

Recovery Strategy for the Northern Bobwhite (*Colinus virginianus*) in Canada

Northern Bobwhite



2017



Recommended citation:

Environment and Climate Change Canada. 2017. Recovery Strategy for the Northern Bobwhite (*Colinus virginianus*) in Canada [Proposed]. *Species at Risk Act Recovery Strategy Series*. Environment and Climate Change Canada, Ottawa. ix + 37 pp.

For copies of the recovery strategy, or for additional information on species at risk, including Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the [Species at Risk \(SAR\) Public Registry](http://sararegistry.gc.ca/default.asp?lang=En&n=24F7211B-1)¹.

Cover illustration: © Dr. George K. Peck

Également disponible en français sous le titre
« Programme de rétablissement du Colin de Virginie (*Colinus virginianus*) au Canada [Proposition] »

© Her Majesty the Queen in Right of Canada, represented by the Minister of Environment and Climate Change, 2017. All rights reserved.

ISBN

Catalogue no.

Content (excluding the illustrations) may be used without permission, with appropriate credit to the source.

¹ <http://sararegistry.gc.ca/default.asp?lang=En&n=24F7211B-1>

Preface

The federal, provincial, and territorial government signatories under the [Accord for the Protection of Species at Risk \(1996\)](#)² agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the federal competent ministers are responsible for the preparation of recovery strategies for listed Extirpated, Endangered, and Threatened species and are required to report on progress within five years after the publication of the final document on the SAR Public Registry.

The Minister of Environment and Climate Change is the competent minister under SARA for the Northern Bobwhite and has prepared this recovery strategy, as per section 37 of SARA. To the extent possible, it has been prepared in cooperation with the province of Ontario and Walpole Island First Nation as per section 39(1) of SARA.

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 and Climate Change Canada, or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this strategy for the benefit of the Northern Bobwhite and Canadian society as a whole.

This recovery strategy will be followed by one or more action plans that will provide information on recovery measures to be taken by Environment and Climate Change Canada and other jurisdictions and/or organizations involved in the conservation of the species. Implementation of this strategy is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

The recovery strategy sets the strategic direction to arrest or reverse the decline of the species, including identification of critical habitat to the extent possible. It provides all Canadians with information to help take action on species conservation. When critical habitat is identified, either in a recovery strategy or an action plan, SARA requires that critical habitat then be protected.

In the case of critical habitat identified for terrestrial species including migratory birds SARA requires that critical habitat identified in a federally protected area³ be described in the *Canada Gazette* within 90 days after the recovery strategy or action plan that identified the critical habitat is included in the public registry. A prohibition against destruction of critical habitat under ss. 58(1) will apply 90 days after the description of the critical habitat is published in the *Canada Gazette*.

² <http://registrelep-sararegistry.gc.ca/default.asp?lang=en&n=6B319869-1#2>

³ These federally protected areas are: a national park of Canada named and described in Schedule 1 to the *Canada National Parks Act*, The Rouge National Park established by the *Rouge National Urban Park Act*, a marine protected area under the *Oceans Act*, a migratory bird sanctuary under the *Migratory Birds Convention Act, 1994* or a national wildlife area under the *Canada Wildlife Act* see ss. 58(2) of SARA.

For critical habitat located on other federal lands, the competent minister must either make a statement on existing legal protection or make an order so that the prohibition against destruction of critical habitat applies.

If the critical habitat for a migratory bird is not within a federal protected area and is not on federal land, within the exclusive economic zone or on the continental shelf of Canada, the prohibition against destruction can only apply to those portions of the critical habitat that are habitat to which the *Migratory Birds Convention Act, 1994* applies as per SARA ss. 58(5.1) and ss. 58(5.2).

For any part of critical habitat located on non-federal lands, if the competent minister forms the opinion that any portion of critical habitat is not protected by provisions in or measures under SARA or other Acts of Parliament, or the laws of the province or territory, SARA requires that the Minister recommend that the Governor in Council make an order to prohibit destruction of critical habitat. The discretion to protect critical habitat on non-federal lands that is not otherwise protected rests with the Governor in Council.

Acknowledgments

The initial draft of the Recovery Strategy for the Northern Bobwhite was prepared by Al Sandilands of Gray Owl Environmental Inc.. Subsequent versions were prepared by Shawn Meyer and Ken Tuininga with assistance from Angela McConnell and John Brett, Environment and Climate Change Canada, Canadian Wildlife Service - Ontario and Patrick Hubert, Ontario Ministry of Natural Resources and Forestry.

The following people provided information for the Northern Bobwhite Recovery Strategy: Madeline Austen and Mike Cadman, Environment and Climate Change Canada, Canadian Wildlife Service-Ontario; Amelia Argue, Alan Dextrase, Ron Gould, Don Hector, Pud Hunter, Catherine Jong, Jake Lozon, Ron Ludolph, Kate MacIntyre, Chris Risley, Bree Walpole and Allen Woodliffe, Ontario Ministry of Natural Resources and Forestry; Don Sutherland, Natural Heritage Information Centre – Ontario Ministry of Natural Resources and Forestry; Greg George, Kettle and Stoney Point First Nation; Clint Jacobs, Kennon Johnson, Walpole Island First Nation; Ross James, Royal Ontario Museum; Erica Nol, Trent University; Hal Schraeder, Ontario Ministry of the Environment and Jon McCracken, Bird Studies Canada.

This recovery strategy also benefited from the input, review and suggestions from the following individuals: Marie Archambault, Madeline Austen, Lesley Dunn, Judith Girard, Krista Holmes, Elizabeth Rezek, Environment and Climate Change Canada, Canadian Wildlife Service – Ontario, Kim Borg and Veronique Brondex, Environment and Climate Change Canada, Canadian Wildlife Service – National Capital Region and Jay Fitzsimmons, Leanne Jennings, Sarah McGuire and Don Sutherland, Ontario Ministry of Natural Resources and Forestry.

Acknowledgment and thanks is given to all other parties that provided advice and input used to help inform the development of this recovery strategy including various Indigenous organizations and individuals, individual citizens, and stakeholders who provided input and/or participated in consultation meetings.

Executive Summary

The Northern Bobwhite (*Colinus virginianus*) is a tallgrass prairie-savanna bird which also inhabits early to mid-successional forest habitats and open areas such as agricultural fields. It prefers areas subject to periodic natural disturbances, such as fire, and uses sites with large amounts of shade-intolerant herbaceous species. It requires large and/or well-connected patches of suitable habitat that include open grassy areas for nesting interspersed with early-successional shrubby areas for roosting and plants such as agricultural crops for feeding. The Northern Bobwhite is a non-migratory species that typically spends its entire lifetime close to its natal⁴ area. Consequently, all of its life history requirements must be in close proximity for habitat to be considered suitable for the species.

Currently, native Northern Bobwhites are only known from Walpole Island First Nation in extreme southwestern Ontario in Canada. The species is listed as Endangered under Schedule 1 of the *Species at Risk Act* and also under the *Ontario Endangered Species Act, 2007*. Its breeding population was estimated at 230 birds in 2000 (based on a count of 92 singing males), but numbers are believed to have declined since then. Multiple sightings of Northern Bobwhite on Walpole Island First Nation in 2015 and 2016 have, however, confirmed the persistence of the population. The species has experienced significant declines throughout most of its North American range.

Despite the threats to the Northern Bobwhite and based on the criteria that Environment and Climate Change Canada uses to establish recovery feasibility, the recovery of the Northern Bobwhite has been deemed technically and biologically feasible. Habitat loss and fragmentation are key threats to the viability⁵ of the Northern Bobwhite in Ontario. Predation (wildlife and domestic pets) is also a threat, particularly due to the critically small remnant population. Indiscriminate burning of grassland habitats may eliminate cover particularly in the fall and winter. And the release of non-native Northern Bobwhite is a potential threat because of interbreeding which may compromise native genetic stock and fitness. The use of herbicide and pesticide reduces the amount of forage available, particularly invertebrates which are vital for chick growth and survival. The European Fire Ant (*Myrmica rubra*) is also a potential threat that could impact the Northern Bobwhite in a similar way to how another invasive ant species has impacted it in the United States.

The population and distribution objectives for the Northern Bobwhite in Canada are:

Short term (5 - 10 years):

- Maintain the existing population on Walpole Island First Nation and where biologically and technically feasible increase the abundance of the existing population to at least 230 adult birds.

⁴ Relating to birth.

⁵ The probability of persistence.

Medium term (10 - 20 years):

- If biologically and technically feasible, increase the population on Walpole Island First Nation to at least 500 adult birds and increase its distribution to historically occupied areas on Walpole Island First Nation.

Long term (time frame to be determined):

- If biologically and technically feasible, to achieve a self-sustaining, resilient and redundant population, by establishing at least one viable population on Walpole Island First Nation and re-establish one viable population on the mainland.

Critical habitat has not been identified for the only known remaining population of native Northern Bobwhite in Canada on Walpole Island First Nation nor on the mainland at this time because sufficient location and habitat information is not currently available to Environment and Climate Change Canada. The Schedule of Studies (Section 7.2) outlines the activities required to identify critical habitat necessary to support the population and distribution objectives for this species.

One or more action plans will be completed for Northern Bobwhite by December 2023.

Recovery Feasibility Summary

Based on the following four criteria that Environment and Climate Change Canada uses to establish recovery feasibility, there are unknowns regarding the feasibility of recovery of the Northern Bobwhite. 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 technically and biologically 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.*

Unknown. The most recent targeted surveys for Northern Bobwhite were completed on Walpole Island First Nation in 2000. At this time the population on Walpole Island was estimated to be around 230 adult birds (MacIntyre 2002). While the population has likely declined since 2000, local knowledge from Walpole Island First Nation suggests that a small population persists on the island. Five individuals reported sighting Northern Bobwhites in 2015 and 7 others reported sightings in 2016. Numbers of birds seen ranged from single individuals to coveys⁶ of 30 - 40 birds (Jacobs and Johnson 2016). While these Northern Bobwhites are considered native the current size of the population is not known. Native Northern Bobwhites are not known to exist on the mainland. Because the only remaining native population exists on Walpole Island and the size of that population is not known, whether sufficient individuals exist to establish a native population on the mainland is not known. The remaining population is also vulnerable to environmental events. Deep snow and prolonged cold periods have caused up to 50% mortality in northern populations (Errington and Hammerstrom 1936). While recovery of the Walpole Island First Nation population and re-establishing a population on the mainland may both be feasible, both may also not be feasible. The species has declined across much of its range, particularly at the northern extent of its range (Lohr et al. 2011). Connectivity with other populations in the United States appear to be limited. A recent genetic analysis found that historically (prior to 1884) there was little genetic exchange between Ontario and Michigan populations (Chabot 2014). Page and Austen (1994) said that the Ontario population was likely isolated. Today habitat that would allow colonization and/or rescue from a neighbouring population (e.g., Michigan) is very limited in Ontario. Habitat is available on Walpole Island First Nation, however, the major portion of adjacent Michigan, Harsen's Island, hasn't supported Northern Bobwhites, native or pen-reared, since at least 2012 (T. McFadden pers. comm. 2016).

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

Unknown. An analysis of habitat in 2008 on Walpole Island First Nation estimated there were 1348 hectares of natural habitat available for Northern Bobwhite (Jacobs and

⁶ Small flocks or family groups.

Johnson 2016). The amount of tallgrass prairie and savanna habitat has declined on Walpole Island First Nation due to conversion to agriculture, housing and invasion by European Common Reed (*Phragmites australis* ssp. *australis*) (COSEWIC 2013). On-going efforts by the Walpole Island Heritage Centre and Walpole Island Land Trust have contributed to restoration and protection of tallgrass prairie and savanna sites (Jacobs and Johnson 2016), however, a habitat assessment is needed to determine if a sufficient quantity and mixture of early successional wooded areas and open and semi-open habitats (e.g. brushy cover, cropland and grassland habitats) are currently available for Northern Bobwhite recovery. Substantial habitat restoration will be necessary if a mainland population is to be re-established in southern Ontario, as little habitat for the species remains on the mainland.

