PROPOSED

Species at Risk Act
Recovery Strategy Series

Recovery Strategy for the Bicknell's Thrush (*Catharus bicknelli*) in Canada

Bicknell's Thrush

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For copies of the recovery strategy, or for additional information on species at risk, including the 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[1].

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[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[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 and Minister responsible for the Parks Canada Agency is the competent minister under SARA for the Bicknell's Thrush and has prepared this recovery strategy, as per section 37 of SARA. To the extent possible, it has been prepared in cooperation with the Quebec Department of Forests, Wildlife and Parks, the New Brunswick Department of Natural Resources, and the Nova Scotia Department of Natural Resources, 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, the Parks Canada Agency, or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this strategy for the benefit of the Bicknell's Thrush 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, the Parks Canada Agency 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, there may be future regulatory implications, depending on where the critical habitat is identified. SARA requires that critical habitat identified within a national park named and described in Schedule 1 to the *Canada National Parks Act*, the Rouge National Urban 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* be described in the *Canada Gazette*, after which prohibitions against its destruction will apply. 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

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

critical habitat applies. 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.

Acknowledgements

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Executive Summary

The Bicknell's Thrush (*Catharus bicknelli*) was listed as a threatened species in Schedule 1 of the *Species at Risk Act* (SARA) in 2012.

The Bicknell's Thrush is a rare, range-restricted passerine species. During the breeding season, the species inhabits inland forests at elevations ranging from 380 to 1,100 m, as well as coastal lowland forests in Quebec, New Brunswick, Nova Scotia and the northeastern United States. It winters in the Greater Antilles, with the bulk of its population occurring in the Dominican Republic (Hispaniola). All the available indices on population trends for the species in Canada indicate a decline in abundance and range.

The main threat facing the Bicknell's Thrush is habitat loss and degradation. The wintering area is particularly subject to pressures such as subsistence farming, logging and human-caused fires. In the breeding range, Bicknell's Thrush habitats are mainly affected by forestry practices as well as the creation of wind farms.

There are unknowns regarding the feasibility of recovery of the Bicknell's Thrush. Nevertheless, in keeping with the precautionary principle, this recovery strategy has been prepared as per section 41(1) of SARA, as is done when recovery is determined to be feasible.

The population and distribution objectives for the Bicknell's Thrush are as follows:

- in the short term (2016-2026), slow the decline in its population while ensuring that no more than 10% of the population is lost during this period, and ensure that no net loss occurs in its biological area of occupancy[3] throughout the species' entire range in Canada;

- in the long term (after 2026), ensure a positive population trend over 10 years, as well as a positive trend in the species' biological area of occupancy, throughout the species' range in Canada.

The broad strategies to be taken to address the threats to the survival and recovery of the species are presented in the section on Strategic Direction for Recovery.

The Bicknell's Thrush critical habitat is partially identified in this recovery strategy. The identification of critical habitat is based on two criteria: the presence of suitable habitat for the Bicknell's Thrush and occupancy of this habitat by the species. It corresponds to suitable habitat within a radius of 5 km of all coordinates representing a possible, probable or confirmed breeding record obtained over the period from 1995 to 2014. A

[3] The "biological" area of occupancy is the total area of habitat occupied by all existing populations. For a species of bird, the number of pairs and the average home range can be estimated; the area of occupancy can be roughly estimated by multiplying the two values (COSEWIC. 2013. Instructions for the Preparation of COSEWIC Status Reports. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 30 p. (www.cosewic.gc.ca/htmlDocuments/Instructions_e.htm).

schedule of studies outlines the key activities that are required to complete the identification of critical habitat. Examples of activities likely to result in the destruction of critical habitat are also outlined.

One or more action plans for the Bicknell’s Thrush will be posted on the Species at Risk Public Registry within five years after the final version of this recovery strategy is posted.

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 Bicknell's Thrush. In keeping with the precautionary principle, this recovery strategy has been prepared as per subsection 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.

Yes. The Bicknell's Thrush population has a significant number of wild breeding individuals. According to the most recent status report, the global population is between 98,050 and 125,898 individuals and the Canadian population is between 40 570 and 49 258 (COSEWIC 2009). This number of individuals is sufficient to sustain and increase the population.

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

Unknown. The potential breeding habitat for the species in Canada is an estimated 48,850 km² (COSEWIC 2009). A large part of this area is located in managed[4] forests, and the size of the area therefore depends on how the forests are managed and on the nature of the forest treatments. Certain types of activities carried out in forests, such as the construction of access roads and wind farm developments, can permanently reduce the area of suitable habitat. The availability of wintering habitat (located in the Greater Antilles) is considered an important limiting factor for the species. Its total current area has been assessed at ±33 170 km² (McFarland et al. 2013) and will likely continue to decrease given the major challenge of reducing the threats to the species' habitat owing to the difficult socio-economic situation in the Dominican Republic and Haiti (Stattersfield et al. 1998; Perdomo and Arias 2008; Sergile 2008) and given the fact that less than 30% of the potential habitat identified has conservation status (McFarland et al. 2013). Efforts to manage or restore the species' wintering habitat could improve the situation, but it is not certain that such efforts would succeed in reversing this trend and increasing the area of wintering habitat.

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

Unknown. The primary threats to the Bicknell's Thrush and its habitat in its breeding range can be avoided or mitigated through legal measures or other methods such as

[4] This document uses the expression "managed" forest rather than "industrial" forest, which was used in the COSEWIC Status Report on Bicknell's Thrush (*Catharus bicknelli*) in Canada (COSEWIC 2009). It better describes the reality and uses.

stewardship or appropriate management approaches. The threats relating to climate change, if confirmed, pose a challenge, but it is reasonable to believe that avoidance or mitigation of other threats, some of which have greater impacts, will make it possible to improve the environmental and ecological conditions to the point of enabling the species to recover. The likelihood of success in avoiding or mitigating the threats present in the species' wintering area, in particular threats to its habitat, is however more uncertain for the reasons noted in criterion 2.

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

Yes. Forest management techniques and measures for managing habitat used by the Bicknell's Thrust exist which, taken together, can maintain or promote the regeneration of breeding habitat. In the wintering area, different habitat creation or conservation techniques will have to be developed or adapted.

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1. COSEWIC* Species Assessment Information

Date of Assessment: November 2009

Common Name (population): Bicknell's Thrush

Scientific Name: *Catharus bicknelli*

COSEWIC Status: Threatened

Reason for Designation: This species has one of the most restricted breeding ranges among the forest birds of North America. It inhabits the forests of montane and cool coastal zones, as well as high-elevation regenerating forests over 600** m in Quebec, New Brunswick, Nova Scotia and the northeastern United States. It winters in the Greater Antilles, where the bulk of its population appears to be in the Dominican Republic. Despite the difficulty of adequately monitoring the species, all the available indices on trends point to significant declines in population and area of occupancy. Preliminary results from the Maritimes Breeding Bird Atlas project suggest a 40% decline in the area occupied over the last three generations, while the High Elevation Landbird Program suggests more dramatic declines in the same regions. Recent surveys in Quebec also indicate declines in some locations. While reasons for the decline are unclear, habitat loss on the wintering grounds, management practices such as pre-commercial thinning in regenerating forests and climate change are leading to a reduction of suitable high-elevation habitat.

Canadian Occurrence: Quebec, New Brunswick, Nova Scotia

COSEWIC Status History: Designated Special Concern in April 1999. Status re-examined and designated Threatened in November 2009.

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

** New information that has become available since the publication of the COSEWIC status report on the Bicknell's Thrush indicates that the species occurs in forests ranging in elevation from 380 m to 1,100 m (IBTCG 2010).

2. Species Status Information

Approximately 95% of the Bicknell's Thrush potential breeding habitat is in Canada (COSEWIC 2009). The Bicknell's Thrush was listed as Threatened in Schedule 1 of the *Species at Risk Act* in 2012. It is designated Vulnerable in Quebec under the *Act Respecting Threatened or Vulnerable Species* (CQLR, c. E-12.01), Vulnerable in Nova Scotia under the *Endangered Species Act* (c. 11, s. 1.) and Threatened in New Brunswick under the *Species at Risk Act* (Regulation 2013-38). It is listed as a Species of Concern in all the U.S. states in which it occurs.

The Bicknell's Thrush is considered to be "apparently secure globally" (G4) (NatureServe 2013) and has national breeding status ranks of N4B (apparently secure) in Canada and N3B (vulnerable) in the United States. The subnational conservation status ranks for the species vary by state or province (see Table 1).

Table 1. Subnational Conservation Status Ranks (S-ranks) for the Bicknell's Thrush in Canada and the United States (NatureServe 2013)

Country	Provinces/States and NatureServe conservation status ranks *
Canada	New Brunswick (S2S3B), Nova Scotia (S1S2B), Ontario (SNA), Prince Edward Island (SUB), Quebec (S2**)
United States	Connecticut (SNA), Delaware (SNA), Georgia (SNA), Maine (S3B), Maryland (SNA), Massachusetts (SXB), New Hampshire (S2S3B), New Jersey (SNA), New York (S2S3B), North Carolina (SNA), Pennsylvania (SNA), Rhode Island (SNA), South Carolina (SNA), Vermont (S2B), Virginia (SNA)

* See Appendix A for definitions of the status ranks used by NatureServe (2013).
** Source: Centre de données sur le patrimoine naturel du Québec (2015).

3. Species Information

3.1 Species Description

Discovered in 1882 but only recognized as a distinct species since 1995, the Bicknell's Thrush is the smallest of the northern *Catharus* thrushes (body length: 16–18 cm; body mass: 25–30 g). Its upperparts are mainly drab olive brown and the underparts are gray with dark spots on the throat and breast. The folded primaries and rump (upper tail) feathers are chestnut brown. During the breeding season, its lower mandible is pale yellow on at least the proximal half. There is no obvious sexual dimorphism, but males can be slightly larger than females (Frey et al. 2008). The Bicknell's Thrush is similar to the other northern *Catharus* thrushes, particularly the larger Gray-cheeked Thrush (COSEWIC 2009).

3.2 Population and Distribution

The Bicknell's Thrush has a restricted range. Its breeding range lies entirely within the northeastern part of the North American continent (Figure 1). In Canada, the Bicknell's Thrush nests in southern Quebec, in north-central and northwestern New Brunswick and on Cape Breton Island in Nova Scotia. The breeding range is fragmented owing to the specific conditions sought by this species (e.g., high elevation, specific forest stands; see section 3.3 for more information). The species' wintering area is equally restricted and located in the Greater Antilles, primarily the Dominican Republic (Hispaniola Island) (Figure 2; IBTCG 2010; McFarland et al. 2013).

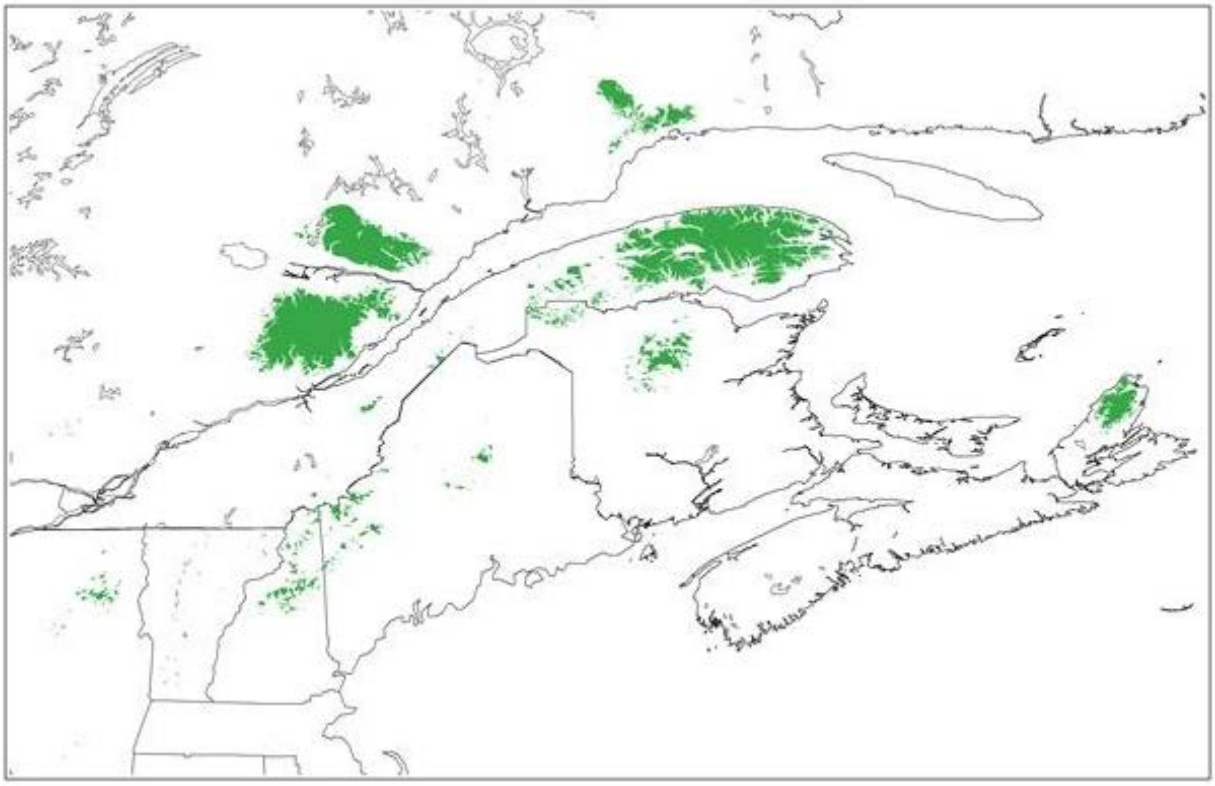

Figure 1. Bicknell's Thrush breeding range in Canada and the United States, in green (adapted from Lambert et al. 2005; Hart et al. in prep.; and unpublished data of Environment and Climate Change Canada's Canadian Wildlife Service).

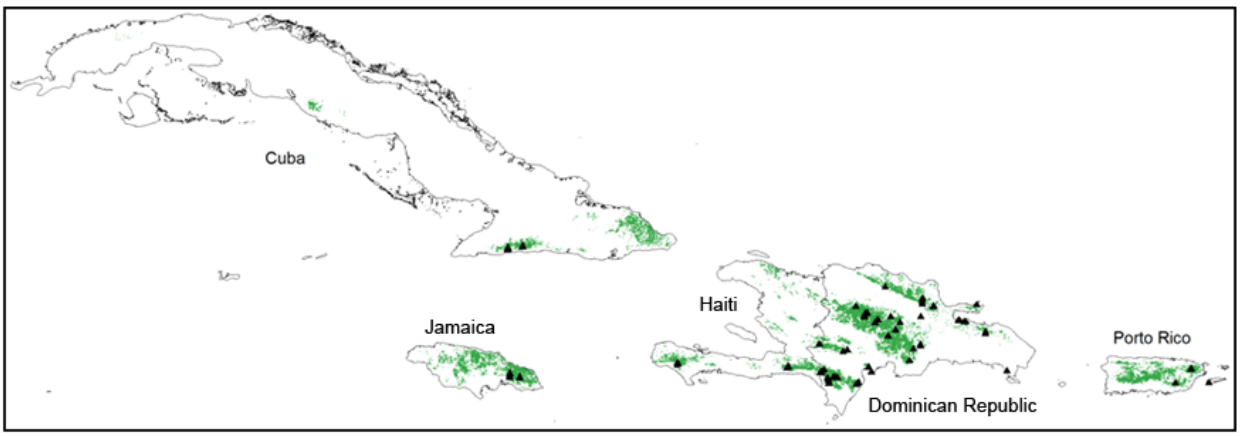

Figure 2. Potential wintering area of the Bicknell's Thrush in the Greater Antilles, in green. The black triangles indicate the known observation sites of the species (adapted from McFarland et al. 2013)

The species has a small global population (estimated at 98 050 to 125 898 individuals), of which 40 570 to 49 258 individuals breed in Canada (COSEWIC 2009). Given this species' skewed sex ratio, there would be only 10 142 to 16 419 females. This represents the maximum reproductive population size for the species in Canada (COSEWIC 2009).

Population trends for the Bicknell's Thrush in Canada have declined, regardless of the region and period considered. The data collected through the Breeding Bird Survey program indicate a 3.42% overall annual decline in Bicknell's Thrush abundance in Canada between 1970 and 2012.[5] According to data from the same program, the annual decline for Nova Scotia over the same period is 7.07%, which is comparable to the results of the analysis of the data of the High Elevation Landbird Program (HELP) conducted by Campbell and Stewart (2012), which found an abundance decline of approximately 7.4% annually between 2002 and 2011. For New Brunswick, this figure rises to 11.5% over the same period (Campbell and Stewart 2012). For these two provinces combined, Bicknell's Thrush distribution has reportedly decreased by 65% over approximately 20 years and by more than 40% in the last 10 years (COSEWIC 2009). In Quebec, while a population trend cannot yet be calculated for the species, monitoring carried out at Mount Gosford from 2001 to 2007 reveals a 60% decline in the number of individuals detected (Y. Aubry, Environment and Climate Change Canada, unpublished data reported by IBTCG 2010).

3.3 Needs of the Bicknell's Thrush

Breeding habitat

The Bicknell's Thrush is a habitat specialist. It is generally associated with dense undisturbed coniferous forest or disturbed areas undergoing vigorous succession dominated by Balsam Fir *(Abies balsamea*) with high stem densities (10,000-50,000 stems/ha) (COSEWIC 2009; Bredin and Whittam 2009). Elevation is an important characteristic of the species' breeding habitat. In Canada, at inland sites in the southern part of the species' range, the minimum elevation is approximately 800 m. This minimum elevation declines with increasing latitude, to approximately 380 m in the northern limit of its range (IBTCG 2010). In coastal localities, the Bicknell's Thrush occurs from elevations starting near sea level. Because of these specific requirements, the species' breeding range is fragmented, which increases its vulnerability of being extirpated from one or more smaller breeding sites (Bredin and Whittam 2009).

Three breeding habitat types are used by the Bicknell's Thrush (COSEWIC 2009). High Balsam Fir stem density is an important characteristic of all three (Wallace 1939; Sabo 1980; Connolly 2000; Nixon et al. 2001; Whittam and Ball 2003; Frey et al. 2008; Aubry and Paradis 2009; Y. Aubry unpubl. data).

[5] www.ec.gc.ca/ron-bbs/P000/A000/

- **High-elevation montane forests**

In high-elevation montane areas, the Bicknell's Thrush selects undisturbed forests and forests regenerating after natural disturbances (e.g., fir stands affected by fir wave mortality [Sprugel 1976], windthrow, ice and snow damage, fire and insects, such as Spruce Budworm [*Choristoneura fumiferana*]), with standing dead conifers and dense regrowth of Balsam Fir (Wallace 1939; Rimmer et al. 2001). The species also uses chronically disturbed, stunted-tree stands (Rimmer et al. 2001).

