



Inventory and Monitoring Plan

Mingo, Pilot Knob and Ozark Cavefish National Wildlife Refuges



Mallards taking off on Mingo NWR. (Photo credit: Brad Pendley, USFWS)

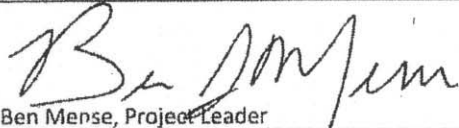
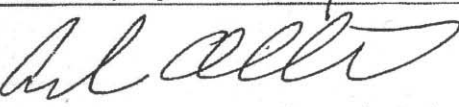
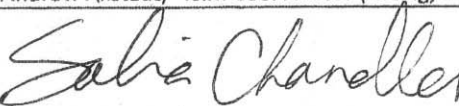
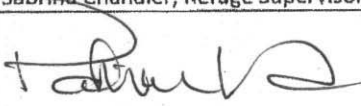
October 2017



Mingo, Pilot Knob and Ozark Cavefish National Wildlife Refuges

Inventory and Monitoring Plan

Signature Page¹

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¹ Signatures apply to all contents of the IMP.

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Introduction

This inventory and monitoring plan (IMP) documents the inventory and monitoring surveys that will be conducted at Mingo, Pilot Knob and Ozark cavefish National Wildlife Refuges (NWRs) from 2017 through 2032, or until the refuges' Comprehensive Conservation Plan (CCP) and Habitat Management Plan (HMP) are revised. The CCP and HMPs identify priority resources of concern and associated habitat types (Appendix A).

The majority of surveys considered in this plan address resource management objectives identified in the HMPs (2011, 2015) for these refuges. 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. This IMP was developed according to the Inventory and Monitoring (I&M) policy (701 FW 2) for the National Wildlife Refuge System.

Established in 1944 under authority of the Migratory Bird Treaty Act, the 21,592-acre Mingo NWR is located in Stoddard and Wayne counties in southeast Missouri. A shallow basin, the Refuge lies in an abandoned channel of the Mississippi River bordered on the west by the Ozark Plateau and on the east by Crowley's Ridge. The Refuge contains approximately 16,000 acres of bottomland and upland hardwood forest, 3,000 acres of marsh and water, 1,800 acres of cropland and moist soil units, and 170 acres of grassy openings.

The refuge is divided into 8 management units covering a diversity and juxtaposition of habitat types. Each management unit provides a unique set of resources that are necessary for target wildlife to complete their respective life cycles. The Mingo Wilderness area overlaps many of the habitat units and will be addressed in each appropriate unit. Seven research natural areas were established on the Refuge in 1970; six are within the Mingo Wilderness Area (USFWS 2011). Each RNA at Mingo NWR represents a specific forest habitat type (e.g. Oak-Hickory, Cypress-Tupelo, etc.). In research natural areas, as in designated wilderness, natural processes predominate without human intervention.

Pilot Knob NWR was established in 1987. The 90-acre Refuge, a donation of the Pilot Knob Ore Company, is located on top of Pilot Knob Mountain in Iron County, Missouri. The Refuge contains abandoned iron mine shafts excavated in the mid-1800s that have since become critical habitat for the federally-listed endangered Indiana bat. Bats enter the shafts in the fall to hibernate and exit in the spring. The numbers have varied, but at one point up to a third of the known world population of Indiana bats were believed to hibernate in the old mine. In the interest of public safety and to avoid disturbance to the bats, the Refuge is closed to public use.

Ozark Cavefish NWR was established in 1991. The 40-acre Refuge is located in Lawrence and Newton counties, 20 miles west of Springfield. Turnback Creek is located on the refuge and is the outlet of an underground spring that contains a population of the federally-threatened Ozark cavefish (*Amblyopsis rosae*). Access to the cave is through Turnback Cave, which is adjacent to the property on Missouri Department of Conservation (MDC) land to the south. Private landowners own the rest of the surrounding properties on the west, north, and east sides. The refuge includes a separate 1.3-acre parcel several miles away along Hearrell Spring in Neosho, Missouri and adjoins the Service's Neosho National Fish Hatchery.

Methods

Station staff generated a list of extant and anticipated surveys by generating a list of all observational efforts to gather information on refuge resources. Survey lists provided by Region 3 Migratory Birds Division and Ecological Services were reviewed during the compilation process. This extensive list was later refined to exclude general observations (reconnaissance) of refuge resources that do not require protocols or data management, surveys conducted for outreach purposes, and research sponsored by external entities. The remaining surveys were then assigned a priority score using 13 pre-defined criteria (Appendix B). Priority scores were used to assign the survey to one of three groups that ranked the surveys (Appendix C).

Prioritizing and selecting surveys

The priority ranking of surveys was determined during a one-day meeting December 1st, 2015 at Mingo NWR. Refuge Manager Ben Mense, Refuge Specialist Corey Kudra and Refuge Wildlife Biologist Brad Pendley met with Region 3 Zone Biologist Brian Loges to prioritize and select the surveys. Background information for each survey was summarized in advance by the Wildlife Refuge 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 (Appendix B). The Mingo Refuge staff made all decisions required to produce the survey priority scores (Appendix C).

Estimating capacity

A cost-benefit analysis (Appendix D) was performed to evaluate the total return of potential sets of selected surveys over the life of the IMP. To determine a budget threshold, the staff responsible for completing natural resource surveys was asked to estimate the portion of their time in a typical year dedicated to the following: analysis and summary, data management, monitoring, research, and supervision. The portions of the year dedicated to the activities required for implementing surveys were converted to weeks. Refuge staff estimate 27.6 weeks are available in a typical year for I&M activities. 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. Since the portfolios were developed to document the total benefit of a set of surveys over the life of the IMP, the exercise was useful in identifying low frequency surveys with high cost efficiencies. Balancing the required commitment of the selected surveys with the resources available to the station at the time of the selection will increase the probability of survey implementation. Estimated annual costs for implementing surveys are documented in Appendix E.

Results: Selected Surveys

The prioritization and cost benefit analysis were used in deliberative selection of surveys to be completed over the life of the IMP. In addition to the priority scores, the level of effort required to complete a survey as well as input from Region 3 Migratory Birds Division and Ecological Services was considered in the selection process. Selected surveys include surveys identified for completion with FY2017 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. Box 1 provides rationales for all selected surveys. Changes in available capacity, CCP 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 16 surveys that can be completed with current staffing levels and budget for the duration of this Inventory and Monitoring Plan (Table 1). Feral hog and bathymetry inventories are two surveys with high ranking scores (50th percentile) that have not been selected for implementation. However, both can receive consideration after committing resources to the selected surveys. The feral hog inventory is very time intensive with unknown effectiveness. Hog control and reconnaissance are expected to continue as long as hogs can be detected on the refuge, but the data needs do not warrant an in-depth inventory. The refuge has recently completed high resolution elevation maps for key pools. This information is expected to be valid for this HMP/IMP cycle. NWRS policy does not require monitoring of RNAs; at Mingo NWR the Wilderness Character Monitoring will address monitoring of the RNAs, since 6 of 7 are within the Wilderness Areas.

