

Mountain Birdwatch 2.0: 2014



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Executive Summary

Mountain Birdwatch (MBW) monitors songbirds that breed in fir and spruce forests of the northeastern United States. MBW's primary focus is Bicknell's Thrush, a montane fir specialist that breeds only in the Northeastern U.S. and adjacent portions of Canada. Initiated in 2000, MBW trained citizen scientists to conduct annual observations along survey routes in Massachusetts, New York, Vermont, New Hampshire, and Maine. In 2010, MBW launched a revised, improved program (MBW2), which includes a randomized selection of routes across the northeastern United States, a revised survey protocol to allow for more stringent statistical analyses, and an attempt to expand into Canada to ensure consistent surveys across the entire breeding range of Bicknell's Thrush.

2014 marked the fourth year of full implementation of MBW2 in the U.S. In June and early July, observers surveyed 650 points in Bicknell's Thrush habitat along 123 routes across New York, Vermont, New Hampshire, and Maine. Bicknell's Thrush was detected at 189 points (29.1%) along 74 routes (60.2%). As in previous years, New York surveys yielded the highest percentage of points at which Bicknell's Thrush was detected (38.3%).

Despite its successful implementation in the US, low numbers of Bicknell's Thrush detections in Canada, especially within Québec, have led to a re-evaluation of MBW2's ability to effectively and efficiently monitor Bicknell's Thrush throughout its entire breeding range. While the US portion of MBW2 will continue unchanged, the International Bicknell's Thrush Conservation Group monitoring subcommittee is evaluating methods to refine its international strategies in order to meet local, provincial, and international monitoring goals.

Background and Rationale

The high-elevation forests of the northeastern United States provide habitat for a unique assemblage of breeding birds, several of which reach the southern limits of their distribution in these montane fir-spruce forests. Most notably, mountain forests provide habitat for Bicknell's Thrush (*Catharus bicknelli*), the region's only endemic songbird. However, due to the inaccessibility of Northeast's high-elevation forests, several montane avian breeders were not included in standardized state or federal bird monitoring schemes (e.g., the Breeding Bird Survey). As such, generating even rudimentary estimates of population trends or population size proved difficult historically for species in this habitat, and the development of scientifically defensible conservation strategies lagged accordingly. Mountain Birdwatch (MBW) was created to fill these information gaps.

Mountain Birdwatch began under the auspices of the Vermont Center for Ecostudies (VCE; at the time part of the Vermont Institute of Natural Science) Forest Bird Monitoring Program. Volunteers and staff surveyed 12 mountains from 1993 to 1999 to monitor changes in the status of Bicknell's Thrush and other high-elevation songbirds. In 2000, VCE biologists launched MBW as an independent project with fifty additional routes in Vermont and offered observers the option to concentrate on five species: Bicknell's Thrush, Swainson's Thrush (*Catharus ustulatus*), Blackpoll Warbler (*Dendroica striata*), White-throated Sparrow (*Zonotrichia albicollis*), and Winter Wren (formerly *Troglodytes troglodytes*; designated *Troglodytes hiemalis* in 2010; Chesser et al, 2010). The survey region was expanded in 2001 to include over 100 new routes in New York, New Hampshire, Massachusetts, and Maine. The objectives of this original Mountain Birdwatch were to: 1) monitor the distribution and abundance of mountain-breeding birds in northern New England and New York; 2) describe the influence of landscape and habitat features on mountain bird distribution and abundance; and 3) guide stewardship of high-elevation forests.

