Photo: Barbara Frei (Bobolink); Russ Chantler (Eastern Meadowlark)

Bobolink
(Dolichonyx oryzivorus) &

Eastern Meadowlark
(Sturnella magna) in Ontario

Ontario Recovery Strategy Series

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

2013

Natural. Valued. Protected.

Ministry of Natural Resources

Ontario

About the Ontario Recovery Strategy Series

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

What is recovery?

Recovery of species at risk is the process by which the decline of an endangered, threatened, or extirpated species is arrested or reversed, and threats are removed or reduced to improve the likelihood of a species' persistence in the wild.

What is a recovery strategy?

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

Recovery strategies are required to be prepared for endangered and threatened species within one or two years respectively of the species being added to the Species at Risk in Ontario list. There is a transition period of five years (until June 30, 2013) to develop recovery strategies for those species listed as endangered or threatened in the schedules of the ESA. Recovery strategies are required to be prepared for extirpated species only if reintroduction is considered feasible.

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

For more information

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

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DECLARATION

The Ontario Ministry of Natural Resources has led the development of this recovery strategy for the Bobolink and Eastern Meadowlark in accordance with the requirements of the *Endangered Species Act, 2007* (ESA). This recovery strategy has been prepared as advice to the Government of Ontario, other responsible jurisdictions and the many different constituencies that may be involved in recovering the species.

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

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

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this strategy.

RESPONSIBLE JURISDICTIONS

Ontario Ministry of Natural Resources
Environment Canada – Canadian Wildlife Service
Parks Canada Agency

EXECUTIVE SUMMARY

The Bobolink (*Dolichonyx oryzivorus*) and Eastern Meadowlark (*Sturnella magna*) both rely upon grasslands for breeding, have similar breeding distributions in Ontario, often co-occur in the same fields, have similar population trajectories, and face similar threats. Because of these relationships, the two species are represented within a single recovery strategy.

Prior to European settlement in eastern North America, Bobolinks and Eastern Meadowlarks nested in native prairies, savannahs, alvar grasslands, beaver meadows, burned-over areas, and areas cleared for agriculture by First Nations. Although most such habitat was destroyed following European settlement, the two species quickly adopted newly-created surrogate grasslands – primarily pastures and hayfields – as nesting habitat. Indeed, were it not for the creation of these agricultural habitats for livestock, the two species may well have disappeared from large parts of their original range.

Though still common and widespread, the Bobolink and Eastern Meadowlark were recently designated as threatened species in Ontario, primarily as a result of strong population declines that have been occurring in Ontario and across most of their breeding ranges. Population losses in Ontario have been occurring over much of the last half century. Over the most recent 10-year period, it is estimated that the Bobolink population in Ontario has declined by an average annual rate of 4 percent, which corresponds to a cumulative loss of 33 percent. Over the same period, Eastern Meadowlark populations have declined at an average annual rate of 2.9 percent (cumulative loss of 25%).

There are several probable factors responsible for driving population declines in Ontario. Chief among them is loss of breeding habitat, especially pasturelands and hayfields which have either been abandoned outright or have been converted to other crop types. In addition, there have been changes in hayfield composition and management that affect habitat quality (e.g., a decrease in the proportion of grass cover as a result of an increase in the amount of Alfalfa planted, because of its higher nutritional value to livestock). Poor reproductive output is also a primary factor. Nest losses are apt to be unsustainably high in intensively-managed hayfields, when the mowing period overlaps with the peak of the birds' breeding season. All of the foregoing issues are ultimately driven by agri-economic forces affecting the livestock industry in Ontario, particularly dairy and beef cattle.

Habitat loss also figures prominently on the wintering grounds of both species. In winter, the Bobolink faces additional threats in South America, where it may be exposed to direct human persecution and to toxic effects from insecticides used on agricultural rice crops.

Recovery of the Bobolink and Eastern Meadowlark in Ontario poses a significant conservation challenge. The majority of their breeding populations occur on private

lands managed by farmers for the production of agricultural goods and services. Given the well-documented, ongoing decline in the extent of pasture and in cattle numbers, coupled with similar declines in the area of hay dominated by grass, a challenge will be to slow the loss of agricultural grasslands in the face of market forces.

The long-term recovery goal is to maintain stable, self-sustaining populations of Bobolinks and Eastern Meadowlarks in Ontario, and in so doing contribute to the conservation of the guild of grassland birds. In the short term (over the 10-year period from 2013-2023), the goal is to slow the annual rate of population decline for both species to an average of no more than 1 percent per year (i.e., no more than 10% over 10 years). Achieving population stability at roughly 90 percent of the present-day population size is the long-term goal thereafter.

Informed by an adaptive management framework, the goals can be achieved through a suite of targeted protection and recovery objectives, which are to:

- describe priority habitats and regions for conservation, identify key issues and factors that may impede or assist species recovery, and establish the target levels of habitat supply and habitat management regimes that are needed to meet the recovery goal;
- increase public awareness of the two species and their habitat;
- improve nesting productivity and habitat quality;
- increase habitat supply of native grassland;
- maintain existing habitat supply of agricultural grasslands to the extent practicable;
- establish strong links to other conservation planning efforts underway for other grassland species that are of high conservation concern, both in Ontario and in other relevant jurisdictions;
- apply appropriate ESA protection, habitat regulations and any other provincial or federal policies and assess the degree to which they help stabilize populations of the two species; and
- track and report on the state of populations in relation to recovery activities.

It is recommended that the habitat regulation for the Bobolink and Eastern Meadowlark focus on sites that one or both species have recently occupied during the breeding season. This includes open country habitats consisting of natural and semi-natural grassland (including but not limited to tallgrass prairie, alvar grasslands, beaver meadows, and grassy peatlands), hayfields, pastures, grassland habitat restoration sites, and abandoned fields where one or both species have been confirmed to breed or probably bred during the current or previous three years. It is also recommended that the habitat regulation should exclude annual row crops (e.g., winter wheat and rye). It is recommended that regulated habitat be delineated (mapped) on a case-by-case basis using the Ecological Land Classification system.

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1.0 BACKGROUND INFORMATION

1.1 Species Assessment and Classification

COMMON NAME: Bobolink

SCIENTIFIC NAME: *Dolichonyx oryzivorus*

SARO List Classification: Threatened

SARO List History: Threatened (2010)

COSEWIC Assessment History: Threatened (2010)

SARA Schedule 1: No schedule, No status.

CONSERVATION STATUS RANKINGS:
GRANK: G5 NRANK: N5B SRANK: S4B

COMMON NAME: Eastern Meadowlark

SCIENTIFIC NAME: *Sturnella magna*

SARO List Classification: Threatened

SARO List History: Threatened (2011)

COSEWIC Assessment History: Threatened (2011)

SARA Schedule 1: No schedule, No status.

CONSERVATION STATUS RANKINGS:
GRANK: G5 NRANK: N5B SRANK: S4B

The glossary provides definitions for technical terms, including the abbreviations above.

1.2 Species Descriptions

<u>Bobolink</u>
The Bobolink (*Dolichonyx oryzivorus*) is a medium-sized member of the blackbird family (length: 15.2 - 20.5 cm; Martin and Gavin 1995). Bobolinks have short, conical bills. The sexes look different only when in "breeding" plumage in spring and summer (Martin and Gavin 1995). At this time, males are unlikely to be confused with any other species. They have a black bill, head, front parts, undertail-coverts, wing underparts and tail, contrasting sharply with a white rump and scapulars, and a buffy-golden to

yellow patch on the back of the head. Females are quite different, resembling large sparrows, having light pink bills and a mostly buff to brown, somewhat streaked, plumage. Young of the year resemble females, but have an overall deeper, ochre appearance, particularly on the underside. Prior to fall migration, males moult into "non-breeding" plumage, at which point they closely resemble females. They retain this plumage until arrival on the wintering grounds, after which they then moult back into their distinctive breeding plumage before returning to their northern breeding grounds (Renfrew et al. 2011).

In the breeding season, male Bobolinks are conspicuous and vocal. Nesting females are much less conspicuous, and can easily go undetected early in the nesting cycle. Males are frequently found perched on shrubs, tall forbs and fence posts, and are often seen performing their characteristic aerial display flights. Performing males repeatedly flutter up into the air, rising on rapidly-vibrating wings and singing their characteristic bubbly songs, before dropping back down (Martin and Gavin 1995).

<u>Eastern Meadowlark</u>
The Eastern Meadowlark (*Sturnella magna*) is a medium-sized songbird (length: 22-28 cm; Lanyon 1995). It is not a lark, but rather is a member of the blackbird family. The sexes are similar. It has a relatively long, pointed bill, a short tail, and relatively long legs. Its bright yellow underparts are marked with a distinctive black V-pattern on the chest. Its head has a dark crown with a median light stripe and a light line over the eyes. The flanks are dull white with blackish streaks. The back, wings and tail are barred with black and brown. White outer tail feathers are most conspicuous in flight.

The Eastern Meadowlark closely resembles the Western Meadowlark (*Sturnella neglecta*), which occurs mostly west of the Eastern Meadowlark's breeding range. The best way to differentiate the two species is by their distinctive songs (Lanyon 1995). The Eastern Meadowlark's song is a simple, four-syllable, slurred whistle, whereas the Western Meadowlark's is a more musical, gurgled series of whistles that trail off toward the end.

1.3 Species Biology

<u>Reproduction</u>

Bobolink
The Bobolink typically nests in loose groups and exhibits a mixed reproductive strategy forming monogamous and polygynous pair bonds (Martin 1971, Wittenberger 1978, Wootton et al. 1986, Moskwik and O'Connell 2006).

Breeding densities vary regionally and with habitat type and management. Examples of situations that encompass typical breeding habitat include the following: means of 26 territorial males/km^2 (± 19 SE; n = 9) in tallgrass prairie; 33 males/km^2 (± 24 SE; n = 12) in mixed-grass prairie; and 91 males/km^2 (± 70 SE; n = 81) in hayfields (Martin and

Gavin 1995). The ‘highest-quality’ hayfields in New York were capable of supporting a mean density of up to 120 territorial males/km^2 (± 81 SE; n = 45; Bollinger and Gavin 1992). Because of small sample sizes and large margins of error, the above figures demonstrate the range in breeding densities, and do not necessarily reflect actual differences among particular habitat types. Moreover, breeding density can be a poor measure of true habitat “quality” because habitats with large numbers of grassland birds may function as population sinks owing to low reproductive success stemming from high rates of nest predation and/or large losses of nests attributable to hayfield mowing (e.g., Norment et al. 2010).

Territory size also depends on habitat, with smaller territories occurring in ‘high-quality’ (high-density) habitats. Reports of mean territory size range from about 0.4 ha to about 2.0 ha (Wiens 1969, Martin 1971, Wittenberger 1978, Bollinger and Gavin 1992, Lavallée 1998). Older males tend to concentrate in relatively small territories in better quality habitats, while first-year breeders typically hold larger, peripheral territories in lower-quality habitat (Nocera et al. 2009).

Nests are built on the ground, usually at the base of tall forbs (Martin and Gavin 1995). The nest is well hidden and notoriously difficult to find (Bent 1958).

Egg-laying begins within about 10 days after pair formation (Wittenberger 1978, Weir 1989, Martin and Gavin 1995). In Ontario, this usually begins during the last week of May (Frei 2009), though egg-laying has been reported as early as 19 May (Peck and James 1987). In western New York, Norment et al. (2010) reported an average clutch initiation date of 25 May (n = 74). Nest initiation date increases with latitude.

Only one brood is usually produced each year. However, second clutches are attempted if the first nest is destroyed early enough in the breeding season to allow time for fledging before the onset of fall migration (Martin and Gavin 1995, Perlut et al. 2006). This assumes that birds are able to find and resettle into suitable nesting habitat (e.g., presence of unmowed hayfields) in the local region (see Shustack et al. 2010). Preliminary studies suggest that females disperse about 10 to15 km (range = 0.5 – 60 km) from the location of their first nesting attempt (N. Perlut, pers. comm. 2011). However, only about 25 to 30 percent of birds that disperse actually try to renest.

In Ontario, clutch size averages five eggs (Peck and James 1987). Renestings have smaller clutch sizes (four eggs) than first nests (Frei 2009). Eggs are incubated by the female (Martin and Gavin 1995).

Incubation lasts about 12 days and young remain in the nest for 10 to 11 days (Martin and Gavin 1995). For first nest attempts, most eggs start to hatch in mid-June and most young have left the nest by early July. In western New York, Norment et al. (2010) reported an average fledge date of 22 June (range 14 June to 24 July; n = 55) for first clutches. In eastern Ontario and western Quebec, later hatch dates for second nesting attempts ranged from 21 to 30 June, while fledge dates ranged from 1 to 12 July (Frei

2009). After leaving the nest, fledglings are fed by the parents for at least a week (Martin and Gavin 1995), during which time they remain poor fliers.

Nesting success is highly variable, depending on habitat type, predation intensity, weather conditions, and the timing and kinds of agricultural operations (e.g., grazing, haying). Reproductive success is also lower in small habitat fragments than large ones (Kuehl and Clark 2002, Winter et al. 2004). There also appear to be regional differences, with an apparent pattern of higher nesting success occurring in eastern hayfields than in the central prairie region (see Norment et al. 2010). Although sometimes calculated differently among studies and not always strictly comparable, regional examples of nest success rates are as follows: mixed-grass prairies of North Dakota (3.5%, n = 108; Kerns et al. 2010); tallgrass prairies of Minnesota and North Dakota (21.9%, n = 315; Winter et al. 2004); uncut eastern hayfields of Ontario/Quebec (43.0%, n = 53; Frei 2009); and uncut eastern hayfields in New York (48.3%, n = 91; Norment et al. 2010). These regional differences appear to largely stem from differential rates of nest predation, which can sometimes be high (e.g., Kerns et al. 2010).

Eastern Meadowlark

Like the Bobolink, the Eastern Meadowlark has a mixed-reproductive strategy (monogamy and polygyny), with polygyny being frequent. In a four-year study in southern Ontario, Knapton (1988) reported that 38 to 56 percent of males were polygynous. Males can mate with up to three females, but two is far more common (Knapton 1988, Lanyon 1995).

Eastern Meadowlarks have multi-purpose territories in which feeding, mating and rearing of young occur (Lanyon 1995). In Wisconsin, territory sizes ranged from 1.2 to 6.1 ha, but were commonly 2.8 to 3.2 ha (Lanyon 1995). In New York, territories averaged 2.8 ha (Saunders 1932 in Lanyon 1995).

Males arrive on the breeding grounds about two to four weeks earlier than females (Lanyon 1995). Pair bonds are established as soon as females arrive, and nest building starts about a week later. Construction of first nests takes about six to eight days (Lanyon 1995). In Ontario, Peck and James (1987) reported egg dates extending from 2 May to 3 August, with most falling between 22 May and 11 June. In western New York, Norment et al. (2010) reported an average clutch initiation date of 14 May (n = 23) and an average fledge date of 11 June (range 30 May to 3 July) for first clutches.

Nests are situated on the ground (often in a shallow depression 2-6 cm deep), and are well-concealed by vegetation (Bent 1958, Wiens 1969, Roseberry and Klimstra 1970). The typical clutch size is four to five eggs (Roseberry and Klimstra 1970, Peck and James 1987, Knapton 1988). Incubation takes 13 to 14 days after the last egg is laid; nestlings fledge 10 to 12 days later (Lanyon 1995). After fledging, young continue to be fed by the adults for about two weeks (Bent 1958, Lanyon 1995). Young are capable of sustained flight when about 21 days old.

Unlike the Bobolink, Eastern Meadowlarks will usually attempt to raise two broods per breeding season (Lanyon 1957, 1995, Wiens 1969, Peck and James 1987, Kershner et al. 2004a). Unsuccessful females will also typically attempt to renest following nest failure (Lanyon 1957). However, double-brooding may not contribute significantly to the population, because second nests experience a high rate of failure (e.g., 67% failure for second nests versus 44% for first nests; Kershner et al. 2004a).

As in the case of the Bobolink, there appear to be regional differences in nesting success of the Eastern Meadowlark, with higher nesting success tending to occur in eastern hayfields than in the central prairie region (see Norment et al. 2010). Examples are 33 percent in Illinois (Lanyon 1957); 30 percent for monogamous females and 52 percent for females paired with polygynous males in southern Ontario (Knapton 1988); 53 percent and 62 percent for the incubation and the nestling stage, respectively, in Wisconsin (Lanyon 1995); and up to 65 percent in late-cut hayfields in western New York (Norment et al. 2010). In Illinois, low nest success was mostly attributed to high rates of predation; losses due to mowing were secondary (Roseberry and Klimstra 1970). Although hayfields may experience the lowest rates of nest success as a result of mowing (Roseberry and Klimstra 1970), losses can also be fairly high in heavily-grazed pastures as a result of trampling by livestock (e.g., Lanyon 1957).

In Wisconsin, females produced an average of 2.56 (± 0.46 SE; n = 23) young per year (Lanyon 1995). In Illinois, the average number of fledglings/nest was estimated at 1.97 (± 0.33 SE; n = 34); the average number of fledglings/successful nest (i.e., those that fledged at least one young) was estimated at 3.53 (± 0.21 SE; n = 23 nests) (Kershner et al. 2004a). The authors reported that given that few females were successfully double-brooded (owing to a large proportion of nest failures in second clutches) and that unsuccessful females did not always renest successfully in later attempts, annual fecundity for females was between 1.27 (± 0.38 SE) and 1.36 (± 0.37 SE) female young per year.

Survivorship and Site Fidelity

Bobolink

As with other migratory songbirds, the Bobolink is not a long-lived species, largely because of high rates of mortality experienced by first-year birds on migration. The longevity record is nine years (Martin and Gavin 1995), but the average age of mature birds in the population (generation time) is probably about three years (COSEWIC 2010).

Adult survival rate has not been studied in Canada. Survival rates of adults are influenced by agricultural activities, with higher rates being noted for adults using late-hayed fields than those using early-hayed and grazed fields (Perlut et al. 2008a). The apparent annual survival rate of adults in New England ranged from 52 percent to 70 percent for males and 35 percent to 54 percent for females; these rates are considered relatively low (Perlut et al. 2008a). In the United States Midwest, Scheiman et al. (2007) reported adult male survival rates ranging from 57 to 90 percent.

In a study of restored, unmowed grasslands in Iowa, Fletcher et al. (2006) suggested that adult survival during the non-breeding season may be the most important parameter contributing to population viability. Population viability analysis (PVA) modeling in the Champlain Valley region in the northeastern United States also found adult survival to be important, but nesting productivity was an even stronger determinant of population viability (Perlut et al. 2008b). The relative importance of adult survivorship versus productivity to long-term population persistence likely varies regionally depending on differences in factors such as predation pressure, land use, and habitat fragmentation.

Return rate of adults to breeding sites has not been studied in Canada, but varies considerably among studies in the United States. In common with other songbirds, all studies of Bobolink report higher rates for males (21-70%) than females (5-44%) (Wittenberger 1978, Bollinger and Gavin 1989, Fletcher et al. 2006, Scheiman et al. 2007). As with other songbirds, adult Bobolink site fidelity is positively related to the previous season's breeding success (Gavin and Bollinger 1988, Bollinger and Gavin 1989, Fajardo et al. 2009). This is tempered by inter-year changes in local habitat availability and site conditions, especially in agricultural situations that undergo crop rotations.

Breeding site fidelity also appears to be influenced by experience-based choices (Bollinger and Gavin 1989). This is especially apparent at poor quality sites that have low reproductive success. Successful birds return to breed at both good quality and poor quality sites, but unsuccessful birds are more likely to return to good quality sites than poor quality sites (Bollinger and Gavin 1989).

Prior to fall migration, young Bobolinks also appear to actively scout for their following year's breeding sites by incorporating 'inadvertent social information'. They effectively explore their surrounding natal landscape and gather advance 'knowledge' of the number and density of territory-holding males, which allows them to gauge the potential suitability of future breeding locations (Nocera et al. 2006). This suggests that Bobolinks may discern a site's apparent 'quality' despite an individual's lack of breeding familiarity with the site, based on habitat explorations that are made outside the nesting season (i.e., during pre-migration aggregations in late summer; Bollinger and Gavin 1989).

Eastern Meadowlark

Lanyon (1995) reported cases of adult banded birds recaptured at the age of five years, with a longevity record of nine years. The average age of mature birds in the population (generation time) is probably about three years (COSEWIC 2011).