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 and available protocols. A Refuge Condition Summary, a reporting tool to summarize status, trends, and desired conditions of the selected surveys, is provided in Appendix H. Environmental Action Statement requirements are addressed in Appendix I.

Ozark Cavefish:

The Ozark Cavefish NWR protects subterranean cavefish habitats by buffering the cave entrance and restricting access. The Ozark Cavefish NWR has no on-site staff and is managed remotely by Mingo NWR, ~230 miles away, which constrains opportunities to monitor habitat conditions or species. The Refuge conducts periodic reconnaissance-level observations for signs of human disturbance. The Ozark Cavefish NWR HMP contains explicit monitoring objectives that overlap multiple agency jurisdictions. Monitoring Ozark cavefish will be conducted using partnerships between USFWS Ecological Services (ES) and Missouri Department of Natural Resources Missouri Ozark Cavefish Working Group (MOCWG) and Missouri Department of Conservation as described in the refuge's HMP. Although the HMP's monitoring objectives will be met with the involvement of staff stationed at Mingo, the estimated annual commitment is below the threshold for a refuge sponsored survey (40 hours/year) and the surveys are not included in this IMP. The Recovery Plan calls for surveying the Ozark cavefish at least every three years. A sighting of at least one Ozark cavefish every 10 years is the minimum guideline to maintain its active status.

Gray, Northern long-eared, & Indiana Bats:

All three species will be covered by the bat surveys selected for Pilot Knob and Mingo NWR. Monitoring of bats at Ozark Cavefish NWR will be conducted using partnerships between USFWS Ecological Services (ES), Missouri Department of Conservation as described in the refuge's HMP. Although the Ozark Cavefish NWR HMP's monitoring objectives will be met with the involvement of staff stationed at Mingo, the estimated annual commitment is below the threshold for a refuge sponsored survey (40 hours/year) and the survey is not included in this IMP.

Box 1. Brief rationale for selected surveys.

<i>Box 1. Brief rationale for selected surveys</i>	
<i>Survey Name</i>	<i>Rationale</i>
Mobile Acoustic Bat Survey	Provides baseline inventory on Mingo NWR for an at-risk order of mammals, including two federally listed species. Survey results will be used to inform future forest management activities.
Tree dormancy	Provides soil temperature and inundation initiation and duration data for Pool 7 and 8 Green Tree Reservoirs (GTRs) on Mingo NWR. This information relates the timing of managed flooding to tree dormancy to lessen the negative impacts of frequent flooding on forest health.
Integrated Waterbird Management and Monitoring Initiative	Mingo NWR has a strong focus on wetland and waterbird management tied to purposes of the refuge. Multiple metrics are relevant to managing impoundments for waterbirds: waterfowl use, water level monitoring, shorebird use, recording management actions & unit level vegetation response.
Water Monitoring	Mingo NWR habitat management is driven by hydrology. Water monitoring assists managers in optimizing water levels for waterfowl foraging and in producing food in moist soil units.
Forest Inventory	Forest Inventory collected in GTRs to determine current conditions and to help in the development of a Forest Management Plan. Invasive plant species will be included by incorporating some aspects of the Forest Invasives Adaptive Management project.
Air Quality	Provides long-term monitoring of air quality and pollutants on Mingo NWR as part of a nationwide effort for all Class 1 air quality areas. Data have been used on a national level and as part of more detailed contaminant studies on the Refuge.
Mercury Deposition Leaf Survey	Provides dry deposition of mercury on Mingo NWR that is used in coordination with the air quality data. Data have been used on a national level and as part of more detailed mercury studies on the Refuge.
Deer Population Survey	Provides annual deer populations at Mingo NWR for managers to use in developing a hunt season strategies and monitoring long-term population trends.

<i>Box 1. (cont.) Brief rationale for selected surveys</i>	
<i>Survey Name</i>	<i>Rationale</i>
Wilderness Character Monitoring	Monitoring of wilderness characteristics such as impacts, infractions, development and long-term weather and habitat changes on the Mingo NWR Wilderness Area.
Monopoly Lake Vegetation Surveys	Conduct vegetation surveys to gauge success of reforestation along perimeter of Monopoly Marsh.
Go Zero Breeding Bird	Monitoring the long-term change in bird assemblages as part of a 2010 forest restoration project on Mingo NWR. Breeding bird information will be used to measure habitat changes and success of the project.
Cane Survey	Monitoring of cane plantings conducted in the late 2000's as part of a habitat restoration project on Mingo NWR. Information will provide overall health and expansion of cane stands on the refuge, as well as indicating future treatment needs.
National Protocol Framework for the Inventory and Monitoring of Bees	Provides baseline pollinator species data for multiple habitat types on Mingo NWR. This information can be used for future habitat monitoring and species response to habitat manipulation.
Mast Production Survey	Provides mast production data in GTRs at Mingo NWR. Information is used to help determine food availability and Duck Energy Days (DEDs) in the GTRs.
Raccoon Population Survey	Population is currently being managed through controlled hunts.
Bat Hibernaculum survey	Provides long-term trend, seasonal population and white-nose syndrome monitoring for bat species, including Indiana, Gray, and Northern long-eared bats, at Pilot Knob NWR.
Management Actions	This survey documents habitat restoration activities completed by refuge staff by fiscal year.

Table 1. Surveys selected to conduct at Mingo National Wildlife Refuge 2017—2032.

Survey Priority ¹	Survey ID Number ² (FF03RM NG00-)	Survey Name/(Type) ³	Survey Status ⁴	Mgmt. Objective Id ⁵	Survey Area ⁶	Staff Time (FTE) ⁷	Avg. Ann Cost (OPR) ⁸	Survey Timing ⁹	Survey Length ¹⁰	Survey Coord. ¹¹	Protocol	
											Citation ¹²	Status ¹³
1	005	Mobile Acoustic Bat Survey (CM)	Current	HMP / 2.1	Multiple stations	FWS: 0.01	\$0	June, July/ Recurring -- every year	2012- Indefinite	Brad Pendley, Wildlife Biologist	(none)	Initial Survey Instructions
2	052	Tree Dormancy (M)	Current	HMP / 1.3C, 1.3A, 1.4, 1.3, 1.3B, 1.3D	Multiple management units	FWS: 0.01	\$0	Fall, winter / Recurring -- every year	2016- Indefinite	Brad Pendley, Wildlife Biologist	(none)	Initial Survey Instructions
3	016	Integrated Waterbird Management and Monitoring Initiative (CM)	Current	HMP / 4.4, 1.2, 1.6, 4.3, 4.5, 4.2, 1.5, 4.1	National	FWS: 0.1	\$0	Oct. - March/ Recurring -- every year	2015- Indefinite	John Stanton, Interim IWMM Coordinator	Loges et al. 2015	National Approved
4	013	Water Monitoring (CM)	Current	HMP / 1.9, 5.1, 5.4, 1.3D	Entire station	FWS: 0.02	\$0	Year around/ Recurring -- every year	1945- Indefinite	Brad Pendley, Wildlife Biologist	(none)	Initial Survey Instructions
5	012	Forest Inventory (CM)	Current	HMP / 1.3C, 1.7, 1.3A, 4.6, 3.4, 1.3, 3.2, 1.3B	Multiple management units	FWS: 0.002	\$0	Summer/ Recurring -- every year	2013- 2018	Brad Pendley, Wildlife Biologist	Booker et al. 2017	Initial Survey Instructions
6	007	Air Quality (CB)	Current	CCP / 4.3	National	FWS: 0.02	\$0	weekly/ Recurring -- every year	2000- Indefinite	Brad Pendley, Wildlife Biologist	(none)	Initial Survey Instructions
7	008	Mercury Deposition Leaf Survey (M)	Current	HMP / 5.3	Entire station	FWS: 0.01	\$0	8 weeks/ Recurring -- every year	2013- Indefinite	Brad Pendley, Wildlife Biologist	(none)	Initial Survey Instructions
8	009	Deer Population Survey (M)	Current	HMP / 6.1	Entire station	FWS: 0.02	\$0	Nov-Jan./ Recurring -- every year	1990- Indefinite	Brad Pendley, Wildlife Biologist	(none)	Initial Survey Instructions
9	018	Wilderness Character Monitoring (BM)	Current	N/A	Entire station	FWS: 0.01	\$0	Recurring -- every five years	2012- Indefinite	Ben Mense, Refuge Manager	(none)	Initial Survey Instructions
10	054	Monopoly Lake Vegetation Surveys (M)	Expected	HMP / 4.4, 5.1, 1.5	Single management unit	FWS: 0.08	\$0	Sporadic or Ad Hoc	2021- Indefinite	Brad Pendley, Wildlife Biologist	(none)	Initial Survey Instructions

