Photo: Mike Burrell

Kirtland's Warbler
(*Setophaga kirtlandii*) in Ontario

Ontario Recovery Strategy Series

Recovery strategy prepared under the *Endangered Species Act, 2007*

2016

Natural. Valued. Protected.

Ministry of Natural Resources and Forestry

Ontario

About the Ontario Recovery Strategy Series

This series presents the collection of recovery strategies that are prepared or adopted as advice to the Province of Ontario on the recommended approach to recover species at risk. The Province ensures the preparation of recovery strategies to meet its commitments to recover species at risk under the *Endangered Species Act, 2007* (ESA) and the Accord for the Protection of Species at Risk in Canada.

What is recovery?

Recovery of species at risk 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 a species' persistence in the wild.

What is a recovery strategy?

Under the ESA a recovery strategy provides the best available scientific knowledge on what is required to achieve recovery of a species. A recovery strategy outlines the habitat needs and the threats to the survival and recovery of the species. It also makes recommendations on the objectives for protection and recovery, the approaches to achieve those objectives, and the area that should be considered in the development of a habitat regulation. Sections 11 to 15 of the ESA outline the required content and timelines for developing recovery strategies published in this series.

Recovery strategies are required to be prepared for endangered and threatened species within one or two years respectively of the species being added to the Species at Risk in Ontario list. Recovery strategies are required to be prepared for extirpated species only if reintroduction is considered feasible.

What's next?

Nine months after the completion of a recovery strategy a government response statement will be published which summarizes the actions that the Government of Ontario intends to take in response to the strategy. The implementation of recovery strategies depends on the continued cooperation and actions of government agencies, individuals, communities, land users, and conservationists.

For more information

To learn more about species at risk recovery in Ontario, please visit the Ministry of Natural Resources and Forestry Species at Risk webpage at:
www.ontario.ca/speciesatrisk

Recommended citation

Ontario Ministry of Natural Resources and Forestry. 2016. Recovery Strategy for the Kirtland's Warbler (*Setophaga kirtlandii*) in Ontario. Ontario Recovery Strategy Series. Prepared by the Ontario Ministry of Natural Resources and Forestry, Peterborough, Ontario. v + 5 pp. + Appendices.

Cover illustration: Photo by Mike Burrell

ISBN 978-1-4606-8988-2 (HTML)
ISBN 978-1-4606-8992-9 (PDF)

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Acknowledgments

We thank Chris Risley of Ontario Ministry of Natural Resources and Forestry for providing information that assisted in the development of this recovery strategy addendum.

Declaration

The recovery strategy for the Kirtland's Warbler (*Setophaga kirtlandii*) was developed in accordance with the requirements of the *Endangered Species Act, 2007* (ESA). This recovery strategy has been prepared as advice to the Government of Ontario, other responsible jurisdictions and the many different constituencies that may be involved in recovering the species.

The recovery strategy does not necessarily represent the views of all of the individuals who provided advice or contributed to its preparation, or the official positions of the organizations with which the individuals are associated.

The goals, objectives and recovery approaches identified in the strategy are based on the best available knowledge and are subject to revision as new information becomes available. Implementation of this strategy is subject to appropriations, priorities and budgetary constraints of the participating jurisdictions and organizations.

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.

Responsible jurisdictions

Ontario Ministry of Natural Resources and Forestry
Environment and Climate Change Canada – Canadian Wildlife Service, Ontario
Parks Canada Agency

Executive summary

The *Endangered Species Act, 2007* (ESA) requires the Minister of Natural Resources and Forestry to ensure recovery strategies are prepared for all species listed as endangered or threatened on the Species at Risk in Ontario (SARO) List. Under the ESA, a recovery strategy may incorporate all or part of an existing plan that relates to the species.

The Kirtland's Warbler (*Setophaga kirtlandii*) is listed as endangered on the SARO List. The species is also listed as endangered under the federal *Species at Risk Act* (SARA). Environment Canada prepared the Recovery Strategy for the Kirtland's Warbler (*Dendroica kirtlandii*) in Canada in 2006 to meet its requirements under the SARA. Environment and Climate Change Canada also prepared an Action Plan for the Kirtland's Warbler (*Setophaga kirtlandii*) in Canada in 2016. Ontario hereby adopts the following under the ESA: 1) the federal recovery strategy, excluding sections 2.4 to 2.10, and 2) the federal action plan in full. The excluded sections of the federal recovery strategy contain content that is replaced or revised in the more up-to-date federal action plan. With the additions indicated below, these documents meet all of the content requirements outlined in the ESA.

The Critical Habitat section of the federal action plan for the Kirtland's Warbler published in 2016 provides an identification of critical habitat (as defined under the SARA). Identification of critical habitat is not a component of a recovery strategy prepared under the ESA. However, it is recommended that the approach used to identify critical habitat in the federal action plan be considered when developing a habitat regulation under the ESA.

Since the publication of the federal recovery strategy, a breeding population of Kirtland's Warbler has been discovered in eastern Ontario and additional observations have been made of the species in central Ontario, pending verification. These new locations should be considered in developing a habitat regulation for the species.

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Adoption of federal recovery strategy and action plan

The *Endangered Species Act, 2007* (ESA) requires the Minister of Natural Resources and Forestry to ensure recovery strategies are prepared for all species listed as endangered or threatened on the Species at Risk in Ontario (SARO) List. Under the ESA, a recovery strategy may incorporate all or part of an existing plan that relates to the species.

The Kirtland's Warbler (*Setophaga kirtlandii*) is listed as endangered on the SARO List. The species is also listed as endangered under the federal *Species at Risk Act* (SARA). Environment Canada prepared the Recovery Strategy for the Kirtland's Warbler (*Dendroica kirtlandii*) in Canada in 2006 to meet its requirements under the SARA. Environment and Climate Change Canada also prepared an Action Plan for the Kirtland's Warbler (*Setophaga kirtlandii*) in Canada in 2016. Ontario hereby adopts the following under the ESA: 1) the federal recovery strategy, excluding sections 2.4 to 2.10, and 2) the federal action plan in full. The excluded sections of the federal recovery strategy contain content that is replaced or revised in the more up-to-date federal action plan. With the additions indicated below, these documents meet all of the content requirements outlined in the ESA.

Species assessment and classification

Table 1. Species assessment and classification of the Kirtland's Warbler (*Setophaga kirtlandii*). The glossary provides definitions for the abbreviations within, and for other technical terms in this document.

Assessment	Status
SARO list classification	Endangered
SARO list history	Endangered (2008), Endangered – Regulated (1977)
COSEWIC assessment history	Endangered (2000), Endangered (1999), Endangered (1979)
SARA schedule 1	Endangered (2008)
Conservation status rankings	GRANK: G3G4 NRANK: N1B

Assessment	Status
	SRANK: S1B

Distribution, abundance and population trends

The federal recovery strategy for the Kirtland's Warbler (Appendix 1) provides a description of the known population and distribution of the Kirtland's Warbler in Ontario up to 2006. Although there had been singing males observed in Ontario in the breeding season, minimal observations have been reported since a somewhat ambiguous report from Simcoe County in 1945 reported fledged young (Environment Canada 2006). In 2007 this changed when a Kirtland's Warbler nest was discovered on Department of National Defence lands in Garrison Petawawa (formerly Canadian Forces Base Petawawa) in Renfrew County (Richard 2008). Since then, additional nests have been found and the population has persisted (Richard 2013a, 2013b, Environment and Climate Change Canada 2016).

Recently, Kirtland's Warblers have been reported at three locations in central Ontario. A single singing male was detected on an automated recording device in Algoma District in June 2012 (Holmes et al. 2015), a singing male was heard and seen in Georgian Bay Township of Muskoka District in both 2014 and 2015 (Burrell and Charlton 2015) and a pair of Kirtland's Warblers was observed in Parry Sound District in June 2015 (AECOM 2016).

If these reports are verified and meet the definition of element occurrences for Kirtland's Warbler, they would be added to Ontario's Natural Heritage Information Centre database.

Area for consideration in developing a habitat regulation

Under the ESA, a recovery strategy must include a recommendation to the Minister of Natural Resources and Forestry on the area that should be considered in developing a habitat regulation. A habitat regulation is a legal instrument that prescribes an area that will be protected as the habitat of the species. The recommendation provided below will be one of many sources considered by the Minister, including information that may become newly available following completion of the recovery strategy, when developing the habitat regulation for this species.

