COSEWIC
Assessment and Update Status Report

on the

Kirtland's Warbler
Dendroica kirtlandii

in Canada

ENDANGERED
2008

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

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Previous reports:

COSEWIC. 2000. COSEWIC assessment and update status report on the Kirtland's Warbler *Dendroica kirtlandii* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. v + 10 pp.

James, R.D. 1999. Update COSEWIC status report on the Kirtland's Warbler *Dendroica kirtlandii* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1-10 pp.

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Kirtland's Warbler — ©U.S. Fish and Wildlife Services.

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COSEWIC
Assessment Summary

Assessment Summary – April 2008

Common name
Kirtland's Warbler

Scientific name
Dendroica kirtlandii

Status
Endangered

Reason for designation
This warbler is a globally endangered species that occurs in very small numbers in Ontario and possibly Quebec. It is a habitat specialist and extremely vulnerable to cowbird nest parasitism. Habitat management and cowbird control in Michigan, the core of its range, have resulted in population increases, which could provide a source of birds for Canada. However, the U.S. population is still small and the number of sightings in Canada has remained low and constant since 1990, so there is no evidence of rescue for the Canadian population.

Occurrence
Ontario

Status history
Designated Endangered in April 1979. Status re–examined and confirmed in April 1999, May 2000, and April 2008. Last assessment based on an update status report.

COSEWIC
Executive Summary

Kirtland Warbler
Dendroica kirtlandii

Species information

The Kirtland's Warbler *Dendroica kirtlandii* is a globally endangered songbird of the family Parulidae (North American Wood Warblers). Adult males have bluish-grey upperparts and a lemon yellow belly, and black streaks on the flanks and sides. Females are similar to males but their plumage is duller with paler yellow underparts and more black streaks on the breast.

Distribution

In the United States, Kirtland's Warblers breed in Michigan's Lower and Upper Peninsulas, and recently in Wisconsin. In Canada, Kirtland's Warblers have been reported from Minaki, Ontario in the west to Kazabazua, Québec in the east. During the boreal winter, the species occurs in the Bahamas; it has also been seen in the Grand Turks and Caicos Islands, Hispaniola, as well as unverified records in Cuba.

Habitat

During the breeding season, the Kirtland's Warbler is restricted to extensive stands of young, even-aged, dense jack pine *Pinus banksiana*, with small openings. The Kirtland's Warbler is also area sensitive, generally occurring in patches greater than 30 ha, with breeding success highest in contiguous stands of 80 ha or more.

Biology

Kirtland's Warblers are generally monogamous. First breeding occurs at one year and clutch size ranges from three to six eggs. Kirtland's Warblers are unusual among Parulidae in that they nest in loose colonies. Brood parasitism (and perhaps egg/nestling predation) by the Brown-headed Cowbird *Molothrus ater* can limit reproductive success. Kirtland's Warblers feed on spittlebugs and aphids (Homoptera), ants and wasps (Hymenoptera), beetles (Coleoptera), moth larvae (Lepidoptera) and blueberries.

Population sizes and trends

Records of the Kirtland's Warbler in Canada date back to 1900. Singing males in suitable breeding habitat have been recorded sporadically since 1939 and breeding has been confirmed twice; once in 1945 near Barrie, Ontario and again in 2007 at Canadian Forces Base Petawawa. The species has been recorded in Canada almost annually since 1990. In Michigan, the stronghold of the species range, the population increased from a low of 167 singing males in 1974 to 1,479 in 2006.

Limiting factors and threats

Three main factors have limited the size and extent of the Kirtland's Warbler population: 1) Reduced habitat quality from fire suppression resulting in fewer suitable habitat patches; 2) Habitat loss and fragmentation due to conversion of jack pine barrens to agriculture, forestry and human development; and 3) Brood parasitism (and predation of eggs/nestlings) by the Brown-headed Cowbird, which has severely reduced breeding success in other parts of its range. Most of these factors are, however, not likely to greatly limit Kirtland's Warblers in Canada, where there appears to be available breeding habitat.

Special significance of the species

The Kirtland's Warbler is endemic to North America and is one of the most critically endangered avian species globally.

Existing protection or other status designations

Designated as endangered by the Ontario government in 1977 and by COSEWIC in 1979, the status of Kirtland's Warbler was confirmed as endangered by COSEWIC in 1999 and 2000. It is on Schedule 1 of the Canadian *Species at Risk* Act (SARA 2003) and is protected under the federal *Migratory Birds Convention Act* (1994). In Ontario, the species is also protected by the provincial *Endangered Species Act*. Only one authenticated record of the species is reported from Québec, where special provision is given to threatened species in the "Act Respecting the Conservation and Development of Wildlife".

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS (2008)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.

Environment Canada
Canadian Wildlife Service

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Canada

The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

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SPECIES INFORMATION

Name and classification

Class – Aves
Order – Passeriformes
Family – Parulidae
Scientific name: *Dendroica kirtlandii* Baird 1852
English name: Kirtland's Warbler
French name: Paruline de Kirtland

The close relatives of Kirtland's Warbler are uncertain, as the phylogenetic relationships among the *Dendroica* warblers have been little studied (Mayfield 1992). Based on DNA fingerprinting the species is usually classified between the Pine Warbler (*D. pinus*) and Prairie Warbler (*D. discolor*; Sibley and Monroe 1990). The Kirtland's Warbler may also be a relict species related to the Yellow-throated Warbler (*D. dominica*; Mengel 1964).

Morphological description

The Kirtland's Warbler is a medium-sized songbird and a relatively large member of the Parulidae (Mayfield 1992). Adult males have bluish-grey upperparts, a lemon yellow belly, and black streaks on the flanks and sides. Females are similar to males but their plumage is duller, with paler yellow underparts and more black streaks on the breast. The Kirtland's Warbler shares its habit of tail-bobbing with the Prairie Warbler, but unlike that species it does not have a yellowish face. It is also similar to the Magnolia Warbler (*D. magnolia*) but its wing bars and tail marks are not as prominent and the Magnolia Warbler does not pump its tail.

Designatable units

There are no subspecies of the Kirtland's Warbler and no known distinctions between populations that would warrant consideration of designatable units below the species level. This report deals with a single designatable unit, *Dendroica kirtlandii.*

DISTRIBUTION

Global range

Kirtland's Warbler is known to breed in the Lower and Upper Peninsulas of Michigan, Wisconsin and in Ontario.

Distribution in United States

The main Kirtland's Warbler population occurs in Michigan, with a very small, recently confirmed population also occurring in Wisconsin. The species has bred in 19 counties in the Lower and Upper Peninsulas of Michigan (Mayfield 1992; Figure 1), with the primary nesting location in the Au Sable River drainage. While the main population occurs in the Lower Peninsula, birds have been recorded in the Upper Peninsula since 1982, and are believed to have bred there since 1995. Four singing males were also recorded in 2006 in central Wisconsin, and three nests were discovered in 2007 (K. Grveles, pers. comm. 2007). The Kirtland's Warbler has been recorded as accidental in a further six states.