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

Yes. The primary threats to Northern Bobwhite are habitat loss and fragmentation due to agricultural and residential development and invasion by European Common Reed, predation, indiscriminate burning, release of non-native Northern Bobwhites, herbicide / insecticide use and potentially European Fire Ant. Indiscriminate burning is largely a threat restricted to Walpole Island First Nation, and with the restrictions on releases of non-native, pen-reared Northern Bobwhites, pen-reared birds may not currently be a threat to the remaining population on Walpole Island First Nation. The remaining threats are present on Walpole Island First Nation and the mainland and mitigation will eventually be required in both of these areas. Threats posed by development can be avoided through the use of planning policies and in some cases, land acquisition or other non-regulatory protection techniques. A variety of methods are available to control European Common Reed including chemical control and prescribed burning. The threat of human-subsidized predators such as raccoons, skunks can be mitigated through best management practices for nuisance animals. Domestic cats etc. can be mitigated through control/removal measures. Predation threats as a whole will be reduced by making more habitat available and increasing connectivity between habitat patches. Outreach and education can be used to better control the extent and timing of fires on Walpole Island First Nation and reduce exposure to herbicide and insecticides. Although the release of non-native, pen-reared Northern Bobwhite and their potential interbreeding with native birds is a concern, releases of non-native Northern Bobwhite in Ontario has been regulated by the province through the *Fish and Wildlife Conservation Act* since 1997 and prior to 1997 through the *Game and Fish Act*. Ontario's current policy for issuing Game Bird Hunting Preserve Licenses is intended to prevent the release of pen-raised Northern Bobwhites on Game Bird Hunting Preserves within 50 km of the native population on Walpole Island First Nation. European Fire Ants can be managed through integrated pest management including various ant baits.

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

Yes. Tallgrass prairie and savanna conservation and restoration are active in southern Ontario including on Walpole Island First Nation, which is the primary habitat need of Northern Bobwhite. Walpole Island First Nation purchased and leased over 300 hectares of land between 2001 and 2011 for conservation, including prairie and savanna habitats. Also, identifying surrounding sites both on Walpole Island First Nation and the mainland that are suitable for tallgrass prairie restoration and assessing habitat connectivity of nesting, foraging and roosting habitats will help achieve the population and distribution objectives over the long-term. Methods to control European Common Reed exist and are being applied at many locations in southern Ontario including on Walpole Island First Nation. A variety of projects have been conducted on Walpole Island First Nation between 2011 and 2016 to control European Common Reed in prairie and savanna habitats. Predation can be addressed through best management practices and habitat creation, and education and outreach can be used in addition to management in the case of feral⁷ cats. Increased public awareness should help encourage the ecologically appropriate use of fire on Walpole Island First Nation. Outreach and education materials on conservation-friendly farming practices, including integrated pest management and organic farming can be promoted within the agricultural community to reduce impacts of herbicides and pesticides in areas supporting Northern Bobwhite. Licenses are not currently issued to pen-rear and release Northern Bobwhites on Game Bird Hunting Preserves in proximity to Walpole Island First Nation in Ontario.

⁷ Having reverted to the wild state, as from domestication.

Table of Contents

Preface.....	i
Acknowledgments	iii
Executive Summary	iv
Recovery Feasibility Summary	vi
1. COSEWIC Species Assessment Information.....	1
2. Species Status Information	1
3. Species Information	2
3.1 Species Description	2
3.2 Species Population and Distribution.....	2
3.3 Needs of the Northern Bobwhite	6
4. Threats.....	10
4.1 Threat Assessment	10
4.2 Description of Threats	11
5. Population and Distribution Objectives	16
6. Broad Strategies and General Approaches to Meet Objectives.....	17
6.1 Actions Already Completed or Currently Underway	17
6.2 Strategic Direction for Recovery.....	19
6.3 Narrative to Support the Recovery Planning Table	22
7. Critical Habitat.....	22
7.1 Identification of the Species' Critical Habitat	22
7.2 Schedule of Studies to Identify Critical Habitat.....	23
8. Measuring Progress.....	23
9. Statement on Action Plans.....	24
10. References	25
Appendix A: Subnational Conservation Ranks of Northern Bobwhite (<i>Colinus virginianus</i>) in Canada and the United States	35
Appendix B: Effects on the Environment and Other Species	37

1. COSEWIC* Species Assessment Information

Date of Assessment: May 2013

Common Name (population): Northern Bobwhite

Scientific Name: *Colinus virginianus*

COSEWIC Status: Endangered

Reason for Designation: Owing to habitat loss, this grassland bird's population has declined dramatically over historical levels and shows no sign of recovery. There is only one viable population remaining in Canada, located on Walpole Island, Ontario. The status of this species is complicated by the presence of introduced pen-reared birds whose genetic composition is believed to pose a threat to the remaining native population.

Canadian Occurrence: Ontario

COSEWIC Status History: Designated Endangered in April 1994. Status re-examined and confirmed in November 2003 and May 2013.

* COSEWIC (Committee on the Status of Endangered Wildlife in Canada)

2. Species Status Information

Globally, the Northern Bobwhite (*Colinus virginianus*) is ranked Near Threatened on the International Union for Conservation of Nature (IUCN) Red List (BirdLife International 2016) and G4G5 (Apparently Secure/Secure⁸), with national ranks of N5 (Secure) in the United States and N1 (Critically Imperilled⁹) in Canada (NatureServe 2015). Provincial and state NatureServe conservation status ranks are listed in Appendix A. It is assessed as nationally Endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2003 and 2013) and listed as Endangered on Schedule 1 of the *Species at Risk Act* in 2005. In Ontario, the Northern Bobwhite is listed as Endangered on the Species at Risk in Ontario List under the *Endangered Species Act, 2007*.

In Canada, the Northern Bobwhite is at the northern limit of its range and only found in Ontario (Page and Austen 1994). In the United States the species' range encompasses

⁸ Apparently Secure/Secure: At a fairly low risk of extirpation in the jurisdiction due to an extensive range and/or many populations or occurrences, but with possible cause for some concern as a result of local recent declines, threats, or other factors/ At very low risk of extinction or elimination due to a very extensive range, abundant populations or occurrences, and little to no concern from declines or threats.

⁹ Critically Imperilled: At very high risk of extirpation in the jurisdiction due to very restricted range, very few populations or occurrences, very steep declines, severe threats, or other factors.

approximately 318,415 km² (Northern Bobwhite Conservation Initiative 2009). Less than 0.02% of the Northern Bobwhite's global range exists in Canada.

3. Species Information

3.1 Species Description

The Northern Bobwhite is a small grouse-like bird, 21 – 26 cm long, about half the size of a Ruffed Grouse (*Bonasa umbellus*) (Peterson 1980). Males have a black necklace, white throat, and a white line above the eye while females have a buffy throat and eye-stripe. Males give a loud, whistled “bob-bob-WHITE!” call in spring to advertise their presence (James and Cannings 2003).

3.2 Species Population and Distribution

The Northern Bobwhite ranges from the eastern side of the Great Plains from southeastern Wyoming to eastern Colorado and eastern New Mexico and Texas east to the Atlantic Ocean (Figure 1). The range also extends southward through eastern Mexico to extreme southwest Guatemala. The northern extent of its range includes southeastern Massachusetts, southeastern and west-central New York, extreme southwestern Ontario, southeastern Lower Peninsula of Michigan, west-central Wisconsin, southeastern Minnesota, southern Iowa, southeastern South Dakota, and west-central Nebraska (Brennan et al. 2014). Within its range, the Northern Bobwhite is a resident, with no migration occurring outside of the breeding range (Dziepak 1991).



Figure 1: Distribution of the Northern Bobwhite in North America and the western Caribbean (Brennan et al. 2014). Note that distribution has contracted in some areas including in Ontario and several other jurisdictions at the northern edge of range, since this map was created.

The Northern Bobwhite has been widely introduced in many areas. Most of the Caribbean populations are considered introduced as well as those present in the Puget Sound region of Washington, Malheur County in Oregon, and possibly in western Idaho (Brennan et al. 2014). In Canada, introductions have occurred in southern British Columbia (Campbell et al. 1990), Quebec (Lanque and Doyon 1996), and Ontario (Baillie and Harrington 1936). Introductions have been poorly documented, including in Ontario, where there have been many (Page and Austen 1994).

In the majority of states in the United States the Northern Bobwhite declined 70-90% between 1965 and 1995, with many local populations disappearing entirely (Hernandez et al. 2012 in Brennan et al. 2014). Populations at the northern extent of the range have experienced some of the more significant declines (Lohr et al. 2011).

In Canada, Ontario has the only known population of Northern Bobwhite thought to be native, given that introduction attempts in British Columbia were unsuccessful

(Campbell et al. 1990; Page and Austen 1994) and birds in Quebec are considered to be pen-reared¹⁰ birds (Lanque and Doyon 1996).

With European settlement in Ontario and expansion of farming activities Northern Bobwhite populations increased dramatically and there was a rapid northward and eastward expansion in the 1840s and 1850s. During that time, Northern Bobwhites could be found from the Bruce Peninsula through Muskoka District to the Kingston area (Baillie and Harrington 1936; Lumsden 1994). Prior to European settlement southern Ontario had many indigenous farms (Riley 2013). It's possible that the Northern Bobwhite expanded from the extensive tallgrass prairies of southwestern Ontario and at times occupied some of these features throughout southern Ontario similar to how its range expanded with the spread of European farms.

Severe winter weather in the second half of the 19th century affected populations and by 1904, the range of the Northern Bobwhite had contracted to extreme southwestern Ontario (DeVos 1964; Lumsden 1994). At that time, it was common only in Essex, Kent, and Lambton Counties and the western portions of Middlesex and Elgin Counties (Figure 2). Coveys were reported during this period west to Oxford and Brant Counties. To augment populations in the latter part of 19th century numerous releases of pen-reared birds occurred (Baillie and Harrington 1936).

¹⁰ In Ontario pen-reared birds are non-native birds raised in captivity primarily for hunting and generally have low survival rates in the wild.

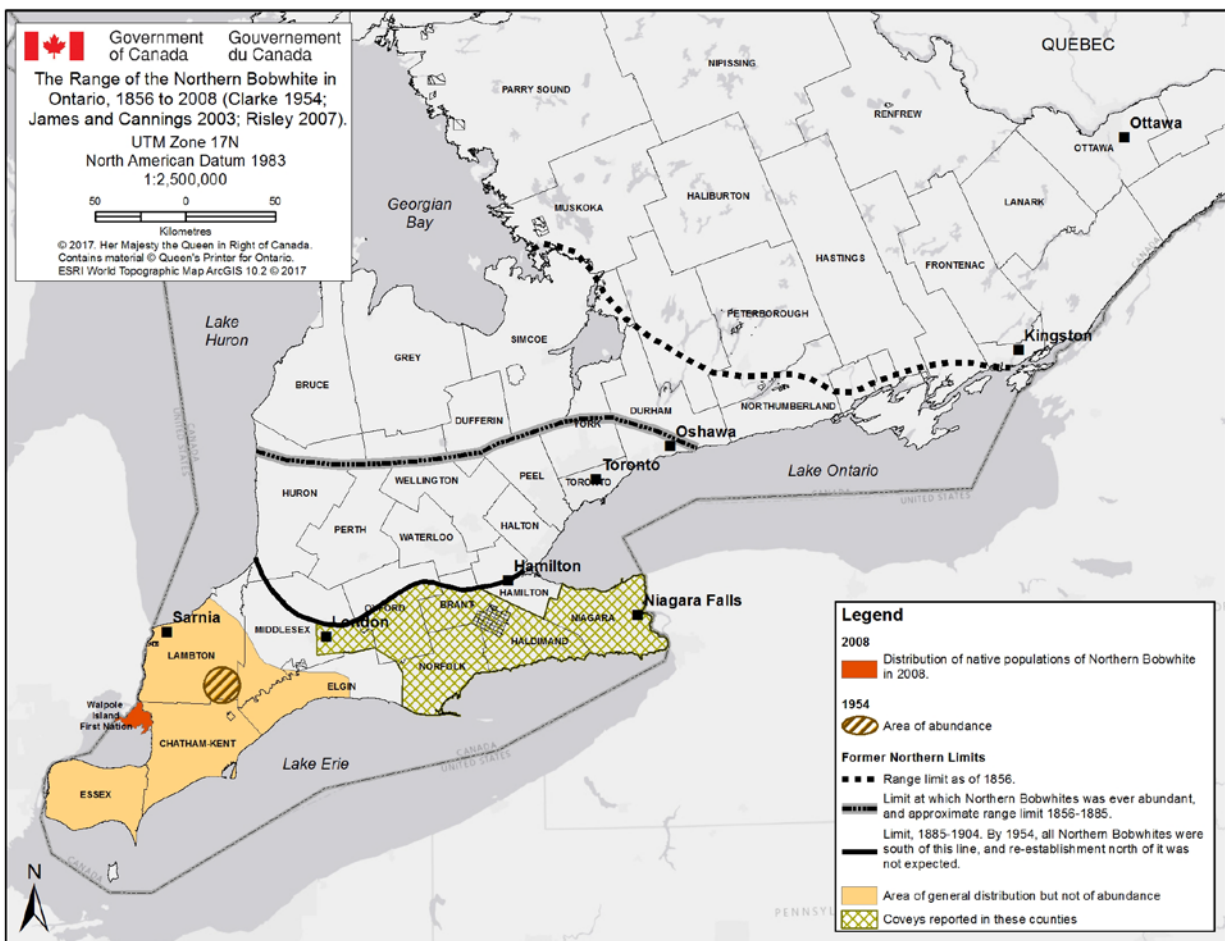


Figure 2. The range of the Northern Bobwhite in Ontario, 1856 to 2008 (Clarke 1954; James and Cannings 2003; Risley 2007).