Data collected under MBW have been put to a variety of uses: we have assessed the power of MBW to detect population trends (Lambert et al. 2001); examined the influence of landscape structure on high-elevation bird communities (Lambert et al. 2002); measured

habitat characteristics on 45 survey routes (Lambert 2003); quantified short-term population trends (Lambert 2005); produced and validated a Bicknell's Thrush distribution model (Lambert et al. 2005); and projected effects of climate change on Bicknell's Thrush distribution (Lambert and McFarland 2004). We have also identified key management units and conservation opportunities for Bicknell's Thrush (Lambert 2003). More recently, we have conducted a ten-year trend analysis of MBW's five target species (Scarl 2011) and assessed the relative contribution of local and landscape variables to Bicknell's Thrush habitat occupancy in Vermont (Frey et al. 2011). We are currently using ten years of MBW data to evaluate high-elevation bird abundance in relation to climate events, habitat, predation, and competition. These analyses provide critical conservation tools for scientists, policymakers, and landowners.

Mountain Birdwatch remains integral to the ongoing efforts of the International Bicknell's Thrush Conservation Group (IBTCG; www.bicknellsthrush.org) and serves as the main tool to evaluate progress towards the group's goals. In 2010, the IBTCG unveiled a Conservation Action Plan for Bicknell's Thrush; analyses of population trends and occupancy based on MBW data informed development of the Bicknell's Thrush Conservation Action Plan (IBTCG, 2010).

Despite the enormous potential of this monitoring project, the original MBW design exhibited several limitations. First, MBW investigated breeding birds in the high-elevation regions of New York, Vermont, New Hampshire, and Maine, yet birds are not constrained by state and country borders. High-elevation spruce-fir forests extend northward into Canada, as does the breeding range of Bicknell's Thrush (IBTCG, 2010). While Canadian-based Bicknell's Thrush distribution surveys and the High Elevation Landbird Program monitored this species in Québec and the Canadian Maritimes, respectively, differences in survey protocols and timing hindered integration of results across regions. Second, while initial MBW route selection made an attempt at randomization across the available habitat, limitations in volunteer effort and the addition of new, non-randomly selected routes created a non-random MBW survey sample. This limits inferences that can be drawn across an entire population or habitat. Third, the original MBW allowed observers to choose between two survey protocols: while one protocol focused on five species of high-elevation birds, the other protocol recorded all species observed during a survey.

Differences in observer attention or effort may have influenced results, even for detections of the five species surveyed by all volunteers. Finally, in recent years, scientists have recognized that detectability is an essential consideration in bird monitoring programs (MacKenzie et al. 2005); detectability measures the probability of detecting a species if that species is present. Analyses that account for detectability tend to more accurately represent population trends than those that do not consider this variable, especially for difficult-to-detect species (Rota et al. 2011). Although estimates of detectability are possible with MBW data, important variables that may influence detectability were not measured, and thus accuracy of detectability estimates may be poor.

Mountain Birdwatch 2.0

VCE and the IBTCG developed Mountain Birdwatch 2.0 (MBW2) to address the shortcomings of the original MBW and provide a long-term, international monitoring program that surveyed high-elevation birds across the entire breeding range of the Bicknell's Thrush. MBW2 incorporates the following improvements:

1. MBW2 is a partnership between government, non-government, and academic institutions in the U.S. and Canada. Using a Bicknell's Thrush potential habitat model (McFarland and Hart, 2009; based on Lambert et al. 2005) to identify a survey frame, we randomly selected MBW2 routes across all potential Bicknell's Thrush habitat in both countries. A Generalized Random Tessellation Stratified (GRTS) sampling design ensured a spatially balanced but randomized selection of survey stations while also allowing for randomized subsampling in specific regions of interest. With randomly selected routes and systematic surveys conducted across the entire breeding range of the Bicknell's Thrush, MBW2 was designed to enable researchers to draw strong conclusions about abundance, occupancy, trends, and distribution across an entire habitat.
2. MBW2 incorporates a new survey protocol that focuses on a broader array of montane species while allowing for improved calculations of detectability. All MBW2 participants collect data on 11 species (Table 1), yielding an expanded and

consistent target list with one protocol for all participants. This expanded focus, which also incorporates surveys of a common avian montane nest predator, will allow us to draw conclusions about the broader ecosystem and predator-prey cycles as well as standardize volunteer effort.

