

Post-Delisting Monitoring Plan for the Kirtland's Warbler (*Setophaga kirtlandii*)



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I. Introduction

Section 4(g) of the Endangered Species Act (ESA) requires the U.S. Fish and Wildlife Service (USFWS) to implement a system in cooperation with the States to monitor, for not less than five years, the status of all species that have recovered and been removed from the List of Endangered and Threatened Wildlife and Plants (lists).

Post-delisting monitoring (PDM) refers to activities undertaken to verify that a species delisted due to recovery remains secure from risk of extinction after the protections of the ESA no longer apply. The primary goal of PDM is to monitor the delisted species to ensure the status does not deteriorate, and, if a substantial decline in the species (numbers of individuals or distribution across its range) or an increase in threats is detected, to take measures to halt the decline so that re-proposing it as an endangered or threatened species is not necessary.

II. Overview of the Kirtland's Warbler PDM Strategy

The Kirtland's Warbler PDM (KW-PDM) includes monitoring four focus areas: (1) Kirtland's warbler breeding population, (2) measures to evaluate the efficacy of brown-headed cowbird (*Molothrus ater*) management, (3) adequacy of breeding habitat regenerated annually, and (4) new information concerning the species full life cycle. Lastly, the KW-PDM includes reporting results at the Kirtland's Warbler Conservation Team meetings for discussion and appropriate management action or recommendation.

The specific goals of the KW-PDM are to provide the State and Federal agencies managing the species with sufficient information to determine that (1) the Kirtland's warbler population remains above the recovery goal and to detect any significant population trends that may require additional management intervention, (2) brown-headed cowbird management remains effective, (3) an adequate supply of effective breeding habitat will be available, and (4) any new information on other factors influencing the Kirtland's warbler population (e.g., extent and frequency of drought in wintering habitats) is incorporated in management plans and species status evaluations.

The KW-PDM reflects that the Kirtland's warbler conservation program will continue to evolve and be adaptively managed as it has for over 40 years. Therefore, we have included measures to monitor the efficacy of changing management approaches. We also recognize that the management efforts that saved the species from extinction and ultimately allowed for recovery do not necessarily show immediate results (e.g., today's suitable habitat was regenerated five to 20 years ago). Lastly, we designed the KW-PDM to reflect that the Kirtland's warbler life cycle involves a complex network of factors that are not static. For example, brown-headed cowbird populations in the Kirtland's warbler breeding habitat may be influenced by changes in cowbird survival rates on their wintering grounds, and, therefore, the management program may need to be adjusted accordingly.

The KW-PDM is based largely on the commitments of the Federal and State agencies engaged in Kirtland's warbler conservation through the Kirtland's Warbler Breeding Range Conservation Plan (MDNR *et al.* 2015), an Interagency Memorandum of Understanding (MOU) (2016), and a Memorandum of Agreement (MOA) between the USFWS and the Michigan Department of Natural Resources (MDNR) (2015). The Kirtland's Warbler Conservation Team is an integral part of the KW-PDM and provides an important forum for sharing information, coordinating management efforts, and ensuring that effective adaptive management occurs. The Kirtland's Warbler Alliance is a non-profit organization dedicated to helping to ensure the needs of the species are addressed post-delisting.

Key components of the KW-PDM:

- The duration of the post-delisting monitoring period for the Kirtland's warbler is 12 years.
- Census or selectively survey sites for Kirtland's warbler singing males in all or a representative subset of breeding habitat every other year;
- Annually assess the effectiveness of brown-headed cowbird management;
- Compile information on the breeding habitat regenerated annually by land ownership including, but not limited to, the number of acres, regeneration techniques, and stand sizes;
- Conduct adequate population monitoring to confirm efficacy when using techniques for regenerating habitat that are considered alternative or experimental (i.e., have not previously shown or been evaluated for effectiveness). Selected sites may be monitored for Kirtland's warbler productivity, as necessary, to ensure alternative management techniques are providing similar reproductive rates as traditional management;
- Compile information annually on factors that may influence the Kirtland's warbler full life-cycle conservation;
- Report out the KW-PDM program results annually at the Kirtland's Warbler Conservation Team meeting for discussion and appropriate management action; and
- Review monitoring results to ensure management efforts are sufficient to support a recovered population or reevaluate species status under the ESA.

III. Role of PDM Cooperators

A. Kirtland's Warbler Partnership

The management of the Kirtland's warbler and the jack pine system on which it depends is a remarkable conservation success. Collaboration among the land management agencies, conservation organizations, and other partners has been a hallmark of this effort. For over four decades, the parties have collaborated on habitat management, brown-headed cowbird control, monitoring, research, and public education necessary to support the recovery of the Kirtland's warbler. The KW-PDM builds upon this collaborative approach and adaptive framework.

Michigan Department of Natural Resources

The MDNR is committed to the conservation, protection, management, accessible use and enjoyment of the State's natural resources for current and future generations. The MDNR is legally mandated to implement the provisions of the state endangered species legislation in Part 365 of Public Act 451 of 1994. Furthermore, the MDNR is responsible for the protection and conservation of all wildlife, including the Kirtland's warbler, even if it is removed from the state or federal endangered species list. The MDNR must also seek and maintain forest certification under Public Act 125 of 2004. One important facet of forest certification is to sustain forest biodiversity. The MDNR has participated actively in the recovery of the Kirtland's warbler since the songbird was first added to state and federal endangered species lists. The goal of the State's program for nearly four decades has been the recovery of the species and eventual removal from those lists. Through interagency agreements (i.e., 2016 MOU and 2015 MOA), the MDNR has committed to the continued implementation of habitat management, cowbird control efforts, and

monitoring post-delisting. These agreements provide an important element in maintaining a viable population of Kirtland's warbler post-delisting.

U.S. Forest Service

The mission of the U.S. Forest Service (USFS) is to sustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations. The USFS has actively participated in the recovery of the Kirtland's warbler since the songbird was first added to the list of federally endangered species. The Huron-Manistee National Forests, Hiawatha National Forest, Ottawa National Forest, and Chequamegon-Nicolet National Forests manage jack pine habitat for the conservation of multiple animal and plant species including the Kirtland's warbler as part of their Land and Resource Management Plans. In the 2016 MOU, the USFS affirmed its commitment to continue habitat management efforts for Kirtland's warbler.

U.S. Fish and Wildlife Service

The mission of the U.S. Fish and Wildlife Service (USFWS) is working with others to conserve, protect, manage, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people. The USFWS implements the provisions of the ESA and Migratory Bird Treaty Act. The Michigan Ecological Services Field Office, Minnesota-Wisconsin Ecological Services Field Office, and regional Ecological Services program have helped coordinate protection and recovery of Kirtland's warblers under the ESA since the species was listed. In addition, the Seney National Wildlife Refuge manages the Kirtland's Warbler Wildlife Management Area in cooperation with MDNR and other partners to provide habitat for Kirtland's warblers and other species. The USFWS's Migratory Bird Program may be engaged in long term conservation of Kirtland's warblers in multiple ways including ensuring the species remains a priority after delisting, helping develop long term population monitoring within a conservation context, and strengthening national and international partnerships. The USFWS does not have sufficient personnel available for conducting the necessary field work, data analysis, and reporting required for this PDM effort. The USFWS will work with our partners to seek funding opportunities through existing grant programs and the efforts of the Kirtland's Warbler Conservation Team.

USFWS staff will participate in and maintain oversight of all activities undertaken as part of the PDM. This may include developing and managing one or more grants or contracts, interpreting the intent of the PDM plan, reviewing and commenting on draft reports, distributing final reports and other information to interested parties, approving and documenting any changes to the PDM plan, conducting any necessary future status reviews of the Kirtland's warbler, and determining when the PDM is complete.

