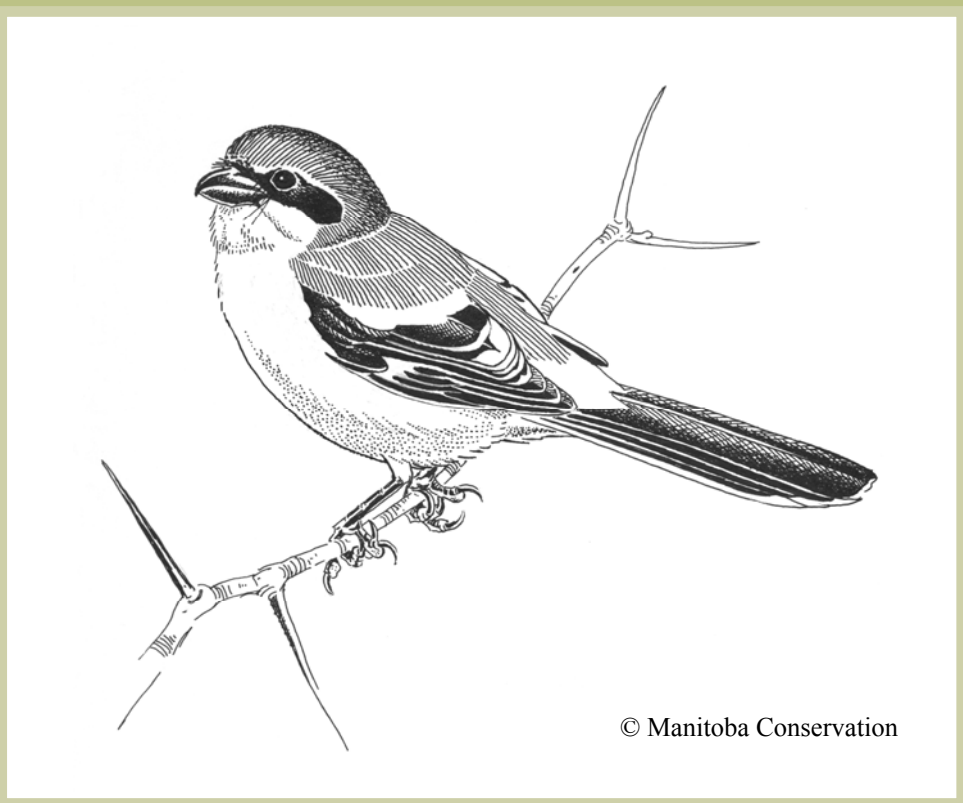
PROPOSED

Species at Risk Act
Recovery Strategy Series

Recovery Strategy for the Loggerhead Shrike, *migrans* subspecies (*Lanius ludovicianus migrans*), in Canada

Loggerhead Shrike, *migrans* subspecies



2010

Environment Canada Environnement Canada

Canada

About the *Species at Risk Act* Recovery Strategy Series

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

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

What is recovery?

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

What is a recovery strategy?

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

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

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

What's next?

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

The series

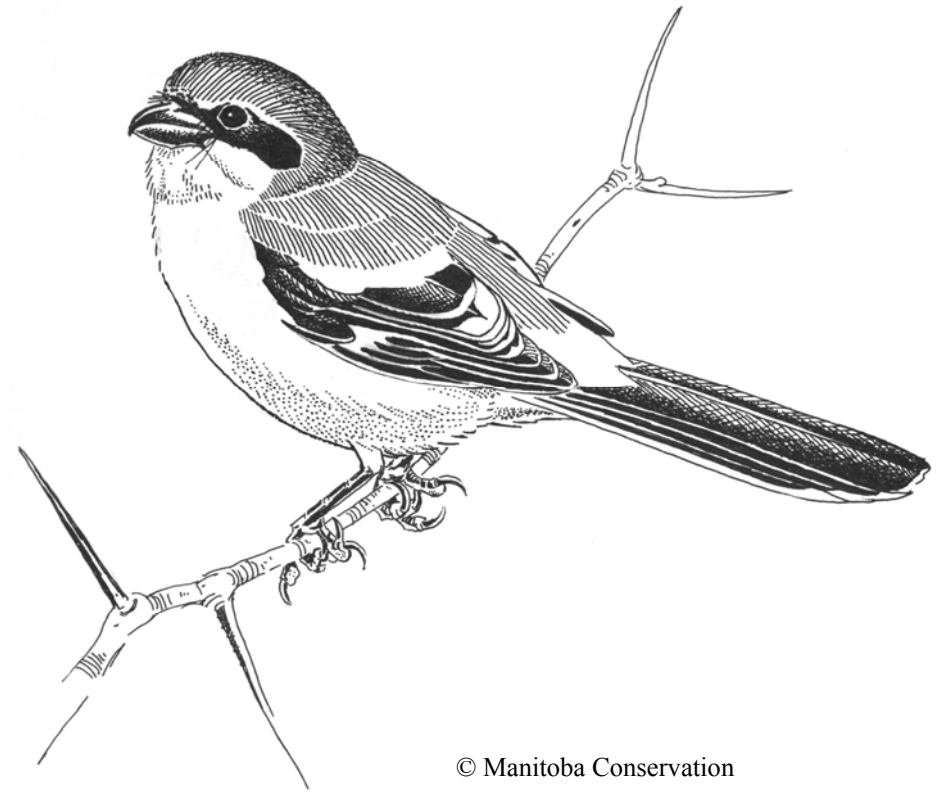
This series presents the recovery strategies prepared or adopted by the federal government under SARA. New documents will be added regularly as species get listed and as strategies are updated.

To learn more

To learn more about the *Species at Risk Act* and recovery initiatives, please consult the Species at Risk (SAR) Public Registry (www.sararegistry.gc.ca).

Recovery Strategy for the Loggerhead Shrike, *migrans* subspecies (*Lanius ludovicianus migrans*) in Canada [Proposed]

2010



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Additional copies:

Additional copies can be downloaded from the SAR Public Registry (www.sararegistry.gc.ca).

Cover illustration: Manitoba Conservation

Également disponible en français sous le titre
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DECLARATION

The Minister of the Environment and the Minister responsible for the Parks Canada Agency are the competent ministers for the recovery of the Loggerhead Shrike, *migrans* subspecies and have prepared this recovery strategy, as per section 37 of SARA. It has been prepared in cooperation with all jurisdictions responsible for the Loggerhead Shrike, *migrans* subspecies. This recovery strategy also constitutes advice to other jurisdictions and organizations that may be involved in recovering the species.

The objectives and broad strategies identified in the strategy are based on the best existing knowledge and are subject to modifications resulting from new findings and revised objectives.

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

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

CONTRIBUTORS

This recovery strategy was prepared by Dr. David Anthony Kirk, Aquila Applied Ecologists; Dr. Jennie Pearce, Pearce & Associates Ecological Research; Ken Tuininga, Environment Canada, Canadian Wildlife Service and Tara Imlay, formerly Environment Canada, Canadian Wildlife Service – Ontario.

ACKNOWLEDGMENTS

The original national recovery strategy (Johns *et al.* 1994) and two documents prepared by Dr. Murray Smith (The Biodiversity Management Group) and Pierre Laporte, Environment Canada – Quebec were used to prepare this current recovery strategy. Many individuals contributed to the development of the document prepared by Dr. Murray Smith: Dr. David Bird (Avian Science and Conservation Centre, McGill University), Robin Bloom (Contract Biologist with Environment Canada), Amy Chabot (Contract Biologist with Environment Canada and Queen's University), Don Cuddy (Ontario Ministry of Natural Resources), Richard Danziger (City of Kawartha Lakes), Ken De Smet (Manitoba Conservation), Andrew Didiuk (Environment Canada – Prairie and Northern), Chris Grooms (Contract Biologist with Environment Canada), Pierre Laporte (Environment Canada – Quebec), Michel Lepage (Ministère des Richesses naturelles et de la Faune du Québec), Dr. Steve Lougheed (Queen's University), Tom Mason (Toronto Zoo), Jon McCracken (Bird Studies Canada), Todd Norris (Ontario Ministry of Natural Resources), Isabelle Ringuet (Environment Canada – Quebec), Dr. Laird Shutt (Environment Canada – National Wildlife Research Centre), Peggy Strankman (Canadian Cattlemen's Association), Shaun Thompson (Ontario Ministry of Natural Resources), Robert Wenting (formerly with Environment Canada, Canadian Wildlife Service – Ontario), and Elaine Williams (Wildlife Preservation Canada). In addition to many of the above, Luc Robillard and Francois Shaffer (Environment Canada – Quebec), and Jessica Steiner (Wildlife Preservation Canada) contributed to the current strategy. As well, numerous local landowners and action groups have played a significant role in the development and delivery of the shrike program. Thanks are extended to Manitoba Conservation for providing the cover illustration. Thanks also to the official sponsors of the Ontario Breeding Bird Atlas (Bird Studies Canada, Canadian Wildlife Service, Federation of Ontario Naturalists, Ontario Field Ornithologists, and Ontario Ministry of Natural Resources) for supplying atlas data, to the Natural Heritage Information Centre for supplying the latest occurrence data, and to the thousands of volunteer participants who gathered data for the project. Thanks are extended to the many Canadian Wildlife Service staff, particularly Krista Holmes and Angela Darwin, who assisted in preparing data, providing advice and preparing this document for posting.

STRATEGIC ENVIRONMENTAL ASSESSMENT STATEMENT

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

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

This recovery strategy will clearly benefit the environment by promoting the recovery of the Loggerhead Shrike, *migrans* subspecies. The potential for the strategy to inadvertently lead to adverse effects on other species was considered. The SEA concluded that this strategy will clearly benefit the environment and will not entail any significant adverse effects. The reader should refer to the section on Effects on the Environment and Other Species in particular.

RESIDENCE

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

Residence descriptions, or the rationale for why the residence concept does not apply to a given species, are posted on the SAR Public Registry:
www.sararegistry.gc.ca/recovery/residence_e.cfm

PREFACE

The Loggerhead Shrike, *migrans* subspecies was listed as Endangered under SARA in June 2003. It is also a migratory bird protected under the *Migratory Birds Convention Act, 1994* which places it under the management jurisdiction of the federal government. The Minister of the Environment and the Minister responsible for the Parks Canada Agency are the competent ministers for the recovery of the Loggerhead Shrike, *migrans* subspecies and have prepared this strategy, as per section 37 of SARA. It has been prepared in cooperation with the provinces of Manitoba and Ontario. Other organizations and individuals provided advice and information during the preparation of the strategy. All responsible jurisdictions reviewed and support the posting of this recovery strategy.

EXECUTIVE SUMMARY

The Loggerhead Shrike, *migrans* subspecies (*Lanius ludovicianus migrans*) also known as the Eastern Loggerhead Shrike was most recently assessed as Endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2000 because it occurs in very small and isolated populations and is declining in numbers in Canada. It has been listed under the *Species at Risk Act* (SARA) as Endangered since 2003. While individuals or individual breeding pairs are found sporadically throughout the species' historic range in North America, few populations remain. In Canada, breeding populations larger than a few pairs remain only in Ontario but are no longer found in Manitoba or Quebec. In addition to the Ontario population, a small migratory population of Loggerhead Shrike, *migrans* subspecies breeds annually in Illinois and another in Iowa in the United States. Threats to Loggerhead Shrike, *migrans* subspecies populations on the breeding and wintering grounds include habitat loss and fragmentation, environmental contaminants, disease, mortality caused by collisions with cars, extreme weather, and predation.