Adult survival rates have not been quantified. In Illinois, Kershner et al. (2004a) suggested that an annual adult survival rate of 59 to 61 percent was necessary for the maintenance of a stable population. Radio-telemetry studies on post-fledgling movements of birds tracked over the course of a summer have revealed a cumulative probability of survival of juvenile Eastern Meadowlarks of 0.63 (95% CI: 0.54-0.74) in Missouri (Suedkamp Wells et al. 2008) and a similar value of 0.69 (95% CI: 0.55-0.83) in Illinois (Kershner et al. 2004b).

Adults of both sexes exhibit site fidelity to previous breeding sites (Lanyon 1957, 1995). As with other songbirds, young Eastern Meadowlarks exhibit little attachment to their natal areas (Lanyon 1995).

Migration

Bobolink

The Bobolink makes a 20,000-km trans-equatorial roundtrip flight between its nesting and wintering grounds (Martin and Gavin 1995); one of the longest migrations of all North American songbirds.

Bobolinks make a rapid return to the breeding grounds in spring, covering an average of 210 to 260 km per day for five to six weeks, with tailwind-assisted oceanic flights of up to 1,900 km per day (R. Renfrew unpubl. data). Most Bobolinks return to Ontario from about 1 to 30 May (Long Point Bird Observatory unpubl. data). Arrival of males generally precedes that of females by about a week (Martin and Gavin 1995).

After the breeding season, adults and immatures form flocks prior to their southbound departure. In Ontario, most fall migration occurs between about mid-August and 20 September (Long Point Bird Observatory unpubl. data). Most birds from Ontario likely migrate southeasterly to the United States Atlantic coast (Campbell et al. 2001). As migration proceeds, flock size builds in numbers, and can reach into the tens of thousands of individuals (Martin and Gavin 1995). Bobolinks are believed to leave the eastern seaboard via Florida, crossing the Caribbean to reach their wintering grounds in South America (Martin and Gavin 1995). Once on their wintering grounds, Bobolinks remain highly gregarious (e.g., concentrations of ~140,000 birds), and flocks may move distances of 100 km per day or more in search of food (Renfrew and Saavedra 2007).

In spring, northward return flights appear to generally follow a similar route as the fall migration, but stopover locations and exact paths differ, at least in South America (R. Renfrew unpubl. data).

Eastern Meadowlark

Although a few birds winter in southwestern Ontario, the Eastern Meadowlark is a short-distance, diurnal migrant (Lanyon 1995). Its wintering range is limited by snow cover (Lanyon 1995).

In southern Ontario, spring migration extends from late March through much of May (Long Point Bird Observatory unpubl. data). The peak period of fall migration extends from about 21 September through to about 10 November (Long Point Bird Observatory unpubl. data). In fall and winter, Eastern Meadowlarks can congregate in flocks of up to 200 to 300 birds (Bent 1958), considerably fewer than what is seen in Bobolinks.

Diet

Bobolink

During the breeding season, adult Bobolinks feed on insects (57%) and seeds (43%; Martin and Gavin 1995). Insects mostly include caterpillars, adult moths and butterflies, grasshoppers, beetles and weevils (Wittenberger 1978, 1980, Lavallée 1998). Nestlings are fed insects exclusively (Martin and Gavin 1995). Seeds eaten during the breeding season are mostly weed seeds (Martin and Gavin 1995). During migration and on the wintering grounds, the diet switches largely to seeds (Meanley and Neff 1953, Wittenberger 1978, Pettingill 1983, Martin and Gavin 1995, Di Giacomo et al. 2005, Renfrew and Saavedra 2007). This process begins to take place before fall migration, while the birds are still in Ontario.

Eastern Meadowlark

During the breeding period, Eastern Meadowlarks feed mainly on insects (74%) and plant matter (26%; Lanyon 1995). Crickets and grasshoppers comprise 26 percent of the annual diet, but are especially important in August (72% of the diet; Lanyon 1995). In spring, caterpillars, cutworms and grubs are preferred (Lanyon 1995). The species will also feed on bird eggs (Lanyon 1995). In Illinois, Kershner et al. (2004a) found that nesting females regularly foraged in adjacent agricultural fields (notably soybean).

During migration and on the wintering grounds, the diet consists primarily of weed seeds and waste grain, though some berries are also consumed (Bent 1958, Lanyon 1995).

1.4 Distribution, Abundance and Population Trends

There are two main sources of information on the distribution, abundance and population trends of the Bobolink and Eastern Meadowlark in Ontario: the North American Breeding Bird Survey (Environment Canada 2011) and the first and second Ontario Breeding Bird Atlas projects (Cadman et al. 2007).

Distribution

Bobolink

The Bobolink breeds in southern Canada (from southwestern British Columbia eastward to Newfoundland/Labrador) and the northern United States. It is one of only a few grassland bird species that overwinters outside of North America (Murphy 2003), wintering in Bolivia, Paraguay and Argentina (Martin and Gavin 1995). Although Bobolinks historically wintered in the Pampas grasslands of South America, they are not currently found in the eastern and southern regions of the Pampas, such as the Buenos Aires province in Argentina, the Rio Grande do Sul province in Brazil, and Uruguay (Di Giacomo et al. 2005, Blanco and López-Lanús 2008, R. Renfrew pers. obs.). This change in distribution presumably occurred because agricultural conversion has rendered much of this former habitat inhospitable.

As shown by the Ontario Breeding Bird Atlas (Figure 1), the Bobolink's distribution in Ontario is mostly confined to areas south of the Shield.

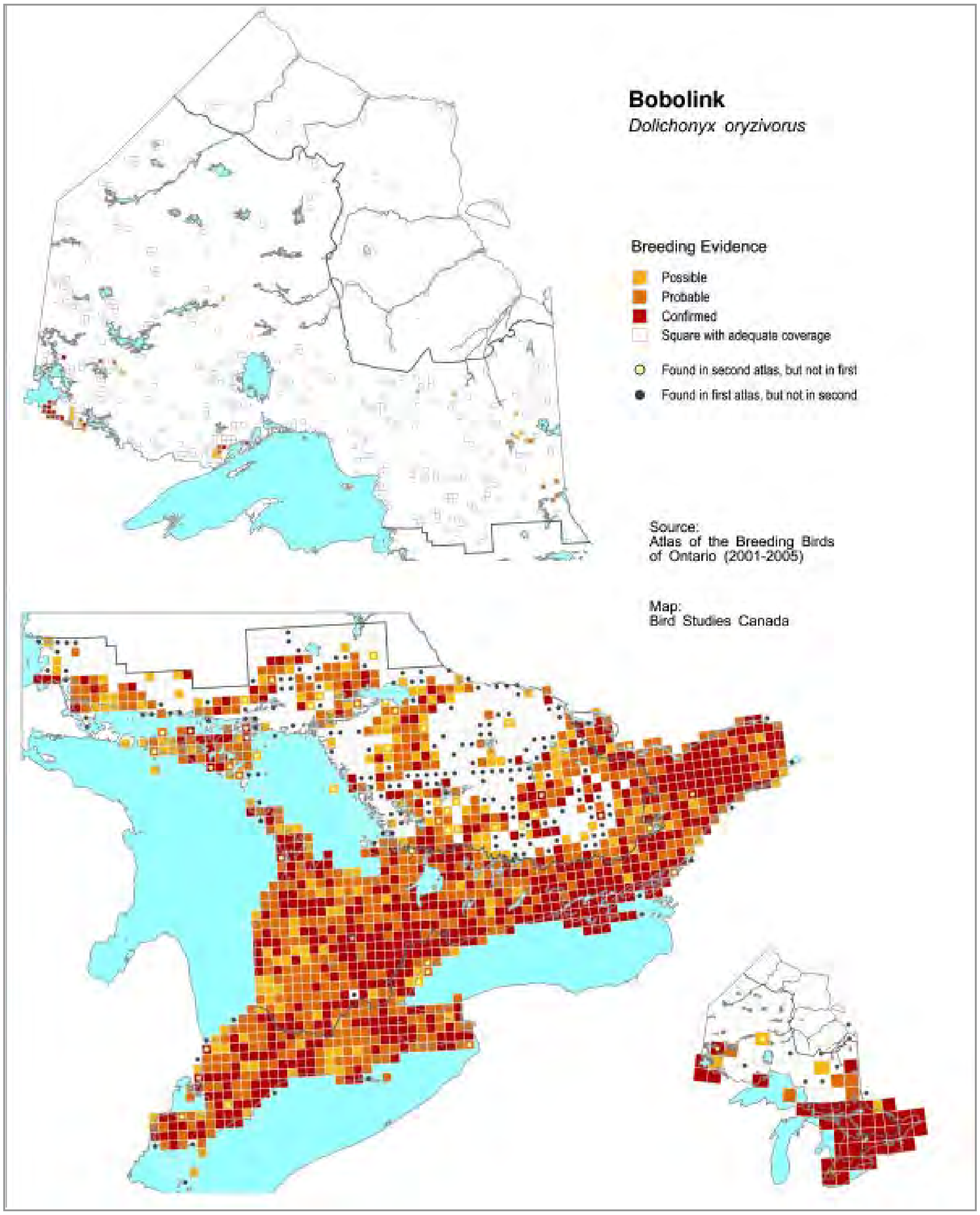

Figure 1. Breeding distribution of the Bobolink in Ontario in two time periods, based on breeding bird atlas data compiled in 1981-85 and 2001-05 (see Cadman et al. 2007). Black dots indicate squares in which the species was found in the first atlas period but not the second.

Its range extends north to the Highway 17 corridor between North Bay and Sault Ste. Marie (Cadman et al. 2007). Scattered populations occur locally farther north, most notably in the Clay Belt areas in Timiskaming and Cochrane districts in the northeast. It is largely absent around the north shore of Lake Superior, but there are pockets of occurrence in the Thunder Bay area and in the extreme northwest in the Rainy River and Dryden areas.

Eastern Meadowlark
The breeding range of the Eastern Meadowlark includes southeastern Canada (southern Ontario, southern Quebec, New Brunswick and Nova Scotia) and the eastern United States. Several other subspecies occur outside Canada – in Mexico, Central America, Cuba, and several South American countries (Lanyon 1995). Information is lacking, but it is surmised that most Eastern Meadowlarks that breed in Ontario likely winter in the southeastern United States.

In Ontario, its breeding range extends from the extreme southwestern part of the province north to southern Algoma, Sudbury and Nipissing districts. In the northeast, it also occurs in pockets of agricultural land associated with Clay Belts in Timiskaming and Cochrane districts. In northwestern Ontario, it is rare in the Lake of the Woods region, where it is largely replaced by the Western Meadowlark (Cadman et al. 2007; Figure 2).

<u>Abundance</u>
In Ontario, Bobolinks and Eastern Meadowlarks are most common in the Bruce/Grey/Dufferin region, the Kawartha Lakes/Peterborough region, the north shore area of Lake Ontario between Belleville and Kingston, and between the Ottawa and St. Lawrence rivers (Cadman et al. 2007; Figures 3 and 4). These areas correspond with the greatest densities of cattle in Ontario, and the largest areas of hay and pasture (see Figures 5 and 6).

Bobolink
In Canada, the Bobolink reaches its greatest abundance in southern Manitoba, southern Ontario, and in the regions of Montérégie, Outaouais and Abitibi in southern Québec (COSEWIC 2010). It is relatively uncommon in Saskatchewan, Alberta and British Columbia. Southern Ontario is home to about 13 percent of the world's Bobolink population (Ontario Partners in Flight 2008). Based on Ontario Breeding Bird Atlas point counts for the period 2001 to 2005, Ontario's population was estimated to consist of about 800,000 adults (~400,000 breeding pairs; Blancher and Couturier 2007). Factoring in the Breeding Bird Survey estimates of population decline that have taken place since then, the adjusted population size (as of 2010) was roughly 570,000 adult birds (~285,000 breeding pairs).

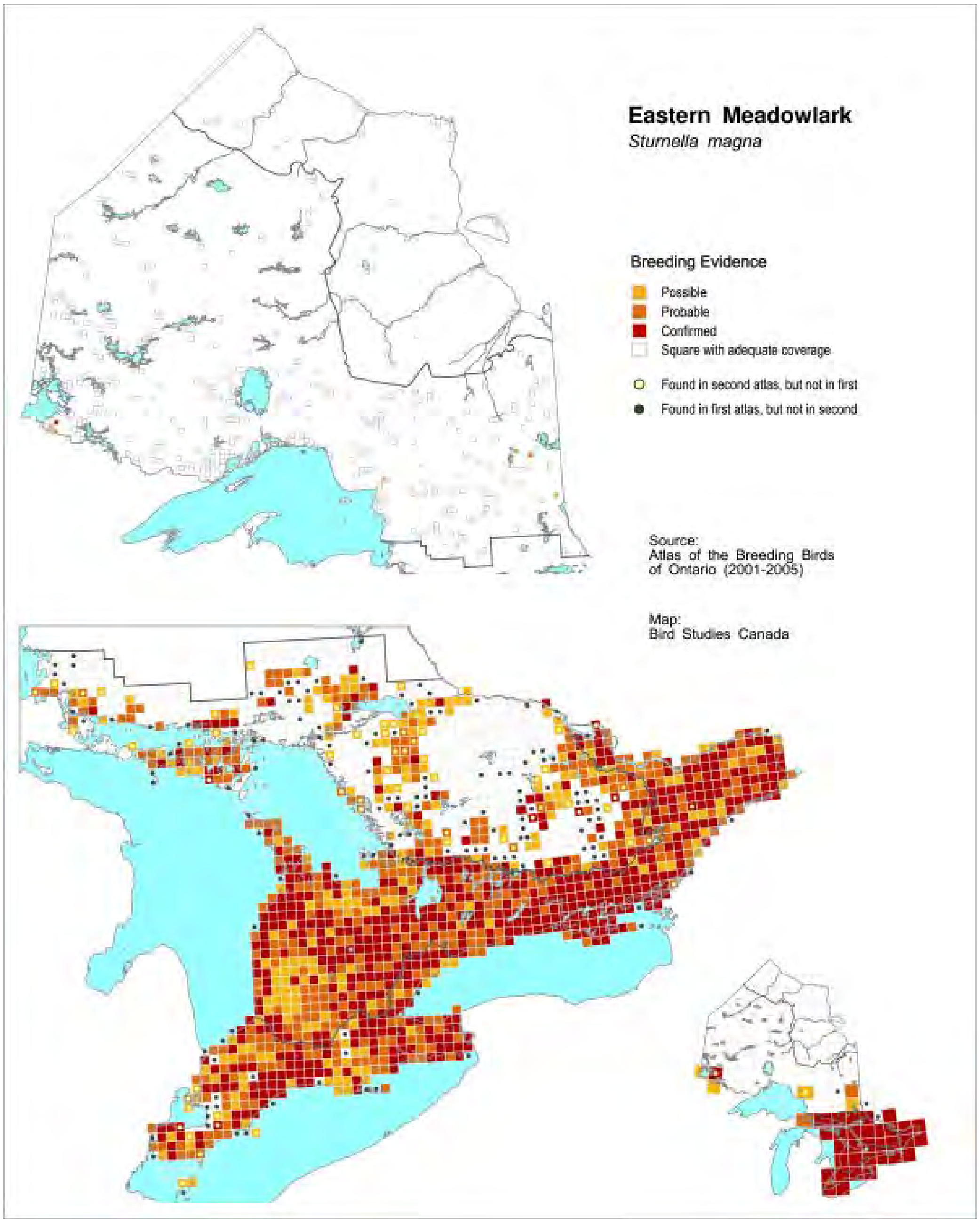

Figure 2. Breeding distribution of the Eastern Meadowlark in Ontario in two time periods, based on breeding bird atlas data compiled in 1981-85 and 2001-05 (see Cadman et al. 2007). Black dots indicate squares in which the species was found in the first atlas period but not the second.

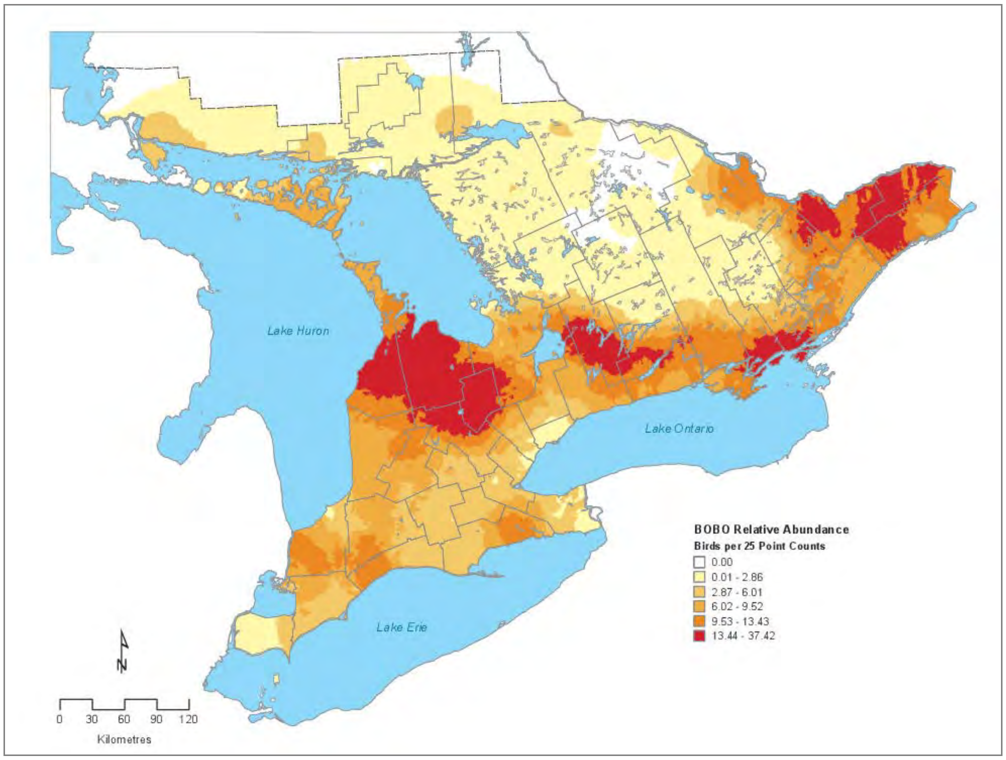

Figure 3. Relative abundance of Bobolinks in southern Ontario in 2001-05 based on breeding bird atlas point count data (adapted from Cadman et al. 2007).

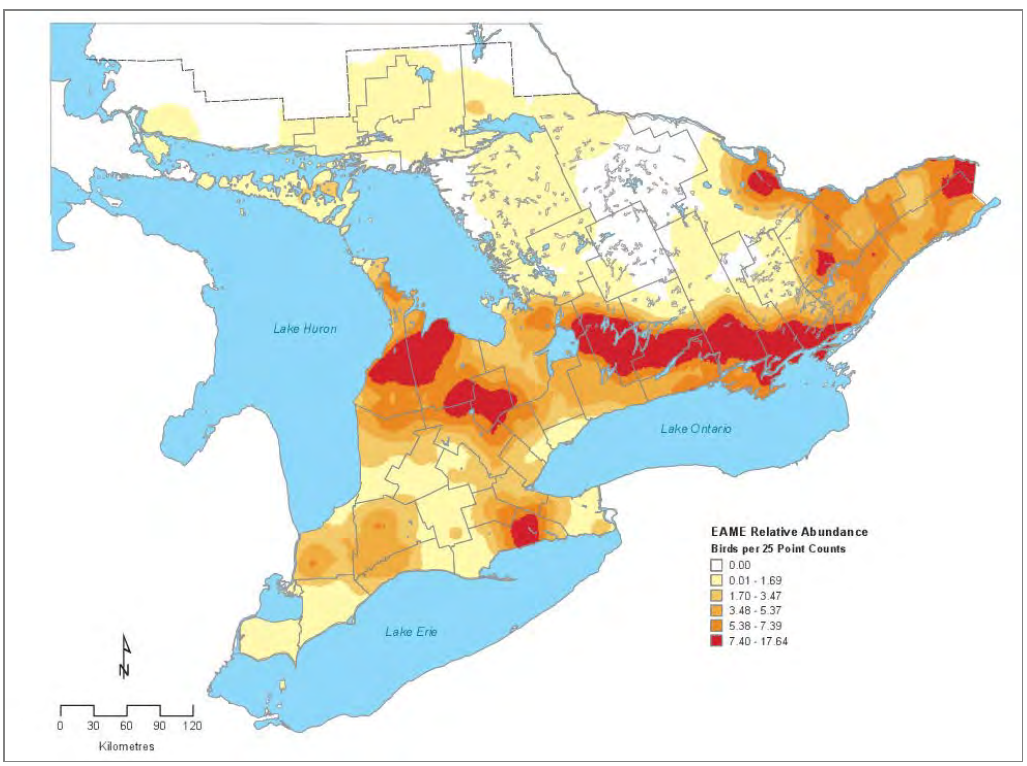

Figure 4. Relative abundance of Eastern Meadowlarks in southern Ontario in 2001-05 based on breeding bird atlas point count data (adapted from Cadman et al. 2007).

