

Developing a protocol for monitoring the Bicknell's Thrush (*Catharus bicknelli*) and other high elevation bird species in Atlantic Canada

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Executive Summary

The goal of this project was to develop a protocol for a volunteer-based survey of Bicknell's Thrush (*Catharus bicknelli*) and other high elevation bird species in Atlantic Canada. The two objectives of the survey would be to: 1) monitor populations of high elevation species; and 2) characterize Bicknell's Thrush habitat in Atlantic Canada. Eighteen routes consisting of 5 stops spaced 250 m were run in June 2001 in the highlands of Nova Scotia, in order to test short (10-minute) and long (15-minute) protocols, and to determine whether time of day, date, weather, and/or playback affect the detectability of the four target species (Bicknell's Thrush, Swainson's Thrush, Blackpoll Warbler and Fox Sparrow). Qualitative habitat data were also collected along each stop for each route.

Using the data collected during this study, along with data collected in New Brunswick in 1997, a power analysis indicated that a sufficiently powerful survey protocol (power of 0.90 or more and a declining trend of 3%/year, at a significance level of 0.85) could be accomplished using 65 routes surveyed once per year over 20 years.

Results of generalized linear models indicated that neither day of year, route, observer, time of day, temperature, wind, cloud or precipitation influenced vocalizations by any of the four target species. The likelihood of detecting Bicknell's Thrush increased on each successive run of a route, although the Probability of Occurrence of Bicknell's Thrush on any given run of a point was relatively high, at 0.66. There was no difference in the mean number of individual target species detected using the short versus the long protocol, although the Relative Abundance of Bicknell's Thrush was higher using the long versus the short protocol. Bicknell's Thrush vocalizations peaked between 4-4:30 am and 8-8:30 pm. While playback did not significantly increase the number of Bicknell's Thrush detected, there was a tendency for more Bicknell's Thrush to be detected for the first time following playback compared with before playback. Bicknell's Thrush did not appear to habituate to playback using data from multiple runs of the same route.

Stops where Bicknell's Thrush were present were categorized more often as having dense conifer stems compared with stops where Bicknell's Thrush were absent. Hardwood stems were sparse in all cases. Stops where Bicknell's Thrush were present also tended to fall into the shorter canopy height category compared with stops where Bicknell's Thrush were not present. All types of stops (whether Bicknell's Thrush were present or absent) were categorized as predominantly spruce/fir.

We recommend a monitoring program involving 65 routes run once per year, either in the morning or evening in mid-June, with each route consisting of 5 stops spaced 250 m. At each stop, a 10-minute protocol consisting of silent listening and playback should be used. Routes where Bicknell's Thrush are not detected should be revisited during the peak survey period to verify the presence or absence of the species for more accurate habitat characterization.

Introduction

The main goal of this project was to develop a protocol for a volunteer-based survey of Bicknell's Thrush (*Catharus bicknelli*) and other high elevation bird species in Atlantic Canada. This habitat is under threat by climate change (causing loss of red spruce and balsam fir), development (ski areas, cell tower and wind power development) as well as industry, and is often not well covered by existing bird monitoring programs like the Christmas Bird Count and Breeding Bird Survey.

The Bicknell's Thrush is one of the rarest songbirds in North America, with a population of between 5,000-15,000 pairs (Nixon 1998). It is listed as a species of "High responsibility, High Concern" by Partners in Flight Canada (Downes et al. 2000), and as a Species of Special Concern by the Committee on the Status of Endangered Wildlife In Canada (COSEWIC). Furthermore, it is listed as Globally Vulnerable by the IUCN (Stattersfield and Capper 2000). These designations are largely a result of the species' fragmented populations, and the fact that very little is known about its population status and breeding biology, because of its shy habits, remote breeding habitat, and only very recent designation as a full species (Ouellet 1992, AOU 1995). A monitoring program is urgently needed to help determine the status of the Bicknell's Thrush population: is it increasing, decreasing, or remaining stable? Secondly, a survey could help provide information on habitat used by the Bicknell's Thrush in Atlantic Canada. Therefore, the main objectives of this project were:

1. To use the Bicknell's Thrush population in Cape Breton Highlands National Park (CBHNP) and nearby Cape North to develop and test a protocol for a volunteer-based survey of high elevation bird species, with particular emphasis on the Bicknell's Thrush, and secondary emphasis on Fox Sparrow (*Passerella iliaca*), Swainson's Thrush (*Catharus ustulatus*) and Blackpoll Warbler (*Dendroica striata*). Specifically, we wanted to determine: a) how many routes are required to achieve appropriate statistical power to detect population change over time; b) how long a point count needs to be; c) how many times a route needs to be surveyed in a season; d) whether time of day (morning versus evening) affects survey results; e) whether date affects results; and f) whether or not playback is necessary to increase the ability to detect Bicknell's Thrush.
2. To submit new Bicknell's Thrush records to the Parks Canada GIS database for use in mapping Bicknell's Thrush habitat in Atlantic Canada.

Methods

Along with a field crew, we scouted eighteen survey routes between 4 and 11 June in five general areas: Pacquet Lake Trail (CBHNP), Lac a Simeon Trail (CBHNP), Tipover Lake Trail (CBHNP), French Mountain (CBHNP), and Money Point Road, Cape North (Figs. 1-6). We chose routes based on habitat suitability, and almost always placed them in areas known (from previous research; R. Knapton and D. Busby, unpubl. data) to have Bicknell's Thrush. Each route consisted of 5 stops separated by 250 m. We waypointed each stop along each route (NAD 83; see Appendix A). We also collected basic qualitative habitat information for each stop using the Mountain BirdWatch protocol (VINS 2001): at each stop, we categorized conifer, hardwood,

and understorey stem density as *dense*, *moderate* or *sparse*, and we also categorized each stop by tree dominance (*conifer & hardwood co-dominant*, *hardwood dominant*, or *spruce/fir dominant*) and canopy height (1-3m, 3-5m, 5-7m, or 7-9m).

Routes were run between 11 - 27 June. We collected weather data (cloud, precipitation, temperature) for every survey, and noted the time we started and finished each route. We attempted to survey each route 8 times: twice in the morning (3:30-6:30 am) and evening (7:00-10:00 pm) within a 36 hour period, alternating between long and short survey protocols (see below), then repeated again about one week later. For example, for a single route we might attempt to run it Monday evening (long protocol), Tuesday morning (long protocol), Tuesday evening (short protocol) and Wednesday morning (short protocol). We did not vary the order of protocols (i.e. we almost always ran them long pm, long am, short pm, short am). We then attempted to repeat this series of 4 survey runs approximately one week later.

We tested both *long* and *short* survey protocols. The long protocol was 15 minutes in total, beginning with 10 minutes of silent listening, followed by a 30 second broadcast of Bicknell's Thrush vocalizations and another 5 minutes of silent listening. The short protocol was 10 minutes in total, beginning with 5 minutes of silent listening, and then a 30 second broadcast of Bicknell's Thrush vocalizations, then another 5 minutes of silent listening. The Bicknell's Thrush broadcast tape consisted of a 30 second sequence of calls and songs, originally recorded by Dan Busby. The same model of sound equipment was used for almost all surveys (Sony CFS-E2 Radio-Cassette Recorder; recommended by the Vermont Mountain Birdwatch program). An alternate unit (Sony CFD-S22), which was less portable but equally audible, was used when four researchers were working simultaneously as we only had three CFS-E2s.

On each survey stop, we concentrated on detecting the four target species: Bicknell's Thrush, Fox Sparrow, Swainson's Thrush, and Blackpoll Warbler. If a target species was detected we recorded the time it began to vocalize, its approximate position in relation to a 100 m radius study plot, and the number of minutes it continued to vocalize following detection (in minute-by-minute intervals). We did not distinguish between songs and calls. Whenever possible, we also noted the presence of any non-target bird species seen or heard during the stop.

The same person surveyed the same routes as much as possible. Each surveyor surveyed only one route per period (i.e. morning/evening). Five different people conducted surveys throughout the length of the project (Sean Blaney, Beth Flanigan, Nev Garrity, Mike Russell, and Becky Whittam), but generally only three to four people conducted surveys on any given day (BF, MR, BW). Each surveyor was trained to recognize the four target species using the Mountain BirdWatch training tape and by practicing in the field with knowledgeable biologists.

Analyses and Results

Route Choice

We established 18 routes, all of which had at least one of the four target species: 15 had Bicknell's Thrush, 18 had Swainson's Thrush, 16 had Blackpoll Warbler, and 12 had Fox Sparrow. Because of unfavourable weather conditions, limited personnel, and situations that posed a risk to the surveyors (i.e. presence of a bear) we were unable to run all survey routes 8 times. We ran each route an average of 5.8 times (range 4-8; Table 1), and we ran each route during at least 2 mornings (one short one long) and 2 evenings (one short, one long). In total, we completed 105 surveys along these 18 routes.