There are unknowns regarding the feasibility of recovery of Loggerhead Shrike, *migrans* subspecies. In keeping with the precautionary principle, this recovery strategy has been prepared as per section 41(1) of SARA as would be done when recovery is determined to be feasible. This recovery strategy addresses the unknowns surrounding feasibility of recovery.

The ultimate recovery objective is to re-establish a viable Loggerhead Shrike, *migrans* subspecies population in Canada. However, achieving this presents a challenge, given that fewer than 100 individuals are believed to remain in the wild in Canada. Recent evaluations of the experimental captive breeding and release program show that the program has contributed to the augmentation of the wild population in Ontario while retaining the genetic structure and diversity of the founder population. The captive breeding and release program will be refined to maximize breeding success and releases in core areas and expedite recovery.

This strategy focuses recovery activities on rebuilding the population in Ontario where the majority of Loggerhead Shrike, *migrans* subspecies in Canada remain. To better guide recovery efforts, three population and distribution objectives have been identified. The short-term objective (5 years) is to stabilise the existing population and prevent further declines, the medium-term objective (10 years) is to foster overall population growth, and the long-term objective (25 years) is to ensure that birds are consistently breeding in at least three of the six core areas in Ontario. The targets of the short term objective are to achieve at least 20 breeding pairs in Carden, at least 10 pairs in Napanee and at least five pairs elsewhere in Ontario (35 pairs total). The targets of the medium term objective are to maintain at least 20 pairs in Carden, at least 20 pairs in Napanee, at least 10 pairs in a third core area in Ontario and at least ten pairs elsewhere in Ontario (60 pairs total). The identification of the third core area is dependant on the success of on-going recovery efforts. The long term target is to have at least 20 pairs in each of these three core areas and at least 20 pairs elsewhere in Ontario (80 pairs total).

The reason(s) for the decline of the Loggerhead Shrike, *migrans* subspecies in North America remain unclear, but a 2009 population viability analysis suggested that the most important factors limiting the recovery of the Canadian population are juvenile and adult overwintering survival

and/or recruitment into the breeding population. Current estimates of annual survival are variable and require refinement. Recent research has narrowed the location of wintering grounds for this subspecies to the southeastern United States, but further refinement is required. Recovery priorities for the wintering grounds include confirming these locations, and investigating associated threats in cooperation with agencies and organizations in the United States.

On the Canadian breeding grounds, research and monitoring activities on habitat-related issues will continue to be a priority. Habitat mapping suggests that more quantitative information is needed to assess the impact of habitat fragmentation on Loggerhead Shrike, *migrans* subspecies. Information on the minimum size of grassland patches and their dispersion and connectivity within the landscape throughout the range of the subspecies is of particular interest. It is possible that the decline of this subspecies can in part be attributed to a decrease in reproduction and survival of individuals as a consequence of the small population size.

Critical habitat has been identified, to the extent possible, for Ontario based on the best available information on site occupancy of shrikes in the last 10 years and habitat suitability. Additional habitat suitability and bird survey information from other locations in Ontario may result in the identification of additional critical habitat in an action plan. One or more action plans will be posted on the Species at Risk Public Registry within five years of the posting of this recovery strategy.

RECOVERY FEASIBILITY SUMMARY

Based on the following criteria outlined by the Government of Canada (SARA Policies, 2009), there are unknowns regarding the feasibility of recovery of the Loggerhead Shrike, *migrans* subspecies. In keeping with the precautionary principle, this recovery strategy has been prepared as per section 41(1) of the *Species at Risk Act* as would be done when recovery is determined to be feasible. This recovery strategy addresses the unknowns surrounding the feasibility of recovery.

1. **Individuals of the wildlife species that are capable of reproduction are available now or in the foreseeable future to sustain the population or improve its abundance.**

Yes. The reproductive potential of the remaining population suggests that increases to population growth and abundance are possible. Genetic research currently underway suggests that recruitment of individuals from widely separated populations does occur (A. Chabot pers. comm.). Also, recruitment of released birds from the captive breeding and release program has had a positive impact on population abundance within Ontario (Tischendorf 2009).

2. **Sufficient suitable habitat is available to support the species or could be made available through habitat management or restoration.**

Yes. There is sufficient suitable breeding habitat available to support the subspecies in Canada, and more could be made available through grassland habitat management or restoration. Maintenance of what is currently understood to be suitable habitat is essential to provide breeding habitat while potential limiting factors along migration routes and on the wintering

grounds are assessed and addressed. Techniques for protection and management of grassland habitat are available and effective (Yosef 1996; Dechant *et. al.* 1998; K. Hennige pers.comm.).

3. **The primary threats to the species or its habitat (including threats outside Canada) can be avoided or mitigated.**

Unknown. The 2009 population viability analysis highlighted that annual survival of adults and juveniles along migration routes and on the wintering grounds is a key limiting factor for shrike recovery. There is a need to refine our estimates of survival and the factors affecting it. While research indicates several U.S. states are likely wintering areas (Burnside 1987; Hobson and Wassenaar 2001; A. Chabot pers.comm.), wintering locations for the subspecies have yet to be confirmed. Confirming specific wintering locations will allow for assessment of potential threats impacting the continued persistence of this subspecies. On the breeding grounds, habitat enhancement and restoration have been successful along with the captive breeding program which has provided a safeguard for Canadian populations, enabled a close examination of shrike life history characteristics and also encouraged the need for close monitoring of the wild population because of the need to monitor the return and survival of captive bred birds.

4. **Recovery techniques exist to achieve the population and distribution objectives or can be expected to be developed within a reasonable timeframe.**

Unknown. Many of the necessary recovery techniques exist and have proven effective over the short-term. Habitat restoration activities in Ontario have resulted in new habitat being commonly utilized by breeding pairs. The captive breeding and release program has demonstrated its ability to maintain the genetic diversity of the founder population and augment the wild population (Tischendorf 2009). Further refinements to husbandry and release techniques should improve efficiency and increase recruitment of released birds, thereby speeding up recovery. Many factors such as habitat loss and degradation, competition with resident shrikes, pesticides, and collisions with motor vehicles can be mitigated using known techniques (Yosef and Grubb 1994; Flickinger 1995; Yosef 1996; Cade and Woods 1997; Dechant *et al.* 1998; Lynn et.al. 2006). It is unknown, however, whether the overall recovery objective can be effectively achieved through the application of these techniques, until potential threats to the subspecies on the wintering areas are confirmed.

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1. COSEWIC SPECIES ASSESSMENT INFORMATION

Date of Assessment: November 2000

Common Name (population): Loggerhead Shrike, *migrans* subspecies

Scientific Name: *Lanius ludovicianus migrans*

COSEWIC Status: Endangered

Reason for Designation: This species occurs in very small and declining numbers in Canada. It is facing a number of threats both on its breeding and wintering ranges, including: decrease in habitat availability and quality, casualties due to collisions with cars; and possible effects of environmental contaminants.

Canadian Occurrence: MB, ON, QC

COSEWIC Status History: The species was considered a single unit and designated Threatened in April 1986. Split according to subspecies in April 1991. The *migrans* subspecies was designated Endangered in April 1991. Status re-examined and confirmed in November 2000.

2. SPECIES STATUS INFORMATION

The Loggerhead Shrike, *migrans* subspecies has been listed as Endangered under *the Species at Risk Act* (SARA) since 2003. The species *Lanius ludovicianus* is listed as Endangered under Ontario's *Endangered Species Act 2007*, it is listed as Threatened under Quebec's *An Act Respecting Threatened or Vulnerable Species* and Endangered under Manitoba's *Endangered Species Act*. The global conservation status of the Loggerhead Shrike, *migrans* subspecies is G4T3Q (G4 - apparently secure - uncommon but not rare; the infraspecific status (subspecies) is T3 - vulnerable or at moderate risk of extinction or elimination; Q – questions remain with regard to taxonomy that may reduce conservation priority) (NatureServe 1999). Throughout the range of the *migrans* subspecies, conservation status ranks for the Loggerhead Shrike vary, as outlined in Table 1.

Table 1. Subnational Ranks (S-Ranks) for the Loggerhead Shrike, *migrans* subspecies in North America (NatureServe 2008).

Country	State/Province and NatureServe status ranks*
Canada	Manitoba (S1B), *New Brunswick (SHB)*, *Nova Scotia (SHB)*, Ontario (S2B), Prince Edward Island (SNR), *Quebec (S1)*
United States	Arkansas (S3B,S3N), Connecticut (SXN), District of Columbia (SHN,SXB), Georgia (S3), *Illinois (S3)*, Iowa (S3B,S3N), Maine (SHB,S1?N), Maryland (S1), Massachusetts (SXB,S1N), Michigan (S1), Minnesota (S2B), *Missouri (S2)*, *Nebraska (S5)*, New Hampshire (SHB), New Jersey (S1B,S1N), New York (S1B), *Ohio (S1)*, Oklahoma (S2?), Pennsylvania (S1B), *South*

	Carolina (S3), Tennessee (S3), Texas (S2B), Vermont (SHB), Virginia (S1), West Virginia (S1B,S2N), *Wisconsin (S1B)*

*Italics denote jurisdictions that have not ranked Loggerhead Shrike at the subspecies level, but have provided conservation status ranks at the species level. Definitions for NatureServe ranks are provided in Appendix A.

3. DESCRIPTION OF THE SPECIES AND ITS NEEDS

3.1 Species description

The Loggerhead Shrike (*Lanius ludovicianus)* is one of only two species of shrike in North America, the other being the Northern Shrike (*Lanius excubitor*). Like corvids, shrikes are predators of other vertebrates (small mammals, birds, frogs). A characteristic of shrikes is their habit of impaling prey on thorny branches or barbed wire to secure it after killing, in order to tear the food item apart with their hooked beaks.

The Loggerhead Shrike, *migrans* subspecies (*Lanius ludovicianus migrans*), also known as the Eastern Loggerhead Shrike, is a medium-sized black, white, and grey bird with a small hook at the tip of its bill. The upper parts are dark grey, with mostly black wings and tail, and whitish underparts. The species has a characteristic black facial mask, which extends through the eyes across the lower forehead. Light greyish-brown bars occur on the breast and sides of juveniles, and they have a less prominent black facial mask.

The Loggerhead Shrike, *migrans* subspecies is slightly smaller than the Northern Shrike (*Lanius excubitor*), with which it is sometimes confused, however, their ranges only overlap during migration and in the winter. The Loggerhead Shrike, *migrans* subspecies is also very similar in appearance to the Loggerhead Shrike, *excubitorides* subspecies (*L. ludovicianus excubitorides*) which occurs from southwestern Manitoba to Alberta.

