountain maple (*Acer spicatum*) in areas where canopy trees have been wind thrown. Ferns, lichens, and mosses are common in the understory. This community type typically dominates the interior of the larger islands of the refuges. Supporting the increasingly rare Canada yew (*T. canadensis*) as well as remnants of a very rich spring ephemeral herbs and the priority resource bald eagle. Managing

for northern wet-mesic forest communities preserves an important regional habitat for a variety of species.

Great Lakes Beach represents the area exposed to the effects of wind and water. Often with a dolomitic substrate low in the landscape, this community displays vegetation that is either endemic such as American sea-rocket (*Cakile edentula var. lacustris*), or seaside spurge (*Euphorbia polygonifolia*), or weedy annual species. On the smaller islands, this community type often sees colonies of nesting birds as lake-levels allow, and is recognized as an imperiled habitat in Wisconsin. This community's presence on the refuges represents the continuity of the region's biological integrity and the preservation of habitat of endemic plant species and native bird habitat. Fissured, depressed dolomite pavement support shallow pools, which warm and provide a food source for migrating waterbirds.

Great Lakes Alkaline Rockshore is similar to Great Lakes beach but it is typically higher, allowing for more permanent vegetation to establish. This includes ninebark (*Physocarpus opulifolius*), shrubby cinquefoil (*Dasiphora fruticose*), arctic primrose (*Primula eximia*), and other specialists. During years with high lake levels, some areas may be inundated. Due to the specificity of the factors that create this community, it is rare in Wisconsin, found only in this region. Great Lakes alkaline rockshore is also recognized as an imperiled habitat in Wisconsin. This community also supports geographically limited and uncommon species such as dwarf lake iris (*I. lacustis*), low calamint (*Clinopodium arkansanium*), and elk sedge (*Carex garberi*). Managing for this community helps to maintain habitat for colonial nesting birds and preserves the local biological integrity of the Great Lakes region.

Table 3-2 Priority ROCs and Other Benefiting Resources at Green Bay and Gravel Islands National Wildlife Refuges

Priority Refuge Resource	Habitat Types	Key Habitat Relationships		
		Habitat Structure	Life History	Other Benefiting Species
Bald eagle	Northern Mesic Forest	Mature and old-growth forest with relatively open canopy; close (usually <2 km) to water with suitable foraging opportunities; some form of habitat discontinuity or edge	Entire life cycle	American woodcock Pileated woodpecker Black-throated green warbler Canada Yew Northern flicker Least flycatcher Black-throated blue warbler Blue-spotted salamander American redstart Black-billed cuckoo
Northern Mesic Forest		Windthrow of canopy trees common, but irregular; tall canopy associates create multi-layered canopy; tall shrub layer often well developed	N/A	

Priority Refuge Resource	Habitat Types	Key Habitat Relationships		
		Habitat Structure	Life History	Other Benefiting Species
Great Lakes Beach	Great Lakes Alkaline Rock Shore and Alvar (Includes coastal wetland component)	Occurs in association with active dune systems. The beaches of the Great Lakes are extremely dynamic features, strongly influenced by water level changes and storm events.	N/A	Climbing fumitory Double-crested cormorant Sticky (Dune) goldenrod Sedge wren Semi-palmated sandpiper Red-breasted merganser Eastern fox snake Monarch
Great Lakes Alkaline Rockshore		Creviced, wave-splashed, nearly horizontal dolomite ledges; may be either inundated or exposed during a given year	N/A	
Dwarf Lake Iris		Old beach ridges or behind open dunes. On sand or in thin soil over limestone-rich gravel or bedrock with partial sun. Semi-open Great Lakes shorelines with cool moist lakeshore air.	Entire life cycle	
Black-crowned Night-heron	Early Successional Transitional Habitat / Colonial Nesting Bird Areas	Wide variety of nesting habitat; nesting in shrubs, trees, and cattails with proximity to foraging habitat- usually in a habitat safe from predators such as on an island, swamp, or over water. Good vegetative cover is essential.	Migration, nesting, brood rearing, foraging	Double-crested cormorant American sea rocket Great egret Great blue heron Herring gull Common tern
Caspian Tern		Flat rocky islands, beaches, and sandy shores littered with driftwood, are typical breeding habitat for this species. Favors protected waters such as bays, lagoons, lakes etc for foraging	Migration, nesting, brood rearing, foraging	

3.5 HABITAT TYPES AND ASSOCIATED PRIORITY SPECIES

At present, the Green Bay and Gravel Island NWRs encompass approximately 2,165 acres of mesic forest stands and rock shore communities. Rare plants such as the dwarf lake iris (*I. lacustris*) find habitat in the gradient between these communities. The communities on these islands provide habitat for a number of regionally rare and otherwise important species. Inevitably,

when managing with limited resources, areas must be prioritized to ensure the most important resource needs are met. The habitat types within the refuges were prioritized by the planning team based on information including current vegetation, management capability, and conservation needs of priority species (Tables 3-3).

Because personnel and funding resources are limited, and due to their remote location, management activities at Green Bay and Gravel Island NWRs are primarily directed toward invasive species management, including both plant and animal species. Habitat types on the refuge can generally be categorized into three broad categories:

- Northern Mesic Forest
- Great Lakes Alkaline Rock Shore and Alvar
- Early Successional/Transitional Habitat and Colonial Nesting Areas

Using criteria taken from the Handbook, refuge habitats are categorized into Priority 1 Habitats and Priority 2 Habitats.

Priority 1 Habitats demonstrate the following attributes:

- 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 2 Habitats demonstrate the following attributes:

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

An overview of these habitats, their priority for management, and how they benefit the refuges' priority resources are presented in Table 3-3.

Table 3-3 Priority Habitats at Green Bay and Gravel Island National Wildlife Refuges

Habitat	Priority Rank	Reasons for Priority Ranking	Limiting Factors/Stressors
Priority 1 Habitats			
Early Successional Habitat/ Colonial Nesting Areas	1	Supports 2 of the 7 priority resources (black-crowned night heron and Caspian tern), and provides breeding and migratory stopover habitat for a variety of resources. Helps maintain rare natural communities and associated species. Management includes cormorant and invasive species control; public education regarding site sensitivity and prohibited access.	Ongoing disturbance from breeding colonial waterbirds, windthrown trees, and wave action. Vegetation loss from breeding bird activity; wind and wave action on low-lying islands, especially during high-water years; non-native plant and animal species such as Phragmites and mute swan
Northern Mesic Forest	2	Supports 2 of the 7 priority resources (Northern wet-mesic forest, bald eagle), and provides breeding, overwintering, and migratory stopover habitat for a variety of resources. Active management includes invasive species control and white-tailed deer culling.	White-tailed deer herbivory hinders forest regeneration; woody and herbaceous invasive species; Forest vegetative cover on the smaller islands is limited to mostly standing dead trees due to the effects of nesting waterbirds. Large cormorant colonies have eliminated the forest on Spider and Pilot Islands. Wind throw is main factor in forest succession; fire is uncommon yet periodic. Maintenance of USCG property includes mowing, which encourages weedy invasive species such as Kentucky bluegrass and other common non-native species found in disturbed areas.

Habitat	Priority Rank	Reasons for Priority Ranking	Limiting Factors/Stressors
Great Lakes Alkaline Rock Shore; Alvar	3	Supports 3 of the 7 priority resources (Great Lakes beach, Great Lakes alkaline rockshore, and dwarf lake iris), provides breeding and migratory stopover habitat for a variety of species. Helps maintain areas of rare and imperiled natural communities and associated species. Management is focused on invasive species control.	Lake Michigan water levels dominate the extent of habitat and disturbance regime that sustains the shoreline.

3.6 CONFLICTING HABITAT MANAGEMENT

Given the diversity of goals, purposes, mandates, and conservation priorities for the National Wildlife Refuge System, it is not uncommon to have conflicting management priorities at a specific refuge. Balancing the types and proportion of habitats (and their management) requires special consideration and a process for determining the best course of action. Green Bay and Gravel Island NWRs contain habitat and management decisions that require such consideration, and those considerations are reflected in the objectives and strategies developed by the HMP planning team (Chapter 4).

One example of these conflicts is the effort to control cormorant colonies on the islands. These birds are native to the region, but their expansion since DDT was banned and their protection under the Migratory Bird Treaty Act has added stress to other native communities including the refuge islands. The removal of white-tailed deer on the forested islands can also be difficult and controversial even though evidence suggests northern white cedar, Canada yew, and other vegetation are not regenerating under deer herbivory.

From a broader perspective in habitat management, when deciding to actively manage a community, there are conflicting reasons for either preserving an area as-is versus imparting change through management techniques. Sometimes habitat management is intended to slow down or stop progression to a late-successional community type. The Service recognizes that the variety of habitats in their current extent provide a range of benefits for multiple resources throughout the year, as evidenced by the priority resources previously mentioned. The management goals are derived from historical knowledge of the region and its resources as well as current species use and community type. The current extent of habitat types are largely kept unchanged except where noted otherwise.

3.7 ADAPTIVE MANAGEMENT

Priority species and their respective habitat attributes were used to develop habitat objectives (Chapter 4). Habitat management objectives must be achievable, and factors may reduce or eliminate the ability of the Service to achieve objectives. Although these factors were considered during the development of management objectives, conditions may change over the next 15 years and beyond.

Through the development of this HMP, the refuge is working towards enhancement of adaptive management and SHC principles in their delivery of on the ground management. Chapter 4 will outline SMART objectives for habitat management. These habitat management objectives will enable the refuges to evaluate their ability to provide the conditions required for priority resources of concern. The management strategies outlined are the intended actions outlined by the planning team (including refuge staff) to achieve these management objectives. Following HMP completion, an inventory and monitoring plan (IMP) will be developed by the refuge to plan the evaluation and monitoring strategies needed to measure the achievement of the stated objectives. In developing these planning efforts and executing associated management and monitoring actions, the refuge will implement adaptive management.

As noted in Chapter 1, Annual Habitat Work Plans (AHWP) are step down plans tiered from this HMP that detail the specific habitat management strategies and prescriptions relevant to the refuge each year. The AHWP is a product of the adaptive management process (Figure 3-1); they are detailed on a yearly basis to capture site-specific and climate-specific needs in order to fulfill overall habitat management objectives set forth in HMPs.

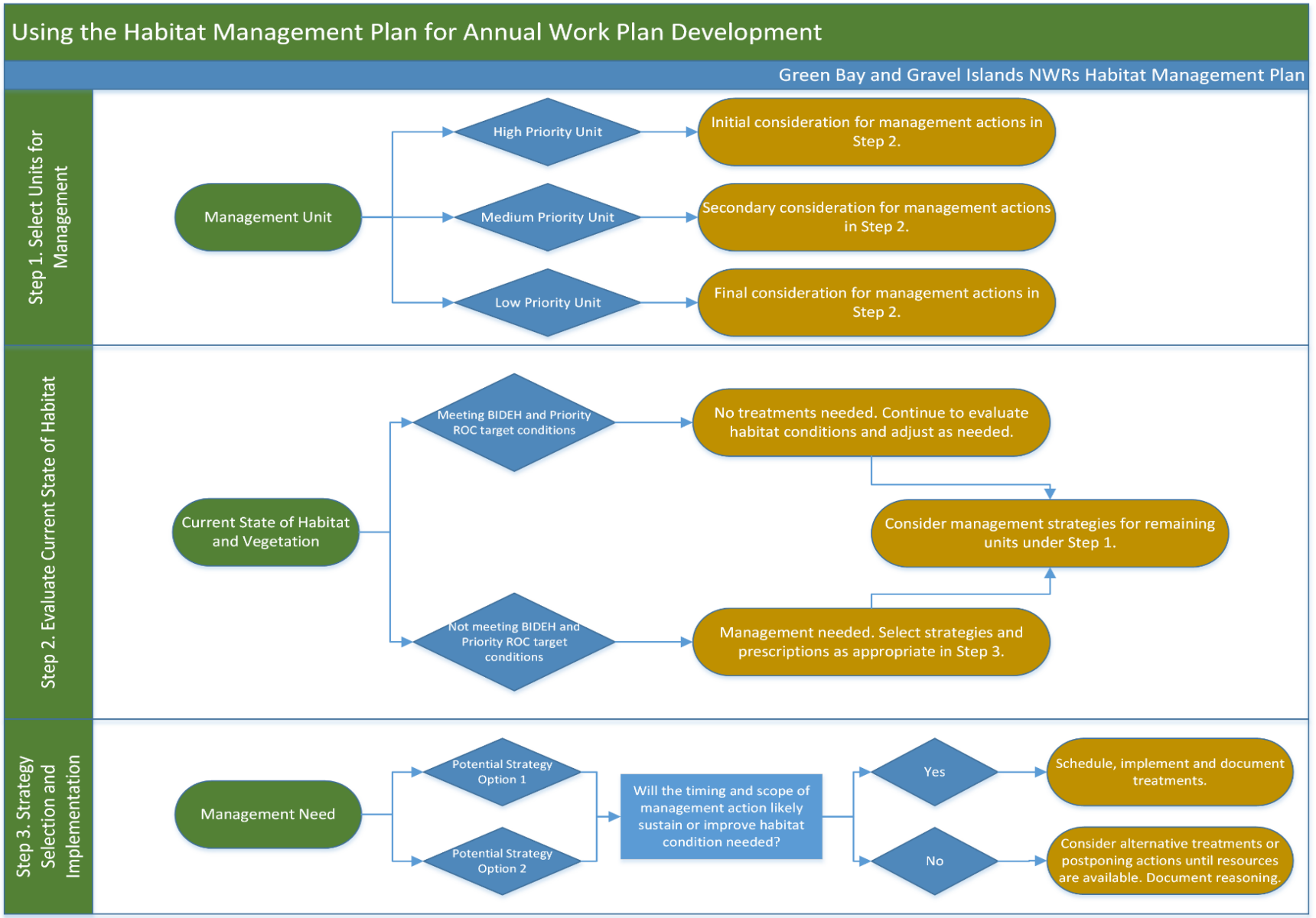

Figure 3-1 Using the Habitat Management Plan for Annual Work Plan Development

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CHAPTER 4.

HABITAT GOAL, OBJECTIVES, AND MANAGEMENT STRATEGIES

Dwarf Lake Iris

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4. HABITAT GOAL, OBJECTIVES, AND MANAGEMENT STRATEGIES

4.1 REFINING CCP OBJECTIVES WITHIN THE HMP

The CCP habitat management goals and associated objectives for the Green Bay and Gravel Island NWRs were developed in 2013 and act as a broad framework from which to further define desired habitat conditions on the refuges over a 15 year timeframe (602 FW 1.4A; USFWS 2007). Likewise, the Service requires habitat objectives be developed using the SMART criteria, specifically that objectives be Specific, Measurable, Achievable, Result-oriented, and Time-fixed (USFWS 2004). Upon review, the HMP planning team determined that goals and objectives stated in the 2013 CCP could be improved in order to provide clear and concise direction for the management of the refuges' natural resources (620 FW 1.8) and could be further refined to represent the preferred ROC/surrogate approach, existing conditions, and desired future management. Some of the original objectives did not apply directly to habitat management or lacked explicit specificity pertaining to desired results, targeted resources, or defined timeframe (SMART criteria). Thus, the CCP habitat objectives were refined and/or consolidated. Table 4-1 summarizes the objective amendments from the CCP to the HMP. The newly drafted objectives provide improved specificity and bring objectives into compliance with Service policy. The acquisitions of St. Martin Island and Rocky Island occurred in 2015 and the Service is currently in the process of acquiring Poverty and a portion of Detroit Island and they will be covered under the HMP objectives and strategies.

Table 4-1 Refinement of Green Bay and Gravel Islands National Wildlife Refuges Habitat Objectives

CCP Objective	Change between CCP and HMP	Revised HMP Objective	Rationale
CCP Objectives specific to Green Bay NWR			
1 Northern Mesic Forest	Updated to meet SMART criteria	Northern Mesic Forest (objective 3)	Updated to encompass St. Martin Island. Refined to align with selected ROC and associated habitat management targets.
2 Great Lakes Alkaline Rock Shore and Alvar	Updated to meet SMART criteria	Great Lakes Alkaline Rock Shore and Alvar (objective 4)	Updated to encompass St. Martin and Rocky Island. Refined to align with selected ROC and associated habitat management targets.
3 Open Land	Deleted as separate objective	Northern Mesic Forest (objective 3)	Maintenance of historic structures and USCG property will be under forestry management practices.
4 Invasive Species Management	Deleted as separate objective and added as component of all habitat management objectives	Incorporated into HMP (objectives 1-4)	Exotic and invasive species control is an objective component and strategy for each habitat objective.

CCP Objective	Change between CCP and HMP	Revised HMP Objective	Rationale
CCP Objectives specific to Gravel Islands NWR			
1 Waterbird Habitat (also applicable to Spider and Hog Island of GB NWR)	Updated to meet SMART criteria	Early Successional Habitat/Colonial Nesting Areas (objective 2)	Updated to include Rocky Island. Refined to align with selected ROC associated habitat management targets.
2 Exotic and Invasive Species Control	Deleted as separate objective and added as component of all habitat management objectives	Incorporated into HMP (objectives 1-4)	Exotic and invasive species control is an objective component and strategy for each habitat objective.

Likewise, the management strategies and rationales stated in the 2013 CCP for each of the early goals and objectives are further refined to specifically relate to and justify the revised HMP objectives as listed below.

4.2 HMP GOAL, OBJECTIVES, AND MANAGEMENT STRATEGIES

Habitat Management Goal

According to the CCP for the Green Bay and Gravel Island NWRs, the goal of habitat management on the refuges is to:

> *Perpetuate the biological diversity and integrity of native plant communities to sustain high quality habitat for migratory birds, fish, and endangered species.*

Habitat Management Objectives

To achieve this goal, the CCP included separate habitat objectives for the two refuges (Table 4-1). The HMP planning team has combined and revised these objectives, now covering three major habitat type objectives of the combined Green Bay and Gravel Island as identified and prioritized in Chapter 3 (Table 3-3). This prioritization will focus the management tasks for the refuge staff going forward with the intention of creating defined and rational goals in each community.

Revised HMP objectives are provided for each habitat type in, Green Bay and Gravel Islands Objectives (Table 4-1 in Section 4.1). These revised objectives include specific and measurable thresholds based on life history requirements of the identified ROC. Invasive plant management was intentionally removed as a stand-alone objective (i.e. not carried forward from the CCP) to reinforce the management focus on providing quality habitat for native wildlife and Federal trust resources and to specifically acknowledge the various types of species and control methods relevant to each habitat type. The intent of the original CCP invasive species management objective is retained in this HMP as a component of all habitat objectives and associated management strategies.

For guiding management resources, the planning team created the objectives hierarchy shown in Figure 4-1. This hierarchy depicts the relationships among Refuge purpose and goals, the habitat

management objectives, and measurable attributes, which are features that tie habitat management into the adaptive management framework noted previously in Chapter 3.

Figure 4-1 also presents administrative objectives potentially influenced by cost and public perception. While these factors do not directly dictate habitat management actions, planning and implementation of management strategies should consider their potential influence on timing and duration of certain activities.

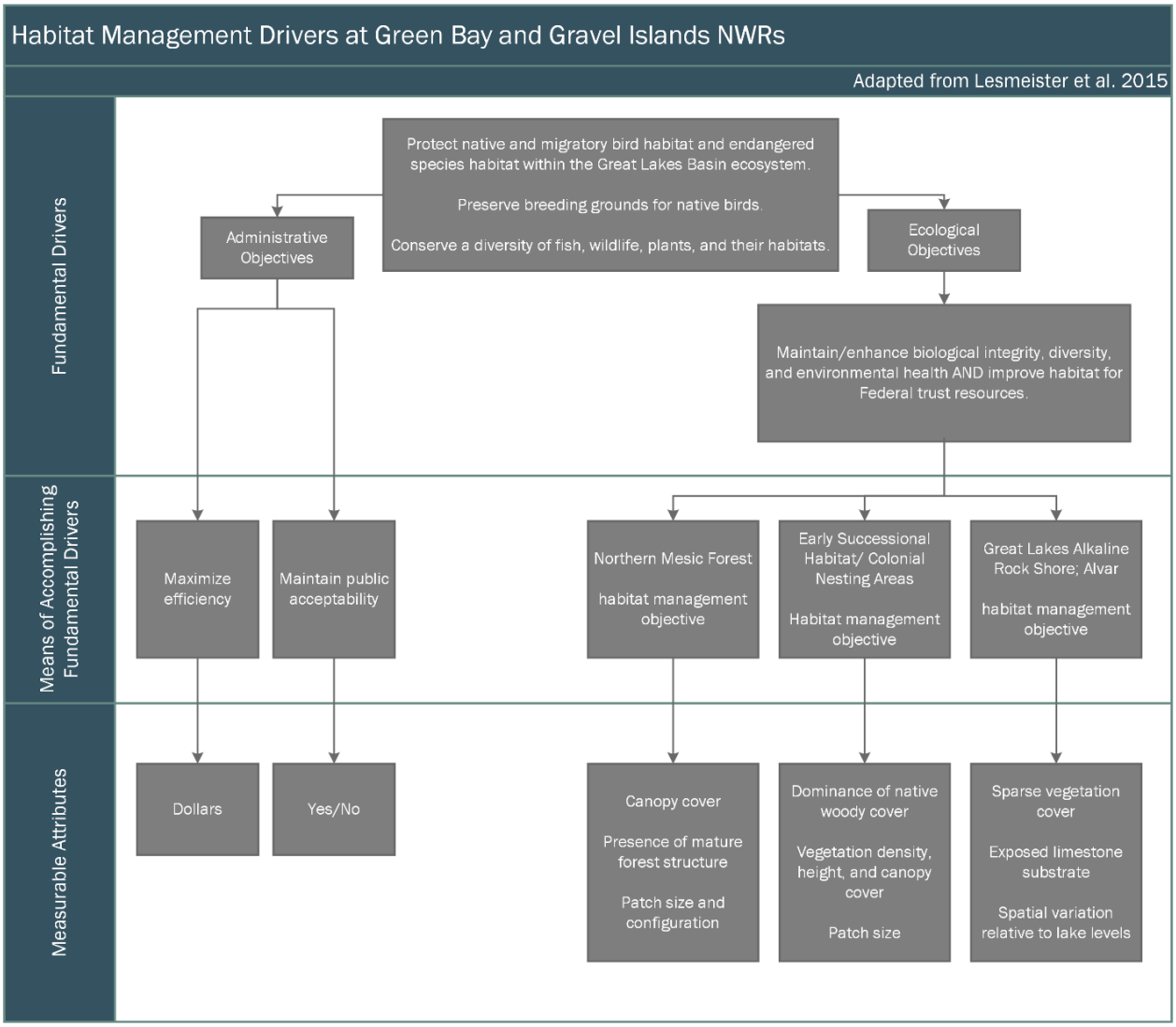

Figure 4-1. Habitat Management Objectives Hierarchy for Green Bay and Gravel Island National Wildlife Refuges

Each habitat type described below includes either percentage thresholds or targeted acreages, to be maintained on the refuges, occasionally both occur. The metrics on which these objectives are based will vary depending on the management capabilities and goals of the refuge. Habitat management goals on these refuges are constrained by staffing and safety issues. All island

refuges are unstaffed and habitat management, inventory and monitoring, and research are done under the leadership of Horicon NWR staff. The closets island is four hours (under perfect conditions) from Horicon NWR. Consideration of safety issues in the open waters of the Great Lakes precluded visitation during any time other than periods with low winds and waves (<3ft). Hypothermia is possible nearly every month of the year Therefore, severe limitation exists in what can practically be done on these islands. These objectives were created with the knowledge and assumption that climatic trends in temperature and precipitation and fluctuations of lake levels will also influence the refuge habitat objectives.

4.3 PRIORITIZATION OF MANAGEMENT UNITS

Management strategies identify the tools and techniques that would be used and provide prescriptions by which the strategies will be implemented (e.g. timing, frequency, duration, and location) to achieve the habitat objectives. The management strategies identified for each habitat objective were selected by reviewing previous and current refuge practices and their effectiveness in supporting management priorities, consultation with other refuges' biologists as well as consultation with other ecologists and practitioners. Many factors, including wildlife populations, seasonal variations, and habitat conditions, will affect the selected strategies and the ability to achieve objectives from year to year and not all management strategies are applicable to or should be implemented within every unit.

The work outlined within this HMP is intended to be feasible given the current availability of refuge staff and resources. However, it is impossible to predict the full suite of management strategies required over this period. Funding or staffing availability and new studies may cause paradigm shifts. Thus, per the spirit of adaptive management, some strategies may be amended or added as available resources change over time and will be identified in the Annual Habitat Work Plan.

To help inform the Annual Habitat Work Plan, refuge units were prioritized based on management priority, ROC needs, and unit accessibility. Table 4-2 provides a prioritization of refuge units to help guide management efforts within objectives and habitats. This table reflects the HMP planning team's assessment of where management is capable of achieving its greatest contribution to ROC highlighted in Chapter 3, while considering the overall management purpose, goals and objectives (Figure 4-1). Ranking is based upon consideration of numerous factors, including (in general order of priority):

- Determined habitat priority
- Value or contribution to ROC
- Management capabilities
- Use by Federal and State listed species
- Habitat quality and potential
- Spatial patch size
- Intensity, frequency, and type of management needed
- Personnel availability, safety, and operating costs

Factors such as climate change could shift the priority of these units, for instance, if severe declines in precipitation impact lake levels and associated habitat needs on the refuges.

Priority 1

Generally receive more management effort than other units. They tend to have higher value for ROC and have few limitations for management capability.

Priority 2

Still receive active management, but at a reduced level as compared to Priority 1 units. Generally, this reduction is due to increasingly limited management capabilities. If factors limiting the unit are repaired or upgraded, or as funding becomes available to address management limitations, these units could be reclassified as Priority 1. These units provide important habitat for ROC but generally require limited or no management on an annual basis.

Priority 3

Generally have several limitations impacting management potential, such as a lack of authority or jurisdiction to manage water levels, or altered ecological condition that prohibits management success. Some units are also limited by the potential to influence or impact adjacent land use. Additionally, most Priority 3 units would require significant resources or restoration to achieve designated potential. If restoration funds become available, some of these units could be elevated to a higher priority. This category also includes habitats where no day-to-day management is possible or needed, such as hard to access colonial nesting bird islands.

Table 4-2 Green Bay and Gravel Islands NWR Unit Prioritization

Management Unit	Primary Habitats	Unit Size (Land Acres)	Rationale
Priority 1 Units: Comparatively large, high-quality units that encompass top priority habitat types and provide habitat for priority resources. Single management actions (i.e. exotic species control or vegetation management) from existing, USFWS-owned, and accessible land could have beneficial impact or connect prioritized habitats.			
St. Martin Island	• Northern Mesic Forest	1,388.4	• Contains largest tract of northern mesic forest on Refuge complex. Supports several ROC.
Plum Island	• Northern Mesic Forest • Great Lakes Alkaline Rock Shore / Alvar	315.7	• Contains second largest tract of northern mesic forest on Refuge complex. Supports several ROC. • Plum Island also contains limited public access and supports other ROC, including endangered plants.
Hog Island	• Early Successional Habitat / Colonial Nesting Areas • Great Lakes Alkaline Rock Shore / Alvar	6.9	• Only unit currently with implemented management for DCCO. • Designated as a Wilderness Area.
Priority 2 Units: Generally large enough to support minimum ROC patch requirements. These units provide important habitat for ROC but generally require limited or no management on an annual basis.			

Management Unit	Primary Habitats	Unit Size (Land Acres)	Rationale
Pilot Island	• Northern Mesic Forest • Early Successional Habitat / Colonial Nesting Areas • Great Lakes Alkaline Rock Shore / Alvar	6.4	• Maintains an existing DCCO colony to prevent colonization of other islands. Serves as a reference areas for an island in the Great Lakes that does not conduct DCCO control.
Gravel Island	• Great Lakes Alkaline Rock Shore / Alvar	10.3	• Under normal lake levels, Gravel Island has hosted the largest Great Lakes colony of Caspian terns, a species with significant threats to its breeding population in the region. • Designated as a Wilderness Area. • Available habitat closely tied to lake levels; occasionally partially submerged by high lake levels.
Spider Island	• Great Lakes Alkaline Rock Shore / Alvar	24.6	• Available habitat closely tied to lake levels; occasionally partially submerged by high lake levels. • Maintains an existing DCCO colony to prevent colonization of other islands. Serves as a reference areas for an island in the Great Lakes that does not conduct DCCO control. • Designated as a Wilderness Area.
Priority 3 Units: This class includes lowest priority units and areas that are relatively inaccessible. For the Priority 3 areas, the patches are generally too small to meet habitat objectives for selected ROC. Alternatively, logistical constraints or management needs may contribute to high management costs or significant time investments.			
Rocky Island	• Early Successional Habitat / Colonial Nesting Areas	26.2	Maintains an existing DCCO colony. Largely a self-sustaining habitat condition. Distance and accessibility limit access for management and monitoring.

4.4 HMP OBJECTIVE 1: MAINTAIN AND EVALUATE WILDERNESS CHARACTERISTICS

Annually maintain and evaluate wilderness characteristics on 42 acres designated as Wilderness Areas on Hog, Gravel, and Spider Islands.

Management Strategies:

1. By 2018, prepare a 1-page trip inspection and evaluation form to be used on all visits. This form will allow for documentation and evaluation of measures selected by refuge staff for the Wisconsin Islands Wilderness Character Monitoring Report (O'Dell 2012). The form would include reason for visit (e.g., bird census, research, survey, monitoring, and management) current status of invasive species and any new invasive plants observed, breeding bird presence, and evidence of unauthorized entry or other illegal activity.

2. Annually, update wilderness character monitoring database with wilderness character monitoring data established for the Wisconsin Islands Wilderness Area to monitor trends in wilderness character.

3. Annually, follow Wilderness Policy and Minimum Requirements Decision Guide (MRDG) process for all management and monitoring actives proposed on federally designated wilderness areas.

Rational:

Monitoring wilderness character is part of the USFWS National Wildlife Refuge System's Wilderness Character Monitoring Program of 2012. The goal of the program was to develop a wilderness stewardship and monitoring plan to preserve the wilderness character at each refuge. The monitoring strategies and measures are based on the national strategy described in Keeping It Wild: An Interagency Strategy to Monitor Trends in Wilderness Character Across the National Wilderness Preservation System (Landers et al 2008). A report establishing a baseline assessment and monitoring measures for the Wisconsin Islands Wilderness was completed in 2012 (Odell 2012). Modifications to the original measures were made in 2015 to comply with the revised monitoring protocol of *Keeping It Wild 2* (Landers et al. 2015) (Gantz et al. 2016).

Wilderness monitoring tracks changes in the following wilderness qualities: 1) untrammeled; 2) natural 3) undeveloped and 4) solitude or primitive and unconfined recreation. Measurers include tracking number of visits, management actions, invasive species, and tracking annual winter minimum/maximum temperature anomaly, annual summer minimum/maximum temperature anomaly, and the annual Palmer drought severity index.

According to the 2014 Climate Change Impacts in the United States: The Fourth National Climate Change Assessment, the rate of warming in the Midwest has markedly accelerated over the past few decades. Between 1900 and 2010, the average Midwest air temperature increased by more than 1.5° F. However, between 1950 and 2010, the average temperature increased twice as quickly, and between 1980 and 2010, it increased three times as quickly as it did from 1900-2010 (Pryor et. al 2014). Significant changes in temperature over time may cause several impacts including changes in annual snowfall, extent of ice coverage on lakes, the timing of bird migration and nesting, forest composition and structure, changes to water temperatures causing a shift in fish species, plant phenology patterns (Great Lakes Integrated Sciences and Assessments 2014). The Wisconsin Islands Wilderness are sensitive islands that can be significantly affected by the hydrologic cycle. For example, the sedge meadow on Plum Island is connected to Lake Michigan water levels, increasing and decreasing in size with water level fluctuations On Hog Island, lower water levels can expose a "land bridge" linking the island to the larger adjacent Washington Island and allow predator access to the detriment of ground nesting waterbirds. Monitoring climate patterns will provide important insight into annual conditions within a historical perspective.

USFWS policy requires a minimum requirements analysis (MRA) for all management activities conducted in federally designated wilderness areas. The Minimum Requirements Decision Guide (MRDG) is a process that was developed by the Arthur Carhart National Wilderness Training Center to help land managers make informed, defensible decisions that comply with Section 4(c) of the Wilderness Act of 1964. The MRDG Overview, Instructions, Workbook, and Agency Guidelines are found at: www.wilderness.net/MRA

4.5 HMP OBJECTIVE 2: EARLY SUCCESSIONAL HABITAT/COLONIAL NESTING AREAS

Annually maintain approximately 20 acres of early successional habitat as colonial nesting bird habitat on Gravel, Hog, Spider, Pilot, and Rocky Islands. Areas of sparse vegetation (less than 10% cover) will be maintained through successional processes and natural disturbance to sustain nesting conditions for Caspian tern and other ground-nesting waterbirds. Scattered tree cover consisting of dogwoods (*Cornus spp*.), willows (*Salix spp*.), and elderberry (*Sambucus canadensis*) may persist on some islands but will typically be less than 20% of the total canopy cover and will support nesting conditions for black-crowned night herons and other tree-nesting waterbirds. No active management of the vegetation (habitat) is currently proposed. Based on historical bird observations and sustaining these conditions noted, the refuge expects to maintain and support robust waterbird populations over the life of the HMP.

Management Strategies:

1. Annually, protect waterbird colonies by limiting human disturbance on colonial nesting bird islands. Access to the Gravel, Spider, and Hog Islands will be limited to monitoring and research. Except for at Hog Island when access may be allowed for cormorant management if deemed necessary. Access to Pilot Island for building inspections and maintenance projects will occur before migratory bird arrival on breeding grounds and after chick fledging. Breeding season on refuge islands begins in late March and continues until mid-late July.

2. By 2018, formalize a monitoring program to track the presence, abundance, population trends, and habitat associations of breeding colonial waterbirds on refuge islands. Monitoring will be conducted on an annual or bi-annual basis and used to inform regional population abundance, distribution, trends, and waterbird conservation planning strategies. Population thresholds for breeding bird populations will be determined at the regional and/or eco-regional scales (Bird Conservation Region). Primary sources of information used to inform migratory bird species of concern are described in section 3.2.

3. Annually, monitor cormorant populations on refuge islands and if necessary manage to prevent vegetation loss and waterbird species displacement due to cormorant nesting activities. Cormorant management plans will carefully consider impacts to co-nesting species and actions would only be taken if adverse impacts to non-target species can be avoided. Non-lethal management actions (nest destruction) is the preferred measure. If non-lethal measures are ineffective, lethal methods may be considered in combination with non-lethal methods as a means to reinforce non-lethal measures. A federal USFWS depredation permit will be required in accordance with the USFWS Environmental Assessment for Issuing Depredation Permits for Double-crested Cormorant Management (USFWS 2017). Additionally, any proposed cormorant management actions on wilderness islands will require a MRA.

4. Annually, continue to coordinate with partners and agencies regarding annual cormorant management and monitoring.

5. Annually, continue to coordinate with partners such as Wildlife Services and Wisconsin DNR for monitoring and control of resident mute swan population.

Rationale:

Colonial waterbird nests are typically built on the ground in the open where predation is a constant threat. This, combined with their tendency to form breeding colonies of potentially thousands of individuals, makes these species highly visible targets for predators. The birds appear to minimize this threat by nesting in remote areas near foraging habitat, a habitat niche that allows the Great Lakes islands, such as those on the refuge, to support regionally important bird colonies (Wires et al. 2010). However, due to site disturbance, predator introduction, and competition among other birds for nesting sites, some waterbirds, such as Caspian Terns, are seeing population declines across the region (Kreitinger 2013). Colonial nesting areas are a unique and important habitat that is difficult to replace once it has been degraded or altered.

The existing colonial nesting areas on the islands fulfill the original purpose of the refuge's establishment as preserves and breeding grounds for native ground-nesting waterbirds, and is therefore listed as the highest management priority in this plan. These nesting areas are dynamic and self-sustaining areas on Gravel, Hog, Spider, Pilot, and Rocky Islands and the primary environmental drivers at these sites are wind, wave action, and the bird colonies themselves as discussed in Chapter 3. Vegetation management will be limited to treating invasive species such as giant reed grass (*Phragmites australis*), both to minimize disturbance of bird colonies but also to respect the wilderness character of Gravel, Hog, and Spider Islands. There is no public access allowed to further protect colonial nesting birds from human disturbance.

The priority ROC in this habitat are both regionally significant, declining bird species that rely on this unique landscape. Black-crowned night herons (state special concern) and Caspian terns (state endangered) are species of greatest conservation need in Wisconsin. The refuges lie within BCR 12, or the boreal hardwood transition, where both species are listed as JV focal species. The quality of nesting habitat on Great Lakes islands is highly dynamic with the value of islands changing due to human activity and Great lakes water levels. For this reason, changes in waterbird distribution and abundance during breeding and non-breeding periods are observed and documented at both the refuge and regional scale (Wires, L.R., 2010). Under normal lake levels, Gravel Island has hosted the largest Great Lakes colony of Caspian terns, a species with significant threats to its breeding population in the region (Wires et al. 2010). Caspian terns prefer low-lying, rocky areas that are often exposed to disturbance, especially when Lake Michigan water levels are above normal. Habitat management is limited in their nesting areas, where the most important strategy is often removing human disturbance, especially from the public, to the colonies during nesting season. Chick mortality of 30% has been reported during a single one-hour visit to a Caspian tern colony (Penland 1982).

