

**RECOVERY PLAN FOR THE *BICKNELL'S THRUSH*
(*CATHARUS BICKNELLI*) IN NOVA SCOTIA**



**A recovery plan adopted by the Nova Scotia Department of Lands and
Forestry**

2020 - 2025



Recommended citation:

Nova Scotia Department of Lands and Forestry. 2020. Recovery Plan for the Bicknell's thrush (*Catharus bicknelli*) in Nova Scotia [Final]. *Nova Scotia Endangered Species Act Recovery Plan Series*.

Cover illustration: Bicknell's thrush — Photo by Greg Campbell

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Adoption of a Recovery Plan per Section 15(9) of the Endangered Species Act

Species:

Bicknell's thrush (*Catharus bicknelli*)

Reference:

Environment and Climate Change Canada. 2020. Recovery Strategy for the Bicknell's Thrush (*Catharus bicknelli*) in Canada, Species at Risk Recovery Strategy Series, Environment and Climate Change Canada, Ottawa, viii + 96 pp.

Whereas a Species at Risk Act Recovery Strategy has been prepared for this species by Environment and Climate Change Canada, and that plan has been reviewed by members of the applicable Nova Scotia Recovery Team and determined to fulfil the requirements of Section 15(4) of the Endangered Species Act as they pertain to Nova Scotia, the above-named recovery strategy shall be adopted in lieu of a Nova Scotia Recovery Plan subject to the following:

Date of Adoption: 18 November 2020

Expiry/renewal Date: 18 November 2025

Conditions:

1. Adoption of this recovery plan will be reviewed 5 years from the Date of Adoption.
2. Only elements of this plan that are relevant to Nova Scotia and are in accordance with the Endangered Species Act (Nova Scotia) shall be used. This includes the following sections of the reports:

Environment and Climate Change Canada (2020). Species Description (3.1), Species Population and Distribution (3.2), Needs of the Bicknell's Thrush (3.3), Threat Assessment (4.1), Description of Threats (4.2), Population and Distribution Objectives (5), Strategic Direction for Recovery (6.2), Narrative to



Support the Recovery Planning Table (6.3), Identification of Critical Habitat (7.1). Activities Likely to Result in the Destruction of Critical Habitat (7.3), Measuring Progress (8), Critical Habitat for Bicknell's Thrush in Canada (Appendix C).

3. Should any additional requirements be identified the Nova Scotia Department of Lands and Forestry may prepare an addendum to this plan under the Endangered Species Act.

Approved:

Date:

A handwritten signature in black ink, appearing to read "D. Herburt".

18 November 2020

Appendix A:

Environment and Climate Change Canada. 2020. Recovery Strategy for the Bicknell's Thrush (*Catharus bicknelli*) in Canada, Species at Risk Recovery Strategy Series, Environment and Climate Change Canada, Ottawa, viii + 96 pp.

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

Bicknell's Thrush



2020



Government
of Canada

Gouvernement
du Canada

Canada

Recommended citation:

Environment and Climate Change Canada. 2020. Recovery Strategy for the Bicknell's Thrush (*Catharus bicknelli*) in Canada, *Species at Risk* Recovery Strategy Series, Environment and Climate Change Canada, Ottawa, viii + 96 pp.

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](https://www.sarregistry.gc.ca/)¹.

Cover illustration: Yves Aubry ©

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¹ www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html

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 Energy and Resource Development, and the Nova Scotia Department of Lands and Forestry, 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, SARA requires that critical habitat then be protected.

In the case of critical habitat identified for terrestrial species including migratory birds SARA requires that critical habitat identified in a federally protected area³ be described in the *Canada Gazette* within 90 days after the recovery strategy or action plan that identified the critical habitat is included in the public registry. A prohibition against

² www.canada.ca/en/environment-climate-change/services/species-risk-act-accord-funding.html#2

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

destruction of critical habitat under ss. 58(1) will apply 90 days after the description of the critical habitat is published in the *Canada Gazette*.

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

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

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

Acknowledgements

This recovery strategy was prepared by François Shaffer (Environment and Climate Change Canada, Canadian Wildlife Service – Quebec Region), based on a draft by Benoît Audet (private consultant). This document was made possible through the contributions of Yves Aubry, Martine Benoit, Bruno Drolet, Sébastien Paradis, Karine Picard, Josée Tardif, Charles Clavet, Geneviève Langlois and Vincent Carignan (Environment and Climate Change Canada, Canadian Wildlife Service – Quebec Region), Andrew Boyne, Sean Lemoine, Becky Whittam, Peter Thomas and Samara Eaton (Environment and Climate Change Canada, Canadian Wildlife Service – Atlantic Region), James Bridgland, Mathieu Côté, Edouard Daigle, Jean-Louis Provencher, Darroch Whitaker (Parks Canada Agency), Isabelle Gauthier and Jérôme Lemaître (Quebec Department of Forests, Wildlife and Parks), Scott Makepeace, Steve Gordon, Hubert Askanas and Maureen Toner (New Brunswick Department of Energy and Resource Development), Mark Elderkin (Nova Scotia Department of Energy and Resource Development), Manon Dubé, Véronique Lalande and Véronique Brondex (Environment and Climate Change Canada, Canadian Wildlife Service – National Capital Region) and Marie-José Ribeyron and Véronique Connolly (private consultants).

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. The species nests in dense high-elevation forests dominated by Balsam Fir (*Abies balsamea*) in Quebec, New Brunswick, Nova Scotia and the northeastern United States as well as in coastal lowland coniferous forests in Quebec and the Maritimes. 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 threats to the Bicknell's Thrush are agriculture and wood harvesting on the wintering grounds, forestry practices and the development of wind farms in the breeding range, and climate change. All of these threats contribute to habitat loss and degradation. Other threats include clearing for the development of recreational and telecommunications facilities on the breeding grounds and the presence of invasive exotic species on the wintering grounds. Further research is needed to determine the relative importance of existing and potential threats to the species and its habitat.

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 subsection 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 (2020-2030), 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 decrease occurs in the species' extent of occurrence⁴ throughout its range in Canada;
- in the long term (after 2030), ensure a positive population trend over 10 years, as well as a positive trend in the species' biological area of occupancy⁵, throughout its 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 "Strategic Direction for Recovery."

⁴ The area included in a polygon without concave angles that encompasses the geographic distribution of all known populations of a species (COSEWIC 2013).

⁵ The "biological" area of occupancy is the total area of habitat occupied by all existing populations. For a bird species, 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).

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 5-km radius of all coordinates representing a possible, probable or confirmed breeding record obtained over the period from 1995 to 2014. A 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 recognizes that there are unknowns related to 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 managed⁶ forests, and the size of the area therefore depends on how the forests are managed, including the nature of the silvicultural treatments applied. 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 $\pm 33,170$ 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

⁶ This document uses the expression "managed" forest rather than "industrial" forest, which was used in the COSEWIC Assessment and Status Report on the 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 considerable challenge, but it is reasonable to believe that avoidance or mitigation of the other threats, some of which have significant known 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 Thrush 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 (Lloyd and McFarland 2017).

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), Endangered 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).

The Bicknell's Thrush is also on the Red Watch List (species of greatest concern at the continental level) of Partners in Flight, a North American landbird conservation program (Rosenberg et al. 2016).

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 Species 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 range is equally restricted and located in the Greater Antilles, primarily the Dominican Republic (Hispaniola Island) (Figure 2; McFarland et al. 2013; Lloyd and McFarland 2017).

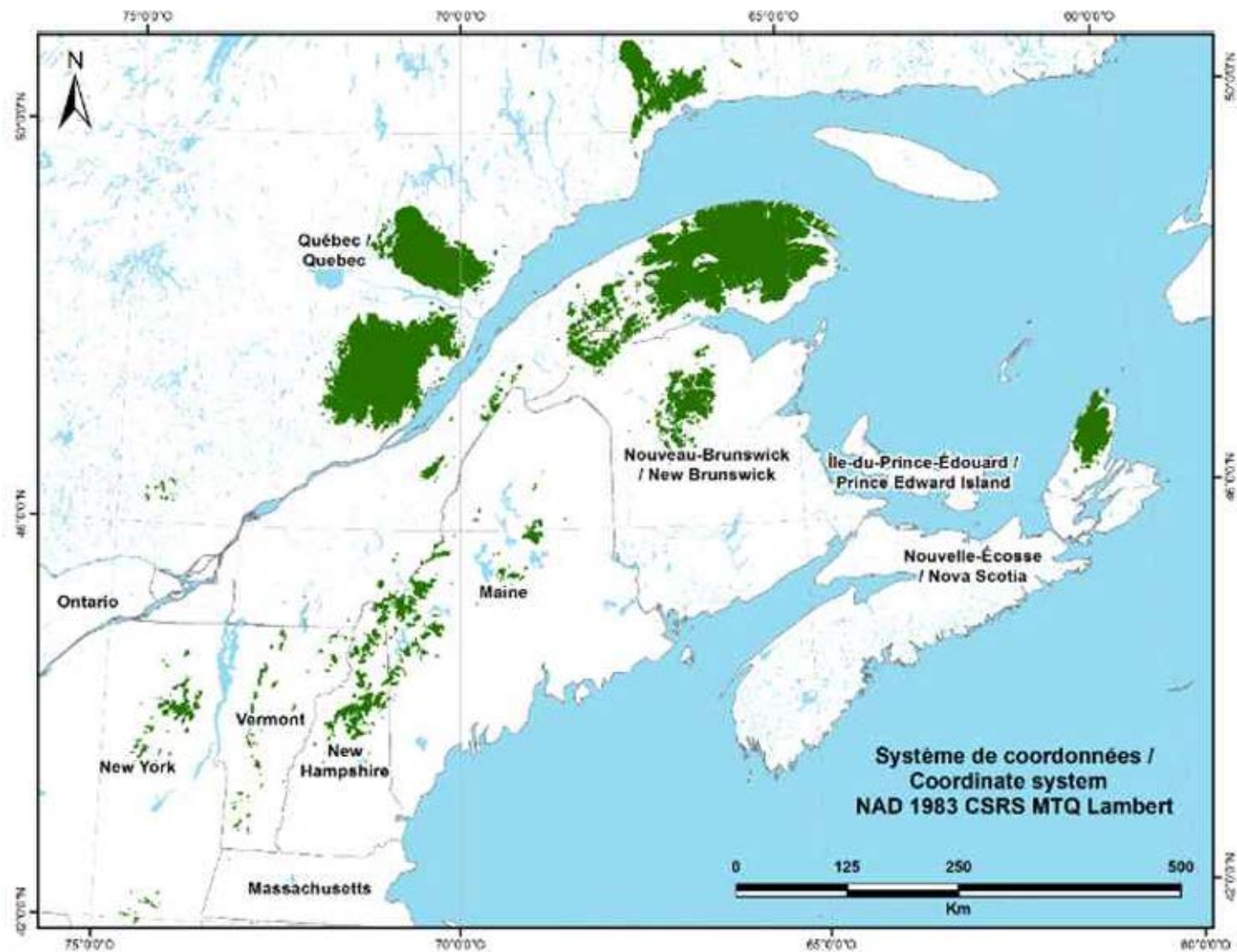


Figure 1. Bicknell's Thrush breeding range in Canada and the United States, in green (adapted based on Lambert et al. 2005, Hart et al. in preparation, and unpublished data from Environment and Climate Change Canada's Canadian Wildlife Service).

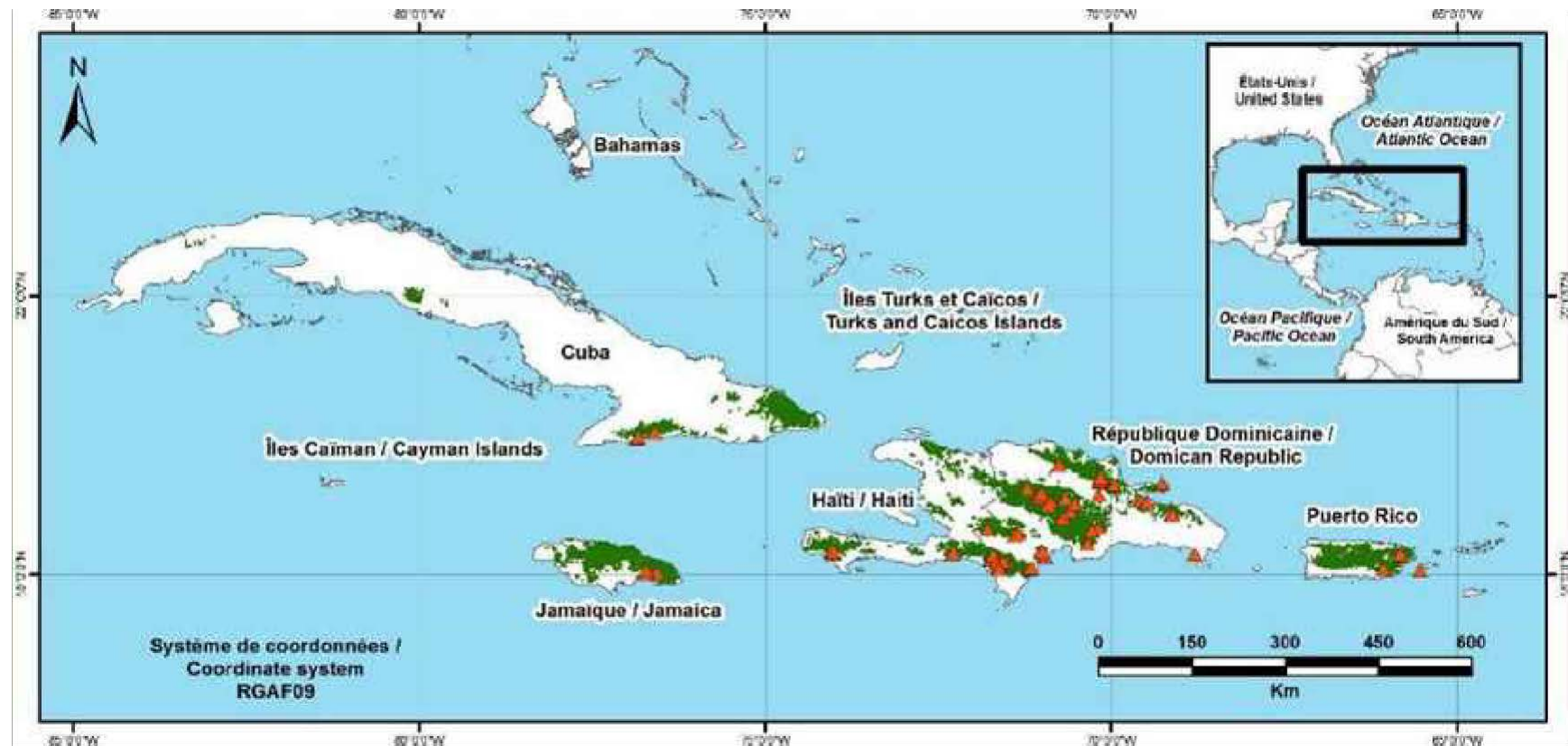


Figure 2. Potential wintering range of the Bicknell's Thrush in the Greater Antilles, in green. The black triangles indicate the known observation sites of the species (adapted from McFarland et al. 2013).

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 the species' skewed sex ratio (2–3 males per female), 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 2012.⁷ 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 Lloyd and McFarland 2017).

Data collected under the Mountain Birdwatch program between 2001 and 2010 in the United States show stable to increasing numbers across most of the U.S. range, except in the southern part of the Green Mountains (Lambert et al. 2017; D. Lambert, pers. comm. 2017).

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 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 greater than 380 m (IBTCG 2010; Lloyd and McFarland 2017). 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;

⁷ <https://wildlife-species.canada.ca/resultats-releve-oiseaux-nicheurs>

Sabo 1980; Connolly 2000; Nixon et al. 2001; Whittam and Ball 2003; Frey et al. 2008; Aubry and Paradis 2009; Y. Aubry unpubl. data).

- **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 [cf. 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; Townsend et al. 2015). The species also uses chronically disturbed stands of stunted trees (Townsend et al. 2015).

- **Mid- and high-elevation managed forests⁸**

Managed forests are defined as forests managed for wood or fibre production (COSEWIC 2009). The Bicknell's Thrush breeds in these forests affected by anthropogenic or natural disturbances, such as 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 krummholtz⁹.

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 high 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

⁸ The expression "mid- and high-elevation managed forests" includes commercial forests and productive high-elevation coniferous forests that are likely to be harvested at some point.

⁹ Thickets of wind-blown stunted, deformed trees that grow in mountainous or coastal habitat.

little specificity of habitat use (COSEWIC 2009; Townsend et al. 2015). 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 making the oceanic flight to their wintering grounds (Townsend et al. 2015). Northbound migrants apparently travel through eastern Florida and northward along the coastal plain (Evans 1994; Townsend et al. 2015). Some individuals fitted with geolocators flew from the wintering grounds to the central portion of the coastal plain and then cut inland before continuing their journey to their breeding sites (Townsend et al. 2015).

Wintering habitat

The forests occupied by the species on its wintering grounds span a series of successional and disturbance regimes, from undisturbed primary forest to moderately disturbed secondary forest (Townsend et al. 2015). 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 km² 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).

Limiting factors

The strong breeding site fidelity of the Bicknell's Thrush and its unusual mating system are limiting factors that could influence the species' survival and reproduction. Since this species shows considerable fidelity to breeding sites (Townsend et al. 2015), some individuals might try to nest in habitat that has become degraded, which could have a negative effect on their productivity. The mating system of the Bicknell's Thrush is unusual in that both females and males mate with multiple partners (Goetz et al. 2003). In this system, while females defend a home range during the breeding season, males do not defend conventional territories and a male's home range overlaps with that of several males and females (McFarland et al. 2008; Aubry et al. 2011). This results in a concentration of breeding individuals in the habitat; hence, any local habitat disturbance could affect many males and females at the same time.

4. Threats

4.1 Threat Assessment

Table 2. Threat Assessment Table

Threat	Level of Concern ^a	Extent	Occurrence	Frequency	Severity ^b	Causal Certainty ^c
Habitat loss or degradation						
Agriculture and wood harvesting 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 Anticipated (Nova Scotia)	Continuous	High	Medium
Climate change	Medium	Widespread	Anticipated	Continuous	Moderate	Low
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						
Invasive exotic species in 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

Threat	Level of Concern ^a	Extent	Occurrence	Frequency	Severity ^b	Causal Certainty ^c
Changes in ecological dynamics or natural processes						
Suppression of natural disturbance events	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

^a 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.

^b Severity: reflects the population-level effect (high: very large population-level effect, moderate, low, unknown).

^c 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.

Agriculture and wood harvesting in the wintering area

In the past, 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). Smallholder farming (not necessarily subsistence farming) and industrial agriculture (e.g., production of avocado, cocoa and coffee for export) result in loss of wintering habitat and are now considered threats of high concern for the species (Lloyd and McFarland 2017). Slash-and-burn agriculture is also a concern, but it seems to be less widespread in the wintering range than the other two types of farming (Lloyd and McFarland 2017). Wood harvesting (single-tree or small-group selection) for charcoal production is another threat that adds to the loss and degradation of wintering habitat (Lloyd and McFarland 2017).

Losses of original forest cover in the Greater Antilles have been estimated at >90% in the Dominican Republic, >98% in Haiti, ~75% in Jamaica, ~80% in Cuba and ~50% in Puerto Rico (see McFarland et al. 2013). The rate of deforestation is unlikely to

decrease in Haiti or the Dominican Republic 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 a 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, 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 thinning¹⁰—are a threat to this species (Aubry et al. 2016). 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 a regenerating forest to provide a suitable structure and density for the Bicknell's Thrush can vary among regions within the species' range. It has been estimated at 10 to 15 years in New Brunswick and Nova Scotia (forest 3.5 to 5 m tall; Campbell et al. 2005; Bredin and Whittam 2009), and about 20 years in Quebec (2 to 3 m tall), with climate factors and length of growing season varying by region and elevation.

Pre-commercial thinning and other stand tending operations at the sapling stage pose a threat to the species and its habitat, because they are carried out at a time when stem density is favourable to nesting and during the species' breeding season (Campbell et

¹⁰ 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.

al. 2005; Bredin and Whittam, 2009). 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 (Rousseau 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).

Although there are no specific studies on the different silvicultural treatments conducted in a forest management context, any such interventions that reduce fir stand density could have impacts on the Bicknell's Thrush and its habitat

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.

Construction of wind farms in the breeding range

The mountain tops used by the Bicknell's Thrush as breeding habitat are the site of wind farm construction. Wind power has experienced rapid growth over the past decade, and a number of wind farm projects have been 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). In Nova Scotia, 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. 2015).

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 habitat loss (Zimmerling et al. 2013) and may therefore have a negative effect on the Bicknell's Thrush. In addition, mortality resulting from collisions with wind turbines has been reported for various bird species (Zimmerling et al. 2013), and even though there are no known cases of Bicknell's Thrush mortality, the species may nonetheless be exposed to this risk (see also Collisions with human-made structures).

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 an 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 Bicknell's Thrush potential habitat 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.

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 breeding areas (Lloyd and McFarland 2017), 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).

There are several unknowns concerning the potential effects of climate change on the Bicknell's Thrush and further research is needed to better evaluate the impacts of this threat.

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 of

Quebec. 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 and digital televisions (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, direct mortality of a number of migratory bird species has occurred through collisions with telecommunication towers (Longcore et al. 2012; 2013) and although there are no known cases involving the Bicknell's Thrush, it can be assumed that the species is exposed to this risk (see also Collisions 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.

Invasive exotic species in the wintering area

Introduced invasive exotic species such as feral pigs, rats, cats and mongoose are widespread in forests used by the Bicknell's Thrush in its wintering range (Lloyd and McFarland 2017). Pigs cause habitat degradation through the disturbance they cause to understorey vegetation during foraging, and rats, cats and mongoose cause direct mortality (Lloyd and McFarland 2017). On the island of Hispaniola, five of the 53 (9.4%) Bicknell's Thrush individuals monitored with transmitters were predated by rats (Townsend et al. 2009).

Acid precipitation

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 Red Spruce (*Picea rubens*) needles (DeHayes et al. 1990; 1999), a species found in Bicknell's Thrush breeding habitat. This loss of needle calcium would reduce the spruce trees' tolerance to low temperatures, and studies have suggested that the decline in Red Spruce observed in most of its range in the past (Eager and Adams 1992) is related to this phenomenon (DeHayes et al. 1990; 1999). The threat posed by acid precipitation nonetheless seems less worrisome than in the past, since studies have shown that the control of emissions required under the *U.S. Clean Air Act* in the United States has resulted in reductions in acid deposition (Burns et al. 2011) and that there has been a reversal of forest-soil acidification in the northeastern United States (Lawrence et al. 2015). However, in Eastern Canada, the situation remains of concern as current rates of acid deposition in sensitive areas of this region still exceed critical loads (NEG-ECP, 2007; Keys et al. 2016).

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, collisions with human-made structures such as wind turbines and communication towers (see Construction of wind farms and Development for telecommunications in the breeding range) as well as other vertical structures represent a source of mortality for various bird species (Calvert et al. 2013) and could adversely affect the Bicknell's Thrush.

Suppression of natural disturbance events

Control of 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. Suppression of natural disturbance events (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's Thrush eggs and nests (Y. Aubry unpubl. data; Vermont Center for Ecostudies, unpubl. 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 (Townsend et al. 2015). 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 (Townsend et al. 2015). 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 (Townsend et al. 2015), 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.

5. Population and Distribution Objectives

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

- in the short term (2020-2030), 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 decrease occurs in the species' extent of occurrence throughout its range in Canada;
- in the long term (after 2030), ensure a positive population trend over 10 years, as well as a positive trend in the species' biological area of occupancy, throughout its 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). Given that the population objectives are based on the species' population trends, the recovery strategy includes approaches for improving population monitoring. The long-term objectives involve ensuring a positive 10-year trend. Restoring the population to its previous known maximum level is not an objective since, in large part, the habitat losses on the species' wintering and breeding grounds cannot easily be reversed.

The short-term distribution objectives for the Bicknell's Thrush are based on the extent of occurrence and the long-term objectives on the biological area of occupancy. Since the population could decrease further in the short term, it is preferable to use the species' extent of occurrence which encompasses the distribution of all known populations. Since a positive trend is targeted in the long term, the decision was made to use the biological area of occupancy, the parameter that best reflects the distribution of the species, which occupies only a small portion of its extent of occurrence owing to its specific habitat requirements, its strong fidelity to its breeding sites and its unusual mating system (see 3.3 Needs of the Bicknell's Thrush). Finally, 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 population 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 habitat on its breeding and wintering grounds. These uncertainties have been identified in the assessment of the feasibility of recovery (see that section, p. vi).

