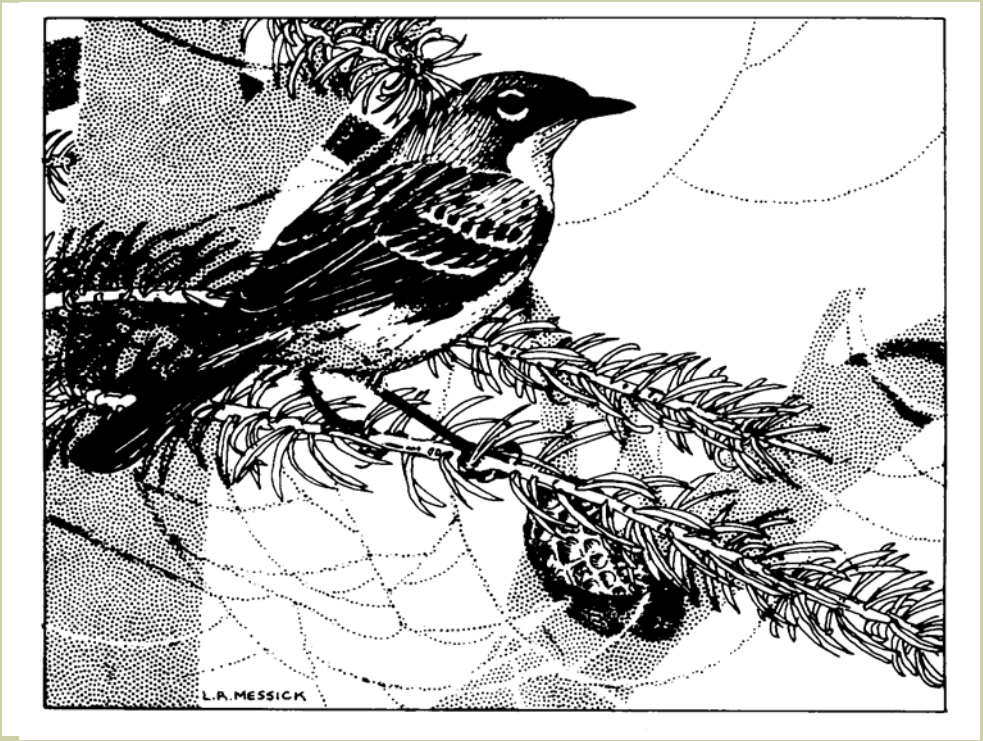
Species at Risk Act
Recovery Strategy Series

Recovery Strategy for the Kirtland's Warbler (*Dendroica kirtlandii*) in Canada

Kirtland's Warbler



October 2006

Environment Canada Environnement Canada

Canada

About the *Species at Risk Act* Recovery Strategy Series

What is the *Species at Risk Act* (SARA)?

SARA is the Act developed by the federal government as a key contribution to the common national effort to protect and conserve species at risk in Canada. SARA came into force in 2003, and one of its purposes is "to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity."

What is recovery?

In the context of species at risk conservation, **recovery** is the process by which the decline of an endangered, threatened, or extirpated species is arrested or reversed and threats are removed or reduced to improve the likelihood of the species' persistence in the wild. A species will be considered **recovered** when its long-term persistence in the wild has been secured.

What is a recovery strategy?

A recovery strategy is a planning document that identifies what needs to be done to arrest or reverse the decline of a species. It sets goals and objectives and identifies the main areas of activities to be undertaken. Detailed planning is done at the action plan stage.

Recovery strategy development is a commitment of all provinces and territories and of three federal agencies — Environment Canada, Parks Canada Agency, and Fisheries and Oceans Canada — under the Accord for the Protection of Species at Risk. Sections 37–46 of SARA (http://www.sararegistry.gc.ca/the_act/default_e.cfm) outline both the required content and the process for developing recovery strategies published in this series.

Depending on the status of the species and when it was assessed, a recovery strategy has to be developed within one to two years after the species is added to the List of Wildlife Species at Risk. Three to four years is allowed for those species that were automatically listed when SARA came into force.

What's next?

In most cases, one or more action plans will be developed to define and guide implementation of the recovery strategy. Nevertheless, directions set in the recovery strategy are sufficient to begin involving communities, land users, and conservationists in recovery implementation. Cost-effective measures to prevent the reduction or loss of the species should not be postponed for lack of full scientific certainty.

The series

This series presents the recovery strategies prepared or adopted by the federal government under SARA. New documents will be added regularly as species get listed and as strategies are updated.

To learn more

To learn more about the *Species at Risk Act* and recovery initiatives, please consult the SARA Public Registry (http://www.sararegistry.gc.ca/) and the Web site of the Recovery Secretariat (http://www.speciesatrisk.gc.ca/recovery/default_e.cfm).

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October 2006

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Additional copies:

Additional copies can be downloaded from the SARA Public Registry (http://www.sararegistry.gc.ca/).

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DECLARATION

This recovery strategy has been prepared in cooperation with the jurisdictions responsible for the Kirtland's Warbler. Environment Canada has reviewed and accepts this document as its recovery strategy for the Kirtland's Warbler, as required under the *Species at Risk Act*. This recovery strategy also constitutes advice to other jurisdictions and organizations that may be involved in recovering the species.

The goals, objectives and recovery approaches identified in the strategy are based on the best existing knowledge and are subject to modifications resulting from new findings and revised objectives.

This recovery strategy will be the basis for one or more action plans that will provide details on specific recovery measures to be taken to support conservation and recovery of the species. The Minister of the Environment will report on progress within five years.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this strategy and will not be achieved by Environment Canada or any other jurisdiction alone. In the spirit of the Accord for the Protection of Species at Risk, the Minister of the Environment invites all responsible jurisdictions and Canadians to join Environment Canada in supporting and implementing this strategy for the benefit of the Kirtland's Warbler and Canadian society as a whole.

RESPONSIBLE JURISDICTIONS

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STRATEGIC ENVIRONMENTAL ASSESSMENT

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that strategies may also inadvertently lead to environmental effects beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts on non-target species or habitats. The results of the SEA are incorporated directly into the strategy itself, but are also summarized below.