Double-crested cormorant management poses a challenge to the protection of other colonial waterbirds. Nest site competition is a conservation concern when priority resources of concern are unable to sustain losses due to increasing numbers of cormorants. As outlined in an Environmental Assessment developed for Wisconsin in 2009, cormorants can have a negative effect on vegetation through the accretion of their acidic guano as well as by physically stripping leaves and branches off trees and shrubs as they roost (USDA 2009). The photos below show Spider Island (Gravel Island NWR) before and after cormorant colonization. Cormorant colonies

Spider Island, 1977, USFWS

Spider Island, 2002, USFWS

will also displace other colony nesters such as ROC black-crowned night herons (USDA 2012). Black-crowned night herons will use a variety of vegetation during breeding season, but having vegetative cover is essential and the colony will not remain in an open landscape (Hothem 2010).

Past cormorant control in the Great Lakes region was authorized under a 2003 Public Resource Depredation Order (PRDO), allowing the species to be controlled when "committing or about to commit depredations on the public resources of fish, wildlife, plants, and their habitats" (Wires et al. 2010). This order was used to implement lethal management on Hog Island in 2007-2016 to protect standing vegetation and co-nesting species. Past cormorant management on Hog Island included both non-lethal (nest destruction) and lethal (when eggs were present and destroyed during the nest destruction) management. The PRDO was vacated in May 2016 when a federal judge ruled in favor of the plaintiffs in a lawsuit filed by the Public Employees for Environmental Responsivity. This lawsuit and its corresponding cessation of all cormorant control activities, led the Service to be unable to implement control activities after May 2016. As a result, cormorants established themselves on Hog Island in 2016 and 2017.

The USFWS released an updated Environmental Assessment (EA) for Issuing Depredation Permits for Double-crested cormorant Management in October of 2017 (USFWS 2017). In this EA, the USFWS will make decisions on depredation permit applications for the annual take (lethal removal) of up to 51,571 cormorants. The USFWS will allocate the maximum allowable take across three managed sub-populations: Atlantic, Mississippi/Central, and Florida. USFWS will evaluate permit applications on an individual basis based on the scope and environmental consequences identified in the EA. They may issue permits to take cormorants if there is convincing evidence that cormorants are adversely affecting species of high conservation concern or rare and declining plant communities at the local scale.

Refuge management has only approved and/or implemented cormorant management at Hog Island and cormorant management is not currently being used as a strategy on Spider and Pilot Islands. The absence of control at these islands is intentional due to their lack of vegetation, which is most likely due to prolonged cormorant colonization. On these islands, cormorant exclusion and vegetation restoration to conditions prior to cormorant colonization would be prohibitively expensive and time intensive. For this reason, the USFWS proposes that cormorant colonies on Spider and Pilot islands be protected, and because cormorant control without strong justification, as there is at Hog, conflicts with the island refuges' specific purpose of protecting native migratory bird species (USDA 2012).

Control of mute swans, an invasive bird introduced from Eurasia, also occurs although populations in the region are much more limited than cormorant colonies. These large birds will compete with native species by consuming large amounts of submerged, aquatic vegetation as well as displacing other waterbirds from breeding territories. Mute swan control will be handled in conjunction with other agencies including Wildlife Services, a division of the USDA (USDA 2012).

4.6 HMP OBJECTIVE 3: NORTHERN MESIC FOREST

Over the life of the HMP, maintain approximately 1,500 acres of northern mesic forest on Plum and St. Martin Islands to sustain a rare natural community that supports a variety of migratory and breeding landbirds, including the bald eagle. Forest will be managed through natural disturbance, lake fluctuations, and vegetation management to enhance forest structure, composition, and regeneration. Forest structure will maintain greater than 80% canopy cover dominated by native species such as white cedar (*T. occidentalis*), beech (*F. grandifolia*), sugar maple (*A. saccharum*), and balsam fir (*A. balsamea*). The shrub layer consists of native species such as viburnum (*Viburnum acerifolium*), eastern hop-hornbeam (*Ostrya virginiana*), hazelnut (*Corylus americana*), and remnant Canada yew (*T. canadensis*) Shrub and herbaceous invasive species cover will be limited to less than 5% of the total cover of any individual management unit. The addition of Poverty and Detroit Island will add over 300 acres of northern mesic forest habitat.

Management Strategies:

1. Annually, make inspections and use chemical and/or mechanical control techniques to control invasive species, such as hounds-tongue (*Cynoglossum officinale*), below 5% total cover.

2. Annually, implement EDRR strategies for new infestations of invasive species such as garlic mustard (*Alliaria petiolata*).

3. Annually, continue working with the WIDNR and MIDNR to liberalize legal hunting to eliminate and/or significantly reduce white-tailed deer populations:

    - Currently, a maximum of 10 deer are able to be harvested from St. Martin Island by USFWS staff and/or contract service provided by USDA Wildlife Services under a MIDNR issued special permit and harvest can occur at any time during the year. A Nuisance Deer Control Plan is currently being developed.

- For Plum Island, a Nuisance Deer Control Hunting Program is implemented and a maximum of 30 deer are able to be harvested by special permit during all State of WI deer hunting seasons. An application and random drawing for hunters is held annually. A formal Hunt Plan for Plum Island is currently being developed.

4. Within 2 years of HMP completion, develop a long-term monitoring plan for white-tailed deer and associated browse related impacts to provide quantitative information to effectively manage deer populations. Objectives of monitoring are to determine the impact of deer on browse sensitive vegetation such as Canada yew and to determine relative population levels of deer needed to guide management. From these two types of data, changes in vegetation communities corresponding to fluctuations in deer populations can be traced over time. The monitoring plan will consider surveys to determine changes in relative deer abundance to determine the impact on browse sensitive species such as Canada yew and the use of trail cameras to obtain deer population estimates.

5. Within 5 years of HMP completion, evaluate and implement a forest ecosystem monitoring plan on Plum, St. Martin, Plum, Detroit, and Poverty Islands to provide insight into forest structure composition and to increase understanding of existing ecological conditions of refuge forests to facilitate future monitoring and management.

6. Annually, maintain open areas around historic structures on Plum Island through mowing buffer areas and maintain pollinator enhancement areas by maintaining a diversity of native plant species by a combination of seeding, plant propagation/planting, mowing, and hand-pulling invasive weeds to encourage pollinator diversity and abundance.

7. Annually, minimize disturbance and harmful impacts from management and public use activities to the one active bald eagle nest on Plum Island following guidelines provided in USFWS National Bald Eagle Management Guidelines (USFWS 2007). Distance buffers will be maintained by keeping an appropriate distance between the activity and the nest. Buffers will be large enough to protect existing nest trees and provide for alternative or replacement nest. Management activities that have the potential to disturb nesting eagles will be avoided during the breeding season. Coordinate nest monitoring efforts with the WIDNR annual statewide aerial nesting surveys and nest monitoring efforts.

Rationale:

Northern mesic forest habitat is the most abundant habitat of the refuges, but it is concentrated on the large islands of Plum and St. Martin where it covers over 1,500 acres with 300 acres being added with the acquisition of Poverty and Detroit Islands. The canopy is dominated by mature sugar maple (*A. saccharum*), beech (*F. grandifolia*), and paper birch (*B. papyrifera)* trees while the understory supports a rich variety of spring ephemeral herbaceous species. Northern white cedar (*T. occidentalis*) becomes more dominant on Plum, St. Martin, and Poverty near the edges of the forest community. The interior of Poverty Island more resembles boreal forest with white spruce (*Picea glauca*) and balsam fir (*A. balsamea*) common. Even though upland forest in this region of Wisconsin and Michigan, described as Boreal Hardwood Transition in the UMRGLR JV Plan, is the dominant ecotype, it saw a large area loss between 2001 and 2006, with nearly 60,000

acres being converted into other habitat types or lost to development and agriculture. This habitat loss also does not include the increased fragmentation or degraded status of the remaining forest units (Pierce et al. 2014). The most recent State Wildlife Action Plan for Wisconsin also identifies the increased habitat fragmentation that this community has seen over the past century, leading to stress on species that require large, contiguous blocks of forested land. As these areas recover from disturbance, they often develop into even-aged stands that only benefit a certain guild of species instead of serving the historic diversity of the region (WDNR 2015). The insect-fungi complex referred to as beech bark disease has been identified on St. Martin Island. Beech bark disease threatens to cause overstory mortality and canopy gaps in the forest. Northern mesic forest is a priority habitat that requires refuge management due to its relatively large size compared to other habitats present on the refuges and its regional importance in creating diverse, extensive habitat blocks.

The priority ROC for this habitat, the bald eagle is a resident of, and indicator species for mature, varied forests near large bodies of water (Buehler 2000). Management practices protecting the integrity of the northern mesic forest community will also provide suitable habitat for bald eagles. There is one active nest on Plum Island and an active nest was recently observed on Poverty Island.

Invasive species will be managed annually and as new populations occur. Now-common woodland non-native species such as hounds tongue (*C. officinale*) will be treated regularly to keep total invasive species cover below 5% threshold. New populations of invasive species not yet documented on the islands, such as garlic mustard (*A. petiolata*), will be prioritized for swift control. Early detection rapid response (EDRR) efforts aim to address and eliminate new populations as they occur, while still localized and populations are manageable. The tenants of EDRR include: 1) potential threats are being identified in time to allow risk-mitigation measures be taken; 2) new invasive species are being detected in time to allow efficient and environmentally sound decisions to be made; 3) responses to invasions are effective and environmentally sound and prevent the spread and permanent establishment of invasive species; 4) adequate and timely information is being provided to decision-makers and the public about the status of invasive species within an area; and 5) lessons learned from past efforts are being used to guide current and future efforts (NISC 2003).

Beginning in 2017, efforts to enhance pollinator habitat on Plum Island were initiated with USFWS Coastal Management funding. The enhancement areas are located in areas maintained as open land around the historic structures otherwise dominated by introduced species. These pollinator enhancement areas will be maintained to encourage pollinator diversity and abundance by encouraging and maintaining a diversity of native plant species. Pollinators are vital to healthy ecosystems. Managing and maintaining the pollinator enhancement areas will encourage the health of resident and migratory populations of pollinating animals like the monarch butterfly. Additionally, this effort is an excellent way to connect and engage volunteers and visitors in conservation stewardship activities on the refuge.

Canada yew was historically important in this community, and was documented as being abundant on the Grand Traverse Islands in vegetation surveys in the 1970s, though some of these same reports warned of imminent collapse of the Canada yew population if white-tailed

deer herbivory were allowed to continue at high levels (WDNR 1978). These findings were echoed by more recent surveys of St. Martin Island, in which Canada yew was determined to be functionally extirpated from the island, and would remain so until white-tailed deer were removed from the landscape (Epstein et al. 2002). Wisconsin DNR deer management guidelines concur that deer populations can negatively affect forest regeneration, especially impacting preferred species such as eastern hemlock, northern white cedar, and Canada yew (WDNR 1998). Effects can be seen in the absence of saplings in an area even though adults of the species are present, or in browse-lines, where trees and shrubs are browsed at heights easily reached by deer.

White-tailed deer browse-lines on northern white cedar, Little Summer Island, MI; photo by E. Judziewicz

Other than invasive species control, the primary management strategy implemented by the refuge will be white-tailed deer eradication and/or control. In order to allow for the northern mesic forest community to maintain its biological integrity, especially regarding regeneration of natural and formerly dominant species, a reduction or elimination of the deer population from the forested islands is considered necessary. The deer population on St. Martin Island, which historically had no white-tailed deer, or occasional individuals, will be targeted for extermination. Plum Island, which is closer to the mainland, will likely receive occasional influx over the ice-pack in the winter and deer movement from adjacent islands during the hunting season and will be managed actions

in accordance with the forthcoming Hunt Plan. With no resident predators, deer that reside on the island reproduce quickly and have had measurable impact on forest vegetation (WDNR 2015).

Double-crested cormorant colonies do not currently exist on Plum, Poverty, St. Martin, or Detroit Islands and any future colonization efforts will be resisted following protocol as described above. Actions taken to prevent cormorant colonization will be taken with the intention of protecting the integrity of the northern mesic forest communities on these islands.

Baseline biological inventories including breeding and migratory bird surveys and vegetation inventories have been completed on Plum and St. Martin Islands to document species use and vegetation communities; however a detailed evaluation of the forest communities is needed on Plum, St. Martin, Detroit, and Poverty Islands to address future forest management needs. A Rapid Ecological Assessment is a tool that can be used to investigate spatial and temporal patterns within an ecological context (USFWS 2014). These metrics can be used to establish future goals and objectives for the forest stands on Plum, St. Martin, Detroit, and Poverty Islands.

To achieve the goals of landscape scale coastal habitat conservation, refuge staff works with a diverse group of conservation partners on the Door Peninsula of Wisconsin and the Grand Traverse Island chain including The Nature Conservancy, Door Land Trust, Wisconsin DNR and Michigan DNR. For example, these partnerships leverage grant funding to enhance coastal areas on refuge islands and surrounding private and state conservation areas to control invasive species and acquire and conserve coastal habitat. Funds provided by the North American Waterfowl Conservation Act (NAWCA), and Natural Resource Damage Assessment (NRDA) Program were used and for the acquisition of St. Martin Island and NRDA is providing funds for the future acquisition of a portion of Detroit Island adding to long-term efforts to protect this island. The Wisconsin DNR and Door County Land Trust currently own over 70 acres on the north end of Detroit Island.

4.7 HMP OBJECTIVE 4: GREAT LAKES ALKALINE ROCK SHORE AND ALVAR

Over the life of the HMP, maintain approximately 190 acres of Great Lakes Alkaline Rock Shore and Alvar habitat across the Green Bay NWR and Gravel Islands NWR. Areas of rocky shoreline and alvar will be characterized by exposed limestone boulder, cobble, and bedrock substrates and will be maintained through natural disturbance and lake fluctuations. Vegetation cover of shoreline obligate species like silverweed (*P. anserine*), American sea-rocket (*C. edentula var. lacustris*), and Artic primrose (*P.vulgaris*), as well as listed and rare species such as dwarf lake iris (*I. lacustiris*), will be preserved by keeping invasive species cover less than 5% of total area.

Management Strategies:

1. Annually, use chemical and/or mechanical treatments to control invasive species populations below 5% total cover, such as *Phragmites* and reed canary grass (*Phalaris arundinacea*), to maintain unique Great Lakes coastal habitat.

2. Within 2 years of HMP completion, establish and implement an inventory and monitoring program for dwarf lake iris. Components of this plan would include an assessment of the dwarf lake iris population on Plum and St. Martin Island, surveys to more precisely determine dwarf lake iris population size, updated mapping of iris locations, and

development of protocols to measure current and future status and effectiveness of conservation and management strategies.

3. Within 5 years of HMP, develop and implement a site specific management plan for dwarf lake iris to ensure important habitat, such as those on Plum and St. Martin, remain available to support long-term viability of the species.

4. Annually, at Plum Island, continue to maintain designated entry points with boot-cleaning station and invasive species informational kiosk. Maintain signage to inform public of access and activity restrictions.

5. Annually, continue to work with local partners to coordinate trash removal, invasive species control, and other clean-up activities.

Rationale:

This habitat encompasses a few distinct communities that are managed similarly and are all relatively rare in the Wisconsin and the Great Lakes region. The first is alvar, which consists of sparsely vegetated rock barrens that develop on limestone flats or dolostone bedrock where soils are very shallow or not existent. Due to the thin soil, an often rare variety of species, and sporadic locations, alvars are more susceptible to degradation than other communities. In Ontario, where the majority of North American alvar is found, 54 species have the majority of their occurrences in alvar and 43 plant species classified as rare in Ontario occur on alvar (Reschke et al. 1999). Alvar is listed as Endangered in Wisconsin and is a globally rare community that exists in the U.S. only in the Great Lakes region. On the refuge, alvar like communities are found primarily on flat ledges of Poverty and St. Martin Islands. The community hosts rare and endemic species as well as regional outliers that are considered dry prairie or savanna species elsewhere in the state (Epstein et al. 2002). Northern white cedar (*T. occidentalis*), along with ninebark (*P. opulifolius*) and red-osier dogwood (*Cornus sericea*) are often the most common woody vegetation when any is present. Alvar, unlike the colonial bird nesting areas, is not defined by lake levels and wave or ice action, but by the thin soil and limestone bedrock (Judziewicz 2001).

The other two priority resources, Great Lakes Beach and Great Lakes Alkaline Rockshore, are both rare in the state, and they differ from alvar in that they are more influenced by ice and wave action. Accordingly, these shoreline communities are more vulnerable to changes in lake levels. In years that Lake Michigan is low, these communities will expand, while in high water years, they may become scarcer. This reliance on lake levels and disturbance at intervals makes these communities more susceptible to the effect of long-term climate change (WDNR 2015). Potholes and cracks in these rocky shore communities will hold water during portions of the year. These sporadic pools become important for migratory waterbirds as sources for food such as various invertebrates.

Due to the sparse vegetation and natural, recurrent disturbance to the system, this habitat is also vulnerable to invasive species transported by wind, water, human traffic, or through bird guano. Even though soil is often thin and of poor quality in these areas, a variety of non-native invasive species have been problematic in the past, most notably *Phragmites* (WDNR 2015). The most

active management in this habitat type will be responses to invasive species establishment using EDRR tactics to keep invasive cover to less than 5%.

On the refuge, the most noted example is a priority ROC in this habitat, the dwarf lake iris, a Wisconsin/Michigan and Federally Endangered Species growing in shallow soil over moist calcareous sands, gravel and beach rubble. The species is most often associated with coniferous forest dominated by northern white-cedar and balsam fir. Dwarf lake iris is found on the northern shoreline of Plum Island on an abandoned U.S. Coast Guard road and on St. Martin Island near the shoreline. Sunlight is one of the most critical factors to growth and reproduction of the species, and partly shaded or sheltered edges are optimal for sexual reproduction (USFWS 2011). One of the primary threats to the dwarf lake iris is natural forest succession in its microhabitat. Habitat management must include a strategy to maintain semi-open habitat to ensure long-term viability of the species. Past disturbance and maintenance of the now abandoned Coast Guard trail likely promoted favorable conditions. Active management will likely be required to maintain the forest openings that provide the partial shade conditions optimal for dwarf lake iris growth and reproduction. Research focusing on the dwarf lake iris and its habitat requirements continues. As guidance is developed regarding the species and its ecology, refuge management may be updated during the life of this HMP.

Other management will likely be passive or periodic. There is a designated entry point to Plum Island, which is open to the public from Memorial Day through Labor Day. The dock on the northeast side of the island is open to small, non-motorized boat traffic during this period, and visitors are obliged to use the boot brush currently in place to prevent the spread of invasive species. There are plans for an improved and expanded dock to be installed in the future, which may lead to larger craft and more visitors to the island. This area will be maintained by refuge staff and provide information regarding allowable activities on the island. Future management strategies may be revised to reflect public use. A trail on Plum Island has been re-routed to protect the dwarf lake iris population, and visitors are encouraged to stay on trails in order to minimize the spread of invasive species.

There is an active friends group that has been working with the refuge, The Friends of Plum & Pilot Islands (FOPPI). The refuge has coordinated with the group in the past on trail clearing, invasive species control, informational sign installation, historic structure maintenance, and trash clean-up (FOPPI 2016). Refuge staff will aim to continue this relationship with FOPPI and other local volunteers to continue these efforts.

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5. REFERENCES

Audubon Guide to North American Birds, text by Kaufmann, K. https://www.audubon.org/field-guide/bird/caspian-tern

Ayers, Christopher R., Katie C. Hanson, Sadie O'Dell, Charles D. Lovell, Michael L. Jones, Jason R. Suckow, and Brian S. Dorr. 2015. Impacts of colonial waterbirds on vegetation and potential restoration of island habitats. Restoration Ecology. Vol. 23, No. 3. Pp. 252-260.

Blomquist, S., Heglund, P., D. Salas, and M. Pranckus. 2013. Surrogate Species Version 1.0. Department of Interior, U.S. Fish and Wildlife Service, Region 3. 113 pp. Available online at:http://www.fws.gov/midwest/science/surrogatespecies/documents/MidwestStatusReport.pdf

Brand, C.J., R.M. Duncan, S.P. Garrow, D. Olson, and L.E. Schumann. 1983. Waterbird mortality from botulism Type E in Lake Michigan: an update Wilson Bulletin 95(2): 269-275.

Buehler, D. A. 2000. Bald Eagle (*Haliaeetus leucocephalus*). *In* The Birds of North America, No. 564 (A. Poole and F. Gill, eds.). The Birds of North America Online, Ithaca, New York.

Buehler, David A. 2000. Bald Eagle (Haliaeetus leucocephalus), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/506

Caro, T. 2010. Conservation by Proxy: Indicator, Umbrella, Keystone, Flagship and Other Surrogate Species. Island Press, Washington, DC. 374 pp.

Corace, RG III, Petrillo, HA. 2014. Rapid ecological assessment methods for forests in the Laurentian Mixed-Forest-Great Lakes Coastal Biological Network, Midwest Region, National Wildlife Refuge System, US Fish and Wildlife Service. Seney NWR, Seney MI.

Cuthbert, Francesca J. and Linda R. Wires. 1999. Caspian Tern (*Hydroprogne caspia*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/403

Dale, Tara B., Stromborg, Kenneth L. 1993. Reconnaissance surveys of contaminates potentially affecting Green Bay and Gravel Island National Wildlife Refuge. US Fish and Wildlife Service. Green Bay Ecological Services Field Office, Green Bay WI.

Door County Pulse. 2013. St. Martin Island: Frequently Asked Questions. Accessed online December 15, 2015 at https://doorcountypulse.com/st-martin-island-frequently-asked-questions/

Dutch, Steve. 1999. The Niagara Escarpment. University of Wisconsin - Green Bay. Accessed online December 14, 2015 at https://www.uwgb.edu/dutchs/GeologyWisconsin/niagesc.htm

Dwarf Lake Iris Fact Sheet, 2015, U.S. Fish and Wildlife Service, Midwest Region, http://www.fws.gov/midwest/endangered/plants/dwarflak.html

Dwarf Lake Iris (*Iris lacustris*), Elaine A Chittenden with assistance from the Natural Heritage Program and Michigan Natural Features Inventory staff. MI Department of Natural Resources,http://www.michigan.gov/dnr/0,4570,7-153-10370_12146_12213-61409--,00.html

Environmental Protection Agency (EPA). 2015. Great Lakes Facts and Figures. Accessed December 14, 2015 online at http://www.epa.gov/greatlakes/great-lakes-facts-and-figures

Epstein, E.J., E.J. Judziewicz, and E.A. Spencer. 2002. Wisconsin Natural Community Abstracts. Department of Natural Resources, Bureau of Endangered Resources, Madison, WI.

Fox 11 News. 2015. St. Martin, Rocky islands added to wildlife refuge. Sinclair Broadcast Group, Inc. September 23, 2015. Accessed December 14, 2015. http://fox11online.com/news/local/lakeshore/st-martin-rocky-islands-added-to-wildlife-refuge

Friends of Plum & Pilot Islands, Inc. (FOPPI). 2016. Forum. Friends of Plum & Pilot Islands Winter Newsletter. Accessed online at: http://www.plumandpilot.org/uploads/2/8/5/6/28563169/newsletterwinter2016..pdf

Gants, M. et al. 2016. Green Bay and Gravel Island National Wildlife Refuge, Wisconsin Islands Wilderness Character Monitoring Summary.US Fish and Wildlife Service, Midwest Region, Minneapolis, MN

Glaser, L.C.,I.K. Barker, D.V.C Weseloh, J. Ludwig, R.M. Windingstad, D. W. Key, and T.K. Bollinger. 1999. The 1992 epizootic of Newcastle disease in Double-crested cormorants in North America: Journal of Wildlife Diseases. 35:319-330.

Great Lakes Integrated Science and Assessment, 2014, *Fact Sheet – Climate Change in the Great Lakes Region,* Accessed online December 15, 2015 http://glisa.umich.edu/media/files/GLISA_climate_change_summary.pdf

Gregg, R.M., K.M. Feifel, J.M. Kershner, and J.L. Hitt. 2012. The State of Climate Change Adaptation in the Great Lakes Region. EcoAdapt, Bainbridge Island, WA.

Hagenow, Kari, Mike Grimm, Sadie O'Dell, & Steve Lenz. 2013. Door Peninsula Green Bay Watershed Project Report. The Nature Conservancy. 27 pp.

Hanson, H. P., Hanson, C. S., & Yoo, B. H. 1992. Recent Great Lakes Ice Trends. Bulletin American Meteorological Society, 73:577-584.

Hothem, Roger L., Brianne E. Brussee and William E. Davis, Jr. 2010. Black-crowned Night-Heron (Nycticorax nycticorax), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online:http://bna.birds.cornell.edu/bna/species/074

Haseltine, S.D.,G.H. Heinz, W.L. Reichel, and J.F. Moore. 1981. Organochlorine and metal residues in eggs of waterfowl nesting on islands in Lake Michigan off Door County, Wisconsin, 1977-1978. Pestic. Monit. J. 15(2):90-97.

Heinz, G.H., S.D. Haseltine, W.L. Reichel, and Hensler. 1983. Relationship of environmental contaminants to reproductive success in red-breasted mergansers *Mergus serrator* from Lake Michigan. Environ. Polutt. (Ser.A) 32:211-232.

Hothem, Roger L., Brianne E. Brussee and William E. Davis, Jr. 2010. Black-crowned Night-Heron (Nycticorax nycticorax), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/074

Huntoon, J.R. 1977. Preliminary environmental report for proposed acquisition, development and management of Grand Traverse Islands State Park, Door County, Wisconsin. Unpublished report prepared by Bureau of Environmental Impact, Wisconsin Department of Natural Resources

International Joint Commission (IJC). 2013. International Joint Commission's Advice to Governments on the Recommendations of the International Upper Great Lakes Study. Accessed online December 17, 2015 at http://ijc.org/iuglsreport/wp-content/uploads/2013/04/IUGLS-IJC-Report-Feb-12-2013-15-April-20132.pdf

Janowiak, M.K., et al. 2014. Forest ecosystem vulnerability assessment and synthesis for northern Wisconsin and western Upper Michigan: a report from the Northwoods Climate Change Response Framework. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. GTR-NRS-136. 247p. www.nrs.fs.fed.us/pubs/46393.

Judziewicz, Emmet J. 2001. Flora and Vegetation of the Grand Traverse Islands (Lake Michigan), Wisconsin and Michigan. The Michigan Botanist. Vol. 40. Pg. 81-208.

Judziewicz, E.J., Fewless, G., Grimm, M. 2016. Vascular Plants of St.Martin Island, Delta County, Michigan. The Michigan Botanist. Vol. 55. Pg. 18-53.

Kling, G.W., K. Hayhoe, L.B. Johnson, J.J. Magnuson, S. Polasky, S.K. Robinson, B.J. Shuter, M.M. Wander, D.J. Wuebbles, D.R. Zak, R.L. Lindroth, S.C. Moser, and M.L. Wilson. 2003. Confronting Climate Change in the Great Lakes Region: Impacts on our Communities and Ecosystems. Union of Concerned Scientists, Cambridge, Massachusetts, and Ecological Society of America, Washington, D.C.

Klug, Fritz. 2013. Here's why St. Martin Island in the Upper Peninsula just sold for $1.5 million. MLive. Accessed online December 16, 2015 at http://www.mlive.com/news/index.ssf/2013/11/nature_conservancy_buys_majori.html

Kreitinger, Kim, Y. Steele, and A. Paulios. 2013. The Wisconsin All-bird Conservation Plan, Version 2.0. Wisconsin Bird Conservation Initiative. Wisconsin Department of Natural Resources. Madison, WI.

Landres, Peter; Barns, Chris; Dennis, John G.; Devine, Tim; Geissler, Paul; McCasland, Curtis S.; Merigliano, Linda; Seastrand, Justin; Swain, Ralph. 2008. Keeping it wild: an interagency strategy to monitor trends in wilderness character across the National Wilderness Preservation System. Gen. Tech. Rep. RMRS-GTR-212. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 77 p.

Landres, Peter; Barns, Chris; Boutcher, Steve; Devine, Tim; Dratch, Peter; Lindholm, Adrienne; Merigliano, Linda; Roeper, Nancy; Simpson, Emily. 2015. Keeping it wild 2: an updated interagency strategy to monitor trends in wilderness character across the National Wilderness Preservation System. Gen. Tech. Rep. RMRS-GTR-340. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 114 p.

Lark, T.J., Salmon, J.M., and H.K. Gibbs. 2015. Cropland expansion outpaces agricultural and biofuel policies in the United States. Environmental Research Letters. 10 (2015) 044003. doi:10.1088/1748-9326/10/4/044003. 11 pp.

Larson, J, Karasov, W., Sileo, L., Stromborg, S., Hanbridge, B., Giesy, J., Jones, P., Tillitt, D., Verbrugge, D. 1996. Reproductive success, development anomalies, and environmental contaminants in double-crested cormorants (*Phalacrocorax auritus*). Environmental Toxicology and Chemistry, 15: 553-559.

Lesmeister Damon B. Blomquist, Sean M.; Lonsdorf, Eric V.; Wood, Daniel; Williams, Perry J.; Pendley, Brad; Mangan, Karen E.; Walker, Benjamin A. 2015. Forest invasive adaptive management on national wildlife refuge lands in the central hardwood region. Proceedings of the 19th Central Hardwood Forest Conference. Pp. 22-35.

Ludwig, J.P. 2013. The dismal state of the Great Lakes. Xlibris, USA.

Michigan Department of Natural Resources (MDNR). August 2005. Double-crested Cormorants in Michigan: A review of history, status, and issues related to their increased population. Report No.2. Accessed online at https://www.michigan.gov/documents/Cormorant_Report_136470_7.pdf

Michigan Department of natural Resources (MDNR). 2015. State of Michigan Wildlife Action Plan. Available online at http://www.michigan.gov/dnr/0,4570,7-350-79136_79608_83053---,00.html

Mills, E.L.,J.H.Leach, J.T. Carlton and C.L. Secor.1993. Exotic Species in the Great Lakes: a history of biotic crises and anthropogenic introductions. Journal of Great Lakes research 19(1):1-54.

National Assessment Synthesis Team (NAST). 2000. Climate Change Impacts on the United States:The Potential Consequences of Climate Variability and Change, US Global Change Research Program, Washington DC. Accessed online December 17, 2015 at http://data.globalchange.gov/assets/9a/aa/ec5b4bb3b895bc8369be2ddac377/nca-2000-report-overview.pdf

National Audubon Society. 2015. Audubon's Birds and Climate Change Report: A Primer for Practitioners. National Audubon Society, New York. Contributors: Gary Langham, Justin Schuetz, Candan Soykan, Chad Wilsey, Tom Auer, Geoff LeBaron, Connie Sanchez, Trish Distler. Version 1.3.

National Invasive Species Council (NISC). 2003. General Guidelines for the Establishment & Evaluation of Invasive Species Early Detection & Rapid Response Systems. Version 1. Department of the Interior. Accessed online at: http://www.invasivespecies.gov/global/EDRR/EDRR_documents/Guidelines%20for%20Early%20Detection%20&%20Rapid%20Response.pdf

Natureserve. 2013. National Vegetation Classification Standard (NVCS) Accessed at: http://www.natureserve.org/conservation-tools/projects/us-national-vegetation-classification

Northern Institute of Applied Climate Science. 2015. Climate Change Projections for Individual Tree Species, Landscape: Southern Wisconsin. United States Department of Agriculture Forest Service.

O'Dell, S. 2012. Wisconsin Islands Wilderness: A Report on Wilderness Character Monitoring. US Fish and Wildlife Service, Midwest Region, Minneapolis, MN

Outdoor News. 2009. MI DNR: Internet speculation of St. Martin deer case overblown. December 18, 2009. Article online at http://www.outdoornews.com/2009/12/18/mi-dnr-internet-speculation-on-st-martin-deer-case-overblown/

Paveglio, F.L. and J.D. Taylor. 2010. Identifying refuge resources of concern and management priorities: a handbook. Department of Interior, U.S. Fish and Wildlife Service, Washington, DC. 60 pp.

Petrie, S.A. and C.M. Francis. 2003. Rapid increase in the lower Great Lakes population of feral Mute Swans: a review and recommendation. Wildlfie Society Bulletin 31:407-416.

Pierce, R.L., B.M. Kahler, and G.J. Soulliere. 2014. State x BCR Assessment: Wisconsin 12 – Boreal Hardwood Transition. Upper Mississippi River and Great Lakes Region Joint Venture, U.S. Fish and Wildlife Service, Bloomington MN, USA.

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

Potter, B. A., G. J. Soulliere, D. N. Ewert, M. G. Knutson, W. E. Thogmartin, J. S. Castrale, and M. J. Roell. 2007. Upper Mississippi River and Great Lakes Region Joint Venture Landbird Habitat Conservation Strategy. U.S. Fish and Wildlife Service, Fort Snelling, MN. 124pp.

Powers, N., M. Brouder, S. Blomquist, B. Potter, J. Dingledine, C. Deloria, G. Soulliere, T. Kerr, K. Steiger-Meister. 2014. Selecting surrogate species for Strategic Habitat Conservation in the Upper Midwest Great Lakes geography. Bloomington, MN.

Prince, K, Chipault, JG, White CL, Zuckerberg B. 2018. Environmental conditions synchronize waterbird mortality events in the Great Lakes. J Appl Ecol. 2018; 00:11-12.

Pritzl, Jeff and Paul Peeters. February 2008. Cormorant Conundrum: Island habitats feel the pressure as populations of these once-endangered waterbirds grow. Wisconsin Natural Resources magazine. Accessed online at http://dnr.wi.gov/wnrmag/html/stories/2008/feb08/cormorant.htm

Pryor, S. C., D. Scavia, C. Downer, M. Gaden, L. Iverson, R. Nordstrom, J. Patz, and G. P. Robertson, 2014: Ch. 18: Midwest. *Climate Change Impacts in the United States: The Third National Climate Assessment*, J. M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe, Eds., U.S. Global Change Research Program, 418-440

Reschke, C., R. Reid, J. Jones, T. Freeney, & H. Potter. 1999. Conserving Great Lakes alvars. Final technical report of the International Alvar Conservation Initiative. The Nature Conservancy. Chicago. 230pp.

Ricciardi, A.2001. Facilitative interactions among aquatic invaders: is an “invasional meltdown” occurring in the Great Lakes? Canadian Journal of Fisheries and Aquatic Sciences 58:2513-2525.

Rosenberg,K.V., J. A. Kennedy, R. Dettmers, R. P. Ford, D. Reynolds, J.D. Alexander, C. J. Beardmore, P. J. Blancher, R. E. Bogart, G. S. Butcher, A. F. Camfield, A. Couturier, D. W. Demarest, W. E. Easton, J.J. Giocomo, R.H. Keller, A. E. Mini, A. O. Panjabi, D. N. Pashley, T. D. Rich, J. M. Ruth, H. Stabins, J. Stanton, T. Will. 2016. Partners in Flight Landbird Conservation Plan: 2016 Revision for Canada and Continental United States. Partners in Flight Science Committee. 119 pp Available at: https://www.partnersinflight.org/resources/the-plan/

Roth, A.M. 2001. Impact of forest succession on shrubland-dependent birds in aspen forests managed with traditional and alternative clear-cutting systems in northern Wisconsin. M.S. thesis. University of Wisconsin, Madison, Wisconsin. 118 pp.

Ryckman, D.P., D.V. Chip Weseloh and C.A. Bishop. 2000. Great Lakes Fact Sheet: Contaminants in Herring Gull Eggs from the Great Lakes: 25 years of Monitoring Levels and Effects. Environment Canada/Canadian Wildlife Service, Ontario Region.

Schramm, A and R. Loehman. 2010. Understanding the science of climate change: talking points - impacts to the Great Lakes. Natural Resource Report NPS/NRPC/CCRP/NRR—2010/247. National Park Service, Fort Collins, Colorado.

Schwartz, M.D., R. Ahas, and A. Aasa. 2006. Onset of spring starting earlier across the Northern Hemisphere. Global Change Biology 12:343–351.

Shuford, W. D., and D. P. Craig. 2002. Status Assessment and Conservation Recommendations for the Caspian Tern (Sterna Caspia) in North America. U.S. Department of the Interior, Fish and Wildlife Service, Portland, OR.

Smith, P.A. 2009. Deer bust on St. Martin Island. Milwaukee Journal-Sentinel, December 16, 2009

Smithsonian. 2015. Great Lakes, Mighty Rivers. National Museum of American History. Accessed online December 15, 2015 at http://americanhistory.si.edu/onthewater/exhibition/4_2.html

Soulliere, G. J., B. A. Potter, D. J. Holm, D. A. Granfors, M. J. Monfils, S. J. Lewis, and W. E. Thogmartin. 2007. Upper Mississippi River and Great Lakes Region Joint Venture Waterbird Habitat Conservation Strategy. U.S. Fish and Wildlife Service, Fort Snelling, MN. 68pp.

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.

The Nature Conservancy. 2014. Map of St. Martin Island Acquisitions. Accessed online at: http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/wisconsin/explore/st-martin-island-map.pdf

UMRGLR JV. 2007. Upper Mississippi River and Great Lakes Region Joint Venture Implementation Plan. U.S. Fish and Wildlife Service, Fort Snelling, Minnesota.

U.S. Department of Agriculture (USDA). 2009. Environmental Assessment: Reducing Double-crested Cormorant Damage in Wisconsin. Accessed online at: http://www.fws.gov/midwest/midwestbird/documents/wieafinal.pdf

USDA. 2012. Final Environmental Assessment: Mute Swan Damage Management in Michigan. Accessed online at: https://www.aphis.usda.gov/regulations/pdfs/nepa/Mute%20Swan%20EA%20Final%209-27-12.pdf

U.S. Fish and Wildlife Service (USFWS). 2004. Writing Refuge Management Goals and Objectives: A Handbook. U.S. Fish and Wildlife Service.

USFWS. 2002. Habitat Management Planning. USFWS Policy 620 FW 1. Division of Conservation Planning and Policy. Arlington, Virginia.