- **High-elevation managed forests**

Managed forests are defined as forests managed for wood or fibre production (COSEWIC 2009). The Bicknell's Thrush breeds in these anthropogenically disturbed forests, i.e., in regenerating clearcuts and unthinned conifer plantations 10 to 15 years after cutting (Bredin and Whittam 2009), when they have been invaded by dense regeneration of Balsam Fir. Studies conducted in New Brunswick and Nova Scotia indicate that these stands are dominated by Balsam Fir and that the Bicknell's Thrush uses stands with a stem density as high as 50 000 stems per hectare and an average young tree height of 3.4 m in New Brunswick and 5 m in Nova Scotia (Campbell et al. 2005; Bredin and Whittam 2009).

- **Coastal lowland forests**

Locally, the species also occupies similar habitats in coastal localities, where the maritime climate, cool offshore winds and high precipitation levels maintain dense spruce-fir stands (COSEWIC 2009). This is the case in Nova Scotia where, according to Bredin and Whittam (2009), the species traditionally nests in dense, often stunted coniferous forests typically found on coastal headlands. These forests are composed primarily of Balsam Fir and Black Spruce (*Picea mariana*) and are sometimes referred to as krummholtz[6] or taiga.

Post-breeding habitat

Little information is available on post-breeding habitat use by Bicknell's Thrush. The species may use forest habitat at a lower elevation than the breeding habitat because this habitat provides the conditions and food resources necessary for the species' survival just ahead of migration (Collins 2007). However, the species has also been found in habitats located at higher elevations prior to migration (Rimmer and McFarland 2000).

Migration habitat

Little is known about habitat selection by the Bicknell's Thrush during migration. It appears to use a variety of habitats at both coastal and inland localities, which suggests little specificity of habitat use (Rimmer et al. 2001; COSEWIC 2009). Migratory routes for the Bicknell's Thrush are poorly documented, but appear to be concentrated east of the Appalachian Mountains (Wilson and Watts 1997). Southbound migrants gather north of the Carolinas before an oceanic flight to their wintering grounds. Northbound

[6] Thickets of stunted, twisted spruce and fir that grow along the coast.

migrants apparently travel through eastern Florida and northward along the coastal plain (Evans 1994; Rimmer et al. 2001).

Wintering habitat

The forests occupied by the species in its wintering grounds span a series of successional and disturbance regimes, from undisturbed primary forest to moderately disturbed secondary forest (Rimmer et al. 2001). The variables that are the best predictors of wintering habitat use by this species are elevation, land cover (marked preference for broadleaf forests), average winter precipitation, slope and aspect (McFarland et al. 2013).

The available wintering habitat covers only 33 170 km^2 in the Greater Antilles, 28.5% of which has protected status of some kind (McFarland et al. 2013). The availability of wintering habitat is considered an important limiting factor for this species. The wintering habitat is subject to serious threats (see section 4).

4. Threats

4.1 Threat Assessment

Table 2. Threat Assessment Table

Threat	Level of Concern[1]	Extent	Occurrence	Frequency	Severity[2]	Causal Certainty[3]
Habitat loss or degradation						
Subsistence farming, logging and human-caused fires in the wintering area	High	Localized	Current	Continuous	High	High
Forestry practices in the breeding range	High	Localized	Current	Seasonal	High	High
Construction of wind farms in the breeding range	High	Localized	Current NS:Anticipated	Continuous	High	High
Clearing for recreational development in the breeding range	Medium	Localized	Current	Continuous	Moderate to high	High
Development for telecommunications in the breeding range	Medium	Localized	Current	Continuous	Moderate	High

Overgrazing by moose in the breeding range	Low Medium (Nova Scotia)	Localized	Current	Continuous	Moderate	Low Medium (Nova Scotia)
Coastal development along flyways	Low	Localized	Current	Continuous	Unknown	Low
Exotic, invasive or introduced species/genome						
Rats and cats introduced into the wintering area	Medium	Localized	Current	Seasonal	Moderate	Medium
Pollution						
Acid precipitation	Low	Widespread	Current	Continuous	Unknown	Medium
Mercury bioaccumulation	Low	Widespread	Current	Continuous	Low	Low
Lead poisoning	Low	Widespread	Anticipated	Continuous	Unknown	Low
Accidental mortality						
Collisions with human-made structures	Low	Localized	Anticipated	Seasonal	Unknown	Low
Changes in ecological dynamics or natural processes						
Control over natural disturbances	Low	Widespread	Current	Continuous	Moderate	Medium
Natural processes or activities						
Red Squirrel predation	Low	Widespread	Common	Recurrent	Moderate	Low
Disturbance or harm						
Recreational activities	Low	Localized	Anticipated	Seasonal	Unknown	Low
Climate and natural disasters						
Climate change	Unknown	Widespread	Anticipated	Continuous	Unknown	Unknown

[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

This section describes the threats outlined in Table 2, emphasizes key points, and provides additional information. The threats are listed individually. Although a number of threats are considered a low level of concern, it is important to take account of their cumulative effects over time. The threats are described below in order of decreasing level of concern.

Subsistence farming, logging and human-caused fires in the wintering area

Forest habitat loss from subsistence farming and logging has been severe on the island of Hispaniola (Haiti and Dominican Republic) where the bulk of the Bicknell's Thrush population winters (Stattersfield et al. 1998; Rimmer et al. 1999, Rimmer *et al*., 2005a). Fires caused by people are an additional threat to the Bicknell's Thrush winter habitat (IBTCG 2010). Only 10% of the original forest cover remains in the Dominican Republic (Stattersfield et al. 1998), while just 2% persists in Haiti (Paryski et al. 1989; Sergile 2008). The rate of deforestation is unlikely to decrease in the near future, given the socio-economic pressures in both countries (Stattersfield et al. 1998; Perdomo and Arias 2008; Sergile 2008). The massive loss of habitat on Hispaniola could be the primary cause of the Bicknell's Thrush population decline (Aubry and Paradis 2009; IBTCG 2010). A higher proportion of males seem to occupy habitats less disturbed by farming, while females are more likely to be found in more disturbed habitats, which could affect their survival (Townsend et al. 2011). In Cuba, more Bicknell's Thrush habitat is available since 21% of the island retains forest cover, partly as a result of reforestation since 1960 (Mugica 2008). However, the distribution and size of the Bicknell's Thrush population wintering in Cuba are not well documented. As a result, the extent to which these forests benefit the Bicknell's Thrush is unclear. The Sierra Maestra mountain chain in Cuba is the only area where the Bicknell's Thrush has been located. This area has dense forest cover and benefits from the protection of the Sierra Maestra National Park and the Turquino National Park (Y. Aubry pers. comm. 2015).

The limited availability of wintering habitat makes these threats all the more serious. Furthermore, since only a small proportion of this habitat has protected status, it is very likely that the availability of suitable wintering habitat will continue to decline in the years ahead.

Forestry practices in the breeding range

In Canada, roughly 90% of potential Bicknell's Thrush breeding habitat is located within managed forest (Aubry and Paradis 2009; COSEWIC 2009) and is therefore subject to forest management. High stem density is an important characteristic of the species' breeding habitat, such that forest management practices that do not promote the maintenance of high stem density or the creation of suitable habitat—whether

harvesting or pre-commercial thinning[7]—are a threat to this species (Aubry et al., in press). The larger the area affected, the greater the loss of suitable habitat. The area of habitat required to support the species at the current level is unknown.

Stand stem density is related to the age of the regenerating forest, with a higher stem density in the initial stages, followed by a reduction in density as the forest reaches maturity. The time it takes for the development of a forest having a suitable structure and stand density for the species can differ from one part of its range to another. It has been estimated at 10 to 15 years in New Brunswick and Nova Scotia (Bredin and Whittam 2009; Campbell et al. 2005) and likely up to 20 years in Quebec, with climate factors and length of growing season varying as a function of region and elevation.

Pre-commercial thinning is a threat to the species and its habitat, because it is carried out during the period at which stem density is favourable to nesting of the species and during the species' breeding period (Bredin and Whittam, 2009; Campbell et al. 2005). Pre-commercial thinning also prematurely reduces the quality of suitable habitat. This type of management practice is typically carried out between June and September, which largely corresponds to the nesting period, when the risk of harming or disturbing nests and eggs is the highest (Rousseu and Drolet 2015). As a result, this practice is likely to lead to the direct destruction of nests, eggs and chicks (Environment Canada 2014). It can also disturb nesting attempts.

Thinned stands are not suitable habitat for the Bicknell's Thrush, but there remains some uncertainty regarding the species' use of recently pre-commercially thinned stands or unthinned areas remaining within thinned stands (Chisholm and Leonard 2008; Aubry et al. 2011). There is some suggestion that the Bicknell's Thrush may re-use pre-commercially thinned stands once the canopy recloses (Chisholm and Leonard 2008; Aubry et al. 2011).

Other silvicultural treatments may also have impacts on the Bicknell's Thrush and its habitat, although no specific studies have been conducted on them. They include commercial thinning and planting,[8] which also reduce or modulate stand stem density to promote the growth of crop trees (MRN 2013). In most cases, the resulting stand density does not meet the requirements of the Bicknell's Thrush. Further studies are needed to determine their impacts.

Lastly, the construction of infrastructure (forest roads, sand pits, etc.) can also have an impact on the Bicknell's Thrush, including habitat fragmentation, creation of barriers likely to restrict movements and destruction of nests.

[7] Pre-commercial thinning is a partial tree harvest in an immature stand to create more space for the remaining trees in order to accelerate diameter growth, and also, through proper selection, to improve their general shape. The harvested trees have no commercial value and are generally left on site.
[8] Planting is designed to regenerate a previously harvested area by planting an appropriate species to obtain optimal density.

Construction of wind farms in the breeding range

The mountain tops used by Bicknell's Thrush as breeding habitat are the site of wind farm construction. Since wind power is currently experiencing rapid growth, a number of wind farm projects are being proposed and developed in Bicknell's Thrush habitat (e.g., Caribou Mountain, in New Brunswick, and the Massif du Sud, Terres du Séminaire, Rivière du Moulin, Saint-Robert-Belleramin and Murdochville, in Quebec) (COSEWIC 2009). The construction of wind farms is also anticipated elsewhere in the species' habitat, for example in the Lower St. Lawrence and Gaspé regions of Quebec, as well as in Nova Scotia, where the sites occupied by the species during the breeding season are also some of the windiest in the province. The development of these sites for wind power is therefore of great economic interest and the pressure to develop these sites will intensify over the coming years (M. Elderkin pers. comm.).

Land clearing for turbine foundation installation, as well as for the construction of access roads and electricity transmission corridors associated with the turbines, results in the permanent loss and fragmentation of Bicknell's Thrush breeding habitat (Zimmerling et al. 2013). In addition, direct mortality results from collisions with these tall structures, both during migration and during the summer season (Rimmer et al. 2001) (see Collisions with human-made structures).

Clearing for recreational development in the breeding range

In some areas, Bicknell's Thrush habitat is also threatened by clearing for recreational development such as trails and areas for skiing, hiking, biking and all-terrain vehicles (COSEWIC 2009). Backcountry skiing is increasingly popular in the Gaspé region. In backcountry skiing areas, the objective is to provide skiable areas through bush, such that 60% to 80% of the area is cut. The rest of the area is conserved as small wooded patches (M. Morin pers. comm. 2015).

Development for telecommunications in the breeding range

Bicknell's Thrush breeding habitat located at high elevations is also threatened by telecommunications development. Such development is escalating in Canada with the rapid increase in cell phones, pagers and digital television (Bredin and Whittam 2009). The construction of telecommunication towers has a similar impact to that of wind turbines, although less severe since a given site typically has only one tower, unlike wind farms, where a number of turbines are generally constructed in the same area. In addition, telecommunication towers are usually accompanied by small buildings surrounded by fences and lighting (Bredin and Whittam 2009), which have an impact on the species' habitat and can also cause disturbance to the birds themselves. Finally, in the same way as wind turbines, telecommunication towers can cause direct mortality of birds (Rimmer et al. 2001) (see Collision with human-made structures).

Overgrazing by moose in the breeding range

Locally, in areas where moose are hyper-abundant, overgrazing by moose can alter the composition and structure of the forest. Areas that should have regenerated into dense fir-birch stands, characteristic of the first stages of succession, are transformed into open clearings typically dominated by herbaceous vegetation (McLaren et al. 2004). Since the breeding habitat of the Bicknell's Thrush is primarily composed of Balsam Fir stands, this habitat can sometimes be significantly reduced. Such changes have been observed in northern Cape Breton, Nova Scotia, by Smith et al. (2010) and in the Cascapédia Lake area, in Gaspésie National Park (Y. Aubry, pers. comm. 2015). Smith et al. (2010) conclude that there is a relationship between sustained, intensive moose browsing and alterations to the cyclic successional system between Balsam Fir and Spruce Budworm outbreaks. The impact of intensive moose browsing on the forest has not been studied in other parts of the Bicknell's Thrush breeding range, but it is conceivable that impacts may exist in areas with a high moose population.

Coastal development along flyways

The flyways used by the Bicknell's Thrush are not yet well known, but scientists believe that the species migrates along the east coast of North America. While the characteristics of the species' staging areas have not been studied, coastal development (new buildings, wind turbines, communications towers, etc.) is damaging the habitats of other migratory birds (Moore et al. 1995; Moore 2000). The Bicknell's Thrush could therefore also be affected by this type of development.

Rats and cats introduced into the wintering area

Introduced rats on the island of Hispaniola attack the Bicknell's Thrush: five of the 53 (9.4%) birds monitored with transmitters have been the victims of rats (Townsend et al. 2009). Other introduced predators, such as cats, also pose a threat to birds (IBTCG 2010). A study conducted in Canada showed that cats killed 100 to 350 million birds a year in the country. Ground nesting and feeding birds appear to be more vulnerable (Blancher 2013).

Acid precipitations

Nitrogen compounds (nitrates and ammonia) emitted into the atmosphere by the industrial and transportation sectors are deposited at high elevations as acid precipitation; this contributes to the leaching of calcium from soils, a phenomenon that is particularly marked in the northeastern part of the continent (Driscoll et al. 2001). The resulting loss of large quantities of soil calcium could reverberate through the food chain as far as the Bicknell's Thrush, causing a calcium deficiency that could result in weaker shells, as is the case with other passerine birds from northern Europe that nest in acidified areas (Graveland and Drent 1997; Mand et al. 2000). The calcium leaching caused by acid precipitation (rain, mist and fog) may also act directly on vegetation, particularly with respect to the calcium contained in the cell membranes of spruce

needles (DeHayes et al. 1990; 1999). This loss of needle calcium would reduce the spruce trees' tolerance to low temperatures, and studies suggest that the decline in Red Spruce (*Picea rubens*) observed in most of its range since the 1960s (Eager and Adams 1992) is related to this phenomenon (DeHayes et al. 1990; 1999). This decline could disturb Bicknell's Thrush breeding habitat by allowing other less suitable tree species to become established.

Mercury bioaccumulation

High-elevation environments are more prone to airborne contaminant deposition (Rimmer et al. 2005b), and the Bicknell's Thrush could therefore be exposed to significant concentrations of these contaminants. In addition, the mercury released into the atmosphere from waste incineration and coal burning is a concern because of its capacity to bioaccumulate in the food chain. Researchers have also found significant levels of mercury in Bicknell's Thrush tissues (Rimmer et al. 2005b; Townsend 2011; Townsend et al. 2013). On the whole, the concentrations were higher in the wintering grounds than in the breeding grounds (Rimmer et al. 2005b; Townsend et al. 2013). However, the effects on physiology and behaviour have not been documented in detail. High concentrations could compromise the birds' immune systems and cause reduced fecundity (Brasso and Cristol 2008; Hawley et al. 2009; Jackson et al. 2011).

Lead poisoning

High levels of lead have been detected in high-elevation soils in the northeastern United States (Kaste et al. 2006). Research is needed to determine whether exposure to elevated levels of lead or other trace elements in the soils could affect the physiology or behaviour of the Bicknell's Thrush.

Collisions with human-made structures

As mentioned earlier (see Construction of wind farms and Development for telecommunications in the breeding range), collisions with structures such as communication towers, buildings and other vertical structures have occasionally been reported (Rimmer et al. 2001; Calvert et al. 2013).

Control over natural disturbances

Control over plant succession may alter the availability or quality of Bicknell's Thrush breeding habitat. The species usually nests in very dense regenerating stands that follow disturbances such as fires or insect infestations. Control over natural disturbances (e.g., fires, insect pests) may result in fewer stands regenerating to a stage where they can be used by the Bicknell's Thrush for breeding (IBTCG 2010).

Red Squirrel predation

Video monitoring of nests has shown that the Red Squirrel is a major predator of Bicknell Thrush eggs and nests (Y. Aubry unpubl.; VCE unpublished data). Research conducted in the United States has found that Bicknell's Thrush breeding success is lower in the years following summers with especially abundant Balsam Fir and spruce cone crops, which occurs every other year (Rimmer et al. 2001; Bredin and Whittam 2009). This biennial pattern of breeding success has been traced to population cycles of Red Squirrels, which feed heavily on cones, especially fir and spruce cones (Rimmer et al. 2001; Bredin and Whittam 2009). This situation results in better winter survival of the squirrels, which produce more young the following spring, leading to increased squirrel predation of Bicknell's Thrush eggs and nestlings. In the Atlantic provinces however, the High Elevation Landbird Program (HELP), which counts the number of squirrels observed on each route annually, has so far not detected any relationship between Red Squirrel numbers and Bicknell's Thrush abundance in Nova Scotia and New Brunswick (Bredin and Whittam 2009).

Recreational activities

Summer recreational activities at high elevations, such as hiking, mountain biking and ATV use, could pose another threat. While various indicators suggest that the species is able to tolerate a moderate level of human disturbance (Rimmer et al. 2001), there are no studies that confirm that the species is tolerant of the above-mentioned activities. It can, however, be said that such activities pose a localized threat, the potential impact of which is more anticipated than real.

Climate change

Climate change could push the forest stands used by breeding Bicknell's Thrushes to even higher elevations (Iverson et al. 2008; Rodenhouse et al. 2008). Such a change has already been documented in the Green Mountains of New England, where Beckage et al. (2008) estimated that a 91–119 m upslope shift in the lower elevational limit of the spruce-fir zone occurred between 1964 and 2004. This change coincided with a 1° C increase in average temperatures over the same period. Given that the Bicknell's Thrush already frequently nests at high elevations, displacement to even higher elevations would mean that it would be confined to progressively smaller and more isolated mountain patches. A study conducted on this potential threat indicates that a 1 °C increase in temperature would reduce potential habitat of the Bicknell's Thrush by more than half, while an increase of 2 °C could eliminate all breeding sites in the Catskill Mountains and most of Vermont (Rodenhouse et al. 2008). A 3 °C increase in growing season temperature could eliminate nearly all the Bicknell's Thrush habitats in the northeastern United States (IBTCG 2010). However, there is a strong possibility that the species' range is shifting northward (Cumming et al. 2014). In Canada, a northward shift in the Balsam Fir distribution range could result in the reduction or elimination of the Bicknell's Thrush population in New Brunswick and Nova Scotia, since the current range of this species is close to the northern boundaries of those provinces.

Climate change could also lead to an increased frequency of tropical storms and other adverse weather conditions (e.g., heavy rain, extreme temperatures). This increase in adverse weather conditions could result in higher nest failure and direct mortality rates for these birds throughout their annual cycle (Angeles et al. 2007; Rodenhouse et al. 2008). More intense and frequent rain and wind storms could reduce foraging opportunities, abnormally cold weather or prolonged heat waves could interfere with thermoregulation, and stronger and more frequent hurricanes could disrupt migrations and damage wintering habitats. It is currently impossible to assess the severity of the potential indirect effects of climate change on the Bicknell's Thrush.