Survey Priority ¹	Survey ID Number ² (FF03RM NG00-)	Survey Name/(Type) ³	Survey Status ⁴	Mgmt. Objective Id ⁵	Survey Area ⁶	Staff Time (FTE) ⁷	Avg. Ann Cost (OPR) ⁸	Survey Timing ⁹	Survey Length ¹⁰	Survey Coord. ¹¹	Protocol	
											Citation ¹²	Status ¹³
11	003	Go Zero Breeding Bird (M)	Current	HMP / 3.1	Entire station	FWS: 0.02	\$0	Spring/ Recurring -- every three years	2010- Indefinite	Brad Pendley, Wildlife Biologist	Knutson et al. 2016	Initial Survey Instructions
12	055	Cane Survey (M)	Current	HMP / 3.3	Entire station	FWS: 0.002	\$0	Sporadic or Ad Hoc	2016- 2017	Brad Pendley, Wildlife Biologist	(none)	Initial Survey Instructions
13	017	National Protocol Framework for the Inventory and Monitoring of Bees (CB)	Current	N/A	National	FWS: 0.01	\$0	April-Sept./ Recurring -- every year	2013- Indefinite	Brad Pendley, Wildlife Biologist	Droege et al. 2017	National In Review
14	006	Mast Production Survey (CM)	Current	HMP / 1.4, 1.3	Single management unit	FWS: 0.004	\$0	Sept- Oct/ Recurring -- every year	1967- Indefinite	Brad Pendley, Wildlife Biologist	(none)	Initial Survey Instructions
15	010	Raccoon Population Survey (M)	Current	HMP / 6.1	Entire station	FWS: 0.01	\$0	Fall/ Recurring -- every year	2013- Indefinite	Brad Pendley, Wildlife Biologist	(none)	Initial Survey Instructions
16	001	Bat Hibernaculum survey (CB)	Current	HMP / 1.1	Single management unit	FWS: 0.01	\$0	Nov-March/ Sporadic or Ad Hoc	1978- Indefinite	Brad Pendley, Wildlife Biologist	(none)	Initial Survey Instructions
NR ¹⁵	089	Management Actions	Current	HMP / see survey profile	Entire station	FWS: 0.01	\$0	December	2017- Indefinite	Brad Pendley, Wildlife Biologist	(none)	Initial Survey Instructions

¹ The rank for each survey listed in order of priority. NR = not ranked

² A unique identification number assigned by the computer. This number is prefaced by the station cost-center code 33621.

³ Short titles for the survey name, preferably the same names in station work plans.

⁴ Type of survey: I = Inventory; M = Monitoring; CM = Cooperative Monitoring.

⁵ Current: surveys that are either continued or scheduled to begin in the year of IMP, Expected: previously conducted or new surveys that have a likely chance of being conducted during the span of an IMP.

⁶ The management plan and objectives that justify the described survey.

⁷ Station management unit names, entire station, or names of other landscape units included in survey.

⁸ Estimates of Service (FWS) and non-Service (Other) staff time needed to complete the survey (1 work year = 2080 hours = 1 FTE).

⁹ Average annual operations costs for conducting the survey (e.g., equipment, contracts, travel) not including staff time. \$ = \$0 to 4,999; \$\$ = \$5,000 to 24,999; TBD = to be determined.

¹⁰ Timing and frequency of survey field activities.

¹¹ The years during which the survey has been or will be conducted.

¹² Name and position of the Survey Coordinator for each survey.

¹³ Title, author, and version of the survey protocol (if there is no protocol to cite, enter None).

¹⁴ Scale of intended use (National Framework, Regional Framework, Site-specific) and stage of approval of the survey protocol (Initial Survey Instructions, Complete Draft, In Review, or Approved)

¹⁵ Not ranked

Narratives for Selected Surveys

Survey: *Mobile Acoustic Bat Survey (FF03RMNG00-005)*

Refuge: *Mingo 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: support the recovery of the endangered Indiana bat

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.

Mobile acoustic bat surveys are conducted as part of a larger effort on 58 field stations to measure relative abundance, habitat association and species richness. The data will serve as a baseline to monitor long-term trends in species richness and abundance on the Refuge. Data summaries for each Refuge, including Mingo, will be produced annually. These data can be used to monitor for needed habitat treatments or species specific monitoring needs. The data will also serve as a baseline for pre-white nose syndrome populations and richness.

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

Biological Integrity; At-risk Biota; Mammalia (mammals); Chiroptera (bats); *Myotis sodalis* (Indiana bat) - E- Entire; *Eptesicus fuscus* (big brown bat); *Myotis lucifugus* (little brown myotis, little brown bat); Recurring -- every year; 3 survey nights in June and July

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

Coop Monitoring to Inform Management; U.S. Fish and Wildlife Service, Ecological Services; National Park Service; R3, Endangered Species Program; Southeast Region, Ecological Services Division; National Wildlife Refuge ; U.S. Fish and Wildlife Service, Regional Office, R4 Atlanta; U.S. Fish and Wildlife Service

Survey: *Tree Dormancy (FF03RMNG00-052)*

Refuge: *Mingo 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: Manage Green-tree reservoirs; Red Oak Regeneration; Red Oak Regeneration; bottomland hardwood composition; bottomland hardwoods; improve water levels and natural flow in bottomland hardwood 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.

The long-term health and sustainability of the Green Tree Reservoirs (GTR) on Mingo NWR are dependent on water control and flooding regimes. For red oak seedlings to survive, flooding must occur only when the trees are dormant. Soil temperature and other parameters will be used to determine when trees enter and leave dormancy each year. This information will be used to determine when GTR will be flooded and dewatered. Typically, dormancy occurs when soil temperatures fall below 40 degrees F.