The Critical Habitat section of the federal action plan for the Kirtland's Warbler provides an identification of critical habitat (as defined under the SARA) (Environment and Climate Change Canada 2016). Identification of critical habitat is not a component of a recovery strategy prepared under the ESA. However, it is recommended that the approach used to identify critical habitat in the federal action plan be considered when

developing a habitat regulation under the ESA. Pending verification, the new locations of Kirtland's Warbler noted above, beyond what are currently proposed as critical habitat in the federal action plan for the Kirtland's Warbler in Canada (Environment and Climate Change Canada 2016), should also be considered in developing a habitat regulation for this species.

Glossary

Committee on the Status of Endangered Wildlife in Canada (COSEWIC): The committee established under section 14 of the Species at Risk Act that is responsible for assessing and classifying species at risk in Canada.

Committee on the Status of Species at Risk in Ontario (COSSARO): The committee established under section 3 of the *Endangered Species Act, 2007* that is responsible for assessing and classifying species at risk in Ontario.

Conservation status rank: A rank assigned to a species or ecological community that primarily conveys the degree of rarity of the species or community at the global (G), national (N) or subnational (S) level. These ranks, termed G-rank, N-rank and S-rank, are not legal designations. Ranks are determined by NatureServe and, in the case of Ontario's S-rank, by Ontario's Natural Heritage Information Centre. The conservation status of a species or ecosystem is designated by a number from 1 to 5, preceded by the letter G, N or S reflecting the appropriate geographic scale of the assessment. The numbers mean the following:

1 = critically imperilled
2 = imperilled
3 = vulnerable
4 = apparently secure
5 = secure
NR = not yet ranked

Element occurrence: The basic unit of record for documenting and delimiting the presence and extent of a species on the landscape. It is an area of land and/or water where a species is, or was, present, and which has practical conservation value.

Endangered Species Act, 2007 (ESA): The provincial legislation that provides protection to species at risk in Ontario.

Species at Risk Act (SARA): The federal legislation that provides protection to species at risk in Canada. This act establishes Schedule 1 as the legal list of wildlife species at risk. Schedules 2 and 3 contain lists of species that at the time the Act came into force needed to be reassessed. After species on Schedule 2 and 3 are reassessed and found to be at risk, they undergo the SARA listing process to be included in Schedule 1.

Species at Risk in Ontario (SARO) List: The regulation made under section 7 of the *Endangered Species Act, 2007* that provides the official status classification of species at risk in Ontario. This list was first published in 2004 as a policy and became a regulation in 2008.

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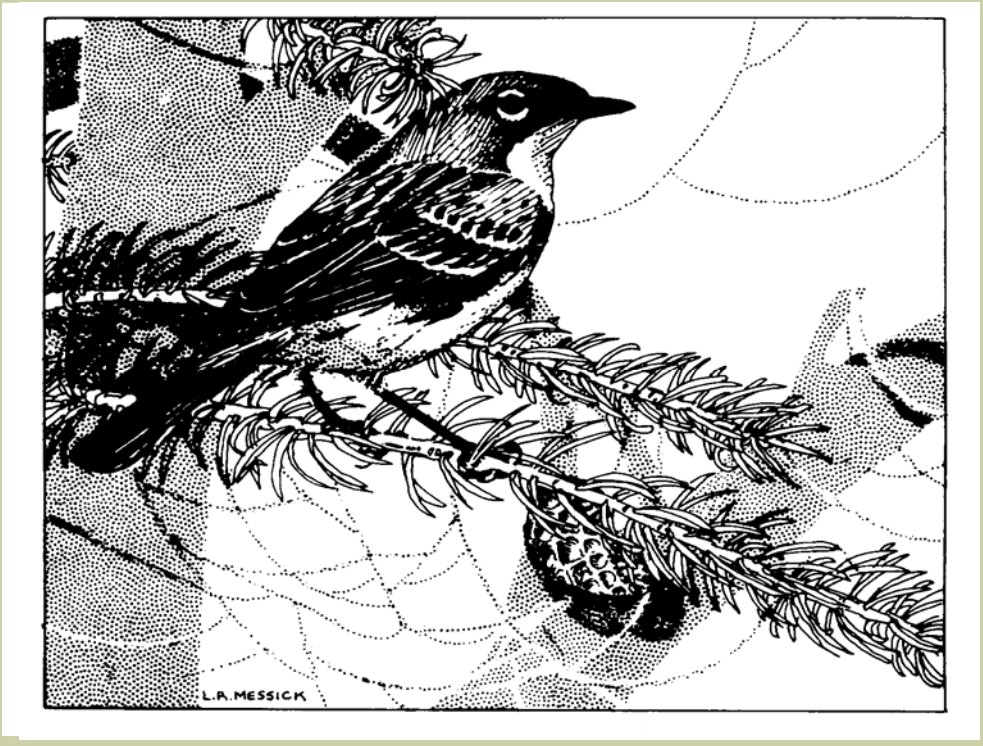
Appendix 1. Recovery strategy for Kirtland's Warbler (*Dendroica kirtlandii*) in Canada

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).

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

October 2006

Recommended citation:

Environment Canada. 2006. Recovery Strategy for the Kirtland's Warbler (*Dendroica kirtlandii*) in Canada. *Species at Risk Act* Recovery Strategy Series. Environment Canada, Ottawa. vi + 23 pp.

Additional copies:

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

Cover illustration: L.A.Messick courtesy of USDA Forest Service

Également disponible en français sous le titre
« Programme de rétablissement de la Paruline de Kirtland (*Dendroica kirtlandii*) au Canada »

ISBN 0-662-44249-0
Cat. no. En3-4/7-2006E-PDF

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

Environment Canada – Ontario Region
Parks Canada Agency
Government of Ontario

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ACKNOWLEDGMENTS

Special thanks to Madeline Austen, Heather Dewar, Paul Aird, Irene Bowman, and Rick Pratt for developing the draft National Recovery Plan for Kirtland's Warbler, January 20, 2000 on which this recovery strategy was based. The following people provided valuable information on the ecology and conservation of the Kirtland's Warbler as well as useful comments on earlier drafts of this recovery strategy: Robin Bloom, Mike Cadman, Elaine Carlson, Tracey Casselman, Andre Dupont, Phil Huber, Burke Korol, Jan McDonnell, Chris Risley, Steve Sjogren, Don Sutherland and several anonymous reviewers. Thanks are extended to Paul Aird and Mike Petrucha for providing occurrence data. Thanks also to the US Department of Agriculture, Forestry Service for the cover drawing and the Michigan Department of Natural Resources, Wildlife Division for providing the breeding season distribution map. Christine Vance prepared the Canadian distribution evidence map. Thanks also to Canadian Wildlife Service, Habitat Conservation Section for their advice and Canadian Wildlife Service, Recovery Section for their advice and efforts in preparing this document for posting.

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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Figures

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).

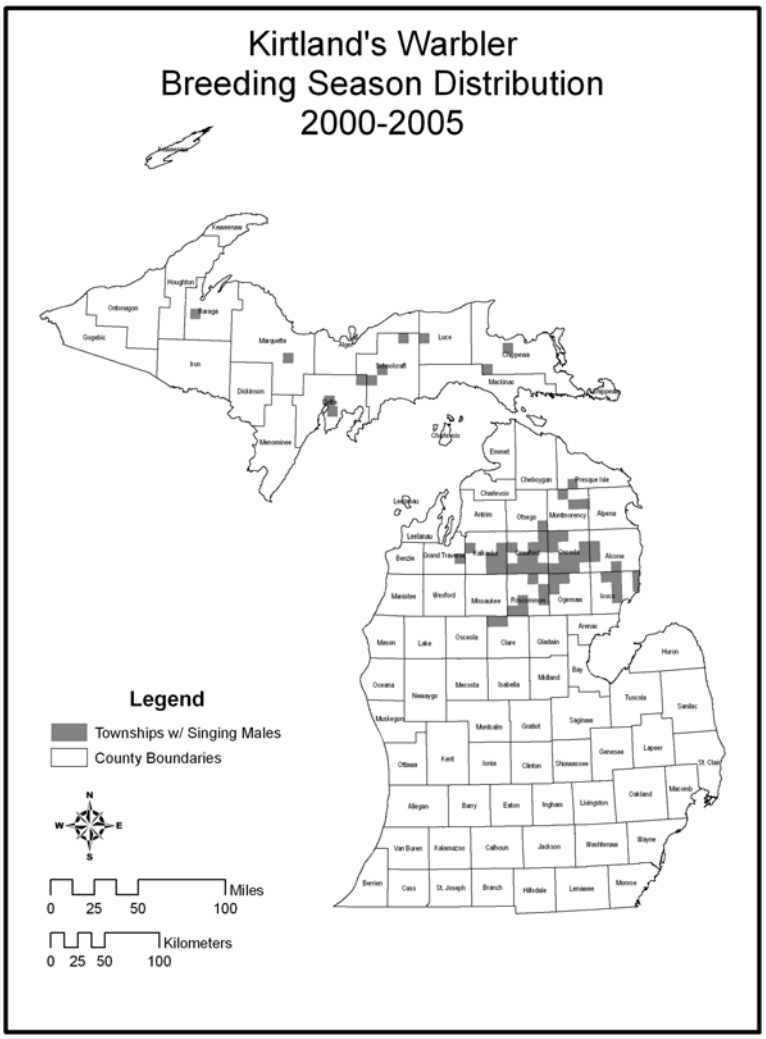

Figure 1. Kirtland's Warbler breeding season distribution

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).

