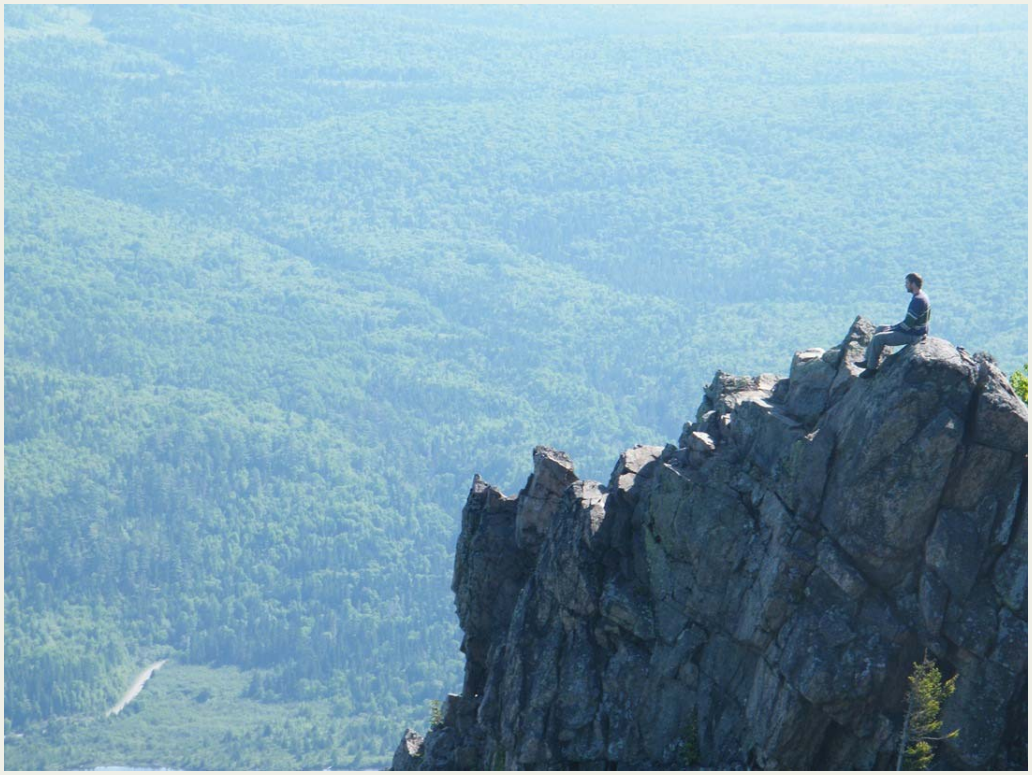
High Elevation Landbird Program

10-year report



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The Government of Canada Habitat Stewardship Program for Species At Risk
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EXECUTIVE SUMMARY

The High Elevation Landbird Program (HELP) was initiated by Bird Studies Canada (BSC) in 2002 with the goal of monitoring long-term trends in Bicknell's Thrush populations. Also included were other landbirds breeding at high elevations in New Brunswick and Nova Scotia, Swainson's Thrush, Fox Sparrow, Blackpoll Warbler, Winter Wren and White-throated Sparrow.

In NB, the number of Bicknell's Thrush reported on survey routes declined by 11.5% annually from 2002-2011. White-throated Sparrow and Winter Wren also showed significant declines of 7.8% and 7.9%, respectively. However, Blackpoll Warbler and Swainson's Thrush detections increased significantly over the 10 years (9.1% and 3.5% annually, respectively). Fox Sparrow remained stable. In NS, Blackpoll Warbler detections declined significantly at a rate of 9.3%. Swainson's Thrush detections also increased significantly at a rate of 8.9% annually.

Bicknell's Thrush population estimates were calculated for NB and NS using bird density information from HELP along with the model of potential Bicknell's Thrush habitat (VCE 2008), the NB Forest Inventory Database (NBFID), and the NS forest inventory. In NB, the population is estimated at 2,851 individuals, with 95% lower and upper confidence limits of 1,137 and 10,652. In NS, the estimate is 3,845 individuals, with 95% confidence limits of 1,823 and 7,049.

While HELP has shown declines on HELP routes in NB, whether these declines have occurred throughout the province is unclear. Since HELP routes were not randomly selected and because Bicknell's Thrush habitat in industrial forest is ephemeral, declines may reflect habitat changes along routes rather than Bicknell's Thrush declines. This could potentially impact population trend and estimate calculations, which are based on HELP trends. However, HELP is not the only monitoring program to detect declines in Bicknell's Thrush in the Maritimes. Since the first Maritimes Breeding Bird Atlas (MBBA; 1986-1990) Bicknell's Thrush appear to have undergone substantial range shrinkage in northern NB. During the recently completed second Atlas (2006-2010) Bicknell's Thrush were detected in 39% fewer squares in the north-western and central mountains. This suggests that declines have occurred at a broader scale than HELP routes.

In NS, too few routes have had consistent Bicknell's Thrush detections to detect trends. Bicknell's Thrush densities have been low in Cape Breton's industrial forest since the beginning of HELP. The industrial forest there is now approximately 25 years old, and has undergone treatments to reduce stem density, likely making it unsuitable for Bicknell's Thrush. The lack of Bicknell's Thrush along half of HELP routes likely means that the current sampling intensity is inadequate for monitoring trends in Cape Breton. Data from the MBBA suggest that distribution is probably declining, with Bicknell's Thrush present in 32% fewer squares in the Cape Breton Highlands in the second Atlas.

The HELP survey played a key role in the Committee of the Status of Endangered Wildlife in Canada's (COSEWIC) recent status assessment of the Bicknell's Thrush as Threatened and has shown that Bicknell's Thrush have declined significantly along HELP routes in NB. It has also brought to light some key issues and challenges in monitoring a bird species whose habitat preferences are relatively ephemeral. However, non-random route selection in NB, low population densities and sampling intensity, limit the inferences that can be made regarding population declines at provincial and regional scales. In 2012-13, BSC will refine HELP, using a new sampling design to randomly select routes and increase sampling intensity in Cape Breton, thus enabling us to meet international, national and regional information needs, and to better monitor Bicknell's Thrush in the Maritimes.

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INTRODUCTION

BSC has conducted the HELP in NB and NS since 2002. The primary goal of this survey is to monitor long-term trends in landbird populations breeding at high elevations, with a particular focus on the Bicknell's Thrush, but also Swainson's Thrush, Fox Sparrow, Blackpoll Warbler, Winter Wren and White-throated Sparrow. The Bicknell's Thrush is a primary focus of this survey because it is not well-monitored by the North-American Breeding Bird Survey www.pwrc.usgs.gov/BBS due to its low population numbers combined with its highly restricted and remote breeding range.