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 (Lloyd and McFarland 2017).
- The Conservation Action Plan for Bicknell's Thrush was published in 2010 (IBTCG 2010), followed by a revised version in 2017 (Lloyd and McFarland 2017).
- 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 and other types of conservation activities may be undertaken (IBTCG 2010; Broeckaert 2011; Bussière 2012; Julien et al. 2014; Julien 2015; Julien and Perreault 2015; Y. Aubry, pers. comm. 2015).
- The Bicknell's Thrush Habitat Protection Fund was created in the United States in 2005 and liquidated in 2015. The fund was administered by the Adirondack Community Trust, and its primary purpose was 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; Pesca Environnement 2013).

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

Population monitoring

- Bird Studies Canada's High Elevation Landbird Program (HELP) was undertaken between 2002 and 2011 in Nova Scotia and New Brunswick (Campbell and Stewart 2012). A new, improved survey methodology (Mountain BirdWatch 2.0), based on the new protocol 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 Regroupement QuébecOiseaux since 1989 (e.g., Perreault 2013; RQO 2014; 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 research projects on the Bicknell's Thrush have been undertaken in a number of regions in southern Quebec and in the Maritimes (including Rompré et al. 1999; Connolly 2000; Nixon et al. 2001; Connolly et al. 2002; Gardiner 2005; Chisholm and Leonard 2008; McKinnon 2009; Aubry et al. 2011; Arkansas 2012; McKinnon et al. 2014; Aubry et al. 2016).
- 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 being carried out on the impact of climate change on Bicknell's Thrush critical habitat in New Brunswick and Quebec (J.A. Tremblay [Environment and Climate Change Canada] and Y. Boulanger [Natural Resources Canada]).
- A study is underway on the pre-migratory habitat of the Bicknell's Thrush in the Montmorency Forest (J.A. Tremblay and Y. Aubry [Environment and Climate Change Canada] and A. Desrochers [Université Laval]).

- A study is being carried out on the migratory routes of three thrush species (including Bicknell's Thrush) in the St. Lawrence Valley and the Great Lakes during fall migration (Camille Bégin-Marchand, M.Sc. candidate, Université Laval; under the supervision of A. Desrochers and J.A. Tremblay).
- A study is underway to estimate Bicknell's Thrush occupancy rates in managed forests in northern New Brunswick (Chelsae Postma, M.Sc. candidate, University of New Brunswick, under the supervision of A.W. Diamond).
- A study is being carried out on the characteristics of the home ranges of male and female Bicknell's Thrush in New Brunswick (Chris Ward, M.Sc. candidate, University of New Brunswick, under the supervision of A.W. Diamond).

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 two versions of the Conservation Action Plan for Bicknell's Thrush (IBTCG 2010; Lloyd and McFarland 2017) prepared by the International Bicknell's Thrush Conservation Group.

Table 3. Recovery Planning Table

Threat or Limiting Factor	Broad Recovery Strategy	Priority ^a	General Description of Research and Management Approaches
All threats Knowledge gaps	Monitoring and research	High	<p>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:</p> <ul style="list-style-type: none"> - Determine the distribution and size of the population as well as their trends in the breeding range and wintering area; - Estimate the following demographic parameters: survival (adult and juvenile), recruitment and reproductive success; - Determine the relative importance of the existing and potential threats to the species and its habitat; - Determine whether the unthinned habitat remaining after pre-commercial thinning^b 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	<ul style="list-style-type: none"> - Identify the primary migration routes and increase knowledge related to migration chronology.

Threat or Limiting Factor	Broad Recovery Strategy	Priority ^a	General Description of Research and Management Approaches
All threats	Conservation and management	High	<ul style="list-style-type: none"> - 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	<ul style="list-style-type: none"> - 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	<ul style="list-style-type: none"> - 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	<ul style="list-style-type: none"> - Promote compliance with environmental acts, regulations and policies, in particular the <i>Migratory Birds Convention Act, 1994</i>^c 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.

^a "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.

^b Pre-commercial thinning carried out in strips will create a habitat mosaic of unthinned stands and thinned stands.

^c Environment and Climate Change Canada's website on avoidance guidelines: <https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/guidelines.html>.

6.3 Narrative to Support the Recovery Planning Table

Bicknell's Thrush recovery will require commitment and collaboration among international, federal and provincial jurisdictions, Indigenous peoples, 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. Certain characteristics of the different habitat types have yet to be confirmed (e.g., the relationship between the probability of occurrence of the species, latitude and forest elevation). The characteristics of the types of habitat used by the species in its range during the post-breeding and migration periods are not well known and merit study since these habitats could play an important role in the species' recovery. Knowledge about the wintering habitat must also be improved. Given the limited availability of wintering habitat and the serious threats to this habitat, research to improve knowledge thereof 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 are needed. To that end, a landscape¹¹ approach will have to be adopted. Conservation and management approaches should focus on maintaining known Bicknell's Thrush breeding sites as long as possible. 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.

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.

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 and where this proves necessary. While some silvicultural treatments pose a threat to the Bicknell's Thrush, forest management practices that encourage the establishment of dense stands dominated by Balsam Fir could help to create habitat for the species. 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 agriculture and wood harvesting 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, cats and mongoose on the wintering grounds and the risk of collisions with communication towers and wind turbines. The presence of environmental contaminants, such as mercury and lead, and acid precipitation raise 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, monitoring of species at risk (SOS-POP; RQO 2014) 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 policies and programs aimed at reducing greenhouse gas emissions and pollutants responsible for acid precipitation as well as the accumulation of mercury, and the existing policies and programs related to development in the natural environment (e.g., wind farms, telecommunication towers). In addition, appropriate policies and programs should be developed 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 Bicknell's Thrush has a clumped distribution, 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 evidence in order to 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 is 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 is determined on the basis of all breeding records obtained during at least one breeding season (June 1 to August 15). 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 activities 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 conifer-dominated mixedwood stands primarily composed of 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** (approximate elevation ≥ 750 m in New Brunswick, ≥ 340 m in Nova Scotia and ≥ 750 m in Quebec)
 - Dense coniferous forests ($> 10,000$ stems/ha), typically not managed for forest harvesting. They may consist of regenerating fir waves (c.f. Sprugel 1976). On some sites, such as exposed ridgelines or along the edges of human-created openings, they can be characterized by the presence of stunted firs deformed by high winds and heavy winter snow and ice accumulation. These stands are also characterized by the short 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.
- **Mid- and high-elevation managed forests** (approximate minimum elevation ≥ 380 m depending on the region)
 - Dense coniferous stands ($> 10,000$ stems/ha), generally managed for timber harvesting, characterized by dense Balsam Fir regeneration and the presence of standing conifer snags 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.

Or

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

- Dense (> 10,000 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** (approximate elevation < 380 m)
 - Dense (> 10,000 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.

At the local 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 a clumped distribution (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 both scales. It must also include habitats that, although they do not currently have biophysical attributes suitable for 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 Bicknell's Thrush record 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. To this end, it is important to conserve habitat used by the species as long as possible. 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 mid- and high-elevation managed forests and for coastal lowland forests remains unknown. However, 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 5-km radius 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 5-km radius 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 included in the schedule of studies (section 7.2).

The biophysical attributes of habitat during the post-breeding period are not known. An activity was included 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 derived from 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 shaded yellow polygons shown on each map, where the critical habitat identification criteria and methodology described in section 7.1 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, unforested portion of 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 length of the radius should be modified.	2020-2025
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.	2020-2025
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.	2020-2025
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.	2020-2025
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.	2020-2025

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 (> 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.

Bicknell's Thrush critical habitat in mid- and 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. The focus should be on maintaining suitable habitat used by the Bicknell's Thrush as long as possible.

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 (> 10,000 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 mid- and 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 (> 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 human 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 and stand tending operations at the sapling stage	<p>Direct impact on critical habitat, whether it is considered suitable habitat or potentially suitable habitat.</p> <p>Given that the Bicknell's Thrush occurs in forests with a high stem density ($> 10,000$ stems/ha), a forest whose stem density has been reduced to less than 10,000 stems/ha no longer has the biophysical attributes of critical habitat for the species.</p>	<p>Destruction of critical habitat.</p> <p>Once the landscape-scale habitat requirements have been determined, it may be found that pre-commercial thinning outside the breeding season will not result in the destruction of critical habitat, provided that long-term planning of forestry operations ensures the availability of sufficient suitable habitat over time and within the critical habitat boundaries. However, forestry interventions should be avoided in habitat known to have been recently occupied by Bicknell's Thrushes.</p>
Clearcutting and other types of cutting aimed at reducing stem density	<p>Direct impact on critical habitat by reducing the amount of suitable habitat available.</p> <p>Certain types of treatments can reduce stem density and create canopy openings, which modifies suitable breeding habitat for the Bicknell's Thrush or reduces its area. The larger the area treated, the higher the habitat loss and the greater the risk of homogenization of the landscape.</p> <p>In mixedwood stands (dominated by fir), forest harvesting can favour the regeneration of deciduous species to the detriment of fir.</p> <p>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 attributes of the critical habitat.</p>	<p>Degradation or destruction of critical habitat.</p> <p>Once the landscape-scale habitat requirements are determined, clearcutting or some other type of cutting aimed at reducing stem density 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.</p>

Description of Activity	Description of Effect	Details of Effect
	<p>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.</p> <p>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.</p>	
Activities aimed at reducing the impact of insect pests on forests (e.g., Spruce Budworm)	<p>Direct impact on critical habitat, whether it is considered suitable habitat or potentially suitable habitat.</p> <p>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. This is true of preventive measures aimed at encouraging the growth of spruce to the detriment of fir and modifying stand composition.</p>	<p>Degradation or destruction of critical habitat.</p> <p>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.</p>
Tending and sanitation operations	<p>Direct impact on critical habitat considered potentially suitable habitat and on the availability of critical habitat considered suitable habitat.</p> <p>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.</p>	<p>Degradation or destruction of critical habitat.</p> <p>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.</p> <p>A vegetation management activity carried out in habitat known to have been recently occupied by Bicknell's Thrushes would be</p>

Description of Activity	Description of Effect	Details of Effect
	<p>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.</p> <p>The application of herbicides and other vegetation control measures also have an impact on stand density, on the tree species present in the stands immediately following treatments and on stand development. The amount of suitable habitat and potentially suitable habitat can therefore be affected.</p>	<p>considered an activity likely to destroy critical habitat.</p>
Forest road / access road construction	<p>Direct impact on critical habitat by reducing the amount of suitable habitat available.</p> <p>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.</p>	<p>Destruction of critical habitat.</p> <p>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.</p> <p>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, as long as the density of fir stands along roads and highways is not reduced.</p>
Transmission line construction	<p>Direct impact on critical habitat by reducing the amount of suitable habitat available.</p> <p>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.</p>	<p>Destruction of critical habitat.</p> <p>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.</p>

Description of Activity	Description of Effect	Details of Effect
		Maintenance of existing transmission lines is not considered an activity that is likely to result in the destruction of critical habitat.
Clearing for wind turbine and communications tower corridors	<p>Direct impact on critical habitat by reducing the amount of suitable habitat available.</p> <p>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.</p>	<p>Destruction of critical habitat.</p> <p>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.</p> <p>Maintenance of already cleared areas around wind farms and communications towers is not considered an activity that is likely to result in the destruction of critical habitat.</p>
Trail development, ski area development	<p>Direct impact on critical habitat by reducing the amount of suitable habitat available.</p> <p>The creation of trails or ski runs requires the felling of stands in areas targeted for this type of development.</p> <p>Habitat alterations become permanent and irreversible.</p>	<p>Destruction of critical habitat.</p> <p>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.</p> <p>Maintenance of already cleared areas around trails and ski resorts is not considered an activity that is likely to result in the destruction of critical habitat.</p>

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 2020 to 2030
2. No decrease has occurred in the species' extent of occurrence throughout its Canadian range from 2020 to 2030.

In the long term

- 1) After 2030 a positive 10-year population trend, measured by BBS and other available data (e.g., targeted surveys) is achieved (i.e., the population is increasing).
- 2) After 2020 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.

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

Table C-1. Description of 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.

Identification Code for Critical Habitat Units ^a	Critical Habitat Unit Area (ha) ^b	Land Tenure ^c
QC-01	7854	Non-federal land
QC-02	9164	Non-federal land
QC-03	8478	Non-federal land
QC-04	7854	Non-federal land
QC-05	8858	Non-federal land
QC-06	8388	Non-federal land
QC-07	7879	Federal and non-federal land
QC-08	7854	Non-federal land
QC-09	12397	Non-federal land
QC-10	28574	Non-federal land
QC-11	29772	Non-federal land
QC-12	13210	Non-federal land
QC-13	7911	Non-federal land
QC-14	17967	Non-federal land
QC-15	86337	Non-federal land
QC-16	9917	Non-federal land
QC-17	22522	Non-federal land
QC-18	14922	Non-federal land
QC-19	7854	Non-federal land
QC-20	80704	Non-federal land
QC-21	17992	Federal and non-federal land
QC-22	13898	Non-federal land
QC-23	7854	Non-federal land
QC-24	35631	Non-federal land
QC-25	10616	Non-federal land
QC-26	15459	Non-federal land

Identification Code for Critical Habitat Units^a	Critical Habitat Unit Area (ha)^b	Land Tenure^c
QC-27	44057	Non-federal land
QC-28	7854	Non-federal land
QC-29	7854	Non-federal land
QC-30	8886	Non-federal land
QC-31	13467	Non-federal land
QC-32	7854	Non-federal land
QC-33	46325	Non-federal land
QC-34	16353	Non-federal land
QC-35	88385	Non-federal land
QC-36	10668	Non-federal land
QC-37	7854	Non-federal land
QC-38	7854	Non-federal land
QC-39	33129	Non-federal land
QC-40	9807	Non-federal land
QC-41	13335	Federal (Forillon National Park of Canada) and non-federal land
QC-42	9512	Non-federal land
QC-43	7854	Non-federal land

^a The unit identification code is composed of the abbreviation for the province followed by a unique number.

^b The area shown is that of an entire critical habitat unit (rounded to the nearest hectare). It is an approximation obtained by drawing a 5-km radius around each observation meeting the habitat occupancy criteria (section 7.1.1). The actual area of critical habitat may be much 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.

^c Land tenure is provided as an approximation of the types of land ownership that exist where critical habitat has been identified 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 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.

Identification Code for Critical Habitat Units ^a	Critical Habitat Unit Area (ha) ^b	Land Tenure ^c
NB-01	7893	Federal and non-federal land
NB-02	7867	Non-federal land
NB-03	7824	Non-federal land
NB-04	138645	Non-federal land
NB-05	18533	Non-federal land
NB-06	7820	Non-federal land
NB-07	8524	Non-federal land
NB-08	26408	Non-federal land
NB-09	14061	Non-federal land
NB-10	71232	Non-federal land
NB-11	7811	Non-federal land

^a The unit identification code is composed of the abbreviation for the province followed by a unique number.

^b The area shown is that of an entire critical habitat unit (rounded to the nearest hectare). It is an approximation obtained by drawing a 5-km radius around each observation meeting the habitat occupancy criteria (section 7.1.1). The actual area of critical habitat may be much 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.

^c Land tenure is provided as an approximation of the types of land ownership that exist where critical habitat has been identified 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 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.

Identification Code for Critical Habitat Units ^a	Critical Habitat Unit Area (ha) ^b	Land Tenure ^c
NS-01	11606	Federal and non-federal land
NS-02	14558	Non-federal land
NS-03	7831	Federal (Cape Breton Highlands National Park of Canada) and non-federal land
NS-04	148656	Federal (Cape Breton Highlands National Park of Canada) and non-federal land
NS-05	7852	Federal and non-federal land

^a The unit identification code is composed of the abbreviation for the province followed by a unique number.

^b The area shown is that of an entire critical habitat unit (rounded to the nearest hectare). It is an approximation obtained by drawing a 5-km radius around each observation meeting the habitat occupancy criteria (section 7.1.1). The actual area of critical habitat may be much 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.

^c Land tenure is provided as an approximation of the types of land ownership that exist where critical habitat has been identified and should be used for guidance purposes only. Accurate land tenure will require cross referencing critical habitat boundaries with surveyed land parcel information.

Figures showing Bicknell's Thrush critical habitat in Canada

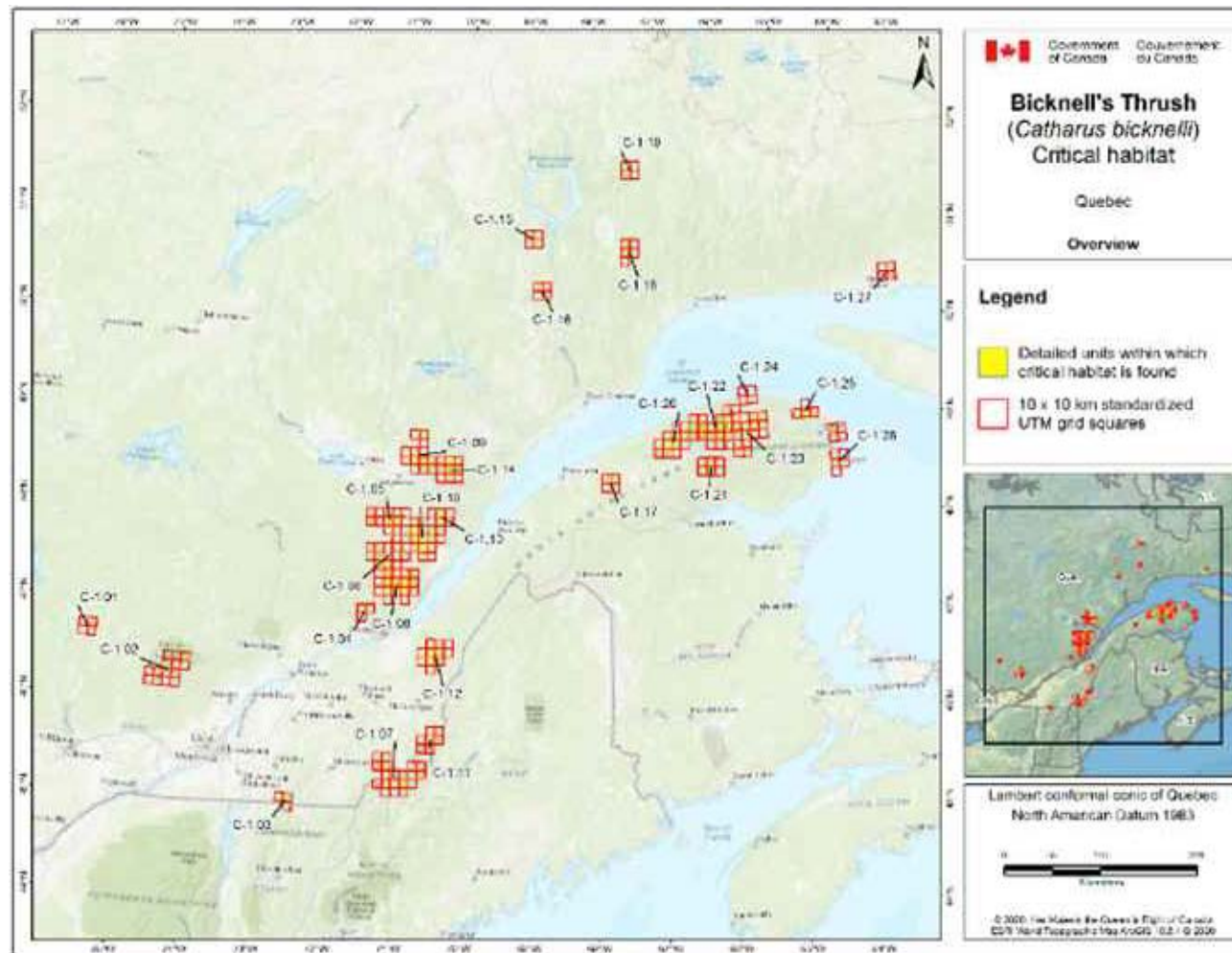


Figure C-1. Critical habitat for the Bicknell's Thrush in Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met.

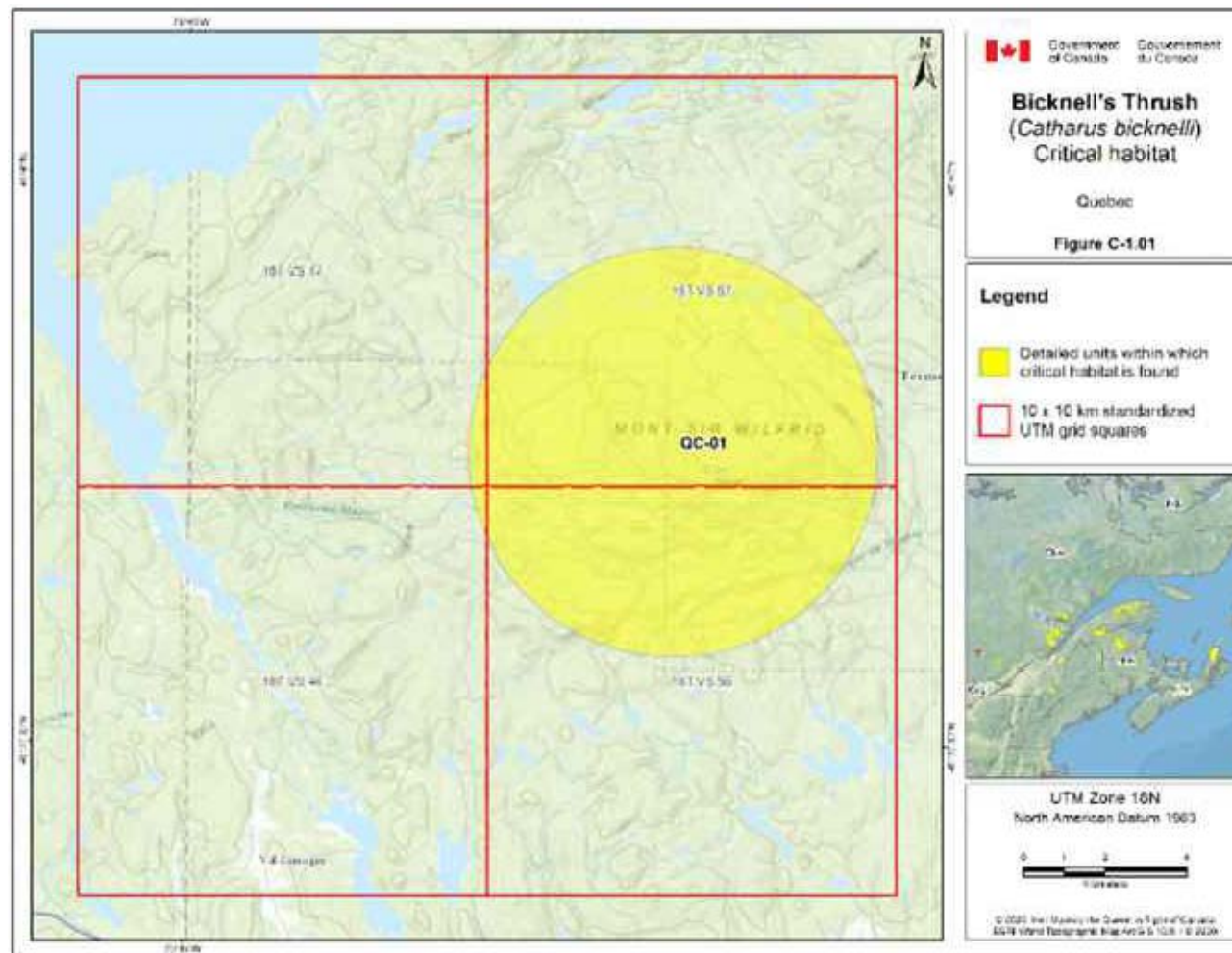


Figure C-1.01. Critical habitat for the Bicknell's Thrush in Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