Figure 1 shows the location of our survey routes in CBHNP and Cape North. Figs. 2-6 show in detail each stop along each route at the five main areas under study (Simeon Lake, French Mountain, Pacquet Lake, Tipover Lake, and Cape North), and indicate which stops had Bicknell's Thrushes at least once and which did not. The mean proportion of survey runs that had Bicknell's Thrushes was 0.71 ± 0.09 (range 0.25-1.0). In other words, on any given run of a route, we had a 71% chance of encountering a Bicknell's Thrush.

In addition to those birds detected on survey routes, we also found five previously unrecorded locations for Bicknell's Thrush in CBHNP (Appendix A, "incidental" detections). In total, including both incidental detections and birds detected on survey routes, we recorded 53 different locations for Bicknell's Thrush in CBHNP (Appendix A).

In order to determine if the 18 routes from the five areas could be considered statistically independent, i.e. no grouping effect of routes by area, we did a nested ANOVA by area and route. Cape North and French Mountain, which each had 4 routes, were tested in one ANOVA, and Simeon Lake, Pacquet Lake, and Lac a Simeon, which each had 3 routes, were tested in another ANOVA. In both groups, routes were significantly different from each other ($F=49.25$, $F_{0.05(2),15,3}$, $P<0.0005$ and $F=49.25$, $F_{0.05(2),6,2}=7.26$, $P<0.0005$, respectively) warranting testing them as independent units.

Number of Routes

Using the count data from Cape Breton in 2001 and data from New Brunswick for 1997 provided by Steve Holmes, we calculated an average mean (0.81) and standard deviation (0.83) of Bicknell's Thrush detected. Using MONITOR, a power analysis program developed by James Gibbs (1995), we ran a number of simulations varying the number of routes, the number of runs of a route and the number of years over which the project would take place. We decided that our goal would be the ability to detect a 3% decline in the population at 90% power with a significance level of $\alpha = 0.15$ (Eagle et al. 2000).

The power analysis indicated that a sufficiently powerful survey protocol (power of 0.90 or more and a trend of 3%/year, at a significance level of 0.85) could be accomplished using 65 routes, surveyed once per year over 20 years (Table 2).

Factors affecting bird vocalizations

To determine whether or not date had any effect on survey results, we compared the mean number of Bicknell's Thrush detected per protocol using only those routes for which each protocol was run twice (separated by a mean of 6.58 days). Such data were available only for the long pm, long am, and short pm protocols. For each of these three protocols, the mean number of Bicknell's Thrush declined slightly from the first to the second run, although the variation around the mean was high (Fig. 7).

In order to gauge any potential difference between birds heard in the morning versus the evening we calculated Relative Abundance by point, or the number of birds heard or seen at each point divided by the total number of times each point was surveyed. We compared am versus pm (data from both the long and short protocol were used) using a Wilcoxin rank-sum test for paired data. The test showed no statistical difference in the number of Bicknell's Thrush heard at the same point surveyed at different times ($T_{-}=281$, $T_{0.05(2),38}=235$, $p=0.20$).

We also ran several generalized linear models to determine if measurements for day of year, route, observer, time of day, as well as temperature, wind, cloud and precipitation at the beginning and end of the survey were influencing bird vocalizations. Generalized linear models are useful for analyzing large amounts of data because they allow the researcher to choose what kind of model best fits the type of data and they do not require transforming the data; for example we used a quasi-poisson model because we were analyzing count data and we used a log-link because of the many zeros present within the data. These models determine how much of the variation in the data is accounted for by the measurements by giving a dispersion and a t-value, i.e. how well the model fits the data and the significance of each measurement within that model. The dispersion value was very high, indicating that much of the variation in bird vocalization was due to factors other than those that were measured. The t-values were for the most part not significant, or only significant for one species (Table 3). However, "route" was significant for 3 of the 4 species, indicating that some birds were more likely to be found on some routes.

Likelihood of Bicknell's Thrush detection

To examine whether or not increasing numbers of runs of a route increased the likelihood of detecting Bicknell's Thrush, we calculated the running maximum number of Bicknell's Thrush detected on subsequent runs of the same route. For example, if a route was run four times, and the number of Bicknell's Thrush detected on each run (in order of running) was 2,0,5,3, then the running maximum would be: 2,2,5,5. We averaged the running maximums for all routes, using only data from the long protocol, and combining morning and evening surveys. The maximum number of Bicknell's Thrush detected per route increased steadily through four runs, but again, the variation around the mean was high in each case (Fig. 8).

We also calculated Probability of Occurrence, or the number of points on which a Bicknell's Thrush was detected in the first run of a survey route divided by the number of times a bird was

heard again in subsequent runs of the same area (Nixon 2001). The Probability of Occurrence of Bicknell's Thrush on any given point in Nova Scotia was 0.66; this is quite a bit greater than the probability of occurrence found previously in New Brunswick (0.40, Nixon et al. 2001), indicating that there is a high level of variability between sites and years.

10 versus 15 minute point count protocols

We compared the number of individuals heard during 10 minute versus 15-minute point count protocols for all species by route, using a Wilcoxin rank-sum test. None of the resulting p-values were significant (Bicknell's Thrush $p=0.198$, Swainson's Thrush $p=0.340$, Fox Sparrow $p=0.388$, Blackpoll Warbler $p=0.164$) (Table 4), indicating that there may not be a significant difference between the numbers of individuals found on the same route using the short protocol versus the long protocol.

We also calculated Relative Abundance for Bicknell's Thrush by point and compared 10 minute and 15 minute protocols to determine which captured the greatest Relative Abundance of birds. The result was significant using the Wilcoxin rank-sum test for paired data ($T_{-}=145$, $T_{0.05(2),42}=319$, $p<0.05$), indicating that the longer protocol does detect a greater Relative Abundance of Bicknell's Thrushes.

Graphs of peak vocalization time for Bicknell's Thrush in Cape Breton during the 2001 season show a distinct peak in song for a 30 minute period from 4-4:30 am and 8-8:30 pm (Figs. 9 and 10). These short windows for best hearing Bicknell's Thrush are similar across the species' breeding range and were one of the major reasons the Mountain Birdwatch program chose a 5-minute protocol for each point count (VINS 2001).

Playback

To determine whether or not playback increased the number of Bicknell's Thrush detected, we examined individual Bicknell's Thrush detections. Using data from all short protocol runs of all routes ($n = 49$), we calculated the number of birds that were detected "before & after playback", "before but not after playback", and "after but not before playback". Out of a total of 87 detections, most birds (37%) were detected both before and after playback; only 21.8% were detected before, but not after playback, and 35.6% were detected after, but not before playback.

We also examined the effects of playback using a slightly different method. We divided the short protocol into two, five-minute periods, and the long protocol into three, five-minute periods. Since the short protocol involved playback *before* the second five-minute period, whereas the long protocol didn't involve playback until *after* the second five-minute period, the proportion of Bicknell's Thrush detected in that second five-minute period could be compared between the short and long protocols to determine whether playback has any effect (hypothesizing that, if playback is important, a larger proportion of Bicknell's Thrush detections would occur in that second five minute period using the short protocol than using the long protocol). Indeed, this appeared to be the case, with 36% of Bicknell's Thrush detected in the

second five-minute period when it was preceded by playback (i.e. short protocol) compared to only 27% when it was not (i.e. long protocol) (Table 5). However, this difference was not significant (chi-square = 1.70, df = 1, $p > 0.10$).

In order to determine if individuals might be becoming habituated to playback over time we did a Friedman's test comparing the number of birds heard at the same points of each route over time (i.e. on successive runs of the same route). Out of the 96 tests done, we had one significant result for Swainson's Thrush on Route 4, which was no longer significant after a Bonferroni correction, indicating that playback did not cause a decline in the number of birds heard over time.

Habitat

Stops where Bicknell's Thrush were present were categorized more often as having dense conifer stems compared with stops where the birds were not present (Table 6). Understorey stem density of stops where Bicknell's Thrushes were present tended to be either sparse or dense compared with stops where the birds were not present (Table 6). Hardwood stems were sparse in all cases (Table 6). Stops where Bicknell's Thrushes were present also tended to fall into the shorter canopy height category compared with stops where Bicknell's Thrush were not present (Table 7). Canopy dominance did not appear to differ between stops with and without Bicknell's Thrush; all types of stops were characterized as predominantly spruce/fir (Table 8).

Discussion

Number of Routes

The preliminary results from the power analysis suggest that 65 routes surveyed once per year should provide sufficient power for detecting population change. However, because both sets of data used in this study were from non-randomly chosen sites (i.e. chosen because of the known presence of Bicknell's Thrush), this power analysis will not reflect the results more likely obtained from the stratified random sampling that will occur during the actual monitoring program. Given this caveat, the power analysis will be redone over the next two years of the monitoring program in order to determine more appropriate estimates of power.

Factors affecting Bicknell's Thrush Vocalizations

Generalized linear modeling suggests that most of the environmental variables measured while doing the counts are not significantly affecting vocalizing by any of the four species. Route was important, however, indicating that there is some variation among routes in different areas. The relatively poor fit of the model indicates that another factor, or factors such as pairing status, may be influencing the vocalization behaviour of these species.