In the early 1970s, there were an estimated 1,055 coveys of Northern Bobwhite in Ontario primarily in Lambton, Middlesex, and Elgin Counties excluding Walpole Island First Nation (MacIntyre 2002) and included native, mixed and non-native birds. Populations declined further in the late 1970s following three successive years of severe winter weather. During the first Ontario Breeding Bird Atlas (1981-1985) and the subsequent Ontario Rare Breeding Bird Program (1989-1991), the Northern Bobwhite was documented in 79 squares within its scattered distribution in southwestern Ontario (Cadman et al. 1987). The first atlas also notes that native birds were still present in several areas on the mainland including along the Thames River in Middlesex and Chatham-Kent Counties (Risley 2007). The abundance during the first atlas period was estimated at 232 to 1,545 pairs (Page and Austen 1994) but many of these birds were likely pen-reared and released as opposed to being native birds (Lumsden 1987).

In 1989-90, the Ontario Ministry of Natural Resources estimated a population of 180 Northern Bobwhite in 15 coveys, but this study did not include Walpole Island First Nation (MacIntyre 2002). Two disjunct areas in Aylmer and Chatham Ontario Ministry of

Natural Resources Districts were identified as possible areas where native stock was probably persistent (Page and Austen 1994).

During the second Ontario Breeding Bird Atlas (2001-2005) most mainland Northern Bobwhites were believed to be pen-reared stock (Risley 2007). Christmas Bird Count results for Wallaceburg showed no Northern Bobwhites detected between 2011 and 2015 (National Audubon Society 2015). Though data are limited, Breeding Bird Survey results for Ontario suggest significant long (1970-2012) and short (2002-2012) term declines of 23.1% and 23% per year, respectively (Environment Canada 2014).

Currently, the only known remaining native Northern Bobwhite population in Canada is on Walpole Island First Nation. Birds on the mainland are presumed to be pen-reared (Risley 2007; COSEWIC 2013). In 2000, 92 males were detected on Walpole Island First Nation during whistling ground surveys with a conservative extrapolation to a population of 230 adult breeding Northern Bobwhite (MacIntyre 2002). Recent local community knowledge indicates that the Northern Bobwhite persists on Walpole Island First Nation. Five individuals reported seeing Northern Bobwhites in 2015 and 7 others reported sightings in 2016. While most reports were of 1 or 2 birds, 3 coveys were reported in 2015 of 5, 9 and 30 birds and another 3 in 2016 having approximately 12, 20 and 30 birds (Jacobs and Johnson 2016; C. Jacobs pers. comm. 2016). Insufficient data is currently available to estimate the current population size on Walpole Island First Nation.

3.3 Needs of the Northern Bobwhite

Habitat and Biological Needs

Northern Bobwhites typically have clutches of 12–14 eggs, (range 7–28) (Stoddard 1931). Peck and James (1983) mentioned 6 nests in Ontario with 11 to 15 eggs. Average clutch size generally decreases as the breeding season progresses and attempts to re-nest occur (Stoddard 1931; Dimmick 1972; Klimstra and Roseberry 1975). Hatching success is greatly influenced by predators, human disturbance, and weather. Hatching success in Illinois was 33% (n = 793 nests) (Roseberry and Klimstra 1984). One clutch is typical but the Northern Bobwhite can produce 2 clutches in Ontario (Risley 2007). Re-nesting (following failure), however, is common (Lumsden 1987). About 80% of Northern Bobwhites live less than one year. (Brennan et al. 2014) and annual mortality is often as high as 80%, the majority of these being juveniles (Johnsgard 1973 as cited in Page and Austen 1994). Average annual mortality of adults is around 30% (Brennan et al. 2014). Exposure can cause significant mortality during winter in northern parts of the range (Kabat and Thompson 1963; Roseberry and Klimstra 1984). Deep snow and long periods of cold can cause losses as high as 50% during severe winters (Errington and Hamerstrom 1936; Robbins et al. 1986). Winter survival of adults may be most important for recovering Northern Bobwhite populations (Sandercock et al. 2008; Williams et al. 2012) and Williams et al. also suggest increasing the survival of young to at least 30 days is necessary for population growth. Folk et al. (2007) suggest that survival of sub-adults (defined as <1 yr. old females)

most strongly influences the population growth rate in Northern Bobwhites. Each of these factors likely plays an important role in population growth, but which is the most important is not clear.

Guthery et al. (2000) found that Northern Bobwhite populations subject to winter catastrophes (but not to hunting) required a population of around 500 birds to be viable. Populations subject to both winter and summer catastrophes, which could include weather causing reproductive failure, require populations to be approximately 800 birds to be viable. While Northern Bobwhites in Ontario could suffer from winter catastrophes, such as heavy and prolonged snows, summer catastrophes, such as extreme rain events are more common further south in the United States (P. Hubert pers. comm. 2016). Guthery et al. (2000) also determined that for each bird approximately 1-2 hectares of usable space are needed. A viable population of 500 birds in Ontario would require around 1000 hectares of suitable habitat (P. Hubert pers. comm. 2016).

General Habitat

The Northern Bobwhite is a tallgrass prairie-savanna species which also inhabits early to mid-successional forest habitats and open areas such as agricultural fields. It prefers areas subject to periodic natural disturbances, such as fire, and uses sites with large amounts of shade-intolerant herbaceous species (Ellis et al. 1969; Taylor et al. 1999a; Collins et al. 2009; Brennan et al. 2014). It requires large and/or well-connected patches of suitable habitat that include grassy areas for nesting, feeding and roosting, interspersed with shrubby areas for roosting and hiding and plants such as agricultural crops for feeding, dusting, loafing and roosting (James and Cannings 2003).

The Northern Bobwhite is a non-migratory species and an individual may spend its entire lifetime in the same geographic proximity. Most live within 2.6 km² of where they were hatched. Most also spend their lifetime within an area of 2.0 km² with each bird requiring approximately 0.02 km² (2 hectares) of usable habitat to survive (Murphy and Baskett 1952; Guthery 1997; Guthery et al. 2000). Home range size, however, varies depending on habitat quality, surrounding land use and sex, with males having a smaller home range in highly fragmented landscapes (Dimmick 1992; Taylor et al. 1999b). Northern Bobwhite home ranges include enough habitat to allow them to complete their essential life cycle activities, including finding enough food. Typically, the maximum distance they move from where they are hatched is 3.5 km (Murphy and Baskett 1952; Rosene 1969). Northern Bobwhites form coveys in the fall and winter and covey home ranges vary in size and shape (1.6 - 31.2 hectares, n=1145; Rosene 1969). There is very little overall movement between seasons, and some Northern Bobwhite families' summer and winter ranges overlap (Johnsgard 1973 as cited in Page and Austen 1994). Smith (2015) found that Ohio Northern Bobwhites moved an average of 0.5 km between the centres of summer and winter home ranges and had an average overlap of 5.0 ha (+/- 1.0) or 34%.

Nesting Habitat

The Northern Bobwhite builds its nests on the ground, usually within 15-20 m of openings such as fields and roads (Rosene 1969). Nests are usually partially covered with standing vegetation less than 51 cm tall (Stoddard 1931; Rosene 1969). Its primary nesting habitat includes large grassy areas with some litter and little bare ground (Taylor et al. 1999a, b; Lusk et al. 2006). It prefers forbs¹¹ and other tall “bunch grass” plants that create an umbrella-like understory for nest concealment and safe movement of broods (Taylor et al. 1999a, b; Lusk et al. 2006; Collins et al. 2009) as well as shrubs, tall grasses and forbs 1.25 – 1.5 metres in height for visual obstruction (Brooke et al. 2015). Interspersion of shrubs within these large grassy areas may also be preferred by calling males and may be important in some areas (Taylor et al. 1999a; Lusk et al. 2006). Optimum breeding areas also have nearby habitats with approximately 50% exposed ground for brood-rearing with remaining areas covered in herbaceous and some woody vegetation. The ideal conditions are large open grasslands with some woodland, transitional habitats and agriculture in close proximity to one another. Northern Bobwhites have been shown to avoid areas overgrown with invasive non-native plants (Brooke et al. 2017). Invasive plant species can also limit the mobility of Northern Bobwhite chicks (Martin et al. 2015). Although the Northern Bobwhite is often associated with grasslands nesting in areas having some litter (Brooke 2017), too much litter build-up has been shown to reduce its survival and restricts its use to more edge habitats (Peters et al. 2015). Northern Bobwhites are sometimes found near human habitation and may nest in agricultural areas (e.g., orchards, pasture, croplands and tree nurseries), gardens, fence lines and roadsides (Bent 1932; Fitch 1958; Graber and Graber 1963; Rosene 1969; Mayfield 1988; Taylor et al. 1999b; James and Cannings 2003; Collins et al. 2009). In Ontario they have nested in hay fields, fence rows, roadsides, city parks and edges of golf courses (Peck and James 1983).

Foraging Habitat

The Northern Bobwhite is an opportunistic feeder that primarily relies on seeds from agriculture, forest and weeds as well as leaves from succulent plants (Brennan et al. 2014). Invertebrates, however, are also consumed and are vital to the growth and survival of chicks. As a result, brood habitat must have an abundance of insects (DeVos and Mueller 1993) which has been linked to plants, such as forbs, that have a high relative moisture content (Taylor and Guthery 1994).). Adult Northern Bobwhites also require an invertebrate rich diet (Lochmiller et al. 1993; Guiliano et al. 1996). Invertebrate numbers and diversity tend to be significantly higher in native plants that they are adapted to than non-native plants (Ballard et al. 2013; Litt et al. 2014). Adequate food supplies near winter cover are essential for Northern Bobwhite survival (Roseberry and Klimstra 1984; James and Cannings 2003), particularly as cold weather, snow cover, rain and wind restrict their movement (Roseberry and Klimstra 1984).

¹¹ An herbaceous flowering plant other than a grass.

Common forage species include: ragweed (*Ambrosia spp.*), tick-trefoil (*Desmodium spp.*), bush-clovers (*Lespedeza spp.*), crabgrass (*Digitaria spp.*), Staghorn Sumac (*Rhus typhina*), Pokeweed (*Phytolacca americana*), pine tree seeds (*Pinus spp.*), wild grape (*Vitus spp.*), panic grasses (*Panicum spp.*), foxtails (*Setaria spp.*), cultivated crops i.e. corn (*Zea mays*), soybeans (*Glycine max*), and wheat (*Triticum aestivum*). Mast producing trees: oaks (*Quercus spp.*), hickories (*Carya spp.*) and sassafras (*Sassafras albidum*) (Sandilands 2005). Sometimes fruit: raspberry (*Rubus spp.*), Flowering Dogwood (*Cornus florida*), cherry and wild plum (*Prunus spp.*) (Murphy and Baskett 1952; Ellis 1969; Rosene 1969; Schroeder 1985; Brennan et al. 2014).

Roosting Habitat

Safe roosting habitat within the home range is essential, with birds roosting during the day and at night. Typical daytime roosting habitat is dense, tall, woody vegetation with bare ground (Taylor et al. 1999a). The minimum area for a suitable daytime roost is 41 m² and each home range requires 1- 3 roosts (Rosene 1969; Schroeder 1985; Johnson and Guthery 1988). Habitat at nocturnal roosts varies from sparse vegetation and little overhead cover (e.g., wheat stubble) to more litter, less bare ground and tall plants (Klimstra and Ziccardi 1963; Ellis et al. 1969; Rosene 1969; Schroeder 1985; Taylor et al. 1999a).