USDA, Wildlife Services

The U.S. Department of Agriculture's Wildlife Services (USDA-WS) mission is to provide Federal leadership in managing problems caused by wildlife. USDA-WS recognizes that wildlife is an important public resource greatly valued by the American people. By its very nature, however, wildlife is a highly dynamic and mobile resource that can damage agricultural and industrial resources, pose risks to human health and safety, and affect other natural resources. USDA-WS provides high quality wildlife damage management services that result in the protection of agriculture, wildlife and other natural resources, property, and human health and safety. One of the USDA-WS's high priority core functions is the protection of natural resources (including endangered species) from other injurious wildlife. In recent

years, the USDA-WS has conducted the brown-headed cowbird control program in Michigan's Lower Peninsula and in Wisconsin.

Kirtland's Warbler Conservation Team

The Kirtland's Warbler Conservation Team was established to preserve institutional knowledge, share information, and facilitate communication and collaboration among agencies and partners to maintain and improve Kirtland's warbler conservation. The current Kirtland's Warbler Conservation Team is comprised of representatives from the USFWS, USFS, MDNR, Wisconsin Department of Natural Resources (WDNR), USDA-WS, Canadian Wildlife Service, Huron Pines, Kirtland's Warbler Alliance, The Nature Conservancy, and California University of Pennsylvania. Specifically, these organizations share information on the amount of breeding habitat developed and management techniques, research projects, education and outreach, population monitoring, and cowbird management results.

Wisconsin Department of Natural Resources

The Wisconsin Department of Natural Resources (WDNR) is dedicated to working with the citizens and businesses of Wisconsin while preserving and enhancing the natural resources of Wisconsin. In partnership with individuals and organizations, DNR staff manage fish, wildlife, forests, parks, air, and water resources while promoting a healthy, sustainable environment and a full range of outdoor opportunities. The WDNR, along with the USDA-WS, USFS, USFWS, and others, partner to encourage the management of jack pine ecosystems to provide breeding habitat for Kirtland's warblers in Wisconsin. With the formation of a breeding population in Wisconsin, conservation efforts similar to those used in Michigan (habitat management, cowbird control, monitoring, education, and research) were implemented in that State.

Kirtland's Warbler Alliance

Kirtland's Warbler Alliance is a stakeholder group, incorporating as a standalone non-profit conservation organization that is dedicated to raising awareness in support of the Kirtland's warbler and the conservation programs necessary for the health of the species and jack pine forests. The Kirtland's Warbler Alliance was an outgrowth of the Kirtland's Warbler Initiative launched in 2013 and led by Huron Pines, a nonprofit conservation organization based in northern Michigan. The Kirtland's Warbler Initiative brings together State, Federal, and local stakeholders to identify and implement strategies to secure funds for long-term Kirtland's warbler conservation actions given the continuous, recurring costs anticipated with conserving the species into the future. The goal of this partnership is to ensure the Kirtland's warbler thrives as a result of strong public-private funding and land management partnerships.

B. Management Commitments for Post-delisting Conservation

Kirtland's Warbler Breeding Range Conservation Plan (Conservation Plan)

Since 2015, conservation efforts for the Kirtland's warbler have been guided by the Kirtland's Warbler Breeding Range Conservation Plan (MDNR *et al.* 2015). The Conservation Plan outlines the strategy for future cooperative Kirtland's warbler conservation and provides technical guidance on how to create and maintain Kirtland's warbler breeding habitat within an ecosystem management framework. The scope of the Conservation Plan currently focuses only on the breeding range of the Kirtland's warbler within the United States, although the agencies involved (MDNR, USFS, and USFWS) intend to cooperate with other partners to expand the scope of the plan in the future to address the entire species' range (i.e., the entire jack pine ecosystem, as well as the migratory route and wintering range of the species). The

Conservation Plan will be revised every 10 years to incorporate any new information and the best available science (MDNR et al. 2015).

Interagency Memorandum of Understanding (Interagency MOU)

In April 2016, the USFWS, MDNR, and USFS renewed an MOU committing the agencies to continue collaborative habitat management, brown-headed cowbird control, monitoring, research, and education in order to maintain the Kirtland's warbler population at or above 1,000 breeding pairs (USFWS, MDNR, and USFS 2016). The parties agreed to collaboratively develop and implement a monitoring plan for the Kirtland's warbler. The USFWS also committed to work with collaborating agencies, partners, and private landowners to help maintain monitoring efforts and suitable habitat for Kirtland's warblers in Wisconsin.

Brown-Headed Cowbird Management Memorandum of Agreement (Cowbird MOA)

The USFWS and MDNR developed an MOA to set up a process for managing funds to help address long-term conservation needs, specifically brown-headed cowbird control (USFWS and MDNR 2015). A one million dollar donation was made to the dedicated account to support future Kirtland's warbler conservation efforts, and fundraising efforts continue in an attempt to secure additional funds. If the dedicated account generates an annual income greater than the amount needed to manage brown-headed cowbird parasitism rates, the remaining portion of the annual income may be used to support other high priority management actions directly benefiting Kirtland's warbler, including wildlife and habitat management, land acquisition and consolidation, and education. The MOA identifies that for a minimum of 5 years after the species is delisted, MDNR consult with the USFWS on planning the annual brown-headed cowbird control program and other high priority actions. In addition, MDNR recently reaffirmed their commitment to the MOA and confirmed their intent to implement and administer the brown-headed cowbird control program (MDNR 2017).

Migratory Bird Treaty Act

The Kirtland's warbler is protected by the Migratory Bird Treaty Act of 1918 (MBTA; 16 U.S.C. 703–712). The MBTA prohibits take, capture, killing, trade, or possession of Kirtland's warblers and their parts, as well as their nests and eggs. The regulations implementing the MBTA further define “take” as to “pursue, hunt, shoot, wound, kill, trap, capture, or collect” or attempt those activities (50 CFR 10.12).

State Laws

The States of Florida, Georgia, Indiana, Michigan, North Carolina, Ohio, Virginia, and Wisconsin list the Kirtland's warbler as endangered under their respective State endangered species regulations. In Michigan, where the majority of the population breeds, part 365 of Public Act 451 of 1994 prohibits take, possession, transportation, importation, exportation, processing, sale, offer for sale, purchase, or offer to purchase, transportation or receipt for shipment by a common or contract carrier of Kirtland's warblers or their parts.

Legal Protections in Canada and The Bahamas

The Kirtland's warbler was declared federally endangered in Canada in 1979. Canada's Species at Risk Act of 2003 (SARA) is the primary law protecting the Kirtland's warbler in Canada. Canada's SARA bans killing, harming, harassing, capturing, taking, possessing, collecting, buying, selling, or trading of individuals that are federally listed. The SARA extends protection to the residence (habitat) of individuals

that are federally listed. Canada's Migratory Bird Convention Act of 1994 also provides protections to Kirtland's warblers. Under Canada's Migratory Bird Convention Act, it is unlawful to be in possession of migratory birds or nests, or to buy, sell, exchange, or give migratory birds or nests, or to make them the subject of commercial transactions. The Kirtland's warbler is also listed as endangered under Ontario's Endangered Species Act of 2007.

In The Bahamas and the Turks and Caicos Islands, the Kirtland's warbler is recognized as a globally Near Threatened species, but has no federally listed status. In The Bahamas, the Wild Birds Protection Act (chapter 249) allows the Minister of Wild Animals and Birds Protection to establish and modify reserves for the protection of any wild bird. The species is also protected in The Bahamas by the Wild Animals (Protection) Act (chapter 248) that prohibits the take or capture, export, or attempt to take, capture, or export any wild animal from The Bahamas. The Bahamas regulates scientific utilization of the Kirtland's warbler based on recommendations previously provided by the Kirtland's Warbler Recovery Team (Bocetti 2011, pers. comm.).

