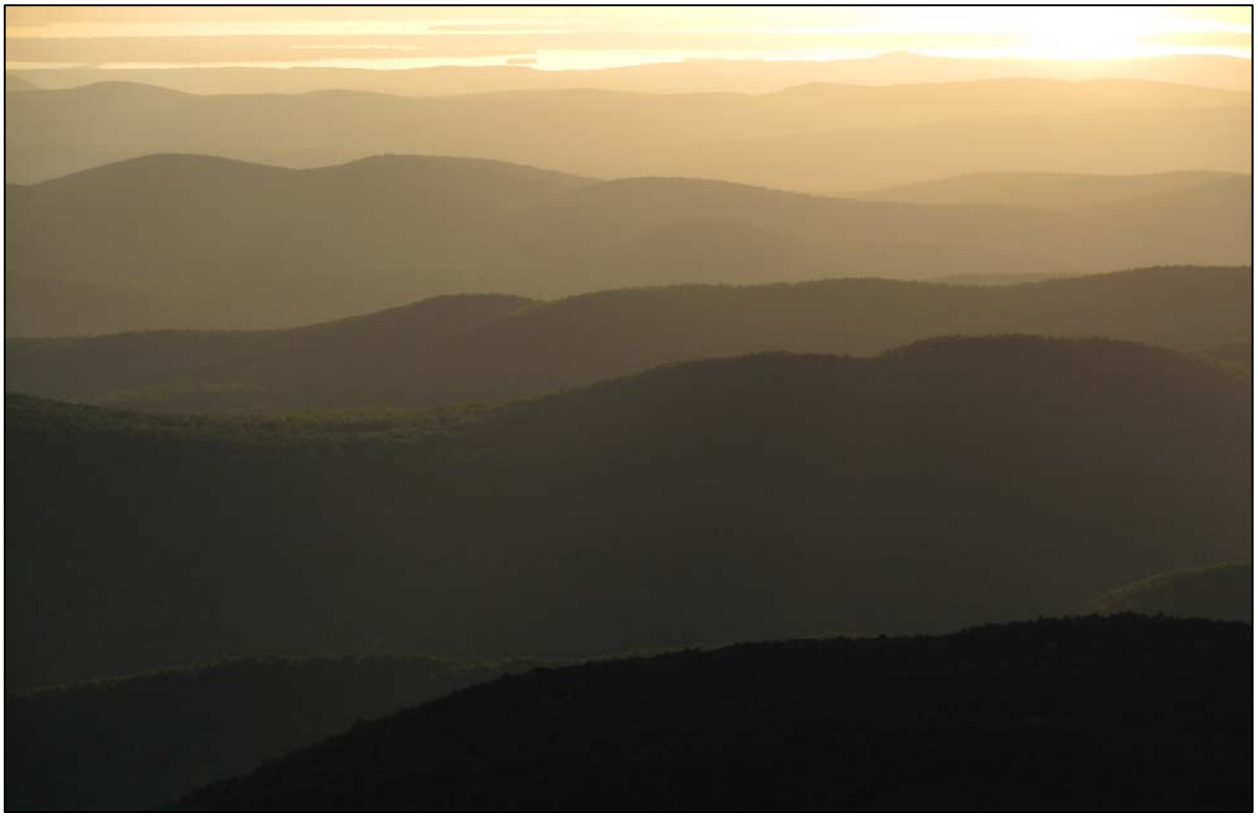
2008 Report to the Vermont Monitoring Cooperative

Part I. Demographic Monitoring of Montane Forest Birds on Mt. Mansfield and Stratton Mountain

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



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VCE Technical Report 09-02

Part I. Demographic Monitoring of Montane Forest Birds on Mt. Mansfield and Stratton Mountain

Kent P. McFarland and Christopher C. Rimmer

We continued demographic monitoring of Bicknell's Thrush *(Catharus bicknelli)*, Swainson's Thrush *(C. usutulatus)*, Blackpoll Warbler *(Dendroica striata)*, and Yellow-rumped (Myrtle) Warbler *(D. coronata coronate)*, completing our 17th consecutive field season on Mt. Mansfield and our 11th on Stratton Mountain. This report presents a summary of data collected through 2008.