This recovery strategy will clearly benefit the environment by promoting the recovery of the Kirtland's Warbler. The potential for the strategy to inadvertently lead to adverse effects on other species was considered. The SEA concluded that this strategy will clearly benefit the environment and will not entail any significant adverse effects.

RESIDENCE

SARA defines residence as: *a dwelling-place, such as a den, nest or other similar area or place, that is occupied or habitually occupied by one or more individuals during all or part of their life cycles, including breeding, rearing, staging, wintering, feeding or hibernating* **[Subsection 2(1)]**.

Residence descriptions, or the rationale for why the residence concept does not apply to a given species, are posted on the SARA public registry:
http://www.sararegistry.gc.ca/plans/residence_e.cfm

PREFACE

The Kirtland's Warbler was listed as endangered under the *Species at Risk Act* (SARA) in June 2003. It is also a migratory bird protected under the *Migratory Birds Convention Act, 1994* and is under the management jurisdiction of the federal government. The *Species at Risk Act* (SARA, Section 37) requires the competent minister to prepare recovery strategies for listed extirpated, endangered or threatened species. Canadian Wildlife Service – Ontario Region, Environment Canada, led the development of this recovery strategy in cooperation with the Province of Ontario. All responsible jurisdictions reviewed and approved the strategy, which covers the five-year period from 2006 to 2011. This strategy meets SARA requirements in terms of content and process (Sections 39–41).

EXECUTIVE SUMMARY

The Kirtland's Warbler (*Dendroica kirtlandii*) is designated as Endangered in Canada (COSEWIC 2000). Its global breeding range is confined to the state of Michigan, although a breeding pair was recorded near Barrie, Ontario, in 1945. Since then, nesting has not been confirmed in Canada, although singing males have been observed in suitable habitat during the breeding season. The Michigan population has recently expanded, birds are now also nesting in Michigan's Upper Peninsula, and singing males have been located within 25 km of the Canadian border near Sault Ste. Marie, so it is possible that breeding pairs may be detected in Canada in the future.

Kirtland's Warblers are habitat specialists. They prefer extensive tracts of early successional, densely stocked jack pine (*Pinus banksiana*). The main threats to Kirtland's Warbler survival include fire suppression and vegetative succession, insufficient suitable habitat, and brood parasitism by Brown-headed Cowbirds (*Molothrus ater*).

The recovery of a viable population of Kirtland's Warblers in Canada is considered feasible.

Recovery goals are:

a) to determine if a breeding population exists in Canada; and
b) to manage habitat at selected locations in Canada to encourage recovery of the species.

Numerical population targets will be identified once Kirtland's Warbler reestablishment has occurred.

Between 2006 and 2011, recovery objectives are to complete surveys to detect the presence of an existing population, increase communication and stakeholder support, and manage habitat for Kirtland's Warbler conservation. Two additional objectives are outlined if breeding is confirmed. These include identifying and protecting critical habitat and conducting an annual census. A number of recovery activities are outlined to fulfil these objectives, and criteria to evaluate recovery efforts and overall success are defined. Recovery actions that have already been undertaken mainly include survey work, although little surveying has been done in relation to the amount of potential habitat in Canada.

Because there has been no recent evidence of breeding documented in Canada, quantitative recovery goals cannot be set and critical habitat cannot be identified at this time. This strategy contains a brief description of habitat requirements for Kirtland's Warblers (based on research in Michigan) and a schedule of studies to help identify their critical habitat in Canada.

An action plan for the Kirtland's Warbler will be completed by November 2010. Critical habitat will be identified following confirmation of a breeding population in Canada, but this may not be possible by 2010.

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1. BACKGROUND

1.1 Species Assessment Information from COSEWIC

Date of the Assessment: May 2000

Common Name: Kirtland's Warbler

Scientific Name: *Dendroica kirtlandii*

COSEWIC Status: Endangered

Reason for Designation: This is a globally endangered species. There are no recent breeding records in Canada, but singing males are occasionally recorded in suitable breeding habitat in Ontario[1].

Canadian Occurrence: Ontario[1]

COSEWIC Status History: Designated Endangered in April 1979. Status re-examined and confirmed in April 1999 and in May 2000. Last assessment based on an existing status report.

1.2 Description

The Kirtland's Warbler is a medium-sized, omnivorous songbird in the Family Parulidae (North American wood-warblers). The adult male Kirtland's Warbler has a bluish-grey head and back that is streaked with black, a lemon yellow front, and black streaks or spots on the sides. The eyelids are white, forming an almost complete eye ring, and indistinct whitish wing bars may also be evident. Adult females resemble males, but with duller plumage and paler underparts. Immature females are generally browner overall. Kirtland's Warblers frequently pump their tails. The song of the male Kirtland's Warbler is a loud, emphatic series of notes. Illustrations and further descriptions may be found in Mayfield (1992), Walkinshaw (1983), and standard field guides.

1.3 Populations and Distribution

The Kirtland's Warbler is one of the world's most critically endangered species, with a global rank of G1[2] (NatureServe 2005). Its breeding range is confined mainly to the northern part of the Lower Peninsula in Michigan (Figure 1). It is ranked S1[3] in Michigan. The Kirtland's Warbler is considered an accidental migrant in six other eastern U.S. states. The Michigan population has steadily rebounded following a steep decline between 1961 and 1971, from a low of 167 singing

[1] One singing male was also recorded in Quebec.
[2] A global rank of G1 indicates that the species is extremely rare globally, usually with very few remaining individuals.
[3] A subnational rank of S1 indicates that the species is extremely rare at the state or provincial level.

males in 1974 to 1478 singing males in 2006 (Byelich et al. 1985; Michigan Department of Natural Resources 2005). This increase is mainly due to the creation of additional jack pine (*Pinus banksiana*) habitat by wildfire (Sykes 1997), the management of large areas of suitably aged jack pine plantations (Probst and Weinrich 1993), and active control of Brown-headed Cowbirds (*Molothrus ater*) (Kelly and DeCapita 1982).

