



Protection measure for the Bicknell's Thrush

in Relation to Forest Management
Activities

COORDINATION

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INTRODUCTION

The protection measure outlined in this document pertain only to forest management activities. It was prepared by a working group (wildlife subcommittee) under the Administrative agreement on the protection of threatened and vulnerable plant and animal species and other biodiversity components in Quebec's forests (Ministère du Développement durable, de l'Environnement et des Parcs and Ministère des Ressources naturelles et de la faune, 2010). The document is intended mainly for forest planners and managers responsible for preparing integrated forest management plans; it therefore includes several notes intended specifically for them.

1. BIOLOGY OF THE BICKNELL'S THRUSH

The Bicknell's Thrush is a rare passerine species that inhabits forests and has a restricted and fragmented range. It breeds in the northeastern United States and southeastern Canada, and then migrates to the Greater Antilles. Southern Quebec is the northern limit of its breeding range (International Bicknell's Thrush Conservation Group, 2010). Sightings have been made in a limited number of locations mainly in the Appalachian Mountains (between Estrie and Gaspésie) and north of the St. Lawrence River (Laurentides, Laurentides Wildlife Reserve, Charlevoix, Monts-Valin and Côte-Nord regions) (Ministère des Forêts, de la Faune et des Parcs, 2014a; Committee on the Status of Endangered Wildlife in Canada [COSEWIC], 2009). Its preferred habitat consists of dense coniferous stands, dominated by balsam fir, in montane and coastal areas (Gauthier and Aubry, 1995). It is also found in regenerating forests with high balsam fir densities. Quebec reportedly contains 95% of potential breeding habitat for the Bicknell's Thrush in Canada (COSEWIC, 2009). Outside of coastal lowland areas, high elevation is an important habitat characteristic for the Bicknell's Thrush: it occurs in interior forests at elevations generally ranging from 450 to 1,100 m, depending on the region (COSEWIC, 2009; Rimmer et al., 2001).

In Quebec, the Bicknell's Thrush is present from late May until October (Gauthier and Aubry, 1995). The species usually returns to sites where it has nested successfully (COSEWIC, 2009). The species exhibits a polygynandrous mating system, in which both males and females mate with multiple partners. Each of the nestlings in a given nest may have a different father, and multiple fathers may assist with feeding them (Goetz, McFarland and Rimmer, 2003). The area required for a breeding unit, composed of several males and females (up to 10 individuals), appears to exceed 60 ha (Aubry, Desrochers and Seutin, 2011).

2. THREATS AND OBJECTIVES

For the Bicknell's Thrush, the main threats related to forest management activities are as follows:

- modification and loss of breeding habitat caused by certain forestry practices (harvesting, stand tending and planting);
- destruction of nests, eggs and chicks as well as disturbance when forest management activities (including forest road work) are carried out during the breeding season.¹

The objectives of the protection measure are to:

- preserve montane fir stands of potential natural vegetation types MS4 and RS4, mostly at high elevations, as well as coastal fir stands (potential natural vegetation types MS7 and RS7);
- maintain dense fir stands currently used as breeding habitat for as long as possible;
- promote the presence of dense balsam fir stands (with more than 10,000 stems/ha at the sapling stage) by carrying out suitable treatments on favourable sites in areas currently used by the species and in areas of high potential for the species;

1. The breeding season includes the species' occupation of breeding sites, mating, and the rearing of young until they fledge.

- prevent the destruction and disturbance of nests, eggs and chicks during the breeding season;
- preserve habitats that are suitable for the species, in order to support a viable population.

3. AREAS OF APPLICATION OF PROTECTION MEASURE

The areas of application of the protection measure related to forest management activities corresponds either to locations where the Bicknell's Thrush occurs (protection zone), or to locations where there is a high likelihood of its presence. They can be defined as follows:

- **Protection zone:** area where the species is known to occur. Each protection zone is identified in a shapefile distributed by the Direction de l'aménagement et de l'environnement forestiers du ministère des Forêts de la Faune et des Parcs (MFFP; Direction of Forest Management and Forest Environment, Department of Forests, Wildlife and Parks). All the protection zones correspond to the occurrences compiled by the Centre de données sur le patrimoine naturel du Québec (CDPNQ);
- **Area of high potential:** area where the likelihood of presence of the Bicknell's Thrush is high, although there may not be any extant records of the species.