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

Biological Integrity; Other Biota; Plantae (plants); Fagaceae (No common name); Recurring -- every year; Fall and winter prior to flooding

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

NO

Survey: *Integrated Waterbird Management and Monitoring Initiative (FF03RMNG00-016)*
Refuge: *Mingo 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: Monitor shorebird and wading bird populations; Provide a minimum of 200 acres of emergent marsh habitat; Provide a minimum of 500 acres of shallowly flooded mudflat habitats with < 25% vegetative cover and varying water levels; Provide quality moist soil habitat and high energy food resources for waterfowl; Time drawdowns of impounded wetlands to provide a minimum of 500 acres of shallowly flooded mudflat habitats with < 25% vegetative cover; maintain 2,008 acres of open marsh habitat; maintain 903 acres of open marsh habitat; provide shallow water feeding areas for wading birds and marshbirds.

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 Initiative protocol records bird use, water levels, general habitat condition and management activities at the management unit scale. The data may be used to generate unit specific use-day estimates, document migration chronologies, and explore relationships between count data and habitat condition. Data summaries will guide state dependent decision making at the unit scale, such as choosing a soil disturbance prescription or a seasonal flood regime. Unit level data can be scaled up to refuge or refuge complex as guild specific or species utilities for broad habitat types. Data can be used to assess the efficacy of management actions (accounting for management costs in terms of use-days for targeted populations) and support learning to improve management. Raw count data are also used to answer public inquiries regarding refuge-wide waterfowl populations. Water levels must be monitored to ensure optimum depths are achieved for waterfowl feeding, especially during peak migration. Data are used during drawdowns to inform management as the drawdown progresses.

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

This survey involves direct counts or estimates of waterbirds in managed wetland units. Biological Integrity; Other Biota; Aves (Birds); Anseriformes (Waterfowl, Swans, Geese, Screamers, Ducks); Gruiformes (Rails, Cranes); Galliformes (Fowls, Gallinaceous Birds); Charadriiformes (Auks, Alcids, Oystercatchers, Plovers, Shore Birds, Gulls); Pelecaniformes (Herons, Ibises, Pelicans); Recurring -- every year; This will occur during spring and fall migration

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

This is a cooperative survey during autumn migration, and is completed in conjunction with the Missouri Department of Conservation weekly waterfowl surveys.

Survey: *Water Monitoring (FF03RMNG00-013)*

Refuge: *Mingo 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: Conserve, restore, and manage 77 miles of flowing water and 220 acres of open water; Continue the development of a Water Resources Plan; Replace and change the elevation of the current spillway.; improve water levels and natural flow in bottomland hardwood 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.

Hydrologic conditions drive the ecology of Mingo NWR. The refuge is within the lower portion of the St. Francis River basin, and acts as a reservoir during periods of flooding. Water monitoring data will be used in all aspects of bottomland habitat management such as flooding and dewatering regimes, plant production, invasive species control, depth for waterfowl foraging and forest management. Each habitat type on the refuge has an optimal hydrological regime and water levels will be used by Refuge Staff to meet those requirements. Water levels will be used to maintain a depth of under 12" from fall until early spring for ideal waterfowl foraging conditions. Water level readings will be used to prevent inundation of forested areas during the growing season. Water levels will be used to prevent flooding on adjacent lands to the Refuge. Each of these situations has its own trigger and management response based on desired habitat conditions, current land use, season and location on the Refuge.

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

Water; Hydrology; Recurring -- every year; Year around

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

Coop Monitoring to Inform Management; U.S. Fish and Wildlife Service, Regional Office, R3 Twin Cities

Survey: *Forest Inventory (FF03RMNG00-012)*

Refuge: *Mingo 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: Manage and maintain 765 acres of pole stand (Figure 4) and early successional forested areas; Monitor, treat and evaluate invasive and exotic species; Red Oak Regeneration; Red Oak Regeneration; bottomland hardwood composition; bottomland hardwoods; manage, restore and maintain 1,315 acres of upland forests; monitor, treat and evaluate invasive and exotic species

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.

Forest inventory is important to identify the current state of the forest on Mingo NWR and to identify areas needing treatment. Forest inventory data will be analyzed and compared with desired forest conditions (DFC) outlined in the HMP. Data will also be used in the development of a Forest Management Plan (FMP). This FMP will look at current forest conditions and develop a management objective and treatment plan for each stand to insure that the stand remains or obtains DFC. Portions of the inventory will follow a regional protocol for invasive plant inventory in forests (Booker et al 2017). Basal area, stand composition, and other traditional metrics follow initial survey instructions.

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

Biological Integrity; Other Biota; Plantae (plants); Fagaceae (No common name);
Recurring -- every year; Summer

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

Coop Monitoring to Inform Management; Academia

Survey: *Air Quality (FF03RMNG00-007)*
Refuge: *Mingo 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?

CCP: Contaminants

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.

Air quality monitoring is conducted in partnership with the national Interagency Monitoring and Protected Visual Environments (IMPROVE) program. Mingo Wilderness area is designated as a Class 1 air quality area and is afforded special protection under the Clean Air Act. The Federal Land Managers are required by the Clean Air Act to protect visibility at designated Class I visibility areas.

The particulate monitoring portion of the IMPROVE program measures the concentration of the fine (PM_{2.5}) particles for mass, optical absorption, major and trace elements, organic and elemental carbon, and nitrate and of PM₁₀ particles for mass. These data are compiled annually as part of the ongoing monitoring effort of all Class 1 visibility areas.

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

Air and Climate; Air Quality; Recurring -- every year; weekly

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

Coop Baseline Monitoring

Survey: *Mercury Deposition Leaf Survey (FF03RMNG00-008)*

Refuge: *Mingo 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: Monitor mercury and other heavy metals

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 supplements the wet mercury deposition sampling occurring on the Refuge. Dry deposition of mercury has the potential to impact all biota on the Refuge. Information from both the wet and dry sampling indicates total mercury deposition and what mercury is available for uptake through the system. This information will be used to monitor long-term deposition levels, provide background information for contaminate studies conducted on the Refuge, and assist in indicating if fish consumption advisories should be updated. Annual reports provided by the USGS will be used to determine if any additional deposition is occurring.

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

Air and Climate; Air Quality; Recurring -- every year; 8 weeks

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

Yes, USGS

Survey: *Deer Population Survey (FF03RMNG00-009)*

Refuge: *Mingo 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: Conserve, restore, and manage up to 21,592 acres of refuge lands to support resident wildlife species and population levels

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.

Deer population surveys are used to determine the number of deer on the Refuge. This information details fecundity rate and buck to doe ratios, as well as the overall population. The current desired population on the Refuge is 800-1200 deer. The population survey lets the refuge staff set the appropriate number of managed hunts for the refuge and helps set an annual goal for overall and doe harvest. Data can be used to assess the efficacy of management actions and support learning to improve management. Raw count data are also used to answer public inquiries regarding refuge-wide deer populations.

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; Nov-January; 6 times

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

Yes, population numbers are used set Refuge deer seasons which are then coordinated with MDC to set season types, limits and numbers of hunts. The seasons are then entered as part of the managed hunt system within MDC.

Survey: *Wilderness Character Monitoring (FF03RMNG00-018)*

Refuge: *Mingo 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?

