

DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR 17

[Docket No. FWS-R3-ES-2018-0005;
FXES1113090000]

RIN 1018-BC01

Endangered and Threatened Wildlife and Plants; Removing the Kirtland's Warbler From the Federal List of Endangered and Threatened Wildlife

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Final rule.

SUMMARY: Under the authority of the Endangered Species Act of 1973, as amended (ESA), we, the U.S. Fish and Wildlife Service (Service), are removing the Kirtland's warbler (*Setophaga kirtlandii*) from the Federal List of Endangered and Threatened Wildlife (List) due to recovery. This determination is based on a thorough review of the best available scientific and commercial information, which indicates that the threats to the species have been eliminated or reduced to the point that the species has recovered and no longer meets the definition of endangered or threatened under the ESA. This rule also announces availability of a post-delisting monitoring plan for Kirtland's warbler.

DATES: This rule is effective November 8, 2019.

ADDRESSES: This final rule and the post-delisting monitoring plan are available on the internet at <http://www.regulations.gov> under Docket No. FWS-R3-ES-2018-0005 or <https://ecos.fws.gov>. Comments and materials we received, as well as supporting documentation we used in preparing this rule, are available for public inspection at <http://www.regulations.gov>. Comments, materials, and documentation that we considered in this rulemaking will be available by appointment, during normal business hours at: U.S. Fish and Wildlife Service, Michigan Ecological Services Field Office, 2651 Coolidge Road, Suite 101, East Lansing, MI 48823; telephone 517-351-2555.

FOR FURTHER INFORMATION CONTACT: Scott Hicks, Field Supervisor, Michigan Ecological Services Field Office, 2651 Coolidge Road, Suite 101, East Lansing, MI 48823; telephone 517-351-2555. If you use a telecommunications device for the deaf (TDD), please call the Federal Relay Service at 800-877-8339.

SUPPLEMENTARY INFORMATION:

Executive Summary

Why we need to publish a rule. Under the Endangered Species Act, a species may be removed from the List ("delisted") if it is determined that it has recovered and is no longer endangered or threatened. Delisting can be completed only by issuing a rule.

*This rule removes the Kirtland's warbler (*Setophaga kirtlandii*) from the List.*

Basis for action. Under the ESA, we determine that a species is an endangered or threatened species based on any of five factors: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence. We must consider the same factors in delisting a species. We have determined that the primary threats to the Kirtland's warbler have been reduced or managed to the point that the species is recovered.

Peer review and public comment. We sought comments on the proposed delisting rule and draft post-delisting monitoring plan from independent specialists to ensure that this rule is based on scientifically sound data, assumptions, and analyses. We also considered all comments and information we received during the proposed delisting rule's comment period.

Previous Federal Actions

On April 12, 2018, we published a proposed rule to remove Kirtland's warbler from the List (83 FR 15758). Please refer to that proposed rule for a detailed description of previous Federal actions concerning this species.

Species Information

Taxonomy

The Kirtland's warbler is a songbird classified in the Order Passeriformes, Family Parulidae. This species was originally described in 1852, and named *Sylvicola kirtlandii* (Baird 1872, p. 207). The American Ornithologists' Union Committee on Classification and Nomenclature-North and Middle America recently changed the classification of the Parulidae, which resulted in three genera (*Parula*, *Dendroica*, and *Wilsonia*) being deleted and transferred to the genus *Setophaga* (Chesser *et al.* 2011, p. 606). This revision was adopted by the Service on February 12, 2014 (78 FR 68370; November 14, 2013).

Distribution

The Kirtland's warbler is a neotropical migrant that breeds in jack pine (*Pinus banksiana*) forests in northern Michigan, Wisconsin, and Ontario. This species has one of the most geographically restricted breeding distributions of any mainland bird in the continental United States. Breeding habitat within the jack pine forest is both highly specific and disturbance-dependent, and likely was always limited in extent (Mayfield 1960, pp. 9–10; Mayfield 1975, p. 39). Similarly, the known wintering range is primarily restricted to The Bahamas (Cooper *et al.* 2019, p. 83).

Kirtland's warblers are not evenly distributed across their breeding range. Female Kirtland's warblers are often observed with singing males; therefore, nesting is generally assumed to occur at most sites where singing males are present (Probst *et al.* 2003, p. 369; MDNR, USFWS, USFS, unpubl. data). More than 98 percent of all singing males have been counted in the northern Lower Peninsula of Michigan since population monitoring began in 1951 (Michigan Department of Natural Resources (MDNR), Service (USFWS), U.S. Forest Service (USFS), unpubl. data). The core of the Kirtland's warbler's breeding range is concentrated in five counties in northern lower Michigan (Ogemaw, Crawford, Oscoda, Alcona, and Iosco), where nearly 85 percent of the singing males were recorded between 2000 and 2015, with over 30 percent counted in Ogemaw County alone and over 21 percent in just one township during that same time period (MDNR, USFWS, USFS, unpubl. data).

Kirtland's warblers have been observed in Ontario periodically since 1900 (Samuel 1900, pp. 391–392) and in Wisconsin since the 1940s (Hoffman 1989, p. 29). Systematic searches for the presence of Kirtland's warblers in States and provinces adjacent to Michigan, however, did not begin until 1977 (Aird 1989, p. 32; Hoffman 1989, p. 1) and have not been conducted consistently across the years. Shortly after these searches began, male Kirtland's warblers were found during the breeding season in Ontario in 1977 and Quebec in 1978 (Aird 1989, pp. 32–35), Wisconsin in 1978 (Tilghman 1979, p. 19), and the Upper Peninsula of Michigan in 1982 (Probst 1985, p. 11). Nesting was confirmed in the Upper Peninsula in 1996 (Weinrich 1996, p. 2; Weise and Weinrich 1997, p. 2), and in Wisconsin and Ontario in 2007 (Richard 2008, pp. 8–10; Trick *et al.* 2008, pp. 97–98). Singing males have been observed in the

Upper Peninsula annually since 1993, with the majority of observations in the central and eastern Upper Peninsula (MDNR, USFWS, USFS, unpubl. data). In Wisconsin, nesting has been confirmed in Adams County every year since 2007 and has expanded into Marinette and Bayfield Counties (USFWS 2017, pp. 2–4). Scattered observations of mostly solitary birds have also occurred in recent years at several other sites in Douglas, Vilas, Washburn, and Jackson Counties in Wisconsin. Similarly, in Ontario, nesting was confirmed in Renfrew County from 2007 to 2016 (Richard 2013, p. 152; Tuininga 2017, pers. comm.), and reports of Kirtland's warblers present during the breeding season have occurred in recent years in both northern and southern Ontario (Tuininga 2017, pers. comm.).

The current distribution of breeding Kirtland's warblers encompasses the known historical breeding range of the species based on records of singing males observed in Michigan's northern Lower Peninsula, Wisconsin, and Ontario (Walkinshaw 1983, p. 23). In Michigan's northern Lower Peninsula, the Kirtland's warbler's breeding habitat is spread over an approximately 15,540-square-kilometer (km) (6,000-square-mile) non-contiguous area. In 2015, the number of singing males confirmed in Wisconsin (19), Ontario (20), and the Upper Peninsula (37) represented approximately 3 percent of the total singing male population (Environment Canada, MDNR, USFS, USFWS, Wisconsin Department of Natural Resources (WDNR), unpubl. data), demonstrating the species' reliance on their core breeding range in Michigan's northern Lower Peninsula. The number of Kirtland's warblers that could ultimately exist outside of the core breeding range is unknown; however, these peripheral individuals do contribute to a wider distribution.

On the wintering grounds, Kirtland's warblers are more difficult to detect and are infrequently observed. Kirtland's warblers are unevenly distributed across the landscape; they tend to hide in low-lying, dense vegetation, and males do not generally sing during the winter (Currie *et al.* 2003, pp. 1–2; Currie *et al.* 2005a, p. 97). Kirtland's warblers winter largely within The Bahamas (Mayfield 1996, pp. 36–38; Lee *et al.* 1997, p. 21; Stone 1986, p. 2). The Bahamas is an archipelago of approximately 700 low-lying islands stretching more than 1,046 km (650 miles) from near the eastern coast of Florida to the southeastern tip of Cuba. The central islands, particularly Eleuthera and Cat Islands, support the largest known population of

wintering Kirtland's warblers (Sykes and Clench 1998, pp. 249–250; Cooper *et al.* 2019, p. 85). Wintering Kirtland's warbler have also been observed in The Bahamas on The Abacos, Andros, Cat Island, Crooked Island, Eleuthera, The Exumas, Grand Bahama Island, Long Island, and San Salvador (Blanchard 1965, pp. 41–42; Cooper, unpubl. data; Cooper *et al.* 2019, p. 85; Ewert and Wunderle, unpubl. data; Haney *et al.* 1998, p. 202; Hundley 1967, pp. 425–426; Jones *et al.* 2013, pp. 638–641; Mayfield 1972, pp. 347–348; Mayfield 1996, pp. 37–38; Sykes and Clench 1998, p. 250).

Although the central islands of The Bahamas support the greatest number of overwintering Kirtland's warblers, less frequent sightings have been reported elsewhere in the Caribbean, including sightings from northern Dominican Republic, coastal Mexico (Haney *et al.* 1998, p. 205), Bermuda (Amos 2005, p. 3), Cuba (Isada 2006, p. 462; Sorenson and Wunderle 2017), Florida (Cooper *et al.* 2019, p. 85), and Jamaica (Weidensaul 2019). These sightings may represent vagrants and do not necessarily represent an extension of the overwintering range.

Recent data from winter playback surveys, citizen scientists, and light-level geolocators also indicate that the majority of overwintering Kirtland's warblers are found in the central Bahamas, with fewer birds overwintering in the western and eastern Bahamas and Cuba (Cooper *et al.* 2017, pp. 209–211; Cooper *et al.* 2019, pp. 84–85).

Although the central islands of The Bahamas support the greatest number of overwintering Kirtland's warblers, less frequent sightings have been reported elsewhere in the Caribbean. Of 107 accessible reports, only 3 originated from outside of The Bahamas: Two sightings from northern Dominican Republic, and one sighting from coastal Mexico (Haney *et al.* 1998, p. 205). In addition, recent winter reports of solitary individuals have originated from Bermuda (Amos 2005, p. 3), Cuba (Isada 2006, p. 462; Sorenson and Wunderle 2017), Florida (Cooper *et al.* 2019, p. 85), and Jamaica (Weidensaul 2019), possibly representing vagrants and not necessarily representative of an extension of the overwintering range.

Although the known wintering range appears restricted primarily to The Bahamas, many of the islands in the Caribbean basin are uninhabited by people, may be overgrown and difficult to access, or have had limited avian survey efforts, which may constrain our ability to comprehensively describe the species' wintering distribution.

Kirtland's warblers readily shift sites on the wintering grounds based on habitat availability and food resources, and they colonize new areas following disturbance (Wunderle *et al.* 2007, p. 123; Wunderle *et al.* 2010, p. 134; Wunderle *et al.* 2014, p. 44). Suitable habitat may exist on other islands, both within The Bahamas and elsewhere in the Caribbean basin, potentially providing habitat and buffering against the effects of catastrophic events such as hurricanes. However, the full extent and availability of suitable habitat on the wintering grounds has not been measured outside of the more-studied island of Eleuthera (Wunderle 2018, pers. comm.).

Breeding Habitat

The Kirtland's warbler's breeding habitat consists of jack pine-dominated forests with sandy soil and dense ground cover (Walkinshaw 1983, p. 36), most commonly found in northern lower Michigan, with scattered locations in the Upper Peninsula of Michigan, Wisconsin, and Ontario. Jack pine-dominated forests of the northern Great Lakes region historically experienced large, frequent, and catastrophic stand-replacing fires (Cleland *et al.* 2004, p. 313). These fires occurred approximately every 60 years, burned approximately 85,420 hectares (ha) (211,077 acres (ac)) per year, and resulted in jack pine comprising 53 percent of the total land cover (Cleland *et al.* 2004, pp. 315–317). Modern wildfire suppression has since increased the average fire return interval within this same landscape to approximately 775 years, decreased the amount of area burned to approximately 6,296 ha (15,558 ac) per year, and reduced the contribution of jack pine to 37 percent of the current land cover (Cleland *et al.* 2004, p. 316). The overall effect has been a reduction in the extent of dense jack pine forest, and in turn, the Kirtland's warbler's breeding habitat.

Kirtland's warblers generally occupy jack pine stands that are 5 to 23 years old and at least 12 ha (30 ac) in size (Donner *et al.* 2008, p. 470). The most obvious difference between occupied and unoccupied stands is the percent canopy cover (Probst 1988, p. 28). Stands with less than 20 percent canopy cover are rarely used for nesting (Probst 1988, p. 28). Tree canopy cover reflects overall stand structure, combining individual structural components such as tree stocking, spacing, and height factors (Probst 1988, p. 28). Tree canopy cover, therefore, may be an important environmental cue for Kirtland's warblers when selecting nesting areas.

Occupied stands usually occur on dry, excessively drained, nutrient-poor glacial outwash sands (Kashian *et al.* 2003, pp. 151–153). Stands are structurally homogeneous with trees ranging 1.7 to 5.0 meters (m) (5.5 to 16.4 feet (ft)) in height and are generally of three types: Wildfire-regenerated, planted, and unburned-unplanted (Probst and Weinrich 1993, p. 258). Wildfire-regenerated stands occur naturally following a stand-replacing fire from serotinous seeding (seed cones remain closed on the tree with seed dissemination in response to an environmental trigger, such as fire). Planted stands are stocked with jack pine saplings after a clear cut. Unburned-unplanted stands originate from clearcuts that regenerate from non-serotinous, natural seeding, and thus do not require fire to release seeds.

Optimal habitat is characterized as large stands (more than 32 ha (80 ac)) composed of 8- to 20-year-old jack pines that regenerated after wildfires, with 27 to 60 percent canopy cover, and more than 5,000 stems per hectare (2,023 stems per acre) (Probst and Weinrich 1993, pp. 262–263). The poor quality and well-drained soils reduce the risk of nest flooding and maintain low shrubs that provide important cover for nesting and brood-rearing. Yet as jack pine saplings grow in height, percent canopy cover increases, causing self-pruning of the lower branches and changes in light regime, which diminishes cover of small herbaceous understory plants (Probst 1988, p. 29; Probst and Weinrich 1993, p. 263; Probst and Donnerwright 2003, p. 331). Kirtland's warblers select nest sites with higher jack pine densities, higher percent cover of blueberry, and lower percent cover of woody debris than would be expected if nests were placed at random (Bocetti 1994, p. 122). Due to edge effects associated with low area-to-perimeter ratios, predation rates may be higher for Kirtland's warblers nesting in small patches bordered by mature trees than in large patches (Probst 1988, p. 32; Robinson *et al.* 1995, pp. 1988–1989; Helzer and Jelinski 1999, p. 1449). Foraging requirements may also be negatively influenced as jack pines mature (Fussman 1997, pp. 7–8).

Conversely, marginal habitat is characterized as jack pine stands with at least 20 to 25 percent tree canopy cover and a minimum density of 2,000 stems per hectare (809 stems per acre, Probst and Weinrich 1993, pp. 261–265; Nelson and Buech 1996, pp. 93–95), and is often associated with unburned-unplanted areas (Donner *et al.* 2010, p. 2). The main disadvantage of marginal habitat is reduced pairing success

(Probst and Haynes 1987, p. 237); however, Kirtland's warblers successfully reproduce in areas with smaller percentages of jack pine and with significant components of red pine (*Pinus resinosa*) and pin oak (*Quercus palustris*) in Wisconsin and Canada (Mayfield 1953, pp. 19–20; Orr 1975, pp. 59–60; USFWS 1985, p. 7; Fussman 1997, p. 5; Anich *et al.* 2011, p. 201; Richard 2013, p. 155; Richard 2014, p. 307). Use of these areas in Michigan is rare and occurs for only short durations (Huber *et al.* 2001, p. 10). 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, p. 204). Preliminary investigation (Anich *et al.* 2011, p. 204) suggests 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. Habitat conditions in documented Kirtland's warbler breeding areas in Ontario had ground cover similar to breeding sites in Michigan and Wisconsin, although tree species composition was more similar to Wisconsin sites than Michigan sites (Richard 2014, p. 306). The tree species composition at the Canadian sites also had high levels of red pine (up to 71 percent), similar to the plantations in Wisconsin (Anich *et al.* 2011, p. 201; Richard 2014, p. 307).

Habitat management to benefit Kirtland's warblers began as early as 1957 on State forest land and 1962 on Federal forest land (Mayfield 1963, pp. 217–219; Radtke and Byelich 1963, p. 209). Efforts increased in 1981, with the establishment of an expanded habitat management program to supplement wildfire-regenerated habitat and ensure the availability of relatively large patches of early successional jack pine forest for nesting (Kepler *et al.* 1996, p. 16). In the late 1980s, maturation of habitat generated through wildfire contributed to a higher percentage of the total suitable habitat available to the Kirtland's warbler compared to other types of habitat (Donner *et al.* 2008, p. 472). By 1992, artificially regenerated plantation habitat was nearly twice as abundant as wildfire habitat, and increased to triple that of wildfire habitat by 2002 (Donner *et al.* 2008, p. 472). From 1979 to 1994, the majority of singing males were found in wildfire-generated habitat (Donner *et al.* 2008, p. 474). By 1994, responding to a shift in available nesting habitat types, males

redistributed out of habitat generated by wildfire and unburned-unplanted habitat and into plantation (planted) habitat. From 1995 to 2004, males continued redistributing into plantations from wildfire habitat, and 85 percent of males were found in plantation habitat by 2004 (Donner *et al.* 2008, p. 475). This redistribution of males into plantations also resulted in males being more evenly distributed across the core breeding range than in previous years. Since 2004, the majority of Kirtland's warblers continue to nest in plantations (USFWS, unpubl. data).

The amount of available suitable habitat has also increased significantly in the past 40 years due to these increased efforts by land management agencies. The goal for 51,638 ha (127,600 ac) of available habitat to support a recovered Kirtland's warbler population was initially set out in the 1981 Management Plan for Kirtland's Warbler Habitat (USFS and MDNR 1981, p. 18). Of this total, approximately 29,987 ha (74,100 ac) of Michigan State forest lands and about 21,650 ha (53,500 ac) of Federal forest lands were identified as lands suitable and manageable for Kirtland's warbler breeding habitat. That plan also provided prescriptions and guidelines to be used in protecting and improving identified nesting habitat. Contiguous stands or stands in close proximity were grouped into 23 areas referred to as Kirtland's Warbler Management Areas (KWMA). KWMA are administrative boundaries that describe parcels of land dedicated to and managed for Kirtland's warbler breeding habitat. The KWMA were further subdivided into cutting blocks containing 200 or more acres of contiguous stands. These acreages were determined by factoring an average population density of one breeding pair per 12 ha (30 ac) into a 45- to 50-year commercial harvest rotation, with the goals of producing suitable habitat as well as marketable timber (USFWS 1985, p. 21). Data collected from the annual singing male census from 1980 to 1995 indicated that a breeding pair used closer to 15 ha (38 ac) within suitably aged habitat (Bocetti *et al.* 2001, p. 1). Based on these data, in 2002, the Kirtland's Warbler Recovery Team (Recovery Team) recommended increasing the total amount of managed habitat to 76,890 ha (190,000 ac) (Ennis 2002, p. 2). Habitat management is currently conducted on approximately 88,788 ha (219,400 ac) of jack pine forest within MDNR (36,705 ha (90,700 ac)), USFS (49,372 ha; 122,000 ac), and Service lands (2,711 ha (6,700 ac)) throughout the northern Lower

Peninsula and Upper Peninsula of Michigan (MDNR *et al.* 2015, pp. 22–23), exceeding both the original and revised acreage goals.

Wintering Habitat

On the wintering grounds, Kirtland's warblers occur in early successional scrublands, characterized by dense, low, broadleaf shrubs of varied foliage layers with small openings, resulting from natural or anthropogenic disturbances (locally known as low coppice) (Maynard 1896, pp. 594–595; Challinor 1962, p. 290; Mayfield 1972, p. 267; Radabaugh 1974, p. 380; Mayfield 1992, p. 3; Mayfield 1996, pp. 38–39; Lee *et al.* 1997, p. 23; Haney *et al.* 1998, p. 207; Sykes and Clench 1998, p. 256; Wunderle *et al.* 2007, p. 123; Wunderle *et al.* 2010, p. 133). Kirtland's warblers predominantly overwinter in broadleaf scrub habitat, rather than pine-dominated habitats (Cooper *et al.* 2019, p. 83). Suitable wintering habitat requires availability of a food source, often fruit plants such as *Erithalis fruticosa* and *Lantana involucrata* (see "Diet and Foraging," below, for additional discussion) that are in fruit at the right time of year, as well as availability of water.