BICKNELL'S THRUSH – T BRANDT RYDER

The Bicknell's Thrush typically breeds in dense coniferous forests of high elevation areas in eastern Canada and the north-eastern United States (Connolly et al. 2002, Lambert et al. 2005). Birds select dense regenerating forests disturbed by windthrows, ice and snow damage, and fire and insect outbreaks (Rimmer et al. 2001). They also use chronically disturbed, stunted-tree stands sometimes characterized as krummholtz (Bredin and Whittam 2009). Rarely, the species is found in coastal areas where dense spruce-fir stands are maintained by cool sea breezes and a high precipitation regime (COSEWIC 2009). In Canada and Maine, Bicknell's Thrush are also found in regenerating clear cuts (Ouellet 1993, Nixon *et al*. 2001, Connolly *et al*. 2002, Gardiner 2006, Chisholm 2008, McKinnon 2009), where forestry operations mimic natural disturbance events, but often at a much larger scale. However, regenerating clearcuts are not left to regrow as in natural regime, they are instead subjected to precommercial thinning, a practice which reduces stem density by as much as 95% to maximize growth in the remaining trees. After the thinning, Bicknell's Thrush are mostly restricted to the edges of the thinned areas, in the dense unthinned balsam fir that remains (Aubry et al. 2011).

CAPE NORTH, NS – B STEWART

The current rough population estimate for the Bicknell's Thrush in Canada is between 40,570 and 49,258 birds, and it was previously estimated that approximately 1,200 breed in NB and NS (COSEWIC 2009, but see results section). Results from the second MBBA show a greater than 40% decline in the distribution of the species over the last 10 years (COSEWIC 2009), and data from the HELP show significant declines of 20.2%/year and 18.9%/year in NB and NS, respectively, between 2002 and 2008, which amounts to population losses of over 70% in just six years (COSEWIC 2009). In addition, the Bicknell's Thrush is believed to be extirpated from some coastal sites where it was once found. As a result of these Maritimes trends and indications of population declines in Quebec, the COSEWIC recommended a status of *Threatened* for the Bicknell's Thrush in November 2009. Currently, the Bicknell's Thrush is federally listed as a Species of

Special Concern but with no legal status under the Species At Risk Act (SARA). If the Threatened recommendation is accepted and the species is federally listed under SARA, the bird and its critical habitat will receive legal protection. The Bicknell's Thrush is also considered the landbird species of highest conservation priority in Bird Conservation Region 14 by Partners in Flight, and was also designated as a temperate breeder of high tri-national concern in 2010 (Berlanga *et al*. 2010). It is designated May be at Risk in NB, Sensitive in NS and Globally Vulnerable by the World Conservation Union (IUCN; Birdlife International 2008).

This report provides results from the 10th year of surveys and an analysis of 10-years trends in the Maritimes, as well as population estimates for NB and NS based on HELP data, and future directions Bicknell's Thrush monitoring in the Maritimes.

METHODS

Survey Routes

HELP now consists of 71 routes: 42 in NB (Figure 1) and 29 in NS (Figure 2). Three routes were discontinued in NB, and 2 in NS, because they were not originally placed in appropriate habitat (four routes), or because of issues with consistency of stop locations between years (one route). Routes were located by first defining appropriate habitat for each province (Whittam and Ball 2003), then placing routes in patches of appropriate habitat that had a suitable road or trail for access. Not all suitable patches were sampled (except within Cape Breton Highlands National Park and Mount Carleton Provincial Park), and the choice of where to place routes was based on logistics rather than a random design. In 2003 and 2004 an additional two routes were added at Cape North at the far northern tip of Cape Breton Island, for a total of four routes in this area.

Each HELP route has five stops spaced 250 m apart. Survey routes are run once annually between 4 June and 26 June. Initially, routes were marked with wooden stakes at stop 1 and flagging tape at successive stops. Stakes are replanted each year and new flagging tape is added. Stakes and flagging are not used within Cape Breton Highlands National Park or Mount Carleton Provincial Park. In these cases stops locations are identified only by coordinates.

Survey Protocol

Surveys start approximately 45 minutes before sunrise and/or 30 minutes before sunset. At each stop, surveyors listen for ten minutes and mark the distance and direction to all Bicknell's Thrush, Swainson's Thrush, Winter Wren, Blackpoll Warbler, Fox Sparrow and White-throated Sparrow detected in relation to the surveyor's standing point at the center of a 50 m radius. Observers note whether each bird is singing and/or calling during each minute of the 10-minute point count, and they also count red squirrels (a known predator of Bicknell's Thrush eggs and nestlings) at each stop. Surveys are not conducted in wind levels greater than four on the Beaufort scale or in conditions of more than trace amounts of precipitation.

Once all five point counts are completed on a route, playback is conducted immediately following the final point count if no Bicknell's Thrushes were detected on any stop (or between stops). The playback protocol consists of playing one minute of Bicknell's Thrush vocalizations, followed by three minutes of silent listening at each of the five stations in reverse order. Data collected through this playback protocol are used for presence/absence only and are not included in trend analyses.