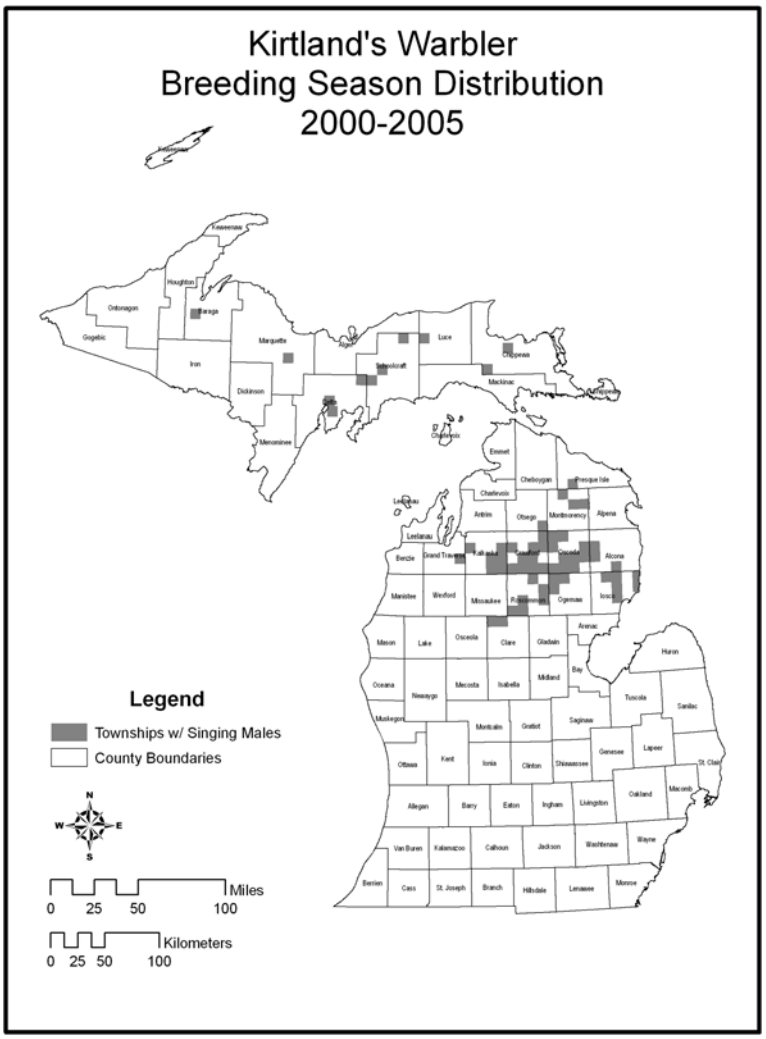

Figure 1. Kirtland's Warbler breeding season distribution

The single breeding record documented for Canada is from the Midhurst (Barrie) area in Ontario in 1945 (Speirs 1984), although there is some ambiguity regarding this record (Natural Heritage Information Centre 2005). Kirtland's Warblers may have been nesting in the Petawawa area in Ontario in the 1800s and early 1900s, and possibly elsewhere in Canada (Harrington 1939; COSEWIC 2000). One singing male was recorded on the Québec side of the Ottawa River, near Kazabazua, Québec, in 1978 (COSEWIC 2000). Singing males were seen and heard regularly at

Canadian Forces Base (CFB) Petawawa, near Petawawa, Ontario, during the summer of 1916, and a male Kirtland's Warbler was also reported in the same area on June 5, 1939 (Harrington 1939). Singing males have been reported in early successional pine habitat in Ontario on at least eight subsequent occasions, the most recent being the sighting of three individuals at CFB Petawawa in June 2006. However, none of these males was believed to be accompanied by a female. It is possible that birds in larger, less accessible patches in this area have gone undetected (COSEWIC 2000) (Figure 2).