IV. Summary of Species' Status

A. Demographic Parameters

The Kirtland's warbler is a neotropical migrant that breeds in jack pine (*Pinus banksiana*) forests in northern Michigan, Wisconsin, and Ontario. This species has always had one of the most geographically restricted breeding distributions of any mainland bird in the continental United States. Breeding habitat within the jack pine forest is both highly specific and disturbance-dependent and likely was always limited in extent (Mayfield 1960; Mayfield 1975). Similarly, the known wintering range is primarily restricted to The Bahamas (Cooper *et al.* 2017; Cooper *et al.* 2019).

Life History

Average lifespan: 2½ years (oldest recorded 11 years)

Nests: On the ground under dense tree cover

Eggs: 4–5 on average (max observed 7) per nest

Incubation: 13–16 days beginning the day before the clutch is complete

Fledge: 9–10 days after hatching

Breeding Territory: Size of breeding territory is highly variable. Averages 6 to 10 acres per pair (ranges from 1.5 acres per pair to 38 acres per pair) (Walkinshaw 1983, Bocetti *et al.* 2001).

Habitat Summary

Summer: Jack pine stands that are 4–25 years old (approximately 5–20 feet tall) and at least 80 acres in size. Dense clumps of trees interspersed with numerous small, grassy openings, sedges, ferns, and low shrubs. This jack pine ecosystem is typically found on glacial outwash (sandy) plains, most commonly in northern Lower Michigan, with scattered locations in the Upper Peninsula of Michigan, Wisconsin, and Ontario.

Winter: Early successional scrublands (dense low broadleaf shrubs) in The Bahamas (occasionally elsewhere in Caribbean).

Life Cycle Stage	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Wintering (Bahamas)												
Spring Migration												
Breeding (MI, WI, Ont.)												
Nesting												
Young Fledge												
Fall Migration												

Additional information on the biology and ecology of the Kirtland’s warbler can be found in the proposed delisting rule (83 CFR 15758).

B. Species’ Status

The size of the Kirtland’s warbler population is currently at its known historical maximum at over 2,300 pairs, which is nearly 10 times larger than it was at the time of listing and close to 2.5 times as large as the recovery goal. Since the species was listed, the population’s breeding range also expanded outside of the northern Lower Peninsula to areas in Michigan’s Upper Peninsula, Wisconsin, and Ontario. This recovery is attributable to successful interagency cooperation in the management of habitat and brood parasitism. The amount of suitable habitat has increased by approximately 150 percent since listing, primarily due to the increased amount of planted habitat generated from adaptive silvicultural techniques. Brown-headed cowbird control has been conducted on an annual basis within the majority of Kirtland’s warbler nesting areas since 1972, and has greatly reduced the impacts of brood parasitism.

Brood parasitism and availability of sufficient suitable breeding habitat are managed through the Kirtland’s Warbler Breeding Range Conservation Plan and the Interagency MOU. The Conservation Plan and the MOU acknowledge the conservation-reliant nature of the Kirtland’s warbler and the need for continued habitat management and brown-headed cowbird control, and affirm that the necessary long-term management actions will continue.

C. Residual Threats

The residual threats to the Kirtland’s warbler consist of brown-headed cowbird parasitism and the disruption of the natural disturbance regime that allows for breeding habitat generation. The brown-headed cowbird is an obligate brood parasite, which typically removes a host egg from a nest and replaces it with one or more of their own eggs. Cowbird chicks usually have shorter incubation periods and are larger than host chicks. These advantages enable cowbird chicks to outcompete host chicks for resources, which typically results in the loss of the entire host brood. Brown-headed cowbird parasitism has been shown to significantly affect the Kirtland’s warbler population (Mayfield 1960), and the Kirtland’s warbler is particularly sensitive to brood parasitism, due to its limited breeding range exposing the entire population to brown-headed cowbird parasitism (Mayfield 1960; Trick, unpubl. data). Brown-headed cowbird control has been shown to be effective at increasing Kirtland’s warbler breeding success (Kelly and DeCapita 1982; USFWS 2017).

Historically, wildfires were the most important factor in the establishment of natural jack pine forests and Kirtland’s warbler breeding habitat. However, modern wildfire suppression greatly altered the natural disturbance regime that generated Kirtland’s warbler breeding habitat for thousands of years (USFWS

1985; Cleland *et al.* 2004). In the absence of wildfire, land managers have taken an active role in mimicking natural processes that regularly occurred within the jack pine ecosystem, namely stand-replacing disturbance events. This is primarily accomplished through large-scale timber harvesting and human-assisted reforestation (i.e., planting).

Potential threats to wintering habitat include habitat loss caused by human development, altered fire regime, changes in agricultural practices, and invasive plant species and climate change (e.g., rising sea level, increased drought, and increased high-intensity hurricanes).

The PDM plan will address the residual threats through monitoring and management of cowbird parasitism, breeding habitat regeneration, and full life-cycle information. The timeframe of this PDM (see Section V Post-Delisting Monitoring Period) is a reasonable period to assess the status of the Kirtland's warbler following delisting. The monitoring of residual threats is a critical process for evaluating the status of the species. Monitoring of residual threats, coupled with collection of census data from known localities, will produce adequate information to evaluate the viability of the species.

V. Post-Delisting Monitoring

A. Post-Delisting Monitoring Period: 12-years

The Post-Delisting Monitoring period for Kirtland's warbler is 12 years from delisting for several reasons. Population modeling suggested that the Kirtland's warbler may be sensitive to a variety of environmental or management changes, so a longer monitoring period provides an improved context for evaluating population variation. Projected population modeling (Rockwell *et al.* 2017) estimated a negative population growth in Kirtland's warbler as a result of a reduction in March rainfall in The Bahamas by more than 12.4 percent from the mean level during the study period (3.04 cm). Brown *et al.* (2017) incorporated full annual cycle (breeding and wintering) dynamics into a population viability model to show the Kirtland's warbler population could be negatively impacted by an extended return to high levels of brood parasitism or significant declines in the amounts of high quality breeding habitat.

The 12-year monitoring period is warranted due to the relatively small population size and need for continued breeding habitat management. Additionally, there is an approximate 5 to 7 year time lag between when jack pine is established and when it becomes breeding habitat. The land management agencies have committed to monitoring the Kirtland's warbler population, recognizing that the species is unlikely to ever have a very large population and will always depend upon recurring effective management; these factors necessitate regular population monitoring. Explicitly making this monitoring period part of the KW-PDM will provide an assurance that monitoring results will provide an important metric for evaluating environmental or program changes as well as provide a longer time horizon to formally reevaluate the species status. Further, if there is any indication that the population is likely to fall below the recovery goal or a substantial new threat is observed, the monitoring period may be extended.

B. Post-Delisting Monitoring: Breeding Population

Comprehensive surveys (censuses) of the entire Kirtland's warbler population began in 1951. Because of the warbler's specific habitat requirements and the frequent, loud and persistent singing of males during the breeding season, it was possible to establish a singing male census (Ryel 1976). It was originally intended to be a decennial census and was conducted in 1951, 1961, and 1971 throughout all known and potential breeding habitat in Michigan. However, results from the 1971 census showed a severe population decline, and the census was conducted on an annual basis until 2013. Since 2013, annual

surveys have been conducted on a subset of potential breeding habitat in Michigan, Wisconsin, and Ontario, Canada.

The Kirtland's Warbler census has enabled managers to:

- Evaluate the population relative to the recovery objective and to consider changing the species' listing status,
- Determine the presence or absence of individuals in areas for protection purposes,
- Evaluate habitat management activities (e.g., value of different-sized areas of breeding habitat),
- Monitor occupancy, duration of use, and density of singing males to learn how the birds are occupying breeding habitat (e.g., acres/pair), and adaptively manage based on this new information,
- Target placement of cowbird traps,
- Build public confidence in endangered species management, and
- Provide data for research.

From 1951-2015, the Kirtland's warbler breeding population census consisted of an extensive annual survey of all known and potential breeding habitat to count singing males. The census protocol assumes that there is a breeding female for each singing male, so the number of singing males is assumed to equate to the number of breeding pairs. Although this may not be true in some cases, the census provides a robust, relative index of the Kirtland's warbler population change over time (Probst *et al.* 2005).

