Kirtland's Warbler
Breeding Range Conservation Plan

Kirtland's Warbler photo by Dan Kennedy, Michigan Department of Natural Resources

Developed by:
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A. Introduction

A.1. Purpose of the plan

The Kirtland's Warbler (*Setophaga kirtlandii*) is a federally endangered migratory songbird that nests exclusively in young jack pine forests in northern Michigan, Wisconsin, and Ontario. In June 2011 the Michigan Department of Natural Resources (MDNR), the U.S. Forest Service (USFS), and the U.S. Fish and Wildlife Service (USFWS) signed a memorandum of understanding (MOU) to clarify agency commitment to Kirtland's Warbler conservation (Appendix A). Each agency committed to continue management of the lands they administer for Kirtland's Warbler. Moreover, the three agencies committed to develop a Kirtland's Warbler Conservation Plan (KWCP). The primary purpose of this inter-agency plan is to provide strategic guidance to the MDNR, USFS, and the USFWS to sustain Kirtland's Warbler across its breeding range within an ecosystem management framework. Similarly, the Wisconsin Department of Natural Resources, the USFWS and the USFS have drafted a Kirtland's Warbler Conservation Plan for Wisconsin (Appendix B).

The scope of the KWCP is limited at this time to the breeding range of the Kirtland's Warbler and does not include geographic areas used by the species during other parts of its annual life cycle (e.g., migration, wintering), nor does it address the entirety of the jack pine ecosystem. The geographic scope of the plan was limited in this way to reflect the jurisdiction of the three agencies responsible for implementing the plan – they do not have any jurisdiction over other states or the Bahamas. The subject matter scope of the plan was limited to ensure that the focus remained specifically on conservation of Kirtland's Warbler. It is the agencies' intention to cooperate with partners to expand the scope of the plan in the future to address migratory and wintering habitat, and revisions may also be more holistic in nature, widening the scope to include more of the jack pine ecosystem. A more holistic view may also be provided in part within the operational plans developed by each agency to prescribe habitat management for Kirtland's Warbler nesting habitat.

Past habitat and cowbird management has been successful in addressing the major conservation needs of the species. In response, the species' population has reached record highs. While these management strategies have been very successful they only treat the afflictions of habitat loss and nest parasitism, but do not cure them. With many factors impacting the species and its breeding habitat, the Kirtland's Warbler cannot transform into a self-sustaining species. To ensure the survival of the Kirtland's Warbler, agencies will need to continue habitat and cowbird management into the foreseeable future.

This plan is complementary to existing agency plans and each agency will continue to contribute and cooperate to manage the Kirtland's Warbler population now and after the species is delisted (removed from federal Endangered Species Act protection). In addition, this plan will help transition the Kirtland's Warbler conservation effort from recovery focused to long-term population sustainability. This plan does not address the needs of Kirtland's Warbler during migration or wintering periods. The KWCP will be revised every 10 years to incorporate new information and science. Lastly, the KWCP has been written in

four major sections. Each section was designed so that it can be shared on its own or as part of the whole KWCP. The following major sections are:

- Section B – Background: Provides historic and current information on the species and its management, which sets the context for future conservation efforts. Most of the Background section was taken directly from the USFWS' Kirtland's Warbler Five Year Review. Please consult that reference for more details.
- Section C – Management Goal, Objectives, and Actions: Outlines the strategy for future Kirtland's Warbler conservation actions.
- Section D – Habitat Management Guidance: Provides technical guidance to land managers and others on how to create and maintain Kirtland's Warbler breeding habitat.
- Section E – Brown-headed Cowbird Management Guidance: Provides an overview of the cowbird management program.

B. Background

The purpose of this section is to provide historic and current information on the species and its management. This information will help set the context for the future conservation efforts outlined in Section C (Management Goal, Objectives, and Actions), and the management guidance provided in Section D (Habitat Management Guidance) and Section E (Brown-headed Cowbird Management Guidance).

The Kirtland's Warbler was one of the first species protected under the Endangered Species Act of 1973. A recovery plan for the Kirtland's Warbler was issued in 1976 and later updated in 1985. The primary objective stated in the recovery plan is to "*re-establish a self-sustaining Kirtland's Warbler population throughout its known range at a minimum level of 1,000 pairs*." In a letter to the USFWS dated January 22, 2002, the Kirtland's Warbler Recovery Team (Recovery Team) recommended clarifying the primary objective to be the following: "*The primary objective is to establish and sustain a Kirtland's Warbler population throughout its known range at a minimum of 1,000 pairs using adaptive management techniques*." The Recovery Team recognized that intensive management would always be needed for this conservation-reliant species and that the Kirtland's Warbler population would never be self-sustaining due to the effects of fire suppression and nest parasitism.

The MDNR, USFS, and USFWS have been very successful in recovering this bird by developing breeding habitat through timber harvest and reforestation. The current population is at its largest recorded, which is 10 times larger than it was at the time of listing and over twice as large as the primary recovery objective (1,000 breeding pairs). Furthermore, the population size has surpassed recovery goals every year since 2001. Achievement of the primary objective is attributable to successful interagency cooperation in habitat management and cowbird control. The Kirtland's Warbler population persists, and will continue to persist, only through intensive management focused on managing appropriately aged stands of jack pine and removal of Brown-headed Cowbird (*Molothrus ater).*

B.1. The Jack Pine Ecosystem

B.1.1. *Ecology*

The Kirtland's Warbler evolved with the jack pine ecosystem and is dependent upon it. Maintenance of a healthy ecosystem is essential in maintaining a healthy Kirtland's Warbler population. In Michigan, the jack pine community is a place of extremes, historically experiencing catastrophic fires, droughts, and summer frosts. The floral and faunal communities are composed of species adapted to this high stress, high disturbance environment. Key elements of this ecosystem include deep, excessively drained sandy soils and sites that not only support jack pine but also commonly support northern pin oak and red pine. Low shrubs, deep-rooted perennial herbs, sedges, and grasses form a mosaic that ranges from areas of sparse vegetation with bare ground to densely covered patches. Many other species benefit from the continued availability of jack pine forests and barrens (Appendix C), with species composition shifting as the jack pine grows.

B.1.2. *Social*

There are multiple social benefits of managing the jack pine ecosystem for Kirtland's Warbler. For example, a healthy jack pine ecosystem provides suitable habitat for game species such as white-tailed deer, turkeys, snowshoe hare and Ruffed Grouse and, therefore, provides additional hunting opportunities for Michigan hunters. In addition, bird watching is a very important recreational activity in Michigan and daily Kirtland's Warbler tours are offered in Mio, Michigan (USFS) and Hartwick Pines State Park (DNR and Michigan Audubon Society). Participants visit the jack pine ecosystem to see a Kirtland's Warbler and gain knowledge about the species' management. Hundreds of people from around the world attend these tours annually.

B.1.3. *Economics*

Jack pine is commercially used in many forest products, including oriented strand board, pulp and paper, and various sawn material, such as studs and pallets. The residue from jack pine, such as the tree tops, can also be burned to produce energy in electric co-generation plants. A possible new market for jack pine may include using jack pine for the production of bio-fuels.

Over the past 13 years, the economic benefit of the KW program has fluctuated annually. For example, the amount of jack pine harvested annually and the associated economic value has varied significantly from year to year (Table 1). This difference in jack pine economic value is likely due to changing demand. Revenue raised from jack pine sales can be substantial and could be used to defray the costs of Warbler management (Table 1).

Table 1. Jack pine timber sales within Kirtland's Warbler Management Areas on state land from 1999-2012.

Agency	Average Acres Sold/Year (range)	Average Cords/Acre (range)	Average Cords/Year (range)	Average Jack Pine Stumpage Price/Cord (range)	Average Selling Price/Acre (range)
MI DNR	1,536 (222 - 3,460)	14 (8 - 24)	21,198 (5,438 - 38,057)	21.46 (13.97 - 31.78)	590.84 (298.63 - 1,231.61)

Kirtland's Warbler tours draw Michigan residents and non-residents into the Northern Lower Peninsula and contribute to the economy of this rural area. In 2013, over 1,100 people from 40 states and 7 foreign countries participated in a tour to view a Kirtland's Warbler and the jack pine ecosystem (USFS and USFWS unpublished data, 2013). An informal survey of tour participants in 2013 indicated that 80% of respondents traveled from outside of Michigan to see the species and spent an average $200 during their visit (William Rapai, personal communication, 2013). Although the current economic contribution of the tours may be small, there is potential for significant growth in this area. The 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation indicated that $1.2 billion was spent in Michigan on wildlife watching by residents and non-residents (USFWS 2011). That fact paired with the demand to see Kirtland's Warbler, the species ranked as the 7th most sought after species by U.S. and Canadian birders (Bird Watching Daily, 2013), indicate the potential economic benefit of this species presence might not be fully realized. Partners are working to strengthen connections between Kirtland's Warbler tours and other natural and cultural assets in this region. These connections may help bring more people to the region, encourage people to stay longer, and ultimately contribute more to the local economy.

B.2. Kirtland's Warbler Biology and Ecology

B.2.1. *Life History*

B.2.1.1. Physical Appearance and Molts

The Kirtland's Warbler is a relatively large, long-tailed, and heavy-billed wood warbler, measuring approximately 14 cm in length and 12-15 g in weight (Mayfield 1960; Walkinshaw 1983; Dunn and Garrett 1997). Compared to other wood warblers, the Kirtland's Warbler has a noticeably longer tarsus (Walkinshaw 1983). The plumage is generally bluish-gray on the upperparts and heavily streaked with black on the back. The throat, breast, and belly are lemon-yellow in color and streaked in black on the sides and flanks, becoming white on the undertail coverts. The species is further distinguished by a broken white eye-ring split in front of and behind the eye. Kirtland's Warblers are also identified by their habit of tail-pumping, similar in behavior to Palm Warblers (*Setophaga palmarum*) and Prairie Warblers (*Setophaga discolor*).

Males are brighter in color than females and have black lores during the breeding season. Juvenile birds are predominately grayish-brown, with heavily splotched,

lighter colored feathers on the breast and belly. Plumage variation in males is fairly continuous from second-year to third-year to after-third-year, where overall plumage becomes more distinctive and brighter with age (Probst et al. 2007). Most males attain definitive alternate plumage by their second breeding season, and Probst et al. (2007) were able to distinguish after-second-year males from second-year males with 78.3% accuracy.

In autumn, the male's bluish-gray plumage becomes mixed with brown, which makes it difficult to distinguish males from females and adults from hatch-year birds (Sykes et al. 1989). Post-breeding molt begins at about the time males stop singing (July 4th – August 15th) and lasts approximately 40 days (Sykes et al. 1989). Adult birds also undergo one partial, pre-breeding molt (body feathers only) on their wintering grounds between February and April (Mayfield 1992). At about 26 days of age, hatch-year birds undergo a post-juvenal molt, which lasts until the approximate age of 43 days (Mayfield 1992).

B.2.1.2. Diet and Foraging Behavior

Kirtland's Warblers are primarily insectivorous and forage by gleaning pine needles, leaves, and ground cover, occasionally making short sallies, hover-gleaning at terminal needle clusters and gathering flying insects on the wing. Kirtland's Warblers have been observed foraging on a wide variety of prey items, including various types of larvae, moths, flies, beetles, grasshoppers, ants, aphids, spittlebugs, blueberries, pine needles, and pitch from twigs and jack pine (Mayfield 1960; Walkinshaw 1983; Fussman 1997). Deloria et al. (2001) identified similar taxa from fecal samples collected from Kirtland's Warblers, but also observed that from July to September, homopterans (primarily spittlebugs), hymenopterans (primarily ants) and blueberries were proportionally greater in number than other taxa among samples. Deloria (2001) suggested that differences in the relative importance of food items between spring foraging observations and late summer fecal samples were temporal and reflected a varied diet that shifts as food items become more or less available during the breeding season. Within nesting areas, arthropod numbers peak at the same time that most first broods reach the fledging stage (Fussman 1997). Planted and wildfire-regenerated habitats were extremely similar in terms of arthropod diversity, abundance, and distribution, suggesting that current habitat management techniques are effective in simulating the effects that wildfire has on food resources for Kirtland's Warblers (Fussman 1997).

Fussman (1997) observed that Kirtland's Warblers foraged predominately from jack pines and to a lesser degree from oak and ground vegetation. However, if oak trees were available, Kirtland's Warblers used them for foraging, indicating that oak may be beneficial to the species. In jack pines, most foraging activities were observed in the middle half of trees, especially within wildfire-regenerated habitat, though females tended to forage lower in height than males. Overall, Fussman (1997) found that the amount of food was similar among differently aged jack pine stands, but tended to shift vertically in abundance within trees as stand age increased. There was some evidence that the vertical distribution of prey abundance within jack pine trees,

especially of larvae, may be related to the Warbler's selection of younger stands and rejection of stands older than 20 years.

B.2.1.3. Mating and Reproduction

Pair formation normally begins within one week after arrival on the breeding grounds (Mayfield 1992). During the breeding season, Kirtland's Warblers may be monogamous or polygynous. Both monogamous and polygynous males establish and maintain multiple territories, and males may opportunistically change mating status from year to year (Bocetti 1994). Polygyny is spatially and temporally widespread across the Kirtland's Warbler breeding range, occurring in stands of all ages, isolated stands, as well as stands that are part of a complex (Bocetti 1994).

Bocetti (1994) found that males in wildfire-regenerated stands had more mates than those in plantations. In wildfire-regenerated stands, 8% of males were unmated and 22% had two females (Bocetti 1994). In plantations, 28% of males were unmated and only 6% had two females (Bocetti 1994). Data collected in 2007, 2008, and 2009 indicate that fewer than 10% of males were unmated in plantations (Sarah Rockwell, Ph.D. candidate University of Maryland, unpubl. data), which likely reflects improvements to management techniques. Bocetti (1994) found that nests are preferentially placed towards the center of territories and hypothesized that females avoid placing nests near the edge of territory boundaries. Nests, which are composed of 50% coarse sedge (*Carex pennsylvanica*), up to 30% red pine needles (*Pinus resinosa*), and twigs of blueberry (*Vaccinium augustifolium*) and other woody plants, are embedded in the ground and concealed by grasses and other low-lying vegetation (Southern 1961; Mayfield 1992). Surrounding vegetation is generally 10-30 cm in height and may include bluestem grasses (*Andropogon* spp.), sedges (*Carex* spp.), blueberry, northern dwarf cherry (*Prunus pumila*), bearberry, (*Arctostaphylos uva-ursi*), and sweet fern (*Comptonia peregrina*) (Smith 1979, Buech 1980). Pine needles and oak leaves also litter the ground adjacent to nests.

The first egg is laid on the day following completion of the nest, with the remaining eggs laid on successive days (Mayfield 1992). Eggs are ovoid, pale buff, whitish, or faintly pinkish with varying amounts of fine brown spots gathered in a cap or wreath pattern at the larger end of the egg (Mayfield 1992). Egg-laying takes five to six days during the first nesting attempt, and four days for subsequent nests, such that five eggs are usually laid in the first clutch and four eggs in replacement clutches (Mayfield 1960). The earliest first-egg date on record is May 17th (Rockwell, unpubl. data), which is close to Mayfield's (1960) estimate of May 16th as the first date that nests could be initiated. Mayfield (1960) found that 80% of nests were completed before June 15th, which is concurrent with more recently gathered data that show June 1st as the average date of the first egg laid (Rockwell, unpubl. data). The latest first-egg date on record is June 30th (Rockwell, unpubl. data), which is consistent with earlier records of late season nesting attempts (June 28 see Berger and Radabaugh 1968, and July 2 recorded in 1990 at Ogemaw Plantation by Carol Bocetti, University of California at Pennsylvania, pers. communication, 2011). A total of 39 double broods have been recorded since 1954 (Mayfield 1960; Radabaugh 1972; Orr 1975;

Rockwell, unpubl. data), with the majority of these occurrences observed since 2007. Approximately 10-12% of pairs will attempt a second nest after successfully fledging young (Rockwell, unpubl. data). Overall, clutches averaged 4.59 eggs per nest attempt and did not differ significantly between planted and wildfire-regenerated habitat (Bocetti 1994). The largest clutch of eggs found in a nonparasitized Kirtland's Warbler nest is seven (Rockwell, unpubl. data). Incubation is done by the female, beginning on the day before the laying of the last egg, and continues for 13 to 15 days (mean = 14.2 days) (Walkinshaw 1983). Young fledge the nest at a mean of 9.4 days after hatching (Mayfield 1992).

B.2.1.4. Demographic features and trends

Since the issuance of the updated recovery plan in 1985, Bocetti (1994) and Rockwell (unpubl. data) have collected new demographic information on reproductive success. Bocetti (1994) conducted nest searches in wildfire-regenerated and planted habitat in 1990, 1991, and 1992, and found a total of 73 nests (41 in wildfire regenerated sites and 32 in plantation sites). Forty-eight of those nests successfully fledged chicks, 14 were depredated, one was parasitized (but successfully fledged young), and 10 were of undetermined fate. Bocetti observed 158 males during the study, of which 29 males were polyterritorial, though only 20 males had females on both territories. Annual production of young was 3.59 young fledged per nest attempt overall and did not significantly vary between planted or wildfire-regenerated habitat. Rockwell (unpubl. data) conducted nest searches in 2007, 2008, and 2009, and found a total of 279 nests, primarily in planted habitat. Of the 279 nests found, 190 successfully fledged chicks, 72 were depredated, three were abandoned during building, seven failed (never hatched), three were parasitized, and four were of undetermined fate. All three parasitized nests were found during the nestling stage, but, despite removal of cowbird chicks, none fledged any Warblers. The majority of these nests (213) were first attempts, but Rockwell also observed 35 renests following the depredation of a first attempt and 25 second nests after the successful fledging of a first nest. Only six of the 279 nests resulted from polyterritoriality with second females. Annual production of mated males averaged 3.52 offspring per nest attempt.

The average life expectancy of adults is approximately two and a half years (Walkinshaw 1983). The oldest Kirtland's Warbler on record was an eleven-year old male, which, when recaptured in the Damon Kirtland's Warbler Management Area (KWMA) in 2005, appeared to be in good health and paired with a female (USFS, unpubl. data). Walkinshaw (1983) suggested that mortality is greatest for adult and juvenile Kirtland's Warblers during migration or on their wintering grounds, where many factors are likely to affect survival. Rockwell (unpubl. data) found that monthly survival rates during summer were higher than monthly survival rates pooled from winter and migratory periods.

Overall, Kirtland's Warbler annual survival estimates are relatively high compared to other wood Warblers, which ranged from 0.32 for the blackpoll Warbler (*Setophaga striata*) to 0.66 for the Golden-winged Warbler (*Vermivora chrysoptera*), and averaged 0.47 across the wood Warbler family (DeSante and Kaschube 2009). In order to maintain population numbers, Ryel (1981) estimated that 35% of young need

to survive their first year of life in order to compensate for losses due to adult mortality. Studies of Kirtland's Warbler indicate that survival rates range from 0.29-0.85 and are likely above the minimum needed to sustain the population (Mayfield 1960, Trick Unpubl data).

Within an individual nesting area, Kirtland's Warblers generally grow in number for three to five years after colonization, level off for four to seven years, and then decline rapidly for three to five years (Probst 1986). Initial colonization of a jack pine stand may occur somewhat at random, with subsequent colony growth stemming from conspecific attraction and the recruitment of yearlings fledged primarily in other colonies (Ryel 1979). Most adults tend to return to the same nesting area year after year (Berger and Radabaugh 1968). Yearlings, however, are more likely to disperse to breeding areas other than the ones where they fledged (reviewed in Ryel 1979). For example, a female banded as a nestling in 1963 was not recaptured the following year but was discovered 45 miles from the banding site in 1965 (Radabaugh et al. 1966). Therefore, the growth of new colonies in new habitat depends on yearling fledged from other colonies.

B.2.2. *Population Status*

The size of the Kirtland's Warbler population has likely fluctuated with habitat availability over time, and it is improbable that the species has ever been particularly abundant during the past 10,000 years (Mayfield 1975). The Kirtland's Warbler population presumably peaked in the late 1800s, a time when conditions across the species distribution were universally beneficial (Mayfield 1960). Widespread agriculture, associated with a period of intense commercialization in The Bahamas, was also decreasing, and winter habitat consisting of low coppice (early-successional and dense, broadleaf vegetation) was becoming more abundant (Sykes and Clench 1998). Furthermore, Brown-headed Cowbirds had not yet become established within the Kirtland's Warbler breeding range.

Between the early 1900s and the 1920s, agriculture in the north woods was being discouraged in favor of industrial tree farming and systematic fire suppression (Brown 1999). Serious efforts to control forest fires in Michigan began in 1927 and resulted in a further reduction of total acres burned, as the number of wildfires decreased and the size of forest tracts that burned decreased (Mayfield 1960; Radtke and Byelich 1963). Brown-headed Cowbirds had also become common within the Kirtland's Warbler nesting range by this time (Wood and Frothingham 1905), and Kirtland's Warblers had declined to the point where they occupied only a fraction of the available breeding habitat (Mayfield 1960).

Comprehensive surveys of the entire Kirtland's Warbler population began in 1951. The census was first conducted in 1951, again in 1961, and conducted every year between 1971 and 2013 (Huber et al. 2011). The 1951 census documented a population of 432 singing males, confined to 28 townships in eight counties in northern Lower Michigan (Mayfield 1953). By 1971, the Kirtland's Warbler population crashed to approximately 201 singing males and was restricted to just 16 townships in six counties in northern

Lower Michigan (Probst 1986). Following listing under the Endangered Species Preservation Act, the Kirtland's Warbler population remained relatively stable at approximately 200 singing males, but experienced record lows of only 167 singing males in 1974 and again in 1987. Shortly after 1987, the population began a dramatic increase (Petrucha and Kintigh 2013; Figure 1). In 2015, the Kirtland's Warbler population reached an all-time high, with 2,365 singing males documented in Michigan during the census. It represents over a 10-fold increase since the all-time low and is more than double the Recovery Plan goal of 1,000 pairs.

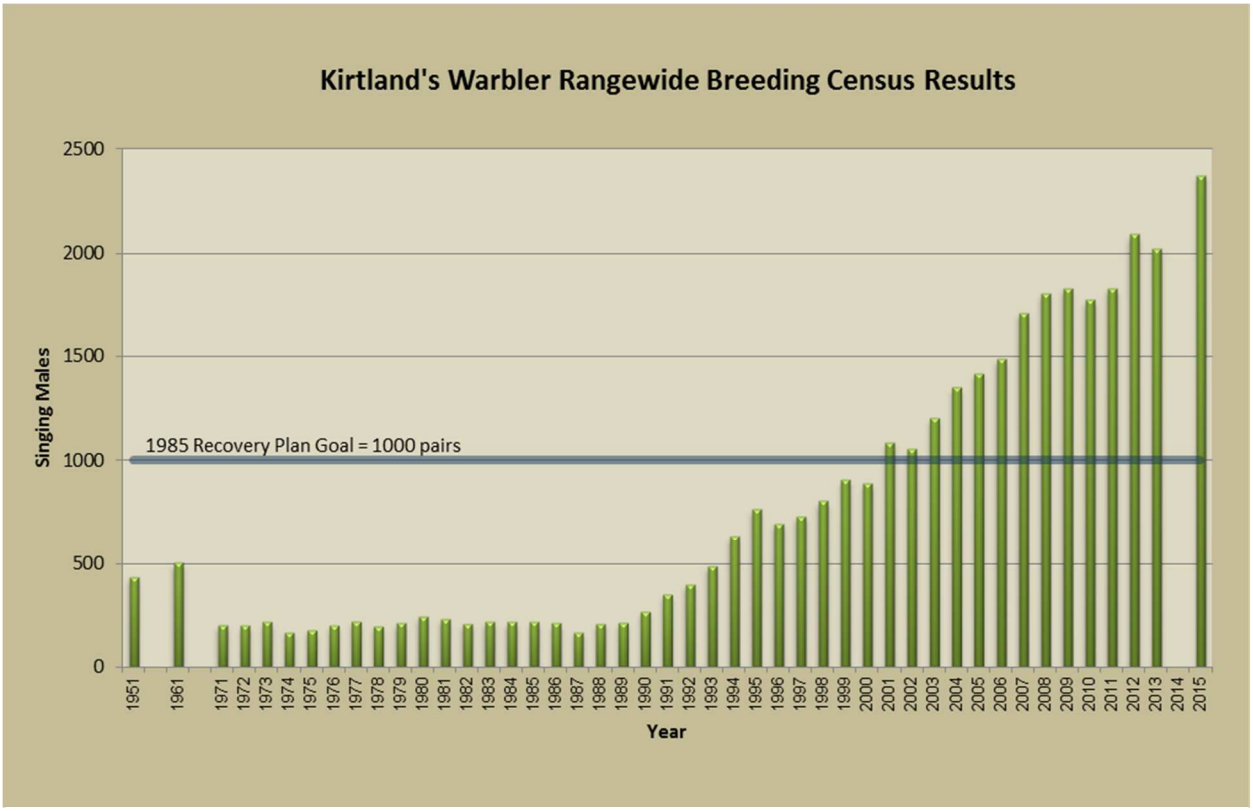

Figure 1. Kirtland's warbler range-wide breeding census results for 1951, 1961, 1971-2013.

B.2.3. *Species Distribution*

Kirtland's Warblers are not evenly distributed across their breeding range. More than 98% of all singing males have been counted in northern Lower Michigan since monitoring began in 1951 (MDNR, unpubl. data). The core of the Kirtland's Warbler breeding range is concentrated in five counties in northern Lower Michigan (Ogemaw, Crawford, Oscoda, Alcona, and Iosco), where more than 86% of the singing males have been recorded since 2000, with nearly 33% counted in Ogemaw County alone and approximately 15% in just one township (MDNR, unpubl. data; Figure 2). The current distribution still reflects a collapse in the heart of the breeding range following the population crash in the 1960s.

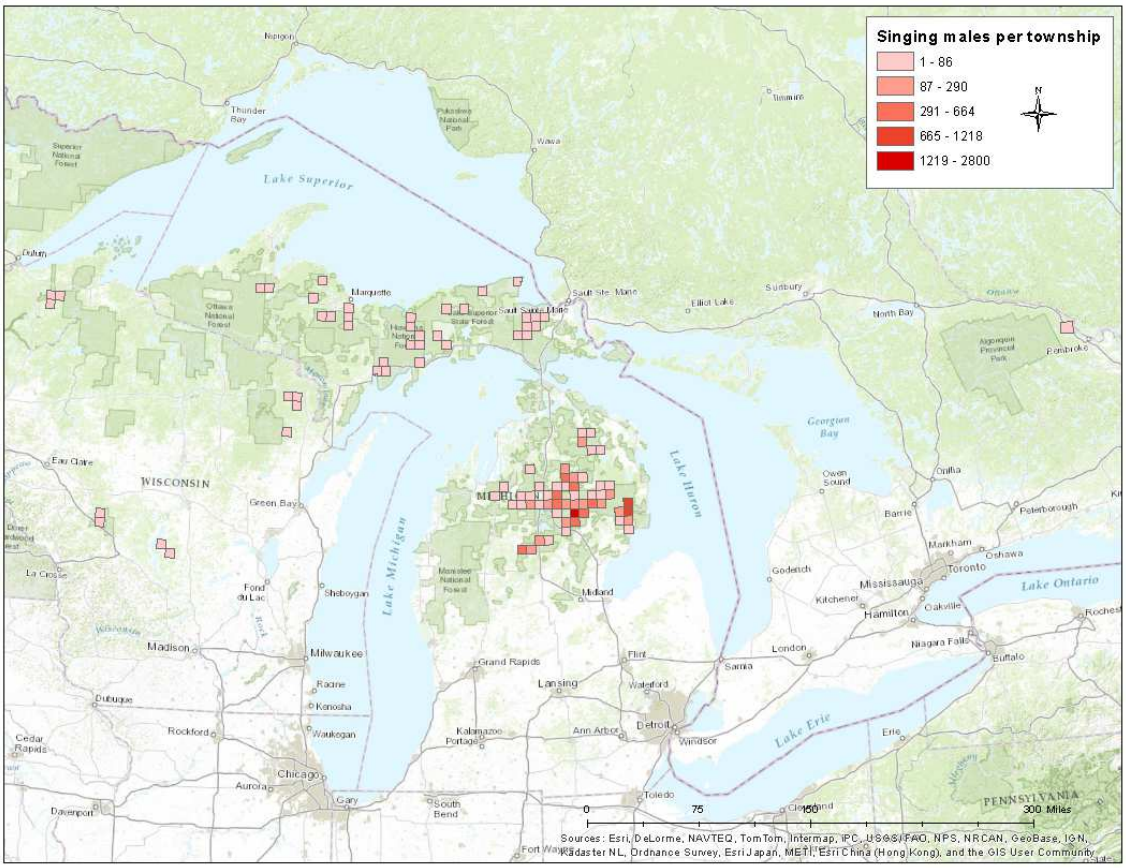

Figure 2. Kirtland's warbler distribution and frequency by Township in Michigan, Wisconsin and Canada (2005-12).

Kirtland's Warblers have also been observed in Ontario since 1900 (Samuel 1900) and in Wisconsin since the 1840s (Hoffman 1989). Systematic searches for the presence of Kirtland's Warblers in states and provinces adjacent to Michigan, however, did not begin until 1977 (Aird 1989; Hoffman 1989). Shortly after these searches began, male Kirtland's Warblers were found on territory in Ontario (in 1977), Quebec (in 1978), Wisconsin (in 1978), and the Upper Peninsula of Michigan (in 1982) (reviewed in Aird 1989). Nesting was confirmed in the Upper Peninsula in 1996 (Weinrich 1996; Weise and Weinrich 1997) and in Wisconsin and Ontario in 2007 (Richard 2008; Trick et al. 2008). In Wisconsin, nesting pairs have been recorded at three locations in Adams County every year since 2007 and once in Marinette County in 2009. Scattered observations of mostly solitary birds have also occurred in recent years at several other sites in Marinette, Bayfield, Douglas, Vilas, Washburn, and Jackson counties in Wisconsin (Joel Trick, U.S. Fish and Wildlife Service, pers. comm. 2011). Similarly in Ontario, nesting pairs have been recorded at Canadian Forces Base Petawawa in Renfrew County every year since 2007 (Paul Aird, University of Toronto, pers. comm. 2007, 2011).