Likelihood of Bicknell's Thrush detection

While variation was high, the maximum number of Bicknell's Thrush recorded on any given route increased slightly, although not significantly, with each additional run of a route, suggesting that multiple runs are necessary in order to exhaustively survey the number of birds on a route. Nixon et al. (2001) also found that the cumulative number of points where Bicknell's Thrush were detected increased steadily, with no leveling off, over six visits, leading to a low probability of detection (0.40) on any given visit. It is difficult to imagine a volunteer survey requiring six or more visits to a site, however, and because population trends are the goal of this monitoring program rather than population size, one or two runs of a route would suffice. Given that fewer Bicknell's Thrush are detected, in general, on the second run of a particular protocol (separated by 6.5 days), one run of each route should suffice.

Neither Bicknell's nor Swainson's thrush appeared to be detected more often in the morning compared with the evening, either in terms of absolute numbers heard or relative abundance. This is an important result, as it suggests that surveys can be run during either of these two periods, making it easier for volunteers to choose a convenient survey time. Blackpoll Warbler and Fox Sparrow, however, appeared to be detected more often in the evening compared to the morning, although these differences were not significant.

10 versus 15 minute point count protocols

Despite the fact that there was no statistical difference in the absolute number of Bicknell's Thrush detected in the short and long protocols, our results do show that on average, the long protocol detected 1.5 to 2 times as many Bicknell's Thrush compared with the short protocol and the Relative Abundance of Bicknell's Thrush was greater on long vs. short protocols.

The other target species (Swainson's Thrush, Blackpoll Warbler, Fox Sparrow) showed very little difference between numbers detected on short and long protocols. These species may be more likely to be singing constantly during the survey period, whereas Bicknell's Thrush may sing less predictably.

One potential problem with using the longer protocol is an increased chance of missing birds on the last few stops of the survey. The window of time for peak Bicknell's Thrush vocalizations in the morning is 4-5:30 and 7:30-9:00 in the evening (Figs.9,10). Only the short protocol allows for all points to fall within the 1.5 hour time frame when Bicknell's Thrush vocalizations are greatest.

Playback

Our results do not definitively prove that playback significantly increases the number of Bicknell's Thrush detections, although playback may improve the detectability of Bicknell's Thrush to a small extent. Our results, however, may be confounded by the fact that we always

ran the short protocol after the long protocol, and fewer Bicknell's Thrush were detected using the short protocol (87) than in the first ten minutes of the long protocol (111, or 97 when corrected for the slight difference in number of runs of the long protocol compared to the short protocol; see Table 3). However, there was no significant decrease in the numbers of Bicknell's Thrush detected on a point over time, indicating that habituation of Bicknell's Thrush to playback may not be an issue.

Rimmer et al. (1996) found that playback increased the efficiency of detecting Bicknell's Thrush. Consequently, playback is used by participants in Mountain BirdWatch, although only when birds are not detected by point counts alone (Lambert et al. 2001). Furthermore, Bicknell's Thrushes detected after playback in Mountain Birdwatch are not included in trend analysis (Lambert et al. 2002).

Habitat

More detailed habitat measurements at point counts are required in order to better elucidate the habitat use of this species. Our qualitative measures of habitat did not show any clear trends, except that conifer stem density was greater at sites that had Bicknell's Thrush compared with those that didn't. This may reflect a preference for overall stem density as well as conifer stem density. Our study involved routes that were chosen because they were known or suspected to have Bicknell's Thrush. The habitat did not vary greatly between sites, and we did not include any controls in the habitat analysis. As a result, there was very little variation between our habitat measurements on sites that did and did not have Bicknell's Thrush. Furthermore, our qualitative measures were so broad that any variation that might have existed was likely not recorded. Routes must be chosen randomly from available habitat, and must not be chosen based on knowledge of Bicknell's Thrush presence, in order to gather unbiased data on population trends and habitat selection by this species.

Because the monitoring protocol is designed to detect population trend and not absolute presence or absence of Bicknell's Thrush in an area it will not provide enough data to allow a proper habitat analysis unless routes where Bicknell's Thrush were not detected are revisited at least once. Therefore, during years when habitat analyses are done (see below), technicians will attempt to re-run routes where no Bicknell's Thrush were found in order to get a better estimate of presence/absence of the bird. This information will then be used in the habitat analysis, but not for the monitoring program. Technicians will then do quantitative measurements on habitat following Nixon (2001) and Connolly (2000), and in conjunction with the methods chosen by the Mountain Birdwatch program.

Recommended Protocol

In 2002, suitable areas in Nova Scotia, New Brunswick and PEI will be chosen using a GIS model based on current information on the elevation and habitat preferences of Bicknell's Thrush (Nixon et al. 2001 and D. Busby pers. com.). Additional constraints on suitable areas will include: availability of roads or trails; areas at, or exceeding, the 1-km transect length and

50m radius of each transect; and access to land. Using stratified random sampling, final routes will be chosen that satisfy the GIS criteria as well as practical limitations (VINS 2001).

We recommend the following protocol:

1. 65 or more routes monitored once, starting 30 minutes before dawn or at dusk, during mid-June in order to provide data for population trends.
2. Each 1 km route should consist of 5 points with 250 m between points.
3. Each point along each route should consist of 5 minutes of silent listening, a playback component of 30 seconds and then 5 more minutes of silent listening.
4. On routes where no Bicknell's Thrushes are found during the first visit, technicians will attempt to re-run the route during the peak period to better determine presence/absence of the bird for habitat analyses. Field technicians will measure habitat in July every 2-5 years, or volunteers will be asked to record basic habitat characteristics each year.

Because routes were chosen non-randomly for this study, this recommended protocol should still be considered tentative. 2002 should be considered another pilot year during which sites will be chosen using stratified random sampling and the power analysis will be re-run with these new independent data; it is likely that the number of routes required for sufficient power will increase.

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Literature Cited

- Downes, C.M., E. H. Dunn and C. M. Francis. 2000. Canadian Landbird Monitoring Strategy: monitoring needs and priorities into the new millennium. Partners In Flight-Canada, Ottawa.
- Eagle, P.C., J.P.Gibbs, S. Droege. 2000. Power Analysis of Wildlife Monitoring Programs: Exploring the trade-offs between survey design variables and sample size requirements. Available online at: <http://www.pwrc.usgs.gov/resshow/droege3rs/salpower.htm>
- Lambert, J. D., K. P. McFarland, C. C. Rimmer, and S. D. Faccio. 2001. Mountain BirdWatch 2000. Final Report to the U.S. Fish and Wildlife Service by the Vermont Institute of Natural Science. Available online at: www.vinsweb.org/conservation/citizenscience/2000fullreport.html.
- Lambert, J.D., S.D. Faccio, B. Hanscom. 2002. Mountain BirdWatch 2001. Final Report to the U.S. Fish and Wildlife Service by the Vermont Institute of Natural Science. Available online at: www.vinsweb.org/conservation/citizenscience/2001fullreport.html.
- Nixon, E.A. 1998. Status report on Bicknell's Thrush, *Catharus bicknelli*, in Canada. COSEWIC, Environment Canada, Ottawa. 53pp.
- Nixon, E.A., S. B. Holmes, and A. W. Diamond. 2001. Bicknell's Thrushes (*Catharus bicknelli*) in New Brunswick clear cuts: their habitat associations and co-occurrence with Swainson's Thrushes (*Catharus ustulatus*). *Wilson Bulletin* 113: 33-40.
- Ouellet, H. 1993. Bicknell's Thrush: taxonomic status and distribution. *Wilson Bulletin* 105: 545-754.
- Rimmer, C. C., J. L. Atwood, K. P. McFarland, and L. R. Nagy. 1996. Population density, vocal behavior, and recommended survey methods for Bicknell's Thrush. *Wilson Bulletin* 108: 639-649.
- Stattersfield, A.J. and D. R. Capper. 2000. Threatened birds of the world: the official source for birds on the IUCN red list. Cambridge: BirdLife International.
- VINS 2001. Mountain BirdWatch protocol. Unpublished survey protocol by the Vermont Institute of Natural Sciences. Available online at: www.vinsweb.org/conservation/citizenscience/mb_procedures.html

Table 1. Number of morning and evening surveys, along with total number of surveys, run for each survey route in 2001. “max BITH” refers to the maximum number of Bicknell’s Thrush detected on any given run of a route. See Appendix A for specific route locations.

route #	name	# am	# pm	total	max BITH	comments
CN - 1	Cape North 1	4	3	7	16	Lost 1 evening to rain
CN - 2	Cape North 2	4	3	7	9	Lost 1 evening to rain
CN - 3	Cape North 3	4	3	7	11	Lost 1 evening to rain
CN - 4	Cape North 4	4	3	7	3	Lost 1 evening to rain
BL - 5	Benjies Lake	4	3	7	7	Lost 1 evening to lack of time
RT - 6	Radio Tower	4	3	7	1	Lost 1 evening to lack of time
LT - 7	La Tourbiere	4	3	7	0	Lost 1 evening to lack of time
SL - 1	Simeon Lake 1	3	3	6	0	Lost 1 AM & 1 PM to bear
SL - 2	Simeon Lake 2	3	3	6	3	Lost 1 AM & 1 PM to bear
SL - 3	Simeon Lake 3	2	2	4	1	
PL - 1	Paquet Lake 1	2	2	4	11	
PL - 2	Paquet Lake 2	4	4	8	4	
PL - 3	Paquet Lake 3	2	2	4	1	
RT - 14	Bog/Radio Tower	4	4	8	5	
TO - 1	Tipover Lake 1	2	2	4	1	
TO - 2	Tipover Lake 2	2	2	4	6	
TO - 3	Tipover Lake 3	2	2	4	7	
SK - 1	Skyline	2	3	5	0	

Table 2. Power analysis for High Elevation Bird Monitoring project. “Routes monitored” are the number of routes considered in the study, “within year effort” is the number of times each route is surveyed per year, and “number of years” is the length of time over which the study is conducted. MONITOR requires a mean and standard deviation from count data over multiple years. On each route we calculated the mean and then subtracted that mean from each count along the same route; using the results we pooled the data and calculated the standard deviation for all routes. By “de-meaning” the counts the spatial variation is removed, i.e. differences due to habitat and random error in counting methodology, and the temporal variation is left which allows pooling of the data. The significance level was 0.15.