NOTE – Protection zones

The forest manager will apply the prescriptions described for each type of area: protection zones or high potential areas.

Where there is overlap between the two types of areas, the measure for the protection zone will be applied on a priority basis.

Protection zones may not be located in an “area of high potential.” This does not mean that habitat considered to require protection is not suitable for the species. This situation is mostly attributable to the methodology that is used to delineate areas of high potential; it is based on present – and improvable – knowledge of Bicknell's Thrush habitat.

Warning!

The areas of high potential have been delineated by experts using the criteria described in Appendix A. Their use is strictly limited to the forest management context.

4. PROTECTION MEASURE

The protection measure for the Bicknell's Thrush are divided into three sections, based on the mandatory character of the prescriptions outlined in this document.

Warning!

The protection measure for the Bicknell's Thrush was developed based on the data available at the time of writing. They may be adjusted over time as new knowledge of the species and its habitat becomes available.

NOTE – Mandatory prescriptions

The mandatory prescriptions (including those subject to potential adjustment) related to the protection measure for the Bicknell's Thrush may be in contradiction with existing measures established for other species (for example, special management plans for caribou). In such a case, the forest manager of the management office concerned and the persons in charge of threatened and vulnerable species in the region (Forest Management and Wildlife Management regional Directions) will agree on the prescriptions to be implemented in the areas concerned. One of these persons will notify the wildlife subcommittee.

4.1 Mandatory prescriptions

The mandatory prescriptions apply only **in the protection zone**.

a) Protection of nest, eggs and chicks

No forest management activities may be carried out during the breeding season, that is, from May 30 to August 15.

- This time restriction does not apply to grading and roadbed resurfacing work (see note concerning roads), or to reforestation (see note concerning reforestation).

NOTE – Reforestation

Planting (or reforestation) is a treatment that is carried out in areas that have been harvested and will therefore not be used as breeding habitat by the Bicknell's Thrush. Furthermore, this type of treatment generally involves manual work, so there is less risk of disturbing the birds. For these reasons, the time restriction pertaining to the breeding season does not apply to reforestation.

However, planting done in the Bicknell's Thrush protection zone must comply with the requirements set out in section 4.2a - Reforestation.

NOTE – Roads

With respect to roads, “forest development activity” as defined in section 4 of the *Sustainable Forest Development Act* includes construction, improvement, repair, maintenance or closure of infrastructure. Consequently, when any of these activities are to be undertaken in a Bicknell's Thrush protection zone, they must be scheduled by taking into account the restricted time period.

Road planning must also take into account the prescriptions described in section 4.2a – Road and sand pits. Any passage in a protection zone must be planned in advance and the phases of work must be organized accordingly. Note, however, that the time restriction does not apply to grading or roadbed resurfacing work or to vehicle traffic.

b) Habitat protection

For natural potential vegetation types MS4, RS4, MS7 and RS7

No forest management activities are permitted in montane fir forests (potential natural vegetation types MS4 and RS4) or coastal fir forests (potential natural vegetation types MS7 and RS7).

NOTE – Potential natural vegetation types MS4, RS4, MS7 and RS7

Stands corresponding to potential natural vegetation types MS4, RS4, MS7 and RS7 represent preferred habitat for the Bicknell's Thrush; they must be preserved in protection zones, that is, locations where the species has been observed. Furthermore, based on the *Guides des stations forestières* [forest site guides] (Cyr, 2014a and 2014b), these forest sites generally have very low forestry potential and are considered of little interest from a forest management perspective. In volume 3 of the *Guide sylvicole du Québec* (Ministère des Forêts, de la Faune et des Parcs, in preparation) it is indicated that intensive silviculture is not recommended in stands corresponding to potential natural vegetation types MS4 and RS4. Extensive silviculture might be possible in certain of these stands; however, the guide specifies that harvest profitability must be assessed in advance in such cases. For these reasons, the preservation of these types of potential natural vegetation in the Bicknell's Thrush protection zone represents an excellent opportunity for conserving the species and its habitat.

It is possible that, prior to the adoption of this measure, some regions may have already devoted efforts and investments to these types of stands (tending treatments, for example). In such cases, it may be possible to complete the stand intervention planning that has been initiated. Another possibility is to modify the planning in order to achieve the objectives of the protection measure, that is, to promote the growth of dense fir stands (more than 10,000 stems/ha when the stand reaches a height of 2 m, at about 15 to 20 years of age) in areas currently used by the species. The activities that are carried out must comply with the time restriction related to the breeding period (see section 4.1a).