Table 1: Species surveyed by all MBW2 participants.

Common Name	Scientific Name	Species Code
Yellow-bellied Flycatcher	<i>Empidonax flaviventris</i>	YBFL
Black-capped Chickadee	<i>Poecile atricapilla</i>	BCCH
Boreal Chickadee	<i>Poecile hudsonica</i>	BOCH
Winter Wren	<i>Troglodytes hiemalis</i>	WIWR
Bicknell's Thrush	<i>Catharus bicknelli</i>	BITH
Swainson's Thrush	<i>Catharus ustulatus</i>	SWTH
Hermit Thrush	<i>Catharus guttatus</i>	HETH
Blackpoll Warbler	<i>Dendroica striata</i>	BLPW
Fox Sparrow	<i>Passerella iliaca</i>	FOSP
White-throated Sparrow	<i>Zonotrichia albicollis</i>	WTSP
Red Squirrel	<i>Tamiasciurus hudsonicus</i>	RESQ

Goals

Mountain Birdwatch 2.0 identifies these monitoring and programmatic goals (reproduced from Hart and Lambert 2008):

Monitoring

Monitoring Goal 1: To measure the annual population status of target species in terms of distribution, abundance/density, and occupancy

Monitoring Goal 2: To measure changes in the population status of target species over time

Monitoring Goal 3: To relate population status and trend information to biotic and abiotic variables that may affect the target species

Programmatic

Programmatic Goal 1: To make observational data (date, location, count, etc.) and associated metadata publicly available for visualization and download through the Avian Knowledge Network (AKN), while recognizing legal, institutional, proprietary, and other constraints.

Programmatic Goal 2: To provide decision-makers with tools and analyses to conserve high-elevation birds in the Northern Appalachian and Laurentian Regions

Programmatic Goal 3: To increase public understanding of the ecology, status, and conservation requirements of high-elevation songbirds in the Northern Appalachian and Laurentian Regions.

For a detailed description of Mountain Birdwatch 2.0 protocols, history, and more specific target goals, please see Hart and Lambert 2008.

United States Initiative

Mountain Birdwatch 2.0 was launched in the United States in 2010. In June and July, nine technicians and Mountain Birdwatch director Judith Scarl established 96 routes across New York, Vermont, New Hampshire, and Maine; each route contains between 3-6 survey stations for a total of 529 U.S. survey points. Technicians mapped and documented these routes using GPS waypoints, written descriptions, and photographs. Since MBW2 aims to assess how avian population trends relate to habitat characteristics, technicians measured habitat variables at up to three subplots around each survey station. Technicians conducted point counts at 410 of these stations in June and July of 2010. By 2012, the full complement of 131 routes had been established in the northeastern United States. These efforts set the stage for decades of future surveys.

New York and Vermont Subsample

MBW2 route selection procedure assigned routes largely in proportion to the available habitat in a given region. We further narrowed route selections by eliminating areas that did not have road or trail access. Based on these criteria, Vermont and New York were assigned fewer routes than Maine and New Hampshire. In Vermont, high-elevation spruce-fir habitat is limited largely to the spine of the Green Mountains and a few high peaks in the Northeast Kingdom, and thus the total area of spruce-fir forest is small compared to other regions. New York's Catskill Mountains have an even smaller area of high-elevation spruce-fir forest. The Adirondacks of New York contain a large percentage of the potential Bicknell's Thrush habitat in the United States; however, large portions of this habitat are difficult to access due to lack of roads or trails or overly long hike durations.