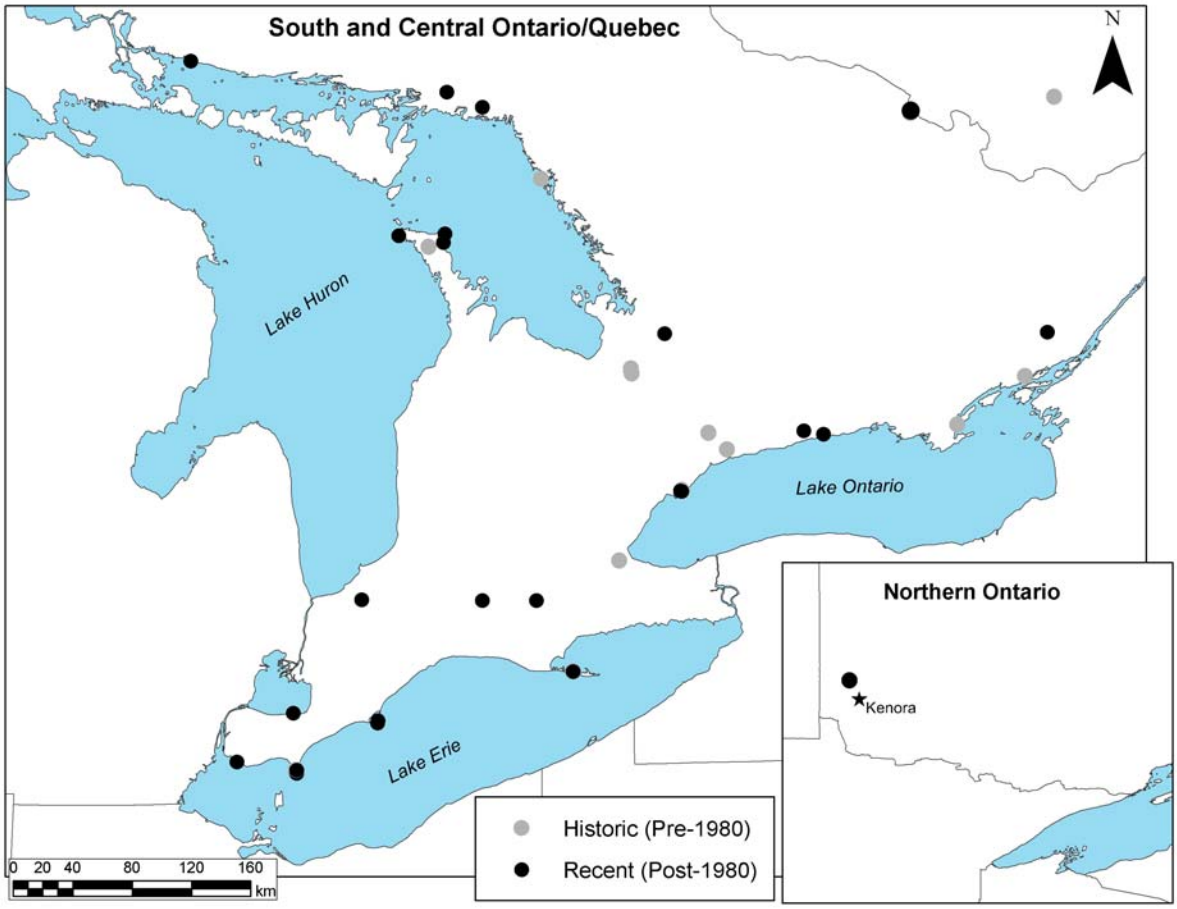

Figure 2. Distribution evidence for the Kirtland's Warbler in Canada
(Multiple records at the same location are not shown)

Sightings have been reported in Canada from Minaki, Ontario, east to Kazabazua, Québec. The majority of the 76 records for this species in Canada, between 1900 and 2006 and principally in Ontario, are of spring migrants, with some summer reports (June to mid-July) of singing males and some fall migrants (Aird and Pope 1987; COSEWIC 2000; P.Aird pers comm. 2006; Petrucha and Sykes, 2006). Although there has generally been at least one sighting of the Kirtland's Warbler each year in Ontario since 1990, there is no trend evident in the number of sightings of singing males. Kirtland's Warblers were not documented as breeding in any region of Ontario during the recent five-year (2001–2005) Ontario Breeding Bird Atlas project (Ontario Breeding Bird Atlas 2005).

The global breeding distribution of the Kirtland's Warbler is therefore confined to the United States. However, based on the expansion of the Michigan population and increasing numbers of singing males reported in Michigan and Wisconsin, some within 25 km of the Canadian border near Sault Ste. Marie, it is possible that breeding may be reported in Canada in the future.

1.4 Needs of the Kirtland's Warbler

1.4.1 Habitat and Biological Needs

The Kirtland's Warbler is a habitat specialist. In Michigan, essential habitat requirements include even-aged stands of jack pine over 32 ha in size (Mayfield 1953) and created by wildfire or specially designed plantations that mimic wildfires. Jack pine stands larger than 80 ha are optimal breeding habitats, indicated by improved nesting success in these stands. Anderson and Storer (1976) found that 90% of nests that fledged Kirtland's Warblers were in stands larger than 80 ha. Optimal habitat also consists of dense stands of jack pine (minimum 3500 stems/ha) interspersed with small openings, which produces high foliage volume and 35–65% canopy cover (Probst 1988; Kepler et al. 1996). Studies suggest higher nest success in dense, scattered patches of trees 1.5–5 m tall (or 7–20 years old), which provide adequate branch cover near the ground for nests; dry, well-drained, sandy soils; and ground cover composed of plants such as blueberry (*Vaccinium angustifolium*, *V. myrtilloides*), bearberry (*Arctostaphylos uva-ursi*), bracken fern (*Pteridium aquilinum*), service-berry (*Amelanchier* spp.), sand cherry (*Prunus pumila*), sweet fern (*Comptonia peregrina*), grasses (*Andropogon* spp.), sedges (*Carex* spp.), and goldenrods (*Solidago* spp.).

Plantations of jack pine and, rarely, red pine (*Pinus resinosa*) also provide suitable habitat for Kirtland's Warblers on the breeding grounds (Weinrich 1994). In recent years, more than 90% of Kirtland's Warblers nested in jack pine plantations specifically established for the species (P. Huber, pers. comm., 2006). Birds nesting in plantations can produce numbers of young comparable to those in naturally regenerated burn areas (Bocetti 1994).

With an average territory size estimated at about 15 ha (38 acres) per singing male, successful breeding of only 25 pairs is estimated to require the maintenance of roughly 375 ha (950 acres) of suitable habitat. Recovery efforts in Michigan are designed to provide a minimum of 15 200 ha (38 000 acres) at all times, involving rotational harvest management of approximately 76 000 ha (190 000 acres) of jack pine (Olson 2002).

In spite of the specific requirements listed above, the required amount and quality of available habitat can be difficult to assess accurately. Areas of apparently high-quality habitat may not be occupied, and occupied habitat may not appear to be ideal, even to an experienced observer (Mayfield 1992). Other factors, including microclimate and specific structural features, may be more important than is currently understood. Further details on habitat requirements can be found in the literature (Wood 1904, 1926; Barrows 1921; Leopold 1924; Wing 1933; Mayfield 1953, 1960, 1962; Line 1964; Anderson and Storer 1976; Chamberlain 1978; Buech 1980; Harwood 1981; Ryel 1981; Wright and Bailey 1982; Probst 1986; Probst and Hayes 1987).

A study of the diet of the Kirtland's Warbler through fecal analysis revealed the major food items as spittlebugs and aphids (Homoptera; in 61% of samples), ants and wasps (Hymenoptera; 45%), blueberry (*Vaccinium angustifolium*; 42%), beetles (Coleoptera; 25%), and moth larvae (Lepidoptera; 22%) (DeLoria-Sheffield et al. 2001). Presumably, sufficient quantities of these foods must be present for habitat to be suitable.

Sites surveyed in Ontario in the 1970s with potentially suitable habitat were not considered to be optimal habitat by Michigan standards: trees were taller than 6 m, and plant associations were different from those found in Michigan (Chamberlain 1978). However, work in 2003 in the Thessalon area in Ontario found plant associations and habitat very similar to those in Michigan's jack pine barrens, with coarse sandy soils and ground cover dominated by low bush blueberry (*V. angustifolium*) and various grasses and sedges (Bloom 2003). Still, the actual amount of survey work completed in Ontario in relation to potential suitable habitat available is very small (P. Aird, pers. comm., 2006). In Ontario, singing males have been found in jack pine stands or plantations of more than 20 ha on well-drained sands or on shallow soils covering bedrock (Aird and Pope 1987). Kirtland's Warblers have also been found in Scots pine (*Pinus sylvestris*) plantations on at least one occasion in Simcoe County, Ontario, on May 16–21, 1964 (Devitt 1967).

