

# **2009 Report to the Vermont Monitoring Cooperative**

## **Part I. Demographic Monitoring of Montane Forest Birds on Mt. Mansfield**

## **Part II. Forest Bird Surveys on Mt. Mansfield and Lye Brook Wilderness Area**



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**VCE Technical Report 09-03**

## **Part I. Demographic Monitoring of Montane Forest Birds on Mt. Mansfield**

**Christopher C. Rimmer, Kent P. McFarland, and Patrick L. Johnson**

In 2009, we continued demographic monitoring of Bicknell's Thrush (*Catharus bicknelli*), Swainson's Thrush (*C. usutulatus*), Blackpoll Warbler (*Dendroica striata*), Yellow-rumped (Myrtle) Warbler (*D. coronata coronata*), and White-throated Sparrow (*Zonotrichia albicollis*), completing our 18<sup>th</sup> consecutive field season on Mt. Mansfield. We initiated a complementary study of migratory patterns and connectivity in Bicknell's Thrush, attaching solar geolocators to adult males on Mt. Mansfield and at 6 other locations throughout the species' breeding range. Geolocators are light-weight (1.3 g) devices that can be attached to birds with methods similar to long-standing VHF radio-transmitters used to radio-track songbirds over short distances and durations. These loggers can take consistent readings of daylight timing for up to two years. The recovered data can be interpreted to determine latitude and longitude of an individual bird for every day the logger was attached and exposed to suitable sunlight. Solar geolocators have returned highly accurate and detailed location information on large pelagic birds (e.g., Phillips et al. 2007, Takahashi et al. 2008), and their utility on small migrating songbirds has recently been demonstrated with Wood Thrush (*Hylocichla mustelina*) and Purple Martin (*Progne subis*) using new miniaturized designs (Stutchbury et al. 2009). One limitation of this technology is that tags must be retrieved before data can be acquired, and their current cost may prohibit broad-scale deployment and large sample sizes. Despite these constraints, the use of geocator tags for studies of migratory connectivity in small passerine birds like Bicknell's Thrush presents an unparalleled opportunity to discover how distant breeding and non-breeding areas connect in space and time.

### **Study Areas and Methods**

We used mist-netting and banding to sample breeding populations of the five target species on an established study plot on the Mt. Mansfield ridgeline between c. 1155-1190 m (3800-3900 ft) elevation. We also used mist nets to target capture Bicknell's Thrush on the Octagon and Forehead study plots for geocator attachment. We conducted 11 banding sessions between 4 June and 10 September 2009, using 4-30 nylon mist nets (12 x 2.5-m and 6 x 2.5-m, 36-mm mesh) placed at sites that have been used annually since 1992, primarily on the Amherst, Lakeview, and Long trails. Nets were generally opened from late afternoon until dusk and from dawn until early afternoon on the following morning. Bicknell's Thrushes were captured both passively and through the use of vocal lures (recorded conspecific vocalizations), while other species were passively captured. Each individual was fitted with a uniquely-numbered U.S. Fish and Wildlife Service (USFWS) leg band and in some cases a unique combination of 3 plastic colored leg bands. We recorded data on age, sex, breeding condition, fat class, ectoparasites, flight feather wear, and net site of capture. Standard morphometrics recorded include wing chord, tail length, weight, tarsal length, culmen length, bill length from mid-nares, bill width, and bill depth. Several non-destructive tissue samples were collected from mist-netted Bicknell's Thrushes for studies of isotope markers and mercury burdens. In most cases, we took a small blood sample (c. 50  $\mu$ l) from the brachial vein. Each sample was stored in a heparinized capillary

tube, refrigerated in a vacutainer in the field, and frozen within 12-48 hours. A tail feather (rectrix #5) on both sides was clipped and stored in envelopes. Approximately 2 mm of claw tip from the middle toe of both feet was collected using sharp dissection scissors, and deposited in a small paper envelope.

We attached geolocators to Bicknell's Thrushes, using a leg-loop backpack harness (Rappole and Tipton 1991) that has been deployed successfully on over 250 Bicknell's Thrushes with 1.2 g radio transmitters, as well as on many other songbirds. The harness material was made of 3/16 inch Teflon ribbon (Bally Ribbon Mills, Pennsylvania, USA) for durability and light weight (Stutchbury et al. 2009). During the 2010 summer, extensive efforts will be made to recapture these individuals. Once recaptured, geolocators will be removed and the data will be downloaded for analysis. The data will be analyzed using TransEdit and BirdTracker software.

## **Results and Discussion**

We operated mist nets on 10 days between 4 June and 10 September 2009, accumulating 910.5 net-hours, with an average of 82.8 (SD=86.0) net-hours per day. We captured and banded 114 individuals of the five target species (Table 1), a capture rate of 10.98 new birds/100 net-hours. We recaptured 31 previously banded individuals a total of 42 times; 21 of these were individuals banded in a previous year (Table 1). Five of the 8 Bicknell's Thrush returns were older than 5 years, including one 10 year old male that we banded on Mt. Mansfield as a hatching-year (HY) in the fall of 2000 (Table 2).

The ratio of male:female Bicknell's Thrush captures was 3.86:1, a greater skew than in previous years of our studies on Mt. Mansfield (e.g., 2008 ratio = 1.375 males to 1 female). Of the 39 Bicknell's Thrush captured, 14 were after second-year (ASY) males, 13 were second-year (SY) males, 5 were ASY females, 2 were SY females, 3 were ASY birds of unknown sex, and 2 were HY individuals of unknown sex. Current research on the species' breeding and wintering grounds is exploring possible causes of this unbalanced sex ratio.

Many studies have investigated the effects of transmitters on avian survivorship, but in general an upper limit of 5% body weight is the accepted maximum transmitter weight for avian telemetry studies (Canadian Council on Animal Care 2003); however, the rationale behind this figure has not been clearly articulated (Caccamise and Hedin 1985). Some studies of thrushes and warblers have had apparent success using weights as high as 5-10% of body weight (Graber and Wunderle 1966; Cochran et al. 1967). Caccamise and Hedin (1985) reported that small passerines can handle a greater transmitter:body weight ratio, because songbirds are better aerodynamically equipped to do so than larger birds. The mean weight of 826 ASY male Bicknell's Thrushes on the breeding grounds was 27.68 g (SD=1.65; VCE unpubl. data). We targeted ASY males because they are larger than females and SY birds, and thus more likely to complete migration with a geocator, and because they have higher annual return rates.

