COSEWIC
Assessment and Status Report

on the

Golden-winged Warbler
Vermivora chrysoptera

in Canada

THREATENED
2006

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE
IN CANADA

COSEPAC
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DES ESPÈCES EN PÉRIL
AU CANADA

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Golden-winged Warbler — Male (left) and female (right) Golden-winged Warblers by Rachel Fraser.

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COSEWIC
Assessment Summary

Assessment Summary – April 2006

Common name
Golden-winged Warbler

Scientific name
Vermivora chrysoptera

Status
Threatened

Reason for designation
This small songbird has declined by 79% over the last 10 years according to Breeding Bird Survey data from Canada. The main threat appears to be competition and genetic swamping (hybridization) from the closely related Blue-winged Warbler, which is spreading north because of habitat change and perhaps climate change.

Occurrence
Manitoba, Ontario, Quebec

Status history
Designated Threatened in April 2006. Assessment based on a new status report.

COSEWIC
Executive Summary

Golden-winged Warbler
Vermivora chrysoptera

Species information

The Golden-winged Warbler (*Vermivora chrysoptera* Linnaeus, Paruline à ailes dorées) is a small (9-11 g) wood warbler. Both sexes are grey with yellow wing patches and crown; males have black masks and bibs.

Distribution

The Golden-winged Warbler breeds in the northeastern United States and southern Ontario, as well as in extreme southwestern Québec, southern Manitoba and southeastern Saskatchewan. The species winters in Central America and northern South America including central Guatemala and northern Honduras, southward to northern and western Venezuela, and western Colombia.

Habitat

On the breeding grounds, Golden-winged Warblers are found in areas of early successional scrub surrounded by mature forests. They are found in dry uplands, swamp forests and marshes. Examples of some preferred habitat areas include hydro/utility right-of-ways, field edges, recently logged areas, beaver marshes and areas that are burned or intermittently farmed.

On the wintering grounds Golden-winged Warblers may be found at high elevations (1,500-3,000 m) in various types of open woodland habitats, pine-oak and scrub. However, they have also been described as lowland dwellers by some. Within the preferred habitat types, the species is found primarily in canopies, within gaps or along edges of forests, and in tall second growth.

Biology

Breeding pairs raise only one brood per year with an average clutch size of 4.75 nestlings per nest (range = 2-6) in Ontario. Subsequent breeding attempts are common in the case of nest failure, especially when failure occurs near the start of the breeding season. Approximately 55% of nests fledge at least one young, while 45% of nests have been known to fail (N=103 nests in Ontario) due to predation and/or abandonment.

The species is known to be strictly insectivorous during the breeding season. The preferred diet consists mainly of tortricid moths and their larvae, although other moths and their pupae, other winged insects and spiders are sometimes consumed. Similar feeding habits are also seen on the wintering grounds.

Population sizes and trends

The Golden-winged Warbler has been experiencing population declines for at least 30 years and is currently one of the fastest declining passerine species in North America. In Canada, the species was showing population growth up until 10 years ago, likely because of a northeastward range expansion. Since that time the species has started to disappear from regions in the southernmost portions of Ontario. The northward range expansion is thought to now have stopped in Ontario and Quebec, but continues northwestward into Saskatchewan.

Inconsistencies in reported numbers of Golden-winged Warblers make accurate estimates of population size difficult. Current best estimates of the global population range from 105,000 to 270,000 breeding pairs. Breeding Bird Survey (BBS) data suggest approximately 20,000 to 50,000 pairs breed in Canada, approximately 18.5% percent of the global population. The vast majority of these breed in Ontario. In Québec, the population has been estimated to be between 210 and 540 pairs. In Manitoba, where breeding has been taking place since 1932, Breeding Bird Survey data estimate a total population of 105 to 270 pairs. However, results from recent intensive surveys and a remaining abundance of unsurveyed land suggest numbers in Manitoba may be as high as several thousand individuals. In Saskatchewan 19 birds have been reported to date with evidence of probable breeding on one 1:50,000 mapsheet and possible breeding on two other mapsheets.

Limiting factors and threats

On the breeding grounds Golden-winged Warbler declines are associated with a decrease in early successional scrub environments required for breeding, hybridization with the Blue-winged Warbler (*V. pinus*), and Brown-headed Cowbird (*Molothrus ater*) parasitism, although great variation is seen in the impact of these factors by location.

Threats associated with migration and wintering ground habitat have not yet been studied directly, but as with most neotropical migrants, they are likely linked to declines in the Golden-winged Warbler.

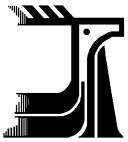
Special significance of the species

The Golden-winged Warbler has generated a great deal of scientific and public interest over the past 30 years. Field research and citizen science projects have been actively exploring reasons for the species' decline for at least 15 years. The species has a unique genetic history, being closely allied to only one other species (the Blue-winged Warbler) even though it is currently considered to be one of nine species within the

Vermivora genus (one of which, the Bachman's Warbler, is extinct). The Golden-winged Warbler can be seen as a representative for many other successional scrub breeding birds that are facing widespread population declines. As such, the conservation of this species will benefit numerous other avian species in Canada.

Existing protection

The Golden-winged Warbler is not federally listed in the United States, although it has designation in 12 states and is currently under federal status assessment in the U.S. to determine whether it warrants protection under the U.S. Endangered Species Act. In Québec its status is "Likely to be designated as threatened or vulnerable". The Migratory Bird Treaty Act of 1918 provides protection from taking, killing or possessing the species. NatureServe gives the Golden-winged Warbler a global ranking of G4 (apparently secure – uncommon but not rare).



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 5th 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 (2006)

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 it 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.

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SPECIES INFORMATION

Name and classification

English name: Golden-winged Warbler
Scientific name: *Vermivora chrysoptera* Linnaeus
French name: Paruline à ailes dorées

Morphological description

The Golden-winged Warbler is a small (9-11 g) wood warbler. Both sexes of adults have white underparts, grey back and wings, and a patch of yellow on each wing. Males have a striking black throat and eye patch which is a soft grey in females (Figure 1). Both sexes also have a yellow crown patch, although this tends to be much brighter in after second-year males than in second year males and females.