In 2012, the number of singing males in Wisconsin (23), Ontario (4), and the Upper Peninsula (38) represented 3% of the total male population (MDNR, unpubl. data). This recent increase may be related to local recruitment or dispersion from the primary

breeding grounds in northern Lower Michigan. For example, 23 males have been banded in Adams County, Wisconsin, since 2008. However, none of these birds was banded as a hatch-year bird (Trick, pers. comm. 2011), making conclusions regarding their origin tenuous. Probst et al. (2003) documented colonization of Michigan's Upper Peninsula by 6 banded males from the Lower Peninsula, including 4 banded males that moved back and forth between the Upper Peninsula and the core breeding range. Banded fledglings returned to the Upper Peninsula to breed in subsequent years.

B.2.4. *Habitat Characteristics*

Extensive tracts of breeding habitat are found on glacial outwash plains, most commonly in northern Lower Michigan, with scattered locations in the Upper Peninsula of Michigan, Wisconsin, and Ontario. Jack pine forests are disturbance-dependent ecosystems that were historically maintained by naturally recurring wildfire. Jack pine-dominated forests of the historic northern Great Lakes Region experienced large, frequent, and catastrophic stand-replacing fires (Cleland et al. 2004). Based on analysis of records from the 1800s, fires occurred approximately every 60 years, burned approximately 14,000 acres per year, and resulted in jack pine comprising 53.4% of all line trees observed in the General Land Office (GLO) data for fire regime 1(Cleland et al. 2004). Modern wildfire suppression has since increased the average fire rotation within this same landscape to approximately 775 years, decreased the amount of area burned to approximately 1,040 acres per year, and reduced the contribution of jack pine to 36.8% of current total land cover in fire regime 1 (Cleland et al. 2004). The overall effect has been a reduction in the extent of dense jack pine forest, and in turn, Kirtland's Warbler breeding habitat.

Kirtland's Warblers generally occupy jack pine stands that are 5-23 years old and at least 80 acres in size (Meyer 2010). The most obvious difference between occupied and unoccupied stands is the percent canopy cover (Probst 1988). Stands with less than 20% canopy cover are rarely used for nesting (Probst 1988). Tree canopy cover reflects overall stand structure, combining individual structural components such as tree stocking, spacing, and height factors (Probst 1988). Tree canopy cover may, therefore, be an important environmental cue for Kirtland's Warblers when selecting nesting areas.

Occupied stands usually occur on dry, excessively drained and nutrient-poor glacial outwash sands. They are structurally homogenous with trees ranging 1.7-5.0 m in height and are generally of three types: wildfire-regenerated, planted, and unburned-unplanted (Probst and Weinrich 1993). Wildfire-regenerated stands occur naturally from serotinous seeding following stand-replacing fire. Planted stands are stocked with jack pine saplings after a clearcut, according to a detailed prescription (see Habitat Management Guidance, Section D). Unburned-unplanted stands originate from clearcuts that regenerate from supplemental or natural seeding.

Kirtland's Warblers will also use stands with significant components of red pine (*Pinus resinosa*) and northern pin oak (*Quercus ellipsoidalis*) (Mayfield 1953; Orr 1975; Byelich et al. 1985, Fussman 1997; Anich et al. 2011). Use of these areas in Michigan is rare and occurs for only short durations (Huber et al. 2001). In Wisconsin, however,

breeding has occurred primarily in red pine plantations that have experienced extensive red pine mortality and substantial natural jack pine regeneration (Anich et al. 2011). Anich et al. (2011) suggest that in this case, a matrix of openings and thickets has produced conditions suitable for Kirtland's Warblers, and that the red pine component may actually prolong the use of these sites due to a longer persistence of low live branches on red pines.

Stand and landscape structure also influence Kirtland's Warbler occupancy. Timing of colonization and extinction events among nesting areas were related to stand size, distance to an occupied stand, habitat regeneration-type, the number of occupied stands in the landscape, and the rate of habitat influx (Probst and Weinrich 1993; Donner et al. 2010). Large stands and stands that were near other occupied sites were colonized at younger ages, used for longer periods of time, and abandoned at older ages. As the number of occupied stands in the landscape increased, stands were also colonized and abandoned at earlier ages. Donner et al. (2010) reported mean patch age for wildfire-regenerated habitat at colonization was 8.5 years, compared to 9.0 years for planted habitat, and 11.6 years for unburned-unplanted habitat. Similarly, wildfire-regenerated habitat was used for an average duration of 8.2 years, compared to 4.9 years in plantation habitat and 2.6 years in unburned-unplanted habitat (Donner et al. 2010). However in a 2013 analysis, biologists found the average duration of use of all habitats to be nine to 10 years (Huber, Kintigh, Sjogren, 2013).

B.3. Past Breeding Ground Conservation Efforts

Increases in the Kirtland's Warbler population above the 1,000 pair Recovery Goal was accomplished by implementing and monitoring key conservation efforts over several decades. Due to the conservation-reliant nature of this species, these conservation efforts will need to continue for the species population to remain above 1,000 pairs. The following sections summarize past conservation efforts that were key to Kirtland's Warbler recovery while section C provides the strategy on how these key conservation efforts will be carried forward into future management over the next 10 years.

Key conservation efforts that help maintain and manage Kirtland's Warbler on its breeding grounds are:

- Manage breeding habitat
- Prevent nest parasitism by Brown-headed Cowbirds
- Minimize land-use conflicts (e.g. limiting public access into breeding habitat)
- Maintain adequate Agency funding
- Maintain public awareness and support
- Continue adaptive management

B.3.1. *Manage Breeding Habitat*

As discussed previously under B.1.4, modern fire suppression has substantially decreased the frequency and size of wildfires, significantly restricting the amount of breeding habitat naturally produced for the Kirtland's Warbler. While fire suppression is necessary to protect human life, property, and valuable natural resources, it eliminates a natural disturbance factor from the jack pine ecosystem on which many species of animals,

plants, and insects depend. Consequently, the Kirtland's Warbler is now considered a conservation-reliant species since it cannot survive without continued regeneration of its habitat. Therefore, intensive habitat management that mimics the regeneration effects of wildfire (primarily harvesting and reforesting jack pine) is a critical part of maintaining the Kirtland's Warbler population.

The scarcity of breeding habitat was identified as a significant threat to the Kirtland's Warbler well before the species was listed under the Endangered Species Act. Efforts at creating habitat to benefit Kirtland's Warblers began as early as 1957 on state forest land and 1962 on federal forest land (Mayfield 1963; Radtke and Byelich 1963). Three areas, approximately four square miles each, were established as Warbler management areas on Michigan state forest lands in 1957 in Ogemaw County near the Ogemaw Deer Refuge, Crawford County near the town of Lovells, and Oscoda County near Muskrat Lake and the town of Red Oak. Portions of two of these areas were reforested with jack pine using a unique strip-planting configuration that provided opening strips within the stand. The intention was to maintain tracts in three age classes, seven years apart, by burning and replanting stands when they reached 21 years of age. Planting of the third area in Oscoda County was deferred because jack pines on that area were approaching a commercially harvestable age. However, in 1964, almost one-third of the tract was burned by wildfire before harvest. The regeneration that resulted from that fire provided breeding habitat for Kirtland's Warblers from 1972 to 1988, and is one of the longest occupied stands recorded to date. These three areas were later incorporated into the 1981 Management Plan for Kirtland's Warbler in Michigan (USFS and MDNR 1981).

In 1962, the Huron-Manistee National Forests approved a management plan for the Kirtland's Warbler. A 4,010-acre tract was dedicated in June 1963 near Mack Lake, Oscoda County. This plan established 12 management blocks of about 320 acres each. Ultimately, each block was to be grown on a 60-year commercial rotation with five years age difference between blocks. In 1973 and 1974, the Huron National Forest cut, burned, and planted areas near Luzerne, Oscoda County, and Tawas, Iosco County, to benefit the Warbler.

In 1971, the third decennial census showed an alarming 60 percent decline in the population of nesting Warblers. This decline initiated a joint meeting sponsored by the USFS and MDNR. One of the outcomes of the meeting was the formation of an ad hoc steering committee whose responsibility was outlining needed habitat research, proposing restrictions on human activity in breeding areas, initiating a Brown-headed Cowbird control program, and locating funding for Kirtland's Warbler management. Through the efforts of committee members, both agencies established an official policy with specific points designed to improve the status of the Kirtland's Warbler. This policy was to treat designated jack pine stands for a period of not less than five years for improving Warbler habitat. Provisions of this policy included the use of clearcutting followed by prescribed burning.

Efforts increased in 1981 with the establishment of an expanded habitat management program to supplement wildfire-regenerated habitat and ensure relatively large patches of

early successional jack pine forest would be continuously available for nesting (Kepler et al. 1996). When the updated recovery plan was issued, 127,600 acres of public forest lands were designated for Kirtland's Warbler habitat management to meet the primary recovery objective of 1,000 pairs. Approximately 74,100 acres were on state forest lands in 16 management areas in nine counties and about 53,500 acres were on federal forest lands in seven management areas in four counties (USFS and MDNR 1981). These acreages were determined by factoring an average population density of one breeding pair per 30 acres into a 45- to 50-year commercial harvest rotation, which would produce habitat as well as marketable timber (Byelich et al. 1985). Data collected from the annual singing male census from 1980 to 1995 indicated that breeding pairs used closer to 38 acres within suitably aged habitat (Bocetti et al. 2001). Based on these data, the Kirtland's Warbler Recovery Team recommended increasing the total amount of managed habitat to 190,000 acres (Ennis 2002). Under this prescription, 38,000 acres of nesting habitat would be maintained on an annual basis (Ennis 2002).

Managers typically develop Kirtland's Warbler breeding habitat by harvesting and regenerating large stands of jack pine. Approximately 3,830 acres are planned to be harvested annually: 1,560 acres on state lands and 2,270 acres on federal lands. Harvested areas are then reforested using mechanical and manual methods to plant seedlings or encourage natural regeneration. The harvested areas are reforested at a stocking density of approximately 1,452 trees per acre (5' x 6' spacing). Small openings are incorporated into the reforested areas in an opposing wave or other pattern to provide habitat diversity (approximately ¼ acre per acre reforested). Due to the openings, this stocking density results in approximately 1,100 trees on each acre reforested.

B.3.2. *Prevent Brown-headed Cowbird Nest Parasitism*

Although Brown-headed Cowbirds were historically restricted to prairie ecosystems, forest clearing and agricultural development of Michigan's Lower Peninsula in the late 1800s facilitated cowbird expansion into Kirtland's Warbler nesting areas (Mayfield 1960). Wood and Frothingham (1905) found that Brown-headed Cowbirds were already common within the Kirtland's Warbler breeding range by the early 1900s. Strong (1919) later reported the first known instance of nest parasitism of a Kirtland's Warbler nest in Crawford County in 1908. Shortly thereafter, Leopold (1944) related the scarcity of Kirtland's Warblers to Brown-headed Cowbird parasitism. Mayfield (1960) supported this hypothesis with empirical data and further recognized that cowbird parasitism threatened the survival of the species.

The Kirtland's Warbler is particularly sensitive to Brown-headed Cowbird nest parasitism. The Warbler's limited breeding range exposes almost the entire population to cowbird parasitism (Mayfield 1960; Trick, unpubl. data). In addition, the peak egg-laying period of the cowbird completely overlaps that of the Kirtland's Warbler, and the majority of birds produce only one brood each year (Mayfield 1960; Radabaugh 1972; Rockwell, unpubl. data). Kirtland's Warblers have limited evolutionary experience with Brown-headed Cowbirds as compared to other hosts and have not developed effective defensive behaviors to thwart nest parasitism (Walkinshaw 1983). Brown-headed Cowbirds also appear to exert greater pressure on Kirtland's Warbler nests than other

passerines within the same breeding habitat. Walkinshaw (1983) reported that 93% of all the cowbird eggs he found in jack pine habitat were located in Kirtland's Warbler nests compared to all other host species combined. Kirtland's Warbler fledging rates averaged less than one young per nest prior to the initiation of cowbird control (Walkinshaw 1972).

Due to significant Brown-headed Cowbird parasitism and resulting low Kirtland's Warbler fledging rates, the USFWS began trapping and removing cowbirds from Kirtland's Warbler nesting areas in 1972. After the cowbird control program began, parasitized nests dropped to 10% while average number of young per nest rose to 2.7 (Kelly and DeCapita 1982). By all accounts, the trapping program was extremely effective and likely prevented the species' extinction. Due to cost, disturbance to breeding Kirtland's Warblers, and other factors, nest monitoring to directly evaluate the cowbird trapping program's effectiveness was not continued. The Kirtland's Warbler annual census, however, has provided indirect monitoring of the program's effectiveness. With the Kirtland's Warbler population reaching a record of 2,090 singing males in 2012, it is likely that the trapping program remains effective and high Kirtland's Warbler fledging rates are being maintained. Additionally, anecdotal evidence from research and monitoring in the 1980s, 2000s, and 2010s all indicate that the trapping program remains highly effective, with very few observations of cowbird eggs in Kirtland's Warbler nests.

Brown-headed Cowbird traps are placed in or adjacent to Kirtland's Warbler breeding habitat on state and federal lands in the northern Lower Peninsula of Michigan. Traps are also maintained at the Adams County breeding site in Wisconsin. Other sites in the Upper Peninsula of Michigan, Wisconsin, and Canada are not trapped for cowbirds due to low densities of Brown-headed Cowbirds and subsequent low parasitism risk. Traps are operated annually from April to the end of June, and field staff follow specific protocols to maximize program success (see Section E for details).

B.3.3. *Minimize Land Use Conflicts*

Breeding Kirtland's Warblers can be impacted by human disturbance, excessive noise, direct mortality from collisions with vehicles, and direct loss of habitat. Human entry into occupied habitat for recreational, scientific, or educational reasons can impact Kirtland's Warblers. If conducted during the breeding season, people can accidentally trample nests or disrupt breeding behavior while blueberry picking, mushroom hunting, riding off-road vehicles, collecting scientific data, taking photographs, hunting, or bird watching. Excessive noise from well pumping can disrupt or mask the sound-based communications that Kirtland's Warblers rely on for many of their breeding behaviors, including defending territories and attracting mates. Numerous studies have documented the potential impacts of excessive noise on bird species densities, foraging behavior, reproductive success, and predator-prey interactions (Francis and Ortega 2011; Bayen et al. 2008; Slabbekoorn and Ripmeester 2008). In addition, vehicles within or adjacent to occupied habitat have the potential to cause mortality from collisions. Finally, some activities, including oil/gas well pad development and pipeline maintenance, may lead to direct loss of occupied habitat.

To minimize the risk of breeding disturbance and direct mortality, land use considerations are applied to public lands managed for breeding habitat and public lands directly adjacent to essential habitat. Currently, human access into Kirtland's Warbler habitat is restricted during the breeding season (May 1 to August 15) in the Lower Peninsula. Existing forest roads and trails are not typically closed during this time period. Habitat in Wisconsin, the Upper Peninsula of Michigan, and a few sites outside of Kirtland's Warbler Management Areas in Michigan's northern Lower Peninsula are not subject to closure during the breeding season. Limited human access permits are granted for scientific and educational uses, including filming and photography for brochures and tours. Other activities adjacent to or within habitat are also reviewed closely and modified if necessary, including: 1) land management activities such as timber sales and reforestation and right-of-way and easement maintenance; 2) recreational activities including trail use and bird watching; and 3) mineral development activities such as well drilling and pipeline maintenance.

B.3.4. *Maintain Public Awareness and Support*

Information and education efforts have played a critical role in communicating with and garnering support from the public for the Kirtland's Warbler program. The public's reaction to the intensive Kirtland's Warbler management effort is sometimes negative. Public concerns surrounding Kirtland's Warbler management include opposition to large clearcuts, opposition to timber harvest in general, concern about fire and fire management, impacts of management on other desired wildlife species, and concerns about restrictions on public land access. Several focused outreach efforts have helped alleviate these concerns and engaged the public in Kirtland's Warbler conservation.

For over 15 years, the Kirtland Community College organized a Kirtland's Warbler Wildlife Festival which offered tours and raised awareness of Kirtland's Warbler natural history and management. The audience for the festival was the communities within or adjacent to Kirtland's Warbler habitat. The Festival ended at Kirtland Community College in 2011, and was reestablished in the community of Roscommon in 2015. In addition, a program, the Kirtland's Warbler Young Artist's Calendar Contest, was continued by the U.S. Forest Service. The calendar contest challenges youth (grades K - 8th) to create original artwork that demonstrates their understanding of the Kirtland's Warbler and jack pine ecosystem. Marguerite Gahagan Nature Preserve and Kirtland Community College support a school naturalist program that promotes the calendar contest to ~4,000 students each year.

In addition, daily Kirtland's Warbler tours are offered in Mio, Michigan (USFS) and Grayling, Michigan (Michigan Audubon Society and MDNR). The audience for these free or nominal-fee tours is bird enthusiasts from all over the world, local community members, and other interested people. These tours are guided by staff knowledgeable about Kirtland's Warbler and the jack pine ecosystem. Participants visit the jack pine ecosystem to see a Kirtland's Warbler and gain knowledge about the species' management. With habitat closed to the public during the breeding season, this has provided a structured way for birders to view one of the rarest songbirds in North America. Hundreds of people attend these tours annually. A self-guided Kirtland's

Warbler auto tour also provides visitors and community members an opportunity to explore the jack pine ecosystem on their own.

The agencies and many partners have also completed additional outreach activities, including presentations to local community groups, sportsman's clubs, school children and youth, university students, state and federal congressional staff, and others. Additionally, an education and outreach subcommittee of the Recovery Team has identified short and long-term goals. Short term (1-year) goals include continuing public tours, improving 3rd grade classroom and field trip programs, and reaching out to community groups. Long term (5-year) goals include developing a Kirtland's Warbler classroom and field trip program for middle school, and expanding the number of schools reached by these elementary and middle school programs. Agencies and partners will need to continue coordinating these activities and communicating key messages around Kirtland's Warbler conservation to the public.

B.3.5. *Maintain Sustainable Agency Funding*

There will be continuous, recurring costs associated with implementing the KWCP and sustaining a viable Kirtland's Warbler population. Funding for the Kirtland's Warbler program is complex and varies by agency. However, the Kirtland's Warbler program includes the following activities: forest management to provide suitable breeding habitat, Kirtland's Warbler population monitoring, program management and coordination, information and education efforts, and Cowbird management. Forest regeneration is by far the greatest cost for the Kirtland's Warbler program. It is important to note, however, that much of the forest management cost, including NEPA documentation, silviculture examinations, sale preparations, and reforestation, are not necessarily specific to maintaining Kirtland's Warbler breeding habitat and likely still would be incurred in the absence of the Kirtland's Warblers. It is impractical to separate out forest management costs due to Kirtland's Warbler conservation alone, because all of the activities are so interdependent.

Adequate funding for Kirtland's Warbler conservation has been a struggle for the agencies over the last 40 years. In some years, lack of funding has threatened to reduce or eliminate essential annual activities such as cowbird trapping and habitat management. Although elimination of these activities has always been avoided in the past, the funding struggle will intensify after delisting, and funding gaps are anticipated. Moving the species off the endangered species list brings the risk of reduced priority and reduced funding within the agencies. In addition, the cowbird management program is currently funded through the USFWS's endangered species program. After delisting, the species will no longer be eligible for this funding, and no alternate source of federal or state funding is available.

While the transition from recovery to delisting brings uncertainty in terms of funding, it also brings opportunities for new partnerships, programs and strategies. To take advantage of these opportunities, address anticipated funding shortfalls and assist with this transition, a collaborative program was developed in partnership with the National Fish and Wildlife Foundation, The Kirtland's Warbler Initiative (Initiative). The goal of

the Initiative is to develop an innovative public-private partnership that will help advance the current transitional phase of Kirtland's Warbler conservation and ensure post-delisting success for the population. Partners in this program – USFWS, USFS, MDNR, Huron Pines and the Kirtland's Warbler Recovery Team - agree to coordinate and implement four (4) key strategies;

- Develop the Kirtland's Warbler Alliance to increase visibility and maintain priority for Kirtland's Warbler conservation
- Establish a long-term fund to provide supplemental dollars for anticipated priority funding gaps
- Finalize the Kirtland's Warbler Conservation Plan to provide guidance on breeding grounds
- Develop the Kirtland's Warbler Conservation Team to provide necessary framework for preservation of institutional knowledge, effective information exchange and collaboration on technical, fiduciary and outreach needs of the species

B.3.6. *Adaptive Management*

The Kirtland's Warbler conservation program has used an adaptive management framework that incorporates the following components:

- Each agency has made their own management and planning decisions based on best available science and observations shared at bi-annual Recovery Team meetings. Specifically, agencies share habitat management acres and techniques, research projects, education and outreach, population monitoring, and cowbird management results.
- A Kirtland's Warbler census has been conducted in 1951, 1961, 1971-2013, and 2015 to estimate Kirtland's Warbler abundance across its breeding grounds (see below).
- The recovery team has worked closely with the scientific community to identify and address research priorities, some of which have supplemented monitoring data.
- Agencies have successfully incorporated new science into their on-the-ground management and planning efforts from information shared through the Recovery Team.

Part of the adaptive management process includes the Kirtland's Warbler census. 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 has since been conducted on an annual basis. More recently, annual surveys have been initiated in both Wisconsin and Ontario, Canada.

Since its inception, the Kirtland's Warbler census has enabled managers to:

- Evaluate the population relative to the recovery objective to consider down-listing or delisting.
- Determine the presence or absence of individuals in areas for protection purposes.
- Evaluate habitat management activities.
- Monitor occupancy, duration of use, and density of singing males to learn how the birds are occupying breeding habitat and adaptively manage based on this new information.
- Target effective placement of cowbird traps.
- Build public confidence in endangered species management.
- Provide data for research.

B.3.7. *Track and Respond Appropriately to Emerging Threats: Climate Change*

The potential impact of climate change has gained widespread recognition as one of many pressures that influence the distributions of species, the timing of biological activities and processes, and the health of populations. Although impacts to the Kirtland's Warbler on its breeding or wintering habitats have not yet been demonstrated, it has been hypothesized that climate change has the potential to decrease and shift breeding habitat outside of its current range (Prasad et al. 2007), decrease the extent of wintering habitat, and decouple the timing of migration from food resource peaks that are driven by temperature and are necessary for migration and feeding offspring (van Noordwijk et al. 1995; Visser et al. 1998; Thomas et al. 2001; Strode 2003).

Swanston et al. (2011) suggest that species with the following characteristics will be better able to accommodate climate change: population that is currently increasing; wider range of ecological tolerances; greater genetic diversity; adapted to disturbance; adapted to warmer, drier climates; populations in middle to northern extent of their range; diverse communities; and habitats in larger, contiguous blocks. While the Kirtland's Warbler population is currently increasing and habitat is managed in larger, contiguous blocks, it has a very limited range of ecological tolerances, and most of its population is concentrated in a very small area. This suggests that some concern is warranted. However, a recent climate change vulnerability assessment of numerous wildlife species by the Michigan DNR (Hoving et al. 2013), using NatureServe's Climate Change Vulnerability Index, categorized Kirtland's Warbler as 'Presumed Stable,' with the caveat that while the population may remain stable globally, its range may shift outside of Michigan.

The quality and extent of breeding habitat within jack pine forests may change over time due to global climate change. In 2013, Handler et al. (2014) completed a vulnerability assessment of the primary forest types currently present in Michigan's northern Lower Peninsula and eastern Upper Peninsula. The assessment found that jack pine is expected to decline in suitable habitat and biomass across the assessment area—under all greenhouse gas emission scenarios assessed—and includes some predictions of large declines.

Jack pine is at the southern extent of its range in Michigan, which may make it even more susceptible to climate change effects. Botkin et al. (1991) hypothesize that heat tolerance may limit growth of jack pine in a warming climate. Additionally, Handler et al. (2014) suggest that warmer temperatures could also lead to greater moisture stress, through accelerated litter layer decomposition leading to lower water-holding capacity. Alternatively, warmer conditions and longer growing seasons could benefit pine forests, if CO_2 fertilization boosts long-term water-use efficiency and productivity (Handler et al. 2014). A warmer climate may increase the susceptibility of current jack pine forests to damage from pests and diseases (Bentz et al. 2010; Cudmore et al. 2010; Man 2010; Safranyik et al. 2010), and may allow for new pests such as western bark beetle to arrive (Handler et al., in press). Additionally, higher air temperatures, causing greater evaporation and reduced soil moisture (NAST 2000), as well as fuel buildup from severe wind events and pest outbreaks (Handler et al. 2014), may result in conditions conducive to forest fires that favor jack pine propagation. However, if there is too much change in the fire regime, this could have a negative effect on jack pine regeneration and result in a shift to barrens (Handler et al. 2014). Competition with deciduous forest species may favor an expansion of the deciduous forest into the southern portions of the boreal forest (USFWS 2009) and affect interspecific relationships between the Kirtland's Warbler and other wildlife (Colwell and Rangel 2009; Wiens et al. 2009). Under different greenhouse gas emission scenarios, there could be a reduction of Kirtland's Warbler breeding habitat in Michigan, as well as an expansion of habitat in western Wisconsin and Minnesota (Prasad et al. 2007). While Kirtland's Warbler will most likely be affected by climate change, the magnitude of affects is uncertain at this time.

C. Kirtland's Warbler Management Goal, Objectives and Actions

The Purpose of this section is to outline the strategy for future Kirtland's Warbler conservation actions. The context for the following goal, objectives, and actions is provided within the historic and current information of the species and its management in Section B (Background). Specific guidance for implementation of some of the actions is provided in Section D (Habitat Management Guidance) and Section E (Brown-headed Cowbird Management Guidance).

C.1. GOAL: Sustain a Kirtland's Warbler population throughout its known breeding range above 1,000 breeding pairs using an adaptive management framework.

The primary objective of the Kirtland's Warbler Recovery Plan (1985) was "to reestablish a self-sustaining Kirtland's Warbler population throughout its known range at a minimum level of 1,000 pairs." In a letter to the USFWS dated January 22, 2002, the Recovery Team recommended clarifying the primary objective to the following: *The primary objective is to establish and sustain a Kirtland's Warbler population throughout its known range at a minimum of 1,000 pairs using adaptive management techniques*. The Recovery Team recognized that intensive management would always be needed for this conservation-reliant species and that the Kirtland's Warbler population would never be self-sustaining due to the effects of fire suppression and nest parasitism.

The 1,000 pair goal was established as part of the original recovery plan in 1975. It was based upon acres of potential habitat available in the northern Lower Peninsula, the ability of the State and Federal land managers to provide suitable nesting habitat on an annual basis and the most recent estimates of the number of acres of habitat required by each pair of Kirtland's Warblers. The population has been above the 1,000 pair goal since 2001, above 1,500 pairs since 2007, and above 2,000 pairs since 2012.

As the agencies continue forward with management, they recognize the need to continue habitat and cowbird management to sustain a Kirtland's Warbler population. The agencies have agreed on a framework to ensure long-term sustainability of Kirtland's Warbler. The agencies have identified a population trigger that if met would result in the agencies taking action. The trigger for response will be if the population falls below 1,300 pairs. This should give the agencies enough time to respond to a potential problem before the population falls below the goal (1,000 pairs). The agencies will take the following actions if the trigger is reached: 1) schedule a face-to-face meeting, 2) discuss the population decline, 3) decide whether or not KWCP objectives and actions need to be changed, and 4) implement recommended changes.

A recent analysis of Kirtland's Warbler habitat use (Table 2) indicates that a trigger of 1,300 pairs is reasonable under current habitat management commitments made in the 2011 MOU (Appendix A). The average acres per singing male and duration of use are based on data gathered over the past 10+ years by MDNR and USFS staff. As treatment block size increases, Kirtland's Warblers have responded positively by occupying the breeding habitat at higher densities. However, if future habitat management is altered, Kirtland's Warbler

densities may also change. Managers should continue to evaluate this relationship to help predict the population response to future management actions.

Table 2. Analysis of Habitat Use by Kirtland's Warbler in Michigan (Huber, Kintigh and Sjogren 2014).

2014 Kirtland's Warbler Breeding Habitat Model								
						Direction Under This Plan		
Agency/Forest	Average Acres / Pair	Duration of Use	Average Acres / Year Goal	Average Acres Available	Predicted Pairs Traditional Management (100%)	Predicted Pairs Traditional Management (75%)	Predicted Pairs Non-Traditional Management* (25%)	Total Predicted Pairs
USFS / Hiawatha NF	100	10	670	6,700	67	50	8	59
USFS / Huron-Manistee NFs	19	9	1,600	13,760	724	543	91	634
MDNR	22	10	1,560	15,600	709	532	89	620
		Total:	3,830	36,060	1,500	1,125	188	1313
* Assumes that non-traditional management is only 1/2 as productive as traditional management.								

Additionally, preliminary results from a population simulation model (Brown et al., in prep) appear to support both the 1,000 pair population goal and ability to maintain that goal even with limited use of non-traditional habitat management techniques. Preliminary results indicate that the population will remain above 1,000 pairs under the following assumptions: 1) the amount and relative suitability of breeding habitat in the future is similar to conditions between 2004 and 2013, 2) cowbird removal continues at the same level of effort in the northern Lower Peninsula KWMAs, and 3) climate and land use changes do not result in reduced habitat suitability on the breeding or wintering grounds.

Preliminary results from the model indicate that if 25% of high suitability breeding habitat is reduced to moderate suitability due to non-traditional habitat management (experimental plantations with lower jack pine densities), a 12.3% reduction in males could result under the following assumptions: 1) the total amount of suitable breeding habitat in the future is similar to current levels, 2) cowbird removal continues at the same level of effort in the northern Lower Peninsula KWMAs, and 3) climate change does not result in reduced habitat suitability on the breeding or wintering grounds. Given these assumptions and assuming that the observed variation in male abundance in Michigan between 2007 and 2013 (i.e., 1,697 to 2,063 males) is indicative of future annual variation, reducing male abundance by 12.3% would result in annual fluctuations between 1,488 and 1,809 males. This is a slightly higher predicted population than what was concluded in the habitat analysis (Table 2), but indicates that with inclusion of 25% non-traditional habitat management the Kirtland's Warbler population should stay about 1,300 singing males.