Distribution on wintering grounds

The Kirtland's Warbler is a Neotropical/Nearctic migrant, spending the non-breeding season in the Bahamas, where it is secretive and hard to locate (Mayfield 1992). Kirtland's Warblers have also been sighted in the Grand Turks and Caicos Islands (Mayfield 1960; Clench 1978) and the Dominican Republic, and there are unconfirmed records from Cuba. In the Bahamas, most sightings have been on islands with open stands of Caribbean pine (*Pinus caribaea*; Haney *et al.* 1998).

Distribution in Canada

Two breeding records are known for Canada. The first is from Oro township, Simcoe County (Midhurst, Barrie), Ontario, where two adult birds were seen with a recently fledged young in August 1945 (Speirs 1985). It is not clear, however, whether the young bird was a Kirtland's Warbler or a Brown-headed Cowbird fledgling. The second record is from Canadian Forces Base (CFB) Petawawa in Ontario, where a nest was discovered in 2007 (Canadian Forces Base Petawawa 2007). Numerous observations of Kirtland's Warbler made between 1916 and 1978 at CFB Petawawa (Appendix 1), suggest that the species may have also bred there in the past (Harrington 1939; Environment Canada 2006).

According to the Kirtland's Warbler Recovery Plan, there have been 77 records of Kirtland's Warbler in Canada, ranging from Minaki, Ontario (76 records from Ontario) in the west to Kazabazua, Québec (one record from Québec) in the east (Environment Canada 2006; Figure 1; Appendix 1). Of the 76 records from Ontario noted in the Recovery Plan, 38 have been accepted by the Ontario Bird Records Committee (OBRC), two records have been rejected and 37 have not been submitted (I. Richards, pers. comm. 2007; Appendix 1), including the 2006 and 2007 observations from CFB Petawawa.

Most observations are of males on spring migration (12 pre-1990, and 16 post-1990), with very few on fall migration (three pre-1990) and even fewer recorded during mid-summer (one pre-1990 and one post-1990). There are 12 records of male Kirtland's Warblers singing in suitable breeding habitat, suggesting, at the very least, some attempts to breed in those areas (Appendix 1).

The Extent of Occurrence and Area of Occupancy in Canada are unknown.

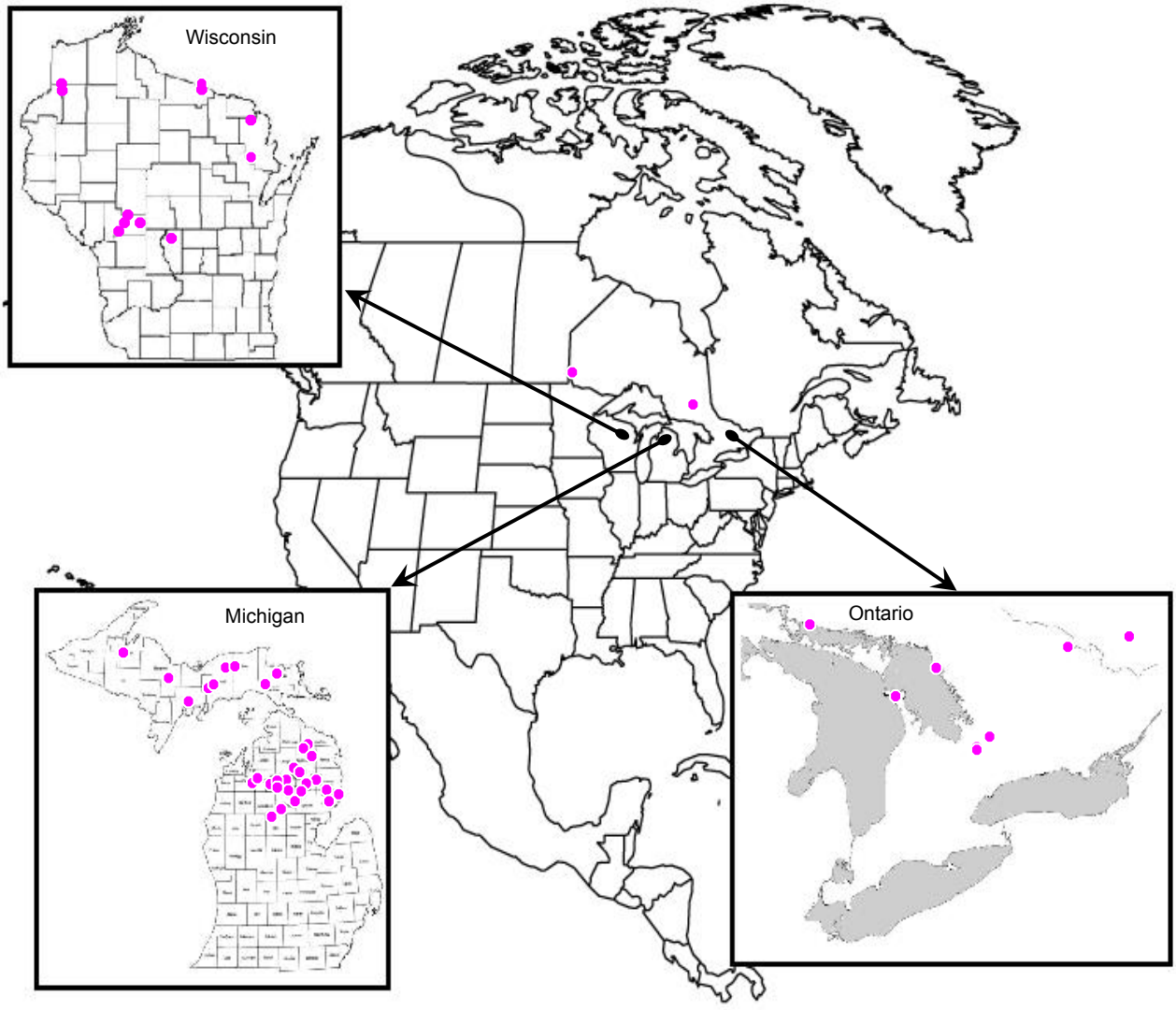

Figure 1. Kirtland's Warbler breeding distribution in Wisconsin, Michigan, and Southern Ontario (J. Trick pers. comm. 2007; T. Hogrefe pers. comm. 2007; P. Aird pers. comm. 2007; K. Tuininga pers. comm. 2007).

HABITAT

Habitat requirements

The Kirtland's Warbler is a habitat specialist, occurring exclusively in early successional jack pine stands. These stands may have regenerated after wildfire or timber harvest (naturally regenerated or planted). However, today most Kirtland's Warblers breed in jack pine plantations specifically managed for the species (Environment Canada 2006).

The species also appears to be area-sensitive. Mayfield (1992) found that they did not breed in tracts of jack pine smaller than 30 ha and that breeding success was higher in patches > 200 ha. Further support for the area sensitivity of the species comes from Anderson and Storer's (1976) study, which demonstrated that 90% of nests that fledged Kirtland's Warblers were from stands greater than 80 ha in area.