Census procedures are designed to detect singing males by addressing the behavior of breeding male Kirtland's warblers. Breeding male Kirtland's warblers: 1) tend to occur in loose assemblages within dense stands of young jack pine usually five to 20 feet tall, 2) defend their territories with loud and persistent singing. Under good weather conditions, a census participant should easily hear singing males within one-eighth mile, 3) have a high probability that a territorial male will sing at least once during any five-minute period between sunrise and 11:00 am in good weather, 4) have variable songs that help in distinguishing between individuals, and 5) frequently move significant distances on their territories.

The MDNR, USFS, and WDNR coordinate the census with extensive support from others and is conducted with employees from the USFS, MDNR, USFWS, WDNR, and experienced volunteers. Pre-census planning involves reviewing past years' monitoring efforts and census results, querying vegetation databases to identify young jack pine stands, and performing on-the-ground examinations to determine if areas need to be censused. Maps of areas that meet the criteria for potential Kirtland's warbler breeding habitat are produced. All areas with habitat likely to be occupied by Kirtland's warbler are censused by agency staff or volunteers experienced in identifying the species by its calls. The location of each singing male is recorded on maps using a standardized approach and the location is later converted to coordinates in a Geographic Information System. Beginning with the 1995 census, increased attention was placed on surveying younger plantings of jack pine in response to observations of Kirtland's warblers in young plantations that are less than five years old. The census period (most recently June 6 through 20) is intentionally kept short to help reduce the possibility of double-counting males moving from one area to another.

To provide a direct comparison to the censuses conducted in 1951-2015 and for a consistent approach across all land ownership, a full census of Kirtland's warbler singing males will be conducted at four-year intervals during the 12-year PDM period. The census will be conducted in 2021, 2025, and 2029 using the traditional census protocol (or other protocol approved by the Conservation Team to assess the full Kirtland's warbler population). In the alternate years, the land management agencies will continue to monitor the Kirtland's warbler singing male population using a variety of methods, as follows:

Due in part to the increase in population numbers and distribution, and significant effort and cost associated with monitoring for the Kirtland's warbler, the MDNR has shifted to a less intensive survey protocol on lands owned by the State of Michigan in the northern Lower Peninsula (Kennedy 2017, pers. comm.; Williams *et al.* 2016). Starting in 2017, surveys for Kirtland's warblers in northern Lower Michigan on state land will occur every other year in a portion of the known occupied habitat. This less intensive survey is designed to detect population trends (Kennedy 2017, pers. comm.; Williams *et al.* 2016). Conducting a full census every four years will help verify the results from the MDNR survey protocol.

The Huron-Manistee National Forests plan to continue with the traditional full census of all potential breeding habitat on National Forest System lands in the northern Lower Peninsula. However, the census will be conducted once every two years instead of annually, starting in 2017. This every-other-year schedule will be synchronous with MDNR efforts and allow HMNF biologists to estimate the Kirtland's warbler population every two years. The HMNF may implement the MDNR survey protocol, or other survey protocol if and when HMNF biologists determine that a more efficient and effective technique is available to assess the number of breeding Kirtland's warblers.

The Hiawatha, Ottawa, and Chequamegon-Nicolet National Forests plan to continue census of potential breeding habitat on National Forest System lands. The census will be conducted annually between June 6 and June 27 to: 1) monitor success of habitat creation, 2) determine locations of occupied habitat to implement project design criteria/conservation measures, 3) obtain an annual count of singing males for the Forests, and 4) to assist in determining progress toward the Kirtland's Warbler Conservation Team breeding pair goal for areas outside of the core breeding range. If census funding becomes a concern, these Forests may implement the MDNR survey protocol, or other survey protocol if and when the forests' biologists determine that a more efficient and effective technique is available to assess the number of breeding Kirtland's warblers.

In Wisconsin, the WDNR plans to continue the traditional annual census.

Agency Commitments to Breeding Population Monitoring

Conservation Plan

The Conservation Plan (MDNR *et al.* 2015) describes the agencies' commitments for monitoring the breeding population of Kirtland's warbler. The Conservation Plan states that the agencies are committed to using an adaptive management approach in the implementation of that plan that will help agencies sustain a population of Kirtland's warbler above 1,000 breeding pairs. The agency commitments as described in the Conservation Plan include:

- Conservation Plan Objective 1: Monitor the breeding population of Kirtland's warblers to assess whether we are achieving our goal (1,000 breeding pairs).

- Conservation Plan Action 1: Agencies will work cooperatively to develop and implement protocols for long-term population monitoring by September 2017.
- Conservation Plan Action 2: If Kirtland’s warbler population falls below 1,300 then the agencies will: 1) schedule a face-to-face meeting, 2) discuss the population decline, 3) decide whether or not Conservation Plan objectives and actions need to be changed, and 4) implement recommended changes.
- Conservation Plan Action 3: Evaluate monitoring data, research, and other information to determine if goals (e.g., the population goal) and objectives in the Conservation Plan need to be modified (MDNR *et al.* 2015, pp. 26-27).

Interagency MOU

Through the Interagency MOU, the Michigan DNR, U.S. Forest Service, and the U.S. Fish and Wildlife Service acknowledged their respective roles in implementing the 2015 Kirtland’s Warbler Breeding Range Conservation Plan and that collaborative habitat management, brown-headed cowbird control, monitoring, research, and education will continue. The MDNR, USFS, and USFWS agreed to collaboratively implement a monitoring plan for the Kirtland’s warbler.

Breeding Population Surveys

To provide the State and Federal agencies managing the species with sufficient information to determine that the Kirtland’s warbler population remains above the recovery goal and to detect any significant population trends that may require additional management intervention, the KW-PDM includes the following measures:

- A full census of Kirtland’s warbler singing males will be conducted every four years beginning in 2021 (i.e., 2021, 2025, and 2029) using Conservation Team-approved census protocols, and dependent on available funding.
- Census or selectively sample for Kirtland’s warbler singing males in representative breeding habitat every other year over a period of 12 years;
- When sampling methods are used to assess the breeding population, the Conservation Team will provide a forum for refining the survey techniques to ensure efficacy of results to address program management needs;
- Report any changes in observations of the duration of expected use (i.e., Kirtland’s warblers use of stands starting earlier or extending later than expected) and breeding pair density (i.e., average acres per singing male); and
- When using measures for regenerating breeding habitat that have not previously proven effective, once Kirtland’s warbler occupancy begins, include these stands in the every other year monitoring efforts (i.e., the goal is to understand how new techniques may affect bird density and duration of use).

C. Post-Delisting Monitoring: Brown-headed Cowbird Program

Since 1972, the USFWS, in conjunction with the USDA-WS, MDNR, and USFS, has implemented an intensive brown-headed cowbird control program within major Kirtland's warbler nesting areas in Michigan's Lower Peninsula. The control program has removed an average of 3,573 brown-headed cowbirds annually from occupied Kirtland's warbler habitat in northern Lower Michigan from 1972 to 2016 (USDA-WS 2016, unpubl. report). Recent trap rates, however, have been below 1,500 brown-headed cowbirds per year (USDA-WS, unpubl. data). Brown-headed cowbird trapping is also conducted in selected Kirtland's warbler breeding areas in Wisconsin. The trapping program in Wisconsin started in 2008, and is run using similar methods to the program in Michigan, with an average of 238 brown-headed cowbirds captured per year (USDA-WS, USFWS unpubl. data).