In 2009, we attached geolocators to 14 Bicknell's Thrushes on Mt. Mansfield. Of these, 13 were ASY males and 1 was an ASY female; 4 were recaptures from previous years (Table 3). The average weight of the 14 birds to which we attached geolocators was 28.52 g (SD=1.99) before being attached with a 1.3 g geocator. Geolocators average 4.58% (SD .29) of the body

weight. We also coordinated rangewide efforts during 2009 that resulted in the attachment of an additional 56 geolocators to adult male Bicknell's Thrushes (22 in New York's Catskill Mountains, 25 in Québec, 5 in New Brunswick, and 4 in Nova Scotia). Intensive efforts will be made by VCE staff and our collaborators to recover geolocators at all sites during 2010, and to attach geolocators to a new cohort of individuals, including females. Based on annual return rates for Vermont adult males of ~65%, we expect to recapture up to 45 individuals in 2010

In addition to our ongoing demographic research and new geocator study, VCE staff completed work on several peer-reviewed manuscripts in 2009, some of which were published during the calendar year, others of which are currently in press or in review. Several of those incorporated data collected through our longstanding collaboration with VMC (below). We expect several additional peer-reviewed publications in 2010.

We made solid progress on completing a key paper, "Modeling population growth of Bicknell's Thrush across a latitudinal gradient", and we presented preliminary results at the 107<sup>th</sup> Stated Meeting of the American Ornithologists' Union in Philadelphia, PA during August. This paper uses sophisticated mark-recapture analyses of banding data to model annual survivorship across both the breeding and winter range of Bicknell's Thrush. VCE staff are working closely with experts at the Smithsonian Migratory Bird Center to conduct these analyses, and we expect to have a final draft of this paper by 31 January 2010.

#### **Peer-reviewed Journal Papers Published in 2009 using VMC Collected Data**

Rimmer, C.C., E.K. Miller, K.P. McFarland, R.J. Taylor, and S.D. Faccio. 2009. Mercury bioaccumulation and trophic transfer in the terrestrial food web of a montane forest. *Ecotoxicology*. DOI 10.1007/s10646-009-0443-x.

Townsend, J.M., C.C. Rimmer, and K.P. McFarland. 2009. Elucidating the limiting factors of a rare, vulnerable species: Bicknell's Thrush. *Proceedings of the Fourth International Partners in Flight Conference: Tundra to Tropics* 91-95.

Strong, A.M., C.C. Rimmer, K.P. McFarland, and K. Hagan. 2009. Effects of mountain resorts on wildlife. Pp. 99-126 *in* *Mountain Resorts: Ecology and the Law* (Milne, J. E., J. Lemense, and R. A. Virginia, eds.). Ashgate Publishing, Surrey, U.K. and Burlington, VT.

#### **Professional Meeting Presentations in 2009 using VMC Collected Data**

Rimmer, C.C., J.A. Hart, R.P. Dettmers, B. Whittam, K.P. McFarland, and Y. Aubry. Bicknell's Thrush – conservation in the face of long odds. Contributed paper at VCE-coordinated symposium, "Ecology and conservation of a rare, declining species: Bicknell's Thrush". The 127<sup>th</sup> Stated Meeting of the American Ornithologists' Union, Philadelphia, PA. August 2009.

McFarland, K.P., C.C. Rimmer, Y. Aubry, T.S. Sillett, and S. Paradis. Modeling population growth of Bicknell's Thrush across a latitudinal gradient. Contributed paper at VCE-coordinated symposium, "Ecology and conservation of a rare, declining species: Bicknell's

Thrush". The 127th Stated Meeting of the American Ornithologists' Union, Philadelphia, PA. August 2009.

Frey, S.J., A.M. Strong, and K.P. McFarland. Population-level implications of climate change for a montane forest songbird, Bicknell's Thrush. Contributed paper at VCE-coordinated symposium, "Ecology and conservation of a rare, declining species: Bicknell's Thrush". The 127<sup>th</sup> Stated Meeting of the American Ornithologists' Union, Philadelphia, PA. August 2009.

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Stutchbury, B. J. M., S. A. Tarof, T. Done, E. Gow, P. M. Kramer, J. Tautin, J. W. Fox, and V. Afanasyev. 2009. Tracking Long-Distance Songbird Migration by Using Geolocators. *Science* 323:896.

**Table 1. Banding totals for 5 focal species on Mt. Mansfield, 2009.**

Species <sup>a</sup>	#New Bandings	# Returns from previous years' bandings
BITH	32	8
SWTH	9	0
BLPW	38	6
MYWA	20	2
WTSP	15	5

<sup>a</sup> BITH = Bicknell's Thrush, BLPW = Blackpoll Warbler, MYWA = Yellow-rumped (Myrtle) Warbler, SWTH = Swainson's Thrush, WTSP = White-throated Sparrow

**Table 2. Summary data for individuals recaptured on Mt. Mansfield in 2009.**

Species <sup>a</sup>	Band #	Date Banded	Age when Banded <sup>b</sup>	Sex	Age in 2009 (years)
BITH	193176308	6/10/2008	ASY	Male	≥ 3
BITH	122190059	9/6/2000	HY	Male	10
BITH	144128837	6/7/2006	ASY	Female	≥ 5
BITH	144128833	6/13/2006	ASY	Male	≥ 5
BITH	157105377	6/19/2006	SY	Male	5
BITH	157106801	6/20/2006	SY	Male	5
BITH	193176478	6/5/2007	SY	Male	4
BITH	193176481	6/6/2007	SY	Female	4
BLPW	211080356	6/9/2008	AHY	Male	≥ 4
BLPW	211080359	6/10/2008	AHY	Female	≥ 2
BLPW	222096465	6/20/2006	AHY	Male	≥ 4
BLPW	222096653	7/24/2007	SY	Male	4
BLPW	249089260	7/7/2007	AHY	Male	≥ 3
BLPW	249089262	7/7/2007	AHY	Female	≥ 3
MYWA	222095600	6/9/2008	ASY	Female	≥ 3
MYWA	249089255	6/6/2007	ASY	Male	≥ 4
WTSP	144128829	6/13/2006	AHY	Male	≥ 4
WTSP	157105380	6/20/2006		Male	≥ 4
WTSP	193176476	6/5/2007	AHY	Male	≥ 3
WTSP	193176489	6/5/2007	AHY	Male	≥ 3
WTSP	193176694	7/6/2007	AHY	Male	≥ 3