Kirtland's Warblers also have specialized local habitat requirements. Dense stands of jack pine with ≥ 3,500 stems/ha, 35-65% canopy cover and high foliage volume are preferred (Probst 1988; Kepler *et al.* 1996). Stands are first colonized by Kirtland's Warblers about six years following a fire, in areas where regenerating vegetation is most dense and 1.5-2.0 m in height (Mayfield 1992). Nesting success is highest in dense patches of pine trees, which are scattered in clumps and are 1.5-5 m tall (7-20 years old).

Although the species formerly bred only in early successional, fire-regenerated jack pine stands, more than 90% of the population now breeds in jack pine plantations specifically created for the species (Environment Canada 2006). In these plantations, trees are planted at 1.2 m intervals with 1.8 m between rows (4,510 trees/ha). Large elliptical spaces are integrated into the plantations to resemble openings in natural jack pine barrens and 25% of the plantation is left unplanted (Houseman and Anderson 2002). Kirtland's Warblers will also breed in mixed plantations and sometimes in red pine (*P. resinosa*) or even Scots pine (*P. sylvestris*) plantations (Weinrich 1994).

Probst *et al.* (2003) suggested that based on historical breeding densities (Probst and Weinrich 1993), 200-400 ha of densely stocked jack pine would be needed on an ongoing basis to support 25 pairs of Kirtland's Warblers. Were warblers to occupy a habitat patch for 10 years and assuming a 50-year rotation, 1,000-2,000 ha would be required to maintain sufficient jack pine regeneration for 25 pairs.

Kirtland's Warblers nest on the ground on well-drained, sandy soils and typically with the following species: low-bush blueberry (*Vaccinium corymbosum*) and velvet-leafed blueberry (*V. myrtilloides*), bearberry (*Arctostaphylos uva-ursi*), bracken fern (*Pteridium aquilinum*), serviceberry (*Amelanchier* spp.), sand cherry (*Prunus pumila*), sweet fern (*Comptonia peregrina*), grasses (e.g., *Andropogon* spp.), sedges (*Carex* spp.) and goldenrods (*Solidago* spp.). Delaying planting for three years following a prescribed burn increased cover of low-bush blueberry – which appears to be an important species associated with warbler breeding (Houseman and Anderson 2002).

More details of habitat requirements are in Wood 1904; 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; Probst and Donnerwright 2003; Probst *et al.* 2003.

Habitat trends

It is hard to determine habitat trends for the Kirtland's Warbler because unless specific management is undertaken, preferred habitat is continuously changing as stands mature. Because no net gain in habitat was projected in the Lower Peninsula of Michigan for the early part of the 21st century, it was predicted that the Kirtland's Warbler population would stabilize in this area (Probst and Weinrich 1993). In the Upper Peninsula, the successional stage of the four areas will soon render them unsuitable for Kirtland's Warblers (tree heights 1.7-5.0 m). However, regenerating jack pine in other areas may compensate for this loss (e.g., in 1998-2000, Baraga Plains, north-east Delta County, and Schoolcraft County provided habitat).

No information is available on habitat trends for Kirtland's Warbler in Canada. However, surveys show that some areas of jack pine in Ontario (e.g., Thessalon, Chapleau, Petawawa) have similar habitat structure and plant species composition to habitats occupied by Kirtland's Warblers in Michigan (Bloom 2003), so suitable habitat may not be limited. Indeed, the Recovery Team, using Ontario Ministry of Natural Resources Forest Resource Inventory mapping, has identified extensive areas of apparently suitable jack pine habitat across central Ontario from Sault St. Marie/Chapleau to North Bay/Petawawa.

Details of differences between management practices in jack pine stands in Michigan managed specifically for Kirtland's Warblers and typical management in jack pine stands in Ontario are provided in Table 1.

A recent theoretical study suggests that the range of the species may be extended northwards as habitat changes in response to warming trends (Botkin *et al.* 1991).

Habitat protection/ownership

One of the largest areas of suitable habitat for Kirtland's Warbler in Canada occurs at CFB Petawawa, Ontario owned by the Canadian Department of National Defence. Other areas with potential suitable habitat are either Crown Land or First Nations Land (e.g., Manitoulin Island, Thessalon, Cartier to Lake Wanapitei and Chapleau to Gowganda). There are likely vast areas of suitable jack pine habitat, probably on Crown Land and thus protected (to some degree); however, the precise area involved is unknown.

Table 1. Comparison of management practices in jack pine in Michigan vs. Ontario (Michigan Department of Natural Resources 2007; T. Hogrefe pers. comm. 2007 .

	Michigan	**Ontario (Algoma)**
Stand size	Stands > 1,000 acres (404.7 ha) have higher nesting densities and are used over a longer period. Treatment blocks are > 300 acres (121.4 ha) and > 1,000 acres when possible	No specific management for stand size
Fire management	Previously used fire to obtain best stand densities for warblers – now timber harvest	Mostly planted, fire avoided (liabilities of getting out of control)
Soil type	Fine to medium sands (Grayling-Rubicon)	Coarse sandy, gravelly soils
Rotation age	55 years (45 years in Upper Peninsula)	75 years
Replanting	Replant clearcuts to achieve 75% regeneration (25% open) with 1-5 openings per acre.	No specific replanting goal
Natural regeneration	May provide cheaper alternative; involves chop and chain green slash; so seeds in cones fall on mineral soil.	
Density	Clear cuts are replanted to density of at least 1,089 stems/acre (0.4 ha) or 1,450 stems/acre with openings	?
Edge management	Not planted to edge in Lower Peninsula; planted to edge in Upper Peninsula	Jack pine is planted to edge (roads etc.); removes foraging habitat
Slash management	Slash chipped back into stands in Lower Peninsula, not in Upper Peninsula	Delimbed at roadside leaves large piles of slash (rarely burned because of liabilities)
Special protection	Stands posted to minimize disturbance in Lower Peninsula; not in Upper Peninsula	Not posted

BIOLOGY

Reproduction, life cycle and diet

Kirtland's Warblers are generally monogamous, but polygyny does occur (perhaps up to 15% of males). The mean clutch size is 4.63 (range 3-6; Mayfield 1992) and first breeding occurs at one year of age. Life expectancy has been calculated at four years (Mayfield 1960; Walkinshaw 1983), with maximum longevity recorded at 11 years for males and eight years for females (Walkinshaw 1983).

Annual adult survival (from June) is estimated at about 65% (Mayfield 1992). Mortality rates for different parts of the life cycle have not been evaluated. Kirtland's Warblers nest in loose colonies and the social need for adjacent nesting pairs may limit populations in some areas.

Kirtland's Warblers feed on spittlebugs and aphids (Homoptera), ants and wasps (Hymenoptera), beetles (Coleoptera), moth larvae (Lepidoptera; DeLoria-Sheffield *et al.* 2001) and blueberries.

Predation

Although predation on adult Kirtland's Warblers has not been observed directly, circumstantial evidence suggests that Sharp-shinned Hawks (*Accipiter striatus*), Northern Harriers (*Circus cyaneus*), Great Horned Owls (*Bubo virginianus*) and domestic cats (*Felis domesticus*) prey on adults. Eggs and young may be taken by Blue Jays (*Cyanocitta cristata*), thirteen-lined ground squirrels (*Spermophilus tridecemlineatus)*, raccoons (*Procyon lotor)*, striped skunks (*Mephitis mephitis)*, domestic cats, and Garter Snakes (*Thamnophis sirtalis*; Walkinshaw 1983; Mayfield 1992). Brown-headed Cowbirds may also prey on eggs and nestlings (Lowther 1993).