Wintering Habitat

Winter habitat requirements are similar to those during the breeding season, but denser cover for roosting is necessary. Suitable winter cover includes tallgrass prairie habitat, dense brush or pine tree stands. The Northern Bobwhite may inhabit wooded ravines or dense growths of tall weeds, but move to woody cover once there is snow on the ground (Schroeder 1985). In Illinois, most winter night roosts were in areas of low to medium topography in well drained areas. Roosts were generally on bare soil or leaf litter, mostly among vegetation 40 - 90 cm tall (Klimstra and Ziccardi 1963). Brushy cover must be sufficiently dense to keep snow off the ground to give access for foraging (Errington and Hamerstrom 1936; Roseberry and Klimstra 1984). Winter habitat is likely key to the survival of Northern Bobwhite populations in Ontario (James and Cannings 2003) where it is at the northern extent of its range.

4. Threats

4.1 Threat Assessment

The threat assessment applies to both Walpole Island First Nation and the mainland, however, indiscriminant burning may not be a concern on the mainland, while release of pen-reared birds is not currently a threat to the population on Walpole Island First Nation. In addition, threats may exist on the mainland even though native Northern Bobwhites have yet to be re-introduced.

Table 1. Threat Assessment Table

Threat	Level of Concern ¹	Extent	Occurrence	Frequency	Severity ²	Causal Certainty ³
Habitat Loss and Fragmentation						
Agricultural development, residential development	High	Widespread (Walpole Island First Nation and mainland)	Historic; current	Recurrent	High	High
Invasive plants: European Common Reed	Medium	Widespread (Walpole Island First Nation)	Current	Recurrent	Moderate	High
Changes in Ecological Dynamics or Natural Processes						
Predation	Medium	Widespread (Walpole Island First Nation and mainland)	Current	Recurrent	Moderate	Medium
Indiscriminate Burning	Medium	Localized (Walpole Island First Nation)	Current	Recurrent	Moderate	Low
Exotic, Invasive, or Introduced Species						
Release of non-native, pen-reared Northern Bobwhite	Medium	Widespread (mainland)	Historic; anticipated	Recurrent	Moderate	Medium
European Fire Ant	Unknown	Widespread	Anticipated	Recurrent	Unknown	Low
Herbicide and Insecticide						
Herbicide and insecticide application resulting in reduced food supply	Unknown	Widespread (Walpole Island First Nation and mainland)	Historic; anticipated	Recurrent	Unknown	High

¹ Level of Concern: signifies that managing the threat is of (high, medium or low) concern for the recovery of the species, consistent with the population and distribution objectives. This criterion considers the assessment of all the information in the table.

² *Severity: reflects the population-level effect (High: very large population-level effect, Moderate, Low, Unknown).*

³ *Causal certainty: reflects the degree of evidence that is known for the threat (High: available evidence strongly links the threat to stresses on population viability; Medium: there is a correlation between the threat and population viability e.g. expert opinion; Low: the threat is assumed or plausible).*

4.2 Description of Threats

The main threats to the Northern Bobwhite in Canada in decreasing order of significance are: habitat loss and fragmentation mainly through agricultural expansion and intensification, residential development and invasion by European Common Reed; predation; indiscriminate burning; release of non-native, pen-reared Northern Bobwhites; herbicide/pesticide use and potentially the European Fire Ant.

Agricultural Development

Although most habitat loss has been historical, with the growth of modern farming practices, some loss is still occurring. On Walpole Island, farm fields continue to be expanded cutting into grassland habitats, hedgerows and woodlands (Jacobs and Johnson 2016). In Ontario, the farming trend has been to move away from pasture and summer fallow to croplands resulting in less suitable habitat for Northern Bobwhite (Page and Austen 1994 and Statistics Canada 1997 in James and Cannings 2003). Similarly in the United States the trend has been toward less pasture and larger farms (MacDonald 2013; Perlut 2014; Sumner 2014). The trend in Ontario is also toward larger farms which have lower biodiversity, including less insect prey diversity (Fahrig et al. 2015). Larger farms also tend to have fewer woody edges (Smith 2015). Further, with more intensive farming practices and cleaner more mechanized farming methods leaving few weeds, croplands no longer provide suitable habitat for Northern Bobwhites for foraging or roosting (Levine 1988 in Page and Austen 1994; Perlut 2014). MacIntyre (2002) showed that there is very little habitat remaining for Northern Bobwhite in Essex County and much of the cropland in Norfolk County is unsuitable to the species.

Residential Development

Habitat fragmentation from residential development and land use change is a particularly serious threat because the Northern Bobwhite is a sedentary species; most birds live within a 2.6 km² of where they hatched (Stoddard 1931; Murphy and Baskett 1952). Because of this, populations can become isolated as habitats become fragmented. In particular, the loss of hedgerows which historically improved connectivity of habitat patches has significantly affected the Northern Bobwhite. In Wisconsin, Northern Bobwhite populations were eliminated as hedgerows declined from 1 km every 113 ha to 1 km every 164 ha (Graber and Graber 1963; Klimstra and Ziccardi 1963; DeVos 1964; Baillie 1967; Schroeder 1985; Mayfield 1988). As remaining habitat patches and corridors between populations are lost, the movement of individuals to sustain local populations and gene flow is eliminated. This leaves remaining isolated

small populations at a high risk of extirpation particularly from chance events such as severe winter weather.

Invasive Plants

Invasion of non-native European Common Reed has impacted moist tallgrass prairie and meadow marsh habitats on Walpole Island First Nation outcompeting native vegetation and resulting in a further reduction of Northern Bobwhite habitat (COSEWIC 2013; Jacobs and Johnson 2016; Catling and Mitrow 2011). While Northern Bobwhites may occasionally use European Common Reed for cover, its structure and density are not suitable for most other habitat needs including foraging and nesting (Jacobs and Johnson 2016; P. Hubert pers. comm. 2016). Another non-native grass (Bermudagrass (*Cylodon dactylon*)) in the United States has been shown to reduce habitat quality for Northern Bobwhite chicks by making movement more difficult and by increasing thermal stress (Martin et al. 2015). Invasive, non-native plant species can also out compete native plant species on which Northern Bobwhites and other wildlife depend for food items such as seeds and arthropods (Sands et al. 2009; Catling and Mitrow 2011; Brooke et al. 2017). Northern Bobwhites may nest in stands of non-native plants, but only if they have a bunch-grass structure and contain openings with bare ground (Sands et al. 2012; Brooke et al. 2017). European Common Reed's tall rigid stems do not provide these features given the tall rigid stem of each plant, the high stem density and litter accumulation within stands.

Predation

Augmented food supplies and the provision of shelter in urban and agricultural areas have significantly increased the population of many predators such as raccoons (*Procyon lotor*), foxes (*Vulpes* spp.), coyotes (*Canis latrans*), Virginia Opossums (*Didelphis virginiana*), and Striped Skunks (*Mephitis mephitis*); all of which prey on Northern Bobwhite (Burger et al. 1995; Brennan et al. 2014). The semiaquatic American Mink (*Neovison vison*) is also believed to be a threat, particularly on Walpole Island First Nation with its extensive shorelines (C. Jacobs pers. comm. 2017). Northern Bobwhites are much more susceptible to predation in a fragmented landscape. Increased predation by raccoons due to reduced cover was noted as a factor in declines to Northern Bobwhites in Elgin County (Page and Austen 1994).

In the United States urban areas where Northern Bobwhites are in close proximity to humans, Domestic Cats (*Felis catus*) can significantly affect Northern Bobwhite populations (Stoddard 1931; Bent 1932). Blancher (2013) suggests that cats are likely the largest source of human-caused mortality of birds in Canada, and notes that Northern Bobwhite is vulnerable to cat predation because it nests and forages on the ground. Feral cats are common on Walpole Island and in the surrounding area (A. Woodliffe pers. comm. in James and Cannings 2003; Jacobs and Johnson 2016) and unwanted pets from the mainland are frequently abandoned on Walpole Island (C. Jacobs pers. comm. 2016).

Other birds are also significant predators of Northern Bobwhites, particularly Cooper's Hawks (*Accipiter cooperii*), buteos¹² and medium to large owls (Burger et al. 1995). Cooper's and Sharp-shinned Hawks (*Accipiter striatus*) as well as Merlin's (*Falco columbarius*) all improved in status between the 1st and 2nd Ontario Breeding Bird Atlases (1981-1985 and 2001- 2005) (Cadman et al. 2007) and may pose a threat to the already critically small Northern Bobwhite population on Walpole Island First Nation.

Indiscriminate Burning

Regular disturbance through prescribed burning is a well-established management practice to maintain tallgrass prairie and savanna habitats. However, indiscriminate burning, consuming entire habitat parcels and burning in the fall and winter, can eliminate cover for Northern Bobwhites and jeopardize survival (James 2000 in MacIntyre 2002; A. Woodliffe pers. comm. in James and Cannings 2003). Burning to rejuvenate prairie habitats has been done successfully on Walpole Island First Nation for generations, but in recent years indiscriminate burning has increased and may be impacting Northern Bobwhite survival (Jacobs and Johnson 2016; C. Jacobs pers. comm. 2016). Ecologically sound prescribed burning in Oklahoma demonstrated little impact on Northern Bobwhite movement and space use (Carroll et al. 2017). Burning followed by specific herbicide treatments was used to successfully maintain suitable habitat structure for Northern Bobwhite in native prairie grasses in Kentucky (Yeiser et al. 2015). Optimal timing of prescribed burning for habitat management for Northern Bobwhite and other local species of conservation concern still needs to be determined.

Release of Non-native Northern Bobwhite

Since the late 1800s, imported or non-native pen-reared Northern Bobwhites have been released for hunting in Ontario (Cadman et al. 1987). With bird's being raised in captivity for so long and there being so many different sources, the genetic origin of pen-reared and released birds in Ontario is not known. Releases of non-native Northern Bobwhites for hunting and dog training and trials have continued, including releases adjacent to the only remaining remnant population of native Northern Bobwhites on Walpole Island First Nation. Between 2007 and 2008, there were three game bird preserves that released pen-reared Northern Bobwhites adjacent to Walpole Island First Nation, with one game bird preserve located in Wallaceburg. Since then, the Ontario Ministry of Natural Resources and Forestry has stopped issuing licences that allow for the release of pen-reared birds within 50 kilometres of Walpole Island First Nation (P. Hubert pers. comm. 2016). While releases of pen-reared birds may have been occurring on Harsen's Island, United States, adjacent to Walpole Island First Nation in the past, there have not been releases there since 2008 and no Northern Bobwhites have been heard or seen on Harsen's Island since 2012 (T. McFadden pers. comm. 2016). Recent genetic analysis of Northern Bobwhite in Ontario supports the belief that Walpole Island First Nation birds are native (Chabot 2014).

¹² Broad-winged hawks such as the Red-tailed Hawk (*Buteo jamaicensis*).

Pen-reared birds can be very similar in appearance to native birds. Genetic markers have been developed to distinguish between native and pen-reared birds (Brennan et al. 2014; Chabot 2014). Pen-reared birds have been thought to be less suitable for reintroduction for a variety of reasons including: lower reproductive and survival success (Perez et al. 2002; Eggert et al. 2009); responding differently to predation threats and being more susceptible to predation (Newman 2015); lower genetic diversity (Evans et al. 2009; Brennan et al. 2014); being less adapted to Ontario winters and habitats (James and Cannings 2003) and posing a potential source of parasites and disease (Olsen et al. 2016). North American Northern Bobwhite populations have been recently shown to have less phylogeographic¹³ structure (relatively low genetic distinctiveness) than previously thought (Williford et al. 2016) suggesting that some mixing of populations, if done properly, could offer conservation benefits. So while some pen-raised birds may not be suitable for reintroduction for the above reasons, inter-breeding with more southerly adapted Northern Bobwhites has the potential to benefit the remaining population if it became necessary in a changing climate (Hamilton and Miller 2015; Jackiw et al. 2015). In Ontario further genetic analysis is needed to confirm the genetic population structure of the extant population on Walpole Island First Nation and identify appropriate strategies for captive breeding and release, if required (Chabot 2014). Chabot (2014) also recommended genetic monitoring if translocation is utilized in Ontario. The potential benefits would include understanding the patterns of geographical expansion from reintroduction areas, dispersal behaviour, connectivity with nearby populations, habitat use and potential sink habitats (Miller et al. 1999; Frankham et al. 2002 in Chabot 2014).