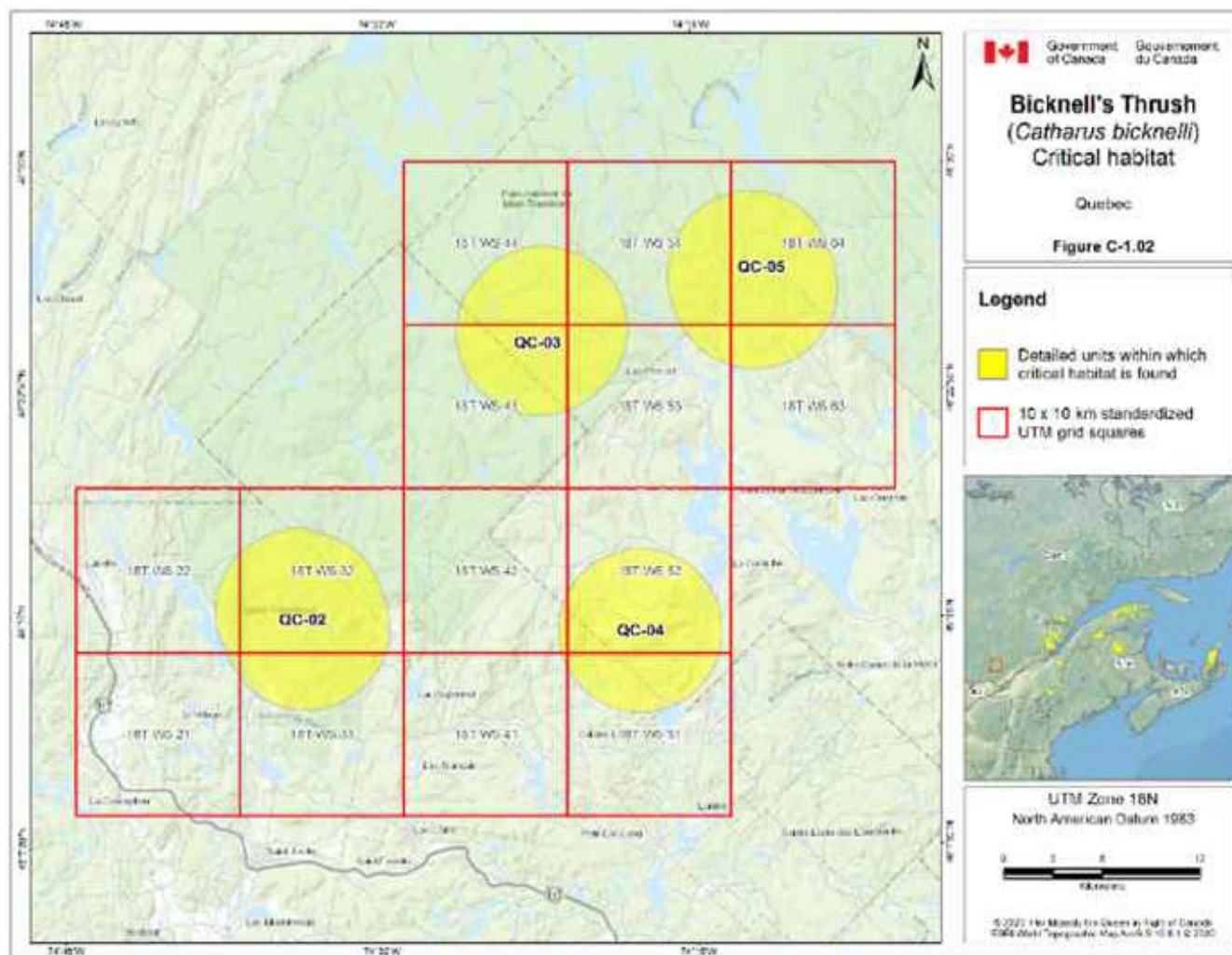


Figure C-1.02. Critical habitat for the Bicknell's Thrush in Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

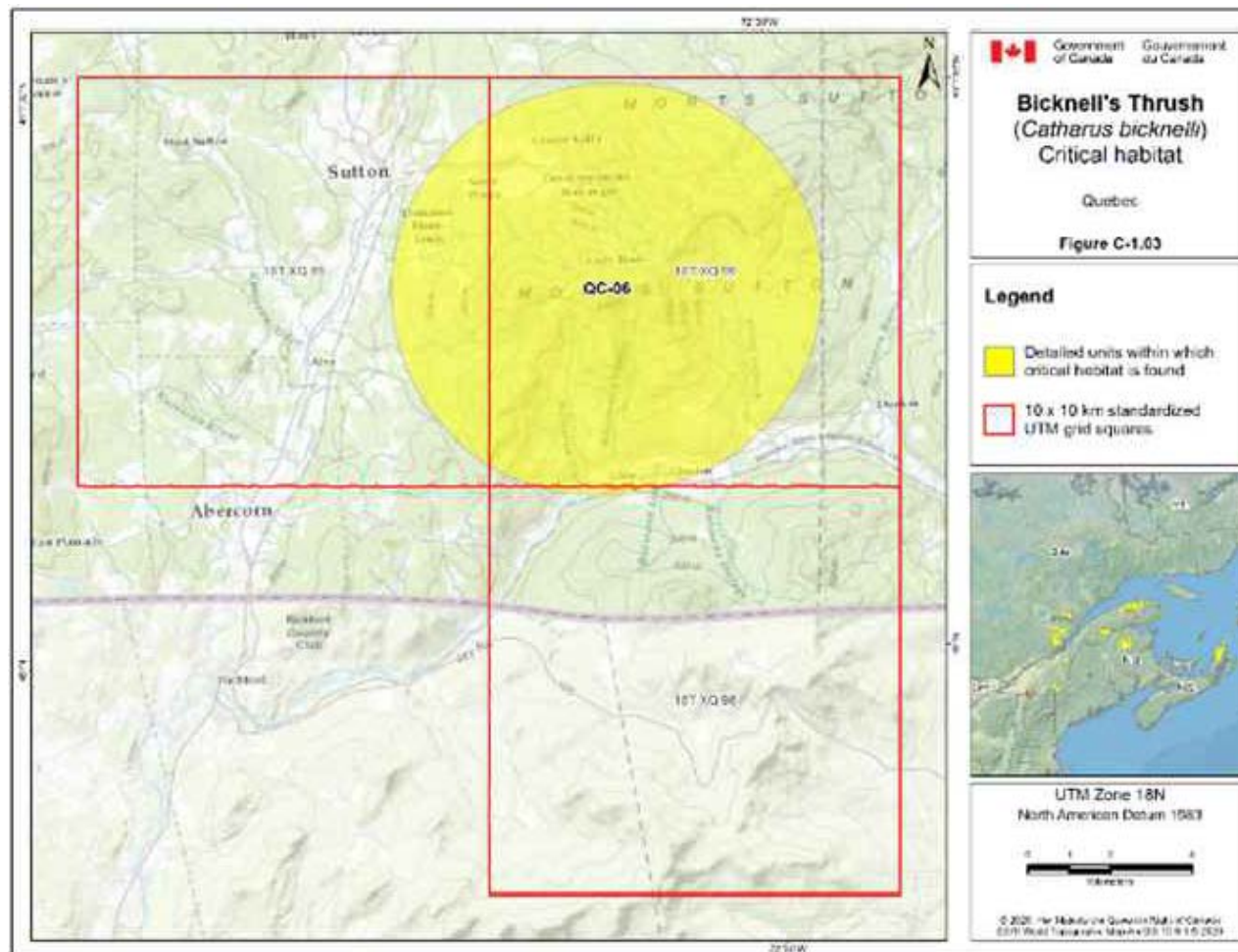


Figure C-1.03. Critical habitat for the Bicknell's Thrush in Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

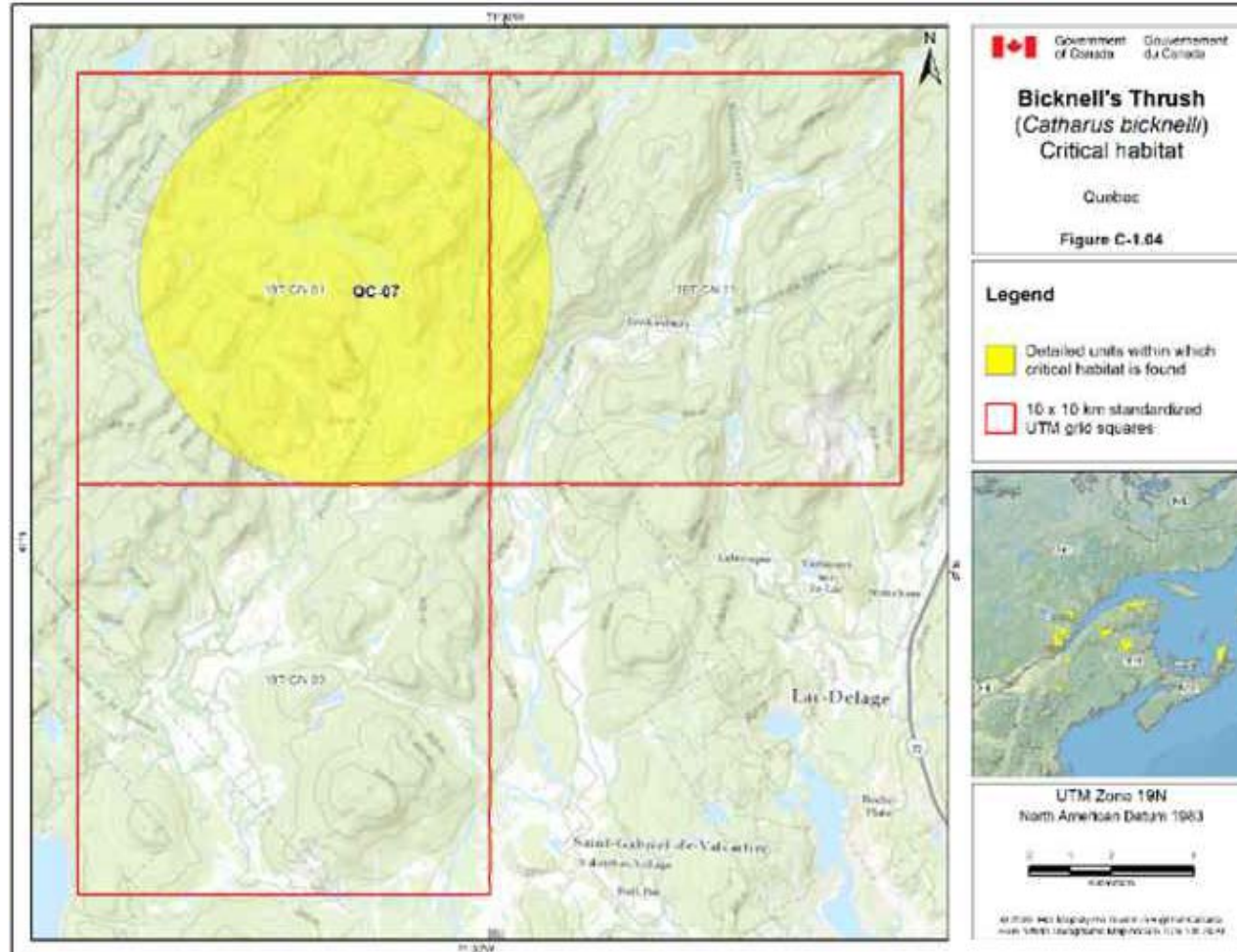


Figure C-1.04. Critical habitat for the Bicknell's Thrush in Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

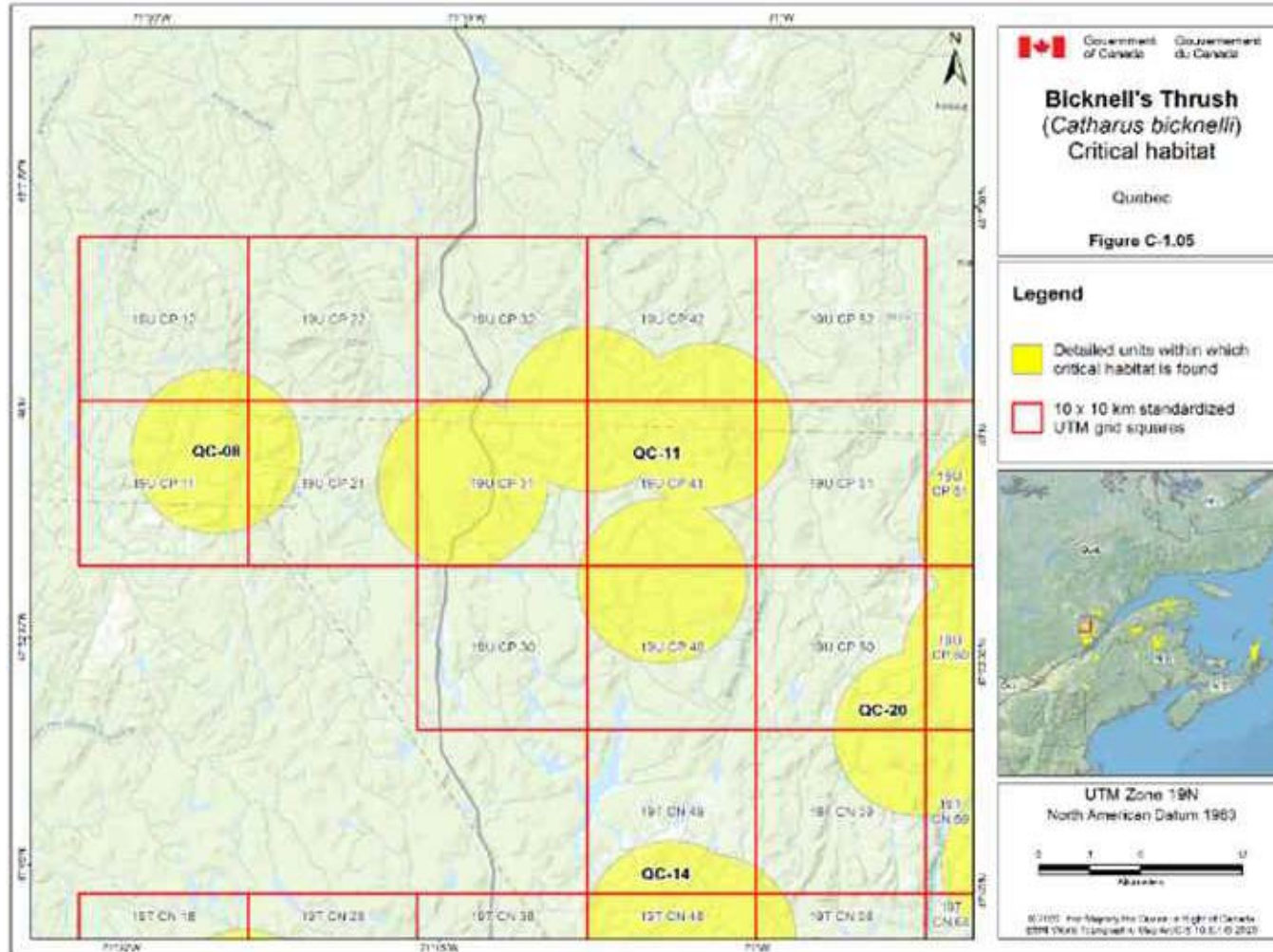


Figure C-1.05. Critical habitat for the Bicknell's Thrush in Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

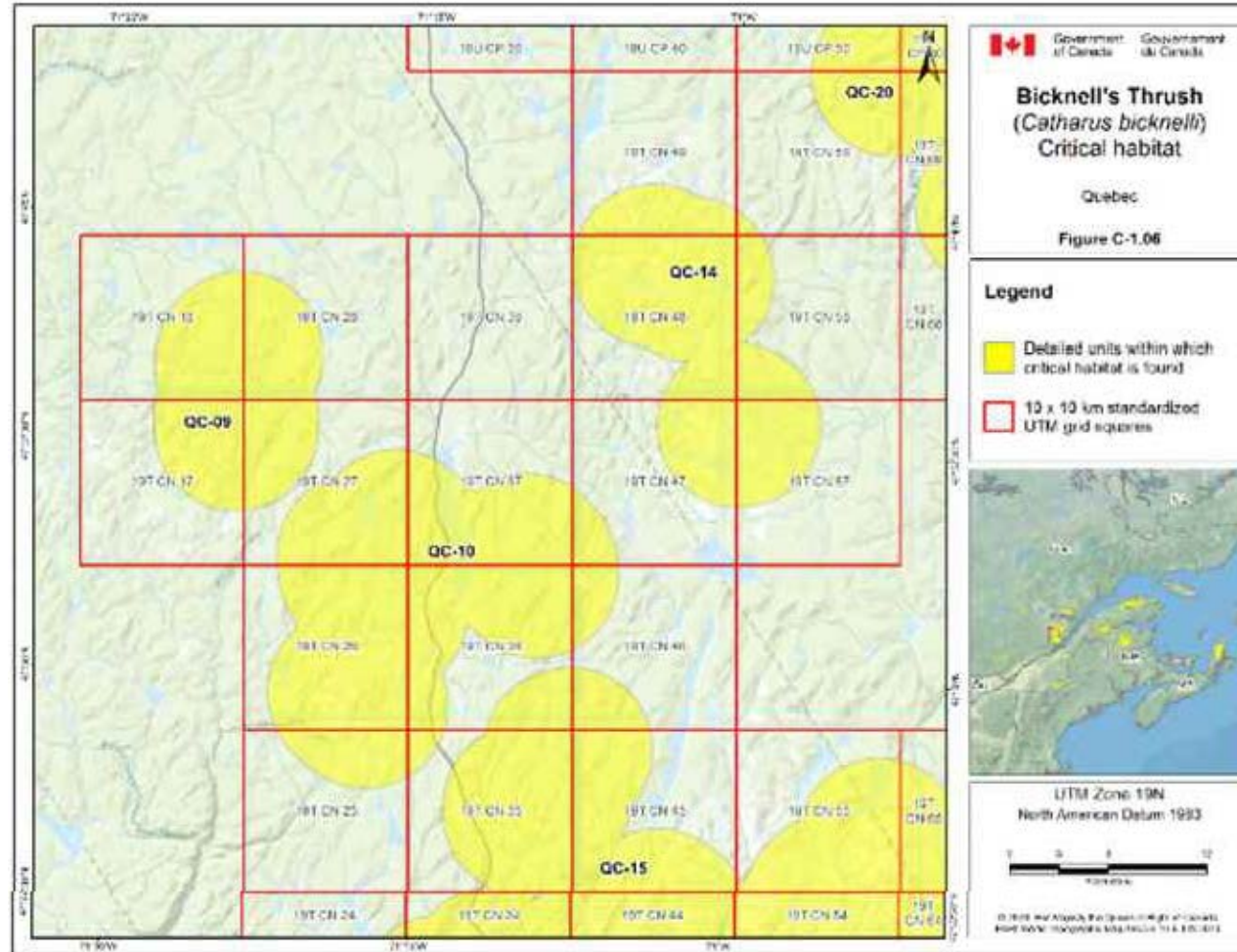


Figure C-1.06. Critical habitat for the Bicknell's Thrush in Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

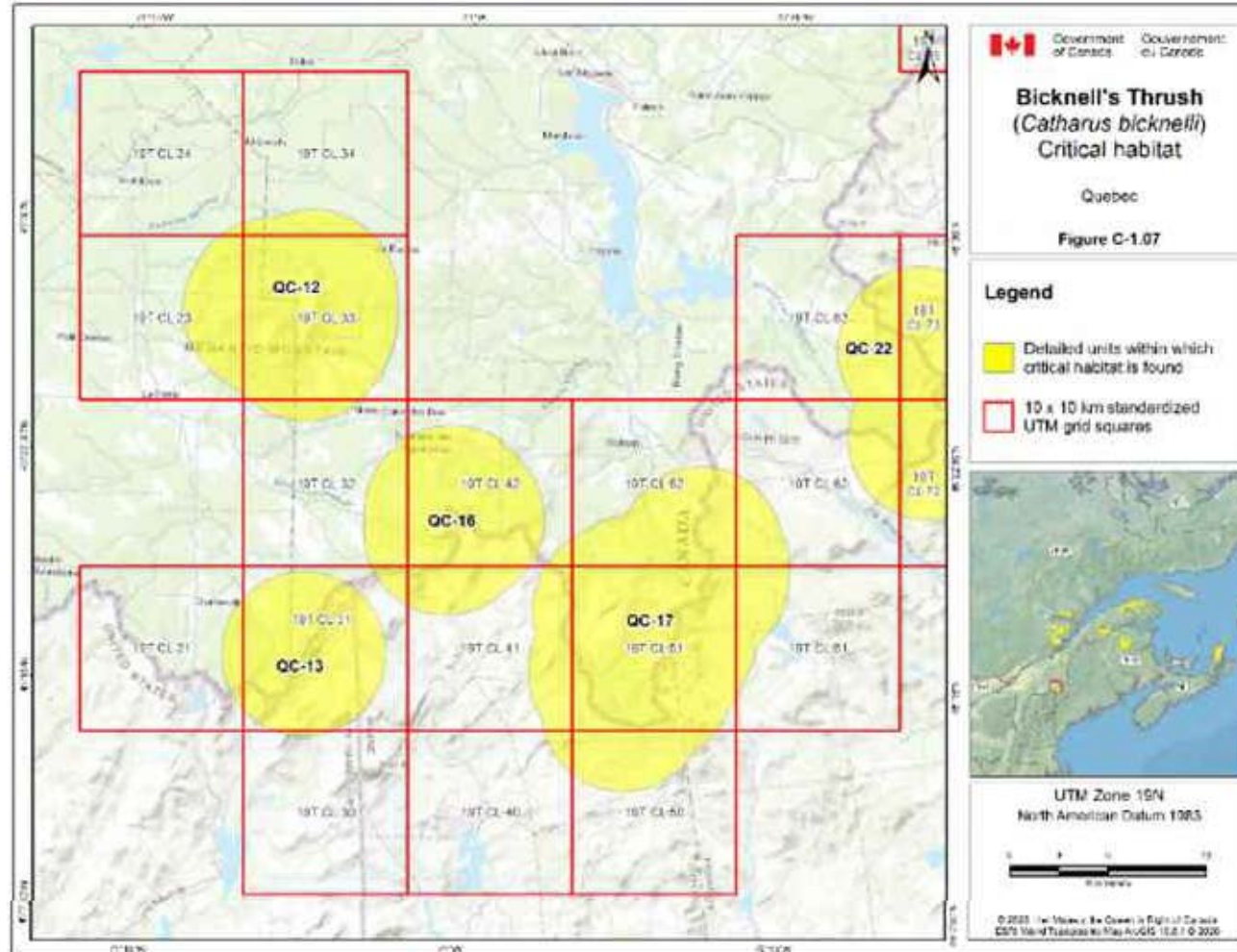


Figure C-1.07. Critical habitat for the Bicknell's Thrush in Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