Routes Monitored	Within Year Effort	Number of Years	Increasing Trend	Power	Decreasing Trend	Power
55	1	10	5%	0.87	10%	0.78
55	1	15	3%	0.92	7%	0.89
55	1	20	2%	0.92	3%	0.85
60	1	10	5%	0.89	10%	0.78
60	1	15	3%	0.91	7%	0.93
60	1	20	2%	0.92	3%	0.89
65	1	10	5%	0.89	10%	0.84
65	1	15	3%	0.93	6%	0.86
65	1	20	2%	0.96	3%	0.91
70	1	10	5%	0.93	10%	0.84
70	1	15	3%	0.95	5%	0.85
70	1	20	2%	0.95	3%	0.93
75	1	10	5%	0.93	10%	0.86
75	1	15	3%	0.96	5%	0.86
75	1	20	2%	0.96	3%	0.95

Table 3. Generalized Linear Model t-value results for Bicknell's Thrush (BITH), Swainson's Thrush (SWTH), Fox Sparrow (FOSP) and Blackpoll Warbler (BLWA). Highlighted values are significant ($\alpha < 0.05$).

Measurements	BITH	SWTH	FOSP	BLWA
Day	-0.32	-0.72	0	2.07
Route	-4.13	-5.90	0	-5.28
Observer	-1.68	3.29	0	0.02
Time Start	1.17	-0.45	0	-0.86
Time End	1.31	0.42	0	0.85
Temp. Start	0.58	-0.07	0	0.41
Temp. End	-0.42	0.62	0	-0.15
Wind Start	-2.28	-4.60	0	-1.05
Wind End	1.86	4.71	0	1.81
Cloud Start	0.66	2.54	0	-0.22
Cloud End	0.79	-2.82	0	1.33
Precipitation Start	2.52	-0.27	0	0.81
Precipitation End	-2.32	0	0	-0.36

Table 4. Mean (\pm SE) number of target species detected per protocol, using data from the first run only. BITH = Bicknell's Thrush, SWTH = Swainson's Thrush, BPWA = Blackpoll Warbler, FO SP = Fox Sparrow. Sample sizes are given in brackets.

	BITH	SWTH	BPWA	FO SP
Long pm (N = 21)	3.28 \pm 0.88	2.89 \pm 0.60	1.56 \pm 0.51	1.11 \pm 0.40
Long am (N = 18)	3.39 \pm 1.03	4.67 \pm 1.06	1.44 \pm 0.36	0.78 \pm 0.37
Short pm (N = 15)	1.5 \pm 0.49	4.06 \pm 0.90	1.61 \pm 0.57	0.72 \pm 0.24
Short am (N = 18)	2.11 \pm 0.60	3.94 \pm 0.96	1.17 \pm 0.46	0.50 \pm 0.29

Table 5. The number (and percent) of Bicknell's Thrush detections (corrected for the number of runs; see below) occurring in five minute intervals for the short protocol (playback after 5 minutes) and the long protocol (playback after 10 minutes). A detection is defined as the first time an individual Bicknell's Thrush was detected on any given run of a route. The total number of stops where the long protocol was employed was 280 (56 routes x 5 stops), and the total number of stops where the short protocol was employed was 245 (49 routes x 5 stops). A correction factor of 0.875 (245/280) was therefore applied to the number of detections under the long protocol. The chi-square test compares the number of detections in the two periods of the short protocol with the number of detections in the first two periods of the long protocol.

	Short Protocol		Long Protocol		
	N	%	N	% (all 3 periods)	% (first two periods only)
1-5 minutes	56	64	81	52	73
6-10 minutes	31	36	30	19	27
11-15 minutes	N/A	N/A	46	29	
Chi-square = 1.70, df = 1, p > 0.10					

Table 6. Number (percent in brackets) of stops with Bicknell's Thrush present and absent for which conifer, hardwood and understory stem densities were categorized as dense, moderate or sparse.

	Conifer stem density		Hardwood stem density		Understorey stem density	
	Present	Absent	Present	Absent	Present	Absent
Dense	26 (55.3)	15 (34.9)	4 (8.5)	2 (4.7)	23 (48.9)	12 (27.9)
Moderate	10 (21.3)	21 (48.8)	11 (23.4)	6 (14)	4 (8.5)	17 (39.5)
Sparse	11 (23.4)	7 (16.3)	32 (68.1)	35 (81.4)	20 (42.6)	14 (32.6)
Chi-square = 7.58, df = 2, p = 0.02						
2.1, df = 2, p = 0.35						
12.41, df = 2, p = 0.002						

Table 7. Number (percent in brackets) of stops with Bicknell's Thrush present and absent that fell into four categories of canopy height.

	BITH present	BITH absent
1-3 m	18 (38.3)	9 (20.9)
3-5 m	24 (51.1)	22 (51.2)
5-7 m	4 (8.5)	11 (25.6)
7-9 m	1 (2.1)	1 (2.3)
Chi-square = 6.19, df = 3, p = 0.10		

Table 8. Number (percent in brackets) of stops with Bicknell's Thrush present and absent that fell into three categories of canopy dominance.

	BITH present	BITH absent
Conifer & hardwood codominant	11 (23.4)	6 (14)
Hardwood dominant	2 (4.3)	2 (4.7)
Spruce/fir dominant	34 (72.3)	35 (81.4)
Chi-square =	1.31, df = 2, p = 0.52	