3.2 Needs of the Loggerhead Shrike, *migrans* subspecies

3.2.1 Habitat needs

Numerous studies indicate that the Loggerhead Shrike is associated with open grassland habitats with scattered trees and shrubs in both breeding and wintering seasons across their range (Pruitt 2000). The Loggerhead Shrike, *migrans* subspecies forages in or along the edges of pastures, hayfields, parking lots, idle pastures, roadside ditches, residential yards, roads, cemeteries and parks, hydro corridors, or other areas in which foraging area is comprised of short to medium grass, often heterogeneous in structure, with interspersed perches (Yosef 1996). Large invertebrates are a major component of the diet but shrikes can also feed on small rodents, birds, amphibians and reptiles, including snakes and lizards (Yosef 1996).

Breeding territories in Ontario and throughout the range usually contain 1) a dense tree or shrub suitable for nesting; 2) elevated perches (both natural, such as tree branches, and artificial, such as power lines or fence posts) for hunting, mating, and territory advertisement; 3) foraging areas (generally, open short to medium height grassy areas with scattered shrubs or perches and some bare ground); and 4) impaling sites (dense, multi-stemmed and/or thorny shrubs or barbed wire fences) (Pruitt 2000, Chabot *et al.* 2001b). Suitable habitat is created and maintained by a balance between successional processes that create habitat structure (i.e., perch and nest trees) and disturbances, such as periodic grassland fires, cattle grazing, or even mowing, that prevent encroachment of woody vegetation (as summarized in Pruitt 2000).

Some differences exist in the types of habitat used for nesting in the three provinces. In Manitoba (near Winnipeg), most pairs reside in transitional habitat; suburban acreages where a mixture of mowed yards or parks, cemeteries, small pastures, idle grassy areas, and roadside ditches all occur within close proximity. In recent years, most nests in that province have occurred in ornamental spruce trees (K. De Smet, pers. comm.), but introduced, ornamental species such as Caragana (*Caragana arborescens*) and Russian Olive (*Elaeagnus angustifolia*) are also commonly used. Hawthorn species (*Crataegus* sp.) offer the most protection to nesting shrikes due to their dense and thorny or prickly nature (Porter *et al.* 1975, Chabot *et al.* 2001a). In Quebec, where there is no longer a breeding population, historical data show that hawthorn was largely preferred as nesting habitat (Robert and Laporte 1991). On the Carden Plain in Ontario, shrikes generally nest in hawthorn. Hawthorns are used in proportion to their availability (Chabot *et al.* 2001a). On the Napanee Plain in Ontario, shrikes tend to nest in Eastern Red Cedar (*Juniperus virginiana*), which has displaced hawthorn as the most common woody vegetation in pastures (Chabot *et al.* 2001b).

Little is known of habitat preferences along migration routes and in the wintering areas. A radio-telemetry study in 2008 recorded captive-reared juveniles utilizing pastures and hayfields as stop-over sites during migration through southern Ontario (Imlay and Andrews 2008).

3.2.2 Ecological role

The Loggerhead Shrike, *migrans* subspecies as a predator of insects and small vertebrates in grassland ecosystems could, in larger numbers, play an integral part of ecosystem function. It is not known whether the Canadian population plays a role in contributing to the viability of the American population. Recruitment rates between the Canadian and American populations are unknown.

3.2.3 Limiting factors

It is likely that a combination of limiting factors, acting cumulatively, is affecting populations. Productivity and survival up to independence vary between years, but consistently appear within the normal range of variation for the subspecies (Pruitt 2000; Chabot *et al.* 2001b). The relative stability of populations nesting in Carden and Napanee, the two core areas supporting the majority of the population in recent years, compared to other areas suggests that there might be a minimum size of local breeding populations needed to assure persistence in a given area. This may be related in part to the Allee effect, which is defined as a positive relationship between the

number of individuals in a population and their fitness, and implies that returning birds will have a reduced probability of locating a mate and breeding when population densities are low (Courchamp *et al.* 2008).

4. THREATS

While it is clear that the Loggerhead Shrike, *migrans* subspecies has declined in many parts of its range, little is known about the precise cause of this decline. COSEWIC (2000) includes a number of factors that are believed to have contributed to the subspecies decline including habitat loss and fragmentation, and several issues on the wintering grounds such as pesticides, intraspecific competition and collisions with vehicles. The recent population viability analysis (Tischendorf 2009) determined that overwintering survival and/or low recruitment rates to the breeding population by juvenile and young adult shrikes was the most sensitive factor affecting population dynamics. Pruitt (2000) lists a variety of possible causes for the decline of the Loggerhead Shrike, several of which may be relevant to juvenile and young adult survival and return rates, including habitat loss and deterioration, increased pesticide use, decreased prey availability, diseases and parasites, collisions with vehicles, wet spring weather, and climate and warming trends that could affect vegetation and predation.

4.1 Description of threats

4.1.1 Habitat loss and degradation

Prior to European settlement, it is probable that the Loggerhead Shrike, *migrans* subspecies occurred in prairie and alvar grasslands in southern and central Ontario and in prairie grassland in Manitoba, both of which were more extensive at the time. European colonization of eastern North America in the 1800s and 1900s led to a decrease in these grasslands, but also led to an increase in pasture habitats which are also suitable for the subspecies (Pruitt 2000).

Since then, habitat for the Loggerhead Shrike, *migrans* subspecies has been lost or has deteriorated in quality. During the last century, land use changes have converted former native grasslands and human-made pastures, particularly on more productive soils, to cropland (Johns *et al.* 1994; Pruitt 2000). The amalgamation of small farm fields to form large fields has eliminated windbreaks and hedgerows resulting in additional habitat losses (Laporte and Robert 1995). Some habitat has been lost to housing developments and aggregate extraction. Vegetation succession poses an additional threat, because without management or grazing, pastures may eventually be replaced by forest. The decline of the pasture cattle industry seems to have accelerated the conversion to other land uses.

Despite significant habitat losses, habitat mapping in Ontario and Quebec suggests that over the last 10 years, some apparently suitable habitat has not been used by nesting birds, implying that habitat quantity is not a limiting factor on the breeding grounds (Jobin 2003). However, habitat fragmentation has increased and habitat quality may also have deteriorated and is likely to continue to do so in areas where the pasture cattle industry is in decline. In addition, loss of suitable habitat in some localized areas (e.g., Smiths Falls, Ontario and Le Gardeur, Quebec)

does appear to account for the local extirpation there (A. Chabot, pers.comm.). Continental declines in the grassland bird guild have largely been attributed to fragmentation effects, including small patch size, isolation of patches and consequent increased predation rates on grassland birds utilizing the remaining small grassland fragments (Herkert *et al.* 2003). Despite this, shrikes in Canada demonstrate versatility as the size of grassland patches used varies substantially, depending on the landscape configuration (R. Bloom, pers. comm.). For example, the subspecies will breed in highly fragmented suburban habitats and large expanses of rural grassland. Overall, recent declines in Loggerhead Shrike, *migrans* subspecies populations in Canada appear to be greater than would be expected based on the extent and rate of habitat loss on the breeding grounds, suggesting that other threats beyond nesting habitat loss are involved.

4.1.2 Environmental contaminants

The role played by pesticides and other contaminants in population declines of the Loggerhead Shrike, *migrans* subspecies is unclear (Yosef 1996). It has been suggested that the advent of organochlorine pesticides coincided with shrike declines. However, a recent comparison of pesticide residues in Loggerhead Shrike eggs collected in 1971–1972 and 1995–1996 suggests that although levels were 79% less in 1995–1996, shrikes have nevertheless continued to decline (Herkert 2004). In contrast, most populations of raptor species affected by organochlorine pesticides have rebounded (see Kirk and Hyslop 1998 for summary).

Suspected candidate wintering areas for the Loggerhead Shrike, *migrans* subspecies in the southeastern United States are also locations where there is evidence that prey species (e.g., mole crickets *Neocurtilla hexadactyla* or *Scapteriscus* spp.; and invertebrate orchard pests) may be exposed to substantial levels of pesticides (e.g., diazinon and its derivative diazoxon, both of which are highly toxic to birds (U.S. EPA 2000)) as part of control programs (P. Mineau, pers. comm.).

Both insecticides and herbicides may have indirect effects on prey availability and habitat structure. Declines of some farmland bird species in Europe have been attributed to pesticide effects on prey availability (e.g., Gray Partridge *Perdix perdix*; Potts 1997). Some herbicides have toxic effects on invertebrates, but their indirect effects are believed to be the most important (Freemark and Boutin 1995). By reducing vertical structural complexity of vegetation, herbicides have a detrimental effect on abundance and species diversity of invertebrates (e.g., Baines *et al.* 1998; Moreby and Southway 1999). Significant increases in territory size and the loss of young and adults was documented in Florida cattle pastures when sodium ammonium nitrate, a common fertilizer, was applied (Yosef and Deyrup 2005).

The increasing prevalence of residues of brominated flame retardant chemicals in the food chain, including the eggs, blood and tissues of predatory birds, suggests that this may also impact the Loggerhead Shrike, *migrans* subspecies. These chemicals are lipophilic and bioaccumulative and extremely high levels have been recorded in several avian top predators, including the Common Kestrel (*Falco tinnunculus;* Chen *et al.* 2007). As endocrine-disruptors, these chemicals have recently been implicated with reproductive failure in captive American Kestrels (*F. sparverius*), a species that shares similar habitats and dietary items with the Loggerhead Shrike (Fernie *et al.*

in press). At this time it is unknown if wild populations of shrikes or kestrels breeding in or adjacent to the remaining core areas have been exposed to these chemicals.

4.1.3 Disease and parasitic infestations

In 2001, several captive Loggerhead Shrike, *migrans* subspeciess died at the Toronto Zoo. An esophageal nematode (*Capillaria* sp.) found during necropsies may have been a contributing factor to the deaths; *Capillaria* sp. has also been found in wild birds (Bertelsen *et al.* 2004). Despite repeated treatments against this parasite, *Capillaria* sp. has been identified during several subsequent necropsies of captive birds at this location, suggesting that it is a persistent parasite.

The deaths of five captive birds at the Toronto Zoo in 2002 and two captive-reared fledglings in 2008 (one at Ingersoll wintering facility and one at the Dyer's Bay field propagation site) were attributed to West Nile virus. The mortality rate of exposed birds was 100% as the captive birds did not naturally develop antibodies (Bertelsen *et al.* 2004), however, the impact of this disease on wild populations is unknown. While susceptibility of wild Loggerhead Shrike, *migrans* subspecies to West Nile virus has been reported by United States Centers for Disease Control and Prevention and may prove to be an important limiting factor, it does not account for past declines.

4.1.4 Intraspecific competition

Intraspecific competition on the wintering areas with resident shrikes that occupy territories year round is likely a factor in the decline of the Loggerhead Shrike, *migrans* subspecies. (Brooks and Temple 1990; Cade and Woods 1997; Pruitt 2000; COSEWIC 2000). Loss of habitat on the wintering areas may exacerbate competition (Lymn and Temple 1991).