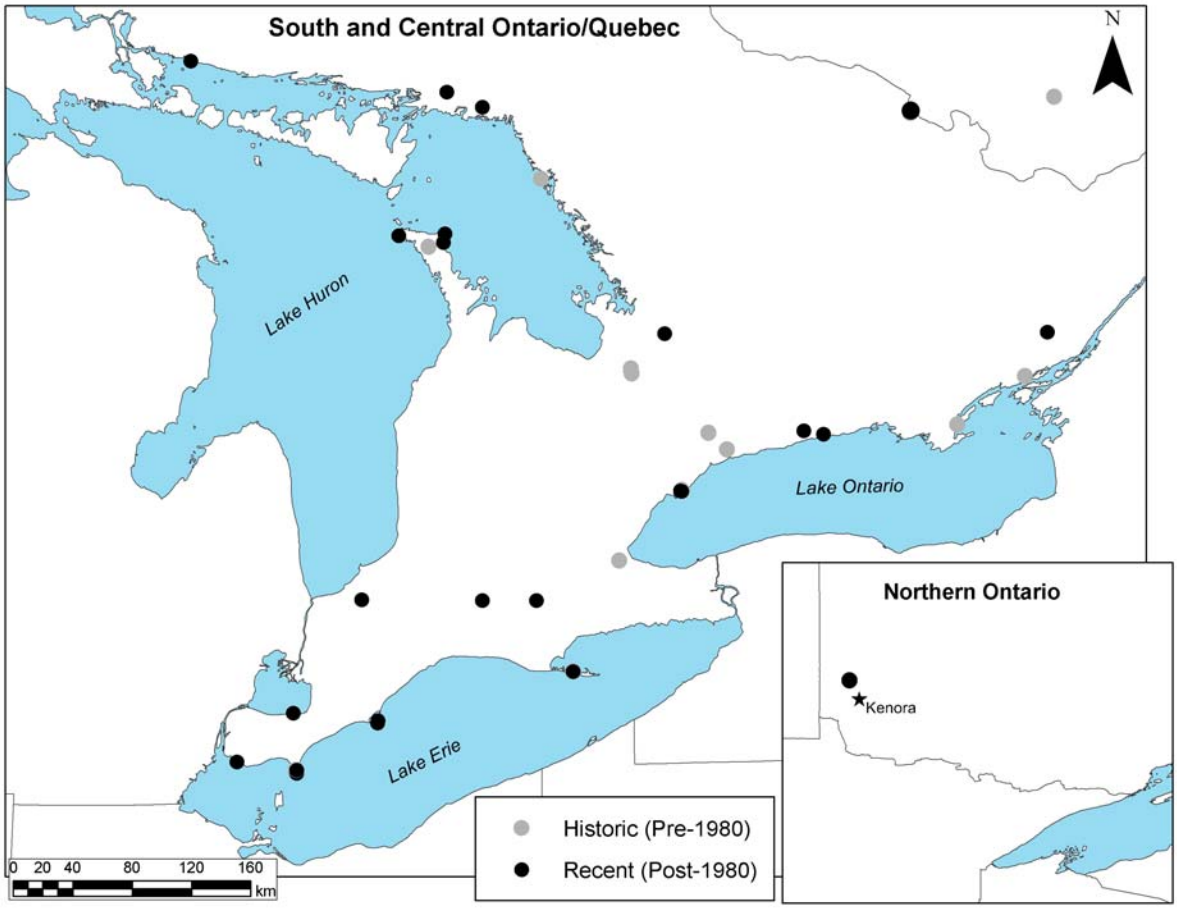

Figure 2. Distribution evidence for the Kirtland's Warbler in Canada
(Multiple records at the same location are not shown)

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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Appendix 2. Action plan for the Kirtland's Warbler (*Setophaga kirtlandii*) in Canada

Species at Risk Act
Action Plan Series

Action Plan for the Kirtland's Warbler (*Setophaga kirtlandii*) in Canada

Kirtland's Warbler

2016

Government of Canada
Gouvernement du Canada

Canada

Recommended citation:

Environment and Climate Change Canada. 2016. Action Plan for the Kirtland's Warbler (*Setophaga kirtlandii*) in Canada. *Species at Risk Act* Action Plan Series. Environment and Climate Change Canada. Ottawa. v + 20 pp.

For copies of the action plan, or for additional information on species at risk, including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Status Reports, residence descriptions, recovery strategies, and other related recovery documents, please visit the Species at Risk (SAR) Public Registry[1].

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Également disponible en français sous le titre
« Plan d'action pour la Paruline de Kirtland (*Setophaga kirtlandii*) au Canada »

ISBN 978-1-100-25736-5
Catalogue no. CW69-21/14-2016E-PDF

[1] http://www.registrelep-sararegistry.gc.ca

PREFACE

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996) agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the federal competent ministers are responsible for the preparation of action plans for species listed as Extirpated, Endangered, and Threatened for which recovery has been deemed feasible. They are also required to report on progress within five years after the publication of the final document on the SAR Public Registry.

Under SARA, one or more action plan(s) provides the detailed recovery planning that supports the strategic direction set out in the recovery strategy for the species. The plan outlines what needs to be done to achieve the population and distribution objectives (previously referred to as recovery goals and objectives) identified in the recovery strategy, including the measures to be taken to address the threats and monitor the recovery of the species, as well as the proposed measures to protect the critical habitat that has been identified for the species. The action plan also includes an evaluation of the socio-economic costs of the action plan and the benefits to be derived from its implementation. The action plan is considered one in a series of documents that are linked and should be taken into consideration together. Those being the COSEWIC Status Report, the recovery strategy, and one or more action plans.

The Minister of Environment and Climate Change and Minister responsible for the Parks Canada Agency is the competent minister under SARA for the Kirtland's Warbler and has prepared this action plan to implement the recovery strategy, as per section 47 of SARA. To the extent possible, it has been prepared in cooperation with the Ontario Ministry of Natural Resources and the Department of National Defence.

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 and actions set out in this action plan and will not be achieved by Environment and Climate Change Canada and the Parks Canada Agency, or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this action plan for the benefit of the Kirtland's Warbler and Canadian society as a whole.

Implementation of this action plan is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

The recovery strategy sets the strategic direction to arrest or reverse the decline of the species, including identification of critical habitat to the extent possible. It provides all Canadians with information to help take action on species conservation. When critical habitat is identified, either in a recovery strategy or an action plan, there may be future regulatory implications, depending on where the critical habitat is identified. SARA requires that critical habitat identified within a national park named and described in Schedule 1 to the *Canada National Parks Act*, the Rouge National Urban Park established by the *Rouge National Urban Park Act*, a marine protected area under the *Oceans Act*, a migratory bird sanctuary under the *Migratory Birds Convention Act, 1994* or a national wildlife area under the *Canada Wildlife Act* be described in the *Canada*

Gazette, after which prohibitions against its destruction will apply. For critical habitat located on other federal lands, the competent minister must either make a statement on existing legal protection or make an order so that the prohibition against destruction of critical habitat applies. For any part of critical habitat located on non-federal lands, if the competent minister forms the opinion that any portion of critical habitat is not protected by provisions in or measures under SARA or other Acts of Parliament, or the laws of the province or territory, SARA requires that the Minister recommend that the Governor in Council make an order to prohibit destruction of critical habitat. The discretion to protect critical habitat on non-federal lands that is not otherwise protected rests with the Governor in Council.