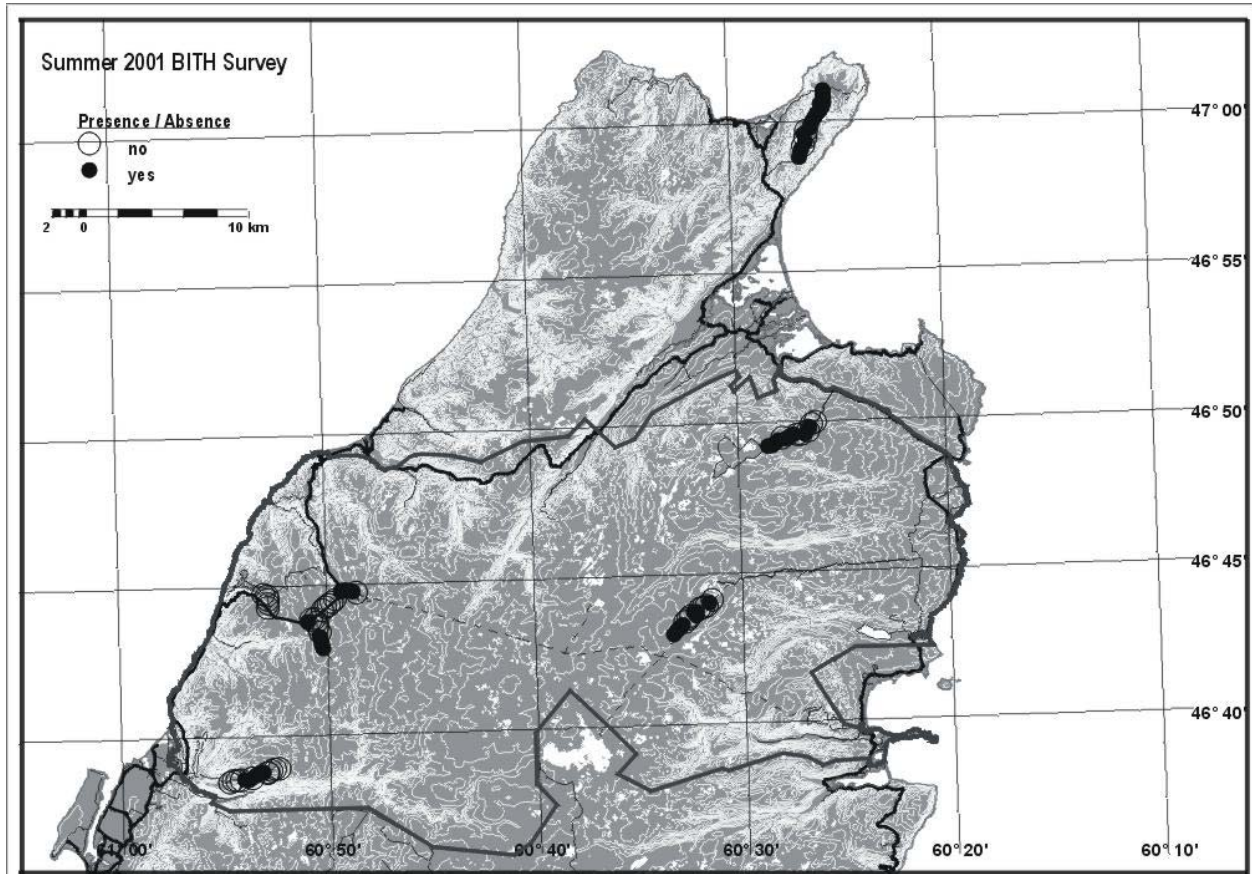
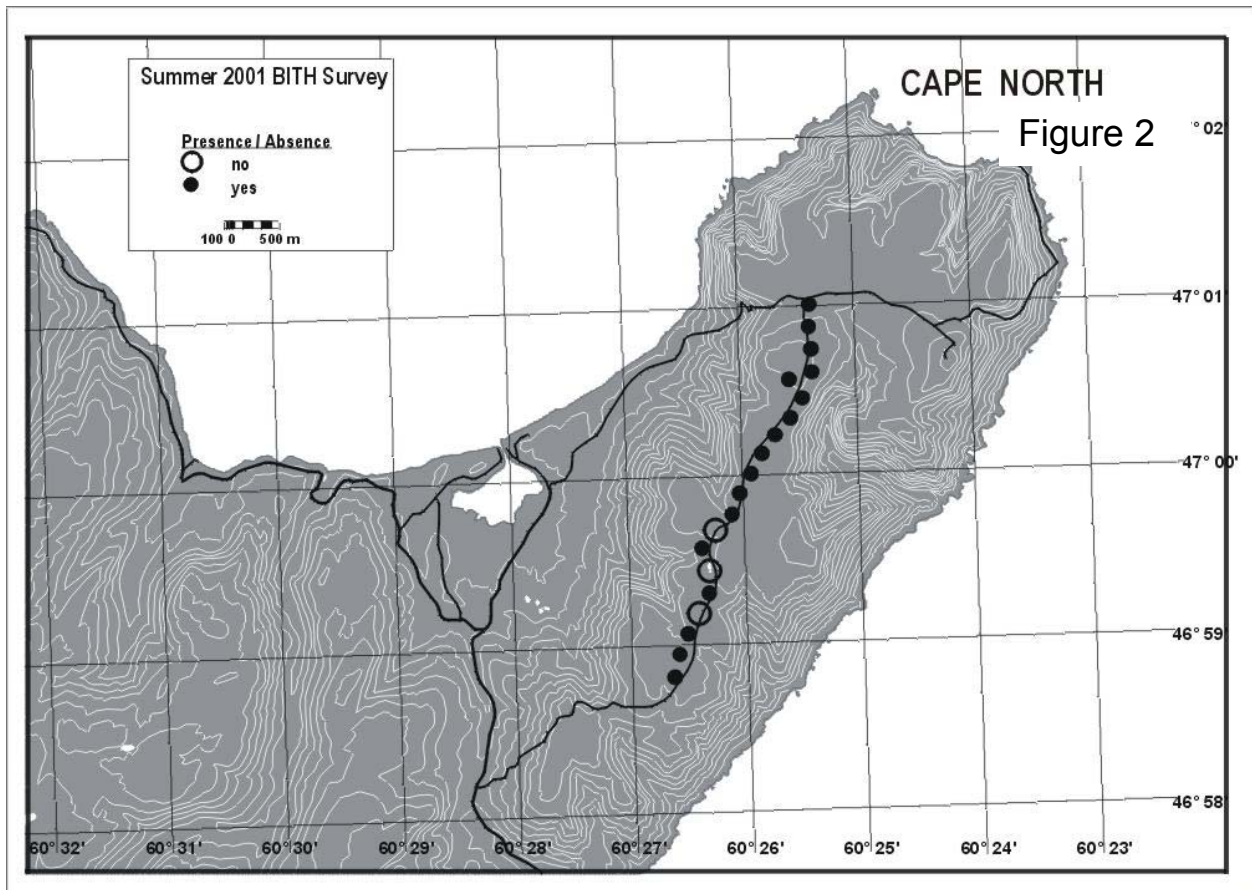
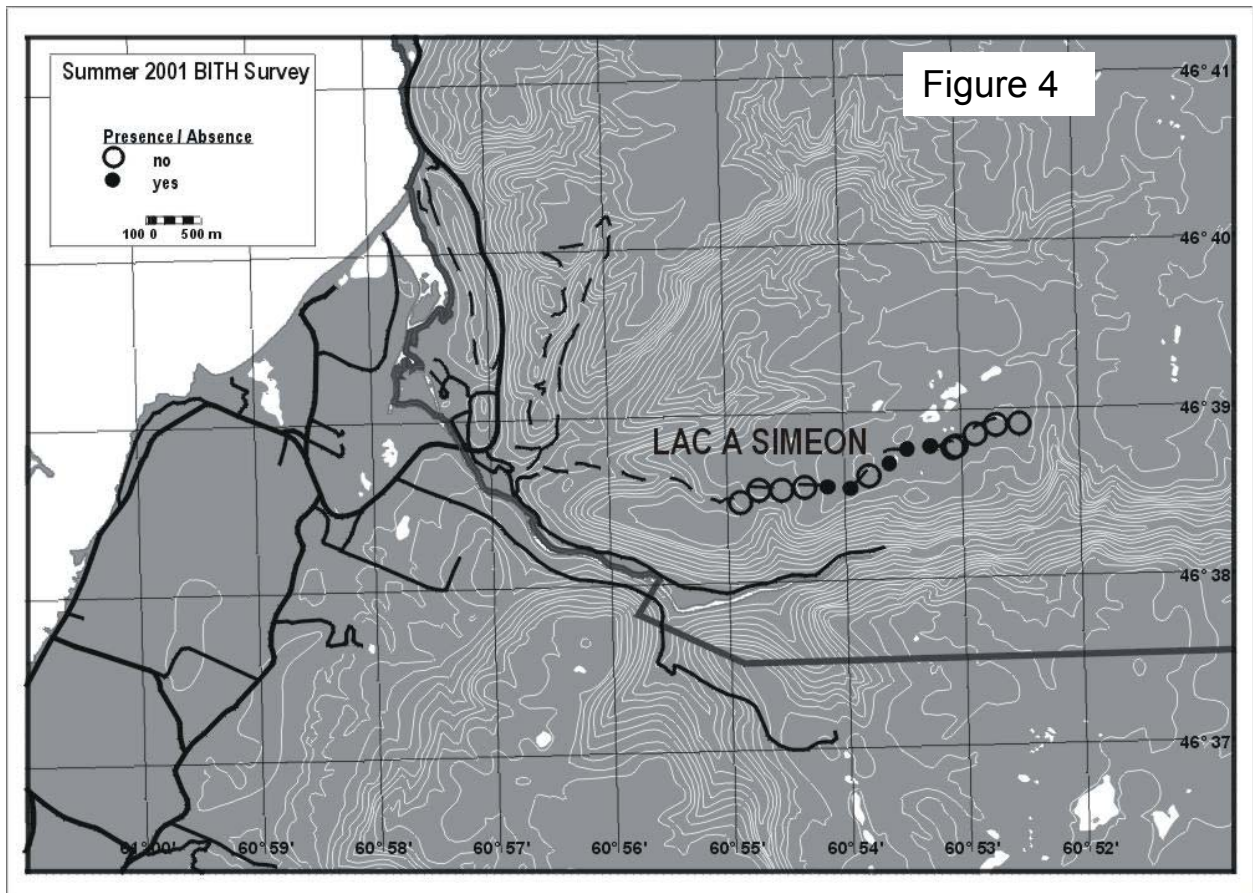