Physiology

There is no information on the physiology of this species.

Dispersal/migration

Juvenile males have been shown to disperse from natal sites to potential breeding sites up to 350 km away (Probst *et al.* 1993). In early autumn, all birds migrate from breeding areas mostly to the Bahama Islands where they spend 40-60% of the annual cycle (Probst *et al.* 2003). On the return migration in the spring, birds migrate in a narrow band through South Carolina, North Carolina, western Virginia, West Virginia, Ohio, and southern Michigan (see references in Mayfield 1992) and Ontario.

Males banded in 1977 and 2006 in Petawawa, Ontario both returned the following year to Petawawa (D. Coulson, M. Oldham, A. Dextrase, pers. comm. 2008).

Interspecific interactions

Relatively few bird species use young jack pine forests, so the potential for interspecific interactions with other species is quite low. One obvious interspecific interaction is between Kirtland's Warblers and Brown-headed Cowbirds, which is a major threat to the species in Michigan.

Adaptability

The Kirtland's Warbler has very specialized habitat requirements (fire-regenerated, early successional jack pine with specific tree densities and habitat structure; Nelson 1992), but shows some adaptability in using plantations of jack pine (and more rarely red pine), which are specifically managed for the species.

POPULATION SIZES AND TRENDS

Search effort

There have been few systematic surveys for the Kirtland's Warbler in Canada until recently. This means that the species could be present in remote unsurveyed regions. For example, extensive early successional jack pine forests exist in Ontario and Québec, so the possibility exists that the species could breed in these locations undetected (Environment Canada 2006). The area actually surveyed for Kirtland's Warbler is quite small compared to the area of potential suitable habitat.

At least four targeted surveys have been orchestrated by the Ontario Ministry of Natural Resources (OMNR) and the Canadian Wildlife Service (CWS) of Environment Canada.

First, following the discovery of a territorial male Kirtland's Warbler on 4 July 1997 in Thessalon, surveys of potential Kirtland's Warbler habitat were contracted out by CWS in the Algoma area (Knudsen 1999; B. Knudsen, pers. comm. 2007). Jack pine stands of 3-20 years were surveyed and identified according to GIS layers from the OMNR Forest Resources Inventory. However, no warblers were detected and it was noted that at least some of the stands were unsuitable for Kirtland's Warblers being of > 20 years of age (Knudsen 1999; B. Knudsen, pers. comm. 2007).

Second, in association with the U.S. Kirtland's Warbler Recovery Team, OMNR and CWS personnel carried out aerial surveys in the Sault Ste. Marie and Chapleau areas to determine priorities for monitoring (Bloom 2003). Reports of these surveys are not available.

Third, searches have been made in the Orillia area following the discovery of a singing male in 1986, as well as the Chapleau-Cartier area, Bruce Peninsula and Manitoulin Island. As yet no breeding pairs have been discovered, although only a small portion of the total potential breeding habitat for Kirtland's Warbler has been surveyed in Ontario (Environment Canada 2006).

Fourth, targeted surveys of suitable habitat have been conducted in the Pembroke area. Searches were conducted by OMNR personnel in 2002 and CFB Petawawa and OMNR personnel in 2003, but Kirtland's Warblers were not detected. Surveys have been expanded to other parts of Renfrew county by OMNR staff while CFB personnel have continued searches of suitable habitat at the base since 2003. In 2006, CFB Petawawa commissioned an inventory of species at risk, and as part of these efforts, suitable habitat for Kirtland's Warbler was searched. Three singing males were found in 2006, two in 2007 (K. Tuininga, pers. comm. 2007) and an active nest, with a female and nestlings was found in 2007 (Canadian Forces Base Petawawa 2007).

Kirtland's Warblers have been recorded only once on a Breeding Bird Survey (BBS) route in Canada (2007, B. McBride, pers. comm. 2007) and thus there are no data available to evaluate changes in numbers.

Targeted surveys of apparently suitable habitat have recently been conducted in Québec (M. Robert and F. Shaffer, pers. comm. 2008). Searches were conducted in Kazabazua, Île aux Allumettes, Île du Grand Calumet, and Parc de la Vérendrye in late-May 2007, where potential habitat for Kirtland's Warbler had been identified using forest stand attributes (tree species, age of stand, size of stand) from Québec government digital forestry maps. Kirtland's Warblers were not detected, and areas visited apparently contained little (if any) potential habitat.

Abundance

The current size of the Kirtland's Warbler population in Canada is unknown. The largest number of singing males recorded at any one time from a specific area was the three singing males recorded at CFB Petawawa in the summer of 2006. Similarly, two males and a female were recorded from Petawawa in 2007. Given the availability of suitable habitat, the population is likely to be greater than three individuals, but is probably less than 10.

Fluctuations and trends

There is no information on population trends for Kirtland's Warbler in Canada. The numbers of individuals reported from Ontario has been stable since 1990 (Appendix 1, Environment Canada 2006). Similarly, Point Pelee National Park has reported the species regularly since the mid-1990s, and annually on spring migration since 2001 (Appendix 2, Wormington 2008).

Kirtland's Warblers have been increasing in the U.S. since the early 1990s (Figure 2). Surveys were begun in Michigan in 1951 and repeated in 1961, 1971 and then on an annual basis (Probst *et al.* 2003). The 1951 survey revealed 432 singing males, and the 1961 survey found 502; however, numbers fell to 201 in 1971 and an all-time low was reached in 1974 with only 167 males being counted. The population was relatively stable over the period 1971-1986 (Figure 2), despite aggressive cowbird control in almost all breeding areas. The greatest increases in population, however, occurred when cowbird populations were controlled and jack pine habitat was created through management and two large wildfires that occurred in 1975 and 1980. By 2006, the population had risen to 1,479 singing males (Figure 2; Byelich *et al.* 1985; Michigan Department of Natural Resources 2007).