C.1.1. *Manage Kirtland's Warbler Breeding Habitat*

Habitat management for Kirtland's Warbler has proven to be an effective tool to increase their numbers in Michigan over the past 25 years. The agencies clearly understand the significance of Kirtland's Warbler habitat management and have crafted the following habitat objectives and actions to help achieve the plan's goal. For clarification, the agencies in the Northern Lower Peninsula consider traditional habitat management as an

opposing wave planting and non-traditional habitat management is considered any other experimental habitat management technique. Outside the Northern Lower Peninsula, traditional management is not as well defined since a variety of reforestation techniques (i.e., planting, natural regeneration, seeding, seed tree burning, etc.) are used to create appropriate jack pine stocking densities and small openings.

Objective 1: Establish an average of 3,830[1] acres of breeding habitat annually.

Action 1. Agencies will annually coordinate to ensure the quantity of breeding habitat needed to support 1,000 pairs or more of Kirtland's Warblers is available.
  i. MDNR will average 1,560 acres annually
  ii. USFS (Hiawatha and Huron-Manistee) will average 2,270 acres annually
  iii. USFWS will maintain habitat as appropriate[2]

Action 2. Develop at least 75% of the agency acreage objectives identified in Action 1 using traditional habitat management techniques.

Action 3. Develop at most 25% of the agency acreage objectives identified in Action 1 using non-traditional habitat management techniques. Non-traditional techniques will be used to evaluate new planting methods that improve timber marketability, reduce costs and improve recreational opportunities while sustaining Kirtland's Warbler's population above goal.

Action 4. Maintain a jack pine harvest schedule.

Action 5. Coordinate with private landowners and other partners (military and conservancies) to develop Kirtland's Warbler breeding habitat.

Action 6. Develop habitat using the "Habitat Management Guidance" identified in Section D (including existing agency plans identified in D.2).

Objective 2: Improve distribution of habitat across the breeding range to reduce risk to the population from catastrophic events and climate change.

Action 1. Manage public and private lands in the Upper Peninsula and Wisconsin in sufficient quantity and quality to provide breeding habitat for 10 percent (100 pairs) or more of the goal. Any breeding habitat managed outside the Hiawatha National Forest or Wisconsin will be in addition to Objective 1, Action 1.

Action 2. State and federal agencies in Wisconsin will draft a conservation plan to identify appropriate conservation needs and actions for Kirtland's Warbler in their State (Appendix B).

Action 3. Conduct an assessment of the jack pine resource to determine if changes are needed to areas currently managed for the Kirtland's

[1] Wildfire regenerated jack pine will count towards each agencies annual average acreage objective if the regenerated habitat is deemed suitable for Kirtland's warbler by agency experts.
[2] See Section D.2.1

Warbler, considering current concentration of breeding pairs and climate change.

Action 4. Improve habitat distribution in Wisconsin by purchasing private land inholdings and other priority parcels from willing sellers, provided funds are available for such purchases and the parcels can be obtained at fair market value.

C.1.2. *Manage Cowbird Parasitism*

Along with habitat management, cowbird management has proven to be an effective tool to increase the number of Kirtland's Warblers in Michigan over the past 40 years. The agencies clearly understand the significance of cowbird management and have crafted the following objectives and actions to help achieve the plan's goal.

Objective 1: Continue operation of a Brown-headed Cowbird management program on targeted state, federal, and other lands following guidance in Section E, and adapt as new information becomes available.

Action 1. Maintain cowbird management at current levels within targeted Kirtland's Warbler habitat in the northern Lower Peninsula of Michigan until additional information on the impacts of cowbirds can be collected.

Action 2. Evaluate cowbird parasitism risk at breeding locations outside the northern Lower Peninsula of Michigan and support efforts to implement cowbird management programs in those areas as appropriate.

Action 3. By September 2018 transfer responsibility for the cowbird management program from the USFWS to the MDNR, depending on available funding.

C.1.3. *Minimize Land Use Activities and Associated Conflicts*

Individual breeding Kirtland's Warblers continue to be at risk from excessive noise, collision and trampling, and direct loss of habitat. The following objectives and actions were developed to avoid or minimize these conflicts.

Objective 1: Minimize adverse effects on habitat, reproduction, and survival from land use activities and follow the technical guidance in Section D.

Action 1. Protect Kirtland's Warbler by restricting entry to occupied habitat in the northern Lower Peninsula from May 1 - August 15.

Action 2. Protect Kirtland's Warbler by attempting to construct recreational trails, parking lots, and campgrounds outside areas managed for Kirtland's Warblers (see D.15.3).

Action 3. Protect Kirtland's Warbler by generally not permitting construction of wind turbines, communication towers, power lines, pipelines, new roads, and other structures within or adjacent (¼ mile) to areas managed for the Kirtland's Warbler (see D.15.5).

C.1.4. *Maintain Public Awareness and Support*

Effective outreach to increase public awareness and understanding of Kirtland's Warblers depends on open and continued communication between the agencies and the public. This communication involves determining and understanding the issues, identifying audiences, crafting messages, selecting the most effective delivery techniques, and evaluating effectiveness. Achieving effective outreach will further the conservation of the Kirtland's Warbler by building understanding of and support for needed management. The following objectives and actions were developed to build effective outreach.

Objective 1: Work with partners, such as Audubon Society, Huron Pines and the Kirtland's Warbler Alliance, to educate the public about Kirtland's Warblers and the jack pine ecosystem.

- Action 1. Maintain existing and create new partnerships (especially with fishing, hunting, recreational users, and community groups) to help strengthen and build a broader base of public support for Kirtland's Warbler conservation.
- Action 2. Work collaboratively with partners to develop a communications and outreach plan by September 2017.
- Action 3. Provide environmental education to local schools as opportunities arise.
- Action 4. Provide visitors and the community with opportunities to experience Kirtland's Warblers and jack pine habitat, including continued support of guided Kirtland's Warbler tours and development of at least one self-guided public access site.

C.1.5. *Maintain Sustainable Funding*

Agency and other funding will be necessary to complete conservation actions outlined in the KWCP. With estimated costs of the program around $3 - $4 million annually, funding is critical to sustaining a long-term and successful Kirtland's Warbler conservation program. The objectives and actions below outline a strategy to identify and secure additional funding.

Objective 1: Continue to develop a sustainable approach for funding the Kirtland's Warbler program, including working with conservation partners to supplement agency funding for implementation of conservation actions identified in this plan.

- Action 1. Agencies will continue to pay for habitat management annually to the best of their abilities and contingent upon available funding.
- Action 2. Work with partners to establish a consistent and self-sustaining funding source for the Cowbird management program
- Action 3. Coordinate and cooperate with Huron Pines and the Kirtland's Warbler Alliance to identify funding for education and outreach
- Action 4. Agencies and conservation partners will seek private, grant, and other funding sources

Objective 2: Agencies will develop a Kirtland's Warbler program budget that includes specific budget items for KWCP objectives and considers both short-term and long-term needs and will identify areas in the budget where shortfalls are anticipated.

Action 1. Cooperatively develop a program budget by September 2017.
Action 2. Report on anticipated budget shortfalls at the annual meeting

C.1.6. *Adaptive Management*

Adaptive management is an iterative process that involves using information gained to facilitate decision-making and reduce uncertainties, leading to more effective management. The agencies are committed to using an adaptive management approach in the implementation of this plan that will help agencies sustain a population of Kirtland's Warbler above 1,000 breeding pairs.

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

Action 1. Agencies will work cooperatively to develop and implement protocols for long-term population monitoring by September 2017.
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 KWCP objectives and actions need to be changed, and 4) implement recommended changes.

Objective 2: Conduct research to answer priority management needs.

Action 1. Agencies will develop project specific research for new non-traditional habitat management techniques (Objective 1, Action 2). If new methods are determined to be successful by the agencies then they will be considered traditional techniques similar to the opposing wave.
Action 2. Agencies will develop and maintain a list of research priorities by March 2017. Researchers will be encouraged to develop and implement projects that address these priorities.
Action 3. Agencies will integrate new science into management decisions through agency specific plans and processes.

Objective 3: Annually determine whether actions in the plan were completed, share those results, and evaluate if changes in management are necessary.

Action 1. Ensure that communication and cooperation continues through the Kirtland's Warbler Recovery Team or the Kirtland's Warbler Conservation Team so that information will be shared between agencies and partners to improve Kirtland's Warbler conservation. The Kirtland's Warbler Conservation Team will be established prior to the species being delisted.

Action 2. Each agency will report the following annually to their leadership and to the Recovery Team or the Conservation Team:

i. Management accomplishments.
   1. Annual habitat accomplishments by agency.
   2. Amount and spatial arrangement of existing and potential future suitable stands for Kirtland's Warbler occupancy.
   3. Cowbird management program results.

ii. Monitoring plans and results.

iii. Research accomplishments.

iv. Information and education efforts.

v. Results from population monitoring efforts.

Action 3. Evaluate monitoring data, research, and other information to determine if goals (e.g., the population goal) and objectives in the KWCP need to be modified.

D. Kirtland's Warbler Habitat Management Guidance

The purpose of this section of the Kirtland's Warbler Conservation Plan is to provide technical guidance to land managers and others on how to create and maintain Kirtland's Warbler breeding habitat. This section provides the details needed to implement habitat-related actions included in Section C (Management Goal, Objectives, and Actions) and it fits within the context of the historic and current information on the species and its management that is provided in Section B (Background). Separate guidance for Brown-headed Cowbird management is provided in Section E.

The Kirtland's Warbler has been described as a habitat specialist, occupying a very narrow habitat niche within its breeding range. The species reaches its highest breeding densities in large patches of young, even-aged, jack pine-dominated forest occurring on sandy outwash plains in Michigan and Wisconsin. While jack pine-dominated forest is found from mid-Michigan and mid-Wisconsin to the continental tree line in Canada, Kirtland's Warblers occupy only a small portion of the extreme southern range. Thus, the jack pine in these locations is essential to the survival of the Kirtland's Warbler.

The jack pine ecosystem is a unique assemblage of species and requires a comprehensive view of the landscape to manage for its many ecological, social, and economic values. Fortunately, these jack pine landscapes are found predominately on public lands in Michigan and Wisconsin. These federal, state, and county lands provide almost the entire breeding habitat for the Kirtland's Warbler. While some breeding habitat is created by wildfire, most is created by mechanically harvesting and reforesting mature stands of jack pine on a 50-year rotation.

D.1. The Framework for Developing Breeding Habitat

Lands biologically appropriate for the development of Kirtland's Warbler breeding habitat have been identified in the Lower and Upper Peninsulas of Michigan and Wisconsin (Figure 3).

Significant areas of both state and federal lands have been designated as *essential habitat* in the core of the Kirtland's Warbler's range in the northeastern portion of the Lower Peninsula of Michigan. Essential habitat is that land identified as biologically appropriate for the development of Kirtland's Warbler breeding habitat. Essential habitat is an aggregation of jack pine stands that have been or will be managed to develop Kirtland's Warbler breeding habitat. Essential habitat is managed in 23 Kirtland's Warbler Management Areas (KWMAs)–16 on state forests and seven on the Huron-Manistee National Forest. USFWS parcels are widely distributed within KWMAs adjacent to state forest lands (Fig. 3).

In the Upper Peninsula of Michigan and Wisconsin, biologically appropriate lands are managed to develop breeding habitat for the Kirtland's Warbler. This management occurs on the Hiawatha, Ottawa and Chequamegon-Nicolet National Forests, as well as private and county lands. No essential habitat has been designated in the Upper Peninsula of Michigan or Wisconsin.

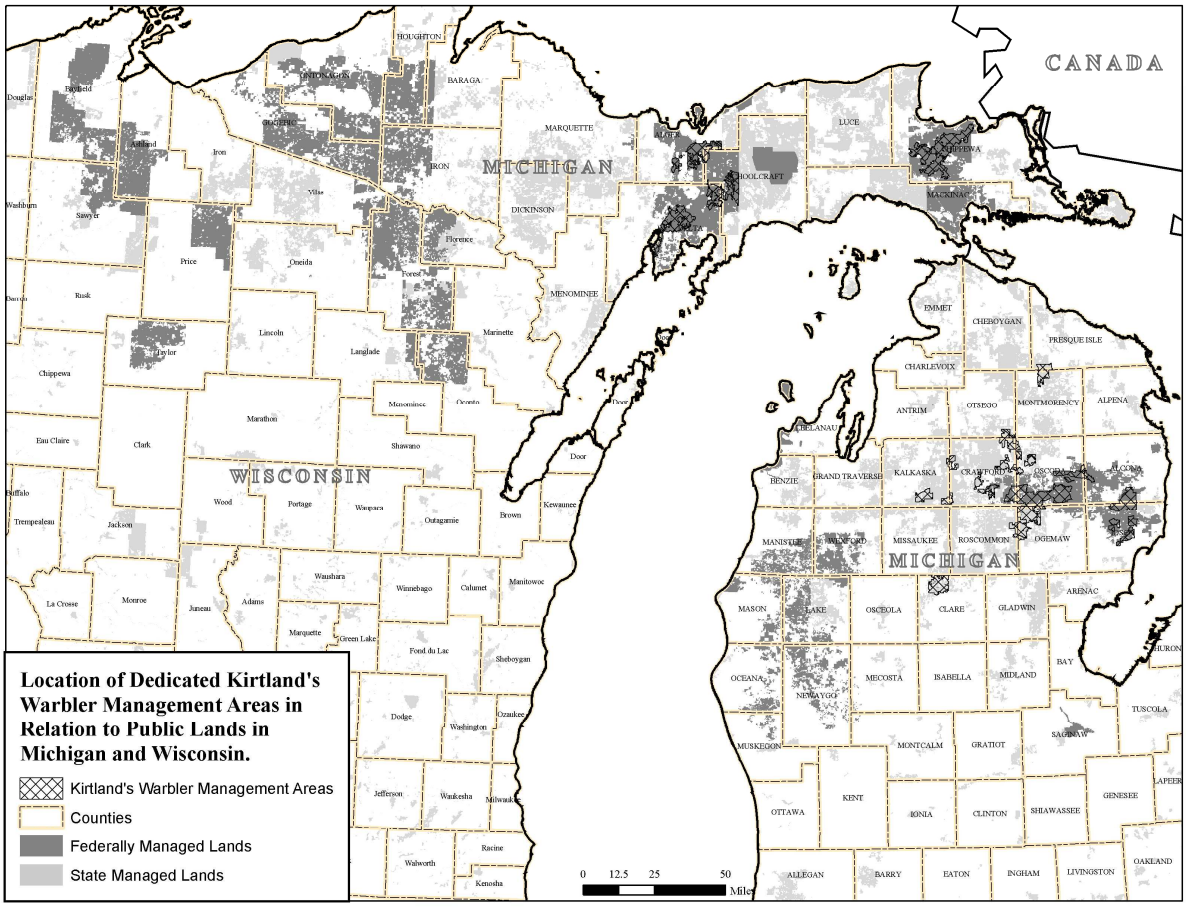

Figure 3. Lands managed for the Kirtland's Warbler in relations to State and Federal Public Lands in Michigan and Wisconsin.

D.2. Management of Public Lands

The MDNR, USFS, and USFWS have actively managed jack pine for Kirtland's Warbler breeding habitat since the late 1950s. Since the early 1990s, the Kirtland's Warbler population has increased dramatically (
Figure 4).

In a memorandum of understanding (MOU) signed in June 2011, these agencies committed to continue management of the lands they administer for Kirtland's Warbler breeding habitat. The partners agreed to review and begin re-negotiating the MOU in 2015 so that adjustments can be agreed upon prior to renewal in five years. The MOU will likely be updated based on the outcome of this Conservation Plan and with new partners, which includes an addendum to this plan from Wisconsin (currently in draft). The MOU was executed in June 2011 and is effective through April 2016. The agencies agreed to the following:

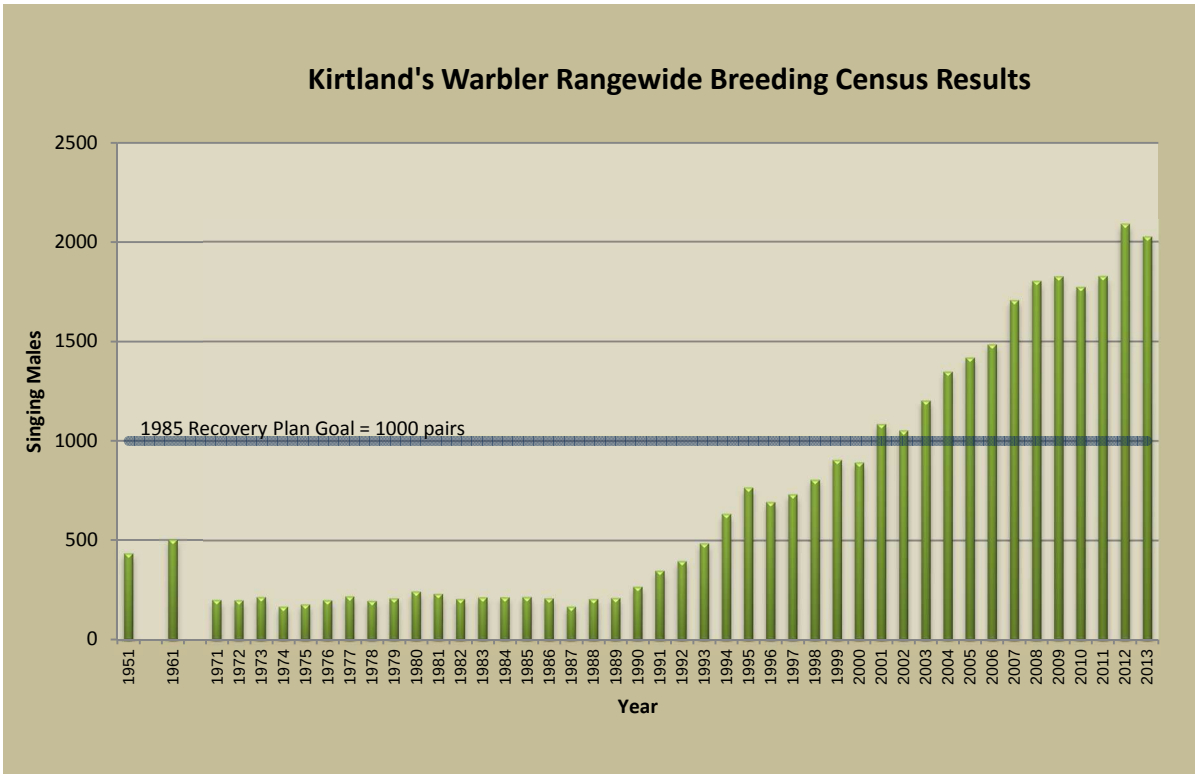

Figure 4. Kirtland's Warbler Range-wide Breeding Census Results, 1951-2013**.**

D.2.1. *The US Fish and Wildlife Service*

Lands managed by USFWS, Kirtland's Warbler Wildlife Management Area (KWWMA), consists of 125 separate parcels in eight counties of northern Lower Michigan. Most parcels are adjacent to and managed in concert with MDNR lands. Due to the generally small size and scattered nature of the KWWMA parcels, an annual habitat acreage target is not provided. Within the KWWMA Habitat Management Plan, however, USFWS shall manage the land, as appropriate, to promote jack pine ecosystems that contribute to a sustainable population of Kirtland's Warblers and associated wildlife species.

D.2.2. *The Michigan Department of Natural Resources*

The MDNR agreed to regenerate forest habitat according to plans already adopted, such as the 2001 Strategy for Kirtland's Warbler Habitat Management, which calls for 1,560 acres of breeding habitat to be developed each year within designated Kirtland's Warbler Management Areas on lands administered by the MDNR. An operational plan detailing state forest Kirtland's Warbler habitat management will be published in 2013.

D.2.3. *The US Forest Service*

The USFS agreed to follow direction in the Huron-Manistee, Hiawatha, Ottawa, and Chequamegon-Nicolet National Forest Plans to regenerate an average of 2,270 acres of breeding habitat per year and to maintain at least 22,660 acres of jack pine in the appropriate size class. The national forests in Michigan and Wisconsin agree to the following:

- Huron-Manistee National Forest agrees to continue to implement the forest plan in relation to Kirtland's Warbler habitat management. The forest plan objective is to create approximately 1,600 acres of breeding habitat each year within designated Kirtland's Warbler Management Areas. Approximately 15,960 acres of breeding habitat will be available at any one time (from Forest Plan).
- Hiawatha National Forest agrees to continue to implement the forest plan in relation to Kirtland's Warbler habitat management. The forest plan objective is to regenerate an average of 670 acres of Kirtland's Warbler habitat per year with a goal to provide a minimum of 6,700 acres of jack pine in the appropriate size class.
- Ottawa National Forest agrees to continue to implement projects that benefit the Kirtland's Warbler compliant with forest plan direction.
- Chequamegon-Nicolet National Forest agrees to continue to implement projects that benefit the Kirtland's Warbler compliant with forest plan direction.

The government agencies responsible for public land management are working together and sharing information to coordinate habitat management and maintenance. On average, 3,830 acres are developed into breeding habitat annually–1,560 acres on state lands and 2,270 acres on national forest system lands on the Huron-Manistee and Hiawatha National Forests (Table 3). As new information becomes available, these numbers may be refined.

Table 3. Annual Habitat Development Objectives and Total Manageable Habitat by Agency.

Agency / Area	Annual Habitat Development Objectives (Acres)	Total Manageable Habitat (Acres)
Michigan DNR Lower Peninsula	1,560	90,700
US Forest Service Huron-Manistee National Forests	1,600	88,300
US Forest Service Hiawatha National Forest	670	33,700
US Fish & Wildlife Service Kirtland's Warbler WMA	0	6,700
Total:	**3,830**	**219,400**

D.3. Habitat Development

Stands identified for habitat development are regulated for a sustained yield of breeding habitat and commercial timber production. Where possible, 15 to 25 percent of each area identified for Kirtland's Warbler management is developed into breeding habitat every decade on a 40- to 80-year rotation. However, rotations will vary due to the variety of stand conditions within each area because of site productivity, previous habitat development, and wildfire. Some habitat may be managed on a shorter rotation with prescribed fire or whole-

tree harvesting to create larger treatment blocks or to attempt to balance the age classes within an area.

Long-term planning and modeling helps achieve forest plan goals and addresses potential problems in regulating the output of jack pine and Kirtland's Warbler breeding habitat in sufficiently sized treatment blocks. Ideally, long-range habitat planning is conducted in a GIS workspace. Age class tables and graphs are created to display current and future age class distribution of jack pine within areas managed for the Kirtland's Warbler, indicating the long-term sustainability of breeding habitat development and timber production.

Prior to management, stands that have been identified for Kirtland's Warbler management should be examined to ensure they are of the appropriate forest type and site index. Often, field examination of stands reveals the need to adjustment stand boundaries, or to remove or add stands based on forest type, site index or other stand conditions.

D.4. Distribution of Breeding Habitat

Breeding habitat should be well distributed across and within areas managed for the Kirtland's Warbler to minimize the risk of catastrophic losses of birds and their breeding habitat.

Managers in Michigan continue to have concerns about the breeding distribution of the Kirtland's Warbler population relative to its total managed habitat and historic range. Throughout recovery, the breeding population has maintained a highly concentrated or clumped distribution with the highest densities in only a handful of locations. For example, based on the 2012 census results, 17% (346) of all singing males occurred on about 6,000 acres in one township, T24N R01E, Ogemaw County. An additional 12% (251 singing males) occurred on about 4,700 acres in T25N R07E, Alcona County. Furthermore, 50% of all singing males occurred in parts of only five townships throughout the northern Lower Peninsula (Table 4).

Table 4. Townships with high percentages of singing males in 2012.

County	Township	Range	Singing Males	% Singing Males
Ogemaw	T24N	R01E	346	17%
Alcona	T25N	R07E	251	12%
Iosco	T24N	R07E	146	7%
Ogemaw	T23N	R01E	129	6%
Oscoda	T25N	R03E	114	6%

In addition, less than 5% of the population breeds in the Upper Peninsula, Wisconsin, and Canada. This poor distribution leads to a high risk of susceptibility to catastrophic events like wildfire, climate change, or forest pest outbreaks. Improving the nesting distribution of the Kirtland's Warbler in Michigan through management of additional acres should be a high priority for managers, particularly on suitable habitat in the Upper Peninsula and Wisconsin. Therefore, this plan sets forth a goal of having 10 percent or more of the population (150 pairs) occurring on public and private lands in the Upper Peninsula and Wisconsin.

In the Lower Peninsula of Michigan, a substantial amount of the jack pine ecosystem outside of Kirtland's Warbler Management Areas is not managed to provide Kirtland's Warbler breeding habitat. Wildfires, insects, disease, or other factors may offer an opportunity to manage these areas for Kirtland's Warbler. These areas also offer managers an opportunity to try new methods of developing breeding habitat.

D.5. Treatment Block Design

D.5.1. *Background*

The 1981 Habitat Management Plan addressed the management of habitat in the Lower Peninsula of Michigan. Each KWMA was divided into management units containing 1,000 to 2,000 acres of jack pine. Most units were subdivided into five cutting blocks, with each block containing 200 or more acres of contiguous stands of jack pine. In theory, one block in each unit was to be developed as breeding habitat each decade. However, after a number of years, managers found that this approach tended to fragment breeding habitat and provided a less-than-optimum landscape configuration for Warblers. This resulted in small blocks of habitat distributed around KWMAs, with new habitat projects being developed well away from occupied habitat both temporally and spatially.

Observations of Kirtland's Warbler biogeography suggest that the birds select large stands (1,000 acres or more) of young jack pine for breeding habitat. It appears that Warblers nest in higher densities in larger stands, and these large stands are used for a longer period across seasons than smaller stands. Census results from large burn areas and plantations support these findings. Therefore, a new habitat management framework was developed in the 2001 Strategy and is used today to better meet the Warblers' preference for large stands and to mimic the effects of large wildfires. Habitat management is now planned at the KWMA level. Management units and subunits were eliminated and replaced by large treatment blocks to reduce fragmentation of breeding habitat and permit more flexibility in habitat management planning.

D.5.2. *Treatment Block Design*

For all areas managed for the Kirtland's Warbler in Michigan and Wisconsin, treatment blocks are:

- Developed at the landscape level within management areas, and typically cross roads and compartment boundaries.
- Sequentially scheduled for habitat development starting with the first block and progressing to the last over the planning period.
- Scheduled for regeneration near other blocks in both space and time. New blocks are developed adjacent or in close proximity to recently developed blocks to better mimic the effects of large crown fires. These blocks are typically regenerated no more than five years apart to ensure they become suitable breeding habitat at the same time, which will maximize benefits of large habitat areas.
- 300 acres or larger and generally no less than ¼ mile wide.

Large treatment blocks provide the best Kirtland's Warbler habitat because they offer the best chance for colonization, are occupied for longer periods, support denser colonies of birds, are beneficial to other species (ex. sharp-tailed grouse), and more closely simulate wildfire conditions.

Treatment blocks of 300 acres or larger are recommended, but blocks 500 acres or larger are most desirable to optimize Kirtland's Warbler productivity. Given the limits of existing stand conditions, visual considerations, and land ownership patterns, some blocks may be smaller.

Treatment blocks should generally be no less than ¼ mile wide, as blocks that are too narrow may not provide breeding habitat. Field observations indicate that Kirtland's Warblers occur in higher densities in treatment blocks with less edge and greater core area. Wildfire-shaped blocks are desirable provided they are not too narrow.

Past management has created an assortment of small stands of different ages and types in some management areas. Therefore, large block designs may be improved by including sub-merchantable jack pine or stands of other forest types. However, if other hardwood forest types like aspen are managed to create a larger treatment block, they should not be converted to jack pine and managed using appropriate silvicultural practices. Red pine plantations should be managed to final rotation wherever possible.

Treatment blocks should be designed considering aesthetic values. Visual management and simulation of wildfire conditions should be considered during timber sale planning. Irregular sale boundaries that follow natural features help to break up the visual impact of large harvested areas. When possible, managers should avoid placing boundaries on hard edges like roads and property boundaries. It is best to design treatment blocks that cross roads and compartment boundaries. For example, motorists are likely to prefer driving a short distance into and out of a harvested area, rather than driving along a straight edge along a harvest area over a long distance. Existing openings should be incorporated into the reforestation scheme to create mixed patterns of tree cover and open space.

Kirtland's Warbler habitat should not be developed within 300 feet of structures because of the fire hazard and risk to emergency responders, citizens and private property.

D.6. Managing Burned Areas

Jack pine within and outside of areas managed for the Kirtland's Warbler may be consumed by wildfire, which may, in time, provide suitable breeding habitat for the Warbler. However, some wildfire areas do not fully regenerate to jack pine. These areas may become barrens, large openings with scattered jack pine and jack pine thickets that were once common in the jack pine ecosystem.

In either case, land managers should carefully consider leaving wildfire areas unaltered. Wildfire areas are a natural and very important part of the jack pine ecosystem, providing structural diversity in regenerating stands for decades after the flames have gone out. Intact wildfire areas are now a rare ecological asset because of fire suppression, timber salvage,

green biomass removal, and jack pine planting that has occurred over the past five decades. In addition, dead trees generally have low value as a timber product but have high ecological, wildlife, scientific, and educational value. Land managers will evaluate wildfire areas and determine the appropriate level of timber salvage and reforestation following wildfires in areas managed for the Kirtland's Warbler.

Although barrens may not provide optimal Kirtland's Warbler breeding habitat, they are structurally more diverse than plantations and provide habitat for the Warbler as well as other animal and plant species. , . A Kirtland's Warbler population well above the maintenance objective is justification for managers to consider incorporating wildfire-created barrens into the landscape. However, managers should consider barrens management experimental (see D.7 below), and should be certain that adequate breeding habitat will be provided for the Kirtland's Warbler over the long term.

Wildfire areas will be evaluated and incorporated into habitat planning. When wildfires occur, the habitat development schedule will be adjusted to ensure a sustainable supply of occupiable habitat over the long term.