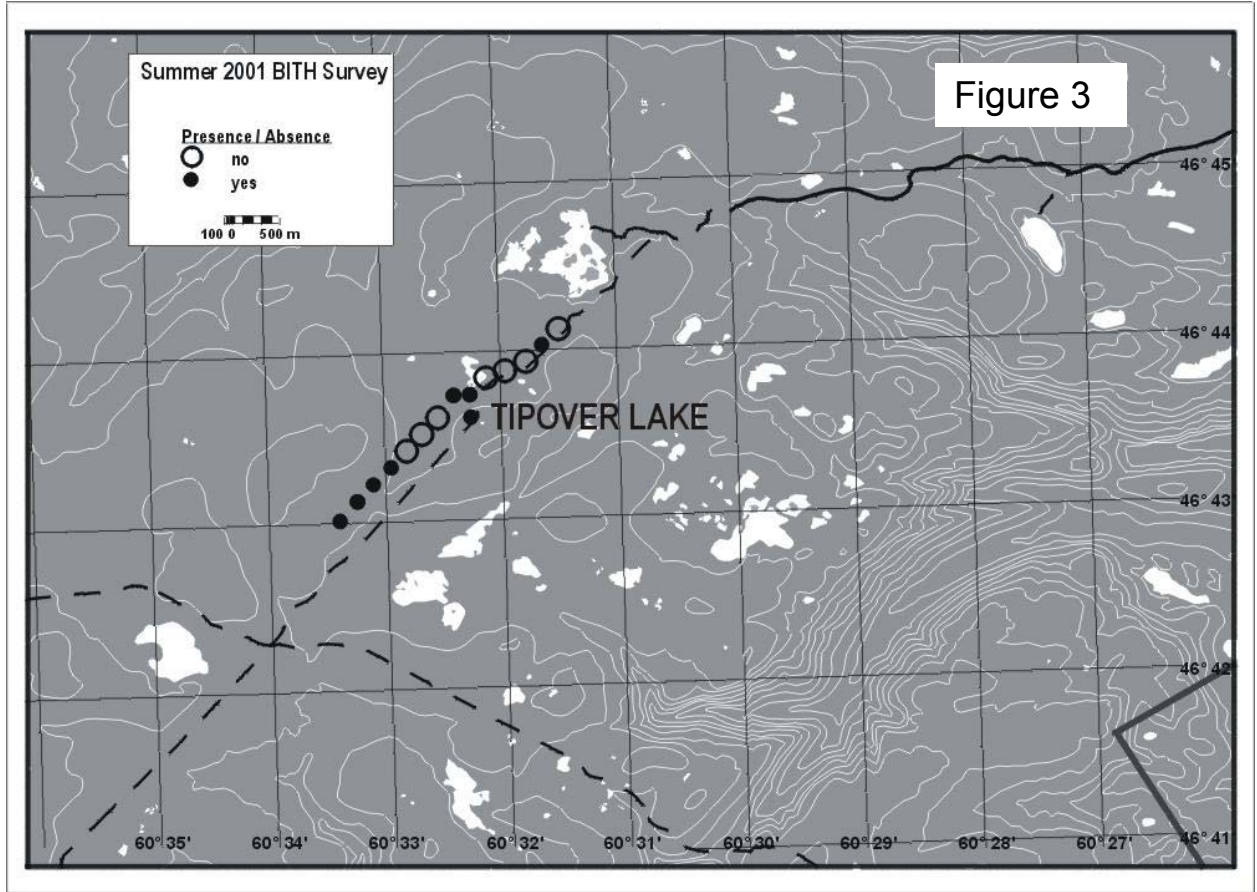
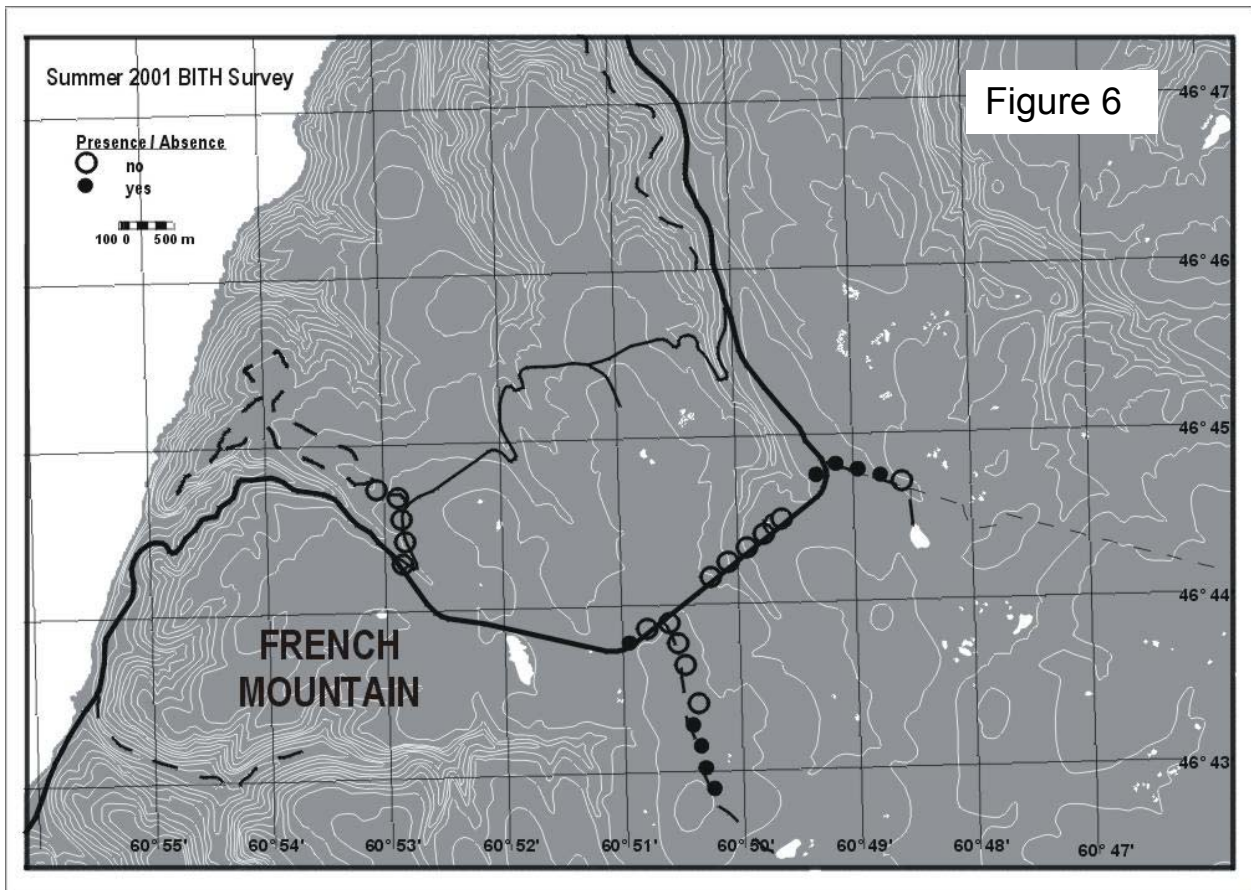
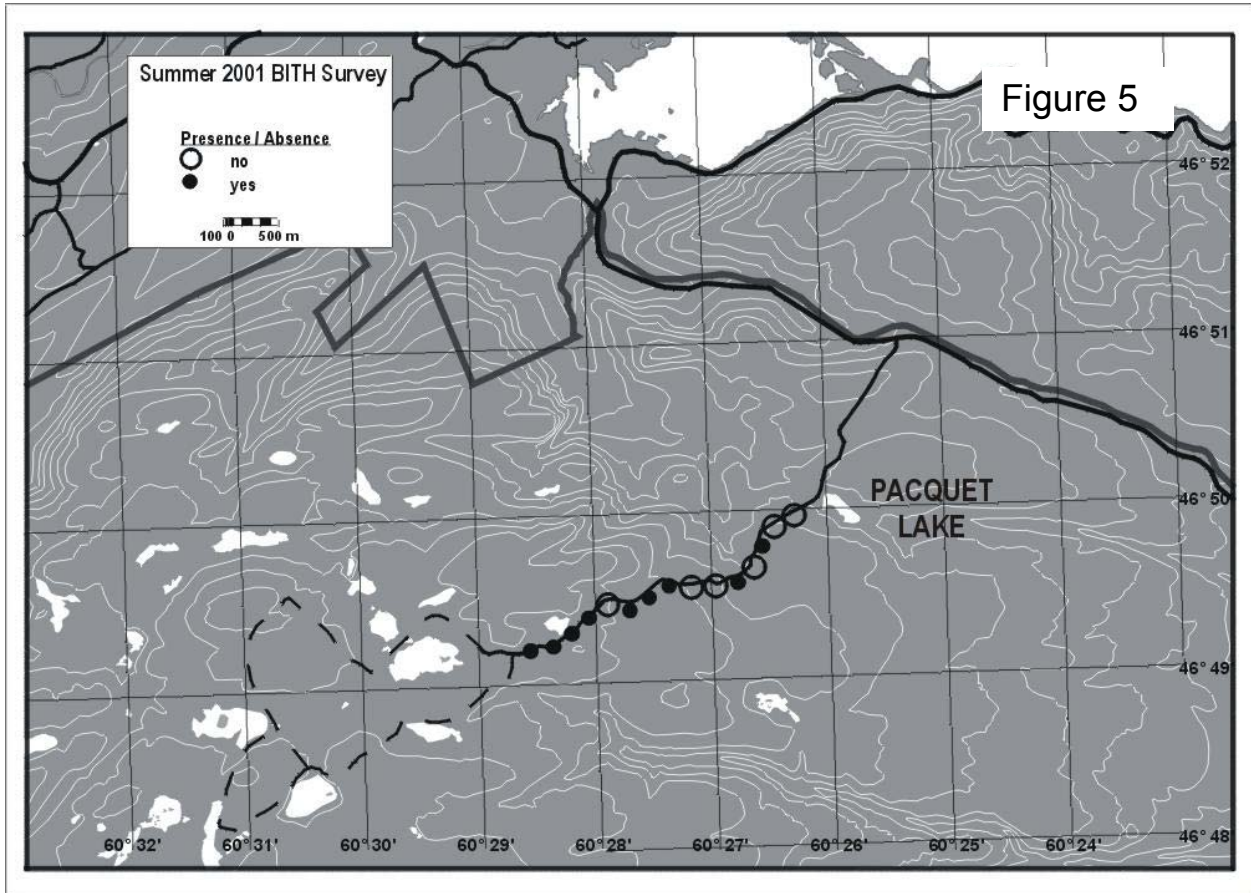