Figure 1. Male (left) and female (right) Golden-winged Warblers (photos by Rachel Fraser)

These birds could initially be confused with the Black-capped Chickadee (*Poecile atricapillus*; Confer 1992) that exhibits the same black throat patch and foraging style. However, the smaller size as well as the yellow patches on the wings and crown can easily distinguish them. If seen, it is unlikely that the Golden-winged Warbler would be confused with any other wood warbler species, except Golden-winged X Blue-winged Warbler hybrids (see Interspecific interactions section below). Identification by song can be more difficult, especially when considering hybrids.

Genetic description

Golden-winged Warblers belong to the order Passeriformes (Perching Birds) and the Family Parulidae (Wood Warblers). Currently Golden-winged Warblers are considered members of the *Vermivora* genus that contains a total of nine species in North America. Recent phylogenetic work suggests that the genus Vermivora may be polyphyletic; Golden-winged Warblers and Blue-winged Warblers are not closely allied

to any other *Vermivora*, except perhaps the extinct Bachman's Warbler (*V. bachmanii*; I. Lovette, pers. comm.). These three species may be the only true *Vermivora* species, as the Blue-winged Warbler is the type-species for the genus (Klein *et al*. 2004).

DISTRIBUTION

Global range

Populations of breeding Golden-winged Warblers are found in northeastern regions of the United States (ranging from West Virginia up to the Canadian border on the east, and extending as far west as Minnesota), southeastern areas of Ontario, southeast to western regions of Manitoba, as well as in the southwestern reaches of Québec (Figure 2). There have been 11 reports of this species in Saskatchewan, with one confirmed and two probable cases of breeding from the far southeast (Smith 1996); the species is currently considered "Accidental" in this province (J. Pepper, pers. comm.). However, given the ongoing range expansion it is likely that this number will increase in coming years.

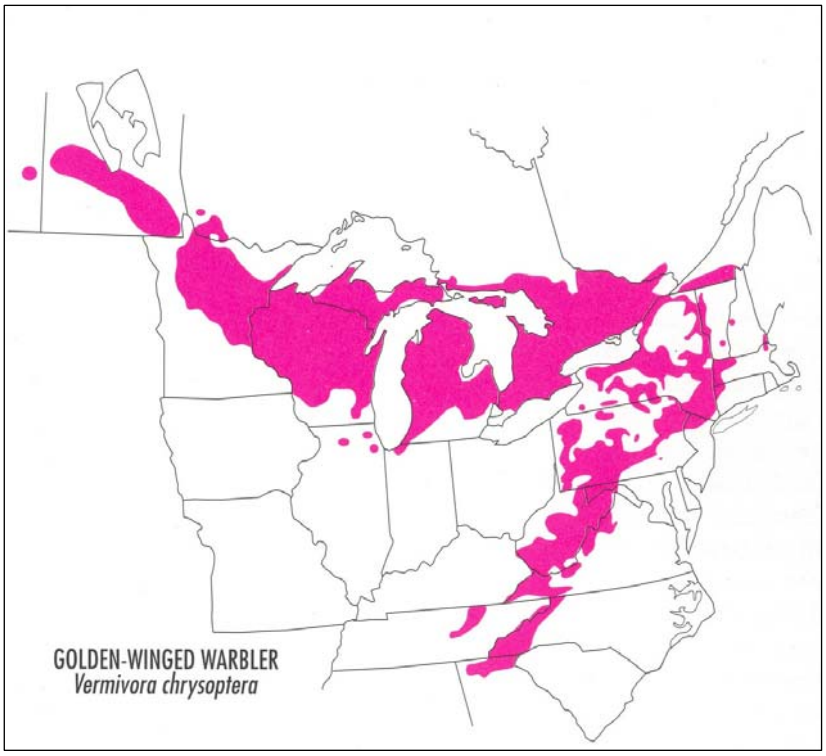

Figure 2. Breeding range of the Golden-winged Warbler (Dunn and Garrett 1997).

Wintering Golden-winged Warblers are found in areas of Central America (Guatemala, Honduras, Nicaragua, Costa Rica and Panama; Figure 3). They appear to be found in quantity in northern South America (Colombia, Venezuela), and in southern

Central America, with smaller numbers in the Greater Antilles (Cuba) and on some of the Caribbean islands (Hilty 1980; Johnson 1980; Moore 1980; Orejuela *et al.* 1980; Raffaele 1989; Raffaele *et al.* 1998; Ridgely and Gwynne 1989).

Figure 3. Wintering range of the Golden-winged Warbler (Based on Rappole *et al*. 1983 and Ridgely and Tudor 1989).

Canadian range

Ontario - From May to August, Golden-winged Warblers breed from extreme southwestern Ontario north to central Nipissing, southern Sudbury and Algoma districts as well as in southwestern Rainy River District near Lake of the Woods. Data from Breeding Bird Surveys indicate Ontario supports 18.2% of the global population of this species, which in turn represents 98.4% of the Canadian population (P. Blancher, pers. comm.; Sauer *et al*. 2005).

Manitoba - In Manitoba the species is found in a narrow band along the prairie-forest transition from the southeastern-most reaches of the province near Winnipeg northwestward to the Saskatchewan-Manitoba border (K. De Smet, pers. comm.). Breeding Bird Survey data suggest that populations in these areas remain small (e.g. a mere 0.1% of the global population; P. Blancher, pers. comm.; Sauer *et al*. 2005) but recent surveys in the Duck Mountain area suggest this region alone contains between 100 and 300 pairs (L.P. Canada Ltd. Swanvalley and R. Berger 2004). Furthermore, the eastern slopes and top of Duck Mountain remain unsampled and if included, the population of Golden-winged Warblers in this area may be as high as several thousand (L.P. Canada Ltd. Swanvalley and R. Berger 2004). These estimates do not include birds found in Porcupine Hills where Golden-winged Warblers have also been reported (Cumming 1998).

Golden-winged Warblers also breed in Riding Mountain National Park and the Mount Agassiz Ski area west of McCreary. Given that the Manitoba population has been deemed genetically pure (based on mitochondrial DNA analyses, Shapiro *et al*. 2004 and nuclear DNA analyses, R. Fraser unpub. data) and currently remain allopatric to Blue-winged Warblers (Manitoba Avian Research Committee; Museum of Manitoba), these areas should be key for conservation initiatives.