<sup>a</sup> BITH = Bicknell's Thrush, BLPW = Blackpoll Warbler, MYWA = Yellow-rumped (Myrtle) Warbler, WTSP = White-throated Sparrow

<sup>b</sup> HY = hatching-year (< 1 year old), SY = second-year (1 year old), AHY = after hatching-year (≥ 1 year old), ASY = after second-year (≥ 2 years old)

**Table 3. Weight, sex, and age of Bicknell's Thrush with geolocators attached on Mt. Mansfield in 2009, and geolocator's % of body weight.**

<b>band #</b>	<b>Weight (g)</b>	<b>Weight w/geolocator (g)</b>	<b>Geolocator % of weight</b>	<b>Sex</b>	<b>Age (yrs)</b>
122190059	29.7	31.0	4.4	Male	10
144128853	30.3	31.6	4.3	Male	≥ 2
144128859	28.3	29.6	4.6	Male	≥ 2
144128869	26.8	28.1	4.9	Male	≥ 2
157105377	26.7	28.0	4.9	Male	5
157106571	27.7	29.0	4.7	Female	≥ 2
157106593	33.6	34.9	3.9	Male	≥ 2
157106594	31.2	32.5	4.2	Male	≥ 2
157106595	27.8	29.1	4.7	Male	≥ 2
157106596	27.3	28.6	4.8	Male	≥ 2
157106597	28.0	29.3	4.6	Male	≥ 2
157106801	27.2	28.5	4.8	Male	5
193176308	26.9	28.2	4.8	Male	≥ 3
193176478	27.8	29.1	4.7	Male	4

## **Part II. Forest Bird Surveys on Mt. Mansfield and Lye Brook Wilderness Area**

**Steven D. Faccio and Christopher C. Rimmer**

In 2009, breeding bird surveys were continued at 3 permanent study sites on Mt. Mansfield, and on a single site at the Lye Brook Wilderness Area (LBWA) of the Green Mountain National Forest. The Mt. Mansfield ridgeline was surveyed for the 19<sup>th</sup> consecutive year, while the Ranch Brook site was censused for the 14<sup>th</sup> year in 2009 (the 2004 survey was not completed due to inclement weather on attempted survey dates). Our permanent study site at Underhill State Park was surveyed for the 17<sup>th</sup> year in 2009 (the site was not surveyed in 2003 or 2005). The LBWA was surveyed for the 10<sup>th</sup> consecutive year in 2009.

The Underhill State Park site consists of mature northern hardwoods ranging from 609 to 731 m (2000 to 2400 ft) elevation, while the Mansfield ridgeline site, at 1158 m (3800 ft), consists of montane fir-spruce. The Ranch Brook site ranges between 975 and 1097 m (3200 and 3600 ft), and is dominated by a paper birch-fir canopy. The Lye Brook study site, located in Winhall, just north of Little Mud Pond, is characterized by mature northern hardwoods at an elevation of 701 m (2300 ft).

These four study sites are part of VCE's long-term Forest Bird Monitoring Program (FBMP). This program was initiated in 1989 with the primary goals of conducting habitat-specific monitoring of forest interior breeding bird populations in Vermont and tracking long-term changes (Faccio et al. 1998). As of 2008, VCE had established 39 monitoring sites in 9 different forested habitats in Vermont, with additional montane sites in New York, New Hampshire, Maine, and Massachusetts. A complementary, volunteer-based, long-term monitoring program, called Mountain Birdwatch, was initiated in 2000 to collect census data on five common montane forest bird species throughout the Northeast. Also, through a cooperative agreement with the National Park Service, VCE is coordinating breeding bird monitoring at 9 National Parks and Historic Sites in the Northeast. Initiated in 2006, annual surveys are conducted at 19 study sites in New Jersey, Connecticut, New York, Massachusetts, Vermont, New Hampshire, and Maine.

### **Methods**

In 2009, surveys were conducted by VCE staff biologists at the Mt. Mansfield Ridgeline, Ranch Brook, and Underhill sites, and by a volunteer observer at the Lye Brook site. Each study site consisted of 5 point count stations. Survey methods consisted of unlimited distance point counts, based on the approach described by Blondel et al. (1981) and used in Ontario (Welsh 1995). The count procedure was as follows:

- 1) Counts began shortly after dawn on days where weather conditions were unlikely to reduce count numbers (i.e., calm winds and very light or no rain). Censusing began shortly (< 1 min) after arriving at a station.



- 2) Observers recorded all birds seen and heard during a 10-min sampling period, which was divided into 3 time intervals: 3, 2, and 5 mins. Observers noted in which time interval each bird was first encountered, and placed birds into one of 2 distance categories (within or beyond 50 m). To reduce duplicate records, individual birds were mapped on standardized field cards, and known or presumed movements were noted. Different symbols were used to record the status of birds encountered (i.e., singing male, pair observed, calling bird, etc.).
- 3) The number of surveys at each site was dependent on elevation; montane fir-spruce sites were sampled once, while LBWA and Underhill were sampled twice during the breeding season, the first during early June (ca. 2-12 June) and the second during late June (ca. 14-30 June). Observers were encouraged to space their visits 7-10 days apart. For each site visit, all stations were censused in a single morning and in the same sequence.