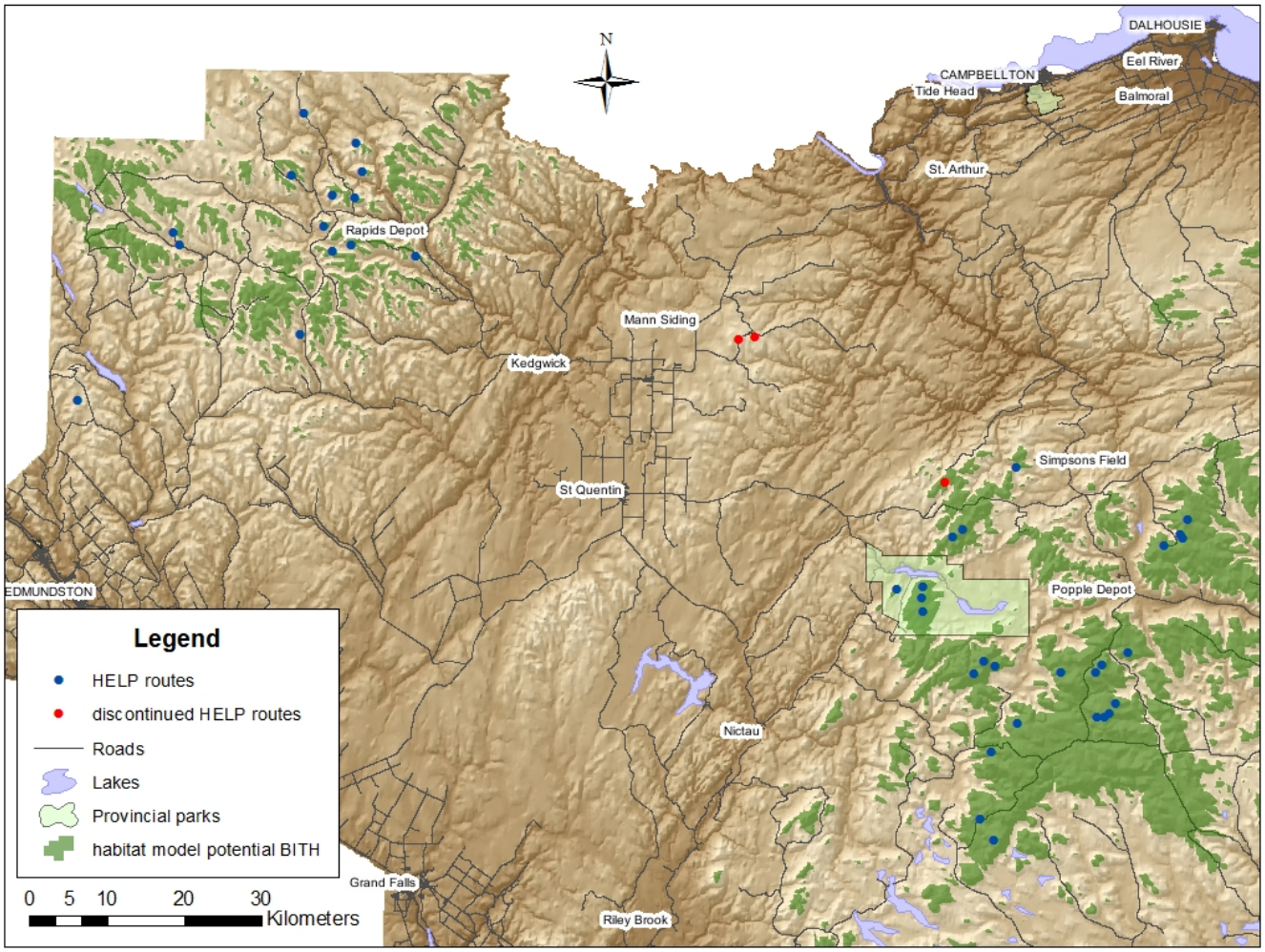

Figure 1. HELP survey routes in NB. Sub-regions are clearly visible based on clustering of routes in North-central NB around Mount Carleton Provincial Park (in light green) and extreme north-western NB. Potential Bicknell's Thrush habitat is marked in dark green and is based on a model that predicts the lowest elevations of potential habitat based on latitude and longitude (VCE 2008).

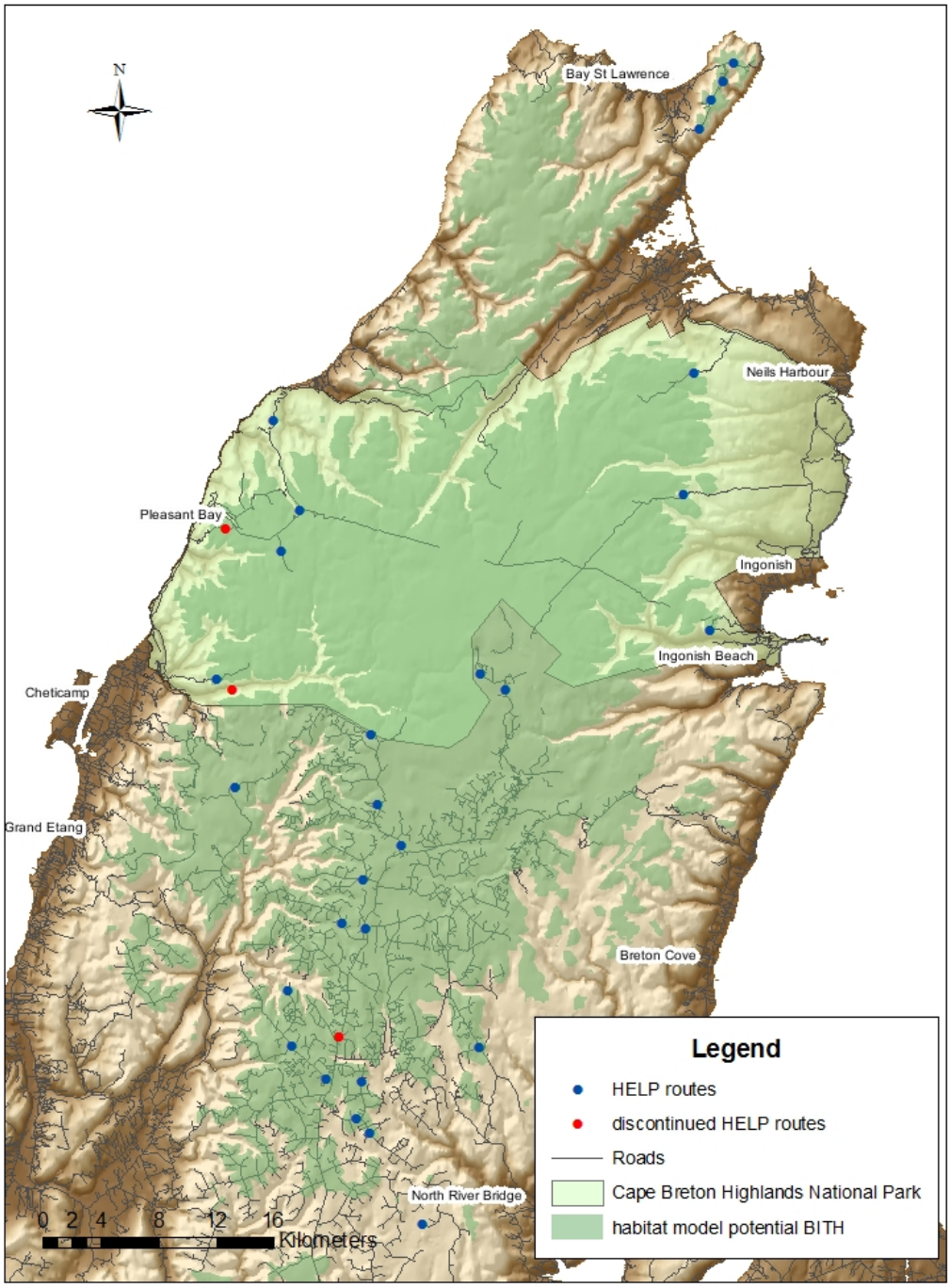

Figure 2. HELP survey routes in Cape Breton, NS. Potential Bicknell's Thrush habitat is marked in dark green and is based on a model that predicts the lowest elevations of potential habitat based on latitude and longitude (VCE 2008).

Data Analysis

1. Frequency of occurrence and relative abundance

Frequency of occurrence and relative abundance were calculated for each of the target species in 2011. Frequency of occurrence was determined by dividing the number of routes where the species was detected by the total number of routes surveyed. Relative abundance is defined as the mean number of individuals of the target species per route and was calculated by dividing the total number of individuals detected by the number of routes surveyed.

2. Trend analyses

Trend analyses were run for each of the target species. Trend analyses for the White-throated Sparrow and Winter Wren include only nine years of data (2003-2011) as they were not monitored during the first year of the program. Analyses for the Swainson's Thrush, Blackpoll Warbler and Fox Sparrow include data from all ten years of monitoring. Analyses for Bicknell's Thrush also include ten years of data; however, data from only the first five minutes of the 10-minute point counts are used due to a protocol change implemented after the first year of the survey. The original (2002) protocol included 30 seconds of Bicknell's Thrush playback in the middle of the 10 minutes of silent listening. This 30 second playback was removed in 2003 to harmonize methods with the Vermont Center for Ecostudies' Mountain Birdwatch program (Hart and Carroll 2004). To use the 2002 data in the trend analyses, only the first five minutes for all years can be used. See Appendix A for an analysis of nine years of Bicknell's Thrush trends using data from the full 10-minute point counts from 2003-2011.