Québec – After moving northward to New England and Ontario, Golden-winged Warblers became established in extreme southern Québec in the early 1970s. While never very abundant, numbers were thought to peak in the late-1980s to early-1990s (N = 19 territorial males in one location) after which time numbers started to decrease; in 2001 the species was only found in 9 locations in the province (Gauthier and Aubry 1996; Environment Canada – CWS Québec Region)

To date Golden-winged Warblers have been reported on five Breeding Bird Survey routes in southern Québec (Sauer *et al.* 2005) and have been recorded in 31 of 2,464 blocks (1.3%) in an atlas project completed in the 1990s (Gauthier and Aubry 1996). Québec currently supports 0.2% of the global population of Golden-winged Warblers (P. Blancher, pers. comm.; Sauer *et al*. 2005).

Saskatchewan – The Saskatchewan Conservation Data Centre report 11 cases of Golden-winged Warblers in Saskatchewan (two from Saskatoon, three from Regina and the remaining six from the east side of the province) to date, and as such it is considered an accidental bird in the province (J. Keith, pers. comm.; Saskatchewan Bird Atlas Project; Smith 1996; J. Pepper, pers. comm.). The first record was from 1962 and they have appeared sporadically since that time with the latest record in 1999 (Saskatchewan Bird Atlas Project). No Golden-winged Warblers have been reported on Breeding Bird Surveys.

One case of breeding has been confirmed in the province and there are several reports of probable breeding in the far southeast of the province (Smith 1996; Saskatchewan Bird Atlas Project). The most recent records come from Duck Mountain near the Saskatchewan-Manitoba border.

HABITAT

Habitat requirements

a) Breeding grounds

Golden-winged Warblers aggressively defend all purpose territories from neighbouring conspecifics. The average territory ranges in size from 1-2 hectares and is considered large relative to that of other warbler species. Golden-winged Warblers tend to nest in loose aggregations or “colonies” that typically contain up to ten pairs of breeding birds (Confer and Knapp 1981; R. Fraser, unpub. data). Generally, areas that are logged, burned, and intermittently farmed can readily support the species.

Territories tend to contain patches of herbs and low shrubs (used for nests which are placed on the ground) and scattered trees plus a forested edge used for song posts and foraging (Frech and Confer 1987). Examples of some preferred habitat areas include hydro/utility right-of-ways, field edges, recently logged areas and beaver marshes. On the Canadian Shield alder bogs are often used, especially when there are some tall tree species present including Black Ash (*Fraxinus nigra*; Mills 1987).

The Golden-winged Warbler is a habitat specialist given its reliance on areas of early successional scrub (10-30 years into succession); they will not persist in an area when the stage of succession has exceeded their requirements (Confer and Knapp 1981; Confer and Larkin 1998). Territories in the earliest stages of succession, with high herb cover, support larger clutches than areas with higher tree and shrub cover (Confer *et al*. 2003)

b) Migration

Very little is known about Golden-winged Warbler habitat use while on migration; they appear to use various open woodland habitats, pine-oak, and scrub, often in foothill regions (NatureServe 2004) likely due to their reliance on insectivorous food items such as Lepidopteran larvae.

c) Wintering grounds

Golden-winged Warblers have been observed in mixed species flocks of Neotropical passerines on the wintering grounds in Costa Rica (Buehler *et al.* 2003), in Panama (Moore 1980) and in Colombia (Johnson 1980). These flocks require areas of open woodland and can be found in evergreen and semi-deciduous forests (Stiles *et al.* 1991). Golden-winged Warblers are rarely found in mixed-species flocks with conspecifics or Blue-winged Warblers (with generally only one Golden-winged Warbler observed in such mixed-species flocks; Moore 1980; Tramer and Kemp 1980).

The species has been observed at high elevations (1,500-3,000 m) while on the wintering grounds in various types of open woodland habitats, pine-oak and scrub (Hilty *et al.* 1985; Raffaele *et al.* 1998; Ridgely and Gwynne, Jr. 1989; Stiles *et al.* 1991; Stotz *et al.* 1996). Exceptions to this were observed by Keast (1980) who defined Blue-winged and Golden-winged Warblers as lowland dwellers, but contrastingly, also found Golden-winged Warblers at 1,000-3,000 m in Venezuela, and also in the Chiriqui highland rainforest in Panama. Within the preferred habitat types, the species is found along edges, primarily in the canopy (Stiles *et al.* 1991).

Habitat trends

Of the 29 avian species that have showed significant population declines between 1980 and 2000 (Breeding Bird Survey data - Sauer *et al*. 2005), 90% of these use disturbance-generated ecosystems. Such ecosystems can be broadly defined as consisting of open fields, shrublands, mid-successional forests, open parkland and forest edges (Confer and Pascoe 2003).

Before the arrival of Europeans scrubby habitat was created when native North Americans employed slash-and-burn agriculture (Askins 2000). After European arrival scrubland habitat likely declined due to intensive grazing and farming. However, beginning in the 1840s upwards of tens of millions of acres of farmland was abandoned once again creating areas of suitable habitat. Much of this land has now passed

through old-field-succession and has become reforested (Askins 1993, 2000; Confer and Pascoe 2003) leading to an overall decrease in the availability of this habitat type in eastern North America (Confer and Pascoe 2003; Dettmers 2003; Gill 2004). In addition, given extensive human development, restoration of historical habitat types is not possible in many areas. Active management of disturbance-generated habitats is crucial for the survival of numerous bird species in North America, including the Golden-winged Warbler (Askins 1993; Confer and Pascoe 2003).

Habitat protection/ownership

Given their reliance on early successional scrub this species is often found on land that is privately owned. General estimates on the proportion of breeding Golden-winged Warblers found on public *vs.* private lands throughout Canada are unavailable.

Areas of protection in Canada include some privately owned land, parks owned by Parks Canada as well as by the Ontario Ministry of Natural Resources and the National Capital Commission (Gatineau). Data from Parks Canada show that Golden-winged Warblers have been seen in five national parks in Ontario: Bruce Peninsula/Fathom Five, Georgian Bay Islands, Point Pelee, St. Lawrence Islands and Pukaskwa (but does not breed at Point Pelee or Pukaskwa) as well as in Riding Mountain National Park in Manitoba (P. Achuff, pers. comm.). At least one university in Ontario (i.e. Queen's University; R.J. Robertson, pers. comm.) also protects and maintains large tracts of land used by this species.

