



# **Inventory and Monitoring Plan**

## **Shiawassee National Wildlife Refuge and Michigan Islands National Wildlife Refuge (Lake Huron islands managed by Shiawassee NWR)**




Photo Credit: David Stimac

March 2020



**Shiawassee National Wildlife Refuge and  
Michigan Islands National Wildlife Refuge  
Inventory and Monitoring Plan**

**Signature Page<sup>1</sup>**

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## Introduction

This Inventory and Monitoring Plan (IMP) documents the inventory and monitoring surveys that will be conducted at Shiawassee National Wildlife Refuge (NWR) and Michigan Islands National Wildlife Refuge (the portion that is managed by Shiawassee NWR) from 2020 through 2035, or until either of the two refuges' Comprehensive Conservation Plans (CCP) or Habitat Management Plans (HMP) are revised.

This IMP was developed according to the Inventory and Monitoring (I&M) policy (701 FW 2) for the National Wildlife Refuge System. The majority of surveys considered in this plan address resource management objectives identified in the two CCPs (USFWS 2001, 2013) and two HMPs (USFWS 2018a and 2018b) for these refuges. Federally-listed species and the species and natural communities that were identified as priority resources of concern (ROC) in the HMPs were also used to identify potential surveys, and are listed in [Appendix A](#). Other surveys are a continuation of past monitoring conducted for the purpose of understanding long-term trends in specific resources or are part of regional and national survey efforts.

Shiawassee NWR was authorized by the Migratory Bird Conservation Commission under the Migratory Bird Conservation Act for use as an inviolate sanctuary, or for any other management purpose, for migratory birds.

16 U.S.C. § 715d (Migratory Bird Conservation Act) "... suitable for— (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species ..."

16 U.S.C. § 460k-1 "... the Secretary ... may accept and use ... real ... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors ..."

16 U.S.C. § 460k-2 (Refuge Recreation Act (16 U.S.C. § 460k-460k-4), as amended). "... conservation, management, and ... restoration of the fish, wildlife, and plant resources and their habitats ... for the benefit of present and future generations of Americans..."

16 U.S.C. § 668dd(a)(2) (National Wildlife Refuge System Administration Act) "... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..."

16 U.S.C. § 742f(a)(4) "... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..."

16 U.S.C. § 742f(b)(1) (Fish and Wildlife Act of 1956) "(1) to protect, enhance, restore, and manage an appropriate distribution and diversity of wetland ecosystems and other habitats for migratory birds and other fish and wildlife in North America; (2) to maintain current or improved distributions of migratory bird populations; and (3) to sustain an

abundance of waterfowl and other migratory birds consistent with the goals of the North American Waterfowl Management Plan and the international obligations contained in the migratory bird treaties and conventions and other agreements with Canada, Mexico, and other countries."

16 U.S.C. § 4401 2(b) (North American Wetlands Conservation Act; USFWS 2012).

Of the nine islands within Michigan Islands NWR, Shiawassee NWR manages Crooked, Sugar, Scarecrow, Big Charity, and Little Charity islands. Michigan Islands NWR was established as a ". . . as a refuge and breeding ground for migratory birds and other wildlife . . ." and ". . . for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. § 715d (Migratory Bird Conservation Act). The refuge also contributes to the ". . . conservation, management, and restoration of the fish, wildlife, and plant resources and their habitats for the benefit of present and future generations of Americans . . ." 16 U.S.C. 668dd(a)(2) (National Wildlife Refuge System Administration Act). Public Law 91-504, October 23, 1970 established Scarecrow Islands within Michigan Islands NWR as designated Wilderness Areas.

## Methods

Station staff generated a list of extant and anticipated surveys. This extensive list was later refined to exclude general observations (reconnaissance) of refuge resources that do not require protocols or data management. The remaining surveys were then assigned a priority score using 13 pre-defined criteria ([Appendix B](#)). Priority scores and time estimates were used to assign each survey to one of four groups that defined the status of the surveys ([Appendix C](#)). This process is described in greater detail below.

## Prioritizing and Selecting Surveys

The priority ranking of surveys was determined during a one-day meeting at Shiawassee NWR on April 29th, 2014. Refuge Manager Steve Kahl and Wildlife Biologist Eric Dunton met with Region 3 Zone Biologist Sean Blomquist to prioritize the surveys. Background information for each survey was summarized in advance by the Wildlife Biologist and briefly discussed prior to prioritizing the surveys. The 13 criteria, assignment rules, weighting and score calculation process followed the Criteria for Prioritizing Surveys Entered into the PRIMR Database<sup>2</sup> ([Appendix B](#)). The Shiawassee NWR and Michigan Islands NWR staff made all decisions required to produce the survey priority scores ([Appendix C](#)). Input from Region 3 Migratory Birds Division, Region 3 Water Resources/Hydrology Branch, and the East Lansing Ecological Services Field Office was also considered in the selection process.

The prioritization scores and draft IMP were kept in draft form until the refuge HMPs were finalized in 2018. In June 2019, Region 3 Zone Biologist Joshua Booker worked with Eric

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<sup>2</sup> Planning and Reporting Inventory and Monitoring at Refuges (PRIMR) Database (<https://ecos.fws.gov/primr/index.gsp>). A database developed by the I&M initiative that describes and archives the surveys conducted on refuges, and which is also used to generate summaries for an IMP.

Dunton to update the survey information and prioritization scores based on new information. We also added additional surveys to consider in the IMP. Thirty-nine surveys were selected for prioritization, scored, and ranked. Two additional surveys were included in the cost-benefit analysis but not scored for prioritization because they are required surveys (Wilderness Character Monitoring and Management Action Database). Also, since the 2014 prioritization workshop, Shiawassee NWR has phased out the International Shorebird and Staff Gage Monitoring surveys, and replaced them with the Integrated Waterbird Management and Monitoring (IWMM) survey because it collects data on the same metrics. Therefore, although the two former surveys were scored and ranked in 2014, they were removed from consideration in 2019. In total, 41 surveys were ultimately considered for selection.

## **Estimating Capacity**

A cost-benefit analysis ([Appendix D](#)) was performed to maximize the value of the selected surveys, given current (FY2019) staffing and budget constraints. Selecting only surveys that can be conducted with anticipated resources should lead to high quality surveys and commitment to all components of conducting a survey (planning, administration, implementation, data analysis and archiving, reporting and feedback to management).

In the cost-benefit analysis, the value (i.e., benefit) of a selected survey was estimated from the priority score from the SMART (Simple Multi-attribute Rating Technique) ranking process, adjusted for frequency over the life of the IMP. The adjustment helps to identify low frequency surveys with high cost efficiencies (for example, one-time inventories). To determine a cost constraint, the Refuge Biologist estimated the portion of time in a typical year dedicated to activities associated with conducting surveys: data analysis and summary, data management, monitoring, research, and supervision (time to hire technicians was not included among these activities because hiring time is associated with other non-survey tasks such as maintenance and visitor services). This amount of time dedicated to surveys was converted to weeks for a total of 20.4 weeks, and then multiplied by 15 to estimate the total available biologist time over the 15-year life of the IMP (305.4 weeks). The time required to implement an annual iteration of a survey was also estimated using past experiences with established protocols or anticipated commitment for protocols that have yet to be developed. Estimated annual costs for implementing surveys are documented in [Appendix E](#). For the cost-benefit analysis, it was assumed that additional support needed to complete a survey (i.e., technician time, statistician time, travel funds, equipment costs, partner resources, and other expenses) would be acquired and thus were not included as constraints. Notes on the assumptions used to estimate these times and costs for each survey can be found within the SMART tool.

## **Results: Selected Surveys**

Selected surveys include surveys identified for completion with FY2019 levels of staffing and support ([Table 1](#)). The list of surveys selected for implementation with existing resources represents a commitment to implementation by refuge staff. Changes in available capacity, CCP objectives, HMP objectives, or other factors that alter the list of selected surveys through addition or removal of selected surveys will trigger a revision of this IMP (701 FW 2) and updates to the PRIMR database.

The process identified 20 surveys that can be completed with current staffing levels and budget for the duration of this IMP ([Box 1](#); [Table 1](#)). We estimated that these 20 surveys would take a total of 308.7 weeks to complete over 15 years, about 3 weeks over the Refuge Biologist’s estimated time budget of 305.4 weeks. Among these 20 surveys, there are five (Bat Survey, Waterfowl Banding, North American Amphibian Monitoring, Winter Aerial Deer Survey, and Fall Sandhill Crane Survey) that are currently being conducted by volunteers or Refuge partners with minimum time commitments by Refuge staff. If volunteer or partner support disappears during the life of this plan, these surveys will be phased out.

An estimated annual work schedule for selected surveys is shown in [Appendix F](#), and non-selected surveys are listed in [Appendix G](#). Survey names were updated after the ranking exercise based on national and regional lists of standardized names, available protocols and companion surveys that must be completed simultaneously to maximize value. Environmental Action Statement requirements are addressed in [Appendix H](#).

Since the initial ranking workshop in 2014, several surveys and projects have been completed and are now considered historic surveys. Bathymetric surveys in all managed wetlands and rivers that run through the Refuge have been collected, analyzed, and incorporated into wetland management. A forest ecological classification for Shiawassee NWR was completed in 2019. Both ranked high in the 2014 ranking workshop and were completed prior to the completion of this plan.

**Box 1. List of Selected Surveys and Rationale for Selection**

Name	Rationale
<b>Integrated Waterbird Management and Monitoring Initiative</b>	Most of the refuge’s habitat management is focused on wetland management. There are several species and communities that are identified as resources of concern in the Habitat Management Plan are addressed by this survey. This will be used to track/document management actions, water levels, and vegetation communities across the refuge.
<b>River Monitoring Gages</b>	This survey allows us to continue operation and maintenance of Shiawassee River and Spaulding drain river monitoring gages and install additional gaging stations to develop a rating curve (a slope-stage-discharge relationship). This information will be used for hydrologic/hydraulic modeling and is critical to understand the complex hydrology of the Refuge and the link between the rivers that run through the Refuge and Great Lakes hydrology.
<b>Michigan Island Ecological Classification</b>	Many of Michigan Islands NWR resources of concern identified in the habitat management plan are natural communities or species that are closely tied with a community. This classification will be used to investigate soil, physiography, hydrology, and vegetation to develop a hierarchical framework which will be used to make management decisions and better understand the communities that are present on each island.

Name	Rationale
<b>Water Quality</b>	This survey was selected to monitor water quality, particularly nutrients (phosphorus and nitrogen) due to the high level of nutrient loading in the area and the impact this has on vegetation and ecological processes on the Refuge.
<b>Hydrologic/Hydraulic Modeling Work</b>	This project involves the development of a hydrologic and hydraulic model for the Refuge, which will inform current and future management actions in terms of water management and wetland reconnection. The project will utilize information from bathymetry surveys and river gages to provide data to run the model, and will provide information to better understand the complex hydrology of the Refuge and the link between the Refuge and Saginaw Bay in Lake Huron.
<b>Management Action Database</b>	Required to document restoration and management activities.
<b>Aquatic Invasive Species Inventory and Monitoring</b>	This survey will gather information necessary to plan treatments for current growing season and monitor effectiveness of previous treatments of aquatic invasive species.
<b>Cattail Biomass Harvest Monitoring</b>	This project is a combination of management and monitoring to evaluate if harvesting above ground cattail biomass and removing from a wetland is an effective management technique for improving wetland vegetation and wildlife use while removing excess nutrients from the wetland and the system.
<b>Michigan Islands Colonial Waterbird Nest Count</b>	This survey estimates the number of apparent colonial waterbirds (i.e., double-crested cormorants, herring gulls, ring-billed, gulls, American white pelicans, and Caspian terns) nests on Little Charity and Scarecrow Islands and is done in cooperation with the Great Lakes Colonial Waterbird Survey. Great blue herons and Caspian terns are priority resources of concern.
<b><i>Phragmites</i> Adaptive Management Framework (PAMF)</b>	Regional adaptive management project to understand the effectiveness of <i>Phragmites</i> management across the Great Lakes. This survey helps reduce uncertainty associated with treating this prominent wetland invader and takes little time to complete.
<b>Yellow Perch/Fish Survey</b>	This survey will assess fish communities (particularly yellow perch and other Great Lakes and river fish that need access to coastal wetlands for various stages of their life history) to understand fish assemblages in the river and managed wetland units at various times throughout the year, particularly the response to GLRI funded wetland restoration projects. Additionally, the survey will provide information to understand the biological link between the Refuge and the fishery of Saginaw Bay in Lake Huron.
<b>Michigan Islands Early Detection and Rapid Response</b>	This survey will gather information necessary to plan treatments for current growing season, monitor effectiveness of previous treatments, and survey for new invasive species.
<b>Forest Invasive Species Inventory</b>	This inventory will collect distribution and abundance of forest invasive species on the Refuge and will serve as base data for developing a forest invasive species management and monitoring plan.
<b>Pitcher's Thistle Monitoring</b>	This survey will monitor an existing population of this federally threatened plant that is being threatened by invasive species encroachment (non-native <i>Phragmites</i> ) on Big Charity Island (Michigan Islands NWR).