We used negative binomial regressions, with route as random effect, to examine the relationship between mean Bicknell's Thrush abundance per route and year. Negative binomial regressions are best for estimating error under increasing variance with the mean, which is a common feature of this data set. Counts were summed over the 5 stops within each route. The result is a log-linear trend, where the trend is the slope of the negative binomial regression on year. As these slopes represent instantaneous rates, they were also transformed into their discrete time equivalents to show the percent change per year. We also examined the relationship between stop occupancy and year using logistic regression with stop treated as a subject (or repeated measure).

The data set was divided into two groups within each province, to see whether the relationship observed between the mean number of Bicknell's Thrush detected and year is consistent between north-western NB and north-central NB, and between Cape Breton Highlands National Park (CBHNP) and other NS sites. Comparisons of trends between sub-regions were made using ANCOVA.

3. Population estimates

In NB, estimates were obtained using density information from HELP surveys, the model of potential Bicknell's Thrush habitat (VCE 2008) and the NB Forest Inventory Database (NBFID). Habitat was classified within a 100 m radius around each HELP point using the NBFID. This was done by placing a 100 m buffer around each point and extracting stand information for each forest stand that was included in the 100 m. Since the buffer around most HELP points included more than 1 development stage, only the dominant development stage was used. The HELP

points fell within the following development categories in the NBFID; Regenerating, Sapling, Young, Immature.

Negative binomial regressions were then used to model changes in Bicknell's Thrush abundance along HELP routes from year to year according to stand development stage. This allowed us to calculate an estimate of Bicknell's Thrush density (birds/hectare) for each development stage.

Next, we used the NBFID to determine how many hectares of each development stage occur within the model of potential Bicknell's Thrush habitat in NB and multiplied each stage by the density of Bicknell's Thrush obtained from HELP data to obtain an estimate of Bicknell's Thrush numbers. These results were then summed to give an overall estimate of the number of Bicknell's Thrush in the area defined by the potential habitat model.

The same steps were used to calculate Bicknell's Thrush estimates in NS, however, the Forest Inventory Database classifications differed. Thus NS HELP points were classified as: Bog, Barren, Natural, Treated, Dead, Brush.

RESULTS

Sixty-five HELP routes were completed in 2011: 39 in NB and 26 in NS.

Frequency and Abundance in 2011

Bicknell's Thrush was found on 13 of the 39 routes in NB in 2011. Of these routes, 12 had detections during the silent point count period, and the other route only had detections of Bicknell's Thrush during the playback period (not included in trends). In NS, Bicknell's Thrush were detected on only 8 of 26 routes, with one route only having a detection during playback.

Table 1. Frequency of occurrence (% routes with species) and relative abundance (average birds/route) for HELP target species on all routes run in 2011. Bicknell's Thrush numbers include birds heard during both silent listening and after playback.

Species		NB (n = 39)	NS (n = 26)
Bicknell's Thrush	Frequency	33.3	30.8
	Abundance	0.77	0.77
Blackpoll Warbler	Frequency	53.8	15.4
	Abundance	1.90	0.31
Fox Sparrow	Frequency	74.4	69.2
	Abundance	2.46	1.54
Swainson's Thrush	Frequency	100	92.3
	Abundance	13.82	10.77
White-throated Sparrow	Frequency	89.7	96.1
	Abundance	7.05	11.46
Winter Wren	Frequency	35.9	0
	Abundance	0.85	0

Trends 2002-2011

1. Trends by province

In NB, the number of Bicknell's Thrush reported on survey routes has declined by 11.5% annually from 2002-2011 (Table 2). White-throated Sparrow and Winter Wren are also showing significant declines of 7.8% and 7.9%, respectively. However, Blackpoll Warbler and Swainson'sThrush detections have increased significantly (9.1% and 3.5% annually, respectively). Fox Sparrow has remained stable.

In NS, Blackpoll Warbler detections have declined significantly at a rate of 9.3% per year along HELP routes. Swainson's Thrush detections have increased significantly at a rate of 8.9% annually. No other significant trends were detected.

Table 2. Results of trend analyses by species for NB. Results for Winter Wren and White-throated Sparrow are from 2003-2011. Results for Bicknell's Thrush, Blackpoll Warbler, Fox Sparrow and Swainson's Thrush are from 2002-2011. LCL and UCL represent lower and upper confidence limits (95%). Significant rates of change (P<0.05) have an asterisk (*).

Species	%annual change	SE(%)	LCL(%)	UCL(%)
Bicknell's Thrush	-11.5*	3.3	-17.4	-5.2
Blackpoll Warbler	9.1*	3.0	3.3	15.4
Fox Sparrow	1.4	2.1	-2.6	5.6
Swainson's Thrush	3.5*	0.9	1.7	5.2
Winter Wren	-7.9*	2.5	-12.8	-2.9
White-throated Sparrow	-7.8*	1.4	-10.5	-5.0

Table 3. Results of trend analyses for NS. Results for Winter Wren and White-throated Sparrow are from 2003-2011. Results for Bicknell's Thrush, Blackpoll Warbler, Fox Sparrow and Swainson's Thrush are from 2002-2011. LCL and UCL represent lower and upper confidence limits (95%). Significant rates of change (P<0.05) have an asterisk (*).

	%annual change	SE(%)	LCL(%)	UCL(%)
Bicknell's Thrush	-7.4	4.9	-16.3	2.2
Blackpoll Warbler	-9.3*	3.2	-15.8	-2.4
Fox Sparrow	-0.5	3.3	-6.5	6.0
Swainson's Thrush	8.9*	2.7	4.0	14.1
Winter Wren	-9.4	7.2	-22.9	6.1
White-throated Sparrow	2.1	1.8	-1.3	5.6

2. Trends by sub-region

In NB, Bicknell's Thrush, Winter Wren, and White-throated Sparrow are declining in both sub-regions, while Swainson's Thrush is increasing in both. Blackpoll Warbler and Fox Sparrow are both increasing in central NB and declining in north-western NB. A significant difference exists between trends in central NB and north-western NB for both Bicknell's Thrush (Figure 3), Blackpoll Warbler, and Fox Sparrow (Table 4).

In NS, only the Blackpoll Warbler within Cape Breton Highlands National Park and Swainson's Thrush outside the Park are showing significant declining trends (Table 4). Blackpoll Warbler is declining within the Park, and Swainson's Thrush are increasing outside CBHNP. Bicknell's Thrush appear to be showing a stable trend, but highly variable between years (Figure 4).

Table 4. Results of trend analyses for all species in four sub-regions. Results for Winter Wren and White-throated Sparrow are from 2003-2011. Results for Bicknell's Thrush, Blackpoll Warbler, Fox Sparrow and Swainson's Thrush are from 2002-2011. LCL and UCL represent lower and upper confidence limits (95%). Significant rates of change (P<0.05) have an asterisk (*). Significant differences in trends between sub-regions were determined using ANCOVA.