BIOLOGY

Life cycle and reproduction

Breeding pairs raise only one brood per year with an average clutch size of 4.75 (range 2 – 6) in Ontario. Clutch sizes of subsequent broods (i.e. renests that occur after a failed nesting event) often decrease with two eggs being the minimum observed in a third nesting attempt within one breeding season. Double brooding has not been reported in this species. Birds often breed at one year of age and can continue to reproduce up to nine years of age. Average generation time for this species is two to three years (R. Fraser, unpub. data). Pairs are socially monogamous but exhibit high rates of extra-pair paternity (i.e. social fathers are not genetic fathers 33% of the time; Fraser *et al*., under review)

In a sample of 103 nests found in Ontario between 2001 and 2004, 55.3% (N=57) of nests successfully fledged at least one offspring, 37.9% (N=39) were depredated, and 6.8% (N=7) were abandoned. Of 435 nestlings in these nests, 256 (58.85%) fledged, while 176 (40.46%) were depredated. Average fledging success was 2.49 nestlings per breeding pair in this population (R. Fraser, unpub. data), which is similar to success rates from New York (2.3 per breeding pair; Confer *et al.* 2003) but lower than reported fledgling success rates from other regions (e.g. 3.7 per breeding pair in

Tennessee; Klaus and Buehler 2001). Nests can be abandoned due to flooding, partial predation, Brown-headed Cowbird parasitism and death of the female (R. Fraser, unpub. data).

Birds are known to be strictly insectivorous during the breeding season. Diet consists mainly of tortricid moths and their larvae (Confer 1992). Other moths and their pupae, other winged insects, spiders and spider egg sacks are also sometimes consumed (R. Fraser, unpub. data). Similar feeding habits are also seen on the wintering grounds.

Predation

Eggs and nestlings of this species are vulnerable to a suite of predators including (in a breeding population in Ontario) the Raccoon (*Procyon lotor*), Red Fox (*Vulpes vulpes*), Coyote (*Canis latrans*), Short-tailed Weasel (*Mustela erminea*), Mink (*Mustela vison*), Red Squirrel (*Tamiasciurus hudsonicus*), Eastern Gray Squirrel (*Sciurus carolinensis*), Eastern Chipmunk (*Tamias striatus*), Fisher (*Martes pennanti*), Striped Skunk (*Mephitis mephitis*), White-footed Mouse (*Peromyscus leucopus*), Deer Mouse (*P. maniculatus*), Meadow Vole (*Microtus pennsylvanicus*), Woodland Jumping Mouse (*Napaeozapus insignis*), Common Garter Snake (*Thamnophis sirtalis*), Eastern Ribbon Snake (*Thamnophis sauritus*), Eastern Ratsnake (*Elaphe o. obsoleta*), Blue Jay (*Cyanocitta cristata*), American Crow (*Corvus brachyrhynchos*; Demmons, unpub. data) and American Toad (*Bufo americanus;* R. Fraser, unpub. data).

Adult birds likely face a less diverse group of predators, although incubating and brooding females have been taken from the nest site (R. Fraser, unpub. data).

Dispersal/migration

Spring migration in Ontario peaks around mid-May, with males typically arriving in areas of northern New York and southern Ontario in the first few days of May and females arriving one to two weeks later. Birds are assumed to have left the tropics by mid-April (Confer 1992). Fall migration peaks in late-August and early-September in areas of southern Ontario and New York (Confer 1992).

Little is known about dispersal movements in this species, although this is currently under investigation (K. Fraser, unpub. data). Mark and recapture studies indicate that some (4.3%) offspring return to their natal area (N=16/368 nestlings banded between 2001 and 2003 in Ontario) and may breed as close as 500m from the nest site where they were born (R. Fraser, unpub. data). Of these 16 nestling returns, 11 were male while five were female.

Adults show strong site-fidelity and exhibit high return rates (64-88% of adult males and 35-53% of adult females) to the same breeding location in subsequent years (R. Fraser, unpub. data). Both males and females have been documented as inhabiting the same breeding territory for seven years (R. Fraser, unpub. data). Return rates in

some areas of the United States are much lower (e.g. 16% in West Virginia; R. Canterbury, pers. comm.) suggesting that patterns of high return rates are not to be interpreted as being a range wide phenomenon and are likely attributable a variety of factors such as changes to the breeding habitat and/or to the surrounding landscape.

Interspecific interactions

Hybridization with Blue-winged Warblers - Overview

One of the key factors implicated in Golden-winged Warbler decline is hybridization with the Blue-winged Warbler. While traditionally breeding in allopatry after glaciers receded, these sister species were brought into geographic contact in the 1800s when clearing of the land facilitated the movement of Blue-winged Warblers into the Golden-winged Warbler breeding range in the northeastern United States (Gill 1980). Therefore, hybridization between these two superspecies is a relatively recent phenomenon exacerbated by anthropogenic disturbances to the landscape (Mayr and Short 1970; Gill 1980). The current hybrid zone extends from the eastern reaches of the species' range through to Minnesota, and is rapidly moving northward (Figure 4).

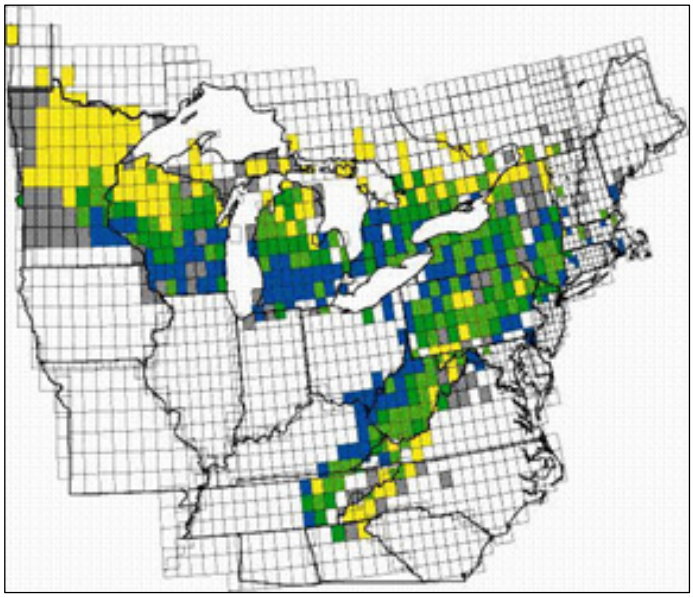

Figure 4. Hybrid index indicating remaining areas of allopatry and areas of contact. Golden-winged Warbler in yellow, Blue-winged Warbler in blue, hybrid zone in green (Data courtesy of K. Rosenberg, GOWAP, Cornell Lab of Ornithology).