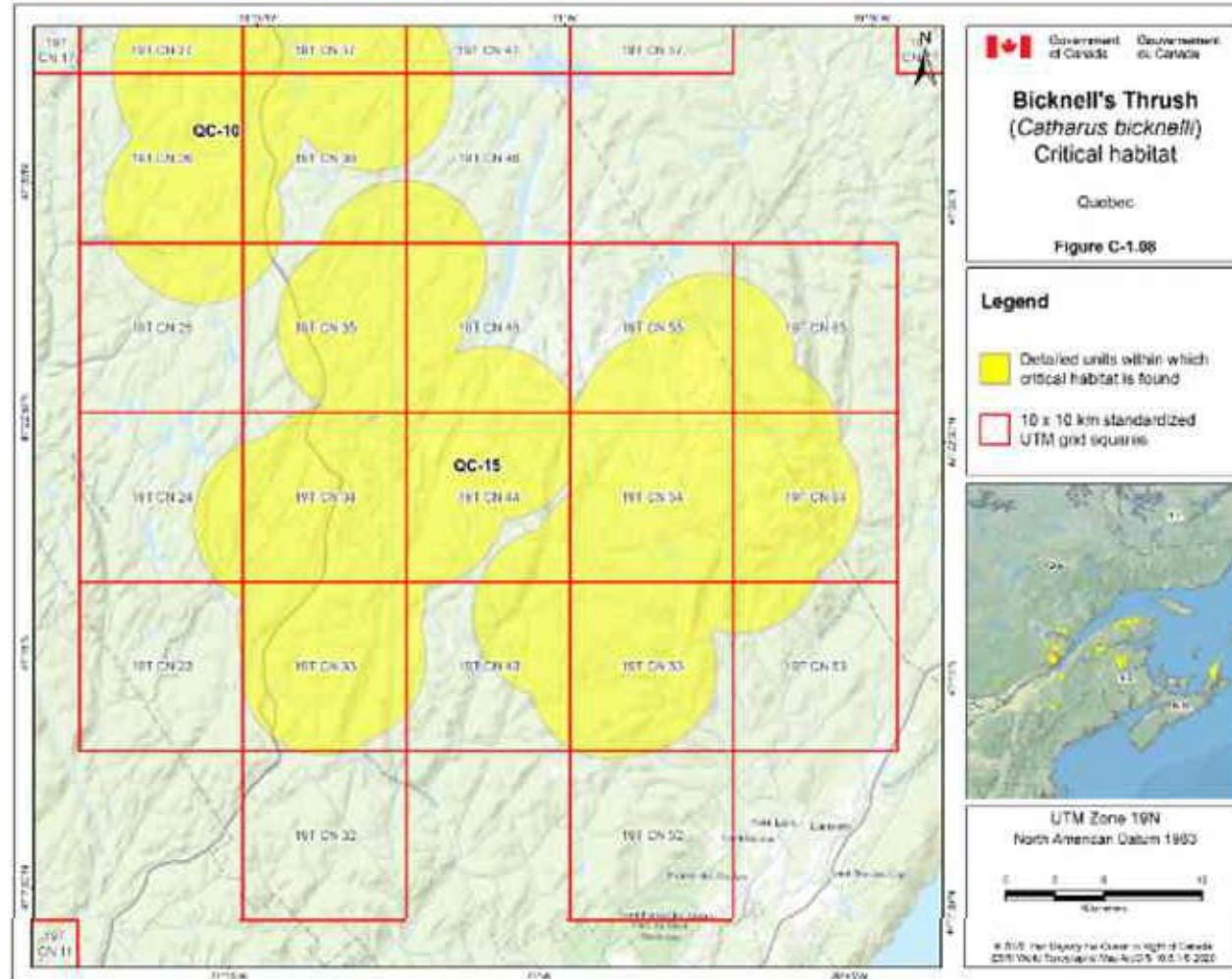


Figure C-1.08. Critical habitat for the Bicknell's Thrush in Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

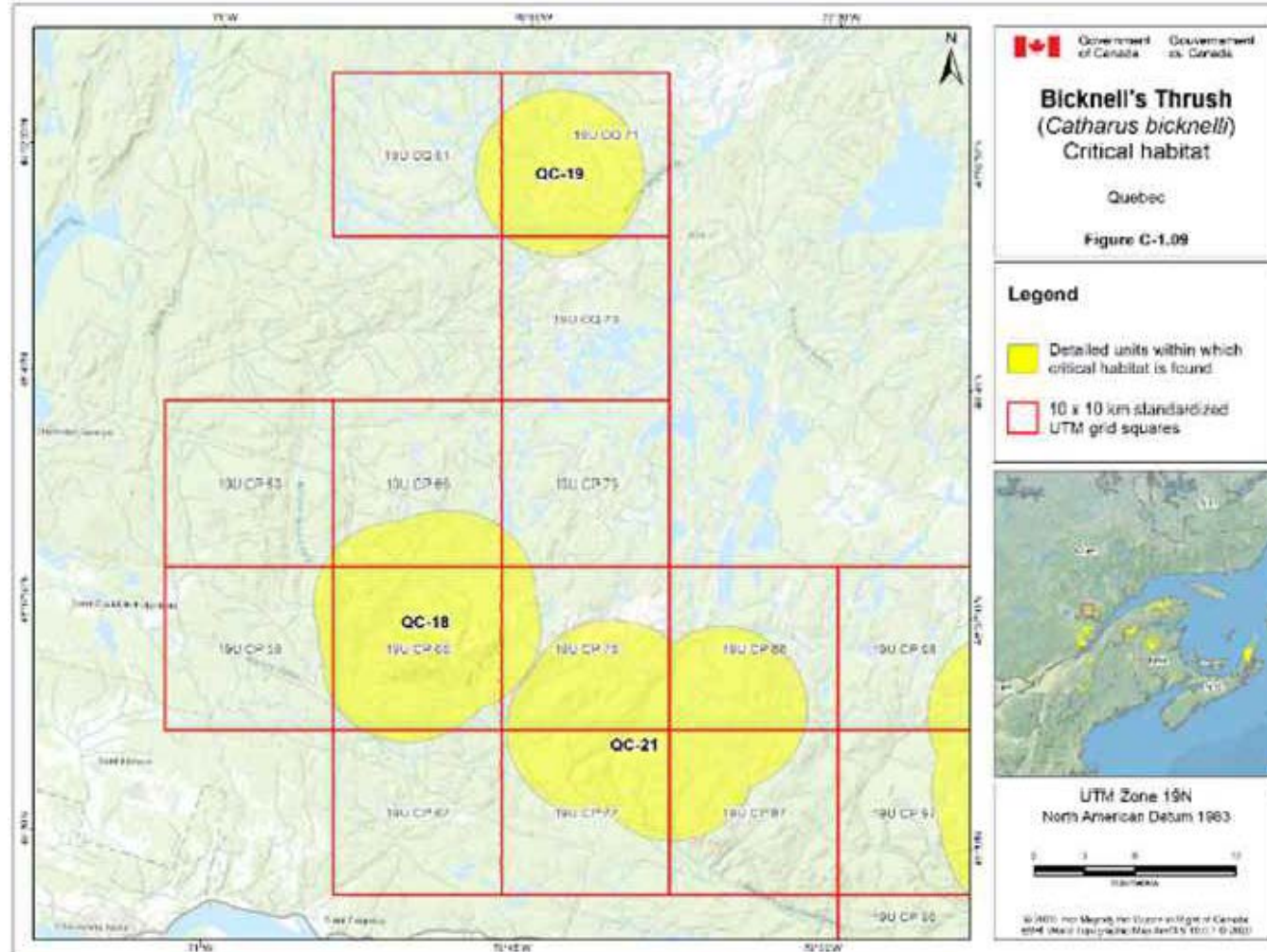


Figure C-1.09. Critical habitat for the Bicknell's Thrush in Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

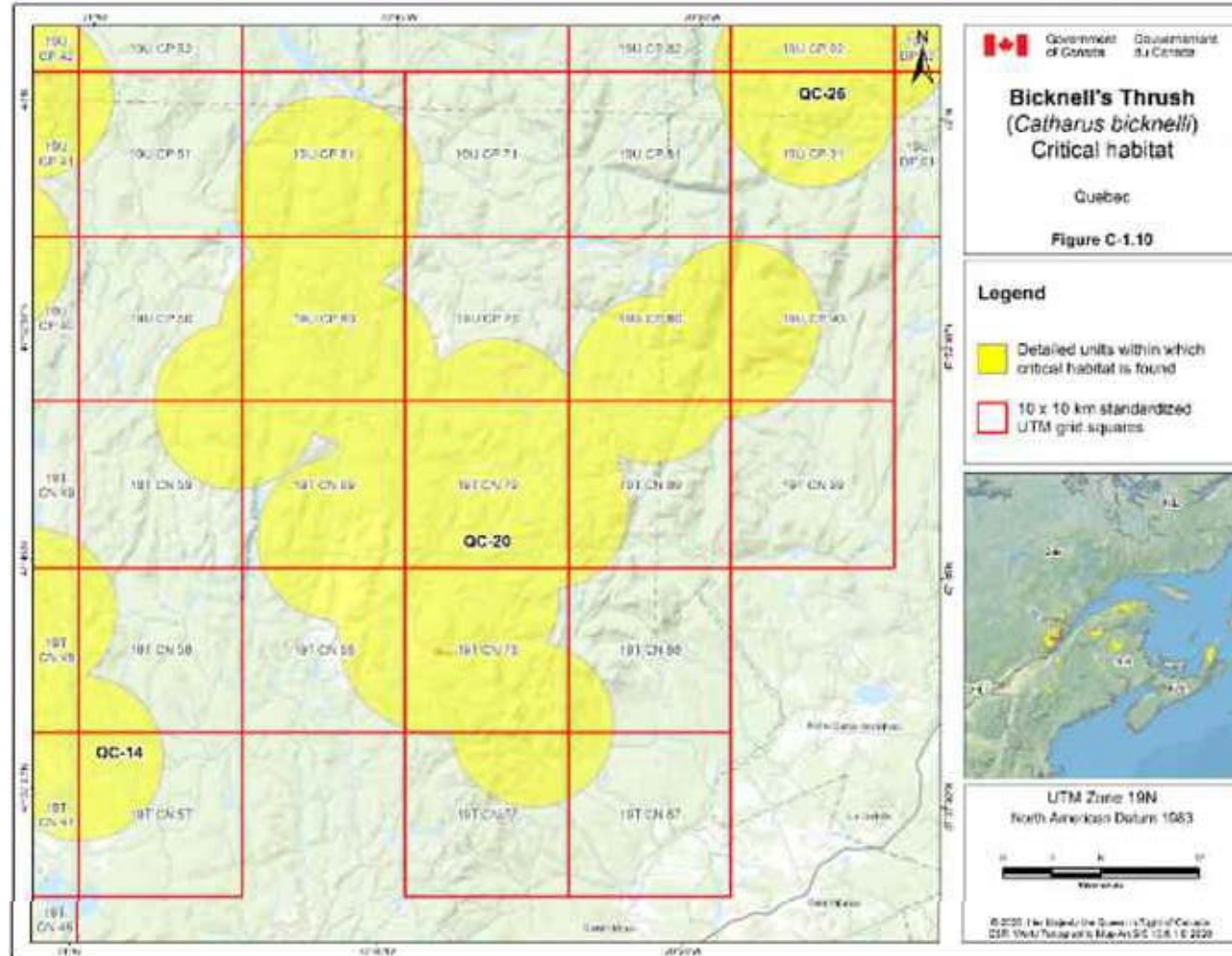


Figure C-1.10. Critical habitat for the Bicknell's Thrush in Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

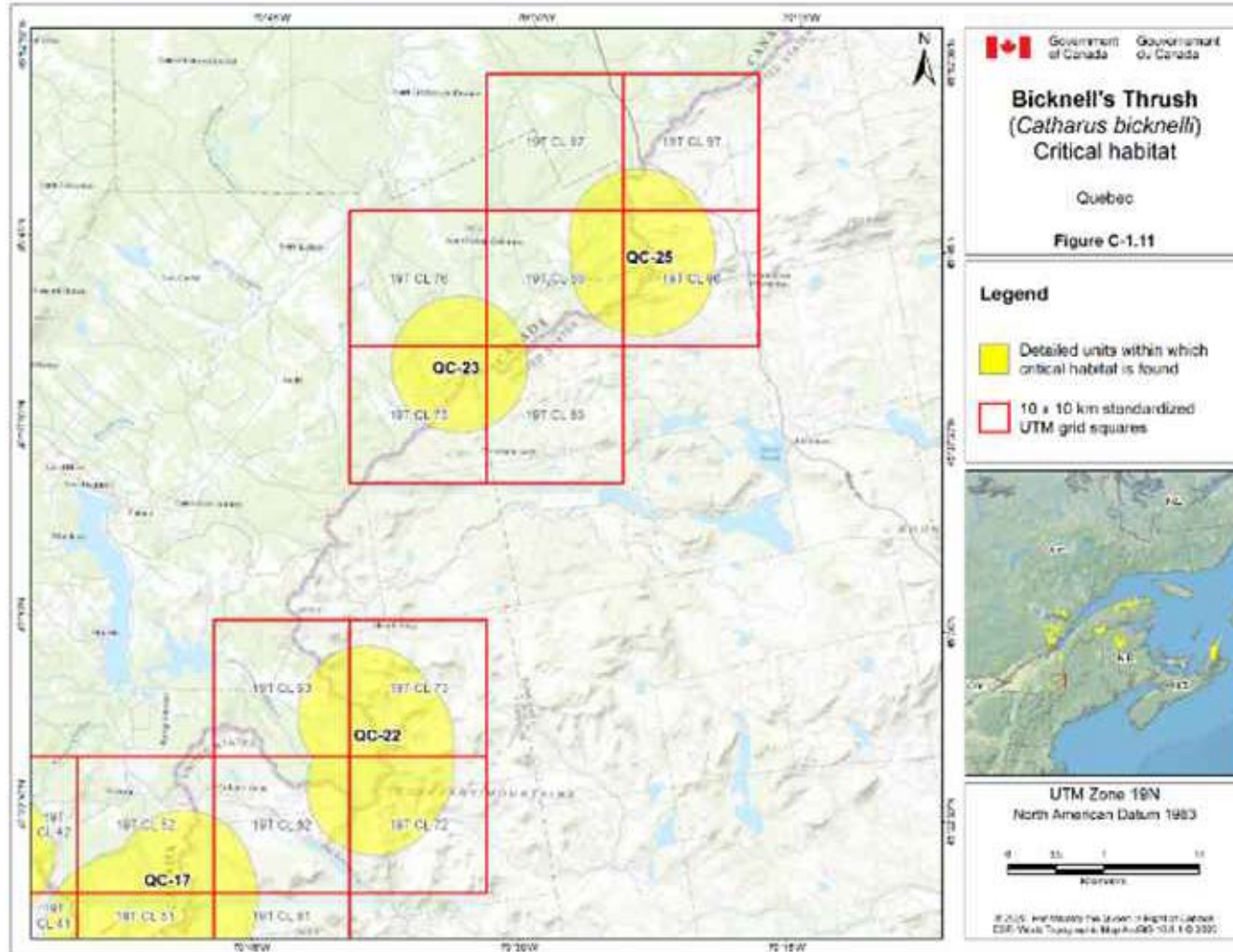


Figure C-1.11. Critical habitat for the Bicknell's Thrush in Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

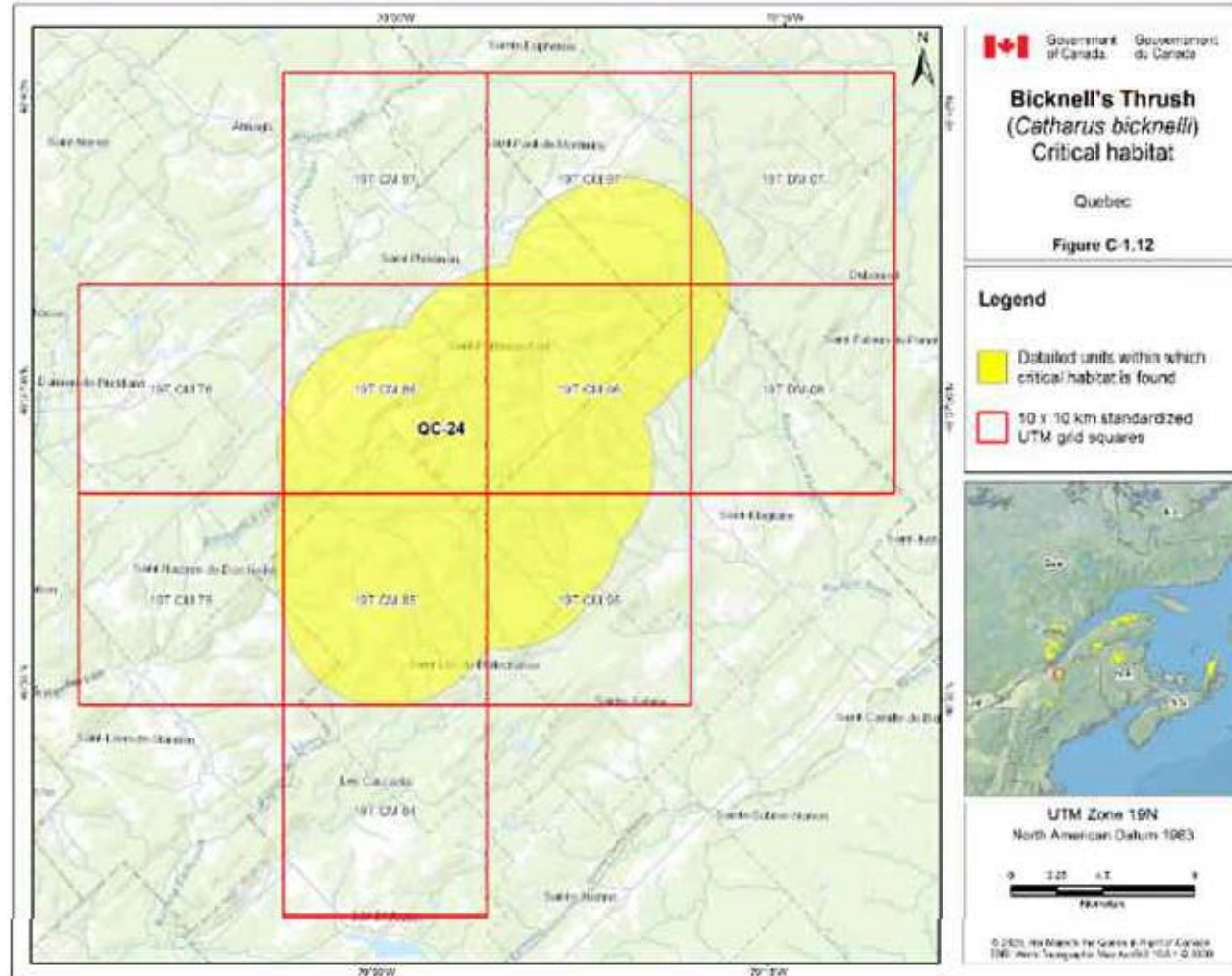
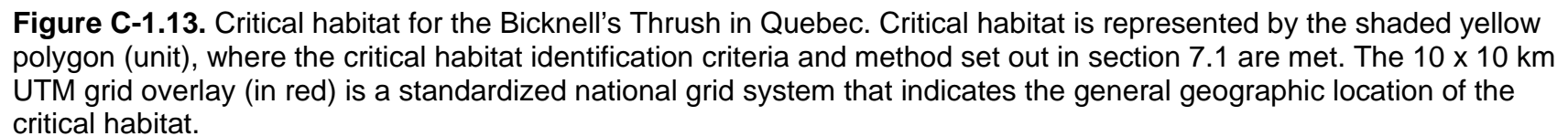


Figure C-1.12. Critical habitat for the Bicknell's Thrush in Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.



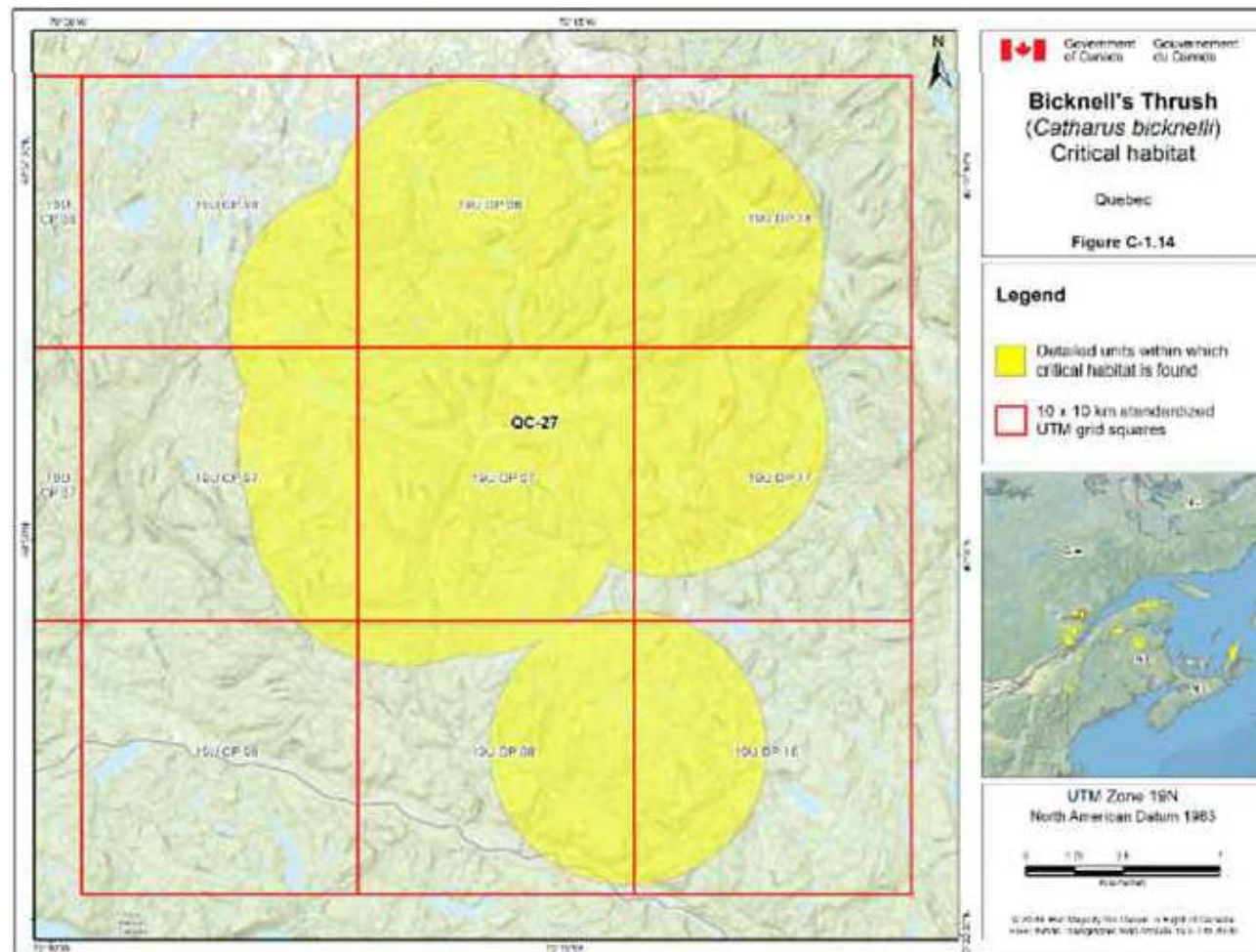


Figure C-1.14. Critical habitat for the Bicknell's Thrush in Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

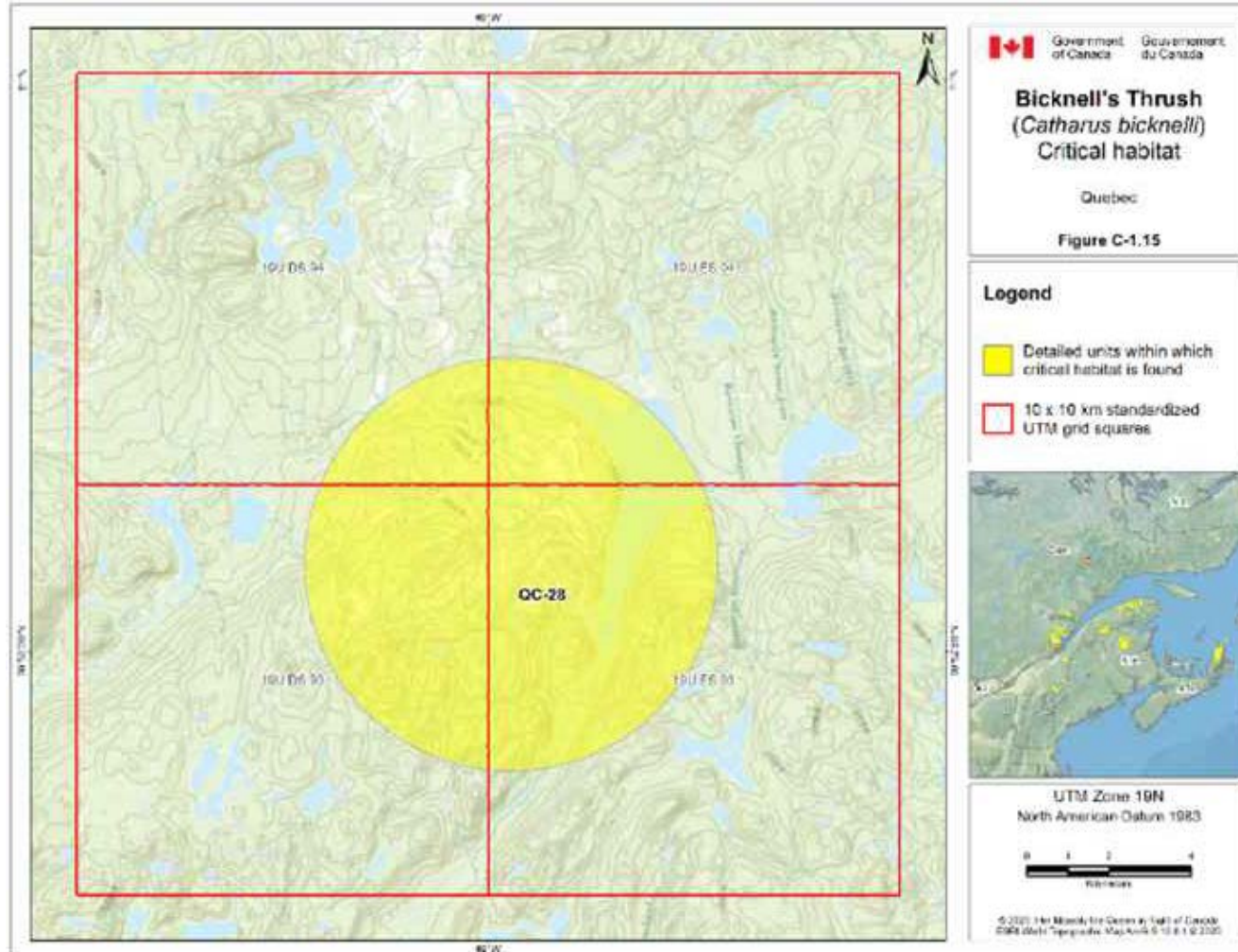


Figure C-1.15. Critical habitat for the Bicknell's Thrush in Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