Study Areas and Overall Methods of Data Collection

Our study sites on Mansfield (44º 32' N, 72º 49' W) and Stratton (43° 05' N, 72° 55' W) were situated between 900 and 1200 m elevation in montane fir forest (Montane Spruce-Fir Forest, cf. Thompson and Sorenson 2000). From 1992-2001, we conducted studies on three plots on Mansfield, ranging in size from 10-20 ha. One of these was in an area developed for skiing around the Octagon restaurant, one on the moderately disturbed Mansfield ridgeline, and the third in an area of relatively undisturbed habitat on the Ranch Brook watershed. Since 2002, field work has been limited to the ridgeline plot. On Stratton, we established two 20-ha study plots in 1997 and have since annually collected field data on each. One plot is on the developed north peak, the other on the undeveloped south peak.

Field sampling was conducted annually from late May through mid to late July at each site. Standardized field methods on each mountain included: (1) mist-netting and banding (including unique color banding of individuals); (2) resighting of color-banded individuals; (3) collection of blood, feather and claw samples for determination of mercury concentrations and isotopes to determine population connectivity; (4) radio telemetry of adult male and female Bicknell's Thrushes (females only on Stratton in 2008); (5) monitoring of Bicknell's Thrush nests and reproductive success (on Stratton only in 2008); (6) point count surveys for population monitoring as part of the regional program, Mountain Birdwatch (see http://www.vtecostudies.org/MBW/), and (7) monitoring of balsam fir cone mast and red squirrel *(Tamiasciurus hudsonicus)* abundance. Our censusing encompassed all avian species, while mist-netting and banding targeted four focal species: Bicknell's Thrush, Swainson's Thrush, Myrtle Warbler, Blackpoll Warbler, and White-throated Sparrow. Additionally, in 2008 we collected hourly temperature data on Stratton Mountain summit using a Fourier Systems MicroLite data logger located ~1m high in the fir forest. Previous temperature data on Stratton were collected as minima and maxima during each 24 hour period when we were on the mountain; we also recorded rainfall amounts.

We used 12-20 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. 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 (tape recorded playbacks), while other species were passively captured. Each individual was fitted with a uniquely-numbered U.S. Fish and Wildlife Service (USFWS) leg band and 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 included wing chord, tail length, weight, tarsal length, culmen length, bill length from mid-nares, bill width, and bill depth. We collected a small blood sample (c. 50 µl) from the brachial vein of all adult Bicknell's

Thrushes and selected individuals of other species for mercury analysis and other trace elements. Each sample was stored in a heparinized capillary tube, refrigerated in a vaccutainer in the field, and frozen within 12-48 hours. We also collected the fifth tail feather and claw samples for stable isotope analysis to study population connectivity.

In 2008 on Stratton Mountain, we located Bicknell's Thrush nests by systematic searches, following radio tagged females, and by observing parental behavior and other cues. The majority of nests were found via radio telemetry, ensuring that our samples were not biased towards nests more easily found by other methods. The chronology and status of all active nests were monitored every 1 to 4 days either directly or, when possible, remotely via binoculars, or by radio telemetry monitoring of females. Nests that fledged at least one young were considered successful. Observations of fledging, fledglings near nests, parents carrying food nearby, or an empty nest cup with depressed edge and excrement were considered evidence of a successful nest. Depredation was assumed when the eggs or nestlings (when too young to fledge) disappeared.

We used the nest-survival module in the program MARK (White and Burnham 1999, Rotella et al. 2004) to compare nest-survival models and obtain estimates of daily survival rates of nests (DSR). Program MARK uses a generalized linear approach to modeling DSR using maximum likelihood estimation to estimate regression coefficients (Rotella et al. 2004). Models were constructed using the logistic transformation (logit) link function. Study mountain (n = 2; Mansfield, Stratton), and red squirrel presence (n=2; high or very low to absent) were modeled as groups, resulting in 4 groups.