4.1.5 Collisions with vehicles

Shrikes have a propensity to forage along roadsides because roads have an abundance of essential habitat features. Both lookout perches and nest trees are often more common along roadsides bordering suitable habitat patches than within suitable habitat patches. Shrikes may also be attracted to invertebrates found on the warm pavement of roads and their practice of swooping low in flight between perches and down upon prey may leave them more susceptible to fatal collisions with vehicles (T. Norris, pers. comm.). In eastern Manitoba, young and, more rarely, adult Loggerhead Shrike, *migrans* subspecies have been killed by vehicles (K. De Smet, pers. comm.). In Virginia, 29% of all winter mortality has been attributed to automobile collisions (Blumton 1989). This could also be a factor contributing to mortality of Loggerhead Shrike, *migrans* subspecies on the wintering grounds (COSEWIC 2000).

4.1.6 Weather

For many years, extreme local weather conditions have been implicated as the cause of high nest failure rates in Loggerhead Shrike, *migrans* subspecies (e.g., nest abandonment or loss of young birds during cold wet breeding seasons, especially with heavy rains; Pruitt 2000; K. De Smet, A. Chabot, and C. Grooms, pers. comm.).

4.1.7 Predation

Predation of shrikes by a variety of species, including cats, raccoons, crows, magpies, and several raptors has been observed (Blumton 1989; Wiggins 2004, R.Wenting, pers. comm.) but the significance of predation to Loggerhead Shrikes has not been evaluated. Nest predators are generally more common near edges in some landscapes (Dijak and Thompson 2000; Winter *et al.* 2000) and several studies have demonstrated that nest predation rates are reduced in larger prairie fragments (Herkert *et al.* 2003). Yosef (1994) suggested that shrikes in linear habitats are more susceptible to predation than those nesting in non-linear habitats, because a variety of predators use linear corridors as conduits (DeGeus 1990).

5. POPULATION AND DISTRIBUTION

5.1 Population and distribution context

The range of the Loggerhead Shrike (*Lanius ludovicianus*), although still covering much of the United States and southern central Canada, has retracted significantly along its northeastern boundary (Pruitt 2000) (Figure 1).

The range of the Loggerhead Shrike, *migrans* subspecies is believed to have expanded in eastern North America after forest clearance and creation of pastures by European settlers (Yosef 1996). It once extended east from Manitoba to New Brunswick and south to northeastern Texas, western North Carolina, and Maryland (COSEWIC 2000). Since the 1960s, there has been a steady decline in range throughout the northeastern United States and Canada. The last breeding record for New England was reported in 1978 and for the Maritime provinces in 1972 (Laughlin and Kibbe 1985; Erskine 1992; Yosef 1996). While individuals or individual breeding pairs of Loggerhead Shrike, *migrans* subspecies are found sporadically throughout the species' historical range, few obligate migrant populations having multiple pairs remain (Pruitt 2000; Cade and Woods 1997; Yosef 1996; Sauer et. al. 2008; A. Chabot pers. comm.). Quebec no longer has a breeding population. The Manitoba population has dwindled from an estimated 12 pairs in 1999 to one pair in 2009 (K. DeSmet pers. comm.). The taxonomic status of the southeastern Manitoba population is uncertain as recent genetic analyses of this population have indicated hybridization between the Loggerhead Shrike *migrans* and *excubitorides* subspecies (Vallianatos *et al.* 2001; Chabot *et al.* 2006). The remaining multi-pair populations include the Ontario population and two populations in the U.S., one in the Midewin National Tallgrass Prairie in Northern Illinois, and the other in Iowa (Pruitt 2000; Cade and Woods 1997; Yosef 1996; Sauer et. al. 2008; A.Chabot, pers. comm.).

Recent preliminary analyses using stable isotope data indicate that Loggerhead Shrikes from Canada and the northern U.S. winter in Arkansas, Louisiana, Mississippi, Alabama, Tennessee, and Texas (A. Chabot, pers. comm.). Research on band returns provides further evidence of this (Burnside 1987). Other research using stable isotopes indicates that suburban areas in eastern Florida (Orange, St. Lucie, Martin and Okeechobee counties) are also used during the winter by northern migrants (Hobson and Wassenaar 2001). Overall, the wintering range for Loggerhead Shrike, *migrans* subspecies seems to be encompassed by the Gulf Coast states and mid-coastal

eastern Florida but excludes other states in the southeastern U.S. Little is known about shrike migration routes in Ontario, however, based upon several recent recoveries of banded birds and telemetry data, it appears that they migrate through southwestern Ontario and funnel along the Lake Erie shoreline from Long Point to Point Pelee in the fall (Imlay and Andrews 2008; J. McCracken pers.comm.).

The Loggerhead Shrike, *migrans* subspecies currently breeds in central and eastern parts of Canada and the United States within the range shown below on the map for the entire species (Figure 1). Both the Ontario and Manitoba shrike populations are essentially isolated during the breeding season, from each other and from the larger populations occurring in the south central United States (Figures 1 and 2). The Loggerhead Shrike, *migrans* subspecies population in Canada is currently believed to number fewer than 100 individuals. In Ontario, the subspecies is mainly found on the Carden Plain (18 pairs in 2009) and Napanee Limestone Plain (9 pairs in 2009) (E. Williams, pers. comm.). A few pairs have been observed in other historically occupied (core) areas (e.g., Smiths Falls (1), Pembroke (1), Grey and Bruce Counties (2)) for a total of 31 pairs in Ontario; no other significant numbers have been found since 2000. However, survey effort is often lower outside of Carden and Napanee.

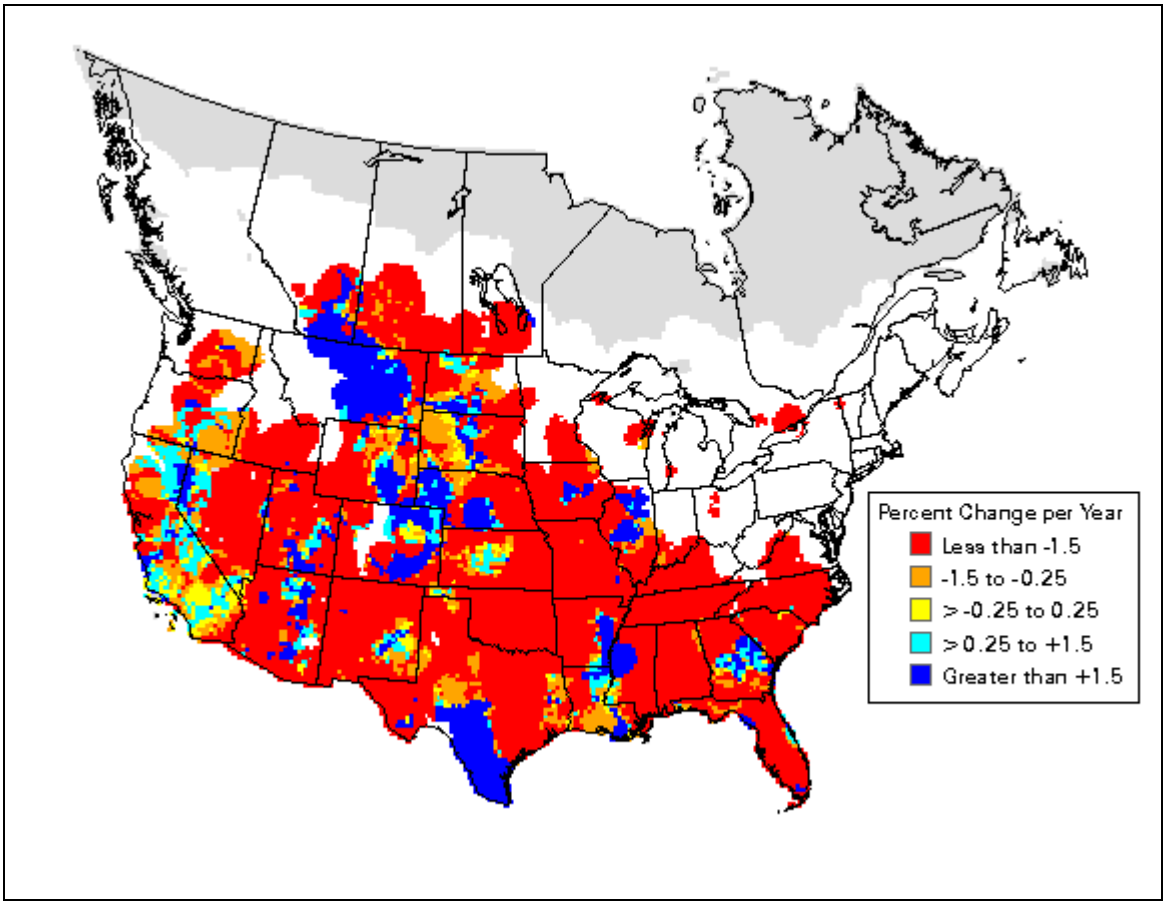

Figure 1. The Loggerhead Shrike breeding range in North America and population trend from 1966-2003 (Breeding Bird Survey).

During the first Ontario Breeding Bird Atlas (1981–1985), the Loggerhead Shrike, *migrans* subspecies was recorded in 145 of the 1,824 squares surveyed (8%) (Cadman *et al.* 1987). Of these records, 60 were evidence of possible breeding (41%), 28 were probable (19%), and 57 were confirmed (39%). The population at this time was estimated at 50-100 pairs (Cadman *et al.* 1987). In the second atlas (2001–2005), the subspecies was recorded in only 29 squares, with an estimated population of 18 pairs (Cadman *et al.* 2007). Fourteen of these squares had records from both the first and second atlases, whereas 15 squares had records only from the second atlas. Since 1991, the maximum number of shrikes observed in all of the core areas (not necessarily in the same year) totals 81 breeding pairs.