Historically, Kirtland's warbler winter habitat was likely created when storm surges or other natural disturbances, such as wildfire, removed vegetation and leaf litter (Wunderle and Ewert 2018, p. 1; Wunderle 2018, pers. comm.), allowing for establishment of the preferred fruit plants (which are shade-intolerant) (Fleming *et al.* 2015, p. 588). Human-caused disturbances may also produce suitable habitat for Kirtland's warblers. Although goats consume the preferred fruit plants, the plants readily regrow in open sunlight and persist, indicating goat grazing could be an effective means of setting back succession and creating or maintaining Kirtland's warbler habitat (Fleming *et al.* 2016, p. 287). Abandonment of garden plots or other cultivated lands are not likely to result in suitable Kirtland's warbler habitat, because the important fruit plants are shaded out by other, faster-growing plants (Wunderle *et al.*, unpubl. data).

Kirtland's warblers typically occupy wintering sites 3 to 28 years (the mean is approximately 14 years) after human disturbance (Wunderle *et al.* 2010, p. 127). As local food resources diminish in abundance, these sites may not be sufficient to sustain an individual for an entire winter; therefore, individuals must move widely from patch to patch, tracking changes in fruit abundance (Wunderle *et al.* 2007, p. 123; Wunderle

et al. 2010, p. 134; Wunderle *et al.* 2014, p. 44).

Migration and Stopover Habitat

Spring departure from the wintering grounds is estimated to occur from late April to early May, and arrival on the breeding grounds occurs approximately 15 days later (Cooper *et al.* 2017, p. 212; Rockwell *et al.* 2012, p. 746; Ewert *et al.* 2012, p. 11). Male Kirtland's warblers have been observed arriving on the breeding grounds between May 1 and June 5 (Petrucha 2011, p. 17; Rockwell *et al.* 2012, p. 747), with the first females arriving a week or so after the first males (Mayfield 1960, pp. 41–42; Rockwell 2013, pp. 48–49).

Fall migration of adult males begins in late September through late October and ends with arrival on the wintering grounds in mid-October to early November (Cooper *et al.* 2017, p. 212). The earliest recorded sighting in The Bahamas was August 20 (Robertson 1971, p. 48). Data from recovered geolocators showed that most Kirtland's warblers exhibited a loop migration, with fall migration occurring farther east than spring migration (Cooper *et al.* 2017, p. 214). Nearly all males departed the breeding grounds and flew in an easterly direction, spending time in southeastern Ontario or in the eastern Great Lakes region of the United States (Cooper *et al.* 2017, pp. 211, 213). Fall migration proceeded in a general southern direction, departing the mainland United States along the Carolina coastline (Cooper *et al.* 2017, pp. 211, 213). Spring migration followed a more westerly path, with landfall occurring in Florida and Georgia (Cooper *et al.* 2017, pp. 213, 216). An additional stopover site was identified in the western Lake Erie basin (Cooper *et al.* 2017, p. 216). An analysis of 562 records of Kirtland's warblers observed during migration found that migration records were spread over most of the United States east of the Mississippi River, clustered around the Great Lakes and Atlantic Ocean coastlines (Petrucha *et al.* 2013, p. 383).

Migrating Kirtland's warblers have been observed in a variety of habitats, including shrub/scrub, residential, park, orchard, woodland, and open habitats (Petrucha *et al.* 2013, p. 390). There is some evidence that dense vegetation less than 1.5 m (4.9 ft) in height may be important to migrating Kirtland's warblers (Stevenson and Anderson 1994, p. 566). The majority of migration records (82 percent) described the habitat as shrub/scrub, similar in structure to what the species uses on the breeding and wintering grounds (Petrucha *et al.* 2013, p. 384).

Diet and Foraging

On the breeding grounds, Kirtland's warblers are primarily insectivorous and forage by gleaning (plucking insects from) 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 forage on a wide variety of prey items, including various types of larvae, moths, flies, beetles, grasshoppers, ants, aphids, spittlebugs, and blueberries (Mayfield 1960, pp. 18–19; Fussman 1997, p. 33). Similar taxa have been identified from fecal samples from Kirtland's warblers, although homopterans (primarily spittlebugs), hymenoptera (primarily ants), and blueberries were proportionally greater in number than other taxa among samples collected from July to September (Deloria-Sheffield *et al.* 2001, p. 385). These differences in the relative importance of food items between spring foraging observations and late summer fecal samples may be temporal and may reflect a varied diet that shifts as food items become more or less available during the breeding season (Deloria-Sheffield *et al.* 2001, p. 386). Within nesting areas, arthropod numbers peak at the same time that most first broods reach the fledging stage (Fussman 1997, p. 27). 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, p. 63).

On the wintering grounds, Kirtland's warblers rely on a mixed diet of fruit and arthropods. During foraging observations, 69 percent of Kirtland's warblers consumed fruits, such as snowberry (*Chiococca alba*), wild sage (*Lantana involucrata*), and black torch (*Erithalis fruticosa*), with wild sage being the overwhelmingly predominant food choice (Wunderle *et al.* 2010, pp. 129–130). Despite variation in food availability among sites and winters, the proportion of fruit and arthropods in fecal samples of Kirtland's warblers was consistent (Wunderle *et al.* 2014, p. 25). Food abundance was a reliable predictor of site fidelity, with birds shifting location to sites with higher biomass of ripe fruit and ground arthropods during the late winter (Wunderle *et al.* 2014, p. 31).

Demographics

The average life expectancy of adult Kirtland's warblers is approximately 2.5

years (Walkinshaw 1983, pp. 142–143). The oldest Kirtland's warbler on record was an 11-year-old male, which, when recaptured in the Damon KWMA in 2005, appeared to be in good health and paired with a female (USFS, unpubl. data).

Overall, Kirtland's warbler annual survival estimates are similar to those of other wood warblers (reviewed in Faaborg *et al.* 2010, p. 12). Survival rates of the Kirtland's warbler varied by sex and age classes (Mayfield 1960, pp. 204–207; Walkinshaw 1983, pp. 123–143; Bocetti *et al.* 2002, p. 99; Rockwell *et al.* 2017, p. 723; Trick, unpubl. data). Based on mark-recapture data from 2006–2010 on breeding grounds in Michigan and from 2003–2010 on the wintering grounds in The Bahamas, the mean annual survival estimates for adults and yearlings were 0.58 and 0.55, respectively (Rockwell *et al.* 2017, pp. 719–721). Monthly survival probabilities were relatively high when birds were stationary on the wintering and breeding grounds, and were substantially lower during the migratory period, which has the highest mortality rate out of any phase of the annual cycle, accounting for 44 percent of annual mortality (Rockwell *et al.* (2017, p. 722). Survival probability was positively correlated to March rainfall in the previous year, suggesting the effects of rain on the wintering grounds carried over to affect annual survival in subsequent seasons. Late winter rainfall in The Bahamas showed a positive effect on Kirtland's warblers corrected body mass (Wunderle *et al.* 2014, p. 47). Reduced rain can result in lower available food resources for Kirtland's warblers, which could result in poorer body condition, making them less likely to survive the subsequent spring migration (Rockwell *et al.* 2017, pp. 721–722) and lowering reproductive success during the breeding season (Rockwell *et al.* 2012, p. 745).

Historically, one of the largest factors influencing Kirtland's warbler's reproductive success was brood parasitism from brown-headed cowbirds (*Molothrus ater*). Brown-headed cowbirds are obligate brood parasites. Females remove an egg from a host species' nest and lay their own egg to be raised by the adult hosts, usually resulting in the death of the remaining host nestlings (Rothstein 2004, p. 375). Prior to initiation of the brown-headed cowbird management program (discussed in more detail under *Factor E: Brood Parasitism*), Kirtland's warblers averaged less than one young fledged per nest (Walkinshaw 1983, p. 151). After brown-headed cowbird control efforts began in 1972, the estimated

number of chicks fledged per nest (1972 to 1977) increased to 2.67, with 63.3 percent nest success (Walkinshaw 1983, pp. 150–152). More recently, mean annual reproductive success of 3.3 fledglings per year per male has been observed (Rockwell *et al.* 2012, p. 748).

Genetics

From the information available, it appears that Kirtland's warblers display winter and breeding-ground panmixia (mixing of individuals across locations within the population). In 2007, eight birds examined from six different wintering sites on Eleuthera Island were found on breeding territories in the Damon KWMA in Ogemaw County, Michigan (Ewert, unpubl. data). Additionally, four other birds banded from one wintering site on Eleuthera Island were found on breeding territories across four counties in northern lower Michigan. Kirtland's warblers are also known to regularly move between KWMA's in northern lower Michigan during the breeding season (Probst *et al.* 2003, p. 371). Regardless of where they overwintered in The Bahamas (*i.e.*, either Cat or Eleuthera Islands), Kirtland's warblers intermixed heavily on the breeding grounds and migrated to various sites throughout the breeding range, showing a weak connectivity between the breeding and wintering grounds (Cooper *et al.* 2018, pp. 5–6). These data suggest that the warbler's population exhibits panmictic (a group of interbreeding individuals where all individuals in the population are potential reproductive partners) rather than metapopulation (groups of interbreeding individuals that are geographically distinct) demographic characteristics (Esler 2000, p. 368).

Analysis of microsatellite DNA markers from Kirtland's warblers in Oscoda County, Michigan, over three time periods (1903–1912, 1929–1955, and 2008–2009) showed no evidence of a genetic bottleneck in the oldest (1903–1912) sample, indicating that any population declines prior to that point may have been gradual (Wilson *et al.* 2012, pp. 7–9). Although population declines have been observed since then, there was only weak genetic evidence of a bottleneck in the two more recent samples (no bottleneck detected in two of three possible models for each sample). The study showed a slight loss of allelic richness between the oldest and more recent samples, but no significant difference in heterozygosity between samples and no evidence of inbreeding. Effective population size estimates varied depending on the methods used, but none was low

enough to indicate that inbreeding or rapid loss of genetic diversity were likely in the future (Wilson *et al.* 2012, pp. 7–9). Based on the available data, genetic diversity does not appear to be a limiting factor for the Kirtland's warbler or indicate the need for genetic management at this time.

Abundance and Population Trends

Prior to 1951, the size of the Kirtland's warbler population was extrapolated from anecdotal observations and knowledge about breeding and wintering habitat conditions. The Kirtland's warbler population may have peaked in the late 1800s, a time when conditions across the species' distribution were universally beneficial (Mayfield 1960, p. 32). Wildfires associated with intensive logging, agricultural burning, and railroads in the Great Lakes region burned hundreds of thousands of acres, and vast portions were dominated by jack pine forests (Pyne 1982, pp. 199–200, 214). Suitable winter habitat consisting of low coppice (early-successional and dense, broadleaf vegetation) was also becoming more abundant, due to a decrease in widespread commercial agriculture in The Bahamas after the abolition of slavery in 1834, resulting in former croplands converting to scrub (low coppice) (Sykes and Clench 1998, p. 245). During this time, Kirtland's warblers were found in greater abundance throughout The Bahamas than were found in previous decades, and reports of migratory strays came from farther north and west of the known migratory range, evidence of a larger population that would produce more migratory strays (Mayfield 1993, p. 352).

Between the early 1900s and the 1920s, agriculture in the northern Great Lakes forests was being discouraged in favor of industrial tree farming, and systematic fire suppression was integrated into State and Federal policy (Brown 1999, p. 9). The estimated amount of jack pine on the landscape suitably aged for Kirtland's warblers had decreased to approximately 40,470 ha (100,000 ac) of suitable habitat in any one year (Mayfield 1960, p. 26). This reduction in habitat presumably resulted in fewer Kirtland's warblers from the preceding time period, and Kirtland's warblers were not observed in all stands of suitable conditions (Wood 1904, p. 10). Serious efforts to control forest fires in Michigan began in 1927 and resulted in a further reduction of total acres burned as the number and size of wildfires decreased (Mayfield 1960, p. 26; Radtke and Byelich 1963, p.

210). By this time, brown-headed cowbirds had expanded from the shortgrass plains and become common within the Kirtland's warbler's nesting

range due to clearing of land for settlement and farming in northern Michigan (Wood and Frothingham 1905, p. 49; Mayfield 1960, p. 146), further

contributing to the decline of Kirtland's warblers.

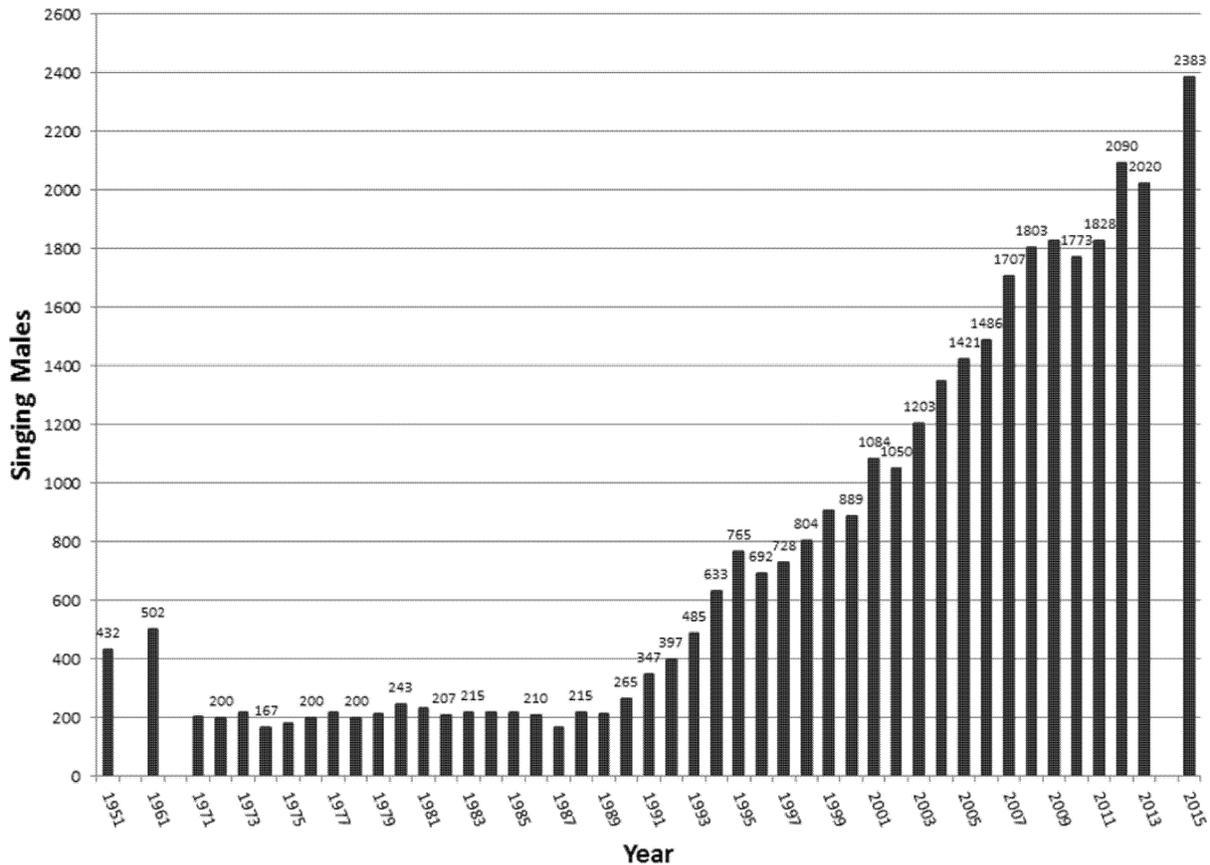


Figure: Kirtland's warbler census results for each year in which a full census was completed (1951, 1961, 1971–2013, and 2015) (MDNR data). Note: A rangewide census was not conducted in the years 1952–1960, 1962–1970, 2014, or 2016–2018.

Comprehensive surveys (censuses) of the entire Kirtland's warbler population began in 1951. Because of the warbler's specific habitat requirements and the frequent, loud, and persistent singing of territorial males during the breeding season, it was possible to establish a singing male census (Ryel 1976, pp. 1–2). The census consists of an extensive annual survey of all known and potential breeding habitat to count singing males.

Censuses were conducted in 1951, 1961, each year from 1971 to 2013, and 2015 (see figure, above). The 1951 census documented a population of 432 singing males confined to 28 townships in eight counties in northern lower Michigan (Mayfield 1953, p. 18). By 1971, the Kirtland's warbler population declined to approximately 201 singing

males and was restricted to just 16 townships in six counties in northern lower Michigan (Probst 1986, pp. 89–90). Over the next 18 years, the Kirtland's warbler population level remained relatively stable at approximately 200 singing males but experienced record lows of 167 singing males in 1974 and again in 1987. In response to conservation efforts, including artificial regeneration of jack pine habitat (see *Breeding Habitat*, above) and brown-headed cowbird trapping program, the population of Kirtland's warbler began to increase dramatically starting in the 1990s (see figure, above) and occupy a wider distribution across the landscape. The population reached a record high of 2,383 singing males in 2015, the year of the last full census (MDNR, USFS, USFWS, unpubl. data).

The census protocol counts singing males, not breeding pairs. Since the census began, Kirtland's warbler conservation partners have often made the assumption that there is a breeding female for each singing male, so the

number of singing males has often been used to approximate the number of breeding pairs. Likewise, some reports estimate a total breeding population by doubling the number of singing males. Extrapolating from singing males to breeding pairs or total breeding population should be done with caution. Mating success of males may vary depending on the quality of habitat, method of regeneration, or other factors (Bocetti 1994, pp. 80–85; Rockwell *et al.* 2013, p. 748; Bocetti 2018, pers. comm.). The annual census provides a robust, relative index of the Kirtland's warbler population change over time, but results should not be interpreted as an absolute count (Probst *et al.* 2005, pp. 50–59).

Population Viability

Full annual cycle (breeding and wintering) dynamics were incorporated into a population viability model to assess the long-term population viability of the Kirtland's warbler under five management scenarios: (1) Current suitable habitat and current brown-

headed cowbird removal; (2) reduced suitable habitat and current brown-headed cowbird removal; (3) current suitable habitat and reduced brown-headed cowbird removal, (4) current suitable habitat and no brown-headed cowbird removal; and (5) reduced suitable habitat and reduced brown-headed cowbird removal (Brown *et al.* 2017a, p. 443). The model that best simulated recently observed Kirtland's warbler population dynamics included a relationship between precipitation in the species' wintering grounds and productivity (Brown *et al.* 2017a, pp. 442, 444), which reflects our understanding of carry-over effects (Rockwell *et al.* 2012, pp. 748–750; Wunderle *et al.* 2014, pp. 46–48).

Under the current management conditions scenario, which includes habitat management at existing levels and brown-headed cowbird control occurring throughout the northern Lower Peninsula of Michigan, the model predicts that the Kirtland's warbler population will be stable over a 50-year simulation period. When simulating a reduced brown-headed cowbird removal effort by restricting cowbird trapping activities to the central breeding areas in northern lower Michigan (*i.e.*, eastern Crawford County, southeastern Otsego County, Oscoda County, western Alcona County, Ogemaw County, and Roscommon County) and assuming a 41 percent or 57 percent reduction in Kirtland's warbler productivity, the results showed a stable or slightly declining population, respectively, over the 50-year simulation period (Brown *et al.* 2017a, p. 447). Other scenarios, including reduced habitat suitability and reduced Kirtland's warbler productivity due to experimental jack pine management on 25 percent of available breeding habitat, had similar results with projected population declines over the 50-year simulation period, but mean population numbers remained above the population goal of 1,000 pairs (Brown *et al.* 2017a, p. 446), the numerical criterion identified in the Kirtland's warbler recovery plan (USFWS 1985).

Future reductions to Kirtland's warbler productivity rates under two reduced cowbird removal scenarios were assumed to be similar to historical rates (Brown *et al.* 2017a, p. 447). This assumption would overestimate the negative effects on Kirtland's warbler productivity if future parasitism rates are lower than the rates modeled (see *Factor E: Brood Parasitism*, below, for additional information on contemporary parasitism rates). Supplementary analysis (Brown *et al.* 2017b, unpubl. report), using the model structure and

assumptions of Brown *et al.* (2017a), simulated the impacts of a 5, 10, 20, and 30 percent reduction in productivity to take into consideration a wider range of possible future parasitism rates. Even small reductions in annual productivity had measurable impacts on population abundance, but there were not substantial differences in mean population growth rate up to a 20 percent reduction in productivity (Brown *et al.* 2017b, p. 3). Even with annual reductions in productivity of up to 5 percent for 50 years, the population trend (growth rate) projected for the final 30 years of the model simulations was 0.998 (range from the 5 simulations 0.993 to 1.007) or nearly the same as that projected in the simulations with no reduction in productivity at 0.999 (range of 0.995 to 1.008) (Brown *et al.* 2017b, p. 3). It is reasonable to infer that the Kirtland's warbler population can support relatively small reductions in productivity over a long period of time (*e.g.*, the 50-year timeframe of the simulations), providing a margin of assurance as management approaches are adaptively managed over time, and the species may be able to withstand as much as a 20 percent reduction in annual productivity, provided it does not extend over several years.