Despite the small number of routes initially selected for New York and Vermont, the high-elevation regions of these two states merit closer attention. The Catskills and the southern Green Mountains of Vermont represent the southernmost extent of the high-elevation spruce-fir forest in which Bicknell's Thrush breeds. Climate-related changes in species' ranges often manifest as expansions or contractions at range edges (Parmesan 2006) and a regional increase of 1 degree Celsius may be enough to eliminate all Bicknell's Thrush breeding habitat from these regions (Rodenhouse et al. 2008). To detect early warning signs of global climate change, the southernmost limits of Bicknell's Thrush breeding habitat warrant careful monitoring. Second, data from the original MBW surveys suggest that unlike in other regions, Bicknell's Thrush detections have increased in the Adirondacks and Catskills over the past decade (Scarl 2011). More extensive monitoring will elucidate whether Bicknell's Thrush population size is increasing in New York State, or whether these trends represent a short-term population spike or an artifact of sampling effort. Third, the greatest numbers of Mountain Birdwatch volunteers have historically conducted surveys in New York and Vermont, demonstrating a potential for closer monitoring in those states.

In 2011 and 2012, 27 of the newly established routes in Vermont and New York represented part of a regional subsample to more closely explore trends in these areas. Our randomized, statistically rigorous subsampling will allow us to draw conclusions about Bicknell's Thrush and other high-elevation breeding birds at international, national, and regional scales.

Re-Launching a Volunteer Program

Mountain Birdwatch has always been a citizen science program at its core, and in 2011 MBW2 welcomed volunteers onto its new routes. In 2011, volunteers surveyed 64 out of 116 routes (54.2%). Volunteer participation increased by 50% in 2012; volunteers surveyed 96 of 126 available routes (76.2%). For the first time since 2010, in 2013, no paid technicians were hired to cover "leftover" United States routes; a volunteer intern at VCE and New York State Department of Environmental Conservation technicians assisted with routes that were not adopted. Citizen science volunteers also increased their participation

levels to fill in the gaps in coverage; Maine-based volunteers Mike and Barb Zimmermann singlehandedly surveyed 9 routes throughout central and western Maine!

To recruit and train volunteers, MBW director Judith Scarl presents annual volunteer training workshops at locations throughout the Northeast. At training sessions, volunteers learn about the history of the MBW program, applications of the original MBW data, the benefits of the revised monitoring program, and identification characteristics of the target species. Volunteers also participate in a practice point count using recorded bird songs and calls. Since 2011, 86 volunteers have attended at least one training workshop, with 21 volunteers attending two or more training sessions across years. These workshops serve both to strengthen volunteer bird identification and point count skills and also to create a sense of community among volunteers who otherwise participate in isolation.

2014 U.S. Season Results

Observers surveyed 650 points along 123 routes within potential Bicknell's Thrush habitat in 2014; 8 routes were not surveyed or data were not submitted. Bicknell's Thrush was detected at 189 points (29.1%) and 74 routes (60.2%) in 2014 (Table 2). As in all previous years, Maine had the lowest percentage of points with BITH detections (25.2%), while New York continues to have the highest percentage of points with BITH detections (38.3%); this was partially driven by the high percentage of points with BITH detections in the Catskills (59.4%), which was almost double the percentage in any other region (Table 3). These data are uncorrected for observer skill, observer experience, or other factors that might influence the likelihood of detecting birds that are present, and thus must be interpreted with caution; however, New York's continually high detection rates suggest that New York mountains continue to provide important habitat for this vulnerable species.