We included red squirrels in our suite of models because their annual abundance has been strongly linked to spruce *(Picea)* or fir *(Abies)* cone production in the previous year (studies reviewed in Gurnell 1983). Morris (1951) documented a biennial masting cycle in fir-dominated forests in New Brunswick, Canada, and a similar pattern has since been reported over a broad geographical area, in both lowland (Morris 1951, KPM pers. obs.) and montane coniferous forests (M. Dodd, pers. comm., VCE unpub. data). Both cone production and red squirrel population fluctuations can be temporally and spatially synchronous across the landscape (Kemp and Keith 1970, Gurnell 1983, KPM pers. obs.). It has long been known that red squirrels prey on songbird eggs and nestlings (e.g., Nelson 1918, Thoms 1922, Hatt 1929). Recent studies have shown that this species can account for a high proportion of avian nest predation in many parts of its range, including the Northeast (Maine: Vander Haegen and Degraaf 1996a, b; New Hampshire: Holmes et al. 1992, Sloan et al. 1998). Wallace (1939) postulated that red squirrels were the main limiting factor for Bicknell's Thrush in montane fir-dominated forests of Vermont. Previously, our work provided strong evidence that balsam fir masting is a pulsed resource that causes a bottom-up response in red squirrel populations which, in turn, exerts top-down pressure on forest songbird populations, over regional scales (Rimmer et al. 2001, VCE unpubl. data).

Encounter histories were constructed in MARK, which requires the following data for each nest (Rotella 2005): (1) the day the nest was found, (2) the last day the nest was checked when still active, (3) the last day the nest was checked, and (4) the fate of the nest. For successful nests, an attempt was made to estimate the actual day that the nest fledged young, rather than simply using the last day checked to avoid unjustifiably adding survival days to a nest when failure was no longer possible. Days were standardized so that the earliest date across all years when a nest was first found was coded as day 1, with the remaining dates numbered sequentially relative to day 1, regardless of year.

Over all years of study, thrush nests were active from 6-June to 6-August, for a 61-day nesting season. Nests were found and monitored on Mansfield from 1992 – 2001, Stratton from 1997-2004 and 2007-2008, and on East Mountain in 2004-2005.

Models were evaluated within an information-theoretic framework (Burnham and Anderson 2002). MARK calculates an Akaike's information criterion corrected for small samples (AIC) for each model. Each model is ranked by AIC with lower values indicating greater empirical support. Models with AIC values <2 were considered to have substantial empirical evidence (Burnham and Anderson 2002).

We are currently collaborating with Dr. Scott Sillett from the Smithsonian Migratory Bird Center, an expert in mark-recapture analytical methods. The complex and specialized statistical analyses necessary to accurately estimate survivorship from mark-recapture data require expertise that VCE must obtain elsewhere. With Dr. Sillett's guidance, we will be estimating and comparing adult survivorship according to methods described in Lebreton et al. (1992), Pradel et al. (1997) and Sillett and Holmes (2002), using the program MARK (White and Burnham 1999).

Results and Discussion

We found and monitored 11 Bicknell's Thrush nests in 2008, a non-mast year (Figure 1), on Stratton Mountain. Five nests fledged young. Over the entire 7-week study period, w detected onlyred squirrel, which remained on the study area for less than one week (Figure 1). We assisted the Cornell Laboratory of Ornithology with filming at three nests in HD video for the Macaulay Library collections. A sample video clip can be viewed at http://www.flickr.com/photos/vtecostudies/3752773846/.

Overall, we have monitored 159 Bicknell's Thrush nests on Mansfield (n=57) and Stratton (n=102), plus an additional 12 nests on East Mountain. Eighty-three of the 159 nests (52%) were successful. Only 30% of the nests failed in non-mast years, while 69% failed in mast years.