The results of the model simulations are more helpful in evaluating the effect of various management decisions relative to one another, rather than providing predictions of true population abundance. In other words, the model output provides projections of relative trends, rather than identifying specific population abundance thresholds. Although there are limitations to all population models based on necessary assumptions, input data limitations, and unknown long-term responses such as adaptation and plasticity, data simulated by Brown *et al.* (2017a and 2017b, entire) provide useful information in assessing relative population trends for the Kirtland's warbler under a variety of future scenarios and provide the best available analysis of population viability.

In summary, Kirtland's warbler population numbers have been greatly affected by brown-headed cowbird parasitism rates and the extent and quality of available habitat on the breeding grounds. The best available population model predicts that limited non-traditional habitat management and continued low brood parasitism rates will result in sustained population numbers above the recovery goal. Monitoring population numbers and brood parasitism rates will be important in ensuring the Kirtland's warbler

population remains stable post-delisting (see Post-delisting Monitoring, below).

Recovery and Recovery Plan Implementation

State and Federal efforts to conserve the Kirtland's warbler began in 1957 and were focused on providing breeding habitat for the species. The Kirtland's warbler was federally listed as an endangered species in 1967, under the Endangered Species Preservation Act of 1966 (Pub. L. 89–669). By 1972, a Kirtland's Warbler Advisory Committee formed to coordinate management efforts and research actions across Federal and State agencies, and conservation efforts expanded to include management of brown-headed cowbird brood parasitism (Shake and Mattsson 1975, p. 2).

Efforts to protect and conserve the Kirtland's warbler were further enhanced when the Endangered Species Act of 1973 became law and provided for acquisition of land to increase available habitat, funding to carry out additional management programs, and provisions for State and Federal cooperation. In 1975, the Recovery Team was appointed by the Secretary of the Interior to guide recovery efforts. A Kirtland's Warbler Recovery Plan was completed in 1976 (USFWS 1976), and updated in 1985 (USFWS 1985), outlining steps designed to protect and increase the species' population.

Recovery plans provide important guidance to the Service, States, and other partners on methods of minimizing threats to listed species and measurable objectives against which to measure progress towards recovery, but they are not regulatory documents. A decision to revise the status of or remove a species from the List is ultimately based on an analysis of the best scientific and commercial data available to determine whether a species is no longer an endangered species or a threatened species, regardless of whether that information differs from the recovery plan.

The Kirtland's warbler recovery plan (USFWS 1985) identifies one "primary objective" (hereafter referred to as "recovery criterion") that identifies when the species should be considered for removal from the List, and "secondary objectives" (hereafter referred to as "recovery actions") that are designed to accomplish the recovery criterion. The recovery criterion states that the Kirtland's warbler may be considered recovered and considered for removal from the List when a self-sustaining population has been re-established throughout its known range at a minimum level of 1,000 pairs. The

1,000-pair goal was informed by estimates of the amount of the specific breeding habitat required by each breeding pair of Kirtland's warblers, the amount of potential habitat available on public lands in Michigan's northern Lower Peninsula, and the ability of State and Federal land managers to provide suitable nesting habitat on an annual basis. The recovery criterion was intended to address the point at which the ultimate limiting factors to the species had been ameliorated so that the population is no longer in danger of extinction or likely to become so within the foreseeable future.

The recovery plan does not clearly articulate how meeting the recovery criterion will result in a population that is at reduced risk of extinction. The primary threats to the Kirtland's warbler are pervasive and recurring threats, but threat-based criteria specifying measurable targets for control or reduction of those threats were not incorporated into the recovery plan. Instead, the recovery plan focused on specific actions necessary to accomplish the recovery criterion. These included managing breeding habitat, protecting the Kirtland's warbler on its wintering grounds and along the migration route, reducing key factors such as brown-headed cowbird parasitism from adversely affecting reproduction and survival of Kirtland's warblers, and monitoring the Kirtland's warbler to evaluate responses to management practices and environmental changes.

At the time the recovery plan was prepared, we estimated that land managers would need to annually maintain approximately 15,380 ha (38,000 ac) of nesting habitat in order to support and sustain a breeding population of 1,000 pairs (USFWS 1985, pp. 18–20). We projected that this would be accomplished by protecting existing habitat, improving occupied and developing habitat, and establishing approximately 1,010 ha (2,550 ac) of new habitat each year, across 51,640 ha (127,600 ac) of State and Federal pine lands in the northern Lower Peninsula of Michigan (USFWS 1985, pp. 18–20). We also prioritized development and improvement of guidelines that would maximize the effectiveness and cost efficiency of habitat management efforts (USFWS 1985, p. 24). The MDNR, USFS, and Service developed the Strategy for Kirtland's Warbler Habitat Management (Huber *et al.* 2001, entire) to update Kirtland's warbler breeding habitat management guidelines and prescriptions based on a review of past management practices, analysis of current habitat conditions, and new findings that would continue to

conserve and enhance the status of the Kirtland's warbler (Huber *et al.* 2001, p. 2).

By the time the recovery plan was updated in 1985, the brown-headed cowbird control program had been in effect for more than 10 years. The brown-headed cowbird control program had virtually eliminated brood parasitism and more than doubled the warbler's productivity rates in terms of fledging success (Shake and Mattsson 1975, pp. 2–4). The Kirtland's warbler's reproductive capability had been successfully restored, and the brown-headed cowbird control program was credited with preventing further decline of the species. Because management of brown-headed cowbird brood parasitism was considered essential to the survival of the Kirtland's warbler, it was recommended that the brown-headed cowbird control program be maintained for "as long as necessary" (USFWS 1985, p. 27).

Although the recovery plan identifies breeding habitat as the primary limiting factor, with brood parasitism as a secondary limiting factor, it also suggests that events or factors outside the breeding season might be adversely affecting survival (USFWS 1985, pp. 12–13). At the time the recovery plan was updated, little was known about the Kirtland's warbler's migratory and wintering behavior, the species' migratory and wintering habitat requirements, or ecological changes that may have occurred within the species' migration route or on its wintering range. This lack of knowledge emphasized a need for more information on the Kirtland's warbler post-fledging, during migration, and on its wintering grounds (Kelly and DeCapita 1982, p. 365). Accordingly, recovery efforts were identified to: (1) Define the migration route and locate wintering areas; (2) investigate the ecology of the Kirtland's warbler and factors that might be affecting mortality during migration and on its winter range; and (3) provide adequate habitat and protect the Kirtland's warbler during migration and on its wintering areas (USFWS 1985, pp. 24–26).

In correspondence with the Service's Midwest Regional Director, and based on more than 20 years of research on the Kirtland's warbler's ecology and response to recovery efforts, the Recovery Team helped clarify recovery progress and issues that needed attention prior to reclassification to threatened status or delisting (Ennis 2002, pp. 1–4; Ennis 2005, pp. 1–3). From that synthesis, several important concepts emerged that continued to inform recovery, including: (1) Breeding

habitat requirements, amount, configuration, and distribution; (2) brood parasitism management; (3) migratory connectivity and protection of Kirtland's warblers and their habitat during migration and on the wintering grounds; and (4) establishment of credible mechanisms to ensure the continuation of necessary management (Thorson 2005, pp. 1–2).

Our understanding of the Kirtland's warbler's breeding habitat selection and use, and the links between maintaining adequate amounts of breeding habitat and a healthy Kirtland's warbler population, has continued to improve. As the population has rebounded, Kirtland's warblers have become reliant on artificial regeneration of breeding habitat, but have also recolonized naturally regenerated areas within the historical range of the species and nested in habitat types previously considered non-traditional or less suitable. As explained in more detail below, recovery efforts have expanded to establish and enhance management efforts on the periphery of the species' current breeding range in Michigan's Upper Peninsula, Wisconsin, and Canada and reflect the best scientific understanding of the amount and configuration of breeding habitat (see *Factor A* discussion, below). These adjustments improve the species' ability to adapt to changing environmental conditions and to withstand stochastic disturbance and catastrophic events, and better ensure long-term conservation for the species.

Along with habitat management, brown-headed cowbird control has proven to be a very effective tool in stabilizing and increasing the Kirtland's warbler population. To ensure survival of the Kirtland's warbler, we anticipate that continued brown-headed cowbird brood parasitism management may be needed, at varying levels depending on parasitism rates, to sustain adequate Kirtland's warbler productivity. As explained in more detail below, brown-headed cowbird control techniques and the scale of trapping efforts have adapted over time and will likely continue to do so, in order to maximize program effectiveness and feasibility (see *Factor E: Brood Parasitism* discussion, below).

We now recognize that the Kirtland's warbler persists only through continual management activities designed to mitigate recurrent threats to the species. The Kirtland's warbler is considered a conservation-reliant species, which means that it requires continuing management to address ongoing threats (Goble *et al.* 2012, p. 869). Conservation of the Kirtland's warbler will continue

to require a coordinated, multi-agency approach for planning and implementing conservation efforts into the future. Four elements that should be in place prior to delisting a conservation-reliant species include a conservation partnership capable of continued management, a conservation plan, appropriate binding agreements (such as memoranda of agreement (MOAs)) in place, and sufficient funding to continue conservation actions into the future (Bocetti *et al.* 2012, p. 875).

The Kirtland's warbler has a strong conservation partnership consisting of multiple stakeholders that have invested considerable time and resources to achieving and maintaining this species' recovery. Since 2016, the Recovery Team is no longer active, but instead new collaborative efforts formed to help ensure the long-term conservation of the Kirtland's warbler regardless of its status under the ESA. These efforts formed to facilitate conservation planning through coordination, implementation, monitoring, and research efforts among many partners and across the species' range. A coalition of conservation partners led by Huron Pines, a nonprofit conservation organization based in northern Michigan, launched the Kirtland's Warbler Initiative in 2013. The Kirtland's Warbler Initiative brings together State, Federal, and local stakeholders to identify and implement strategies to secure funds for long-term Kirtland's warbler conservation actions given the continuous, recurring costs anticipated with conserving the species into the future. The goal of this partnership is to ensure the Kirtland's warbler thrives and ultimately is delisted, as a result of strong public-private funding and land management partnerships. Through the Kirtland's Warbler Initiative, a stakeholder group called the Kirtland's Warbler Alliance was developed to raise awareness in support of the Kirtland's warbler and the conservation programs necessary for the health of the species and jack pine forests.

The second effort informing Kirtland's warbler conservation efforts is the Kirtland's Warbler Conservation Team (KWCT). The KWCT was established to preserve institutional knowledge, share information, and facilitate communication and collaboration among agencies and partners to maintain and improve Kirtland's warbler conservation. The current KWCT is comprised of representatives from the Service, USFS, MDNR, WDNR, U.S. Department of Agriculture's Wildlife Services (USDA–WS), Canadian Wildlife Service, Huron Pines,

Kirtland's Warbler Alliance, The Nature Conservancy, and California University of Pennsylvania.

Since 2015, conservation efforts for the Kirtland's warbler have been guided by the Kirtland's Warbler Breeding Range Conservation Plan (Conservation Plan) (MDNR *et al.* 2015, entire). The Conservation Plan outlines the strategy for future cooperative Kirtland's warbler conservation and provides technical guidance to land managers and others on how to create and maintain Kirtland's warbler breeding habitat within an ecosystem management framework. The scope of the Conservation Plan currently focuses only on the breeding range of the Kirtland's warbler within the United States, although the agencies involved (MDNR, USFS, and USFWS; hereafter "agencies" or "management agencies") intend to cooperate with other partners to expand the scope of the plan in the future to address the entire species' range (*i.e.*, the entire jack pine ecosystem, as well as the migratory route and wintering range of the species). The Conservation Plan will be revised every 10 years to incorporate any new information and the best available science (MDNR *et al.* 2015, p. 1).

In April 2016, the management agencies renewed a memorandum of understanding (MOU) through December 31, 2020, committing to continue collaborative habitat management, brown-headed cowbird control, monitoring, research, and education in order to maintain the Kirtland's warbler population at or above 1,000 breeding pairs, regardless of the species' legal protection under the ESA (USFWS, MDNR, and USFS 2016, entire). In addition, Kirtland's warbler conservation actions are included in the USFS's Land and Resource Management Plans (Forest Plans), which guide management priorities for the Huron-Manistee, Hiawatha, and Ottawa National Forests.

Funding mechanisms that support long-term land management and brown-headed cowbird control objectives are in place to assure a high level of certainty that the agencies can meet their commitments to the conservation of the Kirtland's warbler. MDNR and USFS have replanted approximately 26,420 ha (90,000 ac) of Kirtland's warbler habitat over the past 30 years. Over the last 10 years, only a small proportion of the funding used to create Kirtland's warbler habitat is directly tied to the ESA through the use of grant funding (*i.e.*, funding provided to MDNR through the Service's section 6 grants to States' program). Although there is the

potential that delisting could reduce the priority for Kirtland's warbler work within MDNR and USFS, as noted in the Conservation Plan (MDNR 2015, p. 17), much of the forest management cost (*e.g.*, silvicultural examinations, sale preparation, and reforestation) is not specific to maintaining Kirtland's warbler breeding habitat and would likely be incurred in the absence of the Kirtland's warbler. MDNR and USFS have successfully navigated budget shortfalls and changes in funding sources over the past 30 years and were able to provide sufficient breeding habitat to enable the population to recover, and they have agreed to continue to do so through the MOU. Additionally, the Service and MDNR developed an MOA to set up a process for managing funds to help address long-term conservation needs, specifically brown-headed cowbird control (USFWS and MDNR 2015). If the annual income generated is greater than the amount needed to manage brown-headed cowbird parasitism rates, the remaining portion of the annual income may be used to support other high priority management actions to directly benefit the Kirtland's warbler, including wildlife and habitat management, land acquisition and consolidation, and education. The MOA requires that for a minimum of 5 years after the species is delisted, MDNR consult with the Service on planning the annual brown-headed cowbird control program and other high-priority actions. In addition, MDNR recently reaffirmed their commitment to the MOA and confirmed their intent to implement and administer the brown-headed cowbird control program, even if the Kirtland's warbler is delisted (MDNR 2017).

In summary, the general guidance of the recovery plan has been effective, and the Kirtland's warbler has responded well to active management over the past 50 years. The primary threats identified at listing and during the development of the recovery plan have been managed, and commitments are in place to continue managing the threats. The status of the Kirtland's warbler has improved, primarily due to breeding habitat and brood parasitism management provided by MDNR, USFS, and the Service. 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. The recovery criterion has been met. Since 2015, efforts for the Kirtland's warbler have been guided by a Conservation Plan that will continue to be implemented by the management agencies when the species is delisted.

Since the revision of the recovery plan (USFWS 1985), decades of research have been invaluable to refining recovery implementation and have helped clarify our understanding of the dynamic condition of the Kirtland's warbler, jack pine ecosystem, and factors influencing them. The success of recovery efforts in mitigating threats to the Kirtland's warbler are evaluated below.

Summary of Changes From the Proposed Rule

Based upon our review of the comments received on the April 12, 2018, proposed rule (83 FR 15758), peer review comments, and new information that became available since the publication of the proposed rule, we reevaluated the information in the proposed rule and made changes as appropriate. We made the following changes in this final rule: (1) We added detail on the wintering distribution; (2) we clarified that wintering habitat is broadleaf scrub rather than pine habitat; (3) we added a paragraph on reproductive success; (4) we added a discussion on anthropogenic disturbance regimes on the wintering grounds; (5) we added information on connectivity between winter and breeding grounds; (6) we clarified that census results (number of singing males) are a relative index rather than an absolute count; (7) we added a section on the effects of insects and disease to jack pine; (8) we added a discussion of the effects of recreation; (9) we added a discussion of pesticides; (10) we included new data on brown-headed cowbird parasitism rates and the suspended trapping program during 2018; (11) we updated the analysis on effects of climate change on breeding grounds; (12) we added a discussion of recent drought on the wintering grounds; (13) we included new data on risk of heavy rainfall events and extended period of hurricane force winds due to decreasing translational speeds; and (14) we added a discussion of the effects of hurricanes. In addition, we made efforts to improve clarity, improve organization, and correct typographical or other minor errors. Many of our edits were based on comments from peer reviewers and public comments; additional detail can be found under Summary of Comments and Recommendations, below.

Summary of Factors Affecting the Kirtland's Warbler

Section 4 of the ESA and its implementing regulations (50 CFR part 424) set forth the procedures for listing species, reclassifying species, or

removing species from listed status. The term "species" includes "any subspecies of fish or wildlife or plants, and any distinct population segment [DPS] of any species of vertebrate fish or wildlife which interbreeds when mature" (16 U.S.C. 1532(16)). A species may be determined to be an endangered species or threatened species because of any one or a combination of the five factors described in section 4(a)(1) of the ESA: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence. We must consider these same five factors in delisting a species. We may delist a species according to 50 CFR 424.11(d) if the best available scientific and commercial data indicate that the species is neither endangered nor threatened for one or more of the following reasons: (1) The species is extinct; (2) the species has recovered and is no longer endangered or threatened; or (3) the original scientific data used at the time the species was classified were in error.

For species that are already listed as endangered or threatened, this analysis of threats is an evaluation of both the threats currently facing the species and the threats that are reasonably likely to affect the species in the foreseeable future following delisting or downlisting (*i.e.*, reclassification from endangered to threatened) and the removal or reduction of the ESA's protections. A recovered species is one that no longer meets the ESA's definition of endangered or threatened. A species is "endangered" for purposes of the ESA if it is in danger of extinction throughout all or a "significant portion of its range" and is "threatened" if it is likely to become endangered within the foreseeable future throughout all or a "significant portion of its range." The word "range" in the "significant portion of its range" phrase refers to the range in which the species currently exists. For the purposes of this analysis, we will evaluate whether the Kirtland's warbler should be considered endangered or threatened throughout all of its range. Then we will consider whether there are any significant portions of the Kirtland's warbler's range where the species is in danger of extinction or likely to become so within the foreseeable future.

The ESA does not define the term "foreseeable future." For the purpose of this rule, we define the "foreseeable

future" to be the extent to which, given the amount and substance of available data, we can anticipate events or effects, or reliably extrapolate threat trends, such that we reasonably believe that reliable predictions can be made concerning the future as it relates to the status of the Kirtland's warbler. We used the anticipated habitat and brown-headed cowbird management analyzed over a 50-year timeframe in Brown *et al.* (2017a, b) to define the foreseeable future for the Kirtland's warbler. This analysis considered multiple future management scenarios for Kirtland's warbler, including reduced suitable habitat (from experimental habitat management) and reduced brown-headed cowbird removal. Given the length of time for habitat to become suitable and the warbler's average life span, a 50-year period takes into account multiple rotations of habitat and generations of birds. This is a sufficient amount of time to fully evaluate if the current and potential future experimental approaches to management warrant further refinement. Beyond 50 years, the future conditions become more uncertain, such that we cannot make reliable predictions as to how any differing management scenarios may affect the status of the species.

In considering what factors might constitute threats, we must look beyond the exposure of the species to a particular factor to evaluate whether the species may respond to the factor in a way that causes actual impacts to the species. If there is exposure to a factor and the species responds negatively, the factor may be a threat, and during the status review, we attempt to determine how significant a threat it is. The threat is significant if it drives or contributes to the risk of extinction of the species, such that the species warrants listing as endangered or threatened as those terms are defined by the ESA. However, the identification of factors that could impact a species negatively may not be sufficient to compel a finding that the species warrants listing. The information must include evidence sufficient to suggest that the potential threat is likely to materialize and that it has the capacity (*i.e.*, it should be of sufficient magnitude and extent) to affect the species' status such that it meets the definition of endangered or threatened under the ESA. The following analysis examines all five factors currently affecting or that are likely to affect the Kirtland's warbler in the foreseeable future.

A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range

Breeding Habitat

Historically, wildfires were the most important factor in the establishment of natural jack pine forests and Kirtland's warbler breeding habitat. However, modern wildfire suppression greatly altered the natural disturbance regime that generated Kirtland's warbler breeding habitat for thousands of years (USFWS 1985, p. 12; Cleland *et al.* 2004, pp. 316–318). Prior to the 20th century, the historic fire recurrence in jack pine forests averaged 59 years, but it is now estimated to occur in cycles as long as 775 years (Cleland *et al.* 2004, pp. 315–316).