Finally, once the planning has been completed, no additional forest management activities or treatments, regardless of their nature, may be carried out subsequently in these stands, or in other stands of potential natural vegetation types MS4, RS4, MS7 and RS7 that are present in the protection zone.

For other potential natural vegetation types

- No high yield wood production area (AIPL) may be established in the protection zone.
- No stand tending activities (cleaning and precommercial thinning [PCT]) may be carried out at the sapling stage in the protection zone.
- If forest management activities need to be carried out, the rate of disturbance, **in the protection zone**, must not exceed 33%; the planned interventions must therefore comply with the guidelines described in section 4.2 a.

NOTE – The rate of disturbance in the protection zone

The rate of disturbance **in the protection zone** corresponds to the proportion of the total area that is occupied by disturbed habitats in relation to Bicknell's Thrush requirements.

Built (non-forest) environments (roads, rights-of-way, ski trails, etc.), recently harvested areas (cutting with protection of regeneration and soils [CPRS] or other partial cuts) (less than 15 years of age), areas subjected to tending treatments to promote regeneration (less than 10 years of age) as well as areas that have undergone naturally disturbances (burns, severe outbreaks and windthrow less than 15 years of age) are considered disturbed areas.

4.2 Mandatory prescriptions subject to potential adjustment

The prescriptions outlined hereafter must be followed. However, the forest manager with MFFP may have some leeway if the measure need to be adapted because of specific regional or local characteristics, or because of operational constraints.

Mandatory prescriptions that may be subject to adjustment apply to the protection zones and to areas of high potential.

NOTE – Potential adjustments

Any adjustment of the prescriptions related to this protection measure must be made in keeping with the procedures set out in instruction "IN_446_Mesures_protection_EMVS" available in the environmental management system (SGE-ADF).

a) In the protection zone

Reforestation

In the protection zone, planting (reforestation) may only be done within the context of basic silviculture, and only in stands or potential natural vegetation areas that are not suitable for establishing habitat characteristics required by the Bicknell's Thrush.

Stand tending

Stand tending treatments are permitted only if they meet the conditions set out below.

The only treatments permitted are those that can be carried out at the seedling stage, specifically, release (to eliminate undesirable deciduous stems) and thinning out;

- The treatments must be carried out before May 30 or after August 15, that is, outside of the breeding season as specified in section 4.1a;
- In a thinning out operation, the post-treatment number of fir stems must exceed 11,000 stems/ha with a stocking of at least 65%;
- The selected treatments must help to maintain fir dominance in the stand.

Silvicultural treatments

Stand prescriptions must be aimed at achieving regeneration of balsam fir-dominated stands on suitable forest sites (e.g. potential natural vegetation MS1, MS2, MS3, MS6, RS1, RS2 and RS3).

- The treatments to be prioritized will vary with stand condition, specifically, with the extent of existing fir regeneration. The goal is to produce a stand that will have more than 11,000 stems/ha and a stocking of at least 65% at the sapling stage.

NOTE – Reforestation

Bicknell's Thrush habitat is characterized by the presence of dense fir stands or fir-dominated stands. Balsam fir is a species that generally establishes readily under the forest canopy. Tree planting is therefore not usually required in these stands to supplement natural regeneration of fir.

- The treatments that could be undertaken to meet those objectives include:
 - Variable-retention harvesting (retention of individual trees and groups of trees across the cutblock), which is a variant of CPRS;
 - CPRS;
 - the shelterwood system (CPR) might be an acceptable intervention **in adequately regenerated stands that are at greater risk of conversion to deciduous forest** or in very dense mature stands characterized by deficient fir regeneration.

Harvest management involving partial cuts with continuous canopy cover should be avoided.

During forestry operations, it is important to preserve all snags that do not present a risk to worker safety.

NOTE – Partial harvesting

In Bicknell's Thrush protection zones, it is important to avoid using partial harvesting scenarios such as seed cutting (CPE) or irregular shelterwood method with continuous cover (CPICP). These treatments do not meet the specific habitat needs of the Bicknell's Thrush. This bird species prefers fir-dominated stands with specific stem densities in sapling and young pole strata. These requirements cannot be maintained in landscapes subjected to treatments that create large openings at frequent intervals.