Name	Rationale
<b>Bat Survey<sup>1</sup></b>	Acoustic and mist-net surveys were conducted on the refuge and no listed bat species were detected. Since there are no listed species and the information from these surveys don't directly influence management decisions, the refuge will no longer conduct the survey if volunteer partners quit conducting the survey.
<b>Waterfowl Banding<sup>1</sup></b>	Completed by Michigan Department of Natural Resources (MDNR) Wildlife Division; primarily banding mallard and wood ducks. If MDNR discontinues banding, the Refuge will not continue this work. The Refuge quota is for 200 American black ducks (50 from each age/sex class) to be banded pre-waterfowl season, but due to low black duck abundance on the Refuge this time of year, this goal is not achievable.
<b>North American Amphibian Monitoring Program<sup>1</sup></b>	This survey assesses frog and toad population trends on a regional and national basis. The North American Amphibian Monitoring Program ran through USGS and closed at the conclusion of the 2015 season. The refuge has continued to follow the protocol using volunteers. If there are no volunteer partners to collect this data, the Refuge will not continue this work.
<b>Winter Aerial Deer Count<sup>1</sup></b>	This survey is conducted by Michigan DNR Wildlife Division using DNR aircraft/staff, and is one of the primary population indices to monitor the white-tailed deer herd in the Shiawassee flats, a portion of which includes the Refuge.
<b>Fall Sandhill Crane Survey<sup>1</sup></b>	This survey gathers information on sandhill cranes observed during the fall migration and provides status and trend information. Surveys will not be continued if volunteers stop participating in data collection because sandhill cranes are not a resource of concern and this survey has no impact on management decisions.
<b>Wilderness Character Monitoring</b>	Wilderness character monitoring is a required activity for all designated wilderness areas. Scarecrow Island (Michigan Islands NWR) in Thunder Bay of Lake Huron is designated wilderness.

<sup>1</sup> Surveys are currently conducted entirely or primarily by Refuge partners or volunteers and will be discontinued if partners or volunteers stop collecting data.

**Table 1. Surveys to be conducted at Shiawassee NWR and Michigan Islands NWR 2020—2035.**

Survey Priority <sup>1</sup>	Survey ID Number <sup>2</sup>	Survey Name/(Type) <sup>3</sup>	Survey Status <sup>4</sup>	Mgmt. Objective Id <sup>5</sup>	Survey Area <sup>6</sup>	Staff Time (FTE) <sup>7</sup>	Avg. Ann Cost (OPR) <sup>8</sup>	Survey Timing <sup>9</sup>	Survey Length <sup>10</sup>	Survey Coord. <sup>11</sup>	Protocol Citation <sup>12</sup>	Protocol Status <sup>13</sup>
1	FF03RSHW00-015	Integrated Waterbird Management and Monitoring Initiative (CM)	Current	HMP / Pages 47 - 52	National	FWS: 0.44	\$500.00	Bi-weekly during most of the year and may be conducted weekly over peak use periods./ Recurring -- every year	2012 - Indefinite	Eric Dunton, Wildlife Biologist	<a href="#">Loges et. al. 2014</a>	(none)
2	FF03RSHW00-022	River Monitoring Gages (CM)	Current	HMP / Pages 43 - 56	Multiple management units	FWS: 0.04	\$3,933.33	Constant monitoring throughout the year/ Recurring -- every year	2012 - Indefinite	Eric Dunton, Wildlife Biologist	(none)	Initial Survey Instructions
3	FF03RMCH00-041	Michigan Island Ecological Classification (I)	Expected	HMP / Page 33 – 34, 36 - 37	Multiple management units	N/A	\$0.00	Occurs one time only	2020 - 2022	Eric Dunton, Wildlife Biologist	(none)	Initial Survey Instructions
4	FF03RSHW00-021	Water Quality (CM)	Current	HMP / Pages 52 - 53	Multiple management units	FWS: 0.13, Other: 0.54	\$15,000.00	Recurring -- every year	2013 - 2025	Eric Dunton, Wildlife Biologist	(none)	Initial Survey Instructions
5	FF03RSHW00-026	Hydrologic/Hydraulic Modeling Work (CB)	Current	HMP / Pages 52 -56	Entire station	FWS: 0.88, Other: 1.0	\$22,000.00	Occurs one time only	2014 - 2025	Eric Dunton, Wildlife Biologist	(none)	Initial Survey Instructions
6	FF03RSHW00-140; FF03RMCH00-042	Management Action Database (M)	Current	HMP / All	Entire station	FWS: 0.06	\$1,500.00	Year-round/ Recurring -- every year	2019 - Indefinite	Eric Dunton, Wildlife Biologist	(none)	Initial Survey Instructions
7	FF03RSHW00-027	Aquatic Invasive Species Inventory and Monitoring (M)	Current	HMP / Pages 47 -48, 52 - 53	Multiple management units	FWS: 0.12, Other: 0.02	\$500.00	Recurring -- every year	2015 - Indefinite	Eric Dunton, Wildlife Biologist	(none)	Initial Survey Instructions

Survey Priority <sup>1</sup>	Survey ID Number <sup>2</sup>	Survey Name/(Type) <sup>3</sup>	Survey Status <sup>4</sup>	Mgmt. Objective Id <sup>5</sup>	Survey Area <sup>6</sup>	Staff Time (FTE) <sup>7</sup>	Avg. Ann Cost (OPR) <sup>8</sup>	Survey Timing <sup>9</sup>	Survey Length <sup>10</sup>	Survey Coord. <sup>11</sup>	Protocol Citation <sup>12</sup>	Protocol Status <sup>13</sup>
8	FF03RSHW00-106	Cattail Biomass Harvest Monitoring (CR)	Current	HMP / Pages 47 - 48, 57	Multiple management units	FWS: 0.06	\$5,000.00	Recurring -- every year	2016 - 2020	Eric Dunton, Wildlife Biologist	(none)	Initial Survey Instructions
9	FF03RMCH00-004	Colonial Waterbird Survey (CB)	Current	HMP / Page 35	Multiple management units	FWS: 0.03	\$750.00	May through June/ Recurring -- every year	1997 - Indefinite	Eric Dunton, Wildlife Biologist	(none)	<a href="#">Initial Survey Instructions</a>
10	FF03RSHW00-073	<i>Phragmites</i> Adaptive Management Framework (M)	Current	HMP / Pages 47 - 48	Multiple management units	FWS: 0.04	\$500.00	Summer; Fall/ Recurring -- every year	2017 - Indefinite	Eric Dunton, Wildlife Biologist	(none)	Initial Survey Instructions
11	FF03RSHW00-025	Yellow Perch/Fish Survey (CM)	Current	HMP / Pages 47 - 48, 53 - 56	Multiple management units	FWS: 0.11	\$10,000.00	Recurring -- every year	2016 - 2025	Eric Dunton, Wildlife Biologist	(none)	Initial Survey Instructions
12	FF03RMCH00-005	Shiawassee portion: Michigan Islands Early Detection and Rapid Response (BM)	Current	HMP / Pages 35 - 40	Multiple management units	FWS: 0.14	\$1,000.00	Recurring -- every year	2016 - Indefinite	Eric Dunton, Wildlife Biologist	(none)	Initial Survey Instructions
13	FF03RSHW00-028	Forest Invasive Species Inventory (M)	Current	HMP / Pages 43 - 46	Multiple management units	FWS: 0.78	\$500.00	May - October/ Occurs one time only	2017 - 2023	Eric Dunton, Wildlife Biologist	<a href="#">Booker et. al. 2017</a>	(none)
14	FF03RMCH00-006	Shiawassee portion: Pitcher's Thistle Monitoring (CB)	Current	HMP / Pages 38 - 39	Single management unit	FWS: 0.04, Other: 0.01	\$1,000.00	May - September/ Recurring -- every year	2015 - Indefinite	Michelle VanderHaar, Partners for Fish and Wildlife Biologist	(none)	Initial Survey Instructions
15	FF03RSHW00-029	Bat Survey (CB)	Current*	HMP / Pages 43 - 46, 52	Multiple management units	FWS: 0.09, Other: 0.07	\$0.00	Recurring -- every year	2017 - Indefinite	Eric Dunton, Wildlife Biologist	(none)	Initial Survey Instructions

Survey Priority <sup>1</sup>	Survey ID Number <sup>2</sup>	Survey Name/(Type) <sup>3</sup>	Survey Status <sup>4</sup>	Mgmt. Objective Id <sup>5</sup>	Survey Area <sup>6</sup>	Staff Time (FTE) <sup>7</sup>	Avg. Ann Cost (OPR) <sup>8</sup>	Survey Timing <sup>9</sup>	Survey Length <sup>10</sup>	Survey Coord. <sup>11</sup>	Protocol Citation <sup>12</sup>	Protocol Status <sup>13</sup>
16	FF03RSHW00-032	Waterfowl Banding (CM)	Current*	HMP / Pages 43-52	Multiple management units	FWS: 0.0	\$0.00	Recurring -- every year	1960 - Indefinite	Eric Dunton, Wildlife Biologist	(none)	Initial Survey Instructions
17	FF03RSHW00-016	North American Amphibian Monitoring Program (CB)	Current*	HMP / Pages 43-51	National	FWS: 0.04	\$750.00	Recurring -- every year	1995 - Indefinite	David Peters, Engineering and Equipment Operator	(none)	Initial Survey Instructions
18	FF03RSHW00-010	Winter Aerial Deer Count (CM)	Current*	HMP / Pages 43-52, 57	Entire station	FWS: 0.01, Other: 0.02	\$500.00	Recurring -- every year	1982 - Indefinite	Eric Dunton, Wildlife Biologist	(none)	Initial Survey Instructions
19	FF03RSHW00-037	Fall Sandhill Crane Count (CB)	Current*	HMP / Pages 47-51	(none)	FWS: 0.01	\$0.00	Fall/ Recurring -- every year	2007 - Indefinite	David Peters, Engineering and Equipment Operator	(none)	Initial Survey Instructions
20	FF03RMCH00-043	Wilderness Character Monitoring	Current	HMP / Pages 39 – 40	Single management unit	FWS:	\$500.00	Recurring -- every year	2015 - Indefinite	Eric Dunton, Wildlife Biologist	(none)	Initial Survey Instructions

<sup>1</sup> The rank for each survey listed in order of priority (e.g., numeric, tiered, alpha-numeric, or combination of these).