Climate change also has the potential to affect a variety of environmental and ecological parameters that determine the viability of Bicknell's Thrush populations (e.g., spread of pests and pathogens that attack forests in the species' breeding habitat (IBTCG 2010), timing of predator cycles (McCarty 2001), dates of spring prey emergence (Sillett et al. 2000; Sanz et al. 2003; Both et al. 2006) and interspecific competition (Wormworth and Mallon 2006). These effects are not well understood, and research is required to assess their impacts.

5. Population and Distribution Objectives

The population and distribution objectives for the Bicknell's Thrush are as follows:

- in the short term (2016-2026), slow the decline in its population while ensuring that no more than 10% of the population is lost during that period, and ensure that no net loss occurs in its biological area of occupancy[9] throughout its range in Canada;

- in the long term (after 2026), ensure a positive population trend over 10 years, as well as a positive trend in the species' biological area of occupancy, throughout the species' range in Canada.

The population objectives address the long-term decline of the Bicknell's Thrush population, the factor that led to its designation as a threatened species in Canada (COSEWIC 2009). In order to take into consideration the fact that the population objectives are based on the species' demographic trends, the recovery strategy includes approaches for improving population monitoring. The objectives aim to ensure a positive trend over 10 years, without attempting to restore the maximum known population level, given that the significant reduction in the species' wintering habitat is largely irreversible.

[9] The "biological" area of occupancy is the total area of habitat occupied by all existing populations. For a species of bird, the number of pairs and the average home range can be estimated; the area of occupancy can be roughly estimated by multiplying the two values (COSEWIC 2013).

The distribution objectives are based on the biological area of occupancy of the Bicknell's Thrush, since this datum best reflects the species' distribution. Owing to its specific habitat requirements, the Bicknell's Thrush occupies only a small portion of its extent of occurrence.[10] The distribution objectives cover the species' entire range in Canada in order to prevent the loss of part of this fragmented range.

A 10-year period is appropriate to assess changes in the species' population and distribution. This length of time was chosen because halting the decline is a challenge that cannot be met within the span of a few years. In addition, COSEWIC assesses species every 10 years and its assessment criteria include a review of demographic changes over a 10-year period.

These objectives will be reviewed when preparing the report required every five years to assess the implementation of this recovery strategy and measure the progress toward meeting the strategy's population and distribution objectives (section 46, SARA). The objectives could also be reviewed outside this period in light of new information if this is appropriate for the species' recovery.

It is important to note that there are some uncertainties regarding attainment of the population and distribution objectives because of the challenge posed by reducing the threats to the species and its wintering habitat. These uncertainties have been identified in the assessment of the feasibility of recovery (see that section, p. iv).

6. Broad Strategies and General Approaches to Meet Objectives

6.1 Actions Already Completed or Currently Underway

Conservation and stewardship

- The International Bicknell's Thrush Conservation Group (IBTCG) was formed in 2007 and includes scientists, natural resource managers and conservation authorities from at least seven countries (IBTCG 2010).
- The International Bicknell's Thrush Conservation Group (IBTCG) has published the Conservation Action Plan for Bicknell's Thrush (IBTCG 2010).
- Studies have been conducted to quantify the extent of the forests that are used or could be used by the Bicknell's Thrush in the Canadian part of its breeding range, and to identify landowners so that awareness activities and other types of conservation activities may be undertaken (IBTCG 2010; Broeckaert 2011; Bussière 2012; Y. Aubry pers. comm. 2015).

[10] The area included in a polygon without concave angles that encompasses the geographic distribution of all known populations of a species (COSEWIC 2013).

- The Bicknell's Thrush Habitat Protection Fund was created in the United States in 2005. This fund is administered by the Adirondack Community Trust, and its primary purpose is to financially support conservation projects for the Bicknell's Thrush wintering habitat in the Dominican Republic and Haiti.

- Guides to best management and stewardship practices for the Bicknell's Thrush have been prepared for the forestry industry in Nova Scotia, New Brunswick and Quebec (Campbell et al. 2005; Campbell and Whittam 2006; Bredin and Whittam 2009; Rioux and Poulin 2009; Bussière and Julien, 2012a; Bussière and Julien, 2012b) and for the wind power industry (Julien 2012).

- The Quebec government has developed measures to protect Bicknell's Thrush pertaining to forest management activities (Gouvernement du Québec 2014).

Demographic monitoring

- Bird Studies Canada's High Elevation Landbird Program (HELP) in Nova Scotia and New Brunswick was undertaken between 2002 and 2011 (Campbell and Stewart 2012). A new, improved survey methodology (Mountain BirdWatch 2.0), based on the new protocol for monitoring Bicknell's Thrush populations of the International Bicknell's Thrush Conservation Group, was adopted in Nova Scotia and New Brunswick in 2012. This method will ensure long-term, standardized monitoring of the Bicknell's Thrush throughout its range.

- In Quebec, partial monitoring of the Bicknell's Thrush has been carried out by Environment and Climate Change Canada's Canadian Wildlife Service and by the Regroupement QuébecOiseaux since 1989 (Perreault 2013; Y Aubry pers. comm. 2015). More recently, the Quebec Department of Forests, Wildlife and Parks has conducted monitoring of sites on public lands (MDDEFP 2013).

Research

- Since 1997, various professional and academic projects on the Bicknell's Thrush have been undertaken in a number of regions in southern Quebec and the Maritimes (including Rompré et al. 1999; Connolly 2000; Nixon et al. 2001; Connolly et al. 2002; Gardiner 2005; Askanas 2008; Chisholm and Leonard 2008; McKinnon 2009; Askanas 2011; Aubry et al. 2011; McKinnon et al. 2014; Aubry et al. in press).

- A study that uses solar geolocators attached to the backs of Bicknell's Thrushes is currently underway to gather more information on the species' migratory routes as well as on the connectivity in time and space between the breeding and wintering areas (McFarland et al. in prep.).

- A study is under way to estimate the occupancy rates of the Bicknell's Thrush in managed forests of northern New Brunswick. http://www.unb.ca/research/alar/people/chelsae-postma.html

6.2 Strategic Direction for Recovery

The broad strategies and research and management approaches outlined in this section (Table 3), although worded differently, are essentially the same as those of the Conservation Action Plan for Bicknell's Thrush (IBTCG 2010) prepared by the International Bicknell's Thrush Conservation Group.

Table 3. Recovery Planning Table

Threat or Limiting Factor[1]	Broad Recovery Strategy	Priority[1]	General Description of Research and Management Approaches
All threats Knowledge gaps	Monitoring and research	High	Develop and implement standardized protocols for research and monitoring of the species' population and distribution, their trends, the threats, the species' ecology as well as the various types of habitat required for its life cycle, including: - Determine the distribution and size of the population as well as their trends in the breeding range and wintering area; - Determine the relative importance of the existing and potential threats to the species and its habitat; - Determine whether unthinned habitat remaining after pre-commercial thinning can support adequate productivity; - Determine whether thinned habitat can once again become suitable after the canopy recloses; - Determine the area of unthinned habitat necessary to enable the current breeding population to sustain itself and increase; - Determine at what point of maturity a suitable stand becomes no longer favourable to nesting; - Determine more precisely the characteristics of the various types of habitat used in the breeding range and the wintering area; - Determine the upper limit of human activity that can be allowed in the habitat; - Determine whether habitat availability is a significant limiting factor in the breeding area.
		Medium	- Identify the primary migration routes and increase knowledge related to migration chronology.

Threat or Limiting Factor[1]	Broad Recovery Strategy	Priority[1]	General Description of Research and Management Approaches
All threats	Conservation and management	High	- Determine the best measures for promoting conservation and development of each of the three types of breeding habitat as well as the post-breeding habitat. - Contribute to the conservation, management and, if required, restoration of the habitat used by the species during migration and wintering. - Address the main threats to the species' habitats and determine the best approaches for eliminating, reducing or mitigating the threats to the species.
All threats	Education, awareness, stewardship and partnership	High	- Promote national and international collaboration to fill the knowledge gaps and address the threats to the species and its habitat throughout its range. - Maintain and improve collaboration among stakeholders in order to address the threats to the species and its habitat throughout its range.
		Medium	- Promote public involvement in habitat protection and species conservation initiatives as well as in the surveying and monitoring activities.
All threats	Legislation and policy	Medium	- Promote compliance with environmental acts, regulations and policies, in particular the *Migratory Birds Convention Act, 1994*[2] and its regulations. - Encourage the implementation of environmental policies and programs that address the threats on breeding grounds and develop appropriate policies and programs where deficiencies exist.

[1] "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.

[2] Environment and Climate Change Canada's website on incidental take of migratory birds: www.ec.gc.ca/paom-itmb/default.asp?lang=En&n=C51C415F-1.

6.3 Narrative to Support the Recovery Planning Table

Bicknell's Thrush recovery will require commitment and collaboration among international, federal and provincial jurisdictions, Aboriginal people, local communities, landowners, industry and other interested parties.

Monitoring and research

Standardized protocols are required for monitoring and research activities. Properly designed monitoring activities for determining the size and distribution of the population, as well as their trends, are essential in order to measure achievement of the population and distribution objectives. It is also important to fill the knowledge gaps concerning threats to the species and its habitat. The assessment of threats must be improved in order to determine whether the potential threats actually exist, to take priority action to address the threats of greatest concern, and to determine the most effective action to eliminate, reduce or mitigate those threats. Since there are fewer females than males, particular attention must be paid to the females to determine which threats affect them more, in particular in the wintering habitat. Although certain aspects have yet to be confirmed (e.g., the relationship between the probability of occurrence of the species, latitude and elevation of the forest), the characteristics of the species' breeding habitat are relatively well known; however, the characteristics of the other types of habitat used by the species in its range (post-breeding habitat, migration habitat) are not well known and merit study since they could play an important role in the species' recovery. Knowledge about the wintering habitat must also be improved. Given the limited availability of this habitat and the serious threats to it, research to improve knowledge of this habitat must be considered a priority. Information on the species' migratory routes and the specific migration periods needs to be better documented.

Conservation and management

There are many activities that can affect Bicknell's Thrush breeding habitat. To minimize or mitigate the impacts of such activities, breeding habitat conservation and management practices will be needed. To that end, a landscape[11] approach will have to be adopted. The threats affecting breeding habitat vary, depending on the three habitat types used by the species. This means that the conservation and management measures to be implemented will have to be tailored to each habitat type, taking into consideration habitat dynamics, succession time, and habitat size and shape. Particular efforts will have to be focused on determining the minimum area of habitat required to promote the species' recovery. In addition, development (e.g., wind farms, telecommunication towers, ski hills) on mountain tops where the species occurs will have to be limited to the extent possible. Although the impact of overgrazing by moose on the species is still not well known, it is clear that it will have to be addressed when

[11] The landscape approach is based on landscape ecology. With this approach, it is possible to work at a broader scale and to integrate the various spatial-temporal components of the territory studied—i.e., biological, geographical, physical, socio-economic and heritage components—into the analyses.

and where this proves necessary. The other threats (currently threats with a low level of concern or potential threats) will have to be addressed if necessary.

The conservation and management of the breeding habitat will not be sufficient to ensure the recovery of the Bicknell's Thrush if no measures are taken for its wintering habitat, the availability of which is considered an important limiting factor for the species. The threats to this habitat, in particular subsistence farming, logging and human-caused fires, are of high concern and improving the situation poses a genuine challenge. This requires international collaboration both in order to fill the knowledge gaps and for the planning and implementation of measures to conserve, improve and, if necessary, restore this habitat. Once research has filled the knowledge gaps concerning the post-breeding habitat and the migration habitat, it will be necessary to determine and carry out the required action. All of these measures should have a positive effect on the other species at risk whose habitat requirements overlap those of the Bicknell's Thrush (see Appendix D).

All of the threats that directly affect the Bicknell's Thrush must be considered in order to eliminate, reduce or mitigate their adverse effects on the species. These threats include predation by rats on wintering grounds and the risks of collisions with communication towers and wind turbines. The presence of environmental contaminants, such as mercury, lead and acid precipitation, raises concerns and it will be necessary to identify and implement appropriate measures to limit their adverse effects on the species.

Education, awareness, stewardship and partnership

As mentioned in the introduction to this section, the recovery of the Bicknell's Thrush requires the collaboration and commitment of all the stakeholders, both governments and industries, as well as communities and landowners.

International collaboration is essential because of the serious threats to the species' wintering habitat. To improve the situation on the wintering grounds, it is important to minimize new habitat losses to the extent possible, to protect remaining habitat suitable for the species and, if possible, to increase the area of this habitat. The International Bicknell's Thrush Conservation Group (IBTCG), in which a number of Canadian organizations and experts participate, is a key contributor to this effort. The IBTCG has developed a conservation plan for the species and is already working on its implementation, including certain components of this recovery strategy. The IBTCG is also working on securing the necessary funding to aid in the implementation of recovery measures in the countries of the Greater Antilles.

The key stakeholders with an interest in the Bicknell's Thrush must be identified and engaged in a dialogue in order to develop and apply the most appropriate solutions to the threats affecting the Bicknell's Thrush. Stewardship strategies and appropriate tools must be developed and communicated effectively to the stakeholders. In particular, it is essential to raise the awareness of the key stakeholders concerning the species' requirements and work with them to develop methods for intervention in

the species' habitat that will promote habitat conservation. Best practice guides have already been prepared or are being developed for forestry activities. Such guides could be supplemented if needed and similar initiatives will have to be developed to address the other threats.

Social acceptance of the measures required for conservation of Bicknell's Thrush habitat will depend on the effectiveness of efforts to raise public awareness about the existence of the species and its habitat requirements. In addition to reaching the general public, it will also be necessary to encourage participation by individuals and organizations dedicated to environmental conservation in data collection through species surveying and monitoring activities. Some public participation initiatives already exist, such as the High Elevation Landbird Program and eBird.

Legislation and policy

The general prohibitions set out in the *Migratory Birds Convention Act, 1994* and its regulations also protect the adults, young, nests and eggs of the Bicknell's Thrush throughout Canada, regardless of land ownership. During the breeding season, potentially destructive or disturbing activities should be avoided in areas where the species is likely to be found (Environment Canada 2014).

Throughout the species' range, promotion of compliance with legislation and policies should be a priority. Currently, various legal means exist in order to protect the Bicknell's Thrush and its habitat in Canada (e.g., species at risk legislation). It is necessary to continue implementing the existing environmental policies and programs on the reduction of the pollutants responsible for acid precipitation and the accumulation of mercury, as well as existing policies and programs on development in the natural environment (e.g., wind farms, telecommunication towers), and to develop appropriate policies and programs where deficiencies exist. It is essential that these means be used to their full potential for the protection of the Bicknell's Thrush.

7. Critical Habitat

SARA defines critical habitat as "… habitat that is necessary for the survival or recovery of a listed species." Paragraph 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 subparagraph 41(1)(*c*)(1) of SARA, the recovery strategy must also include a schedule of studies to identify the critical habitat of the species where available information is inadequate, as in the case of the Bicknell's Thrush.

7.1 Identification of the Species' Critical Habitat

On the basis of the best information available, the critical habitat of the Bicknell's Thrush is partially identified in this recovery strategy. Existing knowledge is insufficient to identify all the critical habitat considered necessary for the species' recovery.
For example, information is needed on the habitat used in the post-breeding period and

on the area of habitat necessary for the recovery and survival of the Bicknell's Thrush at the landscape scale. As new information becomes available, the boundaries of the critical habitat could be revised and new critical habitat units could be identified. A schedule of the studies necessary to complete the identification of critical habitat of the species (section 7.2) is also included.

Critical habitat is identified at locations where the criteria of habitat occupancy and the biophysical attributes of suitable habitat, as explained in the following sections, are met.

7.1.1 Habitat Occupancy

The distribution of the Bicknell's Thrush can be described as contagious, in the sense that individuals tend to occur in relatively large numbers with other Bicknell's Thrushes, rather than being uniformly distributed across suitable habitat (Y. Aubry pers. comm. 2016). The home ranges of males largely overlap and are distributed around the home range of one or more females (Collins 2007; Aubry et al. 2011). The presence of one bird therefore suggests that several other birds are also present in the surrounding area. As a result, it is important to define habitat occupancy using known records of the species as a reference point.

Bicknell's Thrush habitat consists of dense forest stands where it is difficult to obtain observations that would confirm breeding. Most existing data are records of birds heard during the breeding season, which corresponds to possible nesting bird behaviour (see Appendix B for definitions). Habitat occupancy will be established using possible, probable and confirmed breeding records (see Appendix B for definitions). Such records are good indicators of habitat occupancy and suitability.

Habitat occupancy will be determined on the basis of all breeding records obtained during at least one breeding season (June 1 to August 15) in suitable habitat. Given that the Bicknell's Thrush was elevated to the rank of species in 1995 (American Ornithologists' Union 1995) and that this triggered, during the same period, the start of inventory work on its breeding range in Quebec, New Brunswick and Nova Scotia, all known records of breeding from 1995 to 2014 are used to define habitat occupancy.

7.1.2 Biophysical Attributes of Suitable Habitat

This criterion for identifying critical habitat refers to the biophysical attributes of the various habitats in which the species can engage in activity associated with breeding (e.g., courtship, territory defence, nest building and foraging) in Canada. Given that the probability of occupancy of a site by the Bicknell's Thrush is associated with the interaction between habitat quality at the local scale and habitat quality at the landscape scale (Frey et al. 2012), it is important to take both scales into consideration in defining the characteristics of suitable habitat. The local scale is defined by the habitat characteristics that are measured at the breeding site. The landscape scale relates to the spatial-temporal dynamics of the biological and physical components affecting vast regions.

The biophysical attributes of suitable habitat required by the Bicknell's Thrush to carry out its activities at the local scale are generally defined by the presence of conifer stands (comprising 75% of stand basal area) or very dense, relatively unfragmented mixedwood stands dominated by Balsam Fir (comprising 50–75% of stand basal area [MRNF 2011]). The biophysical attributes at the local scale correspond to the following definitions for each of the three types of breeding habitat found at the landscape scale:

- **High-elevation montane forest** (elevation of ≥ 750 m in New Brunswick, ≥ 440 m in Nova Scotia and ≥ 600 m in Quebec)
  - Dense coniferous forests (between 10,000 and 50,000 stems/ha), typically not managed for forest harvesting. They can be characterized by Balsam Fir stands affected by regenerating fir waves. On some sites, such as exposed ridgelines or along edges of human-created openings, they can be characterized by the presence of stunted firs due to high winds and heavy winter snow and ice accumulation. These stands are also characterized by the low height of mature trees and by a low growth rate, due to the harsh climate conditions at high elevations. In these environments, Balsam Fir can sometimes be accompanied, to a lesser extent, by White Birch (*Betula papyrifera*), Red Spruce, White Spruce (*Picea glauca*), Black Spruce, Mountain Ash and other deciduous species.