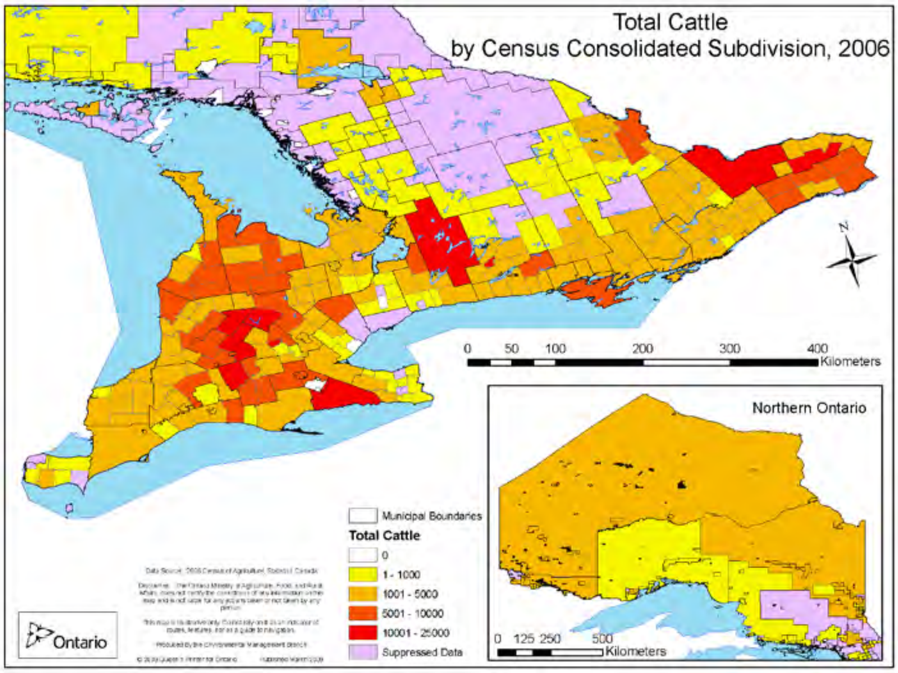

Figure 5. Abundance of cattle (dairy and beef combined) in Ontario in 2006. Map is courtesy of OMAFRA, based on data from Statistics Canada 2011).

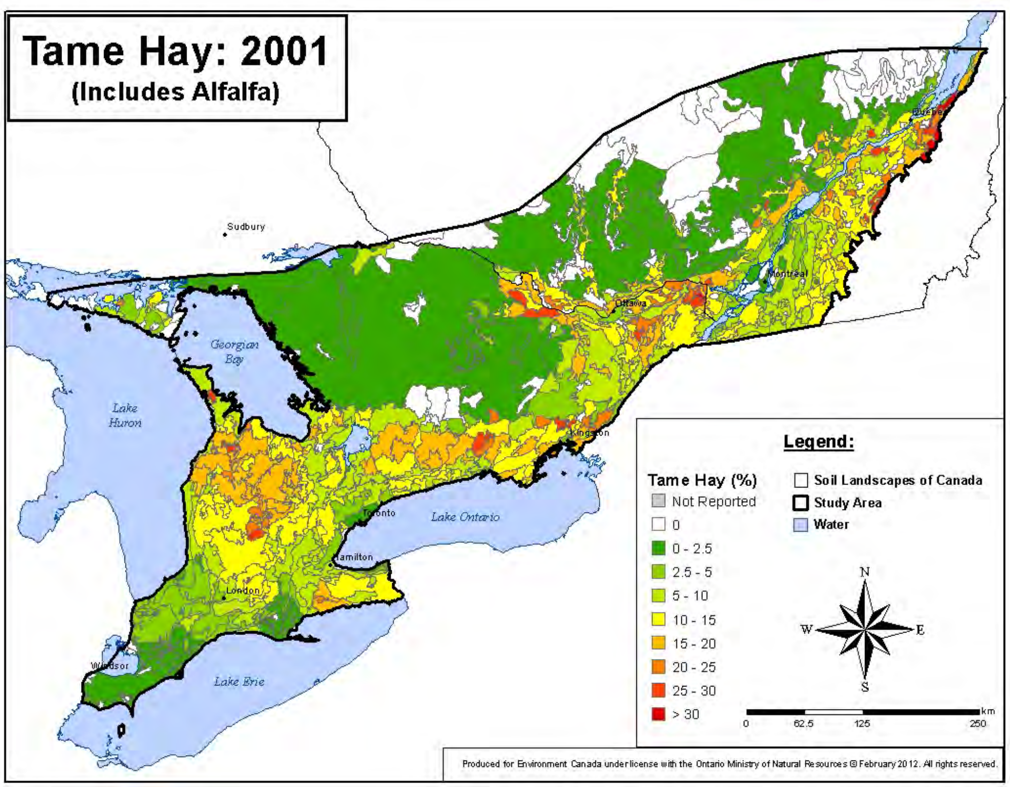

Figure 6. Proportion of land cover in hay in southern Ontario and southwestern Québec in 2001. Map is courtesy of Environment Canada, and is derived from Neave and Baldwin (2011). Mapping is based on Census of Agriculture data, against an overlay of soil landscapes as the regional unit.

Eastern Meadowlark

Based on Breeding Bird Survey data from 1990 to 1999, the global population size for Eastern Meadowlark (including all subspecies found outside Canada) was estimated at 10 million adults (Rich et al. 2004). At that time, the Canadian population was estimated at about 250,000 adults (roughly 125,000 breeding pairs), which represents about 2.5 percent of the global population. The bulk of the Canadian population occurs in Ontario (about 70%), followed by Québec (about 25%). Few now breed in the Maritimes. Based on breeding bird atlas data from 2001 to 2005, the Ontario population was estimated at 150,000 birds (~75,000 breeding pairs) (Blancher and Couturier 2007). Factoring in population declines that have taken place since then, the adjusted population size (as of 2010) was roughly 130,000 adult birds (~65,000 breeding pairs).

<u>Recent Population Trends</u>

Earlier range and population expansions that occurred over a century ago have been undergoing a reversal since at least the 1950s, following agricultural modernization, abandonment of marginal farmlands and subsequent forest succession, and the large-scale conversion of forage crops to row crops (see below and Threats to Survival and Recovery).

Bobolink

Declines in Bobolink populations were first noted in the United States in the early 1900s (Bent 1958), and were attributed to habitat loss on the breeding grounds, coupled with direct human persecution in the southern United States, where the birds fed in rice crops during migration (McAtee 1919, Bent 1958, Martin and Gavin 1995). In addition, Bobolink populations were believed to have been severely reduced as a consequence of unsustainable market hunting. Indeed, following protection afforded by the proclamation of the *Migratory Birds Convention Act* in 1917, Bobolink populations began to rebound in eastern North America (Robbins et al. 1986).

In the last several decades, however, the species has declined throughout most of its range (Environment Canada 2011, Sauer et al. 2011). Based on the Breeding Bird Survey, populations in Ontario have experienced an estimated loss of 77 percent since 1970 and 33 percent since 2000 (see Table 1 and Figure 7). Similar declines are also apparent across Canada (Table 1) and much of the United States.

Between the first (1981-85) and second (2001-05) Ontario breeding bird atlas periods, the Bobolink’s probability of observation showed a statistically significant decline of 28 percent (Cadman et al. 2007). Regional declines in occurrence were greatest in the Southern Shield (28%) and Northern Shield (68%), and less marked in the Lake Simcoe-Rideau (5%) and Carolinian (10%) regions (Cadman et al. 2007). Atlas-based changes in the frequency of occurrence of common/widespread species like the Bobolink underestimate changes in actual abundance (Francis et al. 2009). This is likely why the apparent declines in probability of observation were strongest in regions where Bobolinks occur at the lowest densities.

Table 1. Annual indices of population change for the Bobolink (BOBO) and Eastern Meadowlark (EAME) in Canada and Ontario across various time periods, based on hierarchical analysis of Breeding Bird Survey data (Environment Canada 2011; A. Smith, pers. comm. 2011).

Species-Region	**1970-2010**		**1980-2010**		**1990-2010**		**2000-2010**	
	Annual % Change	**CI**	**Annual % Change**	**CI**	**Annual % Change**	**CI**	**Annual % Change**	**CI**
BOBO-Canada	-3.6	-4.1 to -3.1	-4.0	-4.5 to -3.5	-3.7	-4.4 to -3.1	-3.3	-4.4 to -2.2
BOBO-Ontario	-3.3	-3.8 to -2.7	-3.6	-4.3 to -3.0	-3.7	-4.6 to -2.9	-4.0	-5.6 to -2.6
EAME-Canada	-2.8	-3.3 to -2.4	-2.9	-3.3 to -2.3	-2.7	-3.3 to -2.0	-3.1	-4.3 to -2.0
EAME-Ontario	-2.4	-2.9 to -1.9	-2.5	-3.0 to -1.9	-2.3	-3.0 to -1.5	-2.9	-4.2 to -1.7

CI = 95% lower and upper credible intervals; all average annual changes are statistically significant.

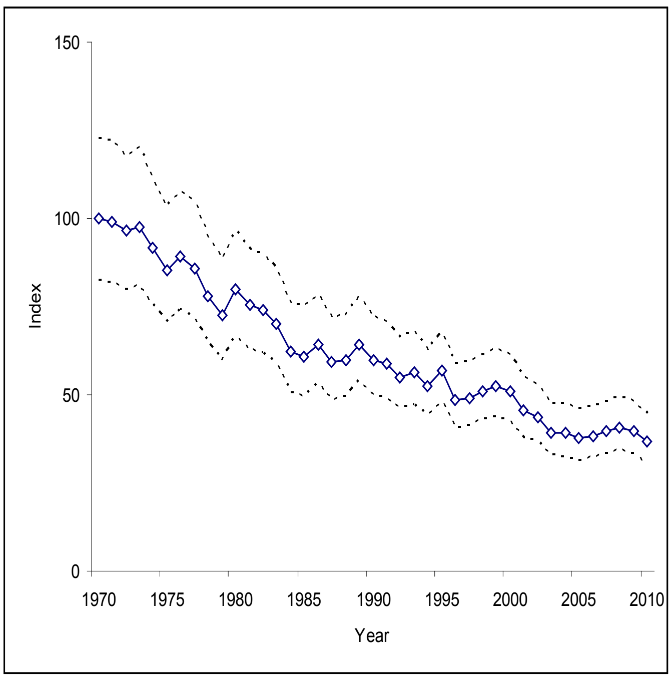

Figure 7. Annual indices of Bobolink populations in Ontario between 1970 and 2010, based on Breeding Bird Survey data, showing 95% lower and upper credible intervals (Environment Canada 2011; A. Smith, pers. comm. 2011).

Eastern Meadowlark

Populations in Canada, and indeed across the Eastern Meadowlark's range, have shown significant declines in recent decades (Environment Canada 2011, Sauer et al. 2011). Based on the Breeding Bird Survey, populations in Ontario have experienced an estimated loss of 62 percent since 1970 and over 25 percent since 2000 (see Table 1 and Figure 8). Similar declines are apparent across Canada (Table 1) and much of the United States.

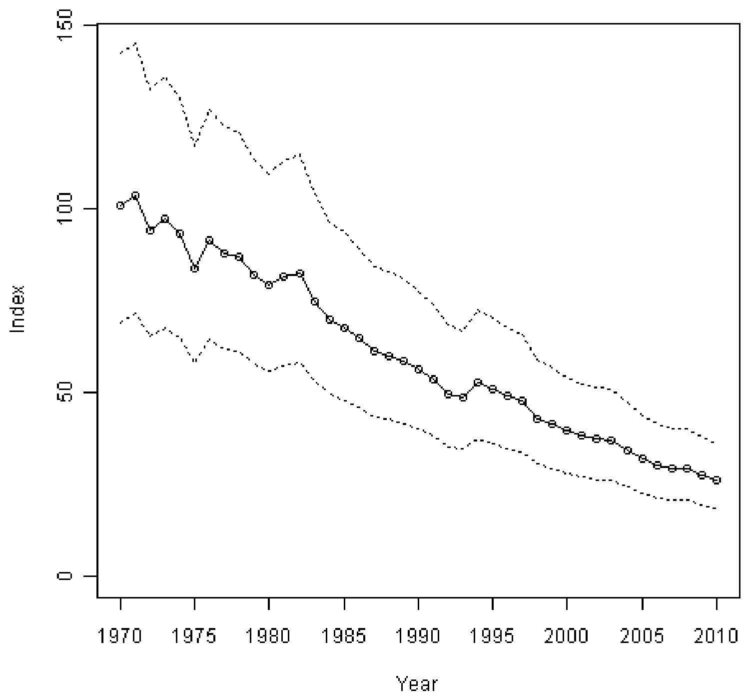

Figure 8. Annual indices of Eastern Meadowlark populations in Ontario between 1970 and 2010, based on Breeding Bird Survey data, showing 97.5% lower and upper credible intervals (Sauer et al. 2011).

A comparison of the Eastern Meadowlark's probability of observation in Ontario between the first (1981-85) and second (2001-05) atlas periods showed a statistically significant decline of 13 percent in occupancy province-wide (Cadman et al. 2007). Statistically significant regional declines were apparent in the Southern Shield (17%), Lake Simcoe-Rideau (9%) and Carolinian (16%) regions. A statistically non-significant decline (39%) was reported for the Northern Shield region. As with the Bobolink, distributional changes in occupancy underestimate change in actual abundance for common birds like Eastern Meadowlark.

<u>Population Trends in Relation to the Supply of Grassland Habitats</u>

Prior to European settlement, Bobolinks and Eastern Meadowlarks were probably most common in the vast tallgrass and mixed-grass prairies of the Great Plains in midwestern Canada and the United States (Bent 1958, Askins et al. 2007). They were also present historically in the east, dating back at least to the mid-1700s (Pettingill 1983, Askins 1999, Askins et al. 2007). Prior to European settlement, it is surmised that Bobolinks and Eastern Meadowlarks were much less common and more scattered in Canada than currently.

Before European settlement, most historical grasslands in the Northeast, including Ontario, resulted from disturbances by fire, wind, tree diseases, insect damage to trees, and flooding from American Beaver (*Castor canadensis*) activity (Askins et al. 2007, Catling 2008). In addition, First Nations commonly practised firewood harvesting, clearing for maize, tobacco, beans and squash, and burning to enhance hunting areas, resulting in grasslands (Askins et al. 2007). The extent to which suitable habitat was created by First Nations in Ontario prior to the sixteenth century is unknown and debatable, but Campbell and Campbell (1994) and Birch and Williamson (2013) provide useful insights into the size of aboriginal communities and the amount of land cleared to support them.

In southern Ontario, when European settlers began to arrive in numbers in the late 1700s and early 1800s, populations of First Nations peoples had already experienced significant declines. At that time, southern Ontario was predominantly a forest-dominated landscape, and only a small proportion of habitat was available for grassland-obligate species. Estimates of the amount of native tallgrass prairie, open savannah and open "plains" that were present at that time are not well documented, but are still well below the present-day amount of agricultural grassland habitat. Catling (2008) estimated that at least 200,000 ha of open "plains" habitat (i.e., prairie, savannah and sand barren) were present in Ontario in the settlement era. However, only about 66,500 ha of "plains" habitat consisted of grasslands, much of it being tallgrass prairie (W. Bakowsky *fide* V. Brownell, pers. comm. 2011). Again, these estimates contrast sharply with the present-day extent of agricultural grasslands in Ontario (see Habitat Needs below).

Nevertheless, following European settlement, most of North America's original prairie (both within and outside Ontario) was altered or destroyed due to agriculture and the loss of natural disturbance regimes like frequent fires (Askins 1993, 1999, Askins et al. 2007). Only 2.4 percent of northern tallgrass prairie remains today in North America (Samson et al. 2004). In Ontario, less than one percent remains (Bakowsky and Riley 1994, Catling and Brownell 1999, Catling 2008). The figure may actually be closer to <0.1 percent of the original condition, given that only about 300 ha of tallgrass prairie exist now (W. Bakowsky *fide* V. Brownell, pers. comm. 2011).

Although loss of most native grassland accompanied European settlement, Bobolinks and Eastern Meadowlarks increased noticeably in the northeastern United States and southeastern Canada during the 19th century, benefiting from widescale deforestation and the spread of early agricultural practices that provided ample 'surrogate' grassland habitat, mostly in the form of Eurasian cool-season grass hayfields and pasturelands (Bent 1958, Lanyon 1995, Martin and Gavin 1995, Gauthier and Aubry 1996, Askins 1999, Brennan and Kuvlesky 2005, Cadman et al. 2007). At about the same time, their ranges expanded to the northwest (McAtee 1919, Bent 1958, Lanyon 1956, Pettingill 1983).

Following a century or more of increasing supplies of surrogate grassland habitat in eastern North America, declines in this habitat type started to occur in the early 1900s, stemming from market-driven shifts within the agricultural sector that involved increased mechanization and conversion of forage crops to cereal and row crops (Herkert 1991, Warner 1994, Martin and Gavin 1995, Rodenhouse et al. 1995, Granfors et al. 1996, Jobin et al. 1996, Murphy 2003, Podulka et al. 2004, Serecon Management Consulting Inc. 2005, Corace et al. 2009).

Over the centuries, Bobolink and Eastern Meadowlark populations have been responding to the supply and quality of grassland habitats, both native and anthropogenic. Current population sizes and declines are strongly linked to habitat shifts that affect both species at all stages in their life-cycle – on their breeding and wintering grounds and at migration stop-over points (see Threats to Survival and Recovery).

1.5 Habitat Needs

Breeding Habitat

Bobolinks and Eastern Meadowlarks are obligate-grassland species (i.e., they require grasslands). In Ontario, the two species still breed in a variety of natural grassland habitat types, including remnant prairies, savannahs and alvar grasslands. They also nest commonly in grassland habitat restoration sites (DeVault et al. 2002, Ingold 2002, Fletcher and Koford 2003, Galligan et al. 2006). Bobolinks will also nest in low densities in large grassy bogs, fens and beaver meadows (D. Sutherland, pers. comm. 2012).

With the loss of most of their preferred native grassland habitats, Bobolinks and Eastern Meadowlarks now nest most commonly in a variety of anthropogenic (i.e., human-created) grassland habitats that effectively mimic the structural attributes (vegetation height and vegetation density) of native prairie and act as “surrogate” grasslands. As such, both species now nest primarily in hayfields and pastures (Bollinger and Gavin 1992, Bollinger 1995, Martin and Gavin 1995, Jobin et al. 1996, Cadman et al. 2007). These habitats are typically dominated by non-native grasses such as Timothy (*Phleum pratense*) and Kentucky Bluegrass (*Poa pratensis*), and various broadleaved plants such as clovers (*Trifolium spp.*) (Dale et al. 1997, Van Damme 1999, Frei 2009).

Because hayfields and pastures are not static systems, their suitability as breeding habitat for Bobolinks and Eastern Meadowlarks ebbs and flows. Vegetation composition changes over time in these fields, with and without active management. For example, Alfalfa (*Medicago sativa*) is a short-lived perennial species that usually dies out after four to five years, leaving grass species and other legumes. This is one reason why Bobolinks and Eastern Meadowlarks prefer older hayfields (Bollinger 1995; see below). Then again, because these same older pastures and hayfields become unproductive as a forage crop over time (J. Bagg, pers. comm. 2011), they are often reseeded to rejuvenate them or rotated to another crop. This temporarily reduces their attractiveness as breeding habitat.

Population sizes and trends of Bobolink and Eastern Meadowlark are directly linked to the supply and trend of grassland habitats. The vast majority of their breeding habitat in Ontario occurs in pastures and hayfields. In 2011, the total area of hay and pasture in Ontario was 1,501,982 ha, which accounts for about 29 percent of all farmland in the province. Of this total, there were about 841,000 ha of hay and 661,000 ha of pasture (Statistics Canada 2011).

Different agricultural sectors are apt to manage hay and pasture in different ways, thus contributing differently to both the amount and quality of breeding habitat for Bobolink and Eastern Meadowlark. In 2011, beef farms made up 13.7 percent of the 51,950 Ontario census farms; dairy made up 7.8 percent; sheep and goat farms made up 2.8 percent; hay farms made up 10.8 percent; and horse farms made up 7.5 percent (Statistics Canada 2011).