Wilderness Act of 1964:

- Statement of Policy, Section 2(a): “a National Wilderness Preservation System...shall be administered...so as to provide for the protection of these areas, the preservation of their wilderness character”
- Use of Wilderness Areas, Section 4(b): “each agency administering any area designated as wilderness shall be responsible for preserving the wilderness character of the area”

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.

In 2012 a baseline Wilderness Character Survey was conducted using 25 measures to determine the condition of the Mingo NWR Wilderness Area. Each year (or as required in the plan) a survey of the 25 measures will be conducted to determine annual impacts and change to the Wilderness Area. Each measure has a benchmark for significant change that indicates a need to address a potential change or impact in wilderness character. If any measure reaches the benchmark in a given survey period, management action may be taken.

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

Human Use; Visitor and Recreation Use; Plantae (plants); Fagaceae (No common name); *Myotis sodalis* (Indiana bat) - E- Entire; Recurring -- every five years;

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

NO

Survey: *Monopoly Lake Vegetation Surveys (FF03RMNG00-054)*

Refuge: *Mingo 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: Conserve, restore, and manage 77 miles of flowing water and 220 acres of open water; Provide a minimum of 200 acres of emergent marsh habitat; maintain 2,008 acres of open marsh 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.

The CCP calls for the drawdown of Monopoly Marsh incrementally over 10 years to progressively expose edge habitats allowing for eventual conversion of about 225 acres to bald cypress and water tupelo. Surveys will be used to determine if drawdowns are successfully increasing desirable forest stands along the perimeter of Monopoly Marsh. If a 10% increase in desirable species isn't detected each 10 year period, additional measures such as tree plantings or additional drawdowns may be needed.

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

Biological Integrity; Other Biota; Plantae (plants); Ranunculaceae (buttercups, crowfoot); Haloragaceae (water milfoil); Potamogetonaceae (Pondweed family, pondweed, pond weed); Nymphaeaceae (water lilies); Nelumbonaceae (Indian lotus); Sporadic or Ad Hoc;

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

NO

Survey: *Go Zero Breeding Bird (FF03RMNG00-003)*

Refuge: *Mingo 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: provide sufficient habitat to support migratory landbirds

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.

As part of the Go Zero project to monitor the changes in bird species richness over time, the Refuge established monitoring plots in reforested tracts and established bird point count locations to determine changes in bird species richness as the forest matures. The Refuge installed three plots per every 100 acres of newly planted area. Point counts on the Go Zero Tracts began in 2010 after planting occurred and have occurred each year since then. This survey follows the National Protocol Framework for the Inventory and Monitoring of Breeding Landbirds Using Point Counts (Knutson et al. 2016). Information from surveys will facilitate comparison of the overall biodiversity effects between afforestation sites and existing agricultural fields, random control plots were established in agriculture units and followed the same sampling protocol.

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

Biological Integrity; Other Biota; Aves (Birds); Cuculiformes (Cuckoos); Columbiformes (Pigeons, Doves); Apodiformes (Hummingbirds, Swifts); Passeriformes (Perching Birds);
Recurring -- every three years; Spring

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

Yes, this survey is identified as part of the requirements for utilizing Go Zero funding to plant trees on the Refuge.

Survey: *Cane Survey (FF03RMNG00-055)*

Refuge: *Mingo 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?

HMP: Establish and expand existing stands of giant cane

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.

In 2008 and 2009, over 4,000 cane rhizomes were planted on Mingo NWR. Monitoring the long-term success of these plantings will provide information about stand establishment, future project viability and expansion, treatment needs and use by at-risk biota such as Bachman's warbler, Swainson's warbler and swamp rabbit. Monitoring will be used to determine if a stand is fully established and when additional treatments will be needed. Treatment will be initiated if total stand size or number of stems is reduced. Stand treatment will be determined based on current conditions.

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

Biological Integrity; At-risk Biota; Plantae (plants); Poaceae (grasses); Sporadic or Ad Hoc;

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

NO

Survey: *National Protocol Framework for the Inventory and Monitoring of Bees*
(FF03RMNG00-017)

Refuge: *Mingo 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?

None

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.

Long-term population and species identification on the Refuge is important in the development and implementation of habitat management activities for pollinators. Survey data will include occurrence and identification of most of the bee species present on the Refuge, their relative abundance within the confines of the protocol/methods, species richness of the bee fauna, and basic phenology. Application of this protocol framework should result in comparable data when applied across habitats and/or stations and provide the baseline information needed for developing subsequent management objectives. These data can also be used to monitor bee populations over time, or in an adaptive management framework, to see what the results of land management actions (e.g., vegetation manipulations) may have on bee populations.

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

Biological Integrity; Other Biota; Arthropoda (arthropods); Hymenoptera (wasps, bees, ants); Recurring -- every year; April-September

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

Coop Baseline Monitoring; U.S. Geological Survey

Survey: *Mast Production Survey (FF03RMNG00-006)*

Refuge: *Mingo 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?

HMP: Manage Green-tree Reservoirs; bottomland hardwoods;

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.

Mast surveys are conducted both on Mingo NWR and Duck Creek Conservation Area in GTRs. These surveys indicate relative abundance of mast available to waterfowl and other species. This information is used to help determine the number of Duck Energy Days (DEDs) for the GTRs as outlined in the Habitat Management Plan. The information can also be used to track acorn production and seedling development for forest management activities. This information may be used to help plan for Timber Stand Improvement (TSI) treatments in years following high mast production.

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

Biological Integrity; Other Biota; Plantae (plants); Fagaceae (No common name); Recurring -- every year; Sept- Oct

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

Coop Monitoring to Inform Management; Missouri Department of Conservation.

Survey: *Raccoon Population Survey (FF03RMNG00-010)*

Refuge: *Mingo 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: Conserve, restore, and manage up to 21,592 acres of refuge lands to support resident wildlife species and population levels

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.

Raccoons are an important species on the Refuge. They predate wood duck, hooded mergansers, and marshbird nests and are vectors for multiple diseases. Their population is currently being managed through controlled hunts which necessitates a population estimate. Field surveys will be conducted on a 5-year interval. Population trends will be gathered through hunter harvest surveys and data from field surveys. This information will be used to develop long-term population trends and to help inform refuge staff when setting season and harvest goals. Surveys will also help in the monitoring of disease outbreaks within the species.

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

Biological Integrity; Other Biota; Mammalia (mammals); Carnivora (carnivores);
Recurring -- every year; Fall

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

NO

Survey: *Bat Hibernaculum Survey (FF03RPLT00-001)*

Refuge: *Pilot Knob 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: continue providing habitat to support the recovery of the Northern long-eared, Indiana and Gray bats;

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.