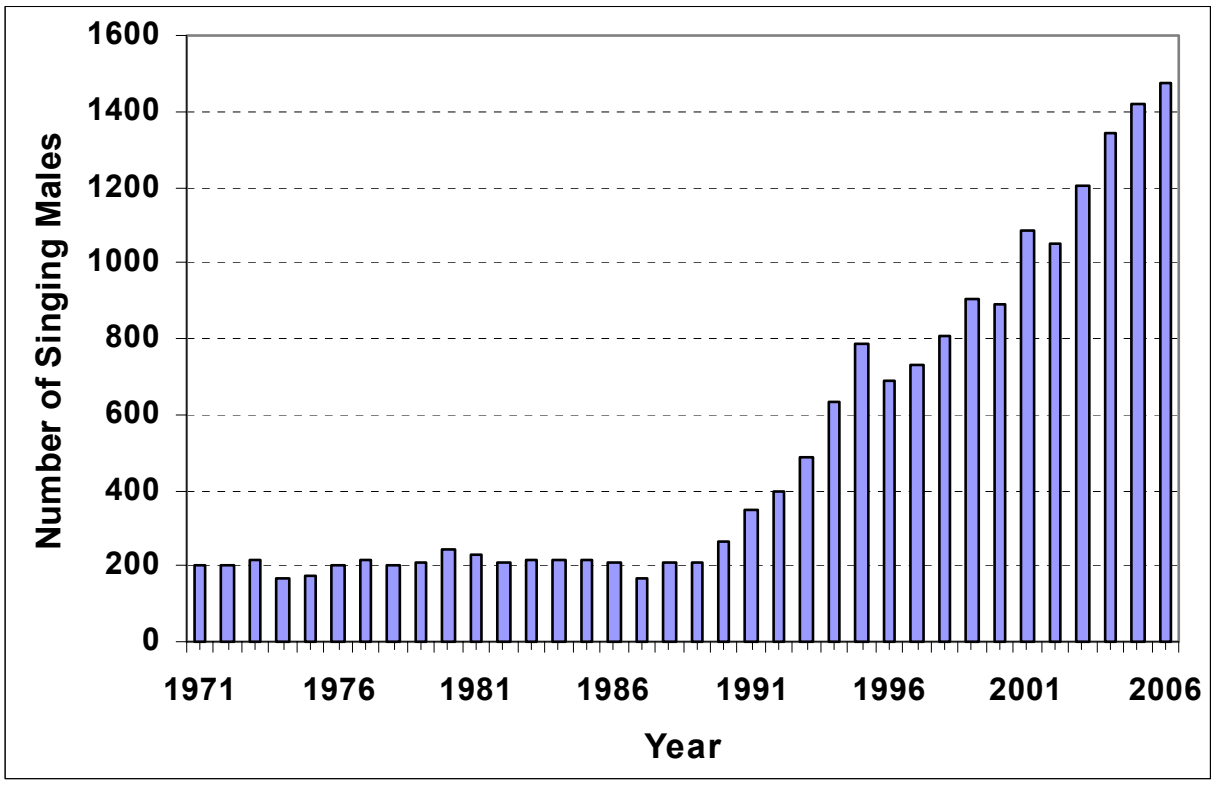

Figure 2. Survey of singing male Kirtland's Warblers in Michigan 1951-2006 (Michigan Department of Natural Resources 2007; T. Hogrefe, pers. comm. 2007).

Rescue effect

Kirtland's Warblers from Michigan (or possibly Wisconsin) could potentially breed in Canada. Large distances and extensive areas of open water do not appear to create a barrier to dispersal (Probst *et al.* 2003) and juvenile males have been known to disperse at least 350 km from their natal sites. Six banded males from the Lower Peninsula of Michigan were found in the Upper Peninsula and regular movements have

been observed between the two populations (Probst *et al.* 2003). Moreover, there was a recent record of a Kirtland's Warbler in Michigan within 25 km of Sault Ste. Marie. Together this information suggests that there is potential for rescue, although the population in the U.S. remains low, so rescue, if it occurred, would be limited.

LIMITING FACTORS AND THREATS

The Kirtland's Warbler has always been rare in Canada and the factors limiting population size in Canada have not been identified. Several factors have, however, been associated with declines in the Kirtland's Warbler population in the U.S. and could apply to birds breeding in Canada.

Reduced habitat quality

Habitat quality for Kirtland's Warbler has been reduced because of fire suppression. Historically (pre-European settlement), the supply of extensive patches of young jack pine (4-20 years of age) was renewed on an ongoing basis by lightening-caused fires in the Michigan pine barrens. For example, in 1871 a fire of 400,000 ha burned in the heart of the species' breeding range in Michigan (Mayfield 1992) and three fires, each more than 6,000 ha in extent, occurred between 1939 and 1946. These stand-replacing fires produced jack pine habitat of the appropriate successional stage (6-23 years), tree height (1.7-5.0 m tall), tree density (> 2000 stems/ha), and ground cover for breeding (Probst and Donnerwright 2003). However, fire suppression has drastically reduced the extent and frequency of these wildfires in the breeding areas. Indeed, the small but stable Michigan population expanded after extensive fires during the 1970s and 1980s (Mayfield 1977; Harwood 1981; Probst and Weinrich 1993; Kepler *et al.* 1996). In the absence of fire, management (timber harvest, prescribed burns, elliptical leave patches, 25% unplanted) has been geared to maximizing habitat suitability for Kirtland's Warblers. The increase in warbler population in Michigan has largely been attributed to management of jack pine plantations (Probst and Weinrich 1993).

Available wintering habitat could also be reduced by hurricanes in pine forest habitat in the non-breeding areas in the Bahama Islands.

Habitat loss and fragmentation

In the past, habitat loss through permanent conversion of jack pine barrens to agriculture or forestry has reduced the amount of suitable habitat for this species. Fragmentation and isolation of jack pine stands may also have contributed to decreases in Kirtland's Warbler populations. The species prefers and has higher breeding success in larger patches of jack pine, thus activities that fragment forest patches could result in population declines.

Cowbird parasitism

Kirtland's Warblers appear to be particularly vulnerable to cowbird parasitism. In the 1960s and 1970s, about 70% of all Kirtland's Warbler nests in Michigan were parasitized by cowbirds and produced an average of less than one young per nest (Ryel 1981). After cowbird control was implemented in 1972, the number of parasitized nests fell to 5% and the average number of young per nest increased to almost three (Kelly and DeCapita 1982; Walkinshaw 1983). Cowbird control appeared to stabilize the population, but increases in Kirtland's Warbler numbers occurred only when cowbird control was accompanied by increases in habitat that followed from management and the two large wildfires that occurred in 1975 and in 1980.

Brown-headed Cowbirds are common throughout southern Ontario, but less common in the parts of Ontario where Kirtland's Warblers have been recorded. In addition, recent Breeding Bird Survey trends show statistically significant long-term population declines for cowbirds in Canada (Downes and Collins 2007), so this factor may not be a significant threat to Kirtland's Warblers in Canada.

SPECIAL SIGNIFICANCE OF THE SPECIES

The Kirtland's Warbler has special significance because it has a very small global breeding distribution, is globally endangered and is the only bird species in North America to exclusively depend on young jack pine stands.

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

In Canada, *D. kirtlandii* has been listed as 'Endangered' by COSEWIC since 1979 (this assessment was confirmed in 1999 and 2000). It is listed under Schedule 1 of the Canadian *Species at Risk* Act (SARA; *Species at Risk Act* 2003). The Kirtland's Warbler is protected by the *Migratory Birds Convention Act* 1994. In Ontario, the species is also protected by the provincial *Endangered Species Act*. Were the species to occur again in Québec, it would be protected by the "Act Respecting the Conservation and Development of Wildlife" (which applies to all wildlife species mammals, birds, fish, amphibians and reptiles; D. Banville, pers. comm. 2006). Special provision is given for threatened or vulnerable species and their habitats.

According to NatureServe (2006), the global status of *D. kirtlandii* is a G1 (globally threatened with extinction, with very few individuals remaining). In Ontario, the Natural Heritage Information Centre (NHIC) ranks the Kirtland's Warbler as extirpated as a breeding species (SHB), occurring only as a non-breeding migrant/vagrant (SZN; NHIC 2006). In Michigan, the species is ranked S1 or extremely rare at the state level.