In areas of sympatry, hybridization occurs with great frequency and has been seen in all areas of contact (e.g. Gill 1980; Confer 1992). Hybridization tends to negatively affect the Golden-winged Warbler with local extirpation occurring within 50 years of Blue-winged Warbler arrival being the norm (Gill 1997), although replacement can occur within as few as four or five years (Gill 2004). Advancing Blue-winged Warbler females apparently lead the introgression causing an asymmetric and apparently rapid

introgression of Blue-winged Warbler DNA into Golden-winged Warbler populations (Gill 1997). These results suggest that Blue-winged Warblers have a genetic advantage over Golden-winged Warblers and this may explain the replacement of Golden-winged Warblers by Blue-winged Warblers in areas of contact.

Recent genetic analyses, however, indicate that there is bidirectional gene flow in at least five currently mixed populations (Michigan, Ohio, West Virginia, New York and Ontario) suggesting that Blue-winged Warblers do not genetically swamp Golden-winged Warblers in all areas of contact (Shapiro *et al*., 2004; Dabrowski *et al*., in press). These results are important because they suggest that patterns of mitochondrial introgression that vary by site may be related to differences in geographic variables, in local population sizes, as well as subtle between-species differences in mate-choice and habitat preferences.

Further work examining habitat use and genetic analyses are needed from sympatric and allopatric populations of these species throughout the entire breeding range to elucidate the true impact of hybridization on populations of Golden-winged Warblers.

Hybrid phenotypes

When Blue-winged and Golden-winged Warblers interbreed they tend to produce one of two phenotypes assigned the names "Brewster's Warbler" ("*V. leuchobronchialis*") and "Lawrence's Warbler" ("*V. lawrencei*"), although exceptions are sometimes observed. The "Brewster's Warbler" exhibits plumage characteristic of a Golden-winged Warbler with a yellow wing patch and white underparts (although some have speculated that a first generation "Brewster's Warbler" may exhibit yellow underparts; Parkes 1951), but they lack the striking black throat and eye patch (Figure 5). The "Lawrence's Warbler" looks mostly like a Blue-winged Warbler with yellow underparts and white wing bars. However, the "Lawrence's Warbler" exhibits the throat and eye patch characteristic of the Golden-winged Warbler (Figure 5), likely representing a combination of recessive characters (Parkes 1951).

Figure 5. Male "Lawrence's Warbler" (left) and a male "Brewster's Warbler" (right). (Photos by Rachel Fraser).

Later generations of hybrids may show only subtle signs of introgression and may be classified as one of the parental species without close (i.e. in-the-hand) examination (Short 1963, 1969). Furthermore, both hybrid phenotypes sing one of the two parental song types, and very rarely a combination of them both (Ficken and Ficken 1968; Gill and Murray 1972). The latter two factors could have pronounced implications for the use of surveys to identify/locate Golden-winged Warblers.

Some studies have suggested that hybrids are at a mating disadvantage and therefore may have overall lower fitness than do the parental species (Confer and Tupper 2000; Confer and Barker 2002). Recent quantitative analyses of reproductive success, however, show that hybrids are not at a disadvantage and in fact hybrid fitness and extra-pair fertilizations are likely playing a major role in the ongoing hybridization between Blue-winged and Golden-winged Warblers (Fraser *et al*. under review; Gill 2004).

Genetic distinctiveness

Prior to the publication of results from genetic analyses it was suggested that Blue-winged and Golden-winged Warblers had a common ancestry that occurred during the recent glacial maxima at approximately 20,000 years before present (e.g., Short 1963). As such, and given the existence of extensive hybridization in many areas, some researchers suggested that Blue-winged and Golden-winged Warblers should be considered conspecific (Mayr and Short 1970).

However, Gill (1997) reported that the nucleotide divergence between these 2 species was estimated to be 3.2% based on RFLP analyses. This suggests these lineages are substantially older and more differentiated than was previously suggested (Short 1963; Shapiro *et al.* 2004). Later work by Dabrowski *et al.* (in press) and Shapiro *et al.* (2004) determined the level of mtDNA sequence divergence to be approximately 4.5%. This level of divergence between ancestral Blue-winged and ancestral Golden-winged Warbler haplotypes is several orders of magnitude greater than expected if these lineages split near the Pleistocene-Holocene boundary. In comparison with other passerine genera the level of nucleotide divergence between the ancestral Blue-winged and ancestral Golden-winged haplotype groups is equivalent to the separation of many other pairs of taxa that comprise clear biological species (reviewed in Johnson and Cicero 2004).

Regions of allopatry

Currently allopatric populations of Golden-winged Warblers only occur in the most extreme northern reaches of the breeding range, as well as at its highest nesting elevations in the Appalachian Mountains (Confer and Knapp 1981; Figure 4). Genetic purity of these populations has not yet been established, but is currently under investigation (R. Fraser, unpub. data). Even populations that were thought to be “safe havens” are now showing evidence of hybrid or Blue-winged Warbler arrival. For example, a previously allopatric population of Golden-winged Warblers in Ontario saw

the first arrival of hybrids and Blue-winged Warblers in the late 1980s. By 2004 17% of the breeding population was made up of hybrid phenotypes (Blue-winged Warbler occurrence remains low at <1%; R. Fraser, unpub, data). In addition, there have already been five reports of Blue-winged Warblers and one hybrid from Saskatchewan (Saskatchewan Bird Atlas Project; J. Keith, pers. comm.), while Manitoba reports only one hybrid sighting to date (a female “Brewster’s Warbler” in 1932; Manitoba Museum - MARC record #2963). One male Blue-winged Warbler was sighted in Manitoba (Manitoba Avian Research Committee; Manitoba Museum); however, this observation took place during the fall and therefore likely represents a disoriented hatch year bird and is not indicative of Blue-winged Warblers expanding their range into Manitoba (K. Hobson, pers. comm.).