North-western NB					
	%annual change	SE(%)	LCL(%)	UCL(%)	Sig. interaction between NW and Central NB
Bicknell's Thrush	-15.4*	6.6	-27.3	-2.7	
Blackpoll Warbler	-15.2*	5.6	-26.1	-3.3	*
Fox Sparrow	-8.1*	3.4	-14.5	-1.3	*
Swainson's Thrush	3.5*	1.2	1.1	5.9	
Winter Wren	-13.0*	5.2	-23.4	-1.6	
White-throated Sparrow	-11.4*	2.1	-15.5	-7.2	
Central NB					
	%annual change	SE(%)	LCL(%)	UCL(%)	
Bicknell's Thrush	-11.0*	3.7	-17.7	-3.9	
Blackpoll Warbler	13.3*	3.2	7.0	20.0	*
Fox Sparrow	3.7	2.5	-1.0	8.7	*
Swainson's Thrush	3.6*	1.2	1.3	5.9	
Winter Wren	-6.9*	2.7	-12.1	-1.3	
White-throated Sparrow	-7.1*	1.6	-10.2	-3.8	
In CBHNP					
	%annual change	SE(%)	LCL(%)	UCL(%)	Sig. interaction between In and Outside of CBHNP
Bicknell's Thrush	-12.0	6.9	-24.7	1.9	
Blackpoll Warbler	-16.3*	7.1	-29.1	-1.6	
Fox Sparrow	4.3	6.4	-6.9	17.0	
Swainson's Thrush	-1.6	5.4	-10.8	8.7	*
Winter Wren	-13.3	11.4	-33.0	10.7	
White-throated Sparrow	3.1	3.5	-3.5	10.1	
Outside CBHNP					
	%annual change	SE(%)	LCL(%)	UCL(%)	
Bicknell's Thrush	-4.9	6.8	-16.8	8.5	
Blackpoll Warbler	6.7	3.6	-14.2	1.4	
Fox Sparrow	-2.4	3.7	-9.2	5.0	
Swainson's Thrush	9.6*	2.7	4.6	14.9	*
Winter Wren	-5.0	9.3	-23.2	17.0	
White-throated Sparrow	1.5	2.1	-2.4	5.5	

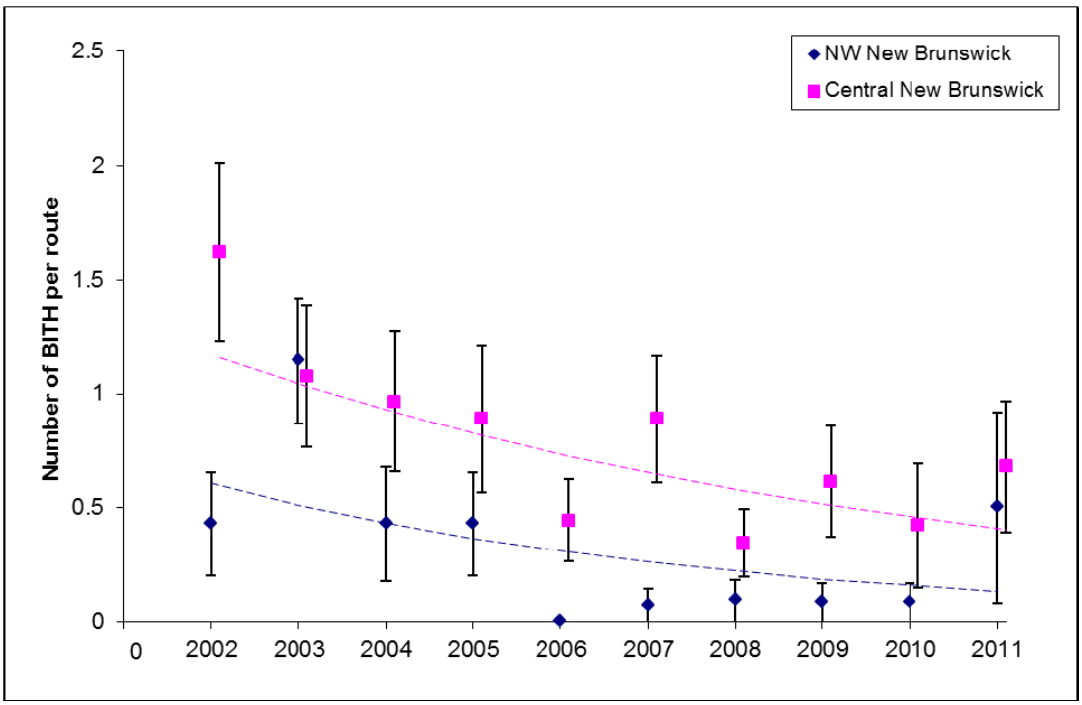

Figure3. Mean number of Bicknell's Thrush per route in north-western NB and central NB (including Mount Carleton) from 2002-2011. The predicted lines are fitted based on logistic regression.

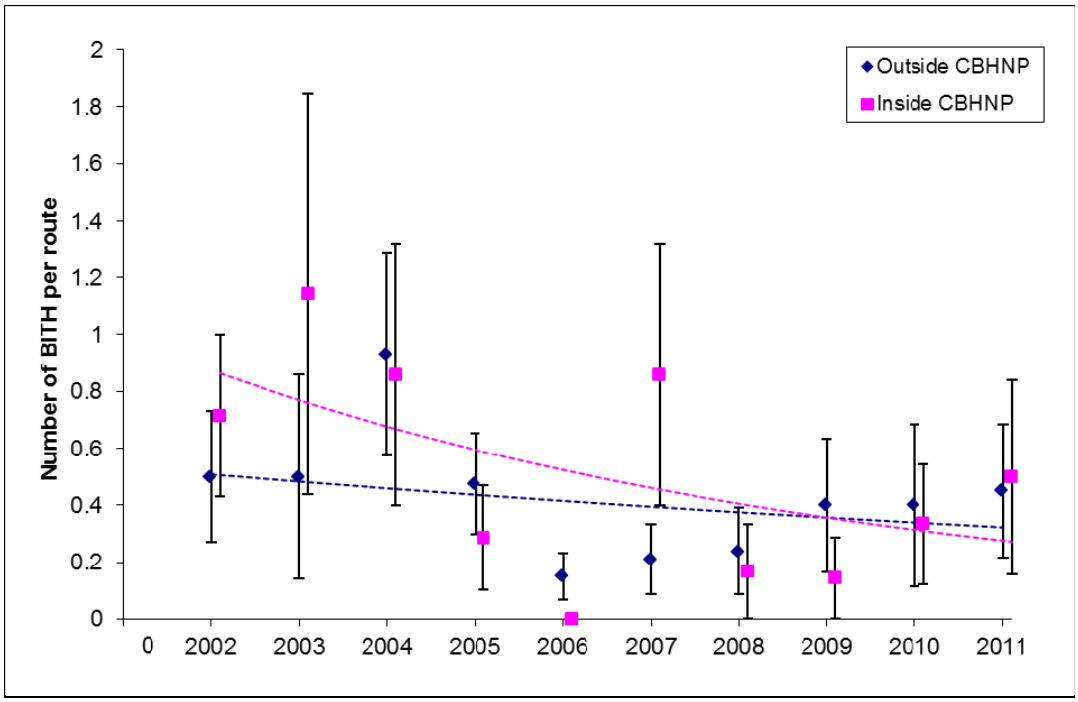

Figure 4. Mean number of Bicknell's Thrush per route on routes outside of CBHNP and routes within CBHNP from 2002-2011. The predicted lines are fitted based on logistic regression.