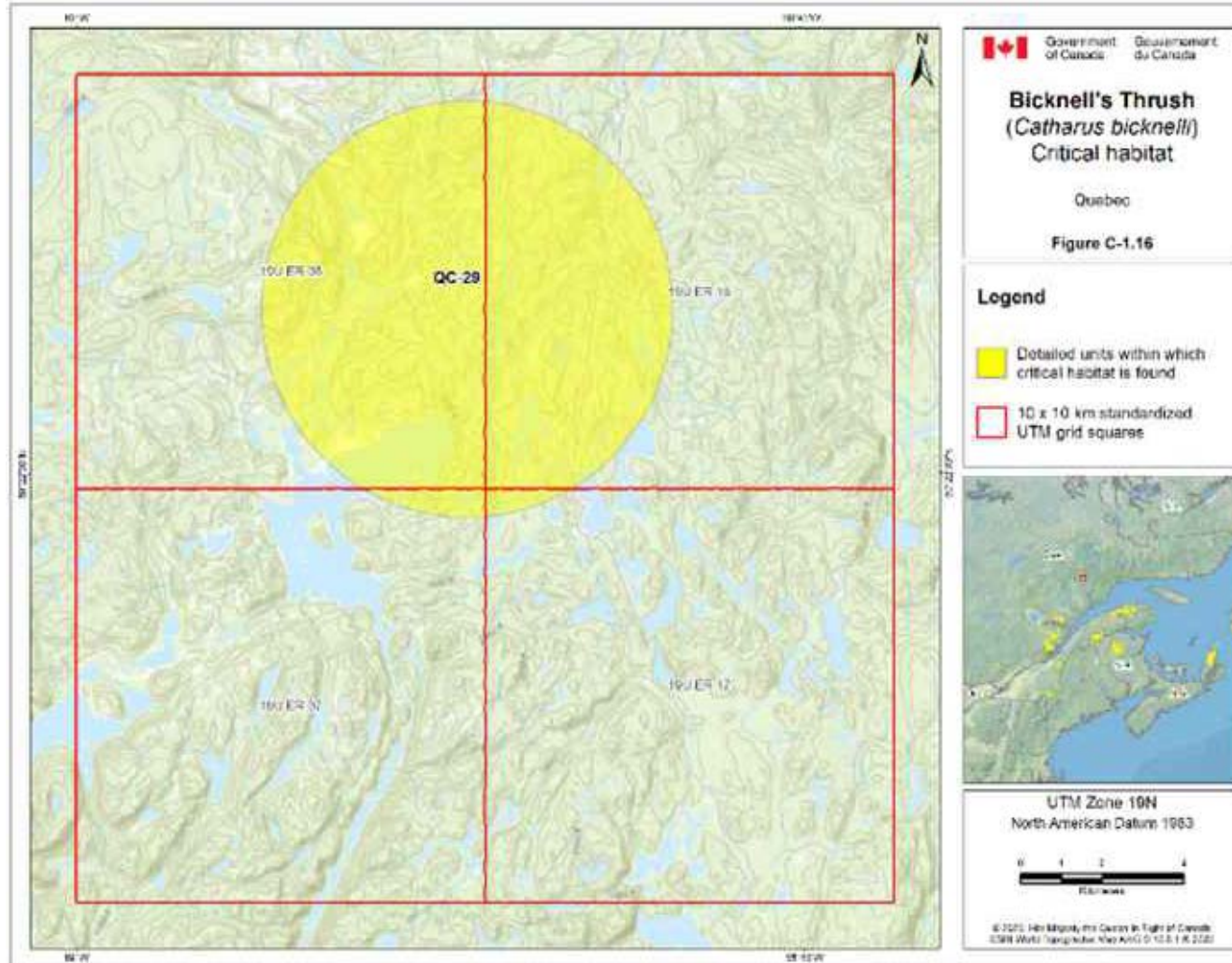
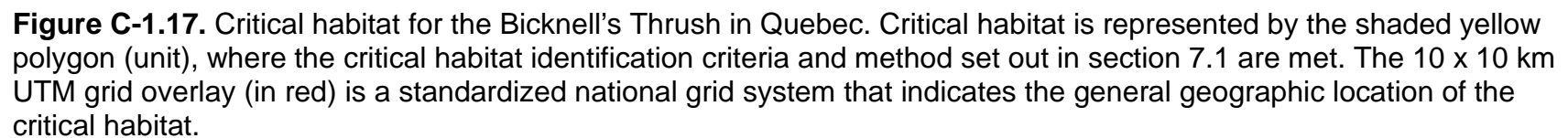


Figure C-1.16. Critical habitat for the Bicknell's Thrush in Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.



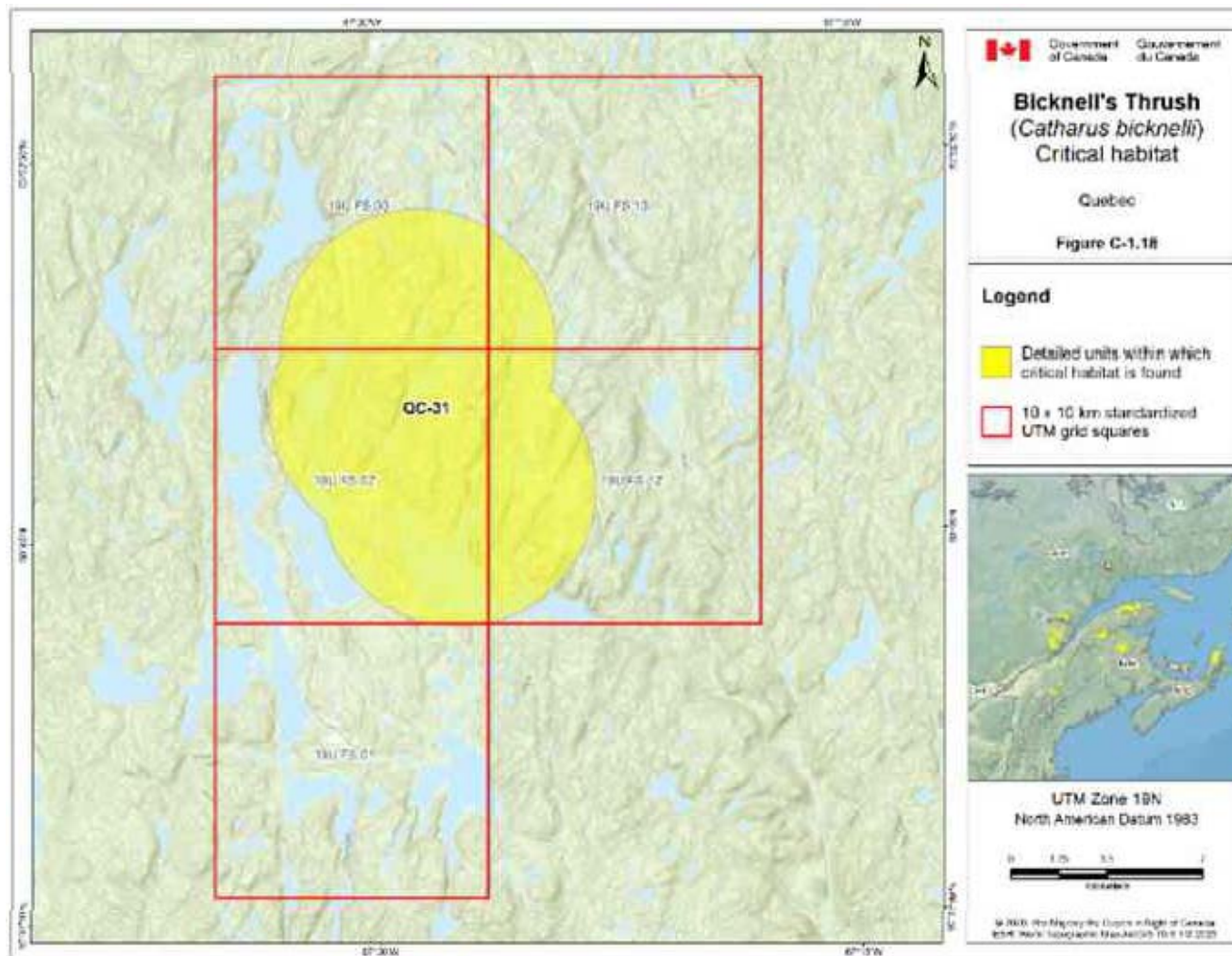


Figure C-1.18. Critical habitat for the Bicknell's Thrush in Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

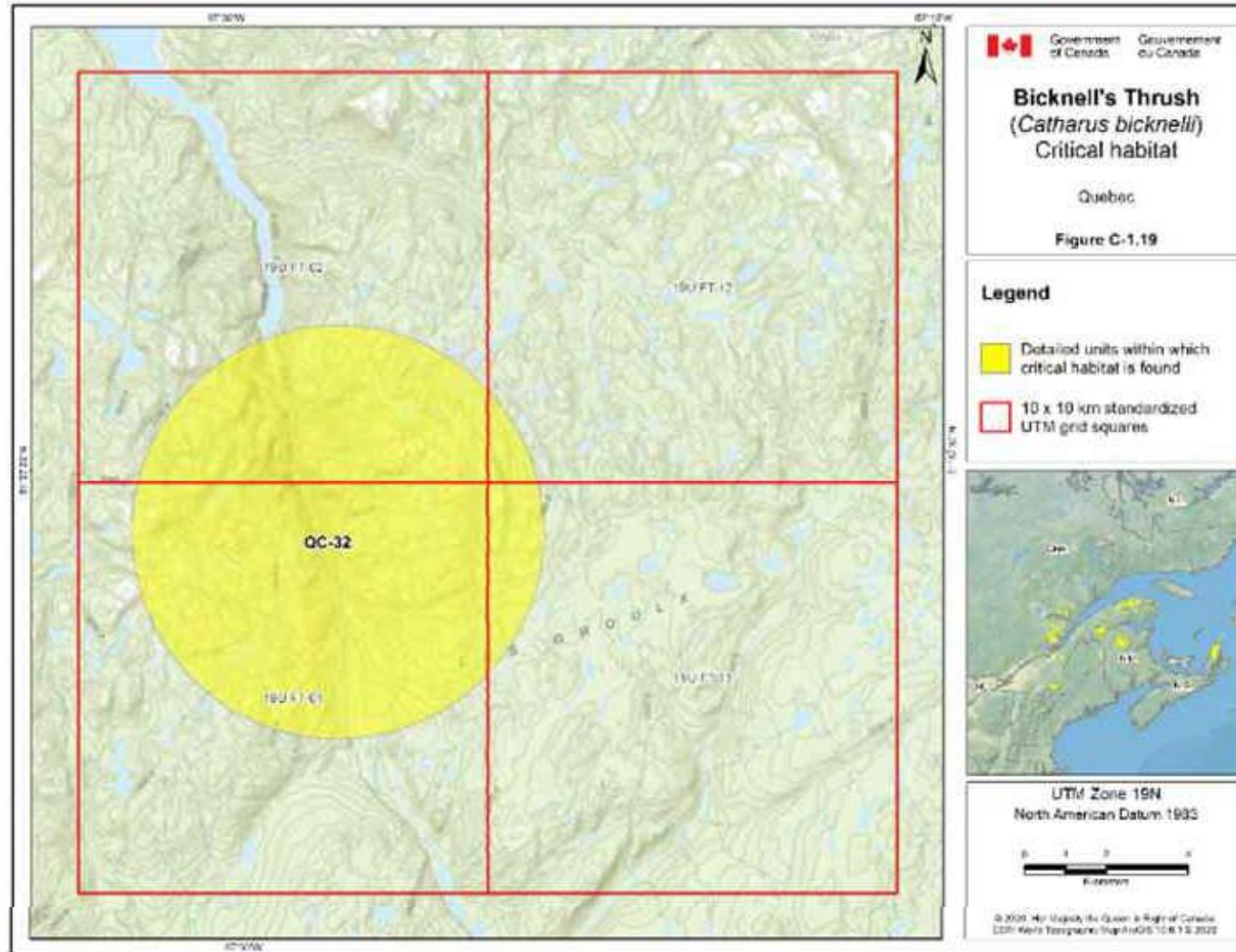
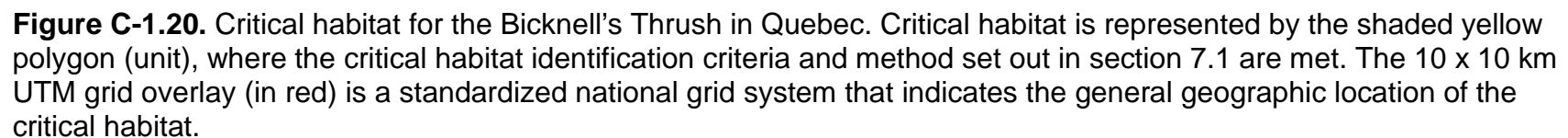
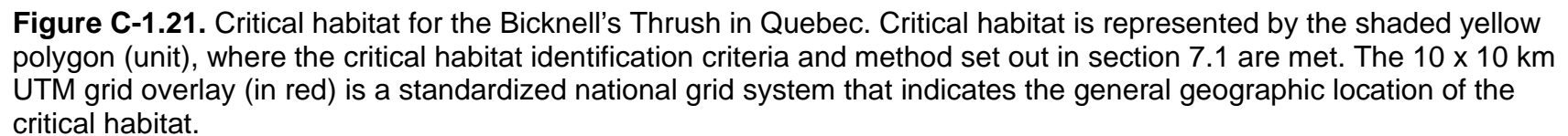


Figure C-1.19. Critical habitat for the Bicknell's Thrush in Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.





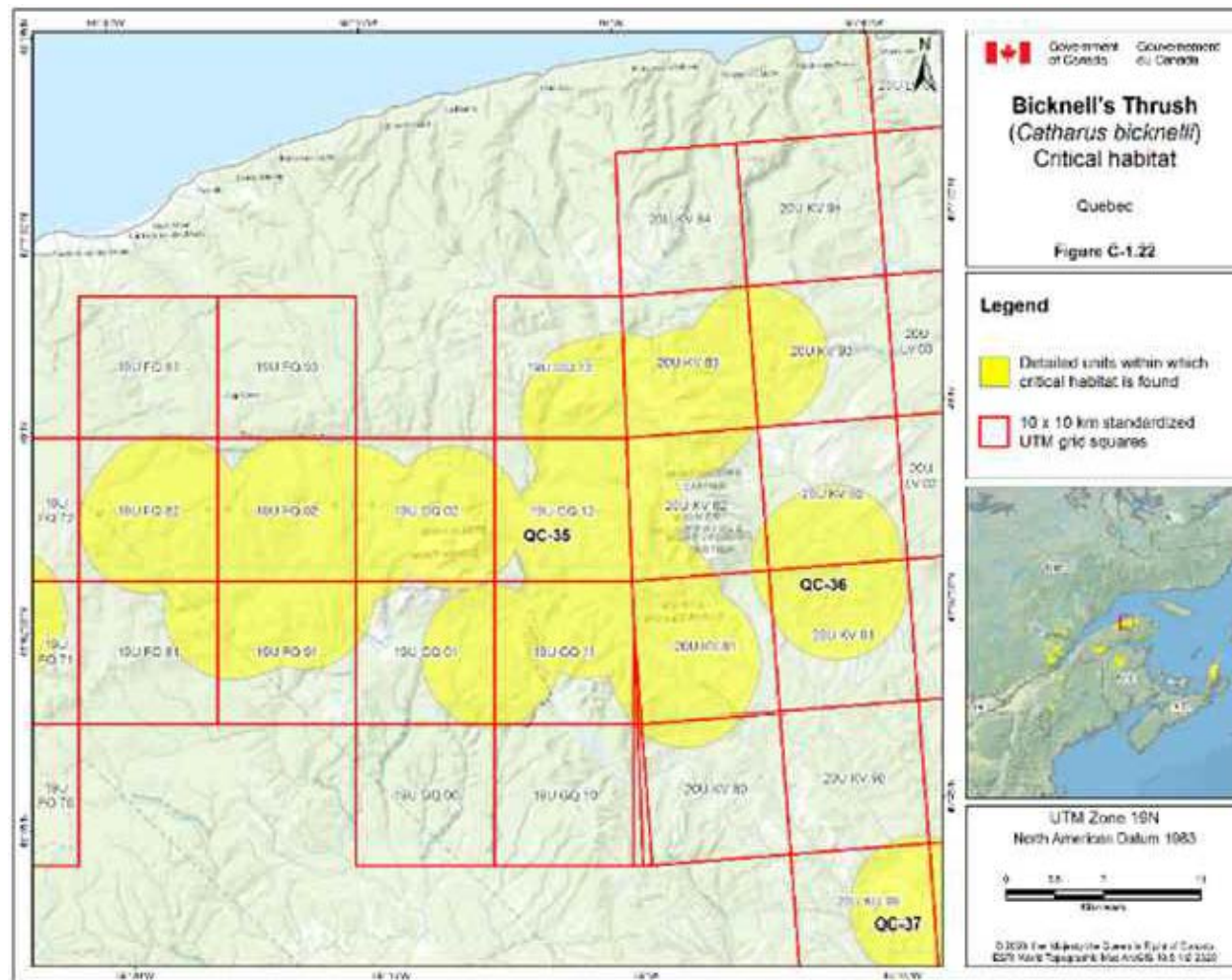


Figure C-1.22. Critical habitat for the Bicknell's Thrush in Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

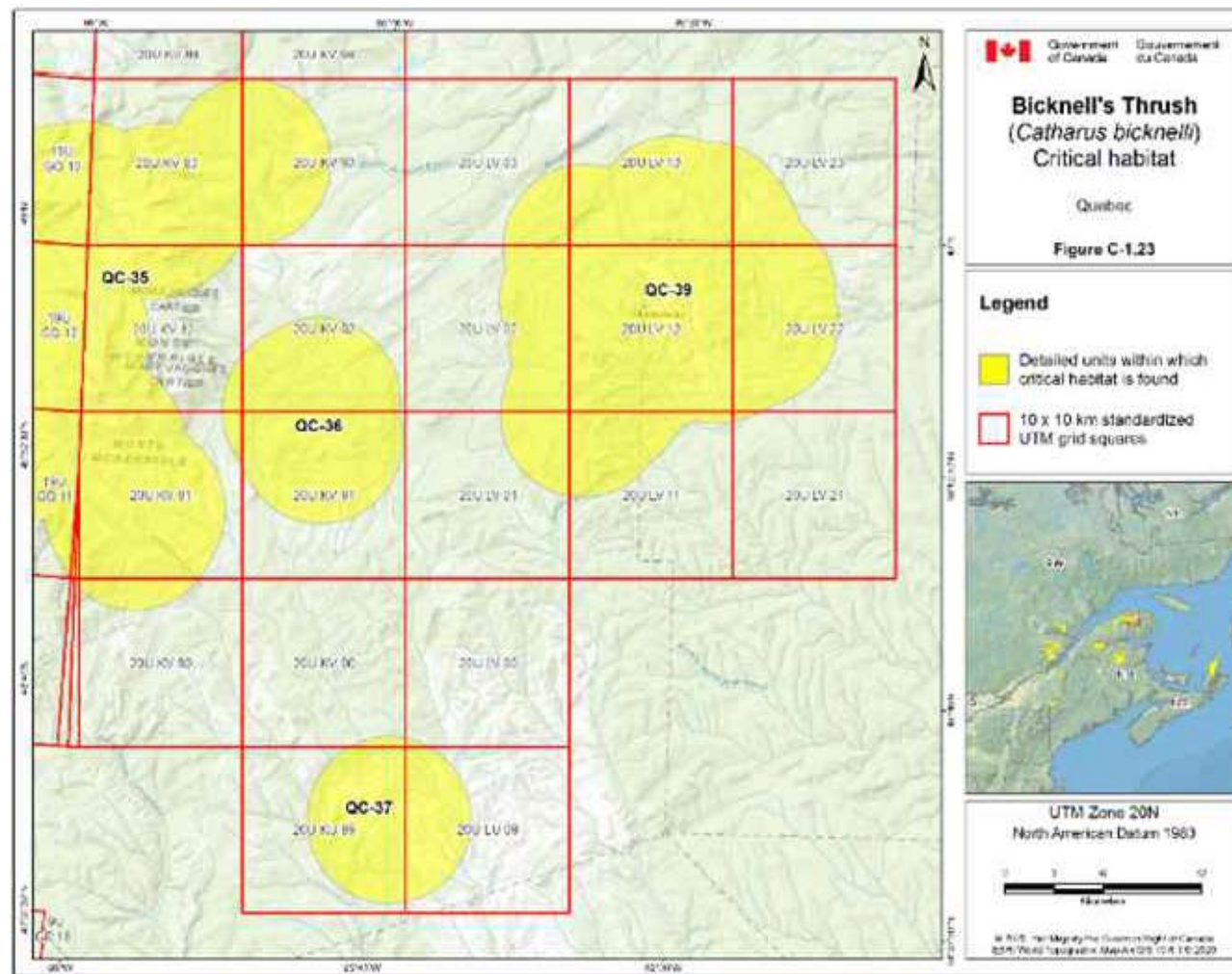


Figure C-1.23. Critical habitat for the Bicknell's Thrush in Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

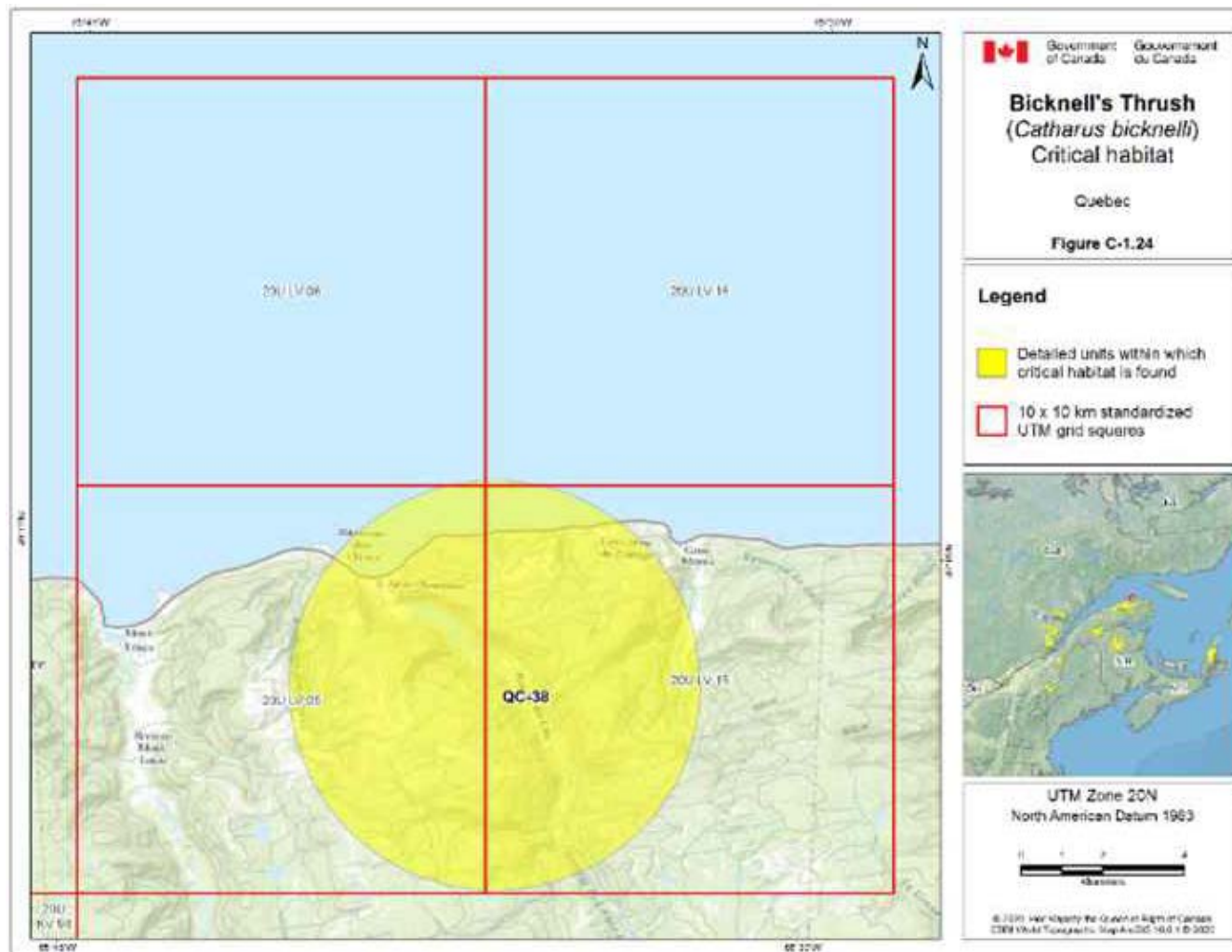


Figure C-1.24. Critical habitat for the Bicknell's Thrush in Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