In summarizing data for analysis, the maximum count for each species was used as the station estimate for each year. All birds seen or heard were each counted as 1 individual unless a family group or active nest was encountered, in which case they were scored as a breeding pair, or 2 individuals. Population trends were calculated for the 8 most commonly encountered species at each site using simple linear regression. For each species, the annual population trend was calculated by plotting the maximum count against year, and then calculating the mean annual rate of change of a linear trendline inserted through the points (e.g. Percent Annual Trend = slope ÷ y intercept x 100). Regression and correlation analyses were done using SYSTAT 10.2.

## **Results**

A combined total of 55 avian species were detected during breeding bird surveys at three study sites on Mt. Mansfield from 1991-2009. Species richness was similar at both montane forest sites, with a total of 30 species detected at the Mansfield ridgeline and 31 at Ranch Brook. Surveys at Ranch Brook continue to average a greater number of individuals and species per year than the higher elevation and more exposed Mansfield ridgeline site (Tables 1 and 2). Surveys at the mid-elevation, northern hardwood study sites at Underhill State Park and Lye Brook Wilderness showed similar species composition, with Underhill averaging 17.88 species per year compared to Lye Brook's 16.30 (Tables 3 and 4).

### ***Mount Mansfield***

On the Mt. Mansfield ridgeline plot in 2009, both species richness and numerical abundance were below the 19-year average, with 61 individuals of 11 species detected (Table 1). Of the 8 most commonly recorded species, 4 were below the 19-year average, and 4 were above. Five species exhibited decreasing population trends, with one species, Blackpoll Warbler, showing a significant decline of 2.79% per year ( $r^2 = 0.283$ ;  $P = 0.019$ ). Three species showed non-significant increasing trends. The number of Bicknell's Thrush rebounded from last year's count of 7 individuals (the lowest since 2004) to 10.

At the Ranch Brook study site in 2009, species richness and numerical abundance were below the 14-year average, with just 37 individuals (the lowest ever) of 14 species counted (Table 2). Among the 8 most abundant species, all were below the 14-year mean in 2009. Overall, 2 of these 8 species showed increasing trends, while 6 declined. Two species declined

significantly; White-throated Sparrow, which continued a downward trend at a rate of 4.94% per year ( $r^2 = 0.535$ ;  $P = 0.003$ ), and Yellow-bellied Flycatcher, which declined at a rate of 2.15% per year ( $r^2 = 0.225$ ;  $P = 0.087$ ). Bicknell's Thrush numbers dropped to just 2 individuals, along with counts of Swainson's Thrush and Dark-eyed Junco, both of which tied all time low counts of 3 and 1 individuals, respectively.

At Underhill State Park in 2009, both species richness and total number of individuals was well below the 17-year average, with just 39 individuals (the lowest count since 1991) of 12 species detected (the lowest count ever) (Table 3). Among the 8 most common species at the site, 2 were above the 17-year mean, and 6 were below. Overall, 6 species showed increasing population trends, including significant increases for Black-throated Blue Warbler (4.27%;  $r^2 = 0.180$ ,  $P = 0.089$ ) and Black-throated Green Warbler (5.80%;  $r^2 = 0.441$ ,  $P = 0.004$ ). After a single Canada Warbler was detected in 2008, the first in 5 years, none were encountered in 2009, continuing its declining trend at 5.38% per year ( $r^2 = 0.688$ ,  $P < 0.001$ ). The count of just 2 Red-eyed Vireos represented the lowest count of the site's 19 year history.

### ***Lye Brook Wilderness***

At Lye Brook Wilderness, species richness was below and numerical abundance above the 10-year average, with 66 individuals of 13 species detected (Table 4). Among the 8 most common species, five were above the 10-year average, while three were below. Of these 8 species, five exhibited increasing population trends, while three showed declines. Among significant trends, Ovenbird declined at a rate of 3.58% ( $r^2 = 0.375$ ;  $P = 0.060$ ), and Hermit Thrush increased at 9.09% per year ( $r^2 = 0.370$ ;  $P = 0.062$ ). The maximum counts for three species (Yellow-bellied Sapsucker, Red-eyed Vireo, and Hermit Thrush) were the highest in site's 10-year history.

## **Discussion**

White-throated Sparrow declined significantly at the Ranch Brook site for the fourth consecutive year, with the count of 5 birds detected in 2009 representing the second lowest total for the species. However, the unusually high maximum count of 22 White-throats recorded in 1995 is largely responsible for driving the trend's statistical significance. The mean count at Ranch Brook was 8.86 over the 14-year study period, and 7.85 without the 1995 outlier. So, while the biological significance of the White-throated Sparrow decline observed at Ranch Brook appears to be low, it bears continued scrutiny.

At the Mt. Mansfield Ridgeline site, Blackpoll Warbler declined significantly for the third consecutive year, although the species appears to be rebounding from its record low count of 2 individuals in 2007. Interestingly, 2007 was also a low year for Blackpolls at the Ranch Brook site, suggesting that the low counts represent an accurate index to the population, at least on Mt. Mansfield, rather than a result of observer error or omission.

At Underhill State Park, the low totals for species richness (12) and total number of individuals (39) may be attributed to the fact that only one survey was conducted in 2009 instead of the usual two.

The site-specific trend estimates presented for the Mt. Mansfield and Lye Brook sites must be interpreted carefully as these are preliminary trends from a limited geographic sample with low power. Year to year changes in survey counts may simply reflect natural fluctuations, variable detection rates, and/or a variety of dynamic factors, such as prey abundance, overwinter survival, and habitat change. Several years of additional data collection, their correlation with other VMC data, and comparison with census data from other ecologically similar sites will be necessary to elucidate meaningful population trends of various species at these sites.

### **Acknowledgements**

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Table 1. Maximum counts of individual birds, and population trends from linear regression analysis for the 8 most common species (bold type) at Mt. Mansfield Ridgeline, 1991-2009.