- **High-elevation managed forests** (minimum elevation ≥ 380 m)
  - Dense conifer stands (10,000 to 50,000 stems/ha), generally managed for forest harvesting, characterized by the presence of standing conifer snags and dense balsam fir regeneration following human or natural disturbance, from the sapling stage, [12] with a height of over 2 to 3 m, to a stage at which stand structure and density become unsuitable. At some sites in the Maritimes, a high density of small white birch stems and the presence of leaf litter on the ground appear to be important components of the species' habitat (Nixon et al. 2001; Campbell and Whittam 2006);

  Or

  - Dense (10,000 to 50,000 stems/ha) mixedwood stands (50% to 75% conifers), generally managed for logging purposes, characterized by regeneration dominated by balsam fir following clearcutting, fire or other disturbances.

- **Coastal lowland forest** (elevation < 380 m)
  - Dense (10,000 to 50,000 stems/ha) maritime spruce-fir forests, generally harvested to only a small extent or not at all, located where cool sea breezes and high precipitation levels reproduce the characteristics of high-elevation forests.

[12] Immature tree whose stem is still relatively flexible with a dbh of over 1 cm and less than 9 cm (MRN, 2013)

At the site scale, habitat that is currently suitable for breeding Bicknell's Thrushes can become unsuitable for breeding as the stand ages or if it is subject to natural or human disturbance. Due to these spatial-temporal habitat dynamics and to the fact that the species tends to have contagious distributions (Y. Aubry pers. comm. 2016), it is critical to maintain availability of suitable habitat not only at the scale of the breeding site, but also at the landscape scale. Using the landscape scale makes it possible to maintain suitable habitat at two scales. It must also include habitats that, although they do not currently have biophysical attributes suitable to the species, have the potential to evolve towards suitable habitat, in order to ensure constant availability of suitable habitat in time and space. As a result, stands within a 5 km radius of a known record of the Bicknell's Thrush that are dominated by balsam fir, but whose stem density or structure is not suitable because the trees are too young or too old, are also considered critical habitat if they have the potential to regenerate into suitable habitat as part of the natural succession process. Similarly, areas within a 5 km radius of a known record that have been disturbed (e.g. logging, windthrow) and that are likely to regenerate into a type of stand with appropriate species composition and stem density are also considered critical habitat.

To ensure that the recovery objectives are met, a minimum area of critical habitat must be maintained at the landscape scale, and appropriate landscape-scale conservation objectives must be developed. The current lack of knowledge means that the minimal habitat area and appropriate conservation objectives cannot be precisely determined. An activity was included in the schedule of studies (section 7.2) to fill this knowledge gap. This information is also important to ensure a better assessment of what constitutes destruction of critical habitat.

As mentioned above, at the landscape scale, the area of suitable habitat that must be considered critical habitat for high-elevation montane forests, for high-elevation managed forests and for coastal lowland forests remains unknown. A study on the Bicknell's Thrush in a high-elevation montane forest environment in Vermont estimated that when the proportion of suitable Bicknell's Thrush habitat within 5 km of a roughly 600-ha patch of suitable habitat reaches a minimum threshold of 0.10 (10%), the probability of occupancy by the species is approximately 1.0 (100%) (Frey et al., 2012). This study indicates that the probability of occupancy of suitable habitat depends on the interaction between habitat conditions at the local (breeding site) scale and those at the landscape scale. Although the study was carried out only in a high-elevation montane forest environment and although it is impossible to rigorously apply the conditions of the study by Frey et al. (2012), it was decided that a radius of 5 km around a breeding record would be adopted as a boundary for identifying critical habitat, for the three types of Bicknell's Thrush breeding habitat. The use of an area of 5 km around possible, probable and confirmed Bicknell's Thrush breeding records corresponds favourably to the potential habitat areas identified by the habitat model of the Vermont Center for Ecostudies (Lambert et al. 2005) when applied to Canada (Y. Aubry, pers. comm. 2015), and thus supports the choice of a radius of 5 km as a boundary for critical habitat. It has been determined that a 5 km radius is likely to ensure the long-term presence of suitable habitat for the species, in a context where the distribution of the

habitat is dynamic in time and space. An activity designed to determine whether using a 5 km radius for the identification of critical habitat captures a large enough area to include all the suitable habitat was entered in the schedule of studies (section 7.2).

The biophysical attributes of habitat during the post-breeding period are not known. An activity was entered in the schedule of studies (section 7.2) to indicate the need to develop further knowledge in this area before we can identify critical habitat for this period. The same is true for knowledge with respect to the species' social structure. A better understanding of the influence of the species' social behaviour on habitat selection and use could improve the identification of critical habitat.

7.1.3 Application of Critical Habitat Identification Criteria

Critical habitat for the Bicknell's Thrush is partially identified in this recovery strategy. It corresponds to areas of suitable habitat and areas with the potential to become suitable habitat that are contained within a 5 km radius polygon centred on all coordinates representing a possible, probable or confirmed breeding record obtained between June 1 and August 15, from 1995 to 2014. When 5 km radius polygons overlap, they are merged into a single polygon. Each of the polygons represents a critical habitat unit. A schedule of studies (Table 4) outlines the activities required to complete the identification of critical habitat.

The application of the criteria described in sections 7.1.1 and 7.1.2 identifies 58 critical habitat units for Bicknell's Thrush in Canada: 43 in Quebec, 11 in New Brunswick and 4 in Nova Scotia. The critical habitat units for Bicknell's Thrush in Canada are presented in Appendix C (tables C-1, C-2 and C-3 and in figures C-1 to C-12). Critical habitat for Bicknell's Thrush in Canada occurs within the polygons shaded in yellow shown on each map, where the criteria and methodology described in this section for identifying critical habitat are met. More detailed information on critical habitat to support protection of the species and its habitat may be requested on a need-to-know basis by contacting Environment and Climate Change Canada – Canadian Wildlife Service at ec.planificationduretablissement-recoveryplanning.ec@canada.ca.

Existing human structures (e.g., communication towers, wind turbines, roads, houses, ski runs) and other areas that do not have the biophysical characteristics of suitable habitat for Bicknell's Thrush are not identified as critical habitat.

7.2 Schedule of Studies to Identify Critical Habitat

Current knowledge is insufficient to identify all critical habitat of the Bicknell's Thrush. Table 4 describes the activities that must be carried out to complete the critical habitat identification or to specify the boundaries. It is important to verify whether the decision to identify critical habitat on the basis of a 5 km radius is adequate for achieving the population and distribution objectives. It is also important to establish the minimum area of suitable habitat to be maintained at the landscape scale for the three types of breeding habitat, to ensure that the critical habitat can fully play its role in the recovery

of the Bicknell's Thrush. The critical habitat identification will be updated in a revised version of the recovery strategy or in an action plan, once sufficient new knowledge has been acquired to determine the critical habitat required to meet the objectives.

Table 4. Schedule of studies to identify critical habitat

Description of Activity	Rationale	Timeline
Verify whether a 5 km radius around a record is adequate for achieving the population and distribution objectives.	This activity is required in order to better support the decision to identify critical habitat on the basis of a 5 km radius. It will make it possible to determine whether the radius should be increased.	2016-2021
Establish the minimum area of suitable habitat to be maintained for the three types of breeding habitat.	This activity is required in order to determine, for each of the three types of breeding habitat, the minimum area of suitable habitat to be maintained to achieve the population and distribution objectives.	2016-2021
Establish landscape-scale habitat conservation criteria.	This activity is required in order to establish the best conservation criteria or action levels to be implemented and to subsequently verify their effectiveness, which could have an impact on critical habitat identification.	2016-2021
Increase knowledge of the social structure of the species.	This activity is required to specify how the behaviour of the Bicknell's Thrush influences habitat selection, use and productivity. This knowledge will contribute to specifying the area of critical habitat required to achieve the population and distribution objectives.	2016-2021
Characterize suitable habitat used by the species during the post-breeding period and verify its use.	This activity is required to identify additional critical habitat units, as there is currently very little information for identifying and characterizing the habitat used by this species during the post-breeding period.	2016-2021

7.3 Activities Likely to Result in the Destruction of Critical Habitat

An understanding of what constitutes destruction of critical habitat is required for the protection and management of critical habitat. Destruction is determined on a case-by-case basis. Destruction occurs when part of the critical habitat is degraded, either permanently or temporarily, such that it can no longer serve its function when needed by the species. Destruction may result from a single activity or multiple activities at one point in time or from the cumulative effects of one or more activities over time.

The breeding habitat of Bicknell's Thrush consists of dense forest (over 10,000 stems/ha). Activities likely to reduce stem density may destroy or degrade critical habitat. Activities that lead to the elimination of dense fir stands also have the same effect.

The critical habitat of the Bicknell's Thrush in high-elevation managed forests is, by definition, subject to forest management activities, which can have effects similar to those of natural disturbance regimes by generating conditions favourable to the creation of suitable habitat. It is important that forest management practices take the needs of the Bicknell's Thrush into account and that sufficient suitable habitat be maintained within critical habitat units to support the achievement of the population and distribution objectives.

Given the dynamic nature of the critical habitat of the Bicknell's Thrush in Canada, areas of critical habitat that lose their suitability due to forest aging or human activity can be replaced by other habitat areas that are currently unsuitable but that have the potential to become suitable. This can occur either through natural vegetation succession or through the implementation of management measures that directly favour the presence of dense fir stands (between 10,000 and 50,000 stems/ha). It is therefore important that the planning of human activity within the 5 km radius area containing critical habitat be carried out with the objective of maintaining, at all times, a critical habitat area that can contribute to achieving the population and distribution objectives.

Efforts should also be made to maintain dense fir stands in the high-elevation managed forests currently occupied by the Bicknell's Thrush for as long as possible to ensure high-quality breeding habitat. Where human activity, such as forest management, is present, it is important that planned forest treatments maintain the availability of dense fir stands (over 10,000 stems/ha when the stand reaches the sapling stage) within the boundaries of the critical habitat over time. To this end, appropriate forest treatments must be implemented at suitable sites to promote regeneration of dense fir stands.

The following list provides examples of activities that are likely to result in the destruction of critical habitat. The activities described in Table 5 are not an exhaustive list. They were selected on the basis of the threats assessed and described in section 4 (Threats) of this recovery strategy. For some of the activities, the determination of thresholds could make it possible to more accurately describe the various aspects likely to result in the destruction of critical habitat by a specific activity.

Table 5. Examples of activities likely to result in the destruction of critical habitat

Description of Activity	Description of Effect	Details of Effect
Pre-commercial thinning	Direct impact on critical habitat, whether it is considered suitable habitat or potential suitable habitat. Given that the Bicknell's Thrush occurs in forests with a high stem density (between 10,000 and 50,000 stems/ha), a forest whose stem density has been reduced to less than 10,000 stems/ha no longer has the biophysical characteristics of critical habitat for the species.	Destruction of critical habitat. Once the landscape-scale habitat requirements are determined, pre-commercial thinning outside the breeding season may not result in the destruction of critical habitat if long-term planning of forest operations ensures the availability of sufficient suitable habitat over time and within the critical habitat boundaries. . Pre-commercial thinning carried out in habitat known to have been recently occupied by Bicknell's Thrushes would be considered an activity likely to destroy critical habitat.

Description of Activity	Description of Effect	Details of Effect
Clearcutting and selection cutting	Direct impact on critical habitat by reducing the amount of suitable habitat available. Certain types of treatments can reduce stem density and create canopy openings, which reduces the area or modifies the suitable breeding habitat for the Bicknell's Thrush. The larger the area treated, the higher the habitat loss and the greater the risk of homogenization of the landscape. In mixedwood stands (dominated by fir), forest harvesting can favour the regeneration of deciduous species to the detriment of fir. Following certain treatments (partial cuts, cleaning and release) in dense fir forests, stand composition can be modified due to the increased presence of spruce or deciduous species, which alters the biophysical characteristics of the critical habitat. These types of treatment (e.g., clearcutting) are normally not carried out in suitable habitat. However, the planning of these treatments will influence the availability of suitable habitat at the landscape scale in time and space. These types of treatment can have a direct impact on the availability of potential suitable habitat if they result in treated areas that no longer have suitable tree species or density.	Degradation or destruction of critical habitat. Once the landscape-scale habitat requirements are determined, clearcutting or selection cutting may not result in the destruction of critical habitat if long-term planning of forest operations ensures the availability of sufficient suitable habitat over time and within the critical habitat boundaries.

Description of Activity	Description of Effect	Details of Effect
Control of insect pests (e.g., Spruce Budworm)	Direct impact on critical habitat, whether it is considered suitable habitat or potential suitable habitat. Forest activities designed to reduce regeneration of fir in order to reduce the intensity and size of habitat areas affected by insect pests may lead to a reduction in the area of critical habitat for the Bicknell's Thrush.	Degradation or destruction of critical habitat. Once the landscape-scale habitat requirements are determined, the control of insect pests may not result in the destruction of critical habitat if long-term planning of forest operations ensures the availability of sufficient critical habitat over time and within the boundaries of the critical habitat.
Plantations	Direct impact on critical habitat considered potential suitable habitat. Plantations result in a species or stem density that does not create the biophysical attributes required for critical habitat. A direct impact of plantations is that they affect the availability of critical habitat at the landscape scale in time and space.	Destruction of critical habitat. Once the landscape-scale habitat requirements are determined, plantations and the application of herbicides (see also the following activity) may not result in the destruction of critical habitat if long-term planning of forest operations ensures the availability of sufficient suitable habitat over time and within the boundaries of the critical habitat.

Description of Activity	Description of Effect	Details of Effect
Tending and sanitation operations	Direct impact on critical habitat considered potential suitable habitat and on the availability of critical habitat considered suitable habitat. Tending and sanitation operations (mechanical stand release and application of herbicides) are often done in plantations or regenerating natural stands. When these activities are carried out in regenerating natural stands, they reduce stand density and the availability of suitable habitat. Tending and sanitation operations in plantations do not have an impact on critical habitat since plantations are not considered suitable habitat or potential suitable habitat. The application of herbicides and other vegetation control measures also have an impact on stand density, on the species present in the stands immediately following treatments and on stand development. The amount of suitable habitat and potential suitable habitat can therefore be affected.	Degradation or destruction of critical habitat. Once the landscape-scale habitat requirements are determined, tending and sanitation operations carried out outside the breeding season may not result in the destruction of critical habitat if long-term planning of forest operations ensures the availability of sufficient suitable habitat over time and within the critical habitat boundaries. A vegetation management activity carried out in habitat known to have been recently occupied by Bicknell's Thrushes would be considered an activity likely to destroy critical habitat.

Description of Activity	Description of Effect	Details of Effect
Forest road / access road construction	Direct impact on critical habitat by reducing the amount of suitable habitat available. Such infrastructure creates openings in the habitat and causes habitat fragmentation. There is also a net loss of suitable habitat area. Habitat alterations become permanent and irreversible.	Destruction of critical habitat. Once the landscape-scale habitat requirements are determined, the construction of forest roads or access roads outside the breeding season may not result in the destruction of critical habitat if long-term land use planning ensures the availability of sufficient suitable habitat over time and within the critical habitat boundaries. Existing forest roads and access roads are not included in critical habitat identification; as a result, road maintenance work is not considered an activity that is likely to result in the destruction of critical habitat.
Transmission line construction	Direct impact on critical habitat by reducing the amount of suitable habitat available. Such infrastructure creates openings in the habitat and causes habitat fragmentation. There is also a net loss of suitable habitat area. Habitat alterations become permanent and irreversible.	Destruction of critical habitat. Once the landscape-scale habitat requirements are determined, the construction of transmission lines outside the breeding season may not result in the destruction of critical habitat if long-term land-use planning ensures the availability of sufficient suitable habitat over time and within the critical habitat boundaries. Maintenance of existing transmission lines is not considered an activity that is likely to result in the destruction of critical habitat.

Description of Activity	Description of Effect	Details of Effect
Clearing for wind turbine and communications tower corridors	Direct impact on critical habitat by reducing the amount of suitable habitat available. Such infrastructure creates openings in the habitat and causes habitat fragmentation. There is also a net loss of suitable habitat area. Habitat alterations become permanent and irreversible.	Destruction of critical habitat. Once the landscape-scale habitat requirements are determined, clearing for wind turbine and communications tower corridors outside the breeding period may not result in the destruction of critical habitat if long-term planning of land-use development ensures the availability of sufficient suitable habitat over time and within the critical habitat boundaries. Maintenance of already wooded areas around wind farms and communications towers is not considered an activity that is likely to result in the destruction of critical habitat.
Trail development, ski area development	Direct impact on critical habitat by reducing the amount of suitable habitat available. The creation of trails or ski runs requires the felling of stands in areas targeted for this type of development. Habitat alterations become permanent and irreversible.	Destruction of critical habitat. Once the landscape-scale habitat requirements are determined, the development of trails or ski areas outside the breeding season may not result in the destruction of critical habitat if long-term land use planning ensures the availability of sufficient suitable habitat over time and within the critical habitat boundaries. Maintenance of already wooded areas around trails and ski resorts is not considered an activity that is likely to result in the destruction of critical habitat.

8. Measuring Progress

The performance indicators presented below provide a way to define and measure progress toward achieving the population and distribution objectives.

The performance indicators for the recovery of the Bicknell's Thrush are as follows:

In the short term

1. The decline in the Bicknell's Thrush population has been slowed such that the Canadian population of this species has not decreased by more than 10% from 2016 to 2026.
2. No net loss has occurred in its biological area of occupancy throughout its Canadian range from 2016 to 2026.

In the long term

1) After 2026, a positive 10-year demographic trend, measured by BBS and other available data (e.g., targeted surveys) is achieved (i.e., the population is increasing).
2) After 2016, the size of the species' biological area of occupancy increases throughout its Canadian range.

9. Statement on Action Plans

One or more action plans detailing the measures to be taken to implement this recovery strategy will be posted on the Species at Risk Public Registry within five years after the posting of the final recovery strategy.

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Appendix A: NatureServe Conservation Status Rank Definitions

The table below lists the conservation status ranks used by NatureServe and their definitions. These status ranks are appended to the letter "G" (global rank, applies to the entire range), "N" (national rank, applies on a national scale) or "S" (subnational rank, for a province or state). A numeric range rank (e.g., S1S2) is used to indicate uncertainty about the status of the species or community in question.

Rank	Definition
1	Critically Imperiled – Species or community that is extremely rare (often five or fewer occurrences) or is affected by very steep declines or other factors that could result in its extirpation.
2	Imperiled – Species or community that is rare because of its very restricted range, very few populations (often fewer than 20), steep population declines or other factors that could result in its extirpation.
3	Vulnerable – Species or community with a very restricted range and relatively few populations (often 80 or fewer) that has experienced recent and widespread declines and is affected by other factors that could result in its extirpation.
4	Apparently Secure – Species or community that is uncommon but not rare. There is some cause for long-term concern because of declines or other factors.
5	Secure – Species or community that is common, widespread and abundant in the jurisdiction.
B	Breeding – Conservation status refers to the breeding population of the species in the nation or state/province.
N	Nonbreeding – Conservation status refers to the non-breeding population of the species in the nation or state/province.
M	Migrant – Migrant species occurring regularly on migration at particular migratory stopovers or staging areas where the species might warrant conservation attention. Conservation status refers to the aggregating transient population of the species in the nation or state/province.
NR	Species or community that is unranked because its status has not yet been assessed.
NA	Not Applicable – The species or community is not a suitable target for conservation activities.
U	Unassessed – Species not assessed due to a lack of information or substantially conflicting information about status or trends.
?	Inexact or Uncertain – Denotes inexact or uncertain numeric rank.