Road and sand pits

Minimize habitat loss resulting from road construction (optimize the road system by using maximum hauling distances).

Avoid building roads with a right-of-way exceeding 30 m.

Minimize areas of disturbance due to sand pits and avoid those with a width greater than 50 m.

NOTE – Road and sand pits

In keeping with the prescriptions set out in section 4.1, no forest management activities are permitted in potential natural vegetation types MS4, RS4, MS7 and RS7. This includes the construction of new roads.

If owing to regional or operational constraints, a region needs to build a road in these potential natural vegetation types, construction of the road in the stands concerned represents an adjustment to the protection measure. In such a case, the region must comply with these directives: “IN_446_Mesures_protection_EMVS” available in the environmental management system (SGE-ADF).

Preventive harvesting or salvage cutting during a spruce budworm outbreak

Considering the current spruce budworm outbreak, the forest management approach in relation to the outbreak (Ministère des Ressources naturelles, 2013), forest planning adjustments in response to an outbreak and the analysis tools available for evaluating the sensitivity and vulnerability of stands (Ministère des Forêts, de la Faune et des Parcs, 2014b); and taking into consideration the data on Bicknell's Thrush habitat use:

- The Bicknell's Thrush protection zones and the forest stands they contain must be assessed for vulnerability to spruce budworm using the criteria established by the MFFP (2014b);
- Stands in which vulnerability classes cannot be applied (balsam fir-white birch domain, elevations of 750 m and over) should not undergo preventive harvesting;
- Stands in the low, very low or nil vulnerability classes (classes 4 and 5) should not be subjected to preventive harvesting;
- Stands in vulnerability classes 1, 2 or 3 that are required to undergo preventive harvesting or salvage cutting may not be treated during the species' breeding period, that is, between May 30 and August 15.

For more details, see Appendix B.

b) In areas of high potential

Preservation of potential natural vegetation MS4 and RS4

Forestry activities may not be carried out in montane fir stands, as they represent preferred habitat for the Bicknell's Thrush. Such sites generally have low forestry potential and are considered to be of little interest from a forest management perspective (Cyr, 2014a; Cyr, 2014b). Maintaining these potential vegetation types in areas of high potential therefore represents an effective conservation approach for the species and its habitat.

NOTE – Concerning potential natural vegetation types MS4 and RS4 in areas of high potential

The preservation of potential natural vegetation types MS4 and RS4 in areas of high potential could have significant impacts in some forest management units which contain a large amount of such vegetation. In other cases, maintaining MS4 and RS4 vegetation may add requirements over and above those already associated with protection measures for other species (e.g. for the Barrow's Goldeneye).

In the event of impacts resulting from extensive presence of MS4 and RS4 types, the forest manager must conduct a more in-depth analysis of the situation:

- Carefully identify stands with potential natural vegetation types MS4 and RS4 that could undergo harvesting;
- Carry out a profitability assessment of the intervention beforehand (as recommended in the *Guide sylvicole du Québec* (Ministère des Forêts, de la Faune et des Parcs, in preparation);
- Carry out the treatment in order to achieve the following objective: promote the regeneration of a dense fir stand (more than 10,000 stems/ha when the stand reaches the sapling stage) by carrying out appropriate treatments on suitable forest sites.

Where the impacts are attributable to the combination of the Bicknell's Thrush protection measure and measure established for another species occurring in the area of high potential, the forest manager for the management unit Office concerned and the persons in charge of threatened or vulnerable species in the region (Forest Management and Wildlife Management regional Directions) may agree on prescriptions to be implemented in the areas concerned. One of these persons will notify the wildlife subcommittee.

Ecosystem-based management

The challenge related to Bicknell's Thrush conservation is mainly linked to three of the six main ecological issues addressed in ecosystem-based management (forest age structure, forest species composition and stand internal structure). Two of these issues (forest age structure, stand internal structure) present a promising opportunity for synergy related to potential prescriptions. In some cases, the third issue, forest species composition, comes into conflict with the needs of the Bicknell's Thrush.