Common Name	'91	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	'06	'07	'08	'09	Mean	SD	r <sup>2</sup>	Annual Trend (%)
Red Squirrel											1									0.05	0.23		
Sharp-shinned Hawk										1										0.05	0.23		
Hairy Woodpecker				1																0.05	0.23		
Northern Flicker			1																	0.05	0.23		
Yellow-bellied Flycatcher			1		1	2	3		1	1	1	1	2	1		1	2	1	3	1.11	0.94		
Alder Flycatcher							1													0.05	0.23		
Red-eyed Vireo									1											0.05	0.23		
Blue Jay		1											1		1					0.16	0.37		
Common Raven			1			1			1	1		1	1	1		2		1		0.53	0.61		
Red-breasted Nuthatch	1	2	3	1	3	1		1	2		1				1		1			0.89	0.99		
<b>Winter Wren</b>	<b>10</b>	<b>9</b>	<b>7</b>	<b>4</b>	<b>5</b>	<b>2</b>	<b>4</b>	<b>10</b>	<b>8</b>	<b>4</b>	<b>4</b>	<b>7</b>	<b>3</b>	<b>7</b>	<b>8</b>	<b>12</b>	<b>7</b>	<b>5</b>	<b>6</b>	<b>6.42</b>	<b>2.67</b>	<b>0.000</b>	<b>0.06</b>
Golden-crowned Kinglet										1										0.05	0.23		
Ruby-crowned Kinglet		2			1							1	1							0.26	0.56		
<b>Bicknell's Thrush</b>	<b>6</b>	<b>15</b>	<b>11</b>	<b>8</b>	<b>10</b>	<b>11</b>	<b>9</b>	<b>9</b>	<b>8</b>	<b>7</b>	<b>9</b>	<b>9</b>	<b>6</b>	<b>5</b>	<b>8</b>	<b>11</b>	<b>12</b>	<b>7</b>	<b>10</b>	<b>9.00</b>	<b>2.40</b>	<b>0.034</b>	<b>-0.81</b>
<b>Swainson's Thrush</b>	<b>3</b>	<b>8</b>	<b>1</b>	<b>1</b>	<b>3</b>	<b>6</b>	<b>7</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>5</b>	<b>1</b>	<b>5</b>	<b>3</b>	<b>3.42</b>	<b>2.09</b>	<b>0.049</b>	<b>-1.94</b>
Hermit Thrush											1		1							0.11	0.32		
American Robin	1	4	1	2	2	2	2	1	1	3	3	2	6	3	1	3	4	3	2	2.42	1.30		
Cedar Waxwing		1	4				9							1						0.79	2.20		
Nashville Warbler	2					2	3	1	1		1		1			1				0.63	0.90		
Magnolia Warbler	1	2				3	1	1			1		3	1	4		1			0.95	1.22		
<b>Yellow-rumped Warbler</b>	<b>9</b>	<b>11</b>	<b>8</b>	<b>9</b>	<b>8</b>	<b>12</b>	<b>10</b>	<b>13</b>	<b>11</b>	<b>9</b>	<b>11</b>	<b>14</b>	<b>10</b>	<b>13</b>	<b>9</b>	<b>9</b>	<b>7</b>	<b>12</b>	<b>12</b>	<b>10.37</b>	<b>1.95</b>	<b>0.039</b>	<b>0.71</b>
<b>Blackpoll Warbler</b>	<b>8</b>	<b>9</b>	<b>9</b>	<b>7</b>	<b>7</b>	<b>15</b>	<b>10</b>	<b>10</b>	<b>9</b>	<b>8</b>	<b>8</b>	<b>3</b>	<b>3</b>	<b>9</b>	<b>8</b>	<b>8</b>	<b>2</b>	<b>4</b>	<b>5</b>	<b>7.47</b>	<b>3.06</b>	<b>0.283</b>	<b>-2.79*</b>
Ovenbird			1						1											0.11	0.32		
Canada Warbler							1													0.05	0.23		
Lincoln's Sparrow	2					1														0.16	0.50		
<b>White-throated Sparrow</b>	<b>6</b>	<b>14</b>	<b>14</b>	<b>12</b>	<b>14</b>	<b>13</b>	<b>20</b>	<b>14</b>	<b>19</b>	<b>14</b>	<b>18</b>	<b>11</b>	<b>13</b>	<b>11</b>	<b>10</b>	<b>14</b>	<b>14</b>	<b>12</b>	<b>10</b>	<b>13.32</b>	<b>3.27</b>	<b>0.005</b>	<b>-0.31</b>
<b>Dark-eyed Junco</b>	<b>3</b>	<b>9</b>	<b>6</b>	<b>2</b>	<b>5</b>	<b>5</b>	<b>9</b>	<b>8</b>	<b>7</b>	<b>2</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>7</b>	<b>4</b>	<b>5</b>	<b>4</b>	<b>6</b>	<b>6</b>	<b>5.58</b>	<b>2.04</b>	<b>0.001</b>	<b>-0.19</b>
<b>Purple Finch</b>	<b>2</b>	<b>4</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>4</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>4</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>4</b>	<b>3</b>	<b>2.53</b>	<b>1.07</b>	<b>0.024</b>	<b>1.34</b>
White-winged Crossbill					8		1	1												0.53	1.84		
Pine Siskin		1			1		2	1			11						5		1	1.16	2.67		
Evening Grosbeak		2																		0.11	0.46		
<b>Species Richness</b> <sup>a</sup>	13	16	15	11	14	15	17	14	15	13	15	12	15	14	11	13	13	11	11	13.58	1.80		
<b>Number of Individuals</b> <sup>a</sup>	54	94	69	49	71	78	94	76	78	56	80	61	61	63	56	62	62	60	61	66.84	12.18		

<sup>a</sup> Does not include counts of Red Squirrel

\* P = 0.019

Table 2. Maximum counts of individual birds, and population trends from linear regression analysis for the 8 most common species (bold type) at Ranch Brook, 1995-2009. Note that a survey was not conducted in 2004.