Using the highest ranked model from MARK, nest DSR following mast years when red squirrels were most abundant was estimated to be 94%, compared to 98% after non-mast years. Assuming a 27-day nesting cycle for Bicknell's Thrush, with 3 days for laying, 12 days for incubation and 12 days for brooding (Rimmer et al. 2001), this indicates only a 19% success rate for nests following mast years and 57% following years with little or no mast. Nest productivity showed a similar pattern to that of daily survival rates. The mean fledged brood size was slightly higher after non-mast years (2.7 ± 1.1) than after mast years (2.4 ± 0.8). These results are presented in more detail in McFarland et al. (2008).

In 2008 we captured 73 Bicknell's Thrushes and nearly 40% of these were returns from previous years. Four birds, two from each mountain, were known to be 8 years old. Two of these, one from each mountain, were first banded as nestlings. The previously determined skewed male sex ratio continued with 33 males, 24 females, 6 unknown sex captured (1.375 males per female). We have captured a total of 803 Bicknell's Thrushes since 1992 (305 males, 189 females and 309 unknown sex). We captured 50 Swainson's Thrushes in 2008 with 24% returning from the previous year, three of these were at least 6 years old. We have banded a total of 434 Swainson's Thrushes since 1992. Seventy-five Blackpoll Warblers were captured in 2008. Over 45% were returns from previous years. Three individuals were six years old. We have banded a total of 1,443 individuals since 1992. We captured 106 Myrtle Warblers

in 2008. Nearly 31% were recaptures from a previous year. One individual was at least four years old, and two were three years old. We have banded a total of 784 Myrtle Warblers since 1992.

We are currently working closely with Dr. Sillett on survivorship analyses for Bicknell's Thrush and the three other focal montane forest species. We anticipate submission of a peer-reviewed manuscript on this topic, as well as on the cone mast-squirrel-avian productivity phenomenon, by 31 December 2009.

Peer-reviewed Journal Papers Published in 2008 using VMC Collected Data

Frey, S. J. K., C. C. Rimmer, K. P. McFarland, and S. Menu. 2008. Identification and sex determination of Bicknell's Thrushes using morphometric data. J. Field Ornithology 79: 408-420.

Rodenhouse, N. L., S. N. Matthews, K. P. McFarland, J. D. Lambert, L. R. Iverson, A. Prasad, T. S. Sillett, and R. T. Holmes. 2008. Potential effects of climate change on birds of the Northeast. Mitigation and Adaptation Strategies for Global Change 13: 517-540.

Professional Meeting Presentations in 2008 using VMC Collected Data

Lambert, J .D. and K. P. McFarland. 2008. Conservation applications of a Bicknell's Thrush distribution model built from monitoring data. 4th International Partners in Flight Conference, McAllen, TX.

Rimmer, C. C., K. P. McFarland and J. M. Townsend. 2008. Elucidating the limiting factors of a rare, declining species: Bicknell's Thrush. 4th International Partners in Flight Conference, McAllen, TX.

Fraser, K. C., C. C. Rimmer , K. P. McFarland, J. M. Townsend, R. A. Cunjak and A. W. Diamond. 2008. Isotopic turn-over in claw tissue of a long-distance migratory thrush (*Catharus bicknelli*): implications for conservation and studies of migratory connectivity. Poster presentation. The 6th International Conference on Applications of Stable Isotope Techniques to Ecological Studies. Honolulu, Hawaii, 25-29 August 2008. http://www.vtecostudies.org/PDF/BITHtoenailposter08.pdf.