In the absence of wildfire, land managers must take an active role in mimicking natural processes that regularly occurred within the jack pine ecosystem, namely stand-replacing disturbance events. This is primarily done through large-scale timber harvesting and human-assisted reforestation. Although planted stands tend to be more structurally simplified than wildfire-regenerated stands (Spaulding and Rothstein 2009, p. 2610), land managers have succeeded in selecting KWMA's that have landscape features of the natural breeding habitat and have developed silvicultural techniques that produce conditions within planted stands suitable for Kirtland's warbler nesting. In fact, over 85 percent of the habitat used by breeding Kirtland's warblers in 2015 in the northern Lower Peninsula of Michigan (approximately 12,343 ha (30,500 ac)) had been artificially created through clearcut harvest and replanting. The planted stands supported over 92 percent of the warbler's population within the Lower Peninsula during the 2015 breeding season (MDNR, USFS, USFWS, unpubl. data). The effectiveness of these strategies is also evident by the reproductive output observed in planted stands, which function as population sources (Bocetti 1994, p. 95). Thus, in a landscape where natural fire disturbance patterns have been reduced, threats to natural breeding habitat are being mitigated through large-scale habitat management. Therefore, the status of the Kirtland's warbler depends largely on the continued production of managed breeding habitat.

Federal and State laws establish the foundation for managing the USFS, USFWS, and MDNR lands that provide the majority of the breeding habitat for Kirtland's warbler. These laws require land management agencies to develop

plans that describe objectives and goals for forest management.

The National Forest Management Act (16 U.S.C. 1600–1640; NFMA) requires that Forest Plans shall “provide for multiple use and sustained yield of the products and services . . . and, in particular, include coordination of outdoor recreation, range, timber, watershed, wildlife and fish, and wilderness” (16 U.S.C. 1604(e)). All projects and activities authorized by the Forest Service must be consistent with the established Forest Plans (16 U.S.C. 1604(i)). The Hiawatha, Huron-Manistee, and Ottawa National Forest Plans include specific goals and objectives for maintaining Kirtland's warbler breeding habitat (USFS 2006a, p. 35; USFS 2006b, p. 82; USFS 2006c, p. 27). The NFMA's implementing regulations will apply to any future Forest Plan revisions and currently require National Forests to develop plans that include standards or guidelines to maintain or restore the ecological integrity of terrestrial ecosystems in the plan area (36 CFR 219.8(a)). Further, additional species-specific standards or guidelines may be required to maintain a viable population of each species of conservation concern within the plan area (36 CFR 219.9(b)(1)). The Forest Service plans to designate Kirtland's warbler as a Sensitive Species upon delisting for a period of at least five years (Hogeboom 2019, pers. comm.). Additionally, in accordance with the Forest Service Manual (FSM), any significant current or predicted downward trends in population numbers, density, or in habitat capability that would reduce a species' existing distribution would be triggers for the Regional Forester to designate the Kirtland's warbler as a Sensitive Species (FSM 2670.5) in the future. Forest Service objectives for Sensitive Species (FSM 2670.22) include developing and implementing management practices to ensure that species do not become threatened or endangered because of Forest Service actions.

The National Wildlife Refuge System Improvement Act of 1997 requires the preparation of Comprehensive Conservation Plans for refuge lands and maintenance of the biological integrity, diversity, and environmental health of the National Wildlife Refuge System. The Service's Kirtland's Warbler Wildlife Management Area defines goals, objectives, and strategies that support Kirtland's warbler and the jack pine ecosystem (USFWS 2009, pp. 31–33).

In Michigan law, Part 525, Sustainable Forestry on State Forest

Lands, of the Natural Resources and Environmental Protection Act (1994 PA 451, as amended) requires the MDNR to manage the State forest lands consistent with the principles of sustainable forestry. Part 525 also requires the MDNR to maintain third-party certification of the management of the State forest that satisfies sustainable forestry standards. The MDNR forest lands are certified under the standards of the Forest Stewardship Council and the Sustainable Forestry Initiative (Kintigh 2019, pers. comm.). These standards also require the MDNR to write, implement, and maintain forest management plans. The MDNR has developed a Regional State Forest Management Plan for the northern Lower Peninsula ecoregion that includes specific plans for 15 units of land managed for Kirtland's warbler (MDNR 2013, pp. 337–354). The Federal and State forest management planning standards, which will remain in effect after delisting, are synthesized and further refined for Kirtland's warbler through the Conservation Plan (MDNR *et al.* 2015).

The Conservation Plan (MDNR *et al.* 2015) identifies continued habitat management needs and objectives to maintain sufficient suitable breeding habitat for Kirtland's warblers. Habitat management is currently conducted on approximately 88,626 ha (219,000 ac) of jack pine forest within MDNR, USFS, and Service lands throughout the northern Lower Peninsula and Upper Peninsula of Michigan (MDNR *et al.* 2015, pp. 22–23). The Conservation Plan incorporates some conservative assumptions about the area needed to support a breeding pair of Kirtland's warblers, as well as how long a stand will be used by the species. The density and duration of use estimates were developed by data gathered over the last decade. Lands within the Lower Peninsula averaged 8 to 9 ha (19 to 22 ac) per pair and had a duration of use between 9 and 10 years. Lands within the Upper Peninsula on the Hiawatha National Forest required an average of 40 ha (100 ac) per pair and had a duration of use averaging 10 years (Huber *et al.* 2013, cited in MDNR *et al.* 2015, p. 22). Using those measures of average hectares per pair and duration of use, 14,593 ha (36,060 ac) of suitable breeding habitat would need to be available at all times to maintain a minimum population of 1,300 pairs, requiring land management agencies to jointly manage 1,550 ha (3,830 ac) of habitat annually (631 ha (1,560 ac) on MDNR land and 918 ha (2,270 ac) on USFS land) through wildfire-

regenerated jack pine or managed reforestation (MDNR *et al.* 2015, pp. 22–23). Importantly, the more recent observations concerning density of Kirtland's warblers in breeding habitat and duration of stand use are often greater than the assumptions used for planning purposes and explain why the Kirtland's warbler population that is actually observed is higher than would be predicted based on the planning assumptions.

As described previously, the majority of managed breeding habitat is currently created through clear cutting and planting jack pine seedlings. However, managing jack pine for Kirtland's warbler breeding habitat typically results in lower value timber products due to the overall poor site quality in combination with the required spacing, density, and rotation age of the plantings (Greco 2017, pers. comm.). Furthermore, the demand for jack pine products has fluctuated in recent years, and long-term forecasts for future marketability of jack pine are uncertain. Commercially selling jack pine timber on sites where reforestation will occur is critical to the habitat management program. Timber receipts offset the cost of replanting jack pine at the appropriate locations, scales, arrangements, and densities needed to support a viable population of nesting Kirtland's warblers that would not otherwise be feasible through conservation dollars. The Conservation Plan directs management agencies to develop at least 75 percent of the Kirtland's warbler's breeding habitat annual acreage objectives using traditional habitat management techniques (*i.e.*, opposing wave planting with interspersed openings), and no more than 25 percent of annual acreage objectives should use non-traditional habitat management techniques (*e.g.*, reduced stocking density, incorporating a red pine component within a jack pine stand, prescribed burning) (MDNR *et al.* 2015, p. 23). Using non-traditional techniques on a maximum of 25 percent of breeding habitat acreage annually will allow the management agencies to evaluate new planting methods that improve timber marketability, reduce costs, and improve recreational opportunities while sustaining the warbler's population above the recovery criterion of 1,000 pairs. The KWCT is currently working on developing additional habitat regeneration techniques through adaptive management that increase the marketability of the timber at harvest while not substantially reducing

Kirtland's warbler habitat suitability (Kennedy 2017, pers. comm.).

The land management agencies have maintained adequate breeding habitat despite times when their budgets were flat or declining, even while costs related to reforestation continued to increase. For example, over the last 30 years, MDNR replanted more than 20,000 ha (50,000 ac) of Kirtland's warbler habitat, averaging over 680 ha (1,700 ac) per year. They took this action voluntarily, and within the past 10 years, they used funding from sources in addition to those available under the ESA. Section 6 grants under the ESA have helped support MDNR's Kirtland's warbler efforts, but that funding has largely been used for population census work in recent years and reflects only a small percentage of the funding the State of Michigan spends annually to produce Kirtland's warbler breeding habitat. Other funding sources used by MDNR include State wildlife grants, competitive State wildlife grants, Michigan's Nongame Fund, and the Forest Development Fund.

Shifting agency priorities and competition for limited resources have and will continue to challenge the ability of land managers to fund reforestation of areas suitable for Kirtland's warblers. Low jack pine timber sale revenues, in conjunction with reduced budgets, increased Kirtland's warbler habitat reforestation costs, and competition with other programs, are all challenges that the land management agencies have met in the past and will need to continue addressing to meet annual habitat development objectives. Commitments by land managers and the KWCT are in place, as described earlier in this document, to ensure recovery of the Kirtland's warbler will be sustained despite these challenges.

The management agencies have agreed through the Conservation Plan (MDNR *et al.* 2015, pp. 24, 43–44) to generally limit or prohibit commercial, recreational, or infrastructure (*e.g.*, roads, pipelines, communication towers) development within or near areas managed for Kirtland's warbler to protect them and provide for the long-term integrity of breeding habitat. Additionally, a regulatory mechanism that aids in the management of breeding habitat is Executive Order (E.O.) 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds" (66 FR 3853; January 17, 2001), which directs Federal agencies to develop a memorandum of understanding (MOU) with the Service to promote the conservation of migratory bird populations. USFS and

the Service signed an MOU (FS Agreement #08–MU–1113–2400–264), pursuant to E.O. 13186, with the purpose of strengthening migratory bird conservation by identifying and implementing strategies that promote conservation and avoid or minimize adverse impacts on migratory birds through enhanced collaboration.

Once planted for Kirtland's warbler habitat, jack pine trees need to survive to provide usable habitat. Multiple natural events, such as fire, drought, disease, and insect outbreaks, may affect the survival of jack pine trees and longevity of suitable habitat. Wildfire can be harmful to Kirtland's warblers when it destroys occupied habitat. For example, on May 18, 2010, a wildfire started in southeastern Crawford County within the Eldorado KWMA. The wildfire eventually burned a total of approximately 3,071 ha (7,588 ac), including 146 ha (362 ac) of occupied habitat (where 30 singing males were counted in 2009) and 36 ha (90 ac) of young jack pine habitat that would have likely been occupied by Kirtland's warblers in 3 years (USFS 2010, pp. 1, 7, 11). The following year on June 7, 2011, lightning ignited a wildfire that destroyed approximately 49 ha (120 ac) of 11-year-old habitat in the Manistee River KWMA, where seven male Kirtland's warblers were counted during the 2011 census (MDNR, unpubl. data). Drought can cause mortality of jack pine seedlings (Rajasekaran and Blake 1999, p. 175) and reduce the density of jack pine trees (Kintigh 2011, pers. comm.). Drought can also stress older jack pines and make them more susceptible to insects and diseases (Kintigh 2011, pers. comm.). Fungal pests, including *Gremmeniella abietina* var. *abietina*, and *Sphaeropsis sapinea* (also known as *Diplodia pinea*), are known to cause mortality in jack pine trees (USFS and MDNR 1981, p. 14; Nicholls and Ostry 1990, p. 55). Jack pine budworm (*Choristoneura pinus pinus*), mountain pine beetle (*Dendroctonus ponderosae*), and jack pine sawfly (*Neodiprion swainei*) can also cause topkill and mortality in jack pine trees (McCullough 2000, p. 252; Colgan and Erbilgin 2011, p. 426; Wilson 1971, p. 1). Generally, past impacts of these natural events on jack pines have had little effect on Kirtland's warbler habitat. Severe outbreaks of insect or fungal pests can have devastating effects on large areas of forest (*e.g.*, the effect of emerald ash borer (*Agrilus planipennis* Fairmaire) on ash species (*Fraxinus* spp.)). Although there are no known imminent threats to Kirtland's warbler, emerging disease and pests warrant continued monitoring

because of the potential to harm significant amounts of managed habitat. Jack pine forests that serve as Kirtland's warbler habitat are under the oversight of forest-management agencies that closely track new forest diseases and pests and will take swift action if a newly emerging issue is detected.

We reviewed available information on the effects to Kirtland's warbler habitat from expanded development on private lands in or near breeding habitat. Although these factors and forest pests and diseases have the potential to affect Kirtland's warblers and their habitat, land management agencies have been successful in maintaining sufficient amounts of suitable habitat to support historically high numbers of Kirtland's warblers. While activities and natural processes (e.g., wildfire, drought, development) that affect breeding habitat may still have some negative effects on individual Kirtland's warblers, the population of Kirtland's warblers appears resilient to these factors within the context of the current management regime. Furthermore, management efforts to date have been adaptive in terms of the acreage and spatial and temporal configuration of habitat needed to mitigate the effects associated with natural breeding habitat loss and fragmentation. The land management agencies have shown a commitment to Kirtland's warbler habitat management through their forest management plans as reflected in the 2016 MOU, agreeing to continue habitat management, and developing and implementing the Conservation Plan.

Migration Habitat

Although Kirtland's warblers spend a relatively small amount of time each year migrating, the migratory period has the highest mortality rate of any phase of the annual cycle, accounting for 44 percent of annual mortality (Rockwell *et al.* 2017, p. 722). Migratory survivorship levels are, however, above the minimum needed to sustain the population (Mayfield 1960, pp. 204–207; Berger and Radabaugh 1968, p. 170; Bocetti *et al.* 2002, p. 99; Rockwell *et al.* 2017, pp. 721–723; Trick, unpubl data). Recent research is refining our knowledge of spring and fall migration timing and routes for the Kirtland's warbler. Little is currently known about the importance of specific stopover sites and any factors affecting them, although coastal areas along the Great Lakes and Atlantic Ocean (e.g., western Lake Erie basin and the Florida and Georgia coasts) that appear important to migrating Kirtland's warblers are also areas where natural habitats have been highly fragmented by human

development. At stopover sites within these highly fragmented landscapes, competition for food sources among long-distance passerine migrants is expected to be high, especially in fallout areas where many migrating birds land to rest, usually due to weather events or long flights over open water (Moore and Yong 1991, pp. 86–87; Kelly *et al.* 2002, p. 212; Németh and Moore 2007, p. 373). Increased competition may prolong stopover duration or increase the number of stopovers that are needed to complete migration between breeding and wintering grounds (Goymann *et al.* 2010, p. 480).

The quantity and quality of migratory habitat needed to sustain Kirtland's warbler numbers above the recovery goal of 1,000 pairs appears to be sufficient, based on a sustained and increasing population since 2001. If loss or destruction of migratory habitat were limiting or likely to limit the population to the degree that maintaining a healthy population may be at risk, it should be apparent in the absence of the species from highly suitable breeding habitat in the core breeding range. In fact, we have seen just the opposite: Increasing densities of breeding individuals in core areas and a range expansion into what would appear to be less suitable habitat elsewhere. This steady population growth and range expansion has occurred despite increased development and fragmentation of migratory stopover habitat within coastal areas.

Wintering Habitat

Similar to the breeding grounds, the quantity and quality of wintering habitat needed to sustain Kirtland's warbler numbers above the recovery goal of 1,000 pairs appears to be sufficient, based on a sustained and increasing population since 2001. Compared to the breeding grounds, less is known about the wintering grounds in The Bahamas. Factors affecting Kirtland's warblers on the wintering grounds, as well as the magnitude of the impacts, remain somewhat uncertain. Few of the known Kirtland's warbler wintering sites currently occur on protected land. Rather, most Kirtland's warblers appear to winter more commonly in early successional habitats that have recently been or are currently being used by people (e.g., abandoned after clearing, grazed by goats), where disturbance has set back plant succession (Wunderle *et al.* 2010, p. 132). Potential threats to wintering habitat include habitat loss caused by human development, altered fire regime, changes in agricultural practices, and invasive plant species. The potential threats of rising sea level, drought, and destructive weather

events, such as hurricanes on the wintering grounds, are discussed below under *Factor E*.

Tourism is the primary economic activity in The Bahamas, accounting for 65 percent of the gross domestic product, and The Bahamas' Family Islands Development Encouragement Act of 2008 supports the development of resorts on each of the major Family Islands (part of The Bahamas) (Moore and Gape 2009, p. 72). Residential and commercial development could result in direct loss of Kirtland's warbler habitat, especially on New Providence and Grand Bahama, which together support 85 percent of the population of Bahamian people (Moore and Gape 2009, p. 73; Wunderle *et al.* 2010, p. 135; Ewert 2011, pers. comm.). This loss could occur on both private and commonage lands (land held communally by rural settlements), as well as generational lands (lands held jointly by various family members).

Local depletion and degradation of the water table from wells and other water extraction and introduction of salt water through human-made channels or other disturbances to natural hydrologies may also negatively impact Kirtland's warblers by affecting fruit and arthropod availability (Ewert 2011, pers. comm.).

Fire may have positive or negative impacts on winter habitat, depending on the frequency, timing, and intensity of fires and where the fires occur. Fires are relatively common and widespread on the pine islands in the northern part of the archipelago and have increased since settlement, especially during the dry winter season when Kirtland's warblers are present (The Nature Conservancy 2004, p. 3). Fire may benefit Kirtland's warblers when succession of low coppice to tall coppice is set back (Currie *et al.* 2005b, p. 79) but may negatively impact wintering Kirtland's warblers if it results in reduced density and fruit production of understory shrubs (Currie *et al.* 2005b, p. 85).

Invasive plants are another potential factor that could limit the extent of winter habitat in The Bahamas. Brazilian pepper (*Schinus terebinthifolius*), jumbie bean (*Leucaena leucocephala*), Guinea grass (*Panicum maximum*), and Casuarina or Australian pine (*Casuarina equisetifolia*) may be the most important invasive species of immediate concern (Ewert 2011, pers. comm.; Wunderle 2018, pers. comm.). These aggressive plants colonize patches early after disturbances and may form monocultures, which preclude the establishment of fruit plant species heavily used by Kirtland's

warblers. Casuarina pine establishment can increase sand loss by out-competing native plants that stabilize dunes, resulting in increased coastal erosion and habitat loss (Sealey 2011, p. 12).

Some invasive species, such as jumbie bean, are good forage for goats. By browsing on these invasive plants, goats create conditions that favor native shrubs and may increase the density of native shrubs used by Kirtland's warblers (Ewert 2011, pers. comm.). Goat farming could play a role in controlling the spread of some invasive species at a local scale, while aiding in the restoration of native vegetation patches. Still, many plants such as royal poinciana (*Delonix regia*), tropical almond (*Terminalia catappa*), and morning glory (*Ipomoea indica*) are commonly imported for landscaping and have the potential to escape into the wild (Smith 2010, pp. 9–10; Ewert 2011, pers. comm.) and could displace native shrubs that provide fruit for Kirtland's warblers.

The Bahamas National Trust administers 32 national parks that cover more than 809,371 ha (2 million ac) (Bahamas National Trust 2017, p. 3). Although not all national parks contain habitat suitable for Kirtland's warblers, several parks provide suitable wintering habitat, including the Leon Levy Native Plant Preserve on Eleuthera Island, Harrold and Wilson Ponds National Park on New Providence Island, and Exuma Cays Land and Sea Park on Hawksbill Cay (The Nature Conservancy 2011, p. 2).

The Bahamas National Trust Act of 1959 and the National Parks Ordinance of 1992 established non-government statutory roles to the Bahamas National Trust and the Turks and Caicos Islands National Trust, respectively. These acts empower these organizations to hold and manage environmentally important lands in trust for their respective countries.

Simply protecting parcels of land or important wintering habitat, however, may be insufficient to sustain adequate amounts of habitat for the Kirtland's warbler because of the species' dependence on early successional habitat (Mayfield 1972, p. 349; Haney *et al.* 1998, p. 210; Sykes and Clench 1998, pp. 256–257; Wunderle *et al.* 2010, p. 124), which changes in distribution over time. In addition, food availability at any one site varies seasonally, as well as between years, and is not synchronous across all sites (Wunderle *et al.* 2010, p. 124). In the face of changes in land use and availability, sustaining sufficient patches of early-successional habitat for Kirtland's warbler in The Bahamas will

likely require a landscape-scale approach (Wunderle *et al.* 2010, p. 135).

Although threats to Kirtland's warblers on the wintering grounds exist as a result of habitat loss due to succession or development, hydrology changes, fire, and invasive species, the current extent and magnitude of these threats appears not to be significantly limiting Kirtland's warbler population numbers based on the species' continuous population growth over the last two decades.