First, the target related to **forest age structure** at the scale of a territorial unit¹ (TU) is to have a maximum of 30% of the area made up of regenerating forest (less than 15 years of age) in the majority of TUs in each management unit. This measure is beneficial for the Bicknell's Thrush because it limits the level of recent disturbance at the landscape level in the short term and, in the medium term, promotes the establishment of new potential habitat for the species. The forest manager must comply with this threshold in **all areas of high potential for the Bicknell's Thrush in each TU**. The manager may, however, adjust the threshold based on the regional situation related to this issue.

The **internal structure** of stands is also an important concern in relation to the Bicknell's Thrush. Owing to the widespread use of stand tending treatments (mainly PCT) in young stands in recent decades, dense young even-aged stands are now a rare component of the landscape. Reducing the differences between managed stands and the natural forest characteristics in terms of internal structure would undoubtedly promote an increase in potential habitat for the Bicknell's Thrush. Thus, in territorial reference units (TRU)² or spatial organization compartments (COS)³ affected by this issue, the maintenance of dense young coniferous stands (dominated by balsam fir) should be given priority in areas of high potential for the Bicknell's Thrush.

Forest composition is another important consideration in relation to the Bicknell's Thrush. It is recognized that in the balsam fir domain, balsam fir can often invade stands and gradually displace the spruce, pine and eastern white-cedar which grow scarce, even rarify (Jetté et al. 2012). While this situation may benefit the Bicknell's Thrush, silvicultural efforts that are deployed to address the issue may be detrimental to the species. Therefore, actions to prevent the loss of certain forest species and invasion by fir trees should be avoided in areas with high potential for the Bicknell's Thrush. Nonetheless, the species might benefit from silvicultural treatments aimed at halting the invasion of shade-intolerant deciduous trees; these treatments should be carried out in areas of high potential.

1. TU: spatial unit used for gap analyses of issues related to age structure.

2. TRU: forest land unit used in the fir and maple domains to carry out gap analyses for ecosystem-based management issues.

3. COS: subdivision of the management unit in the spruce-moss domain created to manage the spatial distribution of interventions and the presence of large forest tracts.

4.3 Recommendations

The recommendations consist of best practices; they are not mandatory.

a) In protection zones

There are no specific recommendations for the protection zones.

b) In areas of high potential

Protection

Minimize forestry operations during the breeding season (May 30 to August 15).

Harvest management

- Promote extensive silvicultural system.

Minimize establishing high yield wood production areas (AIPL).

Silvicultural treatments

- Shelterwood system (CPR, cutting with protection of regeneration) may be an acceptable intervention in adequately regenerated forests at greater risk of conversion to deciduous forest and in very dense mature forests characterized by deficient balsam fir regeneration.
- Encourage the use of cutting with protection of regeneration and soils (CPRS) in adequately regenerated stands.

The use of variable-retention harvesting should be encouraged.

Stand tending treatments

- Minimize the use of stand tending treatments (release, precommercial thinning, cleaning, thinning out, etc.).
- When stand tending treatments need to be carried out in areas with high potential in each COS or TRU, treat up to 33% of the area eligible on a five-year cycle by prioritizing stands that meet the following criteria:
 - stands at lower elevations;
 - stands not dominated by balsam fir;
 - stands with lower stem densities.
- Stand tending treatments could also be adjusted as follows:
 - When the area to be treated (systematic precommercial thinning) exceeds 40 ha, retention of at least 10% of the area (i.e. 4 ha) as untreated patches is recommended. The patches must cover an area of at least 0.25 ha and be located not more than 50 m from the untreated area;

Note – Concerning tending treatments

With regard to stands to be targeted for tending treatments in areas of high potential, elevation and density cannot be specified, since these values may vary with the COS or TRU concerned.

- Promote treatments that allow higher stem densities to be maintained (precommercial crop tree release, precommercial patch-selection thinning, release, cleaning, etc.) in preference to systematic precommercial thinning and thinning out;
- During interventions, preserve fruit-bearing trees and shrubs that do not interfere with the growth of the released stems.

Preventive harvesting or salvage cutting during a spruce budworm outbreak

- The guidelines presented on this topic in section 4.2a could be implemented in areas of high potential.

Road and sand pits

Minimize habitat loss caused by the construction of roads and promote the building of roads with a right-of-way less than 30 m.

Minimize areas of disturbance due to sand pits. If possible, limit the width of the area cleared for such infrastructure to less than 50 m.