Acknowledgments

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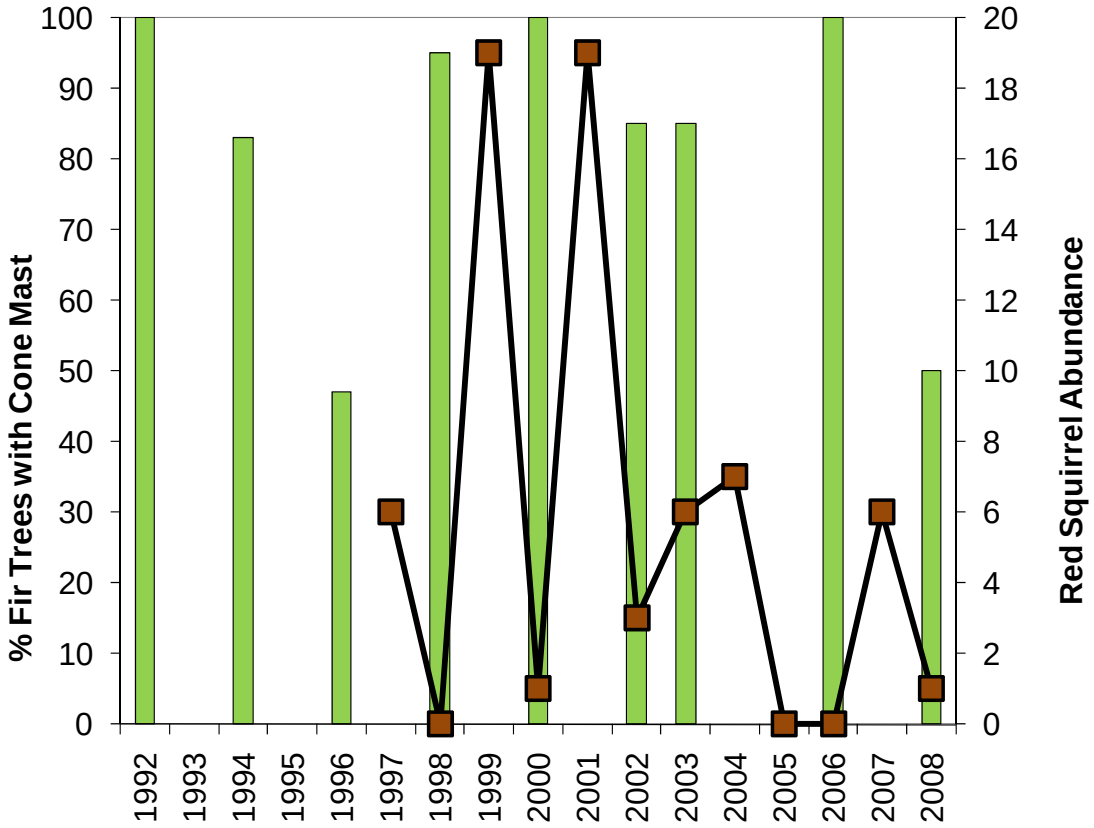

Figure 1. Results of balsam fir mast and red squirrel abundance monitoring on Stratton Mountain, Vermont. Squirrel abundance is depicted in red squares with connecting lines; cone mast is represented by green bars.

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

Steven D. Faccio and Christopher C. Rimmer

In 2008, 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 18th consecutive year, while the Ranch Brook site was censused for the 13th year in 2008 (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 16th year in 2008 (the site was not surveyed in 2003 or 2005). The LBWA was surveyed for the 9th consecutive year in 2008.

The Underhill State Park site consists of mature northern hardwoods at an average elevation of 671 m (2200 ft), 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 of 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, Mountain Birdwatch http://www.vtecostudies.org/MBW, 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 in the Northeast. Pilot surveys were initiated in 2006, and in 2008 surveys were conducted at 19 study sites in New Jersey, Connecticut, New York, Massachusetts, Vermont, New Hampshire, and Maine.

Methods

Surveys were conducted by VCE staff biologists at the Mt. Mansfield Ridgeline and Ranch Brook sites, and by volunteer biologists at the Lye Brook and Underhill sites. 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 1991-2008. 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 18.25 species per year compared to Lye Brook's 16.67 (Tables 3 and 4).

Mount Mansfield

On the Mt. Mansfield ridgeline plot in 2008, both species richness and numerical abundance were below the 18-year average, with 60 individuals of 11 species detected (Table 1). Of the 8 most commonly recorded species, 4 were below the 18-year average, and 4 were above. Four species exhibited decreasing population trends, with one species, Blackpoll Warbler, showing a significant decline of 2.8% per year ($r^2 = 0.255$; $P = 0.033$). Four species showed non-significant increasing trends. After steadily increasing for three consecutive years, the count of Bicknell's Thrush dropped in 2008. The count of Yellow-rumped Warbler rebounded from last year's all time low of 7 individuals to 12.