TECHNICAL SUMMARY

Dendroica kirtlandii
Kirtland's Warbler Paruline de Kirtland
Range of Occurrence in Canada: Ontario, Québec

Extent and Area Information

• *Extent of occurrence (EO)(km²)* [explain source of information and calculation]	Unknown
• *Specify trend in EO*	Unknown
• *Are there extreme fluctuations in EO?*	Not likely
• *Area of occupancy (AO) (km²)* [explain source of information and calculation]	Unknown
• *Specify trend in AO*	Unknown
• *Are there extreme fluctuations in AO?*	Not likely
• *Number of known or inferred current locations*	One
• *Specify trend in #*	Likely stable
• *Are there extreme fluctuations in number of locations?*	Not likely
• *Specify trend in area, extent or quality of habitat*	Relatively stable, although quality changes with succession

Population Information

• *Generation time (average age of parents in the population)*	1-2 years
• *Number of mature individuals*	Unknown but likely < 10
• *Total population trend:*	Unknown
• *% decline over the last/next 10 years or 3 generations.*	Unknown
• *Are there extreme fluctuations in number of mature individuals?*	Not likely
• *Is the total population severely fragmented?*	Unknown
• *Specify trend in number of populations*	Stable
• *Are there extreme fluctuations in number of populations?*	No
• *List populations with number of mature individuals in each:*	

Threats (actual or imminent threats to populations or habitats)

Reduction in habitat quality from fire suppression, loss and fragmentation of jack pine stands, and cowbird parasitism in some areas

Rescue Effect (immigration from an outside source)

• *Status of outside population(s)?*	Increasing
• *Is immigration known or possible?*	Possible
• *Would immigrants be adapted to survive in Canada?*	Yes
• *Is there sufficient habitat for immigrants in Canada?*	Yes
• *Is rescue from outside populations likely?*	Yes, populations in Michigan could provide source

Quantitative Analysis

Current Status

COSEWIC: Endangered (2000 and 2008)

Status and Reasons for Designation

Status:	**Alpha-numeric code:**
Endangered	D1
Reasons for Designation: This warbler is a globally endangered species that occurs in very small numbers in Ontario and possibly Quebec. It is a habitat specialist and extremely vulnerable to cowbird nest parasitism. Habitat management and cowbird control in Michigan, the core of its range, have resulted in population increases, which could provide a source of birds for Canada. However, the U.S. population is still small and the number of sightings in Canada has remained low and constant since 1990, so there is no evidence of rescue for the Canadian population.	

Applicability of Criteria

Criterion A (Declining Total Population): Does not meet criterion.
Criterion B (Small Distribution, and Decline or Fluctuation): Does not meet criterion.
Criterion C (Small Total Population Size and Decline): Does not meet criterion.
Criterion D (Very Small Population or Restricted Distribution): Meets criterion for Endangered D1 with < 250 mature individuals.
Criterion E (Quantitative Analysis): None

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BIOGRAPHICAL SUMMARIES OF REPORT WRITERS

Born in England, Dr. David Anthony Kirk immigrated to Canada in 1989 and for 18 years has worked as a self-employed research ecologist and Executive Director of Aquila Applied Ecologists. Most contractual agreements have been with the federal government of Canada (mainly Environment Canada and Parks Canada Agency), but David has also worked with conservation organizations such as World Wildlife Fund, NatureServe, Ducks Unlimited Canada and the Yellowstone to Yukon Conservation Initiative (the latter with Jennie Pearce). He is particularly interested in integrating resource use with conservation of biodiversity both through ecologically sustainable land use practices and protected area networks. Specifically, this has involved research on 1) the effects of farming and forestry on biodiversity and 2) conservation planning and monitoring biodiversity at multiple scales. David has recently worked on environmental outlooks and scenarios and their implications for biodiversity and

human well-being. Outside Canada, his research ranges from studying the effects of introduced hares on vegetation and avifauna of islands in the Seychelles and conservation of maquis vegetation in North Africa, to resource partitioning among sympatric vultures in South America. He has written 12 previous COSEWIC status reports (6 full reports and 6 updates) and over 30 peer-reviewed scientific papers and reports, on subjects as diverse as approaches to the selection of indicators with reference to Canadian National Parks, to the effects of genetically modified organisms on biodiversity in Canada, and statistically robust approaches to inventory and monitoring of species at risk.

Dr Jennie L. Pearce was born in Australia and immigrated to Canada in 1999. In both countries her research has focused on spatial modelling of the distribution and abundance of wildlife; her Ph.D was on the endangered Helmeted Honeyeater *Lichenostomus melanops cassidix*. She is particularly interested in testing the accuracy of spatial models and how these can be used for solving landscape management concerns, such as conservation of endangered species, managing forests in an ecologically sustainable framework and allocating resource extraction industries over landscapes. She is also interested in the use of bioindicators for sustainable forestry, particularly for large and small mammals (including wolverine *Gulo gulo* and shrews), amphibians, carabid beetle and spider communities. She has published more than 25 scientific papers in this area, as well as participated in numerous workshops and conference proceedings.

COLLECTIONS EXAMINED

No collections were examined during preparation of this status report.

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APPENDIX 1

Locations of Kirtland's Warbler sightings in Canada; grey highlight indicates records accepted by the Ontario Bird Record Committee; yellow highlighted rows are rejected records. Table is a working draft produced by Ken Tuniga and Paul Aird for the Recovery Plan.

Year	Date_	Location	County	Sex	Observer (obrc observer listed)	Source	Comments	Level of breeding certainty	Comments_1
1900	16th May	Toronto		Male	J. H. Samuel	Speirs 1985	ROM Specimen	Observation	
1915	2nd October	Point Pelee National Park (PPNP)	Essex		W.E. Saunders	Speirs 1985	ROM Specimen	Observation	
1916		Petawawa	Renfrew	Males	P. Harrington	Speirs 1985	Singing males in suitable habitat	Possible	Paul Harrington 1941-1924 Field notes F.A. Starr field notes (ROM library)
1939	5th June	Petawawa	Renfrew	Male	P. Harrington	Speirs 1985	Singing male in suitable habitat	Possible	Paul Harrington 1939-1941 Field notes (ROM library)
1941	31st August	Long Point	Halimand-Norfolk	Male	H. A. Sivyer	Speirs 1985	Migrant	Observation	
1945	8-13th August	Barrie		Adults	D. H. Speirs, J. M. Speirs	P. L. Aird	2 adults and 1 recently fledged young	Confirmed	
1946	18th June	Petawawa	Renfrew		P. Harrington	Hibbard, S. and P.L. Aird. 1978 Records of the KIWA in Canada (21 Jan 1978 draft) 2 pp.	Prob. Singing male	Possible	Paul Harrington 1943-1951 Field notes (ROM library)
1946	27th July	Petawawa	Renfrew	Male	P. Harrington	Hibbard, S. and P.L. Aird. 1978 Records of the KIWA in Canada (21 Jan 1978 draft) 2 pp.			Paul Harrington 1943-1951 Field notes (ROM library)
1947	30th May	Toronto		Male	C. Long	Speirs 1985	Report	Observation	ROM Kirtland's Warbler file
1948	14th September	Pickering	Prince Edward	Male	D. Speirs	Speirs 1985	Report	Observation	
1953	10th May	PPNP	Essex		F. Cook, D. Sutton	M. Petrucha and P. W. Sykes			
1958		Toronto		Male	G. Fairfield	Speirs 1985	Report	Observation	
1958	8th-30th June	McVicar	Bruce	Male	G.A. Moore, C.R. S (J. L. Baillie)	Speirs 1985	Singing male in suitable habitat	Observation	