3. Trends in number of stops occupied by Bicknell's Thrush

The number of stops at which Bicknell's Thrush were detected declined significantly between 2002-2011 in both sub-regions in NB. The actual rates of decline differed somewhat, with the number of occupied stops in north-western NB declining faster than the number in the north-central part of the province (Figure 5). In NS, both sub-regions may be showing a decline, but the results highly variable from year to year and are not significant (Figure 6).

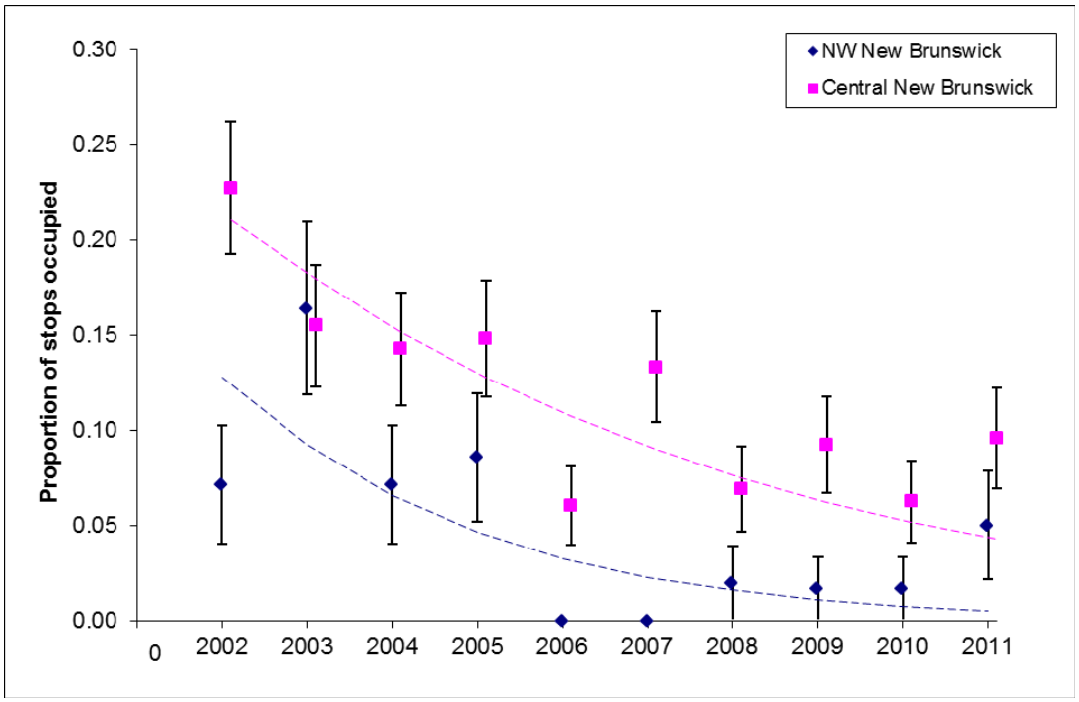

Figure 5. Change in number of stops occupied by Bicknell's Thrush from 2002-2011 in north-western NB and central NB (including Mount Carleton). The predicted lines are fitted based on logistic regression.

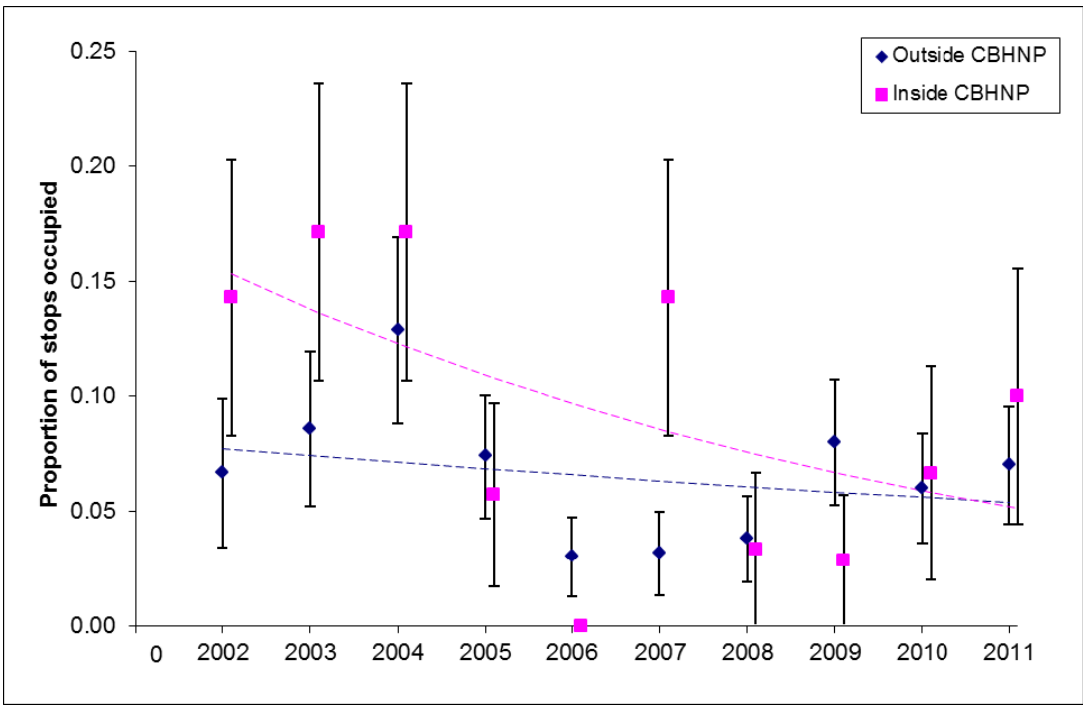

Figure 6. Change in number of stops occupied by Bicknell's Thrush from 2002-2011 on routes outside of CBHNP and routes within CBHNP. The predicted lines are fitted based on logistic regression.

Population estimates

In NB significant declines were observed along HELP points in both Sapling and Immature stages. The Regenerating and Young stages may be declining, but results are not statistically significant. The highest Bicknell's Thrush density was found in the Regenerating stage, and the lowest in the Immature stage (Table 5).

Table 5. Percent of annual change for each development stage in the model of potential Bicknell's Thrush habitat in NB and number of Bicknell's Thrush per hectare calculated from HELP surveys. Significant rates of change (P<0.05) are marked with an asterisk (*).

stage	% annual change	SE(%)	LCL(%)	UCL(%)	BITH/ha
Regenerating	-11.5	12.8	-32.6	14.7	0.045596
Sapling	-12.2*	4.4	-20.3	-3.6	0.022496
Young	-30.4	14.8	-58.3	8.8	0.004207
Immature	-44.4*	10.7	-64.4	-23.1	0.001436

In NS none of the development stages showed significant results, however densities were still calculated in order to have a rough estimate of Bicknell's Thrush numbers in Cape Breton. The highest density was found in the Brush stage and the lowest in the Barren stage (Table 6).