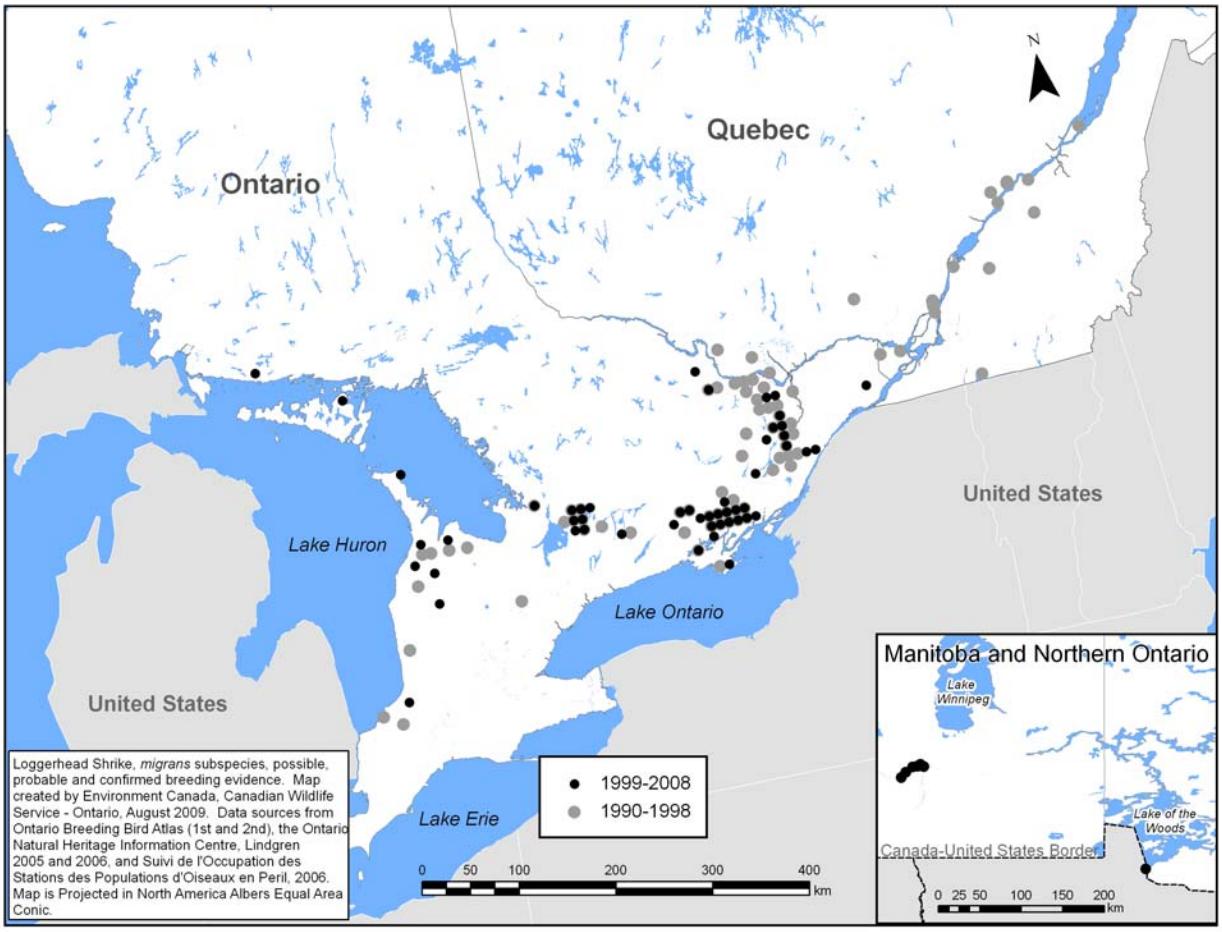

Figure 2. Breeding Range of Loggerhead Shrike, *migrans* subspecies in Canada.

During the early 1900s, Quebec may have supported a population of 100 breeding pairs, but populations began to decline in the 1940s, coinciding with a drastic reduction in pasture lands (Robert and Laporte 1991). Since the 1980s, fewer than 10 pairs have bred in Quebec (Robert and Laporte 1991). Although a single shrike was located in Quebec in 2003, the last breeding pair was observed in 1995 (L. Robillard, pers. comm.). In Manitoba, it was speculated that less than 50 pairs remained in the late 1980s (Cadman 1990). The population in Manitoba has continued to decline and 11 pairs were observed in 2000 (Lindgren 2005). In 2009, only one

breeding pair has been confirmed in Manitoba (K. De Smet, pers. comm.). The subspecies was last recorded as nesting in the Maritimes in 1972.

Long-term population trend information for the Loggerhead Shrike, *migrans* subspecies comes from the Breeding Bird Survey (Canadian Wildlife Service 2007). From 1968, the beginning of the survey in Canada, to 2007, the overall trend for Bird Conservation Region 13 (the Lower Great Lakes and St. Lawrence Plains, south of the St. Lawrence Seaway in Ontario and Quebec up to around Quebec City) was negative but not statistically significant (−24.2 based on 21 routes). The insignificance probably resulted from the relatively few survey routes, which generated very low counts of individual shrikes. Recent analysis of trend data from the annual Loggerhead Shrike, *migrans* subspecies monitoring program indicates that the overall population trend for Ontario from 1991-2008 is a loss of two pairs annually (Tischendorf 2009). Without a reversal in this trend, it is anticipated that the Loggerhead Shrike, *migrans* subspecies will become extirpated in Canada within 50 years (Tischendorf 2009).

5.2 Population and distribution objectives

The ultimate population and distribution objective is to re-establish a viable Loggerhead Shrike, *migrans* subspecies population in Canada.

Three specific population and distribution objectives have been identified to achieve the ultimate objective, each applicable to a different time frame. The short-term objective (5 years) is to stabilise the existing population and prevent further declines, the medium-term objective (10 years) is to foster overall population growth, and the long-term objective (25 years) is to ensure that birds are breeding consistently in at least three core areas in Ontario. The targets of the short term objective are to achieve at least 20 breeding pairs in Carden, and at least 10 pairs in Napanee and at least five pairs elsewhere in Ontario and could consist of individual pairs at various locations (35 pairs total). The targets of the medium term objective are to maintain at least 20 pairs in Carden, at least 20 pairs in Napanee, at least 10 pairs in a third core area in Ontario and at least 10 pairs elsewhere in Ontario (60 pairs total). The identification of the third core area is dependant on the success of on-going recovery efforts. The long term target is to have at least 20 pairs in each of these three core areas and at least 20 pairs elsewhere in Ontario (80 pairs total).

5.3 Rationale for population and distribution objectives

This recovery strategy focuses recovery activities on rebuilding the population in Ontario where the majority of Loggerhead Shrike, *migrans* subspecies remain. The Manitoba population has dwindled to one pair and a breeding population no longer exists in Quebec. It is possible that the populations in Manitoba and Quebec could increase or re-establish naturally as the Ontario population grows and disperses. Population and distribution objectives for Manitoba and Quebec will be re-examined in five years when this strategy is reviewed or sooner, depending on the success of the recovery effort in Ontario and on the clarification of the taxonomic status of the Manitoba population.

The short-term objective is based on the early success of the experimental captive breeding and release program in effectively stabilizing breeding numbers through the recruitment of released birds into the breeding population. Achieving the short-term objective, and perhaps the medium-term objective, will require refining the captive breeding and release program to maximize breeding success and releases in core areas and expedite recovery.

Already, a declining trend has been reversed in Carden and breeding numbers have increased outside the two key core areas (Carden and Napanee). The medium and long-term objectives are based on historical and current abundance (maximums) and distribution of Loggerhead Shrike, *migrans* subspecies in Ontario (total of 77 pairs: 18 pairs in Carden (2009), 39 pairs in Napanee (1994), 20 pairs in Smith Falls (1994)). In 2009, there were 18 pairs in Carden, nine pairs in Napanee, two pairs in Grey and Bruce Counties, one pair in Pembroke and one pair in Smiths Falls, totalling 31 pairs. Refinement of techniques aimed at increasing the annual survival and recruitment rates of released birds, which will be developed while achieving the short and medium term objectives, should help to increase the rate of population growth and maximize the probability of reaching the long-term objective of 80 pairs in Ontario within 25 years. Meeting these objectives will contribute to the ultimate objective of eventually establishing a viable population in Canada.

The 2009 population viability analysis (PVA) suggested that under present circumstances, the Loggerhead Shrike, *migrans* subspecies population faces a serious, if not certain, risk of extinction within a projected time-frame of 100 years (Tischendorf 2009). Using a scenario with significantly higher input parameters for productivity and survival than can presently be maintained by the wild population, the PVA indicated that a population of about 200 breeding pairs could be viable over a 100 year period (95% of the time), and that a population of 100 pairs could be viable over a 70 year period (Tischendorf 2009). However, this would require increasing productivity, survival and recruitment rates through the successful mitigation of current threats and limiting factors described above. This suggests that the actual number of wild breeding pairs required to sustain a viable population is likely well in excess of 200 pairs. The PVA model is a tool that can provide a rough indication of a target population level, but its results vary substantially as input demographic parameters are changed. The current analysis will be revised in the future using demographic parameters that reflect the implementation of conservation actions outlined in this strategy (Broad Strategy and Approach #1). The PVA model could be refined in the future to approximate a numerical target for a viable population.

6. BROAD STRATEGIES AND APPROACHES TO RECOVERY

The broad strategies and approaches recommended for the next five years and are discussed in Table 2.

Research to identify and address population limiting factors is essential for ensuring the long-term recovery of the Loggerhead Shrike, *migrans* subspecies. Data must be gathered through the annual banding of adults, wild young and released young, the monitoring and documenting of vital demographic rates of the population (survival of adults, wild young, released young,

released adults, reproductive success, dispersal distances), and by assessing population recovery and response to conservation actions. Research on release options will help improve the effectiveness of the release program and maximize opportunities for recovery, especially in the early phases.

Annual survival of the Loggerhead Shrike, *migrans* subspecies is a crucial factor affecting population dynamics across the range. There is also concern that while suitable habitat is present on the breeding grounds at the territory level, there may be insufficient habitat for landscape-scale demography due to fragmentation of existing habitat.

Efforts to confirm the location of wintering areas and determine the significance of the potential threats on the wintering areas is essential for the long term recovery of the subspecies. Much remains to be learned about survivability of this subspecies and threats to the subspecies on the wintering grounds.

6.1 Recovery planning

Broad strategies and approaches recommended to meet the population and distribution objectives for the Loggerhead Shrike, *migrans* subspecies in Canada are briefly outlined in Table 2 together with general steps and outcomes.

Table 2. Recovery planning table for Loggerhead Shrike, *migrans* subspecies in Canada

Priority	Broad strategy/ approach	Threat	General steps	Outcomes
High	Population and productivity monitoring	N/A	Monitor population size, distribution, fecundity, and survival of adults and young throughout the Canadian range on a yearly basis. Use monitoring data to further develop the population viability model to refine objectives, broad strategies, and critical habitat.	Further developed population viability analysis and refined objectives and broad strategies. More effective recovery program. Enhanced understanding of limiting factors for the population.
High	Habitat protection	Habitat loss and degradation	Conduct habitat assessments on shrike habitat every 5 years and collect annual information on occurrences. Refine critical habitat at nest site, territory and landscape levels. Determine the degree to which conspecific attraction affects nest site location.	Refined habitat occupancy model. Critical habitat is refined and protected.
Medium	Habitat protection and restoration	Habitat loss and degradation	Refine habitat management techniques and maintain and restore habitat (e.g., rehabilitation of quarries to create and enhance shrike habitat).	Enhanced habitat stewardship.
High	Applied research	Habitat loss and degradation	Use methods such as banding, stable isotopes, morphometrics, genetic analyses, radio-telemetry, and geolocators to refine knowledge of the location of wintering areas and, if possible, identify migration routes and stopover areas.	Known location of wintering areas and, if possible, migration routes and stopover areas. Quality of winter habitat is quantified. Enhanced knowledge of potential threats on the wintering grounds.