Kirtland's Warblers are neotropical migrants that winter in the Bahamas, where they prefer areas of low, sparse vegetation (Mayfield 1972, 1996). Most of the islands are covered with broad-leaved scrub, and the northernmost islands have extensive pinelands. Most records were on islands that support open woodlands of Caribbean pine (*Pinus caribaea*) (Haney et al. 1998). Periods of degradation and recovery of pine ecosystems in the Bahamas may be related to periods of decline and recovery of Kirtland's Warbler populations, and it has been suggested that winter habitat should be considered in conservation planning for the species (Haney et al. 1998). However, habitat availability on wintering grounds has not generally been thought to be a limiting factor (Sykes and Clench 1998).

1.4.2 Ecological Role

The diet of the Kirtland's Warbler includes a variety of insects representing a number of different orders (DeLoria-Sheffield et al. 2001), but there has been no research to determine the specific ecological effect of this warbler on populations of individual insect taxonomic groups. Blueberries (*V. angustifolium*) are also a major component of the Kirtland's Warbler diet, and it is possible that birds assist in dispersing seeds into suitable habitat.

Documented predators of Kirtland's Warbler adults, nestlings, and eggs in Michigan include Blue Jay (*Cyanocitta cristata*), thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), domestic cat, and garter snake (*Thamnophis sirtalis*)(Walkinshaw 1983). It is also suspected that red squirrels (*Sciurus vulgaris*) and crows (*Corvus* spp.) may predate Kirtland's Warbler eggs and nestlings in Michigan, but there has been no need to control predators to date (Huber et al. 2001).

1.4.3 Limiting Factors

Some characteristics of Kirtland's Warbler biology noted from Michigan populations that could limit recovery in Canada include:

- an extremely narrow preference for early successional and densely stocked jack pine. Suitable jack pine habitat created by wildfires due to fire suppression necessitates continued management (e.g. specially designed plantations). Suitable early successional habitats are dispersed and are possibly limiting in some parts of Ontario;
- a preference for nesting territories within expansive tracts of suitable habitat;
- temporary occupation of habitat (8–15 years) due to early successional habitat preferences (Probst 1986);
- a high level of susceptibility to parasitism by Brown-headed Cowbirds in nesting areas (Mayfield 1977; Harwood 1981); and
- dispersal characteristics. Young of the year typically disperse widely in search of new territories. Although dispersal may establish birds on new territories, dispersed singing males may have little chance of finding a mate in areas where the density of this species is very low (Mayfield 1983).

1.5 Threats

There are three main threats to the Kirtland's Warbler. These are all well-demonstrated threats to the Michigan population. Further survey work is necessary to determine the extent to which fire suppression and forest succession and lack of suitable habitat are factors in Ontario. Cowbird parasitism is a significant problem in Michigan's Lower Peninsula, but control has not been necessary in the Upper Peninsula (S. Sjogren, pers. comm., 2006). If a population is detected in Ontario, control may be necessary only in the south, where cowbirds are more common and the habitat is more fragmented.

1.5.1 Fire Suppression and Forest Succession

Jack pine cones normally remain closed until exposed to heat from wildfires, and stand densities are higher following fire than following standard forest harvest practices (Olson 2002). Natural regeneration by wildfire also creates thickets and openings, favoured by breeding female warblers for nest site selection (Bocetti 1994). Optimal habitat was probably most extensive in the late 19th century when forest fires frequently followed extensive logging (Mayfield 1960). Fire suppression in the 20th century has greatly reduced available habitat for the Kirtland's Warbler in both Ontario and Michigan (COSEWIC 2000).

A similar habitat structure can be mimicked by specific rotational harvest prescriptions and natural jack pine regeneration, with or without direct seeding or establishment of jack pine plantations (S. Sjogren, pers. comm., 2006). However, occupation of successional habitat by this species is still limited to 8–15 years (Probst 1986). Rotational harvest of large patches within a very large total area is therefore required to provide long-term occupancy of the Kirtland's Warbler in an area (see section 1.4.1). A broad and potentially complex ecosystem approach that considers not only forestry practices, but also physical site factors, including microclimate and

moisture, will be needed to manage large areas of habitat for the species (Kashian and Barnes 2000).

1.5.2 Lack of suitable habitat

Sufficiently large tracts of high-density, early successional jack pine forest with optimal understorey structure and composition may be limiting the establishment of Kirtland's Warblers in some parts of Ontario. However, patches of suitable habitat have been documented, and there are large tracts of jack pine habitat across Ontario that need to be surveyed, including,Thessalon, the Petawawa area, the area between Cartier and Lake Wanapitei, the region between Chapleau and Gowganda, Manitoulin Island, and the Bruce Peninsula (Austen et al. 1993; Bloom 2003; P. Aird, pers. comm., 2005). There is now considerable evidence that a lack of suitable habitat was limiting the small but stable Michigan population prior to a vast wildfire in the 1980s (Probst and Weinrich 1993; Kepler et al. 1996). It has also been demonstrated that the pairing success rate of the Kirtland's Warbler is lower in habitats of marginal quality (Probst and Hayes 1987).

1.5.3 Brood Parasitism by Brown-headed Cowbird

Brood parasitism by the Brown-headed Cowbird has been shown to reduce both hatchling and fledgling success in Michigan populations (Kelly and DeCapita 1982; Walkinshaw 1983). Through the 1960s and 1970s, a steep decline in the Kirtland's Warbler population led to the confirmation that more than 70% of warbler nests were parasitized, reducing the production of young to fewer than one young per pair per year (Ryel 1981). Cowbird control began in 1972 and reduced parasitism to about 3% or negligible levels (Kelly and DeCapita 1982) and increased productivity to an average of nearly three fledged young per pair per year (Kelly and DeCapita 1982; Walkinshaw 1983).