ACKNOWLEDGMENTS

This action plan was prepared by Environment and Climate Change Canada, Canadian Wildlife Service with assistance from Holly Bickerton, Consulting Ecologist. Ken Tuininga, Environment and Climate Change Canada, Canadian Wildlife Service – Ontario coordinated the development of the action plan. Many thanks also go to the following people, who provided information for and reviewed this action plan: Daryl Coulson, Ontario Ministry of Natural Resources; François Shaffer, Environment and Climate Change Canada, Canadian Wildlife Service – Quebec; Brad Steinberg, Ontario Parks; Tammy Richard, Michelle Perry, Dean Nernberg, Stephen Carroll and Rachel McDonald, Department of National Defence, and Madeline Austen, Angela Darwin, Krista Holmes, Lesley Dunn, and Christina Rohe, Environment and Climate Change Canada, Canadian Wildlife Service - Ontario.

A special acknowledgment to Dr. Paul Aird, Professor Emeritus, Faculty of Forestry, University of Toronto, who not only provided valuable information for this action plan, but who also has been contributing to the recovery of the Kirtland's Warbler in Canada for over 40 years. His voluntary contributions include providing advice to guide recovery for the species as a member of the Kirtland's Warbler Recovery Team, extensive surveying and monitoring for the species and its habitat across Ontario and into Quebec and for many years of contributions to the U.S. Kirtland's Warbler Recovery Team.

EXECUTIVE SUMMARY

The Kirtland's Warbler (*Setophaga kirtlandii*) is a globally rare songbird, listed as Endangered under Schedule 1 of the federal *Species at Risk Act* and also under the Ontario's *Endangered Species Act, 2007*. It breeds mainly in the United States, in the Upper and Lower Peninsulas of Michigan, and was recently discovered in Wisconsin. In Canada, the Kirtland's Warbler has, in recent years, been confirmed nesting at one location, near Petawawa, Ontario. The Kirtland's Warbler primarily breeds in large, even-aged stands of young Jack Pine (*Pinus banksiana*). In Canada, it is threatened by a reduction in habitat quality, and also by habitat loss and fragmentation.

The *Recovery Strategy for the Kirtland's Warbler* (Dendroica kirtlandii[2]) *in Canada* (Environment Canada 2006) was posted in 2006 on the *Species at Risk Public Registry*. This action plan addresses the objectives outlined within the recovery strategy, across the entire range of the Kirtland's Warbler in Canada.

Critical habitat for the Kirtland's Warbler is partially identified within this action plan. Critical habitat for the Kirtland's Warbler is based upon the recent occurrence of nesting pairs or singing males, as well as a vegetation community typically dominated by open Jack Pine woodland of a specific age, size, density, and cover. Examples of activities that are likely to destroy critical habitat are also described in this action plan. Environment and Climate Change Canada (ECCC) is working with the Department of National Defence (DND) at Garrison Petawawa to protect critical habitat, all of which is on federal lands.

Measures to be taken for Kirtland's Warbler in Canada are divided into four broad categories: protection and management, monitoring and assessment, outreach and communication, and habitat restoration.

The potential socio-economic costs and benefits of implementing this action plan are also evaluated. Because the species is only known to occur on DND lands, the anticipated costs will largely be incurred by DND. Costs will generally be related to operational impacts of avoiding the destruction of critical habitat, and could be significant for both Garrison Petawawa locally and the Canadian Army nationally. Nonetheless, overall at a national scale, the economic and social costs incurred are expected to be moderate. The social and economic benefits of contributing to the successful recovery of one of the world's rarest birds are difficult to quantify; it is clear, however, that Canada has a conservation responsibility for this species and the benefits of preserving a globally rare species in terms of biodiversity conservation are very high.

[2] The scientific name *Dendroica kirtlandii* was changed to *Setophaga kirtlandii* in January 2013.

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1. RECOVERY ACTIONS

1.1 Context and Scope of the Action Plan

Until 2007, breeding of this globally rare bird had been documented in Canada only near Midhurst (Barrie), Ontario in 1945, although singing males were infrequently reported in suitable habitat at several sites in Ontario and eastern Quebec (COSEWIC 2008). The global breeding range of this species is restricted to the U.S. states of Michigan and Wisconsin, in addition to Ontario. The Kirtland's Warbler (*Setophaga kirtlandii*) breeds primarily in large, even-aged stands of young Jack Pine (*Pinus banksiana*).

In the summer of 2006, three males were observed at Garrison Petawawa as part of a Species at Risk Monitoring Program. In 2007, three birds (two males and one female) were observed at Garrison Petawawa and nesting was confirmed (Richard 2008). This pair fledged two young. In 2008, one pair fledged four young and two single males were also observed. In 2009, two pairs were found at the site and the two nests produced at least three fledglings. In 2010, two pairs and one single male were detected. One pair fledged two young, while the number of young fledged by the second pair is unknown (Richard 2010). In 2011 one pair was confirmed with at least two fledglings. One single male was also found (Richard pers. comm. 2012). Kirtland's Warblers have now been documented breeding at this location for five consecutive years (2007-2011). No singing males in suitable habitat have been documented during the breeding season at other locations in Ontario or Quebec during this period.

Since active habitat management began in Michigan in the 1970s, the total population of this species has steadily increased. The 2011 U.S. - Canada Kirtland's Warbler census reported 1,825 singing males (Kintigh pers. comm. 2011) with the majority being found in Michigan. Small breeding populations were discovered in 2007 in both Wisconsin and Ontario.

The recovery goals[3] outlined in the Recovery Strategy for the Kirtland's Warbler (*Dendroica kirtlandii*) in Canada (Environment Canada 2006) are:

a) to determine if a breeding population exists in Canada[4]; and
b) to manage habitat at select locations in Canada to encourage the recovery of the species (Environment Canada 2006).

Given the successful breeding of Kirtland's Warblers in eastern Ontario, the context for recovery has changed since the recovery strategy for this species was posted in 2006. Any changes to the recovery goals for Kirtland's Warbler will be incorporated in an updated recovery strategy for the species, however, in the meantime, the approach to recovery will require adjustment within this action plan. Measures are outlined to maintain and, if possible, increase the size of the breeding population in Canada. The discovery of Kirtland's Warbler breeding is a recent occurrence, and information is not yet available to reasonably predict the potential future population size or distribution of this species in Canada.

[3] These recovery goals (2006) were developed before breeding was confirmed in Canada (2007).
[4] This goal has been completed, at least for the confirmed breeding location at Garrison Petawawa. However, more breeding populations may exist, and determining whether this is the case continues to be a recovery goal.

The availability and representation[5] of forest stands dominated by young Jack or Red Pine is integral to the recovery of this species. Efforts have been made in central and northern Ontario to increase the representation of Jack Pine since the posting of the recovery strategy in 2006 by encouraging it through forest management planning. Efforts to create habitat continue to be investigated in conjunction with provincial foresters and biologists and the forest industry in several locations in Ontario. To maintain, and if possible, increase the size of the breeding population in Canada, the creation, maintenance and improvement of forest stands primarily dominated by Jack or Red Pine, particularly in Ontario, must occur.

The measures outlined in this action plan are based on objectives found in the Recovery Strategy for the Kirtland's Warbler. This action plan outlines measures relevant to Ontario and Quebec, where suitable habitat can be found. Protection of wintering grounds will be advocated, largely through the U.S. and Bahamian Kirtland's Warbler recovery programs.

1.2 Critical Habitat

1.2.1 Identification of the species' critical habitat

Critical habitat was not identified in the Recovery Strategy for the Kirtland's Warbler (*Dendroica kirtlandii*) in Canada (Environment Canada 2006).

Critical habitat for the Kirtland's Warbler in Canada is identified in this action plan to the extent possible based on the best available information (current to 2011). Additional critical habitat may be identified across the range as new information becomes available for the Kirtland's Warbler.

Population and distribution objectives were not identified in the 2006 Recovery Strategy and several measures identified in this action plan need to be completed in order to develop population and distribution objectives for Kirtland's Warbler. These measures are outlined in Table 3. Thus it is unknown whether the identified critical habitat is sufficient to recover the species in Canada and therefore critical habitat is considered to be partially identified in this document.

The identification of critical habitat for the Kirtland's Warbler is based on two criteria: occupancy by the Kirtland's Warbler and habitat suitability.

1.2.1.1 Suitable Habitat Occupancy Criterion

Suitable habitat is considered occupied when one or more Kirtland's Warblers has been observed during the breeding season for any single year since 2006.

[5] Retaining a representative sample of all naturally occurring forest types.

Given the rarity of the species, all known observations during the breeding season are considered in the identification of critical habitat which includes observations of confirmed, probable, or possible breeding evidence (presently available information is from the period 2006 to 2011). The definition of confirmed, probable or possible breeders follows standard Breeding Bird Atlas codes in Canada (Appendix B). Confirmed, probable, and possible breeding evidence must be obtained from reliable sources[6] for the site to be considered critical habitat.