USFWS. 2002. Fish and wildlife resource conservation priorities Region 3. January 2002. Available at: http://nctc.fws.gov/resources/knowledge-resources/pubs3/priorities02.pdf

USFWS. 2003. Biological Integrity, Diversity, and Environmental Health. USFWS Policy 601 FW3. Division of Conservation Planning and Policy. Arlington, Virginia.

USFWS. 2004a. Migratory Bird Program Strategic Plan. Available online at http://www.fws.gov/migratorybirds/AboutUS.html

USFWS. 2004b. North American Waterfowl Management Plan. North American Waterfowl Management Plan Committee. Available online at http://www.fws.gov/birdhabitat/NAWMP/Planstrategy.shtm.

USFWS. 2007. National Bald Eagle Management Guidelines. Accessed online at: https://www.fws.gov/southdakotafieldoffice/NationalBaldEagleManagementGuidelines.pdf

USFWS. 2008. Strategic Habitat Conservation Handbook. Version 1.0. Available online at http://www.fws.gov/landscape-conservation/pdf/SHCHandbook.pdf.

USFWS. 2008. Birds of Conservation Concern. Available online at: http://www.fws.gov/migratorybirds/NewReportsPublications/SpecialTopics/BCC2008/BCC2008.pdf

USFWS. 2008. Birds of Conservation Concern 2008. U.S. Fish and Wildlife Service, Division of Migratory Bird Management: Arlington, Virginia, 87.

USFWS. April 20, 2009. Environmental Assessment: Reducing Double-crested Cormorant Damage in Wisconsin. Accessed online at http://www.fws.gov/midwest/MidwestBird/documents/WIeaFinal.pdf

USFWS. 2011. Dwarf lake iris (*Iris lacustris*) Recovery Plan. Bloomington, Minnesota. vii + 61 pp.

USFWS. 2012. Gravel Island, Green Bay, Harbor Island, Huron and Michigan Islands National Wildlife Refuges Comprehensive Conservation Plan. U.S. Fish and Wildlife Service.

USFWS. 2012a. Migratory Bird Program Focal Species Strategy. Available online at http://www.fws.gov/migratorybirds/CurrentBirdIssues/Management/FocalSpecies.html

USFWS. 2012b. DRAFT Guidance on Selecting Species for Design of Landscape-Scale Conservation. Available online at http://www.fws.gov/landscape-conservation/pdf/DraftTechnicalGuidanceJuly2012.pdf

USFWS. 2012. DRAFT Guidance on Selecting Species for Design of Landscape-Scale Conservation. Available online at http://www.fws.gov/landscape-conservation/pdf/DraftTechnicalGuidanceJuly2012.pdf.

USFWS. 2013. Gravel Island, Green Bay, Harbor Island, Huron, and Michigan Islands National Wildlife Refuges Comprehensive Conservation Plan. U.S. Fish and Wildlife Service.

USFWS. 2013. U.S. Fish and Wildlife Service Manual. Available online at http://www.fws.gov/policy/manuals/.

USFWS. 2014. U.S. Fish and Wildlife Service Draft Inventory and Monitoring Policy. Available online at http://www.fws.gov/policy/701fw2.html.

USFWS. 2014. Selecting surrogate species for Strategic Habitat Conservation in the Upper Midwest Great Lakes geography. Bloomington, MN: Powers, N., Brouder, M., Blomquist, S., Potter, B., Dingledine, J., Deloria, C., Soulliere, G., Kerr, T., Steiger-Meister, K.

USFWS. 2014. Selecting surrogate species for Strategic Habitat Conservation in the Upper Midwest Great Lakes geography. Bloomington, MN: Powers, N., Brouder, M., Blomquist, S., Potter, B., Dingledine, J., Deloria, C., Soulliere, G., Kerr, T., Steiger-Meister, K.

USFWS. 2015. Protection Grows for Lake Michigan's 'Stepping Stones'. USFWS Newsroom. September 23, 2015. Accessed online at http://www.fws.gov/midwest/news/805.html

USFWS. 2017. Region 3 Coastal Program- Great Lakes Strategic Work Plan 2017-2021. Accessed online at https://www.fws.gov/midwest/es/coastal/index.html

USFWS. 2017. Environmental Assessment for Issuing Depredation Permits for Double-crested Cormorant Management. Division of Migratory Birds. Accessed online at https://www.fws.gov/migratorybirds/pdf/management/double-crested-cormorants/CormorantEA.pdf

Warren, Joseph. 2015. Wisconsin's Newest Island Destination. Wisconsin Natural Resources Magazine. April 2015. Accessed online at http://dnr.wi.gov/wnrmag/2015/04/island.htm

Weseloh, D.V. and B. Collier. 1995. The rise of the Double-crested cormorant on the Great Lakes: winning the war against contaminants. Great Lakes Fact Sheet. Canadian Wildlife Service, Environment Canada and Long Point Observatory, http://publications.gc.ca/collections/Collection/En40-222-2-1995E.pdf

Wieferich, J.B. 2013. "*Beech Bark Diseases in Michigan: Distribution, Impacts, and Dynamics"* Master's Thesis, Michigan State University, Accessed online at https://www.fws.gov/uploadedFiles/ThesisWieferich.pdf

Wilderness.net. Wisconsin Islands Wilderness. Accessed December 14, 2015 online at http://www.wilderness.net/NWPS/wildView?WID=654

Williams, B.K., R.C. Szaro, and C.D. Shapiro. 2009. Adaptive Management: The U.S. Department of the Interior Technical Guide. Adaptive Management Working Group, U.S. Department of the Interior, Washington, DC.

Windels, Steve K. and David J. Flaspohler. 2013. Scale-Dependent Browsing Patterns on Canada Yew (Taxus canadensis) by White-Tailed Deer (Odocoileus virginianus). International Journal of Forestry Research, vol. 2013, Article ID 276583, 11 pages, 2013.

Windels, Steve K. and David J. Flaspohler. 2014. Considerations for Conservation and Restoration of Canada Yew in Protected Areas. Natural Areas Journal. 34(2). Pp. 249-253.

Wires, L.R., S. J. Lewis, G. J. Soulliere, S. W. Matteson, D. V. "Chip" Weseloh, R. P. Russell, and F. J. Cuthbert. 2010. Upper Mississippi Valley / Great Lakes Waterbird Conservation Plan. A plan associated with the Waterbird Conservation for the Americas Initiative. Final Report submitted to the U. S. Fish and Wildlife Service, Fort Snelling, MN

Wisconsin Department of Natural Resources (WDNR). 1978. Environmental Impact Statement for Proposed Acquisition, Development and Management of Grand Traverse Islands State Park. Bureau of Environmental Impact. Accessed online at: http://www.grandtraverseislands.com/uploads/9/0/6/2/9062041/1978_grand_traverse_islands_state_park_study.pdf

WDNR. 2005. Wisconsin's Strategy for Wildlife Species of Greatest Conservation Need. Madison, WI. Available online at http://dnr.wi.gov/files/PDF/pubs/er/ER0641.pdf

WDNR. 2014. The ecological landscapes of Wisconsin: an assessment of ecological resources and a guide to planning sustainable management. Chapter 15, Northern Lake Michigan Coastal Ecological Landscape. 100 pp. Wisconsin Department of Natural Resources, PUB-SS-1131Q 2014, Madison.

WDNR. 2015. Overwinter Population Density 2014. Accessed online December 17, 2015 at http://dnr.wi.gov/topic/hunt/documents/winterpoppertotal.pdf

WDNR. 1998. Wisconsin's Deer Management Program. The Issues Involved in Decision Making. Second Edition. Accessed online at: http://dnr.wi.gov/topic/wildlifehabitat/documents/deerbook.pdf

WDNR. 2014. The ecological landscapes of Wisconsin: an assessment of ecological resources and a guide to planning sustainable management. Chapter 15, Northern Lake Michigan Coastal Ecological Landscape. 100 pp. Wisconsin Department of Natural Resources, PUB-SS-1131Q 2014, Madison.

WDNR. 2015. Wisconsin Wildlife Action Plan: Draft 2015 – 2025 Revisions. Available online at https://dnr.wi.gov/topic/wildlifehabitat/actionplan.html

Wisconsin Initiative on Climate Change Impacts (WICCI). 2011. Wisconsin's changing climate: impacts and adaptation. 217p. Available online: http://www.wicci.wisc.edu/report/2011_WICCI-Report.pdf

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APPENDIX A - GREEN BAY AND GRAVEL ISLANDS NWRS HABITAT MANAGEMENT PLANNING TEAM

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Green Bay and Gravel Islands NWRs
Habitat Management Plan
Planning Team

Contracted

Dan Salas
Senior Ecologist, ESA/Senior Consultant
Cardno

Will Taylor
Assistant Staff Scientist
Cardno

Fish and Wildlife Service

Steve Lenz
Wildlife Refuge Manager
Horicon NWR Complex

Sadie O'Dell
Wildlife Biologist
Horicon NWR Complex

Jon Krapfl
Biological Technician
Horicon NWR Complex

Dave Bolin
Supervisory Wildlife Refuge Specialist
Horicon NWR Complex

Dustan Hoffman
Wildlife Refuge Specialist
Horicon NWR Complex

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APPENDIX B - ROCSTAR COMPREHENSIVE SPECIES TABLES

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GL Islands NWR http://www.fws.gov/midwest/pl						Habitat				Range Sources						CANADA				BCR Region		FWS			PIF		UMRGLR JV BIRD PLANS					Bird	Fish	Herp	Lepid		
Common Name	*Scientific Name*	Vertebrate/Invertebrate/ plant	Taxa Group	Family	Group/Order	Broad Habitat	GL Bird Habitat, CCP 2013 Appendix D	Harvested Species	NWR CCP Documented Species	Species Documented in Range	GB NWR Spp of Management	PROC Y, N, Maybe?	Fed T&E 2013	MI State T &E, 2013	WI State T&E, 2011	CANADA COSEWIC, 2012	CANADA SARA, 2010	MI SWAP, 2006	WI SWAP, 2011	BCR 12 BCC	BCR 23 BCC	FWS R3 BCC 2012	FWS FY2012- FY2016 Focal Species	Reg. Conserv. Prior. List GRL, 2002	PIF 16 Upper Great Lakes Plain, 2001	PIF 20, Boreal Hardwood Trans, BCR 12, 2009	UMRGLR JV All Bird Implementation Plan,	UMRGLR JV Priority Spp Landbird 2007	UMRGLR JV/BCR 12, 23 Priority Spp	UMRGLR JV/BCR 12, 23 Priority Spp	UMRGLR JV/BCR 12, 23 Priority Spp	ABC Watchlist 2007	Great Lakes Fish (interjurisdictional)	PARC	Xerces	Total Number of Plans	Ratio of Plan Inclusion
Henslow's Sparrow	*Ammodramus henslowii*	Vert	Bird	Emberizidae	Landbird	Gra				X, MI (UP &				E	T	E	E	X	X	X	X	X (f)	f	GRL	X (I)	X (rc) M	X(f)	X (f)				Red				16	0.94
Snuffbox	*Epioblasma triquetra*	Invert	Mollusca		Mussel	Riv				X, MI (UP &			E	E	E	E	E	X	X																7	0.88
Salamander mussel	*Simpsonaias ambigua*	Invert	Mollusca		Mussel	Riv				X, MI (wUP)				E	T	E	E	X	X					GRL												7	0.88
Shortjaw cisco	*Coregonus zenithicus*	Vert	Fish	Salmonidae				X	LH,LM,LS	X				T	SC	T	T	X	X														X			7	0.78
Queensnake	*Regina septemvittata*	Vert	Herp	Snake	Reptile	Rip, Riv				X, MI (wUP)				SC	E	E	E	X	X															D		7	0.78
Eastern Massasauga	*Sistrurus catenatus cate*	Vert	Herp	Snake	Reptile	For, Pal				X, MI (UP &			C	SC	E			X	X					GRL										A		7	0.78
Persius Duskywing	*Erynnis persius*	Invert	Insect	Hesperiidae	Lepidopte	Bar, Gra, Sav				X, MI (UP &				T	SC	E	E	X	X																I	7	0.78
Powesheik Skipperling	*Oarisma powesheik*	Invert	Insect	Hesperiidae	Lepidopte	Gra, Sav				X, MI (wUP)			PE	T	E			X	X					GRL											I	7	0.78
Karner Blue	*Lycaeides melissa samue*	Invert	Insect	Lycaenidae	Lepidopte	Bar, Gra, Sav				X, MI (UP &			E	T	SC			X	X					GRL											CI	7	0.78
Cerulean Warbler	*Setophaga cerulea*	Vert	Bird	Parulidae	Landbird	For				X, MI (UP &				T	T	E	SC	X	X			X	f	GRL	X (I)		X(f)	X (f)				Yellow				13	0.76
Kirtland's Warbler	*Setophaga kirtlandii*	Vert	Bird	Parulidae	Landbird	Shr				X, MI (UP &			E	E	SC	E	E	X	X			E		GRL		X (rc, rs)	X(f)	X (f)				Red				13	0.76
King Rail	*Rallus elegans*	Vert	Bird	Rallidae	Waterbird	Pal				X, MI (UP &				E	SC	E	E	X	X			X (f)	f	GRL	X		X(f)			B		Yello				13	0.76
Gray wolf	*Canis lupus*	Vert	Mamma	Canidae	Carnivora			X		X, WI & MI			E	SC	SC			X	X					GRL												6	0.75
Rainbow	*Villosa iris*	Invert	Mollusca		Mussel	Riv				X, MI (UP &				SC	E	E	E	X	X																	6	0.75
Prothonotary Warbler	*Prothonotary citrea*	Vert	Bird	Parulidae	Landbird	For, Rip				X, MI (UP &				SC	SC	E	E	X	X			X		GRL	X (I)		X(f)	X (f)				Yellow				12	0.71
Piping Plover (Great Lakes pop.)	*Charadrius melodus*	Vert	Bird	Charadriidae	Shorebird	Bar				X, MI (UP &	X		E	E	E	E	E	X	X			E		GRL	X (I)		X(f)		M/B							12	0.71
Upland Sandpiper	*Bartramia longicauda*	Vert	Bird	Scolopacidae	Shorebird	Pal				X	X				SC			X	X	X	X	X	f	GRL	X (I)		X(f)	X (f)	M/b							12	0.71
Black Tern	*Chlidonias niger*	Vert	Bird	Laridae	Waterbird	Lac, Pal, Riv				X, MI (UP &				SC	SC			X	X	X	X	X	f	GRL	X (IIC)		X(f)			B						12	0.71
Yellow Rail	*Coturnicops noveboracer*	Vert	Bird	Rallidae	Waterbird	Pal				X, MI (UP &				T	T			X	X	X	X	X	f	GRL			X(f)			B/m		Red				12	0.71
Lake sturgeon	*Acipenser fulvescens*	Vert	Fish	Acipenseridae		Riv, Lac			LH,LM,LS	X				T	SC			X	X					GRL									X			6	0.67
Pugnose Shiner	*Notropis anogenus*	Vert	Fish	Cyprinidae		Riv, Lac				X, MI (UP &				E	T	E	E	X	X																	6	0.67
Ottoe Skipper	*Hesperia ottoe*	Invert	Insect	Hesperiidae	Lepidopte	Gra, Sav				X, MI (UP &				T	SC			X	X					GRL											V	6	0.67
Hine's emerald dragonfly	*Somatochlora hineana*	Invert	Insect	Corduliidae	Odonata	Aqu, Pal				X, WI & MI			E	E	E			X	X					GRL												6	0.67
Golden-winged warbler	*Vermivora chrysoptera*	Vert	Bird	Parulidae	Landbird	Shr	MF/FE		PI	X	X							X		X	X	X (f)	f	GRL	X (I)	X (rc)	X(f)	X (f)				Red				11	0.65
Common Tern	*Sterna hirundo*	Vert	Bird	Laridae	Waterbird	Bar, Lac, Riv	OW/RS		GLI	X	*X*			T	E			X	X	X	X	X	akes p	GRL			X (f)			B/m						11	0.65
Slippershell	*Alasmidonta viridis*	Invert	Mollusca		Mussel	Riv				X, WI & MI				T	T			X	X					GRL												5	0.63
Northern riffleshell	*Epioblasma torulosa ran*	Invert	Mollusca		Mussel	Riv				X, MI (wUP)			E	E		E	E	X						GRL												5	0.63
Rayed Bean	*Villosa fabalis*	Invert	Mollusca		Mussel	Riv				X, MI (wUP)			E	E		E	E	X																		5	0.63
Mystery Vertigo	*Vertigo paradoxa*	Invert	Mollusca		Snail	Bar, For, Gra, Pal				X, WI & MI				SC	SC			X	X					GRL												5	0.63
Peregrine Falcon	*Falco peregrinus*	Vert	Bird	Falconidae	Landbird	Rip				X, MI (UP &	X			E	E		SC	X	X	X (d)	X (d)	X		GRL	X											10	0.59
Canada Warbler	*Cardellina canadensis*	Vert	Bird	Parulidae	Landbird	For, Shr	MF (m)		GLI	X								X		X	X	X		GRL	X	(rc, rs)	X(f)	X (f)				Yellow				10	0.59
Red-headed Woodpecker	*Melanerpes erythrocepl*	Vert	Bird	Picidae	Landbird	For, Gra, Sav	MF		GLI	X								X		X	X	X		GRL	X (I)	X (rc) M	X(f)	X (f)				Yellow				10	0.59
Short-eared Owl	*Asio flammeus*	Vert	Bird	Strigidae	Landbird	Gra				X, MI (UP &				E	SC			X	X		X (nb)	X		GRL	X (IIC)			X	X							10	0.59
Wood Thrush	*Hylocichla mustelina*	Vert	Bird	Turdidae	Landbird	For				X								X		X		X	f	GRL	X (IIC)	X (rc)	X(f)	X (f)				Yellow				10	0.59
Olive-sided Flycatcher	*Contopus cooperi*	Vert	Bird	Tyrannidae	Landbird	For				X					SC			X	X	X		X		GRL		X (rc) M	X(f)	X (f)				Yellow				10	0.59
Red Knot (rufa ssp.)	*Calidris canutus rufa*	Vert	Bird	Scolopacidae	Shorebird	Pal			GI	X			PT			E	E		X (nb,	(nb,	X	f				X		m, 3			Yellow				10	0.59
American Bittern	*Botaurus lentiginosus*	Vert	Bird	Ardeidae	Waterbird	Pal				X, MI (UP &				SC	SC			X	X	X	X	X		GRL			X			B						10	0.59
Black Buffalo	*Ictiobus niger*	Vert	Fish	Catostomidae		Riv, Aqu									T	dd	SC	X	X																	5	0.56
Lake Chubsucker	*Erimyzon sucetta*	Vert	Fish	Catostomidae		Riv, Aqu									SC	E	E	X	X																	5	0.56
North American Racer	*Coluber constrictor*	Vert	Herp	Snake	Reptile	Gra, Pal, Sav, Shr									SC	E	E	X	X																	5	0.56
Copperbelly Watersnake	*Nerodia erythrogaster n*	Vert	Herp	Snake	Reptile	Aqu, Gra, Sav, Pal, Rip				X, MI (wUP)			T	E				X						GRL										A		5	0.56
Eastern Fox snake	*Pantherophis gloydi*	Vert	Herp	Snake	Reptile	Gra, Lac, Pal				X, MI (UP &				T		E	E	X																A		5	0.56
Gray Ratsnake	*Pantherophis spiloides*	Vert	Herp	Snake	Reptile	Gra, For, Rip				X, MI (UP &				SC	SC	E	E		X																	5	0.56
Butler's Gartersnake	*Thamnophis butleri*	Vert	Herp	Snake	Reptile	Gra									T	E	T		X																C		5	0.56
Spotted Turtle	*Clemmys guttata*	Vert	Herp	Turtle	Reptile	Lac, Pal				X, MI (UP &				T		E	E	X																B		5	0.56
Blanding's Turtle	*Emydoidea blandingii*	Vert	Herp	Turtle	Reptile	Pal, Rip				X, WI & MI				SC	T			X	X															A		5	0.56
Wood Turtle	*Glyptemys insculpta*	Vert	Herp	Turtle	Reptile	For, Riv				X, WI & MI				SC	T			X	X															B		5	0.56
Regal fritillary	*Speyeria idalia*	Invert	Insect	Nymphalidae	Lepidopte	Gra, Sav				X, MI (UP &				E	E			X	X																V	5	0.56
Mitchell's satyr butterfly	*Neonympha mitchellii m*	Invert	Insect	Nymphalidae	Lepidopte	Gra				X, MI (wUP)			E	E				X						GRL											CI	5	0.56
Bald Eagle	*Haliaeetus leucocephalu*	Vert	Bird	Accipitridae	Landbird	For, Rip	OW/RS		PI	X	X			SC	SC			X	X	X (d)	X (d)	X (f)	f	GRL												9	0.53

Loggerhead Shrike	*Lanius ludovicianus*	Vert	Bird	Laniidae	Landbird	Gra, Shr				X, MI (UP &				E	E	E	E	X	X			X		GRL	X													9	0.53
Kentucky Warbler	*Geothlypis formosus*	Vert	Bird	Parulidae	Landbird	For				X			E		T			X	X			X			X (I)		X(f)	X (f)				Red/Y						9	0.53
Louisiana Waterthrush	*Parkesia motacilla*	Vert	Bird	Parulidae	Landbird	For, Rip				X, MI (UP &				T	SC			X	X			X		GRL	X (IIC)		(f, h)	X (f)										9	0.53
Piping Plover (Great Plains pop.)	*Charadrius melodus*	Vert	Bird	Charadriidae	Shorebird	Bar							T	E	E	E	E	X	X			E		GRL														9	0.53
Canada Lynx	*Lynx canadensis*	Vert	Mamma	Felidae	Carnivora					X, MI (all UP)			T	E				X						GRL														4	0.50
Northern Long-eared Bat	*Myotis septentrionalis*	Vert	Mamma	Vespertilionid	Chiroptera					X, WI			PE		T			X	X																			4	0.50
Indiana Bat	*Myotis sodalis*	Vert	Mamma	Vespertilionid	Chiroptera					X, MI (UP &			E	E				X						GRL														4	0.50
Prairie Vole	*Microtus ochrogaster*	Vert	Mamma	Muridae	Rodentia					X, MI (wUP)				E	SC			X	X																			4	0.50
Woodland Vole / Pine Vole	*Microtus pinetorum*	Vert	Mamma	Muridae	Rodentia					X, MI (UP &				SC	SC			X	X																			4	0.50
Northern flying squirrel	*Glaucomys sabrinus*	Vert	Mamma	Sciuridae	Rodentia					X, WI & MI				SC	SC			X	X																			4	0.50
Elktoe	*Alasmidonta marginata*	Invert	Mollusca		Mussel	Riv				X, WI & MI				SC	SC			X						GRL														4	0.50
Purple Wartyback	*Cyclonaias tuberculata*	Invert	Mollusca		Mussel	Riv				X, WI & MI				T	E			X	X																			4	0.50
White cat's paw pearlymussel	*Epioblasma obliquata pe*	Invert	Mollusca		Mussel	Riv				X, MI (wUP)			E	E				X						GRL														4	0.50
Eastern pondmussel	*Ligumia nasuta*	Invert	Mollusca		Mussel	Lac, Riv				X, MI (UP &				E		E	E	X																				4	0.50
Round Hickorynut	*Obovaria subrotunda*	Invert	Mollusca		Mussel	Riv				X, MI (wUP)				E		E	E	X																				4	0.50
Round pigtoe	*Pleurobema sintoxia*	Invert	Mollusca		Mussel	Riv				X, MI (UP &				SC		E	E	X																				4	0.50
Kidneyshell	*Ptychobranchus fasciola*	Invert	Mollusca		Mussel	Riv				X, MI (UP &				SC		E	E	X																				4	0.50
Fawnsfoot	*Truncilla donaciformis*	Invert	Mollusca		Mussel	Riv				X, MI (wUP)				T	SC			X	X																			4	0.50
Ellipse	*Venustaconcha ellipsifor*	Invert	Mollusca		Mussel	Riv				X, MI (UP &				SC	T			X	X																			4	0.50
Sterki's granule	*Guppya sterkii*	Invert	Mollusca		Snail	Bar, For, Gra				X, WI & MI				E	SC			X	X																			4	0.50
Cherrystone Drop	*Hendersonia occulta*	Invert	Mollusca		Snail	Bar, For, Gra				X, WI & MI				T	T			X	X																			4	0.50
Eastern flat-whorl	*Planogyra asteriscus*	Invert	Mollusca		Snail	For, Pal, Shr				X, WI & MI				SC	SC			X	X																			4	0.50
Midwest Pleistocene Vertigo	*Vertigo hubrichti*	Invert	Mollusca		Snail	Bar				X, MI (all UP)				E	E			X	X																			4	0.50
Six-whorl Vertigo	*Vertigo morsei*	Invert	Mollusca		Snail	Pal				X, WI & MI				E	SC			X	X																			4	0.50
Deep-throat vertigo	*Vertigo nylanderi*	Invert	Mollusca		Snail	Bar, Pal				X, WI & MI				E	SC			X	X																			4	0.50
Dickcissel	*Spiza americana*	Vert	Bird	Cardinalidae	Landbird	Gra				X, MI (UP &				SC				X			X	X		GRL	X (I)		X	X										8	0.47
Rusty Blackbird	*Euphagus carolinus*	Vert	Bird	Icteridae	Landbird	Pal, Rip				X										X	X (nb)	X	f			X (rc) M	X	X				Yellow						8	0.47
Blue-winged Warbler	*Vermivora cyanoptera*	Vert	Bird	Parulidae	Landbird	For, Shr				X								X			X	X		GRL	X (I)		X(f)	X (f)				Yellow						8	0.47
Acadian Flycatcher	*Empidonax virescens*	Vert	Bird	Tyrannidae	Landbird	For, Rip									T	E	E	X	X			X		GRL	X (I)													8	0.47
Bell's Vireo	*Vireo bellii*	Vert	Bird	Vireonidae	Landbird	Dev, For, Gra									T				X			X		GRL	X (I)		X	X				Red						8	0.47
Marbled Godwit	*Limosa fedoa*	Vert	Bird	Scolopacidae	Shorebird	Pal														X (nb)	X (nb)	X (f)	f	GRL			X		m, 3			Yellow						8	0.47
Hudsonian Godwit	*Limosa haemastica*	Vert	Bird	Scolopacidae	Shorebird	Gra, Pal														X (nb)	X (nb)	X	f	GRL			X		M, 4									8	0.47
Wilson's Phalarope	*Phalaropus tricolor*	Vert	Bird	Scolopacidae	Shorebird	Pal				X, MI (all UP)				SC	SC			X	X					GRL	X (I)		X(f)		M/b									8	0.47
Buff-breasted Sandpiper	*Tryngites subruficollis*	Vert	Bird	Scolopacidae	Shorebird	Pal														X (nb)	X (nb)	X	f	GRL			X		m, 4			Red						8	0.47
Trumpeter Swan	*Cygnus buccinator*	Vert	Bird	Anatidae	Waterfowl	Lac, Pal, Riv				X, MI (UP &				T	SC			X	X					GRL	X (I)						B/n	Yello						8	0.47
River redhorse	*Moxostoma carinatum*	Vert	Fish	Catostomidae		Riv, Aqu				X, MI (UP &				T	T			X	X																			4	0.44
Redside Dace	*Clinostomus elongatus*	Vert	Fish	Cyprinidae		Riv, Aqu				X, MI (wUP)				E		E	SC	X																				4	0.44
Silver shiner	*Notropis photogenis*	Vert	Fish	Cyprinidae						X, MI (wUP)				E		T	SC	X																				4	0.44
Starhead Topminnow	*Fundulus dispar*	Vert	Fish	Fundulidae		Riv, Lac, Aqu				X, MI (wUP)				SC	E			X	X																			4	0.44
Northern madtom	*Noturus stigmosus*	Vert	Fish	Ictaluridae						X, MI (wUP)				E		E	E	X																				4	0.44
Kiyi	*Coregonus kiyi*	Vert	Fish	Salmonidae				X	LM,LS	X				SC			SC	X																X					4	0.44
Blanchard's Cricket Frog	*Acris blanchardi*	Vert	Herp	Frog	Amphibian	Aqu, Pal				X, MI (UP &				T		E	E	X																				4	0.44
Smallmouth salamander	*Ambystoma texanum*	Vert	Herp	Salamandar	Amphibian	For, Rip				X, MI (wUP)				E		E	E	X																				4	0.44
Four-toed Salamander	*Hemidactylium scutatum*	Vert	Herp	Salamandar	Amphibian	For, Gra, Pal				X, WI					SC			X	X																		B		4	0.44
Six-lined Racerunner	*Aspidoscelis sexlineata*	Vert	Herp	Lizard	Reptile	Bar, Gra				X, MI (wUP)				T	SC			X	X																			4	0.44
Northern Barrens Tiger Beetle	*Cicindela patruela*	Invert	Insect		Coleopter	Bar				X, WI					SC	E	E		X																			4	0.44
Rusty-patched bumble bee	*Bombus affinis*	Invert	Insect		Hymenopt					X, MI (wUP)				SC	SC	E	E																					4	0.44
Early Hairstreak	*Erora laeta*	Invert	Insect	Lycaenidae	Lepidopte					X, MI (UP &				SC	SC			X																			V	4	0.44
Northern Blue	*Lycaeides idas nabokovi*	Invert	Insect	Lycaenidae	Lepidopte	Bar, Gra, Sav				X, WI & MI				T	E			X	X																			4	0.44
Aweme borer	*Papaipema aweme*	Invert	Insect	Noctuidae	Lepidopte	Bar, Pal				X, MI (UP &				SC		E	E	X																				4	0.44
Blazing Star Stem Borer	*Papaipema beeriana*	Invert	Insect	Noctuidae	Lepidopte	Gra				X, MI (UP &				SC	SC			X	X																			4	0.44
Silphium borer moth	*Papaipema silphii*	Invert	Insect	Noctuidae	Lepidopte	Gra				X, MI (wUP)				T	E			X	X																			4	0.44
Phlox Moth	*Schinia indiana*	Invert	Insect	Noctuidae	Lepidopte	Gra				X, MI (UP &				E	E			X	X																			4	0.44
Swamp metalmark	*Calephelis mutica*	Invert	Insect	Riodinidae	Lepidopte	Gra, Pal				X, WI & MI				SC	E			X	X																			4	0.44
Sprague's pygarctia	*Pygarctia spraguei*	Invert	Insect		Lepidopte	Bar, For, Gra, Sav				X, MI (UP &				SC	SC			X	X																			4	0.44
Smokey rubyspot	*Hetaerina titia*	Invert	Insect	Calopterygida	Odonata	Aqu, Pal				X, MI (wUP)				SC	SC			X	X																			4	0.44
Incurvate Emerald	*Somatochlora incurvata*	Invert	Insect	Corduliidae	Odonata	Aqu, Pal				X, MI (all UP)				SC	E			X	X																			4	0.44
Ringed boghaunter	*Williamsonia lintneri*	Invert	Insect	Corduliidae	Odonata	Aqu, Pal				X, MI (all UP)				SC	SC			X	X																			4	0.44
Rapids Clubtail	*Gomphus quadricolor*	Invert	Insect	Gomphidae	Odonata	Aqu, Pal				X, MI (UP &				SC		E	E	X																				4	0.44

Extra-striped snaketail	*Ophiogomphus anomalu*	Invert	Insect	Gomphidae	Odonata	Aqu, Riv				X, WI				SC	E			X	X																4	0.44
Pygmy snaketail	*Ophiogomphus howei*	Invert	Insect	Gomphidae	Odonata	Aqu, Pal				X, MI (wUP)				T	T			X	X																4	0.44
Red-shouldered Hawk	*Buteo lineatus*	Vert	Bird	Accipitridae	Landbird	For	MF		PI	X	X			T	T	dd	SC	X	X					GRL											7	0.41
Whip-poor-will	*Caprimulgus vociferus*	Vert	Bird	Caprimulgidae	Landbird	For, Sav												X				X		GRL	X	X (rc) M	(f, h)	X (f)							7	0.41
Bobolink	*Dolichonyx orizivorus*	Vert	Bird	Icteridae	Landbird	Gra				X								X			X	X	f	GRL	X (I)	X (rc) M									7	0.41
Yellow-breasted Chat	*Icteria virens*	Vert	Bird	Parulidae	Landbird	Shr									SC	E	SC	X							X		(f, h)	X (f)								7	0.41
Connecticut Warbler	*Oporornis agilis*	Vert	Bird	Parulidae	Landbird	For				X					SC			X	X					GRL		X (rc) H	(f, h)	X (f)							7	0.41
American Woodcock	*Scolopax minor*	Vert	Bird	Scolopacidae	Shorebird	Gra, For, Pal	MF/FE	X	PI	X	X							X					f	GRL	X, IIIB		X(f)	X (f)	M/B						7	0.41
Black-crowned Night-heron	*Nycticorax nycticorax*	Vert	Bird	Ardeidae	Waterbird	Pal, Rip	RS/MF		PI,HI	X	X			SC	SC			X				X		GRL			X(f)			*b/w*					7	0.41
Whooping Crane	*Grus americana*	Vert	Bird	Gruidae	Waterbird	Pal				X			E									E		GRL	X (I)		X					Red				7	0.41
Forster's Tern	*Sterna forsteri*	Vert	Bird	Laridae	Waterbird	Lac				X, MI (UP &				T	E			X	X					GRL	X					b/m						7	0.41
Black Rail	*Laterallus jamaicensis*	Vert	Bird	Rallidae	Waterbird	Pal																X	f	GRL	X (I)		X					Red				7	0.41
American Marten	*Martes americana*	Vert	Mamma	Mustelidae	Carnivora			X		X					E			X	X																	3	0.38
Eastern Pipistrelle	*Perimyotis subflavus*	Vert	Mamma	Vespertilionid	Chiroptera					X, WI & MI				SC	T			X																		3	0.38
Woodland jumping mouse	*Napaeozapus insignis*	Vert	Mamma	Muridae	Rodentia					X, WI					SC			X	X																	3	0.38
Least Shrew	*Cryptotis parva*	Vert	Mamma	Soricinae	Soricomor					X, MI (wUP)				T	SC			X																		3	0.38
Water Shrew	*Sorex palustris*	Vert	Mamma	Soricinae	Soricomor					X, WI					SC			X	X																	3	0.38
Scaleshell mussel	*Leptodea leptodon*	Invert	Mollusca		Mussel	Riv				X, MI (wUP)			E	SC				X																	3	0.38
Black Sandshell	*Ligumia recta*	Invert	Mollusca		Mussel	Riv				X, MI (UP &				E				X						GRL											3	0.38
Clubshell	*Pleurobema clava*	Invert	Mollusca		Mussel	Riv				X, MI (wUP)			E	E				X																	3	0.38
Pink Papershell	*Potamilus ohiensis*	Invert	Mollusca		Mussel	Riv				X, MI (UP &				T	SC				X																	3	0.38
Domed disc	*Discus patulus*	Invert	Mollusca		Snail	For, Gra, Pal				X, MI (wUP)				SC	SC			X																		3	0.38
Flanged Valvata	*Valvata winnebagoensis*	Invert	Mollusca		Snail					X, MI (wUP)				SC	SC				X																	3	0.38
Delicate vertigo	*Vertigo bollesiana*	Invert	Mollusca		Snail	Bar				X, MI (all UP)				T				X						GRL												3	0.38
Crested vertigo	*Vertigo cristata*	Invert	Mollusca		Snail	Bar				X, WI & MI				SC				X						GRL												3	0.38
Tapered vertigo	*Vertigo elatior*	Invert	Mollusca		Snail	Bar, For, Pal				X, WI & MI				SC	SC			X																		3	0.38
Black-billed Cuckoo	*Coccyzus erythropthalm*	Vert	Bird	Cuculidae	Landbird	For	FE (b)		PI	X	X							X			X	X		GRL	X (I)	X (rc) M										6	0.35
Le Conte's Sparrow	*Ammodramus leconteii*	Vert	Bird	Emberizidae	Landbird	Gra, Pal				X					SC			X	X			X		GRL									Yellow				6	0.35
Grasshopper Sparrow	*Ammodramus savannar*	Vert	Bird	Emberizidae	Landbird	Gra				X, MI (UP &				SC				X				X	f	GRL	X											6	0.35
Northern Bobwhite	*Colinus virginianus*	Vert	Bird	Odontophorida	Landbird	Gra, Shr				X					SC	E	E	X	X						X											6	0.35
Worm-eating Warbler	*Helmitheros vermivorun*	Vert	Bird	Parulidae	Landbird	For									E			X	X			X					X	X								6	0.35
Willow Flycatcher	*Empidonax traillii*	Vert	Bird	Tyrannidae	Landbird	Pal, Shr	FE (b)		PI	X											X (SS)	X			X	X L	X(f)					Yellow (SW sp)				6	0.35
Barn Owl	*Tyto alba*	Vert	Bird	Tytonidae	Landbird	Gra, Rip, Shr				X, MI (all UP)				E	E	E	E	X	X																	6	0.35
Red Knot (roselaari ssp.)	*Calidris canutus roselaar*	Vert	Bird	Scolopacidae	Shorebird	Pal			GI	X											X (nb)	X	f				X		m, 3			Yellow				6	0.35
Short-billed Dowitcher	*Limnodromus griseus*	Vert	Bird	Scolopacidae	Shorebird	Pal	(m)		GLI	X	X									X (nb)	X (nb)	X		GRL			X(f)		m							6	0.35
Whimbrel	*Numenius phaeopus*	Vert	Bird	Scolopacidae	Shorebird	Pal	SB		GI,HI	X	X									X (nb)	X (nb)	X		GRL			X		m, 3								6	0.35
Least Bittern	*Ixobrychus exilis*	Vert	Bird	Ardeidae	Waterbird	Pal				X, MI (UP &				T	SC			X				X		GRL			X									6	0.35
Horned Grebe	*Podiceps auritus*	Vert	Bird	Podicipedidae	Waterbird	Lac, Riv				X						E	E			X (nb)	X (nb)	X								b/M						6	0.35
Pied-billed Grebe	*Podilymbus podiceps*	Vert	Bird	Podicipedidae	Waterbird	Lac, Pal	OW (m)		PI	X								X		X	X	X					X			B						6	0.35
American Black Duck	*Anas rubripes*	Vert	Bird	Anatidae	Waterfowl	Pal	OW/RS	X	SI,GI	X	X							X					f	GRL	X (IIC)		X(f)				B/n					6	0.35
Black Redhorse	*Moxostoma duquesnei*	Vert	Fish	Catostomidae		Riv, Aqu									E			X	X																	3	0.33
Striped Shiner	*Luxilus chrysocephalus*	Vert	Fish	Cyprinidae		Riv, Aqu				X, WI					E			X	X																	3	0.33
Silver Chub	*Macrhybopsis storeriand*	Vert	Fish	Cyprinidae		Riv, Aqu				X, MI (wUP)				SC	SC			X																		3	0.33
Pugnose minnow	*Opsopoeodus emiliae*	Vert	Fish	Cyprinidae		Riv, Aqu				X, MI (wUP)				E	SC			X																		3	0.33
Least Darter	*Etheostoma microperca*	Vert	Fish	Percidae		Riv, Lac, Aqu				X, WI					SC			X	X																	3	0.33
Cisco (or Lake herring)	*Coregonus artedi*	Vert	Fish	Salmonidae		Riv, Lac, Aqu		X	LH,LM,LS	X				T				X																X		3	0.33
Lake whitefish	*Coregonus clupeaformis*	Vert	Fish	Salmonidae		Lac		X	LH,LM,LS	X						dd	T																X			3	0.33
Northern Cricket Frog	*Acris crepitans*	Vert	Herp	Frog	Amphibian	Pal, Rip				X, WI					E				X																D		3	0.33
Pickerel Frog	*Lithobates palustris*	Vert	Herp	Frog	Amphibian	Pal, Rip, Riv									SC			X	X																		3	0.33
Northern Prairie Skink	*Plestiodon septentrional*	Vert	Herp	Lizard	Reptile	Bar, For, Gra, Rip									SC				X																C		3	0.33
Western Wormsnake	*Carphophis vermis*	Vert	Herp	Snake	Reptile	For, Rip									SC				X																C		3	0.33
Kirtland's Snake	*Clonophis kirtlandii*	Vert	Herp	Snake	Reptile	For, Gra				X, MI (UP &				E				X																	A		3	0.33
Timber Rattlesnake	*Crotalus horridus*	Vert	Herp	Snake	Reptile	Bar, For, Sub									SC				X																	B		3	0.33
Ringneck Snake	*Diadophis punctatus edv*	Vert	Herp	Snake	Reptile	Sav			PI	X	X				SC			X	X																		3	0.33
Lake Erie Watersnake	*Nerodia sipedon insulard*	Vert	Herp	Snake	Reptile	Lac										E	E							GRL												3	0.33
Ornate Box Turtle	*Terrapene ornata*	Vert	Herp	Turtle	Reptile	Gra, Rip									E				X																D		3	0.33
Hungerford's crawling water beetle	*Brychius hungerfordi*	Invert	Insect		Coleopter					X, MI (UP &			E	E										GRL												3	0.33
American burying beetle	*Nicrophorus americanus*	Invert	Insect		Coleopter	Gra, Sav				X, MI (all UP)			E	X										GRL												3	0.33
Dusted Skipper	*Atrytonopsis hianna*	Invert	Insect	Hesperiidae	Lepidopte	Gra, Sav				X, MI (UP &				SC	SC			X																		3	0.33