Pilot Knob NWR protects critical habitat for the Indiana bat. This survey will contain methods for assessing the hibernating bat population, changes in the physical environment of the mine and the condition of protective structures (fence/gate) as outlined in the HMP. Protection of the mine and maintaining mine entrances will be the main focus for habitat protection

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

Biological Integrity; At-risk Biota; Mammalia (mammals); Chiroptera (bats); *Myotis sodalis* (Indiana bat) - E- Entire; *Myotis grisescens* (Gray bat) - E- Entire; *Myotis septentrionalis* (Northern Long-Eared Bat) - T- ; *Myotis* (mouse-eared bats); Sporadic or Ad Hoc; Nov-March

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

Coop Baseline Monitoring; U.S. Fish and Wildlife Service, Ecological Services; State Agencies, Missouri; Bat Conservation International

Survey: *Management Actions (FF03RMNG00-089)*

Refuge: *Mingo National Wildlife Refuge*

Priority: *Not Ranked*

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

HMP: Conserve, restore, and manage 77 miles of flowing water and 220 acres of open water; Establish and expand existing stands of giant cane; Manage and maintain 765 acres of pole stand (Figure 4) and early successional forested areas; Manage open water habitat; Monitor, treat and evaluate invasive and exotic species; Provide a minimum of 200 acres of emergent marsh habitat; Provide a minimum of 500 acres of shallowly flooded mudflat habitats with < 25% vegetative cover and varying water levels; Replace and change the elevation of the current spillway.; maintain 2,008 acres of open marsh habitat; maintain 903 acres of open marsh habitat; monitor, treat and evaluate invasive and exotic species.

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 activities completed by refuge staff for the current fiscal year. The survey is also retroactive capturing available legacy 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 existing in multiple forms ranging from mine reclamation plans to logs of tree planting records will be archived as part of an on-going effort by the Division of Natural Resources and Conservation Planning to secure management history of refuge properties in ServCat. Information will be collected at the greatest available detail required to inform future assessments of long term habitat restorations.

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

Recurring -- every year; December

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

No

Revising the IMP

The Project Leader 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 Appendix J). 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, but not the Refuge Supervisor or Regional Chief of Refuges.

References

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Steenhof, K. L. Bond, and L. L. Dunn. 2008. The midwinter bald eagle survey results and analysis 1986-2005. U.S. Geological Survey, National Biological Information Infrastructure, and Northwest Alliance for Computational Science and Engineering. Available on-line at <http://www.nacse.org/nbii/eagles>.

USFWS (United States Fish and Wildlife Service). 2011. Mingo NWR Habitat Management Plan. Puxico, MO.

USFWS (United States Fish and Wildlife Service). 2015a. Pilot Knob NWR Habitat Management Plan. Puxico, MO.

USFWS (United States Fish and Wildlife Service). 2015b. Ozark Cavefish NWR Habitat Management Plan. Puxico, MO.

Appendix A. Priority Resources of Concern and associated habitat types
(information was derived from each respective HMP, primary habitats are cave or mine voids in bedrock).

<i>Refuge</i>	<i>Resource of concern</i>	<i>bottomland hardwood forests</i>	<i>moist-soil wetlands</i>	<i>flooded agricultural fields</i>	<i>open water areas</i>	<i>shrub/scrub wetlands</i>	<i>spring branch</i>	<i>primary</i>
Mingo	migratory waterfowl	x	x	x	x	x		
Mingo	Indiana bat	x						
Mingo	migratory landbirds	x				x		
Mingo	shorebirds and waterbirds		x		x			
Mingo	aquatic resources				x	x		
Mingo	resident wildlife	x	x	x	x	x		
Ozark Cavefish	gray bat							x
Ozark Cavefish	Ozark cavefish						x	x
Ozark Cavefish	aquatic resources						x	x
Pilot Knob	Indiana bat							x
Pilot Knob	gray bat							x
Pilot Knob	northern-long eared bat							x

Federally listed Threatened or Endangered Species

<i>Refuge</i>	<i>Species</i>	<i>Status</i>
Mingo NWR	Indiana bat (<i>Myotis sodalis</i>)	Endangered
	Bald eagle (<i>Haliaeetus leucocephalus</i>)	Recovery
Ozark Cavefish NWR	Gray bat (<i>Myotis grisescens</i>)	Endangered
	Ozark cavefish (<i>Amblyopsis rosae</i>)	Threatened
Pilot Knob NWR	Gray bat (<i>Myotis grisescens</i>)	Endangered
	Indiana bat (<i>Myotis sodalis</i>)	Endangered
All	Northern long-eared bat (<i>Myotis septentrionalis</i>)	Threatened with 4(d) Rule

Appendix B. Criteria and Weights Used to Prioritize Surveys

Each criterion is grouped under one of eight themes that describe a survey's general contribution to a refuge's or broader needs. Rating values (1—2, 1—3, or 1—4) that are used to score each survey are also given for each criterion. NOTE: The 24 criteria recommended by the NRPC were reduced to the following 13 for use in Region 3. The additional 11 criteria were removed because they would not apply to refuges in the Midwest, were redundant with other criteria, or would not add discrimination among surveys in the Midwest.

Refuge Priorities and Management Needs

1. CCP or Other Management Plan Objectives

How many refuge CCP or other management plan objectives (e.g., HMP, NRMP, Fire Management Plan, Recovery Plan, 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. 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

Partner Priorities and Management Needs

3. 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 ≥ 3 FWS regional or national programs or initiatives

4. 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)

Ecological Applications

5. FWS Surrogate Species

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

These should include any focal, indicator, any other surrogate concept that has been designated and used by the FWS (e.g., JV focal species).

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

6. Refuge Processes

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

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

7. 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

Additional Legal Mandates

8. Listed species or vegetation communities

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

Immediacy of Need

9. 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. 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 a Natural Resources Management Plan (e.g., R8), 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])

Scope and Scale

11. 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. 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)

Protocol

13. Protocol development & data management, analysis, and reporting

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

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

Terms Used in the Prioritization Criteria

For Criterion #1, refuge purpose is defined within the National Wildlife Refuge System Mission and Goals and Refuge Purposes policy (601 FW 1).

The NWRS Improvement Act defines “purposes of the refuge” as the “purposes specified in or derived from the law, proclamation, Executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or refuge subunit.”

Refuges acquired under the authority of general conservation laws take on the purpose of the law. Examples of such laws include the Endangered Species Act of 1973, as amended; the Migratory Bird Conservation Act; the Fish and Wildlife Act of 1956, as amended; the Fish and Wildlife Coordination Act, as amended; the Emergency Wetlands Resources Act of 1986; and the Alaska National Interest Lands Conservation Act of 1980. Executive orders and proclamations, Secretary’s Orders, public land orders, and refuge-specific legislation generally declare the purpose(s) of the refuge, sometimes broadly (e.g., “as a preserve and breeding ground for native birds”) and sometimes very specifically (e.g., “to protect and preserve in the national interest the Key deer and other wildlife resources in the Florida Keys”).

As written in the Wilderness Act of 1964, the purposes of the Act are to be “within and supplemental” to the purpose(s) of those refuges with designated wilderness. We interpret this to mean the wilderness purposes become additional purposes of the refuge, yet apply only to those areas of the refuge designated as wilderness. Wilderness designations provide additional considerations for determining the administrative and management actions we need to take to achieve a refuge’s purpose(s) on designated wilderness areas within the Refuge System.

Throughout the criteria, the term refuge refers to one or more refuges in the NWRS. Based upon 601 FW 1, a refuge is defined as “...all lands, waters, and interests therein administered by the Service as wildlife refuges, wildlife ranges, wildlife management areas, waterfowl production areas, and other areas managed by the Refuge System for the protection and conservation of fish and wildlife, including threatened and endangered species, as determined in writing by the Director of the Service, by Secretary’s Order, or so directed by the President.”