1.2.1.2 Suitable Habitat

Suitable habitat is characterized as the areas where individuals of the species carry out essential aspects of their life cycle (courtship, territory defence, feeding, nesting, perching, fledging, post-fledging and dispersal) in Canada. Kirtland's Warbler habitat includes both forested areas and sparsely treed areas in close proximity to suitable forest habitat. Kirtland's Warblers are habitat specialists, preferring extensive tracts of early successional, densely-stocked Jack Pine, growing in a patchy pattern and with frequent small open to lightly-stocked areas (Probst and Weinrich 1993, Coulson 2009). Kirtland's Warbler will select territories within heterogeneous Jack Pine stands; areas where breeding territories will contain a mixture of open to densely stocked areas, while selecting optimal density treed habitat within territories for nest sites (Nelson and Buech 1996, Walker et al. 2003). Based on U.S. research, Kirtland's Warblers first appear in an area about five to six years following fire, when young Jack Pine are 1.5m to 2.0m tall, and will use the area for approximately 15 to 20 years, or until trees reach 3m to 5m in height (Walkinshaw 1983; Probst 1988; Probst and Weinrich 1993). Kirtland's Warblers will initially colonize areas with 20% to 25% Jack Pine cover, although optimal habitat is considered to be 35% to 65% Jack Pine cover (Probst 1988; Kepler 1996). The species will nest in areas with as few as 3,000 trees/ha, although optimal habitat requires a density of 5,000 to 7,500 trees/ha (Probst 1988). The height of the lowest live branch of Jack Pine may also be a factor in the decline of a stand's suitability, as low branches conceal nests on the ground and provide low perches for adults (Probst 1988). Fledglings will move beyond original natal territories but typically will remain within the forest stand. In Michigan, Kirtland's Warbler fledglings have been observed to move 200m from the breeding territory (Mayfield 1960).

Open to lightly stocked areas of Jack Pine where they occur as small, interspersed patches within a larger stand of trees are important in the selection of nest sites (Walkinshaw 1983). These areas are a refuge for herbaceous flora important to Kirtland's Warbler nest habitat (Houseman and Anderson 2002) and provide essential foraging opportunities (insects, fruits) (COSEWIC 2008). Nests are often built at or near the edges of openings sheltered beneath living pine branches and ground vegetation (Mayfield 1960; Walker et al. 2000). Habitat management efforts in Michigan target the preferred forest stand patchiness of Kirtland's Warbler by creating planting patterns with small openings (<1ha) surrounded by dense patches (preferably >3,900 stems/ha) of Jack Pine (Corace et al. 2010).

[6] Reliable sources may include but are not limited to: records within the Ontario Natural Heritage Information Centre, records in the Ontario Breeding Bird Atlas, observations from acknowledged species experts, observations from recognized birders with photographic evidence, OMNR, ECCC, or Bird Studies Canada (BSC), DND survey reports, etc.

Open to lightly stocked areas of Jack Pine where they occur within the forest landscape are also important dispersal areas for Kirtland's Warbler. Yearlings have shown an innate tendency to disperse to younger habitat from selected nesting habitat (Walkinshaw 1983; Donner et al. 2009). Recruitment into lightly stocked areas (<2,000 trees/ha) by Kirtland's Warbler occurs as the species spatially redistributes from aging suitable habitat into these developing habitat areas (Donner et al. 2008; Donner et al. 2009).

At nest sites in natural settings in Michigan, Jack Pine may also be mixed with Red Maple (*Acer rubrum*) and Trembling Aspen (*Populus tremuloides*) (Mayfield 1992). Although Kirtland's Warblers formerly bred in large, fire-regenerated areas of Jack Pine, most of the Michigan breeding population now occurs within extensive tracts of Jack Pine plantation that was specifically created for the species. The species will also nest in mixed plantations or in Red Pine (*Pinus resinosa*) or Scots Pine (*Pinus sylvestris*) plantations (Weinrich in Sykes 1997; Anich et al. 2011).

Based on the best available information from Michigan and Ontario, the following are the key features of optimal nesting habitat that is suitable habitat for the Kirtland's Warbler in Canada:

- Naturally regenerating forest stand or plantation dominated by Jack Pine or Red Pine
- Stand age of 5-25 years
- Tree height 1.5-5 m
- Stand density of 3,000 trees/ha or greater, and
- Herbaceous ground vegetation such as Low Sweet Blueberry (*Vaccinium angustifolium*), Bearberry (*Arcostaphylos uva-ursi*), Sweet Fern (*Comptonia peregrina*), Bracken Fern (*Pteridium aquilinum*), Canada Mayflower (*Maianthemum canadensis*) and various grass species (Walkinshaw 1983; Deloria-Sheffield et al. 2001; Houseman and Anderson 2002; Richard 2010).

In addition, forest openings and less dense stands where they occur within or alongside habitat areas described above, and up to a maximum distance of 200 m into the open or less dense stands, are also considered suitable habitat for the purposes of maintaining diverse habitat important for Kirtland Warbler nest selection (Probst 1988, Nelson and Buech 1996), foraging, perching, movement and dispersal. The following are the key features of these suitable habitat areas for the Kirtland's Warbler in Canada:

- Stand density of 3,000 trees/ha or less and
- Herbaceous ground vegetation such as Low Sweet Blueberry, Bearberry, Sweet Fern, Bracken Fern, Canada Mayflower and various grass species (Walkinshaw 1983; Deloria-Sheffield et al. 2001; Houseman and Anderson 2002; Richard 2010).

Areas of suitable habitat may be larger than the territories of breeding pairs, as individual Kirtland's Warblers tend to select forest tracts larger than the areas they actually occupy during breeding (Walkinshaw 1983). Juvenile Kirtland's Warbler will also move out of territories and into suitable habitats within the forest stand (Mayfield 1992).

1.2.1.3 Application of Kirtland's Warbler Critical Habitat Criteria

Critical habitat for Kirtland's Warbler is identified as the continuous suitable habitat (see Section 1.2.1.2) known to be occupied by the Kirtland's Warbler according to the Suitable Habitat Occupancy Criterion as described in Section 1.2.1.1. Since suitable habitat is described at a stand level[7], small pockets (i.e. 1 ha or less) of open to less dense trees (< 3,000 trees/ha) are considered as part of the forest stand area; usually described in the field as habitat inclusions or habitat complexes (Lee et al. 1998). The inclusion of small (<1 ha) open to moderately dense patches within a Jack Pine stand is consistent with successful management strategies for Kirtland's Warbler habitat in Michigan (Corace et al. 2010).

Critical habitat includes an additional 200m around the edge of optimal breeding habitat, where it meets the suitable habitat criteria, to protect the critical functions of suitable nesting areas. Including up to 200m of open to less dense stands of suitable habitat where they occur contiguous with dense stands of optimal nesting habitat provides essential edge habitat important to Kirtland's Warbler for foraging, perching, and dispersal. Nests are often built at or near the edges of openings sheltered beneath living pine branches and ground vegetation (Mayfield 1960; Walker et al. 2000). The thickets of Jack Pine provide cover for Kirtland's Warbler early in the life of a stand, while the presence of openings maintain ground vegetation and lower live limbs around their periphery (or edge), extending the useful life of the stand as breeding habitat (Buech 1980). This 200m area also considers the fact that fledglings have been observed to move 200m beyond breeding territories into adjacent suitable habitats (Mayfield 1992) and that adjacent developing habitats are essential for species recruitment. Yearling Kirtland's Warblers typically disperse into younger habitat from selected nesting habitat (Walkinshaw 1983; Donner et al. 2009).

Gravel or single lane paved roads as well as small pockets of bare ground (in areas that are predominantly vegetated) do not constitute a break in continuous suitable habitat as the habitats remain functionally connected for the species. For additional clarity, unsuitable habitat features such as existing anthropogenic features (e.g. existing infrastructure, including roads, trails, and buildings) within a site are not necessary for the survival or recovery of the species and are therefore not critical habitat. Continuous suitable habitat is broken by major roads (e.g. multi-laned paved roads) or the end of suitable habitat as described in Section 1.2.1.2.

Application of critical habitat criteria to available information identifies sites in Renfrew County on Garrison Petawawa as critical habitat. The area containing critical habitat for Kirtland's Warbler is presented in Table 1. Critical habitat for Kirland's Warbler in Canada occurs within the 10 x 10 km standardized UTM grid squares where the critical habitat criteria described in section 1.2 are met. As new information becomes available (see section 1.2.3, Schedule of Studies), additional critical habitat sites may be identified where they meet the critical habitat criteria across the range of the Canadian Kirtland's Warbler population.