<sup>2</sup> A unique identification number consisting of refuge code-computer assigned sequential number. Refuge code comes from the FBMS cost center identifier.

<sup>3</sup> Short titles for the survey name, preferably the same name used in refuge work plans. Also include the PRIMR code for survey type in parentheses. These are: Inventory (I), Cooperative Baseline Monitoring (CB), Monitoring to Inform Management (M), Cooperative Monitoring to Inform Management (CM), Research (R), and Cooperative Research (CR).

<sup>4</sup> Surveys selected for the time period of this IMP (i.e., Current, Expected).

<sup>5</sup> The management plan and objectives that justify the selected survey.

<sup>6</sup> Refuge management unit names, entire refuge, or names of other landscape units included in survey.

<sup>7</sup> Estimates of Service (FWS) and non-Service (Other) staff time needed to complete the survey (1 work year = 2080 hours = 1 FTE).

<sup>8</sup> Estimates of average annual operations cost for conducting the survey during the years it is conducted (e.g., equipment, contracts, travel) but not including staff time.

<sup>9</sup> Timing and frequency of survey field activities.

<sup>10</sup> The years during which the survey is conducted.

<sup>11</sup> The name and position of the survey coordinator (the Refuge Biologist or other designated Service employee) for each survey.

<sup>12</sup> Title, author, and version of the survey protocol (if there is no protocol to cite, enter None).

<sup>13</sup> Scale of intended use (Site-specific, Regional, or National) and stage of approval (Initial Survey Instructions, Complete Draft, In Review, or Approved) of the survey protocol.

\*Surveys marked as Current\* are currently conducted entirely or primarily by Refuge partners or volunteers and will be discontinued if partners or volunteers stop collecting data.

## **Narratives for Selected Surveys**

**Survey:** *Integrated Waterbird Management and Monitoring Initiative (FF03RSHW00-015)*

**Refuge:** *Shiawassee National Wildlife Refuge*

**Priority:** *1*

**Which station management objective does the survey support? Is the objective derived from the CCP, interim objectives, HMP, or other?**

HMP: 4.3 Deep Water Pools and Emergent Marsh; 4.4 Moist Soil Units; 4.6 Riverine; 4.7 Croplands;

**Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.**

The Integrated Waterbird Management and Monitoring Survey is the primary survey we use to monitor bird and vegetation response to wetland management (e.g., moist soil management, marsh management, etc.). The data are used to generate unit specific use-day estimates, document migration chronologies, and understand the relationship between bird use and habitat use/condition. Data generated from IWMM will guide decision making on water level management and vegetation management (particularly for moist soil units), and used to assess outcomes based on those decisions. In addition, water level readings from staff gages are recorded and stored in the database, which is important information to ensure proper water depths and draw-down/flooding timing matches migration chronology.

**What is the population or attribute of interest, what will be measured, and when?**

Biological Integrity; Other Biota; Aves (Birds); Pelecaniformes (Pelicans, Herons, Ibises); Gruiformes (Cranes, Rails); Anseriformes (Ducks, Waterfowl, Screamers, Swans, Geese); Charadriiformes (Shore Birds, Oystercatchers, Alcids, Plovers, Gulls, Auks); Suliformes (Cormorants); Podicipediformes (Grebes); Recurring -- every year; Bi-weekly during most of the year and may be conducted weekly over peak use periods.

**Is this a cooperative survey? If so, what partners are involved in the survey?**

Yes, Coop Monitoring to Inform Management; U.S. Fish and Wildlife Service, Migratory Birds; U.S. Geological Survey Patuxent Wildlife Research Center

**Survey:** *River Monitoring Gages (FF03RSHW00-022)*  
**Refuge:** *Shiawassee National Wildlife Refuge*  
**Priority:** 2

**Which station management objective does the survey support? Is the objective derived from the CCP, interim objectives, HMP, or other?**

HMP: 4.2 Floodplain Forest; 4.3 Deep Water Pools and Emergent Marsh; 4.4 Moist Soil Units; 4.6 Riverine;

**Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.**

Four rivers (Shiawassee, Flint, Cass, and Tittabawassee) meet at the Refuge and form the Saginaw River which is approximately 23 river miles to Saginaw Bay/Lake Huron. The hydrology of the Refuge is very complex and is linked to Great Lakes water levels (i.e., the Refuge is a coastal wetland system that is 20+ miles away from the coast and is characterized by: strong backwater effects, both in conveyance and base-level; long periods of stalled flow with occasional reverse flows; frequent spring flooding with slow drainage and long inundations; and most of the natural floodplain is isolated behind levees). In 2012, a river gage was installed along the Shiawassee River (just downstream of where the Flint River meets the Shiawassee River) in cooperation with FWS Hydrology Branch, University of Michigan and USGS Great Lakes Science Center. In 2014, a second gage was installed along the Spaulding Drain (just downstream from the split of Spaulding Drain and the Flint River). Due to complex hydrology and what we have learned from initial monitoring, additional gages have to be installed in order to construct rating curves, which will help the station better time drawdown, re-flooding, and overall make better water management decisions to meet Deep Water Pool and Emergent Marsh objectives detailed in the HMP.

**What is the population or attribute of interest, what will be measured, and when?**

Water; Hydrology; Recurring -- every year; constant monitoring throughout the year

**Is this a cooperative survey? If so, what partners are involved in the survey?**

Yes. U.S. Geological Survey and University of Michigan.

**Survey:** *Michigan Island Ecological Classification (FF03RMCH00-041)*  
**Refuge:** *Michigan Islands National Wildlife Refuge*  
**Priority:** 3

**Which station management objective does the survey support? Is the objective derived from the CCP, interim objectives, HMP, or other?**

HMP: Alvar / Shore Communities; Baseline Habitat Inventory; Species and natural features inventory and monitoring;

**Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.**

Shiawassee NWR is responsible for maintaining several of islands of the Michigan Islands NWR as habitat for migratory birds and other wildlife. However, these islands are remote and difficult to access and therefore most have never had a vegetative inventory or classification. This information will be used to develop management objectives, which will guide future management responses.

**What is the population or attribute of interest, what will be measured, and when?**

Landscapes (Ecosystem Pattern and Processes); Landscape Dynamics; Plantae (plants); Occurs one time only; May - September

**Is this a cooperative survey? If so, what partners are involved in the survey?**

This is an expected survey. Protocol and partners have not yet been identified.

**Survey:** *Water Quality (FF03RSHW00-021)*  
**Refuge:** *Shiawassee National Wildlife Refuge*  
**Priority:** 4

**Which station management objective does the survey support? Is the objective derived from the CCP, interim objectives, HMP, or other?**

HMP: 4.3 Deep Water Pools and Emergent Marsh; 4.4 Moist Soil Units; 4.6 Riverine; 4.7 Croplands;

**Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.**

This survey is important because nutrient loading (specifically phosphorus and nitrogen) have dramatic impacts on vegetation occurring on the Refuge (e.g., large monotypic stands of hybrid cattails favor nutrient rich environments). In addition, nutrient loading and sedimentation are contributing to harmful algae blooms, and may have a significant role in altering food webs of the Great Lakes. We are working cooperatively with the University of Michigan, USGS Great Lakes Science Center, and FWS Hydrology Branch to implement a water quality monitoring strategy. This work is closely tied to the river gages and hydrologic/hydraulic modeling that is being developed (i.e., preliminary work indicates that nutrient retention and deposition is highly correlated to river hydrology/hydraulics). We are focusing this effort on the Great Lakes Restoration Initiative funded areas to understand the impacts to water quality of restoring and re-connecting thousands of acres of wetlands and floodplain. These water quality data will be used to evaluate the effectiveness of our restoration projects, and to inform future water level management [e.g., impact of hydrologic connection through water control structures on nutrient/sediment retention and the relationship between vegetation and fish/wildlife response]. Currently through our partnership, we are evaluating the time scale that data would need to be collected and how that would be integrated into management decisions (e.g., what are the impacts to water quality, nutrient retention, and other variables based on various hydrologic connectivity scenarios). Ultimately, this information will not be collected annually, but an intensive sampling effort is ongoing to help understand the system and variability.

**What is the population or attribute of interest, what will be measured, and when?**

Water; Water Quality; Recurring -- every year;

**Is this a cooperative survey? If so, what partners are involved in the survey?**

Yes. U.S. Geological Survey Great Lakes Science Center, University of Michigan

**Survey:** *Hydrologic/Hydraulic Modeling Work (FF03RSHW00-026)*  
**Refuge:** *Shiawassee National Wildlife Refuge*  
**Priority:** 5

**Which station management objective does the survey support? Is the objective derived from the CCP, interim objectives, HMP, or other?**

HMP: 4.2 Floodplain Forest; 4.3 Deep Water Pools and Emergent Marsh; 4.4 Moist Soil Units; 4.5 Grasslands; 4.6 Riverine; 4.7 Croplands.

**Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.**

This survey collects extensive river discharge data and integrates with other survey data (i.e., river gauge monitoring and bathymetry) to create a unified hydrologic and hydraulic model for the refuge. Developing a hydrologic (movement of water) and hydraulic (conveyance of water through structures) model for Shiawassee NWR is critically important to inform management decisions. The Refuge is located where four rivers meet (Shiawassee, Flint, Tittabawassee, and Cass) to form the Saginaw River, which is approximately 23 unobstructed river miles from Saginaw Bay/Lake Huron. Work has already been conducted to build a model by a partnership formed between the Refuge, University of Michigan, and USGS Great Lakes Science Center. Through this partnership, bathymetry of most of the Refuge wetland management units and rivers that run through the refuge have been surveyed using bathymetric survey equipment. A LiDAR data set was acquired from Saginaw County Geographic Information System (GIS) authority. The bathymetric data has been merged with the LIDAR data to form a high resolution Digital Elevation Model (DEM), which will serve as the base for model development. The complex hydrology of the Shiawassee flats (i.e., Shiawassee NWR and Shiawassee River State Game Area managed by Michigan DNR) is one of the key ecological drivers for all habitats on the Refuge. Currently, there are several large wetland restoration projects that have been funded through the Great Lakes Restoration Initiative and are focused on reconnecting Refuge wetland management units to the Rivers. A hydrologic and hydraulic model will support the decisions to reconnect these units and then provide support to Managers and Biologists on how to work with the complex hydrology to meet Refuge management goals and objectives. We envision forming a broad partnership with several federal, state, local, and private organizations to complete this work. Additional river monitoring gages need to be installed and additional discharge measurements need to be taken prior to constructing a model.

**What is the population or attribute of interest, what will be measured, and when?**

Water; Hydrology; Plantae (plants); Aves (Birds); Amphibia (Amphibians); Reptilia (Reptiles); *Calidris alpina* (Dunlin); *Perca flavescens* (yellow perch); *Anas platyrhynchos* (Mallard); *Aythya valisineria* (Canvasback); *Cygnus columbianus* (Tundra Swan); *Anas discors* (Blue-winged Teal); *Aythya affinis* (Lesser Scaup); *Ardea herodias* (Great Blue Heron); *Branta canadensis*

(Canada Goose); *Anas rubripes* (American Black Duck); *Podilymbus podiceps* (Pied-billed Grebe); *Botaurus lentiginosus* (American Bittern); *Aix sponsa* (Wood Duck); Occurs one time only;

**Is this a cooperative survey? If so, what partners are involved in the survey?**

Yes. U.S. Geological Survey and University of Michigan, possibly other partners may be involved.