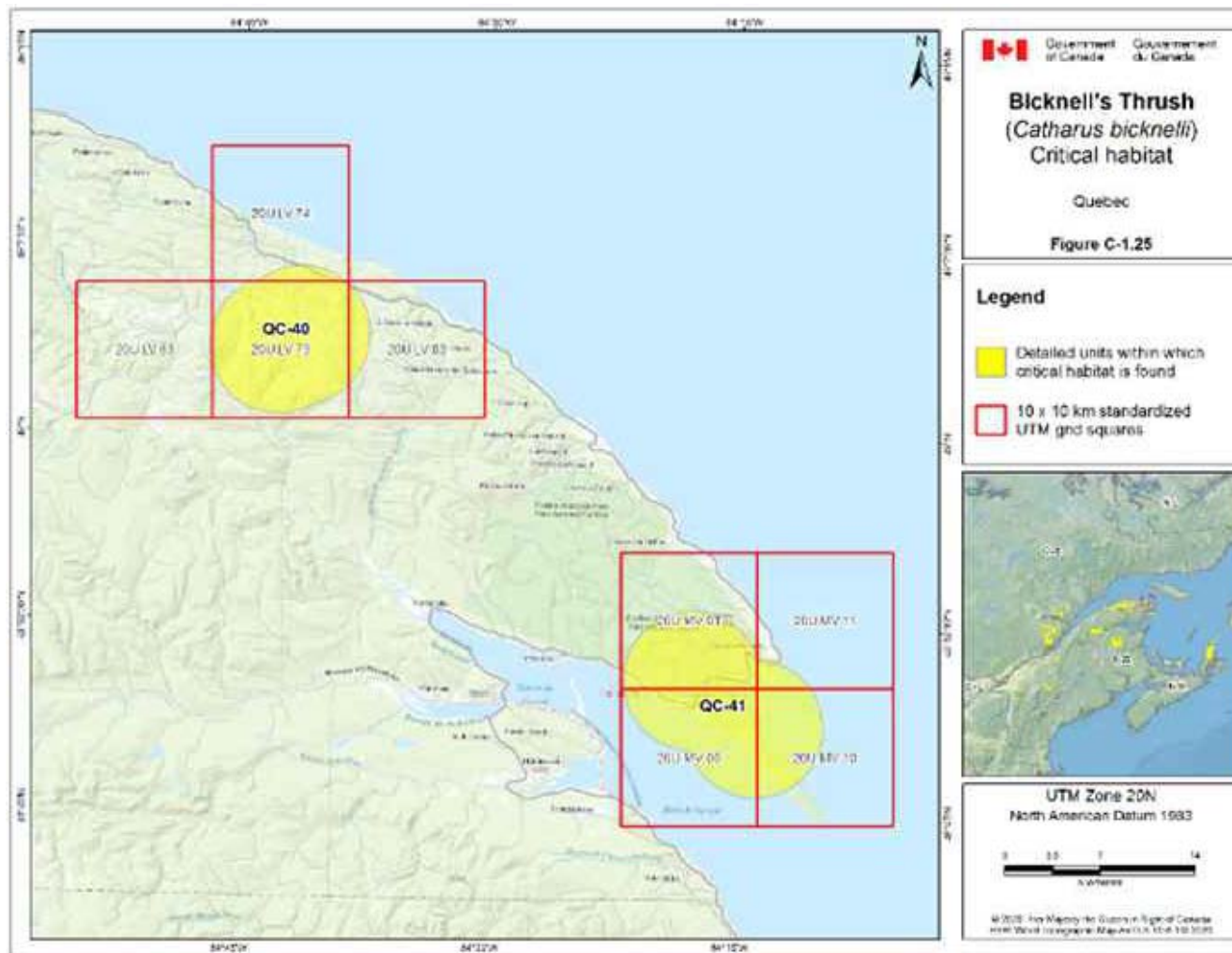


Figure C-1.25. Critical habitat for the Bicknell's Thrush in Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

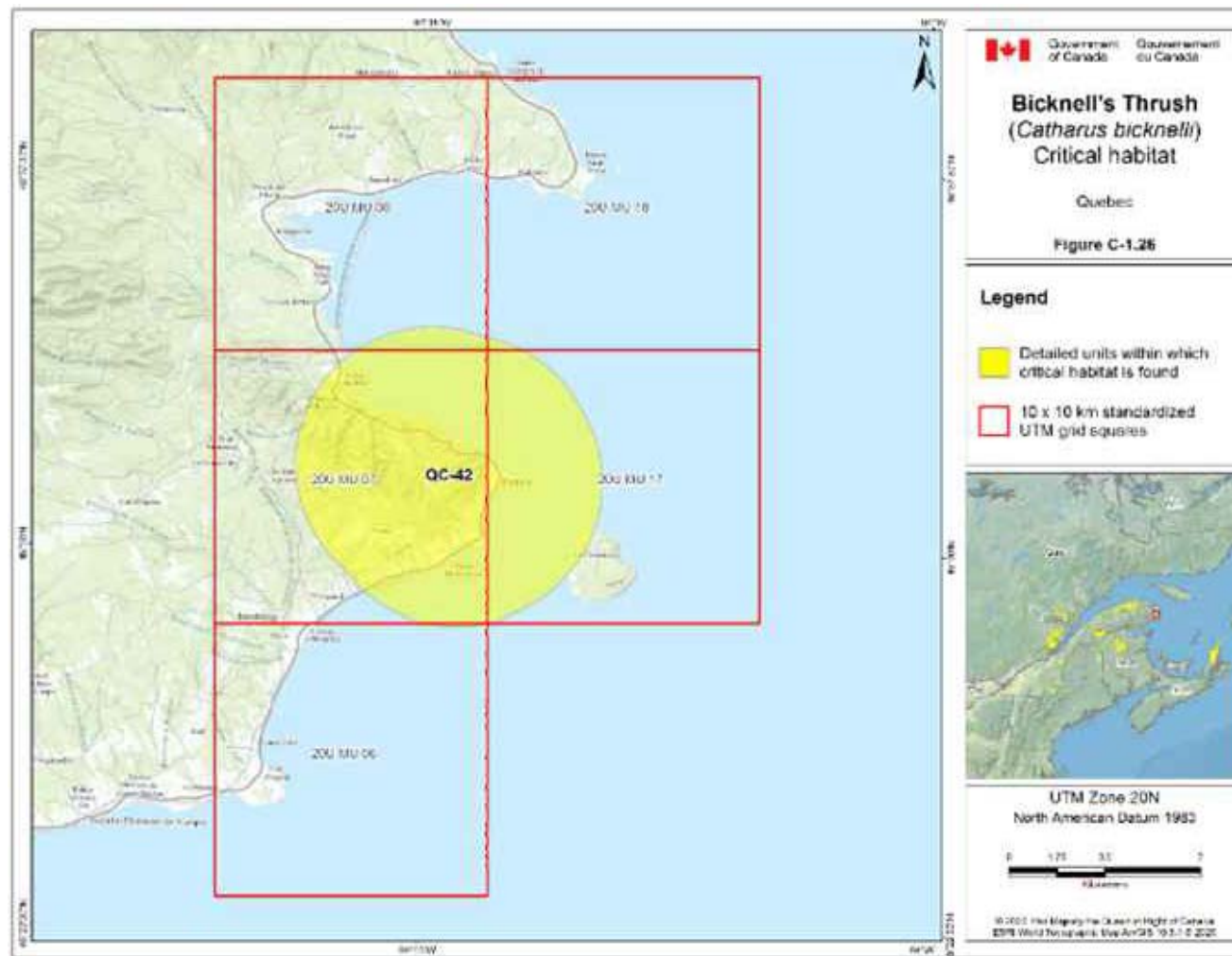


Figure C-1.26. Critical habitat for the Bicknell's Thrush in Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

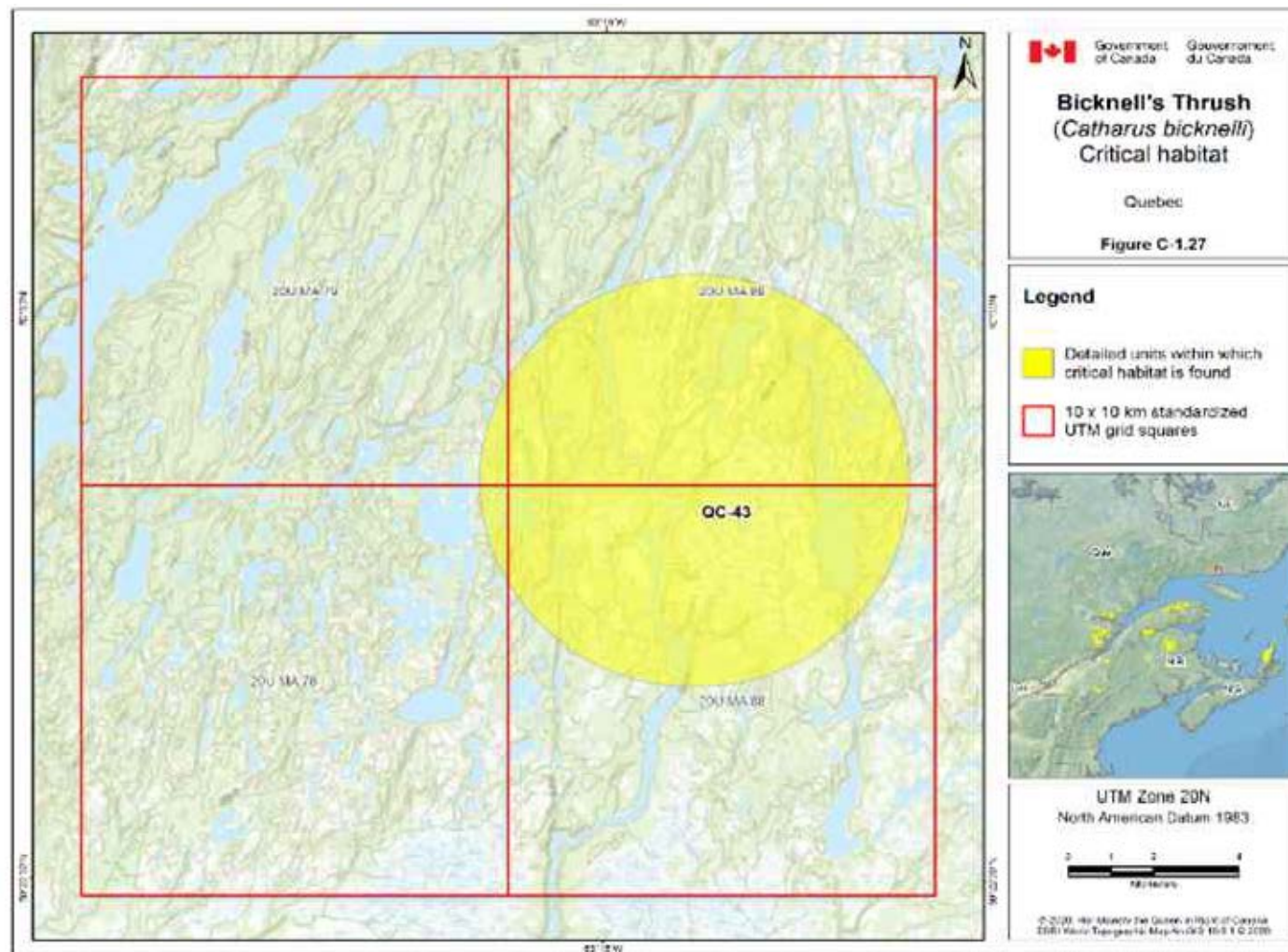
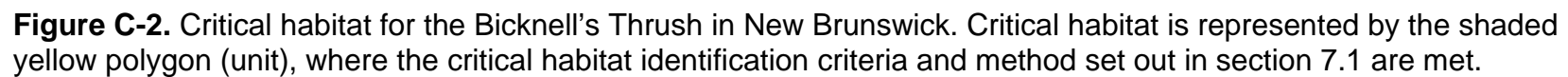


Figure C-1.27. Critical habitat for the Bicknell's Thrush in Quebec. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.



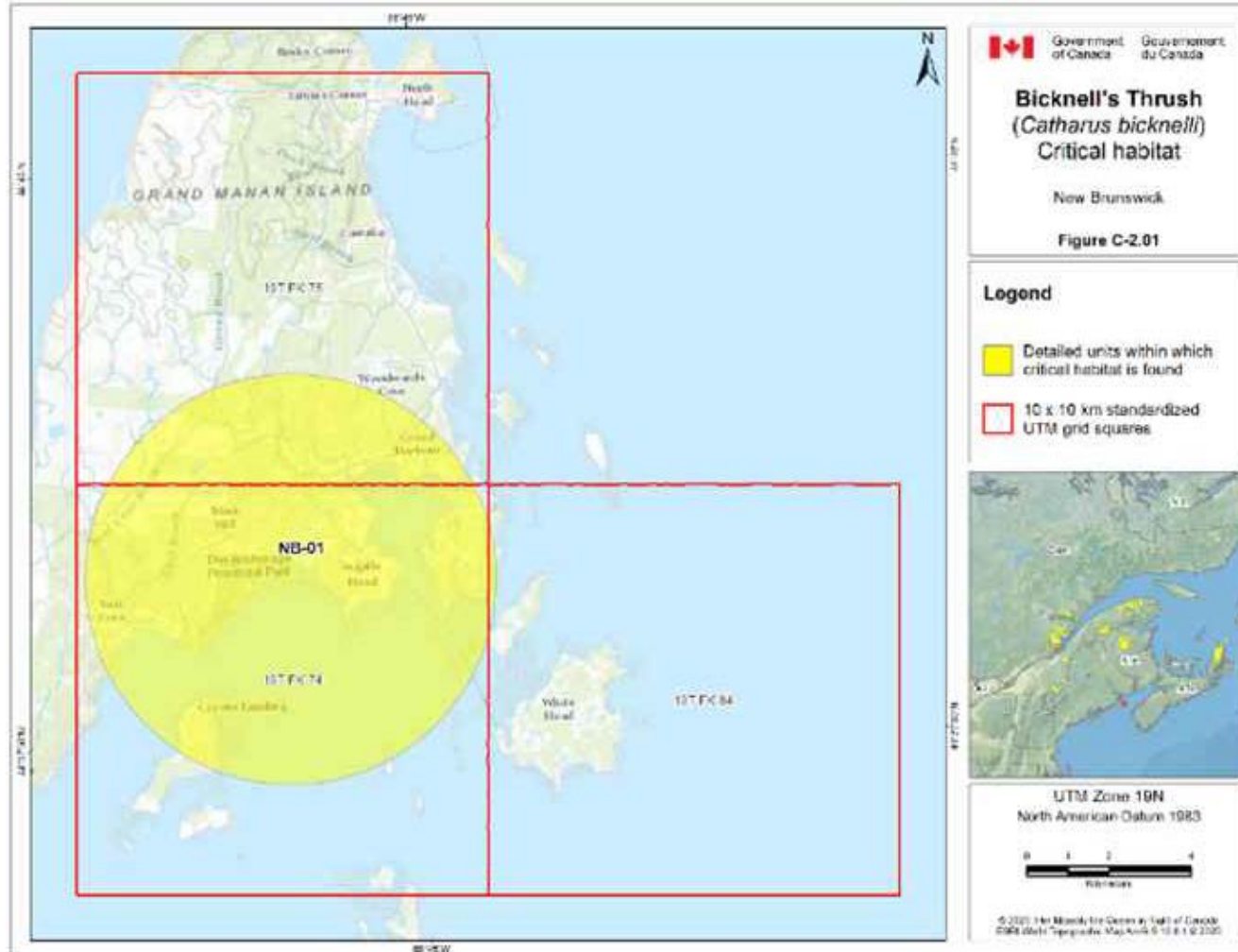


Figure C-2.01. Critical habitat for the Bicknell's Thrush in New Brunswick. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

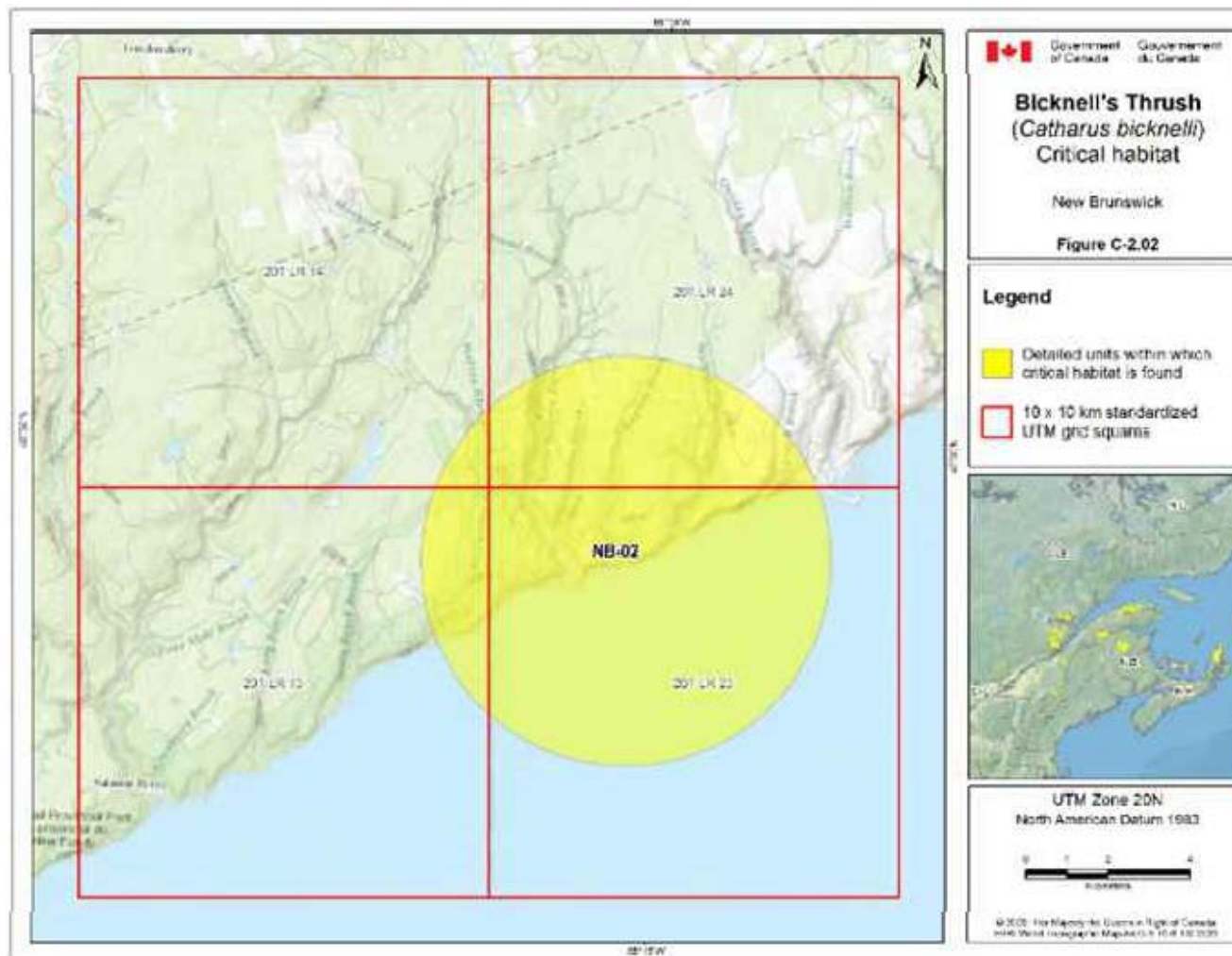


Figure C-2.02. Critical habitat for the Bicknell's Thrush in New Brunswick. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

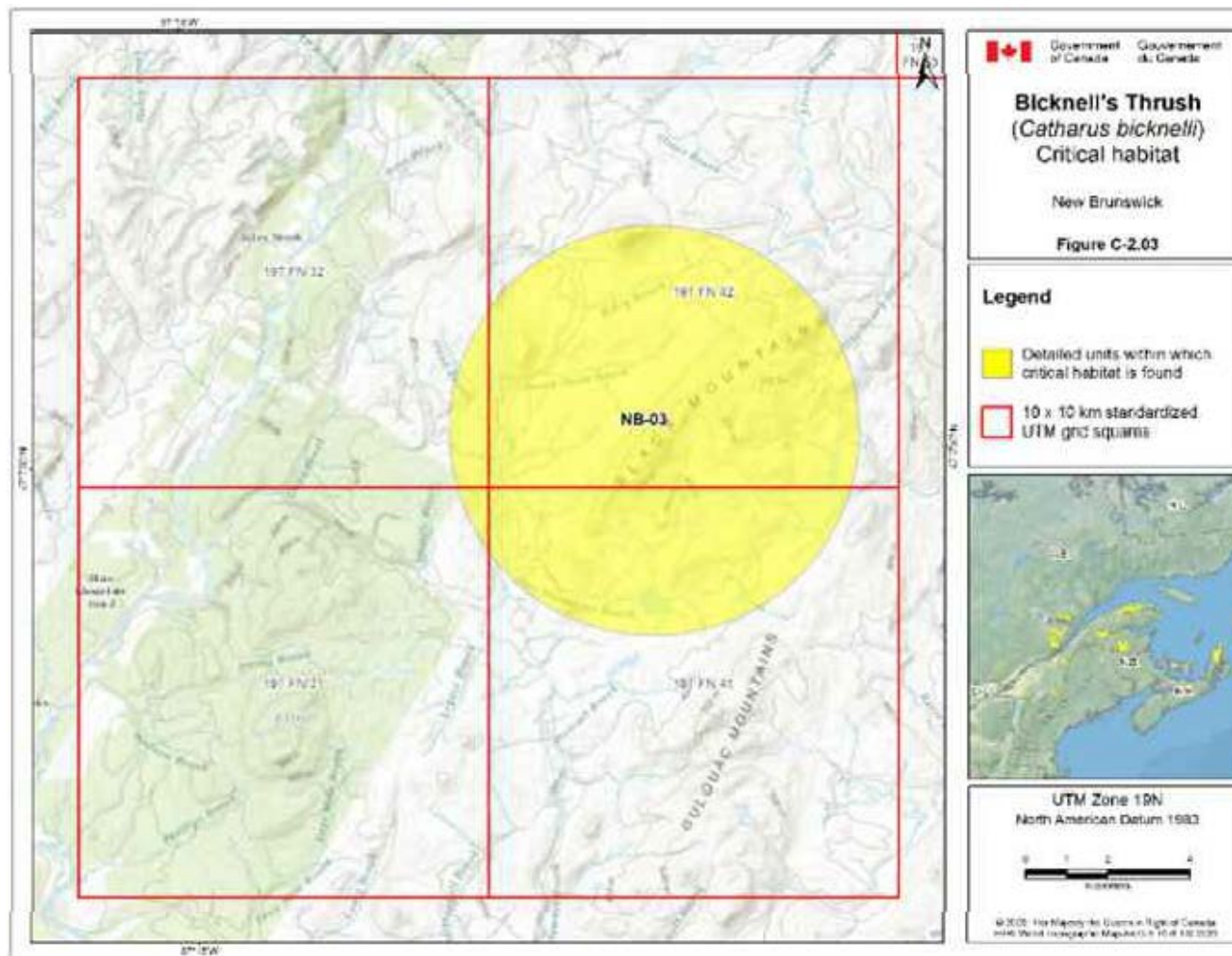


Figure C-2.03. Critical habitat for the Bicknell's Thrush in New Brunswick. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