D.7. Adaptive Management

Managers are encouraged to use adaptive management to test new techniques for developing breeding habitat on a limited portion (up to 25%) of lands managed for the Kirtland's Warbler. The opposing wave pattern of planting jack pine has been extremely successful in providing breeding habitat for the Kirtland's Warbler in the Lower Peninsula of Michigan; however, it is very costly and structurally less diverse than fire-regenerated habitat.

New techniques for developing breeding habitat could reduce costs, provide other ecological and social values and also provide an excellent opportunity for managers to collaborate with researchers. As new techniques are implemented, they must be carefully documented and monitored for success or failure. Techniques that appear to be successful should be replicated for verification and may be adopted if proven successful.

For example, while barrens do not provide optimal breeding habitat for the Kirtland's Warbler, barrens can provide some breeding habitat and greater structural diversity to support other plant and animal species. Managers are encouraged to incorporate barrens into their adaptive management strategy.

In time, managers will learn more about the historical range of variability for the openings that occur with dense patches of jack pine that provides breeding habitat for the Kirtland's Warbler. Managers can then use reforestation techniques to develop breeding habitat with a more natural mosaic of openings within jack pine stands.

D.8. Management Using Timber Harvest

Historically, jack pine depended on wildfire for survival and regeneration. Jack pine stands that originated from wildfire are structurally diverse. These stands are characterized by large tracts of even-aged trees, snags, down wood, individual scattered live trees, "stringers" (narrow strips of live trees), and a mosaic of dense jack pine thickets and scattered openings.

When developing breeding habitat using timber harvest, managers should consider harvest and regeneration techniques that provide structural diversity similar to what would be found following a wildfire. This structure provides perches, forage substrate, and cover for the Kirtland's Warbler and other animals, plants, and microorganisms that have evolved in the jack pine ecosystem.

The economic value of the standing timber and future harvest potential are also important considerations when making habitat management decisions. The multiple objectives of ecosystem management, species management, and appropriate timber utilization will provide the necessary long-term support for and ultimate success of this Plan.

D.8.1. *Clearcutting*

Clearcutting, with reserve trees and snags, is the most practical technique to remove and regenerate jack pine for the Kirtland's Warbler and obtain benefits for animals and plants associated with early successional habitat. In the Lower Peninsula of Michigan, whole tree chipping is presently the most common and efficient operation. Trees are cut full length and chipped, leaving few tops or limbs as slash. While clean sites provide for ease of planting, modifications must be considered for natural regeneration or the use of prescribed burning as a follow-up treatment.

Whole-tree chipping is not as common in the Upper Peninsula where slash and tops are generally left on sites with inherently low fertility.

D.8.2. *Seed Tree/Shelterwood*

In the Lower Peninsula of Michigan, managers have made a few attempts to use the seed tree methods to regenerate jack pine and create Kirtland's Warbler breeding habitat. These attempts were unsuccessful because of inadequate jack pine regeneration. This practice may best be employed in cooler, moister climates such as those in the northern reach of the Lower Peninsula, the Upper Peninsula and northern Wisconsin. Seed tree or shelterwood cuts may create breeding habitat and offer a variation from clearcutting. Generally, 15 or more mature jack pine trees per acre are left standing individually or in groups to provide a seed source. Prescribed burning and/or supplemental seeding of these areas may be desirable.

D.8.3. *General Silvicultural Considerations*

Any intermediate treatments of jack pine, including overstory removal, girdling, or thinning, should be accomplished in those years when stands are not occupied by Kirtland's Warblers.

Pre-commercial thinning or release of jack pine should not occur in areas managed for Kirtland's Warbler until vegetation exceeds the size criterion for Kirtland's Warbler breeding, unless such activity maintains or enhances Kirtland's Warbler habitat.

When possible, red pine plantations that are identified for Kirtland's Warbler habitat development should first be managed to commercial rotation to realize the full economic benefits of red pine management.

In the Upper Peninsula and Wisconsin, some red pine plantations have dense volunteer jack pine reproduction and are occupied by the Kirtland's Warbler. Timber stand improvement treatments in red pine plantations that are located in or near Kirtland's Warbler habitat and that remove jack pine, or reduce the stem density, may have an adverse impact on Kirtland's Warbler breeding habitat, and therefore should be discussed by an interdisciplinary team. Mitigations should include timing of treatments and how treatments could improve Kirtland's Warbler breeding habitat.

D.8.4. *Providing for Habitat Structure and Diversity*

Managers should consider harvest and regeneration techniques that provide structural diversity similar to what would be found following a wildfire. This structure provides perches, forage substrate, and cover for the Kirtland's Warbler and other animals, plants, and microorganisms that have evolved in the jack pine ecosystem.

Where possible, all dead trees should be retained in timber sale areas. An objective of 15-25 dead trees per acre is desirable. Where fewer than 10 standing dead trees per acre are present, live trees greater than six inches dbh may be retained as future snags. These trees may be retained as widely scattered individuals, or may be best left in clumps or stringers (long, narrow strips of unburned trees arranged parallel to the direction of fire spread) to avoid creating an overstory that would degrade Kirtland's Warbler breeding habitat.

Snags, stringers, leave areas, leave trees, down wood, and openings should be incorporated into Kirtland's Warbler areas to enhance habitat for associated species and increase biological diversity. These features should not significantly detract from the original intent of developing occupiable breeding habitat.

Aspen stands, aspen clones and other small hardwood inclusions within treatment blocks should usually be harvested and allowed to naturally regenerate. These stands and inclusions help to increase the size of the treatment blocks and mimic the effects of wildfire. However, if these areas are fully regenerate to hardwood, they should not be planted to jack pine. Managers may retain mature hardwood inclusions for silvicultural reasons, aesthetic or other wildlife values.

Red and white pines, common jack pine associates, are good candidates for retention because they are usually wind-firm and long-lived. Over mature jack pine trees are generally under-represented in the jack pine cover type because they typically have a much shorter lifespan than red pine. These trees will produce snags more quickly and typically remain standing for fewer than 20 years following mortality. These live trees also can be used to maintain breeding openings (beneath the crown) during reforestation.

D.8.5. *Management Considerations for Other Animal and Plant Species*

Managers can improve habitat for other species of wildlife when planning Kirtland's Warbler breeding habitat.

Strategic placement of Kirtland's Warbler treatment blocks can improve habitat for Sharp-tailed grouse (*Tympanuchus phasianellus*). Sharp-tailed grouse are area sensitive and respond positively to timber harvest, wildfire, and habitat improvements that mimic wildfire. On dry pine plains in the Upper Peninsula, sharp-tailed grouse are found foraging and breeding in barren and savanna openings, as well as in the slash and jack pine seedlings following clearcutting. Sharp-tailed grouse habitat can be improved by strategically placing large jack pine clearcuts adjacent to barrens and savannas. Clearcuts and wildfires provide temporary early successional habitat that moves across the landscape over time as new areas are burned, harvested, and reforested. Managed barrens and red pine savannas, maintained with prescribed fire, provide a stable core of early successional habitat. Ideally, core barrens habitat should be surrounded by many age classes of jack pine in constant flux, resulting in a dynamic, large, and coordinated system of early successional habitat in various stages of succession.

The large habitat patch size of Kirtland's Warbler treatment block and landscape heterogeneity found within them benefit the sharp-tailed grouse (*Tympanuchus phasianellus*), upland sandpiper (*Bartramia longicauda*), black-backed woodpecker (*Picoides arcticus*) and spruce grouse (*Falcipennis canadensis)*.

Intact wildfire areas are valuable habitat for many species of wildlife. For example, the black-backed woodpecker, the rarest of the regularly breeding woodpeckers in Michigan, is restricted to conifer-dominated forests. The black-backed woodpecker is a burnt-forest specialist, nesting in the dead trees and feeding on beetles that infest dead trees shortly after forest fires. During periods between large fires, a low-level population survives in mature coniferous forests. Managers should consider maintaining large tracts of recently killed dead trees for this species. Near black-backed woodpecker breeding sites, small patches of mature forest may be retained in clearcuts for habitat diversity.

Young, regenerating stands of jack pine can provide excellent habitat for snowshoe hares (*Lepus americanus*) and eastern cottontails (*Sylvilagus floridanus*), particularly if snags, down wood and slash piles are retained after harvest. Managers should consider the benefits of incorporating woody debris into Kirtland's Warbler breeding habitat.

In landscapes lacking significant lowland conifers, mature jack pine stands may serve as important sources of winter cover for wildlife species, including white-tailed deer (*Odocoileus virginianus*). Managers should identify such landscapes and consider management impacts on total available cover.

Sites with a dominant low bush blueberry ground layer can be important feeding locations for black bears (*Ursus americanus*) and other soft mast foragers in good berry years. In certain parts of the state, blueberry has been successfully promoted on sites through the use of prescribed fire.

Several plants and animals of special concern occur in historic barrens or dry sand prairies within areas managed for the Kirtland's Warbler. Managers should provide

habitat for these and other species by retaining small and large openings within planted areas. Maintenance or enhancement of some of these components may require burning or other active management efforts, whereas a more passive approach may be needed in different situations. Managers should continue to cooperate and communicate with individuals who may be participating in natural features inventories so that species of special concern can be identified and proper management applied.

D.8.6. *Non-native Invasive Species*

To help prevent the spread of non-native invasive plants (NNIP), consider cleaning logging equipment to remove dirt and vegetation prior to unloading, leaving main roads, or moving to a new harvest unit. Consider inspecting the equipment for contractors and others for dirt and vegetation prior to operations.

D.9. Reforestation

A treatment block or burn area is considered potential Kirtland's Warbler breeding habitat when it has a seedling density of approximately 1,452 (5x6 spacing) or more trees per acre over approximately 75 percent of the treatment block, excluding openings.

This prescription is the standard that has been successful at producing Kirtland's Warbler breeding habitat for more than 30 years. Additional research is needed to determine if other seedling densities or configurations would be acceptable. As stated above, managers are encouraged to use adaptive management to test new techniques for developing breeding habitat on a limited portion (up to 25%) of lands managed for the Kirtland's Warbler.

D.9.1. *Site Preparation*

Site preparation can be accomplished by trenching, Bracke mounding, prescribed burning, roller chopping, chain scarification, and disking.

The use of prescribed burning as a method of site preparation mimics wildfire and provides ecological benefits that are not realized with mechanical methods. Although prescribed burning logging slash may not produce regeneration across the stand, it can be an effective form of site preparation for supplemental seeding or planting. However, waiting for the appropriate burning conditions can delay reforestation, and confound the reforestation schedule and Kirtland's Warbler breeding habitat objectives.

D.9.2. *Planting*

Harvested areas are planted or naturally regenerated to a stocking density of 1,452 or more trees per acre (1,089 actual trees per acre) over approximately 75 percent of the treatment block, excluding openings. Generally, the spacing of planted jack pine trees will be 5 feet within rows and 6 feet between rows. Because openings are included, approximately 1,089 trees are needed for each acre reforested.

Small openings (approximately 0.1 to 0.25 acres in size) are incorporated to provide habitat diversity, and are well distributed over approximately 25 percent of the treatment block. About one to five well-dispersed openings per acre are desirable. In the Lower Peninsula of Michigan, this configuration has been achieved with an opposing wave

planting scheme (one opening per acre). Attempts have been made to provide a greater diversity in opening size and spacing by avoiding groups of dead trees, steep terrain, rare plants or other special features. Managers may attempt other planting configurations that achieve the objective mentioned above, but create greater structural diversity (i.e., more numerous openings).

The use of 2-0 (2-year old) bare root stock with machine planting has produced the most consistent regeneration success, but this method is relatively expensive. Hand planting has some advantages (faster planting, a wider window of planting opportunity) and is becoming the most common form of planting.

D.9.3. *Seeding*

In the Lower Peninsula, broadcast seeding has had limited success, especially on dry, sandy sites typically found in Kirtland's Warbler habitat. Other attempts to seed an area using different combinations of a trencher and a seeder apparatus pulled by a large skidder are more promising. A trench or furrow is cut and seed is deposited directly into the furrow. Seed can be sown through soft snow, and one type of machine can vary the seeding rate. This method is relatively cost effective and has some benefits over other replanting schemes. If a site has less than the prescribed stocking density, it is practical to hand plant additional seedlings into existing furrows. This type of seeding is more likely to succeed on moister jack pine sites.

In the Upper Peninsula, broadcast seeding with a snowmobile or aircraft in late winter after timely chop and chain scarification has been successful. Scarification to bare mineral soil on at least 60% of the site produces the most consistent regeneration for direct seeding.

D.9.4. *Natural Regeneration*

In the Lower Peninsula, natural regeneration after a timber harvest depends on the type of harvest, the time of year the area is harvested, and skidding methods. These naturally regenerated areas are typically structurally more diverse than plantations (more and multi-sized openings), and no ground disturbance is necessary. When possible, managers should plan harvests to increase the probability of natural regeneration.

Managers should survey harvested stands for naturally regenerating jack pine. Even small areas of natural regeneration that is stocked sufficiently to develop into Kirtland's Warbler breeding habitat can significantly reduce reforestation costs. Often, clearcuts are planted or surveyed for planting one to two years post-harvest and sufficient time is not allowed for natural regeneration to become fully established.

In the Upper Peninsula, natural regeneration is less expensive than planting and has been shown to be successful in creating dense stands of jack pine, even on well-drained soils. Natural regeneration works best if the soil is scarified to bare mineral soil on at least 60% of the site before the jack pine cones open (generally in July following harvest), so that seeds falling off the logging slash germinate on mineral soil. If seeds fall and germinate on unsuitable ground (i.e., in an unscarified grass mat), they will not survive. In some

cases, seeding or planting jack pine may be prescribed if jack pine budworm has reduced the number of cones on the mature jack pine, or if natural regeneration has failed. One option is to prepare a site for natural regeneration, then wait one to three years and use stocking survey information to determine if fill-in planting is needed.

Due to the Kirtland's Warbler's nesting preference near small grass openings, up to ¼ acre of opening for each acre of breeding habitat should be incorporated into natural regeneration areas. Because of the current low breeding density of Kirtland's Warblers on the Hiawatha NF, managers currently strive for a range of ¼ acre of opening per 1 to 5 acres of young jack pine. Therefore, it is not necessary to prepare the entire acre for regeneration since the objective is to reforest just ¾ of the acre. A 60-foot radius around a flag or leave tree, which is a large-diameter red or white pine, on each acre will provide the ¼-acre opening per acre required. The presence of leave trees also helps to maintain the opening by discouraging regeneration. Natural regeneration results in a more variable mosaic of dense and sparse areas of jack pine stocking compared to plantations, and in some cases breeding openings have been provided by the inherent variability of natural regeneration. Managers should consider these openings before reforestation efforts begin to avoid the extra effort and cost of unnecessary site preparation or creating openings later.

D.9.5. *Stocking Surveys*

Follow-up checks for survival of planting stock or success of seeding establishment are very important to evaluate management goals and options. These should be accomplished in the first and third years after regeneration attempts to evaluate sites for adequate stocking densities.

D.10. Prescribed Burning

Since fire is a key disturbance factor in the jack pine ecosystem, prescribed burning of standing jack pine or jack pine seed trees may be an appropriate tool for developing breeding habitat.

Historically, burning jack pine slash after harvest has not provided breeding habitat because the cones and seed are usually consumed or killed by the sustained heat in the slash.

Prescribed burning barrens, red pine seed trees and other non-Kirtland's Warbler habitat, within and adjacent to Kirtland's Warbler breeding habitat, will increase the overall quality of the jack pine ecosystem, and may provide breeding habitat or other benefits for the Kirtland's Warbler.

In combination with even-aged timber management, managers may use prescribed fire as an integrated approach to jack pine ecosystem management. Prescribed fire may be used as a tool to restore and maintain high quality habitat and simulate historical conditions. The application of fire should be designed to establish a mosaic of jack pine thickets, grasses, shrubs, snags, and blueberries over large areas.

D.11. Management of Private Lands

The agencies will work with private landowners whose property supports occupied or developing Kirtland's Warbler breeding habitat to provide protection for the species and its habitat.

The agencies will work with individuals to encourage management of early successional jack pine or barrens on private lands. The MDNR has successfully operated a private lands program over the past 20 years. The program conserves, protects, and enhances habitat for Kirtland's Warbler on private lands and uses grant monies to provide financial and technical assistance to private landowners across Michigan. Large property owners within or adjacent to state or federal Kirtland's Warbler management areas are targeted for financial assistance. The program focuses on harvesting and planting jack pine to provide Kirtland's Warbler breeding habitat or restoring the areas to barrens for Kirtland's Warblers and other rare species.

D.12. Management of Military Lands

A Cooperative Agreement between the Michigan Departments of Military Affairs (DMA) and MDNR dated 22 May, 1986, addresses potential Warbler habitat on Camp Grayling's Range 30. Lands in the North Down River Kirtland's Warbler Management Area, which are under long-term lease to the DMA from the MDNR, were designated for habitat management under the 1986 Cooperative Agreement. The agreement also provided for protection of other areas of occupied or potential Warbler habitat on Range 30. This agreement continues to be maintained and may be revisited in the future at the request of DMA or MDNR.

D.13. Land Acquisition and Exchange

Since 1981, the agencies have pursued acquisition of private inholdings identified in the 1981 Habitat Management Plan and the 2001 Strategy. Although approximately 7,500 acres have been acquired, a number of parcels that could be managed for Kirtland's Warbler breeding habitat remain privately owned. The agencies will continue to work with landowners to acquire these parcels as they become available.

D.14. Consolidation of FWS Kirtland's Warbler Wildlife Management Area Lands

The Kirtland's Warbler WMA managed by FWS consists of 125 separate tracts of land located in eight counties of Michigan's northern Lower Peninsula. Their sizes range from two to 600 acres, and most tracts are located within larger tracts of land owned by the state of Michigan. Currently, management is accomplished through a cooperative agreement between USFWS and the MDNR. Under this agreement, USFWS retains ownership and oversight functions on Kirtland's Warbler WMA lands, while the MDNR determines when timber on a given parcel should be cut and regenerated. The USFWS is responsible for the timber harvest and the MDNR contracts for replanting services.

Consolidation of Kirtland's Warbler WMA lands is being considered to increase management efficiency. Currently the travel distances between Seney National Wildlife Refuge and WMA lands limits administrative oversight and management effectiveness. Due to their small size, WMA lands cannot be managed independent of the surrounding

landscape. Therefore, a high degree of coordination with the MDNR is required to accomplish any meaningful management.

The concept of land consolidation is supported by all agencies involved in Kirtland's Warbler management. In general, the USFWS, the MDNR, and the USFS would seek lands to exchange amongst the agencies to consolidate ownership and increase the land base managed for Kirtland's Warbler habitat. Public input on any exchange proposal would be sought in compliance with the National Environmental Policy Act.

Land Consolidation Guidelines. In general, lands to be consolidated:

1. must be manageable for Kirtland's Warbler (i.e., sites of sufficient size with jack pine as a major constituent of seral stages);
2. must improve management efficiency for all agencies involved;
3. should contain no substantial buildings or improvements; and
4. should not contain hazardous materials or environmental contaminants.

D.15. Protection of the Kirtland's Warbler and Its Habitat

The agencies are committed to protecting Kirtland's Warblers and the long-term integrity of their breeding habitat. This section of the plan provides direction to reduce human and environmental factors that may adversely affect Kirtland's Warblers and their breeding habitat.

D.15.1. *Habitat Closures*

In the Lower Peninsula of Michigan, occupied habitat will be closed to the public and domestic animals during the breeding season from May 1 through August 15. However, areas that have few Kirtland's Warblers or little potential for adverse effects may remain open at the discretion of agency biologists. Closure areas will be posted along roads at one tenth-mile intervals.

In the Upper Peninsula of Michigan and in Wisconsin, occupied habitat will generally remain open, but may be closed by the agency authority at the recommendation of agency biologists. For the MDNR, this decision will be made in consultation with the lead land manager.

D.15.2. *Bird Watching*

People who wish to observe the Kirtland's Warbler in its breeding habitat will be encouraged to participate in the agency guided tours.

Those who desire to bird on their own will be encourage to view Kirtland's Warblers from open roads at locations predetermined by the agencies. In these instances, the agencies should provide these individuals with a detailed map that includes information specific to that area such as closure restrictions and birding etiquette:

- Do not enter closed habitat areas.
- Keep pets out of closed habitat areas.
- Do not use song playback to attract birds.
- Be careful with fire.

D.15.3. *Recreational Trails and Associated Developments*

Recreational trails, parking lots and campgrounds will generally not be constructed in areas managed for the Kirtland's Warbler.

Snowmobile trails are permitted in areas managed for the Kirtland's Warbler, but they should be gated during the closure period if the habitat is occupied by the Kirtland's Warbler. Snowmobile parking lots should not be constructed in areas managed for the Kirtland's Warbler.

Where possible, new trails will be constructed outside of areas managed for the Kirtland's Warbler (See changes in C.1.3).

D.15.4. *Special Events*

Special events such as off-road vehicle events, equestrian trail rides, and military training exercises will generally be discouraged in areas managed for the Kirtland's Warbler.

D.15.5. *Wind Turbines, Towers and Other Developments*

Wind turbines, communication towers, powerlines, pipelines, new roads, and other structures will generally not be constructed within or adjacent (¼ mile) to areas managed for the Kirtland's Warbler (See changes in C.1.3).

D.15.6. *Right-of-way Maintenance*

Maintenance activities on road and utility rights-of-way must be performed for the safety and welfare of the public. Maintenance activities within or adjacent to occupied habitat will not be conducted between May 1 and August 15. Agencies will work with county road commissions, MDOT and other entities to:

- Minimize the loss of potential and existing breeding habitat.
- Avoid working within or adjacent to occupied habitat during the breeding season.

D.15.7. *Mineral Development*

State of Michigan

For all areas managed as essential habitat for Kirtland's Warbler, or areas located within 300 feet of essential habitat where the State of Michigan owns the mineral rights, leasing of these rights for oil and gas shall be for non-development only. Extraction of all other minerals, including sand and gravel, shall not be allowed in areas managed for the Kirtland's Warbler.

Huron-Manistee National Forests

On the Huron-Manistee National Forest, limited oil and gas development may be allowed on areas managed for the Kirtland's Warbler for which the mineral rights are owned by the Federal Government, but with major restrictions on activities within occupied habitat. Use of common variety mineral deposits will only be for use within the Management Area 4.2KW (Kirtland's Warbler Management Area). For more details, see the Huron-Manistee National Forest Land and Resource Management Plan (2006).

Hiawatha National Forest

On the Hiawatha National Forest, surface occupancy for mineral extraction will not be allowed on lands with federal mineral ownership and these resources or uses:

- Sensitive wildlife nesting/mating areas.
- Threatened and endangered wildlife and plant habitats.

Ottawa National Forest / Chequamegon-Nicolet National Forests

On the Ottawa and Chequamegon-Nicolet National Forests, all requests for mineral exploration and development would be processed according to USFS and Bureau of Land Management policies. Generally, this includes a NEPA process, public involvement, and issuance of permits.

US Fish and Wildlife Service

Barring situations where reserved rights or legal mandates allow certain uses, all requests for mineral development on the Kirtland's Warbler Wildlife Management Area will be handled according to policy. Upon receipt of a request for a proposed use of refuge land, the use must first be determined to be appropriate under the appropriate use policy. If the use, such as mineral development, is found to be appropriate, it must then go through a compatibility determination as found in the *National Wildlife Refuge Administration Act of 1966* as amended by the *National Wildlife Refuge system Improvement Act of 1997* (16 U.S.C. 668dd-668ee). Although a refuge use may be found both appropriate and compatible, the refuge manager retains the authority to not allow the use or to modify the use.

D.16. Land Management Considerations

D.16.1. *Wildfire Suppression*

Fire is an integral and important factor in the jack pine ecosystem. Nevertheless, fire can also be a threat to occupied or developing Warbler habitat and to the lives, homes, and property of local residents.

Therefore, wildfires that occur in developing or occupiable breeding habitat will be suppressed to minimize loss of habitat and investment. When the age of the jack pine is from one to 21 years, managers should consider areas managed for the Kirtland's Warbler as very high priority for prevention and suppression of fire.

The incident commander directs fire suppression tactics. The incident commander should consider the beneficial and adverse effects of direct and indirect attack on the Kirtland's Warbler and its breeding habitat. For example, backfiring off a road may have a beneficial effect because the action may create future breeding habitat if the jack pine being burned is older and no longer occupied. If the area considered for backfiring is developing or occupied habitat, the effects on the Kirtland's Warbler would be detrimental.

D.16.2. *Fuelbreaks*

An integrated approach to management of the jack pine ecosystem incorporates benefits of Kirtland's Warbler management for wildfire control or fuelbreaks. Kirtland's Warbler habitat management provides rotating, temporary fuelbreaks as mature and overmature jack pine is harvested and replaced by open ground and seedlings. Jack pine stands become increasingly flammable with age and wildfire control becomes more complex due to increased fire intensity and flame length. In combination with managed barrens, strategic landscape planning of treatment blocks can significantly reduce the impact of potential wildfires or produce favorable conditions for the use of prescribed fire.

When fuelbreaks are constructed for protection of life and property, they should be constructed to standards that properly protect the values at risk without compromising public safety. Likewise, Kirtland's Warbler breeding habitat should not be developed within 300 feet of structures because of the fire hazard and risk to emergency responders, citizens and private property.

Fuelbreaks may be constructed within areas managed for Kirtland's Warbler breeding habitat to assist in regenerating jack pine using prescribed fire. Fuelbreaks may also be constructed to help prevent wildfires from consuming large tracts of occupied or recently regenerated habitat as has occurred in the past.

Fuelbreak construction or maintenance activities within or near occupied breeding habitat will be accomplished outside of the Kirtland's Warbler breeding season (May 1 to August 15).

Permanent fuelbreaks are typically managed in a way that will not provide breeding habitat for the Kirtland's Warbler and therefore should be removed from the inventory of lands identified for Kirtland's Warbler habitat management. Managers should consider replacing these areas to avoid a cumulative loss of habitat acres over time.

D.16.3. *Insect and Disease Control*

Kirtland's Warbler habitat can be affected by outbreaks of certain insects or diseases, especially some of foreign origin. In general, large-scale control of native insects and diseases will be avoided, since these organisms are an integral part of the jack pine ecosystem.

Outbreaks of certain non-native insects or diseases could present a more serious dilemma. Measures used to control non-native insects or diseases should avoid direct or indirect negative effects on Kirtland's Warblers.

D.16.4. *Timber Harvest and Reforestation Activities Adjacent to Occupied Habitat*

Timber harvest activities adjacent to occupied habitat should be avoided during the Kirtland's Warbler breeding season (May 1 to August 15). Where possible, harvest activities should be at least ¼ mile away from occupied habitat. Timber hauling should be routed away from occupied habitat where practical to reduce the potential for adverse impacts to breeding Warblers.

Reforestation activities adjacent to occupiable habitat should be completed prior to May 20. If planting cannot be completed before May 20, reforestation operations should be designed so those portions of the planting area immediately adjacent to occupiable habitat are planted first. Planting should then move away from the occupied habitat.

D.16.5. *Prescribed Burning Adjacent to Occupied Habitat*

Managers may consider prescribed burning within or adjacent to occupied Kirtland's Warbler habitat. While the species is listed as federally endangered, managers should consult with the US Fish and Wildlife Service when proposing such actions.

D.16.6. *Non-native Invasive Species*

Non-native invasive species (NNIS) can severely alter the natural habitats that they infest. To maintain the integrity of the jack pine ecosystem over the long term, managers must proactively address existing occurrences and prevent new NNIS from becoming established. The most common infestations are non-native invasive plants (NNIP) like spotted knapweed. However, animal species may become just as problematic in time (e.g., sirex wood wasp (*Sirex noctilio*), feral swine, etc.).

Activities that promote the spread of NNIS should be avoided. Managers are encouraged to treat NNIP infestation to reduce or eliminate NNIP and to prevent further spread. However, treatment should occur in areas and at times that will have no impacts on Kirtland's Warblers.

When restoring sites within areas managed for the Kirtland's Warbler (e.g., road closures), managers should seed or plant native grasses and forbs rather than non-native plants.

D.16.7. *Kirtland's Warblers on Private Lands*

Private lands may provide breeding habitat for Kirtland's Warblers as a result of wildfire or land management activities. Agency personnel will contact private landowners for permission to enter their property to conduct a census of Kirtland's Warblers. Private landowners interested in managing habitat for Kirtland's Warblers will be forwarded to the MDNR's Landowner Incentive Program or the USFWS's Partners for Fish and Wildlife Program. In addition, private landowners will be encouraged to protect Kirtland's Warblers and their breeding habitat.

E. Cowbird Management for the Conservation of the Kirtland's Warbler

The purpose of this section is to provide an overview of the cowbird management program. This section provides supplemental information for cowbird-related actions included in Section C (Management Goal, Objectives, and Actions), and it fits within the context of the historic and current information on the species and its management that is provided in Section B (Background). Separate guidance for habitat management is provided in Section D.

E.1. Cowbird Management in the Northern Lower Peninsula of Michigan

Since 1972, the USFWS has implemented a targeted cowbird management program within Michigan's Northern Lower Peninsula in cooperation with the MDNR and USFS. During that time, USFWS has significantly reduced nest parasitism by trapping and removing cowbirds from known Kirtland's Warbler nesting areas. Between 1972 and 1981, nest parasitism rates dropped below 10% and Kirtland's Warbler fledging rates averaged more than 2.7 young per nest (Kelly and DeCapita 1982). Since the 1972 – 1981 study, intensive nest monitoring to evaluate the cowbird management program has not occurred. With the Kirtland's Warbler population reaching a record of 2,090 singing males in 2012, it is assumed the management program continues to support high Kirtland's Warbler fledging rates. Additionally, anecdotal evidence from research and monitoring in the 1980s, 2000s, and 2010s indicates that the management program has remained highly effective with very few observations of cowbird eggs in Kirtland's Warbler nests. By all accounts, the management program has been extremely effective and remains one of the more intensive actions associated with Kirtland's Warbler management.