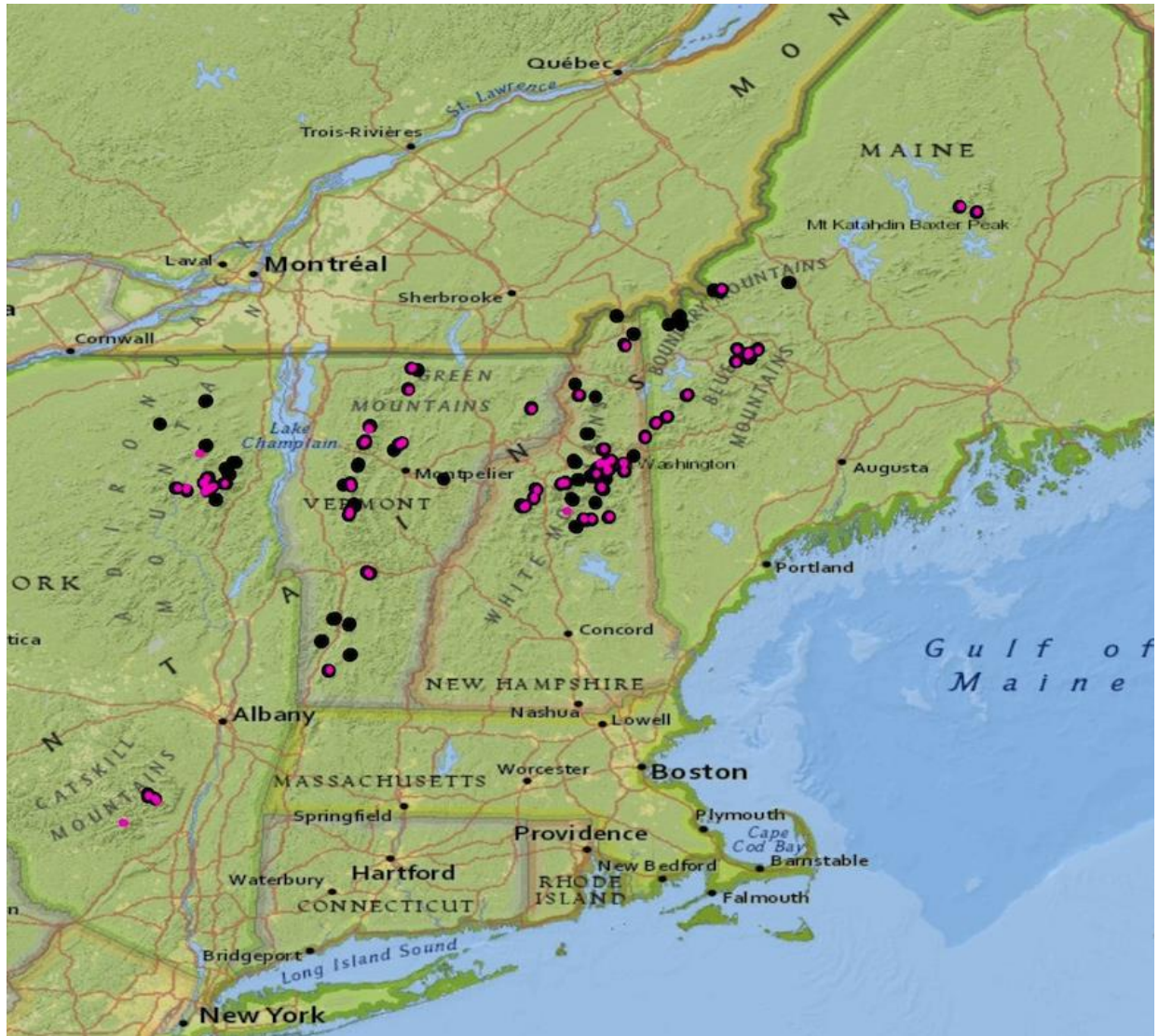


Figure 1: All non-confidential points surveyed within Bicknell's Thrush potential habitat in the U.S. in 2014. Bicknell's Thrush was detected at 29.1% of points surveyed within Bicknell's Thrush habitat. Pink points represent locations with BITH detections, while black points represent locations where BITH was not detected in 2014.

Table 2: U.S. sampling effort and detections in 2014.