Year	Date_	Location	County	Sex	Observer (obrc observer listed)	Source	Comments	Level of breeding certainty	Comments_1
1959	24th May	Toronto		Male	J. Harrison, A. Sa (Barry Harrison)	Speirs 1985	Report	Observation	Ontario Birds August 1987 Barry Harrison
1959	10th May	PPNP	Essex	Male	Ontario Bird Bander's Assoc	M. Petrucha and P. W. Sykes		Observation	Comment from Petrucha et al. habitat: scrub willow in an open sandy area bording a cattail marsh
1960	17th June	Hamilton		Male	D. Campbell, J. Miles, G.W. North	Speirs 1985	Singing male in jack pine	Observation	
1961	17th June	Point au Baril	Parry Sound	Male	H. Savage	P. L. Aird, COS	Singing male in suitable habitat	Possible	ROM photograph and skeleton
1961	13th May	PPNP	Essex		G.M. Stirrett	ROM photo ROM KIWA file			
1962	18th May	Whitby		Male	N. LeVay	Speirs 1985	Report	Observation	
1962	22nd September	PPNP	Essex		Stirett (1973).	Speirs 1985	Report	Observation	
1962	19th May	Point Traverse	Prince Edward			Goodwin C.E. 1963, ON Naturalists 1(3):23-26			
1963	1st June	Whitby		Male	N. LeVay	Goodwin CE 1963 ON Naturalists 1(3):23-26	Report	Observation	
1963	2nd July	Gores Landing	Northumberland	Male	N. Martin	Bain, M. 2002, Ontario Birds August 2003	Brodie Club minutes, meeting 617, ROM library		
1963	13th May	PPNP	Essex			M. Petrucha and P. W. Sykes			
1964	16th May	Midhurst/Barrie		Male	F. Westman (Devitt	Speirs 1985	Singing male in suitable habitat	Possible	ROM photo, Devitt, OE 1967, The Birds of Simcoe County ON
1964	12th May	Kingston Cemetery	Cataraqui Prince Edward			M. Petrucha and P. W. Sykes			
1967	19th May	Barrie		Unknown	H.B. Haugh	Devitt OE 1967	Report	Observation	
1974	16th May	Toronto		Unknown	J. A. Kelley	OBRC			
1977	9th June-14th July	Petawawa	Renfrew	Male	P. L. Aird, J. Bouvier	P. L. Aird, COS	Singing male in suitable habitat	Possible	
1978	2nd June-14th July	Petawawa	Renfrew	Male	P. L. Aird (B. R. Barrett)	P. L. Aird, COS	Singing male in suitable habitat	Possible	

Year	Date_	Location	County	Sex	Observer (obrc observer listed)	Source	Comments	Level of breeding certainty	Comments_1
1978	27 May-21 June	Kazabazua,QC		Male	P. L. Aird, J. Wright	David 1996, M. Gosselin, pers. comm..	Singing male in suitable habitat	Possible	
1979	14-19th May	PPNP	Essex		(R. Smith, A. Parker, R. E. Coker, P. Carlton, J. P. Kleiman)	M. Petrucha and P. W. Sykes			
1981	9th September	Morton		Male	M. and T. Hendrick	Speirs 1985	Report	Observation	
1982	14th May	Rondeau Provincial Park	Chatham-Kent	Male	N. Tucker, F. van der Meer	OBRC			
1982	1st June	Makwa Lake, Gogama	Sudbury	Male	S. V. Nash, A. V. Nash	OBRC			
1985	22nd June-9th July	Orillia		Male	P. L. Aird, D. Pope	P. L. Aird	Singing male in suitable habitat	Possible	
1987	15th May	Rondeau	Kent	Male	R.E. Fiehweg. R.A. Byers	M. Petrucha and P. W. Sykes			
1988	14th August	Minaki	Kenora		I. Kirkham	Ontario Birds April 1990 first bird for N. Ont. Also northern most occurrence in N.A. (3 Aug. 1921 Lake Winnipegosis (Taverner 1921)likely an error, not included in Taverner 1928.	Not first for N. ON See 1982	Observation	
1990	26th May	Cabot Head	Bruce	Male	Curry 1991 (C. Michener, G. B. Cameron, A. Heagy)	COSEWIC 1999	Report	Observation	
1990	31st May	Port Hope	Northumberland	Male	Curry 1991 (A. K. Sculthorpe, E. R. MacDonald, also found by I. P. Tate)	COSEWIC 1999	Report	Observation	Ontario Birds
1990	20th May	Upper Bruce Peninsula	Bruce			M. Petrucha and P. W. Sykes			
1991	19th May	Toronto		Unknown	Bain 1992	COSEWIC 1999	Report	Observation	Ontario Birds

Year	Date_	Location	County	Sex	Observer (obrc observer listed)	Source	Comments	Level of breeding certainty	Comments_1
1991	22nd May	Toronto, Leslie St. Spit			M. McNicholl	Ontario Birds August 1992			
1993	9th May	PPNP	Essex	Male	Pittaway 1995 (G. Peterson, E. Peterson, J. Flynn, A. Wormington)	COSEWIC 1999	Report	Observation	Ontario Birds
1993	19th August	Killarney PP, Balsam Lake		Male	R. Scovell	P. L. Aird	Singing male	Observation	in migration
1994	18th-20th May	Rondeau	Kent	Unknown	Pittaway 1995 (M. J. Taylor)	COSEWIC 1999	Report	Observation	Ontario Birds
1994	18th May	Kopegaron Woods	Essex	Male	M. Harrigan	M. Petrucha and P. W. Sykes			
1995	21st May	PPNP	Essex	Female	Dobos 1996 (D. R. Gardiner, K. A. McLaughlin, A. Wormington)	COSEWIC 1999	Report	Observation	Ontario Birds
1995	4th September	Long Point	Haldimand-Norfolk		J. Bowles, M.Drenth	M. Petrucha and P. W. Sykes			
1995	10th May	Rondeau	Kent		P.A. Woodliffe	M. Petrucha and P. W. Sykes			
1996	10th May	PPNP	Essex	Male	Dobos 1997 (J. B. Lesser, A. Wormington, J. N. Flynn, also found by J. Goldsmith, S.Kirsch)	COSEWIC 1999	Report	Observation	Ontario Birds
1996	14th May	Stoney Point	Essex	Male	Dobos 1998 (G. Seamans, also found by M. Schablach, N. Schablach, T. Beachy, B. Beachy, E. Baker)	COSEWIC 1999	Report	Observation	Ontario Birds
1996	16th May	PPNP	Essex	Unknown	Dobos 1998 (R. R. Sokolowski, J Luce, also found by M. O'Connor, R. Frew)	COSEWIC 1999	Report	Observation	Ontario Birds
1997	24th May	St. Williams Forestry Station	Halimand-Norfolk	Male	Dobos 1998 (T. Smith)	COSEWIC 1999	Report	Observation	Ontario Birds
1997	4th July	Thessalon Area		Male	B. Knudsen	COSEWIC 1999	Report	Observation	
1997	13-14th May	Delaware (Cedarcroft Property)	Middlesex	Male	J. H. Griffin, P. Cole, J. Ewart	Ontario Birds August 1999	Photo on file	Observation	
1998	Sept.	Killarney PP -		Female	P. L. Aird	P. L. Aird	Report	Observation	