Herbicide and Insecticide Use

The application of herbicides and insecticides (pesticides) used in modern farming practices can have both direct and indirect effects on Northern Bobwhite. Direct effects include both lethal and sub-lethal effects of ingesting pesticides with food or through contact with pesticides during spraying (Driver et al. 1991; Mineau and Whiteside 2013), and vary with the type of pesticide and the amount ingested by the bird. For example, of three common systemic insecticides, one is rated as practically non-toxic, one as moderately toxic and one as highly toxic to Northern Bobwhite under EPA guidelines (reviewed by Gibbons et al. 2015). Sub-lethal effects result from exposure to pesticides at doses that are not high enough to cause mortality. Sub-lethal effects are more difficult to detect and include reductions in growth and survival (reviewed by Gibbons et al. 2015), increases in predation rates (Buerger et al. 1991), behavioural disturbances, and reduced reproductive and liver function (Turaga et al. 2016). The use of lethally toxic insecticides seems to play a role in grassland bird declines (Mineau and Whiteside 2013). Lopez-Antia et al. (2015) document lethal and sub-lethal impacts of neonicotinoid-seed ingestion on Red-legged Partridge (*Alectoris rufa*) a species in the same order (Galliformes) as Northern Bobwhite. Turaga et al. (2016) investigated impacts of seeds treated with neonicotinoids in Texas and Oklahoma, but found no

¹³ The field of study concerned with the geographical distribution of genealogical lineages, especially within species.

treated seeds in crops of the birds examined, possibly due to avoidance or other reasons. If birds were avoiding treated seeds, it could help them avoid toxins, but prevent foraging in certain agricultural environments. Overall, evidence suggests that exposure to pesticides is likely having a negative effect on species such as Northern Bobwhite and that more detailed investigation is warranted.

Indirect effects of pesticides on Northern Bobwhite come primarily through reductions in food supply, when pesticide use reduces the diversity and abundance of plants, weed seeds and invertebrates that are available for Northern Bobwhite to eat. The use of neonicotinoids is an important consideration as they have become the most widely used class of insecticides in the world (Douglas and Tooker 2015). Neonicotinoids are likely to have significant and wide ranging effects on non-target terrestrial invertebrates (Pisa et al. 2015; Hallman et al. 2014) and could reduce prey availability for Northern Bobwhites in agricultural areas. Reductions to food supply are particularly important for chicks, as chick survival and growth in quails such as Northern Bobwhite, is linked to protein in the diet, obtained by eating invertebrates (especially arthropods) (Nestler et al. 1942; Hurst 1972; Potts 1986; Jackson et al. 1987; DeVos and Mueller 1993; Lochmiller et al. 1993). Adults can also be impacted by reduced invertebrate availability through compromised immune systems, delayed egg laying, reduced egg production and ovary degeneration (Lochmiller et al. 1993; Giuliano et al. 1996). Some of these indirect effects of pesticides on birds have been shown most clearly for the Gray Partridge (*Perdix perdix*), a European quail of similar size and behaviour to Northern Bobwhite. Declines in Gray Partridge populations have been explained by declines in invertebrate food supply caused by herbicides which caused reduced growth and survival in chicks (reviewed by Potts 1986).

European Fire Ant

The invasive Red Imported Fire Ant (*Solenopsis invicta*) is known to reduce Northern Bobwhite fitness in the United States (Allen et al. 1995; Myers et al. 2014). While this species does not inhabit Canada, nor is it expected to in the near future, a different non-native fire ant in Ontario may pose a similar threat. The European Fire Ant (*Myrmica rubra*) is found in Ontario, and it can have devastating effects on the rest of the ant community. When this ant invades a habitat, all other ant species vanish (Naumann and Higgins 2015), and some non-ant insects can also suffer declines (Naumann & Higgins 2015; Verble-Pearson and Pearson 2016). This ant is also known to kill chicks of ground-nesting birds and reduce birds' reproductive success (DeFisher and Bonter 2013). It is not known whether direct consumption of European Fire Ants would be bad for Northern Bobwhites, as it is when they consume the Red Imported Fire Ant (Myers et al. 2014). But it seems reasonable to suggest that, given the known threat posed by the Red Imported Fire Ant to the Northern Bobwhite in the United States and given the similar effects the European Fire Ant has on local ant communities and other insects (i.e., Northern Bobwhite prey) and on other ground-nesting birds, this invasive ant poses an uncertain, but possibly significant threat to the Northern Bobwhite in Ontario.

5. Population and Distribution Objectives

The population and distribution objectives for the Northern Bobwhite in Canada are:

Short term (5 - 10 years):

- Maintain the existing population on Walpole Island First Nation and where biologically and technically feasible increase the abundance of the existing population to at least 230 adult birds.

Medium term (10 - 20 years):

- If biologically and technically feasible, increase the population on Walpole Island First Nation to at least 500 adult birds and restore it to historically occupied sites on Walpole Island First Nation.

Long term (timeframe to be determined):

- If biologically and technically feasible, to achieve a self-sustaining¹⁴, resilient¹⁵, and redundant¹⁶ population, by establishing at least one viable population on Walpole Island First Nation and re-establish one viable population on the mainland.

Rationale:

The priority for recovering the Northern Bobwhite is through management of the remaining native population and its habitat on Walpole Island First Nation. Environment and Climate Change Canada is committed to working in cooperation with the Walpole Island First Nation towards the recovery and protection of this species and its habitat.

At least 500 birds are required to maintain a single viable¹⁷ Northern Bobwhite population in northern landscapes like Ontario where the birds may experience periodic winter catastrophes (Guthery et al. 2000). At least one viable population on both Walpole Island First Nation and the mainland are likely required to ensure recovery of the species. The current population size on Walpole Island First Nation is not known, but is probably much reduced since the most recent estimate of 230 birds in 2000. Additional surveys and monitoring will provide information on the size, extent and current trend of the existing population. As the populations on Walpole Island First Nation and the mainland may have little interaction, the intent of the recovery objectives are to establish populations of several hundred adult birds on both Walpole Island First Nation and the mainland, within the species former range, if feasible.

¹⁴ The term self-sustaining refers to a population that does not require human intervention for long-term persistence.

¹⁵ The term resilient refers to a population that is of sufficient size to recover from periodic disturbance and avoid genetic collapse.

¹⁶ The term redundant refers to a population with sufficient subpopulations available to withstand catastrophic events and facilitate rescue if necessary.

¹⁷ Having a high probability of survival.

Threat mitigation and restoring habitat are needed to achieve the recovery objectives. Specifically, working with Walpole Island First Nation to identify habitat restoration opportunities that can promote connectivity between suitable habitats required by Northern Bobwhites. Because Walpole Island First Nation is the only known source of native Northern Bobwhites in Canada, success in increasing the amount of habitat available to Northern Bobwhite and increasing the population on Walpole Island First Nation needs to be shown to be feasible before recovery activities on the mainland can be advanced. That said identifying opportunities for restoring habitats that focus on connectivity of suitable habitats and reducing threats will also be essential. Identifying habitat restoration opportunities on the mainland is also important already in the short-term to evaluate potential recovery sites and guide habitat restoration activities. Targeted restoration activities will support increasing species' abundance at the extant population and help re-establish historical populations. Once habitat restoration opportunities have been evaluated a decision can be made as to whether captive breeding and release is necessary to achieve the recovery objectives.

With approximately 2 hectares of habitat required for every bird, at least 1000 hectares of more or less contiguous, suitable habitat will be necessary to support each population of 500 birds. There is uncertainty whether or not sufficient habitat can be made available (e.g. through restoration) to support population expansion. The short term goal of 230 adult birds will require around 460 hectares of habitat. The medium term goal of 500 adult birds will require approximately 1000 hectares of habitat. A 2008 Walpole Island First Nation habitat analysis suggested 1348 hectares of suitable Northern Bobwhite habitat remained on the First Nation. A habitat assessment will be required to determine how much of this habitat remains today as well as its level of connectivity. The long term goal of establishing viable populations on both Walpole Island First Nation and the mainland may be feasible, but it may also not be feasible. Recovery on the mainland will be particularly challenging as little contiguous habitat remains and most is in private ownership. If recovery cannot be achieved for either of these populations efforts will focus on maintaining the survival of the existing population, but at a level below what would be required for recovery. Extensive, large scale restoration is expected to be necessary before a viable population can be established on the mainland. The timeframe for the long-term objective is unclear at this time. It will depend on the rate of Northern Bobwhite population growth on Walpole Island First Nation, potential merits of captive breeding and release, and the speed at which habitat restoration occurs on Walpole Island First Nation and the mainland. The long-term objective may be revised as new habitat assessment data on the mainland becomes available and additional habitat restoration projects are completed.

6. Broad Strategies and General Approaches to Meet Objectives

6.1 Actions Already Completed or Currently Underway

Broad strategies have been identified below to support the recovery of Northern Bobwhite in Canada.

The Walpole Island Heritage Centre has leased lands (5 year tenures) for conservation purposes to reduce the rate of conversion of tallgrass prairie and savannah habitat to agriculture. Over 120 hectares of tallgrass prairie, oak savanna and forest have been protected on Walpole Island First Nation since 2001 through leasing agreements and acquisitions. The Walpole Island Land Trust was established in 2008 to conserve land on Walpole Island First Nation. Between 2002 and 2017 multiple species at risk stewardship projects have or will be completed on Walpole Island First Nation including the preparation of habitat management and threats mitigation plans, species and habitat surveys, and invasive plant removal/control.

Numerous education and public awareness projects have been conducted on Walpole Island First Nation and in the surrounding area from 2002 to 2016. The efforts included the production of many resource materials that have been provided to schools, at conferences and disseminated throughout the community.

The Rural Lambton Stewardship Network together with the St. Clair Region Conservation Authority has planted over 400 hectares of tallgrass prairie/meadow habitat between 1995 and 2016. Several locations of historical tallgrass prairie habitat have been restored and numerous other sites have been planted with tallgrass prairie seed in Lambton and Kent Counties, much of it funded through the Habitat Stewardship Program for Species at Risk.

In 2014 a genetic analysis was completed comparing the genetics of 80 Northern Bobwhite museum specimens from populations in Ontario and Michigan. The study provided insight into the genetic make-up of current versus pre-release Northern Bobwhites in Ontario and supports the contention that native birds persist in Ontario (Chabot 2014).

A provincial grassland stewardship initiative, a provincial government supported action under the Bobolink and Eastern Meadowlark Government Response Statement, was established in 2015 to create, maintain and enhance 30,000 hectares of grassland habitat by 2036.

In 2016 the province released the Ontario Pollinator Health Action Plan http://www.omafr.gov.on.ca/english/pollinator/action_plan.htm. Although this plan is targeted to pollinators it may benefit Northern Bobwhite by reducing neonicotinoids in Ontario and increasing the availability of habitat for prey insects of Northern Bobwhite.

In March 2017 the Northern Bobwhite Conservation Initiative signed a five year (2017-2022) memorandum of understanding with Quail Forever to work collaboratively with state agencies and other organizations to promote the restoration of early successional habitat on public and private lands for Northern Bobwhite and other wildlife.

6.2 Strategic Direction for Recovery

Table 2. Recovery Planning Table^a

Threat or Limitation	Priority ^b	Broad Strategy to Recovery	General Description of Research and Management Approaches
All threats	High	Monitor / assess populations	<ul style="list-style-type: none"> • Conduct regular population surveys and monitoring in suitable habitat on Walpole Island First Nation and update species and habitat mapping. • Identify opportunities for restoring habitat (including corridors) to increase abundance at the extant population and/or re-establish historical populations; prioritize potential sites on Walpole Island and the mainland for habitat restoration and management. • Review current survey and monitoring methods and develop and implement new standardized methods for accurate population counts and monitoring of Northern Bobwhite, if necessary.
Agricultural development; Residential development; Invasive plants	High	Conserve and manage habitat	<ul style="list-style-type: none"> • Work with Walpole Island First Nation to enable population and habitat restoration/conservation. • Develop and implement habitat management and restoration methods (e.g., prescribed burning, removal of woody vegetation, control of European Common Reed and other invasive plants in grassland habitats) to maintain and/or restore suitable habitat for Northern Bobwhite at extant and historical population sites, as appropriate. • Conduct comprehensive habitat assessments, possibly through modelling, on Walpole Island First Nation and the mainland to determine recovery potential and inform future recovery efforts. • Collaborate with land trusts, conservation organizations and public agencies to identify and prioritize sites for stewardship, easement or other securement techniques or conservation measures to potentially enable Northern Bobwhite to thrive on the mainland in Ontario.
Predation	High	Threat Mitigation	<ul style="list-style-type: none"> • Work with landowners and communities to reduce human-subsidized predation through removal of abandoned structures, eliminating inadvertent feeding and implementing these and other measures on Walpole Island and in the future on the mainland in potential restoration sites.