If Blue-winged Warbler breeding range advances continue, currently allopatric populations of Golden-winged Warblers can be expected to come into contact with Blue-winged Warblers in the near future making extirpation via hybridization and competition more likely, but not a certainty, as the Sterling Forest site in New York demonstrates.

Adaptability

Currently there are no studies on the adaptability of this species directly. Because of the ephemeral nature of early successional scrub environments this species uses on the breeding ground, it presumably deals well with reestablishment of breeding populations in suitable habitat (NatureServe 2004) when others have grown to a stage where they are no longer of use. Indeed, the species has been known to move into areas that have been recently logged, or burned, and they readily move into areas that are intermittently farmed (Klaus and Buehler 2001). Edge creation experiments carried out since 1997 near Elgin, Ontario have documented that the species will move into an area of suitable habitat within three years of its creation (R. Fraser, unpub. data).

POPULATION SIZES AND TRENDS

Search effort

Researchers at the Cornell Lab of Ornithology in Ithaca, New York are carrying out a Golden-winged Warbler Atlas Project (GOWAP) that aims to determine the range of acceptable habitats and area requirements (if any) of Golden-winged Warblers, especially in relation to natural *vs.* human-created habitat types; map the frequency of hybridization with Blue-winged Warblers throughout the range of Golden-winged Warblers; and define the parameters that constitute a “safe haven” site for Golden-winged Warblers in the regions of coexistence with Blue-winged Warblers

The Breeding Bird Survey (BBS) has approximately 4,400 active routes throughout Canada and the United States with roughly 2,900 routes being surveyed annually. Each route is 39.2 km long with 3-minute point counts every 0.8 km (Sauer *et al*. 2005). BBS

data represent the most comprehensive data set in North America for analysis of bird population trends.

The entire Golden-winged Warbler breeding range falls within the BBS coverage area. However, several caveats in using these data should be acknowledged: 1) in areas of hybridization between Blue-winged and Golden-winged Warblers, hybrids and phenotypic Blue-winged Warblers may also sing the Golden-winged Warbler song and visual confirmation is not required (Sauer *et al*. 2005); 2) later generation hybrids often show only subtle signs of introgression meaning that their classification would be, incorrectly, to the parental species; and 3) BBS routes are limited to areas with roads and experienced observers, leading to inadequate sampling of the species in some areas.

The Ontario Breeding Bird Atlas (OBBA) also conducts surveys to determine prevalence of Golden-winged Warblers in the province, using coverage of 10-km squares as well as random point counts. Data currently available from the second OBBA come from a search effort about 85% of that of the first atlas so comparisons made between the two should accurately reflect changes in abundance of the Golden-winged Warbler (M. Cadman, pers. comm.). However, the first OBBA (1981-1985) treated the Golden-winged/Blue-winged Warbler complex differently than the second (2001-2005). As with the BBS, “heard only” records were used for the first atlas, while now only records that actually involve a sighting of the singing bird are included. This makes comparisons between the two atlases more difficult (M. Cadman, pers. comm.) although the data are likely still indicative of population trends.

Abundance

Estimates of population size are “best guesses” and are based primarily on BBS data which have limitations (discussed above) – actual numbers of Golden-winged Warblers in Canada are yet to be confirmed and this can only be accomplished by intensive surveys in a wide variety of terrains and locations.

The global population size is estimated at 105,000 to 270,000 breeding pairs (K. Rosenberg, pers. comm.; Partners in Flight (PIF) data; Sauer *et al.* 2005). Forty percent of the population is thought to breed in Minnesota, with 69% of all the birds being found in Minnesota, Michigan and Wisconsin. Canada currently supports an estimated 18.5% of the breeding population (N = 19,425 - 49, 950), with 18.2% of the global population being found in Ontario (N = 19,110 - 49,140; P. Blancher, pers. comm.; BBS data, Sauer *et al*. 2005).

Fluctuations and trends

Declines have been taking place for over 30 years (Gill 1997; Sauer *et al.* 2005) with the current rate of decline being estimated at 3.4%/year (P = 0.00001, 241 routes) in the United States, with declines as steep as 8.5% /year (P = 0.000, 127 routes) being seen in USFWS Region 5 (see Table 2 for list of States; Sauer *et al*. 2005). The species

is currently experiencing an overall (i.e. U.S. and Canada combined) decline of 2.4%/year (P = 0.001, 271 routes), making the Golden-winged Warbler one of the most vulnerable and steeply declining of all North American passerines.

In Canada, BBS data between 1968 and 2002 indicate a significant annual increase of 8.9% ($p < .05$, 47 routes), but there has been a dramatic 79% decrease in the last ten years (-14.4%/year, $P < .05$, 37 routes, 1993-2002; CWS 2005).

An Ontario Breeding Bird Atlas is currently in the final year of data collection (i.e. 2005) which will provide an up-to-date picture of what the trends are for this species in Ontario. In the first Ontario BBA (1981-1985) Golden-winged Warblers were located in 469 10-km squares, whereas data collected for the second atlas thus far (2001-2004) reports them in 278 squares. Their range has thought to have contracted in 200 squares (i.e. were found in these squares in the first atlas, but were not located in the same squares during the second atlas), and has expanded in 118 squares. There is an overlap between the first and second atlases in 160 squares (34%).

In contrast, the Blue-winged Warbler occurred in 139 squares in the first atlas, and has been recorded in 196 squares in the second atlas thus far. In addition, while the Blue-winged Warbler has contracted its range in 47 squares, it has expanded in 123 squares. These data suggest that Golden-winged Warblers are decreasing in many areas of Ontario, while Blue-winged Warblers and their hybrids are increasing (BBA data supplied by M. Cadman, pers. comm.).

Banding data from the Long Point Bird Observatory (LPBO, Port Rowan, ON) show that the number of captured Golden-winged Warblers increased until the mid-1980s then decreased (Table 1). The number of Blue-winged Warblers banded at LPBO has also been increasing over the past thirty years, and at a much greater rate than Golden-winged Warblers. Indeed, there has been a change in the ratio of Golden-winged Warblers to Blue-winged Warblers from 2.4:1 to 0.14:1 over a period of thirty years (LPBO data; J. McCracken, pers. comm.; Table 1).