E.1.1. *Cowbird Trap Placement and Design*

To reduce Brown-headed Cowbird parasitism of Kirtland's Warbler nests, cowbird traps are placed within occupied Kirtland's Warbler breeding habitat in the northern Lower Peninsula of Michigan. Occupied habitat is suitably aged jack pine that is used by one or more singing males. The majority of Kirtland's Warblers nest in jack pine stands managed by USFS, MDNR, and USFWS, and therefore, the majority of traps are found within designated KWMAs (Figure 5).

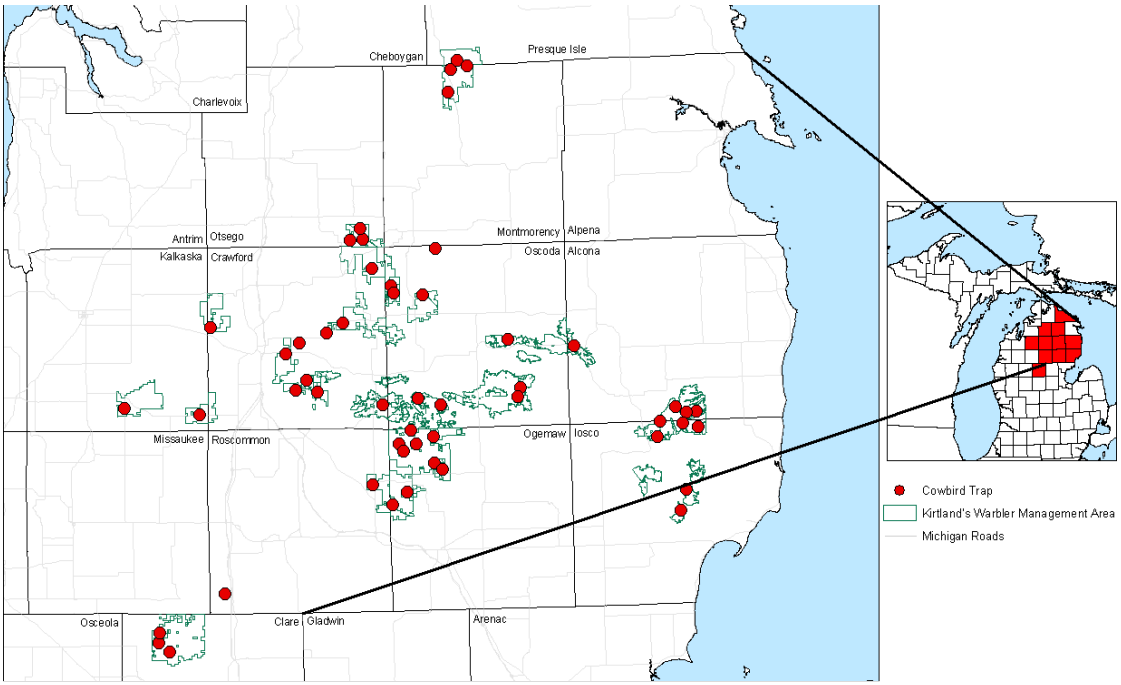

Figure 5. Brown-headed Cowbird trap distribution within Kirtland's Warbler management areas in the northern Lower Peninsula of Michigan, 2011.

The USFWS assumes that each trap prevents parasitism of Kirtland's Warbler nests within an approximately one-mile radius. Traps are constructed and left in place year-round, with each trap providing about 7-10 years of service before the adjacent habitat becomes unsuitable (trees are >16 years old). After habitat becomes unsuitable for breeding, cowbird traps are not operated in these areas and are eventually removed. Traps are operated annually for approximately 11 weeks (mid-April through end of June). In 2013, 57 traps were deployed over a 6,000-square-mile area to protect breeding habitat in the Lower Peninsula of Michigan (C. Mensing, USFWS, pers comm. 2013).

Currently, two trap designs are used to remove cowbirds from Kirtland's Warbler breeding habitat (Figures 6). Both allow trappers easy walk-in access and are designed around the same general principles. Traps are baited with live cowbird decoys, millet seed, and water. Cowbirds are attracted to the trap by the calls and songs of live decoy birds. Birds enter the trap through a recessed ceiling panel or a built-in top funnel that has a slightly larger opening. Cowbirds are small enough to drop through this panel with their wings closed. Once inside, the birds would have to fly up through the ceiling panel to leave the trap. With their wings open in flight, the cowbird can't fit through the openings in the panel and therefore cannot escape. Trapped cowbirds are humanely euthanized and non-target species are released. The cowbird management program is operated under both a depredation permit and a migratory bird scientific collecting permit issued by the USFWS' Regional Migratory Bird Permit Office in Minnesota.

Figure 6. Modified Australian crow traps used in the cowbird management program for the Kirtland's warbler. Top photo shows the funnel trap design; bottom photo shows the flat ceiling panel design.

E.2. Cowbird Management outside the Northern Lower Peninsula of Michigan

Trapping is currently conducted in only one location outside of the northern Lower Peninsula of Michigan. After documenting significant cowbird parasitism at the Adams County, Wisconsin nesting site, cowbird management activities were initiated in 2008 and have occurred every year since. Three funnel-style traps (Figure 7) were placed on Plum Creek Timber, LLC, property deployed and were operated similar to trap in the northern Lower Peninsula of Michigan (USDA Wildlife Services, 2011). The Wisconsin cowbird management program is a collaborative effort among USFWS, USDA-Wildlife Services, Wisconsin Department of Natural Resources, and Plum Creek Timber, LLC.

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.

Monitoring of Brown-headed 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.

E.3. Cowbird management program responsibilities

Since the program's inception, the USFWS's East Lansing Field Office has been responsible for all aspects of the cowbird management program. However, once the Kirtland's Warbler is removed from Endangered Species Act protection, the USFWS will no longer operate the cowbird management program. In addition, funding for the cowbird management program will no longer be available through the USFWS's endangered species program.

In the 2011 Interagency MOU, the MDNR agreed to take responsibility for the program provided funding was available. Currently, non-agency partners are actively seeking funding that could support the cowbird management program and other aspects of the Kirtland's Warbler management program. The USFWS expects that funding for cowbird management will be identified and in place prior to beginning the delisting process. To provide for a seamless transition and ensure no break in cowbird management activities, responsibility for operation of this program will shift over the next several years from the USFWS to the MDNR.

E.4. Monitoring and Research Needs

Other than modifications to the cowbird trap design and an increase in the number of traps, the cowbird management program has remained relatively unchanged since the early 1970s. Unfortunately, detailed nest success data have not been available to help inform managers about opportunities to modify the cowbird management program. Continuation of the program "as is" at a time when Kirtland's Warblers are at record levels and funding is limited is being challenged by program participants and agency partners. Potential changes that have been suggested include a reduction in scale or scope, or even eventual elimination of the cowbird management program.

Understanding how these changes 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.

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Appendix A. 2011 Memorandum of Understanding

USDA, Forest Service | OMB 0596-0217 FS-1500-15

FS Agreement No. 11-MU-11090100-008
Cooperator Agreement No. _____
Cooperator Agreement No. _____

MEMORANDUM OF UNDERSTANDING
Among The
USDI, FISH AND WILDLIFE SERVICE,
The
MICHIGAN DEPARTMENT OF NATURAL RESOURCES,
And The
USDA, FOREST SERVICE, EASTERN REGION
(LAKE STATES FORESTS IN MICHIGAN AND WISCONSIN)

This MEMORANDUM OF UNDERSTANDING (MOU) is hereby made and entered into by and between the USDI, Fish and Wildlife Service, hereinafter referred to as "U.S. Fish and Wildlife Service," the Michigan Department of Natural Resources, hereinafter referred to as "Michigan DNR," and the USDA, Forest Service, Eastern Region (Lake States Forests in Michigan and Wisconsin), hereinafter referred to as the "U.S. Forest Service." The U.S. Forest Service, U.S. Fish and Wildlife Service, and Michigan DNR are hereinafter referred to collectively as "the parties."

Background: The management of the endangered Kirtland's warbler and the jack pine system on which it depends has been hailed a conservation success story. Collaboration among the parties and conservation organizations has been a hallmark of this management and success. 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. These coordinated management actions were successful; the population has increased from a low of 167 breeding pairs in 1987 to 1,747 breeding pairs in 2010.

With the population above 1,000 breeding pairs, the parties have begun discussing the eventual removal of this species from the federal list of threatened and endangered species. Delisting is the ultimate measure of success in showing that species are recovered. To consider delisting the Kirtland's warbler two criteria must be met: 1) the population must be at or above 1,000 breeding pairs for five years, and 2) mechanisms must be in place to ensure future management will sustain the population at or above 1,000 breeding pairs. Although the population has remained above 1,000 breeding pairs for well over five years, mechanisms to support future management and monitoring actions are not currently in place. Without assurances that habitat management, brown-headed cowbird control, monitoring, education, and research will continue, removal of the Kirtland's warbler from the list of threatened and endangered species is not possible.

Habitat management, brown-headed cowbird control, monitoring, education and research will be needed perpetually to maintain the Kirtland's warbler population. These actions have significant staff time and monetary costs associated with them. Funding these activities will continue to be

a challenge for the parties regardless of the species' Endangered Species Act (ESA) protected status. The parties can make commitments to management and future collaboration only as appropriated funds are available. Some ESA-specific funding, which is currently used to conduct the brown-headed cowbird control program, will not be available after delisting. To help address these funding challenges, non-profit groups are currently working with private sector interests to develop a Kirtland's warbler trust fund. This trust fund is anticipated to provide primary funding for the brown-headed cowbird control program and supplemental funding for Kirtland's warbler habitat management, monitoring, education, and research. This MOU represents the commitment of the parties to continue this program, but the parties stress that additional funds will be necessary to meet these commitments.

This MOU provides written assurances to continue collaborative habitat management, brown-headed cowbird control, monitoring, research, and education as it relates to Kirtland's warbler and jack pine management. These assurances represent a critical step toward delisting Kirtland's warblers, but it is not the only step. The U.S. Fish and Wildlife Service believes at least two other actions are necessary: 1) securing funding for continued brown-headed cowbird control, and 2) developing a post-delisting monitoring plan.

Title: Kirtland's Warbler Interagency MOU

I. PURPOSE:

The purpose of this MOU is to document the cooperation between the parties to continue their commitment to collaborative habitat management, brown-headed cowbird control, monitoring, research, and education to maintain a Kirtland's warbler population at or above 1,000 breeding pairs, regardless of the species' legal protection under the ESA in accordance with the following provisions. This MOU is expected to be a critical component supporting the eventual delisting of this species.

II. STATEMENT OF MUTUAL BENEFIT AND INTEREST:

The mission of the U.S. Fish and Wildlife Service 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 U.S. Fish and Wildlife Service is legally mandated to implement the provisions of the ESA and Migratory Bird Treaty Act. The East Lansing 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 Michigan DNR and other partners to provide habitat for Kirtland's warblers and other species. Finally, the U.S. Fish and Wildlife Service'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 Michigan DNR is committed to the conservation, protection, management, accessible use and enjoyment of the State's natural resources for current and future generations. The Michigan DNR is legally mandated to implement the provisions of the state endangered species legislation in Part 365 of Public Act 451 of 1994. Furthermore, the Michigan DNR 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 Michigan DNR 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 Michigan DNR 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. Michigan DNR hopes that this MOU will move us one step closer to the goal of a viable and sustainable population of Kirtland's warbler that is no longer in danger of extinction in the foreseeable future.

The mission of the U.S. Forest Service is to sustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations. As part of their Land and Resource Management Plans, the Huron-Manistee National Forest, 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.

To ensure the long term conservation of Kirtland's warbler and the jack pine system, the U.S. Forest Service, U.S. Fish and Wildlife Service, and Michigan DNR must cooperate and coordinate activities. This MOU will ensure that important and globally rare elements of the jack pine landscape, including Kirtland's warblers, will persist in a way that reduces wildfire danger, creates habitat for game and nongame species, provides timber products, and supports the local economy.

In consideration of the above premises, the parties agree as follows:

III. THE U.S. FISH AND WILDLIFE SERVICE SHALL:

A. Maintain habitat in suitable densities and age classes for Kirtland's warblers on the Kirtland's Warbler Wildlife Management Area. Because of the small size and dispersed nature of the Kirtland's Warbler Wildlife Management Area, management will occur in concert with adjacent agency or privately-owned land.
B. Develop a monitoring plan to evaluate the status of Kirtland's warbler after delisting.

IV. THE MICHIGAN DEPARTMENT OF NATURAL RESOURCES SHALL:

A. Regenerate forest habitat according to plans already adopted by the Michigan DNR, such as the 2001 Strategy for Kirtland's Warbler Habitat Management, which calls for 1,560 acres of breeding habitat to be developed each year within designated Kirtland's Warbler Management Areas on Michigan DNR lands.

B. Manage brown-headed cowbird populations on the parties' lands to reduce nest parasitism on Kirtland's warblers to sustainable levels, if appropriate funding is available. Any work on U.S. Forest Service lands will be conducted through a separate agreement (see provision VI.L.).

V. THE U.S. FOREST SERVICE SHALL:

A. Follow direction in the Huron-Manistee, Hiawatha, Ottawa and Chequamegon-Nicolet National Forest Plans to regenerate an average of 2,270 acres of breeding habitat per year and to maintain at least 22,660 acres of jack pine in the appropriate size class. The National Forests in Michigan and Wisconsin agree to the following:

i. Huron-Manistee National Forest agrees to continue to implement the Forest Plan in relation to Kirtland's warbler habitat management. The Forest Plan objective is to create approximately 1,600 acres of breeding habitat each year within designated Kirtland's Warbler Management Areas. Approximately 15,960 acres of breeding habitat will be available at any one time.

ii. Hiawatha National Forest agrees to continue to implement the Forest Plan in relation to Kirtland's warbler habitat management. The Forest Plan objective is to regenerate an average of 670 acres of Kirtland's warbler habitat per year with a goal to provide a minimum of 6,700 acres of jack pine in the appropriate size class.

iii. Ottawa National Forest agrees to continue to implement projects that benefit the Kirtland's warbler compliant with Forest Plan direction.

iv. Chequamegon-Nicolet National Forest agrees to continue to implement projects that benefit the Kirtland's warbler compliant with Forest Plan direction.

VI. IT IS MUTUALLY UNDERSTOOD AND AGREED BY AND BETWEEN THE PARTIES THAT:

A. The parties agree to collaboratively implement Kirtland's warbler management actions as outlined in their Forest Plans (Michigan DNR and U.S. Forest Service) or Comprehensive Conservation Plan (U.S. Fish and Wildlife Service). At least 38,000 acres of breeding habitat shall be available at any time across Kirtland's Warbler Management Areas. As new information becomes available, these numbers are expected to be refined. The parties agree to annually report to each other the quantity, category and location of Kirtland's warbler breeding habitat developed each year.

B. The parties agree to collaboratively develop a Kirtland's Warbler Conservation Plan that:

i. Is consistent with the commitments within this MOU;

ii. Replaces the 2001 Strategy for Kirtland's Warbler Habitat Management and, when the Kirtland's warbler is delisted, also will replace the Recovery Plan;
iii. Incorporates the best available science, provides an adaptive framework to maintain a population of at least 1,000 breeding pairs of Kirtland's warblers, and summarizes techniques used to conserve the jack pine ecosystem for Kirtland's warbler and associated species; and
iv. Is completed by April, 2013 and then periodically updated so that new scientific findings and new management techniques can be incorporated. The Michigan DNR will be the lead agency in developing and updating the Conservation Plan.

C. The parties agree to allow brown-headed cowbird traps to be placed and operated on lands they administer to maintain a Kirtland's warbler fledging rate that sustains a minimum population of 1,000 breeding pairs.

D. The parties agree to conduct an annual census to monitor the Kirtland's warbler population, or to monitor the population according to the post-delisting monitoring plan developed by the U.S. Fish and Wildlife Service. The Michigan DNR will be the lead agency in coordinating the monitoring effort.

E. The parties agree to continue annual coordination of Kirtland's warbler conservation efforts through the existing Recovery Team or, if delisted, through a Kirtland's Warbler Advisory Committee.

F. The parties agree to review and begin re-negotiating this MOU in four years so that adjustments can be agreed to prior to renewal in five years. The MOU may be updated, based on the outcome of the Conservation Plan and new information on the Kirtland's warbler or the jack pine ecosystem.

G. PRINCIPAL CONTACTS. Individuals listed below are authorized to act in their respective areas for matters related to this instrument.

Principal U.S. Fish and Wildlife Contacts:

U.S. Fish and Wildlife Program Contact	U.S. Fish and Wildlife Administrative Contact
Name: Scott Hicks Address: 2651 Coolidge Rd., Suite 101 City, State, Zip: East Lansing, MI 48823 Telephone: (517) 351-2555 FAX: (517) 351-1443 Email: scott_hicks@fws.gov	Name: Janet Brewer Address: 2651 Coolidge Rd., Suite 101 City, State, Zip: East Lansing, MI 48823 Telephone: (517) 351-6221 FAX: (517) 351-1443 Email: janet_brewer@fws.gov

Principal Michigan DNR Contacts:

Michigan DNR Program Contact	Michigan DNR Administrative Contact
Name: Doug Reeves Address: P.O. Box 30444 City, State, Zip: Lansing, MI 48909 Telephone: 517-373-9311 FAX: 517-373-6705 Email: reevesd@michigan.gov	Name: Cara Boucher Address: P.O. Box 30444 City, State, Zip: Lansing, MI 48909 Telephone: 517-335-7009 FAX: 517-373-6705 Email: boucherc@michigan.gov

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U.S. Forest Service Program Manager Contact	U.S. Forest Service Administrative Contact
Name: Becky Ewing, Regional Wildlife Biologist Address: 626 E. Wisconsin Ave. City, State, Zip: Milwaukee, WI 53202 Telephone: (414) 297-3612 FAX: (414) 944-3963 Email: rewing@fs.fed.us	Name: Mike Rogers Address: 401 Fairgrounds Road City, State, Zip: Rolla, MO 65401 Telephone: (573) 341-7477 FAX: (573) 426-6814 Email: mkrogers@fs.fed.us

H. NON-LIABILITY. The U.S. Forest Service does not assume liability for any third party claims for damages arising out of this instrument.

I. NOTICES. Any communications affecting the operations covered by this agreement given by the U.S. Fish and Wildlife Service, Michigan DNR, or U.S. Forest Service is sufficient only if in writing and delivered in person, mailed, or transmitted electronically by email or fax, as follows:

To U.S. Fish and Wildlife Service, as U.S. Fish and Wildlife Service's address shown in MOU or such other address designated within the MOU.

To Michigan DNR's address shown in the MOU or such other address designated within the MOU.

To the U.S. Forest Service Program Manager, at the address specified in the MOU.

Notices are effective when delivered in accordance with this provision, or on the effective date of the notice, whichever is later.

J. PARTICIPATION IN SIMILAR ACTIVITIES. This MOU in no way restricts the U.S. Fish and Wildlife Service, Michigan DNR, or U.S. Forest Service from participating in similar activities with other public or private agencies, organizations, and individuals.

K. ENDORSEMENT. Any of U.S. Fish and Wildlife Service's or Michigan DNR's contributions made under this MOU do not by direct reference or implication convey U.S. Forest Service endorsement of U.S. Fish and Wildlife Service's or Michigan DNR's products or activities.

L. NONBINDING AGREEMENT. This MOU creates no right, benefit, or trust responsibility, substantive or procedural, enforceable at law or equity. The parties shall manage their respective resources and activities in a separate, coordinated and mutually beneficial manner to meet the purpose(s) of this MOU. Nothing in this MOU authorizes any of the parties to obligate or transfer anything of value.

Specific, prospective projects or activities that involve the transfer of funds, services, property, and/or anything of value to a party requires the execution of separate instruments and are contingent upon numerous factors, including, as applicable, but not limited to: agency availability of appropriated funds and other resources; cooperator availability of funds and other resources; agency and cooperator administrative and legal requirements (including agency authorization by statute); etc. This MOU neither provides, nor meets these criteria. If the parties elect to enter into an obligation instrument that involves the transfer of funds, services, property, and/or anything of value to a party, then the applicable criteria must be met. Additionally, under a prospective instrument, each party operates under its own laws, regulations, and/or policies, and any U.S. Fish and Wildlife Service, Michigan DNR, or U.S. Forest Service obligation is subject to the availability of appropriated funds and other resources. The negotiation, execution, and administration of these prospective instruments must comply with all applicable law.

Nothing in this MOU is intended to alter, limit, or expand the agencies' statutory and regulatory authority.

M. USE OF U.S. FOREST SERVICE INSIGNIA. In order for the U.S. Fish and Wildlife Service or Michigan DNR to use the U.S. Forest Service insignia on any published material, such as a Web page, printed publication, or audiovisual production, permission must be granted from the U.S. Forest Services' Office of Communications. A written request must be submitted and approval granted in writing by the Office of Communications (Washington Office) prior to use of the insignia.

N. MEMBERS OF U.S. CONGRESS. Pursuant to 41 U.S.C. 22, no U.S. member of, or U.S. delegate to, Congress shall be admitted to any share or part of this instrument, or benefits that may arise therefrom, either directly or indirectly.

O. FREEDOM OF INFORMATION ACT (FOIA). Public access to MOU or agreement records must not be limited, except when such records must be kept confidential and would have been exempted from disclosure pursuant to Freedom of Information regulations (5 U.S.C. 552).

P. PUBLIC NOTICES. It is the U.S. Forest Service's policy to inform the public as fully as possible of its programs and activities. U.S. Fish and Wildlife Service and Michigan DNR are encouraged to give public notice of the receipt of this instrument and, from time to time, to announce progress and accomplishments. Press releases or other public notices should include a statement substantially as follows:

> "Region 9 of the U.S. Forest Service, Department of Agriculture, Kirtland's warbler program."

U.S. Fish and Wildlife Service or Michigan DNR may call on the U.S. Forest Service's Office of Communication for advice regarding public notices. U.S. Fish and Wildlife Service and Michigan DNR are requested to provide copies or notices or announcements to the U.S. Forest Service Program Manager and to the U.S. Forest Service's Office of Communications as far in advance of release as possible.

Q. U.S. FOREST SERVICE ACKNOWLEDGED IN PUBLICATIONS, AUDIOVISUALS AND ELECTRONIC MEDIA. U.S. Fish and Wildlife Service and Michigan DNR shall acknowledge U.S. Forest Service support in any publications, audiovisuals, and electronic media developed as a result of this MOU.

R. NONDISCRIMINIATION STATEMENT – PRINTED, ELECTRONIC, OR AUDIOVISUAL MATERIAL. U.S. Fish and Wildlife Service and Michigan DNR shall include the following statement, in full, in any printed, audiovisual material, or electronic media for public distribution developed or printed with any Federal funding.

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S. TERMINATION. Any of the parties, in writing, may terminate this MOU in whole, or in part, at any time before the date of expiration.

T. DEBARMENT AND SUSPENSION. U.S. Fish and Wildlife Service and Michigan DNR shall immediately inform the U.S. Forest Service if they or any of their principals are presently excluded, debarred, or suspended from entering into covered transactions with the federal government according to terms of 2 CFR Part 180. Additionally, should U.S. Fish and Wildlife Service and Michigan DNR or any of their principals receive a transmittal letter or other official Federal notice of debarment or suspension, then they shall notify the U.S. Forest Service without undue delay. This applies to whether the exclusion, debarment, or suspension is voluntary or involuntary.

U. MODIFICATIONS. Modifications within the scope of this MOU must be made by mutual consent of the parties, by the issuance of a written modification signed and dated by all properly authorized, signatory officials, prior to any changes being performed. Requests for modification should be made, in writing, at least 30 days prior to implementation of the requested change.

V. COMMENCEMENT/EXPIRATION DATE. This MOU is executed as of the date of the last signature and is effective through **April 30, 2016** at which time it will expire.

W. AUTHORIZED REPRESENTATIVES. By signature below, each party certifies that the individuals listed in this document as representatives of the individual parties are authorized to act in their respective areas for matters related to this MOU. In witness whereof, the parties hereto have executed this MOU as of the last date written below.

Mark Wooley 6/7/11

CHARLES M. WOOLEY, Deputy Regional Director — Date
U.S. Fish and Wildlife Service

Kelley D Smith 5/13/2011

KELLEY D. SMITH, Acting Deputy Director — Date
Michigan Department of Natural Resources

for Gene Blankenbuhler 5/21/11

LOGAN LEE, Acting Regional Forester — Date
U.S. Forest Service, Eastern Region

The authority and format of this instrument have been reviewed and approved for signature.

Mike Rogers 5/4/11

MIKE ROGERS Date

U.S. Forest Service Grants & Agreements Specialist

Burden Statement

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Appendix B. DRAFT Wisconsin Kirtland's Warbler Conservation Plan

DRAFT Wisconsin Kirtland's Warbler Conservation Plan

Photo: Ashley Hannah, 2014

Developed by:

Wisconsin Department of Natural Resources

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October 22, 2015

Table of Contents

A. Introduction

A.1. Purpose of Plan

The Wisconsin Kirtland's Warbler Conservation Plan (Wisconsin KWCP), developed by the Wisconsin Kirtland's Warbler Partnership which consists of the Wisconsin Department of Natural Resources (WDNR), the U.S. Forest Service (USFS), and the U.S. Fish and Wildlife Service (USFWS). It is an addendum to the Kirtland's Warbler Breeding Range Conservation Plan (Breeding Grounds KWCP) developed by the Michigan Department of Natural Resources (MDNR), USFS, and USFWS in 2014. The Breeding Grounds KWCP was developed as a result of those three agencies signing a memorandum of understanding in 2011 to clarify agency commitment to the conservation of the Kirtland's warbler (*Setophaga kirtlandii*). The primary purpose of this addendum to the Breeding Grounds KWCP is to encourage the management of jack pine (*Pinus banksiana*) ecosystems to provide breeding habitat for Kirtland's warblers in Wisconsin.

Kirtland's warbler habitat management, which includes brown-headed cowbird (*Molothrus ater*) control, has been a successful strategy for increasing Kirtland's warbler populations. The population has reached recovery goal levels and is at record highs. Geographic distribution of Kirtland's warblers is important for the long-term sustainability of the population, especially for a species that relies on early successional habitat that is continuously shifting and changing. Wisconsin has suitable habitat for Kirtland's warblers and a small population currently breeds in the Central Sands Region (Adams County); however, breeding expansion is expected in the state. The continuance of the species requires management because of the many factors impacting the species and its habitat. To do this, agencies need to provide and maintain breeding habitat for Kirtland's warblers and continue to manage cowbirds where necessary.

This plan is similar in scope to the Breeding Grounds KWCP. Each participating agency has committed to cooperatively manage Kirtland's warbler habitat now and after the species is removed from the federal Endangered Species list. This plan does not address the needs of the Kirtland's warbler outside of Wisconsin, including breeding ground areas in Michigan, during migration, or wintering periods. The Wisconsin KWCP has been written following the same format as the Michigan KWCP (MDNR, USFWS, and USFS 2014). There are four major sections, each of which is designed so that it can be considered on its own or as part of the whole plan. This plan provides details specific to Kirtland's warbler management in Wisconsin, and includes only critical background material to set the context around management. For more detailed background information on Kirtland's warbler life history, demography, habitat management, cowbird control, and reducing impacts from land use practices, please see the Breeding Grounds KWCP.

The four major sections in the Wisconsin KWCP are:

- Section B – Background: Provides historical and current information on the species and its management. Much of this information can be found in the Breeding Grounds KWCP (MDNR, USFWS, USFS 2014) or in the USFWS Kirtland's Warbler Five Year Review (USFWS 2012).
- Section C – Management Goal, Objectives, and Actions: Outlines the strategy for future Kirtland's warbler conservation in Wisconsin.
- Section D – Habitat Management Guidance: Provides the framework for habitat development in Wisconsin; references the Breeding Grounds KWCP for technical guidance on how to create and maintain Kirtland's warbler breeding habitat.
- Section E – Brown-headed Cowbird Management Guidance: Provides an overview of cowbird management in Wisconsin.

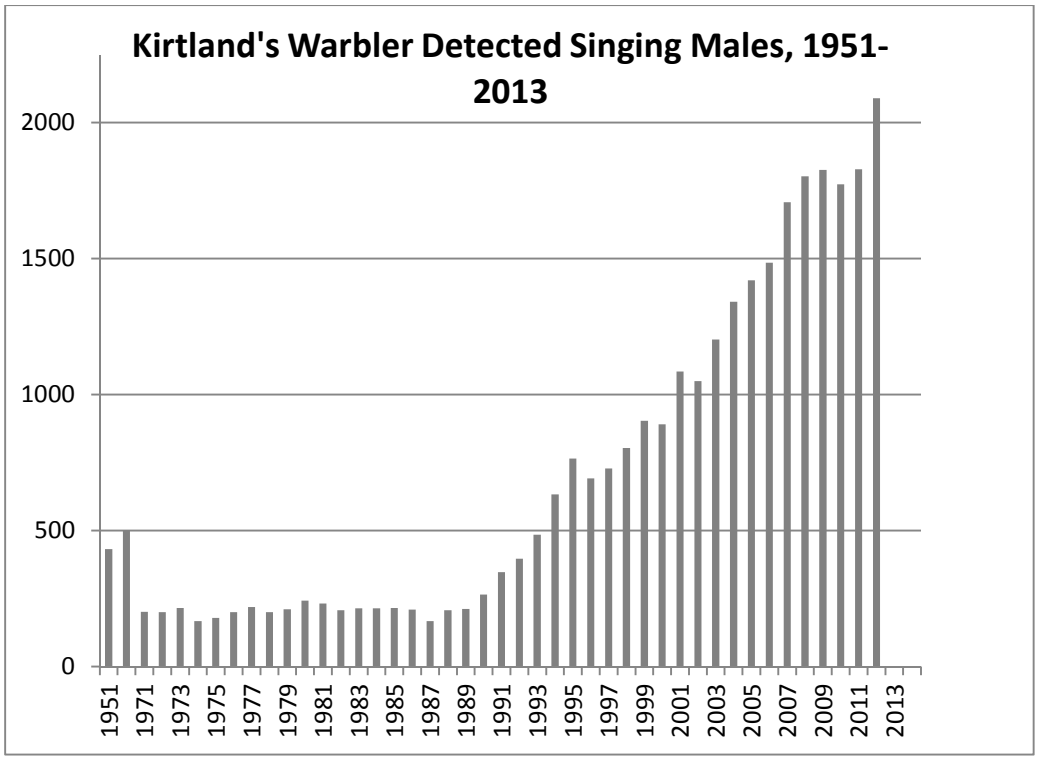
B. Background

The purpose of this section is to provide historic and current information about the Kirtland's warbler and its management. This information will help set the context for future conservation efforts outlined in sections C (Management Goal, Objectives, and Actions), D (Habitat Management Guidance), and E (Brown-headed Cowbird Management Guidance). For additional general background information see Breeding Grounds KWCP.