Region	Points Surveyed In Habitat	Points w/BITH Detections	Routes Surveyed	Routes w/BITH
Adirondacks (NY)	109	35 (32.1%)	21	12 (57.1%)
Catskills (NY)	32	19 (59.4%)	6	5 (83.3%)
NY (all)	141	54 (38.3%)	27	17 (63.0%)
VT	146	45 (30.8%)	28	17 (60.7%)
NH	232	59 (25.4%)	43	25 (58.1%)
ME	131	31 (23.7%)	25	15 (60.0%)
TOTAL	650	189 (29.1%)	123	74 (60.2%)

2011-2014 Comparisons

As of 2014, Mountain Birdwatch volunteers and staff have completed four full seasons of MBW2 data collection in the United States. Across all regions, 2011 was a banner year for Bicknell's Thrush detections, with 2014 yielding similar results; this species was detected at 31.9% and 29.1% of all points respectively, compared with 25.2% (2012) and 25.1% (2013) of points (Table 3). Both Vermont and Maine showed increases in the percentage of points with BITH from 2013 to 2014; BITH was detected at 7.8% more points in Maine and 8.4% more in Vermont in 2014. In New York, the overall percentage of points with BITH detections decreased between 2013 and 2014, and this was driven by decreased detection rates in the Adirondacks; BITH was detected at only 32.1% of surveyed points in 2014, compared with 38.2% in 2013. Examining route-level data, 60.2% of all surveyed routes yielded BITH detections, a percentage similar to 2011 and 2013 (Table 4).

Table 3: Percentage of all surveyed points at which observers detected Bicknell's Thrush.

Region	2011	2012	2013	2014
Adirondacks (NY)	39.3	33.0	38.2	32.1
Catskills (NY)	58.1	48.4	54.8	59.4
NY (total)	44.3	36.4	43.0	38.8
VT	23.0	23.4	22.4	30.8
NH	33.5	22.6	23.6	25.4
ME	26.7	20.1	15.9	23.7
TOTAL	31.9	25.2	25.6	29.1

Table 4: Percentage of surveyed routes at which observers detected Bicknell's Thrush.

Region	2011	2012	2013	2014
Adirondacks (NY)	56.3	52.4	53.3	57.1
Catskills (NY)	100.0	83.3	83.3	83.3
NY (total)	68.2	59.3	61.9	63.0
VT	47.8	53.8	57.7	60.7
NH	67.4	52.2	62.8	58.1
ME	48.1	55.6	52.0	60.0
TOTAL	59.3	54.8	59.1	60.2

Although an attempt is made to survey all established points within Bicknell's Thrush habitat each year, weather, observer availability, and changing land permissions and route access feasibility preclude a number of points from being accessed in any given year. However, 464 points along 93 routes within Bicknell's Thrush habitat were surveyed every year from 2011-2014. Of these sites, observers detected Bicknell's Thrush during at least one of the four surveys at 228 (49.1%) points. Within this subset of 464 points, the number of points at which Bicknell's Thrush was detected was similar in 2012 and 2013 (105 and 103 points, respectively) but slightly higher in 2011 and 2014 (122 and 126 points, respectively), mirroring the results for the complete dataset. Consistency in Bicknell's Thrush detection at points was low; just over half (57.5%) of points with a Bicknell's Thrush detection in one year had another BITH detection over the four year period, and Bicknell's Thrush was observed during all four years at only 30 points (8%). However, route-level observations of Bicknell's Thrush exhibited higher consistency. Observers detected Bicknell's Thrush in all four years at a third of all routes (31 routes; 33.3%), and on only 8 routes (8.6%) was BITH detected during only one year. The difference in detection consistency at points compared to routes may represent large Bicknell's Thrush male home ranges and the changing mosaic of local habitat used by Bicknell's Thrush. In addition, detectability for a given species is rarely 100%, so it is likely that Bicknell's Thrush was present at some points in multiple years but was missed by observers.