Appendix B: Standard Breeding Bird Atlas Codes

Atlas code*	Description
Possible breeding	
H	Species observed in suitable nesting habitat during its breeding season.
S	Individual singing or producing other sounds associated with breeding (e.g., calls or drumming) in suitable nesting habitat during the species' breeding season.
Probable breeding	
P	Pair observed in their breeding season in suitable nesting habitat
T	Permanent territory presumed through registration of territorial behaviour (song, etc.), or the occurrence of an adult bird, on at least two days, a week or more apart, at the same place, in suitable nesting habitat during the breeding season.
D	Courtship or display between a male and a female or two males including courtship, feeding or copulation.
V	Visiting probable nest site.
A	Agitated behaviour or anxiety calls of an adult indicating nest-site or young in the vicinity.
B	Brood patch on adult female or cloacal protuberance on adult male.
Confirmed breeding	
NB	Nest building or carrying nest materials.
DD	Distraction display or injury feigning.
NU	Used nest or egg shells found (occupied or laid within the period of the survey). Use only for unique and unmistakable nests or shells
FY	Recently fledged young or downy young.
AE	Adults leaving or entering nest sites in circumstances indicating occupied nest (including nests the contents of which cannot be seen).
FS	Adult carrying fecal sac.
CF	Adult carrying food for young during its breeding season.
NE	Nest containing eggs.
NY	Nest containing young seen or heard.

* Atlas codes and descriptions can vary slightly from one province to another but convey similar meanings. Atlas codes for possible breeding are not presented here.

Appendix C: Critical habitat for the Bicknell's Thrush in Canada

Table C-1. Description of the 10 x 10 km Standardized UTM Grids and Critical Habitat Units for the Bicknell's Thrush in Quebec. Critical habitat refers to areas where the criteria set out in section 7.1 are met.

10 x 10 km Standardized UTM Grid Square ID[1]	UTM Grid Square Coordinates[2]		Critical Habitat Unit Area (ha)[3]	Land Tenure[4]
	Easting	Northing		
18VS46	440000	5160000	28	Non-federal
18VS47	440000	5170000	99	Non-federal
18VS56	450000	5160000	3093	Non-federal
18VS57	450000	5170000	4675	Non-federal
18WS21	520000	5110000	124	Non-federal
18WS22	520000	5120000	703	Non-federal
18WS31	530000	5110000	2818	Non-federal
18WS32	530000	5120000	6001	Non-federal
18WS41	540000	5110000	35	Non-federal
18WS42	540000	5120000	189	Non-federal
18WS43	540000	5130000	3216	Non-federal
18WS44	540000	5140000	2649	Non-federal
18WS51	550000	5110000	2776	Non-federal
18WS52	550000	5120000	5808	Non-federal
18WS53	550000	5130000	1899	Non-federal
18WS54	550000	5140000	3789	Non-federal
18WS62	560000	5120000	23	Non-federal
18WS63	560000	5130000	1241	Non-federal
18WS64	560000	5140000	4610	Non-federal
18XQ89	680000	4990000	1481	Non-federal
18XQ98	690000	4980000	51	Non-federal
18XQ99	690000	4990000	7105	Non-federal
18XR90	690000	5000000	71	Non-federal
19CL21	320000	5010000	634	Non-federal
19CL23	320000	5030000	2695	Non-federal
19CL24	320000	5040000	76	Non-federal
19CL31	330000	5010000	7519	Non-federal
19CL32	330000	5020000	2295	Non-federal
19CL33	330000	5030000	8863	Non-federal

10 x 10 km Standardized UTM Grid Square ID[1]	UTM Grid Square Coordinates[2]		Critical Habitat Unit Area (ha)[3]	Land Tenure[4]
	Easting	Northing		
19CL34	330000	5040000	960	Non-federal
19CL41	340000	5010000	3991	Non-federal
19CL42	340000	5020000	6547	Non-federal
19CL51	350000	5010000	9894	Non-federal
19CL52	350000	5020000	4507	Non-federal
19CL62	360000	5020000	3044	Non-federal
19CL63	360000	5030000	2465	Non-federal
19CL72	370000	5020000	4627	Non-federal
19CL73	370000	5030000	5044	Non-federal
19CL75	370000	5050000	3801	Non-federal
19CL76	370000	5060000	2034	Non-federal
19CL85	380000	5050000	1388	Non-federal
19CL86	380000	5060000	3567	Non-federal
19CL87	380000	5070000	681	Non-federal
19CL96	390000	5060000	5589	Non-federal
19CL97	390000	5070000	1396	Non-federal
19CM75	370000	5150000	171	Non-federal
19CM76	370000	5160000	76	Non-federal
19CM84	380000	5140000	5	Non-federal
19CM85	380000	5150000	9095	Non-federal
19CM86	380000	5160000	7981	Non-federal
19CM87	380000	5170000	77	Non-federal
19CM95	390000	5150000	4191	Non-federal
19CM96	390000	5160000	9043	Non-federal
19CM97	390000	5170000	3941	Non-federal
19CN00	300000	5200000	6	Federal
19CN01	300000	5210000	7134	Federal
19CN11	310000	5210000	738	Non-federal
19CN17	310000	5270000	3167	Non-federal
19CN18	310000	5280000	3599	Non-federal
19CN23	320000	5230000	180	Non-federal
19CN24	320000	5240000	1933	Non-federal
19CN25	320000	5250000	2221	Non-federal
19CN26	320000	5260000	7915	Non-federal

10 x 10 km Standardized UTM Grid Square ID[1]	UTM Grid Square Coordinates[2]		Critical Habitat Unit Area (ha)[3]	Land Tenure[4]
	Easting	Northing		
19CN27	320000	5270000	6839	Non-federal
19CN28	320000	5280000	3137	Non-federal
19CN32	330000	5220000	48	Non-federal
19CN33	330000	5230000	9266	Non-federal
19CN34	330000	5240000	9643	Non-federal
19CN35	330000	5250000	7422	Non-federal
19CN36	330000	5260000	7749	Non-federal
19CN37	330000	5270000	5484	Non-federal
19CN38	330000	5280000	0	Non-federal
19CN43	340000	5230000	4751	Non-federal
19CN44	340000	5240000	9561	Non-federal
19CN45	340000	5250000	6096	Non-federal
19CN46	340000	5260000	2369	Non-federal
19CN47	340000	5270000	3506	Non-federal
19CN48	340000	5280000	7570	Non-federal
19CN49	340000	5290000	2342	Non-federal
19CN52	350000	5220000	132	Non-federal
19CN53	350000	5230000	8738	Non-federal
19CN54	350000	5240000	9998	Non-federal
19CN55	350000	5250000	5633	Non-federal
19CN57	350000	5270000	2833	Non-federal
19CN58	350000	5280000	2466	Non-federal
19CN59	350000	5290000	2432	Non-federal
19CN63	360000	5230000	1129	Non-federal
19CN64	360000	5240000	6917	Non-federal
19CN65	360000	5250000	2978	Non-federal
19CN68	360000	5280000	4503	Non-federal
19CN69	360000	5290000	9151	Non-federal
19CN77	370000	5270000	2694	Non-federal
19CN78	370000	5280000	9790	Non-federal
19CN79	370000	5290000	10000	Non-federal
19CN87	380000	5270000	753	Non-federal
19CN88	380000	5280000	1276	Non-federal
19CN89	380000	5290000	5283	Non-federal

10 x 10 km Standardized UTM Grid Square ID[1]	UTM Grid Square Coordinates[2]		Critical Habitat Unit Area (ha)[3]	Land Tenure[4]
	Easting	Northing		
19CN99	390000	5290000	219	Non-federal
19CP11	310000	5310000	4859	Federal
19CP12	310000	5320000	889	Non-federal
19CP21	320000	5310000	3383	Federal
19CP22	320000	5320000	200	Non-federal
19CP30	330000	5300000	149	Non-federal
19CP31	330000	5310000	8366	Non-federal
19CP32	330000	5320000	1688	Non-federal
19CP40	340000	5300000	4728	Non-federal
19CP41	340000	5310000	8697	Non-federal
19CP42	340000	5320000	3523	Non-federal
19CP50	350000	5300000	2337	Non-federal
19CP51	350000	5310000	1006	Non-federal
19CP52	350000	5320000	291	Non-federal
19CP58	350000	5380000	636	Non-federal
19CP59	350000	5390000	30	Non-federal
19CP60	360000	5300000	9761	Non-federal
19CP61	360000	5310000	7730	Non-federal
19CP67	360000	5370000	246	Non-federal
19CP68	360000	5380000	9545	Non-federal
19CP69	360000	5390000	2774	Non-federal
19CP70	370000	5300000	3612	Non-federal
19CP71	370000	5310000	490	Non-federal
19CP77	370000	5370000	4697	Non-federal
19CP78	370000	5380000	6788	Federal
19CP79	370000	5390000	249	Non-federal
19CP80	380000	5300000	6739	Non-federal
19CP81	380000	5310000	228	Non-federal
19CP82	380000	5320000	249	Non-federal
19CP87	380000	5370000	3530	Non-federal
19CP88	380000	5380000	4487	Non-federal
19CP90	390000	5300000	4449	Non-federal
19CP91	390000	5310000	6005	Non-federal
19CP92	390000	5320000	6622	Non-federal

10 x 10 km Standardized UTM Grid Square ID[1]	UTM Grid Square Coordinates[2]		Critical Habitat Unit Area (ha)[3]	Land Tenure[4]
	Easting	Northing		
19CP96	390000	5360000	180	Non-federal
19CP97	390000	5370000	3867	Non-federal
19CP98	390000	5380000	2383	Non-federal
19CQ61	360000	5410000	775	Non-federal
19CQ70	370000	5400000	491	Non-federal
19CQ71	370000	5410000	6583	Non-federal
19DM06	400000	5160000	576	Non-federal
19DM07	400000	5170000	503	Non-federal
19DP01	400000	5310000	556	Non-federal
19DP02	400000	5320000	1818	Non-federal
19DP06	400000	5360000	5024	Non-federal
19DP07	400000	5370000	9748	Non-federal
19DP08	400000	5380000	8965	Non-federal
19DP16	410000	5360000	3648	Non-federal
19DP17	410000	5370000	5101	Non-federal
19DP18	410000	5380000	5267	Non-federal
19DS93	490000	5630000	2518	Non-federal
19DS94	490000	5640000	850	Non-federal
19EP85	580000	5350000	339	Non-federal
19EP86	580000	5360000	3388	Non-federal
19EP95	590000	5350000	419	Non-federal
19EP96	590000	5360000	4736	Non-federal
19ER07	500000	5570000	138	Non-federal
19ER08	500000	5580000	4228	Non-federal
19ER17	510000	5570000	81	Non-federal
19ER18	510000	5580000	3398	Non-federal
19ES03	500000	5630000	3288	Non-federal
19ES04	500000	5640000	1190	Non-federal
19FP49	640000	5390000	2989	Non-federal
19FP59	650000	5390000	3710	Non-federal
19FP69	660000	5390000	114	Non-federal
19FP97	690000	5370000	5084	Non-federal
19FP98	690000	5380000	2092	Non-federal
19FQ40	640000	5400000	2582	Non-federal

10 x 10 km Standardized UTM Grid Square ID[1]	UTM Grid Square Coordinates[2]		Critical Habitat Unit Area (ha)[3]	Land Tenure[4]
	Easting	Northing		
19FQ50	650000	5400000	9746	Non-federal
19FQ51	650000	5410000	1860	Non-federal
19FQ60	660000	5400000	8458	Non-federal
19FQ61	660000	5410000	7771	Non-federal
19FQ62	660000	5420000	397	Non-federal
19FQ71	670000	5410000	6886	Non-federal
19FQ72	670000	5420000	1988	Non-federal
19FQ81	680000	5410000	2382	Non-federal
19FQ82	680000	5420000	8793	Non-federal
19FQ83	680000	5430000	30	Non-federal
19FQ91	690000	5410000	6205	Non-federal
19FQ92	690000	5420000	9456	Non-federal
19FQ93	690000	5430000	19	Non-federal
19FS01	600000	5610000	8	Non-federal
19FS02	600000	5620000	6459	Non-federal
19FS03	600000	5630000	3258	Non-federal
19FS12	610000	5620000	3001	Non-federal
19FS13	610000	5630000	767	Non-federal
19FT01	600000	5710000	4644	Non-federal
19FT02	600000	5720000	2580	Non-federal
19FT11	610000	5710000	466	Non-federal
19FT12	610000	5720000	158	Non-federal
19GP07	700000	5370000	4131	Non-federal
19GP08	700000	5380000	4893	Non-federal
19GP17	710000	5370000	62	Non-federal
19GP18	710000	5380000	119	Non-federal
19GQ00	700000	5400000	34	Non-federal
19GQ01	700000	5410000	5002	Non-federal
19GQ02	700000	5420000	8979	Non-federal
19GQ10	710000	5400000	19	Non-federal
19GQ11	710000	5410000	8075	Non-federal
19GQ12	710000	5420000	8640	Non-federal
19GQ13	710000	5430000	4711	Non-federal
19GQ20	720000	5399999	4	Non-federal

10 x 10 km Standardized UTM Grid Square ID[1]	UTM Grid Square Coordinates[2]		Critical Habitat Unit Area (ha)[3]	Land Tenure[4]
	Easting	Northing		
19GQ21	720000	5410000	95	Non-federal
20KU99	290000	5390000	4791	Non-federal
20KV70	279330	5400000	12	Non-federal
20KV71	279727	5410000	94	Non-federal
20KV80	280000	5400000	1013	Non-federal
20KV81	279997	5410000	8229	Non-federal
20KV82	280119	5420000	5669	Non-federal
20KV83	280514	5430000	7542	Non-federal
20KV84	280909	5439999	0	Non-federal
20KV90	290000	5400000	149	Non-federal
20KV91	290000	5410000	5544	Non-federal
20KV92	290000	5420000	4588	Non-federal
20KV93	290000	5430000	4324	Non-federal
20KV94	290000	5440000	2	Non-federal
20LU09	300000	5390000	2880	Non-federal
20LV00	300000	5400000	37	Non-federal
20LV01	300000	5410000	1599	Non-federal
20LV02	300000	5420000	3949	Non-federal
20LV03	300000	5430000	1448	Non-federal
20LV05	300000	5450000	3689	Non-federal
20LV11	310000	5410000	2850	Non-federal
20LV12	310000	5420000	10007	Non-federal
20LV13	310000	5430000	5851	Non-federal
20LV15	310000	5450000	4153	Non-federal
20LV21	320000	5410000	50	Non-federal
20LV22	320000	5420000	5615	Non-federal
20LV23	320000	5430000	1936	Non-federal
20LV63	360000	5430000	26	Non-federal
20LV73	370000	5430000	8480	Non-federal
20LV74	370000	5440000	521	Non-federal
20LV83	380000	5430000	804	Non-federal
20MA78	470000	5580000	97	Non-federal
20MA79	470000	5590000	116	Non-federal
20MA88	480000	5580000	3699	Non-federal

10 x 10 km Standardized UTM Grid Square ID[1]	UTM Grid Square Coordinates[2]		Critical Habitat Unit Area (ha)[3]	Land Tenure[4]
	Easting	Northing		
20MA89	480000	5590000	3966	Non-federal
20MU06	400000	5360000	13	Non-federal
20MU07	400000	5370000	6161	Non-federal
20MU08	400000	5380000	542	Non-federal
20MU17	410000	5370000	3236	Federal
20MU18	410000	5380000	47	Non-federal
20MV00	400000	5400000	5050	Federal (Forillon National Park of Canada)
20MV01	400000	5410000	4606	Federal (Forillon National Park of Canada)
20MV10	410000	5400000	3192	Federal (Forillon National Park of Canada)
20MV11	410000	5410000	572	Federal (Forillon National Park of Canada)

[1] The grid square ID is based on the standard UTM Military Grid Reference System (see http://www.nrcan.gc.ca/earth-sciences/geography-boundary/mapping/topographic-mapping/10098), where the first two digits represent the UTM Zone, the following two letters indicate the 100 x 100 km standardized UTM grid, and the last two digits represent the 10 x 10 km standardized UTM grid containing all or a portion of the critical habitat unit. This unique alphanumeric code is based on the methodology used for the Breeding Bird Atlases of Canada (see http://www.bsc-eoc.org/ for more information on breeding bird atlases).

[2] The listed coordinates are a cartographic representation of where critical habitat can be found, presented as the southwest corner of the 10 x 10 km standardized UTM grid containing all or a portion of the critical habitat. The coordinates may not fall within critical habitat and are provided as a general location only.

[3] The area presented is the sum of the area of critical habitat units within the UTM grid square (rounded up to the nearest 1 ha). It is an approximation obtained by drawing a 5 km radius around each observation meeting the habitat occupancy criteria (section 7.1.1). The exact area of critical habitat may be significantly less depending on where the criteria for critical habitat are met (see section 7.1). Field verification is required to determine the precise area of critical habitat.

[4] Land tenure is provided as an approximation of the types of land ownership that exist at the critical habitat units and should be used for guidance purposes only. Accurate land tenure will require cross referencing critical habitat boundaries with surveyed land parcel information.

Table C-2. Description of the 10 x 10 km Standardized UTM Grids and Critical Habitat Units for the Bicknell's Thrush in New Brunswick. Critical habitat refers to areas where the criteria set out in section 7.1 are met.