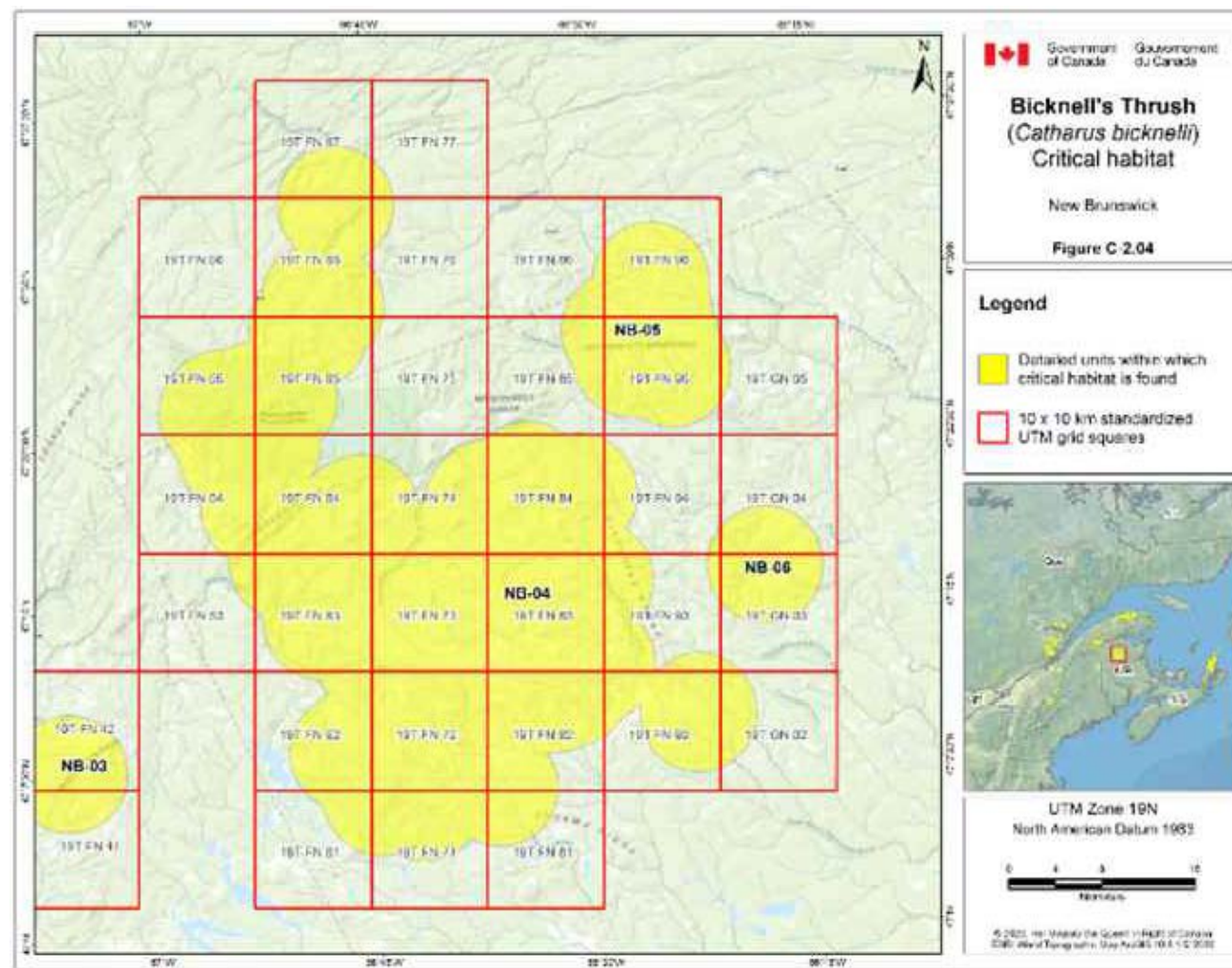
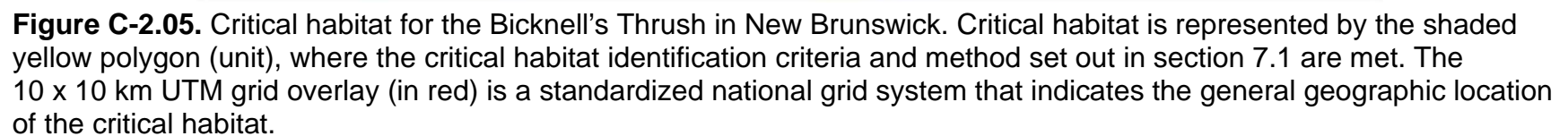


Figure C-2.04. Critical habitat for the Bicknell's Thrush in New Brunswick. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.



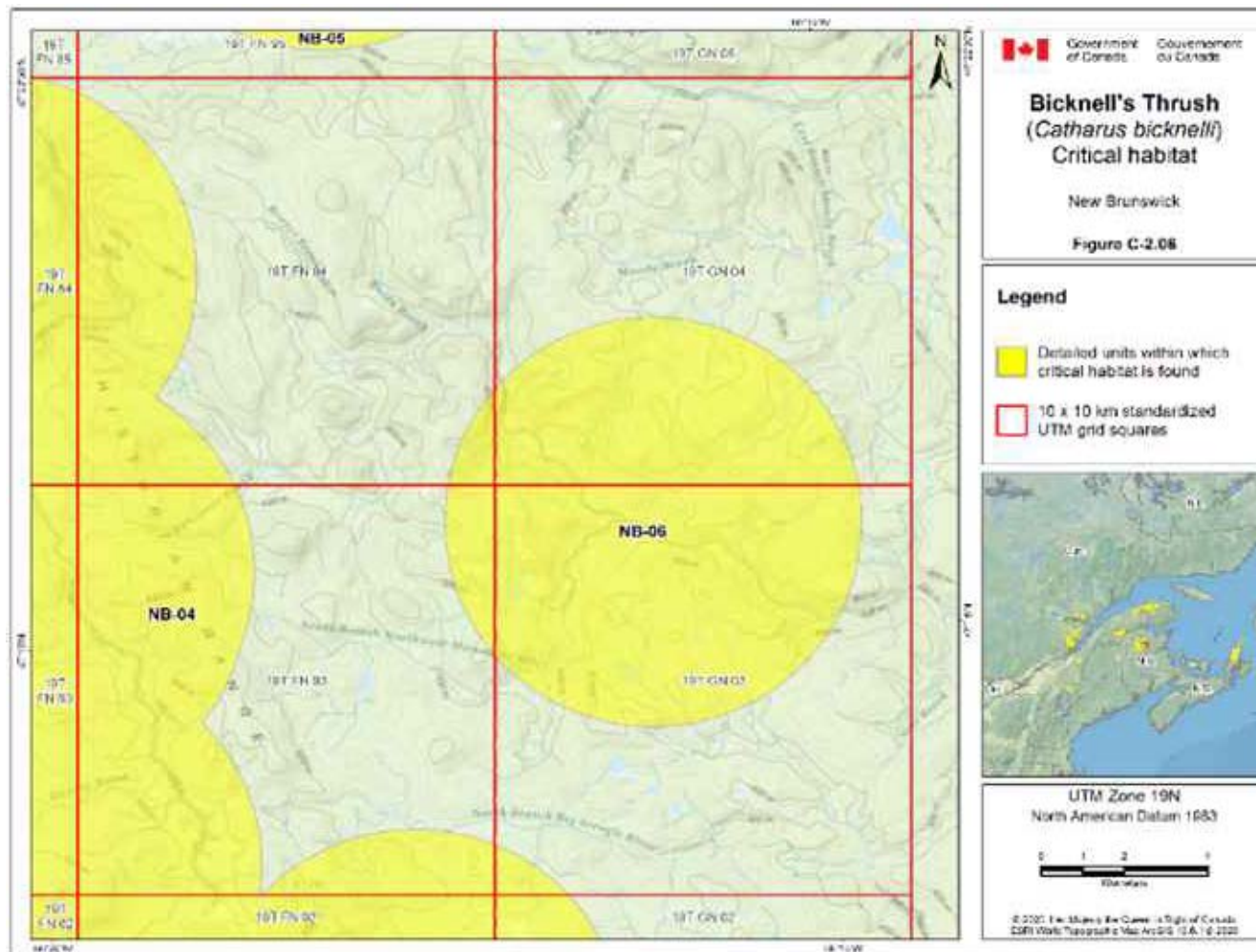


Figure C-2.06. Critical habitat for the Bicknell's Thrush in New Brunswick. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

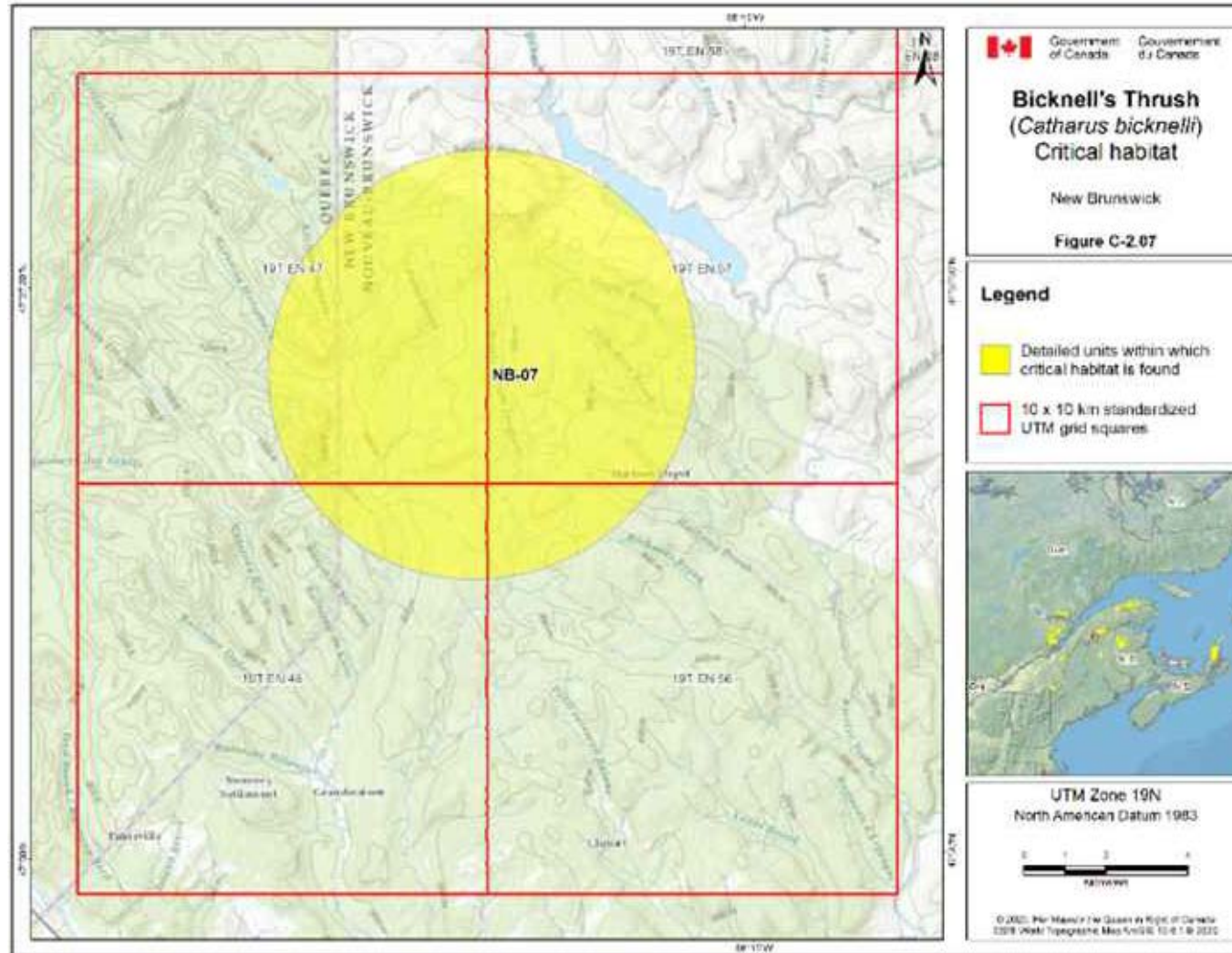


Figure C-2.07. Critical habitat for the Bicknell's Thrush in New Brunswick. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

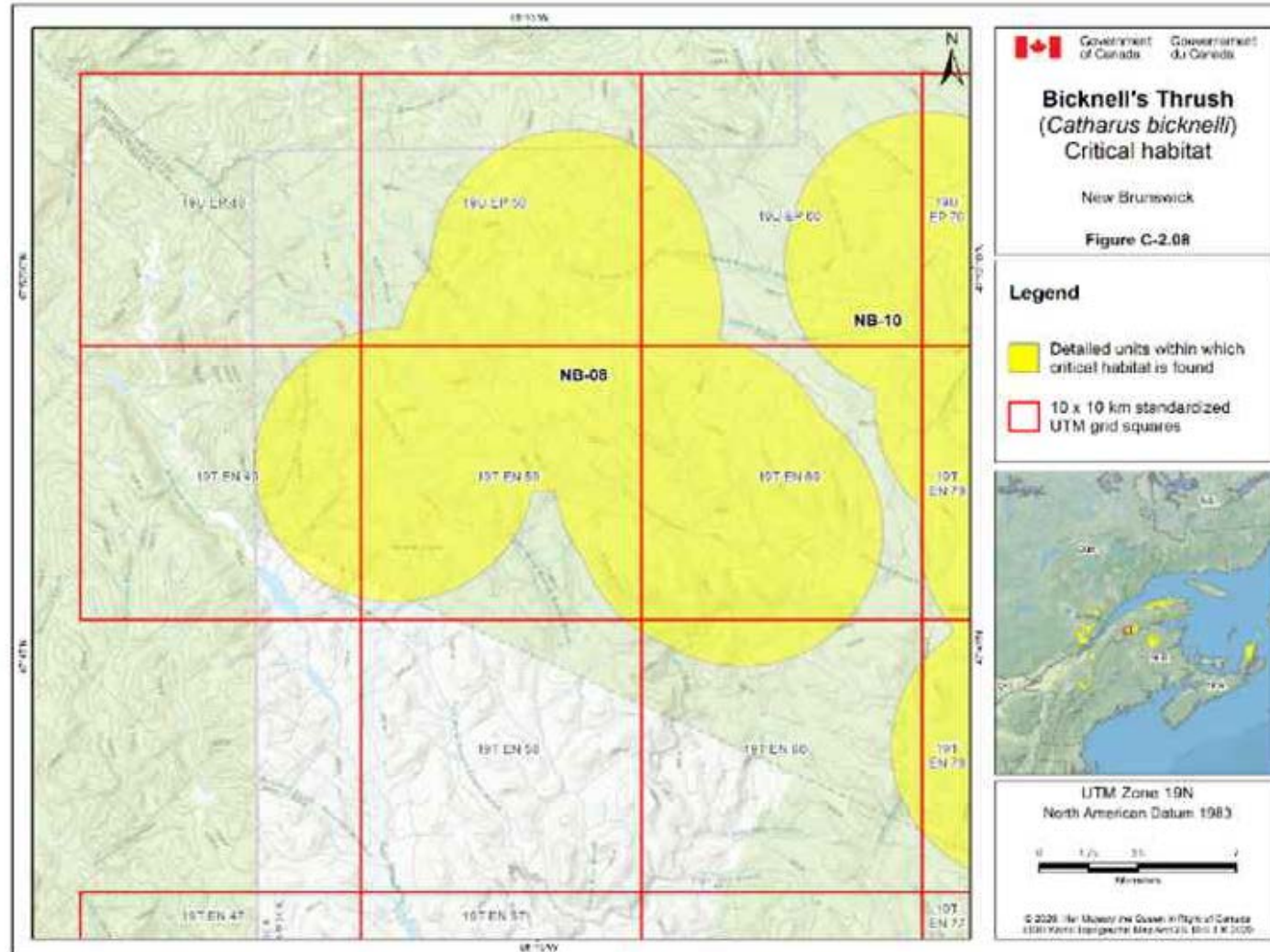


Figure C-2.08. Critical habitat for the Bicknell's Thrush in New Brunswick. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

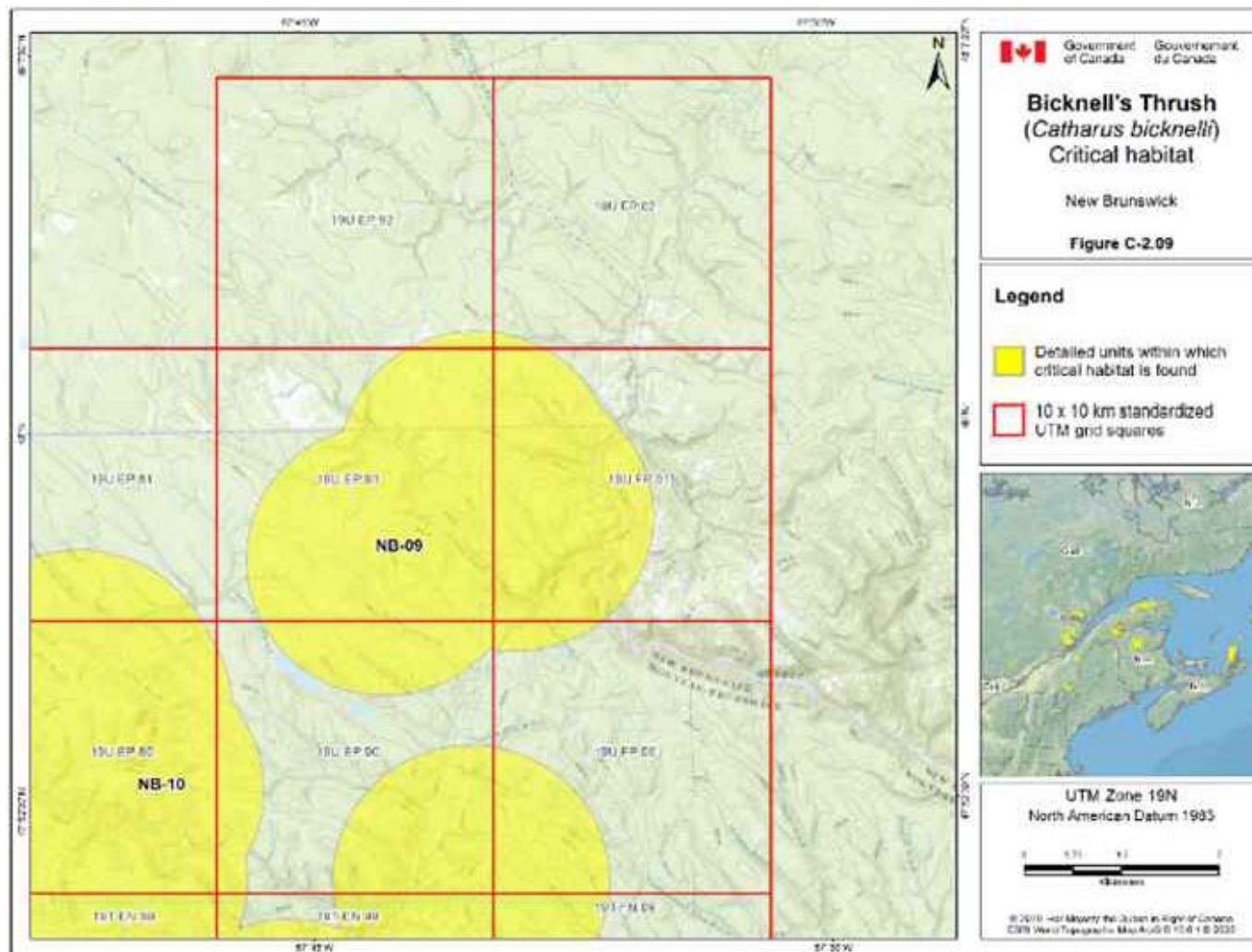
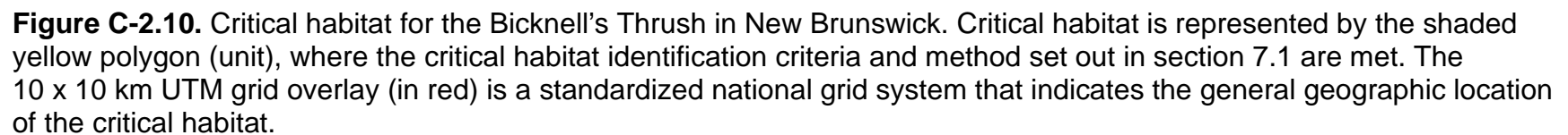


Figure C-2.09. Critical habitat for the Bicknell's Thrush in New Brunswick. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.