The Launch

2011 marked the international launch of Mountain Birdwatch 2.0 and the first full year of MBW2 surveys in the U.S. Observers surveyed a total of 1038 points in potential Bicknell's Thrush habitat across the northeastern U.S. and Canada; approximately 469 of these points were part of the original international sample, while the remaining points represented U.S. and statewide subsamples designed to more closely evaluate critical Bicknell's Thrush habitat within the U.S. In 2011, observers surveyed 612 points along 116 routes in the United States, and Bicknell's Thrush was detected at 196 points (32%) along 70 routes in the U.S. alone (Scar1 2012). In Québec, 338 points along 58 routes were surveyed in 2011, with BITH detected at only 3% of these points. In the Maritimes, 88 points were surveyed along 15 routes (10 in New Brunswick and 5 in Nova Scotia), and Bicknell's Thrush was detected at 7 (8%) of these points, all in New Brunswick (Figure 2). Overall, BITH was detected at 6% of international survey stations (see Table 5).

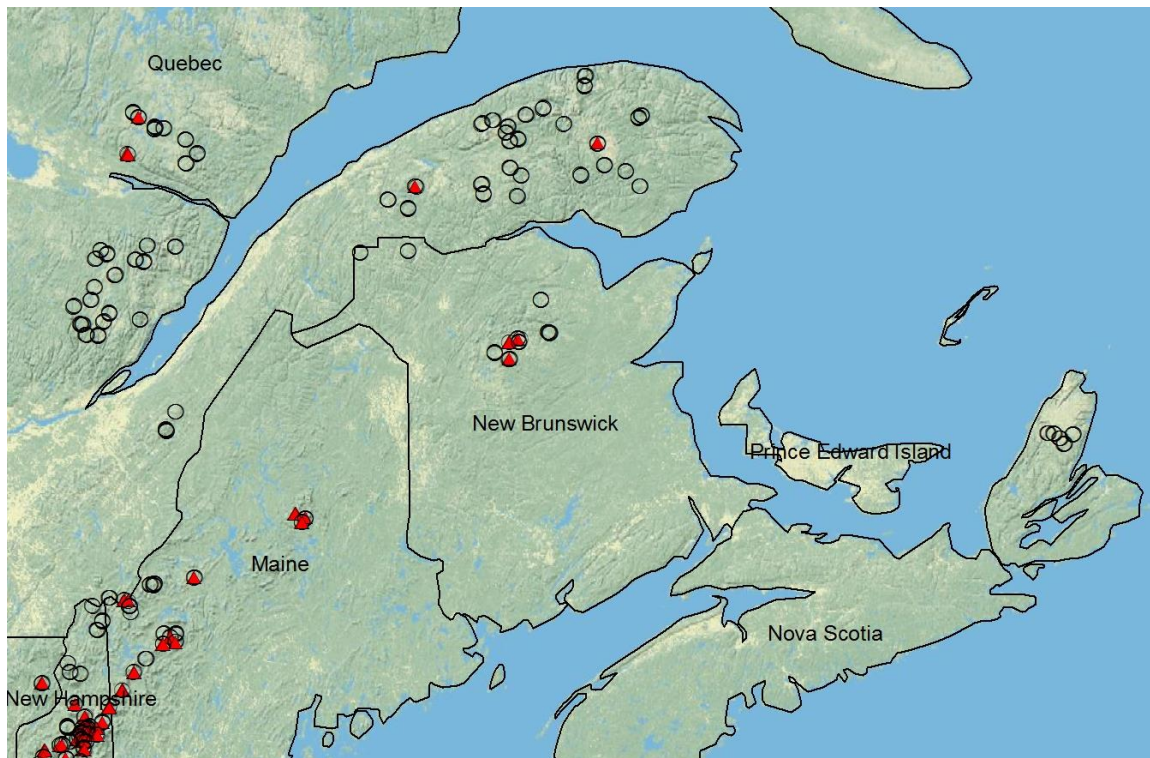


Figure 2: MBW2 points surveyed in Canada in 2011. Red triangles represent points with BITH detections; open circles represent points where no BITH was detected.

Table 5: International MBW2 sampling effort in 2011. Data from the U.S. represent points surveyed as part of the international sample only.