**Survey:** *Management Action Database (FF03RSHW00-140; FF03RMCH00-042)*

**Refuge:** *Shiawassee National Wildlife Refuge and Michigan Islands National Wildlife Refuge*

**Priority:** 6

**Which station management objective does the survey support? Is the objective derived from the CCP, interim objectives, HMP, or other?**

Shiawassee HMP: 4.2 Floodplain Forest; 4.3 Deep Water Pools and Emergent Marsh; 4.4 Moist Soil Units; 4.5 Grasslands; 4.6 Riverine; 4.7 Croplands

Michigan Islands HMP: 1 Baseline Habitat Inventory; 2 Species and natural features inventory and monitoring; 3 Colonial waterbirds; 4 Alvar / Shore Communities; 5 Pitcher's Thistle and Dwarf Lake Iris; 6 Wilderness Area (Scarecrow Island); 7 Northern Mesic Forests.

**Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.**

This survey documents habitat restoration and management activities completed by Refuge staff for the current fiscal year. The survey is also retroactive capturing available legacy restoration and management actions completed by the refuge or by other entities prior to refuge acquisition. Current fiscal year activities will be organized by annual work plans while legacy information exists in multiple forms including Management Unit Files, Refuge Lands Geographic Information System, and more. Information will be collected at the greatest available detail required to inform site assessments, as well as making future restoration and management decisions. The highest priority will be to enter current data while legacy data will be input as time allows. Staff will use the Collector for ArcGIS mobile app to input these data into the regional Management Actions Database.

**What is the population or attribute of interest, what will be measured, and when?**

Recurring -- every year; Year-round

**Is this a cooperative survey? If so, what partners are involved in the survey?**

NO

**Survey:** *Aquatic Invasive Species Inventory and Monitoring (FF03RSHW00-027)*  
**Refuge:** *Shiawassee National Wildlife Refuge*  
**Priority:** 7

**Which station management objective does the survey support? Is the objective derived from the CCP, interim objectives, HMP, or other?**

HMP: 4.3 Deep Water Pools and Emergent Marsh; 4.6 Riverine;

**Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.**

This survey is important to inventory existing patches of aquatic invasive species (except non-native *Phragmites*, which is captured in a separate survey) and monitor management treatments to evaluate success and inform future management decisions. Aquatic invasive species are one of the biggest threats to wetland habitat and wildlife use at Shiawassee NWR. The inventory portion of this survey will help assess current conditions and the abundance and distribution of aquatic invasive species. The monitoring portion of the survey will be used to inform management actions.

**What is the population or attribute of interest, what will be measured, and when?**

Biological Integrity; Invasive Species; Plantae (plants); Aves (Birds); Amphibia (Amphibians); Reptilia (Reptiles); Mammalia (mammals); Anseriformes (Geese, Screamers, Waterfowl, Ducks, Swans); *Aythya valisineria* (Canvasback); *Ardea herodias* (Great Blue Heron); *Botaurus lentiginosus* (American Bittern); *Calidris alpina* (Dunlin); *Cygnus columbianus* (Tundra Swan); *Branta canadensis* (Canada Goose); *Anas discors* (Blue-winged Teal); *Aythya affinis* (Lesser Scaup); *Anas platyrhynchos* (Mallard); *Podilymbus podiceps* (Pied-billed Grebe); Recurring -- every year;

**Is this a cooperative survey? If so, what partners are involved in the survey?**

NO

**Survey:** *Cattail Biomass Harvest Monitoring (FF03RSHW00-106)*  
**Refuge:** *Shiawassee National Wildlife Refuge*  
**Priority:** 8

**Which station management objective does the survey support? Is the objective derived from the CCP, interim objectives, HMP, or other?**

HMP: 4.3 Deep Water Pools and Emergent Marsh; 4.7 Croplands;

**Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.**

This project ties management and monitoring together and addresses several resources of concern. The Saginaw Bay watershed has high levels of nutrient loading (e.g., phosphorus and nitrogen), which has contributed to the shift in vegetative communities in many emergent marsh wetlands on the refuge (e.g., many emergent marsh wetlands are now dominated by cattails which thrive in nutrient rich environments). The goal of this project is to evaluate if removing the above ground cattail biomass (and by proxy all the nutrients that are bound in that above ground biomass) result in more diverse wetlands with higher wildlife use. In addition, we are evaluating if multiple harvests over several years start reducing the excessive nutrients within the wetland resulting in a long-term management technique for managing cattail dominated wetlands through biomass (and nutrient) removal. We received funding through the U.S. Department of Agriculture Conservation Innovation Grant program and Great Lakes Restoration Initiative through 2020.

**What is the population or attribute of interest, what will be measured, and when?**

Landscapes (Ecosystem Pattern and Processes); Nutrient Dynamics; Recurring -- every year; June-Dec

**Is this a cooperative survey? If so, what partners are involved in the survey?**

Yes. Loyola University Chicago, The Nature Conservancy, and Saginaw Bay Watershed Initiative Network.

**Survey:** *Colonial Waterbird Survey (FF03RMCH00-004)*  
**Refuge:** *Michigan Islands National Wildlife Refuge*  
**Priority:** 9

**Which station management objective does the survey support? Is the objective derived from the CCP, interim objectives, HMP, or other?**

CCP: Wildlife Objective 3: Protect Waterbird Colonies; HMP: Waterbird Colonies;

**Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.**

Currently, there are two important colonial waterbird nesting islands under Shiawassee NWR jurisdiction (Little Charity and Scarecrow). Colonial waterbird nest counts are conducted on each island to determine long term trends in apparent nesting abundance, chronology, species used for each island and the data is shared as part of the Great Lakes-wide colonial waterbird monitoring. Sharp and persistent decreases in total nest numbers will be investigated to determine any appropriate and feasible management actions. The Little Charity Island survey is a ground based survey. The Scarecrow Island survey was ground based through 2012, when we switched to aerial surveys due to the high level of disturbance caused on this particular island. The timing of the nest counts corresponds with peak incubation for each species and/or at a time that disturbance to breeding birds can be minimized. Herring Gulls (*Larus argentatus*) and Ring-billed Gulls (*Larus delawarensis*) Great Blue Herons (*Ardea herodias*), Black-crowned Night-herons (*Nycticorax nycticorax*), Caspian Terns (*Hydroprogne caspia*) and Double-crested Cormorants (*Phalacrocorax auritus*) are counted late May to early June.

**What is the population or attribute of interest, what will be measured, and when?**

Biological Integrity; At-risk Biota; Aves (Birds); Pelecaniformes (Pelicans, Herons, Ibises); Suliformes (Cormorants); Charadriiformes (Gulls, Alcids, Oystercatchers, Plovers, Shore Birds, Auks); *Hydroprogne caspia* (Caspian Tern); *Larus delawarensis* (Ring-billed Gull); *Ardea herodias* (Great Blue Heron); *Phalacrocorax auritus* (Double-crested Cormorant); *Sterna hirundo* (Common Tern); *Nycticorax nycticorax* (Black-crowned Night Heron); *Larus argentatus* (Herring Gull); Recurring -- every year; May through June

**Is this a cooperative survey? If so, what partners are involved in the survey?**

Coop Baseline Monitoring; Academia; U.S. Fish and Wildlife Service, Migratory Birds; University of Minnesota

University of Minnesota, Dr. Francesca Cuthbert. Coordinates Great Lakes Colonial Waterbird Survey.

**Survey:** *Phragmites Adaptive Management Framework (FF03RSHW00-073)*  
**Refuge:** *Shiawassee National Wildlife Refuge*  
**Priority:** 10

**Which station management objective does the survey support? Is the objective derived from the CCP, interim objectives, HMP, or other?**

HMP: 4.3 Deep Water Pools and Emergent Marsh;

**Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.**

*Phragmites* is one of the biggest threats to wetland systems in the Great Lakes. The *Phragmites* Adaptive Management Framework (PAMF) is a multi-agency effort to manage and collectively evaluate effectiveness of a variety of *Phragmites* treatments to help land managers manage *Phragmites*. Monitoring results are fed into a model that provides management recommendations based on the current state of each management unit.

**What is the population or attribute of interest, what will be measured, and when?**

Biological Integrity; Invasive Species; Plantae (plants); Poaceae (grasses); *Phragmites australis* (common reed); Recurring -- every year; Summer; Fall

**Is this a cooperative survey? If so, what partners are involved in the survey?**

Yes. Great Lakes Commission, U.S. Geological Survey, and many other partners involved in PAMF.

**Survey:** *Yellow Perch/Fish Survey (FF03RSHW00-025)*  
**Refuge:** *Shiawassee National Wildlife Refuge*  
**Priority:** *11*

**Which station management objective does the survey support? Is the objective derived from the CCP, interim objectives, HMP, or other?**

HMP: 4.3 Deep Water Pools and Emergent Marsh; 4.6 Riverine;

**Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.**

This survey is important because the Refuge is directly connected to Saginaw Bay in Lake Huron. The goal of this survey is to better understand the biological link between the Refuge and Saginaw Bay, particularly Great Lakes and large river fish that need access to coastal wetlands. In particular, what the response of fish communities are to the wetland restoration and hydrologic re-connection projects that have been completed on the Refuge. Fish are an important food source for several resources of concern identified in the habitat management plan and the fish assemblages present in re-connected coastal wetlands are a good indicator of a functional coastal system. We are currently working with partners from the University of Michigan and U.S. Geologic Survey to evaluate fish abundance and diversity. The partnership collected nearly four years of pre-restoration fish data from the rivers that run through the Refuge, existing Refuge wetlands (e.g., Pool 1a and Grefe), and in ditches located in planned restoration areas. Now that the restoration work is nearing completion we are starting to collect post-restoration data to assess the benefits of restoring and re-connecting thousands of acres of coastal wetlands. We envision a more intensive sampling effort in the next few years to try to capture variability that will ultimately inform how often fish would have to be sampled and then relate this work to water management recommendations (e.g., if we open/close water control structures under a variety of flow, temperature, or seasonal conditions, how would the fish community respond).

**What is the population or attribute of interest, what will be measured, and when?**

Biological Integrity; Other Biota; Osteichthyes (bony fishes); Perciformes (perch-like fishes); *Perca flavescens* (yellow perch); Recurring -- every year;

**Is this a cooperative survey? If so, what partners are involved in the survey?**

Yes. U.S. Geological Survey and University of Michigan

**Survey:** Michigan Islands Early Detection and Rapid Response (FF03RMCH00-005)  
**Refuge:** Michigan Islands National Wildlife Refuge  
**Priority:** 12

**Which station management objective does the survey support? Is the objective derived from the CCP, interim objectives, HMP, or other?**

CCP: Habitat Objective 1: Preserve Pitcher's Thistle; Habitat Objective 2: Protect Sensitive Habitat by Reducing Invasive Plant Species; Wildlife Objective 1 (specific to Shiawassee's portion): Maintain and Protect Nesting Habitat.

**Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.**

This survey is important due to the constant threat of terrestrial and aquatic invasive species to the islands in the Great Lakes ecosystem. Big and Little Charity Islands currently have established stands of *Phragmites*. Big Charity Island has populations of the federally threatened Pitcher's thistle (*Cirsium pitcheri*) that is being threatened by *Phragmites*. The goal of this survey is to conduct an early detection and rapid response survey of all the islands that would detect new invasive species and allow Refuge staff to treat within the year of detection so the islands resources are protected from existing and new threats.

**What is the population or attribute of interest, what will be measured, and when?**

Biological Integrity; Invasive Species; Plantae (plants); Iridaceae (No common name); Asteraceae (sunflowers); Recurring -- every year;

**Is this a cooperative survey? If so, what partners are involved in the survey?**

NO

**Survey:** *Forest Invasive Species Inventory (FF03RSHW00-028)*  
**Refuge:** *Shiawassee National Wildlife Refuge*  
**Priority:** 13

**Which station management objective does the survey support? Is the objective derived from the CCP, interim objectives, HMP, or other?**

HMP: 4.2 Floodplain Forest;

**Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.**

This inventory is part of the Forest Invasive Adaptive Management (FIAM) project. The inventory component of this survey evaluates the spatial distribution of invasive plant species as well as the state (i.e., magnitude) of the infestation based on a sample of points on a grid system across the entire Refuge. This systematic, grid-based approach samples points across the Refuge to assess two categorical variables: state of infestation for each species and invasive species aggressiveness. The result is a quick assessment of the complete invasion problem throughout a refuge.