10 x 10 km Standardized UTM Grid Square ID[1]	UTM Grid Square Coordinates[2]		Critical Habitat Unit Area (ha)[3]	Land Tenure[4]
	Easting	Northing		
19EN46	540000	5260000	773	Non-federal
19EN47	540000	5270000	3624	Non-federal
19EN49	540000	5290000	2696	Non-federal
19EN56	550000	5260000	643	Non-federal
19EN57	550000	5270000	3517	Non-federal
19EN58	550000	5280000	15	Non-federal
19EN59	550000	5290000	8271	Non-federal
19EN68	560000	5280000	1394	Non-federal
19EN69	560000	5290000	7892	Non-federal
19EN77	570000	5270000	726	Non-federal
19EN78	570000	5280000	9351	Non-federal
19EN79	570000	5290000	8281	Non-federal
19EN87	580000	5270000	101	Non-federal
19EN88	580000	5280000	2852	Non-federal
19EN89	580000	5290000	9771	Non-federal
19EN98	590000	5280000	827	Non-federal
19EN99	590000	5290000	8570	Non-federal
19EP40	540000	5300000	35	Non-federal
19EP50	550000	5300000	5671	Non-federal
19EP60	560000	5300000	5105	Non-federal
19EP70	570000	5300000	5035	Non-federal
19EP80	580000	5300000	9890	Non-federal
19EP81	580000	5310000	1655	Non-federal
19EP90	590000	5300000	5387	Non-federal
19EP91	590000	5310000	7151	Non-federal
19FK74	670000	4940000	2842	Federal
19FK75	670000	4950000	1663	Federal
19FK84	680000	4940000	21	Non-federal
19FN09	600000	5290000	1351	Non-federal
19FN28	620000	5280000	2	Non-federal
19FN31	630000	5210000	68	Non-federal

10 x 10 km Standardized UTM Grid Square ID[1]	UTM Grid Square Coordinates[2]		Critical Habitat Unit Area (ha)[3]	Land Tenure[4]
	Easting	Northing		
19FN32	630000	5220000	316	Non-federal
19FN37	630000	5270000	54	Non-federal
19FN38	630000	5280000	7790	Non-federal
19FN41	640000	5210000	2483	Non-federal
19FN42	640000	5220000	4980	Non-federal
19FN53	650000	5230000	202	Non-federal
19FN54	650000	5240000	5055	Non-federal
19FN55	650000	5250000	5562	Non-federal
19FN56	650000	5260000	29	Non-federal
19FN61	660000	5210000	1878	Non-federal
19FN62	660000	5220000	5944	Non-federal
19FN63	660000	5230000	7057	Non-federal
19FN64	660000	5240000	9106	Non-federal
19FN65	660000	5250000	7537	Non-federal
19FN66	660000	5260000	8330	Non-federal
19FN67	660000	5270000	2961	Non-federal
19FN71	670000	5210000	5359	Non-federal
19FN72	670000	5220000	1000	Non-federal
19FN73	670000	5230000	1000	Non-federal
19FN74	670000	5240000	7806	Non-federal
19FN75	670000	5250000	30	Non-federal
19FN76	670000	5260000	719	Non-federal
19FN77	670000	5270000	402	Non-federal
19FN81	680000	5210000	2319	Non-federal
19FN82	680000	5220000	7247	Non-federal
19FN83	680000	5230000	1000	Non-federal
19FN84	680000	5240000	9983	Non-federal
19FN85	680000	5250000	2182	Non-federal
19FN86	680000	5260000	1038	Non-federal
19FN92	690000	5220000	1233	Non-federal
19FN93	690000	5230000	3905	Non-federal
19FN94	690000	5240000	2322	Non-federal
19FN95	690000	5250000	5931	Non-federal
19FN96	690000	5260000	6447	Non-federal
19FP00	600000	5300000	2076	Non-federal
19FP01	600000	5310000	4732	Non-federal

10 x 10 km Standardized UTM Grid Square ID[1]	UTM Grid Square Coordinates[2]		Critical Habitat Unit Area (ha)[3]	Land Tenure[4]
	Easting	Northing		
20LR13	310000	5030000	649	Non-federal
20LR14	310000	5040000	147	Non-federal
20LR23	320000	5030000	1984	Non-federal
20LR24	320000	5040000	2019	Non-federal

[1] The grid square ID is based on the standard UTM Military Grid Reference System (see http://www.nrcan.gc.ca/earth-sciences/geography-boundary/mapping/topographic-mapping/10098), where the first two digits represent the UTM Zone, the following two letters indicate the 100 x 100 km standardized UTM grid, and the last two digits represent the 10 x 10 km standardized UTM grid containing all or a portion of the critical habitat unit. This unique alphanumeric code is based on the methodology used for the Breeding Bird Atlases of Canada (see http://www.bsc-eoc.org/ for more information on breeding bird atlases).

[2] The listed coordinates are a cartographic representation of where critical habitat can be found, presented as the southwest corner of the 10 x 10 km standardized UTM grid containing all or a portion of the critical habitat. The coordinates may not fall within critical habitat and are provided as a general location only.

[3] The area presented is the sum of the area of critical habitat units within the UTM grid square (rounded up to the nearest 1 ha). It is an approximation obtained by drawing a 5 km radius around each observation meeting the habitat occupancy criteria (section 7.1.1). The exact area of critical habitat may be significantly less depending on where the criteria for critical habitat are met (see section 7.1). Field verification is required to determine the precise area of critical habitat.

[4] Land tenure is provided as an approximation of the types of land ownership that exist at the critical habitat units and should be used for guidance purposes only. Accurate land tenure will require cross referencing critical habitat boundaries with surveyed land parcel information.

Table C-3. Description of the 10 x 10 km Standardized UTM Grids and Critical Habitat Units for the Bicknell's Thrush in Nova Scotia. Critical habitat refers to areas where the criteria set out in section 7.1 are met.

10 x 10 km Standardized UTM Grid Square ID[1]	UTM Grid Square Coordinates[2]		Critical Habitat Unit Area (ha)[3]	Land Tenure[4]
	Easting	Northing		
20PS55	650000	5150000	1335	Non-federal
20PS56	650000	5160000	3562	Federal (Cape Breton Highlands National Park of Canada)
20PS57	650000	5170000	1769	Federal (Cape Breton Highlands National Park of Canada)
20PS58	650000	5180000	33	Federal (Cape Breton Highlands National Park of Canada)
20PS62	660000	5120000	13	Non-federal
20PS63	660000	5130000	3978	Non-federal
20PS64	660000	5140000	8656	Non-federal
20PS65	660000	5150000	6222	Non-federal
20PS66	660000	5160000	9308	Federal (Cape Breton Highlands National Park of Canada)
20PS67	660000	5170000	9156	Federal (Cape Breton Highlands National Park of Canada)
20PS68	660000	5180000	6192	Federal (Cape Breton Highlands National Park of Canada)
20PS72	670000	5120000	4147	Non-federal
20PS73	670000	5130000	7470	Non-federal
20PS74	670000	5140000	9925	Non-federal
20PS75	670000	5150000	9383	Non-federal
20PS76	670000	5160000	8674	Federal (Cape Breton Highlands National Park of Canada)
20PS77	670000	5170000	1814	Federal (Cape Breton Highlands National Park of Canada)
20PS78	670000	5180000	393	Federal (Cape Breton Highlands National Park of Canada)
20PS84	680000	5140000	2085	Non-federal
20PS85	680000	5150000	423	Non-federal

10 x 10 km Standardized UTM Grid Square ID[1]	UTM Grid Square Coordinates[2]		Critical Habitat Unit Area (ha)[3]	Land Tenure[4]
	Easting	Northing		
20PS86	680000	5160000	4671	Federal (Cape Breton Highlands National Park of Canada)
20PS87	680000	5170000	8139	Federal (Cape Breton Highlands National Park of Canada)
20PS88	680000	5180000	3440	Federal (Cape Breton Highlands National Park of Canada)
20PS89	680000	5190000	354	Federal (Cape Breton Highlands National Park of Canada)
20PS97	690000	5170000	3628	Federal (Cape Breton Highlands National Park of Canada)
20PS98	690000	5180000	7820	Federal (Cape Breton Highlands National Park of Canada)
20PS99	690000	5190000	2631	Federal (Cape Breton Highlands National Park of Canada)
20PT80	680000	5200000	345	Non-federal
20PT90	690000	5200000	4305	Federal
20PT91	690000	5210000	905	Federal
20QT12	710000	5220000	4	Federal
20QT13	710000	5230000	502	Federal

[1] The grid square ID is based on the standard UTM Military Grid Reference System (see http://www.nrcan.gc.ca/earth-sciences/geography-boundary/mapping/topographic-mapping/10098), where the first two digits represent the UTM Zone, the following two letters indicate the 100 x 100 km standardized UTM grid, and the last two digits represent the 10 x 10 km standardized UTM grid containing all or a portion of the critical habitat unit. This unique alphanumeric code is based on the methodology used for the Breeding Bird Atlases of Canada (see http://www.bsc-eoc.org/ for more information on breeding bird atlases).

[2] The listed coordinates are a cartographic representation of where critical habitat can be found, presented as the southwest corner of the 10 x 10 km standardized UTM grid containing all or a portion of the critical habitat. The coordinates may not fall within critical habitat and are provided as a general location only.

[3] The area presented is the sum of the area of critical habitat units within the UTM grid square (rounded up to the nearest 1 ha). It is an approximation obtained by drawing a 5 km radius around each observation meeting the habitat occupancy criteria (section 7.1.1). The exact area of critical habitat may be significantly less depending on where the criteria for critical habitat are met (see section 7.1). Field verification is required to determine the precise area of critical habitat.

[4] Land tenure is provided as an approximation of the types of land ownership that exist at the critical habitat units and should be used for guidance purposes only. Accurate land tenure will require cross referencing critical habitat boundaries with surveyed land parcel information.

Figures of Bicknell's Thrush critical habitat in Canada

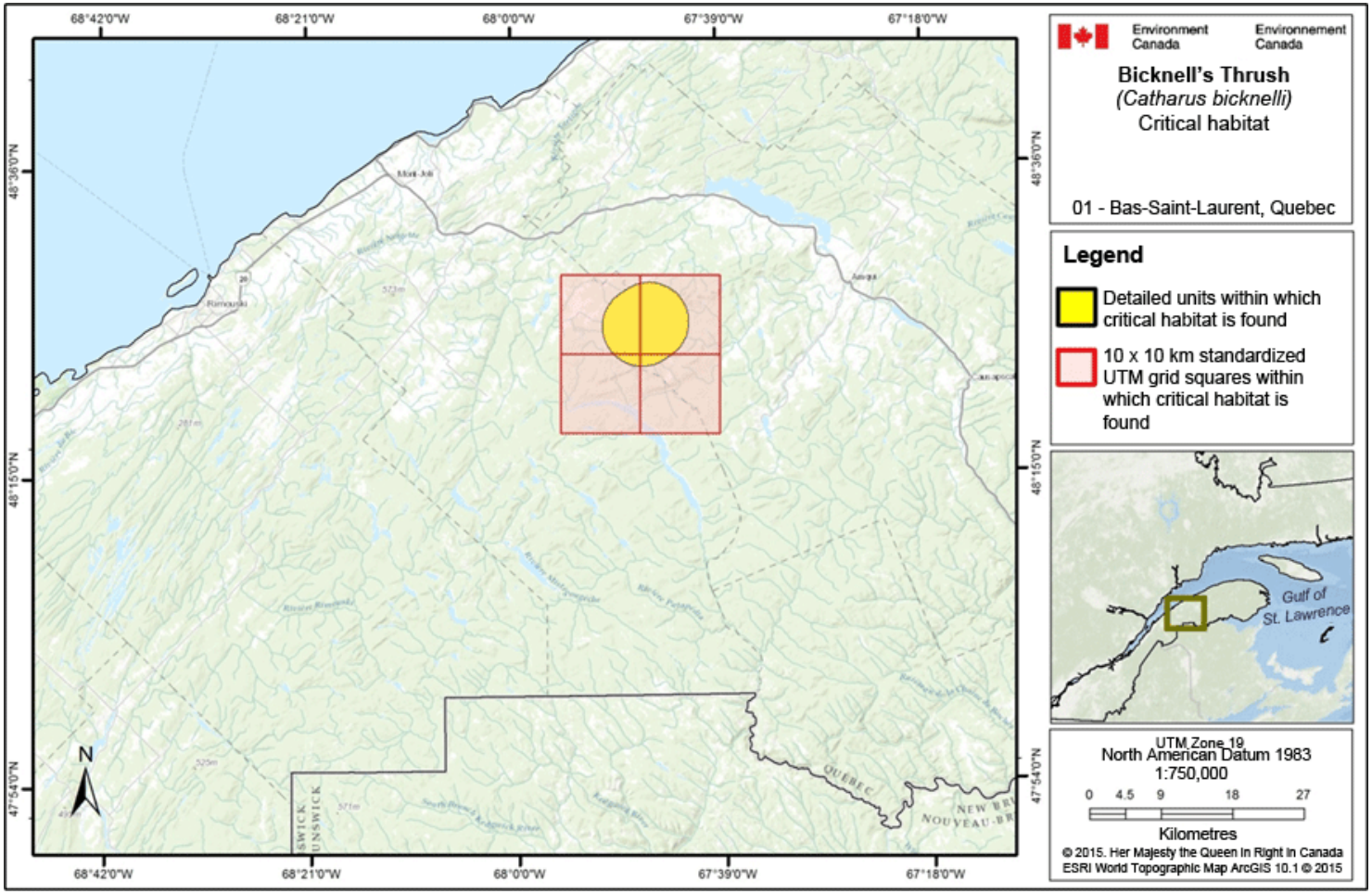

Figure C-1. Critical habitat for the Bicknell's Thrush in the administrative region of Bas-Saint-Laurent, Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

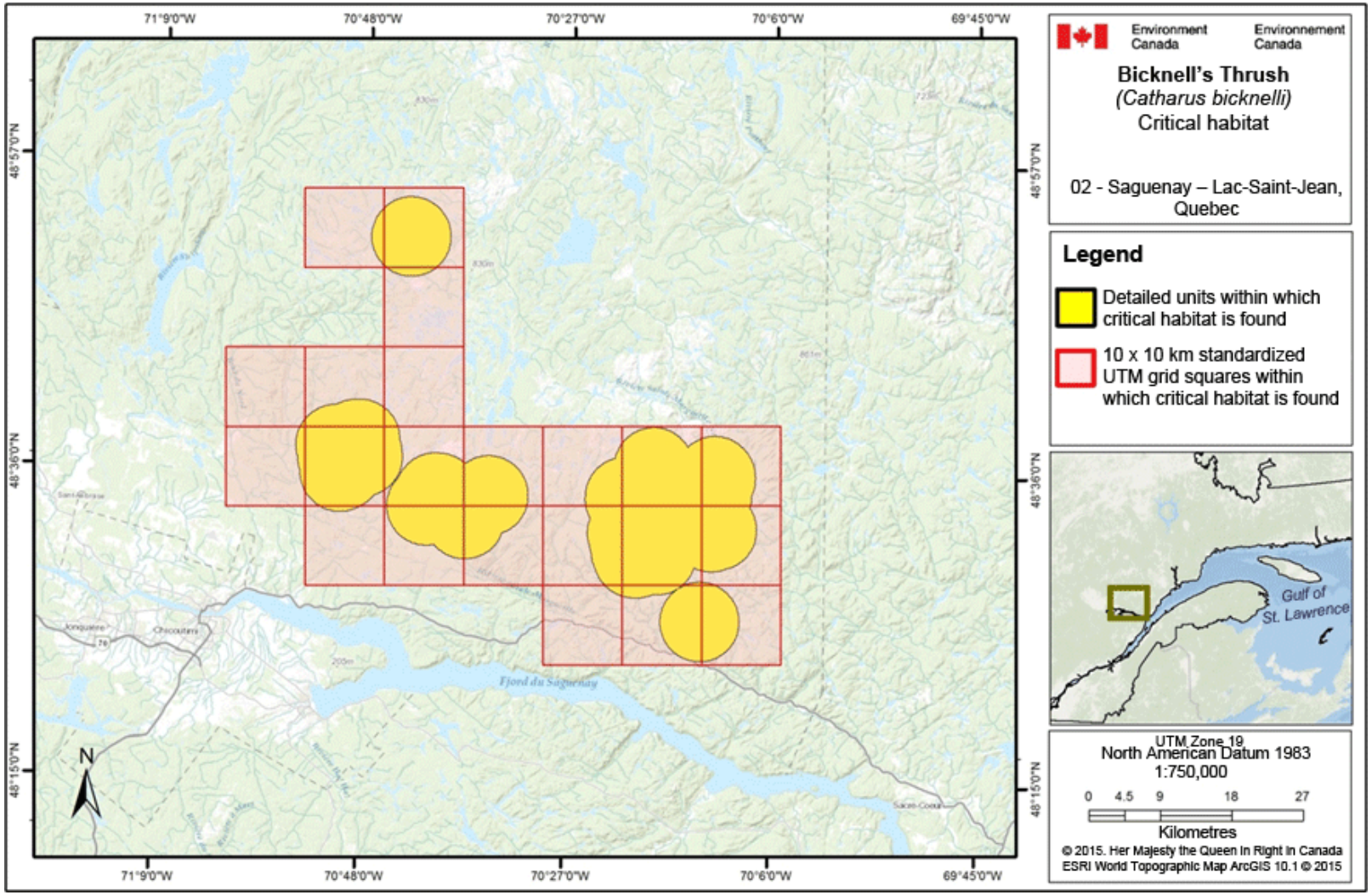

Figure C-2. Critical habitat for the Bicknell's Thrush in the administrative region of Saguenay – Lac Saint-Jean, Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

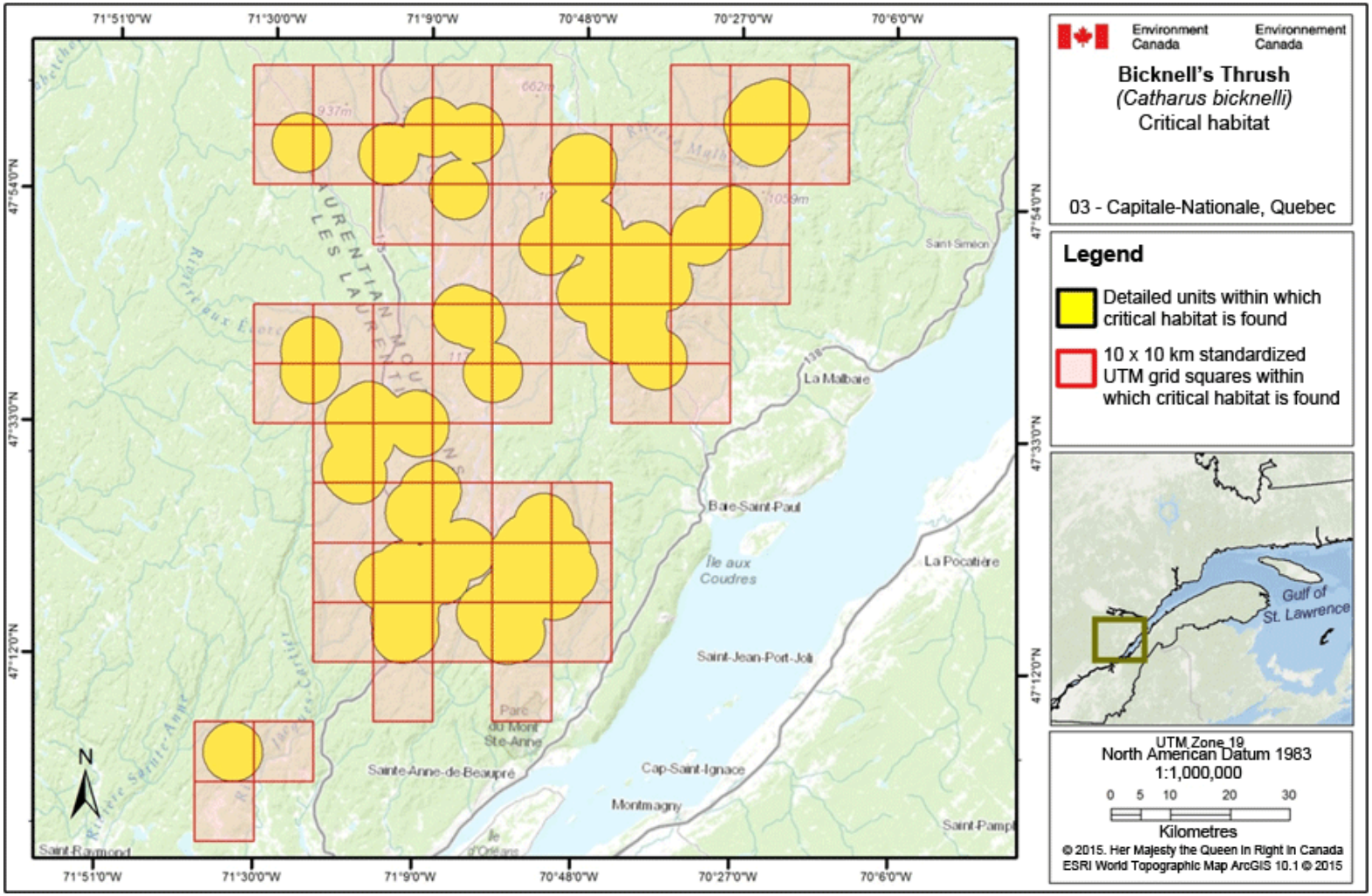

Figure C-3. Critical habitat for the Bicknell's Thrush in the administrative region of Capitale-Nationale, Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