In Lower Michigan, fifty to sixty cowbird traps were typically used, located in eleven counties: Alcona, Clare, Crawford, Iosco, Kalkaska, Montmorency, Ogemaw, Oscoda, Otsego, Presque Isle, and Roscommon. Traps are operated each year from mid-April through June, with trapping beginning approximately one month before Kirtland's warblers arrive in order to take advantage of cowbird phenology and behavior. Brown-headed cowbirds are short- to medium-distance migrants that typically begin arriving in the northern Lower Peninsula of Michigan during late March and early April. At that time cowbirds aggregate into flocks and are highly social. Using live decoy cowbirds in traps is most effective while cowbirds remain in these gregarious flocks, compared to later in the season when they disperse across the landscape to breed. Therefore, it is important to initiate trapping at the approximate time cowbirds arrive in the area for optimal trap effectiveness.

One or two cowbird traps were also operated for several years in the mid-1990s in Schoolcraft County (Upper Peninsula of Michigan) on the Hiawatha National Forest. After very few cowbirds were captured, the program was discontinued (S. Sjogren, Hiawatha National Forest, pers. comm. 2013). Kirtland's warbler census efforts in the Upper Peninsula continue to document absence or low numbers of brown-headed cowbirds in Kirtland's warbler breeding areas.

Brood parasitism of Kirtland's warbler nests also occurs in Wisconsin. In 2007, two of three Kirtland's warbler nests observed were parasitized (USFWS unpubl. data). After the initiation of brown-headed cowbird control in 2008, brood parasitism rates in Wisconsin have fluctuated substantially among years, from 10 percent to 66 percent (USFWS unpubl. data; Trick unpubl. data). However, in the same time period (2008–2017), overall nest success has ranged from 19–80 percent, and the average fledge rate was estimated to be between 1.51–1.92 chicks per nest (USFWS 2017).

Limited studies on the effectiveness of the brown-headed cowbird control program in relation to Kirtland's warbler nest productivity in Michigan have been conducted since the early 1980s. De Groot and Smith (2001) found that brown-headed cowbirds were nearly eliminated in areas directly adjacent to a trap, and brown-headed cowbird densities increased slightly at sites 5 km (3 miles) and greater from brown-headed cowbird removal areas. Brown-headed cowbird densities significantly increased at distances greater than 10 km (6 miles) from brown-headed cowbird removal areas, further demonstrating the localized effect of brown-headed cowbird control (De Groot and Smith 2001, p. 877). Although brown-headed cowbird density increased with distance beyond 5 km (3 miles) of brown-headed cowbird traps, brown-headed cowbird densities were still low in those areas compared to other parts of North America (De Groot and Smith 2001). Anecdotal observation of brood parasitism rates have also indicated

very low levels of brood parasitism within Kirtland's warbler nesting areas (Bocetti 1994; Rockwell 2013).

A study is currently underway in Michigan to evaluate the effective range of a brown-headed cowbird trap and to determine the brood parasitism rate of Kirtland's warbler nests when traps are not operated during the warbler's breeding season. Beginning in 2015, 12 brown-headed cowbird traps (out of 55 total) were closed for two breeding seasons, and Kirtland's warbler nests were searched to determine the rate of parasitism (Cooper *et al.*, unpubl. data). In 2015, only one nest out of 150 was parasitized, approximately 8 km (5 miles) away from the nearest brown-headed cowbird trap. In 2016, similar low levels of parasitism were observed, with only two parasitized nests out of 137. Due to the low levels of brood parasitism observed, an additional six traps were closed in 2017, and none of the 100 nests observed in 2017 was parasitized (Cooper *et al.*, unpubl. data). These preliminary data corroborate similar findings that the effective range of a brown-headed cowbird trap is likely much larger than the range (1-mile radius) traditionally used in planning and implementing the brown-headed cowbird control program.

Additionally, point count surveys were conducted during 2015 and 2016 in Kirtland's warbler nesting areas in Michigan's northern Lower Peninsula where brown-headed cowbird traps were not being operated. Only 13 brown-headed cowbirds were observed during 271 point count surveys (Cooper *et al.*, unpubl. data). Trend estimate data from Breeding Bird Survey routes between 2005 and 2015 have also shown decreased brown-headed cowbird population trends in Michigan and the Upper Great Lakes (Sauer *et al.* 2017).

The best available information indicates that cowbird removal efforts can be reduced without adversely impacting Kirtland's warbler productivity rates. Given the historical impact that the brown-headed cowbird has had on the Kirtland's warbler, and the potential for the brown-headed cowbird to negatively affect the warbler, a sustainable Kirtland's warbler population depends on monitoring the magnitude and extent of brood parasitism and subsequently adjusting the level of cowbird trapping appropriately.

Agency Commitments: Cowbird Management Monitoring Program

Conservation Plan

The Conservation Plan reflects the importance of an effective cowbird management program and the key role that monitoring would play as the cowbird program is adaptively managed and further refined.

Understanding how these changes [in cowbird parasitism] could impact the Kirtland's warbler population and incorporating adaptive management principles into the cowbird management program will be important components of Kirtland's warbler conservation over the next 10 years. This will require periodic nest monitoring and implementation of key research projects to identify new, innovative strategies to reduce cowbird parasitism. Although not all inclusive, priority monitoring and research needs for the cowbird management program include:

- Periodically monitor a subset of Kirtland's warbler nests to document brown-headed cowbird parasitism rates.
- Design and implement research to determine the appropriate level of cowbird trapping necessary considering the current Kirtland's warbler population.
- Evaluate other cowbird control techniques and strategies, focusing on identifying and evaluating cowbird control techniques that maximize performance and minimize effort.

- Evaluate 40+ years of cowbird trapping data to understand landscape factors that may affect trapping efficacy.
- Identify habitat area covered by individual traps. Traps are assumed to protect a one-mile radius, but De Groot and Smith (2001) suggested effective trapping distance was much larger.
- Develop a decision tool or framework that identifies thresholds that trigger implementation, duration, and cessation of cowbird control.

The Conservation Plan also notes that monitoring of cowbirds "...should continue in peripheral breeding areas. If cowbird densities increase or nest parasitism is documented, trapping efforts may need to be initiated in other locations."

Brown-headed Cowbird MOU

The MOU requires that, for a minimum of 5 years after the species is delisted, MDNR consult with the USFWS on planning the annual brown-headed cowbird control program in Michigan and other high priority actions. Specifically the MOA includes compiling and monitoring the following information: (1) trap locations, (2) dates traps were operated, (3) number of male, female, and juvenile cowbirds captured at each trap, (4) type of trap, and (5) other relevant details about the implementation of the program (i.e., number of decoy birds used per trap, captures of non-target species, predation events, escapes of decoy birds, etc.).

Cowbird Management

The primary goal of the PDM is to annually confirm that brown-headed cowbird management is effective. For the agencies and the Conservation Team to evaluate the efficacy of the program, the following actions are part of the Post-Delisting Monitoring Plan:

- MDNR will coordinate with the USFWS for the brown-headed cowbird control program in Michigan for each of the first five years post-delisting.
- In locations where the brown-headed cowbird management program is being adaptively managed, periodically monitor a subset of Kirtland's warbler nests or use another protocol approved by the Conservation Team to estimate the extent of the threat resulting from brown-headed cowbird parasitism.
- MDNR (or USDA-WS) will compile information for the Conservation Team on the details and results of the trapping program in Michigan from the prior year.
- USDA-WS will compile information for the Conservation Team on the details and results of the trapping program in Wisconsin from the prior year.
- The USFWS's Migratory Bird Program will report annually to the Conservation Team concerning the prior year's Breeding Bird Survey results for brown-headed cowbird in northern Michigan and the region in order to help identify changes in cowbird population trends and to help inform management plans.

D. Post-Delisting Monitoring: Breeding Habitat Regeneration

To provide breeding habitat for Kirtland's warblers in the absence of wildfire, land managers must take an active role in mimicking natural processes that regularly occurred within the jack pine ecosystem,

namely stand-replacing disturbance events. This is primarily done through large-scale timber harvesting and reforestation to jack pine. Although planted stands tend to be more structurally simplified than wildfire-regenerated stands (Spaulding and Rothstein 2009), land managers have developed silvicultural techniques that produce conditions within planted stands suitable for Kirtland's warbler nesting and foraging.