Habitat Distribution

The Kirtland's warbler has always occupied a relatively limited geographic range on both the breeding and wintering grounds. This limited range makes the species naturally more vulnerable to catastrophic events compared to species with wide geographic distributions, as having multiple populations in a wider distribution reduces the likelihood that all individuals will be affected simultaneously by a catastrophic event (*e.g.*, large wildfire in breeding habitat, hurricane in The Bahamas). Since the species was listed, the geographic area where the Kirtland's warbler occurs has increased, reducing the risk to the species from catastrophic events. As the population continues to increase and expand in new breeding and wintering areas, the species will become less vulnerable to catastrophic events. The Conservation Plan, which land management agencies agreed to implement under the 2016 MOU, includes a goal to improve distribution of habitat across the breeding range to reduce this risk by managing lands in the Upper Peninsula of Michigan and in Wisconsin in sufficient quantity and quality to provide breeding habitat for 10 percent (100 pairs) or more of the goal of 1,000 pairs (MDNR *et al.* 2015, p. 23).

B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

The Kirtland's warbler is a non-game species, and no commercial harvest is known to occur in either the breeding or wintering grounds. Land management agencies within the Kirtland's warbler's breeding range previously had, and will continue to have, the ability to implement seasonal closures to specific areas for a variety of reasons and, when necessary, could limit access outside of designated roads and trails to further protect the species. Within the 23 KWMA's in the northern Lower Peninsula of Michigan and designated lands in Michigan's Upper Peninsula, approximately 71 km (44 miles) of

routes are designated for off-road vehicle (ORV), all-terrain vehicle (ATV), or motorcycle use. In addition, approximately 151 km (94 miles) of trails are designated for hiking, biking, and horseback riding (USFWS, unpubl. data). Additionally, approximately 3,510 km (2,181 miles) of authorized ungraded and graded roads occur within the KWMA's (USFWS, unpubl. data). As described in the Conservation Plan (MDNR *et al.* 2015, p. 16), existing forest roads and trails have not typically been closed or otherwise restricted specifically because of the presence of adjacent Kirtland's warbler habitat.

On a few occasions (Enger 2007, pers. comm.; Kaiser 2014, pers. comm.), motor vehicles used on roads open to such use have collided with and killed Kirtland's warblers. In addition, the noise from roads has been shown to reduce breeding success of other passerines (Schroeder *et al.* 2012, pp. 6–7; Proppe *et al.* 2013, pp. 1080–1082) and could have similar negative effects to Kirtland's warblers. Any past direct and indirect effects of road use have not hindered progress toward recovering the Kirtland's warbler, however, and we do not anticipate a greater extent of effects related to recreation post-delisting. Because Kirtland's warblers occupy large blocks of habitat over long periods of time (Donner *et al.* 2010, p. 5), maintaining larger areas of habitat is a primary management goal (MDNR 2015, pp. 33–34). Managing for larger blocks of breeding habitat reduces the effects of roads and trails that are on the edges of the habitat blocks.

A variety of State, national, and international laws protect Kirtland's warblers independent of their status under the ESA. Laws outside of the U.S. played an important role in helping to recover the species, and State laws will in some cases provide additional protections after delisting. The Kirtland's warbler is protected by the Migratory Bird Treaty Act of 1918 (MBTA; 16 U.S.C. 703–712). The MBTA prohibits take, capture, killing, trade, or possession of Kirtland's warblers and their parts, as well as their nests and eggs. The regulations implementing the MBTA further define “take” as to “pursue, hunt, shoot, wound, kill, trap, capture, or collect” or attempt those activities (50 CFR 10.12).

The States of Florida, Georgia, Indiana, Michigan, North Carolina, Ohio, Virginia, and Wisconsin list the Kirtland's warbler as endangered, under their respective State endangered species regulations. In Michigan, where the majority of the population breeds, part 365 of Public Act 451 of 1994 prohibits take, possession,

transportation, importation, exportation, processing, sale, offer for sale, purchase, or offer to purchase, transportation or receipt for shipment by a common or contract carrier of Kirtland's warblers or their parts.

The Kirtland's warbler was declared federally endangered in Canada in 1979. Canada's Species at Risk Act of 2003 (SARA) is the primary law protecting the Kirtland's warbler in Canada. SARA bans killing, harming, harassing, capturing, taking, possessing, collecting, buying, selling, or trading of individuals that are federally listed. SARA also extends protection to the residence (habitat) of individuals that are federally listed. In addition, the Kirtland's warbler is listed as endangered under Ontario's Endangered Species Act of 2007. Canada's Migratory Bird Convention Act of 1994 also provides protections to Kirtland's warblers. Under Canada's Migratory Bird Convention Act, it is unlawful to be in possession of migratory birds or nests, or to buy, sell, exchange, or give migratory birds or nests, or to make them the subject of commercial transactions.

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

Through the MBTA, SARA, laws in The Bahamas, and State laws, the species remains protected from pursuit, wounding, or killing that could potentially result from activities focused on the species in breeding, wintering, and migratory habitat (*e.g.*, wildlife photography without appropriate care to ensure breeding birds can continue to feed and care for chicks and eggs normally and without injury to their offspring).

C. Disease or Predation

There is no information of any disease impacting the Kirtland's warbler.

For most passerines, nest predation has the greatest negative impact on

reproductive success and can affect entire populations (Ricklefs 1969, p. 6; Martin 1992, p. 457). Nest predation may be particularly detrimental for ground-nesting bird species in shrublands (Martin 1993, p. 902). Predation rates of Kirtland's warbler nests have ranged from 3 to 67 percent of nests examined (Mayfield 1960, p. 204; Cuthbert 1982, p. 1; Walkinshaw 1983, p. 120); however, few predation events have been directly observed, and, in general, evidence regarding the importance of certain nest or adult predators lack quantitative support (Mayfield 1960, p. 182; Walkinshaw 1972, p. 5; Walkinshaw 1983, pp. 113–114).

Overall, nest predation rates for Kirtland's warblers are similar to other passerines and are below levels that would compromise population replacement (Bocetti 1994, pp. 125–126; Cooper *et al.*, unpubl. data). The increasing numbers of domestic cats (*Felis catus*) in the breeding and wintering habitats is recognized (Lepczyk *et al.* 2003, p. 192; Horn *et al.* 2011, p. 1184), but there is not sufficient evidence to conclude at this time that predation from cats is currently having population-level impacts to the Kirtland's warbler.

D. Inadequacy of Existing Regulatory Mechanisms

Under this factor, we examine the threats identified within the other factors as ameliorated or exacerbated by any existing regulatory mechanisms or conservation efforts. Section 4(b)(1)(A) of the ESA requires that the Service take into account "those efforts, if any, being made by any State or foreign nation, or any political subdivision of a State or foreign nation, to protect such species." In relation to Factor D under the ESA, we interpret this language to require the Service to consider relevant Federal, State, and Tribal laws, regulations, and other such binding legal mechanisms that may ameliorate or exacerbate any of the threats we describe in threat analyses under the other four factors or otherwise enhance the species' conservation. Our consideration of the regulatory mechanisms addressing the threats to the species, is described where applicable in the relevant factor section (see discussion under *Factors A, B, and E*).

E. Other Natural or Manmade Factors Affecting Its Continued Existence

Pesticides

Pesticides have the potential to cause direct and indirect effects to non-target species, but we are not aware of any

pesticides that are negatively affecting the Kirtland's warbler population. Kirtland's warblers could be exposed to pesticides on the breeding or wintering grounds or during migration. On the breeding grounds, forest managers are not routinely using any pesticides within occupied jack pine stands (Huber 2018, pers. comm.; Kintigh 2018, pers. comm.). For Kirtland's warbler, exposure to pesticides would be most likely through dietary exposure (treatment of insects or fruit plants) or accidental spray drift on the edges of suitable habitat.

The U.S. Environmental Protection Agency used Kirtland's warbler as a case study during the re-registration process for two organophosphate pesticides, chlorpyrifos and malathion (Moore *et al.* 2017, p. 1). A probabilistic model was developed to assess the risks of the two pesticides to the birds during the breeding season and migration. The model results predicted very low acute and chronic risk for these pesticides for Kirtland's warbler (Moore *et al.* 2017, p. 265). This conclusion is unsurprising, as Moore *et al.* (2017, p. 267) found that treatments do not occur on Kirtland's warbler breeding grounds and only rarely would warblers be exposed during migration.

Brood Parasitism

Brood parasitism can depress reproduction of avian hosts in several ways, including the direct removal or predation of eggs or young, facilitating nest predation by other nest predators, reducing hatching or fledging success, altering host population sex ratios, and increasing juvenile and adult mortality beyond the nest (Elliot 1999, p. 55; Hoover 2003, pp. 928–929; Smith *et al.* 2003, pp. 777–780; Zanette *et al.* 2005, p. 818; Hoover and Reetz 2006, pp. 170–171; Hoover and Robinson 2007, p. 4480; Zanette *et al.* 2007, p. 220).

The brown-headed cowbird is the only obligate brood parasite within the Kirtland's warbler's breeding range and the only species documented parasitizing Kirtland's warbler nests. Two facultative interspecific nest parasite species, the black-billed cuckoo (*Coccyzus erythrophthalmus*) and the yellow-billed cuckoo (*Coccyzus americanus*), may occur within the Kirtland's warbler's breeding range, but parasitism of a Kirtland's warbler nest has not been documented for these species and is not believed to be a threat.

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 the brown-headed cowbird's range expansion into Kirtland's warbler nesting areas (Mayfield 1960, p. 145) such that brown-headed cowbirds were common within the Kirtland's warbler's breeding range by the early 1900s (Wood and Frothingham 1905, p. 49). The first known instance of brood parasitism of a Kirtland's warbler nest occurred in Crawford County, Michigan, in 1908 (Strong 1919, p. 181). Shortly thereafter, the scarcity of Kirtland's warblers was attributed to brown-headed cowbird parasitism (Leopold 1924, p. 57), which later data confirmed as significantly affecting the survival of the Kirtland's warbler (Mayfield 1960, pp. 180–181).

The Kirtland's warbler is particularly sensitive to brown-headed cowbird brood parasitism. The warbler's limited breeding range likely exposes the entire population to brown-headed cowbird parasitism (Mayfield 1960, pp. 146–147; Trick, unpubl. data). In addition, the peak egg-laying period of the brown-headed cowbird completely overlaps with that of the Kirtland's warbler, and the majority of Kirtland's warblers produce only one brood each year (Mayfield 1960, pp. 151–152; Radabaugh 1972, p. 55; Rockwell, unpubl. data). Kirtland's warblers have limited evolutionary experience with brown-headed cowbirds compared to other hosts and have not developed effective defensive behaviors to thwart brood parasitism (Walkinshaw 1983, pp. 157–158).

Between 1903 and 1971, observed parasitism rates of Kirtland's warbler nests ranged from 48 percent to 86 percent (reviewed in Shake and Mattson 1975, p. 2). Brown-headed cowbirds also appear to exert greater pressure on Kirtland's warbler nests than other passerines within the same breeding habitat, with 93 percent of brown-headed cowbird eggs found in jack pine habitat placed in Kirtland's warbler nests compared to all other host species combined (Walkinshaw 1983, p. 154). Kirtland's warbler fledging rates averaged less than one young per nest prior to the initiation of brown-headed cowbird control (Walkinshaw 1972, p. 5).

The effect of brown-headed cowbird parasitism exacerbated negative impacts associated with habitat loss in the decline of the Kirtland's warbler population (Rothstein and Cook 2000, p. 7). Once trapping of brown-headed cowbirds within Kirtland's warbler nesting areas was demonstrated to decrease parasitism rates and increase Kirtland's warbler nesting success (Cuthbert 1966, pp. 1–2), intensive brown-headed cowbird removal was

recommended on major Kirtland's warbler nesting areas as one of the necessary steps for the recovery of the Kirtland's warbler (Shake and Mattsson 1975, p. 2).

Starting in 1972, the Service, in conjunction with the USDA–WS, MDNR, and USFS, implemented an intensive brown-headed cowbird control program within Kirtland's warbler nesting areas in Michigan's Lower Peninsula. On average, the control program annually removes approximately 3,573 brown-headed cowbirds from occupied Kirtland's warbler habitat in northern lower Michigan (USDA–WS 2016, unpubl. report). Recent trap rates, however, have been below 1,500 brown-headed cowbirds per year (USDA–WS, unpubl. data).

Following the initiation of brown-headed cowbird control in northern lower Michigan in 1972, brood parasitism rates decreased to 6.2 percent, and averaged 3.4 percent between 1972 and 1981 (Kelly and DeCapita 1982, p. 363). Kirtland's warbler fledging rates simultaneously increased from less than one per nest to 2.8 per nest, and averaged 2.78 young fledged per nest between 1972 and 1981 (Kelly and DeCapita 1982, pp. 364–365). Had brown-headed cowbird parasitism not been controlled, the Kirtland's warbler population may have been reduced to only 42 pairs by 1974 (Mayfield 1975, p. 43).

Brood parasitism of Kirtland's warbler nests also occurs in Wisconsin, and brown-headed cowbird trapping is conducted in select Kirtland's warbler breeding areas. The trapping program in Wisconsin started in 2008, and is run using similar methods to the program in Michigan, with an average of 238 brown-headed cowbirds captured per year (USDA–WS, USFWS unpubl. data). In 2007, two of three Kirtland's warbler nests were parasitized (USFWS, unpubl. data). After the initiation of brown-headed cowbird control in 2008, brood parasitism rates in Wisconsin have fluctuated substantially among years, from 10 percent to 66 percent (USFWS, unpubl. data; Trick, unpubl. data). However, in the same time period (2008–2017), overall nest success has ranged from 19 to 80 percent, and the average fledge rate was estimated to be between 1.51 to 1.92 chicks per nest (USFWS 2017, pp. 2–3).

Limited studies on the effectiveness of the brown-headed cowbird control program in relation to Kirtland's warbler nest productivity in Michigan have been conducted since the early 1980s. Brown-headed cowbirds were nearly eliminated in areas directly adjacent to

a trap, and brown-headed cowbird densities increased 5 km (3 miles) and greater from brown-headed cowbird removal areas (De Groot and Smith 2001, p. 877). Brown-headed cowbird densities also significantly increased at distances greater than 10 km (6 miles) from brown-headed cowbird removal areas, further demonstrating the localized effect of brown-headed cowbird control (De Groot and Smith 2001, p. 877). Although brown-headed cowbird density increased with distance beyond 5 km (3 miles) of brown-headed cowbird traps, brown-headed cowbird densities were still low in those areas compared to other parts of North America (De Groot and Smith 2001, p. 877). Anecdotal observations of brood parasitism rates within Kirtland's warbler nesting areas during periods of brown-headed cowbird control indicated very low levels of brood parasitism; parasitism rates have been reduced to less than 1 percent of all nests in areas where trapping occurred (Bocetti 1994, p. 96; Rockwell 2013, pp. 80, 93; Rockwell, unpubl. data).

A study is currently underway in Michigan to evaluate the effective range of a brown-headed cowbird trap and to determine the brood parasitism rate of Kirtland's warbler nests when traps are not operated during the warbler's breeding season. Beginning in 2015, 12 brown-headed cowbird traps (out of 55 total) were closed for two breeding seasons. In 2015, only one nest out of 157 was parasitized, approximately 4.6 km (2.9 miles) away from the nearest brown-headed cowbird trap. In 2016, similar low rates of parasitism were observed, with only 2 parasitized nests out of 128. Due to the low levels of brood parasitism observed, an additional 6 traps were closed in 2017, and none of the 100 nests observed between 0.5 and 22.1 km (0.3 and 13.7 miles) from a brown-headed cowbird trap in 2017 were parasitized (Cooper *et al.*, unpubl. data). In total, only 3 of 385 Kirtland's warbler nests were parasitized in areas with a spatially reduced trapping program from 2015 to 2017. These preliminary data corroborate similar findings that the effective range of a brown-headed cowbird trap is likely much larger than the range (*i.e.*, 1.6 km (1 mile) radius) traditionally used in planning and implementing the brown-headed cowbird control program. Following these results, all brown-headed cowbird trapping in Michigan's northern Lower Peninsula was suspended for the 2018 nesting season. Only 1 of 129 Kirtland's warbler nests was found to be

parasitized (Cooper *et al.*, unpubl. data) in 2018.

Trend estimate data from Breeding Bird Survey routes between 2005 and 2015 show decreasing brown-headed cowbird populations in Michigan and the Upper Great Lakes (Sauer *et al.* 2017, p. 169). Reduced brown-headed cowbird abundance within Kirtland's warbler nesting areas is supported by results from point count surveys conducted between 2015 and 2018 in Kirtland's warbler nesting areas in Michigan's northern Lower Peninsula where brown-headed cowbird traps were not being operated. Only 67 brown-headed cowbirds were observed during 1,134 point count surveys (Cooper *et al.*, unpubl. data).

However, in similar experiments where brown-headed cowbird trapping was reduced or brought to an end following a lengthy period of trapping, brood parasitism rates elevated or returned to pre-trapping rates. Research at Fort Hood Military Reservation in Texas showed that after 3 years of decreased brown-headed cowbird trapping levels, parasitism rates increased from 7.9 percent to 23.1 percent and resulted in black-capped vireo (*Vireo atricapilla*) nest survival decreasing to unsustainable levels (Kostecke *et al.* 2009, p. 1). Other studies have found similar results with parasitism frequency and host bird productivity returning to pre-trapping levels quickly upon discontinuing cowbird removal (Kosciuch and Sandercock 2008, p. 546).

After 45 years of brown-headed cowbird trapping in Michigan, the threat of brood parasitism on the Kirtland's warbler has been greatly reduced but not eliminated. Brown-headed cowbirds remain present, but potentially in lower numbers, in jack pine habitat away from brown-headed cowbird traps, even if that area had been trapped in previous years (DeGroot and Smith 2001, p. 877; Bailey 2007, pp. 97–98; Cooper *et al.*, unpubl. data). Female brown-headed cowbirds are highly prolific, estimated to produce up to 40 eggs in a breeding season (Scott and Ankney 1980, p. 680). Successful brown-headed cowbird reproduction outside of trapped areas may maintain a population of adult brown-headed cowbirds that could return in subsequent years with the ability to parasitize Kirtland's warbler nests. It is unclear if reduced parasitism rates are a permanent change to the landscape of northern lower Michigan. The best available information, however, indicates that cowbird removal efforts can be reduced, at least temporarily, without adversely impacting Kirtland's

warbler productivity rates. Given the historical impact that the brown-headed cowbird has had on the Kirtland's warbler, and the potential for the brown-headed cowbird to negatively affect the warbler, a sustainable Kirtland's warbler population depends on monitoring the magnitude and extent of brood parasitism and subsequently adjusting the level of cowbird trapping appropriately.

The MOA (see Recovery and Recovery Plan Implementation, above) established in 2015 between the Service and MDNR addresses the commitment and long-term costs associated with future efforts to control brown-headed cowbirds. The MOA established a dedicated account from which income can be used to implement cowbird management and other conservation actions for the Kirtland's warbler. To date, the account has greater than \$2.1 million invested for long-term growth. The MDNR has re-confirmed their commitment to implement and administer the brown-headed cowbird management program once the species is delisted (MDNR 2017). Given our understanding of the status of brown-headed cowbirds in northern lower Michigan, the \$2.1 million investment, coupled with the MDNR's commitment, is sufficient to provide an effective brown-headed cowbird management program into the foreseeable future.

Climate Change

Our analyses under the ESA include consideration of ongoing and projected changes in climate. A recent compilation of climate change and its effects is available from reports of the Intergovernmental Panel on Climate Change (IPCC) (IPCC 2014, entire). In our analyses, we use our expert judgment to weigh relevant information, including uncertainty, in our consideration of various aspects of climate change.

The effects of climate change on Kirtland's warblers were not identified as a threat to the species in the listing rule (32 FR 4001; March 11, 1967) or in the updated recovery plan (USFWS 1985, entire). Potential effects of climate change to the Kirtland's warbler could occur as a result of changes on the breeding or wintering grounds and include a decrease and shift in suitable breeding habitat outside of the species' current range (Prasad *et al.* 2007, unpaginated), increase in pests or pathogens of jack pine, a decrease in the extent of wintering habitat, and decoupling of 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, p. 456; Visser *et al.* 1998, pp. 1869–1870; Thomas *et al.* 2001, p. 2598; Strode 2003, p. 1142).