The Kirtland's warbler was one of the first species to be protected under the Endangered Species Act (ESA) of 1973. In 1976, a recovery plan for the species was created with a primary objective of re-establishing "a self-sustaining Kirtland's warbler population throughout its known range at a minimum of 1,000 pairs using adaptive management techniques" (Byelich et al. 1976). On January 1, 2014, the Kirtland's warbler was listed as Endangered in the state of Wisconsin due to documented nesting.

The MDNR, USFS, and USFWS, along with many partners, have had great success recovering the Kirtland's warbler. In Michigan, the core of its historic and current distribution, the current population is almost twice the ESA recovery goal of 1,000 pairs and has surpassed that goal every year since 2001 (Fig. 1). Presumably because of this growth in the population, a satellite breeding population arose in Wisconsin, with successful reproduction detected in 2007 and every year since (Fig. 1). Interagency and landowner cooperation has helped protect the breeding site in Wisconsin and allowed the Wisconsin population to grow. The Kirtland's warbler will continue to persist only through habitat and cowbird management - techniques that have contributed to the successful recovery of the species today.

Fig. 1. Total number of singing males detected during Kirtland's warbler population surveys and census throughout Michigan, Wisconsin, and Canada - 1951-2013.



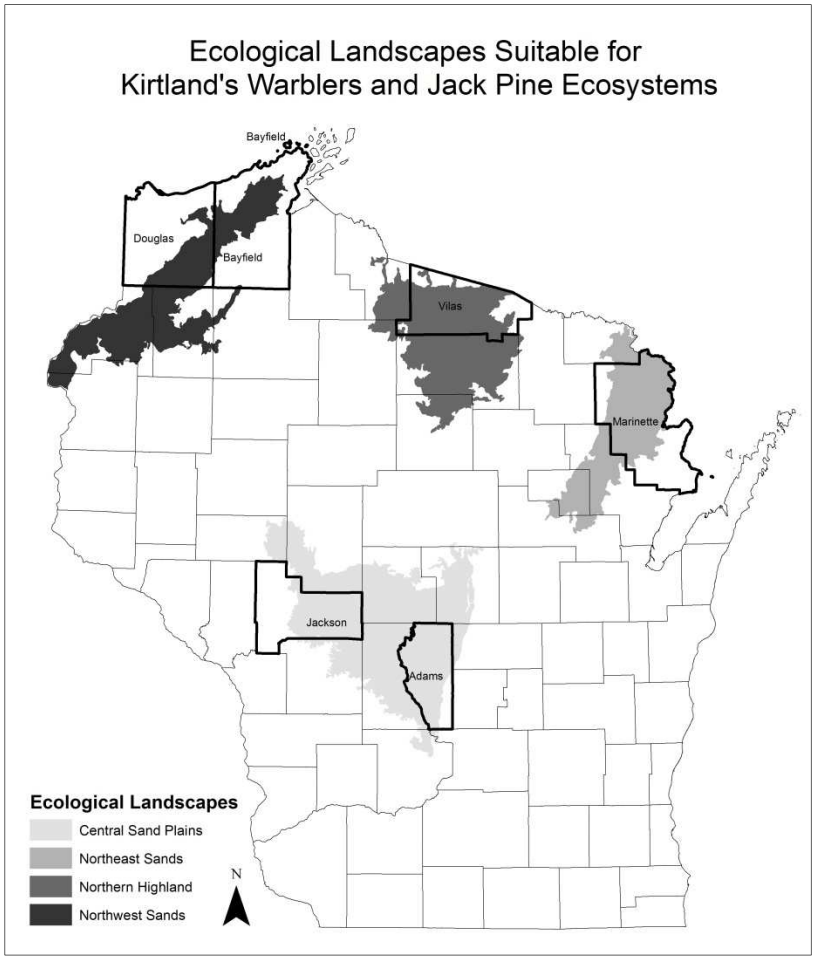
B.1. The Jack Pine Ecosystem/Pine Barrens

B.1.1. *Ecology*

The WDNR has mapped the state into areas of similar ecological potential and geography called "ecological landscapes." These ecological landscapes are based on aggregations of smaller ecoregional units (Subsections) from a national system of delineated ecoregions known as the National Hierarchical Framework of Ecological Units (Cleland et al. 1997). Opportunities for sustaining natural communities and wildlife Species of Greatest Conservation Need in Wisconsin's ecological landscapes were identified in the Wisconsin Wildlife Action Plan (WDNR 2005a). The habitat that the Kirtland's warbler depends upon occurs in four ecological landscapes in Wisconsin (Fig. 2). Since 2007, Kirtland's warblers have been found in six counties in Wisconsin; these counties are outlined in bold in Fig. 2 below. While the four ecological landscapes suitable for jack pine ecosystems extend beyond these counties, there have been no verified records of the species occurring outside of them. The four ecological landscapes are:

- Northeast Sands (Marinette County)
- Central Sand Plains (Adams and Jackson Counties)
- Northern Highlands (Vilas County)
- Northwest Sands (Douglas and Bayfield Counties)

Fig. 2. Ecological Landscapes in Wisconsin that can Provide Suitable Habitat for the Kirtland's Warbler.



These ecological landscapes formed in glacial outwash landforms and have excessively drained, sandy soil. The outwash sands historically supported jack pine/oak (*Quercus* spp.) barrens, pine forests, and grasslands, with wildfire being an important source of disturbance. Many other species besides the Kirtland's warbler benefit from the continued presence of pine forests and barrens in the state (WDNR 2005a; Appendix A). In recent years, Kirtland's warblers have been detected during survey efforts on these landscapes and each landscape supports suitable habitat for the species. Detailed descriptions of these four ecological landscapes follow, with most text borrowed heavily from "Ecological Landscapes of Wisconsin" (WDNR 2014a).

B.1.1.1 Northeast Sands

The **Northeast Sands Ecological Landscape** occupies a narrow, crescent-shaped area in northeastern Wisconsin on a nearly level to rolling landscape. Much of this ecological landscape formed in sandy glacial outwash landforms, ground moraines, and end moraines. The dominant soil is excessively drained and sandy with a loamy sand surface, rapid

permeability, and very low available water capacity. More than half the land surface is made up of outwash sand and gravel.

Historically, extensive jack pine/oak barrens, bracken grasslands, and jack pine forests were found on the outwash sands of this ecological landscape. Moraines supported forests of hardwoods, red pine (*Pinus resinosa*), and eastern white pine (*Pinus strobus*). Pitted outwash plains often contained numerous depressions, which contained wetlands and kettle lakes. Barrens vegetation was widespread in nutrient poor, drought-prone, level-to-gently undulating portions of this ecological landscape; these areas experienced frequent fire. The largest areas of barrens occurred in Marinette County, eastern Florence County, and southern Oconto County. The easternmost part of the Menominee Reservation also supported some barrens vegetation.

With the widespread implementation of fire suppression policies in the early 1900s, most of the barrens sites succeeded to dense forests of pine, oak, and aspen (*Populus* spp.). The persisting open remnants are generally small, and are becoming increasingly isolated. Today, forests cover about 75% of this ecological landscape, with aspen and northern hardwoods the predominant cover types. Dry forests dominated by scrub-oak and jack pine are also common. Plantation-grown pine, hemlock (*Tsuga canadensis*)-hardwoods, and northern hardwoods are important upland cover types.

B.1.1.2 Central Sand Plains

The **Central Sand Plains Ecological Landscape** is located in central Wisconsin on flat to gently rolling terrain. This ecological landscape formed in and around what was once Glacial Lake Wisconsin, which at its highest stage contained glacial meltwater that covered over 1.1 million acres. The soils are primarily sand, including lacustrine deposits, glacial outwash, and material eroded from the underlying sandstone bedrock. Organic soils are also common, but are confined to the extensive poorly drained peatlands. Sandstone mesas, buttes, pinnacles, and cliffs are found in and around Glacial Lake Wisconsin.

The historical vegetation of this area included some of Wisconsin's most extensive wetlands, especially within the old glacial lakebed. Silts and clays on the lake's bottom impeded drainage in many places, promoting development of large areas of bog, fen, sedge meadow, muskeg, and conifer swamp. On the uplands there were extensive areas of pine and oak forests. Areas that burned frequently were vegetated with pine barrens, oak barrens, and sand prairie.

Historical land use has greatly changed the landscape since pre-settlement times. A large pinery of major commercial importance occurred in eastern Jackson County, while many of the wetlands throughout the ecological landscape were drained for agriculture early in the 20th century. While most of the drained wetlands east of the Wisconsin River continue to be used for agricultural purposes in current times, many of the drained wetlands to the west

failed to support farming initiatives due to poor soils, poor drainage, and growing season frosts. Many decades of fire suppression have greatly reduced or degraded the extent of the more open barrens.

Today, the eastern portion of the Central Sand Plains is a mosaic of cropland, managed grasslands, peatlands, and scattered woodlots of pine, oak, and aspen. The western portion of this ecological landscape is mostly forest or wetland. Oak, pine, and aspen are the most abundant forest cover types. Plantations of red pine are common in some areas.

B.1.1.3 Northern Highlands

The **Northern Highland Ecological Landscape** is located in north central Wisconsin on the "Wisconsin Dome," an upwarping section of the Canadian Shield with resistant volcanic/metamorphic bedrock as its foundation. The ecological landscape has a few bedrock outcrops, but most of the area is deeply buried beneath glacial drift. It is predominantly a sandy outwash plain formed when sediment was deposited by glacial streams. Outwash in some areas was deposited on solid ground and still retains a flat topography, but in most areas it was deposited on stagnant glacial ice and collapsed as the underlying ice melted, resulting in pitted and hummocky topography. Outwash sands are mostly underlain by glacial till that impedes drainage, so the area has high water tables with extensive areas of wetlands and kettle lakes. Moraines, drumlins, and eskers protrude through the mantle of outwash in some locations. Most soils range from excessively drained to somewhat poorly drained, and have sandy to sandy loam textures, though richer loams can occur in association with moraines.

Historically, forests of the Northern Highlands were dominated by eastern white pine and red pine, with smaller pockets of jack pine. Hemlock-hardwood forests were found in some areas with loamier soils, while aspen-birch (*Betula* spp.) forests occurred in openings formed by disturbances such as wind or fire. Fire was formerly an important and widespread disturbance factor.

Current land cover of the ecological landscape consists of 48% upland forest, 34% wetlands, 13% open water, and 5% grassland/open land. Much of the former pinery was destroyed or severely altered by heavy logging and subsequent slash fires, and the pines were often replaced by stands of aspen, white birch (*Betula papyrifera*), or more rarely, northern red oak (*Quercus rubra*). Overall, quaking aspen (*Populus tremuloides*) is now the primary forest dominant, sometimes mixed with pines, red maple (*Acer rubrum*), and white birch. Much of the red pine and some of the jack pine are now grown in plantations. Although true savannas have not been documented here, recently disturbed stands of dry forest may have a sparse or patchy canopy and bear a superficial structural resemblance to the pine barrens community. Jack pine, red pine, and scrub oak (*Q. ellipsoidalis* or *velutina*) occur on such sites, but there is an almost total absence of the prairie flora that characterizes barrens

communities elsewhere in Wisconsin. Grasslands may also occur on nutrient-poor sites that were severely burned in the slash fires that accompanied or followed the Cutover.

B.1.1.4 Northwest Sands

The **Northwest Sands Ecological Landscape** is a large glacial outwash ecosystem consisting primarily of two major landforms: flat plains or terraces along glacial meltwater channels, and pitted or "collapsed" outwash plains containing kettle lakes. Bedrock is typically covered by 100 to 600 feet of glacial sediment, with the thickest deposits in the northern half (WGNHS 1983). Bedrock is so deeply buried by glacial materials that it does not directly influence the ecology of the ecological landscape. Soils are predominantly deep sands, and are low in organic material and nutrients.

Historically, forest and barrens dominated by pine (mostly jack, some red) and scrub oak were the common cover types. Eastern white pine and red pine forests also occupied a sizeable area. Fire was prevalent due to permeable sandy soils, areas of nearly level topography, and extensive areas over which wildfires could run unimpeded.
Today, the ecological landscape harbors a mix of forest, grassland, barrens, and wetlands. Many of the large areas historically kept in an open or semi-open condition by periodic wildfire now support dense forests. The percentage of pine on the landscape has decreased, while that of deciduous trees has increased (especially oaks, quaking aspen, and red maple). Natural forests or barrens in which red pine is dominant are now very rare; they have been mostly relegated to plantations. Approximately 76% of the area is forested, with pine (jack and red), aspen-birch, and oak occupying roughly equal areas (USFS 2009).

B.1.2. *Social – See Breeding Grounds KWCP*
B.1.3. *Economics (Forest Products) – See Breeding Grounds KWCP*

B.2. Kirtland's Warbler Biology and Ecology

B.2.1. *Life History*
B.2.1.1. Physical Appearance and Molts – See Breeding Grounds KWCP
B.2.1.2. Diet and Foraging Behavior – See Breeding Grounds KWCP
B.2.1.3. Mating and Reproduction – See Breeding Grounds KWCP
B.2.1.4. Demographic Features and Trends
This section covers Wisconsin-specific population trends. For more information about range-wide Kirtland's warbler demographics, please see section B.2.1.4. in the Breeding Grounds KWCP.

Prior to 1978, there were only 9 verified records of Kirtland's warblers in Wisconsin – all of which were found in late May and were considered to be migrants (Tilghman 1979). After a

territorial male was reported in Ontario, Canada in 1977, the WDNR began to identify potential nesting areas by looking for habitat similar to where Kirtland's warblers were found in Michigan. In 1978, WDNR implemented a census of those areas in May and June (Tilghman 1979); 103 jack pine stands in 15 counties were identified for the 1978 census, and 99 were surveyed.

Two males held territories approximately one quarter of a mile apart on a 90-acre jack pine stand in Jackson County from June 10 through late July 1978, when they were no longer heard singing. One of these males had an aluminum USFWS band, and when recaptured indicated that the six-year-old male had been color-banded as a nestling on the National Guard Camp in Grayling, MI (approximately 300 miles away). Neither male showed behavior indicating nesting – when nesting had begun in Michigan, both males were still singing almost constantly, and neither was observed carrying food (Tilghman 1979). One male was recorded in the same area in 1979 and 1980.

Another male was found approximately 35 miles away in Juneau County on June 9, 1978, by volunteers (Tilghman 1979). The male responded five times to the taped Kirtland's warbler recording used for the surveys, but the observers were unable to visually locate the bird. On subsequent visits the male in Juneau County was not re-located.

Ten years later, another census for Kirtland's warblers was conducted by the WDNR; 104 jack pine stands were surveyed during June of 1988 (Hoffman and Abernathy 1988). Eight singing males were visually identified in five stands. Two males were located in Douglas County, two were located in Washburn County, and four were located in Jackson County. Three of the males in Jackson County were located within a two-mile stretch. One surveyor did have responses to the taped call at two separate locations far removed from the other four Jackson County birds, but the birds could not be visually identified.
In 1989, the WDNR surveyed 160 jack pine stands to update the occurrence of Kirtland's warblers in Wisconsin (Hoffman 1989). This survey was similar to that conducted in 1988 but included additional areas identified as potential habitat. Of the two males recorded, one had been banded in 1988 and had returned to the same site in Douglas County. The second bird, unbanded, was confirmed by response to a taped call in Jackson County.

From 1989–2006, other non-WDNR efforts found Kirtland's warblers throughout the state, but none had documented nesting. Until 1995, the Kirtland's warbler bred only in a few counties in the northern part of the Lower Peninsula of Michigan. In 1995, the species began breeding in the Upper Peninsula of Michigan, and in 2007 the species was recorded nesting in Ontario, Canada (Richard 2008).

The year 2007 marked the initial discovery of a population in Wisconsin. Dean DiTommaso stumbled upon the birds in an Adams County red pine stand. Continued monitoring throughout summer 2007 confirmed the presence of eight males, three females, and three

nests (Trick et al. 2008). No evidence of Kirtland's young was found, but adult Kirtland's were observed feeding cowbirds near two of the three nests. Monitoring has continued in Adams County every year since this population was discovered.

In 2008, annual surveys for singing males began and the USFWS started banding adult Kirtland's; color-banding has made it possible to identify individual males at the breeding site each year.

The following list summarizes key nest and survey data from 2008–2014. The information represents estimates based on observed Kirtland's warblers. The nest observations are not drawn from repeated visits to nests; therefore, reproductive success and nest fate information are best estimates and have a range of uncertainty.

- Of 78 successful nests, the average number of young fledged per nest was estimated to be between 1.2 to 1.5 (range = 0.6 to 2.7 young per nest)
- The percentage of returning males each year ranged from 50-100% (Fig. 3).
- Each year several pairs attempted to re-nest after the failure of their first nest. The percentage of re-nests varied from year to year, but was between 18% and 31%.
- The estimated percentage of parasitized nests each year was between 18% and 44%.
- The population in Wisconsin grew from eight singing males in 2007 to 23 singing males in 2010 and 2012, and decreased to 13 males in 2014 (Fig. 4). In Adams County, the years 2010 and 2011 saw the greatest number of pairs (11), 2011 and 2012 had the highest numbers of singing males (20), and 2010 had the highest number of nests (16) (Figs. 4 and 5). In 2014, 11 males were observed in Adams County, with eight documented nests from seven pairs (Fig. 5). The year 2009 had the highest percentage of successful nests (60–70%, n=78), with the most young fledged (23–27) since monitoring began.
- There have been two known nesting attempts outside of Adams County, both of which occurred in Marinette County. In 2009, there was one successful nesting attempt (three fledged), and in 2013 there was one failed nesting attempt.

In 2008, an annual census to detect singing males in suitable habitat across Wisconsin was initiated. To date, singing males have been detected in four counties: Adams, Bayfield, Douglas and Marinette. The census results have shown a growth in the number of males in Wisconsin between 2008 and 2012, followed by a decrease in numbers from 2012 to 2014 (Fig. 4). In 2014, there was a decline in the number of males detected at the primary breeding site in Adams County. This could be because four of the six males would have been five years old in 2014, much over the average lifespan of the species, which is 2.5 years (Walkinshaw 1983).

Fig. 3. Number of returning and new males per year at the Adams County, Wisconsin breeding site. Banding of males began in 2008; thus return rates of males for 2007 and 2008 are unknown. All males for those years are included in the new male category.

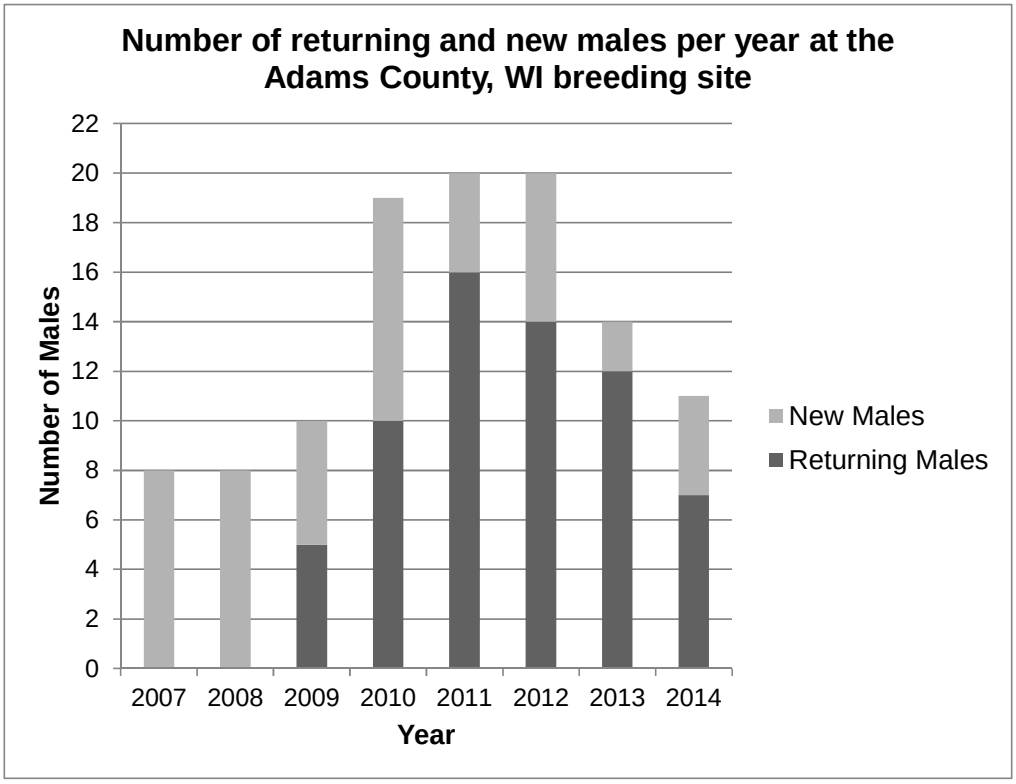


Fig. 4. Number of singing Kirtland's warbler males detected during the annual Wisconsin census. Numbers do not include reports of Kirtland's warblers outside of the census period or unconfirmed reports. The census is only conducted in suitable habitat in counties located in the four identified ecological landscapes.

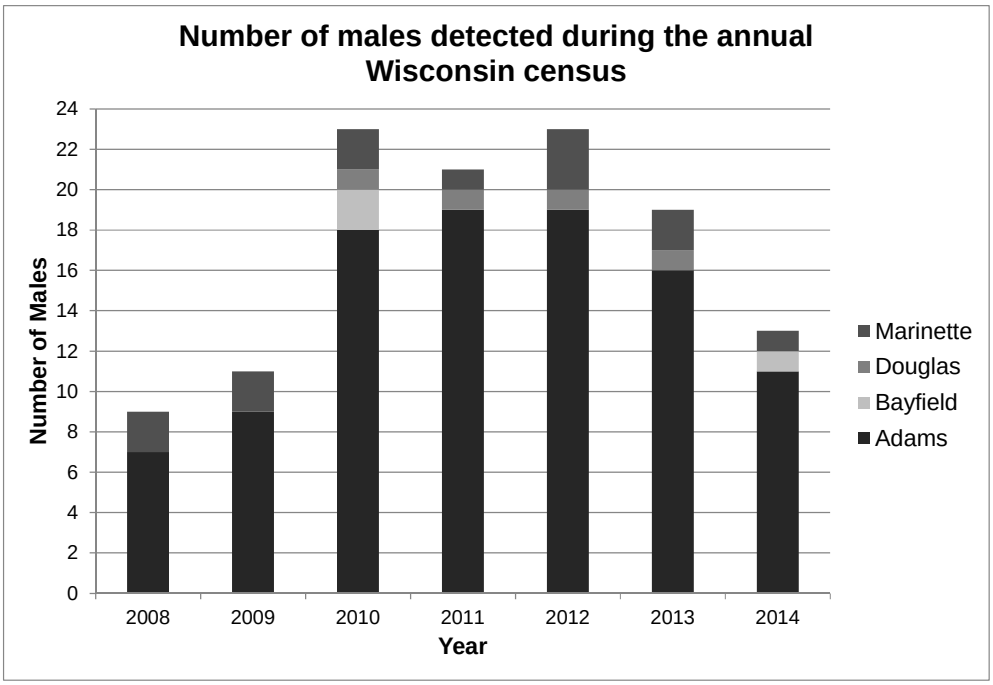
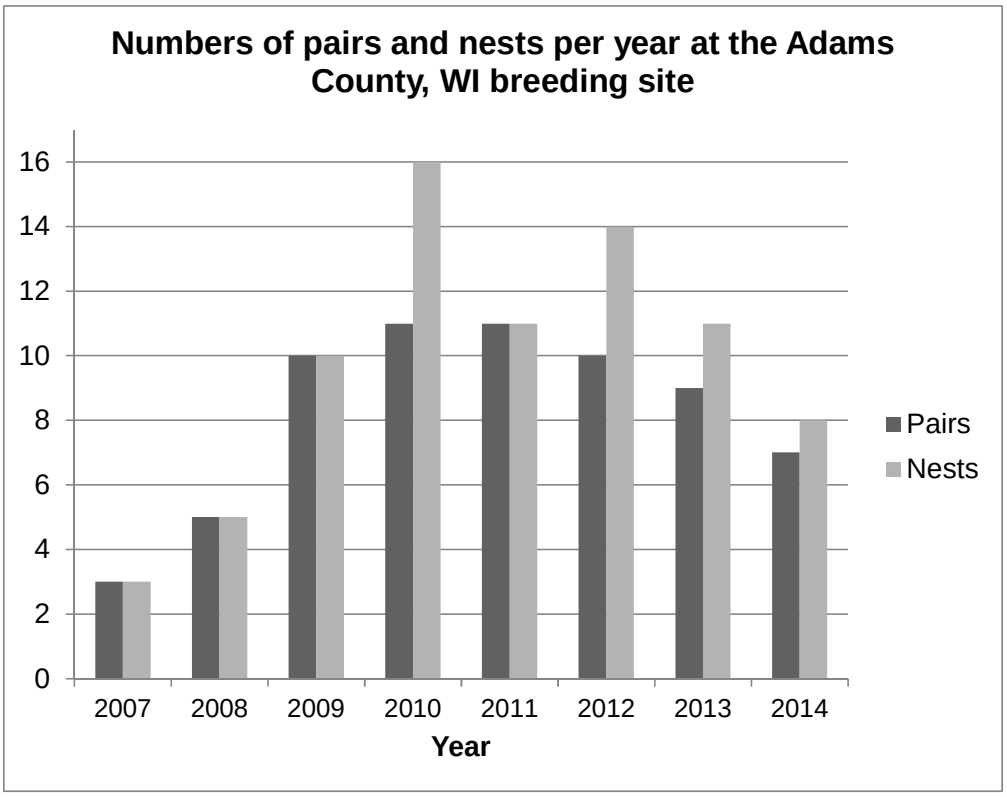


Fig. 5. Number of pairs and nests per year at the Adams County, Wisconsin breeding site.



B.2.2. *Population Status – See Breeding Grounds KWCP*

B.2.3. *Species Distribution – See Breeding Grounds KWCP*

B.2.4. *Habitat Characteristics – See Breeding Grounds KWCP*

B.3. Past Breeding Ground Conservation Efforts

An increase in the Kirtland's warbler population to almost twice the recovery goal has been accomplished by implementing conservation efforts over several decades, primarily in Michigan. This success has likely contributed to the appearance of this species in Wisconsin and Canada as the Michigan habitat became saturated and new, unoccupied territories were sought (Probst et al. 2003). 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 to give the species the best chance at persisting. For the species to continue to persist in Wisconsin, conservation efforts must continue in Wisconsin and in Michigan. Due to fire suppression, natural forest succession, loss of large acreages of timber lands, and cowbird parasitism, the Kirtland's warbler will always be a conservation-reliant species (Bocetti et al. 2014). Continued habitat and cowbird management in Michigan will ensure that the population will remain above the recovery goal of 1,000 pairs. Satellite populations, such as the one in Wisconsin, face difficulties from being a small, spatially-segregated breeding population, in addition to issues such as cowbird parasitism and habitat availability. Also, in Wisconsin there are fewer state and federal lands that can be managed for the species, making it more difficult to maintain a population of Kirtland's warblers in the state.

The following section summarizes past conservation efforts made in Wisconsin that are key to maintain a breeding population. Section C of the Wisconsin KWCP will provide the strategy on how these key conservation efforts will be carried out in the future.

Key conservation efforts that are used to manage Kirtland's warblers on the breeding grounds are:

- Manage, improve, and protect breeding habitat
- Minimize nest parasitism by brown-headed cowbirds
- Minimize land-use conflicts
- Maintain adequate agency funding
- Maintain public awareness
- Continue adaptive management

B.3.1. *Manage and Protect Breeding Habitat*

A primary factor in Wisconsin that limits the breeding range of this species is the absence of large tracts of suitable habitat which, outside of Michigan, are uncommon (Tilghman 1979; Probst 1986). Since the late 1800s, there has been a scarcity of large young jack pine stands in Wisconsin. During the 1930s, a fire control program was developed in the state and the size of timber-cutting blocks decreased, both of which limited the size of jack pine habitat (Tilghman 1979). Due to issues such as poor pine regeneration, fire suppression, and natural succession, pine barrens habitat has decreased. To maintain barrens and potential Kirtland's warbler habitat, consistent, continued active management in Wisconsin is necessary.

Habitat Management and Protection in Adams County:

In 2010, Plum Creek, the forest products company that previously owned the Kirtland's warbler core breeding site in Adams County (1,639 acres of red pine plantation), in cooperation with the USFWS, initiated a habitat project adjacent to the nesting site. The habitat created by this project will create suitable future nesting sites as the currently occupied pine stands age and become unsuitable for nesting. The project is also an experiment to understand how different silvicultural practices can be implemented on private lands to contribute to Kirtland's warbler breeding habitat while providing merchantable timber for the landowner (USFWS and Plum Creek Timber Co. 2010; Trick et al. 2012). The habitat enhancement project has four treatment plots which were installed in 2013: (1) red pine/jack pine row combination, (2) red pine rows with jack pine openings, (3) red pine rows only with openings, (4) jack pine only. As these plots age, they will be monitored for use by Kirtland's warblers (Trick et al. 2012).

In 2013, the WDNR acquired, via the Forest Legacy Program, a conservation easement on the 1,639 acres of Kirtland's breeding habitat previously owned by Plum Creek in Adams County. This easement permanently protects the current core Kirtland's warbler breeding site from development, and lies within a larger 9,088-acre easement acquired

to protect Karner blue butterfly habitat, another federally endangered species that also uses pine barrens habitat. In 2014, Plum Creek sold most of their pine lands in Adams County (including the habitat enhancement plots and the core breeding site) to Timber Investment Resources (TIR). Because of failure of jack pine establishment in treatment plot 4 and a need to meet Managed Forest Law requirements, the treatment plot will be replanted by TIR in 2015.