Dukes' Skipper	*Euphyes dukesi*	Invert	Insect	Hesperiidae	Lepidopte	Gra, Sav				X, MI (wUP)					T				X																V	3	0.33
Leadplant Flower Moth	*Schinia lucens*	Invert	Insect	Noctuidae	Lepidopte	Gra				X, MI (wUP)					E	SC			X																		3	0.33
Gorgone checkerspot	*Chlosyne gorgone*	Invert	Insect	Nymphalidae	Lepidopte	Bar, Gra, Sav				X, MI (UP &					SC	SC			X																		3	0.33
Bog conehead	*Neoconocephalus lyriste*	Invert	Insect		Orthopter	Gra				X, MI (wUP)					SC	SC				X																	3	0.33
Delicate Meadow Katydid	*Orchelimum delicatum*	Invert	Insect		Orthopter	Gra				X, MI (wUP)					SC	SC				X																	3	0.33
Spotted-winged Grasshopper	*Orphulella pelidna*	Invert	Insect		Orthopter	Gra				X, MI (wUP)					SC	SC				X																	3	0.33
Black-striped Katydid	*Scudderia fasciata*	Invert	Insect		Orthopter	Gra				X, MI (UP &					SC	SC				X																	3	0.33
Lake Huron locust	*Trimerotropis huroniana*	Invert	Insect		Orthopter	Gra				X, WI & MI					T	E				X																	3	0.33
Northern Goshawk	*Accipiter gentilis*	Vert	Bird	Accipitridae	Landbird	For				X, MI (UP &					SC	SC			X	X					GRL												5	0.29
Field Sparrow	*Spizella pusilla*	Vert	Bird	Emberizidae	Landbird	Gra	GM		PI	X									X				X		GRL	X (I)	X (rc) M										5	0.29
Western Meadowlark	*Sturnella neglecta*	Vert	Bird	Icteridae	Landbird	Gra				X, MI (all UP)					SC	SC			X	X					GRL												5	0.29
Brown Thrasher	*Toxostoma rufum*	Vert	Bird	Mimidae	Landbird	Shr	FE		PI	X									X			X	X			X (IIA)	X (rc) M										5	0.29
Black-throated Blue Warbler	*Setophaga caerulescens*	Vert	Bird	Parulidae	Landbird	For	MF (m)		GLI	X	X								X						GRL		X (rs) H	(f, h)	X (f)								5	0.29
Hooded Warbler	*Setophaga citrina*	Vert	Bird	Parulidae	Landbird	For				X, MI (UP &					SC	T			X	X						X											5	0.29
Marsh Wren	*Cistothorus palustris*	Vert	Bird	Troglodytidae	Landbird	Pal	W		PI	X					SC				X			X	X			X (IIC)											5	0.29
Sedge Wren	*Cistothorus platensis*	Vert	Bird	Troglodytidae	Landbird	Pal	W (b)		PI	X	X								X				X		GRL	X (IIC)	X (rs) M										5	0.29
Solitary Sandpiper	*Tringa solitaria*	Vert	Bird	Scolopacidae	Shorebird	Pal				X											X (nb)	X (nb)	X					X (c)		M/b							5	0.29
Caspian Tern	*Sterna caspia*	Vert	Bird	Laridae	Waterbird	Bar, Lac, Riv	OW/RS		PI	X	X				T	E			X	X										B/m						5	0.29
Redhead	*Aythya americana*	Vert	Bird	Anatidae	Waterfowl	Lac, Riv	OW (m)	X	GLI	X	X					SC				X						X (IIC)		X (s)				b/n				5	0.29
Moose	*Alces americanus*	Vert	Mamma	Cervidae	Artiodacty			X		X, MI (all UP)					SC				X																	2	0.25
Puma / Cougar / Mountain Lion	*Felis concolor*	Vert	Mamma	Felidae	Carnivora					X, MI (wUP)					E				X																	2	0.25
Wolverine, Eastern pop.	*Gulo gulo*	Vert	Mamma	Mustelidae	Carnivora					X							E	E																		2	0.25
American Badger	*Taxidea taxus*	Vert	Mamma	Mustelidae	Carnivora			X		X							E	E																		2	0.25
Evening Bat	*Nycticeius humeralis*	Vert	Mamma	Vespertilionid	Chiroptera					X, MI (wUP)					T				X																	2	0.25
Smoky shrew	*Sorex fumeus*	Vert	Mamma	Soricinae	Soricomor					X, MI (all UP)					T				X																	2	0.25
Wavyrayed Lampmussel	*Lampsilis fasciola*	Invert	Mollusca		Mussel	Riv				X, MI (UP &					T				X																	2	0.25
Threehorn wartyback	*Obliquaria reflexa*	Invert	Mollusca		Mussel	Riv				X, MI (wUP)					E				X																	2	0.25
Hickorynut	*Obovaria olivaria*	Invert	Mollusca		Mussel	Riv				X, MI (wUP)					E				X																	2	0.25
Round lake floater	*Pyganodon subgibbosa*	Invert	Mollusca		Mussel	Lac, Riv				X, MI (wUP)					T				X																	2	0.25
Purple Lilliput	*Toxolasma lividum*	Invert	Mollusca		Mussel	Lac, Riv				X, MI (wUP)					E				X																	2	0.25
Lilliput	*Toxolasma parvum*	Invert	Mollusca		Mussel	Lac, Pal, Riv				X, MI (UP &					E				X																	2	0.25
Spindle lymnaea	*Acella haldemani*	Invert	Mollusca		Snail	Pal				X, MI (wUP)					SC				X																	2	0.25
Banded globe	*Anguispira kochi*	Invert	Mollusca		Snail	For, Gra, Pal				X, MI (wUP)					SC				X																	2	0.25
Spike-lip crater	*Appalachina sayanus*	Invert	Mollusca		Snail	For, Gra, Pal				X, MI (UP &					SC				X																	2	0.25
Pleistocene catinella	*Catinella exile*	Invert	Mollusca		Snail	Bar, Pal				X, MI (all UP)					T				X																	2	0.25
Appalachian Pillar	*Cochlicopa morseana*	Invert	Mollusca		Snail					X, WI						SC				X																	2	0.25
A land snail (no common name)	*Euconulus alderi*	Invert	Mollusca		Snail	Bar, For, Pal, Shr				X, MI (all UP)					T				X																	2	0.25
Watercress snail	*Fontigens nickliniana*	Invert	Mollusca		Snail	Pal				X, MI (UP &					SC				X																	2	0.25
Lambda snaggletooth	*Gastrocopta holzingeri*	Invert	Mollusca		Snail	Bar, Pal				X, MI (all UP)					E				X																	2	0.25
Sculpted Glyph	*Glyphyalinia rhoadsi*	Invert	Mollusca		Snail					X, WI						SC				X																	2	0.25
Bright Glyph	*Glyphyalinia wheatleyi*	Invert	Mollusca		Snail					X, WI						SC				X																	2	0.25
Smooth coil	*Helicodiscus singleyanus*	Invert	Mollusca		Snail					X, MI (wUP)					SC	SC																					2	0.25
Proud globe	*Mesodon elevatus*	Invert	Mollusca		Snail	For, Gra, Pal				X, MI (wUP)					T				X																	2	0.25
Copper button	*Mesomphix cupreus*	Invert	Mollusca		Snail	For, Gra, Pal				X, MI (wUP)					SC				X																	2	0.25
Foster mantleslug	*Pallifera fosteri*	Invert	Mollusca		Snail	For, Gra				X, MI (wUP)					T				X																	2	0.25
Dentate Supercoil	*Paravitrea multidentata*	Invert	Mollusca		Snail					X, WI						SC				X																	2	0.25
Carolina mantleslug	*Philomycus carolinianus*	Invert	Mollusca		Snail	For, Gra, Pal				X, MI (UP &					SC				X																	2	0.25
Acorn ramshorn	*Planorbella multivolvis*	Invert	Mollusca		Snail	Pal				X, MI (wUP)					E				X																	2	0.25
An aquatic snail (no common name	*Planorbella smithi*	Invert	Mollusca		Snail	Pal				X, MI (UP &					E				X																	2	0.25
Brown walker	*Pomatiopsis cincinnatier*	Invert	Mollusca		Snail	For, Pal				X, MI (UP &					SC				X																	2	0.25
Widespread column	*Pupilla muscorum*	Invert	Mollusca		Snail	Bar, For, Gra, Pal				X, MI (all UP)					SC				X																	2	0.25
Gravel pyrg	*Pyrgulopsis letsoni*	Invert	Mollusca		Snail	Bar, For, Pal				X, MI (wUP)					SC				X																	2	0.25
Deepwater pondsnail	*Stagnicola contracta*	Invert	Mollusca		Snail	Pal				X, MI (UP &					E				X																	2	0.25
Petoskey pondsnail	*Stagnicola petoskeyensis*	Invert	Mollusca		Snail	For, Pal, Shr				X, MI (UP &					E				X																	2	0.25
Black Striate	*Striatura ferrea*	Invert	Mollusca		Snail					X, WI						SC				X																	2	0.25
A land snail (no common name)	*Vallonia gracilicosta alb*	Invert	Mollusca		Snail	Bar, For, Gra				X, MI (all UP)					E				X																	2	0.25
Trumpet vallonia	*Vallonia parvula*	Invert	Mollusca		Snail	Bar, For, Gra				X, MI (wUP)					SC	SC																					2	0.25
A land snail (no common name)	*Vertigo modesta parieta*	Invert	Mollusca		Snail	Bar				X, MI (wUP)					E				X																	2	0.25
Crested vertigo	*Vertigo pygmaea*	Invert	Mollusca		Snail	Bar, For, Pal				X, MI (all UP)					SC				X																	2	0.25

Honey vertigo	*Vertigo tridentata*	Invert	Mollusca		Snail	Bar, Gra				X, WI & MI				SC	SC																									2	0.25
Transparent Vitrine Snail	*Vitrina angelicae*	Invert	Mollusca		Snail					X, WI					SC				X																					2	0.25
Velvet wedge	*Xolotrema denotata*	Invert	Mollusca		Snail	For, Gra, Pal				X, MI (wUP)				SC				X																					2	0.25
Boreal Top	*Zoogenetes harpa*	Invert	Mollusca		Snail					X, WI					SC				X																					2	0.25
Northern Harrier	*Circus cyaneus*	Vert	Bird	Accipitridae	Landbird	Gra, Pal				X, MI (UP &				SC					X						GRL	X (IIC)														4	0.24
Nelson's Sparrow	*Ammodramus nelsoni*	Vert	Bird	Emberizidae	Landbird	Gra, Pal				X					SC				X			X															Yellow				4	0.24
Eastern Meadowlark	*Sturnella magna*	Vert	Bird	Icteridae	Landbird	Gra				X									X						GRL			(f, h)	X (f)										4	0.24
Prairie Warbler	*Setophaga discolor*	Vert	Bird	Parulidae	Landbird	Bar, Gra				X, MI (UP &				E					X			X															Yellow				4	0.24
Yellow-throated Warbler	*Setophaga dominica*	Vert	Bird	Parulidae	Landbird	For				X, MI (all UP)				T	E				X	X																					4	0.24
Spruce Grouse	*Falcipennis canadensis*	Vert	Bird	Phasianidae	Landbird	For		X		X, MI (UP &				SC	T				X	X																					4	0.24
Sharp-tailed Grouse	*Tympanuchus phasianel*	Vert	Bird	Phasianidae	Landbird	Gra		X		X, MI (all UP)				SC	SC				X	X																					4	0.24
Northern Flicker	*Colaptes auratus*	Vert	Bird	Picidae	Landbird	For, Gra, Sav	MF/GM		PI	X	X								X			X			GRL		X (rc) M												4	0.24
Long-eared Owl	*Asio otus*	Vert	Bird	Strigidae	Landbird	For, Gra				X, MI (UP &				T	SC				X						GRL															4	0.24
Yellow-crowned Night-heron	*Nyctanassa violacea*	Vert	Bird	Ardeidae	Waterbird	Pal				X					T					X									X					b/m						4	0.24
Common Loon	*Gavia immer*	Vert	Bird	Gaviidae	Waterbird	Lac, Riv	OW (m)		GLI	X	X			T					X						GRL									B/m						4	0.24
Least Tern, Interior	*Sternula antillarum*	Vert	Bird	Laridae	Waterbird	Bar, Riv							E						X			E														Red				4	0.24
American White Pelican	*Pelecanus erythrorhynch*	Vert	Bird	Pelecanidae	Waterbird	Lac, Pal, Riv	OW/RS		PI,HI	X	X				SC				X							X									w/m						4	0.24
Common Moorhen	*Gallinula chloropus*	Vert	Bird	Rallidae	Waterbird	Pal		X		X, MI (UP &				T					X						GRL									b/m						4	0.24
Lesser Scaup	*Aythya affinis*	Vert	Bird	Anatidae	Waterfowl	Lac, Riv	OW (m)	X	GLI	X	X												f		GRL				X(f)						b/N					4	0.24
American Eel	*Anguilla rostrata*	Vert	Fish	Anguillidae		Riv		X		X, WI					SC					X																					2	0.22
Pirate perch	*Aphredoderus sayanus*	Vert	Fish	Aphredoderid		Riv, Aqu									SC				X																						2	0.22
Blue Sucker	*Cycleptus elongatus*	Vert	Fish	Catostomidae		Riv									T					X																						2	0.22
Creek chubsucker	*Erimyzon claviformis*	Vert	Fish	Catostomidae						X, MI (wUP)				E					X																							2	0.22
Copper Redhorse	*Moxostoma hubbsi*	Vert	Fish	Catostomidae												E	E																									2	0.22
Greater redhorse	*Moxostoma valencienne*	Vert	Fish	Catostomidae		Riv									SC				X																							2	0.22
Long-ear sunfish	*Lepomis megalotis*	Vert	Fish	Centrarchidae		Riv, Lac, Aqu									T				X																							2	0.22
Skipjack herring	*Alosa chrysochloris*	Vert	Fish	Clupeidae		Riv		X							E				X																							2	0.22
Spoonhead sculpin	*Cottus ricei*	Vert	Fish	Cottidae		Lac				X, MI (wUP)				SC					X																							2	0.22
Pallid Shiner	*Hybopsis amnis*	Vert	Fish	Cyprinidae		Riv									E				X																							2	0.22
Redfin Shiner	*Lythrurus umbratilis*	Vert	Fish	Cyprinidae		Riv, Aqu									T				X																							2	0.22
Shoal Chub	*Macrhybopsis aestivalis*	Vert	Fish	Cyprinidae		Riv									T				X																							2	0.22
Bigmouth shiner	*Notropis dorsalis*	Vert	Fish	Cyprinidae		Riv				X, MI (UP &				SC					X																							2	0.22
Ozark Minnow	*Notropis nubilus*	Vert	Fish	Cyprinidae		Riv									T				X																							2	0.22
Southern Redbelly Dace	*Phoxinus erythrogaster*	Vert	Fish	Cyprinidae		Riv, Aqu				X, MI (wUP)				E					X																							2	0.22
Gravel Chub	*Erimystax x-punctatus*	Vert	Fish	Cyprinidae		Riv									E				X																							2	0.22
Goldeye	*Hiodon alosoides*	Vert	Fish	Hiodontidae		Riv									E				X																							2	0.22
Mooneye	*Hiodon tergisus*	Vert	Fish	Hiodontidae		Riv, Aqu				X, MI (all UP)				T					X																							2	0.22
Margined Madtom	*Noturus insignis*	Vert	Fish	Ictaluridae												dd	T																									2	0.22
Brindled madtom	*Noturus miurus*	Vert	Fish	Ictaluridae		Riv, Aqu				X, MI (wUP)				SC					X																							2	0.22
Slender Madtom	*Noturus exilis*	Vert	Fish	Ictaluridae		Riv									E					X																							2	0.22
Spotted Gar	*Lepisosteus oculatus*	Vert	Fish	Lepisosteidae		Riv		X		X, MI (UP &				SC					X																							2	0.22
Walleye	*Stizostedion vitreum*	Vert	Fish	Percidae		Riv, Lac		X	LH,LM,LS	X															GRL												X				2	0.22
Western Sand Darter	*Ammocrypta clara*	Vert	Fish	Percidae		Riv									SC					X																							2	0.22
Eastern sand darter	*Ammocrypta pellucidaa*	Vert	Fish	Percidae		Riv, Aqu				X, MI (wUP)				T					X																							2	0.22
Crystal Darter	*Crystallaria asprella*	Vert	Fish	Percidae		Riv									E					X																							2	0.22
Bluntnose Darter	*Etheostoma chlorosoma*	Vert	Fish	Percidae		Riv									E					X																							2	0.22
Orangethroat Darter	*Etheostoma spectabile*	Vert	Fish	Percidae		Riv, Aqu				X, MI (wUP)				SC					X																							2	0.22
Channel Darter	*Percina copelandi*	Vert	Fish	Percidae		Riv, Aqu				X, MI (UP &				E					X																							2	0.22
Gilt Darter	*Percina evides*	Vert	Fish	Percidae		Riv									T					X																							2	0.22
River Darter	*Percina shumardi*	Vert	Fish	Percidae		Riv, Aqu				X, MI (UP &				E					X																							2	0.22
Paddlefish	*Polyodon spathula*	Vert	Fish	Polyodontida		Riv				X, MI (wUP)					T					X																							2	0.22
Blackfin cisco	*Coregonus nigripinnis*	Vert	Fish	Salmonidae				X		X, MI (wUP)						dd	T																									2	0.22
Shortnose cisco	*Coregonus reighardi*	Vert	Fish	Salmonidae				X		X, MI (wUP)						E	E																									2	0.22
Spring Cisco	*Coregonus sp.*	Vert	Fish	Salmonidae				X								E	E																									2	0.22
Deepwater Sculpin	*Myoxocephalus thompso*	Vert	Fish														T	X																									2	0.22
American Bullfrog	*Lithobates catesbeianus*	Vert	Herp	Frog	Amphibian	Aqu, Pal		X							SC				X																							2	0.22
Northern Leopard Frog	*Lithobates pipiens*	Vert	Herp	Frog	Amphibian	Aqu, Gra, Pal				X, WI					SC				X																							2	0.22
Mink Frog	*Lithobates septentrional*	Vert	Herp	Frog	Amphibian	Aqu, Lac, Riv				X, WI					SC					X																							2	0.22
Boreal chorus frog	*Pseudacris triseriata ma*	Vert	Herp	Frog	Amphibian	Aqu, For, Gra				X, MI (wUP)				SC					X																							2	0.22

Blue-spotted Salamander	*Ambystoma laterale*	Vert	Herp	Salamandar	Amphibian	Aqu, For			PI	X								X																C		2	0.22
Marbled Salamander	*Ambystoma opacum*	Vert	Herp	Salamandar	Amphibian	For, Rip				X, MI (wUP)				E				X																		2	0.22
Common Mudpuppy	*Necturus maculosus ma*	Vert	Herp	Salamandar	Amphibian	Lac, Riv				X, WI								X																C		2	0.22
Western lesser siren	*Siren intermedia netting*	Vert	Herp	Salamandar	Amphibian	Lac, Pal, Riv				X, MI (wUP)				SC				X																		2	0.22
Slender Glass Lizard	*Ophisaurus attenuatus*	Vert	Herp	Lizard	Reptile	Bar, Sav, Sub									E				X																	2	0.22
Common Five-lined Skink	*Plestiodon fasciatus*	Vert	Herp	Lizard	Reptile	Bar, Sav, Sub										E	E																			2	0.22
Smooth Greensnake	*Opheodrys vernalis*	Vert	Herp	Snake	Reptile	Gra, Pal				X, WI								X																B		2	0.22
Gophersnake (Bullsnake)	*Pituophis catenifer*	Vert	Herp	Snake	Reptile	For, Gra, Shr									SC				X																	2	0.22
Western Ribbonsnake	*Thamnophis proximus*	Vert	Herp	Snake	Reptile	Gra									E				X																	2	0.22
Eastern Ribbonsnake	*Thamnophis sauritus sau*	Vert	Herp	Snake	Reptile	Gra				X, WI					E				X																	2	0.22
Smooth Softshell	*Apalone mutica*	Vert	Herp	Turtle	Reptile	Lac, Riv									SC				X																	2	0.22
Eastern Box Turtle	*Terrapene carolina carol*	Vert	Herp	Turtle	Reptile	Gra				X, MI (UP &				SC				X																		2	0.22
A Water Scavenger Beetle	*Agabetes acuductus*	Invert	Insect		Coleopter	Aqu				X, WI					SC				X																	2	0.22
A Predaceous Diving Beetle	*Agabus discolor*	Invert	Insect		Coleopter	Aqu				X, WI					SC				X																	2	0.22
Beach-dune Tiger Beetle	*Cicindela hirticollis rhod*	Invert	Insect		Coleopter	Bar				X, WI					SC				X																	2	0.22
A Predaceous Diving Beetle	*Heterosternuta wickham*	Invert	Insect		Coleopter	Aqu				X, WI					SC				X																	2	0.22
A Minute Moss Beetle	*Hydraena angulicollis*	Invert	Insect		Coleopter	Aqu				X, WI					SC				X																	2	0.22
A Predaceous Diving Beetle	*Hydroporus morio*	Invert	Insect		Coleopter	Aqu				X, WI					SC				X																	2	0.22
A Predaceous Diving Beetle	*Hygrotus compar*	Invert	Insect		Coleopter	Aqu				X, WI					SC				X																	2	0.22
A Predaceous Diving Beetle	*Hygrotus farctus*	Invert	Insect		Coleopter	Aqu				X, WI					SC				X																	2	0.22
Cantrall's Bog Beetle	*Liodessus cantralli*	Invert	Insect		Coleoptera					X, MI (wUP)					SC				X																	2	0.22
A Riffle Beetle	*Stenelmis antennalis*	Invert	Insect		Coleoptera					X, WI					SC				X																	2	0.22
Douglas Stenelmis Riffle Beetle	*Stenelmis douglasensis*	Invert	Insect		Coleoptera					X, MI (UP &					SC				X																	2	0.22
A Spiny Crawler Mayfly	*Eurylophella aestiva*	Invert	Insect		Ephemero	Aqu				X, WI					SC				X																	2	0.22
Yellowbanded Bumble Bee	*Bombus terricola*	Invert	Insect		Hymenopt					X, MI (wUP)				SC	SC																					2	0.22
The Leadplant Underwing Moth	*Catocala amestris*	Invert	Insect	Erebidae	Lepidopte					X, MI (wUP)				E				X																		2	0.22
Quiet underwing	*Catocala dulciola*	Invert	Insect	Erebidae	Lepidopte					X, MI (wUP)				SC				X																		2	0.22
Magdalen underwing	*Catocala illecta*	Invert	Insect	Erebidae	Lepidopte					X, MI (wUP)				SC				X																		2	0.22
Robinson's underwing	*Catocala robinsoni*	Invert	Insect	Erebidae	Lepidopte					X, MI (wUP)				SC				X																		2	0.22
Semirelict Underwing Moth	*Catocala semirelicta*	Invert	Insect	Erebidae	Lepidopte					X, WI					SC				X																	2	0.22
Red-disked alpine	*Erebia discoidalis*	Invert	Insect	Erebidae	Lepidopte					X, MI (wUP)				SC				X																		2	0.22
Wild indigo duskywing	*Erynnis baptisiae*	Invert	Insect	Hesperiidae	Lepidopte	Gra, Sav				X, MI (wUP)				SC				X																		2	0.22
Cobweb Skipper	*Hesperia metea*	Invert	Insect	Hesperiidae	Lepidopte	Gra, Sav				X, WI					SC				X																	2	0.22
Grizzled skipper	*Pyrgus wyandot*	Invert	Insect	Hesperiidae	Lepidopte	Gra, Sav				X, MI (UP &				SC				X																		2	0.22
Riley's lappet moth	*Heteropacha rileyana*	Invert	Insect	Lasiocampidae	Lepidopte					X, MI (wUP)				SC				X																		2	0.22
Northern Hairstreak	*Fixsenia favonius*	Invert	Insect	Lycaenidae	Lepidopte	For, Sav				X, MI (wUP)				SC				X																		2	0.22
Dune cutworm	*Euxoa aurulenta*	Invert	Insect	Noctuidae	Lepidopte	Bar				X, MI (UP &				SC				X																		2	0.22
Newman's brocade	*Meropleon ambifusca*	Invert	Insect	Noctuidae	Lepidopte					X, MI (wUP)				SC				X																		2	0.22
3-striped oncocnemis	*Oncocnemis piffardi*	Invert	Insect	Noctuidae	Lepidopte					X, MI (UP &				SC				X																		2	0.22
Three-horned moth	*Pachypolia atricornis*	Invert	Insect	Noctuidae	Lepidopte					X, MI (UP &				SC				X																		2	0.22
Corylus dagger moth	*Acronicta falcula*	Invert	Insect	Noctuidae	Lepidopte					X, MI (wUP)				SC				X																		2	0.22
Golden borer	*Papaipema cerina*	Invert	Insect	Noctuidae	Lepidopte	For, Gra, Pal				X, MI (wUP)				SC				X																		2	0.22
Maritime sunflower borer	*Papaipema maritima*	Invert	Insect	Noctuidae	Lepidopte	Gra, Pal				X, MI (wUP)				SC				X																		2	0.22
Culvers root borer	*Papaipema sciata*	Invert	Insect	Noctuidae	Lepidopte	Gra				X, MI (UP &				SC				X																		2	0.22
The Royal Fern Borer Moth	*Papaipema speciosissim*	Invert	Insect	Noctuidae	Lepidopte	For, Gra, Pal				X, MI (wUP)				SC				X																		2	0.22
Spartina moth	*Spartiniphaga inops*	Invert	Insect	Noctuidae	Lepidopte	Gra				X, MI (UP &				SC				X																		2	0.22
Freija fritillary	*Boloria freija*	Invert	Insect	Nymphalidae	Lepidopte	Gra				X, MI (all UP)				SC				X																		2	0.22
Frigga fritillary	*Boloria frigga*	Invert	Insect	Nymphalidae	Lepidopte	Gra				X, MI (all UP)				SC				X																		2	0.22
Tawny Crescent	*Phyciodes batesii*	Invert	Insect	Nymphalidae	Lepidopte	Gra				X, MI (UP &				SC				X																		2	0.22
Pipevine swallowtail	*Battus philenor*	Invert	Insect	Papilionidae	Lepidopte	Gra				X, MI (wUP)				SC				X																		2	0.22
Chryxus Arctic	*Oeneis chryxus*	Invert	Insect	Papilionidae	Lepidopte	Bar, Gra				X, WI					SC				X																	2	0.22
Macoun's arctic	*Oeneis macounii*	Invert	Insect	Papilionidae	Lepidopte	Gra				X, MI (wUP)				SC				X																		2	0.22
Large marble	*Euchloe ausonides*	Invert	Insect	Pieridae	Lepidopte	Gra				X, MI (wUP)				SC				X																		2	0.22
West Virginia White	*Pieris virginiensis*	Invert	Insect	Pieridae	Lepidopte	Gra				X, WI					SC				X																	2	0.22
Pine imperial moth	*Eacles imperialis pini*	Invert	Insect	Saturniidae	Lepidopte	Bar, For				X, MI (wUP)				SC				X																		2	0.22
Barrens buckmoth	*Hemileuca maia*	Invert	Insect	Saturniidae	Lepidopte	Bar, Gra, Pal, Sav				X, MI (UP &				SC				X																		2	0.22
Yellow-banded day-sphinx	*Proserpinus flavofasciat*	Invert	Insect	Sphyngidae	Lepidopte	For				X, MI (wUP)				SC				X																		2	0.22
Gold moth	*Basilodes pepita*	Invert	Insect		Lepidopte	For, Pal				X, MI (wUP)				SC				X																		2	0.22
Boreal brachionyncha	*Brachionycha borealis*	Invert	Insect		Lepidopte	Bar, For				X, MI (UP &				SC				X																		2	0.22

Phyllira Tiger Moth	*Grammia phyllira*	Invert	Insect		Lepidopte	Bar				X, WI					SC				X																					2	0.22
Small heterocampa	*Heterocampa subrotata*	Invert	Insect		Lepidopte	For, Pal, Shr				X, MI (wUP)				SC				X																					2	0.22
Doll's merolonche	*Merolonche dolli*	Invert	Insect		Lepidopte	Bar				X, MI (UP &				SC				X																					2	0.22
Hoary comma	*Polygonia gracilis*	Invert	Insect		Lepidopte	For, Rip				X, MI (all UP)				SC				X																					2	0.22
Pink sallow	*Psectraglaea carnosa*	Invert	Insect		Lepidopte					X, WI					SC				X																					2	0.22
Mottled Darner	*Aeshna clepsydra*	Invert	Insect	Aeshnidae	Odonata	Aqu, Pal				X, WI					SC				X																					2	0.22
Delta-spotted Spiketail	*Cordulegaster diastatop*	Invert	Insect	Cordulegastri	Odonata	Aqu, Pal				X, WI					SC				X																					2	0.22
Tiger spiketail	*Cordulegaster erronea*	Invert	Insect	Cordulegastri	Odonata	Aqu, Pal				X, MI (UP &				SC				X																					2	0.22
Lemon-faced Emerald	*Somatochlora ensigera*	Invert	Insect	Corduliidae	Odonata	Aqu, Pal				X, WI					SC				X																					2	0.22
Forcipate Emerald	*Somatochlora forcipata*	Invert	Insect	Corduliidae	Odonata	Aqu, Pal				X, WI					SC				X																					2	0.22
Ebony boghaunter	*Williamsonia fletcheri*	Invert	Insect	Corduliidae	Odonata	Aqu, Pal				X, MI (UP &				SC				X																					2	0.22
Splendid clubtail	*Gomphus lineatifrons*	Invert	Insect	Gomphidae	Odonata	Aqu, Pal				X, MI (UP &				SC				X																					2	0.22
Riverine snaketail	*Stylurus amnicola*	Invert	Insect	Gomphidae	Odonata	Aqu, Pal				X, MI (all UP)				SC				X																					2	0.22
Laura's snaketail	*Stylurus laurae*	Invert	Insect	Gomphidae	Odonata	Aqu, Pal				X, MI (UP &				SC				X																					2	0.22
Elusive snaketail	*Stylurus notatus*	Invert	Insect	Gomphidae	Odonata	Aqu, Pal				X, MI (wUP)				SC				X																					2	0.22
Russet-tipped clubtail	*Stylurus plagiatus*	Invert	Insect	Gomphidae	Odonata	Aqu, Pal				X, MI (wUP)				SC				X																					2	0.22
Grey petaltail	*Tachopteryx thoreyi*	Invert	Insect	Petaluridae	Odonata	Aqu, Pal				X, MI (wUP)				T				X																					2	0.22
Swamp Darner	*Epiaeschna heros*	Invert	Insect		Odonata	Aqu, Pal				X, WI					SC				X																					2	0.22
Slaty Skimmer	*Libellula incesta*	Invert	Insect		Odonata	Aqu, Pal				X, WI					SC				X																					2	0.22
Clear-winged Grasshopper	*Camnula pellucida*	Invert	Insect		Orthopter	Gra				X, WI					SC				X																					2	0.22
Blue-legged Grasshopper	*Melanoplus flavidus*	Invert	Insect		Orthopter	Gra				X, MI (wUP)				SC	SC																									2	0.22
Quadrate Sallfly	*Haploperla orpha*	Invert	Insect		Plecoptera	Aqu				X, WI					SC				X																					2	0.22
A Long-horned Casemaker Caddisfl	*Triaenodes nox*	Invert	Insect		Trichopter	Aqu				X, WI					SC				X																					2	0.22
A Fingernet Caddisfly	*Wormaldia moesta*	Invert	Insect		Trichopter	Aqu				X, WI					SC				X																					2	0.22
Chimney Swift	*Chaetura pelagica*	Vert	Bird	Apodidae	Landbird	Dev, For	GM			PI	X																	X (rc) M		(f, h)	X (f)									3	0.18
Painted Bunting	*Passerina ciris*	Vert	Bird	Cardinalidae	Landbird	For, Shr																X	f												Yellow					3	0.18
Lark Sparrow	*Chondestes grammacus*	Vert	Bird	Emberizidae	Landbird	Gra					X, MI (all UP)				X	SC				X																				3	0.18
Yellow-headed Blackbird	*Xanthocephalus xanthoc*	Vert	Bird	Icteridae	Landbird	Pal					X, MI (all UP)				SC	SC			X																					3	0.18
Boreal Chickadee	*Poecile hudsonicus*	Vert	Bird	Paridae	Landbird	For					X					SC			X	X																				3	0.18
Bay-breasted Warbler	*Setophaga castanea*	Vert	Bird	Parulidae	Landbird	For					X																X (rc) H		X	X									3	0.18
Blackburnian Warbler	*Setophaga fusca*	Vert	Bird	Parulidae	Landbird	For	MF (m)			PI	X								X							X	X (rc) M												3	0.18
Cape May Warbler	*Setophaga tigrina*	Vert	Bird	Parulidae	Landbird	For	MF (m)			PI	X	X													GRL				(f, h)	X (f)									3	0.18
Veery	*Catharus fuscescens*	Vert	Bird	Turdidae	Landbird	For	MF (b)			PI	X																X (rc, rs)		(f, h)	X (f)									3	0.18
Killdeer	*Charadrius vociferus*	Vert	Bird	Charadriidae	Shorebird	Gra, Pal	RS (b)			PI,GI,HI	X								X										(f, h)		M/B								3	0.18
Sanderling	*Calidris alba*	Vert	Bird	Scolopacidae	Shorebird	Pal					X																		X (f, c)		M								3	0.18
Dunlin	*Calidris alpina*	Vert	Bird	Scolopacidae	Shorebird	Pal	SB (m)			GI,HI	X												f						(f, h)		m								3	0.18
Stilt Sandpiper	*Calidris himantopus*	Vert	Bird	Scolopacidae	Shorebird	Pal					X													GRL						m, 4								3	0.18
Semi-palmated Sandpiper	*Calidris pusilla*	Vert	Bird	Scolopacidae	Shorebird	Pal				SI,GI,HI	X											X	f							M, 4								3	0.18
Wilson's Snipe	*Gallinago delicata*	Vert	Bird	Scolopacidae	Shorebird	Pal		X			X								X										(f, h)		M/B								3	0.18
Great Egret	*Ardea alba*	Vert	Bird	Ardeidae	Waterbird	Pal	RS/MF			GLI	X	X				T				X												b/m							3	0.18
Roseate tern	*Sterna dougallii*	Vert	Bird	Laridae	Waterbird	Bar								E			E	E																					3	0.18
Red-necked Grebe	*Podiceps grisegena*	Vert	Bird	Podicipedidae	Waterbird	Lac, Riv					X					E				X												B/M							3	0.18
Sora	*Porzana carolina*	Vert	Bird	Rallidae	Waterbird	Pal	W (b)	X		PI	X								X										X			B							3	0.18
Wood Duck	*Aix sponsa*	Vert	Bird	Anatidae	Waterfowl	For, Pal, Rip		X		PI	X	X												GRL				(f, h)					b/n						3	0.18
Blue-winged Teal	*Anas discors*	Vert	Bird	Anatidae	Waterfowl	Pal	OW (m)	X		PI,GI,HI	X	X							X									X (f, s)					b/n						3	0.18
Mallard	*Anas platyrhynchos*	Vert	Bird	Anatidae	Waterfowl	Gra, Pal	OW/RS	X		PI,SI,GI	X	X												GRL				X (f, s)					b/n						3	0.18
Canvasback	*Aythya valisineria*	Vert	Bird	Anatidae	Waterfowl	Lac, Riv		X			X													GRL				X(f)					n						3	0.18
Canada Goose	*Branta canadensis*	Vert	Bird	Anatidae	Waterfowl	Dev, Lac, Riv	OW/RS	X		PI,SI,GI	X	X												GRL				X					b/n						3	0.18
Common Goldeneye	*Bucephala clangula*	Vert	Bird	Anatidae	Waterfowl	Lac, Riv	OW	X		GLI	X	X				SC												X (s)					B/N						3	0.18
Elk or Wapiti	*Cervus elaphus*	Vert	Mamma	Cervidae	Artiodacty			X			X					SC																							1	0.13
Least Weasel	*Mustela nivalis*	Vert	Mamma	Mustelidae	Carnivora			X			X								X																					1	0.13
Big Brown Bat	*Eptesicus fuscus*	Vert	Mamma	Vespertilionid	Chiroptera						X, WI					T																								1	0.13
Silver-haired Bat	*Lasionycteris noctivagar*	Vert	Mamma	Vespertilionid	Chiroptera						X								X																					1	0.13
Eastern Red Bat	*Lasiurus borealis*	Vert	Mamma	Vespertilionid	Chiroptera						X								X																					1	0.13
Hoary Bat	*Lasiurus cinereus*	Vert	Mamma	Vespertilionid	Chiroptera						X								X																					1	0.13
Little Brown Myotis	*Myotis lucifugus*	Vert	Mamma	Vespertilionid	Chiroptera						X, WI					T																								1	0.13
Deermouse	*Peromyscus maniculatus*	Vert	Mamma	Cricetidae	Rodentia					PI	X								X																					1	0.13
Least Chipmunk	*Tamias minimus*	Vert	Mamma	Sciuridae	Rodentia						X								X																					1	0.13
Greater European pea clam	*Pisidium amnicum*	Invert	Mollusca		Mussel						X, MI (wUP)				SC																									1	0.13