It is important to conduct this inventory to understand the current distribution and abundance of forest invasive species on Shiawassee NWR. Information from this inventory will be used to develop a decision support tool for the Refuge that will inform what species to treat and where treatment should occur. A considerable amount of Refuge resources are allocated to manage forest invasive species, but there is no comprehensive inventory on distribution and abundance of these species. This will guide management under the principles of early detection and rapid response, in which new species will be located and management actions can be taken before that particular species becomes established.

**What is the population or attribute of interest, what will be measured, and when?**

Biological Integrity; Invasive Species; Plantae (plants); Oleaceae (olives); Poaceae (grasses); Celastraceae (bittersweet); Caprifoliaceae (honeysuckle); Simaroubaceae (quassias); Fabaceae (legumes, peas); Elaeagnaceae (oleasters); Rosaceae (roses); Brassicaceae (mustards, crucifers); Lythraceae (loosestrife); Occurs one time only; April – Dec

**Is this a cooperative survey? If so, what partners are involved in the survey?**

NO

**Survey:** *Pitcher's Thistle Monitoring (FF03RMCH00-006)*  
**Refuge:** *Michigan Islands National Wildlife Refuge*  
**Priority:** 14

**Which station management objective does the survey support? Is the objective derived from the CCP, interim objectives, HMP, or other?**

CCP: Habitat Objective 1: Preserve Pitcher's Thistle; Habitat Objective 2: Protect Sensitive Habitat by Reducing Invasive Plant Species.

HMP: Objective 5: Pitcher's Thistle and Dwarf Lake Iris

**Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.**

Pitcher's thistle is a federally threatened species and is present on Big Charity Island. The survey will involve an inventory of the existing population of Pitcher's thistle on the island, which is being threatened by *Phragmites*, and to monitor the population over time. Currently, the Partners for Fish and Wildlife Biologist has developed a partnership with Au Gres Sims school district, Huron Pines Resource Conservation and Development (RC&D), Michigan Sea Grant, Saginaw Bay Watershed Initiative Network, and several other partners to have fourth grade students from Au Gres Sims schools assist in the monitoring of Pitcher's thistle. In addition, the students are helping monitor *Phragmites* treatments and are in the process of cultivating Pitcher's thistle in a greenhouse to be planted on the island.

**What is the population or attribute of interest, what will be measured, and when?**

Biological Integrity; Other Biota; Plantae (plants); Asteraceae (sunflowers); *Cirsium* (thistle);  
Recurring -- every year; May - September

**Is this a cooperative survey? If so, what partners are involved in the survey?**

Yes. USFWS Partners for Fish and Wildlife Program, Au Gres Sims school district, Huron Pines RC&D, Michigan Sea Grant, Saginaw Bay Watershed Initiative Network, and several other partners

**Survey:** *Bat Survey (FF03RSHW00-029)*  
**Refuge:** *Shiawassee National Wildlife Refuge*  
**Priority:** *15*

**Which station management objective does the survey support? Is the objective derived from the CCP, interim objectives, HMP, or other?**

HMP: 4.2 Floodplain Forest; 4.6 Riverine;

**Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.**

We have conducted mist-net and acoustic bat surveys in the recent past at Shiawassee NWR and have not detected any listed bat species. We currently have a partnership with the Saginaw Children's Zoo and Detroit Zoo, in which staff from the Saginaw Children's Zoo drive an established route in the Shiawassee NWR using acoustic monitoring equipment from the Detroit Zoo. The Detroit Zoo analyzes the data and provides annual summary information. Currently, these data are not used to make management decisions but provide information on status and trends of bats. Since there are no listed species and the survey is not directly related to management decisions, the refuge would not continue this work if the zoos stop participating.

**What is the population or attribute of interest, what will be measured, and when?**

Biological Integrity; Other Biota; Mammalia (mammals); Chiroptera (bats); Recurring -- every year;

**Is this a cooperative survey? If so, what partners are involved in the survey?**

Yes. Saginaw Children's Zoo and Detroit Zoo

**Survey:** *Waterfowl Banding (FF03RSHW00-032)*  
**Refuge:** *Shiawassee National Wildlife Refuge*  
**Priority:** 16

**Which station management objective does the survey support? Is the objective derived from the CCP, interim objectives, HMP, or other?**

HMP: 4.2 Floodplain Forest; 4.3 Deep Water Pools and Emergent Marsh; 4.4 Moist Soil Units; 4.6 Riverine;

**Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.**

Waterfowl banding is a priority for U.S Fish and Wildlife Service. The banding quota for the refuge (as determined by Migratory Birds Division) is for 200 American black ducks (50 of each age/sex class) to be banded pre-waterfowl hunting season. This quota is not achievable on the Shiawassee NWR, as black duck numbers are very low, with peak black duck numbers generally not occurring until late fall. Consequently, the Refuge partnered with Michigan DNR Wildlife Division to allow the DNR to band waterfowl on the Refuge and contribute to the State of Michigan banding quota, particularly for mallards and wood ducks (both of which are priority resources of concern for the Refuge).

**What is the population or attribute of interest, what will be measured, and when?**

Biological Integrity; Other Biota; Aves (Birds); Anseriformes (Swans, Geese, Waterfowl, Screamers, Ducks); Recurring -- every year;

**Is this a cooperative survey? If so, what partners are involved in the survey?**

Yes. Michigan DNR Wildlife Division.

**Survey:** *North American Amphibian Monitoring Program (FF03RSHW00-016)*  
**Refuge:** *Shiawassee National Wildlife Refuge*  
**Priority:** 17

**Which station management objective does the survey support? Is the objective derived from the CCP, interim objectives, HMP, or other?**

HMP: 4.2 Floodplain Forest; 4.3 Deep Water Pools and Emergent Marsh; 4.4 Moist Soil Units;

**Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.**

This survey has been conducted by volunteers since the 1990's. The survey will continue to be conducted on a volunteer only basis. Refuge staff time for this project will focus on developing a partnership to archive, analyze, and report the historic data.

**What is the population or attribute of interest, what will be measured, and when?**

Biological Integrity; Other Biota; Amphibia (Amphibians); Anura (Frogs, Toads); Caudata (Salamanders); Recurring -- every year;

**Is this a cooperative survey? If so, what partners are involved in the survey?**

Yes; Coop Baseline Monitoring; Saginaw Children's Zoo

**Survey:** *Winter Aerial Deer Count (FF03RSHW00-010)*  
**Refuge:** *Shiawassee National Wildlife Refuge*  
**Priority:** 18

**Which station management objective does the survey support? Is the objective derived from the CCP, interim objectives, HMP, or other?**

HMP: 4.2 Floodplain Forest; 4.3 Deep Water Pools and Emergent Marsh; 4.4 Moist Soil Units; 4.5 Grasslands; 4.7 Croplands.

**Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.**

Michigan Department of Natural Resources (DNR) conducts an aerial deer survey of the entire Shiawassee flats (Shiawassee NWR and Shiawassee River State Game Area). The survey is conducted in winter when snow conditions are adequate (i.e., typically 6 inches or more) to see deer during the survey. The survey has been conducted since the early 1980's and is used as an indicator of the deer herd in the flats. In the 1990's, Michigan DNR, FWS, and a group of citizens agreed to keep the Shiawassee flats deer herd between 600 to 800 deer observed during the aerial winter survey. There is no documentation on how this number was generated but it was a consensus number that hunters felt there would be enough deer and neighboring landowners felt that crop damage would not be too high. If the DNR discontinues the survey, FWS will not continue this survey. Time and cost estimates reflect time spent coordinating and discussing data with DNR to set upcoming deer harvest regulations.

**What is the population or attribute of interest, what will be measured, and when?**

Biological Integrity; Other Biota; Mammalia (mammals); Artiodactyla (cloven-hoofed ungulates, even-toed ungulates, artiodactyls); Recurring -- every year;

**Is this a cooperative survey? If so, what partners are involved in the survey?**

Coop Monitoring to Inform Management; State Agencies

**Survey:** *Fall Sandhill Crane Survey (FF03RSHW00-037)*  
**Refuge:** *Shiawassee National Wildlife Refuge*  
**Priority:** *19*

**Which station management objective does the survey support? Is the objective derived from the CCP, interim objectives, HMP, or other?**

HMP: 4.3 Deep Water Pools and Emergent Marsh; 4.4 Moist Soil Units

**Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.**

This survey is conducted by volunteers during fall migration. Data are sent to the Michigan coordinator to assess regional trends in sandhill crane populations. This survey is not informing refuge management decisions. Cost and time estimates reflect what is currently spent on the survey. The survey will continue to be conducted on a volunteer only basis.

**What is the population or attribute of interest, what will be measured, and when?**

Biological Integrity; Other Biota; Aves (Birds); Gruiformes (Cranes, Rails); *Grus canadensis* (Sandhill Crane); Recurring -- every year; Fall

**Is this a cooperative survey? If so, what partners are involved in the survey?**

Yes. Saginaw Children's Zoo

**Survey:** *Wilderness Character Monitoring (FF03RMCH00-008)*  
**Refuge:** *Michigan Islands National Wildlife Refuge*  
**Priority:** 20

**Which station management objective does the survey support? Is the objective derived from the CCP, interim objectives, HMP, or other?**

HMP: Baseline Habitat Inventory; HMP: Wilderness Area (Scarecrow Island);

**Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.**

Scarecrow Island is designated wilderness. All designated wilderness areas are required to monitor wilderness character. Scarecrow Island is closed to all public use and is an important colonial waterbird nesting island located in Thunder Bay, Lake Huron. This work can be completed with the colonial waterbird survey for the island and requires a few extra hours to report into the interagency wilderness character monitoring database.

**What is the population or attribute of interest, what will be measured, and when?**

Human Use; Visitor and Recreation Use; Biological Integrity; Other Biota; Plantae (plants); Aves (Birds); *Larus argentatus* (Herring Gull); *Phalacrocorax auritus* (Double-crested Cormorant); *Hydroprogne caspia* (Caspian Tern); *Larus delawarensis* (Ring-billed Gull);  
Recurring -- every year;

**Is this a cooperative survey? If so, what partners are involved in the survey?**

NO

## **Revising the IMP**

The Refuge Manager will review the refuge capacity and status of surveys annually and determine which of the selected surveys will be implemented in that year. The PRIMR database was updated along with this IMP; it will be updated as approved protocols are linked to the selected surveys and when surveys are added or removed from the set of selected surveys.

The IMP will be revised according to I&M Policy and as CCP and HMP plans are modified (see Revision Signature Page). An IMP revision is triggered when surveys are added or removed from the set of selected surveys. IMP revisions require signatures from refuge staff, Regional I&M staff, Regional Refuge Biologist/Natural Resources Division Chief, and Refuge Supervisor, but not the Regional Chief of Refuges.

## **References**

[USFWS] U.S. Fish and Wildlife Service. 2001. Shiawassee National Wildlife Refuge Comprehensive Conservation Plan and Environmental Assessment. Bloomington, MN.

[USFWS] U.S. Fish and Wildlife Service. 2013. Gravel Island, Green Bay, Harbor Island, Huron, and Michigan Islands National Wildlife Refuge Comprehensive Conservation Plan. Bloomington, MN.

[USFWS] U.S. Fish and Wildlife Service. 2018a. Michigan Islands National Wildlife Refuge (Lake Huron islands managed by Shiawassee NWR) Habitat Management Plan. Bloomington, MN. 99pp.

[USFWS] U.S. Fish and Wildlife Service. 2018b. Shiawassee National Wildlife Refuge Habitat Management Plan. Bloomington, MN. 121pp.