Priority	Broad strategy/ approach	Threat	General steps	Outcomes
High	Applied research	Habitat loss and degradation, intraspecific competition	Assess potential habitat loss/degradation and intraspecific and interspecific competition in wintering areas; determine effect on survival.	Potential habitat loss and intraspecific and interspecific competition in wintering areas assessed and effect on survival are known.
Medium	Applied research	Environmental contaminants, weather, disease and parasitic infestations, collisions with vehicles, predation	Assess prey availability and effects of habitat characteristics and pesticide use on prey. Assess significance of mortality along roads. Assess impact of diseases such as West Nile virus. Assess importance of predation as a limiting factor.	Knowledge of the importance of predation as a limiting factor and of the impacts of prey availability, use of pesticides, weather, collisions with vehicles and diseases such as West Nile virus on the population.
			Undertake research to determine taxonomic status of Manitoba birds.	Taxonomic status of Manitoba population is known.
High	Captive breeding in Ontario	N/A	Further refinements to husbandry and release techniques should improve efficiency, increase recruitment of released birds and validate conspecific attraction, thereby speeding up recovery. Conduct genetic assays to determine the genetic composition of the captive population in relation to the wild population. Consult with affected stakeholders on potential release sites prior to releases to provide opportunity for identification and mitigation of potential concerns.	Wild populations are augmentated. Genetic diversity is maintained. A management plan for the captive breeding and release program that outlines the most effective techniques for management and release is created.
High	Communication and stewardship	All	Establish research priorities annually. Develop educational materials to raise potential recovery participants' awareness. Promote cooperative landowner agreements and other voluntary measures to protect habitat. Engage relevant U.S. authorities and organizations regarding threats associated with migration and overwintering.	Increased awareness among recovery participants and U.S. partners. Improvement in the number and quality of stewardship initiatives.

Priority	Broad strategy/ approach	Threat	General steps	Outcomes
Medium	Applied research	Weather	Assess effects of local and continental weather on shrike survival and productivity. Assess the frequency of extreme weather in the last few decades and determine any correlations with population fluctuations.	Knowledge of the importance of local and continental weather on productivity, survival and population size.

6.2 Narrative to support recovery planning table

The approach for recovery focuses on protection and enhancement of suitable breeding habitat with concurrent efforts to determine migration and wintering area locations, along with studies addressing potential threats on the breeding grounds and eventually on the wintering grounds in cooperation with partners in the U.S. Intensive monitoring will provide important information for habitat protection, to fill key knowledge gaps and to better understand threats. Concurrent studies will also attempt to identify the wintering areas and investigate causes of low survival in these areas which are thought to be a primary reason for population declines. Management of the captive breeding and release program will be refined to increase return rates, expedite recovery and better augment existing subpopulations. Recovery of the Loggerhead Shrike, *migrans* subspecies in Canada will require the viability of early successional grasslands and managed grassland habitats; this will depend upon effective partnerships with habitat stewards. Recovery may also benefit from participation in multispecies or landscape approaches for species at risk recovery.

7. CRITICAL HABITAT IDENTIFICATION

7.1 Identification of the species' critical habitat

SARA requires the identification of habitat that is necessary for the survival or recovery of the subspecies in Canada. Critical habitat for the Loggerhead Shrike, *migrans* subspecies has been identified, to the extent possible, for the breeding grounds in Ontario based on the best available information. As additional information becomes available, critical habitat identification may be refined or sites meeting critical habitat criteria may be added in order to provide enough habitat to meet the population and distribution objectives. Critical habitat is not identified in this strategy for Manitoba birds because their taxonomic status is uncertain, nor in Quebec because a breeding population does not occur in the province. If either situation changes, populations and distribution objectives may be updated and critical habitat may be identified in these parts of the Loggerhead Shrike, *migrans* subspecies range.

This identification of critical habitat for the Loggerhead Shrike, *migrans* subspecies is based on site occupancy and suitable habitat. Suitable habitat within the breeding territory consists of short to medium grassland and/or alvar habitat, interspersed with suitable nesting sites and adequate perching structures. A significant proportion of the suitable habitat for this subspecies is being maintained through active livestock grazing regimens.

Sites have been identified as critical habitat where they fulfill at least one of the following criteria in the last ten years (applied for the period 1999-2008).

Criterion 1: Sites where there is reliable evidence of a minimum of one confirmed or probable[1] breeding pair of Loggerhead Shrike, *migrans* subspecies in any single year within a floating window of the last five years[2]; OR

Criterion 2: Sites where there is reliable evidence of a minimum of one confirmed or probable breeding pair of Loggerhead Shrike, *migrans* subspecies in any two years within a floating window of the last six to ten years; AND the current habitat (within 5 years) is suitable.

These criteria are designed to respond to changes in shrike population and distribution characteristics over time. Change is anticipated as a result of recovery activities and of the dynamic nature of grassland and alvar habitats, which may result in some sites becoming unsuitable over time, and other sites becoming suitable. The criteria aim to achieve a balance between consistent management and responsiveness. Table 3 lists critical habitat identified by applying the above criteria to bird monitoring data collected between 1998 and 2008 and to available habitat data.

Critical habitat will be reassessed every five years as priorities and resources allow. Reassessment of critical habitat will provide for regular evaluation of old and new breeding records and for the update of critical habitat identification over time. The scheduled review does not preclude the possibility of identifying additional critical habitat in the interim years, should new information become available. In the absence of a review, the current identification will remain valid.

Loggerhead Shrike, *migrans* subspecies occurrences in the six core breeding areas of Ontario were originally mapped in the mid-1990s in terms of the habitat patch on which they occurred. These patches were identified by air photo interpretation using a protocol developed by the Ontario Ministry of Natural Resources and then ground-truthed and assessed for suitability (protocols described in *Eastern Loggerhead Shrike Recovery Habitat Surveying and Monitoring Field Protocols* 2008). Occurrences continue to be monitored on these patches and this baseline information was used in the identification of critical habitat. Accordingly, under Criterion 1, confirmed or probable breeding evidence within the last five years identifies the associated habitat patch as critical habitat and suitable habitat within the patch is assumed to still exist.

In the case of older breeding evidence for those occurrences meeting Criterion 2, habitat suitability was assessed by examining the results from 2007 and 2008 habitat and survey monitoring, or from analysis of 2006 through 2008 orthophotography (air photos). If recent habitat assessment data or air photos were unavailable for a site then the 2003 habitat assessment data were used to determine habitat suitability.

Where these occurrences were on habitat patches monitored through habitat surveys and monitoring, habitat assessment attributes were used to determine the habitat suitability of

[1] Probable breeders are determined though observations of pairs observed in suitable nesting habitat, courtship displays including courtship feeding or copulation, and/or presence of brood patch (female) or cloacal protuberance (male).

[2] Sites meeting Criterion 1 were presumed to be located within suitable habitat.

the patch. Nesting and perching vegetation that were not dense enough to obstruct the species view of the ground were considered suitable. Habitat variables collected in the field pertaining to land use; nest site availability; perch site availability, including multiple perch types; and tree/shrub interspersion were used to assess the suitability of the habitat for Loggerhead Shrike, *migrans* subspecies. Fences and utility wires were considered part of the suitability assessment as they are frequently used as perching sites. Those habitat patches that met the requirements for habitat suitability are identified as critical habitat under Criterion 2.

Some species' occurrences, both recent and older, were on habitat patches not monitored through Loggerhead Shrike, *migrans* subspecies habitat surveys and monitoring. In this case, habitat patch boundaries and habitat suitability were evaluated based on air photo interpretation by experts, using available 1: 10,000 or larger scale imagery. Habitat patches containing tracts of alvar communities and active or idle pasture not requiring thinning, and interspersed with potential nesting sites and adequate perching structures were considered suitable habitat. Habitat patches deemed suitable through this process were identified as critical habitat under either Criterion 1 or Criterion 2, depending on the observation date.

A 50 ha area of occupancy around each nest site has been considered by some as the minimum area required to encompass the breeding territory of a pair of shrikes breeding in Ontario and elsewhere, particularly if adjusted to the actual shape of the available habitat (Johns *et al.* 1994 citing Brooks and Temple 1990; Cuddy and Leviton 1996). However, habitat beyond the 50 ha breeding territory is utilized by shrikes particularly in the post-fledgling phase prior to independence (Novak 1989; Haas 1995). Novak observed post-fledglings using habitat up to 750 m from the nest, while Haas observed use that extended on average as far as 1.6 km from the nest, though the latter study included observations that extended to the period of independence. Recent telemetry work, territory use studies and nest and habitat monitoring in Ontario also indicate post-fledging use of habitat beyond the 50 ha breeding territory, as young become more mobile prior to and following independence from parents and then also after independence (Argue and Crowley 2007; Imlay and Andrews 2008; A. Chabot and K. Hennige pers. comm.). For these reasons, both the nest site and any adjacent suitable grassland habitat intersecting the 50 ha breeding territory are identified as critical habitat.

Therefore, for sites that meet the above criteria, critical habitat includes all entire patches of habitat determined to be suitable for the subspecies and that intersect a 400 m-radius circle surrounding the centre point of the occurrence record.

The 108 patches of critical habitat listed in Table 3 were identified using the habitat suitability model described above. The majority of patches are either in the City of Kawartha Lakes, or the County of Lennox and Addington and the County of Hastings. All critical habitat identified in Table 3, with the exception of patch #2 (1.7 ha, Bedford Township), is within the six traditional core areas (Table 4). Patches are listed by their latitude and longitude coordinates (centre points), core area, township/municipality information and approximate area in hectares.

Table 3. Patches containing critical habitat for the Loggerhead Shrike, *migrans* subspecies in Ontario*

Patch No.	Decimal Degrees, North	Decimal Degrees, East	Patch Area (Hectares)	Geographic Township	Core Area Name
1	45.474	-76.856	64.6	ADMASTON	PEMBROKE
2	-	-	1.7	BEDFORD	
3	44.626	-78.948	47.0	BEXLEY	CARDEN
4	44.648	-78.957	58.6	BEXLEY	CARDEN
5	44.353	-76.960	44.8	CAMDEN EAST	NAPANEE
6	44.345	-76.898	46.4	CAMDEN EAST	NAPANEE
7	44.334	-76.927	136.8	CAMDEN EAST	NAPANEE
8	44.320	-76.937	14.8	CAMDEN EAST	NAPANEE
9	44.351	-76.886	41.6	CAMDEN EAST	NAPANEE
10	44.325	-76.940	51.3	CAMDEN EAST	NAPANEE
11	44.349	-76.916	47.8	CAMDEN EAST	NAPANEE
12	44.363	-76.927	20.6	CAMDEN EAST	NAPANEE
13	44.360	-76.930	25.4	CAMDEN EAST	NAPANEE
14	44.354	-76.972	110.4	CAMDEN EAST	NAPANEE
15	44.349	-76.969	33.5	CAMDEN EAST	NAPANEE
16	44.356	-76.944	117.8	CAMDEN EAST	NAPANEE
17	44.308	-76.939	28.6	CAMDEN EAST	NAPANEE
18	44.314	-76.930	25.7	CAMDEN EAST	NAPANEE
19	44.293	-76.930	103.5	CAMDEN EAST	NAPANEE
20	44.311	-76.932	10.9	CAMDEN EAST	NAPANEE
21	44.348	-76.894	34.2	CAMDEN EAST	NAPANEE
22	44.353	-76.890	18.4	CAMDEN EAST	NAPANEE
23	44.355	-76.893	18.2	CAMDEN EAST	NAPANEE
24	44.354	-76.920	72.7	CAMDEN EAST	NAPANEE
25	44.348	-76.868	87.0	CAMDEN EAST	NAPANEE
26	44.355	-76.871	53.7	CAMDEN EAST	NAPANEE
27	44.359	-76.875	23.0	CAMDEN EAST	NAPANEE
28	44.587	-79.069	97.8	CARDEN	CARDEN
29	44.590	-79.061	61.9	CARDEN	CARDEN
30	44.609	-78.983	57.9	CARDEN	CARDEN
31	44.629	-78.999	27.9	CARDEN	CARDEN
32	44.636	-78.989	98.8	CARDEN	CARDEN
33	44.635	-78.978	115.1	CARDEN	CARDEN
34	44.608	-78.971	80.9	CARDEN	CARDEN
35	44.614	-78.963	83.0	CARDEN	CARDEN
36	44.622	-79.006	183.2	CARDEN	CARDEN
37	44.637	-78.962	54.1	CARDEN	CARDEN
38	44.628	-78.959	53.6	CARDEN	CARDEN
39	44.635	-78.970	36.9	CARDEN	CARDEN
40	44.612	-79.067	159.2	CARDEN	CARDEN