5. OTHER CONSIDERATIONS

5.1 Surveys

Conduct field surveys to confirm the presence of the Bicknell's Thrush in certain regions. For example, surveys could be carried out on a priority basis in high potential areas where the species has not yet been detected, as well as in high-density second-growth fir-dominated stands, where tending and other operations are planned. The surveys should be conducted prior to these treatments.

5.2 Monitoring of treatments

As indicated in the note at the beginning of section 4, the protection measure were developed on the basis of existing knowledge. From the standpoint of recommended treatments, monitoring of activities that are carried out would provide a better understanding of the situation and of the changes in regenerating forest, and make it possible to determine whether the prescriptions described in this document permit the attainment of the objectives established for treated stands. The prescriptions could be adjusted to ensure the maintenance of suitable habitat for the Bicknell's Thrush, a species that has been designated as vulnerable.

APPENDIX A Delineation of areas of high potential for the Bicknell's Thrush

Warning!

Areas of high potential delineated based on the criteria explained below are intended for use **solely** in a forest management context. They cannot be used for any other purpose.

Context

Considering the precarious situation of the Bicknell's Thrush and its sporadic occurrence in small numbers in forests, it was agreed to establish a new scale for implementation of the protection measure, that is areas of high potential.

Definition of “area of high potential”: **area where the likelihood of presence of the Bicknell's Thrush is high**, even though there may be no extant records of the species.

At present, experts are seeking to identify habitat variables that can predict the species' presence, in order to carry out large-scale modelling of habitat potential. Pending the results of this research, the short-term objective is to target areas of high potential (where there is a high degree of certainty concerning the species' presence). These areas would be the focus of a series of prescriptions that would contribute significantly to the species' protection in those areas. Over the coming years, the protection measure and the areas that are delineated could be adjusted or enhanced as new knowledge is acquired, in accordance with an adaptive management approach.

Delineation of areas of high potential

Given that the species' presence is strongly correlated with high elevations, elevation is the only variable that has been taken into consideration to date in delineating areas of high potential. High elevation habitats are characterized by natural dynamics that are conducive to the presence of forest stands that have high potential for the Bicknell's Thrush (dense balsam fir-dominated stands).

The approach used to delineate areas of high potential is based on the elevations associated with extant Bicknell's Thrush records. However, relying solely on the lowest elevations associated with known occurrences to delineate areas of high potential can lead to questionable results, that is, overly large expanses of forest that are not relevant enough for identifying high potential habitat for the species. As a result, the approach considers other spatial scales as well (ecological region, ecological district) when necessary to capture variations in elevation associated with areas used by distinct groups of individuals or populations. The analysis therefore involved determining the

lowest elevation encompassing the majority of records as well as the smallest area of land in order to determine the most realistic threshold for applying specific management practices.

This method was applied by specialists with the MFFP (forest section and wildlife and parks section) and Environment Canada using the data currently available on the species: CDPNQ, second Quebec breeding bird atlas (Regroupement QuébecOiseaux, Canadian Wildlife Service and Bird Studies Canada, 2014), survey reports and other publications. Table 1 presents the elevation criteria that were used.

For some regions, such as the Côte-Nord, only a few isolated occurrences of the species have been reported. Such a situation makes it impossible to delineate areas with high potential.

Table 1 Lowest elevations used¹ to delineate areas of high potential in high elevation ecosystems

Region	Ecological Region	Ecological District	Lowest Elevation Used ^a (m)	Complementary Information
Capitale-Nationale–Chaudière-Appalaches (03-12) Saguenay-Lac-Saint-Jean (02)	5e	-	900	Massif du lac Jacques-Cartier
Saguenay-Lac-Saint-Jean (02)	5f	-	800	Massif du mont Valin
Gaspésie–Îles-de-la-Madeleine (11), Bas-Saint-Laurent (01)	5i	-	800	Haut massif gaspésien
Bas-Saint-Laurent (01)	4f	I001 (Hautes collines du lac Otis)	800	Secteur du mont Saint-Pierre (Amqui)
Laval-Lanaudières-Laurentides (13-14-15)	3b et 3c	-	750	
Capitale-Nationale–Chaudières-Appalaches (03-12)	3d	V010 (Hautes collines du lac Gosselin)	750	Massif du Sud
Estrie–Montréal–Monterégie (5-6-16)	3d	D009 (Collines de la rivière Linière)	850	Secteur du mont Bélanger
Estrie–Montréal–Monterégie (5-6-16)	3d	D008 (Collines de la rivière Kokombis)	900	Secteur du mont Brown et environs
Estrie–Montréal–Monterégie (5-6-16)	3d	D007 (Hautes collines du lac Arnold), D004 (Collines de la rivière Clinton)	850	Secteurs des monts Gosford et Saddle
Estrie–Montréal–Monterégie (5-6-16)	3d	D005 (Mont Mégantic)	900	Secteur du mont Mégantic
Estrie–Montréal–Monterégie (5-6-16)	3d	D002 (Collines du lac Wallace)	750	Secteur du mont Hereford
Estrie–Montréal–Monterégie (5-6-16)	2c	P006 (Hautes collines de Glen Sutton)	800	Secteur du mont Sutton