Because of the large areas of hay and pasture needed to sustain them, Ontario's beef industry is of particular importance for maintaining Bobolink and Eastern Meadowlark populations. Again, there are temporal changes in habitat quality at the site level, because hay and pasture management typically follow a cycle from initial grassland establishment through to rotation to another crop (OMAFRA 1994, 2000). At the site level, pasture management also takes a number of forms in Ontario, including continuous grazing, rotational grazing, ranchland and other variations. These too affect the quality of breeding habitat. For example, ranchland often has a low livestock density, which generally offers higher-quality breeding habitat for Bobolinks and Eastern Meadowlarks than more intensive grazing systems. Likewise, many hayfields that occur on poorly drained, shallow or stoney soils are never or seldom rotated. These too may provide preferred nesting habitat.

Habitat needs for each species are presented in greater detail below, followed by a summary of some of the important differences regarding microhabitat structure.

Bobolink

In New York, Bobolinks prefer hayfields that are eight or more years old since establishment (but still cut annually), followed by lightly-grazed pastures, fallow fields, old fields, and young hayfields (Bollinger and Gavin 1992, Bollinger 1995). They also commonly nest in old fields that have been abandoned (cultural meadows), and less commonly in grain fields (Martin 1971, Bollinger et al. 1990, Van Damme 1999, Dechant et al. 2001, Norment et al. 2010).

Bobolinks do not nest in annual row crops like corn and soybean (Sample 1989, Jobin et al. 1996). However, in at least some parts of southwestern Ontario (e.g., Norfolk, Chatham-Kent, Essex, Durham), Bobolinks will nest in some large (i.e., >50 ha) fields of winter wheat and rye (D. Martin and J. Holdsworth, pers. comms. 2011, J. McCracken, pers. obs. 2012), apparently where the availability of more suitable, alternative nesting opportunities are in short supply, and perhaps more so when the grain crop is underplanted with clover or Alfalfa and/or is bisected by a wet grassy section (J. McCracken, pers. obs. 2012). Given the large areas under cultivation (445,000 ha in

2011; Statistics Canada 2011), it is conceivable that winter wheat could be supporting a small, but potentially significant proportion of the province's Bobolink population, if the birds are reproducing successfully (see Knowledge Gaps).

Alfalfa-dominated hayfields are variably occupied by Bobolinks (Bent 1958, Bollinger and Gavin 1992, Bollinger 1995, Martin and Gavin 1995, Corace et al. 2009), again probably depending somewhat on the regional availability of alternative, more-preferred habitat types. Fields containing Alfalfa are much more apt to be occupied when it is planted as a part of a grass-dominated mixture like Timothy (Bollinger and Gavin 1992, Patterson and Best 1996).

Bobolinks avoid heavily-grazed pastures (Renfrew and Ribic 2002, Dechant et al. 2001). The effects of grazing intensity on grass height (and other habitat characteristics) depend on the region (climate), plant species composition, stocking rate, and grazing rotation (if any). In the Great Plains, Bobolinks responded positively to moderate grazing in tallgrass situations, but negatively to heavy grazing in shortgrass situations (Bock et al. 1993).

The Bobolink is sensitive to vegetation structure and composition (Wiens 1969, Wittenberger 1980, Bollinger and Gavin 1989, 1992, Nocera et al. 2007). Grass height is probably most critical at the onset of territory establishment (Nocera et al. 2007). Generally, grass cover should be about 25 cm or more at the start of the breeding season (e.g., Derner et al. 2009). Late in the nesting season, Bobolinks in native mixed-grass prairie in South Dakota were most clearly associated with grassland habitats averaging about 45 to 52 cm in height (Fritcher et al. 2004). At nest sites in tallgrass prairie, grass heights late in the season averaged about 39 cm (Winter et al 2004).

Bobolinks are positively associated with high grass-to-forb ratios (i.e., grass cover is usually dominant; Bollinger 1988, Bollinger and Gavin 1989, 1992, Patterson and Best 1996, Fritcher et al. 2004). They also prefer a moderate grass-litter depth (generally 2-5 cm; Wiens 1969, Herkert 1994, Schneider 1998, Renfrew and Ribic 2002, Johnson et al. 2004, Winter et al. 2004, Warren and Anderson 2005, Frei 2009). They avoid fields having a thick litter layer (Wiens 1969, Heckert 1994, Renfrew and Ribic 2002, Johnson et al. 2004, Warren and Anderson 2005), and areas with bare ground (Schneider 1998, Warren and Anderson 2005).

Bobolinks will occupy fields having scattered shrubs or fence posts that are used as perches (Schneider 1998), but avoid fields where the cover of woody shrubs and saplings exceeds about 25 percent of the area (Bollinger 1988, Bollinger and Gavin 1992). They also respond negatively to the presence of nearby forest edges (Fletcher 2003, Fletcher and Koford 2003, Bollinger and Gavin 2004), but the degree of sensitivity is somewhat site-specific, depending on how open the surrounding landscape is (Keyel et al. 2011). Results from Fletcher and Koford (2003) suggest that effects are strongest within about 75 m of a forest edge, while Bollinger and Gavin (2004) found that effects were greatest within 25 m.

Grassland species that are “area sensitive” have higher or lower rates of occupancy and/or population density in relation to field size (reviewed by Ribic et al. 2009). The Bobolink is sensitive to habitat patch size, preferring larger grasslands (i.e., generally >10 ha; Johnson and Igl 2001, Renfrew and Ribic 2002, Fletcher and Koford 2003, Murphy 2003, Bollinger and Gavin 2004, Horn and Koford 2006, Renfrew and Ribic 2008, Shustack et al. 2010). Even so, sensitivity to habitat patch size is affected by other landscape attributes, like topography and shape of the patch. For example, in the rolling topography of southwestern Wisconsin, Bobolinks were more likely to occur in large, open upland areas than in the smaller, closed-in valley lowlands (Renfrew and Ribic 2002). In a study in Nebraska, the Bobolink’s probability of occurrence was significantly inversely correlated with perimeter-area ratio (Helzer and Jelinski 1999).

The degree of area sensitivity is also heavily influenced by the amount of regional grassland cover, such that Bobolink densities in smaller fields increase as the amount of suitable habitat in the surrounding landscape increases (Ribic and Sample 2001, Bélanger and Grenier 2002, Horn and Koford 2006, Renfrew and Ribic 2008, Ribic et al. 2009, Shustack et al. 2010). As such, the highest Bobolink densities generally occur in more homogeneous, grassland-based landscapes compared to more heterogeneous landscapes that include other habitats such as forests and shrublands. Although relatively small grasslands (e.g., 5-10 ha) in fragmented landscapes can provide suitable breeding habitat for Bobolinks (Weidman and Litvaitis 2011), these sites represent poor habitat if surrounded by forest (Bollinger and Gavin 2004).

Eastern Meadowlark

The Eastern Meadowlark is most common in pastures, followed by hayfields, native grasslands, and savannahs (Roseberry and Klimstra 1970, Lanyon 1995). It also nests in a wide variety of other grassland habitats, including weedy meadows, young orchards, golf courses, restored grasslands on surface mines, grassy roadside verges, young oak plantations, grain fields, herbaceous fencerows, and grassy airfields (Peck and James 1987, Bryan and Best 1991, Warner 1992, Lanyon 1995, Kershner and Bollinger 1996, DeVault et al. 2002, Hull 2003, Galligan et al. 2006). Like the Bobolink, it rarely nests in row crops such as corn and soybean (Cadman et al. 2007), except perhaps when grassed waterways are present (Bryan and Best 1991).

At the field scale, the Eastern Meadowlark’s response to vegetation structure varies among studies (Hull 2003). Optimal nesting habitat generally contains moderately tall (25 to 50 cm) grass with abundant litter cover, a high proportion of grass cover (>80% is optimal; <20% is inadequate), moderate forb density, low proportions of shrub and woody vegetation cover (<5%; >35% is too dense), and low percent cover of bare ground (Wiens 1969, Roseberry and Klimstra 1970, Rotenberry and Wiens 1980, Schroeder and Sousa 1982, Askins 1993, Vickery et al. 1994, Granfors et al. 1996, Kershner et al. 2004a, Warren and Anderson 2005, Coppedge et al. 2008). Eastern Meadowlarks frequently use scattered trees, shrubs, telephone poles, and fence posts as elevated song perches (Wiens 1969, Sample 1989, Hull 2003), which could be an additional important habitat component.

As with Bobolink, older hayfields are preferred by Eastern Meadowlarks. As fields age, litter cover, plant diversity and vegetation patchiness increase, whereas total plant cover, legume cover, and vegetation height decrease (Zimmerman 1992, Bollinger 1995). Grass-dominated hayfields are preferred over Alfalfa fields, at least in part because Eastern Meadowlarks require grass as nesting material (Roseberry and Klimstra 1970). Fields that lack a grass component are generally not occupied.

Like the Bobolinks, Eastern Meadowlarks do not tolerate repeated hay cutting that is carried out during the breeding season, but will respond positively to infrequent mowing that is conducted at intervals of three to five years (Hays and Farmer 1990, Granfors et al. 1996, Jones and Vickery 1997).

As with Bobolink in pastures, there is an inverse relationship between intensity of grazing and Eastern Meadowlark use (Roseberry and Klimstra 1970). The species generally copes well in the face of low to moderate rotational grazing that maintains grass heights of about 10 to 30 cm (Risser et al. 1981, Jones and Vickery 1997).

Eastern Meadowlarks also respond positively to periodic, prescribed burning conducted at intervals of two to four years (Skinner 1975 in Lanyon 1995, Jones and Vickery 1997, Walk and Warner 2000, Hull 2003, Powell 2008, Coppedge et al. 2008). Response to fire varies, however, depending on soil type, climate, grassland type (native vs non-native), fire frequency, and time elapsed between burns (Zimmerman 1992, Hull 2003).

The suitability of grassland habitat for Eastern Meadowlark involves a combination of landscape and patch characteristics (Herkert 1991, Vickery et al. 1994, Renfrew and Ribic 2008). Studies conducted in Missouri and New York suggest that the Eastern Meadowlark is not especially area-sensitive; breeding density was not influenced by patch size and the species was not found to be affected by edge density, distance to another patch of grassland or forest, or by cover, patch size or core area of grassland (Bollinger 1995, Winter 1998, Horn et al. 2000). Neverthess, large tracts of grasslands are generally preferred over smaller ones (Herkert 1991, 1994, Vickery et al. 1994, O'Leary and Nyberg 2000). The minimum size required is about five hectares (Herkert 1994).

There appear to be regional differences in the degree of sensitivity of Eastern Meadowlarks to habitat fragmentation. For example, in Illinois, the species was considered moderately sensitive to grassland habitat fragmentation attributes (O'Leary and Nyberg 2000, Hull 2003). In Wisconsin, relative abundance was greatest in pastures with more grassland core area (i.e., area of grassland occurring >25 m from the edge of a patch) and in landscapes having greater amounts of grassland cover (Renfrew and Ribic 2008).

<u>Breeding Microhabitat Needs</u>

Bobolinks and Eastern Meadowlarks share similar broad habitat requirements, have similar distributional patterns of regional abundance, and frequently occur within the same fields (McCracken et al. 2012). However, there are some within-field differences that can be important considerations for habitat conservation and management efforts:

- While both species display some degree of area-sensitivity, Bobolinks appear to prefer larger fields than Eastern Meadowlarks.
- Bobolinks tolerate and may even prefer wetter portions of fields, and are most apt to select nesting sites that are closer to field centres. Eastern Meadowlarks prefer to nest in drier sites, and will frequently nest around field margins.
- Bobolinks are more closely associated with hayfields than Eastern Meadowlarks, and less closely associated with pasture (e.g., Ribic et al. 2009).
- Forb composition in grass-dominated fields occupied by Eastern Meadowlarks tends to be slightly lower (e.g., 11-15% forb cover; Kershner et al. 2004a, 11.1%; Jensen 1999) than for Bobolinks (e.g., 22.6%; Winter et al. 2004).
- Bobolinks tend to nest in patches of denser and taller herbaceous vegetation (Martin 1971, Schneider 1998) than Eastern Meadowlarks (Sample 1989, McCoy 1996).
- Eastern Meadowlarks have a higher tolerance to shrub encroachment (e.g., up to 35% shrub cover; Schroeder and Sousa 1982) than Bobolinks (less than 25% shrub cover; Bollinger 1988, Bollinger and Gavin 1992).
- Bobolinks have a lower tolerance to the presence of patches of bare ground (e.g., 0.3%; Schneider 1998, Winter et al. 2004, Warren and Anderson 2005) than Eastern Meadowlarks (e.g., 8.5%; Jensen 1999, 0.5-3%; Kershner et al. 2004a).

For Bobolinks, microhabitat preferences are best matched in regularly maintained hayfields and grasslands. If not maintained, Bobolinks may decline significantly due to accumulation of litter and shrub encroachment (Johnson 1997). The species responds positively to properly-timed mowing and burning, with abundance peaking one to three years after disturbance (Bollinger and Gavin 1992, Johnson 1997, Madden et al. 1999).

Eastern Meadowlark densities are higher in heterogeneous vegetation habitat than homogenous (Risser et al. 1981, Schroeder and Sousa 1982). These preferences are best matched with periodically mowed and burned grasslands (3-5 years; Hays and Farmer 1990, King and Savidge 1995), lightly to moderately grazed pastures (Skinner et al. 1984), and idle grasslands.

Non-breeding Habitat

Bobolink

Bobolinks retain their association with grasslands throughout migration and winter, at which time they have largely switched from a diet dominated by insects to one dominated by seeds. As on the breeding grounds, the species has adopted surrogate habitats, and can be found feeding in open areas wherever seed is abundant, including pastures, rice and sorghum fields, idle fields, crop field margins, grassy wetlands, and large reedy marshes (Pettingill 1983, Sick 1993, Martin and Gavin 1995, Di Giacomo et al. 2005, Lopez-Lanus et al. 2007).

In Ontario, little is known about habitat use outside the breeding season. Prior to fall migration, they group into small flocks, often relocating to the interface between marshy wetlands and agricultural areas. No concentration areas have been identified as providing important "staging" or "stopover" habitat for large numbers of Bobolinks in Ontario during migration, at least not in some enduring or predictable manner.

Eastern Meadowlark
Habitat used during migration and winter is similar to that used during the breeding season, but also includes shallow marshes and cultivated fields (Bent 1958). Like the Bobolink, no important stopover sites for large numbers of migrating Eastern Meadowlarks have been identified in Ontario.

1.6 Limiting Factors

Bobolink and Eastern Meadowlark population sizes are chiefly limited by habitat supply on their breeding grounds, at migratory stopovers, and on the wintering grounds.

Outside the breeding season, the Bobolink is a highly gregarious species that feeds and roosts in large flocks numbering well in excess of 1,000 birds (Renfrew and Saavedra 2007, Blanco and López-Lanús 2008). This trait can expose large numbers to localized hazards (e.g., hurricanes during migration, lethal-control measures in rice crops), making it potentially vulnerable to rapid population declines (Martin and Gavin 1995).

Eastern Meadowlark populations are also thought to be regulated somewhat by periodic bouts of severe winter weather (Lanyon 1995).

1.7 Threats to Survival and Recovery

For the most part, the Bobolink and Eastern Meadowlark face similar threats. These are discussed below in order of their scope and severity, from highest to lowest importance.

<u>Habitat Loss and Degradation on the Breeding Grounds</u>
Across the breeding ranges of the two species, habitat loss and degradation are considered to be the primary threats to their populations. Large areas of hayfield and pasture in Ontario and across eastern North America have been converted to grain and oilseed crops (e.g., wheat, corn and soybean); many farms and ranches on non-productive agricultural lands were abandoned and have subsequently succeeded into forest; and urban sprawl and various development activities have cut into agricultural habitat (Herkert 1991, Bollinger and Gavin 1992, Askins 1993, Warner 1994, Lanyon 1995, Rodenhouse et al. 1995, Jobin et al. 1996, Murphy 2003, Brennan and Kuvlesky 2005, Cadman et al. 2007). When they happen within existing grasslands, tree-planting programs and the creation of pits and quarries are additional sources of habitat loss.

Details on the major sources of habitat loss, and some of the underpinning reasons, are provided below.

In Ontario, growth in urban areas encroached on about 4,300 km^2 of agricultural land during the period from 1971 to 2001, and this trend is expected to continue (Hofmann et al. 2005).

Remnant native grasslands continue to be lost through encroachment of woody vegetation in the absence of wildfires, grazing or active management. Indeed, there has been substantial regrowth of forests on large areas of abandoned hayfields and pasturelands in northeastern North America, including southeastern Ontario (Askins 1993, OMNR 1997, Cadman et al. 2007). Such lands often occur on marginal soils, where opportunities to rotate to other crops are limited by poor drainage, stoniness, shallow soils, low natural fertility, steep slopes, or susceptibility to erosion (J. Bagg, pers. comm. 2011). Costs of maintaining fencing and limited access to water for grazing beef cattle are additional limitations that contribute to land abandonment (J. Bagg, pers. comm. 2011).

Over the past century, the amount of land seeded in hay in Ontario has declined strongly, particularly in the periods from about 1930 to 1940 and again from about 1965 to 1975 (Figure 9). Early declines resulted from the shift to mechanization on farms and the resulting decline in the need for forage for horses. Land in hay remained relatively stable in Ontario from the 1980s until 2006, but declined sharply between 2006 and 2011 (Figure 10). Moreover, since the 1960s, there has been an increasing trend towards the use of Alfalfa and Alfalfa-grass mixtures in Ontario hayfields (Figure 11), which are less attractive to Bobolinks and Eastern Meadowlarks than grass-dominated fields (Bollinger and Gavin 1992, Warner 1994, Patterson and Best 1996). Because of the higher nutritional value given to livestock, the trend towards hayfields planted with increasing amounts of Alfalfa is likely to continue in Ontario (J. Bagg, pers. comm. 2011).

There have also been recent declines in the amount of pastureland. In Ontario, the area of improved and unimproved pasture has declined by about 77 percent and 38 percent since 1966 and 1971, respectively (Figure 10).

Declines in hay and pasture are directly related to changes within the livestock industry. Numbers of cattle, which represent the majority of livestock in Ontario, have declined significantly (Eilers et al. 2010; Figure 12). There are several reasons for this. During the late 20th century, a significant amount of beef production in Canada shifted from Ontario to western Canada (Agriculture and Agri-Food Canada 1997). Moreover, consumer demand for beef in Canada has declined steadily in recent decades and this trend is expected to continue (Serecon Management Consulting Inc. 2005). At the same time, overall feed needs have been reduced owing to increased productivity and efficiencies within the dairy and beef industries (Sargeant et al. 1998, White et al. 2000). Increasingly attractive prices for grain and oilseed crops, coupled with new technology (improved cultivars, agronomic practices, machinery), also now allow greater use of formerly marginal lands for grain and oilseed production at the expense of agricultural grasslands (e.g., Wang et al. 2002).

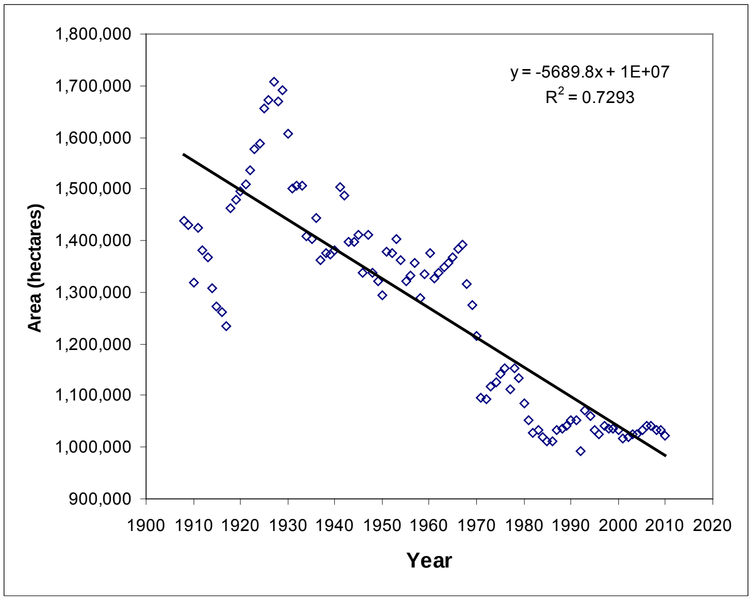

Figure 9. Long-term historical perspective of the estimated area of hay grown in Ontario from 1908 to 2010. Data are from the Canadian Socio-Economic Information Management System database (Statistics Canada 2011).