41	44.605	-79.072	50.9	CARDEN	CARDEN
42	44.637	-78.949	181.9	CARDEN	CARDEN
43	44.629	-79.027	65.7	CARDEN	CARDEN
44	44.631	-79.018	106.1	CARDEN	CARDEN
45	44.643	-78.969	81.7	CARDEN	CARDEN
46	44.652	-78.970	106.1	CARDEN	CARDEN
47	44.661	-78.980	114.8	CARDEN	CARDEN
48	44.669	-78.975	27.3	CARDEN	CARDEN
49	44.628	-79.056	297.0	CARDEN	CARDEN
50	44.648	-79.049	276.9	CARDEN	CARDEN
51	44.655	-79.023	45.2	CARDEN	CARDEN
52	44.534	-78.988	184.4	ELDON	CARDEN
53	44.508	-78.960	74.9	ELDON	CARDEN
54	44.502	-78.965	30.0	ELDON	CARDEN
55	44.475	-78.969	87.9	ELDON	CARDEN
56	44.495	-78.962	29.4	ELDON	CARDEN
57	44.495	-78.953	20.8	ELDON	CARDEN
58	44.564	-79.004	45.9	ELDON	CARDEN
59	44.572	-79.014	120.7	ELDON	CARDEN
60	44.556	-78.997	81.4	ELDON	CARDEN
61	44.580	-78.983	40.9	ELDON	CARDEN
62	44.569	-78.992	166.8	ELDON	CARDEN
63	44.267	-76.707	223.2	ERNESTOWN	NAPANEE
64	44.261	-76.769	25.5	ERNESTOWN	NAPANEE
65	44.371	-77.336	72.9	HUNGERFORD	NAPANEE
66	44.323	-76.635	116.7	KINGSTON	NAPANEE
67	44.321	-76.646	14.6	KINGSTON	NAPANEE
68	44.329	-76.647	46.3	KINGSTON	NAPANEE
69	44.311	-76.665	37.8	KINGSTON	NAPANEE
70	44.672	-78.970	57.1	LAXTON	CARDEN
71	44.677	-78.973	23.1	LAXTON	CARDEN
72	44.677	-78.981	48.4	LAXTON	CARDEN
73	45.166	-81.374	20.7	LINDSAY	GREY-BRUCE
74	-	-	8.1	LINDSAY	GREY-BRUCE
75	45.011	-75.924	98.8	MONTAGUE	SMITHSFALLS
76	44.417	-77.542	76.4	RAWDON	NAPANEE
77	-	-	7.8	RAWDON	NAPANEE
78	44.304	-77.052	84.8	RICHMOND	NAPANEE
79	44.298	-76.943	26.8	RICHMOND	NAPANEE
80	44.299	-77.073	19.2	RICHMOND	NAPANEE
81	44.300	-77.068	31.6	RICHMOND	NAPANEE
82	44.333	-77.060	23.4	RICHMOND	NAPANEE
83	44.295	-77.065	61.3	RICHMOND	NAPANEE
84	44.297	-77.057	27.8	RICHMOND	NAPANEE
85	44.366	-77.033	45.0	RICHMOND	NAPANEE

86	44.364	-77.035	17.2	RICHMOND	NAPANEE
87	44.362	-77.042	43.0	RICHMOND	NAPANEE
88	44.329	-77.068	30.6	RICHMOND	NAPANEE
89	44.295	-77.011	19.2	RICHMOND	NAPANEE
90	44.356	-77.043	73.3	RICHMOND	NAPANEE
91	44.286	-77.136	18.6	TYENDINAGA	NAPANEE
92	-	-	5.9	TYENDINAGA	NAPANEE
93	44.281	-77.148	14.6	TYENDINAGA	NAPANEE
94	44.304	-77.115	14.3	TYENDINAGA	NAPANEE
95	44.275	-77.205	47.2	TYENDINAGA	NAPANEE
96	44.276	-77.193	33.9	TYENDINAGA	NAPANEE
97	44.276	-77.183	29.5	TYENDINAGA	NAPANEE
98	44.278	-77.173	29.3	TYENDINAGA	NAPANEE
99	44.279	-77.165	12.9	TYENDINAGA	NAPANEE
100	44.274	-77.172	21.5	TYENDINAGA	NAPANEE
101	44.274	-77.165	22.6	TYENDINAGA	NAPANEE
102	44.282	-77.140	28.2	TYENDINAGA	NAPANEE
103	44.291	-77.143	43.0	TYENDINAGA	NAPANEE
104	44.303	-77.137	96.7	TYENDINAGA	NAPANEE
105	44.303	-77.125	18.6	TYENDINAGA	NAPANEE
106	44.299	-77.127	37.2	TYENDINAGA	NAPANEE
107	44.331	-77.150	91.8	TYENDINAGA	NAPANEE
108	44.168	-77.146	172.6	TYENDINAGA	NAPANEE
		TOTAL AREA:	6805.0 Ha		

Jurisdictional Geographic Township boundaries obtained from Land Information Ontario: Geographic Townships, Improved, downloaded Aug.2009
Core Areas obtained through the Eastern Loggerhead Shrike Recovery Team
Note: Some irregularly shaped patches may have a patch centre that falls outside the boundary of the patch.
*Coordinates have not been provided for the four smallest patches (less than 10 hectares in size) to maintain the confidentiality of specific nesting areas found within these patches.

Over 6,800 ha of Loggerhead Shrike, *migrans* subspecies habitat is included within this critical habitat identification; the bulk of the area being identified within two core breeding areas: Carden (3,581 ha) and Napanee (3,030 ha) totalling 6,611 ha or 97% of the critical habitat identified (Table 4). Included in the Napanee core area is a 173 hectare patch of habitat on Mohawks of the Bay of Quinte land. The Carden and Napanee core areas supported 27 of the 31 breeding pairs in 2009 or 87% of the breeding pairs. Data used to identify critical habitat are held by Environment Canada, Canadian Wildlife Service – Ontario.

Table 4. Area of critical habitat identified within each of the six core areas recognized in Ontario

Core Name	*No. Patches*	*Area (ha)*	*% of total CH area currently identified*
CARDEN	40	**3581.2**	52.63
GREY-BRUCE	2	**28.8**	0.42
MANITOULIN ISLAND	0	**0**	0
NAPANEE	63	**3029.9**	44.52
PEMBROKE	1	**64.6**	0.95
SMITHS FALLS	1	**98.8**	1.45
TOTAL	107	**6,803.3**	99.97

Note: One additional patch (1.7 ha) has been identified outside the core areas, between the Smiths Falls and Napanee cores.

This identification of critical habitat will require some refinement over time.

Additional sites will be considered for identification of critical habitat for Loggerhead Shrike, *migrans* subspecies. Information on current habitat suitability, along with recent bird survey information at other locations in Ontario, is needed before these locations can be considered for critical habitat identification in a subsequent action plan. Alternatively, if Loggerhead Shrike, *migrans* subspecies no longer occupy a site (and do not meet the site occupancy criteria above), then the site will be reevaluated by Environment Canada in consultation with the Ontario Ministry of Natural Resources and/or other partners, as necessary, to determine whether it should remain designated as critical habitat.

Refinement and further identification of critical habitat will require significant technical efforts and close cooperation between the Responsible Jurisdictions to address Loggerhead Shrike, *migrans* subspecies recovery needs.

7.2 Activities likely to result in destruction of critical habitat

Anthropogenic activities that result in the removal of important habitat features, such as perching structures (e.g., shrubs), impaling sites (e.g. thorny shrubs) and nest trees, and/or fragmentation of habitat on the landscape will likely result in the destruction of critical habitat. Examples of activities likely to result in destruction of critical habitat include, but are not limited to, residential developments including rural residences, aggregate extraction, and other activities which result in the complete elimination of shrubs, nest trees and herbaceous vegetation that shrikes require for perching, nesting, impaling, hunting and other life-cycle requirements.

7.3 Activities NOT likely to result in destruction of critical habitat[3]

Pasture and agricultural grasslands are far more common throughout the existing Canadian range of the Loggerhead Shrike, *migrans* subspecies than native grasslands. The decline of the pasture cattle industry, however, has resulted in habitat succession and a decrease in available grassland habitat for this subspecies. The maintenance and creation of pastures for grazing animals will help maintain short, grassland habitat and may contribute greatly to the recovery needs of the Loggerhead Shrike, *migrans* subspecies and other grassland bird species. Maintaining native grasslands and open alvar communities through well-planned management activities such as prescribed grazing, prescribed fires and manual removal of dense shrub thickets is compatible with protection of critical habitat for Loggerhead Shrike, *migrans* subspecies. Habitat conservation by private landowners will be important in reducing fragmentation, and protecting habitat for shrike and other grassland birds. A cooperative approach ensuring stewardship and careful landuse by landowners and recovery managers can result in continued use of critical habitat by both landowners and the Loggerhead Shrike, *migrans* subspecies.

7.4 Schedule of studies to identify critical habitat

Future work to complete the identification of critical habitat in Canada includes the enhancement of the habitat suitability model to complete habitat assessments and update spatial boundaries. Improvements to the habitat occupancy model may be made through further examination of species-habitat relationships at the territory and landscape scale and temporal variability in species' occurrence. Owing to variability in habitat characteristics across the range of this subspecies, recovery will have to be based on the characteristics of the specific habitats that these geographically isolated populations occupy. The habitat suitability model may also be enhanced with features such as predictors of pattern of occupancy, details of dispersal behaviour, and influences of site fidelity, as this information becomes available.

Future work will also include examination of the subspecies status of the Manitoba population to determine if these individuals should be considered Loggerhead Shrike, *migrans* subspecies or a hybrid population peripheral to the Loggerhead Shrike, excubitorides subspecies. The resulting taxonomic status will impact future recovery efforts directed at the Manitoba population, including areas considered in the identification of critical habitat.

Activities to complete the identification of critical habitat are outlined in Table 5.

[3] The following section is not intended to meet the requirements of subsection 83(4) of *SARA*, which allows for certain activities to be exempt from the general prohibitions of *SARA*, provided the activities are permitted in recovery strategies, actions plans or management plans. Some beneficial management activities listed in this section may require permitting, either under *SARA* and/or other legislation.