Table 6. Percent of annual change for each development stage in the model of potential Bicknell's Thrush habitat in NS and number of Bicknell's Thrush per hectare calculated from HELP surveys.

stage	% annual change	SE(%)	LCL(%)	UCL(%)	BITH/ha
Bog	-13.1	7.2	-26.8	1.7	0.034776
Barren	-42.1	16.6	-72.5	-7.2	0.000653
Natural	-6.6	5.9	-17.4	5.3	0.023862
Treated	-38.9	15.6	-72.1	0.2	0.000386
Dead	11.9	52.7	-88.3	NA	0.052312
Brush	12.9	9.6	-3.9	34.5	0.203509

The model of potential Bicknell's Thrush habitat in NB includes encompasses a total 220 564 hectares, and an estimated 2,851 Bicknell's Thrush (Table 7). Lower and Upper Confidence Limits are 1,137 and 10,652 Bicknell's Thrush, respectively.

In NS, the model covers an area of 185,986 hectares, with an estimated 3,845 Bicknell's Thrush. Lower and Upper Confidence Limits are 1,823 and 7,049 (Table 8).

Table 7. Estimated number of Bicknell's Thrush in the model of potential Bicknell's Thrush habitat in NB.

stage	hectares in model	BITH	BITH LCL	BITH UCL
Regenerating	27429	1250.649	219.209	7795.044
Sapling	61995	1394.639	880.943	2095.9
Young	42339	178.132	36.031	526.853
Immature	19057	27.371	1.146	234.373
TOTAL	**220564**	**2850.79**	**1137.329**	**10652.17**

Table 8. Estimated number of Bicknell's Thrush in the model of potential Bicknell's Thrush habitat in NS.

stage	hectares in model	BITH	BITH LCL	BITH UCL
Bog	27596	959.674	338.385	2183.887
Barren	11962	7.811	0.038	155.717
Natural	98010	2338.694	1291.981	4083.489
Treated	14195	5.481	0.043	79.762
Dead	3664	191.687	0.031	NA
Brush	1684	342.613	192.705	546.449
TOTAL	**185986**	**3845.96**	**1823.183**	**7049.304**

DISCUSSION

Bicknell's Thrush is showing a significant decline over the 10 years of HELP in NB. These declines occurred in both sub-regions. However, the rate of decline slowed over the 10 year period; declines during the final five years were less steep than those observed prior to 2006. Between 2006 and 2010, the trend was -3.1% per year compared to -5.8% prior to 2006 (Campbell 2011). This may be due to the extensive precommercial thinning that was conducted in along HELP routes between 2002 and 2006. Nearly 70% of stands along HELP routes were thinned between these years, while only 2 stands were thinned after 2006 (Whittam and Campbell 2010). Studies have shown declines in Bicknell's Thrush abundance following pre-commercial thinning in NB (Campbell et al. 2005, Chisholm and Leonard 2008, Appendix B) with the remaining birds likely returning to nearby unthinned patches for nesting (McKinnon 2009, Aubry et al. 2011).

BICKNELL'S THRUSH – B STEWART

While HELP has shown declines on HELP routes in NB, whether these declines have occurred throughout the province is unclear. Since HELP routes were not randomly selected and because Bicknell's Thrush habitat in industrial forest is ephemeral, declines may reflect habitat changes along routes. In 2002, all routes were placed in what appeared to be optimal Bicknell's Thrush habitat, and as a result, areas surveyed consisted of stands of similar age and structure. As these stands aged and/or were thinned, Bicknell's Thrush may have moved to other suitable habitats and their presence would no longer have been captured through HELP surveys. However, results from the second MBBA, which measures changes over a 20 year period, from 1990 to 2010, indicates that declines may indeed be province-wide.

MANAGED LANDSCAPE, NORTHERN NB – G CAMPBELL

Since 1990, Bicknell's Thrush appears to have undergone substantial range shrinkage in northern NB. They were present in 39% fewer squares in the north-western and central mountains than during the first Atlas, suggesting that the declines may be more extensive than just on HELP routes. The conversion from a natural disturbance regime into one dominated by man-made disturbances has likely had an influence on Bicknell's Thrush distribution, particularly in the Christmas Mountains area, which was largely unlogged until the early 90's. Natural mountain top disturbances are usually of smaller size than industrial forest ones, but take more time to regenerate. As a result, the landscape in natural mountainous regions is usually characterized by a mosaic of small patches

in various stages of regeneration. Disturbances on the industrial landscape tend to be large scale and result in a landscape of large patches of even-aged regenerating forest. This could lead to a boom-or-bust scenario, where large amounts of regenerating habitat are initially available 10 to 15 years clearcutting, followed by a substantial drop in suitable habitat once large patches are thinned or mature. In NB, long-term wood supply analyses indicate that this reduction in Bicknell's Thrush habitat is likely to continue with less regenerating and sapling forest within the Bicknell's Thrush range in the next 10 to 25 years as a result of the cycle of wood supply in the province (New Brunswick Crown Land Task Force 2011).

In NS, Bicknell's Thrush trends are inconsistent. While previous analyses indicated significant declines (Campbell 2011), low overall abundances and high between-year variability in detections have made trends difficult to detect. NS has much more natural Bicknell's Thrush habitat compared to NB and the number HELP routes are divided relatively evenly between natural and industrial habitat. However, in general, Bicknell's Thrush densities have been low in Cape Breton's industrial forest since the beginning of HELP. The industrial forest is more even-aged than in NB, mostly due to a large infestation of Spruce Budworm on Cape Breton Island in the late 1970s that destroyed 85% of the foliage (Piene 1989). In addition, this forest is now approximately 25 years old, and has undergone treatments to reduce stem density, likely making it unsuitable for Bicknell's Thrush now. The lack of Bicknell's Thrush along half of HELP routes likely means that the current sampling intensity is inadequate to capture trends in Cape Breton, in either habitat type. Data from the MBBA do suggest that distribution is probably declining, with Bicknell's Thrush being present in 32% fewer squares in the Cape Breton Highlands in the second Atlas.


BICKNELL'S THRUSH HABITAT, NB – E MACKINNON

Non-random route selection makes estimates of Bicknell's Thrush population less reliable. In NB, the "regenerating" and "sapling" development stages were likely overrepresented along HELP routes, whereas older stages were under-represented or not represented at all. This makes estimates less accurate, as results were extrapolated from HELP points across the entire model of potential habitat. The population estimates for NS are likely less accurate than in NB. In addition to non-random route selection, the provincial forest inventory is also largely outdated, e.g., the last inventory update for Cape Breton was in 2003. As a result, the number of stands included in the "natural" stage was likely exaggerated, and the number in the "treated" class was likely underrepresented. Also, the low Bicknell's Thrush detections in NS made it impossible to detect any significant results in the modeling of changes for any of the development stages.

It is clear that the current model needs to be refined, as the only variables included are latitude and longitude (VCE 2008). The inclusion of habitat variables for Bicknell's Thrush would enhance the model's predictive powers and provide a more precise picture of potential Bicknell's Thrush habitat across the industrial landscape. Despite these issues, the population estimates are an important first step in developing population and habitat targets, and the methodology developed will be used in the future to refine these targets, track population changes and improve sampling methodologies.