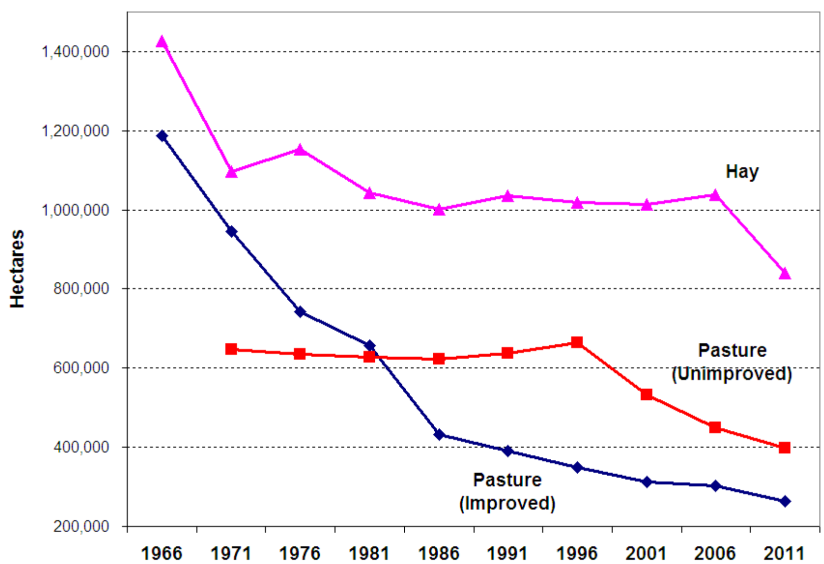

Figure 10. Area in hay and pasture in Ontario from 1966 to 2011 (courtesy OMAFRA).

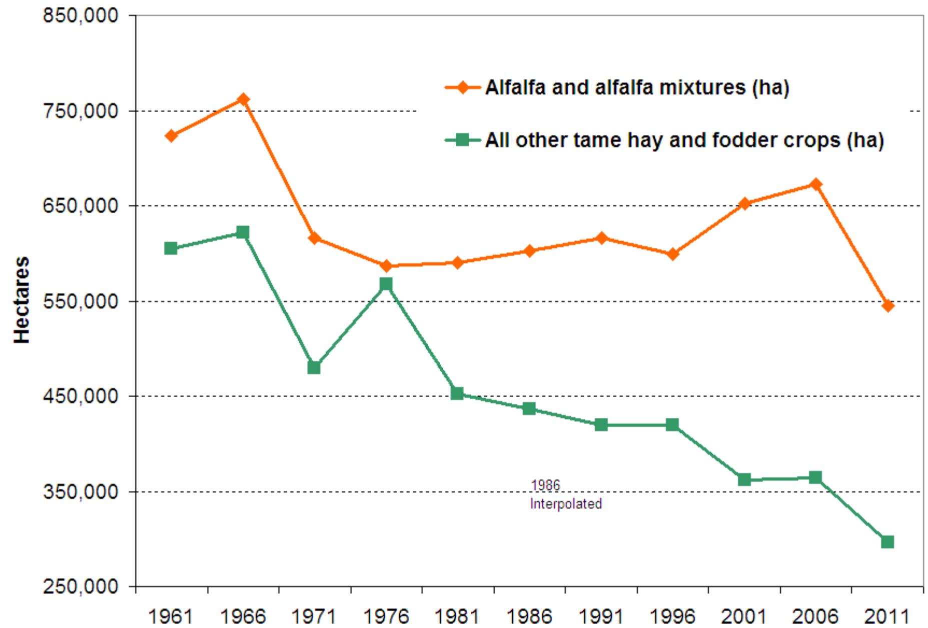

Figure 11. Change in hay composition from 1961-2011 (Statistics Canada and OMAFRA, unpublished data).

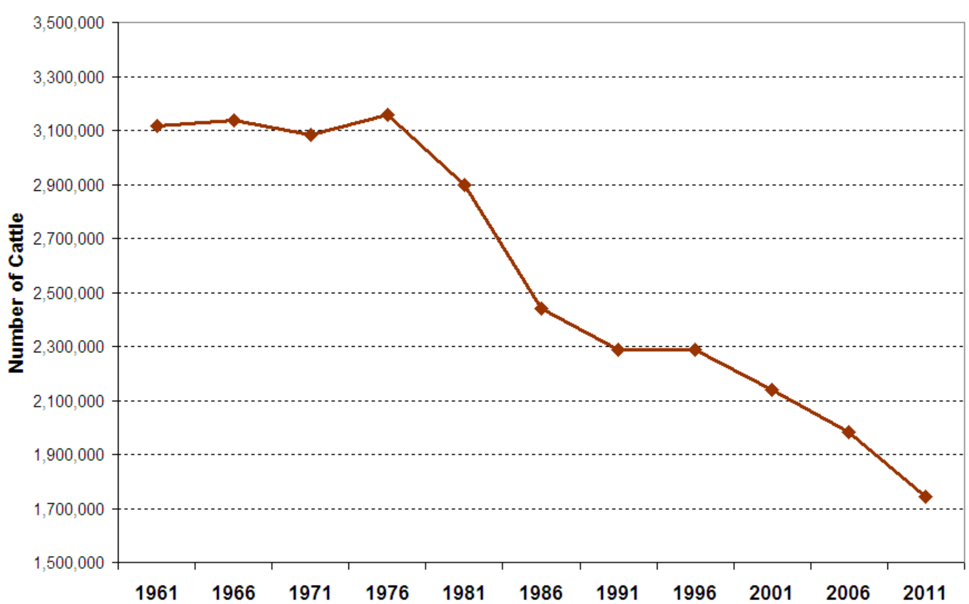

Figure 12. Total number of cattle in Ontario from 1961 to 2011 (courtesy OMAFRA).

While the numbers of cattle in Ontario have fallen in recent decades, the number of horses has increased (Wright 2005, Wilton 2008, Wilton and Caldwell 2009). Between 1996 and 2011, horse numbers on farms in Ontario increased by 13.2 percent (Statistics Canada 2011). The extent to which the increase in horse numbers might offset the decline in cattle numbers (and hence declines in habitat supply) is probably minor, except perhaps in local regions where equine operations tend to be concentrated (e.g., about 50% of the agricultural landbase in the Credit River Watershed is occupied by equine operations; Y. Roy, pers. comm. 2012). Even so, the amount of pasture and hay needed to support horses may be poised to decline as a result of recent withdrawal of provincial government support for the horse racing industry (P. Jeffery, pers. comm. 2012).

Habitat Loss on the Non-breeding Grounds
Across the ranges of both species, the amount of grassland habitat available during the non-breeding period has declined in recent decades.

The extent of native grassland on the Bobolink's South American wintering grounds has declined due to conversion to agriculture and urbanization (Krapovickas and Di Giacomo 1998, Di Giacomo et al. 2005, Renfrew and Saavedra 2007, Azpiroz et al. 2012). Quantitative data across the region are sparse, but in Argentina, over 90 percent of the native grassland has been converted (Di Giacomo et al. 2005), and there have been significant declines in grassland birdlife (Codesido et al. 2011). Because the Bobolink forages in rice crops, the decline in natural habitat in South America may have been balanced somewhat by increases in the area planted to rice (Vickery et al. 2003, Renfrew and Saavedra 2007). However, it is not yet understood how the conversion of native grassland to rice affects wintering populations (Renfrew and Saavedra 2007).

Winter habitat for Eastern Meadowlark in the United States has declined as a result of conversion of forage crops to row crops (Rodenhouse et al. 1995, Murphy 2003).

Incidental Mortality from Agricultural Operations
Incidental loss of nests as a result of early and/or frequent cutting of hayfields is regarded as one of the primary threats to Bobolink and Eastern Meadowlark populations across their breeding ranges (Bollinger and Gavin 1989, 1992, Lanyon 1995, Martin and Gavin 1995, Granfors et al. 1996, Jobin et al. 1996, Kershner and Bollinger 1996, Herkert 1997, Ingold 2002, Nocera et al. 2005, 2007, Perlut et al. 2006, With et al. 2008). Overall mortality of nests as a result of haying operations can be 90 percent or more (e.g., Bollinger et al. 1990). Using the Bobolink as a test case, an unpublished, preliminary modelling exercise estimated that Bobolink productivity (measured as the number of fledged young that would otherwise be expected to survive to migrate south and adjusted for natural mortality) was reduced by 600,000 birds as a consequence of haying operations in Canada each year (Tews et al. 2009).

However, not all hayfields are cut during the peak nesting season, and not all are cut every year. In any given year, some unknown proportion of Bobolink and Eastern Meadowlark nestings in hayfields in Ontario are successful and hence are contributing to the overall provincial population. Otherwise, their populations would be expected to be declining much more rapidly than they are. At the scale of the Upper Great Lakes, Corace et al. (2009) could find no significant relationship between measures of hayfield mowing intensity and regional population trends of Bobolinks and Eastern Meadowlarks.

For the above reasons, the authors of this recovery strategy regard the incidental-take issue as posing a lower level of threat than outright habitat loss. Since Bobolinks are considerably more common in actively-managed hayfields than Eastern Meadowlarks and nest later, the level of this particular threat would likely be greater for Bobolinks (e.g., see Bollinger 1995).

Nest losses from haying occur both directly through the physical destruction of nest contents during routine mowing/raking operations and indirectly through increased predation exposure that follows mowing. For example, in Vermont, haying machinery was responsible for 78 percent of Bobolink nest failures; predation following mowing (mostly by gulls, crows and ravens) accounted for the remaining 22 percent (Perlut 2007).

Changes in harvesting techniques and equipment (e.g., greater mechanization, lower mowing heights, faster tractor speeds, and changes in raking and baling operations) have likely contributed to an increased proportion of nest losses. Hay crops are also apt to be cut more frequently now than historically (e.g., Troy et al. 2005). Owing to changes in hay seed mixtures, increased emphasis on productivity and efficiency, and potentially changes in climate, hay cutting in parts of eastern North America is reportedly carried out about two to three weeks earlier compared to 50 years ago (Warner and Etter 1989, Bollinger et al. 1990, Giuliano and Daves 2002, Troy et al. 2005). Early-season hay cuts have greater nutritional benefits to livestock than cuts later in the season.

The extent to which there has (or has not) been a shift towards earlier haying dates in Ontario is currently unknown. The only data presently available are from the University of Guelph's Elora Research Station, which suggest little change in first-cut date since the 1960s (University of Guelph, Elora Research Station, unpub. data). Of relevance here is that it appears that concern about Bobolink and Eastern Meadowlark nest losses due to early haying has been registered since at least the turn of the last century. In New York, Eaton (1914, pg. 24) writes *…"the nest is often uncovered by the mowers and the young destroyed on account of this practice, which is becoming more and more prevalent, of mowing the meadows in June rather than in July, as was formerly the custom. Consequently, the Bobolink is becoming less common in most portions of New York."* He presents a similar account for Eastern Meadowlark.

In any case, it is true that nesting success in hayfields largely depends on the timing of mowing events. Hayfields that are cut during the height of the nesting season can greatly influence the productivity of both species. For example, in northwestern Arkansas, early mowing activities (mid-May) during the nesting period destroyed 83 percent of songbird nests (including Eastern Meadowlark), but nest loss was substantially reduced (to only 4%) when harvest was delayed until the third week of June (Luscier and Thompson 2009). Likewise, Norment et al. (2010) found that Bobolink nesting productivity in western New York was high in fields that were not mowed until 1 August.

The effect of mowing date on nest productivity is also influenced by the biology of the species. Constrained by its long-distance migration, the Bobolink nesting season (nests with eggs or young) is shorter than that of the Eastern Meadowlark. If hayfield mowing occurs late in the nesting cycle, many birds will not have sufficient time to locate alternative nesting habitat, find mates, and renest (Shustack et al. 2010). Bobolinks are capable of successfully renesting if mowing occurs early – right at the onset of the nesting season (e.g., late May), provided that the second cut occurs 65 or more days later (Perlut et al. 2011). Even so, renesting birds that move on and find refuge in another uncut hayfield can still be exposed to one or more additional cuts of the hay crop. Moreover, depending on the plant composition of the hayfield, the kind of regrowth that emerges following the first cut may no longer provide birds with suitable nesting habitat. This is most clearly the case in Alfalfa-Timothy mixtures, which become strongly dominated by Alfalfa after the first cut.

Habitat Fragmentation

Fragmentation of grassland habitat is occurring across the breeding range of the two species, though no quantitative information is currently available for Ontario. Although Bobolinks and Eastern Meadowlarks can nest in relatively small patches of grassland, abundance and productivity are higher in large patches (>10 ha) and in patches surrounded by other open habitats (e.g., Ribic and Sample 2001, Herkert et al. 2003, Bollinger and Gavin 2004, Keyel et al. 2011).

Bobolinks and Eastern Meadowlarks also respond negatively to edge effects that are associated with habitat fragmentation, particularly forest edges and road edges (Helzer and Jelinski 1999, Fletcher 2003, Fletcher and Koford 2003, Bollinger and Gavin 2004). For Bobolinks and other grassland birds, a primary effect is on rates of nest predation and cowbird parasitism, which are generally higher near edges (Johnson and Temple 1990, Lavallée 1998, Van Damme 1999, Ribic and Sample 2001, Herkert et al. 2003, Bollinger and Gavin 2004, Galligan et al. 2006, Patten et al. 2006). Bobolink and Eastern Meadowlark also avoid heavily-travelled roads, probably owing to highway traffic noise (Forman et al. 2002).

Overgrazing and Trampling by Livestock

Grazing intensity affects grassland bird communities differently depending on factors such as local soils, plant species composition, temperature and precipitation within a given year, productivity of the grassland, and the bird species of interest (e.g., Perlut and Strong 2011). Saab et al. (1995) summarize studies that evaluate the effects of low, medium and heavy grazing on grassland birds, but most of the studies cited do not provide specific stocking rates.

Cattle grazing at low to moderate densities leads to a more diversified vegetation structure within a pasture (Baker and Guthery 1990, Bock et al. 1993, Patterson and Best 1996, Delisle and Savidge 1997, Temple et al. 1999, Hughes et al. 2000, Hull 2003, Powell 2008), which can be associated with greater numbers of successfully-nesting Bobolinks and Eastern Meadowlarks (Bock et al. 1993, Bélanger and Picard 1999, Renfrew and Ribic 2001). However, overgrazing due to high stocking rates leaves grass under 10 cm tall and can severely alter the structure and composition of the vegetation (Roseberry and Klimstra 1970, Kantrud 1981, Holechek et al. 1982, Kantrud and Kologiski 1982, Baker and Guthery 1990, Bock et al. 1993, Hull 2003, Scheiman et al. 2007) and even alter the insect food supply (Jepson-Innes and Bock 1989, Quinn and Walgenbach 1990), degrading habitat suitability for Bobolinks and Eastern Meadowlarks. Likewise, ‘management-intensive rotational grazing’ can result in trampled nests due to high stocking rates and/or frequent disturbance within a given paddock (see Jensen et al. 1990, Lavallée 1998, Temple et al. 1999, Renfrew et al. 2005, Perlut and Strong 2011).

A demographic analysis of Eastern Meadowlarks in the largest remaining region of tall-grass prairie in North America (Flint Hills in Kansas and Oklahoma: 2 million ha) indicated a negative population growth rate (ranging between 0.76 ± 0.096 SE in one year to 0.88 ± 0.17 SE in the next; With et al. 2008). In this region, Eastern Meadowlarks were predicted to decline by 16 to 27 percent per year and the probability that this region supports a viable population was less than 15 percent (With et al. 2008). Therefore, despite the region’s large size, it appears to represent a population sink (With et al. 2008). Intensive livestock grazing, combined with extensive and intensive fire management regimes, were the negative driving factors (With et al. 2008).

<u>Pesticide Exposure</u>

Pesticides include herbicides and insecticides. Their effects can be both direct (e.g., mortality) or indirect (e.g., physiological impairment, reduction of insect food supplies). Pesticide exposure is suspected of contributing to the decline of bird species associated with farmlands in North America (Mineau 2009). Unlike insecticides, herbicides likely do not pose much, if any, direct threat to Bobolinks or Eastern Meadowlarks. The overall effect of pesticide exposure on their populations is unknown, but the scope and severity of this threat could be high, especially for Bobolink. Outside Canada and the United States, pesticide regulations, types, usage and application rates vary throughout the Bobolink’s migratory routes and wintering range, and are poorly documented. Some pesticides that have never been registered due to their toxicity to wildlife and/or humans in Canada and the United States are used in some countries in Latin America and the Caribbean. Indeed, for Bobolink, a potentially large source of exposure comes from insecticides applied to rice fields that the species commonly feeds in during the non-breeding period (Basili 1997, Renfrew and Saavedra 2007). For example, in Bolivia, 40 percent of Bobolinks feeding on rice were exposed to lethal or sublethal pesticide levels (Renfrew et al. 2007, R. Renfrew unpubl. data).

A large-scale analysis conducted in the Canadian prairies suggested that the Western Meadowlark was among the top three species being most affected by large-scale use of granular carbofuran pesticides used in row crops (Mineau et al. 2005). Within the last several years, carbofuran formulations have been banned in Canada and the United States, but they probably contributed to declines in Eastern Meadowlark populations prior to their being taken off the market. On the Eastern Meadowlark’s wintering grounds in the United States, the species commonly occurs in various types of cropland. A national analysis of the risk of bird mortality due to pesticide exposure suggested that the greatest number of bird kills likely occurs in the southeastern states, owing to the high proportion of farmlands using pesticides on crops such as cotton, corn, and cranberry (Mineau and Whiteside 2006).

Within Ontario itself, the limited and declining use of pesticides on hay crops and pastureland (Gallivan et al. 2001, McGee et al. 2010) is unlikely to be having a severe negative impact on breeding populations of Bobolink or Eastern Meadowlark. Nevertheless, Bobolink breeding densities are positively related to the availability of insect prey (Nocera et al. 2007), which is presumably also the case for Eastern Meadowlark. Hence, it is possible that their populations in Ontario could be affected indirectly if insect populations are suppressed by pesticides applied to non-forage crops that are being used as feeding areas by birds nesting in adjacent grasslands.

Human Persecution

In the present day, human persecution is a more important threat for Bobolink than Eastern Meadowlark. Eastern Meadowlarks were once hunted in “large numbers” for food (Bent 1958, pg. 75), but this is no longer the case because of legal protection. Historically, far greater numbers of Bobolinks were once taken by market hunters during fall migration. For example, Forbush (1927 in Bent 1958) estimated that over 700,000 Bobolinks were killed for market in a single year in South Carolina. Birds were also hunted on the wintering grounds, at least as late as 1926 (Bent 1958). While hunting in the United States and Canada is no longer a threat to either species, the extent to which Bobolinks are currently hunted, either for market or sustenance, in South America and the Caribbean is unknown.

Considered a pest in rice crops in some regions during fall migration and the winter, Bobolinks have been intentionally poisoned through lethal control programs (Basili and Temple 1999, Temple 2002, Renfrew and Saavedra 2007, Blanco and López-Lanús 2008, Parsons et al. 2010) and killed by other methods. The extent to which lethal control measures are currently in place in either the United States or elsewhere during the non-breeding period is unknown. Because of the Bobolink’s propensity to occur in very large flocks at this time of year, lethal control measures have the potential to represent a severe threat.

Unknown numbers of Bobolinks are captured in South American and Caribbean countries for illegal sale in the local pet trade (Bent 1958, Martin and Gavin 1995, Di Giacomo et al. 2005). The scale and scope of this particular threat are unknown, but there is currently little evidence that it would have substantial population-level impacts.

In the United States, wintering populations of Eastern Meadowlarks could be negatively affected by blackbird control programs that employ various avicides, including DRC-1339, which is used in the southeastern states where rice plantations are subject to high depredation rates by blackbirds (Denison 2003, Pipas et al. 2003). In Louisiana and Texas, Eastern Meadowlarks are among the most frequent species using rice fields baited with DRC-1339 (Pipas et al. 2003).

Collisions with Tall Structures

Collision threats occur across the Bobolink's breeding and non-breeding range. Although the scope of this threat is increasing, the severity and cumulative impact on populations are undetermined at this time. As a nocturnal migrant, the Bobolink frequently falls victim to nighttime collisions with tall lighted structures, such as tall buildings, communication towers and lighthouses (Evans Ogden 1996, Shire et al. 2000, Long Point Bird Observatory unpubl. data). When situated in grassland habitats, wind turbines can also be a source of Bobolink mortality (Committee on Environmental Impacts of Wind-Energy Projects 2007, Stantec Consulting Ltd. 2011, Anonymous 2012), presumably in part because of its aerial displays.