At the Ranch Brook study site in 2008, species richness and numerical abundance were below the 13-year average, with 59 individuals of 16 species counted (Table 2). Among the 8 most abundant species, the count of only one (Winter Wren) was above the 13-year mean in 2008, while Bicknell's Thrush was equal to the mean. Overall, 2 of these 8 species showed increasing trends, while 6 declined. The only significant population trend evident was for White-throated Sparrow, which continued to decline at a rate of 5.2% per year ($r^2 = 0.514$; $P = 0.006$). Bicknell's Thrush numbers remained consistent with 2007's count of 5, while Dark-eyed Junco rebounded from last year's all time low of 1 individual to 4 in 2008. In addition, a count of 4 Blue Jays represented the highest count for that species in the 13-year survey.

At Underhill State Park in 2008, both species richness and total number of individuals was below the 16-year average, with 58 individuals of 17 species detected (Table 3). Among the 8 most common species at the site, 3 were above the 16-year mean, and 5 were below. Overall, 6 species showed increasing population trends, including significant increases for Black-throated Blue Warbler (7.0%; $r^2 = 0.319$, $P = 0.023$, Black-throated Green Warbler (8.8%; $r^2 = 0.657$, $P = 0.0001$, and Ovenbird (2.5%; $r^2 = 0.189$, $P = 0.092$. Despite the first detection of Canada Warbler at the site since 2002, the species continued to exhibit a declining trend at 5.4% per year ($r^2 = 0.648$, $P = 0.0002$).

Lye Brook Wilderness

At Lye Brook Wilderness, both species richness and numerical abundance were above the 9-year average, with 66 individuals of 18 species detected (Table 4). Among the 8 most common species, five were above the 9-year average, while three were below. Of these 8 species, half exhibited non-significant, increasing population trends, while half showed declines. Among negative trends, only Ovenbird declined significantly at a rate of 4.3% ($r^2 = 0.428$; $P = 0.056$). The maximum count of 13 Red-eyed Vireos was the highest in sites 9-year period, while 6 Hermit Thrushes equaled the high count from 2002. Three new species were detected in 2008: Yellow-billed Cuckoo, Ruby-throated Hummingbird, and Northern Flicker, contributing to the highest species richness count since the survey's first year.

Discussion

Standardized bird surveys on Mt. Mansfield continue to show interesting patterns, and the population fluctuations evident for some species underscore the need for continued monitoring and development of a long-term database. White-throated Sparrow declined significantly at the Ranch Brook site for the third consecutive year, with the number of birds detected in 2008 equaling the all time previous low count of 4 in 2006. 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 9.15 over the 13-year study period, and 8.08 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.

After four consecutive years without being detected, a single Canada Warbler was heard singing at the Underhill study site in 2008. Canada Warbler is a species of high conservation concern within the bioregion (Rich et al. 2004), and results from the North American Breeding Bird Survey indicate that it has exhibited significant population declines throughout the northeastern portion of its breeding range between 1991 and 2006 (Sauer et al. 2007). Although the species has declined at a rate of 6.7% annually on Vermont Forest Bird Monitoring sites between 1989-2006, the result was not statistically significant ($P = 0.28$; Faccio and Rimmer 2006). In upland forests such as Underhill State Park, Canada Warbler is primarily a disturbance specialist, occupying forest stands with small to medium size canopy gaps resulting from windthrow, ice storms, silvicultural practices, or other disturbances (Faccio 2003, Lambert and Faccio 2005). Within these gaps, Canada Warblers typically occur at low densities (ca. 1 to 3 pairs per gap, depending on size) and tend to exhibit strict habitat requirements, preferring areas with high densities of shrub and fern cover, and lower average canopy height (Chace et. al. *In Press*). Such gaps are ephemeral however, providing suitable conditions for a limited time until the canopy closes again. Evidence from the Northeast indicates that regenerating forests are most suitably

structured for Canada Warbler for a 10-15 year period, approximately 6-20 years following a disturbance (DeGraaf 1985, Hagan et al. 1997). While the single Canada Warbler detected in 2008 could indicate that a small disturbance created suitable habitat to support a breeding pair at the study site, it is also possible that the bird was an un-mated male seeking a suitable territory and mate.