CONCLUSIONS AND FUTURE DIRECTIONS FOR MONITORING BICKNELL'S THRUSH IN THE MARITIMES

BSC is one of the founding groups of the International Bicknell's Thrush Conservation Group (IBTCG), whose stated goal is to increase the global population of Bicknell's Thrush by 25% over the next 50 years (2011-2060) and to maintain or increase the species' current distribution. This is described in the Conservation Action Plan for Bicknell's Thrush, which identifies habitat loss associated with forestry activities, particularly precommercial thinning, as one of the highest priority threats to Bicknell's Thrush (IBTCG 2010). To track population change and the effectiveness of our conservation actions as described in the Plan, we need a statistically robust sampling design which meets the needs of all partners at local, national and international scales. The HELP survey, in its current form, cannot meet these needs.

In 2011, BSC, in partnership with other members of the IBTCG, piloted a new, international Bicknell's Thrush monitoring program across the species range (Mountain Birdwatch 2.0). The goals of the survey are to measure the annual population status of Bicknell's Thrush in terms of distribution, abundance and occupancy as well as measure changes in population status over time. While the survey protocol is very similar to HELP, there are some key differences in the survey sampling design. Routes are randomly selected using a Generalized Random Tessalation Stratified (GRTS) sampling design across the Bicknell's Thrush distribution model (see VCE 2008). There are several advantages to adopting this approach. It incorporates randomization into route selection and, if desired, allows us also to intensify sampling within certain strata (e.g., specific management units) without deviating from the international design. It is also possible to add additional survey sites over time.

The HELP survey played a key role in COSEWIC's recent status assessment of the Bicknell's Thrush as Threatened and has shown that Bicknell's Thrush have declined significantly along HELP routes in NB. It has also brought to light some of the key issues and challenges in monitoring a bird species whose habitat preferences are relatively ephemeral. However, non-random route selection in NB, low population densities and sampling intensity, currently limit the inferences that can be made regarding population declines at provincial and regional scales. In 2012-13, BSC will refine HELP, using a GRTS sampling design to randomly select routes and increase sampling intensity in Cape Breton, thus enabling us to meet international, national and regional information needs.

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APPENDICES

A. Five year trends for Bicknell's Thrush using the 10-minute data set

Table A1. Results of trend analyses for Bicknell's Thrush from 2003-2010 using the full 10 minutes of HELP surveys. Results are listed by province and then by sub-regions within the two provinces. Significant rates of change (P<0.05) are highlighted in grey.

	All New Brunswick				**All Nova Scotia**			
	%annual change	SE(%)	LCL(%)	UCL(%)	%annual change	SE(%)	LCL(%)	UCL(%)
Bicknell's Thrush	-8.1	3.8	-15.0	-0.8	-7.0	5.8	-16.7	3.6
	North-western NB				**In CBHNP**			
	%annual change	SE(%)	LCL(%)	UCL(%)	%annual change	SE(%)	LCL(%)	UCL(%)
Bicknell's Thrush	-12.7	7.4	-25.2	1.2	-8.3	8.7	-23.0	8.7
	Central NB				**Outside CBHNP**			
	%annual change	SE(%)	LCL(%)	UCL(%)	%annual change	SE(%)	LCL(%)	UCL(%)
Bicknell's Thrush	-7.4	4.3	-15.3	1.1	-6.4	7.5	-18.7	7.5

B. Results for three routes examined pre- and post-thinning in NB

In 2003, 2004 and 2005 Chisholm (2005) and Gardiner (2006) examined impacts of pre-commercial thinning in north-central NB on UPM Kymmene's crown lease by counting abundance of Bicknell's Thrush along three routes in the year before thinning (2003) and the two years following thinning (2004, 2005). Since then, HELP staff have been running these three routes once per year. Figure B1 shows the average abundance of Bicknell's Thrush on these three routes from 2003 to 2011. It is worth noting that along two of these three routes the Bicknell's Thrushes that were detected in the years post-thinning were heard singing or calling from patches of unthinned habitat within the (mostly thinned) stand.

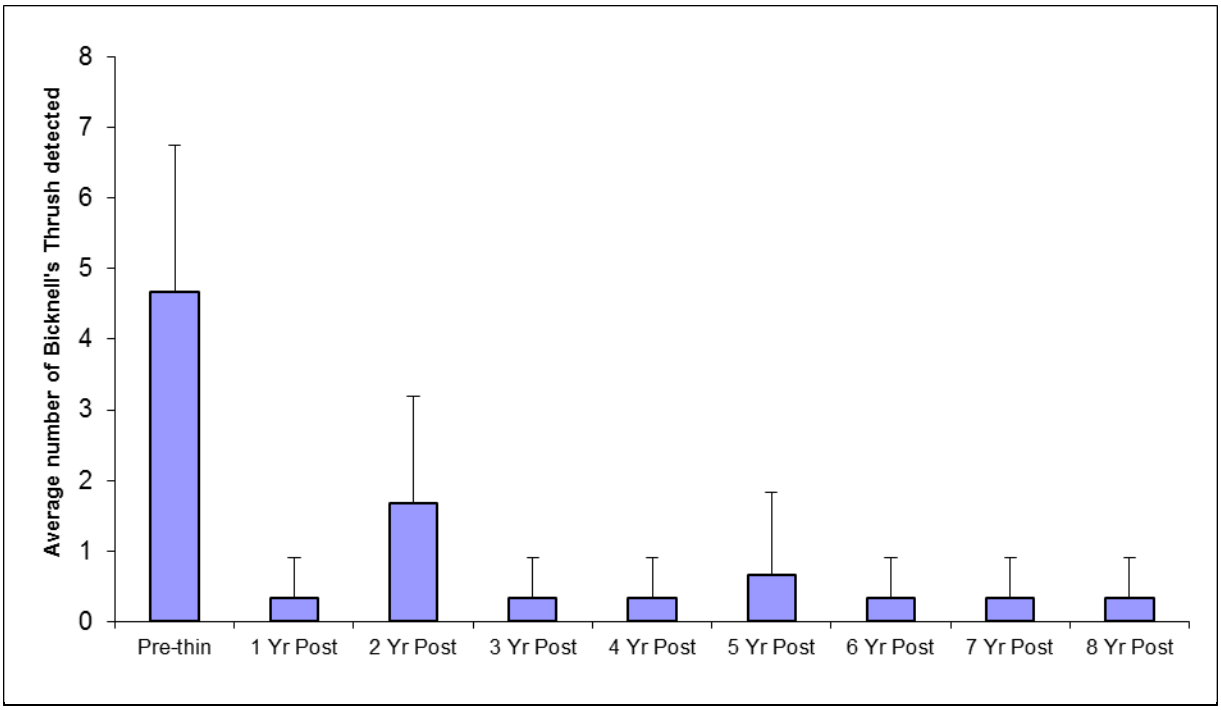

Figure B1. Average number of Bicknell's Thrush detected (± Standard Error) along three routes in central NB from pre-thinning (2003) to eight years post-thinning (2011).