Ornamanted peaclam	*Pisidium cruciatum*	Invert	Mollusca		Mussel					X, MI (wUP)				SC																										1	0.13
Round peaclam	*Pisidium equilaterale*	Invert	Mollusca		Mussel					X, MI (wUP)				SC																										1	0.13
Giant northern pea clam	*Pisidium idahoense*	Invert	Mollusca		Mussel					X, MI (UP &				SC																										1	0.13
A fingernail clam	*Pisidium simplex*	Invert	Mollusca		Mussel					X, MI (wUP)				SC																										1	0.13
Lake floater	*Pyganodon lacustris*	Invert	Mollusca		Mussel	Lac, Riv				X, MI (UP &				SC																										1	0.13
European pea clam	*Sphaerium corneum*	Invert	Mollusca		Mussel					X, MI (wUP)				SC																										1	0.13
River fingernail clam	*Sphaerium fabale*	Invert	Mollusca		Mussel					X, MI (UP &				SC																										1	0.13
Deertoe	*Truncilla truncata*	Invert	Mollusca		Mussel	Lac, Riv				X, MI (wUP)				SC																										1	0.13
Paper pondshell	*Utterbackia imbecillis*	Invert	Mollusca		Mussel	Lac, Riv				X, MI (UP &				SC																										1	0.13
Globe siltsnail	*Birgella subglobosus*	Invert	Mollusca		Snail					X, MI (wUP)				SC																										1	0.13
File thorn	*Carychium nannodes*	Invert	Mollusca		Snail	Bar, For, Gra				X, MI (UP &				SC																										1	0.13
Frigid Ambersnail	*Catinella gelida*	Invert	Mollusca		Snail	Bar				X, MI (wUP)				T																										1	0.13
A land snail (no common name)	*Catinella protracta*	Invert	Mollusca		Snail	Bar, For, Gra,				X, MI (UP &				E																										1	0.13
Campeloma spire snail	*Cincinnatia cincinnatien*	Invert	Mollusca		Snail					X, MI (UP &				SC																										1	0.13
Carinate pillsnail	*Euchemotrema hubricht*	Invert	Mollusca		Snail	Bar				X, MI (wUP)				T																										1	0.13
Bugle fossaria	*Fossaria cyclostoma*	Invert	Mollusca		Snail	Pal				X, MI (wUP)				T																										1	0.13
Boreal fossaria	*Fossaria galbana*	Invert	Mollusca		Snail					X, MI (UP &				SC																										1	0.13
A land snail (no common name)	*Glyphyalinia solida*	Invert	Mollusca		Snail	For, Gra				X, MI (wUP)				SC																										1	0.13
Southeastern gem	*Hawaiia alachuana*	Invert	Mollusca		Snail	For, Gra				X, MI (wUP)				SC																										1	0.13
Lake Superior ramshorn	*Helisoma anceps royaler*	Invert	Mollusca		Snail					X, MI (wUP)				SC																										1	0.13
Canadian duskysnail	*Lyogyrus walkeri*	Invert	Mollusca		Snail					X, MI (UP &				SC																										1	0.13
Yellow globelet	*Mesodon clausus*	Invert	Mollusca		Snail	For, Gra				X, MI (wUP)				SC																										1	0.13
Sealed Goblet	*Mesodon mitchellianus*	Invert	Mollusca		Snail	For, Gra				X, MI (wUP)				SC																										1	0.13
Proud globelet	*Mesodon pennsylvanicu*	Invert	Mollusca		Snail	For, Gra				X, MI (wUP)				SC																										1	0.13
Depressed ambersnail	*Oxyloma peoriense*	Invert	Mollusca		Snail	Pal				X, MI (wUP)				SC																										1	0.13
Great Lakes physa	*Physella magnalacustris*	Invert	Mollusca		Snail					X, MI (UP &				SC																										1	0.13
Broadshoulder physa	*Physella parkeri*	Invert	Mollusca		Snail					X, MI (wUP)				T																										1	0.13
Coldwater pondsnail	*Stagnicola woodruffi*	Invert	Mollusca		Snail					X, MI (wUP)				SC																										1	0.13
Ribbed Striate	*Striatura exigua*	Invert	Mollusca		Snail					X, WI					SC																									1	0.13
Median striate	*Striatura meridionalis*	Invert	Mollusca		Snail	For, Gra, Pal				X, MI (wUP)				SC																										1	0.13
Purplecap valvata	*Valvata perdepressa*	Invert	Mollusca		Snail					X, MI (wUP)				SC																										1	0.13
Pyramid dome	*Ventridens intertextus*	Invert	Mollusca		Snail	For, Gra				X, MI (wUP)				SC																										1	0.13
Flat dome	*Ventridens suppressus*	Invert	Mollusca		Snail	For, Gra				X, MI (wUP)				SC																										1	0.13
A land snail (no common name)	*Vertigo modesta modest*	Invert	Mollusca		Snail	Bar				X, MI (wUP)				E																										1	0.13
Osprey	*Pandion haliaetus*	Vert	Bird	Accipitridae	Landbird	For, Rip				X, MI (UP &				SC				X																					2	0.12
Common Nighthawk	*Chordeiles minor*	Vert	Bird	Caprimulgidae	Landbird	Dev, For, Sav	GM		PI	X					SC			X																					2	0.12
Yellow-billed Cuckoo	*Coccyzus americanus*	Vert	Bird	Cuculidae	Landbird	For	FE (b)		GLI	X	X							X								X													2	0.12
Swamp Sparrow	*Melospiza georgiana*	Vert	Bird	Emberizidae	Landbird	Pal	W		PI	X																X (IIA)	X (rs) L												2	0.12
Merlin	*Falco columbarius*	Vert	Bird	Falconidae	Landbird	For, Gra	MF		GLI	X				T				X																					2	0.12
Purple Martin	*Progne subis*	Vert	Bird	Hirundinidae	Landbird	Pal, Rip				X					SC			X																					2	0.12
Northern Rough-winged Swallow	*Stelgidopteryx serripenn*	Vert	Bird	Hirundinidae	Landbird	Gra, Rip				X																X (IIA)	X (rc) M												2	0.12
Orchard Oriole	*Icterus spurius*	Vert	Bird	Icteridae	Landbird	Gra, Shr				X														X		GRL													2	0.12
Sprague's Pipit	*Anthus spragueii*	Vert	Bird	Motacillidae	Landbird	Gra				X			C											f															2	0.12
Mourning Warbler	*Oporornis philadelphia*	Vert	Bird	Parulidae	Landbird	Rip, Shr	MF		PI	X																X	X (rs) M												2	0.12
Black-backed Woodpecker	*Picoides arcticus*	Vert	Bird	Picidae	Landbird	For				X, MI (UP &				SC				X																					2	0.12
Ruby-crowned Kinglet	*Regulus calendula*	Vert	Bird	Regulidae	Landbird	For	MF/FE		PI	X					SC			X																					2	0.12
Least Flycatcher	*Empidonax minimus*	Vert	Bird	Tyrannidae	Landbird	For	FE (b)		PI	X								X									X (rs) M												2	0.12
White-eyed Vireo	*Vireo griseus*	Vert	Bird	Vireonidae	Landbird	For												X								X													2	0.12
Semipalmated Plover	*Charadrius semipalmatu*	Vert	Bird	Charadriidae	Shorebird	Pal	SB (m)		SI,GI	X																											m, 4							2	0.12
American Golden Plover	*Pluvialis dominica*	Vert	Bird	Charadriidae	Shorebird	Gra				X																					X(f)					m							2	0.12
Spotted Sandpiper	*Actitis macularius*	Vert	Bird	Scolopacidae	Shorebird	Pal	RS/SB		PI	X								X																		M/B,							2	0.12
Ruddy Turnstone	*Arenaria interpres*	Vert	Bird	Scolopacidae	Shorebird	Pal			SI,GI	X																				X (c)					M, 4							2	0.12
White-rumped Sandpiper	*Calidris fuscicollis*	Vert	Bird	Scolopacidae	Shorebird	Pal				X																									M, 4							2	0.12
Western Sandpiper	*Calidris mauri*	Vert	Bird	Scolopacidae	Shorebird	Pal																													m, 3							2	0.12
Pectoral Sandpiper	*Calidris melanotos*	Vert	Bird	Scolopacidae	Shorebird	Pal			SI,GI	X																									M, 4				Red			2	0.12
Long-billed Curlew	*Numenius americanus*	Vert	Bird	Scolopacidae	Shorebird	Pal																		f														Yellow			2	0.12
Eskimo Curlew	*Numenius borealis*	Vert	Bird	Scolopacidae	Shorebird	Pal										E	E																							2	0.12
Lesser Yellowlegs	*Tringa flavipes*	Vert	Bird	Scolopacidae	Shorebird	Pal	RS (m)		GLI	X														X											M, 5							2	0.12
Greater Yellowlegs	*Tringa melanoleuca*	Vert	Bird	Scolopacidae	Shorebird	Pal	RS (m)		GLI	X	X															GRL									M, 5							2	0.12

Great Blue Heron	*Ardea herodias*	Vert	Bird	Ardeidae	Waterbird	Pal, Rip	RS/MF		PI,HI	X								X												B/w						2	0.12
Green Heron	*Butorides virescens*	Vert	Bird	Ardeidae	Waterbird	Pal, Rip				X								X												*B*						2	0.12
Snowy Egret	*Egretta thula*	Vert	Bird	Ardeidae	Waterbird	Pal				X					E				X																	2	0.12
Thayer's Gull	*Larus glaucoides*	Vert	Bird	Laridae	Waterbird	Lac, Riv																								W		Yellow				2	0.12
Double-crested Cormorant	*Phalacrocorax auritus*	Vert	Bird	Phalacrocoraci	Waterbird	Lac, Riv	OW/RS		PI,GI,HI	X	Xn													GRL						B/w/						2	0.12
American Coot	*Fulica americana*	Vert	Bird	Rallidae	Waterbird	Lac, Pal, Riv	OW (m)		GI	X								X												B/m						2	0.12
Virginia Rail	*Rallus limicola*	Vert	Bird	Rallidae	Waterbird	Pal		X		X								X												B						2	0.12
Northern Pintail	*Anas acuta*	Vert	Bird	Anatidae	Waterfowl	Pal	OW	X	GLI	X	X												f				X									2	0.12
American Wigeon	*Anas americana*	Vert	Bird	Anatidae	Waterfowl	Lac, Riv	OW (m)	X	GLI	X																	X (s)				b/n					2	0.12
Greater Scaup	*Aythya marila*	Vert	Bird	Anatidae	Waterfowl	Lac	OW (m)	X	GLI	X													f								N					2	0.12
Tundra Swan	*Cygnus columbianus*	Vert	Bird	Anatidae	Waterfowl	Lac, Riv	OW		GLI	X																	(f, h)				N					2	0.12
Hooded Merganser	*Lophodytes cucullatus*	Vert	Bird	Anatidae	Waterfowl	Lac, Pal, Rip, F	OW (m)	X	SI	X															X						b/n					2	0.12
Bowfin	*Amia calva*	Vert	Fish	Amiidae		Riv, Lac		X	LH,LM	X																							X			1	0.11
White Sucker	*Catostomus commerson*	Vert	Fish	Catostomidae		Riv, Lac			LH,LM,LS	X																							X			1	0.11
Bigmouth buffalo	*Ictiobus cyprinellus*	Vert	Fish	Catostomidae		Riv											SC																			1	0.11
Spotted Sucker	*Minytrema melanops*	Vert	Fish	Catostomidae		Riv, Aqu												X																		1	0.11
Golden Redhorse	*Moxostoma erythrurum*	Vert	Fish	Catostomidae		Riv, Aqu												X																		1	0.11
Pumpkinseed	*Lepomis gibbosus*	Vert	Fish	Centrarchidae		Riv, Lac		X	LH,LM,LS	X																							X			1	0.11
Orange-spotted sunfish	*Lepomis humilis*	Vert	Fish	Centrarchidae		Riv		X									SC																			1	0.11
Rock bass	*Ambloplites rupestris*	Vert	Fish	Centrarchidae		Riv, Lac		X	LH,LM,LS	X																							X			1	0.11
Smallmouth bass	*Micropterus dolomieu*	Vert	Fish	Centrarchidae		Riv, Lac		X	LH,LM,LS	X																							X			1	0.11
Alewife	*Alosa pseudoharengus*	Vert	Fish	Clupeidae		Lac		n	LH,LM	X																							X			1	0.11
Gizzard shad	*Dorosoma cepedianum*	Vert	Fish	Clupeidae		Riv, Lac, Aqu			LH,LM,LS	X																							X			1	0.11
Slimy Sculpin	*Cottus cognatus*	Vert	Fish	Cottidae		Riv, Lac, Aqu												X																		1	0.11
Common carp	*Cyprinus carpio*	Vert	Fish	Cyprinidae		Riv, Lac		n	LH,LM,LS	X																							X			1	0.11
Brassy Minnow	*Hybognathus hankinson*	Vert	Fish	Cyprinidae		Riv, Aqu												X																		1	0.11
Ironcolor Shiner	*Notropis chalybaeus*	Vert	Fish	Cyprinidae		Riv				X, MI (wUP)				X																						1	0.11
Finescale Dace	*Phoxinus neogaeus*	Vert	Fish	Cyprinidae		Riv, Aqu												X																		1	0.11
River chub	*Nocomis micropogon*	Vert	Fish	Cyprinidae		Riv, Aqu												X																		1	0.11
Bigeye chub	*Notropis amblops*	Vert	Fish	Cyprinidae						X, MI (wUP)				X																						1	0.11
Weed Shiner	*Notropis texanus*	Vert	Fish	Cyprinidae		Riv, Aqu				X, WI					SC																					1	0.11
Grass pickerel	*Esox americanus*	Vert	Fish	Esocidae		Riv, Aqu												X																		1	0.11
Northern pike	*Esox lucius*	Vert	Fish	Esocidae		Riv, Lac, Aqu		X	LH,LM,LS	X																							X			1	0.11
Muskellunge	*Esox masquinongy*	Vert	Fish	Esocidae		Riv, Lac		X	LH,LM,LS	X																							X			1	0.11
Burbot	*Lota lota*	Vert	Fish	Gadidae		Lac		X	LH,LM,LS	X																							X			1	0.11
Round goby	*Neogobius melanostom*	Vert	Fish	Gobiidae		Lac		n	LH,LM,LS	X																							X			1	0.11
Brown Bullhead	*Ameiurus nebulosus*	Vert	Fish	Ictaluridae		Riv		X										X																		1	0.11
Stonecat	*Noturus flavus*	Vert	Fish	Ictaluridae		Riv, Aqu												X																		1	0.11
Tadpole Madtom	*Noturus gyrinus*	Vert	Fish	Ictaluridae		Riv, Aqu												X																		1	0.11
White bass	*Morone chrysops*	Vert	Fish	Moronidae		Riv, Lac		X	LH,LM	X																							X			1	0.11
Rainbow smelt	*Osmerus mordax*	Vert	Fish	Osmeridae		Lac		Xn	LH,LM,LS	X																							X			1	0.11
White perch	*Morone americana*	Vert	Fish	Percichthyida		Riv, Lac		X	LH,LM,LS	X																							X			1	0.11
Sauger	*Stizostedion canadense*	Vert	Fish	Percidae		Riv, Aqu		X		X, MI (UP &				T																						1	0.11
Mud Darter	*Etheostoma asprigene*	Vert	Fish	Percidae		Riv, Lac, Aqu									SC																					1	0.11
Greenside Darter	*Etheostoma blennioides*	Vert	Fish	Percidae		Riv											SC																			1	0.11
Fantail Darter	*Etheostoma flabellare*	Vert	Fish	Percidae		Riv, Aqu												X																		1	0.11
Banded Darter	*Etheostoma zonale*	Vert	Fish	Percidae		Riv												X																		1	0.11
Yellow perch	*Perca flavescens*	Vert	Fish	Percidae		Lac		X	LH,LM,LS	X																							X			1	0.11
Eurasian ruffe	*Petromyzon marinus*	Vert	Fish	Percidae		Lac		Xn	LH,LM,LS	X																							X			1	0.11
Northern Brook Lamprey	*Ichthyomyzon fossor*	Vert	Fish	Petromyzonti		Riv											SC																			1	0.11
Sea lamprey	*Petromyzon marinus*	Vert	Fish	Petromyzonti		Lac		n	LH,LM,LS	X																							X			1	0.11
Siskiwit lake cisco	*Coregonus bartlettii*	Vert	Fish	Salmonidae						X, MI (wUP)				T																						1	0.11
Bloater	*Coregonus hoyi*	Vert	Fish	Salmonidae		Lac		X	LH,LM,LS	X																							X			1	0.11
Ives lake cisco	*Coregonus hubbsi*	Vert	Fish	Salmonidae						X, MI (wUP)				T																						1	0.11
Pink salmon	*Oncorhynchus gorbusch*	Vert	Fish	Salmonidae		Lac		X	LH	X																							X			1	0.11
Rainbow trout	*Oncorhynchus mykiss*	Vert	Fish	Salmonidae		Riv, Lac		X	LH,LM,LS	X																							X			1	0.11
Round whitefish	*Prosopium cylindraceum*	Vert	Fish	Salmonidae				X	LH,LM,LS	X																							X			1	0.11
Brown trout	*Salmo trutta*	Vert	Fish	Salmonidae		Riv, Lac		X	LH,LM,LS	X																							X			1	0.11
Brook trout, Heritage strains	*Salvelinus fontinalis*	Vert	Fish	Salmonidae		Riv, Lac		X	LH,LM,LS	X																							X			1	0.11

Freshwater drum	*Aplodinotus grunniens*	Vert	Fish	Sciaenidae		Riv, Lac			LH,LM,LS	X																							X			1	0.11
Pygmy whitefish	*Prosopium coulterii*	Vert	Fish															X																		1	0.11
Spotted Salamander	*Ambystoma maculatum*	Vert	Herp	Salamandar	Amphibian	For, Rip				X, WI								X																		1	0.11
Eastern Ratsnake	*Elaphe obsoleta*	Vert	Herp	Snake	Reptile	For												X																		1	0.11
Eastern Foxsnake	*Elaphe vulpina*	Vert	Herp	Snake	Reptile	For, Pal, Rip			PI	X								X																		1	0.11
Eastern Hog-nosed Snake	*Heterodon platirhinos*	Vert	Herp	Snake	Reptile	For, Gra				X, WI								X																		1	0.11
Eastern Ratsnake	*Pantherophis obsoletus*	Vert	Herp	Snake	Reptile	Gra, For, Sav												X																		1	0.11
Plains Gartersnake	*Thamnophis radix*	Vert	Herp	Snake	Reptile	Gra									SC																					1	0.11
Bog turtle	*Clemmys muhlenbergii*	Vert	Herp	Turtle	Reptile	Pal							T																							1	0.11
False Map Turtle	*Graptemys pseudogeogr*	Vert	Herp	Turtle	Reptile	Lac, Pal, Riv									SC																					1	0.11
Six-banded Longhorn Beetle	*Dryobius sexnotatus*	Invert	Insect		Coleopter					X, MI (wUP)				T																						1	0.11
Black lordithon rove beetle	*Lordithon niger*	Invert	Insect		Coleopter					X, MI (wUP)				SC																						1	0.11
Walker's tusked sprawler	*Anthopotamus verticis*	Invert	Insect		Ephemero	Aqu				X, MI (wUP)				SC																						1	0.11
A mayfly	*Epeorus suffusus*	Invert	Insect		Ephemero	Aqu				X, MI (wUP)				SC																						1	0.11
A mayfly	*Habrophlebiodes americ*	Invert	Insect		Ephemero	Aqu				X, MI (wUP)				SC																						1	0.11
A Flat-headed Mayfly	*Maccaffertium pulchellu*	Invert	Insect		Ephemero	Aqu				X, WI					SC																					1	0.11
Secretive locust	*Appalachia arcana*	Invert	Insect		Hemiptera					X, MI (UP &				SC																						1	0.11
Leafhopper	*Dorydiella kansana*	Invert	Insect		Hemiptera					X, MI (wUP)				SC																						1	0.11
A Leafhopper	*Flexamia delongi*	Invert	Insect		Hemiptera					X, MI (UP &				SC																						1	0.11
Huron River leafhopper	*Flexamia huroni*	Invert	Insect		Hemiptera					X, MI (wUP)				T																						1	0.11
A Leafhopper	*Flexamia reflexus*	Invert	Insect		Hemiptera					X, MI (wUP)				SC																						1	0.11
Angular Spittlebug	*Lepyronia angulifera*	Invert	Insect		Hemiptera					X, MI (wUP)				SC																						1	0.11
Great Plains spittlebug	*Lepyronia gibbosa*	Invert	Insect		Hemiptera					X, MI (UP &				SC																						1	0.11
A fishfly	*Neohermes concolor*	Invert	Insect		Hemiptera	Aqu				X, MI (wUP)				SC																						1	0.11
Red-legged spittlebug	*Prosapia ignipectus*	Invert	Insect		Hemiptera					X, MI (UP &				SC																						1	0.11
Henry's elfin	*Incisalia henrici*	Invert	Insect	Lycaenidae	Lepidopte					X, MI (UP &				T																						1	0.11
Frosted elfin	*Incisalia irus*	Invert	Insect	Lycaenidae	Lepidopte					X, MI (wUP)				T																						1	0.11
Pronghorned Clubtail	*Gomphus graslinellus*	Invert	Insect	Gomphidae	Odonata	Aqu, Pal				X, WI					SC																					1	0.11
Davis's shield-bearer	*Atlanticus davisi*	Invert	Insect		Orthopter					X, MI (wUP)				SC																						1	0.11
Conehead grasshopper	*Neoconocephalus retusu*	Invert	Insect		Orthopter	Gra				X, MI (wUP)				SC																						1	0.11
Tamarack tree cricket	*Oecanthus laricis*	Invert	Insect		Orthopter	Gra				X, MI (wUP)				SC																						1	0.11
Pinetree cricket	*Oecanthus pini*	Invert	Insect		Orthopter	Gra				X, MI (UP &				SC																						1	0.11
Red-faced meadow katydid	*Orchelimum concinnum*	Invert	Insect		Orthopter	Gra				X, MI (wUP)				SC																						1	0.11
Hoosier locust	*Paroxya hoosieri*	Invert	Insect		Orthopter	Gra				X, MI (wUP)				SC																						1	0.11
Atlantic-coast locust	*Psinidia fenestralis*	Invert	Insect		Orthopter	Gra				X, MI (wUP)				SC																						1	0.11
A caddisfly	*Limnephilus pallens*	Invert	Insect		Trichopter	Aqu				X, MI (wUP)				SC																						1	0.11
Cooper's Hawk	*Accipiter cooperii*	Vert	Bird	Accipitridae	Landbird	For				X								X																		1	0.06
Broad-winged Hawk	*Buteo platypterus*	Vert	Bird	Accipitridae	Landbird	For	(m)		PI	X																X (rs) M										1	0.06
Swainson's Hawk	*Buteo swainsoni*	Vert	Bird	Accipitridae	Landbird	Gra																X														1	0.06
Belted Kingfisher	*Ceryle alcyon*	Vert	Bird	Alcedinidae	Landbird	Rip	RS/FE		GLI	X																X (rc) M										1	0.06
Chuck-will's-widow	*Caprimulgus carolinensis*	Vert	Bird	Caprimulgidae	Landbird	For, Sav				X								X																		1	0.06
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	Vert	Bird	Cardinalidae	Landbird	For	MF (b)		PI	X																X (rs) M										1	0.06
Gray Jay	*Perisoreus canadensis*	Vert	Bird	Corvidae	Landbird	For				X								X																		1	0.06
Savannah Sparrow	*Passerculus sandwichens*	Vert	Bird	Emberizidae	Landbird	Gra	GM		PI	X								X																		1	0.06
Eastern Towhee	*Pipilo erythrophthalmus*	Vert	Bird	Emberizidae	Landbird	Gra, Shr	FE (b)		PI	X								X																		1	0.06
Vesper Sparrow	*Pooecetes gramineus*	Vert	Bird	Emberizidae	Landbird	Gra				X								X																		1	0.06
White-throated Sparrow	*Zonotrichia albicollis*	Vert	Bird	Emberizidae	Landbird	Shr	FE		PI	X																X L										1	0.06
Purple Finch	*Carpodacus purpureus*	Vert	Bird	Fringillidae	Landbird	Shr				X																X (rc) M										1	0.06
Evening Grosbeak	*Coccothraustes vespertir*	Vert	Bird	Fringillidae	Landbird	For				X								X																		1	0.06
Red Crossbill	*Loxia curvirostra*	Vert	Bird	Fringillidae	Landbird	For				X								X																		1	0.06
White-winged Crossbill	*Loxia leucoptera*	Vert	Bird	Fringillidae	Landbird	For				X								X																		1	0.06
Barn Swallow	*Hirundo rustica*	Vert	Bird	Hirundinidae	Landbird	Dev, Gra, Rip	GM (b)		PI	X																X (rc) M										1	0.06
Bank Swallow	*Riparia riparia*	Vert	Bird	Hirundinidae	Landbird	Rip				X																X (rc) M										1	0.06
Baltimore Oriole	*Icterus galbula*	Vert	Bird	Icteridae	Landbird	For	FE (b)		PI	X															X											1	0.06
Northern Shrike	*Lanius excubitor*	Vert	Bird	Laniidae	Landbird	Gra, Shr				X								X																		1	0.06
Northern mockingbird	*Mimus polyglottos*	Vert	Bird	Mimidae	Landbird	Shr				X								X																		1	0.06
Common Yellowthroat	*Geothlypis trichas*	Vert	Bird	Parulidae	Landbird	Gra, Pal	W (b)		PI	X																X (rs) M										1	0.06
Swainson's Warbler	*Limnothlypis swainsonii*	Vert	Bird	Parulidae	Landbird	For																X														1	0.06
Northern Parula	*Setophaga americana*	Vert	Bird	Parulidae	Landbird	For	MF (m)		PI	X								X																		1	0.06

Palm Warbler	*Setophaga palmarum*	Vert	Bird	Parulidae	Landbird	For, Gra	FE (m)		PI	X								X																		1	0.06
Chestnut-sided Warbler	*Setophaga pensylvanica*	Vert	Bird	Parulidae	Landbird	For, Rip, Shr	FE (m)		PI	X																X (rs) M										1	0.06
Black-throated Green Warbler	*Setophaga virens*	Vert	Bird	Parulidae	Landbird	For	MF (b)		PI	X																X (rc) M										1	0.06
Nashville Warbler	*Vermivora ruficapilla*	Vert	Bird	Parulidae	Landbird	For	FE		PI	X																X L										1	0.06
Ruffed grouse	*Bonasa umbellus*	Vert	Bird	Phasianidae	Landbird	For, Shr		X		X																X (rs) M										1	0.06
Yellow-bellied Sapsucker	*Sphyrapicus varius*	Vert	Bird	Picidae	Landbird	For	FE/MF		GLI	X																X (rs)										1	0.06
Swainson's Thrush	*Catharus ustulatus*	Vert	Bird	Turdidae	Landbird	For	MF (m)		PI	X	X				SC																					1	0.06
Eastern Kingbird	*Tyrannus tyrannus*	Vert	Bird	Tyrannidae	Landbird	Rip, Shr	FE (b)		PI	X								X																		1	0.06
Yellow-throated Vireo	*Vireo flavifrons*	Vert	Bird	Vireonidae	Landbird	Gra, Shr	MF (b)		PI	X															X											1	0.06
Black-bellied Plover	*Pluvialis squatarola*	Vert	Bird	Charadriidae	Shorebird	Pal			GI	X																			M, 4							1	0.06
American Avocet	*Recurvirostra americana*	Vert	Bird	Recurvirostrid	Shorebird	Pal				X																			M							1	0.06
Baird's Sandpiper	*Calidris bairdii*	Vert	Bird	Scolopacidae	Shorebird	Pal				X																			M, 4							1	0.06
Least Sandpiper	*Calidris minutilla*	Vert	Bird	Scolopacidae	Shorebird	Pal			SI,GI	X																			M, 5							1	0.06
Long-billed Dowitcher	*Limnodromus scolopace*	Vert	Bird	Scolopacidae	Shorebird	Pal				X																			m, 5							1	0.06
Red-necked Phalarope	*Phalaropus lobatus*	Vert	Bird	Scolopacidae	Shorebird	Pal																							M, 3							1	0.06
Willet	*Tringa semipalmata*	Vert	Bird	Scolopacidae	Shorebird	Pal				X																			m, 3							1	0.06
Cattle Egret	*Bubulcus ibis*	Vert	Bird	Ardeidae	Waterbird	Dev, Gra				X																				b/m						1	0.06
Red-throated Loon	*Gavia stellata*	Vert	Bird	Gaviidae	Waterbird	Lac, Riv				X																				M						1	0.06
Sandhill Crane	*Grus canadensis*	Vert	Bird	Gruidae	Waterbird	Pal	GM	X	PI	X																				B						1	0.06
Little Gull	*Hydrocoloeus minutus*	Vert	Bird	Laridae	Waterbird	Lac, Riv																								M						1	0.06
Herring Gull	*Larus argentatus*	Vert	Bird	Laridae	Waterbird	Dev, Lac, Riv	RS/SB		PI,SI,GI	X																				B/w						1	0.06
Ring-billed Gull	*Larus delawarensis*	Vert	Bird	Laridae	Waterbird	Dev, Lac, Riv	SB/RS		PI,SI,GI	X																				B/w						1	0.06
Iceland Gull	*Larus glaucoides*	Vert	Bird	Laridae	Waterbird	Lac, Riv																								W						1	0.06
Glaucous Gull	*Larus hyperboreus*	Vert	Bird	Laridae	Waterbird	Dev, Lac				X																				W						1	0.06
Great Black-backed Gull	*Larus marinus*	Vert	Bird	Laridae	Waterbird	Dev, Lac	RS (b)		GLI	X	X																			b/w						1	0.06
Bonaparte's Gull	*Larus philadelphia*	Vert	Bird	Laridae	Waterbird	Lac, Riv	SB/RS		GLI	X	X																			*w/m*						1	0.06
Franklin's Gull	*Leucophaeus pipixcan*	Vert	Bird	Laridae	Waterbird	Lac, Riv				X																				M						1	0.06
Parasitic Jaeger	*Stercorarius parasiticus*	Vert	Bird	Laridae	Waterbird	Lac																								*M*						1	0.06
Sabine's Gull	*Xema sabini*	Vert	Bird	Laridae	Waterbird	Lac, Riv																								*M*						1	0.06
Western Grebe	*Aechmophorus occident*	Vert	Bird	Podicipedidae	Waterbird	Lac, Riv																								B/m						1	0.06
Eared Grebe	*Podiceps nigricollis*	Vert	Bird	Podicipedidae	Waterbird	Lac, Pal, Riv				X																				B						1	0.06
Northern Shoveler	*Anas clypeata*	Vert	Bird	Anatidae	Waterfowl	Pal		X		X																					b/n					1	0.06
Green-winged Teal	*Anas crecca*	Vert	Bird	Anatidae	Waterfowl	Pal	OW (m)	X	GLI	X																					b/n					1	0.06
Gadwall	*Anas strepera*	Vert	Bird	Anatidae	Waterfowl	Gra, Pal	OW (m)	X	GI	X																					b/n					1	0.06
Ring-necked Duck	*Aythya collaris*	Vert	Bird	Anatidae	Waterfowl	Lac, Rip, Riv		X		X																					B/N					1	0.06
Bufflehead	*Bucephala albeola*	Vert	Bird	Anatidae	Waterfowl	Lac, Riv	OW (m)	X	GLI	X																					b/N					1	0.06
Long-tailed Duck	*Clangula hyemalis*	Vert	Bird	Anatidae	Waterfowl	Lac	OW (m)	X	GLI	X																					n					1	0.06
Mute swan	*Cygnus olor*	Vert	Bird	Anatidae	Waterfowl	Lac, Riv	OW/RS		PI,SI,GI,HI	X																					B/N					1	0.06
White-winged Scoter	*Melanitta fusca*	Vert	Bird	Anatidae	Waterfowl	Lac		X		X																					N					1	0.06
Black Scoter	*Melanitta nigra*	Vert	Bird	Anatidae	Waterfowl	Lac		X		X																					N					1	0.06
Surf Scoter	*Melanitta perspicillata*	Vert	Bird	Anatidae	Waterfowl	Lac		X		X																					N					1	0.06
Common Merganser	*Mergus merganser*	Vert	Bird	Anatidae	Waterfowl	Lac, Riv	OW (m)	X	PI,SI,GI	X																					b					1	0.06
Ruddy Duck	*Oxyura jamaicensis*	Vert	Bird	Anatidae	Waterfowl	Lac, Pal, Riv		X		X																					B/n					1	0.06
Sharp-shinned Hawk	*Accipiter striatus*	Vert	Bird	Accipitridae	Landbird	For	FE		PI	X																										0	0.00
Golden Eagle	*Aquila chrysaetos*	Vert	Bird	Accipitridae	Landbird	For, Gra																														0	0.00
Red-tailed Hawk	*Buteo jamaicensis*	Vert	Bird	Accipitridae	Landbird	Gra	FE/GF/		GLI	X																										0	0.00
Rough-legged Hawk	*Buteo lagopus*	Vert	Bird	Accipitridae	Landbird	Gra				X																										0	0.00
Horned Lark	*Eremophila alpestris*	Vert	Bird	Alaudidae	Landbird	Dev, Gra				X																										0	0.00
Cedar Waxwing	*Bombycilla cedrorum*	Vert	Bird	Bombycillidae	Landbird	Shr	FE		PI	X																										0	0.00
Northern Cardinal	*Cardinalis cardinalis*	Vert	Bird	Cardinalidae	Landbird	Dev, Shr	MF (b)		PI	X																										0	0.00
Blue Grosbeak	*Guiraca caerulea*	Vert	Bird	Cardinalidae	Landbird	Gra, Shr				X																										0	0.00
Indigo Bunting	*Passerina cyanea*	Vert	Bird	Cardinalidae	Landbird	Shr	FE (b)		PI	X																										0	0.00
Scarlet Tanager	*Piranga olivacea*	Vert	Bird	Cardinalidae	Landbird	For				X																										0	0.00
Summer Tanager	*Piranga rubra*	Vert	Bird	Cardinalidae	Landbird	For																														0	0.00
Turkey Vulture	*Cathartes aura*	Vert	Bird	Cathartidae	Landbird	For, Gra	FE (m)		PI	X																										0	0.00
Brown Creeper	*Certhia americana*	Vert	Bird	Certhiidae	Landbird	For	MF		PI	X																										0	0.00
Mourning Dove	*Zenaida macroura*	Vert	Bird	Columbidae	Landbird	Dev, Shr	GM/FE	X	PI	X																										0	0.00
American Crow	*Corvus brachyrhynchos*	Vert	Bird	Corvidae	Landbird	Dev, For, Shr	MF (b)	X	PI	X																										0	0.00
Common Raven	*Corvus corax*	Vert	Bird	Corvidae	Landbird	For	MF (b)		PI	X																										0	0.00