Collision with tall structures does not appear to pose a significant threat to Eastern Meadowlarks, because they are diurnal migrants and not subject to light-attraction, nor do they perform aerial displays that would routinely bring them into contact with turbine blades. A recent compilation of mortality data from wind turbines in Ontario reported very few Eastern Meadowlark casualties, whereas Bobolink was among the top 10 species in terms of overall kills (Anonymous 2012). The same pattern is present from decades of kill statistics from the Long Point Lighthouse (Long Point Bird Observatory, unpubl. data).

Nest Depredation

The Bobolink and Eastern Meadowlark face similar nest depredation risks from a similar suite of predators. Predation rates vary among studies and regions (e.g., Granfors et al. 1996, Renfrew et al. 2005, Warren and Anderson 2005, Rahmig et al. 2008). The dominant nest predators depend on the make-up of the local predator community.

Overall, the extent to which nest predation is an actual threat (versus a natural, background limiting factor) depends on the extent to which populations of the local predator community are unnaturally "subsidized" by human activities. An assessment of the threat level also needs to be balanced against the knowledge that some nest predators (e.g., carnivores) keep populations of some others (e.g., rodents) in check.

Known or suspected nest predators include various kinds of native species of snakes and rodents, American Crow (*Corvus brachyrhynchos*), Ring-billed Gull (*Larus delawarensis*), domestic cat (*Felis catus*), Raccoon (*Procyon lotor*), Striped Skunk (*Mephitis mephitis*), Red Fox (*Vulpes vulpes*), and more rarely Coyote (*Canis latrans)* and domestic dog (*Canis lupus familiaris;* Bollinger et al. 1990, Lanyon 1995, Martin and Gavin 1995, Lavallée 1998, Van Damme 1999, Dion et al. 2000, Campbell et al. 2001, Jobin and Picman 2002, Renfrew and Ribic 2003, Suedkamp Wells et al. 2008).

Brown-headed Cowbird Nest Parasitism

Grassland songbirds can be frequent hosts of the Brown-headed Cowbird (*Molothrus ater*). Nest parasitism rates on grassland birds are greatest near forest and shrub edges (e.g., Johnson and Temple 1990, Winter et al. 2000). Parasitism rates also vary regionally, because of regional differences in cowbird densities (e.g., Herkert et al. 2003, Patten et al. 2006, Rahmig et al. 2008). For this reason, parasitism rates of both

Bobolink and Eastern Meadowlark are lowest in eastern North America (Norment et al. 2010).

For Bobolink, parasitism rates range from lows of zero percent in western New York (Norment et al. 2010) and zero to six percent in Ontario (Peck and James 1987, Frei 2009), to about 11 percent in northwest Minnesota and southeast North Dakota (Winter et al. 2004), 18 percent in Iowa (Fletcher et al. 2006), and up to 37 percent in Wisconsin (Johnson and Temple 1990), 43 percent in Nebraska (Skipper 2008), and 50 percent in Manitoba (Davis and Sealy 2000).

Although Eastern Meadowlarks generally show a high rate of cowbird egg rejection (Peer et al. 2000), rates of parasitism vary regionally. They are low in New York (0%, n = 25 nests; Norment et al. 2010); Indiana (0%, n = 131; Galligan et al. 2006), Illinois (1.8%, n = 221; Peer et al. 2000), Ontario (2.4%, n = 370; Peck and James 1987), and Oklahoma (6.1%, n = 512; Patten et al. 2006), but relatively high in Wisconsin (16%, n = 38 nests; Lanyon 1957) and Kansas (7.7- 36.5%; Rahmig et al. 2008).

Given the low rates of nest parasitism in Ontario, the direct impact of parasitism on Bobolink and Eastern Meadowlark populations here is minor relative to other losses in nesting productivity.

<u>Climate Change and Extreme Weather</u>
Climate change is predicted to increase the frequency and intensity of bouts of extreme weather events, including droughts, heavy precipitation, and hurricanes. In winter and early spring, Eastern Meadowlarks are sensitive to extreme weather events, such as ice storms and deep snow cover (Krutzsch 1950, Lanyon 1995). Furthermore, With et al. (2008) reported a decrease in fecundity and nesting success in Eastern Meadowlarks during a severe drought. Because Bobolinks migrate in very large flocks in the fall over the Gulf of Mexico, they could also be exposed to higher mortality events associated with anticipated increases in the frequency and intensity of hurricanes.

1.8 Knowledge Gaps

Executing conservation measures efficiently and effectively requires an understanding of the demographics, population dynamics, limiting factors, threats, and socio-economic barriers that are specific to Bobolink and Eastern Meadowlark populations in Ontario. The ultimate goal in addressing knowledge gaps is to determine the most effective actions that are most likely to lead to successful recovery, a process that involves measuring their efficacy once implemented. As such, an adaptive management framework (see Glossary) allows periodic adjustments to be made as needed, as new knowledge is accumulated. Key knowledge gaps are briefly outlined below.

<u>Habitat Availability and Quality in Ontario</u>
- Knowledge about how much habitat is presently available, where it occurs and its “quality.” An inventory and assessment of the current types, distributions,

proportions, and areal extents of habitat used by both species in Ontario are required.This includes an assessment of the proportion of land that is under different land-use and management regimes within general habitat types (e.g., areal extents of beef, dairy, and horse pastures and hayfields, winter wheat and rye).

- Knowledge of the relative importance of different types of agricultural lands to the density and productivity of the two bird species. Simply understanding the proportion of the Bobolink and Eastern Meadowlark breeding populations that occurs within pasture versus hayfield is an important information gap.
- The importance of the current supply of natural grasslands (e.g., remnant prairie, savannah, alvar grassland, beaver meadow, restored prairie) to the two species.
- Preferences for vegetation composition and structure (e.g., the relative use of native versus non-native grass species, grazer stocking rates, hay crop types, microhabitat needs).
- The importance of other, currently less common agri-grassland habitat (e.g., lands used to support sheep, bison, and other species). This may identify additional land-use types that can be managed or supported to enhance populations of Bobolink and Eastern Meadowlark.
- Knowledge of the relative quality of habitat under various general management regimes. For example, there is a need to differentiate the reproductive importance of hay versus pasture habitats and to differentiate between different types of hayfields and pastures and the climate, landform and soils on which they occur. While much higher densities of Bobolinks and Eastern Meadowlarks are often associated with hayfields, it may be that the lower-density pasture birds are actually more successful in fledging young.
- Research on the degree to which each habitat and management regime is likely a population ‘source’ or ‘sink’.
- Research on the thresholds for, and effects of, grassland patch size in relation to landscape composition (e.g., tree cover). This will assist in determining the scale(s) at which management should occur in Ontario and will aid in developing focal areas for management.
- Knowledge about how different agricultural sectors present different opportunities and constraints for Bobolink and Eastern Meadowlark conservation.

<u>Habitat Availability and Quality in Ontario: Emerging Industries and Institutional Lands</u>

- Cumulative effects that the wind and solar industries may have on Bobolink or Eastern Meadowlark populations in Ontario.
- Effects and merits of large-scale planting of perennial, biomass crops using polycultural mixtures of native species of grasses and forbs (e.g., Switchgrass (*Panicum virgatum*) and Big Bluestem (*Andropogon gerardii*)) versus monocultures of non-native species (e.g., *Miscanthus*) (see Murray 2003, Meehan et al. 2010, Robertson et al. 2010, Fletcher et al. 2011).
- The extent to which biomass crops will be grown in Ontario, and where.
- The amount and location of native grassland that is protected, managed or restored in Ontario.

Assessment of Threats to Survival and Recovery

- Knowledge about the extent and rate that grassland habitat is being lost or converted in various regions of Ontario, and the relationship to regional Breeding Bird Survey trends.
- Proportion of hayfields that is routinely cut late enough to allow successful fledging of Bobolinks and Eastern Meadowlarks.
- Understanding of significance of constraints within the full life-cycle of the species (e.g., including potential population bottlenecks occurring outside of the province).
- A population viability analysis for Ontario will provide a better understanding of factors that limit populations here. These models should include parameters such as breeding productivity, adult survivorship, post-fledgling survival, dispersal, immigration and emigration rates, and habitat supply across various time periods (e.g., see Perlut 2007 and Perlut et al. 2008a, b). Prioritizing the kinds of key data that need to be collected is a first-stage knowledge gap.

Management Options: Prioritizing Actions and Assessing Performance

- The degree to which the adoption of various best management practices can be expected to benefit Bobolink and Eastern Meadowlark populations (see With et al. 2008 and Brambilla et al. 2010 for useful examples).
- An evaluation of socio-economic factors that influence land management decisions that could benefit the target species (e.g., economic impacts, costs of various management options, and barriers).

Important Migratory Stop-over Sites for Bobolink

- No information is presently available about the nature or extent of migratory stop-over sites in Ontario. During fall migration, the Bobolink often occurs in large flocks (i.e., >1,000 birds) at migratory stop-over sites in the United States and farther south (Pettingill 1983, Martin and Gavin 1995). Because such sites could represent critical feeding/refueling areas, they are worthy of conservation attention.

Rescue Effect

- An assessment of immigration and emigration rates is important to understand the extent to which Bobolink and Eastern Meadowlark populations in Ontario rely on source populations that originate from other jurisdictions.

1.9 Recovery Actions Completed or Underway

Conservation Planning

Collaborative actions with other existing initiatives that have been developed or are under development will improve efficiency and effectiveness of recovery efforts for Bobolink and Eastern Meadowlark.

- Single-species recovery strategies have been developed for several other grassland species at risk in Ontario, including American Badger (Ontario

American Badger Recovery Team 2010), Eastern Prairie Fringed-orchid (Eastern Prairie Fringed-orchid Recovery Team 2010), Barn Owl (Ontario Barn Owl Recovery Team 2010), Henslow's Sparrow (Environment Canada 2010a), and Eastern Loggerhead Shrike (Environment Canada 2010b).
- Ecosystem-based recovery planning documents have been drafted for various habitats containing native grasslands in Ontario. Examples include tallgrass prairie (Rodger 1998, Bowles 2005), alvars (Jones and Jalava 2005), and grassland birds (Bird Studies Canada 2009). Similarly, a plan for conserving grassland birds in New York has been developed, with much relevant information and tools applicable to recovery efforts in Ontario (Morgan and Burger 2008).
- Site-specific conservation action plans have been developed for some important grassland areas in Ontario, including the Carden Plain (Coxon and Reid 2001), Luther Marsh (Cheskey and Wilson 2001) and Prince Edward County South Shore (Wilson and Cheskey 2001). The Nature Conservancy of Canada has also been heavily involved in conservation planning in the Napanee and Carden Plains (D. Kraus, pers. comm. 2012).

<u>First Nations Protection and Recovery Activities</u>
- While each First Nation has its own unique views and beliefs, there are many examples of decisions taken to preserve habitats as part of a shared belief in the sacredness of natural lands. These are deeply coupled with a consideration of projected long-term community effects across multiple generations. The Alderville First Nation prairie restoration project, as part of the Rice Lake Plains Joint Initiative (see Farrell et al. 2004), is an example. In addition, the Chippewas of Nawash have been documenting and monitoring species at risk on grasslands (including alvar grasslands) at Cape Croker and elsewhere within their traditional territory in Grey and Bruce counties (Jalava and Chegahno 2010). A draft ecological restoration plan has been developed for the Prairie Point Alvar at Cape Croker (Jalava 2011). Likewise, a draft ecosystem recovery strategy is informing activities at Walpole Island First Nation, which supports large areas of tallgrass prairie and oak savannah (Bowles 2005).

<u>Restoration of Native Grasslands</u>
- Tallgrass Ontario has undertaken a number of activities to promote the conservation, restoration, rehabilitation and creation of native prairie and savannah habitats in Ontario. These include the development of a web site (www.tallgrassontario.org) with information on prairie conservation, restoration, species at risk, financial incentives, and outreach. In 2011, it launched a new program ('Ontario Grassland Initiative') that aims to restore 400 ha of native grasslands per year (K. Breault, pers. comm. 2012).
- The Nature Conservancy of Canada plans to protect at least 1,000 ha of tallgrass prairie and alvar grasslands in the next five years, and to restore an additional 400 ha (D. Kraus, pers. comm. 2012).
- Many other conservation-oriented agencies and institutional landowners in Ontario, as well as many private landowners, have been including tallgrass prairie/savannah restoration initiatives in their land management plans.

- Guidelines that incorporate grassland priorities have been developed for species at risk associated with rehabilitation projects on lands affected by the aggregate industry (Savanta Inc. 2008).

Incentive and Related Programs

- In Ontario, several government-supported incentive programs are currently available that can benefit Bobolinks and Eastern Meadowlarks. These include federal programs: (1) Canada-Ontario Environmental Farm Plan, (2) Habitat Stewardship Fund for Species at Risk and (3) Aboriginal Fund for Species at Risk. There are also three provincial programs: (1) Conservation Land Tax Incentive Program, (2) Species at Risk Farm Incentive Program and (3) Species at Risk Stewardship Fund.
- The Alternative Land Use Services (ALUS) program, which began in Norfolk County in 2005 and has recently expanded to several other regions in southern Ontario, can serve as a useful conceptual model for planned retirement of marginal agricultural lands and for the adoption of other beneficial farmland practices (see http://www.norfolkalus.com). ALUS projects frequently incorporate stewardship of agricultural grasslands and the restoration of native prairies and savannahs (B. Gilvesy, pers. comm. 2011). Participating landowners in Norfolk County currently receive an annual payment of $150 per acre, which is based on local, current land-rental values.
- With support from the OMNR, the Ontario Soil and Crop Improvement Association (OSCIA) is currently piloting the ‘Grassland Habitat Farm Incentive Program’ for 2012 and 2013 (C. Schmalz, pers. comm. 2012). This province-wide environmental incentive program directs cost-share dollars towards registered farmers with hay or pasture, who are actively enhancing grassland bird habitat through the adoption of best management practices. The program has a competitive bid structure, which includes a scoring system specifically designed for grassland habitat, that assesses applications within a cost/benefit framework.
- Beginning in 2011, the Couchiching Conservancy offered to pay Carden Plain landowners who have nesting Loggerhead Shrikes an initial rate of $10 per acre. To qualify for the program, landowners must protect the habitat around active nests, and allow access by conservation staff to monitor nest success (R. Reid pers. obs. 2012). This program will last for at least three years, supported by private funding. Bobolinks and Eastern Meadowlarks also occur on many of these lands.

Research and Monitoring

- The International Alvar Conservation Initiative documented and surveyed alvars across the Great Lakes Basin in the late 1990s (Reschke et al. 1999, Brownell and Riley 2000). Subsequent inventory and research have been undertaken at a more detailed and comprehensive level in Ontario, particularly on the Bruce Peninsula (Jalava 2008) and the Carden Plain (Jalava 2005, Jalava and Bowles 2007).

- In 2011, OSCIA developed a three-year project to: (1) investigate the suitability of purpose-grown biofuel crops as nesting habitat for Bobolinks, (2) assess management of intensive rotational grazing to accommodate Bobolinks and (3) pilot a conservation tender approach to awarding incentives for managing farms to accommodate grassland birds. Project sites are located on farm properties.
- In 2012, OSCIA initiated a research project in partnership with the Ontario Ministry of Agriculture, Food and Rural Affairs and the George Morris Centre to examine the range of agricultural practices that have been shown or can be expected to benefit populations of Bobolink and Eastern Meadowlark; analyze the effectiveness of these practices in benefiting these species; analyze the economic viability of these practices for the Ontario agricultural sector; examine incentive and education program tools used in other jurisdictions to benefit farmland birds; and propose recommendations for Ontario that can be expected to benefit populations of Bobolink and Eastern Meadowlark without negatively affecting agricultural production.
- At Trent University, an MSc student is working on a project in collaboration with the Rice Lake Plains Joint Initiative. This study is testing whether grassland bird species prefer non-intensive agricultural fields (hay or pasture) over intensive agricultural fields (grains, soy, corn), cultural meadows (shrubby fields), or small isolated patches of natural grassland (prairie, savannah; J. Nocera, pers. comm. 2011). A similar study was initiated in 2011 by the Alternative Land Use Services program and Bird Studies Canada in Norfolk County, though this research focuses on assessing the value of various kinds of habitat restoration treatments on retired farmland.
- Another MSc student at Trent University is assessing the utility of very early hay harvest (*sensu* Perlut et al. 2011) for Bobolinks in Ontario. She is monitoring the movements and breeding phenology of Bobolinks and insect communities, in control and experimental fields across south-central Ontario. Another project is replicating the study of Nocera et al. (2005) in Ontario, to determine the circumstances in which delayed hay harvest is feasible. Students and researchers with Trent University are also engaged in this project (E. Nol, pers. comm. 2012).
- From 2009 to 2011, Environment Canada conducted the Ontario Grassland Bird Survey, delivered under the auspices of Wildlife Preservation Canada. While focused on locating Loggerhead Shrikes, surveys were conducted within regionally important areas for Bobolink and Eastern Meadowlark.
- Grassland bird surveys and monitoring have been undertaken in the Carden Plain Important Bird Area and adjacent areas for several years since 2000 (Couchiching Conservancy 2011, R. Reid, pers. obs. 2012).

<u>Communications and Outreach</u>

- A Bobolink fact sheet has been produced by OMNR (see http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/288994.html).

<u>Policy Development</u>

- In June 2011, the province provided a three-year exemption to farmers from protection provisions under the ESA for Bobolink. The exemption lasts until 31 October 2014 and was amended in July 2012 to include Eastern Meadowlark.
- The province also formed a special roundtable panel that is intended to examine and recommend activities related to: (a) dedicated and targeted funding for stewardship incentives, (b) the establishment of applied research projects, (c) targeted outreach and extension services to support landowner conservation activities and (d) recognition for outstanding grassland stewardship. The panel consists of 13 members, representing the interests of conservation organizations, agricultural organizations, the wind industry, the aggregate industry, developers, and municipalities. OMNR and the Ontario Ministry of Agriculture, Food and Rural Affairs provide secretariat support. As part of its work, the roundtable is examining options for overall-benefit permitting, exploring the potential to introduce safe harbour provisions, and considering the merits of extending the current exemption for agricultural activities.

2.0 RECOVERY

2.1 Recovery Goal

The long-term recovery goal is to maintain stable, self-sustaining populations of Bobolinks and Eastern Meadowlarks in Ontario, and in so doing contribute to the conservation of the guild of grassland birds. In the short term (over the 10-year period from 2013-2023), the goal is to slow the annual rate of population decline for both species to an average of no more than 1 percent per year (i.e., no more than 10% over 10 years). Achieving population stability at roughly 90 percent of the present-day population size is the long-term goal thereafter.

Narrative to Support Recovery Goal

Analyses of existing data demonstrate that there is strong overlap in the patterns of occurrence and abundance of Bobolinks and Eastern Meadowlarks in southern Ontario at both regional and site scales (McCracken et al. 2012). This reinforces the value of incorporating both species into a multi-species recovery strategy and the value of having a shared recovery goal.

Because of their present-day reliance on human-modified, privately-owned, agricultural landscapes, conservation of grassland birds in eastern North America poses a particularly significant ecological, financial and political challenge (e.g., Norment 2002). In setting the recovery goal for the Bobolink and Eastern Meadowlark, the recovery strategy authors considered these challenges within the context of several options.

One option was to allow the populations of both species to further decline to levels that might approximate their pre-European settlement condition in Ontario. This was not judged to be a reasonable goal for a number of reasons, but ultimately because it risks making a bad situation much worse, not just for Bobolink and Eastern Meadowlark, but for all grasslands-dependent wildlife, both within and outside Ontario.

At the opposite end of the spectrum, increasing the size of the populations to some previously-higher arbitrary level was also not identified as a reasonable or feasible goal, nor is it warranted from the perspective of what is likely needed to ensure population persistence.

In Ontario, both species were designated threatened based largely on documented population declines that exceeded a 30-percent threshold over the most recent 10-year period (COSSARO 2010, 2011). Hence, stabilizing their population sizes at roughly present-day levels over a 10-year period could result in downlisting to a lower category of risk when the species are reassessed by COSSARO. This “no net loss” goal is also consistent with the Partners in Flight planning document for Ontario’s Bird Conservation Region 13 (Ontario Partners in Flight 2008).

However, in reality, stabilizing populations at present-day levels is deemed impossible because of the nature and number of threats. Habitat loss in Ontario can be expected to continue, at least over the next 10 years, owing to provincial trends in urbanization, agricultural commodity prices, human population growth, and changes in the beef and dairy sectors. As such, immediately stabilizing populations at present-day levels is not considered feasible, even though both species demonstrate a capacity to respond fairly quickly to targeted habitat management efforts (e.g., Herkert 2009).