Over 85 percent of the habitat used by breeding Kirtland's warblers in 2015 in the northern Lower Peninsula of Michigan (approximately 12,343 ha (30,500 ac)) had been artificially created through clearcut harvest and replanting. The planted stands supported over 92 percent of the warbler's population within the Lower Peninsula during the breeding season (MDNR, USFS, USFWS, unpubl. data). The effectiveness of these strategies is also evident by the reproductive output observed in planted stands, which function as population sources (Bocetti 1994). Thus, in a landscape where natural fire disturbance patterns have been reduced, threats to natural breeding habitat are being mitigated through large-scale habitat management. Therefore, the status of the Kirtland's warbler depends largely on the continued development of managed breeding habitat.

The Conservation Plan (MDNR *et al.* 2015) identifies continued habitat management needs and objectives to maintain sufficient breeding habitat for Kirtland's warblers. Habitat management is currently conducted on approximately 88,626 ha (219,000 ac) of jack pine forest identified for Kirtland's warbler management within MDNR, USFS, and USFWS lands throughout the northern Lower Peninsula and Upper Peninsula of Michigan (MDNR *et al.* 2015). The Conservation Plan incorporates some conservative assumptions about the area needed to support a breeding pair of Kirtland's warblers, as well as how long a stand will be used by the species. The density and duration of use estimates were developed by data gathered over the last decade. Lands within the Lower Peninsula averaged 8 to 9 ha (19 to 22 ac) per pair and had a duration of use between 9 and 10 years. Lands within the Upper Peninsula on the Hiawatha National Forest required an average of 40 ha (100 ac) per pair and had a duration of use averaging 10 years (Huber *et al.* 2013 cited in MDNR *et al.* 2015). Using those measures of average hectares per pair and duration of use, 14,593 ha (36,060 ac) of suitable breeding habitat would need to be available at all times to maintain a minimum population of 1,300 pairs, requiring land management agencies to jointly manage 1,550 ha (3,830 ac) of habitat annually (631 ha (1,560 ac) on MDNR land and 918 ha (2,270 ac) on USFS land) through wildfire-regenerated jack pine or managed reforestation (MDNR *et al.* 2015). It is important to recognize that the more recent observations concerning density of Kirtland's warblers in breeding habitat and duration of stand use are often different than the assumptions used for planning purposes and explains at least in part why the Kirtland's warbler population that is actually observed is higher than would be predicted based on the planning assumptions (wildfire regeneration also plays a role). The Conservation Plan also includes an objective of improving the distribution of habitat across the breeding range and identifies for action managing public and private lands in the Upper Peninsula and Wisconsin in sufficient quantity and quality to provide breeding habitat for 100 pairs of Kirtland's warbler (i.e., approximately 5,805 acres of appropriate age jack pine).

The Conservation Plan identifies a goal to develop at least 75 percent of the Kirtland's warbler's breeding habitat acreage using traditional habitat management techniques (opposing wave planting with interspersed openings), and no more than 25 percent of habitat using non-traditional habitat management techniques (e.g., reduced stocking density, incorporating a red pine component within a jack pine stand, prescribed burning) (MDNR *et al.* 2015). Non-traditional techniques will be used to evaluate new planting methods that improve timber marketability, reduce costs, and improve recreational opportunities

while sustaining the warbler's population above the recovery criterion of 1,000 pairs. The majority of managed breeding habitat is created through clearcutting mature jack pine and then planting jack pine seedlings. However, managing jack pine for Kirtland's warbler breeding habitat typically results in lower value timber products due to the overall poor site quality in combination with the required spacing, density, and rotation age of the plantings (Greco 2017, pers. comm.). Furthermore, the demand for jack pine products has fluctuated in recent years, and long-term forecasts for future marketability of jack pine are uncertain. Commercially selling jack pine timber on sites where reforestation will occur is critical to the habitat management program. Timber receipts offset the cost of replanting jack pine at the appropriate locations, scales, arrangements, and densities needed to support a viable population of nesting Kirtland's warblers that would not otherwise be feasible through conservation dollars. The Kirtland's Warbler Conservation Team is currently working on developing techniques through adaptive management that increase the marketability of the timber at harvest while not substantially reducing the suitability of Kirtland's warbler habitat (Dan Kennedy 2017, pers. comm.).

Agency Commitments: Monitoring Breeding Habitat Regeneration

Conservation Plan

Under the Conservation Plan each agency agreed to provide an annual report on their habitat accomplishments and the amount and spatial arrangement of existing and potential future Kirtland's Warbler breeding habitat.

Interagency MOU

The Interagency MOU identifies each agency's commitment for regenerating Kirtland's warbler breeding habitat and for reporting on these efforts:

The parties agree to collaboratively implement Kirtland's Warbler management actions as outlined in their Forest Plans (MDNR and USFS) or Comprehensive Conservation Plan (USFWS). On average, 36,060 acres of breeding habitat shall be available at any time within Michigan. As new information becomes available, this number is expected to be refined. The parties agree to annually report to each other the quantity, treatment/event type, and location of Kirtland's warbler breeding habitat available each year.

Breeding Habitat Regeneration

Each land management agency will report on the following information at a Conservation Team meeting:

- For new stands of breeding habitat regenerated (using the USFS's Kirtland's Warbler Breeding Habitat Accomplishments reporting form, Appendix A):
 - Location (i.e., County, KW Management Area, Township, Range, Section(s))
 - Regeneration Type (e.g., planting, wildfire, natural)
 - Treatment (e.g., trench, roller chopper, bracke scarification, prescribed burn, replanting)
 - Regeneration techniques used per stand (e.g., fire, bare root, container, stocking density)
- Every two years, share available information (e.g., spatial data) on the stands occupied during the previous survey/census period and for each stand the approximate acres of habitat and approximate age or jack pine height. This information will help managers anticipate across landownership the relative proportions of occupied habitat in the progression of occupancy (e.g., early use, peak-use, declining use).

- Every three years provide a jack pine market update (e.g., a discussion to include a summary of Kirtland’s warbler jack pine stands sold during the previous three years, timber sale information, if available (e.g., board-feet, price, etc.), or other available information on changes in timber markets (e.g., current price for jack-pine), jack-pine buyers, processing facilities, etc.). This information will help ensure the Conservation Team is aware of market variables that may affect habitat regeneration feasibility.
- The USFWS’s Kirtland’s Warbler Wildlife Management Area includes 125 separate tracts ranging in size from 2 acres to 600 acres, and many of these tracts are located within larger tracts of land owned by the MDNR. The MDNR will identify stands anticipated for harvest or regeneration in the next one to five years on lands adjacent to the USFWS lands to help highlight opportunities for collaboration and management efficiencies across both ownerships.

E. Post-Delisting Monitoring: Full Life-Cycle Information

A variety of factors throughout the Kirtland’s warbler full life cycle (i.e., breeding, migration, and wintering) have the potential to affect the species status and may warrant additional management action or research. These factors include the importance of key migratory stop-over habitat or other factors in migration; winter habitat loss caused by human development, altered fire regime, changes in agricultural practices, and invasive plant species; and impacts from climate change including rising sea level, drought, and increased high-intensity hurricanes on the wintering grounds, and the changes in precipitation, temperature, and carbon dioxide levels on breeding habitat.

Kirtland’s Warbler’s Full-Life Cycle Information

The Conservation Team coordinator will identify an individual, entity, or sub-teams responsible annually for compiling information concerning the species’ full-life cycle for discussion at least annually at a conservation team meeting. Specific items to address include, but are not limited to:

- Coordinating with The Bahamian government for information that may be important for the Conservation Team to consider
- Reporting on severe or extensive drought in wintering habitat during critical periods (e.g., amount of March rainfall)
- Coordinating with the Conservation Team to develop base-line wintering habitat information
- Identifying any critical stop-over or other migration sites, and any new information that might affect the function of those key locations
- Identifying changes in forest health conditions (e.g., invasive species, key plant species distribution due to climate change)
- Identifying changes in avian disease occurrences (e.g., new pathogen reports significantly affecting neotropical migrants)
- Identifying changes in climate conditions that may affect Kirtland’s warblers throughout the species’ full-life cycle.