[7] The Ecological Land Classification for Southern Ontario (Lee et al. 1998) identifies the appropriate scale for site or stand level research e.g. habitat inventory or mapping to be approximately 1:10,000.This identifies a minimum mapping unit of 1 hectare or less, depending on the resolution of available data. In other words, at this resolution patches within the forest stand that are less than 1 ha will be considered part of the homogeneous stand area.

Table 1. Grid squares identified as containing critical habitat for Kirtland's Warbler in Canada.

Critical habitat for Kirtland's Warbler in Renfew County occurs within the 10 x 10 km UTM grid squares, where the criteria described in section 1.2 are met.

10 x 10 km Standardized UTM grid square ID[1]	UTM Grid Square Coordinates[2]		Land tenure[3]
	Easting	Northing	
18TR98	290000	5080000	Federal
18TR99	290000	5090000	Federal
18UR08	300000	5080000	Federal
18UR09	300000	5090000	Federal
18UR18	310000	5080000	Federal
18UR19	310000	5090000	Federal
18UR28	320000	5080000	Federal
18UR29	320000	5090000	Federal
18US10	310000	5100000	Federal

[1]Based on the standard UTM Military Grid Reference System (see http://www.nrcan.gc.ca/earth-sciences/geography-boundary/mapping/topographic-mapping/10098), where the first two digits represent the UTM Zone, the following two letters indicate the 100 x 100 km standardized UTM grid followed by two digits to represent the 10 x 10 km standardized UTM grid containing all or a portion of the critical habitat unit. This unique alphanumeric code is based on the methodology produced from the Breeding Bird Atlases of Canada (See http://www.bsc-eoc.org/ for more information on breeding bird atlases).

[2]The listed coordinates are a cartographic representation of where critical habitat can be found, presented as the southwest corner of the 10 x 10 km standardized UTM grid squares containing Garrison Petawawa. The coordinates may not fall within critical habitat and are provided as a general location only.

[3]Land tenure is provided as an approximation of the types of land ownership that exist where critical habitat has been identified and should be used for guidance purposes only.

1.2.2 Examples of activities likely to result in destruction of critical habitat

Understanding what constitutes destruction of critical habitat is necessary for the protection and management of critical habitat. Destruction is determined on a case by case basis. Destruction would result if part of the critical habitat were degraded, either permanently or temporarily, such that it would not serve its function when needed by the species. Destruction may result from a single activity or multiple activities at one point in time or from the cumulative effects of one or more activities over time.

Below is a list of activities that would likely destroy critical habitat based on where the activity takes place and the component of critical habitat it affects. It is not an exhaustive list of all activities likely to destroy crtical habitat:

- Activities that result in forest clearing or large-scale/extensive removal that reduce overall forest size or density such that a large portion of the species' suitable habitat features are eliminated. For example through construction of roads, buildings or similar structures which result in removing large numbers of trees that could provide cover for birds, shelter for nests, perches and food sources.

  Forest harvesting that follows management guidelines, including the creation of one to five well-dispersed small openings for every 4,000 m^2 (1 acre) of forest, which are desirable to Kirtland's Warblers for nesting and having a total openness of approximately 25% or 1,000 m^2 for every 4,000 m^2 (Huber 2001; Spaulding and Rothstein 2009) in dense stands of trees, is not likely to result in the destruction of critical habitat. Some forest management is generally required to maintain sufficient areas of suitable habitat for this species over time.

- Activities that result in fragmentation of suitable habitat (e.g., the construction of roads, buildings, hydro towers, wind turbines and lines and other similar structures) such that forest stand size is reduced leaving the remaining forest areas in stands of sizes that would no longer be sufficient for the Kirtland's Warbler to fulfil its life cycle (e.g. a reduction in stand size such that the species will not utilize habitats it formerly used following the completion of the activity).

- Activities that remove or kill ground vegetation (e.g., spraying of herbicides and/or pesticides, trampling and off-road vehicle use), creating easily discernible open areas of four square metres or larger and/or trails 0.3 metres or greater in width and four square metres or larger in total area[8]. This creates areas devoid of native ground vegetation that typically provides cover/shelter, food etc. for Kirtland's Warblers. These activities, or the removal of trees when performed along road sides and on ground vegetation that is encroaching on the road, may not destroy critical habitat when conducted outside of the breeding season. Numerous studies cite the importance of ground cover to the Kirtland's Warbler (Smith 1979; Buech 1980; Zou et al. 1992; Houseman and Anderson 2002).

1.2.3 Schedule of studies to identify critical habitat

A schedule of studies was provided in the Recovery Strategy for the Kirtland's Warbler in Canada (Environment Canada 2006) (Table 2). Activities within this schedule of studies have either been completed or are currently underway.

The critical habitat identified in this action plan is considered partial. As Kirtland's Warbler surveys continue in Ontario and Quebec, additional areas of critical habitat may be identified. It will be important to collect the relevant information needed to determine which areas meet the criteria for further identification of Kirtland's Warbler critical habitat. Therefore, a supplement to the schedule of studies is included in this action plan (Table 3) to update the activities described

[8] Until more information becomes available for this globally rare species, found at only one location in Canada, this size area will be used to describe "easily discernible".

in the 2006 schedule of studies. The schedule of studies supplement will be incorporated in any updated recovery strategy for the species.

Table 2. Schedule of studies (Environment Canada 2006).
*All activities not yet completed are currently underway and have been incorporated into Table 3.

Targeted completion date*	Research required	Anticipated benefit
2006-2009	Complete surveys and ground-truth 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 **[Completed]**	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 **[Completed]**	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

Table 3. Schedule of studies supplement.

Activity	Timeline
Assess population and distribution of Kirtland's Warbler in Canada	
▪ Complete annual census of known Canadian occurrence(s); and ▪ When possible, continue to monitor and survey annually in high-potential sites in Ontario and Quebec, including the Chapleau area, Renfrew County, western Quebec, eastern Algonquin Provincial Park, Manitoulin Island, the Bruce Peninsula, eastern Georgian Bay, and North Bay areas	Underway / 2016-2021
Assess quantity, attributes, and location of known and potential suitable habitat	
▪ Map areas of suitable habitat based on survey results; ▪ Describe suitable habitat using Forest Ecosystem Classification and Ecosystem Land Classification communities for all past, current and future nest sites and territories; and ▪ Use this and additional site characteristics (density, cover) to refine the description of key habitat attributes for Canadian sites.	Underway / 2016-2021

Fully identify critical habitat for the Kirtland's Warbler in Canada	
▪ Develop numerical population and distribution objectives for the persistence of the current breeding population of Kirtland's Warbler in Canada; ▪ Use habitat mapping together with population and distribution objectives to calculate and refine critical habitat area required to meet recovery targets; and ▪ Revise critical habitat identification based on results.	2021

1.3 Proposed Measures to Protect Critical Habitat

In Canada, critical habitat for Kirtland's Warbler occurs only on federal land owned by the Department of National Defence. In the event that the critical habitat identified in this action plan is determined to be legally protected, a statement to that effect will be made available on the SAR Public Registry. In the event that it is determined that any portions remain unprotected, steps will be taken to ensure that they are protected in accordance with SARA s. 58.

Measures to be taken to protect critical habitat include working with the Department of National Defence on an order or other suitable mechanism for any portion of critical habitat that is not already legally protected by provisions in or measures under SARA or any other Act of Parliament.

1.4 Measures to be Taken and Implementation Schedule

The measures to be taken and implementation schedule proposed to meet the broad strategies outlined in section 2.4 of the *Recovery Strategy for the Kirtland's Warbler in Canada* (Environment Canada 2006) are presented in Table 4.

1.4.1 Measures completed or underway

Since confirmation of breeding by Kirtland's Warbler in 2007, many actions have been undertaken. Below is a brief description of measures completed or in progress.

Habitat was created on Garrison Petawawa through forest fires caused by military training and through regeneration of Jack Pine between 1999 and 2005 through aerial seeding and hand-planting (Richard pers. comm. 2012). Surveys were conducted for Kirtland's Warbler at Garrison Petawawa in 2002, 2004 and 2005 and a survey and monitoring program has been implemented annually since 2006. Garrison Petawawa has also conducted annual habitat assessments since 2006 (Richard 2010). Birds were colour banded from 2006 – 2009.

Garrison Petawawa has also developed a species at risk identification field guide that includes Kirtland's Warbler, which is distributed to personnel utilizing the range and training area to

facilitate the reporting of sightings (Richard 2010). In 2013 a Master's thesis was completed characterizing Kirtland's Warbler habitat on Garrison Petawawa (Richard 2013).