Figure 1. Our five study areas in Cape Breton Highlands National Park (grey border) and Cape North, NS. Stops along survey routes are illustrated by filled circles (Bicknell's Thrush present) and open circles (Bicknell's Thrush absent). Figures 2-6 (below) show each of the five study areas in detail.







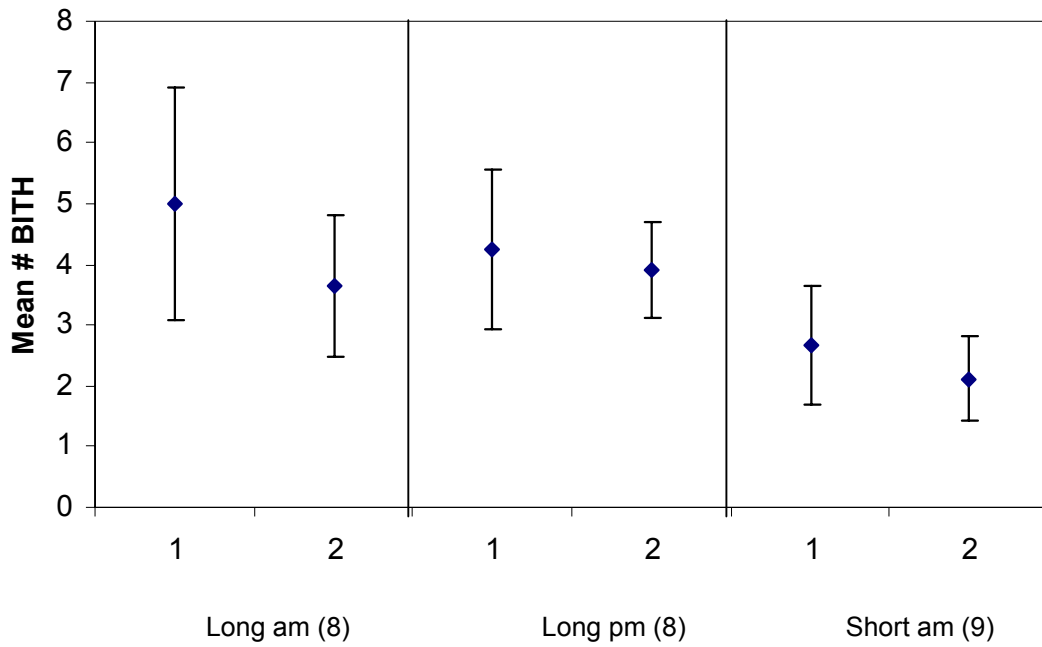


Figure 7. Change in the mean (\pm SE) number of Bicknell’s Thrushes detected per route on the first and second run of a given protocol (separated by 6.5 days on average). Sample sizes are given in brackets.

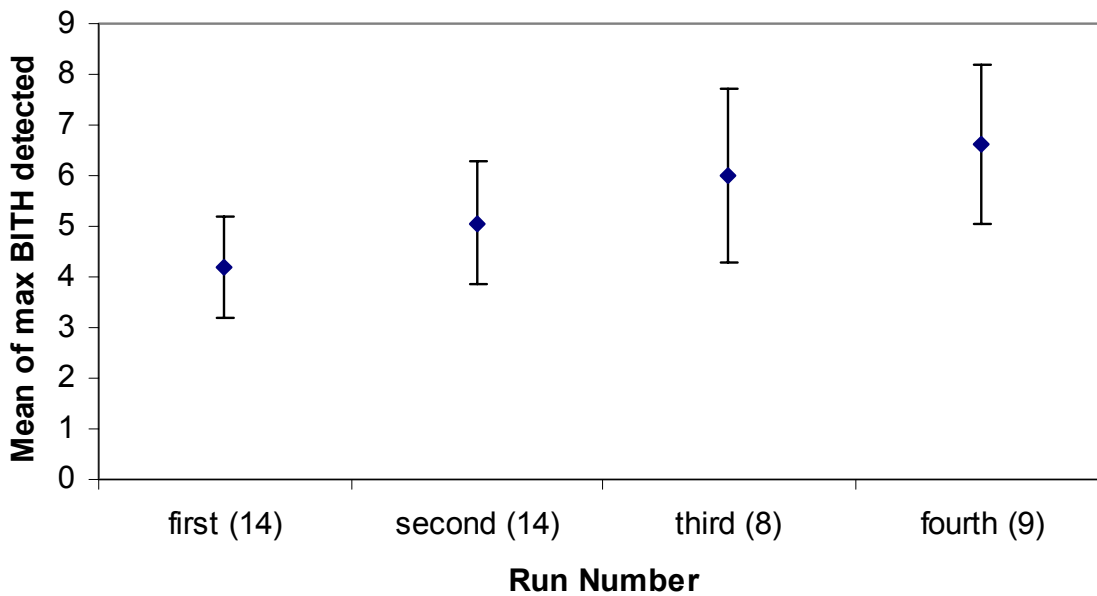


Figure 8. Change in the maximum number of Bicknell’s Thrushes detected per route with successive runs. Data are from the long protocol only, and are averaged across routes. Sample sizes are given in brackets.

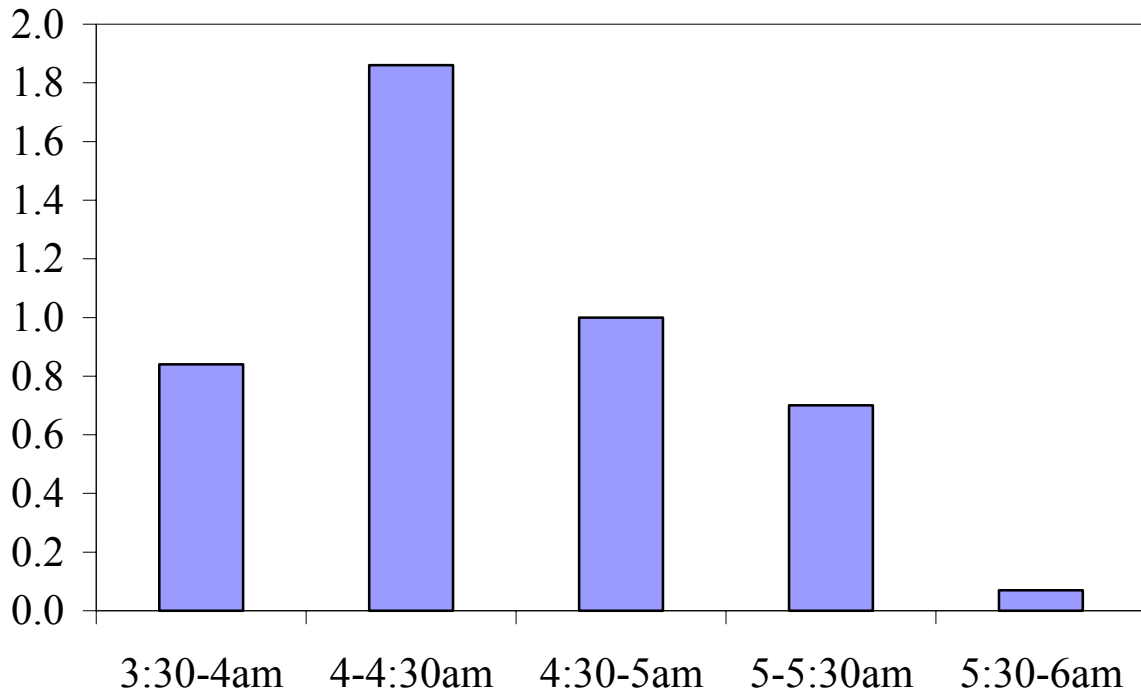


Figure 9. Mean number of Bicknell's Thrush heard per minute within each 30 minute morning period.