Agricultural development; Residential development; Invasive plants; Predation; Indiscriminate burning; Herbicide and pesticide use	Medium	Education and outreach	<ul style="list-style-type: none"> • Identify best land management practices for Northern Bobwhite habitat. • Conduct outreach with landowners to communicate the possible impacts of land management practices and communicate best land management practices for Northern Bobwhite habitat. • Conduct outreach and awareness to reduce the number of feral cats on Walpole Island and on the mainland in potential re-introduction sites as required. • Increase public awareness of and provide training for sound ecological use of fire on Walpole Island First Nation. • Increase awareness of integrated pest management and organic farming within the agricultural community and encourage its implementation on or near sites occupied by Northern Bobwhite.
All threats	Medium	Conduct research	<ul style="list-style-type: none"> • Determine the effects of prescribed fire on the Northern Bobwhite population and make recommendations on its use as habitat restoration technique. • Determine factors affecting Northern Bobwhite productivity (e.g., adult, sub-adult, and chick survival in relation to habitat variables). • Evaluate the need for and scope of a translocation and/or captive breeding and release program to contribute to the recovery of the species on Walpole Island First Nation and the mainland. • Develop a guidance document to direct the genetics of translocation and captive breeding and release, if they are deemed necessary. • Conduct genetic analyses using samples from the existing population on Walpole Island First Nation and possibly the mainland to inform decisions about a potential captive breeding and release program. • Determine the need for genetic monitoring if translocations or captive breeding and release are needed. • Conduct genetic analyses to understand future patterns of population expansion, habitat use and identification of potential sink habitats. • Evaluate the diet of Northern Bobwhites on Walpole Island First Nation, to determine which plants and animals are used by Northern Bobwhites in this population in relation to their availability in available habitats. • Evaluate the feasibility and necessity of supplemental feeding programs for the existing population and for re-introduction. • Determine the direct and indirect effects of the European Fire Ant on Northern Bobwhite. • Coordinate on relevant research with agencies and organizations in the United States.

Release of non-native, pen-reared Northern Bobwhite	Medium	Population management	<ul style="list-style-type: none"> Once potential recovery sites are identified encourage the province of Ontario to re-assess restrictions on release of pen-reared birds both adjacent to the existing Walpole Island First Nation population (to potentially increase the 50 km buffer) and on the mainland (to establish buffer(s)).
European Fire Ant	Low	Threat mitigation	<ul style="list-style-type: none"> Monitor European Fire Ants in existing and potential Northern Bobwhite habitat in southwestern Ontario and implement control measures as required.

^a All activities pertaining to the Walpole Island population will be completed in cooperation with the Walpole Island First Nation.

^b “Priority” reflects the degree to which the broad strategy contributes directly to the recovery of the species or is an essential precursor to an approach that contributes to the recovery of the species.

6.3 Narrative to Support the Recovery Planning Table

The approaches above focus on conserving and, where feasible, increasing, the distribution and abundance of the extant population on Walpole Island First Nation and re-introducing native Northern Bobwhites to the mainland. Activities also highlight the need for habitat restoration. The recovery effort for Northern Bobwhite will be completed in cooperation with Walpole Island First Nation. Various stakeholders will also need to be engaged including private and public landowners, land users, planners, non-government and government organizations. Partnerships will need to be developed with willing landowners and conservation groups particularly when considering re-introduction on the mainland. Habitat protection, management and restoration are of the utmost importance to recover Northern Bobwhite, as habitat loss and fragmentation have been the most significant threats to the species. On-going implementation of best management practices to control European Common Reed and other invasive plant species will be needed. Assessing habitat for interspersed key habitat types and ensuring sufficient quantity and connectivity of habitat, particularly of winter habitat, will be required to guide habitat restoration on Walpole Island First Nation and the mainland. Threat mitigation will be necessary to reduce predation and other causes of mortality and encourage population growth of the remaining population on Walpole Island First Nation and eventually if feasible of a re-introduced population on the mainland. Outreach and education will be needed to reduce exposure to herbicides and insecticides and encourage ecologically appropriate use of fire on Walpole Island First Nation. Further restriction of game bird hunting preserves on the mainland will need to be considered as locations for habitat restoration and re-introduction are identified and prioritized. Collaboration with agencies and organizations involved in Northern Bobwhite research in the United States will be important to learn from the extensive body of work completed and underway south of the border. Where technically feasible, further genetic analysis in the form of a monitoring program could provide more insight into the genetic diversity of Northern Bobwhites on Walpole Island First Nation and if necessary birds on the mainland, and also help understand future patterns of population expansion, dispersal behaviour, habitat use and identification of potential sink habitats (Miller et al. 1999; Frankham et al. 2002 in Chabot 2014). It could also help evaluate the need for and scope of a captive breeding and release program, if deemed appropriate and feasible. As a potential threat European Fire Ant presence and impact on Northern Bobwhite will need to be monitored.

7. Critical Habitat

7.1 Identification of the Species' Critical Habitat

Section 41(1)(c) of SARA requires that recovery strategies include an identification of the species' critical habitat, to the extent possible, as well as examples of activities that are likely to result in its destruction. Under section 2(1) of SARA, critical habitat is "the habitat that is necessary for the survival or recovery of a listed wildlife species and that

is identified as the species' critical habitat in the recovery strategy or in an action plan for the species".

Critical habitat for the Northern Bobwhite cannot be identified at this time for Walpole Island First Nation or the mainland. A schedule of studies has been included that describes the activities required to complete the identification of critical habitat in support of the population and distribution objectives. The identification of critical habitat will be updated when the information becomes available, either in a revised recovery strategy or action plan(s).

7.2 Schedule of Studies to Identify Critical Habitat

Table 3. Schedule of Studies to Identify Critical Habitat

Description of Activity	Rationale	Timeline
Work with Walpole Island First Nation to secure the necessary information and identify critical habitat.	Further work is required to complete the identification of critical habitat to meet the population and distribution objectives.	2017-2024
Update population status and distribution on Walpole Island First Nation and confirm the current extent of suitable habitat.	Information on population status and presence of suitable habitat is required to allow for critical habitat identification.	2017-2024
Where possible, restore historically occupied suitable habitat(s) on Walpole Island First Nation.	Identify additional critical habitat.	2017-2024
Identify priority sites for habitat restoration and species re-introduction on the mainland. With the assistance of landowners verify occurrences.	Identify critical habitat at priority sites on the mainland.	Unknown at this time. To be determined.

8. Measuring Progress

The performance indicators presented below provide a way to define and measure progress toward achieving the population and distribution objectives. Every five years, success of recovery strategy implementation will be measured against the following performance indicators:

Short term:

- The existing population on Walpole Island First Nation will be maintained and where biologically and technically feasible the abundance of the existing population will be increased to at least 230 adult birds.

Medium term:

- If biologically and technically feasible, the population on Walpole Island First Nation will be increased to at least 500 adult birds and its distribution increased to historically occupied areas on Walpole Island First Nation.

Long term:

- If biologically and technically feasible, a self-sustaining, resilient, and redundant population will be achieved, and at least one viable population on Walpole Island First Nation will be established and one viable population on the mainland will be re-established.

9. Statement on Action Plans

One or more action plans for Northern Bobwhite in Canada will be posted on the Species at Risk Public Registry by December 2023.

10. References

- Allen, C. R., R.S. Lutz and S. Demarais. 1995. Red Imported Fire Ant impacts on Northern Bobwhite populations. *Ecological Applications* 5(3): 632-638.
- Baillie, J.L. 1967. A century of change. *Birds. Ontario Naturalist* 5: 14-19.
- Baillie, J.L., and P. Harrington. 1936. The distribution of breeding birds in Ontario. Part 1. *Transactions of the Royal Canadian Institute* 21(1): 1-50.
- Ballard, M., J. Hough-Goldstein, D. Tallamy. 2013. Arthropod Communities on Native and Nonnative Early Successional Plants. *Environmental Entomology* 42 (5): 851-859.
- Bent, A.C. 1932. *Life Histories of North American Gallinaceous Birds*. Washington, DC: United States National Museum, Bulletin 162. 583 pp.
- BirdLife International. 2016. *Colinus virginianus*. The IUCN Red List of Threatened Species 2016: e.T22728956A95000808. [accessed on 08 December 2016].
- Blancher, P. 2013. Estimated number of birds killed by house cats (*Felis catus*) in Canada. *Avian Conservation and Ecology* 8(2): 3. <http://dx.doi.org/10.5751/ACE-00557-080203>.
- Brennan, L. A., F. Hernandez and D. Williford. 2014. Northern Bobwhite *Colinus virginianus*. *The Birds of North America*. P. G. Rodewald (ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: <https://birdsna.org/Species-Account/bna/species/norbob> DOI: 10.2173/bna.397.
- Brooke, J. M., D.C. Peters, A. M. Unger, E.P. Tanner, C.A. Harper, P.D. Keyser, J.D. Clark, and J.J. Morgan. 2015. Habitat manipulation influences northern bobwhite resource selection on a reclaimed surface mine. *Journal of Wildlife Management* 79: 1264–1276.
- Brooke, J.M., E.P. Tanner, D.C. Peters, A.M. Tanner, C.A. Harper, P.D. Keyser, J.D. Clark, and J.J. Morgan. 2017. Northern Bobwhite breeding season ecology on a reclaimed surface mine. *Journal of Wildlife Management* 81(1):73–85.
- Buerger, T.T., R.J. Kendall, B.S. Mueller, T. DeVos, and B.A. Williams. 1991. Effects of methyl parathion on northern bobwhite survivability. *Environmental Toxicology and Chemistry* 10:527-532.
- Burger, L.W. Jr., T.V. Dailey, E.W. Kurzejeski, and M.R. Ryan. 1995. Survival and cause-specific mortality of Northern Bobwhite in Missouri. *Journal of Wildlife Management* 59: 401-410.

Cadman, M.D., P.F.J. Eagles, and F.M. Helleiner (eds.). 1987. Atlas of the Breeding Birds of Ontario. University of Waterloo Press. Waterloo, ON. 617 pp.

Cadman M.D., D.H. Sutherland, G.G. Beck, D. Lepage, and A.R. Couturier (eds.). 2007. Atlas of the Breeding Birds of Ontario, 2001- 2005. Bird Studies Canada, Environment Canada, Ontario Field Ornithologists, Ontario Ministry of Natural Resources, and Ontario Nature. Toronto, ON. xxii + 706 pp.

Campbell, R.W., N.K. Dawe, I. McTaggart-Cowan, G.W. Kaiser, and M.C.E. McNall. 1990. The Birds of British Columbia. Volume 2. Nonpasserines, Diurnal Birds of Prey through Woodpeckers. Royal British Columbia Museum. Victoria, BC. 636 pp.

Carroll, J.M., C.A. Davis, R.D. Elmore and S.D. 2017. Fuhlendorf. Response of Northern Bobwhite movements to management-driven disturbance in a shrub-dominated ecosystem. Rangeland Ecology & Management 70, 175–182.

Catling, P.M. and G. Mitrow. 2011. Major invasive alien plants of natural habitats in Canada. Canadian Botanical Association Bulletin 44(2) 52-61.

Chabot, A. 2014. Development of genomic tools for population management and risk assessment for Northern Bobwhite in Ontario. Unpublished report for Canadian Wildlife Service – Ontario. Arden, Ontario. 30 pp.

Clarke, C.H.D. 1954. The Bob-White Quail in Ontario. Fish and Wildlife Service, Technical Bulletin 2. Ontario Department of Lands and Forests, Maple, ON.

Collins, B.M., C.K. Williams and P.M. Castelli. 2009. Reproduction and microhabitat selection in a sharply declining Northern Bobwhite population. The Wilson Journal of Ornithology 121(4):688-695.

COSEWIC. 2003. COSEWIC assessment and update status report on the Northern Bobwhite *Colinus virginianus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 20 pp.

COSEWIC 2013. COSEWIC status appraisal summary on the Northern Bobwhite *Colinus virginianus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xiii pp.

DeFisher, L.E. and D.N. Bonter. 2013. Effects of invasive European Fire Ants (*Myrmica rubra*) on Herring Gull (*Larus argentatus*) reproduction. PLoS ONE 8(5): e64185. doi:10.1371/journal.pone.0064185

DeVos, A. 1964. Range changes of birds in the Great Lakes region. American Midland Naturalist 71: 489-502.

DeVos, T., and B.S. Mueller. 1993. Reproductive ecology of Northern Bobwhite in north Florida. 1993. Pp. 83-90, in K.E. Church and T. V. Dailey (eds.). Quail III: Proceedings of the National Quail Symposium. Kansas City, Missouri.

Dimmick, R.W. 1972. The influence of controlled burning on nesting patterns of bobwhite in west Tennessee. Proceedings of Annual Conference, Southeast Fish and Wildlife Agencies no. 25:149-155.