Dark-eyed Junco	*Junco hyemalis*	Vert	Bird	Emberizidae	Landbird	Gra, Shr	FE/GM		PI	X																										0	0.00
Lincoln's Sparrow	*Melospiza lincolnii*	Vert	Bird	Emberizidae	Landbird	Gra, Shr	FE (m)		PI	X																										0	0.00
Song Sparrow	*Melospiza melodia*	Vert	Bird	Emberizidae	Landbird	Gra, Shr	FE (b)		PI	X																										0	0.00
Fox Sparrow	*Passerella iliaca*	Vert	Bird	Emberizidae	Landbird	For, Shr				X																										0	0.00
American Tree Sparrow	*Spizella arborea*	Vert	Bird	Emberizidae	Landbird	Gra, Shr				X																										0	0.00
Clay-colored Sparrow	*Spizella pallida*	Vert	Bird	Emberizidae	Landbird	Gra, Shr				X																										0	0.00
Chipping Sparrow	*Spizella passerina*	Vert	Bird	Emberizidae	Landbird	Gra, Shr	GM (b)		PI	X																										0	0.00
White-crowned Sparrow	*Zonotrichia leucophrys*	Vert	Bird	Emberizidae	Landbird	Shr	FE (m)		PI	X																										0	0.00
Harris's Sparrow	*Zonotrichia querula*	Vert	Bird	Emberizidae	Landbird	Shr				X																										0	0.00
American Kestrel	*Falco sparverius*	Vert	Bird	Falconidae	Landbird	Gra				X																										0	0.00
Common Redpoll	*Acanthis flammea*	Vert	Bird	Fringillidae	Landbird	Gra				X																										0	0.00
American Goldfinch	*Carduelis tristis*	Vert	Bird	Fringillidae	Landbird	Gra, Shr	FE/GM		PI	X																										0	0.00
House Finch	*Carpodacus mexicana*	Vert	Bird	Fringillidae	Landbird	Dev, Shr	FE (b)		PI	X																										0	0.00
Pine Siskin	*Spinus pinus*	Vert	Bird	Fringillidae	Landbird	Gra, Shr				X																										0	0.00
Cliff Swallow	*Hirundo pyrrhonota*	Vert	Bird	Hirundinidae	Landbird	Rip	SB/RS		GLI	X																										0	0.00
Tree Swallow	*Tachycineta bicolor*	Vert	Bird	Hirundinidae	Landbird	Gra, Pal, Rip	FE		PI	X																										0	0.00
Red-winged Blackbird	*Agelaius phoeniceus*	Vert	Bird	Icteridae	Landbird	Gra, Pal	GM/W		PI	X																										0	0.00
Brewer's Blackbird	*Euphagus cyanocephalu*	Vert	Bird	Icteridae	Landbird	Dev, Gra				X																										0	0.00
Brown-headed Cowbird	*Molthrus ater*	Vert	Bird	Icteridae	Landbird	Dev, For, Shr	FE (b)		PI	X																										0	0.00
Common Grackle	*Quiscalus quiscula*	Vert	Bird	Icteridae	Landbird	Dev, For, Shr	FE (b)		PI	X																										0	0.00
Blue Jay	*Cyanocitta cristata*	Vert	Bird	Mimidae	Landbird	For, Shr	MF		PI	X																										0	0.00
Gray Catbird	*Dumetella carolinensis*	Vert	Bird	Mimidae	Landbird	Shr	FE		PI	X																										0	0.00
Black-capped Chickadee	*Parus atricapillus*	Vert	Bird	Paridae	Landbird	For, Shr	MF (b)		PI	X																										0	0.00
Tufted Titmouse	*Parus bicolor*	Vert	Bird	Paridae	Landbird	For, Shr																														0	0.00
Carolina Chickadee	*Parus carolinensis*	Vert	Bird	Paridae	Landbird	For, Shr																														0	0.00
Wilson's Warbler	*Cardellina citrina*	Vert	Bird	Parulidae	Landbird	For, Rip				X																										0	0.00
Black-and-white Warbler	*Mniotilta varia*	Vert	Bird	Parulidae	Landbird	For	MF (m)		PI	X																										0	0.00
Orange-crowned Warbler	*Oreothlypis celata*	Vert	Bird	Parulidae	Landbird	For				X																										0	0.00
Northern Waterthrush	*Parkesia noveboracensis*	Vert	Bird	Parulidae	Landbird	Rip				X																										0	0.00
Ovenbird	*Seiurus aurocapilla*	Vert	Bird	Parulidae	Landbird	For	MF (b)		PI	X																										0	0.00
Yellow-rumped Warbler	*Setophaga coronata*	Vert	Bird	Parulidae	Landbird	For, Pal, Rip	FE (m)		PI	X																										0	0.00
Magnolia Warbler	*Setophaga magnolia*	Vert	Bird	Parulidae	Landbird	For	FE (m)		PI	X																										0	0.00
Yellow Warbler	*Setophaga petechia*	Vert	Bird	Parulidae	Landbird	Rip, Shr	FE (b)		PI	X																										0	0.00
Pine Warbler	*Setophaga pinus*	Vert	Bird	Parulidae	Landbird	For	MF (m)		PI	X																										0	0.00
American Redstart	*Setophaga ruticilla*	Vert	Bird	Parulidae	Landbird	For	FE/W		PI	X																										0	0.00
Blackpoll Warbler	*Setophaga striata*	Vert	Bird	Parulidae	Landbird	For, Shr	MF (m)		PI	X																										0	0.00
Tennessee warbler	*Vermivora peregrina*	Vert	Bird	Parulidae	Landbird	For	MF/FE		PI	X																										0	0.00
Wild Turkey	*Meleagris gallopavo*	Vert	Bird	Phasianidae	Landbird	For, Shr		X		X																										0	0.00
Ring-necked Pheasant	*Phasianus colchicus*	Vert	Bird	Phasianidae	Landbird	Gra		X		X																										0	0.00
Pileated Woodpecker	*Dryocopus pileatus*	Vert	Bird	Picidae	Landbird	For	MF		PI	X																										0	0.00
Red-bellied Woodpecker	*Melanerpes carolinus*	Vert	Bird	Picidae	Landbird	For	MF		PI	X																										0	0.00
Downy Woodpecker	*Picoides pubescens*	Vert	Bird	Picidae	Landbird	For	MF (b)		PI	X																										0	0.00
Three-toed woodpecker	*Picoides tridactylus*	Vert	Bird	Picidae	Landbird	For				X																										0	0.00
Hairy Woodpecker	*Picoides villosus*	Vert	Bird	Picidae	Landbird	For	MF (b)		PI	X																										0	0.00
Golden-crowned Kinglet	*Regulus satrapa*	Vert	Bird	Regulidae	Landbird	For, Shr	MF/FE		PI	X																										0	0.00
Red-breasted Nuthatch	*Sitta canadensis*	Vert	Bird	Sittidae	Landbird	For	MF		PI	X																										0	0.00
White-breasted Nuthatch	*Sitta carolinensis*	Vert	Bird	Sittidae	Landbird	For	MF (b)		PI	X																										0	0.00
Northern Saw-whet Owl	*Aegolius acadicus*	Vert	Bird	Strigidae	Landbird	For				X																										0	0.00
Boreal Owl	*Aegolius funereus*	Vert	Bird	Strigidae	Landbird	For				X																										0	0.00
Great Horned Owl	*Bubo virginianus*	Vert	Bird	Strigidae	Landbird	For, Gra	FE (b)		PI	X																										0	0.00
Barred Owl	*Falco sparverius*	Vert	Bird	Strigidae	Landbird	For, Gra				X																										0	0.00
Snowy Owl	*Nyctea scandica*	Vert	Bird	Strigidae	Landbird	Gra				X																										0	0.00
Eastern Screech Owl	*Otus asio*	Vert	Bird	Strigidae	Landbird	For				X																										0	0.00
European Starling	*Sturnus vulgaris*	Vert	Bird	Sturnidae	Landbird	Dev, Gra, Shr	FE/GM		PI	X																										0	0.00
Blue-gray Gnatcatcher	*Polioptila caerulea*	Vert	Bird	Sylviidae	Landbird	For	MF (m)		PI	X																										0	0.00
Scarlet Tanager	*Piranga olivacea*	Vert	Bird	Thraupidae	Landbird	For	FE/MF		PI	X																										0	0.00
Ruby-throated Hummingbird	*Archilochus colubris*	Vert	Bird	Trochilidae	Landbird	For, Gra	FE		PI	X																										0	0.00
Carolina Wren	*Thryothorus ludovicianu*	Vert	Bird	Troglodytidae	Landbird	For, Shr																														0	0.00
House Wren	*Troglodytes aedon*	Vert	Bird	Troglodytidae	Landbird	Dev, For, Shr	FE (b)		PI	X																										0	0.00

Winter Wren	*Troglodytes troglodytes*	Vert	Bird	Troglodytidae	Landbird	For, Rip	W (b)		PI	X																										0	0.00
Hermit Thrush	*Catharus guttatus*	Vert	Bird	Turdidae	Landbird	For	MF		PI	X																										0	0.00
Gray-cheeked Thrush	*Catharus minimus*	Vert	Bird	Turdidae	Landbird	For, Shr	MF (m)		PI	X																										0	0.00
Eastern Bluebird	*Sialisa sialis*	Vert	Bird	Turdidae	Landbird	Gra, Shr	GM (b)		PI	X																										0	0.00
American Robin	*Turdus migratorius*	Vert	Bird	Turdidae	Landbird	Dev, For, Gra	MF/FE		PI	X																										0	0.00
Great Crested Flycatcher	*Myiarchus crinitus*	Vert	Bird	Tyranidae	Landbird		MF (b)		GLI	X																										0	0.00
Eastern Wood-pewee	*Contopus virens*	Vert	Bird	Tyrannidae	Landbird	For	MF (b)		PI	X																										0	0.00
Alder Flycatcher	*Empidonax alnorum*	Vert	Bird	Tyrannidae	Landbird	For, Rip	FE		PI	X																										0	0.00
Yellow-bellied Flycatcher	*Empidonax flaviventris*	Vert	Bird	Tyrannidae	Landbird	For, Rip				X																										0	0.00
Great-crested Flycatcher	*Myiarchus crinitus*	Vert	Bird	Tyrannidae	Landbird	For, Rip			PI	X																										0	0.00
Eastern Phoebe	*Sayornis phoebe*	Vert	Bird	Tyrannidae	Landbird	Dev, For, Shr	MF (b)		PI	X																										0	0.00
Western Kingbird	*Tyrannus verticalis*	Vert	Bird	Tyrannidae	Landbird	Gra, Rip, Shr				X																										0	0.00
Warbling Vireo	*Vireo gilvus*	Vert	Bird	Vireonidae	Landbird	For				X																										0	0.00
Red-eyed Vireo	*Vireo olivaceus*	Vert	Bird	Vireonidae	Landbird	Shr	MF/FE		PI	X																										0	0.00
Philadelphia Vireo	*Vireo philadelphicus*	Vert	Bird	Vireonidae	Landbird	For				X																										0	0.00
Blue-headed Vireo	*Vireo solitarius*	Vert	Bird	Vireonidae	Landbird	For	MF		PI	X																										0	0.00
Laughing gull	*Larus atricilla*	Vert	Bird	Laridae	Waterbird	Dev, Lac, Riv																														0	0.00
Lesser Black-backed Gull	*Larus fuscus*	Vert	Bird	Laridae	Waterbird	Lac, Riv																														0	0.00
Black skimmer	*Rynchops niger*	Vert	Bird	Laridae	Waterbird	Pal																														0	0.00
Greater White-fronted Goose	*Anser albifrons*	Vert	Bird	Anatidae	Waterfowl	Gra, Lac, Riv		X																												0	0.00
Atlantic brant	*Branta bernicla*	Vert	Bird	Anatidae	Waterfowl	Lac		X																												0	0.00
Snow Goose, Greater	*Chen caerulescens*	Vert	Bird	Anatidae	Waterfowl	Gra, Pal		X		X																										0	0.00
Ross's Goose	*Chen rossii*	Vert	Bird	Anatidae	Waterfowl	Gra, Pal		X		X																										0	0.00
Harlequin duck	*Histrionicus histrionicus*	Vert	Bird	Anatidae	Waterfowl	Lac, Riv		X																												0	0.00
Red-breasted Merganser	*Mergus serrator*	Vert	Bird	Anatidae	Waterfowl	Lac, Riv	OW/RS	X	PI,HI	X																										0	0.00
Green sunfish	*Lepomis cyanellus*	Vert	Fish	Centrarchidae		Riv, Lac, Aqu		X																												0	0.00
Bluegill	*Lepomis macrochirus*	Vert	Fish	Centrarchidae		Riv, Lac, Aqu		X																												0	0.00
Redear Sunfish	*Lepomis microlophus*	Vert	Fish	Centrarchidae				X																												0	0.00
Redspotted sunfish	*Lepomis miniatus*	Vert	Fish	Centrarchidae		Riv, Aqu		X																												0	0.00
Bantam Sunfish	*Lepomis symmetricus*	Vert	Fish	Centrarchidae		Riv		X																												0	0.00
Largemouth bass	*Micropterus salmoides*	Vert	Fish	Centrarchidae		Riv, Lac, Aqu		X																												0	0.00
White crappie	*Pomoxis annularis*	Vert	Fish	Centrarchidae		Lac		X																												0	0.00
Black crappie	*Pomoxis nigromaculatus*	Vert	Fish	Centrarchidae		Lac, Aqu		X																												0	0.00
Redbreast sunfish	*Lepomis auritus*	Vert	Fish	Centrarchidae		Lac		X																												0	0.00
Spotted bass	*Micropterus punctulatus*	Vert	Fish	Centrarchidae		Riv		X																												0	0.00
Goldfish	*Carassius auratus*	Vert	Fish	Cyprinidae		Lac		n																												0	0.00
Lake Chub	*Couesius plumbeus*	Vert	Fish	Cyprinidae		Lac																														0	0.00
Grass carp	*Ctenopharyngodon idell*	Vert	Fish	Cyprinidae		Riv, Aqu		n																												0	0.00
Bigeye Chub	*Hybopsis amblops*	Vert	Fish	Cyprinidae		Riv																														0	0.00
Silver carp	*Hypophthalmichthys mo*	Vert	Fish	Cyprinidae		Riv		n																												0	0.00
Bighead carp	*Hypophthalmichthys nol*	Vert	Fish	Cyprinidae		Riv		n																												0	0.00
Flathead chub	*Platygobio gracilis*	Vert	Fish	Cyprinidae		Riv		X																												0	0.00
Banded Pygmy Sunfish	*Elassoma zonatum*	Vert	Fish	Elassomatida		Riv		X																												0	0.00
Black bullhead	*Ameiurus melas*	Vert	Fish	Ictaluridae		Riv, Lac, Aqu		X																												0	0.00
Blue catfish	*Ictalurus furcatus*	Vert	Fish	Ictaluridae		Riv																														0	0.00
Yellow bullhead	*Ictalurus natalis*	Vert	Fish	Ictaluridae		Riv, Lac, Aqu		X																												0	0.00
Channel catfish	*Ictalurus punctatus*	Vert	Fish	Ictaluridae		Riv		X																												0	0.00
Flathead catfish	*Pylodictis olivaris*	Vert	Fish	Ictaluridae		Riv		X																												0	0.00
Alligator Gar	*Atractosteus spatula*	Vert	Fish	Lepisosteidae		Riv		X																												0	0.00
Longnose gar	*Lepisosteus osseus*	Vert	Fish	Lepisosteidae		Riv		X																												0	0.00
Hybrid striped bass	*Morone chrysops x M. s*	Vert	Fish	Moronidae		Riv, Lac		n																												0	0.00
Yellow Bass	*Morone mississippiensis*	Vert	Fish	Moronidae				X																												0	0.00
Striped bass	*Morone saxatilis*	Vert	Fish	Moronidae		Riv, Lac		n																												0	0.00
Mosquitofish	*Gambusia affinis*	Vert	Fish	Poeciliidae		Riv		n																												0	0.00
Deepwater cisco	*Coregonus johannae*	Vert	Fish	Salmonidae				X		X, MI (wUP)																										0	0.00
Cutthroat trout	*Oncorhynchus clarki*	Vert	Fish	Salmonidae		Riv, Lac		X																												0	0.00
Lake trout	*Salvelinus namaycush*	Vert	Fish	Salmonidae		Lac		X																												0	0.00
Gray Treefrog	*Hyla versicolor*	Vert	Herp	Frog	Amphibian	Aqu, For, Pal			PI	X																										0	0.00
Spring Peeper	*Pseudacris crucifer*	Vert	Herp	Frog	Amphibian	Aqu, Pal			PI	X																										0	0.00

Eastern Newt	*Notophthalmus viridesce*	Vert	Herp	Salamandar	Amphibian	Aqu, For			PI	X																								0	0.00
Northern water snake	*Nerodia sipedon*	Vert	Herp	Snake	Reptile	Lac, Riv, Rip			PI	X																								0	0.00
Northern Brown Snake	*Storeria dekayi dekayi*	Vert	Herp	Snake	Reptile				PI	X																								0	0.00
Eastern Gartersnake (melanistic)	*Thamnophis sirtalis sirta*	Vert	Herp	Snake	Reptile	Gra			PI	X																								0	0.00
Spiny Softshell	*Apalone spinifera*	Vert	Herp	Turtle	Reptile	Lac, Riv		X																										0	0.00
Common Snapping Turtle	*Chelydra serpentina*	Vert	Herp	Turtle	Reptile	Lac, Pal, Riv		X																										0	0.00
American Bison	*Bison bison*	Vert	Mamma	Bovidae	Artiodacty					X																								0	0.00
White-tailed deer	*Odocoileus virginianus*	Vert	Mamma	Cervidae	Artiodacty			X	PI	X	X																							0	0.00
Coyote	*Canis latrans*	Vert	Mamma	Canidae	Carnivora			X	PI	X																								0	0.00
Gray fox	*Urocyon cinereoargente*	Vert	Mamma	Canidae	Carnivora			X		X																								0	0.00
Red fox	*Vulpes vulpes*	Vert	Mamma	Canidae	Carnivora			X		X																								0	0.00
Bobcat	*Lynx rufus*	Vert	Mamma	Felidae	Carnivora					X																								0	0.00
Mountain Lion	*Puma concolor*	Vert	Mamma	Felidae	Carnivora					X																								0	0.00
Striped skunk	*Mephitis mephitis*	Vert	Mamma	Mephitidae	Carnivora			X		X																								0	0.00
River Otter	*Lontra canadensis*	Vert	Mamma	Mustelidae	Carnivora			X		X																								0	0.00
Fisher	*Martes pennanti*	Vert	Mamma	Mustelidae	Carnivora			X		X																								0	0.00
Ermine	*Mustela erminea*	Vert	Mamma	Mustelidae	Carnivora			X		X																								0	0.00
Long-tailed weasel	*Mustela frenata*	Vert	Mamma	Mustelidae	Carnivora			X		X																								0	0.00
Black-footed Ferret	*Mustela nigripes*	Vert	Mamma	Mustelidae	Carnivora			X		X																								0	0.00
Mink	*Mustela vison*	Vert	Mamma	Mustelidae	Carnivora			X		X																								0	0.00
Raccoon	*Procyon lotor*	Vert	Mamma	Procyonidae	Carnivora			X	PI	X																								0	0.00
Black Bear	*Ursus americanus*	Vert	Mamma	Ursidae	Carnivora			X		X																								0	0.00
Virginia Opossum	*Didelphis virginiana*	Vert	Mamma	Didelphidae	Didelphim			X		X																								0	0.00
Snowshoe hare	*Lepus americanus*	Vert	Mamma	Leporidae	Lagomorp			X		X																								0	0.00
Eastern cottontail	*Sylvilagus floridanus*	Vert	Mamma	Leporidae	Lagomorp			X		X																								0	0.00
Beaver	*Castor canadensis*	Vert	Mamma	Castoridae	Rodentia			X		X																								0	0.00
Muskrat	*Ondatra zibethicus*	Vert	Mamma	Cricetidae	Rodentia			X		X																								0	0.00
Eastern gray squirrel	*Sciurus carolinensis*	Vert	Mamma	Sciuridae	Rodentia			X		X																								0	0.00
Eastern fox squirrel	*Sciurus niger*	Vert	Mamma	Sciuridae	Rodentia			X		X																								0	0.00
Red Squirrel	*Tamiasciurus hudsonicus*	Vert	Mamma	Sciuridae	Rodentia			X		X																								0	0.00
Zebra mussel	*Dreissena polymorpha*	Invert	Mollusca		Mussel	Lac, Riv		n		X																								0	0.00

GL Islands NWR http://www.fws.gov/mid						Habitat				Range Sources						CANADA					Ratio of Plan Inclusion			
Common Name	*Scientific Name*	Vertebrate/Invertebrate/ plant	Taxa Group	Family	Group/Order	Broad Habitat	GL Bird Habitat, CCP 2013 Appendix D	Harvested Species	NWR CCP Documented Species	Species Documented in Range	GB NWR Spp of Management Concern	PROC Y, N, Maybe?	Fed T&E 2013	MI State T &E, 2013	WI State T&E, 2011	CANADA COSEWIC, 2012	CANADA SARA, 2010	MI SWAP, 2006	WI SWAP, 2011	Total Number of Plans		National Rank	Global Rank	MI RANK
Northern Wet-mesic Forest		Habitat	Terrestrial		Forest	For				X, WI									X	1	#N/A		G3?	
Lake Michigan		Habitat	Aquatic		Lacustrine	Lac				X, WI MI								X	X	2	#N/A			
Lake Superior		Habitat	Aquatic		Lacustrine	Lac				X, WI MI								X	X	2	#N/A			
Inland Lakes		Habitat	Aquatic		Lacustrine	Lac				X, WI MI								X	X	2	#N/A			
Mesic Cedar Forest		Habitat	Terrestrial		Forest	For				? WI									X	1	1.00		G3?	
Great Lakes Barrens		Habitat	Terrestrial		Savanna	Bar, Sav				X, WI									X	1	1.00		G2	
Interdunal Wetland		Habitat	Terrestrial		Palustrine	Bar, Pal				X, WI MI								X	X	2	1.00		G2?	S2
Patterned Peatland		Habitat	Terrestrial		Palustrine	Pal, Shr				? WI MI									X	1	1.00		GNR	S2
Alavar		Habitat	Terrestrial		Primary	Gra, Shr				X, WI MI								X	X	2	1.00		G3	S1
Roundstem foxglove	*Agalinis gattingeri*	Plant	Plant	Scroph		Gra, Sav								E	T	E	E			4	0.80		G4	
Boreal Forest		Habitat	Terrestrial		Forest	For				X, WI MI									X	1	0.75		G3?	S3
Bracken Grassland		Habitat	Terrestrial		Grassland	Gra				X, WI									X	1	0.75		G3	
Wet-mesic Prairie/Lakeplain Wet-mesic Prairie		Habitat	Terrestrial		Grassland	Gra, Pal				X, WI MI								X	X	2	0.75		G2	S1
Pine Barrens		Habitat	Terrestrial		Savanna	Bar, Sav				X, WI MI								X	X	2	0.75		G2	S2
Boreal Rich Fen		Habitat	Terrestrial		Palustrine	Pal				X, WI									X	1	0.75		G4G5	
Great Lakes/Wooded Ridge and Swale		Habitat	Terrestrial		Palustrine	Aqu, Pal				X, WI MI								X	X	2	0.75		G3	S3
Shore Fen/Coastal Fen		Habitat	Terrestrial		Palustrine	Aqu, Pal				X, WI MI								X	X	2	0.75		GNR	S2
Great Lakes Alkaline Rockshore		Habitat	Terrestrial		Primary	Sav, Shr				X, WI									X	1	0.75		G3	
Great Lakes Beach		Habitat	Terrestrial		Primary	Bar				X, WI MI								X	X	2	0.75		G3	S3
Great Lakes Dune		Habitat	Terrestrial		Primary	Bar				X, WI									X	1	0.75		G3	
Pitcher's thistle	*Cirsium pitcheri*	Plant	Plant	Compo		Bar				X, WI MI			T	T	T					3	0.60		G3	S3
Dwarf Lake Iris	*Iris lacustris*	Plant	Plant	Iridace		Bar, For			PI	X	X		T	T	T					3	0.60		G3	S3
Northern Dry Forest		Habitat	Terrestrial		Forest	For				X, WI MI								X	X	2	0.50		G3?	S3
Northern Dry-mesic Forest		Habitat	Terrestrial		Forest	For				X, WI MI								X	X	2	0.50		G4	S3
Northern Hardwood Swamp		Habitat	Terrestrial		Forest	For, Pal				X, WI MI								X	X	2	0.50		G4	S3?
Tamarack Poor Swamp/ Poor Conifer Swamp		Habitat	Terrestrial		Forest	For, Pal				? WI MI								X	X	2	0.50		G4	S4
Northern Sedge Meadow/ Northern Wet Mead		Habitat	Terrestrial		Palustrine	Gra, Pal				X, WI MI								X	X	2	0.50		G4	S4
Poor Fen		Habitat	Terrestrial		Palustrine	Pal, Shr				? WI MI								X	X	2	0.50		G3G4	S3
Bedrock Glade		Habitat	Terrestrial		Primary	Bar				X, WI MI								X	X	2	0.50		G2?	S2
Climbing fumitory	*Adlumia fungosa*	Plant	Plant	Fumariaceae		Bar, For			PI	X	X			SC	SC					2	0.40		G4	S3
Round-leaved Orchis	*Amerorchis rotund*	Plant	Plant			For				X, WI MI				E	T					2	0.40		G5	S1
Missouri Rockcress	*Arabis missouriens*	Plant	Plant	Brassicaceae		Bar, For, Gra, Sav				X, WI MI				SC	SC					2	0.40		G5T3?Q	S2
Lake-cress	*Armoracia lacustri*	Plant	Plant			Pal				X, WI MI				T	E					2	0.40		G4?	S2
Dwarf Milkweed	*Asclepias ovalifolia*	Plant	Plant	Asclepiadaceae		Bar, Gra, Sav				X, WI MI				E	T					2	0.40		G5?	S1
Green Spleenwort	*Asplenium viride*	Plant	Plant							X, WI MI				SC	E					2	0.40		G4	S3
Cooper's Milkvetch	*Astragalus neglect*	Plant	Plant			Bar, For				X, WI MI				SC	E					2	0.40		G4	S3
Twining Screwstem	*Bartonia paniculat*	Plant	Plant			Gra, Pal				X, WI MI				T	SC					2	0.40		G5	S2

Prairie Dunewort	*Botrychium campe*	Plant	Plant	Ophiog		Bar, Gra				X, WI MI				T	E					2	0.40		G3G4	S2
Little Goblin Moonwort	*Botrychium morm*	Plant	Plant	Ophiog		For				X, WI MI				T	E					2	0.40		G3	S2
Spoon-leaf Moonwort	*Botrychium spathu*	Plant	Plant	Ophiog		For				X, WI MI				T	SC					2	0.40		G3	S2
Slim-stem Small Reed Grass	*Calamagrostis stri*	Plant	Plant			Gra, Pal				X, WI MI				T	SC					2	0.40		G5	S1
Broad-leaf Sedge	*Carex platyphylla*	Plant	Plant	Cyperaceae		For				X, WI MI				E	SC					2	0.40		G5	S1
Ram's-head Lady's-slipper	*Cypripedium arieti*	Plant	Plant	Orchid		For				X, WI MI				SC	T					2	0.40		G3	S3
Rock Whitlow-grass	*Draba arabisans*	Plant	Plant			Bar				X, WI MI				SC	SC					2	0.40		G4	S3
Limestone Oak Fern	*Gymnocarpium ro*	Plant	Plant	Polypo		Bar, For				X, WI MI				T	SC					2	0.40		G5	S2
Marsh Grass-of-Parnassus	*Parnassia palustris*	Plant	Plant							X, WI MI				T	T					2	0.40		G5	S2
Spotted Pondweed	*Potamogeton pulc*	Plant	Plant							X, WI MI				E	E					2	0.40		G5	S1
Giant Pinedrops	*Pterospora andror*	Plant	Plant							X, WI MI				T	E					2	0.40		G5	S2
Canada Gooseberry	*Ribes oxyacanthoi*	Plant	Plant	Grossul						X, WI MI				SC	T					2	0.40		G5	S3
Marsh Ragwort	*Senecio congestus*	Plant	Plant	Compos						X, WI MI				X	SC					2	0.40		G5	SX
Lake Huron Tansy	*Tanacetum huron*	Plant	Plant	Compos						X, WI MI				T	E					2	0.40		G5T4T5	S3
Dwarf Huckleberry	*Vaccinium cespito*	Plant	Plant							X, WI MI				T	E					2	0.40		G5	S1S2
Northern Mesic Forest		Habitat	Terrestrial		Forest	For				X, WI MI								X	X	2	0.25		G4	S3
Northern Wet Forest		Habitat	Terrestrial		Forest	For				X, WI									X	1	0.25		G4	
Alder Thicket/Northern Shrub Thicket		Habitat	Terrestrial		Palustrine	Pal, Shr				X, WI MI								X	X	2	0.25		G4	S5
richardson's sedge		Habitat	Terrestrial		Palustrine	Aqu, Pal				X, WI MI								X	X	2	0.25		G4	S4
Muskeg		Habitat	Terrestrial		Palustrine	Pal, Shr				? WI MI								X	X	2	0.25		G4G5	S3
Open Bog		Habitat	Terrestrial		Palustrine	Pal, Shr				X, WI MI								X	X	2	0.25		G5	S4
Shrub Carr		Habitat	Terrestrial		Palustrine	Pal, Shr				X, WI MI								X	X	2	0.25		G5	S5
Moist Cliff		Habitat	Terrestrial		Primary	Bar				X, WI									X	1	0.25		GNR	
Dry Cliff		Habitat	Terrestrial		Primary	Bar				X, WI									X	1	0.25		G4G5	
Striped Maple	*Acer pensylvanicu*	Plant	Plant	Acerac		For				X, WI					SC					1	0.20		G5	
Puttyroot	*Aplectrum hyemal*	Plant	Plant			For				X, WI					SC					1	0.20		G5	
Maidenhair Spleenwort	*Asplenium trichon*	Plant	Plant			Bar, For				X, WI					SC					1	0.20		G5	
Common Moonwort	*Botrychium lunari*	Plant	Plant	Ophiog		For				X, WI					E					1	0.20		G5	
Mingan Moonwort	*Botrychium minga*	Plant	Plant	Ophiog		For				X, WI					SC					1	0.20		G4	
Rugulose Grape-fern	*Botrychium rugulo*	Plant	Plant	Ophiog		Bar				X, WI					SC					1	0.20		G3	
American Sea-rocket	*Cakile lacustris*	Plant	Plant	Brassicaceae		Bar			PI GI	X	X				SC					1	0.20		G5	
Low Calamint	*Calamintha arkans*	Plant	Plant			Aqu, Bar, Gra, Pal				X, WI					SC					1	0.20		G5	
Sand Reedgrass	*Calamovilfa longif*	Plant	Plant			Bar				X, WI					T					1	0.20		G5T3T5	
Fairy Slipper	*Calypso bulbosa*	Plant	Plant			For				X, WI					T					1	0.20		G5	
Rocky Mountain Sedge	*Carex backii*	Plant	Plant	Cyperaceae		Bar, For				X, WI					SC					1	0.20		G4	
Hair-like Sedge	*Carex capillaris*	Plant	Plant	Cyperaceae		For				X, WI					SC					1	0.20		G5	
Beautiful Sedge	*Carex concinna*	Plant	Plant	Cyperaceae		For				X, WI					T					1	0.20		G5	
Coast Sedge	*Carex exilis*	Plant	Plant	Cyperaceae		Aqu				X, WI					T					1	0.20		G5	
Handsome Sedge	*Carex formosa*	Plant	Plant	Cyperaceae		Aqu, For				X, WI					T					1	0.20		G4	
Elk Sedge	*Carex garberi*	Plant	Plant	Cyperaceae		Bar				X, WI					T					1	0.20		G5	
Livid Sedge	*Carex livida*	Plant	Plant	Cyperaceae		Aqu, Pal				X, WI					SC					1	0.20		G5T5	
Drooping Sedge	*Carex prasina*	Plant	Plant	Cyperaceae		Aqu, For, Gra				X, WI					T					1	0.20		G4	
Many-headed Sedge	*Carex sychnocephe*	Plant	Plant	Cyperaceae		Aqu, For, Pal				X, WI					SC					1	0.20		G4	
Seaside Spurge	*Chamaesyce (=Eup*	Plant	Plant			Bar				X, WI					SC					1	0.20		G5?	
Tufted Hairgrass	*Deschampsia cesp*	Plant	Plant			Aqu, Bar, For			PI	X	X				SC					1	0.20		G5	
Lanceolate Whitlow-cress	*Draba lanceolata*	Plant	Plant			Bar				X, WI					E					1	0.20		G3G5Q	
Linear-leaved Sundew	*Drosera linearis*	Plant	Plant							X, WI					T					1	0.20		G4	

Spreading Woodfern	*Dryopteris expans*	Plant	Plant	Polypo		For				X, WI					SC					1	0.20		G5	
Fragrant Fern	*Dryopteris fragran*	Plant	Plant	Polypo		Bar, For				X, WI					SC					1	0.20		G5	
Capitate Spike-rush	*Eleocharis flavesce*	Plant	Plant	Cyperaceae		Gra, Pal				X, WI					SC					1	0.20		G5	
Beaked Spike-rush	*Eleocharis rostella*	Plant	Plant	Cyperaceae		Aqu				X, WI					T					1	0.20		G5	
Wolf Spike-rush	*Eleocharis wolfii*	Plant	Plant	Cyperaceae		Gra, Pal				X, WI					E					1	0.20		G3G4	
Thickspike	*Elymus lanceolatu*	Plant	Plant	Poacea		Bar				X, WI					T					1	0.20		G5T3	
Downy Willow-herb	*Epilobium strictum*	Plant	Plant	Onagra		Aqu, Gra, Pal				X, WI					SC					1	0.20		G5?	
Marsh Horsetail	*Equisetum palustr*	Plant	Plant	Equiset		Aqu, For, Gra, Pal, Shr				X, WI					SC					1	0.20		G5	
Variegated Horsetail	*Equisetum variego*	Plant	Plant	Equiset					PI	X, WI	X				SC					1	0.20			
Western Fescue	*Festuca occidenta*	Plant	Plant	Poacea		Bar, For			PI	X, WI					T					1	0.20		G5	
Swamp Bedstraw	*Galium brevipes*	Plant	Plant	Rubiac		Aqu, For, Pal, Shr				X, WI					SC					1	0.20		G4?	
Marsh Bedstraw	*Galium palustre*	Plant	Plant	Rubiac						X, WI					SC					1	0.20		G5	
Northern Comandra	*Geocaulon lividum*	Plant	Plant			Bar, For				X, WI					E					1	0.20		G5	
Giant Rattlesnake-plantain	*Goodyera oblongij*	Plant	Plant			For				X, WI					SC					1	0.20		G5?	
Shrubby St. John's-wort	*Hypericum prolific*	Plant	Plant	Clusiaceae		Gra, Sav				X, WI					SC					1	0.20		G5	
Large-flowered Ground-che	*Leucophysalis gra*	Plant	Plant							X, WI					SC					1	0.20		G4?	
One-flowered Broomrape	*Orobanche uniflor*	Plant	Plant	Oroban					PI	X	X				SC					1	0.20		G5	
Chilean Sweet Cicely	*Osmorhiza berter*	Plant	Plant	Apiace						X, WI					SC					1	0.20		G5	
Small-flowered Grass-of-Par	*Parnassia parvifloi*	Plant	Plant							X, WI					E					1	0.20		G4	
Hairy Beardtongue	*Penstemon hirsutu*	Plant	Plant	Scrophulariaceae						X, WI					SC					1	0.20		G4	
Tubercled Rein-orchid	*Platanthera flava*	Plant	Plant	Orchidaceae						X, WI					T					1	0.20		G4T4Q	
Hooker's Orchid	*Platanthera hooke*	Plant	Plant	Orchidaceae						X, WI					SC					1	0.20		G4	
Christmas Fern	*Polystichum acros*	Plant	Plant							X, WI					SC					1	0.20		G5	
Bird's-eye Primrose	*Primula mistassini*	Plant	Plant							X, WI					SC					1	0.20		G5	
Small Yellow Water Crowfoo	*Ranunculus gmelir*	Plant	Plant	Ranunculaceae						X, WI					E					1	0.20		G5	
Brown Beak-rush	*Rhynchospora fusc*	Plant	Plant							X, WI					SC					1	0.20		G4G5	
Tufted Bulrush	*Scirpus cespitosus*	Plant	Plant	Cyperac						X, WI					T					1	0.20		G5	
Low Spike-moss	*Selaginella selagin*	Plant	Plant							X, WI					E					1	0.20		G5	
Sticky (Dune) Goldenrod	*Solidago simplex v*	Plant	Plant	Compositae					PI	X	X				T					1	0.20		G5T3?	
Shining Ladies'-tresses	*Spiranthes lucida*	Plant	Plant							X, WI					SC					1	0.20		G5	
White Mandarin	*Streptopus amplex*	Plant	Plant	Liliaceae						X, WI					SC					1	0.20		G5	
Canada yew	*Taxus canadensis*	Plant	Plant	Taxaceae					PI HI	X	X				SC					1	0.20			
Heart-leaved Foam-flower	*Tiarella cordifolia*	Plant	Plant							X, WI					E					1	0.20		G5	
Sticky False-asphodel	*Tofieldia glutinosa*	Plant	Plant							X, WI					T					1	0.20		G4G5	
Slender Bog Arrow-grass	*Triglochin palustri*	Plant	Plant	Legumir						X, WI					SC					1	0.20		G5	
Purple False Oats	*Trisetum melicoide*	Plant	Plant							X, WI					E					1	0.20		G4	
Marsh Valerian	*Valeriana sitchens*	Plant	Plant	Valerian						X, WI					T					1	0.20		G4Q	
Narrow-leaved Vervain	*Verbena simplex*	Plant	Plant							X, WI					SC					1	0.20		G5	
Northern Wild-raisin	*Viburnum nudum*	Plant	Plant							X, WI					SC					1	0.20		G5T5	
Long-spurred Violet	*Viola rostrata*	Plant	Plant	Violacea						X, WI					SC					1	0.20		G5	
White Camas	*Zigadenus elegans*	Plant	Plant						PI	X	X				SC					1	0.20		G5T4T5	