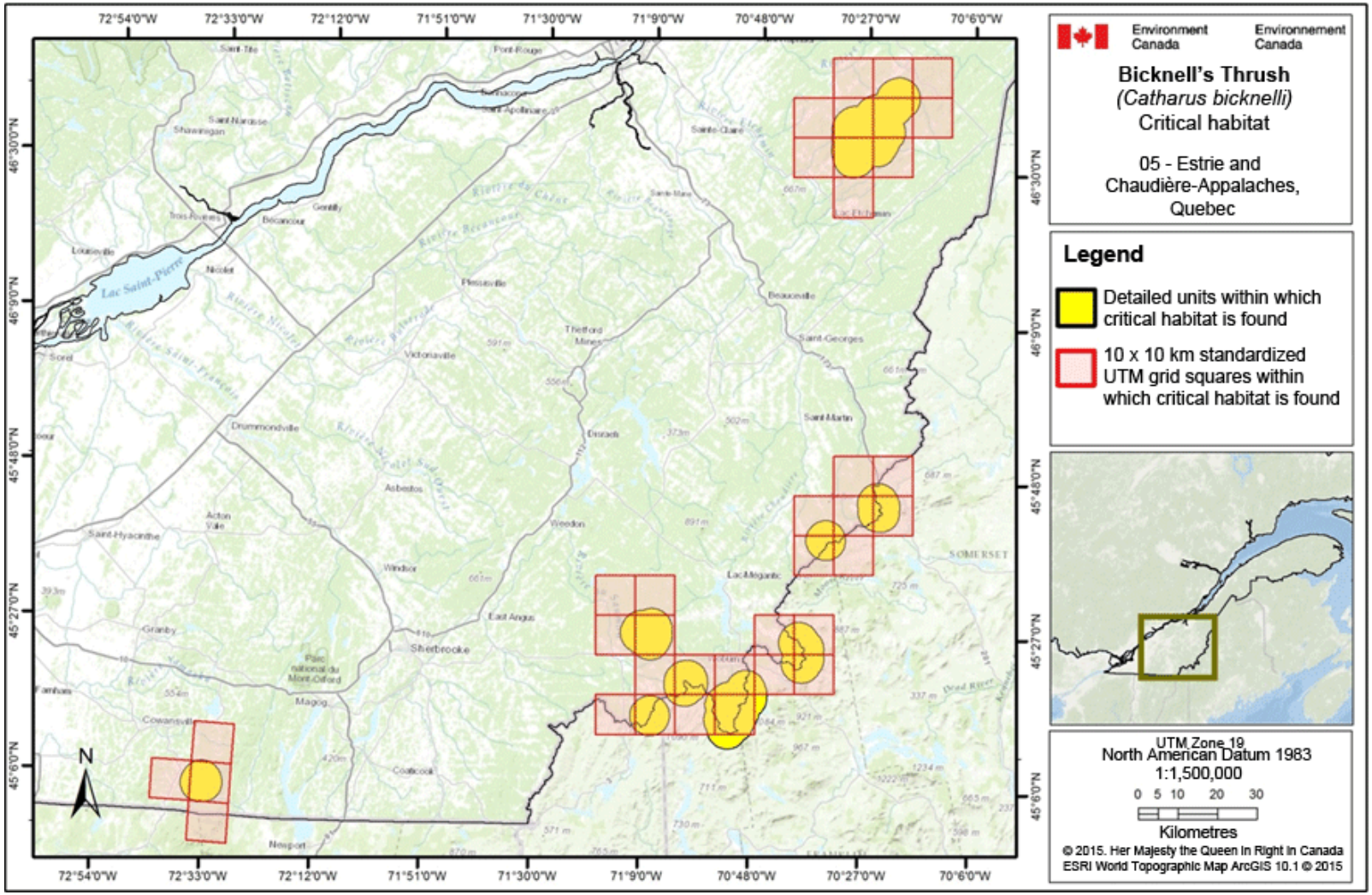

Figure C-4. Critical habitat for the Bicknell's Thrush in the administrative regions of Estrie and Chaudière-Appalaches, Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

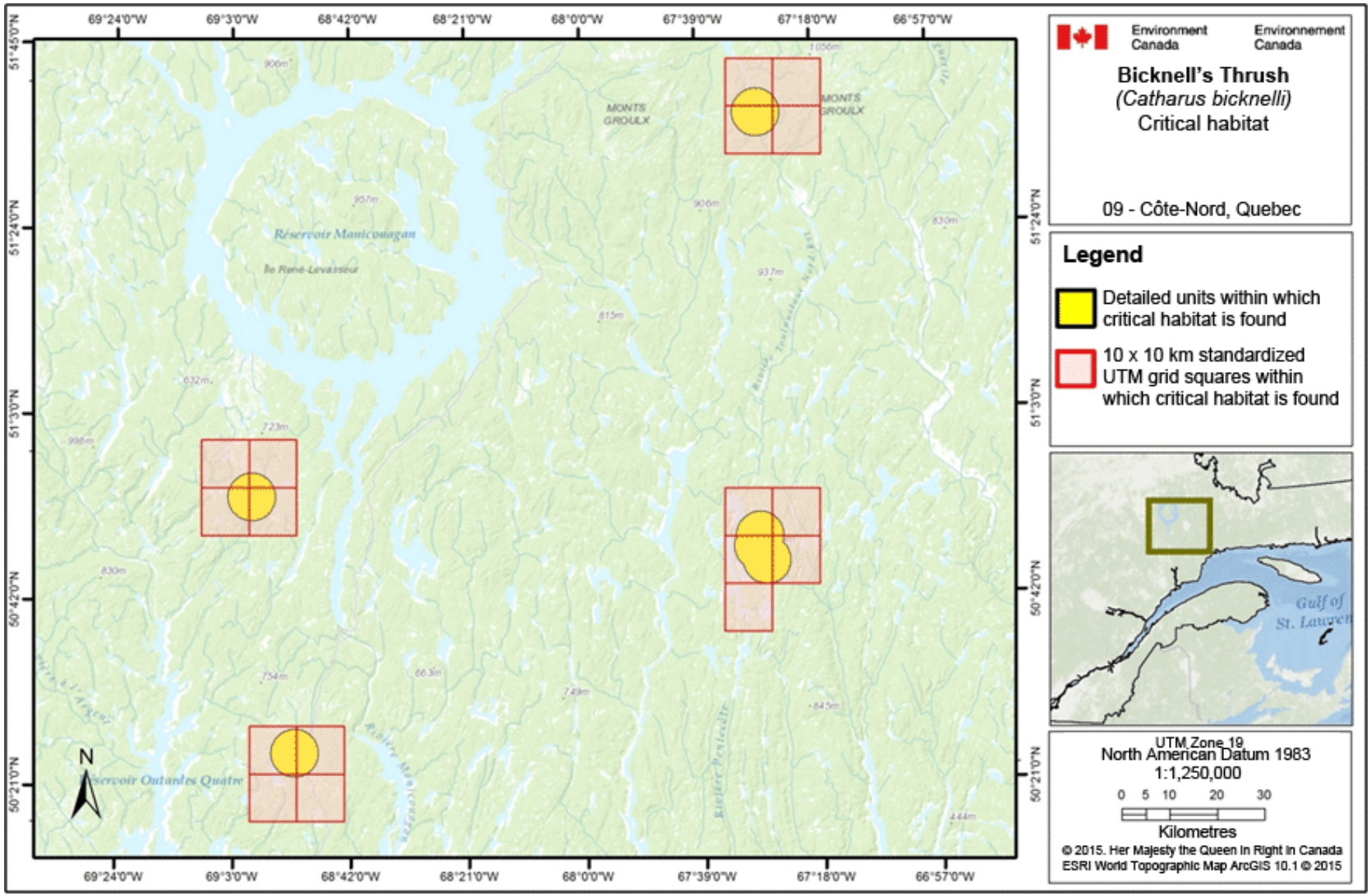

Figure C-5. Critical habitat for the Bicknell's Thrush in the administrative region of Côte-Nord, Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

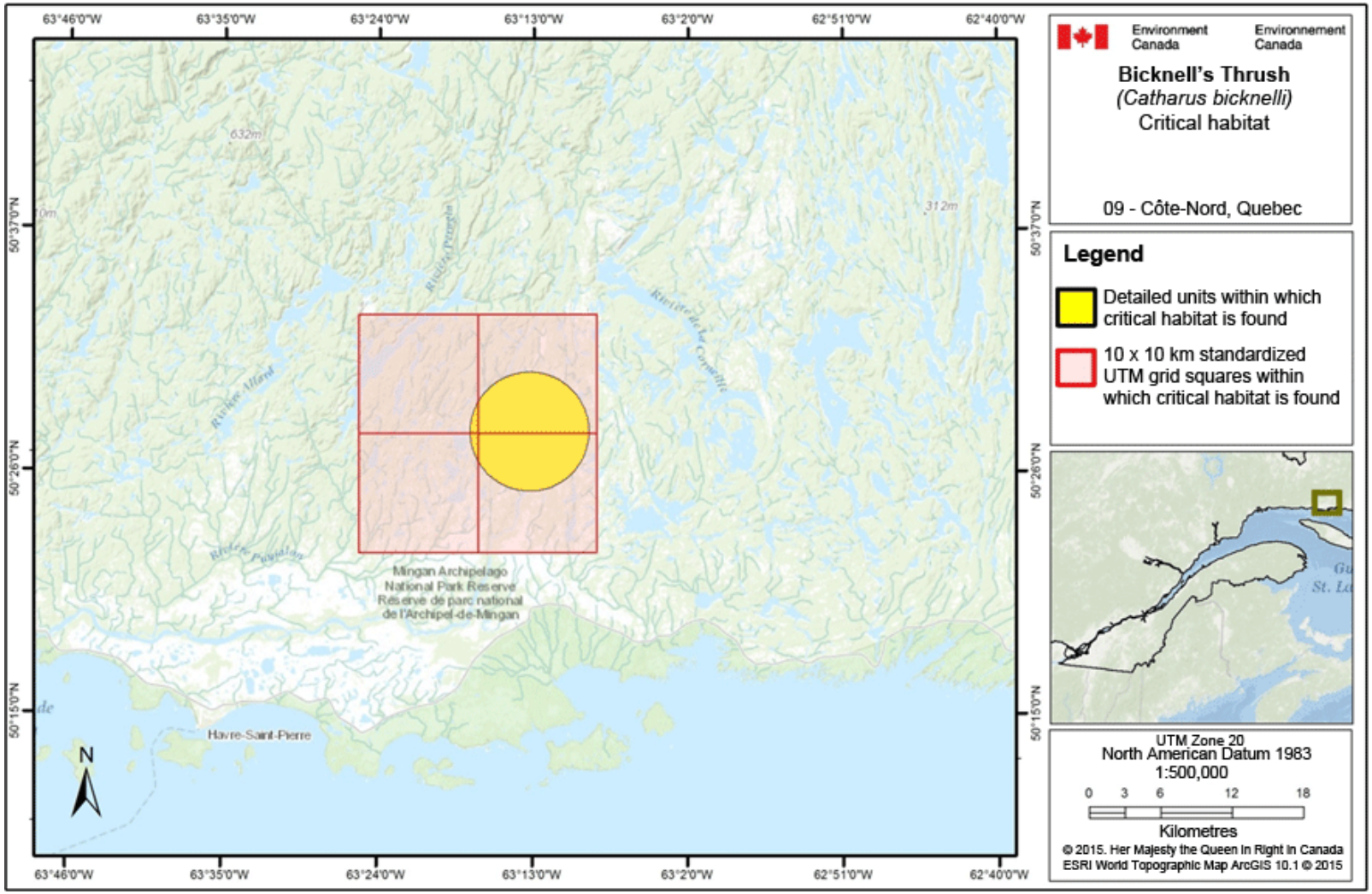

Figure C-6. Critical habitat for the Bicknell's Thrush in the administrative region of Côte-Nord, Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

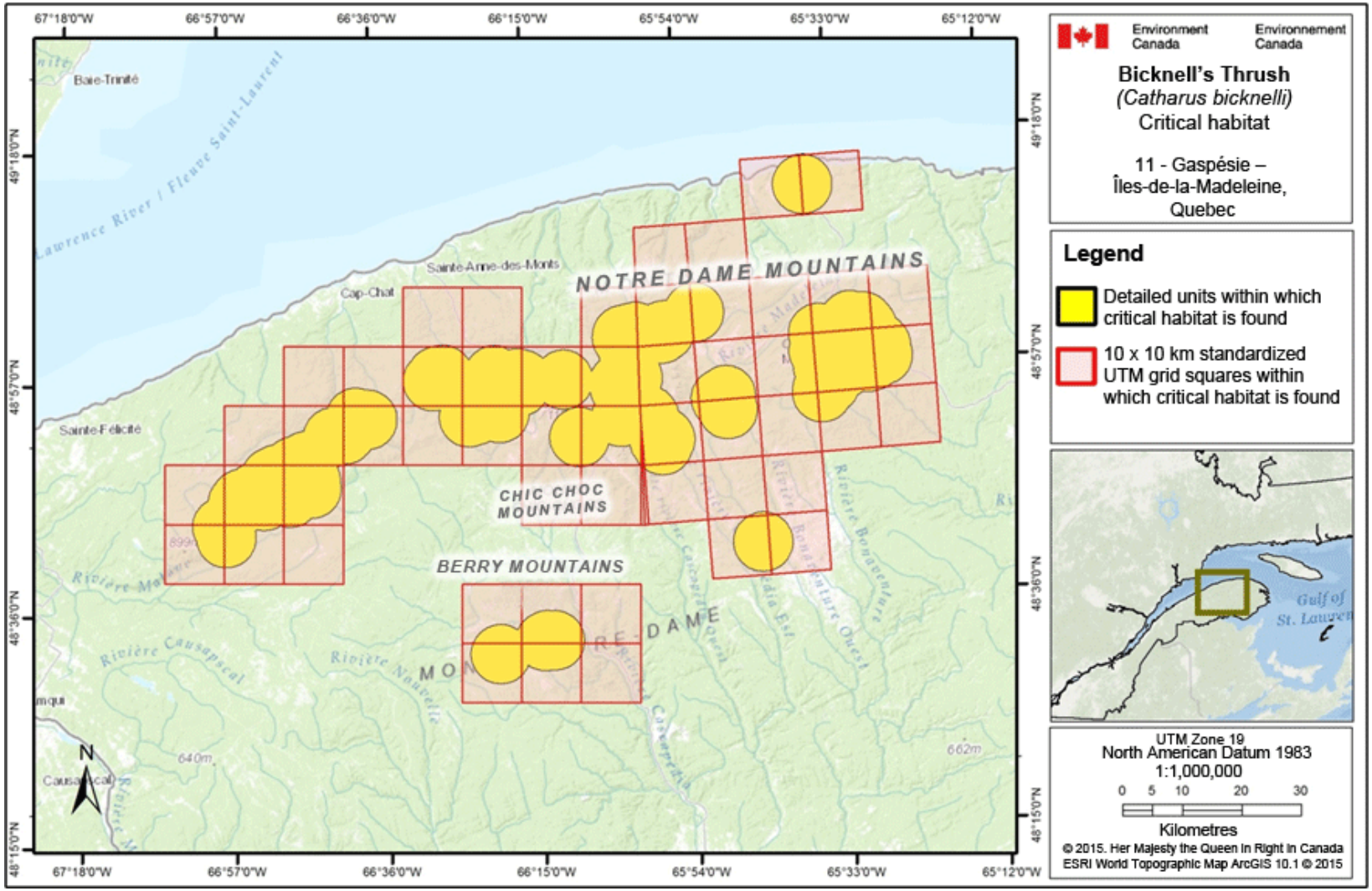

Figure C-7. Critical habitat for the Bicknell's Thrush in the administrative region of Gaspésie – Îles-de-la-Madeleine, Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

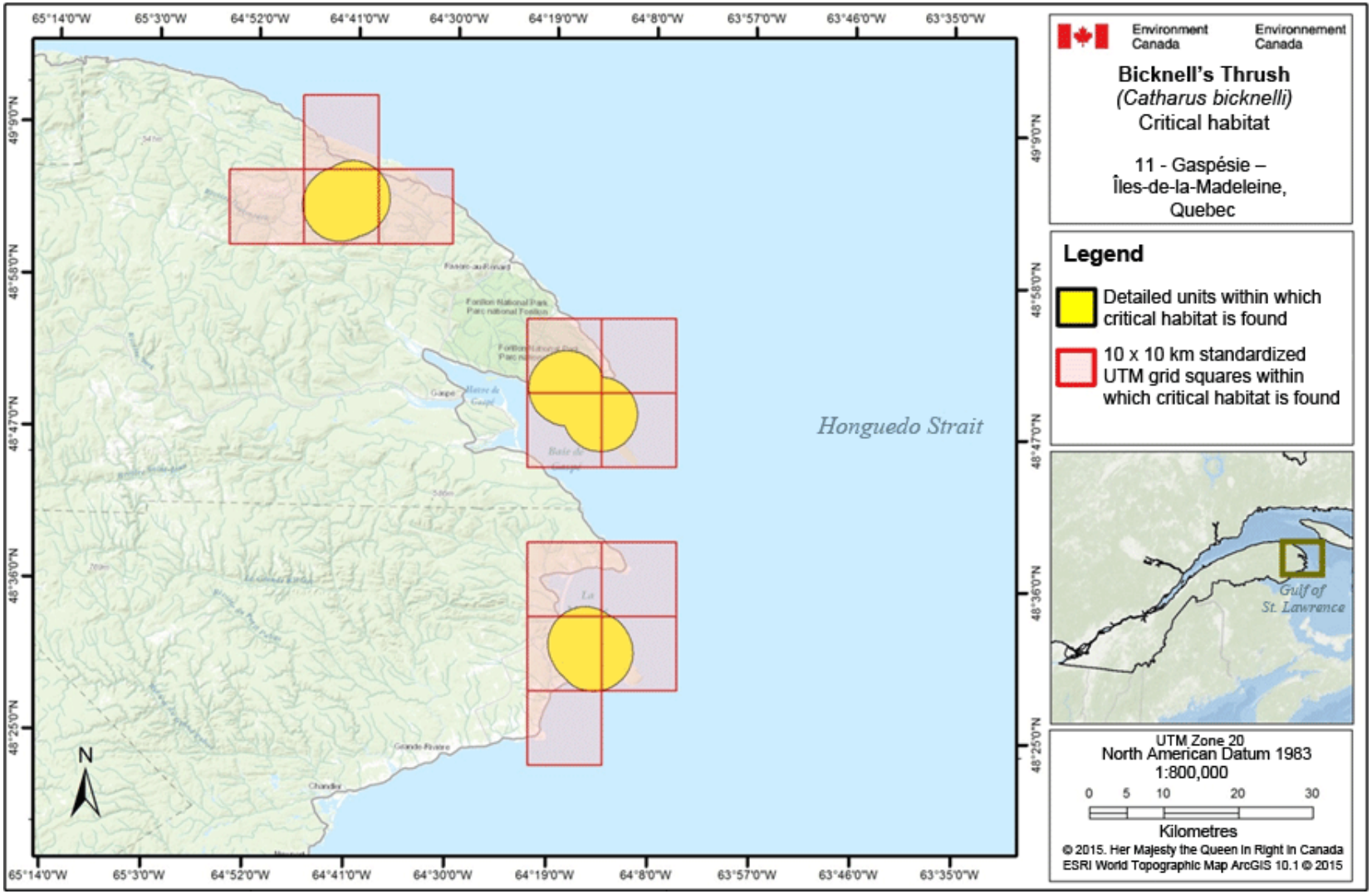

Figure C-8. Critical habitat for the Bicknell's Thrush in the administrative region of Gaspésie – Îles-de-la-Madeleine, Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