If there is an undetected breeding population of the Kirtland's Warbler in Canada, it is possible that cowbird parasitism is a threat to nesting success, and an assessment may eventually be needed.

1.5.4 Other

Forest management practices that do not consider the Kirtland's Warbler's specialized habitat requirements may inadvertently cause jack pine forests to become unsuitable. Conversion of jack pine to less preferred species, fragmentation of jack pine by harvesting in small blocks when large blocks are available, and planting unsuitable stocking densities may all threaten occupation by the Kirtland's Warbler.

1.5.5 Actions already completed or under way

A long-term, multiagency recovery program has been extremely successful in Michigan (Solomon 1998). With over 800 published works on the Kirtland's Warbler, sustained census, management, and research activities have been well documented in the literature (Mayfield

1992). In 2003, a joint recovery meeting was held with members of several U.S. recovery teams and representatives from the Canadian Wildlife Service (CWS). Opportunities for collaboration and joint recovery efforts for the Kirtland's Warbler were discussed (R. Bloom, pers. comm., 2005).

In Canada, recovery actions have been limited mainly to survey work. There have been several targeted search efforts to detect breeding of the Kirtland's Warbler in the past decade. In response to a report of a Kirtland's Warbler sighting on July 4, 1997, in the Thessalon area, a survey for the species was conducted in this vicinity in 1999, but without success (Knudsen 1999).

This general area was later used to develop a site prioritization scheme using spatial data. Areas of suitable jack pine habitat in northern Ontario are potentially very large, and a prioritization method was developed to help focus future survey effort. Spatial information (e.g. pine cover, successional stage, soils) was used to evaluate sites for likelihood of dispersal and to set priorities for monitoring. Sections of this area were then surveyed by air by CWS staff, accompanied by American researchers (Bloom 2003). Although the project was not finalized, the mapping to date could be used to intensify aerial and ground surveys, initiate a monitoring program, or ground-truth sites for habitat suitability using established field methods (e.g. Bocetti 1994).

Targeted search efforts have also been undertaken in the Pembroke area. In 2002 and 2003, staff from the Ontario Ministry of Natural Resources (OMNR) and CFB Petawawa searched suitable habitat unsuccessfully. Since 2003, survey work has been continued by CFB Petawawa, and OMNR staff have begun to focus search efforts on other areas of suitable habitat in Renfrew County. Suitable habitat on CFB Petawawa was searched as part of a larger inventory of species at risk commissioned by the Base in 2006. Three singing males were located in June 2006 and one was eventually banded and released.

Searches have been undertaken annually in suitable habitat near Orillia, where a singing male was located in 1986, and over the past decade in the Chapleau–Cartier area, on the Bruce Peninsula, and on Manitoulin Island. Still, of the entire range of jack pine across Ontario, only a very small percentage has been surveyed. To date, no breeding pairs have been located (P. Aird, pers. comm., 2005).

Periodic sightings of migrant Kirtland's Warblers by Ontario birders are generally reported to one or more of the following: the Ontario Field Ornithologists listserv (ontbirds@hwcn.org), Ontario Bird Records Committee, the Ontario Natural Heritage Information Centre, Bird Studies Canada, the Kirtland's Warbler Recovery Team, or the Ontario Breeding Bird Atlas project.

1.5.6 Knowledge Gaps

Despite substantial research on this species, several knowledge gaps remain for the global population of the Kirtland's Warbler. These include population responses to habitat change and foraging ecology, migration routes, winter habitat requirements, and the potential role of global climate warming on jack pine habitats (Woodby et al. 1989; Olson 2002).

The most urgent knowledge gaps in Canada are related mainly to distribution, location, and availability of suitable habitat. If the Kirtland's Warbler is reconfirmed as breeding in Canada, the following areas will also require research:

- the extent of cowbird parasitism;
- habitat characteristics (including a comparison with habitat in Michigan);
- recruitment levels (nesting and fledging success);
- dispersal tendencies;
- site fidelity;
- competing species and predators; and
- possible management requirements.

2. RECOVERY

2.1 Rationale for Recovery Feasibility

Recovery of Kirtland's Warblers in Canada is considered biologically and technically feasible. First, an expanding source population exists in nearby Michigan. As the Michigan population is increasing, available territories may be reaching their carrying capacity, and juvenile males may disperse more widely to reach new territories. It is increasingly possible that a nesting pair of Kirtland's Warblers will become established in Ontario. Breeding was confirmed only through intensive searches in the Michigan Upper Peninsula in 1995 (Probst et al. 2003). Singing males have been documented less than 25 km from the Canadian border near Sault Ste. Marie (S. Sjogren, pers comm., 2006). Dispersal distances of juvenile males of up to 350 km have been reported, and large water bodies do not appear to present a barrier (Probst et al. 2003). The expansion of the Michigan population to the state's Upper Peninsula provides evidence that the species has the capability to disperse and establish successfully where conditions are favourable.

Second, it is likely that there is sufficient habitat to establish an initial population in Ontario and ample habitat that could be managed to sustain a population over time. In 2005, 90% of Michigan's Kirtland's Warblers nested in jack pine plantations established specifically for the species, suggesting that active management can be instrumental in recovery success (P. Huber, pers. comm., 2006).

Third, the U.S. experience has demonstrated that it is possible to reduce threats enough for populations to recover. Evidence suggests that it would be possible, with sufficient resources, to reduce the probable threats in Ontario, mainly through the use of specialized forestry prescriptions, reducing cowbird populations, and limiting site access, if necessary. Finally, these and other successful recovery techniques have been well documented in publications and through contact with the U.S. recovery team and other specialists (Michigan Department of Natural Resources 2005).

2.2 Recovery Goals

The recovery goals are:

a) to determine if a breeding population exists in Canada; and
b) to manage habitat at selected locations in Canada to encourage the recovery of the species.