Definitions of refuge management activities and refuge uses derived from the Compatibility policy (603 FW 2.6) that apply to all refuges:

Table B-1. Weight Applied to Prioritization Criteria.

The following 13 criteria were weighted by refuge staff at Mingo NWR (relative values in parentheses with highest values representing criteria that are most important to refuge staff) and used to rank surveys through a Simple Multi-Attribute Ranking Technique (SMART tool).

	Criteria	Station-specific weight	Comparison to even weight
1	CCP or Other Management Plan Objectives	0.13	0.05
2	Management Utility	0.14	0.06
3	FWS Program Need	0.11	0.04
4	FWS Partner Need	0.07	-0.01
5	FWS Surrogate Species	0.03	-0.05
6	Refuge Processes	0.12	0.04
7	Survey Breadth	0.02	-0.05
8	Listed Species or Vegetation Communities	0.12	0.05
9	Controversy	0.06	-0.02
10	Threat	0.09	0.01
11	Baseline Data	0.05	-0.03
12	Spatial Scale	0.03	-0.04
13	Data Management, Analysis, and Reporting	0.03	-0.05

Appendix C. Prioritization Scores of All Ranked Surveys

Values used to prioritize and select the surveys likely to be conducted through 2031 at Mingo National Wildlife Refuge. Prioritization scores were generated for candidate surveys by refuge staff using 13 criteria for each survey (Appendix B). Candidate surveys represent specific surveys or general information needs and were not always associated with specific protocols. Groups A, B, C, D, and E represent the >90th, >80th, >70th, >50th, and <50th percentiles respectively.

Table C-1 Ranking of priority scores from the SMART tool for all considered surveys.

<i>Survey</i>	<i>Final Rank</i>	<i>Final Score</i>	<i>Group</i>	<i>Status</i>
Bat Hibernaculum Survey	1	0.644	A	Current
Mobile Acoustic Bat Survey	2	0.642	A	Current
Tree dormancy	3	0.634	B	Current
IWMM	4	0.601	B	Current
Water Monitoring Mingo	5	0.530	C	Current
Bathymetry	6	0.524	C	Future
Forest Inventory	7	0.521	D	Current
Feral hog Inventory	8	0.482	D	Future
Air Quality	9	0.370	E	Current
Mercury Deposition Leaf Survey	10	0.363	E	Current
Road Mortality of Snakes	11	0.345	E	Future
Deer Population Survey	12	0.319	E	Current
Wilderness Character Monitoring	13	0.294	E	Current
Veg surveys Monopoly	14	0.244	E	Current
Go Zero Breeding Bird	15	0.231	E	Current
Cane	16	0.227	E	Current
Pollinator/Bee Survey	17	0.206	E	Current
Mast Production Survey	18	0.094	E	Current
Raccoon Population Survey	19	0.023	E	Current

Appendix D. Cost-benefit Analysis

The following table includes results from direct selections and linear programming approaches (all optimized sets). The optimized portfolios used the total of all frequency adjusted scores as an objective function. Main constraints included costs (weeks) and surveys selected prior to solving the linear function (summation of frequency adjusted scores across all surveys). Portfolios represent sets of selected surveys as IMP variants.

Table D-1. Parameters framing IMP portfolios presented in table D-2.

Portfolio	Parameters
1	Top-down selection from ranked list
2	Top 10 selection
3	All surveys selected
4	Optimized for maximum benefit
5	Optimized constrained to select all inventories
6	Optimized constrained for all trust species
7	Optimized constrained for no trust species
8	Optimized constrained to select top 5 by rank
9	Optimized constrained to select top 2 by rank
10	Optimized constrained to 50% staff time
11	Top-down selection from ranked list and 50% staff time
12	Top-down selection from ranked list and 75 % staff time
13	Optimized constrained to 75% staff time
14	Optimized constrained to IWMM
15	Optimized constrained to bathymetry
16	Optimized constrained to IWMM, bathymetry, feral hog
17	Optimized constrained to feral hog
18	Final selected set

Table D-2. Efficiencies in terms of frequency adjusted total benefit for 18 potential IMP portfolios.

Portfolios (x= selected surveys) were created by direct selections or by solving for optimal sets (maximum benefit within constraints) as described in table D-1. Benefit scores are derived from the ranking results presented in table C-1. The constraint was the estimated 27.6 weeks of available biologist time.

Survey Name	Portfolio																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Indiana bat hibernacula & WNS	x	x	x	x		x		x	x	x	x	x	x	x	x		x	x
Mobile Acoustic Bat Survey	x	x	x	x	x	x		x	x	x	x	x	x	x	x		x	x
Tree dormancy	x	x	x	x			x	x	x	x	x	x	x	x	x		x	x
IWMM	x	x	x			x		x			x	x		x		x		x
Water Monitoring Mingo	x	x	x	x			x	x	x	x	x	x	x	x	x		x	x
Bathymetry	x	x	x	x	x		x		x			x			x	x		
Forest Inventory	x	x	x	x	x		x	x	x	x	x		x	x	x		x	x
Feral hog Inventory		x	x		x											x	x	
Air Quality	x	x	x	x			x	x	x	x	x	x	x	x	x		x	x
Mercury Deposition Leaf Survey	x	x	x	x	x		x	x	x	x	x		x	x	x	x	x	x
Road Mortality of Snakes			x	x			x	x	x	x			x	x	x		x	
Deer Population Survey	x		x	x			x	x	x		x		x	x	x		x	x
Wilderness Character Monitoring	x		x	x			x	x	x	x			x	x	x		x	x
Veg surveys Monopoly			x					x					x	x				x
Go Zero Breeding Bird	x		x	x		x		x	x	x			x	x	x		x	x
Cane	x		x	x	x		x	x	x	x		x	x	x	x	x	x	x
Pollinator/Bee Survey			x	x	x		x	x	x	x			x	x	x		x	x
Mast Production Survey	x		x	x			x	x	x	x			x	x	x		x	x
Raccoon Population Survey			x	x			x	x	x	x			x	x	x		x	x
Benefit	1.0	0.7	1.2	1.1	0.5	0.4	0.8	1.1	1.1	1.1	0.7	0.6	1.1	1.1	1.1	0.3	1.1	1.0
Weeks/year	27.6	34.8	45.5	26.5	27.4	7.0	24.5	23.5	26.5	13.5	13.8	20.6	18.5	23.5	26.5	27.4	24.5	20.5
# Surveys	14	10	19	16	7	4	13	17	16	14	9	8	16	17	16	5	16	16

Appendix E. Estimated Annual Costs for Implementing Surveys

(Surveys with historic status are excluded).