Year	Date_	Location	County	Sex	Observer (obrc observer listed)	Source	Comments	Level of breeding certainty	Comments_1
1998	15th May	PPNP	Essex	Unknown	F. Longabaugh	Ontario Birds August 1999		Observation	
1998	21st May	PPNP	Essex	Unknown	M. J. Taylor (also found by D. Taylor)	Ontario Birds August 1999		Observation	
1999	9th-10th June	Forest	Lambton	Male	A. Rider, found by C. Cook	Ontario Birds Aug 2000	Photo on file	Possible	
2000	21st May	Tobermory (Cape Hurd)	Bruce	Male	T.Cheskey (also found by B. Laurent)	Ontario Rare	One, first alternat	Observation	
2002	14th May	PPNP, E. Beach	Essex	Adult	D.K. Sealy	Park records		Observation	
2002	14th May	PPNP, Sleepy Hollow	Essex	Female	J. M. Tate	Park records	Alternate female	Observation	
2002	19th May	PPNP	Essex	Adult	T. R. Pepper	Park records		Observation	
2002	24th May	Dyers Bay	Bruce	Female (unknown?)	K. McGuire, E.J. Meleg, also found by D. Johnson		Photo on file	Observation	
2002	29th August	Cobourg	Northumberland	Adult	M. J. Bain			Observation	
2003	15th May	Long Point, Courtright ridge	Norfolk	Male	H. Robert, M. S. W. Bradstreet	Ontario Bird	Alternate male	Observation	Courtright Ridge
2003	17th May	PPNP	Essex	Male	E. Rauckis, B. S. Cherriere, L. Knaggs, D. Ford, also found by M. Raukis)	Ontario Bird	Alternate male	Observation	
2004	11th May	PPNP	Essex		R. Ortlieb (also found by J. Ortlieb)	Ontario Birds August 2005??		Observation	
2004	17-19th May	PPNP	Essex	Male	A. L. Adamo (B. A. Mann, B. S. Cherriere, B. R. Holden)	Ontario Birds, August 2005			
2005	11th May	Ruscom Shores Conservation Area	Essex	Male	(S. D. Wurker, F. D. Wurker)	OBRC			
2005	25th-26th May	Port Bruce	Elgin	Male	(R. J. Kingswood)				
2005	11-May	Rondeau		Male (unknown)		Withheld	Report	Observation	in migration
2005	11-15th May	PPNP	Essex						
2006	21st May	PPNP	Essex	Male	(A. Wormington, R. A. Hall)	OBRC			
2006	June-July	Petawawa	Renfrew	3 Males	P. Aird, D. Coulson, N. Hiscock, T. Richard	CBC base press release		Possible	
2007	May-July	Petawawa	Renfrew	1 male plus 1 pair	T. Richard	K. Tuininga, pers. comm.		Breeding confirmed	Fledged 2 young

Year	Date_	Location	County	Sex	Observer (obrc observer listed)	Source	Comments	Level of breeding certainty	Comments_1
2007	24 May	Meldrum Bay	Manitoulin Island	Male	Chris Bell	P.L. Aird	Singing male	observation	Not in suitable habitat

APPENDIX 2

Records of Kirtland's Warblers from Point Pelee National Park, which includes a 15-mile diameter circle, with Wheatley and Leamington to the north during spring and fall migration. (x = records accepted by the Ontario Bird Records Committee (OBRC), or records currently under review that are well documented (photos, etc.), u = records that apparently are not documented, but are considered valid. (From Wormington 2008.)

Status	Date	Sex	Location	Observers	Comment
x	May 9, 1993	first-year male	Sanctuary Picnic Area to Northwest Beach	Glenn S. Peterson, Ellen M. Peterson, Mark Hubinger, Jo Anne Hubinger *et al.*)	photos on file.
x	May 9-14, 2005	one definitive male	Sanctuary Beach	Darlene Friedman *et al*	photos on file
u	May 10, 1953	one male	East Beach at Post Woods	William J.R. Wasserfall, John Lunn, Douglas D. Dow, James Woodford *et al*	
x	May 10, 1959	first-year male	East Beach	William J.R. Wasserfall, John Lunn, Douglas D. Dow, James Woodford *et al.*	caught and banded; specimen (breast feather) in ROM: #90325
x	May 10, 1996	one definitive male	West Beach	James B. Lesser, Jeffrey Goldsmith, Sheldon Kirsch *et al.*	photos on file
x	May 11, 2004	one definitive male	Northwest Beach	Rick Ortlieb, Jeanne Ortlieb	video on file
x	May 11-14, 2005	one female or first-year male	Northwest Beach	Jeff Atkinson *et al.*	photos on file
x	May 13, 1961	one male	West Beach	T. Ronald Scovell, Douglas E. Scovell *et al.*	photos on file
x	May 14, 2002	one female or first-year male	East Beach	D. Keith Sealy	
x	May 14, 2002	one female	Sleepy Hollow Beach	J. Michael Tate *et al.*	
x	May 14, 2007	one first-year female	Woodland Nature Trail to DeLaurier Fields	R. Smith *et al.*	
x	May 15, 1998	one	West Beach	Nancy Longabaugh, Frederick Longabaugh	
x	May 16, 1996	one	Tilden's Woods	Ryan R. Sokolowski, John Luce, Robert Frew, Mark O'Connor	
x	May 17, 2003	one definitive male	Sanctuary Beach	Emilia Rauckis, Marius Rauckis *et al.*	photos on file
x	May 17-19, 2004	one first-year male	Woodland Nature Trail & PPNP Group Campground	Alfred L. Adamo, David Langford *et al*	photos on file
x	May 19, 2002	one	DeLaurier Trail	Todd R. Pepper *et al.*	
x	May 21, 1995	one female	east side of Tip	Denys R. Gardiner *et al.*	
x	May 21, 1998	one	Post Woods	Martin J. Taylor, Dixie Szasz-Taylor	

Status	Date	Sex	Location	Observers	Comment
x	May 21, 2006	one definitive male	Sparrow Field	Alan Wormington *et al.*	photos on file
u	May 21-23, 2007	one male	west side of Tip	G. Brock May *et al.*	
u	May 24, 1976	one male	Loop Woods	John Lamey, Luc S. Fazio	
x	October 2, 1915	one immature male	Tip	William E. Saunders	specimen (skin) in ROM: #70101