Table 5. Schedule of studies

Description of activity	Outcome rationale	Timeline
Resolve subspecies status of Manitoba population	A critical review of existing genetic information is necessary to determine if recovery actions, including identification of critical habitat for this subspecies in Manitoba, is necessary.	2010-2012
Evaluate information gaps and limitations, and complete data collection	Information from recent habitat assessments and spatial boundaries is required to proceed with modelling and critical habitat refinement.	2010-2012
Develop a spatial population viability analysis model	An estimate of the dynamic distribution of the population in Canada	2010-2012
Analyze subspecies -habitat relationships and enhance the habitat suitability model	This model will quantify the amount of suitable habitat in Canada and identify potential restoration areas.	2010-2012
Targeted surveys to assess habitat suitability model	Assess the accuracy of the habitat suitability model.	2010-2012
Refinements to the habitat occupancy model from the habitat suitability model and occupancy data based on newly obtained information.	This model will incorporate intrinsic, extrinsic, and stochastic factors to predict patterns of occupancy and determine critical habitat. The model will identify sites of high conservation value and critical habitat required to meet population and distribution objectives.	2011-2013

8. ACTIONS ALREADY COMPLETED OR UNDERWAY

Environment Canada has partnered with a number of government and non-government organizations to support a variety of recovery efforts, including population monitoring, habitat mapping, stewardship for habitat protection, management of the captive population and experimental releases, and communication. The main organizations currently involved include Wildlife Preservation Canada, Ontario Ministry of Natural Resources, the Toronto Zoo, the Couchiching Conservancy, Queen's University, Bird Studies Canada, and African Lion Safari (in Ontario); Manitoba Conservation and Manitoba Cattle Producers Association (in Manitoba); and the Nature Conservancy of Canada, McGill University, the Club des ornithologues de l'Outaouais, Bird Protection Quebec, Ministere des Ressources naturelles et de la Faune and Regroupement Quebec Oiseaux (in Quebec). Habitat restoration and nest monitoring have been successfully implemented in cooperation with some of the above organizations and private landowners. Restored habitat has been increasingly utilized by nesting shrikes in both Carden and Napanee.

Habitat assessment work has been completed in Ontario and Quebec, and has been initiated in Manitoba. Habitat information is being used, in conjunction with occurrence information, to investigate habitat suitability and habitat availability, and to aid critical habitat identification for Loggerhead Shrike, *migrans* subspecies. Some of this information (i.e., nest locations and breeding habitat) has been incorporated into municipal planning processes. Working relationships have been established with farm organizations, local citizens, and affected landowners. Continued cooperation with stakeholders and private landowners with shrikes or shrike habitat on their lands will play a key role in protecting the remaining habitat for the

subspecies in Canada. As well, education packages, videos, news releases, and public service announcements have been developed and distributed.

Throughout the continental range of the Loggerhead Shrike, *migrans* subspecies, genetic, stable isotope, morphometric, and banding data from wild and captive birds have been collected to assess connectivity among populations (i.e. gene flow and dispersal), genetic diversity within and differentiation between populations, migratory behaviour, and to identify wintering grounds for the subspecies. Samples have been stored at Queen's University for future genetic and stable-isotope research.

An intensive program to band wild Loggerhead Shrike, *migrans* subspecies in Ontario was undertaken from 1999 to 2004 and re-initiated in 2008. All released captive-reared birds are also being colour-banded. In recent years, released birds in Ontario and Quebec have been fitted with radio transmitters. In 2009 approximately 50 juvenile Ontario birds were released wearing geolocators, which if recovered in 2010 following return from wintering areas, will provide data on wintering locations. A volunteer-based grassland bird survey was initiated in the six remaining core areas of Loggerhead Shrike, *migrans* subspecies habitat in Ontario in 2009 to increase survey coverage in core areas, identify all returning shrikes, and gain insight into other grassland bird species present in shrike habitat.

A population viability analysis was completed in 2009 and helped establish the current population and distribution objectives for the subspecies. The population viability analysis also indicated that annual juvenile and adult survival rates were key factors to consider in the decline of the subspecies (Tischendorf 2009).

8.1 Captive breeding and release program

A captive breeding and release program was established in the 1990s with facilities in Quebec and Ontario. It was initially developed to maintain genetic diversity within the Loggerhead Shrike, *migrans* subspecies population. Since 2001 the program has been used to experimentally release captive-reared birds into the wild to augment the wild breeding population and to provide a safeguard for the subspecies.

In Quebec captive breeding was conducted at the Avian Science and Conservation Centre of McGill University in Ste-Anne-de-Bellevue and releases were made from Breckenridge. Seven young were released in 2004, and five young and two adults were released in 2005 (P. Laporte, pers. comm.). From 2006 to 2008, 65 young were released (G. Desjardins, I. Ritchie, pers. comm.). A male bird that was released in Quebec in 2008 returned to Ontario in 2009 and successfully paired with a wild female in Carden. It is expected that 2010 will be a transition year as the captive breeding and release program in Quebec will be decommissioned in order to reallocate key recovery activities (Table 2) in Ontario.

In Ontario, birds are currently bred and released at two locations, Carden and Dyer's Bay (Bruce County). Additional breeding facilities in Ontario include the Toronto Zoo and Ingersoll. In Ontario from 2001 to 2008, 418 juvenile shrikes were released from the field propagation and release program (~100 young/year from 2006 to 2008). No birds were released in 2003.

First confirmation that captive-reared birds can survive, migrate successfully, return to nest in the wild, and fledge young came in 2005 and 2006, when two captive-reared females released in each of the previous years were discovered nesting in Carden, Ontario. The juvenile return rate for captive-reared birds released from Carden and Dyer's Bay in 2007 was 6.4% (6 of 94 returned) and in 2008 was 1.9% (2 of 103) which is higher than the 0-1.2% return rate reported for wild migrant juvenile loggerhead shrikes (Brooks and Temple 1990, Collister and De Smet 1997). Five previously released birds returned in 2009; one from 2006, one from 2007, and three from 2008. As of 2009, a total of 19 captive-reared birds had returned to Ontario including the one released from Quebec and 18 others released from Dyer's Bay and Carden in Ontario. Eighteen birds returned to Carden and the remaining bird, an individual from Dyer's Bay returned to Big Bay, near Wiarton. Fourteen of these returning birds paired with wild shrikes and successfully fledged young. The overall return rate of Ontario birds from 2001 to 2009 is 4.3% (18 of 418 birds released).

The captive breeding and release program in Ontario has contributed to the reversal of the declining population trend for the Carden population; it is now estimated that one breeding pair is recruited every two years (Tischendorf 2009). The program has demonstrated relatively early returns (i.e.less than five years from the date of the first releases) compared to other programs, Peregrine Falcon (10 years) and San Clemente Loggerhead Shrike (9 years) and may prove useful for other migratory passerines in the future (D.Kleiman pers. comm.). The captive population studbook continues to be managed by the Canadian Association of Zoos and Aquariums

9. ADDITIONAL INFORMATION REQUIREMENTS ABOUT THE SPECIES

In order to clarify the taxonomy and halt the continuing decline of the Loggerhead Shrike, *migrans* subspecies, additional information is required regarding potential limiting factors. The following knowledge gaps are considered as the highest priority:

1. Specific location of wintering grounds, and if possible migration routes and staging areas.

2. Habitat degradation, loss, intraspecific and interspecific competition on the wintering grounds and the effect on survival.

3. Habitat requirements at the nest, territory and landscape scales and relationship to reproductive success, especially between rural and urban habitats.

4. Relationships between prey availability (quality and quantity) and habitat use, pesticide use or shrike survival.

5. Impact of West Nile virus and other parasites and diseases on the population.

6. Effect of predators on productivity and survival, along with relationship, between predation and habitat configuration (e.g. edge effects).

7. Relative importance of varying climatic conditions on annual productivity and survival rates, including over-wintering survival rates of various age classes.

8. Determination of whether the Manitoba population should be considered a part of the Loggerhead Shrike, *migrans* subspecies population or whether it is more appropriately considered part of the Loggerhead Shrike, *excubitorides* subspecies population.

The results of research targeted toward these knowledge gaps will immediately be used to advance ongoing and planned recovery actions.

10. MEASURING PROGRESS

This recovery strategy will be assessed against progress made in achieving the short term population and distribution objective over the next five years (Table 6). Performance measures for medium and long term objectives will be further developed in the action plan(s).

Table 6. Performance measures

Population and Distribution Objective	Performance measures
Stabilize the existing population and prevent further declines	No further population decline in Canada
	20 breeding pairs established in Carden
	10 breeding pairs established in Napanee
	At least five breeding pairs established elsewhere in Ontario

11. EFFECTS ON THE ENVIRONMENT AND OTHER SPECIES

In the last decade, greater and more widespread declines have occurred in the grassland bird guild than for any other group of North American species (Dunn *et al.* 2000; Sauer *et al.* 2008). Relatively little is known about the specific causes of the declines for most grassland birds. For some, however, a clear link has been demonstrated between declining hay and pasture areas and population trends (e.g., Bobolink *Dolichonyx oryzivorus*; Bollinger and Gavin 1992) and between native grassland patch size and population trends (e.g., Sprague's Pipit *Anthus spragueii*; Davis 2004).

As the factors contributing to the decline of shrike populations become better understood and programs are implemented to mitigate these threats, the results can be shared with those who work on other grassland species. The new knowledge can be shared and incorporated into the

management strategies for all affected species, leading to the development of integrated management plans for certain open space ecosystems (see Davis *et al.* 2004). Shrike recovery may provide benefits to other grassland species at risk, such as Henslow's Sparrow *Ammodramus henslowii*, which may be found within larger grassland habitat complexes, despite using different habitat types than Loggerhead Shrike, *migrans* subspecies. On-going habitat restoration efforts have proven to be successful for shrike while impacts to other species at risk are avoided through project-based evaluation.

12. STATEMENT ON ACTION PLANS

One or more action plans will be posted on the Species at Risk Public Registry within 5 years of posting this strategy on the Registry. An important component of this action plan will be the identification of additional critical habitat, if required, and refinement of the identified critical habitat.

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APPENDIX A: NATURESERVE RANKS AND DEFINITIONS

The table below lists the conservation status ranks used by NatureServe and their definitions. The numbers and letters are appended to G (global rank, for the whole range), N (national rank for within a nation), or S (sub-national rank, for a province or state). A range rank (e.g. S1S2) is used to indicate a range of uncertainty about the status of the species or community.

Rank	Definition
1	Critically Imperiled – Critically imperiled in the jurisdiction because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation.
2	Imperiled – Imperiled in the jurisdiction because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines or other factors making it vulnerable to extirpation.
3	Vulnerable – Vulnerable in the jurisdiction due to a very restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.
4	Apparently Secure – Uncommon but not rare; some cause for long-term concern due to declines or other factors.
5	Secure – common, widespread and abundant in the jurisdiction.
B	Breeding – breeding population of the species in the nation or state/province.
N	Non-breeding – non-breeding population of the species in the nation or state/province.
M	Migrant – occurring regularly on migration at particular staging areas or concentration spots where the species might warrant conservation attention. Conservation status refers to the aggregate transient population of the species in the nation or state/province.
NR	Unranked – status not yet assessed
NA	Not Applicable – species is not a suitable target for conservation activities.
?	Inexact Numeric Rank—Denotes inexact numeric rank