Common Name	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	'06	'07	'08	'09	Mean	SD	r <sup>2</sup>	Annual Trend (%)
Eastern Chipmunk													1			0.07	0.27		
Red Squirrel					4		1		7				4			1.14	2.21		
Sharp-shinned Hawk				1							1					0.14	0.36		
Mourning Dove						1	1									0.14	0.36		
Ruby-throated Hummingbird						1										0.07	0.27		
Hairy Woodpecker	1															0.07	0.27		
Pileated Woodpecker							2									0.14	0.53		
<b>Yellow-bellied Flycatcher</b>	<b>4</b>	<b>4</b>	<b>4</b>	<b>3</b>	<b>3</b>	<b>4</b>	<b>2</b>	<b>4</b>	<b>4</b>		<b>3</b>	<b>2</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>3.29</b>	<b>0.83</b>	<b>0.225</b>	<b>-2.15*</b>
Blue-headed Vireo												1				0.07	0.27		
Red-eyed Vireo				1												0.07	0.27		
Blue Jay	1										1	1		4		0.50	1.09		
Common Raven		4	3	4		4	2						1	1		1.36	1.69		
Black-capped Chickadee	1												1			0.14	0.36		
Red-breasted Nuthatch	7		2		6		2		2		4		5	1		2.07	2.46		
<b>Winter Wren</b>	<b>8</b>	<b>3</b>	<b>7</b>	<b>10</b>	<b>9</b>	<b>10</b>	<b>5</b>	<b>5</b>	<b>9</b>		<b>10</b>	<b>11</b>	<b>6</b>	<b>8</b>	<b>5</b>	<b>7.57</b>	<b>2.44</b>	<b>0.005</b>	<b>0.51</b>
Golden-crowned Kinglet				1	3	1		3			2	1		2		0.93	1.14		
Ruby-crowned Kinglet	3		3			3			1		1	1			1	0.93	1.21		
<b>Bicknell's Thrush</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>5</b>	<b>5</b>	<b>6</b>	<b>2</b>	<b>8</b>	<b>1</b>		<b>8</b>	<b>2</b>	<b>5</b>	<b>5</b>	<b>2</b>	<b>4.79</b>	<b>2.26</b>	<b>0.103</b>	<b>-2.62</b>
<b>Swainson's Thrush</b>	<b>6</b>	<b>15</b>	<b>9</b>	<b>5</b>	<b>3</b>	<b>4</b>	<b>8</b>	<b>11</b>	<b>10</b>		<b>8</b>	<b>5</b>	<b>9</b>	<b>7</b>	<b>3</b>	<b>7.36</b>	<b>3.37</b>	<b>0.051</b>	<b>-1.90</b>
Hermit Thrush	1		3													0.29	0.83		
American Robin		2	2	2	1	1	1	1	3		4	5	2	2	3	2.07	1.33		
Cedar Waxwing				1			1				1					0.21	0.43		
Nashville Warbler		1	3	2	1	3		3	4		3	2	3	2	1	2.00	1.24		
Northern Parula									1							0.07	0.27		
Magnolia Warbler	2	4	4	2	3	5	4	2	4		2	3	1	2	2	2.86	1.17		
Black-throated Blue Warbler	1															0.07	0.27		
<b>Yellow-rumped Warbler</b>	<b>5</b>	<b>6</b>	<b>4</b>	<b>5</b>	<b>7</b>	<b>11</b>	<b>9</b>	<b>11</b>	<b>8</b>		<b>4</b>	<b>8</b>	<b>8</b>	<b>6</b>	<b>4</b>	<b>6.86</b>	<b>2.41</b>	<b>0.002</b>	<b>0.37</b>
<b>Blackpoll Warbler</b>	<b>9</b>	<b>9</b>	<b>15</b>	<b>8</b>	<b>3</b>	<b>8</b>	<b>7</b>	<b>8</b>	<b>8</b>		<b>8</b>	<b>10</b>	<b>4</b>	<b>6</b>	<b>6</b>	<b>7.79</b>	<b>2.83</b>	<b>0.172</b>	<b>-2.61</b>
<b>White-throated Sparrow</b>	<b>22</b>	<b>11</b>	<b>12</b>	<b>9</b>	<b>8</b>	<b>7</b>	<b>7</b>	<b>10</b>	<b>10</b>		<b>7</b>	<b>4</b>	<b>8</b>	<b>4</b>	<b>5</b>	<b>8.86</b>	<b>4.50</b>	<b>0.535</b>	<b>-4.94**</b>
<b>Dark-eyed Junco</b>	<b>9</b>	<b>5</b>	<b>3</b>	<b>2</b>	<b>5</b>	<b>2</b>	<b>5</b>	<b>4</b>	<b>4</b>		<b>7</b>	<b>5</b>	<b>1</b>	<b>4</b>	<b>1</b>	<b>4.14</b>	<b>2.28</b>	<b>0.143</b>	<b>-3.34</b>
Purple Finch	2	1	4	4	2	4	4		6					2	1	2.36	1.86		
White-winged Crossbill	8		2		1		6									1.21	2.55		
Pine Siskin	12		1		7								1		1	1.57	3.52		
<b>Species Richness</b> <sup>a</sup>	19	13	18	17	16	17	18	12	15		17	15	16	16	14	15.93	1.98		
<b>Number of Individuals</b> <sup>a</sup>	107	71	88	65	67	75	69	82	82		74	61	62	59	37	71.36	16.14		

<sup>a</sup> Does not include counts of Eastern Chipmunk or Red Squirrel

\*  $P = 0.087$ ; \*\*  $P = 0.003$

Table 3. Maximum counts of individual birds, and population trends from linear regression analysis for the 8 most common species (bold type) at Underhill State Park, 1991-2009. Note that surveys were not conducted in 2003 or 2005.