Habitat Management and Protection Outside of Adams County:
In 2010, the USFS drafted a Kirtland's Warbler Habitat Improvement Project (USFS 2010) to be implemented on the Washburn Ranger District of the Chequamegon-Nicolet National Forest (CNNF) in Bayfield County. The project includes approximately 370 acres of jack pine stands on the CNNF. On 263 acres of the project area, jack pine will be regenerated to create one contiguous block of Kirtland's warbler habitat. An additional 105 acres will receive various treatment types to improve the jack pine component for future habitat.

In 2012, the WDNR began the largest land conservation transaction in state history -- an easement on 67,347 acres of forest land in Douglas, Bayfield, Burnett, and Washburn Counties in northwest Wisconsin owned by the Lyme St. Croix Forest Company (WDNR 2012). The transaction was completed in 2014, with funding assistance from the Knowles-Nelson Stewardship Program and the federal Forest Legacy Program. A large portion of the easement land lies within the project boundary of Brule River State Forest. Much of this land is classified as pine barrens. The easement encourages jack pine reproduction, with goals including managing a shifting mosaic of 100+ acre blocks of even-aged trees but with blocks planted at different times. Not only does this benefit species such as the Kirtland's warbler and sharp-tailed grouse, but the practice is compatible with commercial forestry management (WDNR 2012). On May 24, 2013 a wildfire coursed across 7,442 acres in Douglas County (WDNR 2014b), including 4,800 acres owned by the Lyme St. Croix Forest Company ("Wisconsin Public Radio 2014"). The wildfire area has the potential for large areas of suitable jack pine habitat in future years; Kirtland's warbler habitat needs will be considered during the planning of habitat regeneration within the burn area. The Lyme St. Croix Forest Company plans on starting regeneration checks in 2015 to assess the success of natural jack pine regeneration within the burn area (Ryan Magana, personal communication).
In addition to state and federal efforts to manage and protect Kirtland's warbler and jack pine habitats, several counties within the four suitable Ecological Landscapes have implemented plans to manage jack pine with consideration for Kirtland's warblers. The only documented nesting attempts of Kirtland's warblers in Wisconsin outside of Adams County have occurred in Marinette County. In 2010–2011, Marinette County identified a Kirtland's Warbler Management Area of approximately 20,000 acres (far less acreage is potentially suitable habitat) within Marinette County Forest. A total of 16 sites (888 acres total) have been identified by the Marinette County Forest for habitat

improvement work within the Management Area. Several of these sites have had habitat improvement work completed, which has largely been funded through the USFWS Partners for Wildlife Program. Bayfield County also created a plan to manage pine barrens on the Bayfield County Forest, and amended the Barnes Barrens Management Plan to include Kirtland's warbler considerations in 2013 (Bayfield County Forestry Department 2006).

B.3.2. *Minimize Brown-headed Cowbird Nest Parasitism*

Historically, the brown-headed cowbird was restricted to short grass prairies, where the species followed large grazing animals and was not a threat to songbirds in eastern forests (Mayfield 1961). However, forest clearing and agricultural development in the late 19th century allowed cowbirds to expand eastward and into Kirtland's warbler breeding habitat.

Unlike western songbirds, the Kirtland's warbler did not evolve with cowbird parasitism and has no defense against it. The Kirtland's warbler is especially vulnerable because of several factors: its limited breeding range exposes much of the population to parasitism, the majority of pairs only produce one brood per year, and the peak egg-laying period of the cowbird overlaps that of the Kirtland's warbler (Mayfield 1960; Radabaugh 1972). In one Michigan study, 93% of cowbird eggs found in jack pine habitat were located in Kirtland's warbler nests compared to all other host species combined, and Kirtland's warbler fledging rates averaged less than one young per nest prior to cowbird control (Walkinshaw 1972).

In Wisconsin, Kirtland's warbler nests have been parasitized by brown-headed cowbirds since the species was first recorded nesting in the state in 2007. That year, two of the three nests had cowbird eggs in them, and later in the season cowbird fledglings were observed being fed by adult Kirtland's warblers in the vicinity of each parasitized nest (Trick et al. 2008). The percentage of nests parasitized each year in Wisconsin has varied from an estimated 18–44% based on visual observations. Cowbird trapping has occurred annually in Wisconsin since 2008; however, nest parasitism rates that existed prior to cowbird control are unknown. Cowbird traps are placed at the Adams County breeding site by the U.S. Department of Agriculture Animal and Plant Health Inspection Service (USDA-APHIS) Wildlife Services with the cooperation of the landowner. Even with annual cowbird control, Kirtland's warbler young fledged per nest in Wisconsin are 1.2–1.5 per nest on average. In Michigan, the average young fledged per nest after cowbird control rose from <1 young per nest to 2.7 young per nest (Kelly and DeCapita 1982). The USFWS and WDNR continue to work closely with USDA-APHIS Wildlife Services on modifying cowbird control methods, such as trap distance to breeding pair, number of traps, the timing of trapping, target shooting individual cowbirds detected in Kirtland's warbler territories, and removing cowbird eggs and fledglings.

Cowbird traps are not located in other parts of the state for several reasons: (1) Very few Kirtland's warblers have been located outside of Adams County; (2) Only one nesting attempt has been documented outside of Adams County; and (3) Cowbirds are thought to be less common in the northern counties of Wisconsin where Kirtland's warblers have been observed and therefore present a small risk to any potential nests.

B.3.3. *Minimize Land Use Conflicts – see Breeding Grounds KWCP (Unlike in Michigan, habitat closures are not being currently implemented at Wisconsin breeding sites).*

B.3.4. *Maintain Public Awareness and Support*

Maintaining public awareness and support for Kirtland's warblers in Wisconsin is achieved in several ways. Since 2008, several tours have been offered each year by the Natural Resources Foundation of Wisconsin and occasionally by the Wisconsin Society for Ornithology early in the breeding season when males are most audible and visible as they try to attract mates. The tours are led by the nest monitors and by WDNR and USFWS staff who are knowledgeable about the species and the pine barrens ecosystem. The tours are limited in size, but provide a structured way for birders to view one of North America's rarest songbirds. Proceeds from these tours have benefited two NRF funds, the Wisconsin Kirtland's Warbler Project and the Bird Protection Fund. Occasionally, other tours for biologists or agency personnel occur.

The Wisconsin Kirtland's Warbler Partnership has led outreach efforts to communicate with students about this rare species:

- From 2008-2011, the WDNR advised a conservation planning class at the University of Wisconsin-Madison Nelson Institute for Environmental Studies on the development of mock Habitat Conservation Plans for Kirtland's warblers in Wisconsin.
- Portions of the proceeds from the 2008 and 2009 Kirtland's warbler tours were donated to the 6th grade environmental class in Adams-Friendship, a public school that is very close to the Kirtland's warbler habitat area in Adams County. The money was used for environmental education at the school.
- Wisconsin partners promoted a poster and calendar competition hosted by Michigan's Kirtland Community College. That program was developed to connect students in the Bahamas, Michigan, and Wisconsin by learning about the warbler that lives in all three of their locations.
- In 2012, the WDNR served as an advisor to two middle school students from the Prairie Crossing Charter School in Gurnee, Illinois. The students chose the Kirtland's warbler as their 8th grade independent conservation project. Their activities included creating a website about the bird, holding a fundraiser to support the project (they carved wooden Kirtland's warbler ornaments and sold them), a visit to Adams County to help with planting jack pines on a private pine

plantation near the Adams County breeding site, and a final presentation on their experiences delivered to their class.

Other outreach efforts include nesting season updates posted periodically on the USFWS Wisconsin Ecological Services Field Office webpage. Season updates are also emailed to many people who are involved or interested in the project. USFWS and WDNR personnel have given presentations about the Kirtland's warbler at local bird clubs and at conferences since 2007. There have also been many media interviews, most notably one in the Wisconsin Natural Resources magazine, a PBS special, and airtime on the Larry Meiller Show (a Wisconsin Public Radio program). Articles have also been published in Wisconsin Natural Resources magazine and in the Passenger Pigeon, the official scholarly publication of the Wisconsin Society for Ornithology. In 2014, a Wisconsin Kirtland's Warbler Facebook page was created to provide another avenue for people to get information about the Kirtland's warbler in Wisconsin and the agencies and people involved in the project.

B.3.5. *Maintain Adequate Agency Funding*

Since 2008, funding for Kirtland's warbler conservation and cowbird management in Wisconsin has been provided by member agencies of the Wisconsin Kirtland's Warbler Partnership, including the WDNR Natural Heritage Conservation Program, the USFWS Section 6 grant, the USFWS Partners for Fish and Wildlife Program, and USDA APHIS Wildlife Services.

Additional funding has been bestowed annually by the Natural Resources Foundation of Wisconsin, who recognizes Kirtland's Warbler Conservation as a high priority project for their Bird Protection Fund (BPF). The BPF served as the primary funding source for this project from 2008 to 2012 and has issued supplemental amounts ($2,000 to $6,000) annually since 2013. NRF also maintains a special Kirtland's Warbler fund acquired from donations made by field trip participants, by local bird clubs, and by other miscellaneous donors. Gifts from this fund support project needs, such as housing for nest monitors, which are difficult to finance through other sources.

Funding for habitat management has been provided in part by landowner partners in areas suitable for Kirtland's warblers in Wisconsin. Plum Creek Timber Co., Inc., former owner of the Adams County sites, financed an experimental planting on 300 acres and a jack pine planting on 63 acres. The current owner of these sites will pay for replanting of failed jack pine at these stands in 2015 and is responsible for planting jack pine after future red pine harvests within the WDNR easement area. Marinette County Forestry Department used a U.S. Environmental Protection Agency Great Lakes Restoration Initiative grant plus match to plant jack pine in multiple stands per Wisconsin Kirtland's Warbler Partnership recommendations and is currently managing (enhancing) habitat on one stand using USFWS Partners for Fish and Wildlife Program cost-share dollars. The Lake Superior Landscape Resource Partnership (administered through the U.S. Department of Agriculture Natural Resources Conservation Service) is a new federal cost-share program that will assist private landowners with restoration of Kirtland's

warbler nesting habitat (among other conservation goals) within Lake Superior sub-watersheds. Suitable sites within this focal area, however, are limited to a few properties.

On occasion (2008-9; 2013), the Wisconsin Society of Ornithology issued small gifts to the project as a result of donations collected during guided field tours they hosted. Also, the WDNR Citizen-based Monitoring Program (CBM) awarded grants to the volunteer survey/census effort in 2010 and 2012. The survey, however, is no longer eligible to receive these CBM awards.

Although Wisconsin has not qualified for a U.S. Neotropical Migratory Bird Conservation Act Grant in past years, we hope to be eligible to apply to this and other appropriate federal programs (e.g., Joint Venture) in the future. Investigation is needed to determine if other federal and non-federal funding sources are available.

B.3.6. *Adaptive Management*

The Wisconsin Kirtland's Warbler Partnership identified an adaptive management framework to manage for Kirtland's warblers. The adaptive management framework incorporates the following components:

- Each agency has made their own management and planning decisions based on best available science and observations shared at bi-annual Recovery Team meetings. Specifically, agencies share habitat management acreages and techniques, research projects, education and outreach, population monitoring, and cowbird management results.
- In Wisconsin, a Kirtland's warbler census has been conducted in 1978, 1988, and every year since 2008 to estimate Kirtland's warbler abundance in suitable habitat across the state.
- The Wisconsin Kirtland's Warbler Partnership has worked closely with the scientific community to identify and address research priorities, some of which have supplemented monitoring data.
- Agencies have successfully incorporated new science into their on-the-ground management and planning efforts from information shared through the Recovery Team.

Wisconsin agency personnel involved in Kirtland's warbler management attend the bi-annual Kirtland's Warbler Recovery Team meetings to report on Wisconsin's annual census, management efforts, nest monitoring, and any other Kirtland's warbler-related research. An annual census is conducted in Wisconsin in counties with suitable Kirtland's warbler habitat. The annual census allows managers to:

- Evaluate the population status.
- Determine the presence or absence of individuals in areas for protection purposes.
- Evaluate habitat management activities.

- Monitor occupancy, duration of use, and density of singing males to understand how the birds occupy breeding habitat.
- Effectively place cowbird traps.
- Provide data for research.
- Build public confidence in endangered species management.

Also, the USFWS bands all singing males, and color bands females opportunistically. Banding of Wisconsin males allows managers to understand male return rates, nest site fidelity, age-related plumage characteristics, and landscape movements. It also allows managers to identify individual territories and nests, and identify new males present on the landscape, aiding in the understanding of population status within the state.

In 2014, the USFWS began banding nestlings to better understand hatch-year behavior, natal philopatry, cohort survival, and movements of returning young and dispersal. It is also less stressful and more efficient than banding adults or fledglings.

Known nests are monitored by hired seasonal field staff according to protocol developed by the Wisconsin Kirtland's Warbler Partnership in consultation with the Recovery Team. Field staff also document spring arrivals and map male territories. Security cameras have been employed on a limited basis to monitor nest predation, with one of three attempts successfully capturing predation.

In 2014, WDNR and Illinois Natural History Survey began a conspecific playback study to draw Kirtland's warblers to new breeding sites in the northern part of the state in landscapes where they occur nearly annually but have so far failed to consistently establish themselves.

In 2015, Marinette County improved a densely stocked and suitably aged stand by cutting openings in it. Future management to promote diversity of the understory in this stand is expected to occur in late 2015.

In 2016, USFWS Partners for Wildlife Program will conduct habitat improvement projects within the Adams county Kirtland's warbler easement.

B.3.7. *Track and Respond Appropriately to Emerging Threats:*

Climate Change – Emerging threats will be evaluated to determine appropriate response.

C. C. Kirtland's Warbler Management Goal, Objectives and Actions

The purpose of this section is to outline the strategy for future Kirtland's warbler conservation actions. Section B (Background) provides the context for the goal, objectives, and actions in this section. Section D (Habitat Management Guidance) and Section E (Brown-headed Cowbird Management Guidance) provide specific guidance for implementation of some of the actions.

The Kirtland's warbler population has remained above 1,000 pairs since 2001 and has been above 2,000 pairs since 2012. The goal of the Breeding Grounds KWCP is to sustain a Kirtland's warbler population throughout its known breeding range above 1,000 breeding pairs using an adaptive management framework. Within that Plan, Wisconsin and the Upper Peninsula of Michigan are tasked with supporting 10 percent or more of the population to meet the 1,000 breeding pair goal (i.e., 100 pairs). Wisconsin currently supports only about 1 percent of the breeding population, and while the breeding population has been present since 2007, the status of the population into the future remains uncertain. Increasing the number of birds within the state will help to reduce risks to the entire population from catastrophic events and ensure that the species will persist into the future. Agencies within the state will continue to work towards increasing the amount of suitable habitat and the number of breeding pairs in the state using an adaptive management framework.

C.1. GOAL:

Encourage the management of jack pine (and red pine) ecosystems as a shifting mosaic in order to provide enough breeding habitat between Wisconsin and the Upper Peninsula of Michigan for 10 percent (100 pairs) or more of the population of Kirtland's warblers. C.1.1. *Manage Kirtland's Warbler Breeding Habitat*

Habitat management is an effective tool to increase Kirtland's warbler numbers. Traditional management is considered to be 'opposing wave planting,' typically used in the northern Lower Peninsula of Michigan where large tracts of state and federal land can be managed; the alternative way currently used in the Upper Peninsula of Michigan relies more on natural regeneration that does not create rows of jack pine but instead incorporates a multiple species approach. In Wisconsin, traditional habitat management is not well-defined because manageable tracts of land are smaller, landowners have different management goals, and a variety of techniques are used to create suitable habitat within those areas. With the understanding that habitat management is important for the persistence of the species, Wisconsin agencies have created the following habitat objectives and actions to help achieve the plan's goal. In Wisconsin, habitat management for the Kirtland's warbler is more in line with the alternative management approach that is currently used in the Upper Peninsula and focuses on a multi-species approach.

Objective 1: Maintain upwards of 5,805 acres of Kirtland's warbler habitat (6- to 20-year old pine stands with trees 5-20 feet in height) annually across the state of Wisconsin. Establish and maintain additional acres of suitable habitat beyond the target acreage as needed or when there is opportunity to do so.

Action 1. In the Northwest Sands Ecological Landscape, maintain upwards of 400 acres of Kirtland's warbler habitat on the Bayfield County Forest and upwards of 370 acres on the Chequamegon-Nicolet National Forest (CNNF).

Action 2. In the Central Sand Plains Ecological Landscape within the KIWA easement in Adams County, maintain upwards of 600 acres of suitable habitat.

Action: 3. In the Central Sand Plains Ecological Landscape in Black River State Forest and Jackson County Forest, maintain upwards of 1,135 acres of suitable habitat.

Action 4. In the Northeast Sands Ecological Landscape within the Kirtland's Warbler Management Area on the Marinette County Forest, maintain upwards of 1,900 acres of suitable habitat.

Action 5. In the Northern Highlands Ecological Landscape, establish and maintain upwards of 1,000 acres of suitable habitat on the CNNF according to USFS management guidelines, and support efforts to establish and maintain upwards of 400 acres of suitable jack pine habitat on the Vilas County Forest and Northern Highland American Legion State Forest.

Action 6. Coordinate with private landowners and other partners (military and conservation non-profits) to develop and maintain suitable habitat within the jack pine range (including existing agency plans identified). Opportunities to provide support to private landowners will be explored.

Action 7. Work with state agencies to explore options to develop suitable habitat within the jack pine range using the "Habitat Management Guidance" identified in Section D (including existing agency plans identified in D.2).

Objective 2. Establish and maintain habitat in the northern three Ecological Landscapes to reduce the risk to the population from catastrophic events and climate change.

Action 1. Assess jack pine habitat to determine if changes are needed to areas currently utilized by Kirtland's warblers, considering the current concentration of breeding pairs and climate change.

Action 2. Identify and explore opportunities to encourage appropriate partners (e.g., land trusts) to include acquisition of appropriate Kirtland's warbler sites as a conservation priority.

Action 3. Work with county forests and private landowners to protect and maintain current habitat and to establish new habitat.

Action 4. Use conspecific playback in an effort to establish populations in northern landscapes.

C.1.2. *Manage Brown-headed Cowbird Parasitism*

Cowbird management is essential to maintain Kirtland's warblers on their breeding grounds. With the understanding that cowbird management is significant for the persistence of the species, the agencies have created the following objectives and actions to help achieve the plan's goal.

Objective 1: Continue operation of a brown-headed cowbird management program following guidance in Section E, and adapt as new information becomes available.

Action 1. Maintain cowbird management at current levels within the primary breeding area in Adams County.

Action 2. Evaluate cowbird parasitism risks at other locations in Wisconsin if breeding occurs outside of Adams County, and implement cowbird management efforts if appropriate.

C.1.3. *Minimize Land Use Activities and Associated Conflicts*

Individual Kirtland's warblers are at risk of disturbance from excessive noise, collisions, trampling, and direct loss of habitat. The following objectives and actions were developed to avoid or reduce these conflicts.

Objective 1: Minimize adverse effects on habitat, reproduction, and survival from land use activities following technical guidance in Section D.

Action 1. On state and federal lands, where appropriate, restrict entry to occupied habitat from May 1- August 15. On private lands, advise landowners to follow the same guidelines.

Action 2. On state and federal lands, where appropriate, avoid placement of recreational trails, parking lots, and campgrounds in areas occupied by or managed for Kirtland's

warblers. On private lands, advise landowners to follow the same avoidance measures.

Action 3. On state and federal lands, follow the WDNR Protocol For Incidental Take Permit and Authorization when conducting or planning forest management activities from May 1—August 5 (WDNR 2014d). On private lands, advise against forest management activities during the avoidance period.

Action 4. Avoid construction of wind turbines, communication towers, power lines, pipelines, roads, and other structures within or adjacent (1/4 mile) to areas occupied by Kirtland's warblers.

C.1.4. *Maintain Public Awareness and Support*

To increase public awareness and support of Kirtland's warblers there must be continued communication between agencies and the public. This involves determining and understanding the issues, identifying audiences, crafting messages, selecting the most effective delivery techniques, and evaluating effectiveness. Achieving effective outreach will further the conservation of the species by building understanding of and support for management efforts. The following objectives and actions were developed to build effective outreach.

Objective 1: Work with partners to educate the public about Kirtland's warblers and the pine barrens ecosystem.

Action 1. Maintain existing and create new partnerships (especially with fishing, hunting, recreational users, and community groups) to help strengthen and build a broader base of public support for Kirtland's warbler conservation.

Action 2. Improve communication and outreach to the public in target areas.

Action 3. Provide environmental education to local schools as opportunities arise.

Action 4. Provide the public with opportunities to experience Kirtland's warblers and jack pine habitat, including continued support of guided Kirtland's warbler tours.

C.1.5. *Maintaining Adequate Funding*

Agency and outside funding will be necessary to complete the conservation actions outlined in this plan. Funding is critical to sustaining a successful long-term conservation program, as conservation measures will need to continue into the future. The objectives and actions listed below outline a strategy to identify additional funding sources.

Objective 1: Agencies will continue to pay for habitat management annually to the best of their abilities.

Action 1. Seek private funding, grants, and other funding sources for habitat management.

Action 2. Seek private funding, grants, and other sources for population monitoring efforts.

Action 3. Develop a sustainable approach for funding habitat management.

Action 4. Develop sustainable approaches for funding population monitoring efforts.

Objective 2: Work with partners to establish a consistent and self-sustaining funding source for cowbird management and to supplement other conservation actions identified in this plan.

Action 1. Coordinate and cooperate with conservation partners to implement habitat management for Kirtland's warblers by providing technical guidance and direction.

Action 2. Advance the development of new and innovative funding opportunities in coordination with partners to provide stronger, sustained support for all conservation actions outlined in this plan.

C.1.6. *Adaptive Management*

Adaptive management is a continual process that involves facilitating decision-making and using information gained from past efforts and research, leading to more effective management. The agencies involved in conserving the Kirtland's warbler are committed to using an adaptive management approach in the implementation of this plan to help sustain a population of Kirtland's warblers in Wisconsin.

Objective 1: Monitor the breeding population of Kirtland's warblers to assess whether the population is stable, increasing, or decreasing.

Action 1. Agencies will work cooperatively to survey and monitor the population annually, using standard protocols established by the Kirtland's Warbler Recovery Team.

Action 2. The Wisconsin Kirtland's Warbler Partnership will continue to communicate and collaborate to support the Wisconsin Kirtland's warbler population.

Objective 2: Conduct research to answer priority management needs.

Action 1. Agencies will continue adaptive management, which is informed by ongoing research.

Action 2. Agencies will develop and maintain a list of research priorities, which will be reviewed annually. Researchers will be encouraged to develop and implement projects to address research priorities.

Action 3. Agencies will integrate new science into management decisions through agency specific plans and processes.

Objective 3: Annually determine whether actions in the plan were completed, share those results, and evaluate if changes in management are necessary.

Action 1. Ensure that communication and cooperation continues through the Kirtland's Warbler Recovery Team meetings so that information will be shared between agencies and partners to improve Kirtland's warbler conservation.

Action 2. Wisconsin Kirtland's Warbler Partnership members will report the following items to the Recovery Team:

i. Management accomplishments.
   a. Annual habitat management and protection accomplishments by agency.
   b. Amount of suitable stands per county surveyed annually for Kirtland's warbler occupancy.
   c. Cowbird management program results.
ii. Monitoring plans and results.
iii. Research accomplishments.
iv. Outreach and education efforts.

Action 3. Evaluate monitoring data, research, and other information to determine if goals and objectives in the plan need to be modified.

D. Kirtland's Warbler Habitat Management Guidance

The purpose of this section is to provide technical guidance to land managers on how to create and maintain Kirtland's warbler breeding habitat. This section provides the details needed to implement habitat related actions included in section C (Kirtland's Warbler Management Goals, Objectives, and Actions).

The Kirtland's warbler breeds in jack pine stands found on sandy outwash plains in Michigan, Wisconsin, and Canada. These jack pine stands, characterized by a patchwork of dense pines and grassy openings, are generally occupied when the trees are between 5.5–16.5 feet tall (Bocetti et al. 2014). These types of jack pine stands were historically created by wildfire, but fire suppression and forest fragmentation reduced the extent of jack pine forests. Most jack pine stands are now created through mechanical harvesting and planting on public lands, where the majority of suitable breeding habitat occurs.

The main breeding population of Kirtland's warblers in Wisconsin is found on a red pine plantation, a nesting habitat choice that is considered to be rare for this species (Huber et al. 2001); nesting has been documented in red pine-dominated areas infrequently elsewhere (except for the Upper Peninsula of Michigan, where 18% of singing males are found in a red pine plantation [36/200 birds] since 2009), and with few details (Mayfield 1960; Anderson and Storer 1976; Walkinshaw 1983; Probst and Weinrich 1993). Jack pine accounted for 12.5% of the total tree density at the Wisconsin breeding site (Anich et al. 2011). However, good nest success, high male return rates, and site fidelity indicate that red pine stands with some percentage of jack pine can be acceptable habitat for Kirtland's warblers. Red pines retain low live branches longer than jack pine, which may extend the use of a stand by Kirtland's warblers. Elsewhere in the state, jack pine stands occur on federal, state, county, and private lands that can be managed for jack pine habitat using methods developed in Michigan.

D.1. The Framework for Developing Breeding Habitat

Lands appropriate for the development of Kirtland's warbler breeding habitat have been identified in four ecological landscapes in Wisconsin. (For more information about the ecology of each ecological landscape see section B.1.1.) These ecological landscapes and associated counties suitable for Kirtland's warbler are: the Northeast Sands in Marinette County, the Central Sand Plains in Adams and Jackson counties, the Northern Highlands in Vilas County, and the Northwest Sands in Bayfield and Douglas counties. With the exception of Adams County, a significant portion of land that can be managed for Kirtland's warbler is public – USFS, WDNR, or county forest land. Each agency subsection will be further divided into lands held in each ecological landscape.

D.2. Management of Public Lands

D.2.1. *U.S. Fish and Wildlife Service*

The USFWS assists with the management and protection of Kirtland's warbler habitat in Wisconsin but does not currently manage USFWS owned lands for the species in Wisconsin

D.2.1.1W. Northeast Sands – no lands manageable for Kirtland's warblers

D.2.1.2W. Central Sand Plains

Necedah National Wildlife Refuge: Necedah National Wildlife Refuge (NWR), located in Juneau County, lies between the Adams County breeding site and suitable areas in Jackson County. During the 1978 census, volunteers heard one singing male in Juneau County, however on later visits the bird could not be located. Kirtland's warblers have not been detected in Juneau County since. Necedah NWR does have the potential to create pine barrens habitat with a meaningful amount of suitable habitat for Kirtland's warblers and this potential will be further explored with the agency.

D.2.1.3W. Northern Highlands – no lands manageable for Kirtland's warblers

D.2.1.4W. Northwest Sands – no lands manageable for Kirtland's warblers

D.2.2W. *Wisconsin Department of Natural Resources*

The WDNR manages several properties within the four suitable ecological landscapes and manages them, as appropriate, to promote jack pine forests and barrens that provide habitat to a variety of species (Appendix A) including the Kirtland's warbler. Management on individual properties is variable and dependent upon property management goals, landscape features, funding, and resources. Currently there are no specific Kirtland's warbler habitat management guidelines included in the master plans of any of the suitable properties, but current management strategies may create suitable habitat for the species, and if the species is located on WDNR properties, appropriate actions will be taken. As property master plans come up for

review, the Wisconsin Kirtland's Warbler Partnership will suggest management strategies that will benefit Kirtland's warblers.

D.2.2.1W. Northeast Sands – no lands manageable for Kirtland's warblers

D.2.2.2W. Central Sand Plains

Black River State Forest (BRSF): The Black River State Forest encompasses approximately 68,000 acres in Jackson County. The current master plan for the BRSF does not have Kirtland's warbler specific management guidelines, but does include jack pine management guidelines. Approximately 32% of the land cover is jack pine, with 4,227 acres set aside as a Jack Pine Habitat Management Area. The Jack Pine Habitat Management Area, defined in the BRSF master plan (WDNR 2010), is managed to provide or enhance habitat, and support specific species of plants or animals; short term management goals include protecting, maintaining, and increasing barrens-associated animals, with specific emphasis on rare animals. In 2014, three stands totaling 135 acres within the Jack Pine Habitat Management Area were planted to jack pine (WDNR 2014c). The long term goals of the Jack Pine Habitat Management Area include maintaining and increasing jack pine forests and barrens for ecological values and rare species habitat needs in some areas, and continuous mill products in other areas.

Meadow Valley Wildlife Area (MVWA): The Wisconsin DNR manages the roughly 44,000 acres of MVWA owned by the USFWS under a long-term agreement. Of those 44,000 acres, 6,700 acres are jack pine, and 2,400 acres will be managed for pine barrens. Jack pine-dominated forests will be managed on the property using standard silvicultural practices (WDNR 2011). While jack pine and pine barrens ecosystems are being managed for on the property, there are currently no considerations or guidelines for managing Kirtland's warbler habitat specifically on the MVWA.

D.2.2.3W. Northern Highlands

*Northern Highland American Legion State Forest***:** The Northern Highland American Legion State Forest (NHAL) encompasses more than 232,000 acres in northern Wisconsin, with 3% of that area being jack pine (WDNR 2005b). Isolated areas within the NHAL may be suitable for Kirtland's warbler habitat. Starting in 2017, assessment and planning will be initiated for the NHAL Master Plan, at which time the Wisconsin Kirtland's Warbler Partnership can suggest management strategies to benefit Kirtland's warblers.

D.2.2.4W. Northwest Sands

Brule River State Forest: There is limited opportunity to manage jack pine in the Brule River State Forest, although in the past, males have been observed in Douglas County. The southern portion of the forest bordering the Lyme Easement, when combined with the

Lyme Easement itself, can provide opportunities to manage large areas of young jack pine habitat.

D.2.3. *U.S. Forest Service*

The USFS follows the Chequamegon-Nicolet National Forest (CNNF) Land and Resource Management Plan (USFS 2004) to implement projects that benefit Kirtland's warblers. The CNNF covers over 150 million acres of northern Wisconsin including areas of the Northern Highlands and Northwest Sands ecological landscapes; not all of this area, however, is suitable for jack pine or Kirtland's warblers.