## Appendix A. Priority Resources of Concern (ROC) and Federally Listed Threatened and Endangered Species.

**Table A1:** The following species were identified as priority resources of concern in Table 6 of the 2018 Shiawassee HMP (USFWS 2018b) and Table 3.2 of the Michigan Islands National Wildlife Refuge HMP (USFWS 2018a).

Priority Refuge Resource	Refuge
Inundated Shrub Swamp	Shiawassee NWR
Floodplain Forest	Shiawassee NWR
Wood Duck ( <i>Aix sponsa</i> , breeding)	Shiawassee NWR
Least Flycatcher ( <i>Empidonax minimus</i> , breeding)	Shiawassee NWR
Rusty Blackbird ( <i>Euphagus carolinus</i> , migrating)	Shiawassee NWR
Rose-breasted Grosbeak ( <i>Pheucticus ludovicianus</i> , breeding)	Shiawassee NWR
Indiana Bat ( <i>Myotis sodalis</i> , breeding)	Shiawassee NWR
Riverine	Shiawassee NWR
Deep Water Pool	Shiawassee NWR
Canada Goose ( <i>Branta canadensis</i> , migrating)	Shiawassee NWR
Canvasback ( <i>Aythya valisineria</i> , migrating)	Shiawassee NWR
Lesser Scaup ( <i>Aythya affinis</i> , migrating)	Shiawassee NWR
Tundra Swan ( <i>Cygnus columbianus</i> , migrating)	Shiawassee NWR
Yellow Perch ( <i>Perca flavescens</i> , Great Lakes population; breeding, larvae or juveniles)	Shiawassee NWR
Moist Soil Unit	Shiawassee NWR
Mallard ( <i>Anas platyrhynchos</i> , breeding, migrating)	Shiawassee NWR
American Black Duck ( <i>Anas rubripes</i> , migrating)	Shiawassee NWR
Blue-winged Teal ( <i>Anas discors</i> , breeding, migrating)	Shiawassee NWR
Dunlin ( <i>Calidris alpina</i> , migrating)	Shiawassee NWR
Emergent Marsh (Great Lakes Marsh)	Shiawassee NWR
Great Blue Heron ( <i>Ardea herodias</i> , breeding, migrating)	Shiawassee NWR
American Bittern ( <i>Botaurus lentiginosus</i> , breeding)	Shiawassee NWR
Pied-billed Grebe ( <i>Podilymbus podiceps</i> , breeding, migrating)	Shiawassee NWR

Priority Refuge Resource	Refuge
Eastern Foxsnake ( <i>Pantherophis gloydi</i> , breeding)	Shiawassee NWR
Lakeplain Wet Prairie	Shiawassee NWR
Northern Harrier ( <i>Circus cyaneus</i> , breeding)	Shiawassee NWR
Sedge Wren ( <i>Cistothorus stellaris</i> , breeding, migrating)	Shiawassee NWR
Bobolink ( <i>Dolichonyx oryzivorus</i> , breeding, migrating)	Shiawassee NWR
Eastern Meadowlark ( <i>Sturnella magna</i> , breeding, migrating)	Shiawassee NWR
Prairie white-fringed orchid ( <i>Platanthera leucophaea</i> )	Shiawassee NWR
Mesic Northern Forest	Michigan Islands NWR
Bald Eagle ( <i>Haliaeetus leucocephalus</i> , breeding, migrating)	Michigan Islands NWR
Little Bluestem Alvar Grassland	Michigan Islands NWR
Alvar Nonvascular Pavement	Michigan Islands NWR
Limestone Bedrock Lakeshore	Michigan Islands NWR
Pitcher's Thistle ( <i>Cirsium pitcheri</i> )	Michigan Islands NWR
Dwarf Lake Iris ( <i>Iris lacustris</i> )	Michigan Islands NWR
Great Blue Heron ( <i>Ardea herodias</i> , breeding, migrating)	Michigan Islands NWR
Caspian Tern ( <i>Hydroprogne caspia</i> , breeding, migrating)	Michigan Islands NWR

**Table A2.** Current federally listed Threatened or Endangered Species at Shiawassee and Michigan Islands NWR

Station	Species	Status
Michigan Islands	Dwarf Lake Iris	Threatened
Michigan Islands	Pitcher's Thistle	Threatened

## **Appendix B. Criteria and Weights Used to Prioritize Surveys**

The following 13 criteria were considered by Shiawassee NWR and Michigan Islands NWR staff to use to prioritize surveys through a Simple Multi-Attribute Rating Technique (SMART tool).

### **1) 1B. CCP or Other Management Plan Objectives**

How many refuge CCP or other management plan objectives (e.g., HMP, Fire Management Plan, Recovery Plan, and Integrated Pest Management Plan) are met by the focus of this survey?

*Example 1: A survey of staff gauge readings for water levels in representative units can be used to evaluate a range of wetland habitat objectives including seasonal, emergent, and permanent types. Example 2: An Early Detection Rapid Response survey can be used to discover the presence of highly invasive plant species in multiple refuge habitats.*

1. Does not address an objective
2. Addresses one objective
3. Addresses two objectives
4. Addresses three or more objectives

### **2) 1D. Management Utility (Decision Support) for the Refuge**

Does the survey provide data for recurring management decisions, especially as part of an existing decision framework that is implemented on a regular basis?

*Surveys providing information to either directly evaluate or serve as indicators of high-priority management actions can be considered as earning a 3 or 4 rating for this criterion.*

1. No set application for the refuge
2. May have management implications, but they are not explicitly defined
3. Has management implications, but no current decision framework
4. Part of an existing adaptive management decision framework

### **3) 2A. FWS Programs**

Does the survey provide information that directly contributes to evaluating the status and trends of resources that are a priority for another FWS regional or national program (e.g., Migratory Birds, Fisheries, Water Resources/Hydrology *other than ESA species*)?

*Example 1: North American Breeding Bird Survey, North American Amphibian Monitoring Program, Mid-Winter Waterfowl Survey, and Circumpolar Biodiversity Monitoring Network are priority surveys for regional or national FWS programs.*

1. Does not address a management priority identified by a FWS regional or national program or initiative
2. Addresses a management priority identified by 1 FWS regional or national program or initiative
3. Addresses a management priority identified by 2 FWS regional or national programs or initiatives
4. Addresses a management priority identified by  $\geq 3$  FWS regional or national programs or initiatives

### **4) 2B. FWS Partners**

Does the survey address an identified priority of a conservation partner, such as a Landscape Conservation Cooperative(s) (LCC), state agencies, or other conservation partner?

*These priorities should be obtained from documents such as the State Wildlife Action and Joint Venture plans. The staff should document where they obtained these priorities and if they were high- or medium-level priorities. The refuge itself does not count as a partner.*

1. Does not focus a management priority identified by FWS partners (e.g., LCC, state agency)
2. Focus on a management priority identified by one FWS partner (e.g., LCC, state agency)
3. Focus on a management priority identified by two FWS partners (e.g., LCC, state agency)
4. Focus on a management priority identified by three or more FWS partners (e.g., LCC, state agency)

5) **3A. FWS Surrogate Species**

Does the survey focus on a surrogate species selected by the FWS?

1. No
2. Yes, one FWS surrogate species
3. Yes, two FWS surrogate species
4. Yes, three or more FWS surrogate species

6) **3B. Refuge Processes**

Does the survey focus on an ecological process (e.g., fire, water temperature, and climate) that is changing at a rate that is important to the refuge or an indicator species associated with that process?

1. No
2. Yes, one significant ecological process or species
3. Yes, two or more significant ecological processes or species

7) **3C. Survey Breadth**

The focus of the survey is:

1. A single species or abiotic parameter
2. Multi-species or multi-abiotic parameters
3. A community – multi-trophic level or biota
4. An ecosystem – biotic community and abiotic parameters

8) **4A. Listed Species**

Is the objective of the survey a species or vegetation community federally listed under ESA, state listed (threatened or endangered only), ranked by the state's natural heritage program (S1 or S2 rank only), globally ranked by NatureServe (G1 or G2 rank only), or globally listed on the IUCN Red List of Threatened Species (Critically Endangered, Endangered, or Vulnerable only)?

1. Not state, federally or globally ranked
2. Yes, state listed or ranked by state's natural heritage program
3. Yes, globally listed by NatureServe or IUCN
4. Yes, federally listed under the ESA as threatened or endangered

9) **5A. Controversy**

Does the survey support decision-making to address an action or management decision related to refuge resources that is controversial to an external party?

*Note: Document why the refuge staff knows or suspects an action is controversial because the interpretation can vary from person to person. Controversy can be associated with the general public, specific interest group(s) (e.g., animal rights activist, cooperative farmers), or one or more conversation partners. This criterion is focused on a high level of known or suspected controversy from outside interests where the Service could be litigated, refuge actions that could result in a precedent setting action, or severely damage a working relationship with the state or other conversation partner. This criterion does not pertain to suspected or known issues among refuge staff members and/or other FWS employees. Examples of controversy include changes to livestock grazing, predator control, and changes to harvest regulations or water allocation.*

1. Not controversial and little to no potential for controversy
2. Not currently controversial, but potentially or suspected of controversy
3. Known controversy, but data or immediate management action is not currently needed but may be in the near future
4. Pressing controversy; data required to support immediate management action

10) **5B. Threat**

Does the survey support decision-making to monitor and mitigate a known or suspected threat to refuge resources?

*Note: This criterion scores surveys addressing known or suspected threats. It does not apply to baseline monitoring intended to detect new (i.e., unknown) threats or changes. If surveys are determined from Natural Resources Management Plan, focus on the threat reduction strategies identified in that plan and use adopt the scoring strategy shown in parentheses. Examples of threats may include invasive species, pollutants or toxins, and climate change.*

1. No existing threat or potential for a threat to Refuge resources (the survey does not relate to threat reduction strategies)
2. No known threat, but potential for a threat to Refuge resources (Yes, supports decision making to address a threat reduction strategy with a score of \_\_\_ [e.g. 2.5])
3. Known threat to Refuge resources, but immediate management action is not currently needed but may be in the near future (Yes, supports decision making to address a threat reduction strategy with a score of \_\_\_ [e.g. 3.0])
4. Urgent threat to Refuge resources; immediate data are needed to support management action (Yes, supports decision making to address a threat reduction strategy with a score of \_\_\_ [e.g. 3.5])

11) **6A. Baseline data**

Does the survey provide high-priority information that contributes to baseline data needs?

Example: Inventories of species guilds (e.g., invertebrates, plants, reptiles) or abiotic parameters (soils, waters).

1. No
2. Yes

**12) 6C. Spatial Scale**

What is the largest scale at which survey results will be applied for resource management?

*Note: Only surveys with a protocol that establishes methods for data management and analysis are scored higher than a 1. The area of inference for larger-scale surveys (e.g., North American Amphibian Monitoring Program) should be considered from the refuge perspective unless the refuge directly contributes to analyses at a larger scale. This criterion is applicable to surveys covering areas on and adjacent to the refuge. Example: If a refuge participates and contributes to a regional survey involving neighboring US Forest Service lands, then this criterion would apply.*

1. Small scale: Applicable to only a single refuge or sites on a refuge
2. Medium scale: Applicable to a few refuges, a refuge complex, or includes the refuge and a small area beyond the refuge boundary
3. Large scale: Applicable to multiple refuges/complexes across an entire ecoregion, LCC, or region
4. Continental scale: Component of a large landscape level survey (e.g., North American Breeding Bird Survey, North American Amphibian Monitoring Program, and Circumpolar Biodiversity Monitoring Network)

**13) 7C. Data management, analysis, and reporting**

At what stage of development is the data management, analysis, and reporting?