The process of identifying and surveying suitable habitat elsewhere in Ontario has occurred annually since 2006. Potentially suitable, large areas of Jack Pine have been identified by recovery team members with the assistance of Ontario Forest Resources Inventory (FRI) databases, and the expertise of OMNR staff, forest industry representatives and volunteers. Ground-truthing and searches, using standard methods i.e. the *Searching and Monitoring Protocol for Kirtland's Warbler in Canada* (Kirtland's Warbler Recovery Team 2010) and *Search Protocol for Kirtland's Warbler* (Kirtland's Warbler Recovery Team 2012) have been undertaken in the following areas:

- Bancroft area,
- Bruce Peninsula,
- Chapleau area,
- Eastern Algonquin Provincial Park,
- Eastern shoreline of Georgian Bay,
- Manitoulin Island,
- North Bay area,
- OMNR Sault Ste. Marie District, and
- Renfrew County.

Forest management prescriptions have been developed through the Forest Management Planning process and are being used in OMNR's Pembroke District. A habitat suitability model for Kirtland's Warbler in the Great Lakes – St. Lawrence forest of Ontario (Coulson 2009) has been developed and provided to other Forest Management Units in Ontario where Kirtland's Warbler may occur.

The OMNR has prepared a guide for the Ontario forest industry, showing Areas of Concern (AOCs) in the forest management planning process, which will help to identify and protect suitable habitat for Kirtland's Warbler. Field identification sheets have also been prepared for OMNR forestry technicians in Renfrew County, and these are being revised for wider audiences (Coulson pers. comm. 2008).

In Algonquin Provincial Park, suitable habitat is monitored annually and surveys for additional habitat have been undertaken in the eastern section of the park. Forest management targets have been developed to ensure areas of suitable habitat (age and density etc.) are available in the future. This includes several areas where the selective removal of other tree species and planting and aerial seeding of Jack Pine is undertaken by forest management personnel (Steinberg pers. comm. 2010).

Potential habitat for Kirtland's Warbler has also been identified in Quebec using forest stand attributes from digital forestry maps (COSEWIC 2008). Targeted surveys have occurred within potential habitat at locations including Kazabazua, Ile aux Allumettes, Ile du Grand Calumet, and Parc de la Vérendrye. No targeted surveys have been conducted in Quebec since 2007.

1.4.2 Measures to be taken and implementation schedule

The measures identified are divided into four broad categories: protection and management, monitoring and assessment, outreach and communication, and habitat restoration. They are described in Table 4, together with the implementation schedule for their completion.

Table 4. Measures to be Taken and Implementation Schedule.

Recovery Measures	Priority	Threats or concerns addressed	Timeline
1. Protection and Management			
1.1 Protect known site(s) from immediate threats and restrict access under existing legislation, policies, guidelines, work plans and management plans.	High	Reduced habitat quality ; habitat loss and fragmentation	Ongoing
1.2 Develop and/or implement site-specific habitat work plan(s)/management plan(s) for Kirtland's Warbler at Garrison Petawawa and adjacent areas, and other sites as required.	High	Reduced habitat quality; habitat loss and fragmentation	2015 and ongoing
1.3 Characterize occupied habitat and compare to Michigan studies to determine differences and inform management.	High	Lack of species information	2016
1.4 Evaluate threats to Kirtland's Warblers at any new breeding locations.	Medium	Lack of species information	Within one year of confirmation of breeding
2. Monitoring and Assessment			
2.1 Work with provincial foresters, biologists and the forest industry to assess quantity, attributes and location of known and other suitable habitat in Ontario and Quebec, using forestry mapping and Geographical Information Systems (GIS): ▪ Characterize occupied habitat ▪ Describe vegetation communities for all past and current nest sites ▪ Map areas of suitable habitat ▪ Identify opportunities for habitat creation	High	Lack of species information	Ongoing
2.2 Conduct annual population census at breeding site(s), and banding where appropriate, and report results annually to recovery teams in Canada and U.S.	High	Lack of species information	2015 and ongoing
2.3 Investigate incidental reports of singing males in suitable habitat	High	Lack of species information	As opportunities arise
2.4 Maintain and update the National Survey and Monitoring Protocol for Kirtland's Warbler.	Medium	Lack of species information	As required

Recovery Measures	Priority	Threats or concerns addressed	Timeline
3. Outreach and Communication			
3.1 Encourage communication among ECCC, DND, OMNR (including Ontario Parks) and other partners, including the forest industry, especially at the management/forestry technician level to achieve recovery.	High	Multi-agency co-operation	Ongoing
3.2 Encourage birding groups and naturalist clubs to seek landowner permission and then search for Kirtland's Warblers and their habitat to increase survey coverage (and report sightings to ECCC and OMNR).	High	Lack of public awareness; Lack of species information	Ongoing
3.3 Produce and deliver communications materials to increase awareness of Kirtland's Warbler and its habitat to Ontario Crown forest licensees, OMNR district foresters and technical staff in priority areas	High	Lack of species awareness; All threats	2015 and Ongoing
3.4 Work co-operatively with the U.S. recovery team and agencies on measures of mutual importance.	Medium	All threats; Lack of information	Ongoing as required
3.5 Educate the public (local and province-wide) about Kirtland's Warbler conservation through field naturalists and media.	Low	Lack of public awareness	2015 and ongoing
4. Habitat Restoration			
4.0 Work with OMNR to strongly encourage Forest Management Planning (FMP) teams in target areas of Ontario to develop and attain specific targets to manage and provide suitable Kirtland's Warbler habitat within planning unit(s).	High	Reduced habitat quantity and quality; habitat loss and fragmentation	2015 and ongoing, according to FMP timelines
4.1 Determine areas suitable for habitat management/creation in Ontario, and create and manage habitat through partnerships with landowners or land managers.	High	Reduced habitat quality; habitat loss and fragmentation	Ongoing

ECCC – Environment and Climate Change Canada; OMNR – Ontario Ministry of Natural Resources; DND – Department of National Defence.

2. SOCIO-ECONOMIC EVALUATION

The *Species at Risk Act* requires that an action plan include an evaluation of the socio-economic costs of the action plan and the benefits to be derived from its implementation (SARA 49(1)(e)). This evaluation addresses only the incremental socio-economic costs of implementing this action plan from a national perspective as well as the social and environmental benefits that would occur if the action plan were implemented in its entirety, recognizing that not all aspects of its implementation are under the jurisdiction of the federal government. It does not address cumulative costs of species recovery in general nor does it attempt a cost-benefit analysis.

Its intent is to inform the public and to guide decision making on implementation of the action plan by partners.

The protection and recovery of species at risk can result in both benefits and costs. The Act recognizes that "*wildlife, in all its forms, has value in and of itself and is valued by Canadians for aesthetic, cultural, spiritual, recreational, educational, historical, economic, medical, ecological and scientific reasons*" (SARA). Self-sustaining and healthy ecosystems with their various elements in place, including species at risk, contribute positively to the livelihoods and the quality of life of all Canadians. A review of the literature confirms that Canadians value the preservation and conservation of species in and of themselves. Actions taken to preserve a species, such as habitat protection and restoration, are also valued. In addition, the more an action contributes to the recovery of a species, the higher the value the public places on such actions (Loomis and White 1996; Fisheries and Oceans Canada 2008). Furthermore, the conservation of species at risk is an important component of the Government of Canada's commitment to conserving biological diversity under the *International Convention on Biological Diversity*. The Government of Canada has also made a commitment to protect and recover species at risk through the Accord for the Protection of Species at Risk. The specific costs and benefits associated with this action plan are described below.

The primary measures to implement Kirtland's Warbler action plan activities in Ontario have been and will continue to be through federal and provincial government cooperation along with the implementation of stewardship initiatives with land managers.

The only known breeding occurrence of Kirtland's Warbler in Canada occurs at Garrison Petawawa, an active military base administered by the federal Department of National Defence. Public access is not permitted. The anticipated socio-economic costs and benefits associated with implementing this action plan, including the protection of critical habitat at Garrison Petawawa, are presented below.

It is possible that the population and geographic extent of breeding Kirtland's Warblers may increase over time, especially if habitat management is undertaken in suitable locations in Ontario and Quebec. This may result in the need for additional measures not identified in this plan, and may significantly change the costs associated with implementing this action plan. Should the population and geographic extent of breeding Kirtland's Warbler increase, such that additional activities are required and additional benefits are realized, the socio-economic evaluation will be updated. The socio-economic evaluation presented below deals only with the current situation.