D.2.3.1W. Northeast Sands – no lands manageable for Kirtland's warblers

D.2.3.2W. Central Sand Plains – no lands manageable for Kirtland's warblers

D.2.3.3W. Northern Highlands

The Eagle River-Florence and Park Falls Ranger Districts of CNNF catch the edge of the Northern Highlands Ecological Landscape, however there are very few management opportunities on these portions of the forest for Kirtland's warbler.

D.2.3.4W. Northwest Sands

Chequamegon-Nicolet National Forest: The USFS is implementing the Kirtland's Warbler Habitat Improvement Project by managing 370 acres of Kirtland's warbler habitat in the Washburn Ranger District in Bayfield County. Of the 370 acres, 263 will be managed as a continuous block of Kirtland's Warbler Habitat. The remaining acreage will be treated to improve the jack pine component for future habitat. (USFS 2010).

D.2.4W. *County Forests*

In each of the four ecological landscapes identified as suitable for Kirtland's warbler habitat, individual counties own forests that can be managed to benefit species dependent on jack pine habitat such as the Kirtland's warbler. Each county has different management guidelines for the forest lands they own.

D.2.4.1W. Northeast Sands

Marinette County Forest: In the Northeast Sands ecological landscape, Marinette County owns approximately 230,000 acres of forest. Marinette County has defined a Kirtland's Warbler Management Area within the county forest of approximately 20,000 acres. Within that area, the currently suitable jack pine stands are of modest size and relatively few, but the county is amenable to creating additional habitat. The WNDR is working with Marinette County to identify the best habitat management practices that will create Kirtland's warbler habitat while limiting the cost to the county.

D.2.4.2W. Central Sand Plains

The Central Sand Plains ecological landscape encompasses Adams, Jackson, and Eau Claire counties. Jackson County has approximately 121,000 acres of county forest land and Eau Claire County has approximately 52,000 acres of forest land. Adams County does not have a county forest.

Jackson County Forest: Kirtland's warblers were documented in Jackson County during the 1978 and 1988 surveys, and in 1989 and 2006. Jackson County Forest has stands that may be currently suitable for Kirtland's warbler, and stands that may provide habitat in the future. The county forest has a total of 15,317 acres of jack pine, of which 632 acres of jack pine are 1-5 years old, 656 acres are 6-10 years old, and 504 acres are 11-15 years old (Dave Spaud, personal communication). Typical jack pine management on the Jackson County Forest involves growing jack pine without thinning until stands are 45 years old or more, then clearcutting stands and regenerating jack pine naturally. Where natural regeneration is anticipated to be poor, stands are re-planted with jack pine. Mixed jack pine/red pine stands may be thinned to favor red pine and cutting of jack pine (Dave Spaud, personal communication). Opportunities to work with Jackson County to manage for young jack pine will be explored.

Eau Claire County Forest: The Eau Claire County Forest, covering over 52,000 acres, is divided into three Ecological Management Units (EMU; Eau Claire County Parks and Forest 2014). Of the three Ecological Management Units within the Eau Claire County Forest, EMU 2 (pine and oak barrens) is the unit that offers the most opportunities for jack pine management.).

Three county-owned State Natural Areas (SNA) that are managed for pine barrens ecosystems are located within EMU 2. However, opportunities within those state natural areas to manage for suitable Kirtland's warbler habitat are limited. Coon Fork Barrens SNA is managed for scattered jack pine, barrens flora, and Karner blue butterfly (Armund Bartz, personal communication). South Fork Barrens SNA, situated on rolling uplands and bluff faces, is managed for older jack pine (Armund Bartz, personal communication). Canoe Landing Prairie SNA is managed for open sand prairie and oak barrens (Armund Bartz, personal communication). Opportunities to work cooperatively with Eau Claire County to manage for young jack pine habitat will be explored.

D.2.4.3W. Northern Highlands

Vilas County Forest: Vilas County Forest covers 41,000 acres. Kirtland's warblers have been documented in the past in Vilas County (WDNR, unpublished data). The county forest has potential to provide suitable habitat for Kirtland's warblers, and with proper support from the WDNR or other partners, the County may support habitat development or enhancement projects in the future.

D.2.4.4W. Northwest Sands

Bayfield County Forest: The Bayfield County Forest encompasses approximately 169,000 acres, of which 8% is jack pine. The Bayfield County Forest Comprehensive Land Use Plan (Bayfield County Forestry Department 2006) identifies pine barrens as a habitat of importance, and outlines parameters regarding barrens management on the county forest. The Barnes Barrens Management Plan was created to provide further direction in the development and maintenance of large areas of pine barrens on the county forest. The Barnes Barrens Management Plan (Bayfield County Forestry Department 2013) has been amended to include considerations for Kirtland's warbler habitat. Within each management zone, approximately 200 contiguous acres are designated as Kirtland's warbler habitat and will be reforested to jack pine at suitable stocking rates and with a proper acreage in openings.

Douglas County Forest: The total forest acreage in the Douglas County Forest is approximately 273,000 acres, of which approximately 11,600 acres of jack pine are manageable using standard forestry management practices. Of those 11,600 manageable jack pine acres, 4,100 are in the 9- to 18-year age class, the upper end of suitable habitat age for Kirtland's warbler. To reduce jack pine mortality related to over-maturity on the large acreages of mature or over-mature stands, the Douglas County Forest has targeted all stands age 60+ to be harvested. Management of jack pine within the Douglas County Forest focuses on establishing healthy stands of jack pine using natural regeneration or artificial methods, and manages for multiple age classes to achieve a patchiness typically found with a natural wildfire regime (Douglas County Forestry Department 2006). The Douglas County Pine Barrens Important Bird Area is also present on the Forest. The Wisconsin Kirtland's Warbler Partnership will explore opportunities to work with the Douglas County Forest in managing jack pine habitat.

Washburn County Forest: The Washburn County Forest encompasses 149,000 acres, approximately 51,000 of which are within the Northwest Sands Ecological Landscape. Approximately 7,000 of those acres are jack pine, and the County Forest's management goal is to retain that amount of acreage. Washburn County has identified jack pine as a critical habitat to maintain, and has invested significant resources into regenerating jack pine habitat since the 1970s. Management efforts are focused on habitats and ecosystems (Mike Peterson, personal communication). The Wisconsin Kirtland's Warbler Partnership will identify opportunities to work cooperatively with Washburn County to manage jack pine habitat.

Burnett County Forest: Burnett County owns 106,000 acres of forest land, 21% of which is in jack pine. Jack pine regeneration and wildlife habitat maintenance have been identified as project goals for the County Forest (Burnett County Forest and Parks Department, 2006). The Wisconsin Kirtland's Warbler Partnership will explore opportunities to work with Burnett County to manage young jack pine habitat.

D.3. Habitat Development

In Wisconsin, publicly owned forest lands that are located in the four suitable ecological landscapes can be managed in a variety of ways to provide jack pine habitat while meeting the needs of the property owners and timber production. In general, jack pine stands are harvested between the ages of 40–65 years. Some areas may be managed on a shorter rotation, when appropriate, to create larger blocks or to balance age classes in an area. Management will vary depending on the property owner and the management goals for each property. State and federally owned lands may be managed more liberally, while county or private land owners may manage more conservatively to suit needs such as recreational demands, Managed Forest Law requirements, or to maintain their profit. Collaboration and cooperation between the Wisconsin Kirtland's Warbler Partnership and county and private landowners is essential to establish and maintain suitable jack pine habitat on those lands.

Long-term planning and collaboration between agencies can help maintain sufficient amounts of jack pine habitat to ensure the growth and persistence of the Kirtland's warbler population in the state. Ideally, age-class tables and graphs can be created to display current and future age-class distribution of jack pine within areas that can be managed for Kirtland's warblers, and long-range planning will be conducted using GIS. Understanding of the future age-class distribution, and where those age-classes will be located on the landscape, will influence long-term management planning. Aging sites should be identified and management plans should be made in advance of anticipated harvests. Currently suitable stands should be identified and visually inspected to identify any immediate management needs. Recently harvested sites should have management plans drawn prior to planting and recently planted sites should be checked for appropriate regeneration. All stands identified for jack pine or Kirtland's warbler management should be examined prior to management to ensure that they are of appropriate habitat type and site index. On-the-ground examinations of stands can reveal the need to adjust stand boundaries, or to add or remove stands based on site conditions.

D.4. Distribution of Breeding Habitat

Jack pine habitat should be distributed across the four ecological landscapes to facilitate the movement of Kirtland's warblers into new breeding locations, to increase the Wisconsin population of the species, and to minimize the risk of losing the species and its breeding habitat to catastrophic disturbance.

Successful breeding has occurred in Wisconsin on commercial red pine plantation in Adams County every year since 2008. The Adams population has grown since 2007, but has remained under 20 singing males each year. As the plantations begin to age and new breeding sites in the immediate area may not become available due to forest rotations, the population is at risk of being lost in the future. Outside of Adams County there have been two documented nesting attempts, both in Marinette County. The 2009 nesting attempt in Marinette County was ultimately successful and fledged 3 young, while a 2013 nest with 3 eggs failed prior to fledging. Single singing males and

occasionally females have been observed in other counties in Wisconsin during the annual census (Table 1).

Table 1. The number of singing Kirtland's warbler males located in Wisconsin counties during the annual census period (June 6-20). The annual census was implemented in 2008.

Wisconsin Counties with Singing Males Located During the Annual Census Period							
County	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Adams	7	9	18	19	19	16	11
Bayfield	0	0	2	0	0	0	1
Douglas	0	0	1	1	1	1	0
Marinette	2	2	2	1	3	2	1
Totals	9	11	23	21	24	19	13

The largest breeding population of Kirtland's warblers is found in northern Lower Michigan, with a small breeding population in the Upper Peninsula of Michigan, a very small population in Ontario, Canada, and a small population in Wisconsin; the restricted distribution of the species makes it highly susceptible to catastrophic events such as wildfire or forest pest outbreaks. Increasing the amount of suitable habitat in Wisconsin, especially in the northern part of the state, along with increasing the number of breeding birds in suitable locations outside of Adams County, will help to broaden the distribution of this species and safeguard against catastrophic losses. The Breeding Grounds KWCP thus sets a goal of having 10 percent or more of the population (100 pairs) on public and private lands in the Upper Peninsula and Wisconsin.

D.5. Treatment Block Design – See Breeding Grounds KWCP

D.6. Managing Burned Areas – See Breeding Grounds KWCP

D.7. Adaptive Management – See Breeding Grounds KWCP

D.8. Managing Using Timber Harvest – See Breeding Grounds KWCP

D.9. Reforestation – See Breeding Grounds KWCP

D.10. Prescribed Burning – See Breeding Grounds KWCP

D.11. Management of Private Lands

There are three main conservation easements on private lands that allow for Kirtland's warbler management within the state. The Kirtland's Warbler Conservation Easement and the Karner Blue Butterfly Conservation Easement are located in the Central Sand Plains Ecological Landscape in Adams County. The Lyme Conservation Easement is located in the Northwest Sands Ecological Landscape in Douglas County. The private lands these easements are on are large-scale commercial forest lands.

Kirtland's Warbler Conservation Easement: Currently, the only breeding pairs of Kirtland's warblers in Wisconsin are found on a privately owned, commercial red pine plantation in Adams County. This plantation is located within the Central Sand Plains Ecological Landscape. In 2013, the WDNR created a conservation easement on 1,639 acres of the property to permanently protect Kirtland's Warbler nesting habitat from development. The landowners, in cooperation with the WDNR and USFWS, have done experimental plantings to improve Kirtland's warbler habitat within the easement. The Wisconsin Kirtland's Warbler Partnership will continue to communicate with the landowner about management activities occurring on the easement.

Karner Blue Butterfly Conservation Easement: Surrounding the Kirtland's warbler easement is a Karner Blue Butterfly Easement on 7,449 acres of forest land in Adams County. The Karner blue butterfly easement was created to protect Karner blue butterfly habitat permanently from development but can also offer protection to nesting Kirtland's warblers should they move into that area.

Lyme Conservation Easement: The Lyme Conservation easement is the largest conservation easement in the state of Wisconsin, covering 67,346 acres of forest land on the Northwest Sands Ecological Landscape. In 2013, 4,800 acres of the Lyme property in Douglas County burned during a wildfire; the fire stopped just south of where Kirtland's warblers had been documented singing in the past. The wildfire area could provide good jack pine habitat in several years, and may help concentrate Kirtland's warblers in that area. Regeneration checks will begin in 2015 to assess the success of natural jack pine regeneration within the burned area (Ryan Magana, personal communication). The landowner, Lyme St. Croix Forest Company, has sought

input from the WDNR regarding habitat considerations, including considerations for Kirtland's warblers, as they develop a plan to reforest the burned acres of their property.

D.12. Management of Military Lands

Fort McCoy occupies 60,000 acres in Monroe County, with portions of the property being found in the Central Sand Plains Ecological Landscape. The property is managed according to the Fort McCoy Integrated Natural Resources Management Plan (US Dept. of Defense, US Army 2012). Approximately 8,300 acres are in jack pine, and another 2,800 acres are in red pine. Jack pine stands are managed for pulpwood on a 45-year rotation and red pine stands are managed for pulpwood and saw timber production at 120 years. Allowable annual harvest for jack pine is 106 acres, and for red pine the annual allowable harvest is 28 acres. With the close proximity of Ft. McCoy to currently occupied jack pine stands in Adams County, and jack pine stands in Jackson County, the WDNR will investigate opportunities to conduct Kirtland's warbler surveys and for compatible habitat management on the military installation.

D.13. Land Acquisition and Exchange

Since 2013, the Wisconsin DNR has pursued the acquisition of conservation easements on private lands to protect forest lands in the state that can or currently do provide habitat for Kirtland's warblers and other species that depend on forests or pine barrens. The Wisconsin Kirtland's Warbler Partnership will continue to identify partners and opportunities to acquire conservation easements on lands to protect Kirtland's warbler and jack pine habitat.

The West Wisconsin Land Trust (WWLT) seeks to conserve all types of natural areas, such as working forests and ecologically sensitive areas that are important for wildlife, in western Wisconsin. The North Central Conservancy Trust (NCCT) works with landowners in central Wisconsin to develop easements that protect and preserve the conservation values of their properties. Although neither of these organizations currently have easements for the protection of Kirtland's warblers, their directors have expressed interest in partnering with the Wisconsin Kirtland's Warbler Team to identify and protect Kirtland's warbler habitat through future land use projects.

D.14. Consolidation of FWS Kirtland's Warbler Management Area – See Breeding Grounds KWCP

D.15. Protection of Kirtland's Warbler and Its Habitat – See Breeding Grounds KWCP

D.16. Land Management Considerations

D.16.1. *Wildfire Suppression – See Breeding Grounds KWCP*

D.16.2. *Fuelbreaks – See Breeding Grounds KWCP*

D.16.3. *Insect and Disease Control – See Breeding Grounds KWCP*

D.16.4. *Timber Harvest and Reforestation Activities Adjacent to Occupied Habitat – See Breeding Grounds KWCP*

D. D.16.5. *Prescribed Burning Adjacent to Occupied Habitat – See Breeding Grounds KWCP*

E. D.16.6. *Non-native Invasive Species – See Breeding Grounds KWCP*

F. D.16.7. *Kirtland's Warblers on Private Lands*

Private lands have the potential to provide breeding habitat for Kirtland's warblers as a result of land management activities by the landowners. Prior to conducting a survey for Kirtland's warblers, agency personnel will obtain permission to enter private property from the landowner(s). Private landowners interested in creating or managing jack pine habitat, either as a general goal or to specifically promote Kirtland's warbler, will be directed to the Natural Heritage Conservation Program of the WDNR, to local WDNR foresters, to the USFWS Partners for Fish and Wildlife Program, or to the USFWS Private Lands Office. The WDNR Kirtland's Warbler Partnership will create a pamphlet of Kirtland's warbler habitat management guidelines that can be distributed to landowners, land managers, and agency personnel. Private landowners will be encouraged to protect jack pine habitat.

E. Cowbird Management for Conservation of the Kirtland's Warbler

The purpose of this section is to provide an overview of cowbird management in Wisconsin. Background information about brown-headed cowbird management in the state of Wisconsin can be found in section B of this plan. This information is supplemental to the information found in Section C (Management Goal, Objectives, and Actions). Separate guidance for habitat management can be found in Section D.

E.1W. <u>Cowbird Management in Adams County, Wisconsin</u>

Cowbird trapping has occurred at the Adams county breeding site in Wisconsin in cooperation with the WDNR, USFWS, USDA-APHIS Wildlife Services, and the landowner since 2008. During that time, nest parasitism has been between 18 and 44%, while fledging rates averaged 1.2–1.5 young per successful nest (USFWS and WNDR, unpublished data). While monitoring of nests has occurred since 2008, parasitism and fledging information is a best estimate; nest approaches and close observation of nests have been limited to reduce disturbance-related nesting failure. In Michigan, the rate of parasitism dropped below 10% once cowbird trapping began, and fledging rates averaged more than 2.7 young per nest (Kelly and DeCapita 1982).

E.1.1. *Cowbird Trap Placement and Design*

Cowbird traps are placed within occupied Kirtland's warbler breeding habitat in Adams County to reduce brown-headed cowbird nest parasitism. This is the only known breeding location in Wisconsin, and Kirtland's warbler males have returned to the site annually since 2007. Traps are placed on the site in mid-April and removed at the end of June or early July. Cowbird traps may not be placed in the same location from year to year; they are placed based on where Kirtland's warbler males establish territories. Also, as the location of breeding has shifted, the number of traps has changed. From 2009-2012 only three traps were placed at the Kirtland's warbler breeding site because the males hadn't spread into newer stands. As some males began moving into newer stands and some still maintained territories at older stands, another trap had to be placed in the new stands to effectively manage cowbirds.

Modified Australian crow traps are used to trap cowbirds (Figs. 5 and 6). The traps are baited with live cowbird "decoys", mixed bird seed, and water. Cowbirds are attracted to the calls of the decoy birds and drop through a built-in top funnel with their wings closed. Once inside the trap, the birds cannot get back through the funnel because they need to open their wings to fly out. The traps are 4' x 4' wide and 5 ½' tall, allowing the trapper to walk into the trap to access the birds. Traps are checked at least every 48 hours and trapped cowbirds are humanely euthanized when approximately 40 individuals are in the trap to prevent crowding. Approximately 20 individuals are left in the trap as decoys. Non-target species are released. The Wisconsin cowbird trapping is a cooperative effort between USFWS, USDA-APHIS Wildlife Services, WDNR, and TIR. USDA-APHIS Wildlife Services has a Depredation Permit which is authorized by the USFWS to allow take of brown-headed cowbirds.

Fig. 5. Adams County cowbird trap. Photos: Barry Benson (USDA-APHIS Wildlife Services), 2012

Fig. 6. Adams County cowbird trap. Photos: Barry Benson (USDA-APHIS Wildlife Services), 2012

E.2.W. Cowbird Management outside of Adams County

Cowbird trapping is currently not conducted in Wisconsin outside of Adams County for several reasons. There have only been two recorded nesting attempts outside of Adams County since 2009. With no consistent, successful breeding occurring outside of Adams County currently, there is no need to maintain traps in other areas of the state. Also, cowbirds may be less abundant in the northern part of the state, so it is unclear if cowbird trapping would be necessary if northern breeding sites become established. Kirtland's warbler breeding activities and brown-headed cowbird populations will continue to be monitored throughout the state. If nesting is documented outside of Adams County, cowbird parasitism risks will be monitored; if cowbird densities increase or parasitism is documented, cowbird management efforts will be initiated.

E.3. Cowbird Management Program Responsibilities

Currently the USFWS and WNDR contract cowbird trapping efforts with USDA-APHIS Wildlife Services.

E.4. Monitoring and Research Needs

Continued monitoring of trap numbers, cowbird numbers, and nest parasitism rates will help inform managers about opportunities to improve the cowbird trapping program in Wisconsin. Monitoring and research needs have been identified for the cowbird trapping program. Information gathered from these lines of research will help improve how cowbirds are managed and give the Wisconsin Kirtland's warblers the best chance of survival. Agencies will develop and maintain a list of research priorities, which will be reviewed annually. Researchers will be encouraged to develop and implement projects to address research priorities.

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Appendix A. Rare Species that occur in pine barrens in Wisconsin according to Wisconsin Natural Heritage Inventory.

Association with Pine Barrens: Species are listed according to their level of association with the pine barrens natural community type, based on the findings in the Wisconsin Wildlife Action Plan. **High** = highly associated with pine barrens, **Med**=medium association with pine barrens, **Low**=low association with pine barrens.

State Status: Protection category designated by the Wisconsin DNR. **END** = Endangered; **THR** = Threatened; **SC** = Special Concern;

WDNR and federal regulations regarding Special Concern species range from full protection to no protection. The current categories and their respective levels of protection are as follows**: SC/P** = protected wild animal; **SC/N** = no laws regulating use, possession, or harvesting; **SC/H** = take regulated by establishment of open closed seasons; **SC/FL** = federally protected as endangered or threatened, but not so designated by WDNR; **SC/M** = fully protected by federal and state laws under the Migratory Bird Act.

Special Concern species are those species about which some problem of abundance or distribution is suspected but not yet proven. The main purpose of this category is to focus attention on certain species before they become threatened or endangered.

US Status: Current federal protection status designated by the U.S. Fish and Wildlife Service indicating the biological status of a species in Wisconsin. **LE** = listed endangered; **LT** = listed threatened; **PE** = proposed for listed as endangered; **NEP** = nonessential experimental population(s) in part of its range; **C** = candidate for future listing; **CH** = Critical Habitat; **SOC** = *Species of Concern; **HPR** = High Potential Range.

> ***Federal Species of Concern are those species that may be in need of concentrated conservation actions, which vary depending on the health of the populations and degree and types of threats. They receive no legal protection and are not necessarily species that will eventually be proposed for listing as threatened or endangered.**

Global Rank: Global element rank.

GLOBAL ELEMENT RANKS:

G1 Critically imperiled globally because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction.

G2 Imperiled globally because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.

G3 Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single state or physiographic region), or because of other factors making it vulnerable to extinction throughout its range; in terms of occurrences, in the range of 21 to 100.

G4 Apparently globally secure, though it may be quite rare in parts of its range, especially at the periphery.

G5 Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.

GH Of historical occurrence throughout its range, i.e., formerly part of the established biota, with the expectation that it may be rediscovered.

GNR Not ranked. Replaced G? rank, and some GU ranks.

GU Possibly in peril range-wide, but their status is uncertain. More information is needed.

GX Believed to be extinct throughout its range (e.g. Passenger pigeon) with virtually no likelihood that it will be rediscovered.

Species with a questionable taxonomic assignment are given a "Q" after the global rank.

Subspecies and varieties are given subranks composed of the letter "T" plus a number or letter. The definition of the second character of the subrank parallels that of the full global rank. (Examples: a rare subspecies of a rare species is ranked G1T1; a rare subspecies of a common species is ranked G5T1.)

Common Name	Scientific Name	Association with Pine barrens	State Status	US Status	Global Rank
Birds					
Black-backed Woodpecker	*Picoides arcticus*	Low	SC		G5
Common Nighthawk	*Chordeiles minor*	High	SC		G5
Connecticut Warbler	*Oporornis agilis*	Med	SC		G4
Golden-winged Warbler	*Vermivora chrysoptera*	Low	SC	SOC	G4
Grasshopper Sparrow	*Ammodramus savannarum*	Low	SC		G5
Kirtland's Warbler	*Setophaga kirtlandii*	High	END	LE	G3G4
Lark Sparrow	*Chondestes grammacus*	Med	SC		G5
Long-eared Owl	*Asio otus*	Med	SC		G5
Olive-sided Flycatcher	*Contopus cooperi*	Low	SC		G4
Red-headed Woodpecker	*Melanerpes erythrocephalus*	Low	SC		G5
Sharp-tailed Grouse	*Tympanuchus phasianellus*	High	SC		G5
Spruce Grouse	*Falcipennis canadensis*	Med	THR		G5
Upland Sandpiper	*Bartramia longicauda*	Med	THR		G5
Vesper Sparrow	*Pooecetes gramineus*	High	SC		G5
Western Meadowlark	*Sturnella neglecta*	Low	SC		G5
Whip-poor-will	*Antrostomus vociferus*	Med	SC		G5
Mammals					
Eastern Red Bat	*Lasiurus borealis*	Low	SC		G5
Franklin's Ground Squirrel	*Spermophilus (Poliocitellus) franklinii*	High	SC		G5
Northern Flying Squirrel	*Glaucomys sabrinus*	Low	SC		G5
Prairie Vole	*Microtus ochrogaster*	Low	SC		G5

Common Name	Scientific Name	Association with Pine barrens	State Status	US Status	Global Rank
Western Harvest Mouse	*Reithrodontomys megalotis*	Low	SC		G5
Woodland Jumping Mouse	*Napaeozapus insignis*	Low	SC		G5
Reptiles and Amphibians					
Boreal Chorus Frog	*Pseudacris maculata*	High	SC		
Gophersnake	*Pituophis catenifer*	High	SC		G5
Prairie Racerunner	*Aspidoscelis sexlineata*	Med	SC		G5
Prairie Skink	*Plestiodon septentrionalis*	High	SC		G5
Slender Glass Lizard	*Ophisaurus attenuatus*	High	END		G5
Insects					
A Grasshopper	*Arphia simplex*	Low	SC		G5
A Leafhopper	*Laevicephalus vannus*	Med	SC		GNR
A Leafhopper	*Limotettix pseudosphagneticus*	Low	SC		GNR
A Leafhopper	*Paraphlepsius maculosus*	Med	SC		GNR
Ash-brown Grasshopper	*Trachyrhachys kiowa*	Med	SC		G5
Bina Flower Moth	*Schinia bina*	High	SC		G4
Chryxus Arctic	*Oeneis chryxus*	High	SC		G5
Cobweb Skipper	*Hesperia metea*	High	SC		G4
Dusted Skipper	*Atrytonopsis hianna*	High	SC		G4G5
Frosted Elfin	*Callophrys irus*	High	THR		G3
Gorgone Checker Spot	*Chlosyne gorgone*	Med	SC		G5
Huckleberry Spur-throat Grasshopper	*Melanoplus fasciatus*	High	SC		G5
Karner Blue Butterfly	*Plebejus melissa samuelis*	High	SC		G5T2
Mottled Dusky Wing	*Erynnis martialis*	Med	SC		G3
Net-veined Leafhopper	*Polyamia dilata*	Med	THR		GNR

Common Name	Scientific Name	Association with Pine barrens	State Status	US Status	Global Rank
Northern Barrens Tiger Beetle	*Cicindela patruela patruela*	High	SC		G3T3
Northern Blue	*Plebejus idas*	High	END		G5
Persius Dusky Wing	*Erynnis persius*	High	SC		G5
Phlox Moth	*Schinia indiana*	High	END		G2G4
Phyllira Tiger Moth	*Grammia phyllira*	Low	SC		G4
Sprague's Pygarctica	*Pygarctia spraguei*	High	SC		G5
Stone's Locust	*Melanoplus stonei*	High	SC		G4G5
Rocky Mountain Sprinkled Locust	*Chloealtis abdominalis*	High	SC		G5
Plants					
Blue Ridge Blueberry	*Vaccinium pallidum*	Med	SC		G5
Brittle Prickly-pear	*Opuntia fragilis*	Med	THR		G4G5
Canada Mountain-ricegrass	*Piptatherum canadense*	Med	SC		G5
Catfoot	*Pseudognaphalium micradenium*	Med	SC		G4G5T3?
Clustered Poppy-mallow	*Callirhoe triangulata*	Low	SC		G3
Dwarf Huckleberry	*Vaccinium caespitosum*	High	END		G5
Dwarf Milkweed	*Asclepias ovalifolia*	High	THR		G5?
Fernald's Sedge	*Carex merritt-fernaldii*	High	SC		G5
Grassleaf Rush	*Juncus marginatus*	Med	SC		G5
Hairy Beardtongue	*Penstemon hirsutus*	Med	SC		G4
Large-flowered Ground-cherry	*Leucophysalis grandiflora*	Med	SC		G4?
Missouri Rock-cress	*Arabis missouriensis*	Med	SC		G5

Common Name	Scientific Name	Association with Pine barrens	State Status	US Status	Global Rank
Pale Beardtongue	*Penstemon pallidus*	Med	SC		G5
Prairie Fame-flower	*Phemeranthus rugospermus*	Med	SC		G3G4
Prairie Sagebrush	*Artemisia frigida*	Low	SC		G5
White Blue-eyed Grass	*Sisyrinchium albidum*	Low	SC		
Woolly Milkweed	*Asclepias lanuginosa*	Low	THR		G4?
Sand Violet	*Viola sagittata var. ovata*	High	END		G5T5

Appendix C. Rare Species that Occur in Jack Pine Barrens in Michigan according to Michigan Natural Features Inventory.

Common Name	Scientific Name	MI Status	US Status	GRank
Animals				
Secretive locust	*Appalachia arcana*	SC	SOC	G2G3
Dusted skipper	*Atrytonopsis hianna*	T		G4G5
Prairie warbler	*Setophaga discolor*	E		G5
Kirtland's warbler	*Setophaga kirtlandii*	E	LE	G1
Pine imperial moth	*Eacles imperialis pini*	SC		G5T3
Red-legged spittlebug	*Prosapia ignipectus*	SC		G4
Sprague's pygarctia	*Pygarctia spraguei*	SC		G5
Grizzled skipper	*Pyrgus wyandot*	SC	SOC	G1G2Q
Eastern massasauga	*Sistrurus catenatus*	SC	C	G3G4
Sharp-tailed grouse	*Tympanuchus phasianellus*	SC		G4
Plants				
Pale agoseris	*Agoseris glauca*	T		G4G5
Hill's thistle	*Cirsium hillii*	SC	SOC	G3
Rough fescue	*Festuca scabrella*	T		G5
Vasey’s rush	*Juncus vaseyi*	T		G5
Alleghany plum	*Prunus alleghaniensis var.davisii*	SC		G4T3