Establishing a numerical population target and specific geographic distribution goal is not currently possible in the absence of confirmed breeding of Kirtland's Warblers in Canada. If a breeding population is discovered, sufficient monitoring and research should be undertaken in order to determine reasonable population and distribution goals within five years. Although a breeding population has not yet been detected in Canada, breeding was only relatively recently confirmed in the Michigan Upper Peninsula, and the Michigan population reached a record high of 1478 singing males in 2006. For these reasons, habitat should be managed in Ontario to support potential further expansion of the global range of the Kirtland's Warbler into Canada.

2.3 Recovery Objectives

The following recovery objectives will be addressed between 2006 and 2011:

1. Identify, survey, and map suitable and potentially suitable habitat for the Kirtland's Warbler.
2. Follow up on breeding evidence for the species in Canada, particularly in Ontario.
3. Achieve a high degree of interorganizational commitment and sustained cooperative management of the recovery program among responsible and interested agencies and organizations — e.g. CWS, OMNR, the Department of National Defence (DND), forestry companies, and the U.S. Department of Agriculture (USDA) Forest Service.
4. Encourage the maintenance and/or improvement of large stands of appropriately stocked jack pine in appropriate areas of Ontario through the forest management planning process.
5. Ensure that landowners, other affected groups (e.g. resource-use companies), and the general public are aware of and consider the needs of the species.

A breeding population may not be located prior to 2010; therefore, the following objectives may not be addressed before that time:

6. Identify and protect critical habitat.
7. Conduct an annual census, and collect information on breeding habitat characteristics and threats.

Without a coordinated survey effort, breeding Kirtland's Warblers are much less likely to be documented in Canada. Targeted surveys to locate and map suitable habitat and breeding populations are critical, because many areas of suitable habitat are difficult to access. Documentation of the population's expansion into Michigan's Upper Peninsula and Wisconsin was made possible through intensive annual searches over two decades by staff from the U.S. Fish and Wildlife Service and the USDA Forest Service (Probst et al. 2003).

Encouraging early communication between organizations and agencies, including federal and provincial government agencies as well as forest licensees, will help to create support for and awareness of Kirtland's Warbler conservation requirements. In the event that a population is discovered, preexisting awareness may speed recovery efforts. The importance of cooperation should not be underestimated. A high degree of interagency commitment, early consensus on science-based recovery goals, and sustained cooperative management in Michigan's Kirtland's Warbler recovery program are regarded as major reasons for the remarkable recovery of the species in the United States (Solomon 1998).

Following confirmation of breeding, site protection is critical to ensure breeding success. The Kirtland's Warbler is an extremely rare bird and is likely to generate considerable interest within the Ontario naturalist and birding communities. However, human disturbance needs to be minimized to ensure breeding success. An annual census, threat identification, and habitat research will help to assess recovery targets, threats, and management needs specific to a Canadian population. Communication with landowners, land managers, and other affected groups will encourage recovery success through stewardship.

2.4 Approaches Recommended to Meet Recovery Objectives

Strategies will include habitat and population surveys to identify potential breeding habitat and detect breeding birds, communication, and habitat management, as required. If breeding is confirmed, strategies will include habitat protection, monitoring, research, habitat management, communication, and education. Habitat management will utilize techniques and expertise documented in Michigan and developed in Canada. The results of habitat and population surveys will be used to determine the need for and timing of habitat management. Habitat management may be implemented prior to the detection of a Canadian population to encourage the establishment of and to benefit the global population.

2.4.1 Recovery Planning Table

Table 1. Strategies to effect recovery

Priority	Objective No.	Broad Approach/ Strategy	Threat addressed	General Steps	Outcomes (measurable targets)
High	1, 2	Survey	N/A	• Adopt standard survey methods for suitable habitat and breeding birds. • Develop annual survey plans. • Complete targeted reconnaissance surveys wherever suitable habitat is found, especially near Thessalon, Chapleau/Gowganda, Cartier/Lake Wanapitei, Petawawa/Renfrew County, the Bruce Peninsula, Manitoulin Island, and Barrie/Orillia areas. • Compile all information in a central location, and coordinate annual efforts based on previous results. Share data with other interested agencies. • Investigate incidental reports of singing males in suitable habitat within the same season to confirm breeding if possible.	• Methods identified, targeted exploratory surveys completed. • Establishment of a central location and contact for all Kirtland's Warbler survey results. • Relevant incidental reports followed up. • Mapping of suitable habitat and high-potential sites completed.
Low	1	Research	N/A	• Consider satellite or radiotelemetry techniques to follow migrating Kirtland's Warblers located in Canada to possible nesting sites.	• Telemetry used to locate nesting sites of migrating birds.
Moderate	3	Communication	N/A	• Encourage communication among OMNR, CWS, and others in coordinating survey efforts. • Encourage awareness of the Kirtland's Warbler at a management level to facilitate rapid site protection if required.	• Working relationship in place among jurisdictions.
Upon breeding: High	6	Habitat protection	N/A	• Gain rapid support for site protection from landowners and/or managers, including OMNR, DND, private landowners, or the forest industry. • Close sites to public entry May 1 – August 15 if necessary (Sykes 1997). • Protect the breeding population from cowbird predation if required.	• Site(s) protected from disturbance and public access in year of discovery. • Access to sites limited or controlled. • Assess need for cowbird control in year of discovery and implement control if required.
Upon	6, 7	Monitoring	N/A	• Conduct annual population census following	• Annual census data collected and

Priority	Objective No.	Broad Approach/ Strategy	Threat addressed	General Steps	Outcomes (measurable targets)
breeding: High				Michigan methods. • Assess need and objectives for banding.	distributed to responsible jurisdictions and U.S. Recovery program. • Banding completed.
Upon breeding: High	6, 7	Research	All	• Investigate breeding habitat characteristics and compare with suitable Michigan sites. • Identify threats (e.g. determine the extent of suitable habitat near the site and the level of cowbird predation).	• Habitat characteristics identified. • Major threats identified.
Moderate	4, 6, 7	Habitat management	All	• Consult with species specialists, including the staff involved in the U.S. Recovery program, to identify management requirements and determine an appropriate time frame for actions. • Consult with Registered Professional Foresters of the OMNR. • Undertake any actions required, and monitor results. Adapt future actions depending upon success.	• Management actions identified. • Required habitat management completed. • Monitoring of management actions in place.
Moderate	5	Communication	All	• Establish communication with affected landowners. • Encourage habitat stewardship and support through education and forest management planning. • Pursue further cooperation with U.S. recovery team.	• Support and assistance obtained from landowners, land managers, and volunteers.
Moderate	5	Education	All	• Educate the public (local and province-wide) about Kirtland's Warbler conservation through field naturalists and media.	• Increased public awareness of Kirtland's Warbler conservation and habitat.