Survey Name	Survey ID Number	Survey Priority	Survey Status	FWS Staff Total	Total Cost
Mobile Acoustic Bat Survey	FF03RMNG00-005	1	Current	\$962.00	\$962.00
Tree Dormancy	FF03RMNG00-052	2	Current	\$962.00	\$962.00
Integrated Waterbird Management and Monitoring Initiative	FF03RMNG00-016	3	Current	\$9,615.00	\$9,615.00
Water Monitoring	FF03RMNG00-013	4	Current	\$1,923.00	\$1,923.00
Bathymetry	FF03RMNG00-053	5	Future	\$23,077.00	\$23,077.00
Forest Inventory	FF03RMNG00-012	6	Current	\$192.00	\$192.00
Feral hog inventory	FF03RMNG00-014	7	Future	\$19,231.00	\$19,231.00
Air Quality	FF03RMNG00-007	8	Current	\$1,923.00	\$1,923.00
Mercury Deposition Leaf Survey	FF03RMNG00-008	9	Current	\$577.00	\$577.00
Deer Population Survey	FF03RMNG00-009	11	Current	\$1,923.00	\$1,923.00
Wilderness Character Monitoring	FF03RMNG00-018	12	Current	\$962.00	\$962.00
Monopoly Lake Vegetation Surveys	FF03RMNG00-054	13	Expected	\$7,692.00	\$7,692.00
Go Zero Breeding Bird	FF03RMNG00-003	14	Current	\$1,923.00	\$1,923.00
Cane Survey	FF03RMNG00-055	15	Current	\$192.00	\$192.00
National Protocol Framework for the Inventory and Monitoring of Bees	FF03RMNG00-017	16	Current	\$962.00	\$962.00
Mast Production Survey	FF03RMNG00-006	17	Current	\$385.00	\$385.00
Raccoon Population Survey	FF03RMNG00-010	18	Current	\$769.00	\$769.00
Bat Hibernaculum Survey	FF03RPLT00-001	1	Current	\$962.00	\$962.00
Management Actions	FF03RMNG00-089	~	Current	\$962.00	\$962.00
				Staff Total	Total Cost
Total for selected (current and expected) surveys:				\$31,924	\$31,924
Total for future surveys:				\$42,308	\$42,308

Appendix F. Estimated Annual Work Schedule for Selected Surveys.

Survey Name	Survey ID Number	Survey Priority	Jan-March	April-June	July-Sept	Oct-Dec
Mobile Acoustic Bat Survey	FF03RMNG00-005	1	P, T	FW, DE, A, R	FW, DE, A, R	
Tree Dormancy	FF03RMNG00-052	2	FW, DE	FW, DE	FW, DE	FW, DE, A, R
Integrated Waterbird Management and Monitoring Initiative	FF03RMNG00-016	3	FW, DE	FW, A, R, P	FW	FW, DE,
Water Monitoring	FF03RMNG00-013	4	FW, DE	P, FW, DE	FW, DE	FW, DE, A, R
Forest Inventory	FF03RMNG00-012	6		P, FW, DE	FW, DE, A, R	
Air Quality	FF03RMNG00-007	8	FW, DE	FW, DE	FW, DE	FW, DE
Mercury Deposition Leaf Survey	FF03RMNG00-008	9				P, FW, DE, A, R
Deer Population Survey	FF03RMNG00-009	11	FW, DE, A, R			FW, DE
Wilderness Character Monitoring	FF03RMNG00-018	12			FW, DE, A, R	
Monopoly Lake Vegetation Surveys	FF03RMNG00-054	13	P, T		FW, DE, A, R	
Go Zero Breeding Bird	FF03RMNG00-003	14		FW, DE	FW, DE, A, R	
Cane Survey	FF03RMNG00-055	15	FW, DE, A, R			
National Protocol Framework for the Inventory and Monitoring of Bees	FF03RMNG00-017	16		P, T, FW, DE, A, R	FW, DE, A, R	
Mast Production Survey	FF03RMNG00-006	17			FW, DE, A, R	
Raccoon Population Survey	FF03RMNG00-010	18				P, T, FW, DE, A, R
Bat Hibernaculum Survey	FF03RPLT00-001	1			FW, DE	FW, DE
Management Actions	FF03RMNG00-089		DE	DE	DE, R	DE

P=Planning, T=Training, FW=Field Work, DE=Data Entry, A=Analysis, R=Reporting

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 recently completed or discontinued and were not ranked.

Survey Name	Survey ID Number	Survey Priority	Survey Status
Bathymetry	FF03RMNG00-053	5	Future
Feral hog inventory	FF03RMNG00-014	7	Future
Fish Survey/Stocking	FF03RMNG00-015	~	Historic
Go Zero Tree Survival	FF03RMNG00-004	~	Historic
Pollinator/Bee Survey	FF03RMNG00-011	~	Historic
Road Mortality of Snakes	FF03RMNG00-001	10	Historic
Winter Waterfowl Surveys (Part of IWMM in 2015)	FF03RMNG00-002	~	Historic

Appendix H. Refuge Condition Summaries

Revisions and improvements to this table are **CURRENTLY UNDER DEVELOPMENT**. Once improvements are completed all IMPs will include this appendix in their IMPs. This summary table will be used as a reporting tool throughout the life of the IMP to track the status, trends, and desired conditions of the selected surveys. Updates to this summary can be made during annual reviews and reported in Annual Habitat Work Plans (AHWP). Table updates will not require an IMP revision, but will be uploaded as a digital file associated with the ServCat record that contains the approved IMP.

REFUGE SUMMARY TABLE

Resource Theme Level 1 ¹	Resource Theme Level 2 ¹	Attribute ²	Current Condition (values) ³	Source of Current Condition ⁴	Desired Condition (values) ⁵	Source of Desired Condition ⁶	Within Desired Condition? ⁷	Survey Name ⁸

¹ Level 1 and 2 refer to the PRIMR Resource Themes 1 and 2 and cannot be altered.

² Characteristics of a system that are of interest of survey and can be observed or estimated.

³ If known, current conditions of system being measured.

⁴ Document in which current condition is reported. If not available enter "unknown" or "N/A".

⁵ Desired conditions of system being measured.

⁶ Document in which desired condition is reported. If not available enter "unknown" or "N/A".

⁸ Survey name should match PRIMR record.

REFERENCES:

Appendix I. 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 Mingo, Pilot Knob and Ozark Cavefish National Wildlife Refuges. This IMP is a step down plan from the 2011 and 2015 Habitat Management Plans (HMP) for the 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 Mingo, Pilot Knob and Ozark Cavefish HMPs were guided by the comprehensive conservation plan (CCP) for three national wildlife refuges in southern Missouri: Mingo NWR, Ozark Cavefish NWR and Pilot Knob NWR (USFWS 2007). The 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 CFR 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)



Project Leader/Refuge Manager

10/23/17
Date

[Note: this signature and dating is not required if a statement is placed below the IMP signature page indicating that the Project Leaders signing of that page applies to all contents of this IMP].

References: U.S. Fish and Wildlife Service. 2007. *Environmental Assessment and Comprehensive Conservation Plan for Mingo, Pilot Knob, and Ozark Cavefish National Wildlife Refuges, Missouri*. USFWS Region 3. Bloomington MN.

Appendix J. IMP Revision Signature Page

An IMP will be revised according to I&M Policy and as CCP and HMP plans are modified. IMP revisions require signatures from the staff listed in table below, which does not include the Refuge Supervisor or Regional Chief of Refuges. A revised IMP will include the completed and signed Revision Signature Page which will be placed at the beginning of the IMP and before the original signed IMP signature page.

IMP Revisions Mingo 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	