*Breeding Grounds: On the breeding grounds, climate change projections, based on low (B1) and high (A1FI) emission scenarios, predict shifts in mean temperature and precipitation as well as altered timing and extremes (Handler *et al.* 2014, pp. 68–84; Janowiak *et al.* 2014, pp. 66–85; GLISA 2018, unpaginated). In the core breeding area, temperatures are expected to increase across all seasons, with more dramatic increases during winter months (Handler *et al.* 2014, p. 72). Precipitation is projected to increase in winter and spring but may decrease in the summer (Handler *et al.* 2014, pp. 73–75), with more extreme precipitation events representing a larger proportion of the total annual and seasonal rainfall (Handler *et al.* 2014, p. 82).*

The extent and availability of suitable Kirtland's warbler habitat within jack pine forests on the breeding grounds could change based on projected changes to temperature and precipitation. The Forest Service's Forest Ecosystem Vulnerability Assessments considered impacts to above-ground biomass for 26 tree species, and projected stable (in Wisconsin) or slight reductions (in Michigan) in the biomass of jack pine over the next 50 years, with more significant declines projected by the end of the 21st century (Handler *et al.* 2014, p. 94; Janowiak *et al.* 2014, p. 99). In addition to a possible reduction in the biomass of jack pine, the spatial distribution of the species may also shift in response to changing climate.

The projections of how jack pine will be affected by climate change vary based on the model used and emission scenario considered. Overall, models predict that jack pine occurrence will contract in the northern Lower Peninsula and shift out of peripheral breeding areas. Scenarios using both low (B1) and high (A1FI) greenhouse gas emissions predicted a reduction of the extent of jack pine in Michigan but an expansion of jack pine in western Wisconsin and Minnesota (Prasad *et al.* 2007, unpaginated). More recent models using emission scenarios with Representative Concentration Pathways (RCPs) of 4.5 and 8.5 similarly projected a decline in jack pine occurrence in Michigan and indicated declines in northern Minnesota, northern Wisconsin, and the Upper Peninsula of Michigan (Donner *et al.* 2018, pp. 270–273). However, conditions were projected to remain suitable for jack pine occupancy in northern lower Michigan (Donner *et al.* 2018, p. 271).

Insect pests may become more problematic to jack pine under future climatic changes, with increasing damage and spread of new jack pine pests in the Kirtland's warbler's habitat areas. A warmer climate may increase the susceptibility of current jack pine forests to damage from pests and diseases (Bentz *et al.* 2010, pp. 606–610; Cudmore *et al.* 2010, pp. 1040–1042; Safranyik *et al.* 2010, p. 432) and may allow for new pests such as western bark beetle to arrive (Handler *et al.* 2014, p.130). Forest managers will continue to monitor pest and pathogen outbreaks in jack pine forests.

Competition with deciduous forest species is also expected to favor an expansion of the deciduous forest into the southern portions of the boreal forest (USFWS 2009, p. 14) and affect interspecific relationships between the Kirtland's warbler and other wildlife (Colwell and Rangel 2009, p. 19657; Wiens *et al.* 2009, p. 19729). However, warmer weather and increased levels of carbon dioxide could also lead to an increase in tree growth rates on marginal forestlands that are currently temperature-limited (NAST 2000, p. 57). Higher air temperatures will cause greater evaporation and, in turn, reduce soil moisture, resulting in conditions conducive to forest fires (NAST 2000, p. 57) that favor jack pine propagation. Too much change in the fire regime could have a negative effect on jack pine regeneration and result in a shift to barrens (Handler *et al.* 2014, p. 130). Additionally, warmer temperatures could also lead to greater moisture stress, through accelerated litter layer decomposition leading to lower water-holding capacity (Handler *et al.* 2014, p. 130). Alternatively, warmer conditions and longer growing seasons could benefit pine forests, if carbon dioxide fertilization boosts long-term water-use efficiency and productivity (Handler *et al.* 2014, pp. 102, 114–115, 130).

Recent vulnerability analyses estimate moderate potential impacts to jack pine forests as a result of the effects of climate change and low-moderate adaptive capacity of jack pine, based on its high tolerance for disturbance and existing management practices (Handler *et al.* 2014, p. 130). A climate change vulnerability assessment for wildlife species by MDNR (Hoving *et al.* 2013, p. 40), using NatureServe's Climate Change Vulnerability Index, categorized Kirtland's warbler as "Presumed Stable," with the caveat that while the population may remain stable, its range may shift outside of Michigan.

In summary, there may be a reduction or a shift in available suitable jack pine habitat over the next 50 years, but these

reductions may be offset to some degree by other ecosystem processes, such as an altered fire regime and adaptive habitat management (harvest of jack pines and techniques, such as the use of containerized saplings rather than bare-root stock, for planting jack pine plantations). Jack pine may also adapt to changing climatic conditions. As suitable habitat shifts, Kirtland's warblers could also adapt by utilizing more marginal habitat, or increasing in density in high-quality habitat. The KWCT will continue to analyze the extent and distribution of suitable habitat, and the effects of pests and disease on jack pine.

Wintering Grounds: On the wintering grounds, effects of climate change to the Kirtland's warbler could occur as a result of changing temperature and precipitation, rising sea levels, and storm events. For migratory species, unfavorable changes on the wintering grounds can result in subsequent negative effects on fitness later in the annual life cycle (Marra *et al.* 1998, p. 1885; Sillett *et al.* 2000, pp. 2040–2041; Rockwell *et al.* 2012, pp. 747–748; Rockwell *et al.* 2017, p. 721). For the Kirtland's warbler, wintering habitat condition affects survival and reproduction (Rockwell *et al.* 2012, pp. 747–748; Rockwell *et al.* 2017, p. 721). These effects likely result from limited resource availability on the wintering grounds that reduces body condition and fat reserves necessary for successful migration and reproduction (Wunderle *et al.* 2014, pp. 47–49). The availability of sufficient food resources is affected by the amount of habitat for arthropods and fruiting plants, temperature, and precipitation (Brown and Sherry 2006, pp. 25–27; Wunderle *et al.* 2014, p. 39).

Temperatures in the Caribbean have shown strong warming trends across all regions, particularly since the 1970s (Jones *et al.* 2016, pp. 3325, 3332), and are likely to continue to warm. A climate model with a high emission scenario (A2) predicted an increase in temperature of almost 2.5 to 3.0 degrees Celsius (4.5 to 6.3 degrees Fahrenheit) above the mean temperatures of 1970–1989 by the 2080s (Karmalkar *et al.* 2013, p. 301). Climate change models using a lower emissions scenario (RCP4.5) project an increase in surface temperature in the Caribbean ranging from 1.2 to 1.9 degrees Celsius (2.2 to 3.4 degrees Fahrenheit) for 2081–2100 when compared to 1986–2005 (Nurse *et al.* 2014, p. 1628). Other models, using high (A2) and low (B2) emission scenarios, also predicted an increase in the number of warm days and nights and a decrease in the frequencies of cool days and nights, in addition to higher

mean daily temperatures, for 2071–2099 relative to 1961–1999 (Stennett-Brown *et al.* 2017, pp. 4838–4840). Increased temperatures could affect food availability by altering food supply (arthropod and fruit availability), although it is unknown to what extent the predicted increases in temperature would increase or decrease food supply for the Kirtland's warbler. Other effects of increasing temperature related to sea level and precipitation are described below.

Increasing temperatures can contribute to sea level rise from the melting of ice over land and thermal expansion of seawater. A wide range of estimates for future global mean sea level rise is found in the scientific literature (Church *et al.* 2013, entire; IPCC 2013a, entire; Simpson *et al.* 2010, pp. 55–61; Sweet *et al.* 2017, entire). By 2070, global mean sea level is projected to increase by 0.35 m (1.15 ft) to 0.42 m (1.38 ft) under RCP4.5 and RCP8.5 scenarios (IPCC 2013a, p. 1445). Another model predicts increases in sea level ranging from 0.35 m (1.15 ft) to 0.79 m (2.59 ft) by 2070 under comparable emission scenarios (Sweet *et al.* 2017, p. 23). An increase in sea level could reduce the availability of suitable habitat due to low-elevation areas being inundated, resulting in a reduction in the size of the islands on which Kirtland's warblers winter (Amadon 1953, p. 466; Dasgupta *et al.* 2009, pp. 21–23). The Bahamas archipelago is mainly composed of small islands, and more than 80 percent of the landmass is within 1.5 m (4.9 ft) of mean sea level (The Bahamas Environment, Science and Technology Commission 2001, p. 43). This makes The Bahamas particularly vulnerable to future rises in sea level (Simpson *et al.* 2010, p. 74), which could result in a reduction of the extent of winter habitat and negatively impact the Kirtland's warbler. Estimates of total landmass loss throughout The Bahamas due to a 1-meter (3.3 ft) rise in sea level vary from 5 percent (Simpson *et al.* 2010, p. 77) to 11 percent (Dasgupta *et al.* 2007, p. 12; 2009, p. 385). However, not all of the land that may be inundated is potentially suitable for Kirtland's warbler (*e.g.*, developed land, closed-canopy forest). To assess how climate change scenarios may affect Kirtland's warbler's wintering habitat, we considered a recent estimate of potential Kirtland's warbler habitat loss due to sea level rise (Wolcott *et al.* 2018, entire). Loss of open-land habitat varied across the archipelago, based on elevational differences (Wolcott *et al.* 2018, p. 10). There have historically

been few observations of Kirtland's warblers on the northern islands (Cooper *et al.* 2019, p. 84), where elevations are lower and where projections indicate the greatest loss of open land (Wolcott *et al.* 2018, p. 10). On Eleuthera, the island with the greatest known density of overwintering Kirtland's warblers, a rise in sea level of 1 meter (3.3 ft) or 2 meters (6.6 ft) would result in a loss of potential Kirtland's warbler wintering habitat of 0.8 percent and 2.6 percent, respectively (Wolcott *et al.* 2018, p. 9). Given that the projected rise in sea level in the foreseeable future is less than 1 meter (3.3 ft), we anticipate the loss of potential Kirtland's warbler winter habitat on Eleuthera due to sea level rise will be less than 0.8 percent.

Generally, climate models predict a drying trend in the Caribbean, but there is considerable temporal and spatial variation and often disagreement among models regarding specific predictions that make it difficult to determine the extent to which reduced rainfall or timing of rainfall may affect the Kirtland's warbler in the future. We reviewed available literature examining precipitation trends and projections in the Caribbean, and specifically The Bahamas, to assess the potential effects of changes in precipitation.

Precipitation patterns in the Caribbean from 1979 to 2012 did not show statistically significant century-scale trends across regions, but there were periods of up to 10 years when some regions were drier or wetter than the long-term averages (Jones *et al.* 2016, p. 10). In the northern Caribbean (which includes The Bahamas, Cuba, Jamaica, Haiti, Dominican Republic, and Puerto Rico), some years were more wet than the average, and other years were more dry across all seasons (Jones *et al.* 2016, p. 3314), with higher precipitation totals since about 2000. Within The Bahamas, precipitation trends during the dry season (November through April) showed a significant drying trend for 1979–2009 (Jones *et al.* 2016, pp. 3328, 3331).

Model projections under two emission scenarios (RCP4.5 and 8.5) found that the projected precipitation varied seasonally and spatially throughout the islands of The Bahamas, both in the mid-term (2050) and long-term (2100) (Wolcott *et al.* 2018, pp. 4–6). The northern and north-central islands are likely to have increased precipitation in March (compared to baseline conditions), whereas the central islands are likely to become drier (Wolcott *et al.* 2018, p. 7–8) under both emission scenarios, with the

magnitude of projected changes greater in RCP8.5.

Accurately projecting future precipitation trends in the Caribbean is difficult due to the complex interactions between sea surface temperatures, atmospheric pressure at sea level, and predominant wind patterns. Further, some models have difficulty accurately simulating the semi-annual seasonal cycle of precipitation observed in the Caribbean (Karmalkar *et al.* 2013, pp. 300–302). Recent models using statistical downscaling techniques have improved resolution but still show limitations for predicting precipitation (Stennett-Brown *et al.* 2017, p. 4840). Thus, rainfall projections where Kirtland's warblers overwinter have limited certainty and should be interpreted with caution. Understanding the likely projected precipitation in The Bahamas and Caribbean is important because of the strong link between late winter rainfall and fitness of Kirtland's warblers. A drying trend on the wintering grounds will likely cause a corresponding reduction in available food resources (Studds and Marra 2007, pp. 120–121; Studds and Marra 2011, pp. 4–6). Rainfall in the previous month was an important factor in predicting fruit abundance (both ripe and unripe fruit) for wild sage and black torch in The Bahamas (Wunderle *et al.* 2014, p. 19), which is not surprising given the high water content (60–70 percent) of their fruit (Wunderle, unpubl. data, cited in Wunderle *et al.* 2014, p. 4). Carry-over effects of weather on the wintering grounds, particularly late-winter rainfall, have been shown to affect spring arrival dates, reproductive success, and survival rates of Kirtland's warblers (reviewed in Wunderle and Arendt 2017, pp. 5–12; Rockwell *et al.* 2012, p. 749; Rockwell *et al.* 2017, pp. 721–722).

Decreases in rainfall and resulting decreases in food availability may also result in poorer body condition prior to migration. The need to build up the necessary resources to successfully complete migration could, in turn, result in delays to spring departure in dry years (Wunderle *et al.* 2014, p. 16) and may explain observed delays in arrival times following years with less March rainfall in The Bahamas (Rockwell *et al.* 2012, p. 747). Delays in the spring migration of closely related American redstarts (*Setophaga ruticilla*) have also been directly linked to variation in March rainfall and arthropod biomass (Studds and Marra 2007, p. 120; Studds and Marra 2011, p. 4), and have also resulted in fewer offspring produced per summer (Reudink *et al.* 2009, p. 1624). These

results strongly indicate that environmental conditions modify the timing of spring migration, which likely carries a reproductive cost. If The Bahamas experience a significant winter drying trend, Kirtland's warblers may be pressured to delay spring departures, while simultaneously contending with warming trends in their breeding range that pressure them to arrive earlier in the spring. Projection population modeling (Rockwell *et al.* 2017, p. 2) estimated a negative population growth in Kirtland's warbler as a result of a reduction of more than 12.4 percent from the current mean levels in March rainfall.

A recent drought in the Caribbean from 2013 to 2016, due in part to El Niño, resulted in some of the highest temperatures and potential evapotranspiration anomalies observed in the region (Herrera and Ault 2017, p. 7822). As a result, it has been characterized as the most severe drought in the region since at least 1950 (Herrera and Ault 2017, p. 7822) and may have been appreciably more severe because of anthropogenic warming (*i.e.*, 15 to 17 percent of the drought's severity and approximately 7 percent of its spatial extent could be attributed to the anthropogenic effects of climate change) (Herrera *et al.* 2018, pp. 4–5). Future droughts are predicted to be increasingly severe because of higher temperatures, which played an important role in the 2013–2016 drought, regardless of changes in precipitation (Herrera *et al.* 2018, p. 7). For the period during and following the 2013–2016 drought, the Kirtland's warbler population remained stable or increased, indicating at least some level of resilience to severe, short-term drought.

Extreme weather events, such as tropical storms and hurricanes, will continue to occur with an expected reduction in the overall frequency of weaker tropical storms and hurricanes and an increase in the frequency of the most intense hurricanes (category 4 and 5 hurricanes), based on several dynamical climate-modeling studies of Atlantic basin storm frequency and intensity (Bender *et al.* 2010, p. 456; Knutson *et al.* 2010, pp. 159–161; Murakami *et al.* 2012a, pp. 2574–2576; Murakami *et al.* 2012b, pp. 3247–3253; Knutson *et al.* 2013, pp. 6599–6613; Knutson *et al.* 2015, pp. 7213–7220). Although very intense hurricanes are relatively rare, they inflict a disproportionate impact in terms of storm damage (*e.g.*, approximately 93 percent of damage resulting from hurricanes is caused by only 10 percent of the storms (Mendelsohn *et al.* 2012,

p. 3)). An increasing trend for hurricanes to have decreased forward or translational speeds may increase the future risk of heavy rainfall events and extended period of hurricane-force winds over an island (Kossin 2018, p. 105). This could result in future increased risks to Kirtland's warblers and their winter habitat.

Hurricanes have the potential to result in direct mortality of Kirtland's warblers during migration and while on the wintering grounds (Mayfield 1992, p. 11), but most birds do not arrive in The Bahamas until mid-October to early November, after peak hurricane season (Wunderle and Ewert 2018, p. 1). There is a high risk of short-term effects following the hurricane due to altered shelter and food (Wiley and Wunderle 1993, pp. 331–336). During recent observations of hurricane effects on the island of San Salvador, post-hurricane declines of Kirtland's warblers relative to previous winters may have been due to food resource loss resulting from salt spray that killed leaves and possibly arthropods and fruit (Wunderle and Ewert 2018, p. 1). Because Kirtland's warblers readily shift sites on the wintering grounds based on food availability, Kirtland's warblers would likely be able to shift locations within and possibly between nearby islands as an immediate post-hurricane response (Wunderle *et al.* 2007, p. 124). Further, hurricanes likely produce new wintering habitat for Kirtland's warblers by opening up closed canopy habitat of tall coppice and may also help set back succession for existing suitable habitat (Wunderle *et al.* 2007, p. 126). Coastal areas at most risk to storm surges (and thus less suitable for development) may provide future habitat for Kirtland's warblers (Wunderle and Ewert 2018, p. 1).

In summary, uncertainties in modeling the projected effects of climate change in The Bahamas, both spatially and temporally, create some uncertainty in effects on the Kirtland's warbler's wintering habitat and food availability. There is more confidence that temperatures are likely to increase, and it is possible that there will be a drying trend over much of the Caribbean. However, it is not clear whether all islands will be equally affected by less precipitation. The Kirtland's warbler population has increased dramatically during the past drying trend (1979–2009) and recent drought (2013–2016) at its wintering grounds. In addition, individual warblers have been reported wintering outside of The Bahamas (see *Distribution*, above). Although the extent of behavioral plasticity and adaptive capacity at the species level to

shift locations in response to the effects of climate change in the Caribbean remains unknown, as a long-distance migrant, the Kirtland's warbler is well suited, in terms of its movement patterns and dispersal ability, to reach other locations both within and outside of its current winter range where suitable winter habitat and food resources may be more available under future temperature and precipitation conditions.

Collision With Lighted and Human-Made Structures

Collision with human-made structures (*e.g.*, tall buildings, communication towers, wind turbines, power lines, and heavily lighted ships) kills or injures millions of migrating songbirds annually (Bocetti 2011, pp. 177–178; reviewed in Drewitt and Langston 2008, p. 259; Longcore *et al.* 2008, pp. 486–489). Factors that influence the likelihood of avian collisions with human-made structures include size, location, use of lighting, and weather conditions during migratory periods (reviewed in Drewitt and Langston 2008, p. 233). The presence of artificial light at night and plate-glass windows are the most important factors influencing avian collisions with existing human-made structures (Ogden 1996, p. 4).

There are five confirmed reports of Kirtland's warblers colliding with human-made structures, all of which resulted in death. Two of these deaths resulted from collisions with windows (Kleen 1976, p. 78; Kramer 2009, pers. comm.), and three resulted from collisions with a lighted structure, including a lighthouse (Merriam 1885, p. 376), an electric light mast (Jones 1906, pp. 118–119), and a lighted monument (Nolan 1954). Another report of a Kirtland's warbler that flew into a window and appeared to survive after only being stunned by the collision (Cordle 2005, p. 2) was not accepted as an official documented observation of a Kirtland's warbler (Maryland Ornithological Society 2010, unpaginated).

Some bird species may be more vulnerable to collision with human-made structures than others due to species-specific behaviors. Particularly vulnerable species include: Night-migrating birds that are prone to capture or disorientation by artificial lights because of the way exposure to a light field can disrupt avian navigation systems; species that habitually make swift flights through restricted openings in dense vegetation; and species that are primarily active on or near the ground (reviewed in Ogden 1996, p. 8;

Gauthreaux and Belser 2006, p. 67). Of the avian species recorded, the largest proportion of species (41 percent) that suffer migration mortality at human-made structures belong to the wood warbler subfamily (Parulinae), of which many species exhibit the above-mentioned behaviors (Ogden 1996, p. 14).

The Kirtland's warbler belongs to the Parulidae family, migrates at night, typically occupies dense vegetation, and is often active on or near the ground. Although Kirtland's warblers exhibit behavioral traits that may contribute to vulnerability to collision with human-made structures, little is known regarding how prone this species is to collision. The majority of bird collisions go undetected because corpses land in inconspicuous places or are quickly removed by scavengers, postmortem (Klem 2009, p. 317). Additionally, while most avian collisions take place during migration, detailed information about Kirtland's warbler migration is still limited. The Kirtland's warbler population is also small, reducing the probability of collision observations by chance alone, compared to other species. These factors have inhibited the gathering of information, and in turn, a more comprehensive understanding of the hazards human-made structures pose to the Kirtland's warbler. It is reasonable to presume, however, that more Kirtland's warblers collide with human-made structures than are reported.