Dimmick, R.W. 1992. Northern Bobwhite (*Colinus virginianus*): Section 4. National Technical Information Service, Springfield, Virginia.

Douglas, M. and J.F. Tooker. 2015. Large-scale deployment of seed treatments has driven rapid increase in use of neonicotinoid insecticides and preemptive pest management in U.S. field crops. Environmental Science & Technology 49(8): 5088-5097.

Driver, C.J., D.B. Drown, M.W. Ligothe, P. Van Voris, B.D. McVeety and B.J. Greenspan. 1991. Routes of uptake and their relative contribution to the toxicological response of Northern Bobwhite (*Colinus virginianus*) to an organophosphate pesticide. Environmental Toxicology and Chemistry 10:21-33.

Dziepak, P. 1991. Northern Bobwhite (*Colinus virginianus*). Pp. 190-191 in R. Brewer, G. McPeck, and R.J. Adams, Jr. (eds.). The Atlas of Breeding Birds of Michigan. Michigan State University Press, East Lansing.

Eggert D.A., B.S. Mueller, L. Robinette, S.D. Wellendorf. 2009. Comparison of survival, productivity, movements, and habitat use of pre-season released quail on wild Northern Bobwhites on Groton Plantation, South Carolina. Pp. 396 – 408, in S.B. Cederbaum, B.C. Faircloth, T.M. Terhune, J.J. Thompson, J.P. Carroll (eds.). Gamebird 2006: Quail VI and Perdix XII. Warnell School of Forestry and Natural Resources, Athens, Georgia.

Ellis, J.A., W.R. Edwards, and K.P. Thomas. 1969. Responses of bobwhites to management in Illinois. Journal of Wildlife Management 33(4): 749-762.

Environment Canada. 2013. *Species at Risk Act* implementation guidance for recovery practitioners, critical habitat identification toolbox. Environment Canada - Canadian Wildlife Service, Ottawa, ON.

Environment Canada. 2014. North American Breeding Bird Survey - Canadian Trends Website, Data-version 2012. Environment Canada, Gatineau, Quebec. [accessed on November 23, 2016].

Errington, P.L and F.N. Hamerstrom Jr. 1936. The northern bob-white's winter territory. Research Bulletin 201. Iowa Agricultural Experiment Station, Ames, Iowa. 304-441 pp.

Evans, K.O., M.D. Smith, Jr. L.W. Burger, R.J. Chambers, A.E. Houston and R. Carlisle. 2009. Release of pen-reared bobwhites: Potential consequences to the genetic integrity of resident wild populations. 2006. Pp. 121-133. *in* S.B. Cederbaum, B.C. Faircloth, T.M. Terhune, J.J. Thompson and J.P. Carroll (eds.). *Gamebird 2006: Quail VI and Perdix XII*. Warnell School of Forestry and Natural Resources, Athens, Georgia.

Fahrig, L., J. Girard, D.Duro, J. Pasher, A. Smith. S. Javorek, D. King, K.F. Lindsay, S. Mitchell and L. Tischendorf. 2015. Farmlands with smaller crop fields have higher within-field biodiversity. *Agriculture, Ecosystems and Environment* 200, 219–234

Fitch, H.S. 1958. Home ranges, territories, and seasonal movements of vertebrates of the National History Reservation. University of Kansas Publications, Museum of Natural History 11: 63-326.

Folk, T.H., R.R. Holmes, J.B. Grand. 2007. Variation in northern bobwhite demography along two temporal scales. *Population Ecology* 49: 211. doi:10.1007/s10144-007-0037-5.

Gibbons, D., C. Morrissey and P. Mineau. 2015. A review of the direct and indirect effects of neonicotinoids and fipronil on vertebrate wildlife. *Environmental Science and Pollution Research International* 22:103-118.

Graber, R.R., and J.W. Graber. 1963. A comparative study of bird populations in Illinois 1906-1909 and 1956-1958. *Illinois Natural History Survey Bulletin* 28: 383-528.

Giuliano, W.M., R.S. Lutz, and R. Patiño. 1996. Reproductive responses of adult female Northern Bobwhite and scaled quail to nutritional stress. *Journal of Wildlife Management* 60:302–309.

Guthery, F.S. 1997. A philosophy of habitat management for northern bobwhites. *Journal of Wildlife Management* 61:291-301.

Guthery, F.S., M.J. Peterson, and R.R. George. 2000. Viability of northern bobwhite populations. *Journal of Wildlife Management* 64: 646-662.

Hallmann, C.A., R.P.B. Foppen, C.A.M. van Turnhout, H. de Kroon, and E. Jongejans. 2014. Declines in insectivorous birds are associated with high neonicotinoid concentrations. *Nature*.12 pp.

Hamilton, J.A., and J.M. Miller. Adaptive introgression as a resource for management and genetic conservation in a changing climate. 2015. *Conservation Biology* 30(1): 33-41.

Hernandez, F., L.A. Brennan, S.J. DeMaso, J.P. Sands, and D.B. Wester. 2013. On reversing the northern bobwhite population decline: 20 years later. *Wildlife Society Bulletin* 37: 177–188.

Hubert, P., pers. comm. 2016. *Email correspondence to K. Tuininga*. November 2016. Senior Wildlife Biologist - Policy Advisor, Ontario Ministry of Natural Resources and Forestry, Peterborough, Ontario.

Hurst, G.A. 1972. Insects and bobwhite quail brood habitat management. Pp. 65-82, *in* J.A. Morrison and J.C. Lewis (eds.). Proceedings of the First National Bobwhite Quail Symposium. Oklahoma State University, Stillwater, Oklahoma.

Jackson, J.R., G.A. Hurst, and E.A. Gluesing. 1987. Abundance and selection of invertebrates by northern bobwhite chicks. Pp. 303-310, *in* Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies. Volume 41 <http://nativegrasses.utk.edu/grassland/show.asp?which=324>

Jacobs, C. and K. Johnson. 2016. Northern Bobwhite on Walpole Island First Nation. Unpublished report to Canadian Wildlife Service - Ontario. Walpole Island Heritage Centre, Walpole Island First Nation. 15 pp.

Jacobs, C., pers. comm. 2016. *Email correspondence to S. Meyer*. September 2016. Natural Heritage Coordinator, Walpole Island Heritage Centre, Walpole Island First Nation.

Jacobs, C., pers. comm. 2017. *Comments on the draft Northern Bobwhite Recovery Strategy in Canada*. March 2017. Natural Heritage Coordinator, Walpole Island Heritage Centre, Walpole Island First Nation.

James, R.D., and R. Cannings. 2003. COSEWIC update status report on the Northern Bobwhite *Colinus Virginianus* in Canada *in* COSEWIC assessment and update status report on the Northern Bobwhite *Colinus Virginianus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, Ontario. 20 pp.

Jackiw, R.N., G. Mandil, and H.A. Hager. 2015. A framework to guide the conservation of species hybrids based on ethical and ecological considerations. *Conservation Biology* 29(4): 1040-1051.

Johnson, D.B., and F.S. Guthery. 1988. Loafing coverts used by Northern Bobwhites in subtropical environments. *Journal of Wildlife Management* 52: 464-469.

Kabat, C. and D.R. Thompson. 1963. Wisconsin quail 1834-1962: population dynamics and habitat management. Wisconsin Conservation. Department. Technical. Bulletin. no. 30. 137 pp.

Klimstra, W.D. and J.L. Roseberry. 1975. Nesting ecology of the bobwhite in southern Illinois. *Wildlife Monographs* 41:1-37.

Klimstra, W.D., and V.C. Ziccardi. 1963. Night-roosting habitat of Bobwhites. *Journal of Wildlife Management* 27(2): 202-214.

Lanque, A., and M.R. Doyon. 1996. Northern Bobwhite *Colinus virginianus*. P. 1130 in J. Gauthier and Y. Aubry (eds.). *The Breeding Birds of Québec*. Association Québécois des Groupes Ornithologues, The Province of Quebec Society for the Protection of Birds, and Canadian Wildlife Service, Environment Canada – Québec Region. 1302 pp.

Litt, A.R., E.E. Cord, T.E. Fulbright and G.L. Schuster. 2014. Effects of invasive plants on arthropods. *Conservation Biology* Volume 28, No. 6, 1532–1549

Lochmiller, R.L., M.R. Vestey, and J.C. Boren. 1993. Relationship between protein nutritional status and immunocompetence in Northern Bobwhite chicks. *Auk* 110:503-510 <https://sora.unm.edu/sites/default/files/journals/auk/v110n03/p0503-p0510.pdf>

Lohr, M., B.M. Collins, C.K. Williams and P. M. Castelli. 2011. Life on the edge; Northern Bobwhite ecology at the northern periphery of their range. *Journal of Wildlife Management* 75(1): 52-60.

Lopez-Antia, A., M.E. Ortiz-Santaliestra, F. Mougeot, and R. Mateo. 2015. Imidacloprid-treated seed ingestion has lethal effect on adult partridges and reduces both breeding investment and offspring immunity. *Environmental Research*, 136, 97-107.

Lumsden, H.G. 1987. Northern Bobwhite *Colinus virginianus*. Pp. 144-145 in Cadman, M.D., P.F.J. Eagles, and F.M. Helleiner, (eds.). *Atlas of Breeding Birds of Ontario*. University of Waterloo Press. Waterloo, Ontario. 617 pp.

Lumsden, H.G. 1994. Northern Bobwhite *Colinus virginianus*. Pp. 236-239 in M.K. McNicholl and J.L. Cramner-Byng, (eds.). *Ornithology in Ontario*. Ontario Field Naturalists Special Publication 1. Toronto, Ontario. 400 pp.

Lusk, J.J., S.G. Smith, S.D. Fuhlendorf, and F.S. Guthery. 2006. Factors influencing Northern Bobwhite nest-site selection and fate. *Journal of Wildlife Management* 70(2): 564-571.

MacDonald, J.M., P. Korb, and R.A. Hoppe. 2013. *Farm Size and the Organization of U.S. Crop Farming*, U.S. Department of Agriculture, Economic Research Service, Economic Research Report 152. 55 pp.

MacIntyre, K. 2002. A technical report outlining the status of Northern Bobwhite *Colinus virginianus* in the Aylmer District Ontario Ministry of Natural Resources. Ontario Ministry of Natural Resources. Aylmer, Ontario. 14 pp.

- Martin, J.A., J.K. Burkhart, R.E. Thackston, and J.P. Carroll. 2015. Exotic grass alters micro-climate and mobility for Northern Bobwhite chicks. *Wildlife Society Bulletin* 39(4): 834-839.
- Master, L.L., D. Faber-Langendoen, R. Bittman, G.A. Hammerson, B. Heidel, L. Ramsay, K. Snow, A. Teucher, and A. Tomaino. 2012. NatureServe Conservation Status Assessments: Factors for evaluating species and ecosystem risk. NatureServe, Arlington, Virginia. Web site: http://www.natureserve.org/sites/default/files/publications/files/natureserveconservationstatusfactors_apr12.pdf [accessed October 2015].
- Mayfield, H.F. 1988. Changes in bird life at the western end of Lake Erie. Part 2 of 3. *American Birds* 42: 1259-1264.
- McFadden, T., 2016. pers. comm. *Email correspondence to K. Tuininga*. October 2016. Wildlife Biologist, Michigan Department of Natural Resources, Harrison Township, Michigan.
- Miller, B., K. Ralls, R.P. Reading, J.M. Scott and J. Estes. 1999. Biological and technical considerations of carnivore translocation: a review. *Animal Conservation* 2: 59-68.
- Mineau, P. and M. Whiteside. 2013. Pesticide acute toxicity is a better correlate of U.S. grassland bird declines than agricultural intensification. *PLoS ONE* 8(2): e57457. doi:10.1371/journal.pone.0057457
- Murphy, D.A., and T.S. Baskett. 1952. Bobwhite mobility in central Missouri. *Journal of Wildlife Management* 16: 498-510.
- Myers, P. E., C.R. Allen, and H.E. Birge. 2014. Consuming Fire Ants reduces Northern Bobwhite survival and weight gain. *Journal of Agricultural and Urban Entomology* 30(1), 49-58.
- National Audubon Society. 2015. The Christmas bird count historical results [Online]. Available <http://www.christmasbirdcount.org> [accessed November 23, 2016]
- NatureServe. 2015. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available <http://explorer.natureserve.org>. [accessed: October 26, 2016].
- Naumann, K. and R.J. Higgins. 2015. The European fire ant (Hymenoptera: Formicidae) as an invasive species: impact on local ant species and other epigaeic arthropods. *Canadian Entomologist* 147: 592–601.