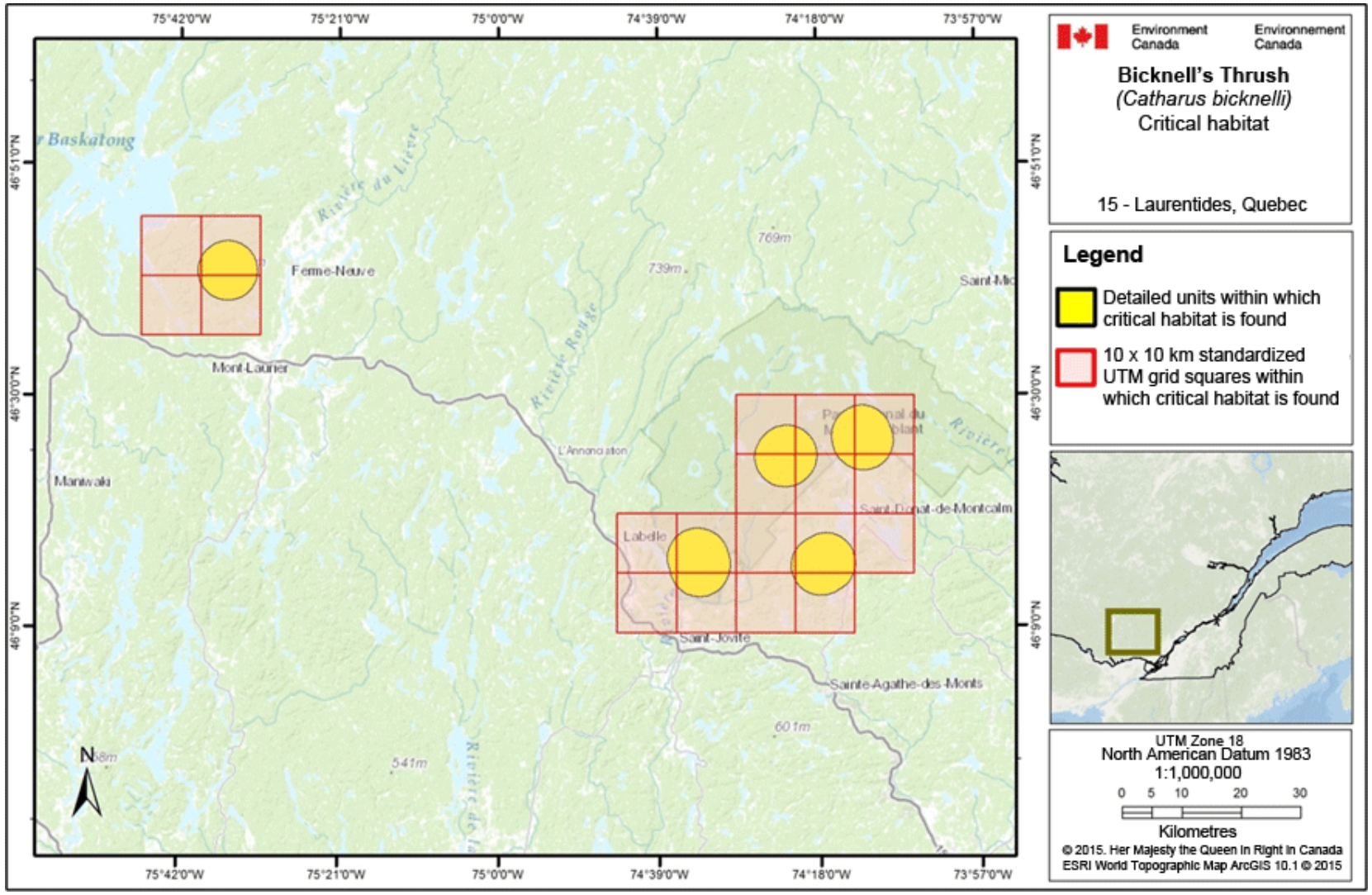

Figure C-9. Critical habitat for the Bicknell's Thrush in the administrative region of Laurentides, Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

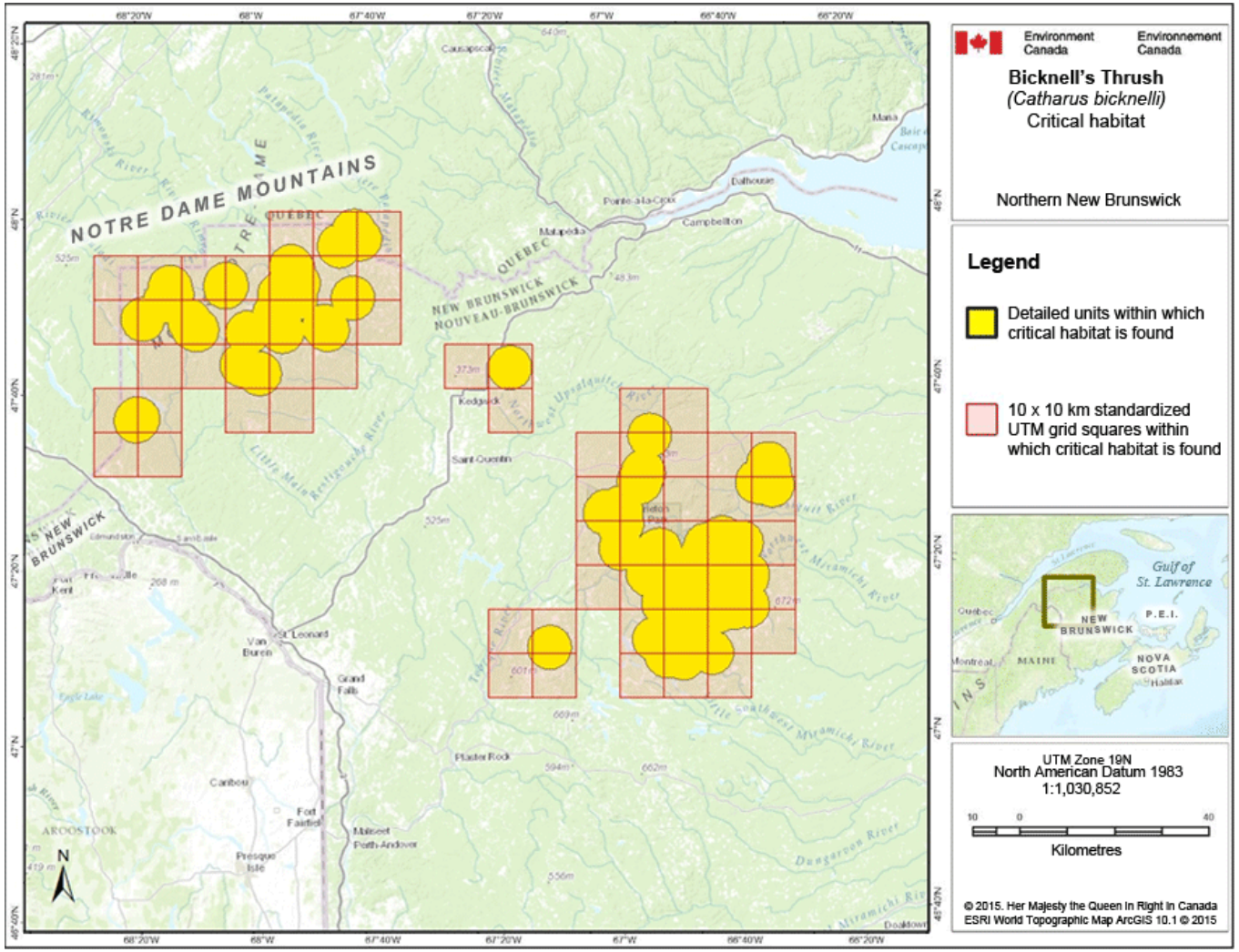

Figure C-10. Critical habitat for the Bicknell's Thrush in northern New Brunswick. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

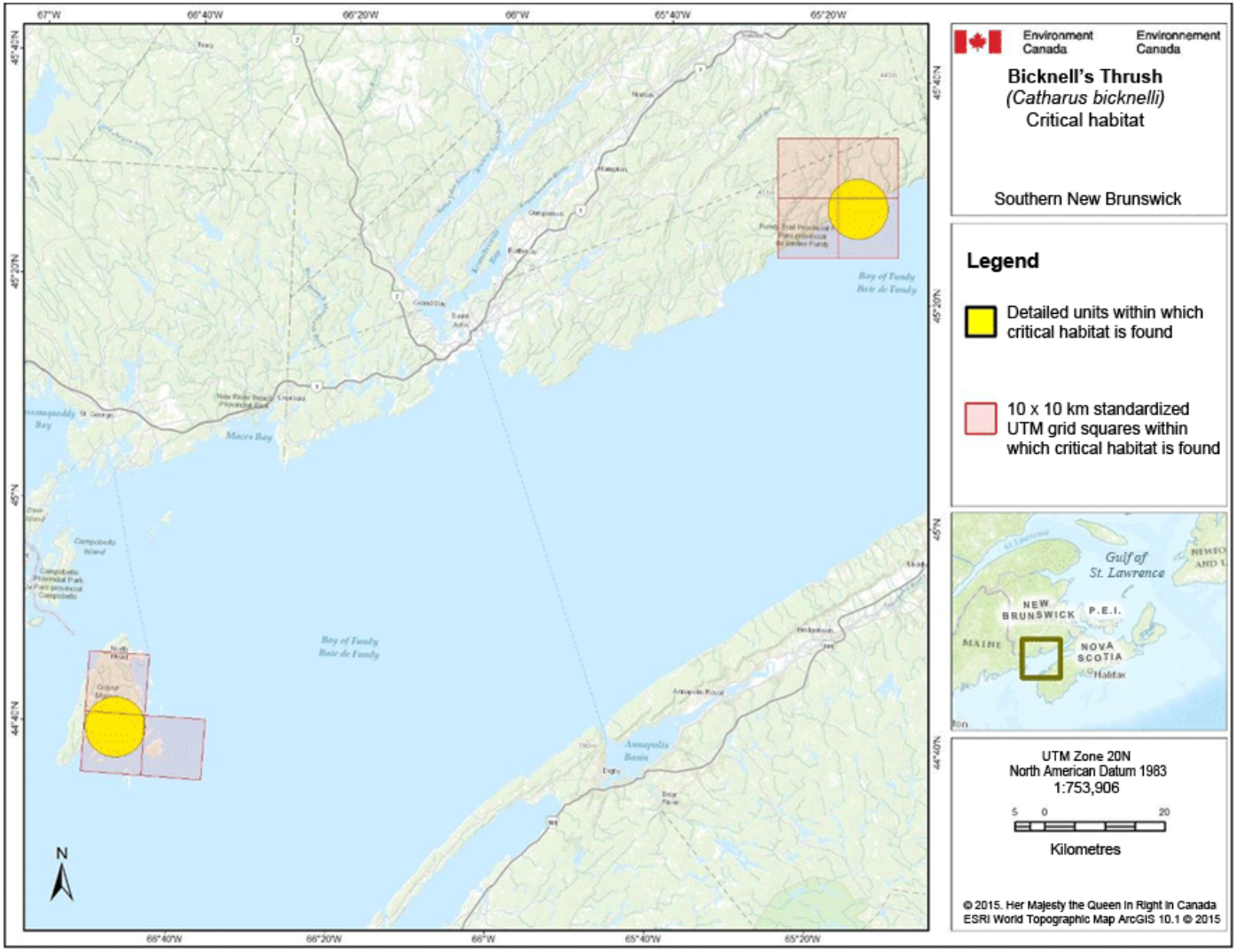

Figure C-11. Critical habitat for the Bicknell's Thrush in southern New Brunswick. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

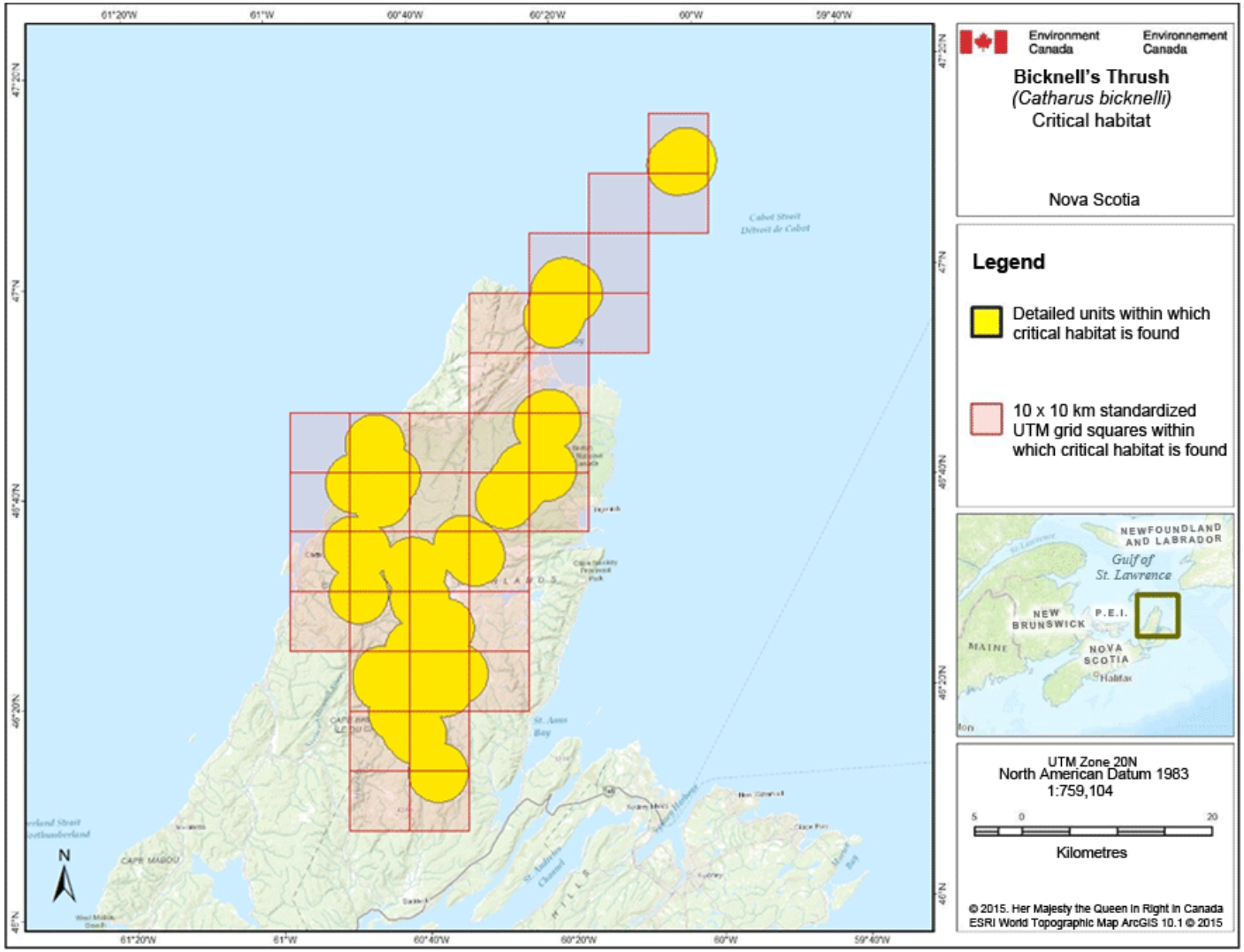

Figure C-12. Critical habitat for the Bicknell's Thrush in Nova Scotia. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

Appendix D: 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*[13]. 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's[14] (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 on 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 broad recovery strategies proposed for the Bicknell's Thrush could also benefit other bird species that breed in habitats similar to those used by the Bicknell's Thrush and that are likewise at risk in Canada, including the Olive-sided Flycatcher (*Contopus cooperi*), Canada Warbler (*Cardellina canadensis*) and Barrow's Goldeneye (*Bucephala islandica*). In addition, the conservation measures taken for the Bicknell's Thrush in its wintering area will benefit a number of other bird species at risk (as per the IUCN criteria) that are present in the wintering area: the Black-capped Petrel (*Pterodroma hasitata*) (endangered), Plain Pigeon (*Patagioenas inornata*) (near threatened), White-fronted Quail-dove (*Geotrygon leucometopia*) (vulnerable), Hispaniolan Parakeet (*Aratinga chloroptera*) (vulnerable), Hispaniolan Amazon (*Amazona ventralis*) (vulnerable), Hispaniolan Trogon (*Priotelus roseigaster*) (near threatened), La Selle Thrush (*Turdus swalesi*) (endangered), White-winged Warbler (*Xenoligea montana*) (vulnerable), Gray-crowned Palm Tanager (*Phaenicophilus poliocephalus*) (near threatened), Eastern Chat-tanager (*Calyptophilus frugivorus*) (vulnerable), Western Chat-tanager (*Calyptophilus tertius*) (vulnerable), Hispaniolan Crossbill (*Loxia megaplaga*) (endangered), White-crowned Pigeon (*Patagioenas leucocephala*) (near threatened) and Cuban Solitaire (*Myadestes elisabeth*) (near threatened) (IBTCG 2010).

Mammals that use habitats near those of the Bicknell's Thrush include the Woodland Caribou (*Rangifer tarandus caribou*), Gaspésie-Atlantic population (endangered) and the Woodland Caribou (*Rangifer tarandus caribou*), boreal population (threatened). The recovery measures developed for the Bicknell's Thrush will also be beneficial for them.

[13] http://www.ceaa.gc.ca/default.asp?lang=En&n=B3186435-1
[14] http://www.ec.gc.ca/dd-sd/default.asp?lang=En&n=CD30F295-1

Another important broad strategy for recovery presented in this recovery strategy involves the conservation, stewardship and management of known and potential Bicknell’s Thrush wintering habitats (which are outside of Canada). In addition, the restoration of these habitats, which now cover only a fraction of the area historically covered, will likely benefit the overall biodiversity of this region. It is therefore reasonable to think that this recovery strategy will not result in significant adverse effects on the environment or other species in the Bicknell’s Thrush wintering area.