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APPENDIX C - ROCSTAR ROC SCORING TABLES

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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 signficiant community type to populate the scoring matrix below.
4. Score filters for each species and/or community based on available data, literature, professional judgement, 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)**

Northern Mesic Forest

Resources	Ratio of Plan Inclusion	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	Comments
Northern wet-mesic Forest	5	10	10	8	7	7	**7.8**	
Bald Eagle	5	10	8	7	10	7	**7.8**	
American Woodcock	5	7	7	10	10	7	**7.5**	Listed as a UMGL surrogate spp. Sensitive to forest succession. Not a focus of future management.
Pileated Woodpecker	1	10	10	7	10	8	**7.45**	Somewhat indicative of old growth forst structure - Studies in Missouri, Virginia, Kentucky, Oregon and Washington report nest tree diameter at breast height (DBH) ranging from 30 to 100 cm (12-40 inches). Pileated Woodpeckers prefer forests with adequate roosting trees, which are often hollow trees with multiple entrance holes. (Nichols 1994). Howe et al. (1992)
Black-throated Green Warbler	1	10	10	5	10	7	**7**	Most northern forest types in WI therefore have this species present, and it is considered a "source/core" species (Howe et al. 1992). Numerous studies show this species is sensitive to forest fragmentation (Askins 2000, Rappole 1995).
Canada Yew	3	8	7	8	7	7	**6.55**	Responsive to deer/moose exclosures (USFS 1993). It is indicative of cool and moist, old-growth conditions (Dansereau, Pierre. 1959. The principal plant associations of the Saint Lawrence Valley. No. 75. Montreal, Canada: Contrib. Inst. Bot. Univ. Montreal. 147 p.)
Northern Flicker	3	7	10	5	7	7	**6.35**	Indicator of cavity nesters and presence of standing dead trees and snags.
Least Flycatcher	1	10	10	5	5	7	**6.25**	WI All bird plan: The Least Flycatcher is a forest generalist. It is found in almost every major type of deciduous and mixed forest, and less commonly in conifers. DellaSala and Rabe (1987) found that disturbances creating forest openings caused aggregations of nesting Least Flycatchers to move deeper into the forest interior. In areas with extensive fragmentation where individual fragments lacked protected interiors, breeding aggregations were absent.
Black-throated Blue Warbler	3	10	3	7	7	7	**6.2**	Robbins et al. (1989) listed this species as area-sensitive, occurring mainly in forest tracts >100 ha. Several authors have found Black-throated Blue Warblers to be tolerant of certain silvicultural systems. Jobes et al. (2004) and Harris and Reed (2002).
Blue-spotted Salamander	3	7	7	7	7	7	**6.2**	Blue-spotted salamanders are considered to be a forest management-sensitive species (deMaynadier and Hunter, 1998). Blue-spotted salamanders are sensitive to forestry management (deMaynadier and Hunter, 1998) and agriculture (Brodman and Kilmurry, 1995; Petranka, 1998) practices. Silviculture produces an edge effect ≤ 35 m that impacts blue-spotted salamander populations in adjacent undisturbed habitat (deMaynadier and Hunter, 1998). Therefore a buffer of at least 35 m should be added to protect core upland habitat, suggesting a radius of 182–199 m is necessary to conserve blue-spotted salamander populations.
American Redstart	1	10	10	5	7	3	**5.95**	
Black-billed Cuckoo	3	7	5	7	7	7	**5.9**	Considered an indicator of intact riparian systems and also insect food resource availability.
							0	
Weight	*0.2*	*0.2*	*0.15*	*0.15*	*0.15*	*0.15*	*1.00*	

Great Lakes Alkaline Rock Shore and Alvar (Includes coastal wetland component)

Resources	Ratio of Plan Inclusion	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	Comments
Great Lakes Beach	7	10	10	5	7	7	**7.75**	From WDNR: This beach community usually occurs in association with active dune systems. The beaches of the Great Lakes are extremely dynamic features, strongly influenced by water level changes and storm events. They support a suite of very specialized organisms, although unprotected shorelines may be entirely unvegetated. The plant species found in this community include (along Lake Michigan) seaside spurge (Euphorbia polygonifolia) and American sea-rocket (Cakile edentula).
Great Lakes Alkaline Rockshore	7	10	10	5	7	7	**7.75**	From WDNR: These are creviced, wave-splashed, nearly horizontal dolomite ledges along Lake Michigan on the Door Peninsula. Depending on lake levels, large expanses of this habitat may be either inundated or exposed during a given year.
Dwarf Lake Iris	7	10	7	8	7	7	**7.75**	Obligate/indicative of intact shoreline habitat. This species has demonstrated that under certain conditions it can readily spread into artificially cleared areas with dryish, calcareous substrates, where it may advance aggressively. (MNFI).
Climbing fumitory	5	10	7	4	7	7	**6.75**	
Double-crested Cormorant	1	10	10	5	7	7	**6.55**	
Sticky (Dune) Goldenrod	3	10	5	5	7	7	**6.2**	From WDNR: Dune Goldenrod (Solidago simplex var. gillmanii), a State Threatened plant, is found on semi-stabilized dunes along Lake Michigan. Blooming occurs early August through early October; fruiting occurs late September through late October. The optimal identification period for this species is late August through early September.
Sedge Wren	3	8	7	7	7	7	**6.4**	Indicative slightly shrubby, open grasslands. (http://water.epa.gov/type/wetlands/assessment/pph2_6.cfm)
Semi-palmated Sandpiper	1	10	7	5	7	7	**6.1**	
Red-breasted Merganser	1	10	10	5	7	5	**6.25**	A study of wintering sea duck habitat selection in southeast Alaska found that mergansers (Red-breasted and Common) were more likely to be present in areas closer to streams and with rocky shoreline and less likely to be in areas with more exposed shoreline and wider intertidal area (Gunn 2009).
Eastern Fox Snake	5	10	7	5	5	5	**6.3**	From MNFI: Requires open wetlands and shorelines. Management of wetland habitats should include maintaining open conditions, providing adequate nesting sites as well as refugia for young snakes by maintaining and/or providing adequate cover (e.g., downed woody debris) and maintaining suitable hibernacula.
Monarch	1	8	7	7	7	7	**6**	Indicative of forb loss and habitat loss on landscape, plus responsive to planting of milkweed and other forbs.
Weight	*0.2*	*0.2*	*0.15*	*0.15*	*0.15*	*0.15*	*1.00*	

Early Successional Transitional Habitat / Colonial Nesting Bird Areas

Resources	Ratio of Plan Inclusion	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	Comments
Black-crowned Night-heron	5	8	5	5	9	7	**6.5**	Indicative of other colonial nesting birds. Responds to ogoing management at islands. Indicates early/mid successional growth.
Caspian Tern	3	10	10	5	7	7	**6.95**	The Caspian Tern nests on freshwater and coastal islands, beaches, and shorelines isolated from human disturbance (Cuthbert and Wires 1999, Strong et al 2004, Matteson 2006). Nest sites generally have little to no vegetation, sometimes resulting from thick layers of fecal deposits surrounding nests (Scharf 1963). The Caspian Tern is able to respond quickly to habitat changes and rapidly colonize new areas (Wires and Cuthbert 2000).
Double-crested Cormorant	1	8	10	5	8	7	**6.3**	
American Sea Rocket	3	7	3	5	5	7	**5**	
Great Egret	1	8	5	7	7	5	**5.4**	See HSI at http://www.nwrc.usgs.gov/wdb/pub/hsi/hsi-078.pdf; Direct from (http://eol.org/pages/1178488/details): The environmental sensitivity of wading birds, coupled with the relative ease of assessing their numbers, makes them attractive as biological indicators of ecosystem health and habitat quality (Custer and Osborn 1977; Powell and Powell 1986; Powell et al. 1989).
							0	
							0	
Weight	*0.2*	*0.2*	*0.15*	*0.15*	*0.15*	*0.15*	*1.00*	

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APPENDIX D - HABITAT MANAGEMENT STRATEGIES AND PRESCRIPTIONS

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This section identifies potential management tools or strategies that are available to land managers to achieve desired habitat objectives. These strategies were identified through successful refuge application, literature review and in consultation with other land managers. This appendix is broken up into four main areas of habitat management routinely encountered by Service staff:

- Invasive Species Management
- Forest Management

The information provided herein is intended to act as a baseline source of background information for managers, technicians, and other individuals involved in management decision making. Additional resources are linked in many sections for additional information regarding management strategies and prescriptions for individual treatments.

D-1 INVASIVE SPECIES MANAGEMENT

Controlling and managing invasive species is a strategy for maintaining the biological integrity and diversity of all habitats. The Fulfilling the Promise National Invasive Species Management Strategy Team developed a national strategy for management of invasive species for the National Wildlife Refuge System in 2002. The importance of invasive species management was also underscored in the Conserving the Future vision document. The strategy recommends the following priority order of action for invasive species management:

1. Prevent invasion of potential invaders.
2. Eradicate new and/or small infestations.
3. Control and/or contain large established infestations.

Potential management strategies for preventing invasive species, prioritizing control efforts for established invasive species, and controlling invasive species are described in detail 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 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

D-2 PREVENTION STRATEGIES

Refuge managers should conduct appropriate and applicable pest detection, environmental surveillance, and monitoring before, during, and after any management activity to determine whether pest management goals are achieved and whether the activity caused any significant unanticipated effects.

In addition to Service 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 invasives 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 Facilities and Construction Projects

Construction projects or mobilization of large equipment and vehicles 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.

To prevent the spread of invasive species along transportation corridors:

- Maintain invasive species-free zones along trails, around parking lots and boat launches, and at other related facilities.
- Inspect these areas often and control new infestations immediately.
- Minimize the number and size of roads on the refuge.
- Remove all mud, dirt, and plant parts from all equipment between projects or when equipment is moved from one location to another.

D-3 CONTROL STRATEGIES

The control prioritization order noted in the introductory section has been demonstrated as the most successful approach to proactively treating invasive species infestations. This is also reinforced by more recent invasive management guidance (Rawlins et al. 2011) and depicted in Figure 1 below.

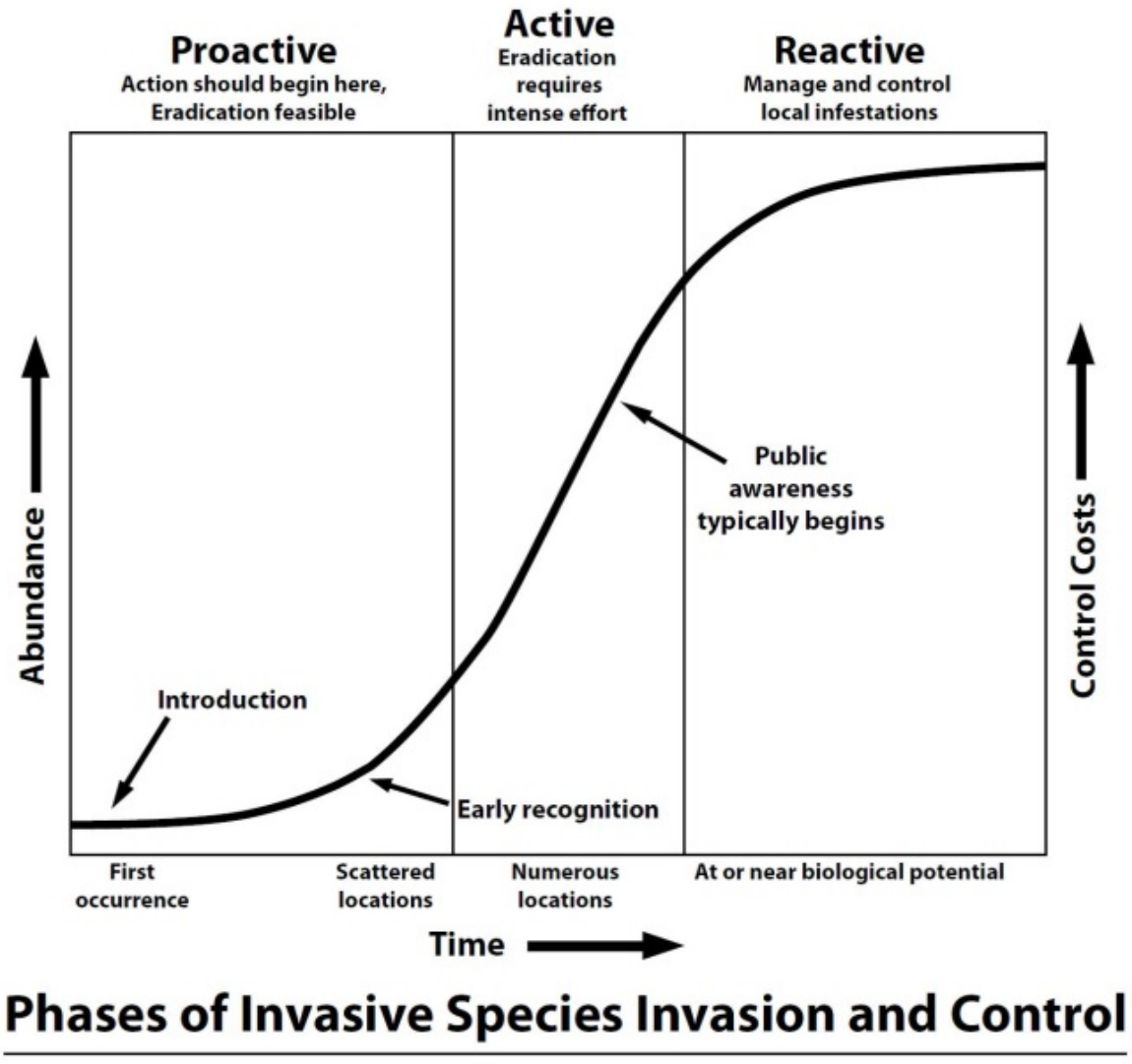

Figure D-1. Phases of invasive species invasion and control (from Rawlins et al. 2011).

Early Detection and Rapid Response

Where prevention is not possible, early detection and rapid response is the next best strategy. Success will depend, in part, on participation by all refuge staff, contractors, volunteers, and visitors in efforts to report and respond to invasions. The refuge manager must have access to up-to-date reliable scientific and management information on species that are likely to invade. For some species, an active monitoring protocol may be established to facilitate early detection.

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 determine the abundance and distribution of invasive species on the refuge or management unit. However, control efforts should not be delayed to collect statistically rigorous survey data. Baseline data regarding the location of many invasives on the refuge already may be available via observations of staff, volunteers, contractors, and refuge visitors. These observations should be documented and mapped. See the

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:

- Smallest scale of infestation
- Poses greatest threat to land management objectives
- 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.

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.

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.

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 citing Rejmánek and Pitcairn 2002). 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, as cited by Zimmerman et al. 2011). 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:

- Areas targeted for planting desired species in order to establish and become competitive.
- Interim competition pressure on desired species needs to be reduced so that they may persist.
- 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 (Department of the Interior 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

Disking and tilling (turning over of top soil and cutting turned soil) is often used in combination with mowing to set back succession and promote both seed germination and invertebrate populations. Disking and tilling breaks up organic root matter, encouraging decomposition, and increasing invertebrate populations. At the same time, it breaks up dense root matter, killing perennial plant and encouraging germinations of annual seed producing plants.

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. The most commonly used chemical for controlling invasive and robust vegetation in impoundment is glyphosate (Rodeo). 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.

D-4 FOREST MANAGEMENT

Silvicultural Prescriptions

Active management generally is not necessary to maintain forest communities. However, if a forested tract is degraded and not meeting habitat objectives, then a silvicultural prescription may be needed. A silvicultural prescription is a detailed set of written instructions for the treatment of a forested property and should be developed prior to the treatment of forested tracts other than invasive species treatments. A forester should be consulted to develop a prescription based on the site conditions and habitat objectives identified in the Habitat Management Plan.

- US Forest Service Silvicultural Methods Overview: http://www.fs.fed.us/ne/newtown_square/publications/technical_reports/pdfs/scanned/ne_gtr144b.pdf
- Wisconsin DNR Silviculture Handbook: http://dnr.wi.gov/topic/ForestManagement/documents/24315/24315.pdf
- Natural Disturbance and Stand Development Principles for Ecological Forestry: http://www.fs.fed.us/nrs/pubs/gtr/gtr_nrs19.pdf

Forest Establishment/Reforestation

Patch size and distribution on the landscape are important considerations in planning and managing habitats. Forest restoration should only occur on parcels within large forested blocks (at least 500 acres, if possible) to reduce fragmentation of the landscape and because many forest-dependent species are area sensitive.

In former agricultural/anthropogenic fields, forests may be established by allowing the area to succeed naturally, by seeding herbaceous, shrub, and tree species, by planting shrub and tree seedlings or saplings, or by a combination of these methods. Shade-tolerant herbaceous species may need to be seeded or planted after a canopy is established as they may not survive full sun conditions. The plants in the surrounding landscape should be surveyed to determine the seed stock. If desirable species are in the surrounding landscape and the invasive species load is low, then natural succession should be allowed to proceed. Invasive or other undesirable species can be selected out with herbicides. It may be desirable to plant only those species that are not already present in the surrounding landscape.

If the area is surrounded by invasive species, then allowing natural succession without seeding or planting natives likely will not be successful. Planting seeds of native species is less expensive than planting seedlings or saplings, but it will take longer for these to become established. A combination of seeding and planting may be the best strategy to “flood” the site with natives to out-compete surrounding invasive species. The seedlings and saplings will produce seed and provide shade more quickly, and the planted seeds will provide competition for invasive seeds already present in the soil. The site must be monitored, and invasive species must be controlled before they become well-established. The invasive species in the surrounding landscape also should be controlled as resources permit.

Whenever nursery shrubs and trees are planted, they should be protected from deer and other herbivores. Selection of species and ecotypes is a critical step in seeding and restoration. Using local seed and plant materials is important in restoration as plants have wide genetic diversity across geographic space.

Additional information regarding tree regeneration, including seeding and planting recommendations, can be found in the links provided above under silvicultural prescriptions.

D-5 REFERENCES

APRS Implementation Team. 2000. Alien plants ranking system version 5.1. Jamestown, ND: Northern Prairie Wildlife Research Center Online. (Version 30SEP2002).

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.

Lane JL, Jensen KC. 1999. Moist-soil impoundments for wetland wildlife. Washington, D.C.: U.S. Army Corps of Engineers Technical Report EL-99-11. Available at: http://el.erdc.usace.army.mil/elpubs/pdf/trel99-11.pdf (March 2011).

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. *Website:*

Rawinski, T.J. 2008. Impacts of White-Tailed Deer Overabundance in Forest Ecosystems: An Overview. Northeastern Area State and Private Forestry. Forest Service, U.S. Department of Agriculture Newtown Square, PA. Available online at: http://www.na.fs.fed.us/fhp/special_interests/white_tailed_deer.pdf

Rawlins, K.A., J.E. Griffin, D.J. Moorhead, C.T. Bargeron, and C.W. Evans. 2011. EDDMapS: Invasive Plant Mapping Handbook. The University of Georgia. Center for Invasive Species and Ecosystem Health, Tifton GA. BW-2011-02. 32 p.

Rejmanek, M. and M. J. Pitcairn. 2002. When is eradication of exotic pest plants a realistic goal? Page 249-253

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

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APPENDIX E - WISCONSIN ISLANDS NWR WILDERNESS CHARACTER MONITORING SUMMARY

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Wisconsin Islands NWR Wilderness Character Monitoring Summary

The table and the report that follow are part of a national initiative to establish a baseline wilderness character assessment for all of the National Wildlife Refuges with designated wilderness. The measures for each wilderness were developed with refuge staff and reviewed at the national level. This addendum document complements the 2012 report on wilderness character monitoring for Wisconsin Islands National Wildlife Refuge.

Steve Lenz, Refuge Manager, Wisconsin Islands NWR **Date**

Nancy Roeper, National Wilderness Coordinator, NWRS **Date**

Wisconsin Islands NWR Wilderness Character Monitoring Summary Table

The following table summarizes the original measures selected by refuge staff for wilderness character monitoring in 2012 and reflects any modifications that were made in 2015 to comply with the revised monitoring protocol of *Keeping it Wild 2*. The reasoning for adding, removing or modifying any measure is explained in detail the narrative section below the table. This table describes each measure, the quality that it informs, and how often data are collected for the measure. As professionals at the refuge have developed these measures with a Wilderness Fellow, it is expected that these measures will form the basis of wilderness character monitoring in the Inventory and Monitoring Plan that is submitted by the refuge to the region.

Wilderness Character Monitoring Measure attributes for Wisconsin Islands Wilderness

Quality	Indicator	Measure	Frequency	Data Adequacy	Significant Change	Baseline [1] Value
Untrammeled	Actions authorized by the federal land manager that intentionally manipulate the biophysical environment	Number of authorized actions to control populations of double-crested cormorants	1 year	High	Any	0
		Number of research, survey, and monitoring projects that manipulate plants or wildlife habitat	1 year	High	25%	1
		Number of actions taken to capture, remove, band, and/or mark birds within the wilderness boundary	1 year	High	Any	1 action
		Number of actions taken by staff and/or agents to reduce or remove nonindigenous mute swans	1 year	High	Any	6 actions
	Actions not authorized by the federal land manager that intentionally manipulate the biophysical environment	Number of unauthorized actions to manipulate colonial bird communities	1 year	Medium	Any	1 action

[1] The baseline value is defined as the data value entered into the Wilderness Character Monitoring Database from the first year of available data for a particular measure. An individual measure's baseline year may be different from the baseline year of Wilderness Character Monitoring as a whole.

Quality	Indicator	Measure	Frequency	Data Adequacy	Significant Change	Baseline [1] Value
Natural	Plants	Number of non-native invasive plant species	1 year	Medium	Any	6 species
	Animals	Index of breeding native colonial waterbird species presence	2 years	High	Any	3
		Average number of nonindigenous mute swans	5 years	High	Any	19
		Index of disturbance to bird populations on wilderness islands	1 year	High	Any	9
	Air and water	Ozone air pollution	5 years	Medium	Categorical	77.85 ppb
		Total nitrogen wet deposition	5 years	Medium	Categorical	4.4 kg/ha
		Total sulfur wet deposition	5 years	Medium	Categorical	2.55 kg/ha
		Visibility	5 years	Medium	Categorical	6.7 dV
	Ecological processes	Annual winter minimum temperature anomaly	1 year	Medium	p-value $\leq$ 0.1	6.8 ° F
		Annual winter maximum temperature anomaly	1 year	Medium	p-value $\leq$ 0.1	6.4 ° F
		Annual summer maximum temperature anomaly	1 year	Medium	p-value $\leq$ 0.1	4.0 ° F
		Annual Palmer drought severity index	1 year	Medium	Categorical	0.1
Undeveloped	Presence of non-recreational structures, installations, and developments	Number of authorized physical structures	5 years	High	Any	8
	Presence of inholdings	Number of inholdings within wilderness	5 years	High	Any	0

Quality	Indicator	Measure	Frequency	Data Adequacy	Significant Change	Baseline [1] Value
	Use of motor vehicles, motorized equipment, or mechanical transport	Index of administrative mechanical transport and motorized equipment	1 year	High	Any	0
Solitude or primitive and unconfined recreation	Remoteness from sights and sounds of human activity *inside* wilderness	Number of visitors (special use permits and staff visits)	1 year	High	25%	30 visitors
	Remoteness from sights and sounds of human activity *outside* the wilderness	Index of the degree of accumulated trash and debris on wilderness islands	5 years	Medium	Any	5
	Facilities that decrease self-reliant recreation	Number of agency provided recreational facilities	5 years	High	Any	0
	Management restrictions on visitor behavior	Number of acres closed to the public	5 years	High	Any	39 acres

The following people participated in the drafting and approval of the new measures and the summary table above:

Sadie O'Dell – Wildlife Biologist
Steve Lenz – Refuge Manager

Narrative

Between February 13 and ___, Wilderness Fellow Morgan Gantz had phone conversations and email exchanges with Sadie O'Dell and Steve Lenz to discuss the recent changes in the monitoring framework of *Keeping it Wild 2*. Sadie was the original author of the 2012 report. From the discussion, measures were added, changed and deleted from the original 2012 wilderness character monitoring report to comply with the updated version of *Keeping it Wild*.

Untrammeled quality

Indicator:	Actions authorized by the federal land manager that intentionally manipulate the biophysical environment
Old Measures:	[1-1] Index of efforts by staff and/or agents conducting double-crested cormorant management activities; [1-2] Days (per island) staff and/or permitted person(s) access wilderness islands to collect colonial bird population information for research and/or inventory and monitoring per year
Change:	These two measures were eliminated from monitoring and replaced with one new measure that simply counts the number of authorized actions to control bird populations. Using an index to account for magnitude is not advised for the Untrammeled Quality under the monitoring protocols outlined in *Keeping it Wild 2*. This quality focuses on whether a particular decision to manipulate is made, not on the magnitude of the decision. Although management actions on the islands are often taken to achieve a positive end, intentionally manipulating the ecological system regardless of scale is an attempt to control "the earth and its community of life" which therefore degrades the Untrammeled Quality of wilderness. The Untrammeled Quality is clearly linked to the Natural Quality but they differ in a key way. The Untrammeled Quality monitors *actions* that intentionally manipulate or control ecological systems, whereas the Natural Quality monitors the *effects* from actions taken inside wilderness. A separate measure was added to the Natural Quality of this monitoring strategy to capture the effects of authorized actions on the wilderness islands which accounts for both the severity of the action and the number of days the action is carried out for each island.
Updated Measure:	Number of authorized actions to control populations of double-crested cormorants

Natural quality

Indicator:	Animals
Old Measure:	N/A
Change:	For the reasons discussed in the paragraph above, this new measure was added to

monitor the effects from human disturbance to the bird populations on the wilderness islands. Refer to the pages following this narrative section for the measure description and index value calculation protocol.

Updated Measure: Index of disturbance to bird populations on wilderness islands

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Indicator: Plants
Old Measure: N/A

Change: There was no measure in the original report to represent this indicator, so a new measure was added. See the detailed measure description in the pages that follow this narrative section.

Updated Measure: Number of non-native invasive plant species

Old Indicator: Climate Change
Old Measures: [2-8, 2-9, 2-10] Climate change measures

Change: The original 2012 report was set up to track mean annual temperatures and total precipitation. It was decided that a more meaningful and useful way to track climate change in terms of wilderness character is to monitor the seasonal anomaly values for the climate division of which the Wisconsin Islands Wilderness is part. See the detailed measure descriptions in the pages to follow after this narrative section.

Updated Indicator: Ecological Processes
Updated Measures: Annual winter minimum temperature anomaly; Annual winter maximum temperature anomaly; Annual summer maximum temperature anomaly; Annual Palmer drought severity index

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Undeveloped quality NO CHANGES

Solitude or primitive and unconfined recreation quality NO CHANGES

Measure: Number of authorized actions to control populations of double-crested cormorants

2012 Data Value: 0
Year of Data Collection: 2012

Background and Context (excerpt taken and modified from the original 2012 report)
Increasing populations of double-crested cormorants and growing concerns about their impacts to natural resources has resulted in the implementation of damage management programs across the Great Lakes region. Double-crested cormorants are one of the wildlife species with resource needs and behaviors that conflict with human activities and resource uses. Conflicts include but are not limited to cormorant foraging on populations of sport, commercial and forage fish, damage to vegetation and habitat used by other wildlife species. Cormorant management has occurred or been proposed on all the wilderness islands (USDA-Wildlife Services, 2009). Refuge managers have faced significant pressure to allow cormorant management on wilderness islands. In a few cases, refuge management has made decisions to manage cormorant populations to protect sensitive vegetation and habitat for co-nesting species. The Untrammeled Quality of wilderness is preserved when land managers exercise restraint, or when actions to intentionally control or manipulate the components of ecological systems inside wilderness are not taken. In general, actions that trammel should be avoided as an essential principle of wilderness stewardship unless it can be shown that these actions are necessary to preserve wilderness character as a whole.[2]

Measure Description and Collection Protocol
This measure is a raw count of the number of authorized actions taken on any wilderness island to control or manipulate bird populations. Each action, regardless of scale, is counted separately under this measure. For example, if cormorant nests are destroyed and eggs are oiled, the data value would be 2 actions. Only accessing the islands for inventory of populations is not considered a trammeling action and should not be counted in this measure (it should be counted in the natural quality measure that monitors the effects of disturbance on the islands). The sum of authorized actions taken on any wilderness island is reported in the WCMD. Over time, an increase in the number of authorized actions would result in a downward trend in this measure. An upward trend in this measure occurs when ongoing habitat manipulation is removed, stopped, or significantly reduced, which will improve the Untrammeled Quality of the Wilderness.

Data Source: Wildlife Biologist or Refuge Manger

Data Adequacy: *High* – All records have been gathered for this measure. Qualified personnel collect the data; therefore the confidence in the data is high.

Frequency: Data will be entered into the WCMD annually.

Significant Change: Any change is considered a significant change for this measure.

[2] Kaye, R. 2014. What future for the wildness of wilderness in the Anthropocene? Alaska Park Science 13(1):41-45.

Measure: Index of disturbance to bird populations on wilderness islands

2012 Data Value: 5
Year of Data Collection: 2012

Background and Context (excerpt taken from the original 2012 report)
The islands composing the Wisconsin Islands Wilderness have exceptional value to colonial nesting waterbird conservation in the Great Lakes Region. The Upper Mississippi Valley/Great Lakes Regional Waterbird Conservation Plan includes Spider Island on its list of the most important sites for breeding colonial waterbirds in the United States Great Lakes. The Waterbird Conservation Plan lists population inventory and monitoring, habitat protection and management, and management of human disturbance as priority conservation actions for waterbirds. Colonial waterbirds are a significant natural resource in the North American Great Lakes and information on their distribution and population trends are essential for their conservation and management, as well as for studying ecosystem change (Cuthbert 2011). Colonial nesting waterbirds are extremely sensitive to human disturbance. Disturbance during the pre-nesting and nest-building phase can cause the birds to abandon the island for the current and future nesting seasons. During the incubation and chick-rearing phase, disturbance may cause loss of eggs and chicks. When incubating adults are induced to leave the nest, eggs and chicks are vulnerable to predation from gulls and other opportunistic predators (consuming eggs and chicks whole) and heat stress, which can kill eggs and chicks in a matter of minutes on a hot day. This activity within wilderness disturbs the unaltered state of the wilderness and therefore mandates monitoring.

Measure Description and Collection Protocol (excerpt modified from the original 2012 report)
Disturbance actions taken under this measure include egg oiling, nest and/or egg destruction, and shooting of adult birds on wilderness islands. This does not include actions conducted outside of the wilderness. However, it should be noted that shooting offshore at the wilderness islands does occur. Not all management methods have the same level of impact associated with them. Shooting adult birds and removing a member of the breeding population of a long-lived bird species has a greater impact on the population dynamics of this species than removing nests. In addition, shooting activities may require additional time, the construction of a temporary blind, and spent ammunition on the island landscape. To account for these differences, an inherent weight has been assigned to each level of disturbance based on its perceived impact to the biophysical resources, as shown in the table below. Any human presence on the islands is assigned a value of 1, this includes any reports or sightings of unauthorized human presence on the islands. Nest or egg destruction or egg oiling is assigned a value of 2, shooting birds is assigned a 3, and both shooting birds and nest or egg destruction or egg oiling is assigned a value of 4.

A total score will be calculated for each disturbance type by multiplying the inherent weight by the number of islands the disturbance occurs on, and multiplied by the number of days the disturbance was initiated each year. If the same disturbance occurs on multiple islands for the exact same number of days, make one entry in the scoring table below indicating how many islands it occurred on. If the disturbance occurred on multiple islands but each for a different number of days, make multiple entries in the table to account for the difference in the number of days on each island. The resulting products for each level of disturbance are summed to generate a total annual score for the entire wilderness. This sum is reported in the Wilderness Character Monitoring Database. Over time, an increase in the index value represents a downward trend in this measure.

Level of disturbance	Inherent Weight
No disturbances	0
Human presence (accessing islands only, for any purpose)	1
Nest or egg destruction/ Egg Oiling	2
Killing Birds	3
Killing Birds & Nest or egg destruction/Egg Oiling	4

Data Source
Annual narratives, Wildlife Biologist

Data Adequacy
High – All records have been gathered for this measure. Qualified personnel collect the data; therefore the confidence in the data is high.

Frequency
Data will be entered into the WCMD annually.

Significant Change
Any change in this measure is considered a significant change.

Year	Level of disturbance	Inherent Weight	# Islands accessed	Total # days of disturbance activity	Score (Inherent weight X # islands X # days)
2012	**Human presence**	**1**	**1 (Spider)**	**4**	**4**
2012	Human presence	1	1 (Hog)	3	3
2012	Human presence	1	1 (Gravel)	2	2
				Total Score for 2012 (sum of all scores):	**9**
2013	Human presence	1	1 (Hog)	2	2
2013	Human presence	1	1(Spider)	4	4
2013	Human presence	1	1(Gravel)	1	1
				Total Score for 2013 (sum of all scores):	7
2014	Human presence	1	1 (Spider)	3	3
2014	Nest or egg destruction	2	1 (Hog)	2	5
2014	Human presence	1	1 (Gravel)	1	1
				Total Score for 2014 (sum of all scores):	9

Measure: Number of non-native invasive plant species

2012 data value: 6 species
Years of data collection: 2004 & 2012

Background and context
The Wisconsin Islands Wilderness is home to many unique, native plant species. However, plant communities are at risk of competition from non-native invasive species. Non-native plants have the potential to displace native vegetation, create monocultures, increase soil erosion, and decrease the quality of wildlife habitat for the waterbirds that nest and breed on the islands. During a vegetation inventory effort completed in 2004 on Spider and Hog Islands, permanent monitoring plots were randomly distributed on both islands and lists of species present were created. No plots were established on Gravel Island due to its relative lack of vegetation and propensity to be overwashed by waves and/or ice during high water. Routine plant surveys are typically not conducted on any of the wilderness islands; therefore any change in the number of species to this measure would be from encounters during site visits to monitor waterbird populations. The baseline value consists of both plants encountered during the 2004 survey and during site visits in 2012.

Measure description and collection protocol
This measure is a count of the number of non-native invasive plant species present in wilderness. The count will be compiled from annual narratives and a data collection form on which staff will make note of any new non-native invasive species encountered during a site visit. Only those species that are classified as introduced and invasive according to the Robert W. Freckman Herbarium website (http://wisplants.uwsp.edu/) will be included in this measure. An increase in the number of non-native invasive plant species found in wilderness produces a downward trend in this measure.

Definitions

- *Invasive species* – nonindigenous species whose introduction causes or is likely to cause economic or environmental harm or harm to human health (WI Statues 23.22(1)c)

Data source
Plant survey GPS records, biological staff

Data collection file
Invasive plant spreadsheet

Data adequacy

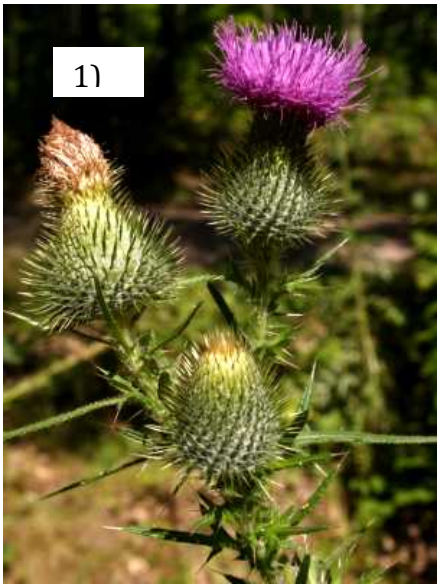
Medium – there has been no comprehensive plant survey within wilderness, but staff does take note of any invasive plants encountered within wilderness.

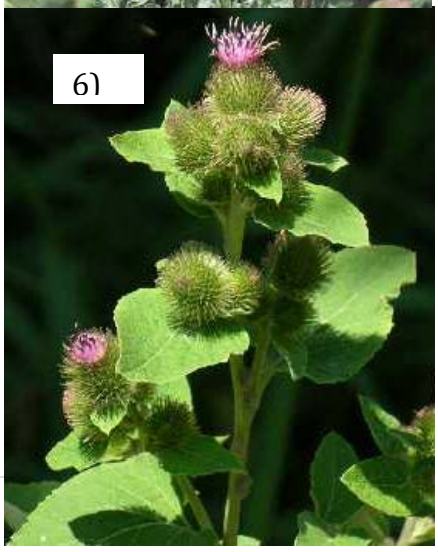
Frequency
Data is entered into the WCMD annually.

Significant change
Any change in the number of species is considered significant.