Region	Routes Surveyed	Points Surveyed	Points with BITH detections
Québec	58	338	11 (3%)
Maritimes	15	88	7 (8%)
U.S. (Int'l Sample)	8	43	10 (23.3%)
TOTAL	81	469	28 (6.0%)

Such low BITH detection rates in Canada necessitated a reevaluation of the international MBW2 program and its ability to achieve national and international monitoring goals. Based on analysis of MBW2 pilot data, this program requires a ~30% Bicknell's Thrush detection rate across the entire survey area in order to "estimate population trends with 80% power to detect a minimum 3% annual change in target species abundance/density over 30 years at a significance level of 0.1" (Hart and Lambert, 2008), a critical goal documented in the Mountain Birdwatch Standard Operating Procedures. While the U.S. subsample achieved this 30% detection target, international survey detections fell well below this goal. This raised concerns that MBW2 would be unable to detect and evaluate changes in target species populations over the desired timescale. In addition, such low detection rates will not allow efficient, cost-effective monitoring of the Canadian population of Bicknell's Thrush and will therefore not meet provincial monitoring requirements for BITH.

On one hand, randomized sampling across all potential breeding habitat is essential in order to draw conclusions that generalize across the entire Bicknell's Thrush population. On the other hand, an all-inclusive sampling frame combined with low densities of Bicknell's Thrush across much of Canada yields low detection rates that do not enable us to effectively gather and analyze information about current Bicknell's Thrush breeding areas. Thus, between 2012 and 2014, MBW2 partners at VCE, the Canadian Wildlife Service (CWS), BSC, and the Regroupement QuébecOiseaux (RQO) explored several methods to refine our monitoring scheme and conducted surveys to help better understand the current distribution of Bicknell's Thrush in each region.

For a description of 2012-2014 surveys for Bicknell's Thrush in Canada, as well as a detailed discussion of the challenges to successful implementation of a unified BITH monitoring program across the US and Canada, see Scarl 2015, which also poses a series of questions that must be answered in order to move forward with international monitoring plans for Bicknell's Thrush.

Conclusions

The past five years have marked an important transition for Mountain Birdwatch: we concluded a decade of data collection across the mountains of NY, VT, NH, and ME, tested an international initiative to monitor high-elevation birds throughout the spruce-fir forests of the northeastern U.S. and Canada, and in the U.S. once again engaged citizen scientists as the mainstay of this volunteer-based program. With a dual focus on high-elevation conservation and citizen science, Mountain Birdwatch engages and trains more than 100 volunteers to collect extensive data that are critical for conservation. The launch of Mountain Birdwatch 2.0 strengthens and broadens an already-successful conservation initiative by increasing its species focus and by enabling scientists to draw more accurate conclusions about trends in abundance, occupancy, and density across the U.S. range of Bicknell's Thrush. Engaging volunteers in this new program since 2011 ensures that MBW2 will continue to represent a strong citizen science presence in the northeastern U.S.

Looking forward, Mountain Birdwatch is poised for several major accomplishments over the next several years. By the end of 2015, we expect to complete a major analysis exploring the first decade of Mountain Birdwatch data. This analysis will link changes in high-elevation songbird abundance to climate events and inter-species competition; it will guide conservation strategies for Bicknell's Thrush and demonstrate to citizen scientists how individual efforts yield wide-scale results. In addition, data collected under the more rigorous Mountain Birdwatch 2.0 can be used to explore current trends in Bicknell's Thrush distribution, abundance, and occupancy. The first four years of MBW2 suggest some consistent patterns of regional distribution, and consistent monitoring over time will allow us to detect how conservation strategies and environmental disturbances influence

long-term high-elevation bird trends. Despite the challenges of monitoring this species internationally, Mountain Birdwatch remains the only consistent, region-wide source of information on birds that breed in the high-elevation spruce-fir forests of the Northeast, and data from this program play a critical role in conserving high-elevation songbirds in this region.

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