Considering the above, it is recommended that a reasonable alternative is to slow the current average annual rate of population decline from an average of three to four percent annually to an average of one percent over the next 10 years (equivalent to an overall loss of 10%). The aim thereafter is to achieve population stability. This approach embeds a short-term goal within the longer-term goal of achieving population stability.

In setting the recommended recovery goal, both higher and lower rates of loss were considered. A stronger annual average rate of decline (e.g., -2%) was not judged acceptable because the confidence intervals around that projected trend would still yield an overall decline of upwards of 30 percent over 10 years. This would maintain the status quo and hence not appear to meet the definition of a reasonable recovery goal. Conversely, a shallower rate of decline (e.g., -0.5%) was judged to be impossible to meet as a recovery goal. Even the recommended short-term goal is ambitious.

2.2 Protection and Recovery Objectives

Table 2. Protection and recovery objectives

No.	Protection or Recovery Objective
1	Describe priority habitats and regions for conservation, identify key factors that may impede or assist species recovery, and establish the target levels of habitat supply and habitat management regimes that are needed to meet the recovery goal.
2	Increase public awareness of the two species and their habitat.
3	Improve nesting productivity and habitat quality.
4	Increase habitat supply of native grassland.
5	Maintain existing habitat supply of agricultural grasslands to the extent practicable.
6	Establish strong links to other conservation planning efforts underway for other grassland species that are of high conservation concern, both in Ontario and in other relevant jurisdictions.
7	Apply appropriate ESA protection, habitat regulations and any other provincial or federal policies and assess the degree to which they help stabilize populations of the two species.
8	Track and report on the state of populations in relation to recovery activities.

2.3 Approaches to Recovery

Table 3. Approaches to recovery of the Bobolink and Eastern Meadowlark in Ontario

Relative Priority[1]	Relative Timeframe[2]	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
1. Describe priority habitats and regions for conservation, identify key factors that may impede or assist species recovery, and establish the target levels of habitat supply and habitat management regimes that are needed to meet the recovery goal.				
Critical	Short-term	Research	1.1. Quantify the proportions of the species' populations that nest in various habitat types (e.g., pasture, hay, grain crops, non-agricultural lands), and determine how much of each habitat type is currently available. Research should also include examining the potential importance of: • large fields of winter wheat and rye (with and without underplanting with clover or Alfalfa); • fields having various mixtures of Timothy and Alfalfa; • crop fields that have grassed waterways running through them; and • fields supporting the horse industry.	• Knowledge of the importance of different kinds of habitats, and where to invest most heavily.
Critical	Short-term	Research	1.2. Investigate issues that may impede or assist in recovery actions being taken to promote species recovery in each of the habitat types listed in 1.1.	• Improved knowledge of where to invest most heavily.
Critical	Short-term	Research	1.3. Identify core regions most likely to be capable of supporting moderate to high densities of the species, and provide mapping at resolutions that inform management at both local and regional scales.	• Knowledge of focal areas that are important to recovery in Ontario.
Critical	Short-term	Research	1.4. Within each core region, determine the recent rate of change of habitat supply and the underlying economic and land-use practices factors driving this change.	• Better understanding of habitat trends and underlying causes.
Critical	Short-term	Research	1.5. To assist in the identification of priority habitats and/or regions and/or industry sectors, determine whether they are ecological sinks and the extent to which they are likely able to continue to sustain populations without assistance or incentives.	• Knowledge of focal regions/habitats/industry sectors that are most important to recovery.

Relative Priority[1]	Relative Timeframe[2]	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
Critical	Long-term	Research	1.6. Assess the relative degree to which the species' populations are impacted by threats that occur within Ontario versus threats that occur outside the breeding season.	• Better understanding of the extent to which actions in Ontario will positively affect populations.
Critical	Short-term	Research	1.7. Based on agro-economic and biological research, assess the degree to which suggested management options to enhance species' breeding productivities will work in Ontario. • Make this information available to land managers as a stewardship package (see Objective 2). • Periodically review research results and make refinements as needed.	• Nesting productivity. • Habitat loss/degradation.
Necessary	Short-term	Research	1.8. For different conservation and management approaches, estimate the amounts of habitat that will be needed to meet the recovery goal.	• Nesting productivity. • Habitat loss/degradation .
Necessary	Long-term	Research	1.9. Assess the degree to which the cumulative effects of mortality and habitat loss associated with various industry and development projects pose a threat to populations (e.g., wind, solar, aggregates, urban development).	• Incidental mortality. • Habitat loss/degradation.
Necessary	Short-term	Research	1.10. Assess the degree to which various configurations of grassland biomass crops can support grassland bird habitat and still satisfy socio-economic needs. • Provide recommendations. • Determine potential negative effects of large-scale corn ethanol production on grassland cover.	• Habitat loss/degradation.
2. Increase public awareness of the two species and their habitat.				
Critical	Short-term and Ongoing	Outreach and Education	2.1. Develop and implement an effective communications strategy aimed at a variety of relevant audiences.	• Increase public understanding of threats and issues.

Relative Priority[1]	Relative Timeframe[2]	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
Critical	Short-term	Research	2.2. Conduct a detailed assessment to determine the behaviours, barriers, and benefits of landowners in order to develop effective stewardship programs that provide lasting results.	• Understanding of the extent to which activities are able to positively affect species populations.
Critical	Long-term	Outreach and Education	2.3. Engage farm industry associations in ongoing research and pilot projects to clarify key issues and assess the effectiveness and economics of various policies and practices in affecting the supply of suitable habitat.	• Habitat loss/degradation. • Evaluation of management options.
Beneficial	Ongoing	Outreach and Education	2.4. Develop and use creative marketing tools to promote consumer demand for Ontario's grass-fed beef industry and thereby help maintain pastureland.	• Habitat loss.
Beneficial	Ongoing	Outreach and Education	2.5. Create an awards program that recognizes significant grassland conservation and restoration work in Ontario, both for agricultural grasslands and native grasslands.	• Habitat loss/degradation.
3. Improve nesting productivity and habitat quality.				
Critical	Short-term and Ongoing	Habitat Management	3.1. Use existing research results to identify and support the most viable options and relative merits of modified haying or pasture management practices within agricultural sectors to minimize disruption to farmers and ranchers, while also benefiting nesting productivity. • Assess economic options and impacts for proposed practices, and assess the types of producers and landowners that selected practices might best suit.	• Habitat degradation. • Incidental mortality. • Habitat fragmentation / nest predation.
Critical	Short-term and Ongoing	Stewardship	3.2. Design and implement an incentive program. • Link to economic analysis in 3.1 and to the adaptive management framework.	• Habitat degradation. • Incidental mortality. • Habitat fragmentation/nest predation. • Overgrazing.

Relative Priority[1]	Relative Timeframe[2]	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
Critical	Short-term	Stewardship	3.3. Develop technical publications, educational materials and delivery system to provide extension services to farmers and landowners on how to implement the most viable practices identified in 3.1.	• Habitat degradation. • Incidental mortality. • Habitat fragmentation/nest predation.
Critical	Short-term	Stewardship	3.4. Provide and support the use of technical guidance on seed mixes, cutting practices and management practices that are optimal for Bobolink and Eastern Meadowlark reproductive success and viable for agricultural landowners.	• Habitat degradation. • Incidental mortality. • Habitat fragmentation/nest predation. • Overgrazing.
Necessary	Short-term	Management/ Stewardship	3.5. Assess and promote suitable planting/management options for biomass crops that are likely to benefit Bobolink and Eastern Meadowlark populations.	• Habitat loss/degradation. • Incidental mortality. • Habitat fragmentation/nest predation.
4. Increase habitat supply of native grassland.				
Critical	Ongoing	Stewardship/ Habitat Management	4.1. Identify and implement incentive programs and/or agro-economic policies that will provide an effective stimulus to landowners to increase the extent of native grasslands that contribute to recovery.	• Habitat loss. • Habitat fragmentation.
Critical	Ongoing	Stewardship/ Habitat Management	4.2. Encourage the use of appropriate management tools (periodic fire, grazing, mowing) to maintain native habitat.	• Habitat loss. • Habitat fragmentation.
Necessary	Short-term	Stewardship/ Habitat Management	4.3. Develop guidelines to help interested landowners decide whether their site should be planted in trees or native grassland, or left to regenerate naturally.	• Habitat loss. • Habitat fragmentation.
Critical	Ongoing	Protection/ Securement	4.4. Protect existing native grassland sites (e.g., through acquisition or easements), and enlarge them where possible.	• Habitat loss.

Relative Priority[1]	Relative Timeframe[2]	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
Necessary	Short-term and Ongoing	Monitoring	4.5. Develop a spatially-referenced database to provide an inventory of all native grassland remnants and all habitat creation and restoration projects. • Develop standardized methods to enable ongoing monitoring and evaluation of projects and associated management activities through an adaptive management framework.	• Habitat loss. • Incidental mortality. • Habitat fragmentation/nest predation.
Beneficial	Ongoing	Stewardship/ Outreach and Communications	4.6. Showcase native grassland conservation and restoration projects and highlight their environmental benefits and natural heritage values.	• Habitat loss. • Incidental mortality. • Habitat fragmentation/nest predation.
5. Maintain existing habitat supply of agricultural grasslands to the extent practicable.				
Critical	Ongoing	Stewardship	5.1. Identify and support incentives and actions that would assist landowners in maintaining the existing supply of pasture, hay and cultural meadow suitable to Bobolinks and Eastern Meadowlarks, with a focus on "marginally" productive agricultural lands.	• Habitat loss/succession. • Habitat fragmentation/nest predation. • Overgrazing.
Beneficial	Ongoing	Stewardship/ Outreach and Communications	5.2. Showcase agricultural grassland conservation projects by setting up demonstration sites that provide working examples of sustainable grassland agriculture.	• Habitat loss. • Incidental mortality. • Habitat fragmentation/nest predation.
6. Establish strong links to other conservation planning efforts underway for other grassland species that are of high conservation concern, both in Ontario and in other relevant jurisdictions.				
Necessary	Ongoing	Communications	6.1. Establish an advisory committee on grassland birds at risk.	• Habitat loss/degradation. • Incidental mortality. • Habitat fragmentation / nest predation. • Overgrazing.

Relative Priority[1]	Relative Timeframe[2]	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
Necessary	Ongoing	Outreach and Education	6.2. Encourage partnership-based projects for stewardship on such areas as community pastures, prairie restoration sites, natural hayfields, reclaimed industrial lands, and other types of managed areas and use them to provide local examples of partnerships and their effectiveness.	• Habitat loss/degradation. • Incidental mortality. • Habitat fragmentation/nest predation. • Overgrazing.
Necessary	Ongoing	Research and Communications	6.3. Identify, inform, collaborate and liaise with other relevant jurisdictions (e.g., other provinces, states, South American countries) that have conservation and/or research programs focusing on the target suite of grassland birds.	• All threats and knowledge gaps.
7. Apply appropriate ESA protection, habitat regulations and any other provincial or federal policies and assess the degree to which they help stabilize populations of the two species.				
Critical	Short-term	Protection and Stewardship	7.1. Define and protect appropriate habitat in a regulation under the ESA, and develop a mechanism to notify and inform affected landowners.	• Habitat loss.
Critical	Short-term	Protection and Stewardship	7.2. Engage in appropriate consultation to determine whether to extend the current three-year exemption for agricultural operations.	• Habitat loss.
Critical	Short-term	Protection and Stewardship	7.3. Engage in appropriate consultation to determine the extent to which safe harbour provisions might benefit the species.	• Habitat loss.
Critical	Short-term	Protection and Research	7.4. Use results from research studies to refine guidelines related to the achievement of overall-benefit conditions needed to offset destruction of regulated habitat (e.g., minimum patch sizes, appropriate off-set ratios, habitat community compositions, management approaches).	• Habitat loss.
Necessary	Short-term	Protection and Stewardship	7.5. If one or both species become legally protected under the federal SARA, work with Environment Canada to determine the extent to which Ontario's recovery strategy can serve as the framework for a national strategy.	• All. • Policy effectiveness.

Relative Priority[1]	Relative Timeframe[2]	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
Critical	Ongoing	Protection	7.6. Within an adaptive management framework, assess the effectiveness of the provincial habitat regulation and related policies at appropriate intervals and modify if deemed necessary.	• Policy effectiveness.
8. Track and report on the state of populations in relation to recovery activities.				
Necessary	Short-term	Monitoring and Assessment	8.1. Assemble a team to design the elements of an adaptive management strategy.	• Knowledge of the effectiveness of recovery strategy implementation.
Necessary	Ongoing	Monitoring and Assessment	8.2. In addition to tracking population changes via the Breeding Bird Survey, undertake focused monitoring studies in a selected set of sample sites where particular management efforts have been implemented to assess the effectiveness of particular recovery actions and to learn from them.	• Knowledge of the effectiveness of recovery strategy implementation.
Critical	Ongoing	Monitoring and Assessment	8.3. Monitor the supply of different types of agricultural grassland habitat through the agricultural census and link these results to population trends of Bobolinks and Eastern Meadowlarks.	• Knowledge of the effectiveness of recovery strategy implementation.
Critical	Ongoing	Monitoring and Assessment	8.4. To ensure that the adaptive management approach is used to adjust any recovery actions that are not demonstrating the desired outcome, monitoring and evaluation results should be provided in regularly-filed reports made publicly accessible by the responsible jurisdictions.	• Knowledge of the effectiveness of recovery strategy implementation.

[1] **Relative Priority**: “Critical” = highest priority for survival and/or recovery and will tend to be those that should be implemented sooner rather than later. “Necessary” = important to implement for survival and recovery but with less urgency than Critical. “Beneficial” = helps to achieve recovery goals but are not considered as important to the survival and recovery of the species as the preceding two classes of approaches.

[2] **Relative Timeframe**: “Short-term” = within five years; “Long-term” = within 10 years; “Ongoing” = annually.

Narrative to Support Approaches to Recovery

Because of the present-day reliance on agricultural landscapes in Ontario (most of it privately-owned), economic, social, and biological factors should be considered when designing pragmatic conservation approaches for the Bobolink and Eastern Meadowlark. To the greatest practical extent, the recovery objectives should be met through the voluntary actions of private landowners, supported by incentives that are tied to best management practices and other conservation measures.The following provides additional information for some of the recovery approaches.

Approach 1.2

The potential for engagement in different kinds of best management practices among the full range of landowners (e.g., beef, dairy, sheep and horse farmers, as well as non-agricultural rural, government, non-government landowners), with and without cash incentives, requires study. Such research should include interviews and surveys with individual landowners to better understand their issues, motivations and attitudes (see Riley 2004, Troy et al. 2005 for useful insights). This information, along with species' demographic parameters, can be used to construct models that better inform where investment in recovery efforts is best placed.

Approaches 1.3 through 1.5

To achieve the recovery goal, it will be worth considering actions that are regionally specific. For example, it may be appropriate to give greater weight to recovery actions in regions that currently hold high densities of Bobolinks and/or Eastern Meadowlarks that are likely to provide source populations ('focal regions') compared to regions that hold low densities. On the other hand, there is a risk of ignoring the ecological importance of birds that have persisted at low densities outside the core breeding range (i.e., areas of central and northern Ontario). Specific details about how best to approach regionally-specific objectives are intended to be resolved as a research action item identified within this recovery strategy. As noted in Approach 1.2, different agricultural sectors (and even crop types) also offer different constraints and potential opportunities.

Approach 1.6

Identifying the actual nature of threats across the full life-cycle of a species with any certainty is difficult, time-consuming and expensive. However, much can be inferred by undertaking studies that provide good information on annual, between-summer, and between-winter survivorship rates. Coupled with similarly good information on breeding productivity, studies can point to the relative extent to which population declines originate from issues encountered on the breeding grounds versus the non-breeding period.

Approach 1.8

A modelling execise can be used to inform the extent to which various elements of the recovery strategy, applied at different levels across a variety of geographic and time scales, can be expected to effectively contribute to species recovery. This could include models quantifying bird population targets in relation to habitat targets, and using spatial decision tools like MARXAN to explore competitive interactions and to prioritize conservation efforts in different parts of the landscape – coupled with agro-economic considerations.

Approach 2.1
Outreach and communications should highlight information and issues relevant to landowners, with a focus on the agricultural community. This should include direction on relevant legislation, policies and incentives, habitat requirements and threats, the importance of farmers and ranchers in sustaining habitat, and a recognition of the challenges that landowners face in managing grassland habitat for birds. Messaging should recognize the value of grasslands in terms of their environmental services (e.g., erosion control, wildlife habitat, carbon sequestration), visual aesthetics, and socio-economic importance. The importance of these habitats to other species of conservation concern (e.g., grassland birds, pollinators, native prairie plants) should also be highlighted.

Approach 3.1
An increasing amount of information is available on an array of management approaches that can be used to benefit grassland birds on working agricultural landscapes. Particularly useful references include Sample and Mossman (1997), Hull (2003), McGauley (2004), Ochterski (2006), Kreitinger and Paulios (2007), Green (2010), and United States Department of Agriculture, Natural Resources Conservation Science (2010). These references include various suggestions, including delayed (or early) mowing, mowing patterns and heights, hayfield rotations, hayfield plant composition, late-cut refuges, grazing, burning, set-asides, and the identification of priority landscapes.

While later harvest clearly benefits nesting success of Bobolink and Eastern Meadowlark, optimal hay harvest dates for farmers are timed to correspond with nutritional values needed for livestock (e.g., Lloyd et al. 1961, Thonney et al. 1979, Worrell et al. 1986, Nocera et al. 2005, Menteşe et al. 2006, Bernes et al. 2008, Burns 2008), modified by the amount of forage available for cropping and by logistical harvesting constraints, such as timing of rainfall (e.g., Brown et al. 1975). Hence, many farmers have limited flexibility to delay cutting. Still, farmers owning livestock that have relatively lower protein requirements may have more flexibility in delaying their harvest. Protein demands are greatest for milking dairy cows and lower for dry dairy cows, beef cows, horses, and sheep (United States Department of Agriculture, Natural Resources Conservation Science 2010).

Similar considerations are evident for very early first cuts that are followed by an extended delay of 65 or more days in the second cut. From a forage quality and productivity standpoint, this is in conflict because the optimum time between cuttings is 28 to 35 days. Moreover, in Ontario, late-May cutting is generally not feasible because of inadequate growth, coupled with the need to “make hay” when drying conditions permit (J. Kyle, pers. comm. 2011).

Approach 3.2 (plus 4.1 and 5.1)
An incentive program should be designed based on an assessment of the nature and scale of financial incentives necessary to produce the desired degree of uptake among landowners in different agricultural sectors. Incentive programs should be carefully designed, targeted and monitored to achieve their goals. They should be tied to site-specific actions that are most apt to contribute to recovery, and should fall within an overall adaptive management framework so that the efficacy of different practices can be measured and, if necessary, modified.

Having a range of incentive options available is also important, because some practices may not be feasible, practical or economical from the perspective of particular landowners. For example, incentives offered for delayed haying will not provide sufficient financial compensation needed to offset losses in forage quality for many farmers (see Troy et al. 2005, Perkins et al. 2011). Still, with incentives, some farmers may be willing to set aside patches that are not cut until after the breeding season (e.g., Masse et al. 2008). Likewise, an alternative approach, which offers an incentive package to farmers who agree to cut hay early in the season (at or just prior to the onset of nesting), followed by a lengthy delay in the second cut, might be attractive to a subset of landowners (United States Department of Agriculture, Natural Resources Conservation Science 2010, Perlut et al. 2011). Others may agree to move some portion of their cool-season hayfields (cut early) into native grass mixtures (cut later), partly to act as ‘insurance’ against summer drought (Fairbairn et al. 1999, Giulano and Daves 2002, Schläpfer et al. 2002, Tilman et al. 2006, Norment et al. 2010, B. Gilvesy, pers. comm. 2011).

Much can be learned by examining incentive programs in the United States and Europe, where large-scale programs that promote the ecological values of agricultural and native grasslands have been in place for many years. In the United Kingdom, examples include the Environmental Stewardship Scheme and and associated targeted habitat stewardship incentives for endangered birds (e.g., Perkins et al. 2011). For a European perspective on the drivers of agricultural policies and incentive programs, and the challenges they face, see Tucker et al. (2010).

In the United States, a variety of incentive programs are authorized under the 2008 Farm Bill. These include programs that involve land rental and easements, as well as ‘practice-based’ programs. In addition, the Fish and Wildlife Service offers an array of incentive programs that benefit species at risk. These include Safe Harbor Agreements, Candidate Conservation Agreements, Candidate Conservation Agreements with Assurances, Habitat Conservation Plans, Conservation Banking, and the Partners for Fish and Wildlife Program (see United States Fish and Wildlife Service 2010).