F. Post-Delisting Monitoring Implementation Summary

	Monitoring Action	Frequency	Responsible Entities	Threshold	Response
Breeding Population	Census or representatively sample breeding population	Every other year	MDNR, USFS, USFWS, WDNR	Population is >1,300 pairs (using the lower 95% C.I.)	Adaptive management
	Duration of expected use	Annually review for anomalies or trends	Conservation Team	Use of stands is consistent with expectations	Adaptive management
	Evaluate efficacy of new habitat techniques by census or survey for KW abundance	Within 6 years of establishment	MDNR, USFS, or USFWS	Confirm use of stands by KW	Re-evaluate use of new habitat techniques
	Evaluate efficacy of new habitat techniques by selectively surveying for productivity	Within 6 years of establishment	MDNR, USFS, or USFWS	Confirm stand regenerated using new techniques produce similar fledging rates	Re-evaluate use of new habitat techniques
Cowbird	Annual plan for managing cowbirds	Annually	MDNR, USDA-WS, USFWS	Submittal of report	N/A
	Areas where cowbird management is adaptively managed	Monitor for cowbird abundance and KW nests as warranted	MDNR, USDA-WS	To be determined based on results from on-going research	Adaptive management, re-evaluate trapping efforts
	Cowbird management results report	Annually	MDNR, USDA-WS	Submittal of report	N/A
	Cowbird Breeding Bird Survey Results Review	Annually	USFWS-MB	Submittal of report	N/A
Breeding Habitat	Acres and Stand details of habitat regenerated	Annually	MDNR, USFS, USFWS, WDNR	Annual targets in Conservation Plan	Adaptive management
	Current Breeding Habitat Summary	Every two years	MDNR, USFS, USFWS, WDNR	Confirm relative proportion of occupied habitat by age class	Re-evaluate duration of use and density estimates
	Analysis of jack pine market	Every three years	MDNR, USFS, USFWS, WDNR	Identify issues that would impact habitat regeneration	N/A
	Adjacent harvest or regeneration coordination	Within 5 years	MDNR, USFWS	Lands identified for collaborative management	N/A

	Monitoring Action	Frequency	Responsible Entities	Threshold	Response
Full Life Cycle	Wintering ground suitability (e.g., March rainfall, fruit availability, sea-level rise)	Annually	Conservation Team	Bahamian March rainfall < 2.7cm and/or other metrics as issues are identified	To be determined
	New Wintering Information (e.g., distribution)	Annually	Conservation Team	As issues are identified	To be determined
	New Migration Information (e.g., stop-over habitats)	Annually	Conservation Team	As issues are identified	To be determined
	New Forest Health Information (e.g., invasive species, forest pests)	Annually	Conservation Team	As issues are identified	To be determined
	New Avian Health Information (e.g., disease)	Annually	Conservation Team	As issues are identified	To be determined

VI. Potential monitoring outcomes and conclusions

To effectively implement this PDM plan, it is essential to identify the circumstances that trigger concern about the species' status to warrant increased frequency or intensity of the monitoring. It is also important to identify the circumstances under which there is no new concern for the species' status and the requirements of the PDM have been fulfilled. The thresholds and responses described below are based on the information collected under this PDM plan and provide a structured process for evaluating the status of the species during the PDM timeframe. However, other circumstances could arise, such as new threats or increased intensity of residual threats that would warrant additional concern and responses for ensuring the status of the Kirtland's warbler remains healthy. Possible responses for each threshold are described below. Generally, the alternative responses may include an extended or intensified monitoring effort, additional research, habitat management at known localities, and implementing cowbird control. Other responses may be proposed in the future, if warranted, based on the collection of new information arising from monitoring activities.

A. Thresholds for Breeding Population Monitoring

As described in the Conservation Plan, the agencies have identified a population trigger that, if met, would result in the agencies taking action; that trigger is if the population falls below 1,300 pairs (based on using the lower value of a 95% confidence interval). This response trigger would provide sufficient time to respond to a potential problem before the population falls below the goal identified in the recovery plan (i.e., 1,000 pairs). The agencies will take the following actions if the trigger is reached: 1) schedule a meeting, 2) discuss the population decline, 3) decide whether Conservation Plan objectives and actions need to be changed, and 4) implement the recommended changes.

If any changes are observed in the duration of expected use of breeding habitat (i.e., Kirtland's warblers use of stands starting or ending earlier or later than expected), the land management agencies will evaluate how those changes impact the amount of breeding habitat that will be available and determine if a revision of habitat management targets is needed.

When new techniques for regenerating breeding habitat are used that have not previously proven effective, the agencies will conduct adequate singing male population monitoring within six years of use to confirm efficacy and selectively monitor Kirtland's warbler productivity to ensure efficacy. Non-traditional management will continue to be limited to less than 25% of the total acreage, until the efficacy of non-traditional technique has been demonstrated.

B. Thresholds for Cowbird Management

The Conservation Team will annually review cowbird trapping results, information on brown-headed cowbird abundance, and, when available, the results from monitoring Kirtland's warbler nests for parasitism rates. The Conservation Team will develop a decision tool or framework that identifies thresholds that trigger implementation, duration, and cessation of brown-headed cowbird control. Until the Conservation Team establishes an accepted decision tool, the threshold for increased brown-headed cowbird management will be a reduction in average productivity greater than 10% over five years. If this threshold is met, it would trigger an increase in trapping effort in subsequent years and a coordination meeting with the Conservation Team to ensure efforts are sufficient to address the impact of brown-headed cowbird parasitism on Kirtland's warbler productivity.

C. Thresholds for Breeding Habitat Regeneration

The Conservation Team will annually review the amount of breeding habitat that has been regenerated, the composition of the current breeding habitat (suitability), the techniques being used, and the opportunities for future collaboration to ensure that the habitat objectives that are in the Conservation Plan are being met.

The Conservation Team will also review the information concerning the timber markets and harvest in order to anticipate the needs to adaptively manage the planting or harvest strategies.

D. Thresholds for New Full-Life Cycle Information

The Conservation Team Coordinator will identify an individual, entity, or sub-teams responsible for compiling new information concerning the species full-life cycle for discussion at least annually at a Conservation Team meeting. Monitoring threat information (e.g., March rainfall, fruit availability, and sea-level rise in the Bahamas) will be a continuous process under this PDM plan. If threat trend data show a consistent increase across the species' range or are focused at critical junctures in the species full life-cycle, a more detailed analysis of the threat will be conducted over the following two years and additional research will be sought to understand the correlation between the threat and the species.

E. Relisting Considerations

If any of the above thresholds are met and response actions are not adequate, or if we believe there are reasons for substantial concerns regarding the status of the Kirtland's warbler, the USFWS will initiate a status review of the species under section 4 of the ESA to evaluate the potential causes, including assessing habitat availability, cowbird parasitism, climate change, and any other possible limiting factors. The USFWS will work with our cooperators to consider necessary remedial actions or more intensive monitoring or research needs.

During any stage of the PDM period, the USFWS may initiate procedures to re-list the Kirtland's warbler if data from this monitoring effort or from some other reliable source indicate that the species or its habitat is experiencing a significant decline and that a proposal to relist the species as threatened or endangered is warranted. Any relisting action taken by the USFWS under section 4(a)(1) of the ESA will be based on the best available information related to the five listing factors and will require public notice and comment. If the best available information indicates an emergency posing a significant risk to the viability of the species, then the USFWS may use ESA section 4(b)(7) authority (emergency listing) to prevent any significant risk to the viability of the Kirtland's warbler.