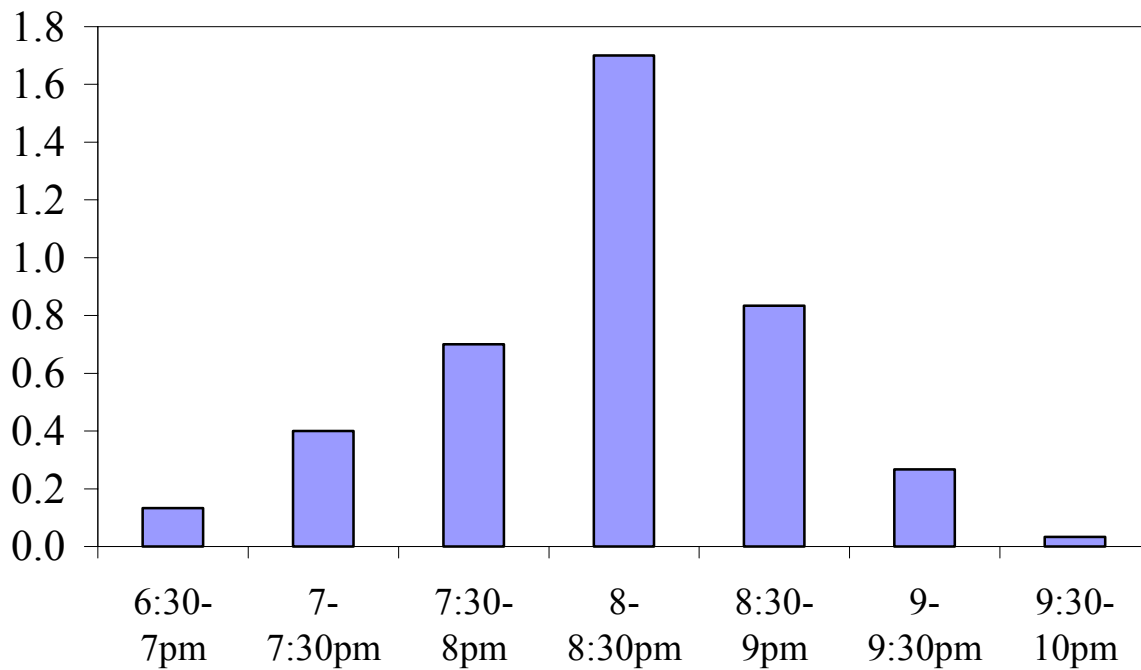


Figure 10. Bicknell's Thrush heard per minute within each 30 minute evening period.

Appendix A. Location (degree decimals, NAD 83) of all survey stops, as well as five incidental detections of Bicknell's Thrushes in Cape Breton Highlands National Park. Also noted is whether or not Bicknell's Thrushes were detected on each stop ("Bicknell's Thrush detected?").

lat	long	route#-station	site	Bicknell's Thrush detected?	comments
47.01673	-60.4231	CN1-005	Cape North 1	yes	
47.01453	-60.4233	CN1-004	Cape North 1	yes	
47.01228	-60.423	CN1-003	Cape North 1	yes	
47.01002	-60.423	CN1-002	Cape North 1	yes	
47.00935	-60.4263	CN1-001	Cape North 1	yes	
47.00746	-60.4245	CN2-001	Cape North 2	yes	
47.00552	-60.4263	CN2-002	Cape North 2	yes	
47.00388	-60.4286	CN2-003	Cape North 2	yes	
47.00208	-60.4306	CN2-004	Cape North 2	yes	
47.00014	-60.4322	CN2-005	Cape North 2	yes	
46.99823	-60.4339	CN3-001	Cape North 3	yes	
46.99614	-60.4351	CN3-002	Cape North 3	yes	
46.99464	-60.4375	CN3-003	Cape North 3	no	
46.99285	-60.4396	CN3-004	Cape North 3	yes	
46.99062	-60.4386	CN3-005	Cape North 3	no	
46.98838	-60.4387	CN4-001	Cape North 4	yes	
46.98642	-60.4403	CN4-002	Cape North 4	no	
46.98444	-60.4419	CN4-003	Cape North 4	yes	
46.9824	-60.4432	CN4-004	Cape North 4	yes	
46.98017	-60.4441	CN4-005	Cape North 4	yes	
46.74591	-60.822	BL5-001	Benjies Lake	yes	
46.74699	-60.8192	BL5-002	Benjies Lake	yes	
46.74639	-60.8161	BL5-003	Benjies Lake	yes	
46.74578	-60.8129	BL5-004	Benjies Lake	yes	
46.74515	-60.8098	BL5-005	Benjies Lake	no	
46.7273	-60.8413	RT6-005	Radio Tower	no	
46.72944	-60.8422	RT6-004	Radio Tower	no	
46.7315	-60.8434	RT6-003	Radio Tower	no	
46.73098	-60.8465	RT6-002	Radio Tower	no	
46.72961	-60.8491	RT6-001	Radio Tower	yes	
46.74164	-60.8271	LT7-001	La Tourbiere	no	
46.74019	-60.8296	LT7-002	La Tourbiere	no	
46.73883	-60.8321	LT7-003	La Tourbiere	no	
46.73748	-60.8348	LT7-004	La Tourbiere	no	
46.73602	-60.8373	LT7-005	La Tourbiere	no	
46.64846	-60.8751	SL1-005	Simeon Lake 1	no	
46.64836	-60.8784	SL1-004	Simeon Lake 1	no	
46.64752	-60.8814	SL1-003	Simeon Lake 1	no	
46.64634	-60.8842	SL1-002	Simeon Lake 1	no	
46.64621	-60.8846	SL1-001	Simeon Lake 1	no	
46.6464	-60.8878	SL2-005	Simeon Lake 2	yes	
46.64616	-60.8911	SL2-004	Simeon Lake 2	yes	
46.64478	-60.8937	SL2-003	Simeon Lake 2	yes	
46.64362	-60.8966	SL2-002	Simeon Lake 2	no	
46.64239	-60.8993	SL2-001	Simeon Lake 2	yes	
46.6426	-60.9025	SL3-001	Simeon Lake 3	yes	

46.64262	-60.9057	SL3-002	Simeon Lake 3	no	
46.64239	-60.9089	SL3-003	Simeon Lake 3	no	
46.64246	-60.9122	SL3-004	Simeon Lake 3	no	
46.64125	-60.9149	SL3-005	Simeon Lake 3	no	
46.7213	-60.8404	RT2-002	Radio Tower 2	yes	
46.7192	-60.8393	RT2-003	Radio Tower 2	yes	
46.71698	-60.8387	RT2-004	Radio Tower 2	yes	
46.71488	-60.8376	RT2-005	Radio Tower 2	yes	
46.72345	-60.8396	RT2-001	Radio Tower 2	no	
46.73068	-60.5354	TL1-001	Tipover Lake 1	no	
46.73132	-60.5327	TL1-002	Tipover Lake 1	no	
46.73217	-60.5297	TL1-003	Tipover Lake 1	no	
46.73379	-60.5274	TL1-004	Tipover Lake 1	yes	
46.73532	-60.525	TL1-005	Tipover Lake 1	no	
46.72903	-60.5378	TL2-005	Tipover Lake 2	yes	tipover cabin and TL2-005
46.72681	-60.5378	TL2-004	Tipover Lake 2	yes	
46.72903	-60.5401	TL2-003	Tipover Lake 2	yes	
46.72681	-60.5425	TL2-002	Tipover Lake 2	no	
46.72524	-60.5447	TL2-001	Tipover Lake 2	no	
46.72361	-60.547	TL3-001	Tipover Lake 3	no	
46.722	-60.5493	TL3-002	Tipover Lake 3	yes	
46.72036	-60.5519	TL3-003	Tipover Lake 3	yes	
46.71875	-60.5542	TL3-004	Tipover Lake 3	yes	
46.71685	-60.5567	TL3-005	Tipover Lake 3	yes	
46.73803	-60.8809	SK1-001	Skyline	no	
46.74025	-60.8805	SK1-002	Skyline	no	
46.74246	-60.881	SK1-003	Skyline	no	
46.74467	-60.8814	SK1-004	Skyline	no	
46.74554	-60.8844	SK1-005	Skyline	no	
46.82435	-60.4649	PL1-001	Paquet Lake 1	no	
46.82311	-60.4677	PL1-002	Paquet Lake 1	yes	
46.8216	-60.4701	PL1-003	Paquet Lake 1	yes	
46.82035	-60.4729	PL1-004	Paquet Lake 1	yes	
46.82003	-60.4761	PL1-005	Paquet Lake 1	yes	
46.82593	-60.4496	PL2-001	Paquet Lake 2	no	
46.82581	-60.4529	PL2-002	Paquet Lake 2	no	
46.82605	-60.4562	PL2-003	Paquet Lake 2	yes	
46.82494	-60.459	PL2-004	Paquet Lake 2	yes	
46.82374	-60.4618	PL2-005	Paquet Lake 2	yes	
46.82618	-60.4463	PL3-001	Paquet Lake 3	yes	
46.82767	-60.4439	PL3-002	Paquet Lake 3	no	
46.82973	-60.4427	PL3-003	Paquet Lake 3	yes	
46.83161	-60.4409	PL3-004	Paquet Lake 3	no	
46.83267	-60.438	PL3-005	Paquet Lake 3	no	
46.71524	-60.4876	LONG-L	Incidental	yes	Long Lake (Glasgow Lakes)
46.71378	-60.4806	LONGL2	Incidental	yes	Long Lake (Glasgow Lakes)
46.81313	-60.4747	LONGL3	Incidental	yes	Long Lake (Glasgow Lakes)
46.81667	-60.463	BRA PON	Incidental	yes	Branch Pond
46.81982	-60.5115	LOI TRA	Incidental	yes	Lake of Islands Trail Junction