2.1 Costs

All of the critical habitat in Canada is currently located on an active federal military base with no public access. Therefore most costs of its protection will be borne by the Department of National Defence. The social and economic costs incurred by the Department of National Defence as a result of the implementation of this action plan, particularly costs to avoid the destruction of critical habitat, could be significant for both Garrison Petawawa locally and the Canadian Army nationally. As one of six major force generation bases with the Canadian Army, any local

reductions in training opportunities at Garrison Petawawa to protect critical habitat could adversely impact land force readiness.

Management of Kirtland's Warbler and its habitat may have several socio-economic costs to operations at Garrison Petawawa and elsewhere in Canada.

1. Critical habitat for Kirtland's Warbler is identified in an area of Garrison Petawawa that is used for military training purposes. The peak training period on Garrison Petawawa is March through October. The protection of critical habitat through personnel access restrictions to portions of the Range and Training Area at Garrison Petawawa could impact the quality of training and limit the number of training opportunities for military and other federal and provincial enforcement personnel. It may be necessary to limit or cease military training in some areas within critical habitat which have unique military training features, as many training exercises cannot be re-located outside of critical habitat within the Garrison Petawawa Range and Training Area. These areas are booked far more frequently than other areas of the property that are not critical habitat. Over 3,800 personnel could be affected annually if all training planned within critical habitat for an entire year was affected (Department of National Defence 2011). The monetary costs associated with reducing land use and loss of training opportunities could be significant to Garrison Petawawa. It is, however, difficult to attribute a monetary value to the loss of training opportunities.

There are also costs associated with planning and altering military training. Large expenditures for food, water, fuel, ammunitions and other consumables are ear-marked at the planning stage, well in advance of the activity that is to possibly occur in critical habitat. Costs of cancelling or relocating major exercises can be as high as several hundred thousand dollars (Department of National Defence 2011). Additional planning costs to shift dates, relocate or alter training are also anticipated since training exercises are often booked a year in advance. Revisions to incorporate changes to training and infrastructure into Garrison Petawawa's three-year plan and budget would also increase planning costs.

Although commercial forestry is conducted at Garrison Petawawa, it is minimal in extent and income generation and does not occur in Jack Pine forest; therefore commercial forest harvesting will not be affected by the action plan (Department of National Defence 2011).

2. Due to the restricted public access to Garrison Petawawa, the enforcement of legal protection of critical habitat and management of the only current nesting location (e.g. habitat assessments, surveying, monitoring, etc.) is likely to be completed mainly by the Department of National Defence, with technical and limited financial support from Environment and Climate Change Canada.

3. Measures in this action plan aim to increase suitable Jack Pine habitat through the Ontario FMP process, and increase the use of partnerships with the forestry sector. This is likely to be a key factor in increasing the Kirtland's Warbler populations in Canada, because much of the potentially suitable Jack Pine habitat in Ontario is approaching an age well beyond what is suitable for nesting and is in need of renewal. Setting minimum area targets for suitable Jack Pine habitat will require additional time and effort by foresters and biologists to become familiar with Kirtland's Warbler habitat management guidelines. Existing guidelines developed in the

United States clearly take into account commercial concerns, such as economic timber values and harvest potential and will be a useful resource (Huber et al. 2001). Management of Jack or Red Pine to provide suitable Kirtland's Warbler habitat is likely to require additional planning and some changes to current management, but significant financial impacts on the forestry sector are not anticipated.

4. Other actions described in this plan, including surveys, habitat management, and developing forest management prescriptions have been recommended for areas throughout Ontario and Quebec. The costs of implementing these activities will largely be borne by existing staff and programs and do not add to existing resources through this action plan.

2.2 Benefits

Many of the benefits derived from biodiversity conservation, including the protection of species at risk, are non-market commodities that are difficult to quantify. Wildlife, in all its forms, has value in and of itself, and is valued by Canadians for aesthetic, cultural, spiritual, recreational, educational, historical, economic, medical, ecological, and scientific reasons. For Canada, biodiversity is important to its current and future economy and natural wealth. A self-sustaining healthy ecosystem with its various elements in place, including species at risk, contributes positively to landowner and public livelihoods.

With effective management of suitable habitat, the potential for an increase in the Kirtland's Warbler population in Canada is high. In the United States, where effective management and expansion of Kirtland's Warbler habitat has resulted in substantial population increases, significant socio-economic benefits have occurred. The recovery of this globally endangered songbird has become a well-known conservation success story, and a source of pride for the state of Michigan. The success has been the result of unprecedented co-operation among federal and state agencies and the forestry sector. Kirtland's Warbler continues to be one of the world's rarest birds, and in Michigan is a highly desirable destination for a growing population of avid birders. Nature-based tourism contributes seasonal income to local economies, and several non-profit organizations contribute to conservation efforts.

Because the only currently known breeding occurrence in Canada is not publicly accessible, there are no opportunities at present for nature viewing or wildlife tourism, and future potential cannot be estimated at this time. The main socio-economic benefits to implementing this plan in Canada are expected to be indirect. For example, increased interaction among staff from federal and provincial agencies and the forest sector (e.g. in the development of forest management plans) may result in stronger working relationships that could also assist in the recovery of Kirtland's Warblers, many other species at risk and other wildlife. Similarly, communication with American agencies would benefit the program and strengthen inter-jurisdictional relationships between Canada and the United States.

The main benefits of implementing this plan are difficult to quantify socio-economically. However, from a biodiversity and population conservation perspective, the main benefit is that the global population and range of this endangered songbird may be increased, preventing it from becoming extirpated in Canada.

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APPENDIX A: EFFECTS ON THE ENVIRONMENT AND OTHER SPECIES

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*[9]. 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 and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or any of the Federal Sustainable Development Strategy's[10] (FSDS) goals and targets.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that implementation of action plans may 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 upon non-target species or habitats. The results of the SEA are incorporated directly into the action plan itself, but are also summarized below in this statement.

At least two other species at risk (the Whip-poor-will (*Caprimulgus vociferus*) and Common Nighthawk (*Chordeiles minor*)) are known to occur in the Jack Pine forest area which has been identified as Kirtland's Warbler critical habitat (Coulson pers. comm. 2010; Richard pers. comm. 2012). A floristic inventory of Garrison Petawawa (Brunton 1999) documented one provincially rare plant, Houghton's Umbrella-sedge (*Cyperus houghtonii*, S3?), which was located on the edge of Kirtland's Warbler habitat. Any management actions within critical habitat, such as stand maintenance in order to maintain suitable age-classes of Jack Pine, should consider the needs of these species.

The effects of potential management actions (e.g. forest harvest, replanting, and prescribed burning) can be managed so that they have minimal negative effects for most species, and have beneficial effects for some. In the United States, the positive effects of Kirtland's Warbler habitat management on other native species have been well documented (e.g. Huber et al. 2001). In Michigan forests that are managed for Kirtland's Warbler, rather than for Jack Pine alone, the openings created have been shown to provide important refugia for the flora native to Jack Pine barrens, now a critically imperiled plant community (Houseman and Anderson 2002). Although cowbird control is not believed to be required in Canada currently, any reduction in the cowbird population would likely also benefit other native songbirds.

Surveys for Kirtland's Warbler in suitable habitat are not expected to have any effect on other species and may provide a benefit by locating other rare species.

[9] http://www.ceaa.gc.ca/default.asp?lang=En&n=B3186435-1
[10] www.ec.gc.ca/dd-sd/default.asp?lang=En&n=F93CD795-1

APPENDIX B: STANDARD ONTARIO BREEDING BIRD ATLAS CODES

DESCRIPTION
POSSIBLE breeder
Singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Species observed in its breeding season in suitable nesting habitat
PROBABLE breeder
Pair observed in their breeding season in suitable nesting habitat
Permanent territory presumed through registration of territorial behaviour (song, etc.) or the occurrence of an adult bird, on at least 2 days, a week or more apart, at the same place, in suitable nesting habitat during the breeding season
Courtship or display between a male and a female or 2 males including courtship feeding or copulation
Visiting probable nest site
Agitated behaviour or anxiety calls of an adult indicating nest-site or young in the vicinity
Brood patch on adult female or cloacal protuberance on adult male
CONFIRMED breeder
Nest building or carrying nest materials.
Distraction display or injury feigning
Used nest or egg shells found (occupied or laid within the period of the survey). Use only for unique and unmistakable nests or shells
Recently fledged young or downy young
Adults leaving or entering nest sites in circumstances indicating occupied nest (including nests which content cannot be seen)
Adult carrying fecal sac
Adult carrying food for young during its breeding season.
Nest containing eggs
Nest containing young seen or heard