a. High elevation (greater than 1,050 m) areas of alpine tundra (non-shrub tundra) (e.g. summit of Mont Albert) can be excluded from the areas with high potential.

1. The elevations presented in this table reflect the current state of knowledge. The data may need to be modified as new knowledge is acquired.

APPENDIX B Protection of Bicknell's Thrush and forest management during a spruce budworm outbreak

Spruce budworm damage is fairly widespread in a number of regions in Quebec, to the extent that the outbreak could be called an epidemic. In light of this situation, the MFFP has adopted a management strategy in relation to the spruce budworm outbreak (Ministère des Ressources naturelles, 2013). The MFFP has also prepared a reference guide (Ministère des Forêts, de la Faune et des Parcs, 2014b) on adjusting forest management activities during a spruce budworm outbreak, while applying the principles of the ecosystem-based forest management approach, including protection for the habitat of threatened and vulnerable species.

In Quebec, management of the actions taken to deal with a spruce budworm outbreak inevitably affects Bicknell's Thrush habitat. This thrush species occupies very dense (more than 10,000 stems/ha) balsam fir, or balsam fir-dominated, stands, as well as regenerating stands, in high-elevation montane or coastal environments. The species prefers high elevation stands, and lowest elevation associated with its presence may vary from region to region.

Balsam fir is the tree species that is most vulnerable to the spruce budworm. This vulnerability—the likelihood that trees will die after several years of severe defoliation—may depend on various factors. At the tree level, the age or maturity of individual stems plays a role: old fir trees are the most vulnerable. By contrast, at the stand level, vulnerability is influenced by factors such as forest composition, stand density and site quality. At the landscape level, vulnerability is influenced by the diversity of existing stands and by elevation.

The MFFP has developed a method for evaluating the vulnerability of stands and areas affected by spruce budworm (Ministère des Forêts, de la Faune et des Parcs, 2014b). The variables taken into account are the relative abundance of fir in the overall forest composition, stage of development and quality of the site. These three variables are combined to establish five classes of vulnerability, ranging from very high (1) to very low or nil (5).

Current knowledge of Bicknell's Thrush habitat can be used to provide a portrait of the vulnerability of forest stands in protection zones for the species, based on the first two variables mentioned.

a) Relative abundance of fir in forest composition

When this variable is considered in isolation, it becomes immediately apparent that Bicknell's Thrush protection zones (composed generally of fir or fir-dominated stands) contain stands that correspond to a fairly high vulnerability class.

b) Stage of development

In Bicknell's Thrush protection zones, the stage of development of forest stands may range from mature (in montane fir stands) to young or premature (regenerating stand). From this perspective, montane fir stands might be more vulnerable than regenerating stands.

However, another factor must also be considered—elevation—because it influences the evaluation of vulnerability. The MFFP believes that it is necessary to adjust the vulnerability classification based on elevation in the balsam fir-white birch bioclimatic domain and in the spruce-moss domain (Ministère des Forêts, de la Faune et des Parcs, 2014b). Depending on their elevation, the vulnerability of stands in these bioclimatic domains might be reduced by one level (class) or the stands might be considered not vulnerable. Based on this information, fir stands or fir-dominated stands within Bicknell's Thrush protection zones located at elevations of 750 m or

more in balsam fir-white birch forests, or at elevations of 500 m or more in spruce-moss forests, should not be considered vulnerable to spruce budworm, because they are at low risk of undergoing several years of severe defoliation.

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