Nestler, R.B., W.W. Bailey and H.E. McClure. 1942. Protein requirements of bobwhite chicks for survival, growth and efficiency of feed utilization. *Journal of Wildlife Management* 6:185-193

https://www.jstor.org/stable/3795900?seq=1#page_scan_tab_contents

Newman, W.L. 2015. Restoration techniques for Northern Bobwhites. Master's thesis. University of North Texas, Denton, Texas. 85 pp.

Northern Bobwhite Conservation Initiative. 2009.

<http://www.qu.org/content/habitat/nbci/index.cfm> [accessed October 16, 2009]

Olsen, A.C., L.A. Brennan and A.M. Fedynich. Helminths and the northern bobwhite population decline: A review. 2016. *Wildlife Society Bulletin* 40(2): 388-393.

Page, A.M., and M.J. Austen. 1994. Status report on the Northern Bobwhite *Colinus virginianus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, Ontario. 34 pp.

Peck, G.K., and R.D. James. 1983. Breeding Birds of Ontario: Nidology and Distribution. Volume 1: Nonpasserines. Life Sciences Miscellaneous Publications. Royal Ontario Museum. Toronto, Ontario. 321 pp.

Perez, R. M., D.E. Wilson, and K.D. Gruen. 2002. Survival and flight characteristics of captive-reared and wild Northern Bobwhite in South Texas. Pages 81–85, in S. J. DeMaso, W. P. Kuvleky, Jr., and F. Hernandez, and M. E. Berger (eds.). Quail V: Proceedings of the Fifth National Quail Symposium. Texas Parks and Wildlife Department, Austin, Texas.

Perlut, N.G. 2014. Grassland birds and dairy farms in the Northeastern United States. *Wildlife Society Bulletin* 38(3):574–579.

Peters, D.C., J.M. Brooke, E.P. Tanner, A.M. Unger, P.D. Keyser, C.A. Harper, J.D. Clark and J.J. Morgan. 2015. Impact of experimental habitat manipulation on northern bobwhite survival. *Journal of Wildlife Management* 79(4): 605-617.

Peterson, R.T. 1980. A Field Guide to the Birds. Houghton Mifflin Company. Boston, Massachusetts. 384 pp.

Pisa, L.W., V. Amaral-Rogers, L. P. Belzunces, J.M. Bonmatin, C. A. Downs, D. Goulson, D. P. Kreutzweiser, C. Krupke, M. Liess, M. McField, C. A. Morrissey, D.A. Noome, J. Settele, N. Simon-Delso, J.D. Stark, J.P. Van der Sluijs, H. Van Dyck, M. Wiemers. 2015. Effects of neonicotinoids and fipronil on non-target invertebrates. *Environmental Science and Pollution Research* 22:68-102.

Potts, G.R. 1986. The Partridge: pesticides, predation and conservation. Collins, London. 274 pp.

Riley, J.L. 2013. The Once and Future Great Lakes Country, An Ecological History. McGill-Queen's University Press. Montreal & Kingston. 488 pp.

Risley, C. 2007. Northern Bobwhite *Colinus virginianus*. Pp. 134-135 in M.D. Cadman, D.A. Sutherland, G.G. Beck, D. Lepage, and A.R. Couturier, (eds.). Atlas of the Breeding Birds of Ontario, 2001-2005. Bird Studies Canada, Environment Canada, Ontario Field Ornithologists, Ontario Ministry of Natural Resources, and Ontario Nature. Toronto, Ontario. 706 pp.

Robbins, C.S., D. Bystrak and P.H. Geissler. 1986. Breeding bird survey: its first fifteen years, 1965-1979. U.S. Fish and Wildlife Service Research Publication 157.

Roseberry, J.L. and W.D. Klimstra. 1984. Population ecology of the bobwhite. Southern Illinois University Press. Carbondale, Illinois. 304 pp.

Rosene, W. 1969. The Bobwhite Quail, Its Life and Management. Rutgers University Press. New Brunswick, New Jersey. 399 pp.

Sandercock, B.K., W.E. Jensen, C.K. Williams and R.D. Applegate. 2008. Demographic sensitivity of population change in Northern Bobwhite. Journal of Wildlife Management 72: 970–982.

Sandilands, A.P. 2005. The birds of Ontario: habitat requirements, limiting factors and status. Volume 1. Nonpasserines: waterfowl through cranes. UBC Press. Vancouver, British Columbia. 365 pp.

Sands, J.P., L.A. Brennan, F. Hernández Jr., W.P. Kuvlesky, J.F. Gallagher and D.C. Ruthven III. 2012. Impacts of introduced grasses on breeding season habitat use by Northern Bobwhite in the South Texas plains. Journal of Wildlife Management 76(3):608-618.

Sands, J.P., L.A. Brennan, F. Hernández Jr., W.P. Kuvlesky, J.F. Gallagher, D.C. Ruthven III and J.E. Pittman III. 2009. Impacts of buffelgrass (*Pennisetum ciliare*) on a forb community in south Texas. Invasive Plant Science and Management 2(2):130-140.

Schroeder, R.L. 1985. Habitat suitability index models: Northern Bobwhite. U.S. Fish and Wildlife Service Biological Report 82(10.104). 32 pp.

Smith O.M. 2015. Effects of agricultural land conversion and landscape connectivity on movement, survival and abundance of Northern Bobwhites (*Colinus Virginianus*) in Ohio. Master's thesis, Ohio State University, Columbus, Ohio. 107 pp.

Stoddard, H.L. 1931. The Bobwhite Quail: Its Habits, Preservation and Increase. C. Scribner and Sons. New York, New York. 559 pp.

Sumner, D. 2014. American farms keep growing: size, productivity, and policy. *Journal of Economic Perspectives*. Volume 28(1) 147–166.

Taylor, J.S. and F.S. Guthery. 1994. Components of Northern Bobwhite brood habitat in southern Texas. *Southwestern Naturalist* 39:73-77.

Taylor, J.S., K.E. Church, and D.H. Rusch. 1999a. Microhabitat selection by nesting and brood-rearing Northern Bobwhites in Kansas. *Journal of Wildlife Management* 63(2):686-694.

Taylor, J.S., K.E. Church, D.H. Rusch and J.R. Cary. 1999b. Macrohabitat effects of summer survival, movements, and clutch success of Northern Bobwhite in Kansas. *Journal of Wildlife Management* 63(2):675-685.

Turaga, U., S.T. Peper, N.R. Dunham, N. Kumar, W. Kistler, S. Almas, S.M. Presley, and R.J. Kendall. 2016. A survey of neonicotinoid use and potential exposure to Northern Bobwhite (*Colinus virginianus*) and Scaled quail (*Callipepla squamata*) in the rolling plains of Texas and Oklahoma. *Environmental Toxicology and Chemistry* Volume 35(6):1511–1515.

Verble-Pearson R. and S. Pearson. 2016. European Fire Ant presence decreases native arboreal insect abundance in Acadia National Park, Maine, USA. *Natural Areas Journal* 36(2):162-165.

Williams, C.K., B.K. Sandercock, B.M. Collins, M. Lohr, and P.M. Castelli. 2012. A Mid-Atlantic and a national population model of northern bobwhite demographic sensitivity. *Proceedings of the National Quail Symposium* 7:163–172.

Williford, D., R.W. Deyoung, R.L. Honeycutt, L.A. Brennan and F. Hernández. 2016. Phylogeography of the bobwhite (*Colinus*) quails. *Wildlife Monographs* 193: 1–49.

Woodliffe, A., pers. comm. 2003 in R.D. James and R. Cannings. 2003. COSEWIC update status report on the Northern Bobwhite *Colinus Virginianus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, Ontario. 20 pp.

Yeiser, J.M., D.L. Baxley, B.A. Robinson, and J.J. Morgan. 2015. Using prescribed fire and herbicide to manage rank native warm season grass for northern bobwhite. *Journal of Wildlife Management* 79 (2015): 69-76.

Appendix A: Subnational Conservation Ranks of Northern Bobwhite (*Colinus virginianus*) in Canada and the United States

Northern Bobwhite (<i>Colinus virginianus</i>)				
Global (G) Rank	National (N) Rank (Canada)	Sub-national (S) Rank (Canada)	National (N) Rank (United States)	Sub-national (S) Rank (United States)
G5	N1	Ontario (S1) British Columbia (SNA)	N5	Alabama (S5), Arizona (S1), Arkansas (S5), Colorado (S4), Connecticut (S4), Delaware (S4), District of Columbia (S1), Florida (SNR), Georgia (S5), Idaho (SNA), Illinois (S5), Indiana (S4), Iowa (S5B), Kansas (S5), Kentucky (S5), Louisiana (S3), Maryland (S5), Massachusetts (S2), Michigan (S4), Minnesota (SU), Mississippi (S3S4), Missouri (S5), Montana (SNA), Nebraska (S5), New Hampshire (SX), New Jersey (S5B,S5N), New Mexico (S5B,S5N), New York (S4), North Carolina (S5), Ohio (S5), Oklahoma (S5), Oregon (SNA), Pennsylvania (S1), Rhode Island (S4B,S4N), South Carolina (S4), South Dakota (S4), Tennessee (S2S3), Texas (S4B), Vermont (SNA), Virginia (S5), Washington (SNA), West Virginia (S3B,S3N), Wisconsin (S2S3B), Wyoming (S1)

Table A-1 – Ranks of Northern Bobwhite in Canada and the United States. (NatureServe 2015)

Rank Definitions (Master et al. 2012)

N1/S1: Critically Imperilled: At very high risk of extirpation in the jurisdiction due to very restricted range, very few populations or occurrences, very steep declines, severe threats, or other factors.

S2: Imperilled: At high risk of extirpation in the jurisdiction due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors.

N3/S3: Vulnerable: At moderate risk of extirpation in the jurisdiction due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors.

S4: Apparently Secure: At a fairly low risk of extirpation in the jurisdiction due to an extensive range and/or many populations or occurrences, but with possible cause for some concern as a result of local recent declines, threats, or other factors.

G5/N5/S5: Secure: At very low risk of extinction or elimination due to a very extensive range, abundant populations or occurrences, and little to no concern from declines or threats).

S#S#: Range rank: A numeric range rank (e.g., S2S3 Vulnerable/Imperilled or S1S3 Critically Imperilled/Vulnerable) is used to indicate any range of uncertainty about the status of the species or ecosystem.

SNA: Not applicable: A conservation status rank is not applicable because the species or ecosystem is not a suitable target for conservation activities.

SNR: Unranked: Subnational conservation status not yet assessed.

SX: Presumed Extirpated – Species or ecosystem is believed to be extirpated from the jurisdiction. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.

B: Breeding - Conservation status refers to the breeding population of the species in the nation or state/province (e.g., S3B).

N: Non-breeding - Conservation status refers to the non-breeding population of the species in the nation or state/province (e.g., S4N).

Appendix B: Effects on the Environment and Other Species

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the [Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals](#)¹⁸. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or any of the [Federal Sustainable Development Strategy](#)'s¹⁹ (FSDS) goals and targets.

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 into the strategy itself, but are also summarized below in this statement.

The approaches in this recovery strategy will clearly benefit the environment by promoting the recovery of the Northern Bobwhite in Canada. The potential for the strategy to inadvertently lead to adverse effects on other species was considered. Many at risk and rare species occur in tallgrass prairie and savanna habitats. Therefore, it is expected that recovery efforts for Northern Bobwhite will benefit many species that occur in these habitats, such as Bobolink (*Dolichonyx oryzivorus*), Eastern Meadowlark (*Sturnella magna*), Henslow's Sparrow (*Ammodramus henslowii*), Colicroot (*Aletris farinosa*), Dense Blazing Star (*Liatris spicata*), Willowleaf Aster (*Symphyotrichum praealtum*), Eastern Foxsnake (*Pantherophis gloydi*) and Butler's Gartersnake (*Thamnophis butleri*). However, the timing and frequency of management activities such as prescribed burning have the potential to negatively affect some species. It will be important to consider the needs of a wide variety of species when designing a fire regime targeted to Northern Bobwhite. Habitat securement, policy, and stewardship approaches are not expected to have any adverse effects on habitat or co-occurring species. 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 following sections of the document in particular: Population and Distribution Objectives and Strategic Direction for Recovery.

¹⁸ www.ceaa.gc.ca/default.asp?lang=En&n=B3186435-1

¹⁹ www.ec.gc.ca/dd-sd/default.asp?lang=En&n=CD30F295-1