VII. Estimated funding requirements and sources

Estimated Funding Requirements

Most of the costs associated with the Post-Delisting Monitoring Plan are built on existing monitoring and reporting efforts that do not create additional funding requirements beyond what agencies are already incurring or have committed to do through their land management plans, the Conservation Plan, MOA, and MOU. Previous estimates developed informally by the recovery team members estimated the monitoring and reporting efforts associated with Kirtland's warbler program at approximately \$130,000 per year with an annual census. The Conservation Team is currently developing more in-depth business plans that will assist with the identification of costs and needs.

Potential Funding Sources

While the ESA authorizes expenditure of both recovery funds and section 6 grants to the states to plan and implement a PDM plan, to date Congress has not allocated any funds expressly for this purpose. Funding of PDM activities will therefore require trade-offs with other competing species needs. Much of the cost will likely be borne as in-kind services provided by cooperating agencies. Working closely with our partners, we anticipate using grant programs to provide funding for activities that go beyond the resources available through in-kind services. Opportunities exist for traditional section 6 grant funds or state wildlife grant funds. The USFWS, MDNR, Forest Service, and other cooperators will continue to work together to secure funding to implement this PDM plan. Many of the tasks in this PDM plan will be carried out by existing staff and will represent in-kind contributions to funding the effort.

In partnership with the Conservation Team, the Kirtland's Warbler Alliance is a non-profit organization that is dedicated to helping secure funding for the needs of the Kirtland's warbler post delisting. Funds obtained through the Kirtland's Warbler Alliance may be used to supplement funding used for habitat management, brown-headed cowbird control, and PDM activities.

Anti-Deficiency Act disclaimer

Post-delisting monitoring is a cooperative effort between the USFWS, States, other Federal agencies, and non-governmental partners. Funding of post-delisting monitoring presents a challenge for all partners committed to ensuring the continued viability of the Kirtland's warbler following removal of ESA protections. To the extent feasible, the USFWS intends to procure funding for post-delisting monitoring efforts through the annual appropriations process. Nonetheless, nothing in this Plan should be construed as a commitment or requirement that any Federal agency, including the USFWS, obligate or pay funds in contravention of the Anti-Deficiency Act, 31 U.S.C. 1341, or any other law or regulation.

VIII. Reporting

Monitoring information collected under this PDM plan will be submitted to the USFWS's Michigan Ecological Services Field Office, MDNR, Forest Service, and the other members of the Kirtland's Warbler Conservation Team. At the completion of year six, an interim summary report will be prepared by December 31, 2025. This report will describe the population and residual threat monitoring that occurred and report all activities and results carried out under the plan. The interim report should include a discussion section that describes any deviations from the PDM plan and make any necessary recommendations for changes in the future PDM data collection or analysis.

A final report will be prepared following the conclusion of the 12-year period of the PDM and be prepared by December 31, 2031. This report will be similar to the interim report, but provide the final review and evaluation of the PDM plan, as well as a conclusion based on this information as described in section IX.

The USFWS will work with its partners to develop the reports under this PDM plan. The primary responsibility for reporting lies with the USFWS, MDNR, and the USFS.

IX. Conclusion of PDM

At the end of the planned PDM period, the USFWS will conduct a final review and summarize the results in the PDM plan report. Any relisting decision by the USFWS will require evaluating the status of the Kirtland's warbler relative to the ESA's five listing factors (section 4(a)(1)). The USFWS intends to work with all of our partners toward maintaining continued recovery of the Kirtland's warbler so as not to require relisting the species.

The following four conclusions are possible at the end of PDM for the Kirtland's warbler:

- PDM indicates that the species remains secure without ESA protections.

PDM will be concluded at the completion of year 12 of the PDM plan and no further monitoring will be required pursuant to the Act. Additional monitoring will continue pursuant to the Conservation Plan and Interagency MOU, dependent upon need as well as available funding and resources.
- PDM indicates that the species may be less secure than anticipated at the time of delisting, but information does not indicate that the species meets the definition of threatened or endangered.

The duration of the PDM period may be extended and additional monitoring and management may be planned and carried out. A new monitoring plan should build upon the information gained from this PDM effort and describe future monitoring activities.
- PDM yields substantial information indicating a decline in the species' status since delisting, such that listing the species as threatened or endangered may be warranted.

In addition to further monitoring and management activities discussed above, the USFWS should initiate a formal status review under section 4 of the ESA to assess changes in threats to the species, its abundance, productivity, survival, and distribution. The purpose of the review is to determine whether a proposal for relisting the Kirtland's warbler as a protected species under section 4 of the ESA is warranted.
- PDM documents a decline in the species' probability of persistence, such that the species once again meets the definition of a threatened or endangered species under the ESA.

If PDM reveals that the Kirtland's warbler is threatened (i.e., likely to become endangered in the foreseeable future throughout all or a significant portion of its range) or endangered, then the species should be promptly proposed for relisting under the ESA in accordance with procedures in section 4(b)(5). Likewise, if the best available information indicates an emergency that poses a significant risk to the well-being of the species, then the USFWS should exercise its emergency listing authority under section 4(b)(7).

X. Review and Adaptation of PDM

This draft PDM plan for the Kirtland's warbler is being made available for review comment by the public. In addition, the USFWS will peer review this draft PDM plan in accordance with the 1994 peer review policy (59 FR 34270). The USFWS will solicit independent expert opinions from knowledgeable individuals with scientific expertise that includes avian ecology and conservation biology principles. All comments received from the public and peer reviewers will be considered and incorporated as appropriate.

into the final PDM plan, which will be made available at the same time as the final delisting rule, should the USFWS determine to proceed with the delisting.

This PDM plan is final when approved by the USFWS's Regional Director for Interior Region 3. However, it may be updated as needed to account for and respond to new information discovered as part of the ongoing data collection and analysis, or as new technology that enhances the effectiveness of monitoring becomes available. If substantial changes are made to the PDM plan or if significant deviations to described PDM procedures set forth in this document occur, this PDM plan will be revised by the USFWS to document the changes and/or deviations. Future changes to the PDM plan will require approval by the Regional Director. The final PDM plan for the Kirtland's warbler, including any future revisions, will be made available on the USFWS's website (<http://endangered.fws.gov>) and the Michigan Ecological Services Field Office website (<https://www.fws.gov/midwest/endangered/birds/Kirtland/>).

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Appendix A. Kirtland's Warbler Breeding Habitat Accomplishment Form

Kirtland's Warbler Breeding Habitat Accomplishments (Acres)														
AGENCY	LOCATION				HABITAT ESTABLISHED	REGENERATION TYPE			TREATMENT				COMMENTS	
	COUNTY	KWMA	TOWN	RANGE		SECTION(S)	PLANT	WILDFIRE	NATURAL	TRENCH	RCHOP	BRACKE		PBURN
MICHIGAN DEPARTMENT OF NATURAL RESOURCES														
	Annual Objective: 1580				Total:	0	0	0	0	0	0	0	0	0
HURON-MANISTEE NATIONAL FORESTS														
	Annual Objective: 1600				Total:	0	0	0	0	0	0	0	0	0
HIWATHA NATIONAL FOREST														
	Annual Objective: 670				Total:	0	0	0	0	0	0	0	0	0
OTTAWA NATIONAL FOREST														
	Annual Objective: 0				Total:	0	0	0	0	0	0	0	0	0
CHEQUAMON NATIONAL FORESTS														
	Annual Objective: 0				Total:	0	0	0	0	0	0	0	0	0
WISCONSIN														
	Annual Objective: 0				Total:	0	0	0	0	0	0	0	0	0
USFWS														
	Annual Objective: 0				Total:	0	0	0	0	0	0	0	0	0
PRIVATE & OTHER														
	Annual Objective: 0				Total:	0	0	0	0	0	0	0	0	0
ALL	TOTAL ANNUAL OBJECTIVE 3,830				GRAND TOTAL:	0	0	0	0	0	0	0	0	0