Table 1. Banding data from Long Point Bird Observatory (LPBO) for Golden-winged (GWWA) and Blue-winged Warblers (BWWA) from 1960-2004 (LPBO data provided by J.D. McCracken).

9-year period	Number Banded		Ratio
	GWWA	BWWA	(GWWA:BWWA)
1960-1968	12	5	2.4:1
1969-1977	12	8	1.5:1
1978-1986	35	65	0.54:1
1987-1995	61	182	0.34:1
1996-2004	25	173	0.14:1

In summary, Golden-winged Warbler numbers are declining overall. Declines are less pronounced in Canada than they are in the U.S., but the rate of decline is now increasing in many areas of the country, especially in Ontario. Some areas may still be experiencing increases associated with their range expansion (e.g. Saskatchewan and Manitoba) but this is not necessarily indicative of them having greater success in these areas than in others and is likely associated with, at least in part, their allopatric status.

Rescue effect

The ongoing range expansion of Golden-winged Warblers into Canada means that populations will likely continue to increase in some areas. However, whether these populations can sustain the species in Canada will depend on both habitat availability and arrival of Blue-winged Warblers. The Golden-winged Warbler may persist in refugia at higher elevations and latitudes, and perhaps in swamps where contact with Blue-winged Warblers is limited (Gill 2004).

LIMITING FACTORS AND THREATS

Golden-winged Warbler declines are likely due to three main pressures they face while on the breeding grounds: a decrease in early successional scrub environments required for breeding, hybridization with the Blue-winged Warbler and perhaps Brown-headed Cowbird parasitism.

Of these three threats, loss of breeding habitat and hybridization with Blue-winged Warblers are the most significant contributors to Golden-winged Warbler declines. However, further research is needed to elucidate the impacts of these threats in concert, or to determine which one is having a more pronounced impact on Golden-winged Warbler populations in Canada.

a) Habitat loss

Due to their reliance on anthropogenic disturbances (e.g. logging, hydro right-of-ways, and abandoned farmland) the Golden-winged Warbler is vulnerable to local extirpation throughout the breeding range. Declines occur with advancing succession and reforestation (Confer 1992) and a general loss of early successional scrub habitat in eastern North America (Confer and Pascoe 2003; Dettmers 2003). As such, it is likely that habitat loss is playing a major role in Golden-winged Warbler declines throughout the breeding range. This is further supported from across-species data showing that the majority of avian species undergoing population declines in North America depend on disturbance-generated ecosystems (Confer and Pascoe 2003; Sauer *et al*. 2005).

However, habitat limitations cannot be solely responsible for Golden-winged Warbler declines as they sometimes are extirpated from areas where suitable habitat remains, but only when sympatric with Blue-winged Warblers, suggesting that interactions between these species are also playing a role in declines (J. Confer, pers. comm.)

b) Hybridization with Blue-winged Warblers

As detailed above (see Interspecific Interactions), hybridization between Blue-winged and Golden-winged Warblers is ongoing and widespread, and replacement of Golden-winged Warblers after 50 years of Blue-winged Warbler arrival is the norm (Gill 1997). Only one region of sympatry has persisted for more than 100 years and reasons for this coexistence are unknown (J. Confer, pers. comm.; Confer 2000).

At present there is no clear genetic reason why Blue-winged Warblers are causing the regional extirpation of Golden-winged Warblers whenever the two species come into contact. However, with the movement of Blue-winged Warblers into currently allopatric populations of Golden-winged Warblers further declines are expected.

c) Parasitism by Brown-headed Cowbirds

Brown-headed Cowbird parasitism is playing a role in population declines of Golden-winged Warblers in some areas of the United States. Up to 30% of all nests in some regions of New York State are parasitized, decreasing the number of fledged Golden-winged Warblers by 17%; Confer *et al.* 2003). The rate of parasitism varies greatly across the Golden-winged Warbler's geographic range. While territories located in areas of high herb cover are able to support larger clutch sizes, these areas are also more susceptible to cowbird parasitism (Confer *et al*. 2003).

Parasitism does not appear to be a major factor in at least one population in Ontario (3.8% of nests parasitized; R. Fraser, unpub. data) but data from other areas in Canada are lacking and the true impact of Brown-headed Cowbird parasitism in Canada is unknown.

SPECIAL SIGNIFICANCE OF THE SPECIES

While the Golden-winged Warbler cannot be defined as a keystone species it is a species symbolic of the availability of early successional scrub areas. Protection of this important habitat type will also have positive impacts on other declining species that use these areas.

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

The Golden-winged Warbler is protected under the Migratory Bird Treaty Act of 1918 which prevents direct take of birds, their nests and the contents. They are currently under status assessment in the United States to determine whether they warrant protection under the U.S. Endangered Species Act, but are not listed federally at this time (Buehler *et al*. 2003). However, in the United States they are listed as Endangered in 3 states, as a Species of Special Concern in 5 states, as Rare or Threatened in 4 states, and In Need of Management in 1 state (Table 2).

Table 2. State summaries of legal status of Golden-winged Warbler; it is unlisted in states not shown. Adapted from U.S. Golden-winged Warbler draft status assessment (Buehler *et al*., 2003).

REGION	STATE	DESIGNATION
USFWS Region 3	Indiana	State Endangered
	Ohio	State Endangered
	Wisconsin	Special Concern
USFWS Region 4	Georgia	Special Concern
	Kentucky	State Threatened
	North Carolina	Significantly Rare
	Tennessee	In need of management
USFWS Region 5	Connecticut	Special Concern
	Maryland	Rare Species
	Massachusetts	Endangered Species
	New Jersey	Special Concern
	New York	Special Concern
	Vermont	Rare Species

The Golden-winged Warbler currently has provincial or territorial listing only in Québec, where it is considered “Likely to be designated as threatened or vulnerable”. NatureServe (2004) gives the species a global rank of G4 – apparently secure, uncommon but not rare. NatureServe ranks by state and province are listed in Table 3.

Table 3. NatureServe ranks for the Golden-winged Warbler in the United States and Canada, by state/province. (Adapted from NatureServe Explorer 2004).