1. Survey has no written protocol for data management, analysis, and reporting
2. Written protocol for data management, analysis, and reporting is in development (drafted)
3. Written protocol for data management, analysis, and reporting is in formal review
4. There is a published record or I&M approved protocol guiding data management, analysis, and reporting

**Table B1. Weight Applied to Prioritization Criteria.**

The following 13 criteria were weighted by Shiawassee NWR and Michigan Islands NWR staff using a direct weighting technique. Because the weights affect the final score in the SMART tool, they must be reported here.

<b>Criteria #</b>	<b>Criteria Description</b>	<b>Station-Specific Weight</b>
<b>1B</b>	<i>CCP or Other Management Plan Objectives</i>	0.130
<b>1D</b>	<i>Management Utility</i>	0.112
<b>2A</b>	<i>FWS Program Need</i>	0.058
<b>2B</b>	<i>FWS Partner Need</i>	0.025
<b>3A</b>	<i>FWS Surrogate Species</i>	0.021
<b>3B</b>	<i>Refuge Processes</i>	0.116
<b>3C</b>	<i>Survey Breadth</i>	0.116
<b>4A</b>	<i>Listed Species</i>	0.100
<b>5A</b>	<i>Controversy</i>	0.018
<b>5B</b>	<i>Threat</i>	0.062
<b>6A</b>	<i>Baseline Data</i>	0.100
<b>6C</b>	<i>Spatial Scale</i>	0.082
<b>7C</b>	<i>Data Management, analysis, and reporting</i>	0.060

## Appendix C. Prioritization Scores of All Ranked Surveys

Values used to prioritize and select the surveys likely to be conducted through 2035 at Shiawassee National Wildlife Refuge and the Michigan Islands National Wildlife Refuge. Prioritization scores were generated for candidate surveys by refuge staff using 13 criteria for each survey (Appendix A). Candidate surveys represent specific surveys or general information needs and were not always associated with specific protocols. Scores were then used as a starting reference to assign the survey status. Status definitions are as follows:

- Historic – surveys that have been completed.
- Current – surveys that are either continued or scheduled to begin in the year of IMP development because the survey is high priority and because it is reasonably certain that the capacity will be available to conduct the survey (e.g., surveys conducted with operational or other FWS funds). [Surveys that start in the current year and will be conducted.] Current surveys with an \* are conducted entirely or primarily by Refuge partners or volunteers and will be discontinued if partners or volunteers stop collecting data.
- Expected – previously conducted or new surveys that have a likely chance of being conducted during the span of an IMP because of moderate to high priority and because the capacity to conduct the survey comes from less certain sources (e.g., from partners or through grants). [Surveys that are selected and will be conducted, but the start year > year the IMP is finalized.]
- Future – surveys that have been prioritized but have low chance of being conducted during the span of the IMP because of low priority or because the capacity to conduct the survey will be difficult to secure. [Surveys that should be done, but we do not anticipate having enough resources (staff or operating funds) to conduct in the foreseeable future and low priority surveys.]

**Table C1.** Priority scores from the SMART tool for all considered surveys. Surveys with n/a were not scored because they are required.

Survey	Final Score	Score Rank	Status
Management Action Database	n/a	n/a	Current
Wilderness Character Monitoring	n/a	n/a	Current
Forest Ecological Classification	0.760	1	Historic
Staff gage monitoring for water management	0.612	2	Historic
<i>Phragmites</i> Adaptive Management Framework (PAMF)	0.610	3	Current
Michigan Island Ecological Classification	0.760	4	Expected
Michigan Islands Early Detection and Rapid Response	0.600	5	Expected
Forest Vegetation Inventory/Rapid Ecological Assessment/Forest Management Plan	0.565	6	Historic
Lakeplain prairie monitoring	0.563	7	Future
Cattail Biomass Harvest Monitoring	0.554	8	Current
Water Quality	0.553	9	Current
Integrated Waterbird Management and Monitoring	0.532	10	Current
Hydrologic/Hydraulic Modeling Work	0.497	11	Expected
River Monitoring Gages	0.479	12	Current
Colonial Waterbird Survey	0.458	13	Current
Aquatic Invasive Species Inventory and Monitoring	0.497	14	Current

<b>Survey</b>	<b>Final Score</b>	<b>Score Rank</b>	<b>Status</b>
International Shorebird Survey	0.447	15	Historic
Bat Survey	0.446	16	Future
Bathymetric	0.374	18	Historic
Forest Invasive Species Inventory	0.372	19	Expected
Waterfowl Banding	0.553	20	Current*
Eastern Prairie-Fringed Orchid	0.344	21	Future
Yellow Perch/Fish Survey	0.553	22	Current
North American Amphibian Monitoring Program	0.320	23	Current*
Grassland bird survey	0.316	24	Future
Secretive Marsh Bird Survey	0.316	25	Future
Winter Aerial Deer Count	0.553	26	Current*
Forest Interior Breeding Bird Point Counts	0.304	27	Future
FWS Mid-Winter Waterfowl Survey	0.296	28	Historic
Pitcher's Thistle Monitoring	0.293	29	Current
North American Breeding Bird Survey	0.279	30	Future
North American Butterfly	0.278	31	Historic
Dwarf Lake Iris	0.266	32	Future
American Woodcock Singing Ground Survey	0.249	33	Historic
Mourning Dove Banding	0.226	34	Future
Northern Harrier	0.222	35	Future
National Midwinter Bald Eagle Survey	0.184	36	Historic
Fall Sandhill Crane Survey	0.184	37	Current*
Eastern Foxsnake	0.093	38	Future
Blanding's Turtle	0.050	39	Historic

## Appendix D. Cost-benefit Analysis

We used linear programming to find the optimum sets of ranked surveys using the total of all priority scores as an objective function. Main constraints included costs (weeks) and surveys selected prior to solving the linear function. Portfolios represent alternative sets of selected surveys and are used for decision support; they do not dictate survey selections.

**Table D1.** Parameters framing IMP portfolios presented in Table D-2. The portfolios H to N were chosen by the Shiawassee NWR and Michigan Island NWR staff for comparison with the optimized portfolios.

Portfolio	Parameters
SQ	Status quo (surveys being conducted immediately prior to the IMP)
A	Top of priority list (filled in sequence from top of list until out of time)
B	Ecological Services requests selected + optimized
C	Migratory Birds requests selected
D	Water Resources requests selected + optimized
E	Inventory surveys selected + optimized
F	Constrained only by time (optimized)
G	Requests from all programs selected
H	Shiawassee Staff Portfolio 1
I	Shiawassee Staff Portfolio 2
J	Shiawassee Staff Portfolio 3
K	Shiawassee Staff Portfolio 4
L	Shiawassee Staff Portfolio 5
M	Shiawassee Staff Portfolio 6
S	Shiawassee Staff Selection June 2019

**Table D2.** Efficiencies in terms of frequency adjusted benefit for 14 potential IMP portfolios (1= selected, 0= not selected). Portfolios were created by direct selections or by solving for optimal sets (maximum benefit within constraints) as described in Table D1. Benefit scores are derived from the ranking results presented in Table C1. Surveys in red are required and were thus included in every portfolio.

Survey Name	SQ	A	B	C	D	E	F	G	H	I	J	K	L	M	S
Bat Survey	0	1	1	0	1	1	1	0	1	0	0	0	0	1	1
Integrated Waterbird Management and Monitoring	1	1	0	1	0	0	0	1	1	1	1	1	1	0	1
Blanding's Turtle	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Dwarf Lake Iris	0	0	1	0	1	1	1	0	0	0	0	1	0	0	0
Eastern Foxsnake	0	0	1	0	1	1	1	0	1	0	0	0	0	0	0
Eastern Prairie-Fringed Orchid	0	0	1	0	1	1	1	1	1	0	0	0	0	0	0
Fall Sandhill Crane Survey	1	0	1	1	1	1	1	1	1	0	0	0	1	0	1
Forest Interior Breeding Bird Point Counts	0	0	0	1	0	1	0	1	1	0	0	0	1	0	0
Forest Invasive Species Inventory	1	1	1	0	1	1	1	0	1	1	1	1	0	1	1
Forest Vegetation Inventory/Rapid Ecological Assessment/Forest Management Plan	0	1	1	0	1	0	1	0	1	1	1	1	0	1	0
FWS Mid-Winter Waterfowl Survey	0	0	1	1	1	0	1	1	0	0	0	0	1	0	0
FWS Woodcock Singing Ground Survey	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0
Grassland bird survey	0	0	1	1	1	1	1	1	0	0	1	0	1	0	0
Colonial Waterbird Survey	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1
Hydrologic/Hydraulic Modeling Work	1	1	1	0	1	1	1	0	1	1	1	1	0	1	1
Lakeplain prairie monitoring	0	1	1	0	1	0	1	0	0	1	0	1	0	0	0
Marsh Bird call Survey	0	0	0	1	0	1	0	1	1	0	1	0	1	0	0
Michigan Islands Early Detection and Rapid Response	0	1	1	0	1	0	1	0	1	1	1	1	0	1	1
Mid-winter bald eagle survey	0	0	1	1	1	1	1	1	0	0	0	0	1	0	0
Mourning Dove Banding	0	0	0	1	0	1	0	1	0	0	0	0	1	0	0
North American Amphibian Monitoring Program	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1
North American Breeding Bird Survey	0	0	1	1	1	1	1	1	0	0	0	0	1	0	0
North American Butterfly	0	0	1	0	1	1	1	0	0	0	0	0	0	0	0
Northern Harrier	0	0	1	1	1	1	1	1	0	0	0	0	1	0	0
Aquatic Invasive Species Inventory and Monitoring	1	1	0	0	0	0	0	0	1	1	1	1	0	1	1
Pitcher's Thistle Monitoring	1	0	0	0	0	0	0	0	0	1	1	1	0	0	1
Bathymetric	1	1	1	0	1	1	1	0	1	1	1	1	0	1	0
River monitoring gages	1	1	1	0	1	0	1	1	1	1	1	1	0	1	1

Survey Name	SQ	A	B	C	D	E	F	G	H	I	J	K	L	M	S
Water Quality	1	1	1	0	1	1	1	0	1	0	0	1	0	1	1
Waterfowl Banding	1	1	1	1	1	1	1	1	0	1	0	0	1	0	1
Wilderness Character Monitoring	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Winter aerial deer Counts	1	0	1	0	1	1	1	0	0	1	0	1	0	0	1
Yellow Perch/Fish Survey	1	0	1	0	1	1	1	0	0	1	1	0	0	1	1
Michigan Island Ecological Classification	0	1	1	0	1	1	1	0	0	0	0	0	0	0	1
Management Action Database	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
<i>Phragmites</i> Adaptive Management Framework (PAMF)	1	1	1	0	1	1	1	0	0	0	0	0	0	0	1
Forest Ecological Classification	1	1	1	0	1	1	1	0	0	0	0	0	0	0	0
Cattail Biomass Harvest Monitoring	1	1	1	0	1	0	1	0	0	0	0	0	0	0	1
<b>Benefit</b>	8.7	9.7	12.3	4.7	12.2	9.6	12.3	5.5	7.5	7.4	6.4	7.2	4.7	5.5	<b>9.4</b>
<b>Total FWS Biologist Weeks (over 15 years)</b>	277.1	300.2	306.9	281.9	306.9	307.1	306.9	323.5	369.2	289.3	331.5	284.1	281.9	191.8	<b>308.7</b>
<b># Surveys</b>	19	19	29	15	29	25	29	18	19	16	15	16	15	12	<b>20</b>

## Appendix E. Estimated Annual Costs for Implementing Surveys

(Historic surveys are excluded, total cost includes operating and staff time costs).