Approach 4.1
Where appropriate and feasible, significant amounts of native grasslands should be restored, created, reconnected and maintained, especially in view of predicted ongoing declines of agricultural grassland. Willing landowners will need to be identified. Obvious candidates include conservation organizations that own or manage tracts of

open land (e.g., conservation authorities, land trusts). Because they do not generally derive a critical income from their lands and represent an increasingly important part of the open country landscape in Ontario, rural non-farm landowners present another important opportunity for grasslands restoration and management. Additional opportunities likely exist on former aggregate-extraction sites, municipal landfills, and on large manicured grasslands around industries.

Approach 4.6
This should include setting up demonstration sites that provide examples of sustainable commercial and agricultural uses of tallgrass plant species, ecotourism opportunities, use as livestock forage, biomass cropping, and flower meadows for honey production.

Approach 5.1
Attempts to help maintain the existing supply of agricultural grasslands should focus on maintaining pastures and hayfields that are on marginally productive agricultural lands that are at most risk of abandonment. There may also be opportunties to re-establish pasture and hay on lands that have recently been abandoned and started to infill with shrub cover. The focus should also be on “core” regions and on sites that are most likely capable of supporting biologically significant densities of successfully breeding birds.

Incentives (e.g., for fencing, livestock watering, reseeding, shrub removal, support for community pastures) will be needed to maintain or rejuvenate pastures and hayfields. The role of long-term easements to help keep land in appropriate agriculture (e.g., through the Ontario Farmland Trust) should also be explored.

Approach 5.2
Examples include use of native plant species for livestock forage and biomass cropping, changes in hay cropping and grazing management, ecotourism opportunities, erosion-control and other environmental benefits, flower meadows for honey production, and harvest of native seed.

Approach 6.1
An advisory committee should be composed of representatives of major farm and environmental organizations, government agencies, universities, and independent experts to ensure that relevant information and perspectives are brought to bear on broad landscape issues and to ensure that recovery activities occur within an adaptive management framework.

Partnerships and collaborations are essential to meeting the recovery goal, while also ensuring that broad conservation issues (e.g., native prairie restoration, afforestation, unintended consequences on other species of concern) are appropriately addressed. Some actions that are explicitly designed to benefit Bobolink and Eastern Meadowlark could be incompatible with the long-term needs of other species. To ensure that recovery actions do not expose other species to an elevated level of risk, it is necessary to consider: (a) the likelihood that an appropriate matrix of habitat types will remain across the landscape of interest, (b) the conservation priority of the affected species and (c) the habitat continuums they occupy.

Approach 6.3
Recognizing that the fates of the Bobolink and Eastern Meadowlark in Ontario are linked to what happens outside the province, there is a need to collaborate and liaise with, and learn from, relevant expertise and conservation efforts that take place in other jurisdictions.The need for international, coordinated conservation planning efforts for grassland birds in South America is a recognized priority (BirdLife International 2011), with the recent establishment of partnerships like the 'Southern Cone Grasslands Alliance'. In addition, under the United Nations *Convention on the Conservation of Migratory Species of Wild Animals,* the Bobolink was recently added to the list of species requiring special international conservation efforts (see http://www.cms.int).

Approach 7.1
Proper delineation of anthropogenic habitat ecosites, as described under the recommended habitat regulation, depends on acceptance and publication of OMNR's revised Ecological Land Classification scheme (see Area for Consideration in Developing a Habitat Regulation).

Approach 7.2
Whether the current three-year temporary exemption for agricultural operations, which expires in October 2014, should be extended is an important topic for consultation. The management of hayfields and pastures by farmers, including routine rotation among crops, creates and sustains habitat for these two species and other grassland birds.
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Approach 7.3
The development of safe harbour provisions may be an important means to engage landowners wishing to create or manage habitat that will benefit the species.

Approach 8.1
Because of the large number of uncertainties involved, implementation of many of the approaches within the recovery strategy should be guided by an overall adaptive management framework. To ensure that this is supported, it is recommended that an adaptive management strategy be developed (e.g., see Wilson and Nyberg 2009).

2.4 Performance Measures

Ultimately, whether recovery efforts are fruitful will be evident by future changes in the Breeding Bird Survey population index levels relative to the 2013 benchmark year used for the recovery goal. Success should also be evaluated by measuring changes in habitat supply.

Evaluation of specific actions taken to recover populations of Bobolink and Eastern Meadowlark in Ontario should be measured against specific timelines and anticipated effects. Evaluation will involve determining whether the actions were actually undertaken as recommended and whether the anticipated effects of the actions were realized. Guided by the adaptive management framework, evaluation of the recovery program should be broadly measured against the performance measures identified in Table 4, which correspond to the objectives of this strategy.

Table 4. Performance measures.

No.	Protection or Recovery Objective	Performance Measure
1	Describe priority habitats and regions for conservation, identify key factors that may impede or assist species recovery, and establish the target levels of habitat supply and habitat management regimes that are needed to meet the recovery goal.	Outline a prioritized list of applied research topics by the end of 2014 and revisit it regularly. Results from research that addresses knowledge gaps relating to priority habitats, core regions, and other key recovery issues are regularly reported on (summarized at least every two years) and are used to inform and direct management efforts. Research is shown to: (a) yield a greater understanding of the scope and severity of threats and (b) assess efficacy of recovery actions.
2	Increase public awareness of the two species and their habitat.	Communications strategy developed by the end of 2014. Consultation initiated with stakeholders to develop appropriate communications materials. Dissemination of information to key landowners and stakeholders initiated by 2013; update information as new knowledge is made available.
3	Improve nesting productivity and habitat quality.	Best management practices, incentive programs and other programs designed to improve reproductive success in working agricultural landscapes are in place no later than 2015. These will be updated as new information from research becomes available. Measure against number of hectares enrolled/affected.
4	Increase habitat supply of native grassland.	Use Tallgrass Ontario’s annual goal of 400 ha of natural grassland as an interim target, with a long-term goal being to recover as much of the historical extent of this habitat as practical. A prioritized list of candidate sites/regions for protection and/or management efforts is developed. Restoration projects are geo-referenced and tracked in a centralized database. Number of hectares restored, enrolled, managed and/or protected measured.
5	Maintain existing habitat supply of agricultural grasslands to the extent practicable.	Actions that help maintain the extent of working pasture and hayfields in Ontario are identified (with appropriate incentives) to maintain them as ‘source populations’ for Bobolink and Eastern Meadowlark are identified and implemented by 2015. Progress against land-use change measured (e.g., change in the rate of habitat turnover).
6	Establish strong links to other conservation planning efforts underway for other grassland species that are of high	Collaboration with grassland conservation planning efforts in other jurisdictions important to Bobolink and/or Eastern Meadowlark recovery begins by 2015.

No.	Protection or Recovery Objective	Performance Measure
	conservation concern, both in Ontario and in other relevant jurisdictions.	Measure progress against number of organizational contacts made, number of meetings/workshops, number of collaborative research projects underway or completed.
7	Apply appropriate ESA protection, habitat regulations and any other provincial or federal policies and assess the degree to which they help stabilize populations of the two species.	Effectiveness of provincial policies aimed at benefiting Bobolinks and Eastern Meadowlarks is monitored regularly and evaluated at no less than 10-year intervals.
8	Track and report on the state of populations in relation to recovery activities.	Monitoring program for Bobolink, Eastern Meadowlark and other grassland bird species of conservation concern is established at grassland restoration sites and focal regions by 2015, together with a system of regular reporting and creation of a centralized database management system. Breeding Bird Survey trend information is updated annually. Specific recovery actions are tracked and applied within an adaptive management framework to adjust approaches that are not having the desired outcome.

2.5 Area for Consideration in Developing a Habitat Regulation

Under the ESA, a recovery strategy must include a recommendation to the Minister of Natural Resources on the area that should be considered in developing a habitat regulation. A habitat regulation is a legal instrument that prescribes an area that will be protected as the habitat of the species. The recommendation provided below by the authors will be one of many sources considered by the Minister when developing the habitat regulation for these species.

Given their widespread distributions and more importantly, the often transitory nature of their breeding habitat, the authors do not recommend mapping Bobolink or Eastern Meadowlark regulated habitat at a provincial or even regional scale. We recommend that the regulation focus on describing habitat features for sites that have been recently used by one or both species as breeding habitat. Nevertheless, it is understood that there will be a need to map regulated habitat on a site-by-site basis (e.g., when triggered by development proposals that may permanently remove habitat from the landscape).

Habitat protection for Bobolink and Eastern Meadowlark in Ontario should focus on breeding habitat. This is the period in their life cycle when the birds are most vulnerable to habitat alteration in Ontario. For this reason, it is important to include breeding habitat that has been recently occupied in the habitat regulation, recognizing the transitory nature of many of these habitats.

Outside the breeding season, the use of habitats by Bobolink and Eastern Meadowlark in Ontario is not well documented. The habitat regulation should consider a future provision for new information that could incorporate important stop-over areas, if and when they are identified according to measurable criteria. Until then, the recovery strategy authors recommend that the habitat regulation focus on breeding habitat.

From the foregoing, it is recommended that the habitat regulation for the Bobolink and Eastern Meadowlark focus on sites that one or both species have recently occupied during the breeding season. Habitat in the regulation can be described as follows: open country habitats that consist of natural and semi-natural grassland (including but not limited to tallgrass prairie, alvar grasslands, beaver meadows, and grassy peatlands), hayfields, pastures, grassland habitat restoration sites, and cultural meadows (abandoned fields) where Bobolink and/or Eastern Meadowlark has been confirmed to breed or probably has bred during the current or previous three years.

The three-year period is based on the estimated average age of adults in the breeding population (COSEWIC 2010, 2011). The habitat regulation would not apply after three years of demonstrated absence of either Bobolink or Eastern Meadowlark.

It is recommended that the level of evidence needed to establish breeding occupancy be based on standards used for the Ontario Breeding Bird Atlas (Cadman et al. 2007) as follows:

PROBABLE BREEDING

- Pair observed during the breeding season in suitable nesting habitat.
- Permanent territory presumed through registration of territorial song on at least two days, a week or more apart, at the same place.
- Courtship or display between a male and a female or two males, including chasing, flight displays, feeding or copulation.
- Agitated behaviour or repeated anxiety calls of an adult.
- Adult carrying nest material.

CONFIRMED BREEDING

- Recently fledged young, including young incapable of sustained flight.
- Adult carrying faecal sac.
- Adult carrying food for young.
- Nest containing eggs or young, or a recently used empty nest.

<u>Delineation of Regulated Habitat</u>

It is recommended that, to the extent possible, delineation of regulated versus unregulated habitat be based on the most current Ecological Land Classification (ELC) scheme for Ontario (see Lee et al. 1998). ELC terminology and methods are familiar to many land managers and conservation practitioners who have adopted this tool as the standard approach. Although presently only available in draft form, ELC has recently been refined to distinguish between different types of anthropogenic community types (e.g., row crops, perennial cover crops, specialty crops, pasture), in addition to various native grassland community types (H. Lee, pers. comm. 2012). As such, it is recommended that the most recent published version of ELC be applied to the habitat regulation. Regulated habitat will thus be delimited by any Ontario ELC-defined ecosite polygon(s) within which Bobolink or Eastern Meadowlark has shown evidence of breeding within three years.

Excluded habitat

The authors recommend that the habitat regulation exclude certain highly-transitory, intensively-managed anthropogenic ecosites that are seldom, if ever, occupied by either of the two species for more than a single breeding season and which provide low-quality breeding habitat. More specifically, this includes all annual row crops (e.g., winter wheat, rye, oats, barley, corn, soy), which are usually rotated on an annual basis.

GLOSSARY

Adaptive Management: A systematic process for continually improving management policies and practices by learning from the outcomes of previously employed policies and practices.

Agricultural Grasslands: Grasslands that are (or were) created by agricultural activities, including hayfields, pastures, and old or abandoned farm fields.

Alvar Grasslands: Grasslands that are on very shallow soils over limestone bedrock; the soil is deep enough to support grasses and sedges.

Best Management Practices (BMPs): A proven, practical, affordable approach to conserving soil, water and other natural resources in rural areas.

Breeding Bird Survey (BBS): Begun in the late 1960s, the BBS is an annual program that is designed to monitor trends in North American breeding bird populations. Abundance data are collected by skilled volunteers for three minutes at each of 50 stops spaced at 0.8-km intervals along permanent 39.2-km routes on roadsides. Routes are randomly distributed across southern Canada and all of the continental United States. There are about 150 routes in Ontario. Surveys are conducted on one morning in June during the height of the breeding period of most landbird species.

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

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

Community Pasture: These are typically large areas of permanent pasturelands that are shared by multiple cattle producers, who individually do not otherwise have sufficient pasture to support their current herds. Participants are charged grazing fees per head.

Conservation Banking: This is described as a “market-based system for conserving species and their habitat. It consists of a partnership between a landowner, one or more government agencies, and the community of developers and others who implement or fund projects that adversely affect endangered or threatened species, other species of concern, or the habitats of these species. The landowner or bank sponsor agrees to permanently protect and manage property for the species of interest in exchange for credits. These credits can then be sold to developers and other project proponents who need to offset project impacts to the same species occurring at another location within the community" (United States Fish and Wildlife Service 2010, pg. 32).

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

1 = critically imperilled
2 = imperilled
3 = vulnerable
4 = apparently secure
5 = secure

Cow-calf Farm: Cow-calf farmers raise beef cattle by keeping a herd of cows to produce calves for later sale. Grazing is a major feeding strategy, coupled with hay production for winter feeding. Cow-calf operations are one of the key components of the beef industry in Ontario.

Cultural Meadow: A grassy field that was created by or is maintained by anthropogenic-based disturbances, and which has less than 25 percent shrub or tree cover.

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

Habitat Fragmentation: Fragmented grassland habitat often refers to a landscape of small, isolated grassland fields or "islands" that occur within a larger matrix of other kinds of habitat. This means that regions with more pasture and hay are less fragmented than those with smaller amounts of hay/pasture. There can also be less fragmentation when a number of hay/pasture fields are clustered together, rather than spread apart.

Hay: Hay is a forage crop planted for use as feed for livestock (OMAFRA 1994). The term "tame hay" is a western Canada concept where hay is harvested from natural grasslands as well as seeded areas. Statistics Canada also uses the term, and further separates tame hay into 'Alfalfa and Alfalfa mixtures' and 'other tame hay'. In Ontario, all hay is generally considered to be 'tame hay', which usually consists of mixtures of cool-season grasses and legumes, especially Alfalfa. Commonly used cool-season grasses include Timothy, Ryegrass, Brome, Fescue, and Orchard Grass. Alfalfa is the predominant legume in hay, but can also include clovers and trefoils. Warm-season, perennial grasses, including native species such as Big Bluestem, Little Bluestem and Switchgrass, are used by some farmers in Ontario.

Incidental Mortality: This term refers to activities that result in the unintentional destruction or harming of protected species as a result of what are otherwise entirely lawful activities and normal practices (e.g., haying operations).

Litter Cover: Standing or flattened, dead herbaceous vegetation remaining from the previous year(s).

Pasture: Pastures are fields established for livestock grazing and are generally composed of grasses and legumes (OMAFRA 2000). Pasture is often divided into ‘unimproved’ and ‘improved’ pastures. Unimproved pasture is often dominated by Kentucky Bluegrass, Canada Bluegrass and Redtop, with different species being more abundant under different conditions. Natural pastures are complex plant associations whose composition is influenced by the growing conditions, the weather, and the animals using the area. Improved pastures include ‘tame’ pastures that have been reseeded, fertilized or fenced to improve productivity and utilization. This term is usually applied to rundown fields that have been renovated or rejuvenated.

Population Sink: A breeding group that does not produce enough offspring to maintain itself over time without immigrants from other populations.

Population Viability Analysis (PVA): A PVA employs the use of advanced statistical modelling to estimate the likelihood that a given population will persist into the future. It is often also used to estimate the likelihood of extinction risk under various scenarios over various time periods. To be meaningful, PVAs require a thorough understanding of the essential demographic parameters of the population being studied, including annual variation in productivity, survivorship of adults and young, dispersal of adults and young, rates of immigration/emigration, and the possibility of catastrophic events. Models can also incorporate predictions of environmental changes (e.g., changes in habitat supply, climate).

Prairie: A largely treeless plain that is dominated by specialized species of native grasses and wildflowers.

Safe Harbour Agreements: Agreements that enable landowners to assist in the protection or recovery of species at risk, or create or enhance their habitat, in exchange for legal assurance that doing so will not result in additional restrictions should they wish to modify their land at a later date.

Savannah: An open plain of specialized grasses and wildflowers, with scattered trees. The trees are widely spaced and occupy 5 to 25 percent of the site.

Scapulars: Feathers on the back of a bird that cover its shoulders.

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

Species at Risk in Ontario (SARO) List: The regulation made under section 7 of the *Endangered Species Act, 2007* (O. Reg. 230/08) that provides the official status classification of species at risk in Ontario. This list was first published in 2004 as a policy and became a regulation in 2008.

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APPENDIX A. PARTICIPANTS AT RECOVERY STRATEGY WORKSHOPS.[1]

Organizational Affiliation	Name	Workshop #1 (8-9 Feb 2011)	Workshop #2 (13 Feb 2012)	Workshop #3 (29 Oct 2012)
Agriculture Canada	Victoria MacPhail		X	
Alternative Land Use Services (ALUS)	Bryan Gilvesy	X		
Bird Studies Canada	Audrey Heagy			X
Bruce Trail Conservancy	Adam Brylowski		X	
Bruce Trail Conservancy	Brian Popelier		X	X
Carolinian Canada Coalition	Michelle Kanter	X		
Canadian Wind Energy Association	Nicole Kopysh		X	X
Christian Farmers Federation of Ontario	Nathan Stevens		X	X
Credit Valley Conservation	Yvette Roy		X	X
Credit Valley Conservation	Charlotte Cox			X
Dairy Farmers of Ontario	Bill Mitchell		X	X
Environment Canada	Mike Cadman		X	X
First Nations (Saugeen Ojibway First Nations)	Anthony Chegano	X	X	X
First Nations (Saugeen Ojibway First Nations)	Jesse Short		X	
First Nations (Six Nations)	Paul General	X		X
First Nations (Six Nations)	Sarah Richer	X		
George Morris Centre	Bob Seguin		X	
Nature Conservancy of Canada	Mark Stabb	X	X	X
OMAFRA	Helma Geerts		X	
OMAFRA	Jack Kyle		X	X
OMAFRA	Joel Bagg	X	X	X
OMAFRA	Linda Pim		X	X
OMAFRA	Paul Smith	X	X	
OMAFRA	Peter Roberts	X	X	X
OMNR	Bree Walpole		X	
OMNR	Chris Risley	X	X	X
OMNR	Joe Nocera	X		
OMNR	Vivian Brownell	X	X	X
OMNR	Marni Vance			X
OMNR	Jeremy Downe			X
OMNR	Stephen Casselman			X
OMNR	Ron Gould			X
Ontario Cattlemen's Association	Gerald Rollins	X	X	X
Ontario Cattlemen's Association	Richard Horne	X		X
Ontario Farmland Trust	Matt Setzkorn		X	
Ontario Federation of Agriculture	Bette Jean Crews		X	
Ontario Federation of Agriculture	Peter Jeffery	X	X	X
Ontario Nature	Anne Bell	X	X	X
Ontario Nature	Joshua Wise		X	X
Ontario Soil & Crop Improvement Association	Christine Schmalz		X	X
Ontario Soil & Crop Improvement Association	Nancy Tilt	X		
Ontario Stone, Gravel & Aggregate Association	Moreen Miller		X	
Ontario Stone, Gravel & Aggregate Association	Valerie Wyatt	X		

Organizational Affiliation	Name	Workshop #1 (8-9 Feb 2011)	Workshop #2 (13 Feb 2012)	Workshop #3 (29 Oct 2012)
Regional Municipality of York	Pamela Fulford		X	
Tallgrass Ontario	Graham Buck		X	X
Tallgrass Ontario	Kyle Breault		X	X
Thames Talbot Land Trust	Bill Maddeford		X	
Thames Talbot Land Trust	Quintin Lang		X	
Thames Talbot Land Trust	Peter Chapman			X
Thames Talbot Land Trust	David Wake			X
Trent University	Nicole MacDonald			X
University of Guelph	Danielle Ethier			X
Vermont United States Department of Agriculture, Natural Resources Conservation Service	Toby Alexander	X		

[1] Excludes attendance by the authors of the recovery strategy.