State/Province	State Rank (season)
Manitoba	3 (breeding)
Ontario	4 (breeding)
Québec	3 (breeding)
Arkansas	2 (non-breeding)
Connecticut	2 (breeding)
District of Columbia	3 (non-breeding)
Georgia	2
Illinois	1-2
Indiana	1 (breeding)
Iowa	1 (non-breeding)
Kentucky	2 (breeding)
Maryland	3 (breeding)
Massachusetts	1
Michigan	5
Minnesota	NR (breeding)
Nebraska	NR (non-breeding)
New Hampshire	2 (breeding)

State/Province	State Rank (season)
New Jersey	3 (breeding)
New Mexico	1 (non-breeding)
New York	4
North Carolina	3 (breeding)
North Dakota	3
Ohio	1
Oklahoma	NR (non-breeding)
Pennsylvania	4 (breeding)
Rhode Island	X (breeding)
	2 (non-breeding)
Tennessee	3 (breeding)
Texas	3
Vermont	2-3 (breeding)
Virginia	3 (breeding)
West Virginia	3 (breeding)
	3 (non-breeding)
Wisconsin	4

1=Critically imperiled because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state or province, 2=Imperiled because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation, 3=Vulnerable due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation, 4=Uncommon but not rare; some cause for long-term concern due to declines or other factors, 5=Common, widespread, and abundant, NR=unranked, X=extirpated; states where ranked as NA (Not applicable because not suitable for conservation activities) are not listed.

TECHNICAL SUMMARY

Vermivora chrysoptera
Golden-winged Warbler Paruline à ailes dorées
Range of Occurrence in Canada: Manitoba, Ontario, Québec

Extent and Area Information	
• Extent of occurrence (EO)(km²) **BBS data – area of land covered, where species found.**	Ca. 475,000 km²
• Specify trend in EO	Increasing?
• Are there extreme fluctuations in EO?	No.
• Area of occupancy (AO) (km²) **PIF estimates of breeding pairs in Canada multiplied by maximum territory size of 2 hectares per pair.**	Ca. 200-500 km²
• Specify trend in AO	Possibly decreasing.
• Are there extreme fluctuations in AO?	No.
• Number of known or inferred current locations	Not applicable
• Specify trend in #	Not applicable
• Are there extreme fluctuations in number of locations?	No.
• Specify trend in area, extent or quality of habitat	Likely decreasing.
Population Information	
• Generation time (average age of parents in the population)	2 – 3 years
• Number of mature individuals	20,000-50,000
• Total population trend:	Declining
• % decline over the last/next 10 years or 3 generations. BBS data 1993-2002, annual decline of 14.4%	Ca. 79% over 10 years
• Are there extreme fluctuations in number of mature individuals?	No.
• Is the total population severely fragmented?	No.
• Specify trend in number of populations	Not applicable
• Are there extreme fluctuations in number of populations?	Not applicable
• List populations with number of mature individuals in each:	
Threats (actual or imminent threats to populations or habitats)	
Threats to the species are still unresolved but likely include: - hybridization with Blue-winged Warblers (V. pinus) - habitat loss on the breeding and wintering grounds - parasitism by Brown-headed Cowbirds (*Molothrus ater*)	
Rescue Effect (immigration from an outside source)	
• Status of outside population(s)? • USA – Large but declining.	
• Is immigration known or possible?	Likely
• Would immigrants be adapted to survive in Canada?	Yes
• Is there sufficient habitat for immigrants in Canada?	Yes
• Is rescue from outside populations likely?	Unknown
Quantitative Analysis	None available
Current Status COSEWIC: Threatened (2006)	

Status and Reasons for Designation

Status: Threatened	**Alpha-numeric code**: Met criterion for Endangered, A2be, but designated Threatened because the species is still widespread, shows the ability to maintain small pure populations within the Blue-winged Warbler range, is still expanding in Manitoba, and is thus not in imminent danger of extinction. Criterion met for Threatened: A2be.

Reasons for Designation:

This small songbird has declined by 79% over the last 10 years according to Breeding Bird Survey data from Canada. The main threat appears to be competition and genetic swamping (hybridization) from the closely related Blue-winged Warbler, which is spreading north because of habitat change and perhaps climate change.

Applicability of Criteria

Criterion A: (Declining Total Population): Met Endangered A2be, through Breeding Bird Survey results, which indicate a 79% decline between 1993 and 2002.

Criterion B: (Small Distribution, and Decline or Fluctuation): not applicable

Criterion C: (Small Total Population Size and Decline): not applicable

Criterion D: (Very Small Population or Restricted Distribution): not applicable

Criterion E: (Quantitative Analysis): not available.

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BIOGRAPHICAL SUMMARY OF REPORT WRITER

Rachel Vallender-Fraser recently completed her Ph.D. at Queen's University under the supervision of Dr. Raleigh J. Robertson. Rachel began studying the breeding behaviour of Golden-winged Warblers in September 2000 for her Master's thesis. She successfully defended this work and began her Ph.D. in April 2002. The title of her dissertation is "Examining avian hybridization using genetic markers: dynamics of mate choice, disease and rapid introgression." During the course of her Ph.D., Rachel formed the Golden-winged Warbler Working Group that brought together more than 25 researchers from Canada and the U.S. in order to share research ideas and facilitate discussion on the conservation of this species. The group held a Golden-winged Warbler Conservation Workshop in Siren, WI in August 2005. The focus of this workshop was to enact conservation measures in areas that are most at risk, and to share results from recent research conducted throughout the breeding and wintering range of this species.

In addition, at the 122nd annual American Ornithological Union Conference in Québec City in August 2004 Rachel organized and chaired a symposium entitled "The conservation of Golden-winged and Blue-winged Warblers: evolutionary, ecological and behavioural dynamics in hybridizing species". Rachel is starting a post-doc at the Cornell Lab of Ornithology in June 2006 where she will continue her work on Golden-winged Warbler conservation and warbler phylogenetics. Rachel will also continue to work with members of the Golden-winged Warbler Working Group and GOWAP (Cornell) using genetic markers to identify pure populations of Golden-winged Warblers, and to aid in enacting appropriate conservation measures.

COLLECTIONS EXAMINED

None.