Solutions to reduce the hazards that cause avian collisions with human-made structures are being implemented in many places. Extinguishing internal lights of buildings at night, avoiding the use of external floodlighting, and shielding the upward radiation of low-level lighting such as street lamps are expected to reduce attraction and trapping of birds within illuminated urban areas, and in turn, reduce injury and mortality caused by collision, predation, starvation, or exhaustion (reviewed in Ogden 1996, p. 31). The Service's Urban Conservation Treaty for Migratory Birds program has worked with several cities to adopt projects that benefit migrating birds flying through urban areas between breeding and wintering grounds. For example, some cities within the Kirtland's warbler's migration corridor, such as Chicago, Indianapolis, Columbus, Detroit, and Milwaukee, have "Lights Out" or similar programs, which encourage the owners and managers of tall buildings to turn off or dim exterior decorative lights, as well as interior lights, during spring and fall migration periods (National Audubon Society 2019,

entire). These programs are estimated to reduce general bird mortality by up to 83 percent (Field Museum 2007, p. 1).

Additionally, migrating birds are not equally attracted to various lighting patterns, and modifying certain types of lighting systems could significantly reduce collision-related mortality. Removing steady-burning, red L-810 lights and using only flashing, red L-864 or white L-865 lights on communication towers and other similarly lit aeronautical obstructions could reduce mortality rates by as much as 50 to 70 percent (Gehring *et al.* 2009, p. 509). On December 4, 2015, the Federal Aviation Administration (FAA) revised its advisory circular that prescribes tower lighting to eliminate the use of L-810 steady-burning side lights on towers taller than 107 m (350 ft) (FAA Advisory Circular 70/7460-1L), and on September 28, 2016, it released specifications for flashing L-810 lights on towers 46–107 m (150–350 ft) tall. These lighting changes should significantly reduce the risk of migratory bird collisions with communication towers.

As noted previously concerning potential threats to migratory habitat, if mortality during migration were limiting or likely to limit the population to the degree that maintaining a healthy population may be at risk, it should be apparent in the absence of the species from highly suitable breeding habitat in the core breeding range. In fact, we have seen just the opposite with increasing densities of breeding individuals in core areas and a range expansion into what would appear to be less suitable habitat elsewhere. This steady population growth and range expansion occurred while the potential threats to the species during migration were all increasing on the landscape (*e.g.*, new communication towers and wind turbines).

Synergistic Effects of Factors A Through E

When threats occur together, one may exacerbate the effects of another, causing effects not accounted for when threats are analyzed individually. Many of the threats to the Kirtland's warbler and its habitat discussed above under Factors A through E are interrelated and could be synergistic, and thus may cumulatively impact Kirtland's warbler beyond the extent of each individual threat. For example, increases in temperature and evaporation could reduce the amount of jack pine habitat available and increase the level of brood parasitism. Historically, habitat loss and brood parasitism significantly impacted the Kirtland's warbler and cumulatively acted to reduce its range and

abundance. Today, these threats have been ameliorated and adequately minimized such that the species has exceeded the recovery goal. The best available data show a positive population trend over several decades and record high population levels. Continued habitat management and brown-headed cowbird control at sufficient levels, as identified in the Conservation Plan and at levels consistent with those to which management agencies committed in the MOU and MOA, will assure continued population numbers at or above the recovery criterion with the current magnitude of other threats acting on the Kirtland's warbler.

Summary of Comments and Recommendations

In the proposed rule published on April 12, 2018 (83 FR 15758), we requested that all interested parties submit written comments on the proposal by July 11, 2018. We also contacted appropriate Federal and State agencies, scientific experts and organizations, and other interested parties and invited them to comment on the proposal. Newspaper notices inviting general public comment were published in *The Milwaukee Journal Sentinel* on April 16, 2018, and in *The Detroit Free Press* on April 23, 2018. We did not receive any requests for a public hearing. The draft Post-delisting Monitoring Plan (PDM) was made available on our website on June 7, 2018. During the comment period for the proposed rule, we received a total of 42 comment letters or statements directly addressing the proposed action. These included comments from seven peer reviewers and 34 comments from the public during the open comment period; all comments are posted on <http://www.regulations.gov> under Docket No. FWS-R3-ES-2018-0005. Many commenters expressed their support or opposition to the proposed rule without offering substantive information.

In accordance with our peer review policy published on July 1, 1994 (59 FR 34270), we solicited expert opinion from 10 knowledgeable individuals with scientific expertise that included familiarity with Kirtland's warbler and its habitat, biological needs, and threats, as well as familiarity with conservation biology, ornithology, climate change, and population ecology. We received responses from seven peer reviewers. Almost all of the peer reviewers supported the proposed delisting rule, although one peer reviewer suggested that a more cautious approach would be to downlist the species to provide a

“buffer” of protection. Many peer reviewers commented that the current status of Kirtland's warbler is accurately presented in the proposed rule.

We reviewed all comments we received from the peer reviewers and the public for substantive issues and new information regarding the delisting of Kirtland's warbler. Substantive comments we received during the comment period are addressed below and, where appropriate, are incorporated directly into this final rule. Comments that we received on the PDM without reference to or comment on the proposed rule are addressed separately in the PDM.

Comment (1): Several peer reviewers and public commenters expressed concern that additional funding will be needed to support the species post-delisting. They discussed the need for sufficient funding to ensure habitat management and brown-headed cowbird control will continue at levels necessary to support the population above the recovery goals. Several peer reviewers also mentioned that funding will be necessary to support monitoring efforts to ensure any significant changes to the species' population levels are detected. A reviewer also stated that an income-producing fund has been created and appears to be successful, but they were concerned over the uncertainty as to whether it will be adequate to support conservation efforts post-delisting.

Our Response (1): We acknowledge that the long-term survival of Kirtland's warbler is dependent upon the continued implementation of conservation programs that require agency commitment and sufficient funding. The vast majority of conservation programs (with the exception of brown-headed cowbird management) were previously funded through agency appropriations and grants, and not funded through ESA recovery funding. Thus, delisting Kirtland's warbler will not eliminate a major source of funding that is tied to its listing status. In the 2016 MOU, the MDNR, USFS, and Service reaffirmed their commitment to continue managing and monitoring Kirtland's warblers if the species is delisted. To supplement agency funding, which can fluctuate, the Kirtland's Warbler Alliance has been working with partners to establish additional funding sources for future conservation efforts. Recently, the American Bird Conservancy (ABC) was awarded a grant to help establish a long-term Kirtland's warbler endowment that would offset some of the agencies' costs and support future Kirtland's warbler

conservation throughout the bird's full life cycle (Graff 2018, unpaginated).

Previous funding of brown-headed cowbird management was provided through ESA funding; therefore, a new funding source is needed to secure brown-headed cowbird management efforts post-delisting. To address this, the MDNR and Service developed a dedicated fund to be used for brown-headed cowbird management and other high priority conservation needs. At the time the proposed delisting rule was published (83 FR 15758; April 12, 2018), the dedicated fund had greater than \$1 million. Since then, an additional \$1.1 million was added, increasing our certainty that sufficient funding for brown-headed cowbird management will be available in the future. This account is invested for long-term growth, and income generated will be used to ensure sufficient brown-headed cowbird management to adequately reduce brood parasitism of the Kirtland's warbler.

Comment (2): Several peer reviewers discussed the issue of brown-headed cowbird control. The majority expressed support of continuing the brown-headed cowbird management program and asked for more detail regarding how the agencies will monitor the rates of parasitism to know when parasitism rates change, how the agencies will respond to increases in parasitism rates, and whether sufficient funding exists to continue to support the brown-headed cowbird program at historical levels of trapping.

Our Response (2): Brood parasitism has historically been one of the primary threats to Kirtland's warbler, and thus the brown-headed cowbird management program has been a critical component of the recovery program. Recent research has shown a reduced brown-headed cowbird population throughout the Kirtland's warbler's core range in the northern Lower Peninsula. An experiment was initiated in 2015 to evaluate the effect of a reduced trapping program on Kirtland's warbler nest success. During a 3-year period (2015–2017), 3 of 385 Kirtland's warbler nests were parasitized in areas with a spatially reduced trapping program. Following these results, all trapping in the northern Lower Peninsula was suspended for the 2018 nesting season. In 2018, only one nest of over 140 was found to be parasitized. Additional information and data have been added to this final rule to reflect the most recent information on parasitism rates, including data from the 2018 nesting season.

We fully expect brood parasitism rates to fluctuate and recognize that

permanent reductions to the brown-headed cowbird management program are not prudent. Rather, an adaptive management approach is appropriate to ensure adequate brown-headed cowbird management into the future. We have included the need for continued research and monitoring in the PDM to help inform future efforts.

Based on the ongoing research, we do not expect that trapping levels will need to return to previous levels for several years, and may never return to historic levels. Through ongoing research, the KWCT hopes to establish trigger points that would dictate when trapping would be resumed and at what level. Through the MOA, and reaffirmed in a letter dated November 9, 2017, the MDNR has agreed to assume responsibility for the brown-headed cowbird management program. Funding for the brown-headed cowbird management program will be available through interest accrued from the brown-headed cowbird dedicated fund (see our response to *Comment (1)*), or other agency funds through the MDNR.

External funding has been secured for the Smithsonian Migratory Bird Center to continue monitoring brown-headed cowbird presence and brood parasitism for the 2019 and 2020 nesting seasons. The results from the cowbird monitoring research conducted during 2015–2020 will be used to develop specific monitoring protocols that will be conducted in accordance with the PDM. We also expect the KWCT to continue assessing the need for further monitoring or research.

Comment (3): Several peer reviewers discussed the importance of continued habitat management for the Kirtland's warbler population. A reviewer asserted that we made a major assumption in stating that management agencies will continue to create habitat post-delisting. Another comment discussed the uncertainty regarding timber marketability and the importance of timber receipts in offsetting the cost of Kirtland's warbler habitat management, and asked that this topic be more explicitly addressed in the rule. Further, a reviewer recommended a better plan on developing forestry techniques that increase marketability of the timber, as well as finding creative ways to fund future habitat management efforts. Many of the comments received regarding continued habitat management related to ensuring management would continue and how habitat management will be funded.

Our Response (3): The management agencies have a long-standing history of providing habitat for the Kirtland's warbler and have described their

commitment to continuing management for the Kirtland's warbler in the Conservation Plan and the MOU. We recognize the uncertainty over future timber markets and the impact that timber receipts may have in offsetting the costs of habitat management. The land managers and the KWCT have also recognized this uncertainty and have started the process to develop and test alternative planting techniques that would reduce costs and improve the marketability of jack pine through increased growth rates while still providing Kirtland's warbler nesting habitat. Currently, the Conservation Plan indicates up to 25 percent of future habitat management, annually, may incorporate non-traditional regeneration techniques designed to address the marketability and regeneration of jack pine.

Specific plans are not yet available, as the habitat management planning process is dynamic. Alternative management techniques will evolve over time and be adaptable to changing circumstances. A subcommittee of the KWCT has routinely met over the last several years to develop alternative techniques. Additional information regarding timber marketability and future jack pine regeneration techniques has been added to this rule.

Habitat management will continue to be funded through appropriated funds provided to the land management agencies for timber harvest and reforestation. Additional funds may be available through the endowment being developed by the Kirtland's Warbler Alliance and ABC, which is described earlier in this rule.

Comment (4): Several peer reviewers provided comments on the Conservation Plan's allowance of up to 25 percent of habitat management to be non-traditional habitat regeneration techniques. They stated that the quality of Kirtland's warbler breeding habitat created through new techniques is not known and could result in a loss of up to 25 percent of breeding habitat and potentially a substantial decrease in the abundance of Kirtland's warbler. The reviewers recommend any non-traditional techniques be used as part of the annual habitat goals only after they have been shown to be effective. They clarified that both density of breeding pairs and fledgling production are important metrics for evaluating the quality of non-traditional breeding habitat. Another peer reviewer asked us to emphasize that the 25 percent experimental habitat regeneration is a maximum and should not be interpreted as an annual requirement. This reviewer also pointed out that the 75 percent of

breeding habitat created using traditional methods is enough to support the population above the recovery goal of 1,000 pairs and reflects the best available science regarding breeding habitat use by the species.

Our Response (4): We have clarified in this rule that the 25 percent experimental habitat amount is a maximum amount annually. Managing habitat with traditional techniques at a minimum of 75 percent of the annual objective will still provide enough breeding habitat to maintain the species well above the recovery goal. Additionally, we expect that the experimental habitat will still provide breeding habitat for Kirtland's warbler but at potentially lower densities or reduced nest success. These experimental designs will be closely monitored to evaluate their effectiveness in regenerating jack pine and providing Kirtland's warbler breeding habitat.

Comment (5): Several peer reviewers also commented on the agencies' commitment to continue conservation actions for Kirtland's warbler and whether the level of commitment provided via the current MOA and MOU are sufficient to support delisting. A peer reviewer expressed concern regarding the level of commitment to continuing habitat management and pointed out that the MOU indicates that management will occur "only as appropriated funds are available" and that "additional funds will be necessary to meet these commitments." They also pointed out that the MOU can be terminated at any time by any agency and asked whether the agreements are legally binding. Multiple peer reviewers and several public commenters indicated that the levels of commitment in the existing MOU and MOA are sufficient to support delisting. One reviewer asked if the MOU had expired and, if so, when it might be renewed. Regarding conservation agreements on the wintering grounds, one reviewer commented that they are not necessary prior to delisting, given our understanding of threats to winter habitat.

Our Response (5): The MOU is a synthesis of the land management agencies' commitments to forest management, developed under the requirements of Federal and State law that will remain in effect after delisting, to sustain Kirtland's warbler. The MOU was first signed in 2011, was renewed in 2016, and currently expires in 2020. Prior and subsequent to the MOU, habitat management and other conservation programs were always dependent on annual appropriated funds provided to the land management

agencies. Further, MDNR did not have any legal obligations under the ESA to conduct habitat management during the last 40 years while the species was listed, but MDNR adopted into their forest plans the habitat management goals set forth by the Kirtland's Warbler Recovery Team and later by the KWCT. The MOA is specific to cowbird management and the development of a dedicated funding source primarily for that activity, but possibly other activities in the future if excess funding resources become available. The MOA was signed in 2015 with no expiration date and stipulates that the Service and MDNR will review progress under the MOA every 5 years to determine whether any modifications are warranted. While not fully legally binding, the MOU and MOA are built on a foundation of Federal and State law guiding land management and further express the agencies' commitments to continue managing for the species, regardless of the species' status under the ESA.

Comment (6): Several peer reviewers asked for additional detail regarding the intensity and extent of population monitoring post-delisting. A peer reviewer expressed concern over the lack of full surveys (censuses) in recent years, noting that the last full population survey was in 2015. Several reviewers questioned the recent (2016) shift from full census to the less intensive survey effort and requested that the MDNR sampling method be better explained. Several peer reviewers indicated that MDNR should continue with the full census until the proposed survey technique undergoes peer review and publication in a reputable journal. One peer reviewer emphasized that any reduced survey effort should be capable of providing a reliable extrapolation of total breeding male abundance, so as to allow comparison with past total singing/territorial male counts from previous population censuses. Another reviewer commented that the census techniques should be improved to assure accuracy, reduce uncertainty, and improve ability to detect small population-level changes. In addition, a reviewer noted that in areas where reduced brown-headed cowbird trapping occurs (as compared to previous levels) or experimental habitat management techniques are used, more intensive population monitoring is necessary. Some reviewers also suggested that the PDM should include monitoring of survival and reproductive success in addition to the number of singing males. Furthermore, one peer reviewer mentioned the possibility of

using mist-netting as an alternative to nest searching to estimate productivity.

Our Response (6): We appreciate the comments regarding the need for further details on how the Kirtland's warbler population will continue to be monitored post-delisting. Our knowledge of the Kirtland's warbler population and its response to habitat management has greatly been informed by conducting an annual census using similar protocols over several decades. We recognize that the complexity of conducting an annual census has changed as the species has expanded from its core breeding range. Further, the intensity of a monitoring effort should be continually reevaluated in accordance with adaptive management needs and the population size (e.g., for a smaller population, intensive monitoring is more feasible and potentially more important). For a recovered population, unless new information or concerns suggest otherwise, a less-intensive monitoring effort (when compared to when populations were critically imperiled) helps ensure staffing and funding resources are used most effectively. Monitoring of the Kirtland's warbler has routinely been coordinated by the respective land management agencies in coordination with the Service and Recovery Team, or more recently, the KWCT. As the species' population and range has expanded, so has the time and resources needed to conduct a full census. While the KWCT recognizes how critically important it is to continue monitoring the species, it has also recognized that there may be more efficient ways to monitor the species' status than a full census.

In 2016, Michigan State University, in conjunction with MDNR, developed a survey protocol designed to detect a 20 percent change in the population. The recommended survey would randomly select 50 percent of occupied stands on which the standard census protocol would be conducted. By incorporating stand size and age with the observed number of singing males, the survey would provide an estimate of the singing male population with enough confidence to detect a 20 percent reduction in individual singing males. The survey design was tested by using previous census results from 2010, 2011, 2012, and 2013. In each case, the reported census number fell within the survey protocols' 95% confidence interval. Other land management agencies, including USFS and WDNR, plan to continue periodic full censuses.

We recognize that there may be instances where more precise population monitoring is warranted.

When experimenting with alternative habitat regeneration techniques or reduced brown-headed cowbird management levels, a higher level of monitoring would need to be conducted in order to accurately determine the warbler's response to those activities. The need for additional monitoring will be determined by the management agencies, researchers, and KWCT. This need is also addressed within the PDM.

We believe that the monitoring proposed in the PDM is sufficient to detect population-level trends, and MDNR's proposed sampling technique will provide a sufficient estimate of the singing male population. The KWCT will continue to evaluate monitoring protocols and may determine that a periodic full census may be warranted as time and resources allow.

Comment (7): A peer reviewer asked for clarification on the population level that will trigger intensified conservation efforts necessary to ensure the population remains above the numerical recovery goal of 1,000 pairs. Another emphasized that maintaining population numbers above the recovery goal provides flexibility (and a buffer) if new threats emerge.

Our Response (7): In development of the Conservation Plan, the agencies agreed that if the population drops below 1,300 singing males, they would discuss the population decline, decide whether their objectives and actions need to be changed, and implement these recommended changes. The primary objective remains to keep the Kirtland's warbler population above the numerical recovery goal of 1,000 pairs. However, any noted decline from current population levels will be discussed amongst the agencies and the KWCT, and any appropriate action will be taken.

Comment (8): Several reviewers commented that a better understanding of wintering habitat needs should be a high priority for the KWCT and recommended fully mapping the extent of wintering habitat, as well as further research on how various activities and land uses on the wintering grounds impact the species.

Our Response (8): Although threats to Kirtland's warblers on the wintering grounds exist, the current extent and magnitude of these threats are not significantly limiting Kirtland's warbler population numbers, based on the species' continuous population growth over the last two decades. If the population shows signs of decline in the future, we will coordinate with the KWCT to assess all potential stressors, including those occurring on the wintering grounds. The KWCT and its

Non-breeding Range Subcommittee recognize the importance of continued research on the needs of the Kirtland's warbler on the wintering grounds, specifically delineating wintering habitat and assessing how land use may impact the species.

Comment (9): Multiple peer reviewers commented on the species' wintering distribution, and provided citations to incorporate into the rule. One reviewer added that occasional vagrant Kirtland's warbler sightings outside of the core islands should not give the impression that suitable habitat is widespread elsewhere in the Caribbean; the rule should be explicit about our ignorance regarding suitable habitat elsewhere (outside of the core), as habitat suitability has not yet been measured except for on Eleuthera Island.

Our Response (9): The text under *Distribution* in this rule has been updated to more clearly reflect this uncertainty regarding wintering distribution.

Comment (10): Several comments received were related to our analysis of the effects of climate change on the Kirtland's warbler's breeding and wintering grounds. Two reviewers stated that the analysis of climate change in the proposed rule was thorough and relied on the best available science. One reviewer stated that delisting will not prohibit the ongoing research to improve our understanding of future potential threats. Another peer reviewer commented that current climate change projections indicate that habitat suitability within the core breeding range will remain suitable for supporting jack pine in this century; another commenter stated that climate change could result in a shift in the range toward Wisconsin. One reviewer mentioned that on the wintering grounds, Kirtland's warbler could be negatively affected by climate change, but added that there is much uncertainty and currently a lack of strong evidence to suggest a major loss or degradation of wintering grounds habitat will occur in the near future. Another reviewer emphasized the importance of acquiring baseline data on wintering habitat availability and quality to provide a context for future climate change analysis. A reviewer commented that climate change projections that predict an increased drought for the central islands of The Bahamas may represent risk to the main wintering area and recommended protecting drought-tolerant sites (e.g., freshwater lens near the ground surface) where the Kirtland's warbler's preferred fruit plants occur. Another reviewer

provided the citation for a recently published paper regarding future risks of heavy rainfall events and extended periods of hurricane-force winds due to an increasing trend for hurricanes to have decreased forward or translational speeds (Kossin 2018, entire). Further, the reviewer asked that the rule be updated to add observations of hurricane effects on the island of San Salvador, where post-hurricane declines of Kirtland's warblers have been observed.