2.5 Critical Habitat

2.5.1 Identification of Critical Habitat for the Kirtland's Warbler

Critical habitat is defined as "the habitat that is necessary for the survival or recovery of a listed wildlife species" (*Species at Risk Act*, *Statutes of Canada* 2002, c. 29, s.2). Critical habitat for the Kirtland's Warbler in Canada can be fully identified only once evidence of breeding is documented. Once breeding is documented, a method to locate and identify critical habitat characteristics in Ontario will be determined (see section 2.5.2 below).

2.5.2 Schedule of Studies

Table 2. Schedule of Studies

Targeted completion date	Research required	Anticipated benefit
2006–2009	Complete surveys and ground-truthing wherever suitable habitat is found, including Thessalon, Chapleau/Gowganda, Cartier/Lake Wanapitei, Petawawa, Manitoulin Island, the Bruce Peninsula, and Barrie/Orillia	Provide focus for survey and monitoring efforts, coordinate data
2007–2011	Select high-potential sites and monitor annually	Locate breeding populations
2006–2011	Continue to undertake surveys and document suitable habitat in other areas of Ontario	Locate breeding populations
Within one season of breeding confirmation	Determine a method to locate and identify critical habitat and complete mapping	Map critical habitat for known breeding occurrences
Within one season of breeding confirmation	Describe habitat in Canadian breeding locations: vegetation communities, density and cover, other habitat features, etc.	Obtain site-specific habitat information; inform management
Annually upon breeding confirmation	Complete annual census of Canadian population	Set population targets for recovery in Canada
Upon breeding confirmation	Completely identify potential critical habitat	Critical habitat identified

2.6 Existing and Recommended Approaches to Habitat Protection

Lack of knowledge about the location of any Kirtland's Warbler habitat precludes any site-specific recommendations for habitat protection. Areas located during surveys that fit the habitat attributes for the Kirtland's Warbler (or areas that could be managed to fit these attributes) should be considered as a high priority for stewardship. Once breeding evidence is found and critical habitat can be identified (as above), land ownership will be identified and appropriate effective protection methods determined. Development of conservation agreements will be favoured.

2.7 Performance Measures

Recovery will be considered successful if a breeding population is discovered in Canada and appears to be increasing in number and/or distribution within the next five years. Clearly, this depends on the arrival or discovery of breeding birds in Canada.

If targeted reconnaissance surveys have been undertaken, incidental reports have been investigated, the Michigan population continues to increase, and no breeding birds have yet been discovered in Canada, a reevaluation of the recovery objectives should be undertaken in five years to determine whether habitat is limiting the establishment of the Kirtland's Warbler.

If a breeding population has been detected, other indicators of success include:

- success at protecting breeding site(s), as required, through communication, stewardship, and legislative tools available;
- completion of annual census and banding;
- completion of site-based research, especially to determine threats to the Canadian population;
- completion of a management plan for the site(s);
- status of management actions (e.g. rotational harvest, cowbird control); and
- extent of awareness of landowners, managers, and the general public, and their involvement in the recovery process.

2.8 Effects on Other Species

The recovery activities outlined for the Kirtland's Warbler (i.e. continued surveys) will enable further information to be gathered on common species associates in migratory or breeding habitats for Kirtland's Warblers in Ontario. Negative impacts on other non-target species will be limited. If management activities are undertaken, impacts on non-target species will be assessed and mitigating measures considered. If other species at risk are found to be present within an area identified for management, the respective recovery teams will be consulted to determine the probability of impact on the species and, if possible, how to manage activities for the benefit of all species within the ecosystem.

2.9 Recommended Approach for Recovery Implementation

The Kirtland's Warbler is being considered in a single species recovery strategy because of its specialized habitat and management requirements. However, there is potential to incorporate Kirtland's Warbler recovery with other conservation efforts. In Michigan, species found in Kirtland's Warbler habitat include Vesper Sparrow (*Pooecetes gramineus*), Chipping Sparrow (*Spizella passerina*), Brown Thrasher (*Toxostoma rufum*), Nashville Warbler (*Vermivora ruficapilla*), Yellow-rumped Warbler (*Dendroica coronata*), Hermit Thrush (*Catharus guttatus*), Clay-colored Sparrow (*Spizella pallida*), Black-capped Chickadee (*Poecile atricapillus*), Eastern Bluebird (*Sialia sialis*), Sandhill Crane (*Grus canadensis*), and Sharp-tailed Grouse (*Tympanuchus phasianellus*) (Mayfield 1960; anonymous reviewer, pers. comm., 1999; S. Sjogren, pers. comm., 2006). The U.S. Kirtland's Warbler program, although focused on a single species, incorporates an ecosystem approach to the management of the jack pine

community of the dry sand plains in Michigan (Probst and Ennis 1989; Kepler et al. 1996). Because Kirtland's Warblers benefit from large forest tracts (Anderson and Storer 1976; Mayfield 1993; Sykes 1997), recovery actions may also benefit other species with similar requirements. Members of the U.S. Kirtland's Warbler Recovery Team provided valuable input to this recovery strategy, and several are also interested in assisting with survey work in Canada. Further and more coordinated cooperation with the U.S. Kirtland's Warbler Recovery Team should be pursued.

There may be an opportunity to incorporate the Kirtland's Warbler recovery activities into future species at risk work at CFB Petawawa.

2.10 Statement of When One or More Action Plans in Relation to the Recovery Strategy Will Be Completed

An action plan will be completed for the Kirtland's Warbler by November 2010. It is anticipated that the Recovery Team will oversee the recovery strategy and action plan.

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