Common Name	'91	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	'06	'07	'08	'09	Mean	SD	r <sup>2</sup>	Annual Trend (%)
Eastern Chipmunk							3	5					/	1	/		1			0.59	1.37		
Red Squirrel							1	3		1			/		/	1	1			0.41	0.80		
Broad-winged Hawk							1						/		/					0.06	0.24		
Mourning Dove								1					/	1	/					0.12	0.33		
Yellow-bellied Sapsucker		2		1	1		1	1	1		3		/	2	/	2	3	2		1.12	1.05		
Downy Woodpecker							1						/		/		1	1		0.18	0.39		
Hairy Woodpecker				1			1	1	2				/		/				2	0.41	0.71		
Northern Flicker			1										/		/					0.06	0.24		
Pileated Woodpecker	2	1	1			1							/		/					0.29	0.59		
Least Flycatcher													/		/		2			0.12	0.49		
Eastern Phoebe												1								0.06	0.24		
Blue-headed Vireo	1	2				1	1			1			/	1	/	2	1	1	3	0.82	0.88		
<b>Red-eyed Vireo</b>	<b>3</b>	<b>4</b>	<b>4</b>	<b>6</b>	<b>9</b>	<b>8</b>	<b>7</b>	<b>6</b>	<b>10</b>	<b>8</b>	<b>8</b>	<b>7</b>	/	<b>5</b>	/	<b>7</b>	<b>8</b>	<b>6</b>	<b>2</b>	<b>6.35</b>	<b>2.18</b>	<b>0.005</b>	<b>0.43</b>
Blue Jay	2	1		1		2	2		1	1	2	1	/	1	/		1	1		0.94	0.75		
American Crow													/		/	1		1		0.12	0.33		
Common Raven				4	1				1		1		/	1	/					0.47	1.01		
Black-capped Chickadee		1	1		2	3	3		3	1	1		/		/	2	1	3		1.24	1.20		
Red-breasted Nuthatch							1						/		/					0.06	0.24		
White-breasted Nuthatch							1						/	1	/					0.12	0.33		
Brown Creeper				1					1	1		1	/	1	/	1	1			0.41	0.51		
<b>Winter Wren</b>		<b>6</b>	<b>2</b>	<b>1</b>	<b>5</b>	<b>3</b>	<b>4</b>	<b>6</b>	<b>4</b>	<b>4</b>	<b>3</b>	<b>3</b>	/	<b>3</b>	/	<b>4</b>	<b>2</b>	<b>1</b>		<b>3.00</b>	<b>1.84</b>	<b>0.061</b>	<b>-2.10</b>
Golden-crowned Kinglet								1					/		/	1				0.12	0.33		
Veery	1	1								1			/		/					0.18	0.39		
Swainson's Thrush		1		2	4	3		1	4	2	2		/		/	1			2	1.29	1.40		
<b>Hermit Thrush</b>		<b>4</b>	<b>1</b>	<b>6</b>	<b>7</b>	<b>3</b>	<b>4</b>	<b>4</b>	<b>2</b>		<b>4</b>	<b>5</b>	/	<b>4</b>	/	<b>4</b>	<b>7</b>	<b>1</b>	<b>4</b>	<b>3.53</b>	<b>2.15</b>	<b>0.025</b>	<b>1.98</b>
Wood Thrush	1	1											/		/					0.12	0.33		
American Robin	1				3	3	3	4	2	1	2	1	/	2	/		1			1.35	1.32		
Magnolia Warbler	1				1								/		/	1				0.18	0.39		
<b>Black-th. Blue Warbler</b>	<b>4</b>	<b>9</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>6</b>	<b>5</b>	<b>6</b>	<b>5</b>	<b>5</b>	<b>5</b>	/	<b>11</b>	/	<b>15</b>	<b>8</b>	<b>11</b>	<b>5</b>	<b>7.12</b>	<b>2.93</b>	<b>0.180</b>	<b>4.27*</b>
Yellow-rumped Warbler				2	2		2	3	3	1	1	3	2	/	/	1		1	1	1.29	1.10		
<b>Black-th. Green Warbler</b>	<b>5</b>	<b>7</b>	<b>6</b>	<b>7</b>	<b>7</b>	<b>7</b>	<b>9</b>	<b>5</b>	<b>8</b>	<b>10</b>	<b>10</b>	<b>8</b>	/	<b>13</b>	/	<b>15</b>	<b>12</b>	<b>10</b>	<b>7</b>	<b>8.59</b>	<b>2.79</b>	<b>0.441</b>	<b>5.80**</b>
Blackburnian Warbler											1	1	/	/	1					0.18	0.39		
Blackpoll Warbler						1	2						/	/						0.18	0.53		

Common Name	'91	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	'06	'07	'08	'09	Mean	SD	r <sup>2</sup>	Annual Trend (%)
Black-and-White Warbler		3	2	2	4	2	3	2	1	3	4	2	/	1	/	2	3		1	2.06	1.20		
American Redstart		4			1	1							/		/					0.35	1.00		
<b>Ovenbird</b>	<b>4</b>	<b>10</b>	<b>11</b>	<b>11</b>	<b>13</b>	<b>12</b>	<b>12</b>	<b>10</b>	<b>13</b>	<b>10</b>	<b>13</b>	<b>6</b>	/	<b>11</b>	/	<b>11</b>	<b>15</b>	<b>14</b>	<b>7</b>	<b>10.76</b>	<b>2.86</b>	<b>0.052</b>	<b>1.17</b>
Mourning Warbler													/		/		1	1		0.12	0.33		
<b>Canada Warbler</b>	<b>3</b>	<b>4</b>	<b>4</b>	<b>6</b>	<b>2</b>	<b>4</b>	<b>4</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>2</b>	<b>2</b>	/		/			<b>1</b>		<b>2.29</b>	<b>1.76</b>	<b>0.688</b>	<b>-5.38***</b>
Scarlet Tanager					1				1				/		/	1				0.18	0.39		
White-throated Sparrow	2		2	1	1		1					1	/		/	1		1		0.59	0.71		
<b>Dark-eyed Junco</b>		<b>3</b>	<b>1</b>	<b>3</b>	<b>4</b>	<b>3</b>	<b>5</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>2</b>	/	<b>1</b>	/	<b>5</b>	<b>5</b>	<b>2</b>	<b>4</b>	<b>2.65</b>	<b>1.54</b>	<b>0.106</b>	<b>4.78</b>
Rose-breasted Grosbeak	4	2		1	3	1	2		1				/		/	1				0.88	1.22		
Purple Finch						1		1			1		/		/	1	1		1	0.35	0.49		
White-winged Crossbill											2		/		/					0.12	0.49		
Pine Siskin					1						1		/		/					0.12	0.33		
American Goldfinch	1												/	1	/					0.12	0.33		
<b>Species Richness</b> <sup>a</sup>	15	19	14	18	20	20	23	16	21	16	20	16	/	17	/	22	18	17	12	17.88	2.93		
<b>Number of Individuals</b> <sup>a</sup>	35	66	43	62	77	69	77	54	67	53	70	48	/	60	/	81	73	58	39	60.71	13.78		