Our Response (10): Climate change predictions are variable and in many cases uncertain. We reviewed the best available data using multiple models and emission scenarios to evaluate the impact of climate change on the Kirtland's warbler in the foreseeable future. On the breeding grounds, temperature will very likely increase, and precipitation will increase for parts of the year but may decrease at the end of the growing season (Handler *et al.* 2014, pp. 72–75; Janowiak *et al.* 2014, pp. 66–85). On the wintering grounds, temperatures will also increase, which could result in rising sea level. The Caribbean is experiencing a general drying trend, but there is temporal and spatial variation.

We will remain engaged with the KWCT and its Non-breeding Range Subcommittee to monitor climate conditions and how they may impact the Kirtland's warbler. We will also work with the KWCT as they engage The Bahamas National Trust and other groups in an effort to identify and protect critical sites in The Bahamas for Kirtland's warbler conservation.

Additional discussion regarding the potential for climate change has been added to this rule under *Factor E: Climate Change*.

Comment (11): Almost all of the peer reviewers indicated their support of delisting the Kirtland's warbler and stated that the analysis in the proposed rule was sufficient to support delisting. Many heralded the Kirtland's warbler as a success story of the ESA. One peer reviewer, however, recommended we apply a more cautious approach and instead reclassify (*i.e.*, downlist) Kirtland's warbler as a threatened species. Several public commenters had similar comments indicating that the proposed delisting rule was premature, and we should maintain protections to ensure we more fully understand proposed and recent changes to habitat management and brown-headed cowbird control programs before changing the status of the Kirtland's warbler.

Our Response (11): During our analysis, we evaluated the status of the

Kirtland's warbler to determine if the species met the definition of an endangered or threatened species based on any of five factors: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence. Based on the status of the species and the known and foreseeable threats, we determined that the species has recovered and does not meet the ESA's definition of an endangered or a threatened species. Thus, the Kirtland's warbler does not warrant listing under the ESA. While we appreciate the concern and suggestion of a more cautious approach, delisting Kirtland's warbler is warranted based on the best available information.

Comment (12): One peer reviewer expressed concern over potential forest pests causing a catastrophic loss of suitable habitat; the reviewer acknowledges that the currently known insect or fungal threats to jack pine or red pine are possible to manage, and forests in this region are under the oversight of forest management agencies. The reviewer added that the Kirtland's warbler may be less vulnerable to catastrophic loss due to pests or disease outbreaks when compared to historically lower population levels. One commenter expressed concern over the effects of pesticides on the Kirtland's warbler and its insect prey.

Our Response (12): Our review of the best available science did not identify any known threats to the status of the Kirtland's warbler from forest pests, disease, or the use of pesticides. We acknowledge that new threats from insects, fungi, other pests, or the use of a new pesticide may emerge in the future, but our analysis concluded that the species has good redundancy, representation, and resiliency, which should allow the species to withstand potential future stressors.

We agree with the reviewer that the management of forest pests and disease primarily falls under the authority of the forest management agencies. Through collaborative efforts, the KWCT and its Breeding Range Subcommittee, the land management agencies' silviculturists, and the forest product industry can collectively monitor these potential threats and respond accordingly if the threats are determined to impact Kirtland's warbler nesting habitat.

We added additional discussion and references regarding forest pests,

disease, and pesticides to this rule (see discussions under *Factors A* and *E*).

Comment (13): A peer reviewer requested that additional discussion be added regarding recreation, access, and development, including current restrictions in areas occupied by the Kirtland's warbler, and regarding changes that would occur if the Kirtland's warbler is delisted. The reviewer expressed concern that unrestricted recreational activity and nearby development could have unforeseen impacts on the population and that this should be more explicitly considered in our analysis.

Our Response (13): Currently, only a portion of the Kirtland's warbler's nesting habitat in the northern Lower Peninsula is posted closed during the species' breeding season by the respective land management agency. Many of the recreational uses of the Kirtland's warbler's nesting habitat (e.g., hunting, blueberry picking) are typically conducted at times when impacts to the species are limited. Further, in areas that are not posted closed, we have not seen evidence of impacts to the species. Delisting Kirtland's warbler would not limit the authority of the land management agencies to close areas as needed to limit resource damage or protect sensitive species. We added additional information and discussion related to other uses of the Kirtland's warbler's nesting habitat to this rule (see *Factor B* discussion).

Comment (14): Several peer reviewers provided additional information and suggested additional references to support statements in the proposed rule. This included information regarding mortality due to lighted cruise ships in the Caribbean, presence of other avian brood parasites (i.e., cuckoo species) in the Kirtland's warbler breeding range, and new information on wintering habitat and distribution.

Our Response (14): We appreciate the additional information provided by the reviewers. We reviewed the additional information and corresponding references, and we updated this final rule accordingly.

Comment (15): A peer reviewer suggested adding a discussion of reproductive rates to the "Demographics" section of the rule.

Our Response (15): We added this discussion as suggested.

Comment (16): A peer reviewer commented that the assumption regarding number of singing males equating to number of breeding pairs needs clarification and suggested caution when interpreting the number of singing males as an indication of number of breeding pairs.

Our Response (16): We added additional clarification to this rule under *Abundance and Population Trends*.

Comment (17): One commenter requested peer review and a public comment period greater than or equal to 90 days.

Our Response (17): The proposed rule was open for public comments for 90 days, from April 12, 2018, through July 11, 2018, and we solicited peer review on the proposal.

Comment (18): One commenter asked for additional detail on State regulatory protections if the Kirtland's warbler is delisted.

Our Response (18): The Kirtland's warbler is currently protected by State law in a number of States in the species' breeding and migratory ranges under the respective State endangered species regulations. Changing the Federal status of the Kirtland's warbler will not automatically change the listing status of the Kirtland's warbler under State law. Each State evaluates the current status of a species to determine whether it warrants protection under the State's respective statutes. We expect that each State will evaluate the State listing status of the Kirtland's warbler at some point in the next several years, but we cannot speculate as to their decisions under State law. Similarly, the Kirtland's warbler is also protected as endangered under Canada's Species at Risk Act of 2003. Canadian officials will decide whether to retain protected status for the Kirtland's warbler based on their laws and regulations.

Comment (19): One commenter asked if we were proposing delisting to benefit the wind industry and suggested the proposed rule was motivated by reducing regulatory burden to make it easier to get "wind towers in place in rural Ohio."

Our Response (19): Our determination is based solely on the status of the species utilizing the best available science, and our status review was initiated due to the species' population and range expansion in recent years, the development of the Kirtland's Warbler Conservation Plan and MOU, and development of a long-term endowment and MOA to conduct brown-headed cowbird management.

Determination

Section 4 of the ESA (16 U.S.C. 1533), and its implementing regulations at 50 CFR part 424, set forth the procedures for determining whether a species is an endangered species or threatened species and should be included on the Federal Lists of Endangered and Threatened Wildlife and Plants. The

ESA defines an endangered species as any species that is “in danger of extinction throughout all or a significant portion of its range” and a threatened species as any species that is “likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.”

Under section 4(a)(1) of the ESA, we determine whether a species is an endangered species or threatened species because of any of the following factors: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence. These same factors apply whether we are analyzing the species’ status throughout all of its range or throughout a significant portion of its range.

Determination of Status Throughout All of the Kirtland’s Warbler’s Range

We have carefully assessed the best scientific and commercial information available regarding the past, present, and future threats to the Kirtland’s warbler. We assessed the five factors to evaluate whether the species is in danger of extinction, or likely to become so in the foreseeable future, throughout all of its range. The size of the Kirtland’s warbler population is currently at its known historical maximum, which is nearly 10 times larger than it was at the time of listing and more than double the recovery goal. The population’s breeding range also expanded outside of the northern Lower Peninsula to areas in Michigan’s Upper Peninsula, Wisconsin, and Ontario. This recovery is attributable to successful interagency cooperation in the management of habitat and brood parasitism. The amount of suitable habitat has increased by approximately 150 percent since listing, primarily due to the increased amount of planted habitat generated from adaptive silvicultural techniques. Brown-headed cowbird control has been conducted on an annual basis within the majority of Kirtland’s warbler nesting areas since 1972, and has greatly reduced the impacts of brood parasitism.

During our analysis, we found that impacts believed to be threats at the time of listing have been eliminated or reduced, or are being adequately managed since listing, and we do not expect any of these conditions to substantially change after delisting and into the foreseeable future. Population

modeling that assessed the long-term population viability of Kirtland’s warbler populations showed stable populations over a 50-year simulation period with current habitat management and maintaining sufficient brown-headed cowbird removal (see *Population Viability*, above). Brood parasitism and availability of sufficient suitable breeding habitat are adequately managed through the Kirtland’s Warbler Breeding Range Conservation Plan and the 2016 MOU. The Conservation Plan and the MOU acknowledge the conservation-reliant nature of the Kirtland’s warbler and the need for continued habitat management and brown-headed cowbird control, and affirm that the necessary long-term management actions will continue. The species is resilient to threats including changing weather patterns and sea level rise due to the effects of climate change, collision with lighted and human-made structures, impacts to wintering and migratory habitat, and cumulative effects, and existing information indicates that this resilience will not change in the foreseeable future. These conclusions are supported by the available information regarding the species’ abundance, distribution, and trends. Thus, after assessing the best available information, we conclude that the Kirtland’s warbler is not in danger of extinction throughout all of its range, nor is it likely to become so within the foreseeable future.

Determination of Status Throughout a Significant Portion of the Kirtland’s Warbler’s Range

Under the ESA and our implementing regulations, a species may warrant listing if it is in danger of extinction or likely to become so in the foreseeable future throughout all or a significant portion of its range (SPR). Where the best available information allows the Service to determine a status for the species rangewide, that determination should be given conclusive weight because a rangewide determination of status more accurately reflects the species’ degree of imperilment and better promotes the purposes of the ESA. Under this reading, we should first consider whether the species warrants listing “throughout all” of its range and proceed to conduct a “significant portion of its range” analysis if, and only if, a species does not qualify for listing as either an endangered or a threatened species according to the “throughout all” language.

Having determined that the Kirtland’s warbler is not in danger of extinction or likely to become so in the foreseeable future throughout all of its range, we

now consider whether it may be in danger of extinction or likely to become so in the foreseeable future in an SPR. The range of a species can theoretically be divided into portions in an infinite number of ways, so we first screen the potential portions of the species’ range to determine if there are any portions that warrant further consideration. To do the “screening” analysis, we ask whether there are portions of the species’ range for which there is substantial information indicating that: (1) The portion may be significant; and (2) the species may be, in that portion, either in danger of extinction or likely to become so in the foreseeable future. For a particular portion, if we cannot answer both questions in the affirmative, then that portion does not warrant further consideration and the species does not warrant listing because of its status in that portion of its range. We emphasize that answering these questions in the affirmative is not a determination that the species is in danger of extinction or likely to become so in the foreseeable future throughout a significant portion of its range—rather, it is a step in determining whether a more detailed analysis of the issue is required.

If we answer these questions in the affirmative, we then conduct a more thorough analysis to determine whether the portion does indeed meet both of the SPR prongs: (1) The portion is significant; and (2) the species is, in that portion, either in danger of extinction or likely to become so in the foreseeable future. Confirmation that a portion does indeed meet one of these prongs does not create a presumption, prejudice, or other determination as to whether the species is an endangered species or threatened species. Rather, we must then undertake a more detailed analysis of the other prong to make that determination. Only if the portion does indeed meet both SPR prongs would the species warrant listing because of its status in a significant portion of its range.

At both stages in this process—the stage of screening potential portions to identify any portions that warrant further consideration and the stage of undertaking the more detailed analysis of any portions that do warrant further consideration—it might be more efficient for us to address the “significance” question or the “status” question first. Our selection of which question to address first for a particular portion depends on the biology of the species, its range, and the threats it faces. Regardless of which question we address first, if we reach a negative answer with respect to the first question

that we address, we do not need to evaluate the second question for that portion of the species' range.

For the Kirtland's warbler, we chose to evaluate the status question (*i.e.*, identifying portions where the Kirtland's warbler may be in danger of extinction or likely to become so in the foreseeable future) first. To conduct this screening, we considered whether the threats are geographically concentrated in any portion of the species' range at a biologically meaningful scale.

Kirtland's warblers occupy different geographic areas (breeding grounds, migratory routes, wintering grounds) throughout the course of a year. Although there are different threats acting on the species on the breeding grounds, migratory routes, and wintering grounds (see discussion under *Factors A* through *E*, above), the threats associated with these areas are uniformly spread across each area (*e.g.*, threats on the breeding grounds are uniform across the breeding range, threats on the wintering grounds are uniform across the winter range). The entire population moves through the full annual cycle (breeding, migration, and wintering) and functions as a single panmictic population (see discussion under "Genetics," above); therefore, these different geographic areas do not represent biologically separate populations that could be exposed to different threats.

We examined the following threats: Availability and distribution of breeding, migration, and wintering habitat; pesticides; brood parasitism; the effects of climate change; collision with lighted and human-made structures; and the cumulative effects of these threats. We found no concentration of threats in any portion of the Kirtland's warbler's range at a biologically meaningful scale. If both (1) a species is not in danger of extinction or likely to become so in the foreseeable future throughout all of its range and (2) the threats to the species are essentially uniform throughout its range, then the species could not be in danger of extinction or likely to become so in the foreseeable future in any biologically meaningful portion of its range. For the Kirtland's warbler, we found both: The species is not in danger of extinction or likely to become so in the foreseeable future throughout all of its range, and there is no geographical concentration of threats so the threats to the species are essentially uniform throughout its range. Therefore, no portions warrant further consideration through a more detailed analysis, and the species is not in danger of extinction or likely to become so in the foreseeable future in any significant portion of its

range. Our approach to analyzing SPR in this determination is consistent with the court's holding in *Desert Survivors v. Department of the Interior*, No. 16-cv-01165-JCS, 2018 WL 4053447 (N.D. Cal. Aug. 24, 2018).

Our review of the best available scientific and commercial information indicates that the Kirtland's warbler is not in danger of extinction or likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Therefore, we find that listing the Kirtland's warbler as an endangered species or a threatened species under the ESA is not warranted at this time.

Conclusion

We have carefully assessed the best scientific and commercial information available regarding the past, present, and future threats to the Kirtland's warbler. The threats that led to the species being listed under the ESA (*i.e.*, primarily loss of the species' habitat (Factor A) and effects of brood parasitism by brown-headed cowbirds (Factor E)) have been removed, have been ameliorated, or have been appropriately managed by the actions of multiple conservation partners over the past 50 years. These actions include habitat management, brown-headed cowbird control, monitoring, research, and education. Given commitments shown by the cooperating agencies entering into the Kirtland's warbler MOU and the long record of engagement and proactive conservation actions implemented by the cooperating agencies over a 50-year period, we expect conservation efforts will continue to support a healthy, viable population of the Kirtland's warbler post-delisting and into the foreseeable future. Furthermore, there is no information to conclude that, at any time over the next 50-year window (as we define the foreseeable future for this species), the species will be in danger of extinction. Thus, we have determined that none of the existing or potential threats, either alone or in combination with others, is likely to cause the Kirtland's warbler to be in danger of extinction throughout all or a significant portion of its range, nor are any of the existing or potential threats likely to cause the species to become endangered within the foreseeable future throughout all or a significant portion of its range. On the basis of our evaluation, we conclude that, due to recovery, the Kirtland's warbler is not an endangered or threatened species. We, therefore, remove the Kirtland's warbler from the Federal List of Endangered and

Threatened Wildlife at 50 CFR 17.11(h) due to recovery.

Effects of This Rule

This rule revises 50 CFR 17.11(h) by removing the Kirtland's warbler from the Federal List of Endangered and Threatened Wildlife. On the effective date of this rule (see **DATES**, above), the prohibitions and conservation measures provided by the ESA, particularly through sections 7 and 9, no longer apply to this species. Federal agencies are no longer required to consult with the Service under section 7 of the ESA in the event that activities they authorize, fund, or carry out may affect the Kirtland's warbler. There is no critical habitat designated for this species; therefore, this rule does not affect 50 CFR 17.95. Removal of the Kirtland's warbler from the List of Endangered and Threatened Wildlife does not affect the protection given to all migratory bird species under the MBTA.

Post-Delisting Monitoring

Section 4(g)(1) of the ESA requires us, in cooperation with the States, to implement a system to monitor for not less than 5 years the status of all species that have been recovered and delisted. The purpose of this requirement is to develop a program that detects the failure of any delisted species to sustain itself without the protective measures provided by the ESA. If, at any time during the monitoring period, data indicate that protective status under the ESA should be reinstated, we can initiate listing procedures, including, if appropriate, emergency listing.

The PDM for the Kirtland's warbler was developed in coordination with our Federal, State, and other partners. The PDM is based upon current research and effective management practices that have improved the status of the species since listing. Ensuring continued implementation of proven management strategies, such as brown-headed cowbird control and habitat management, that have been developed to sustain the species is a fundamental goal of the PDM. The PDM identifies measurable management thresholds and responses for detecting and reacting to significant changes in the Kirtland's warbler's numbers, distribution, and persistence. If declines are detected equaling or exceeding these thresholds, the Service, in combination with other PDM participants, will investigate causes of these declines. The investigation will be to determine if the Kirtland's warbler warrants expanded monitoring, additional research, additional habitat protection or brood

parasite management, or resumption of Federal protection under the ESA. For example, monitoring Kirtland's warbler singing males, annual habitat management acres, and brown-headed cowbird abundance or parasitism rates will inform partners on the Kirtland's warbler's status. If the population falls below 1,300 pairs, this would trigger the partners to (1) schedule a meeting, (2) discuss what is causing the decline, (3) decide how to respond, and (4) implement the recommended changes. The PDM requires census or selectively sampling the Kirtland's warbler breeding population every other year for a period of 12 years. The final PDM plan is available at <https://www.fws.gov/midwest/Endangered/birds/Kirtland>.

Required Determinations

National Environmental Policy Act

We determined that we do not need to prepare an environmental assessment or an environmental impact statement, as defined under the authority of the National Environmental Policy Act of 1969 (42 U.S.C. 4321 *et seq.*), in connection with regulations adopted pursuant to section 4(a) of the ESA. We published a notice outlining our reasons for this determination in the **Federal Register** on October 25, 1983 (48 FR 49244).

Government-to-Government Relationship With Tribes

In accordance with the President's memorandum of April 29, 1994, "Government-to-Government Relations with Native American Tribal Governments" (59 FR 22951), Executive Order 13175, Secretarial Order 3206, the Department of the Interior's manual at 512 DM 2, and the Native American Policy of the Service, January 20, 2016, we readily acknowledge our responsibility to communicate meaningfully with recognized Federal Tribes on a government-to-government basis. We contacted the tribes in the Midwest within the range of the Kirtland's warbler and requested their input and comments on the proposed delisting rule.

References Cited

A complete list of all references cited in this rule is available at <http://www.regulations.gov> under Docket No. FWS-R3-ES-2018-0005 or upon request from the Field Supervisor, Michigan Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**).

Authors

The primary authors of this rule are staff members of the Michigan Ecological Services Field Office in East Lansing, Michigan, in coordination with

the Midwest Regional Office in Bloomington, Minnesota.

List of Subjects in 50 CFR Part 17

Endangered and threatened species, Exports, Imports, Reporting and recordkeeping requirements, Transportation.

Regulation Promulgation

Accordingly, we amend part 17, subchapter B of chapter I, title 50 of the Code of Federal Regulations, as set forth below:

PART 17—ENDANGERED AND THREATENED WILDLIFE AND PLANTS

- 1. The authority citation for part 17 continues to read as follows:

Authority: 16 U.S.C. 1361–1407; 1531–1544; 4201–4245, unless otherwise noted.

§ 17.11 [Amended]

- 2. Amend § 17.11 in the table in paragraph (h) by removing the entry for "Warbler (wood), Kirtland's" under "BIRDS" from the List of Endangered and Threatened Wildlife.

Dated: August 29 2019.

Stephen Guertin,

Principal Deputy Director, U.S. Fish and Wildlife Service, Exercising the Authority of the Director, U.S. Fish and Wildlife Service.

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