Survey Name	Survey ID Number	Survey Priority	Survey Status	FWS Staff Total	Total Cost
Integrated Waterbird Management and Monitoring Initiative	FF03RSHW00-015	1	Current	\$22,308.00	\$22,808.00
River Monitoring Gage	FF03RSHW00-022	2	Current	\$3,800.00	\$7,733.00
Michigan Island Ecological Classification	FF03RMCH00-041	3	Expected	\$38,615.00	\$67,462.00
Water Quality	FF03RSHW00-021	4	Current	\$8,385.00	\$44,923.00
Hydrologic/Hydraulic Modeling Work	FF03RSHW00-026	5	Current	\$43,231.00	\$105,231.00
Management Action Database	FF03RSHW00-140, FF03RMCH00-042	6	Current	\$2,969.00	\$4,469.00
Aquatic Invasive Species Inventory and Monitoring	FF03RSHW00-027	7	Current	\$8,092.00	\$9,361.00
Cattail Biomass Harvest Monitoring	FF03RSHW00-106	8	Current	\$3,762.00	\$8,762.00
Michigan Islands Colonial Waterbird Survey	FF03RMCH00-004	9	Current	\$2,623.00	\$3,373.00
<i>Phragmites</i> Adaptive Management Framework (PAMF)	FF03RSHW00-073	10	Current	\$3,154.00	\$3,654.00
Yellow Perch/Fish Survey	FF03RSHW00-025	11	Current	\$7,538.00	\$17,538.00
Michigan Islands Early Detection and Rapid Response	FF03RMCH00-005	12	Expected	\$11,477.00	\$12,477.00
Forest Invasive Species Inventory	FF03RSHW00-028	13	Current	\$40,769.00	\$41,269.00
Pitcher's Thistle Monitoring	FF03RMCH00-006	14	Current	\$3,369.00	\$4,677.00
Bat Survey	FF03RSHW00-029	15	Current*	\$8,846.00	\$11,769.00
Waterfowl Banding	FF03RSHW00-032	16	Current*	\$385.00	\$385.00
North American Amphibian Monitoring Program	FF03RSHW00-016	17	Current*	\$3,223.00	\$3,973.00
Winter Aerial Deer Survey	FF03RSHW00-010	18	Current*	\$769.00	\$3,192.00
Fall Sandhill Crane Survey	FF03RSHW00-037	19	Current*	\$469.00	\$469.00
Wilderness Character Monitoring	FF03RSHW00-043	20	Current	\$1,923.00	\$2,423.00

<b>Survey Name</b>	<b>Survey ID Number</b>	<b>Survey Priority</b>	<b>Survey Status</b>	<b>FWS Staff Total</b>	<b>Total Cost</b>
Secretive Marsh Bird Survey	FF03RSHW00-005	21	Future	\$18,077	\$22,923
Lakeplain prairie monitoring	FF03RSHW00-023	22	Future	\$38,846.00	\$39,615.00
Grassland bird survey	FF03RSHW00-019	23	Future	\$15,108.00	\$17,031.00
Eastern Foxsnake	FF03RSHW00-038	24	Future	\$3,031.00	\$3,531.00
Forest Interior Breeding Bird Point Counts	FF03RSHW00-018	25	Future	\$31,769.00	\$35,615.00
Eastern Prairie-Fringed Orchid	FF03RSHW00-033	26	Future	\$3,923.00	\$3,923.00
Dwarf Lake Iris	FF03RSHW00-034	27	Future	\$6,692.00	\$8,192.00
North American Breeding Bird Survey	FF03RSHW00-030	28	Future	\$1,346.00	\$1,346.00
Northern Harrier	FF03RSHW00-036	29	Future	\$3,500.00	\$3,500.00
Mourning Dove Banding	FF03RSHW00-035	30	Future	\$6,692.00	\$8,442.00
				<b>Staff Total</b>	<b>Total Cost</b>
Total for selected (current and expected) surveys:				\$215,707.00	\$375,948.00
Total for future surveys:				\$111,869.00	\$122,926.00

**Appendix F. Estimated Annual Work Schedule for Selected Surveys, January – December.**

Survey Name	Survey Priority	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
<b>Integrated Waterbird Management and Monitoring Initiative</b>	1		FW, DE	FW, DE	FW, DE	FW, DE	FW, DE, R	FW, DE	FW, DE	FW, DE	FW, DE	FW, DE	FW, DE, A, R
<b>River Monitoring Gage</b>	2	A, R			FW							FW,	A, R
<b>Michigan Island Ecological Classification</b>	3					FW, DE	FW, DE	FW, DE	FW, DE	FW, DE	FW, DE,	A	R
<b>Water Quality</b>	4			FW	FW	FW	FW	FW	FW	FW	FW, DE	A	R
<b>Hydrologic/Hydraulic Modeling Work</b>	5	FW, DE	FW, DE	FW, DE	FW, DE	FW, DE	FW, DE	FW, DE	FW, DE, A	FW, DE, A	FW, DE, A	FW, DE, A	R
<b>Management Action Database</b>	6	FW, DE	FW, DE	FW, DE	FW, DE	FW, DE	FW, DE	FW, DE	FW, DE, R	FW, DE	FW, DE	FW, DE	FW, DE
<b>Aquatic Invasive Species Inventory and Monitoring</b>	7					FW, DE	FW, DE	FW, DE	FW, DE	FW, DE	FW, DE		
<b>Cattail Biomass Harvest Monitoring</b>	8						FW, DE	FW, DE	FW, DE	FW, DE	FW, DE	A	R
<b>Michigan Islands Colonial Waterbird Survey</b>	9					FW, DE, A, R							
<b><i>Phragmites</i> Adaptive Management Framework (PAMF)</b>	10						FW, DE, R					FW, DE, R	

Survey Name	Survey Priority	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Yellow Perch/Fish Survey	11			FW, DE	FW, DE	FW, DE	FW, DE	FW, DE	FW, DE	FW, DE	FW, DE	FW, DE, A, R	R
Michigan Islands Early Detection and Rapid Response	12						FW, DE	FW, DE	FW, DE	FW, DE			
Forest Invasive Species Inventory	13				FW, DE	FW, DE	FW, DE	FW, DE	FW, DE	FW, DE	A	A	R
Pitcher's Thistle Monitoring	14						FW, DE, A, R						
Bat Survey	15						FW, DE	FW, DE	FW, DE, A, R				
Waterfowl Banding	16							FW, DE, R	FW, DE, R	FW, DE, R			
North American Amphibian Monitoring Program	17				FW, DE	FW, DE							
Winter Aerial Deer Survey	18	FW, DE,	FW, DE, A, R										
Fall Sandhill Crane Survey	19										FW, DE, R		
Wilderness Character Monitoring	20					FW, DE, R							
<b>P=Planning, T=Training, FW=Field Work, DE=Data Entry, A=Analysis, R=Reporting</b>													

## Appendix G. Non-selected Surveys

A status of future denotes surveys that have been prioritized but have low chance of being conducted during the span of the IMP because of low priority or because the capacity to conduct the survey will be difficult to secure. Historic status surveys have been completed or discontinued.

<i>Survey Name</i>	<i>Survey ID Number</i>	<i>Survey Status</i>
Dwarf Lake Iris	FF03RSHW00-034	Future
Eastern Foxsnake	FF03RSHW00-038	Future
Eastern Prairie Fringed Orchid Survey	FF03RSHW00-033	Future
Forest Interior Breeding Bird Point Counts	FF03RSHW00-018	Future
Grassland Bird Survey	FF03RSHW00-019	Future
Lakeplain Prairie Monitoring	FF03RSHW00-023	Future
Mourning Dove Banding	FF03RSHW00-035	Future
North American Breeding Bird Survey	FF03RSHW00-030	Future
Northern Harrier	FF03RSHW00-036	Future
Secretive Marsh Bird Survey	FF03RSHW00-005	Future
American Woodcock Singing-ground Survey	FF03RSHW00-004	Historic
Bathymetric Survey	FF03RSHW00-007	Historic
Blanding's Turtle	FF03RSHW00-039	Historic
Forest Ecological Classification	FF03RSHW00-040	Historic
Forest Rapid Ecological Assessment	FF03RSHW00-006	Historic
Goose Neck Collar Survey	FF03RSHW00-017	Historic
International Shorebird Survey	FF03RSHW00-014	Historic
Mid-December Goose Count	FF03RSHW00-013	Historic
North American Butterfly Count	FF03RSHW00-031	Historic
National Midwinter Bald Eagle Survey	FF03RSHW00-002	Historic
Midwinter Waterfowl Survey	FF03RSHW00-012	Historic
Monitoring Avian Productivity and Survivorship (MAPS)	FF03RSHW00-003	Historic
Staff Gage Monitoring for Water Management	FF03RSHW00-020	Historic
Waterfowl Banding	FF03RSHW00-032	Historic
Waterfowl Brood Survey	FF03RSHW00-011	Historic
White-tailed Deer Sex Ratio Counts	FF03RSHW00-008	Historic
Wood duck breeding survey route	FF03RSHW00-009	Historic

## Appendix H. Environmental Action Statement (EAS)

Within the spirit and intent of the Council on Environmental Quality's regulations for implementing the National Environmental Policy Act (NEPA) (40 CFR 1500-1508), and other statutes, orders, and policies that protect fish and wildlife resources, I have established the following administrative record and determined that the following proposed action does not require additional NEPA documentation.

### Proposed Action, Alternatives, and NEPA Documentation

The proposed action is to implement an Inventory and Monitoring Plan (IMP) for the Shiawassee National Wildlife Refuge and the Michigan Islands National Wildlife Refuge. This IMP is a refinement of the 2001 and 2013 Comprehensive Conservation Plans (CCP) and associated Environmental Assessment (EA) for the two Refuges. This IMP provides more-specific guidance for surveys of Refuge's fish, wildlife, plant, habitat, and abiotic resources to fulfill the Refuge's purposes and help achieve Refuge's goals and objectives.

The EA for Shiawassee National Wildlife Refuge's CCP and the Michigan Islands National Wildlife Refuge's CCP included goals and objectives for the refuge and assessed the impacts associated with a range of reasonable alternatives to achieve those goals and objectives. The rationale for selection of one specific alternative for implementation is explained in the Finding of No Significant Impact (FONSI) accompanying the final CCP. The goals, objectives, and survey strategies included in this IMP fall within the bounds of those described and assessed in the CCP and EA or EIS.

Pursuant to 40 CFR 1502.9, no additional NEPA documentation is required to implement this IMP beyond the EA and FONSI prepared concurrently with the CCP. No substantial changes to the proposed action alternative that was identified, analyzed, and selected for implementation within the CCP, EA, and FONSI are proposed through this IMP. Similarly, no significant new information or circumstances exist relevant to environmental concerns and bearing on the proposed action or its impacts.

In accordance with 43 CRF 46.205 and 40 CFR 1508.4, some surveys within this IMP are covered by the following Departmental categorical exclusion because they would not have significant environmental effects.

“Research, inventory, and information collection activities directly related to the conservation of fish and wildlife resources which involve negligible animal mortality or habitat destruction, no introduction of contaminants, or no introduction of organisms not indigenous to the affected ecosystem.” 516 DM 8.5B(1)

**PAMELA REPP** Digitally signed by PAMELA REPP  
Date: 2020.03.03 10:56:02 -05'00'

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Project Leader/Refuge Manager

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Date

Reference: *U.S. Fish and Wildlife Service. 2001. Comprehensive Conservation Plan and Environmental Assessment for Shiawassee National Wildlife Refuge. USFWS Region 3. Bloomington MN.*

## IMP Revision Signature Page

**IMP Revisions**  
Shiawassee National Wildlife Refuge and  
Michigan Islands National Wildlife Refuge

<i>Action</i>	<i>Signature /Printed Name</i>	<i>Date</i>
Survey list and priority changed:		
Submitted By:	Refuge Manager/Project Leader	
Reviewed By:	Regional I&M Coordinator	
Approved By:	Refuge Supervisor	