Detailed data of the species included in the baseline value for this measure

Common Name	Scientific Name	Year Found	Location
1) Bull thistle	*Cirsium vulgare*	2004	Gravel & Hog Islands
2) Ox-eye daisy	*Leucanthemum vulgare*	2004	Hog Island
3) Canada thistle	*Cirsium arvense*	2004	Spider & Hog Islands
4) White sweetclover	*Melilotus alba*	2004	Hog Island
5) Purple loosestrife	*Lythrum salicaria*	2004	Hog Island
6) Lesser burdock	*Arctium minus*	2012	Spider Island



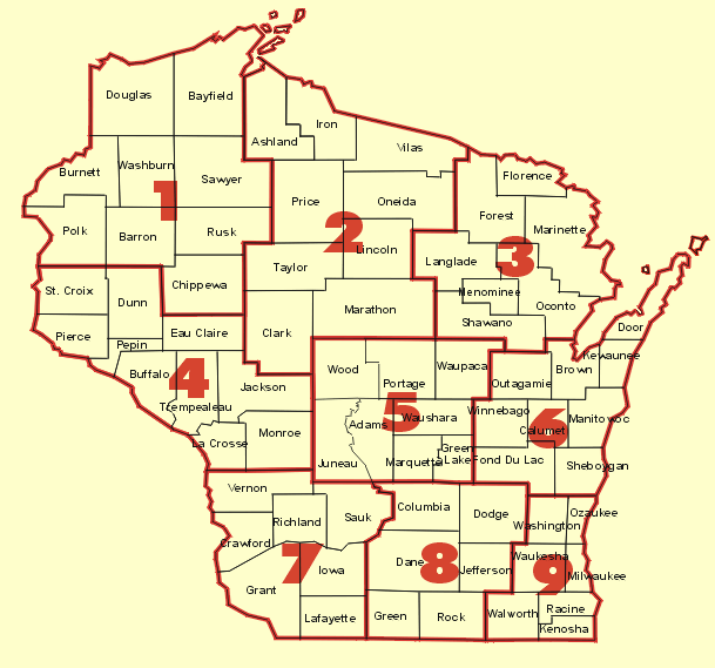


Measure: Annual winter minimum temperature anomaly

2012 Data value (baseline): 6.8 °F
Year of data collection: 2012

Background and context

According to the 2014 Climate Change Impacts in the United States: The Third National Climate Assessment, "[t]he rate of warming in the Midwest has markedly accelerated over the past few decades. Between 1900 and 2010, the average Midwest air temperature increased by more than 1.5°F. However, between 1950 and 2010, the average temperature increased twice as quickly, and between 1980 and 2010, it increased three times as quickly as it did from 1900 to 2010." [3]



Wilderness is located in Door County and lies within the East Central Division, or the 6th climate division of the state.

Climate change has the potential to significantly alter natural systems within wilderness. Significant changes in temperature over time may cause several impacts including changes in annual snowfall, extent of ice coverage on lakes, the timing of bird migration and nesting, forest composition and structure, changes to water temperatures causing a shift in fish species, plant phenology patterns, and increased invasions by non-native species, etc.

According to the Intergovernmental Panel on Climate Change, there will be fewer cold temperature extremes and "[i]n most locations, scientists expect daily minimum temperatures – which typically occur at night – to become warmer at a faster rate than daily maximum temperatures." [4]

Each state is divided into several climate divisions, defined by the National Climatic Data Center's (NCDC) Climate Monitoring Branch, to assess long-term temporal and spatial trends in climate (http://www.ncdc.noaa.gov/ monitoring-references/maps/us-climate-divisions.php). The Wisconsin Islands Wilderness is located in East Central climate division of Wisconsin, or climate division 6. Average climate

[3] Pryor, S. C., D. Scavia, C. Downer, M. Gaden, L. Iverson, R. Nordstrom, J. Patz, and G. P. Robertson. 2014. Ch. 18: Midwest. *Climate Change Impacts in the United States: The Third National Climate Assessment*, J. M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe, Eds., U.S. Global Change Research Program, 418-440. doi:10.7930/J0J1012N

[4] U.S. Environmental Protection Agency. 2014. Climate change indicators in the United States, 2014. Third edition. EPA 430-R-14-004. www.epa.gov/climatechange/indicators

division temperature values are calculated through a 5 km grid-based interpolation technique, which ensures spatial balancing within each division. Every grid node value is calculated through this technique, and an average temperature for the entire division is calculated with each grid node value. Climate change is occurring over a much larger scale than just within the wilderness border. Climate divisions are used for measuring climate change in this monitoring strategy because it will serve as a useful tool for managers to explore and understand temperature changes on a larger scale. NOAA also has a 'Climate at a Glance' GIS mapping tool (http://gis.ncdc.noaa.gov/map/cag/#app=cdo) that will display several climate change variables at all spatial scales: national, regional, statewide, and divisional. This tool can be used to see how patterns in climate change are occurring over time and how they relate to other parts of the country.

Measure description and collection protocol

This measure tracks the trend in annual winter minimum temperature anomalies. Meteorologically, winter is defined as the three month period from December to February (the 'year measured' value in the database will be assigned based on the year in February of the annual analysis, for example 1971 is the 'year measured' for the baseline value because it incorporates the 3-month period of December 1970 – February 1971). An average minimum winter temperature for the climate division in which the Wisconsin Islands Wilderness is located is calculated for the base period built on the current 30-year normals, and annual data values are compared to this value to calculate a temperature departure from that amount, or an anomaly. The current climate normals period is from 1981-2010; this was the base period used in the calculation for the baseline anomaly for this measure. Climate normals are calculated every ten years; the next period will be from 1991-2020. The goal of this analysis is to illustrate how the annual minimum winter temperature is changing over time relative to long term average of what is considered to be the current climate normal value. The base period for the calculation of anomalies in this measure will always use the 30 years of the current climate normals period. By tracking the winter minimum temperature anomaly year-to-year, any patterns of how minimum temperatures are departing from long term averages will be evident.

Although it is difficult to assess whether change in climate variables have a positive or negative impact on wilderness character, trends in this measure will be reported as either stable or significant change. A downward trend will be assigned when a significant change is detected.

Definitions

- *Climate normals* – 30-year averages of climatological variables (NOAA).
- *Climate change* – A non-random change in climate that is measured over several decades or longer. The change may be due to natural or human induced causes (NOAA).
- *Climate* – The average of weather over at least a 30-year period. Note that the climate taken over different periods of time (30 years, 1000 years) may be different. The old saying is climate is what we expect and weather is what we get (NOAA).
- *Current base period (1981 – 2010) average minimum winter temperature* = 12.9 °F

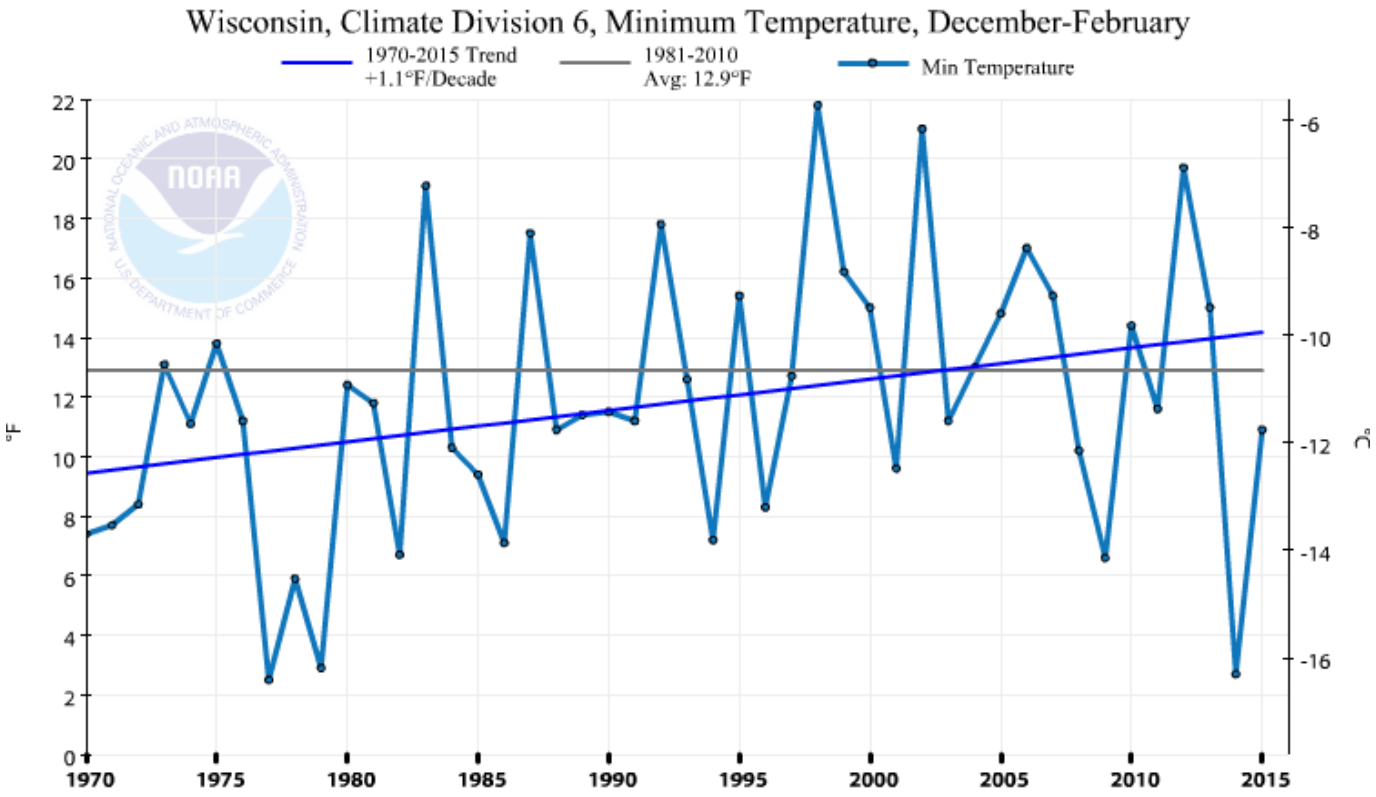
Data source: NOAA, National Climatic Data Center, Climate at a Glance Time Series Tool http://www.ncdc.noaa.gov/cag/time-series/us/47/06/tmin/3/02/1970-2015?base_prd=true&firstbaseyear=1981&lastbaseyear=2010&trend=true&trend_base=10&firsttrendyear=1970&lasttrendyear=2015 *

*The link provided are the results from the analysis completed in 2015. For future monitoring of this measure, simply modify the end year to reflect the current year of data collection. In the options window, you will also need to modify the base period to reflect the years of the current 30-year normal period and the trend years to reflect 1970-present.

Data adequacy: *Medium* – All records have been gathered for this measure but are based on a national data set; data values reflect temperatures and departures of the entire climate division that the Wisconsin Islands Wilderness is located within.

Frequency: Data will be entered into the WCMD annually.

Significant change: Perform a linear regression in Excel with α=0.1 every year for all data values (the anomaly values) since 1970 to evaluate significant change. Any significant trend is a significant change.



Wisconsin Climate Division 6 observed annual minimum winter temperatures. The 1970 - 2015 trend shows an increase in winter minimum temperature of 1.1 ˚F per decade; there is a statistically significant trend from 1970 – 2015 (F=4.62, p-value=0.04). The graph was obtained from the link provided under this measure's heading 'data source'.

Detailed data of the winter temperature anomalies entered into WCMD from the baseline year to present

Base Period: 1981-2010, Average winter minimum temperature of the base period = 12.9 °F		
Year	Divisional average temperature	Anomaly
2012	19.7 °F	6.8 °F
2013	15.0 °F	2.1 °F
2014	2.7 °F	-10.2 °F
2015	10.9 °F	-2 °F

Measure: Annual winter maximum temperature anomaly

2012 Data value (baseline): 6.4 °F
Year of data collection: 2012

Background and context
According to the Midwest chapter of the 2014 Climate Change Impacts in the United States: The Third National Climate Assessment, "[t]he rate of warming in the Midwest has markedly accelerated over the past few decades. Between 1900 and 2010, the average Midwest air temperature increased by more than 1.5°F. However, between 1950 and 2010, the average temperature increased twice as quickly, and between 1980 and 2010, it increased three times as quickly as it did from 1900 to 2010"[3]. The President's Climate Action Plan states that 2012 was the warmest year on record in the contiguous United States and the 12 hottest years on record have all come in the last 15 years.[5] The purpose of this measure is to compare and contrast how changes are occurring relative to the previous measure (annual winter minimum temperature anomaly).

Measure description and collection protocol
This measure tracks the trend in annual winter maximum temperature anomalies. Meteorologically, winter is defined as the three-month period from December to February. An average maximum winter temperature for the climate division of which the Wisconsin Islands Wilderness is located is calculated for the base period built on the current 30-year normals, and annual data values are compared to this value to calculate a temperature departure from that amount, or an anomaly. The current climate normals period is from 1981-2010; this was the base period used in the calculation for the baseline anomaly for this measure. The goal of this analysis is to illustrate how the annual maximum winter temperature is changing over time relative to the long term average of what is considered to be the climate normal value. The base period for the calculation of anomalies in this measure will always use the 30 years of the current climate normals period. By tracking the winter maximum temperature anomaly year-to-year, any patterns of how maximum temperatures are departing from long-term averages will be evident. Although it is difficult to assess whether change in climate variables have a positive or negative impact on wilderness character, trends in this measure will be reported as either stable or significant change. A downward trend will be assigned when a significant change is detected.

Definitions
- *Climate normals* – 30-year averages of climatological variables (NOAA).
- *Climate change* – A non-random change in climate that is measured over several decades or longer. The change may be due to natural or human induced causes (NOAA).
- *Climate* – The average of weather over at least a 30-year period. Note that the climate taken over different periods of time (30 years, 1000 years) may be different. The old saying is climate is what we expect and weather is what we get (NOAA).
- *Current base period (1981– 2010) average maximum winter temperature* = 28.2˚F

Data source: NOAA, National Climatic Data Center, Climate at a Glance Time Series Tool
http://www.ncdc.noaa.gov/cag/time-series/us/47/06/tmax/3/02/1970-

[5] United States. 2013. The President's Climate Action Plan. The White House, Executive Office of the President, Washington D.C. Retrieved on July 22, 2014 online at: http://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf

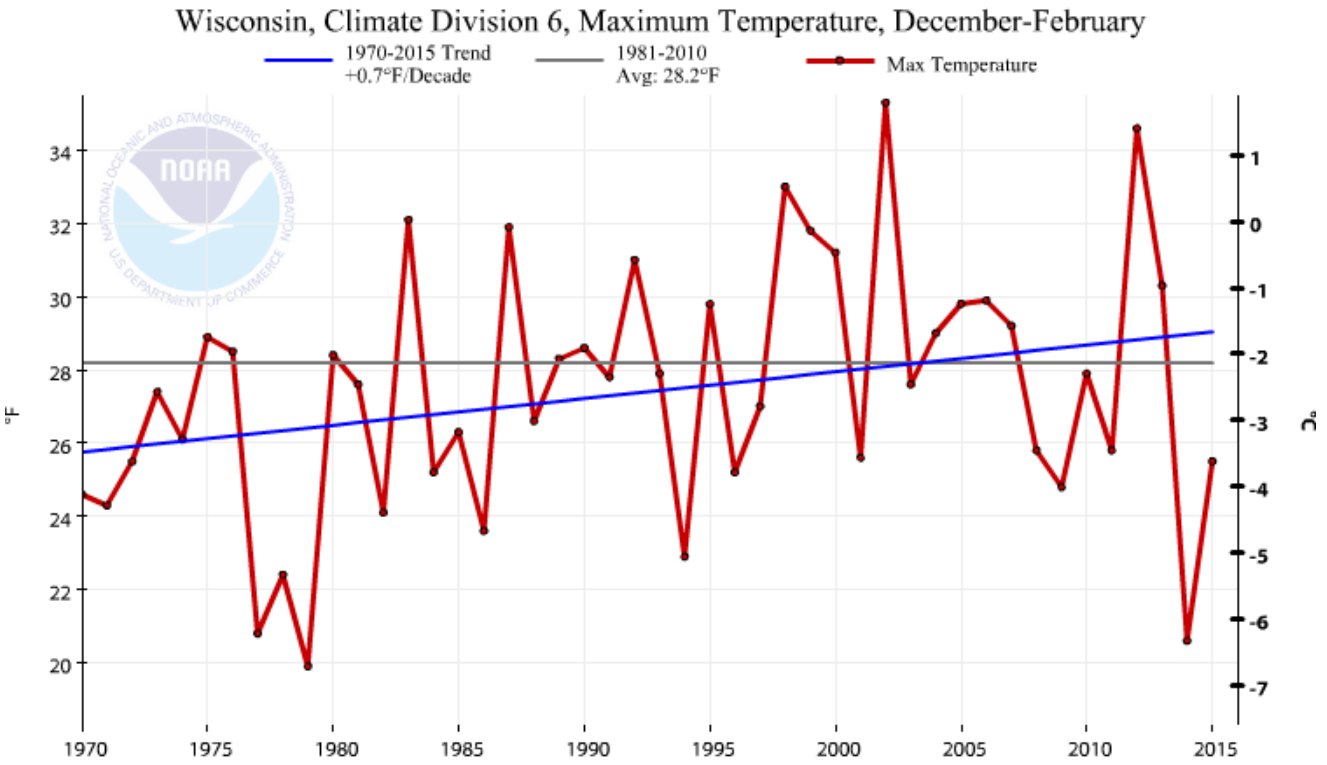
2015?base_prd=true&firstbaseyear=1981&lastbaseyear=2010&trend=true&trend_base=10&firsttrendyear=1970&lasttrendyear=2015*

*The link provided are the results from the analysis completed in 2015. For future monitoring of this measure, simply modify the end year to reflect the current year of data collection. Note: in the options window, you will also need to modify the base period to reflect the years of the current 30-year normal period and the trend years to reflect 1970-present.

Data adequacy: *Medium* – All records have been gathered for this measure but are based on a national data set; data values reflect temperatures and departures of the entire climate division that the Wisconsin Islands Wilderness is located within.

Frequency: Data will be entered into the WCMD annually.

Significant change: Perform a linear regression in Excel with α=0.1 every year for all data values (anomaly values) since 1970 to evaluate significant change. Any significant trend is a significant change.



Wisconsin climate division 6 observed annual maximum winter temperatures. The 1970 - 2015 trend shows an increase in maximum temperature of 0.7 ˚F per decade; there is a statistically significant trend from 1970 – 2015 (F=3.80, p-value=0.06). The graph was obtained from the link provided under the measure's heading 'data source'.

Detailed data of the temperature anomalies entered into the WCMD for the baseline year to present

Base Period: 1981-2010, Average winter maximum temperature of the base period = 28.2 ˚F		
Year	Divisional average temperature	Anomaly
2012	34.6 °F	6.4 °F
2013	30.3 °F	2.1 °F
2014	20.6 °F	-7.6 °F
2015	25.5 °F	-2.7 °F

Measure: Annual summer maximum temperature anomaly

2012 Data value (baseline): 4.0°F
Year of data collection: 2012

Background and context
Higher maximum temperatures could put significant stress upon the waterbirds who utilize the Wisconsin Islands Wilderness. The President's Climate Action Plan states that 2012 was the warmest year on record in the contiguous United States and the 12 hottest years on record have all come in the last 15 years. [5]

NOAA has a 'Climate at a Glance' mapping tool (http://gis.ncdc.noaa.gov/map/cag/#app=cdo) that will display several climate change variables at all spatial scales: national, regional, statewide, and divisional. This tool can be used to see how patterns in climate change are occurring over time and how they relate to other parts of the country.

Measure description and collection protocol
This measure tracks the trend in annual summer maximum temperature anomalies. Meteorologically, summer is defined as the three-month period from June to August. An average maximum summer temperature for the climate division of which the Wisconsin Islands Wilderness is located is calculated for the base period built on the current 30-year normals, and annual data values are compared to this value to calculate a temperature departure from that amount, or an anomaly. The current climate normals period is from 1981-2010; this was the base period used in the calculation for the baseline anomaly for this measure. Climate normals are calculated every ten years; the next period will be from 1991-2020. The goal of this analysis is to illustrate how the annual maximum summer temperature is changing over time relative to the long term average of what is considered to be the climate normal value. The base period for the calculation of anomalies in this measure will always use the 30 years of the current climate normals period. By tracking the summer maximum temperature anomaly year-to-year, any patterns of how maximum temperatures are departing from long-term averages will be evident. Although it is difficult to assess whether change in climate variables have a positive or negative impact on wilderness character, trends in this measure will be reported as either stable or significant change. A downward trend will be assigned when a significant change is detected.

Definitions
- *Climate normals* – 30-year averages of climatological variables (NOAA).
- *Climate change* – A non-random change in climate that is measured over several decades or longer. The change may be due to natural or human induced causes (NOAA).
- *Climate* – The average of weather over at least a 30-year period. Note that the climate taken over different periods of time (30 years, 1000 years) may be different. The old saying is climate is what we expect and weather is what we get (NOAA).
- *Current base period (1981– 2010) average maximum summer temperature* = 77.8˚F

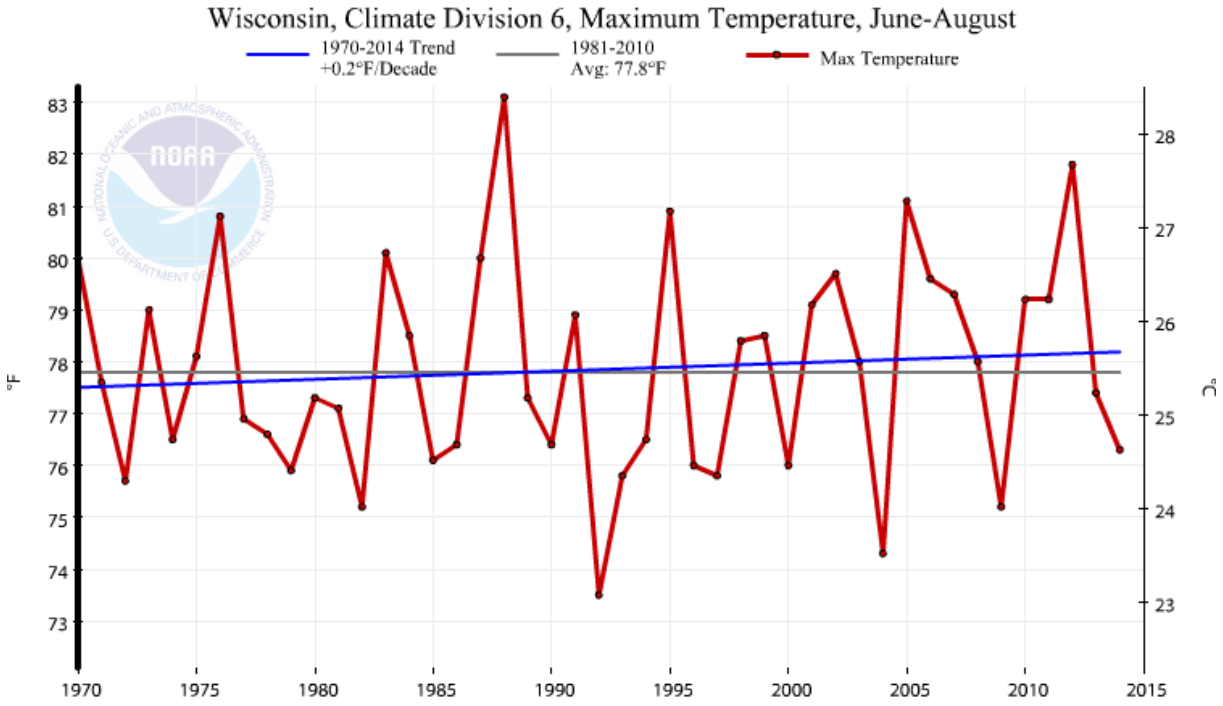
Data source: NOAA, National Climatic Data Center, Climate at a Glance Time Series Tool
http://www.ncdc.noaa.gov/cag/time-series/us/47/06/tmax/3/08/1970-2014?base_prd=true&firstbaseyear=1981&lastbaseyear=2010&trend=true&trend_base=10&firsttrendyear=1970&lasttrendyear=2014*

*The link provided are the results from the analysis completed in 2014. For future monitoring of this measure, simply modify the end year to reflect the current year of data collection. Note: in the options window, you will also need to modify the base period to reflect the years of the current 30-year normal period and the trend years to reflect 1970-present.

Data adequacy: *Medium* – All records have been gathered for this measure but are based on a national data set; data values reflect temperatures and departures of the entire climate division that the Wisconsin Islands Wilderness is located within.

Frequency: Data will be entered into the WCMD annually.

Significant change: Perform a linear regression in Excel with α=0.1 every year for all data values since 1970 to evaluate significant change. Any significant trend is a significant change.



Wisconsin climate division 6 observed annual maximum summer temperatures. The 1970 - 2014 trend shows an increase in maximum summer temperature of 0.2 ˚F per decade; there is no statistically significant trend from 1970 – 2014 (F=0.42, p-value=0.52). The graph was obtained from the link provided under the measure's heading 'data source'.

Detailed data of the temperature anomalies entered into the WCMD for the baseline year to present

Base Period: 1981-2010, Average summer maximum temperature of the base period = 77.8 ˚F		
Year	Divisional average temperature	Anomaly
2012	81.8 °F	4.0 °F
2013	77.4 °F	-0.4 °F
2014	76.3 °F	-1.5 °F

Measure	Priority (H, M, L)	Detailed Description of the Data Source(s) and Protocols for How the Data Were Gathered
ALL temperature anomaly measures	H	*Data source:* Climate division departures spreadsheet (in Wilderness folder) and NOAA National Climatic Data Center, Climate at a Glace Time Series http://www.ncdc.noaa.gov/cag *NOTE: IN THE OPTIONS WINDOW YOU MUST CHANGE THE BASE PERIOD TO REFLECT THE 30 YEARS OF THE CURRENT CLIMATE NORMALS PERIOD. *Collection protocol:* These measures track the trend in winter or summer annual minimum or maximum temperature anomalies. Meteorologically, winter is defined as the three month period from December to February (the 'year measured' value in the database will be assigned based on the year in February of the annual analysis, for example the winter of Dec 2013 – February 2014 is recorded in the data base under the year 2014). While summer is defined as the three month period from June – August. Visit the data source website listed above and modify the parameters for the specific measure you are collecting data for; make sure you modify the end year to the current year of data analysis. In the options window, modify the base period to reflect the 30 years of the current climate normals and modify the trend represent 1970 – present (the first year of wilderness designation). The current climate normals period is from 1981-2010; this was the base period used in the calculation for the baseline anomaly for this measure. Climate normals are calculated every ten years; the next period will be from 1991-2020. The base period for the calculation of anomalies in this measure will always use the 30 years of the current climate normals period. Once the data are plotted, copy the data table provided on the website and paste the values in the spreadsheet under the respective tab (if the current year is in the same climate normal period, you will only need to copy the current year of data and add it to the respective tab). Note: you will need to create a new tab in the spreadsheet once the climate normal period has changed because the base period average temperature will have changed and therefore the calculation of anomalies will be different. Report the current year anomaly value in the WCMD; include in the measure value comment field the actual observed average winter or summer temperature and the climate normal average temperature of the base period. Also include in the comment field the long term trend calculated by NOAA in the graph provided on the website and the results from the regression analysis (the F value, p-value, and if it is considered to be statistically significant - if the p-value is $\leq$ 0.1). To perform a regression in excel, navigate to the data menu and locate the data analysis button. If you do not see it, you may need to add the 'Data Analysis Toolpak' from the Add-Inn menu. To add this, click on File, Options, Add-Ins; search for 'Data Analysis Toolpak' click Go then check the box next to the add in. It should appear in the data menu and just choose "Regression" from the data analysis menu. Over time, trends in this measure will be reported as either stable or significant change. A downward trend will be assigned when a significant change is detected. Report this value annually.

Measure: Annual Palmer drought severity index

2012 Data value (baseline): 0.1
Year of data collection: 2012

Background and context
The Wisconsin Islands Wilderness are sensitive islands that are significantly affected by the hydrologic cycle. Waterfowl who utilize the wilderness could lose breeding habitat due to stronger and more frequent droughts. In 1965 the Palmer drought severity index (PDSI) was developed as a tool to measure the cumulative departure, relative to local mean conditions, in atmospheric moisture supply and demand at the surface [6]. The PDSI is calculated based on precipitation, temperature, and local available water content of the soil; positive index values indicate wet conditions, while negative index values indicate dry conditions. By using surface air temperature and a physical water balance model, the PDSI takes into account the basic effect of climate change through potential evapotranspiration. Monitoring climate patterns will provide important insight into water availability and by tracking the PDSI value, staff will be able to place annual conditions within a historical perspective. This particular measure is important within this monitoring strategy because it ties together the cumulative impact of both temperature and precipitation changes, which together influence wilderness character much more than just measuring the change in temperature and precipitation alone.

Definitions

- *Evapotranspiration* - the sum of evaporation from the land surface plus transpiration from plants; or the water lost to the atmosphere from the ground surface (evaporation from the capillary fringe of the groundwater table) and the transpiration of groundwater by plants whose roots tap the capillary fringe of the groundwater table (USGS).

Measure description and collection protocol
This measures tracks changes in the annual Palmer drought severity index (PDSI) value for the climate division of which the Wisconsin Islands Wilderness is located within, or the East Central climate division (#6) of Wisconsin. Documenting the annual PDSI is a useful tool for refuge staff because it responds to both wet and dry conditions and accounts for long-term trends that may be occurring. This measure should be used congruently with all the other climate change measures to verify the trends that may be occurring separately within them. Visit the NOAA website and modify the end year to reflect the most recent full year of data. Copy only the most recent years data in the first three columns of the data graph provided on the website (dates, value and rank) and paste the values in the Palmer drought index spreadsheet. (Note: the anomaly value is not the focus of this analysis, although it might be interesting to look at). Report the annual PDSI value in the database annually and document in the value comment field the assigned rank of the data. Although it is difficult to assess whether change in climate variables have a positive or negative impact on wilderness character, trends in this measure will be reported as either stable or significant change. A downward trend will be assigned when a significant change is detected.

Palmer drought severity index values entered into the WCMD	
Year	PDSI
2012	0.1
2013	2.28
2014	2.87

[6] Dai, A., Trenberth, K.E., and Qian, T. 2004. A Global Dataset of Palmer Drought Severity Index for 1870 – 2002: Relationship with Soil Moisture and Effects of Surface Warming. *Journal of Hydrometerology*, Volume 5, 1117 – 1130

Data source: NOAA, National Climatic Data Center, Climate at a Glance Time Series tool http://www.ncdc.noaa.gov/cag/time-series/us/47/06/pdsi/ytd/12/1970-2014 *The link provided is the results of data analysis for 2014. For future monitoring of this measure, simply modify the years to be 1970 - present.

This measure is set up to track long-term trends; here is another tool that tracks short term trends in drought conditions: http://droughtmonitor.unl.edu/MapsAndData/DataTables.aspx

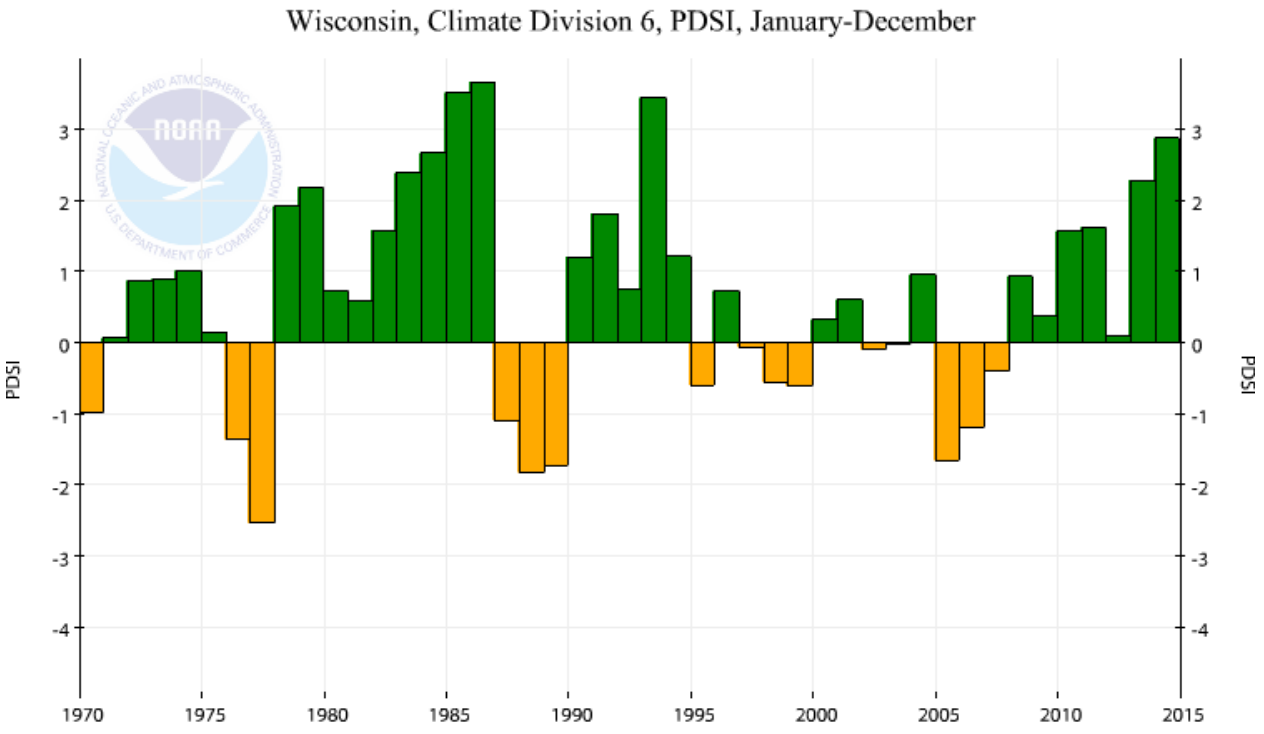
Data collection file: Palmer drought index spreadsheet

Data adequacy: *Medium* - All records have been gathered for this measure but are based on a national data set; data values reflect the entire climate division that the Wisconsin Islands Wilderness is located within. There are also some minor limitations and assumptions of the calculation methodology for the index value.

Frequency: Data will be entered into the WCMD annually.

Significant change: Any change in one category to the next is considered a significant change for this measure.

Palmer drought severity index value classifications				
Wet conditions			**Dry conditions**	
≥ 4.0	extremely wet		≤ - 4.0	extreme drought
3.0 to 3.99	very wet	**Near Normal**	-3.0 to -3.99	severe drought
2.0 to 2.99	moderately wet	0.49 to -0.49	-2.0 to -2.99	moderate drought
1.0 to 1.99	slightly wet		-1.0 to -1.99	mild drought
0.5 to 0.99	Incipient wet spell		-0.5 to -0.99	incipient dry spell



Wisconsin Climate Division 6 annual Palmer drought severity index values (PDSI). There is no statistically significant trend from 1970 – 2014 (F=0.05, p-value=0.82).

Wisconsin Islands NWR Wilderness Character Monitoring Data Update

As part of this process the most current data relating to wilderness character monitoring at Wisconsin Islands was compiled. The following table reflects all of the measure values calculated from data collected from the creation of the baseline report in 2012 until the completion of this update in 2016. The following data should also be entered into the wilderness character monitoring online database.

Updated Wilderness Character Monitoring Measure data for Wisconsin Islands Wilderness

Quality	Measure	Frequency	Baseline Year	Measure Values			
				2012	2013	2014	2015
Untrammeled	Number of authorized actions to control populations of double-crested cormorants	1 year	2012	0	0	2	1
	Number of research, survey, and monitoring projects that manipulate plants or wildlife habitat	1 year	2012	1	2	2	0
	Number of actions taken to capture, remove, band, and/or mark birds within the wilderness boundary	1 year	2012	1 action	1	0	0
	Number of actions taken by staff and/or agents to reduce or remove nonindigenous mute swans	1 year	2012	6 actions	0	0	0
	Number of unauthorized actions to manipulate colonial bird communities	1 year	2012	1 action	0	0	0
Natural	Number of non-native invasive plant species	1 year	2012	6 species	6	6	6
	Index of breeding native colonial waterbird species presence	2 years	2012	3		3	
	Average number of nonindigenous mute swans	5 years	2012	19			

Quality	Measure	Frequency	Baseline Year	Measure Values			
				2012	2013	2014	2015
	Index of disturbance to bird populations on wilderness islands	1 year	2012	9	7	9	5
	Ozone air pollution	5 years	2009	77.85 ppb			
	Total nitrogen wet deposition	5 years	2009	4.4 kg/ha			
	Total sulfur wet deposition	5 years	2009	2.55 kg/ha			
	Visibility	5 years	2009	6.7 dV			
	Annual winter minimum temperature anomaly	1 year	2012	6.8 ° F	2.1 ° F	-10.1 ° F	-2.0
	Annual winter maximum temperature anomaly	1 year	2012	6.4 ° F	2.1 ° F	-7.6 ° F	-2.7 ° F
	Annual summer maximum temperature anomaly	1 year	2012	4.0 ° F	-0.4 ° F	-1.5 ° F	-1.0 ° F
	Annual Palmer drought severity index	1 year	2012	0.1	2.28	2.87	1.68
Undeveloped	Number of authorized physical structures	5 years	2012	8			
	Number of inholdings within wilderness	5 years	2012	0			
	Index of administrative mechanical transport and motorized equipment	1 year	2012	0	0	0	0
primitive and unconfined recreati	Number of visitors (special use permits and staff visits)	1 year	2012	30 visitors	30	23	6

Quality	Measure	Frequency	Baseline Year	Measure Values			
				2012	2013	2014	2015
	Index of the degree of accumulated trash and debris on wilderness islands	5 years	2012	5			
	Number of agency provided recreational facilities	5 years	2012	0			
	Number of acres closed to the public	5 years	2012	39 acres			

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