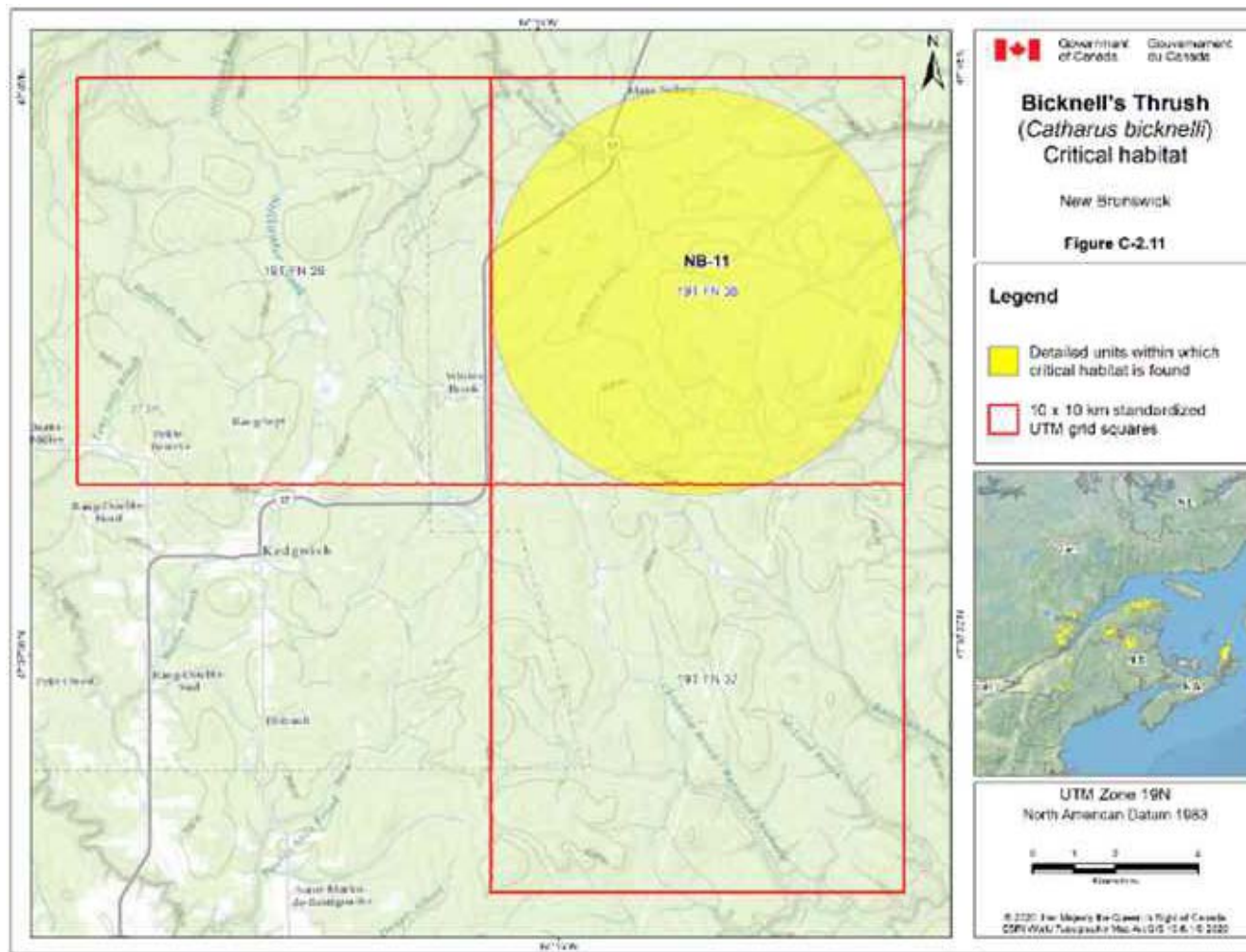


Figure C-2.11. Critical habitat for the Bicknell's Thrush in New Brunswick. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

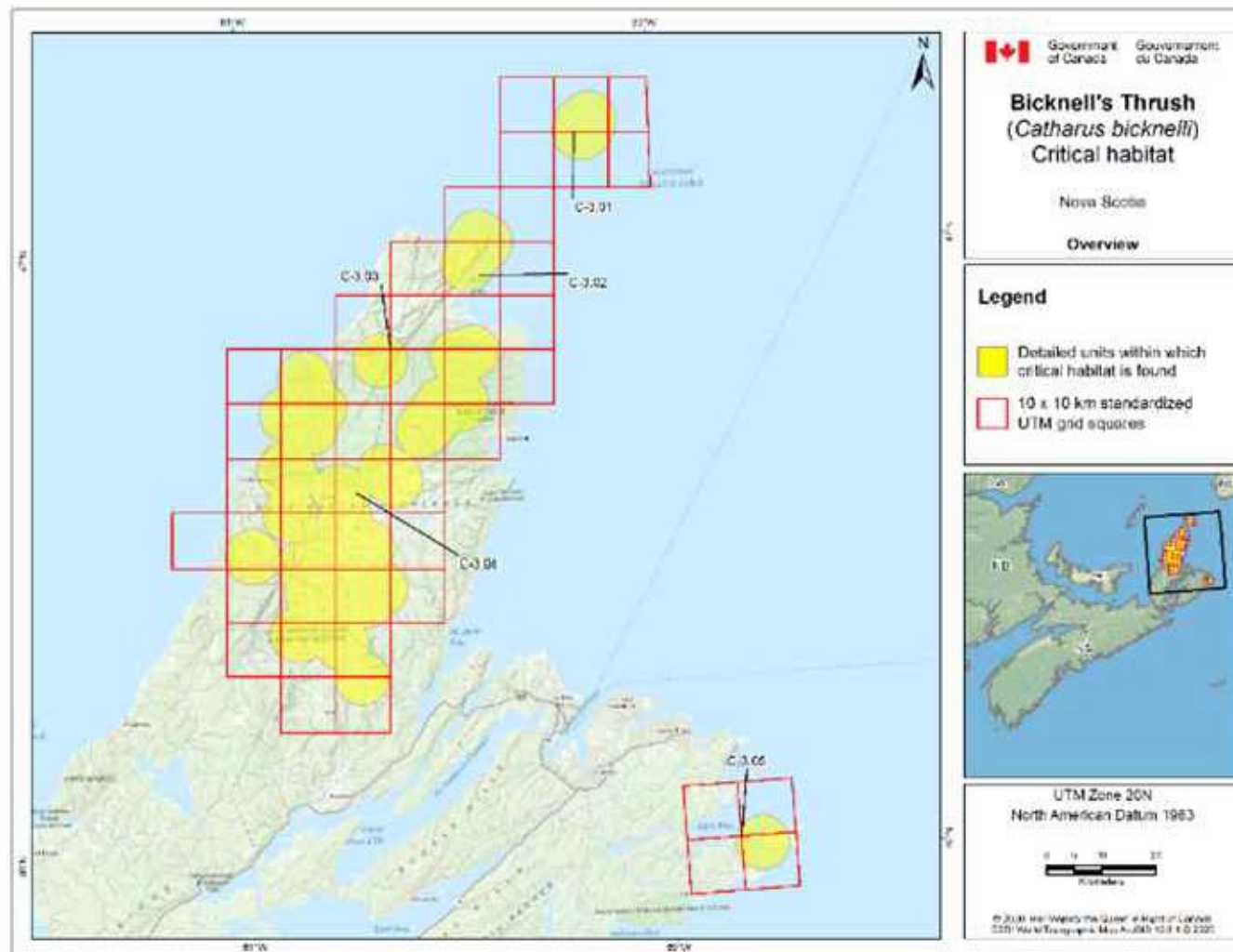


Figure C-3. Critical habitat for the Bicknell's Thrush in Nova Scotia. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met.

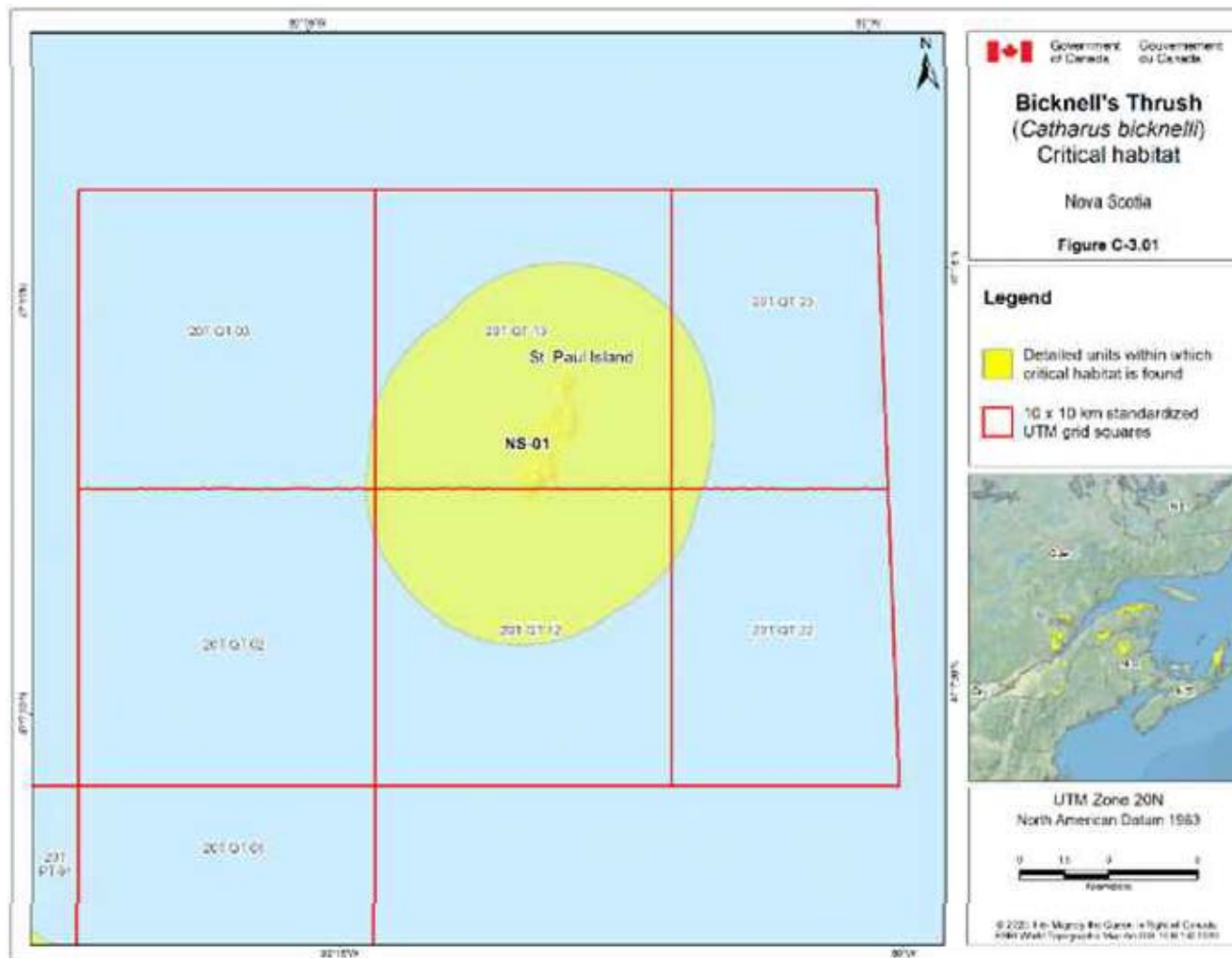


Figure C-3.01. Critical habitat for the Bicknell's Thrush in Nova Scotia. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

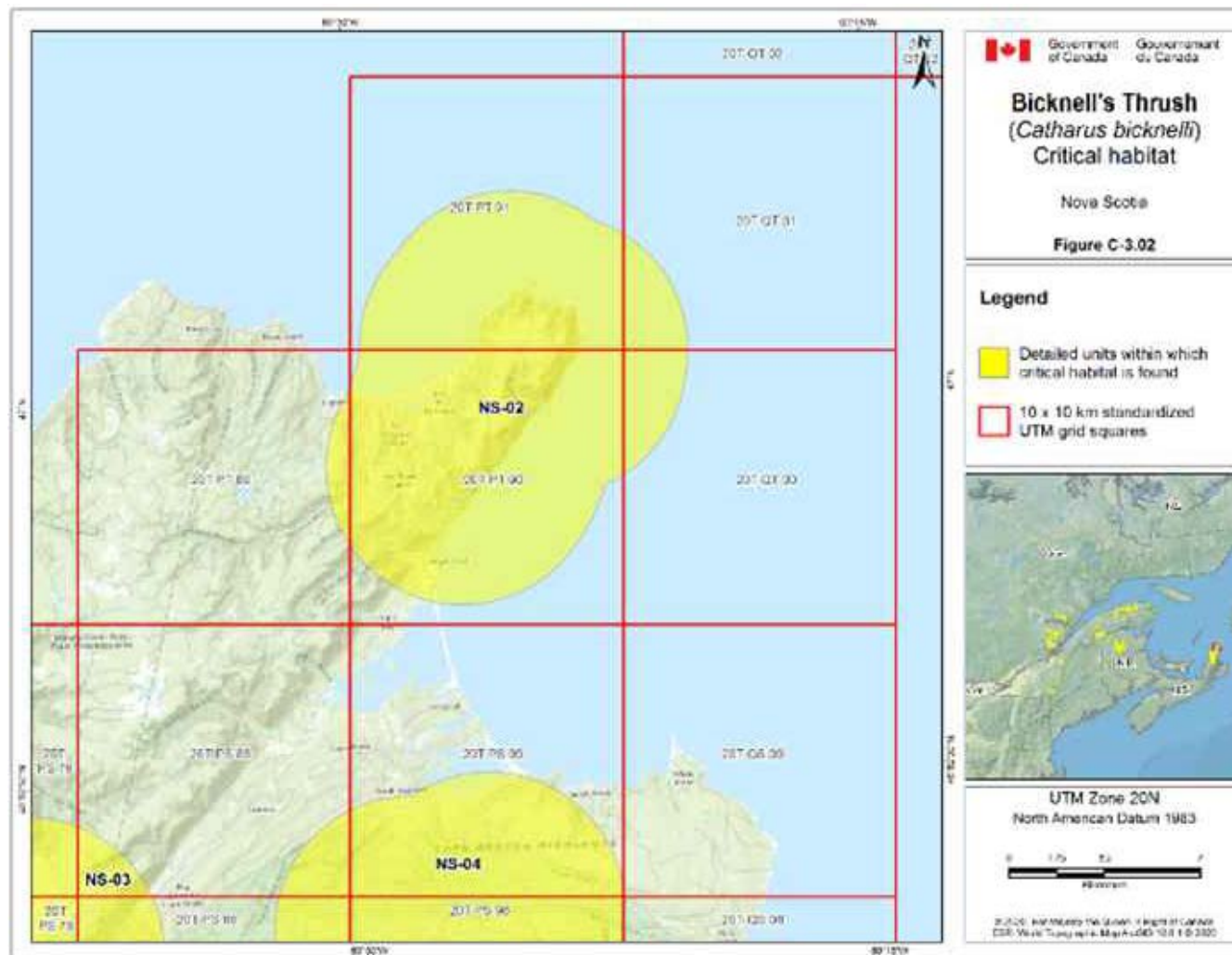


Figure C-3.02. Critical habitat for the Bicknell's Thrush in Nova Scotia. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

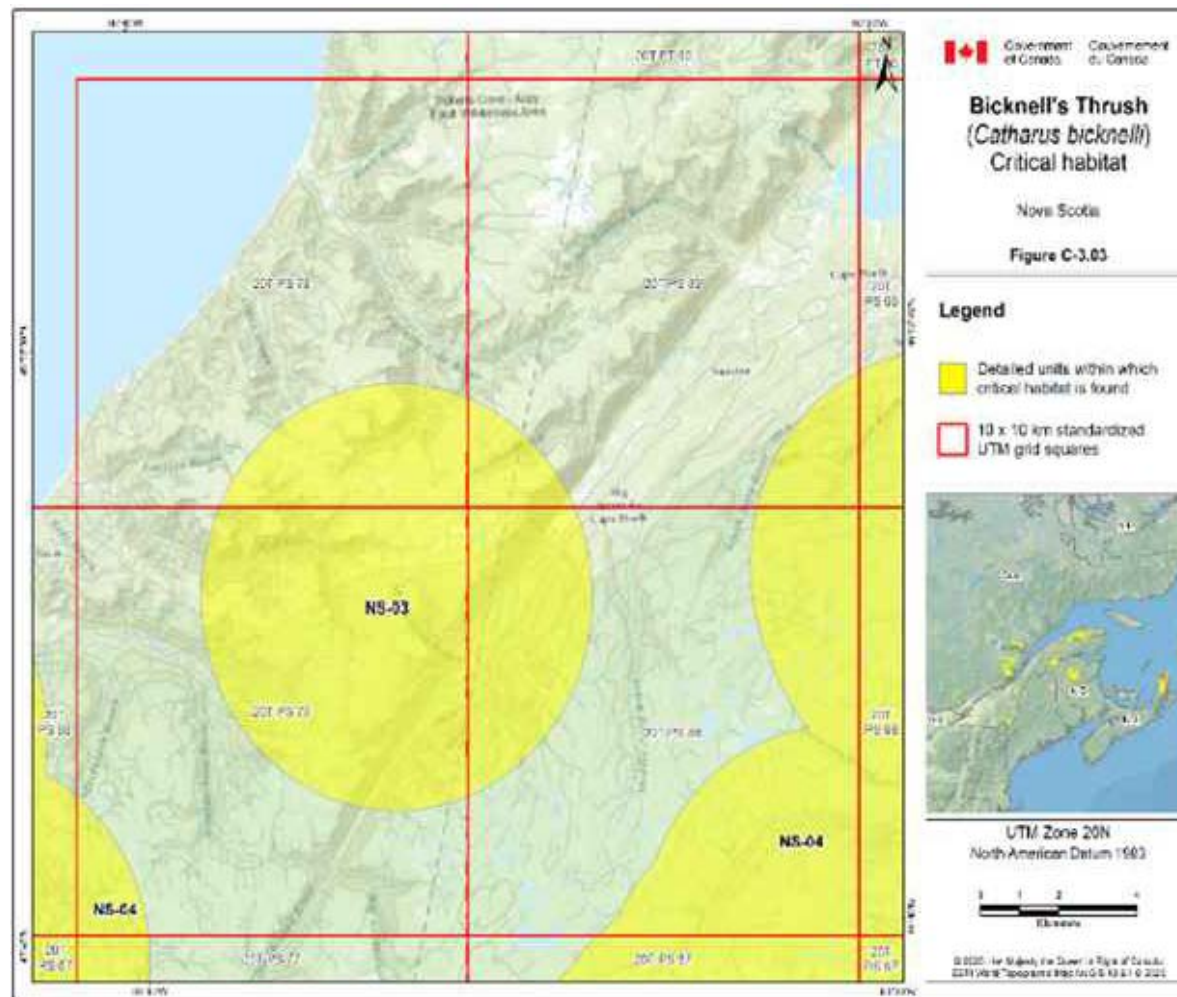


Figure C-3.03. Critical habitat for the Bicknell's Thrush in Nova Scotia. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

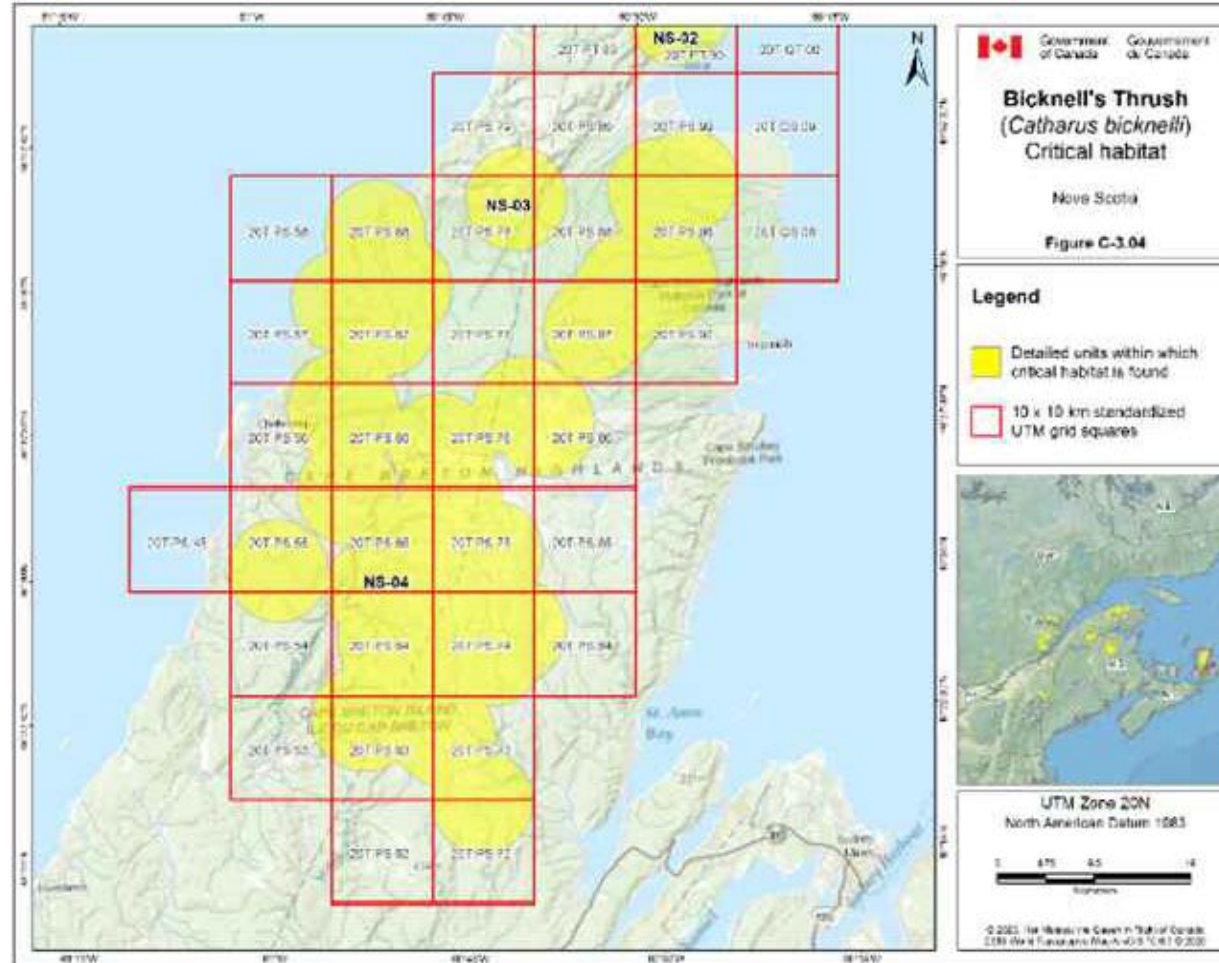


Figure C-3.04. Critical habitat for the Bicknell's Thrush in Nova Scotia. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national grid system that indicates the general geographic location of the critical habitat.

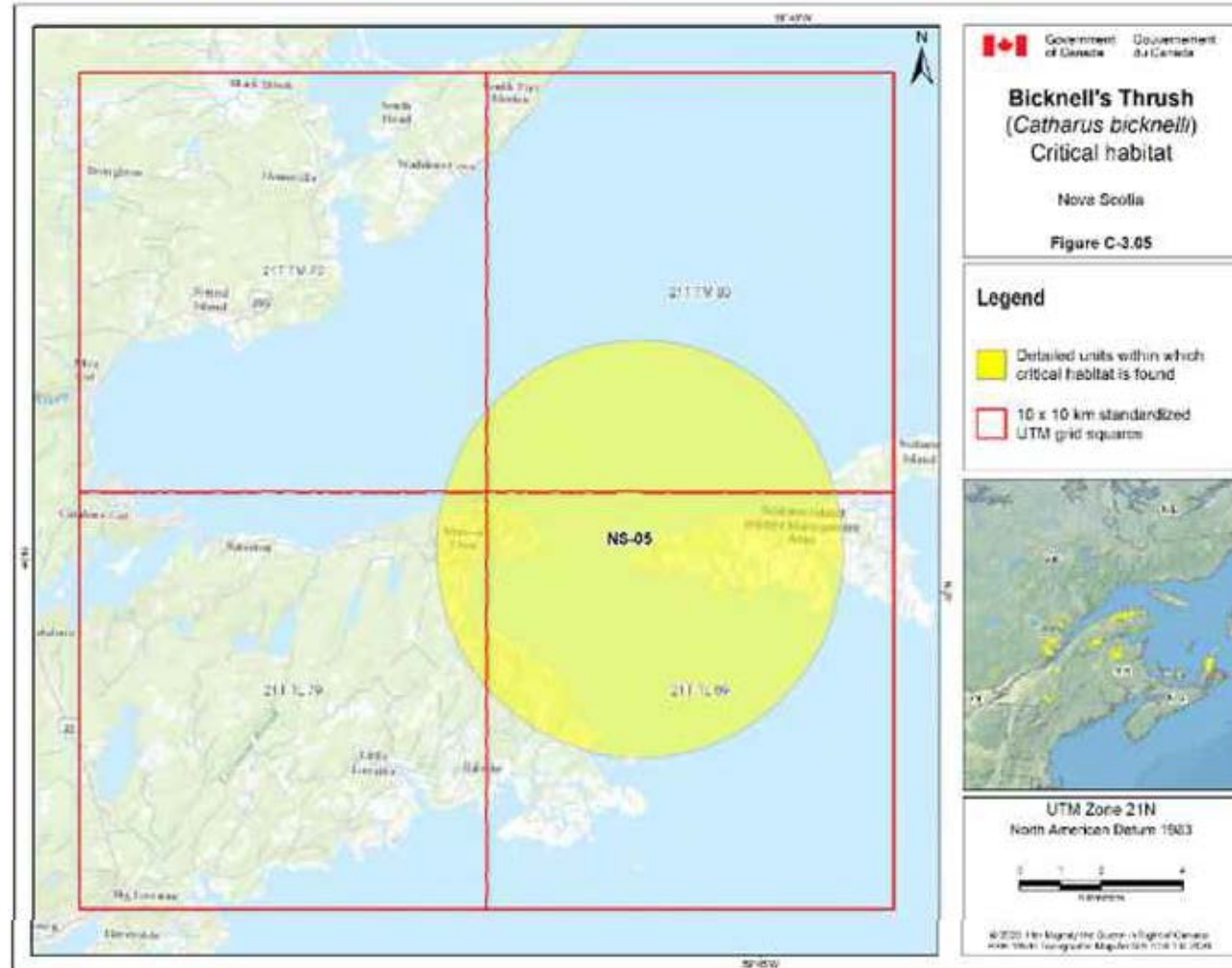


Figure C-3.05. Critical habitat for the Bicknell's Thrush in Nova Scotia. Critical habitat is represented by the shaded yellow polygon (unit), where the critical habitat identification criteria and method set out in section 7.1 are met. The 10 x 10 km UTM grid overlay (in red) is a standardized national 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](#)'s¹⁴ (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) (Lloyd and McFarland 2017).

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 www.canada.ca/en/environmental-assessment-agency/programs/strategic-environmental-assessment/cabinet-directive-environmental-assessment-policy-plan-program-proposals.html

¹⁴ 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.