<sup>a</sup> Does not include counts of Red Squirrel or Eastern Chipmunk

\*  $P = 0.089$

\*\*  $P = 0.004$

\*\*\*  $P < 0.001$

Table 4. Maximum counts of individual birds, and population trends from linear regression analysis for the 8 most common species (bold type) at Lye Brook Wilderness Area, 2000-2009.

Common Name	'00	'01	'02	'03	'04	'05	'06	'07	'08	'09	Mean	SD	r <sup>2</sup>	Annual Trend (%)
Eastern Chipmunk	2			1							0.30	0.67		
Red Squirrel	1	1									0.20	0.42		
Ruffed Grouse	1					2					0.30	0.67		
Mourning Dove		1									0.10	0.32		
Yellow-Billed Cuckoo									1		0.10	0.32		
Barred Owl	1										0.10	0.32		
Chimney Swift	2										0.20	0.63		
Ruby-throated Hummingbird									1	1	0.20	0.42		
<b>Yellow-bellied Sapsucker</b>	<b>5</b>	<b>6</b>			<b>2</b>		<b>2</b>	<b>2</b>	<b>5</b>	<b>8</b>	<b>3.00</b>	<b>2.83</b>	<b>0.049</b>	<b>11.04</b>
Downy Woodpecker	1		1								0.20	0.42		
Hairy Woodpecker	2	1	2					1	1	1	0.80	0.79		
Unidentified Woodpecker	3										0.30	0.95		
Northern Flicker									1		0.10	0.32		
Pileated Woodpecker	1		3	1	4	1	1		2	1	1.40	1.26		
Eastern Wood-Pewee				1							0.10	0.32		
Yellow-bellied Flycatcher							1				0.10	0.32		
Least Flycatcher	2										0.20	0.63		
Great Crested Flycatcher				1							0.10	0.32		
Blue-headed Vireo		1	4	1		1				1	0.80	1.23		
<b>Red-eyed Vireo</b>	<b>10</b>	<b>6</b>	<b>9</b>	<b>4</b>	<b>6</b>	<b>6</b>	<b>4</b>	<b>5</b>	<b>13</b>	<b>14</b>	<b>7.70</b>	<b>3.62</b>	<b>0.108</b>	<b>7.12</b>
Blue Jay		3		1		1			2	1	0.80	1.03		
Common Raven					1	1					0.20	0.42		
Black-capped Chickadee	1	1		2			1	2	1		0.80	0.79		
White-breasted Nuthatch						1	1				0.20	0.42		
Brown Creeper	1										0.10	0.32		
<b>Winter Wren</b>	<b>7</b>		<b>1</b>		<b>3</b>	<b>1</b>			<b>2</b>		<b>1.40</b>	<b>2.22</b>	<b>0.214</b>	<b>-10.39</b>
Ruby-crowned Kinglet						1					0.10	0.32		
Veery					1						0.10	0.32		
<b>Swainson's Thrush</b>	<b>2</b>		<b>1</b>	<b>3</b>	<b>2</b>		<b>2</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>1.40</b>	<b>0.97</b>	<b>0.001</b>	<b>0.91</b>
<b>Hermit Thrush</b>	<b>4</b>	<b>2</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>4</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>4.70</b>	<b>1.42</b>	<b>0.370</b>	<b>9.09*</b>
American Robin	1		1		3			1	1		0.70	0.95		
Cedar Waxwing	1								1		0.20	0.42		
Northern Parula				3	1						0.40	0.97		
Magnolia Warbler	1		3								0.40	0.97		
<b>Black-throated Blue Warbler</b>	<b>9</b>	<b>7</b>	<b>10</b>	<b>9</b>	<b>8</b>	<b>12</b>	<b>11</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>9.00</b>	<b>1.56</b>	<b>0.001</b>	<b>-0.13</b>
Yellow-rumped Warbler	2	1				0				1	0.40	0.70	1	
<b>Black-throated Green Warbler</b>	<b>8</b>	<b>10</b>	<b>4</b>	<b>6</b>	<b>8</b>	<b>9</b>	<b>12</b>	<b>3</b>	<b>11</b>	<b>9</b>	<b>8.00</b>	<b>2.91</b>	<b>0.036</b>	<b>2.60</b>
Blackburnian Warbler	5										0.50	1.58		
American Redstart	2	1	3	1		4					1.10	1.45		
<b>Ovenbird</b>	<b>15</b>	<b>13</b>	<b>19</b>	<b>11</b>	<b>14</b>	<b>13</b>	<b>12</b>	<b>12</b>	<b>8</b>	<b>12</b>	<b>12.90</b>	<b>2.85</b>	<b>0.375</b>	<b>-3.58*</b>
Canada Warbler	1										0.10	0.32		
Scarlet Tanager	1		3	2	2	2			1		1.10	1.10		
White-throated Sparrow	2		2	4		2					1.00	1.41		
Dark-eyed Junco	2	3	1	1	1	4		1			1.30	1.34	0.198	-8.57
Rose-breasted Grosbeak	2	1									0.30	0.67		
<b>Species Richness</b> <sup>a</sup>	28	15	17	17	16	17	11	11	18	13	16.30	4.83		
<b>Number of Individuals</b> <sup>a</sup>	98	58	73	57	60	65	51	41	66	66	63.50	15.06		

<sup>a</sup> Does not include counts of Red Squirrel or Eastern Chipmunk

\*  $P \leq 0.062$