At Lye Brook, both species richness (18) and total number of individuals (66) rebounded to more typical levels following 2 years of below average counts, which were attributed to the fact that only one survey was conducted in each of the previous two years instead of the recommended 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. 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.

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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, 1991-2008.

Common Name	'91	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	'06	'07	'08	Mean	SD	r^2	Annual Trend (%)
Red Squirrel											1								0.06	0.24		
Sharp-shinned Hawk										1									0.06	0.24		
Hairy Woodpecker				1															0.06	0.24		
Northern Flicker			1																0.06	0.24		
Yellow-bellied Flycatcher			1		1	2	3		1	1	1	1	2	1		1	2	1	1.00	0.84		
Alder Flycatcher							1												0.06	0.24		
Red-eyed Vireo									1										0.06	0.24		
Blue Jay		1												1		1			0.17	0.39		
Common Raven			1			1			1	1		1	1	1		2		1	0.56	0.62		
Red-breasted Nuthatch	1	2	3	1	3	1		1	2		1				1		1		0.94	1.00		
Winter Wren	**10**	**9**	**7**	**4**	**5**	**2**	**4**	**10**	**8**	**4**	**4**	**7**	**3**	**7**	**8**	**12**	**7**	**5**	**6.44**	**2.75**	**0.001**	**0.20**
Golden-crowned Kinglet										1									0.06	0.24		
Ruby-crowned Kinglet		2			1							1	1						0.28	0.59		
Bicknell's Thrush	**6**	**15**	**11**	**8**	**10**	**11**	**9**	**9**	**8**	**7**	**9**	**9**	**6**	**5**	**8**	**11**	**12**	**7**	**8.94**	**2.46**	**0.060**	**-1.12**
Swainson's Thrush	**3**	**8**	**1**	**1**	**3**	**6**	**7**	**5**	**4**	**3**	**3**	**2**	**2**	**1**	**2**	**5**	**1**	**5**	**3.44**	**2.15**	**0.049**	**-2.07**
Hermit Thrush											1		1						0.11	0.33		
American Robin	1	4	1	2	2	2	2	1	1	3	3	2	6	3	1	3	4	3	2.44	1.34		
Cedar Waxwing		1	4				9							1					0.83	2.32		
Nashville Warbler	2					2	3	1	1		1		1			1			0.67	0.92		
Magnolia Warbler	1	2				3	1	1			1		3	1	4		1		1.00	1.25		
Yellow-rumped Warbler	**9**	**11**	**8**	**9**	**8**	**12**	**10**	**13**	**11**	**9**	**11**	**14**	**10**	**13**	**9**	**9**	**7**	**12**	**10.28**	**1.96**	**0.017**	**0.49**
Blackpoll Warbler	**8**	**9**	**9**	**7**	**7**	**15**	**10**	**10**	**9**	**8**	**8**	**3**	**3**	**9**	**8**	**8**	**2**	**4**	**7.61**	**3.09**	**0.255**	**-2.81***
Ovenbird			1						1										0.11	0.33		
Canada Warbler							1												0.06	0.24		
Lincoln's Sparrow	2					1													0.17	0.53		
White-throated Sparrow	**6**	**14**	**14**	**12**	**14**	**13**	**20**	**14**	**19**	**14**	**18**	**11**	**13**	**11**	**10**	**14**	**14**	**12**	**13.50**	**3.26**	**0.001**	**0.12**
Dark-eyed Junco	**3**	**9**	**6**	**2**	**5**	**5**	**9**	**8**	**7**	**2**	**7**	**6**	**5**	**7**	**4**	**5**	**4**	**6**	**5.56**	**2.09**	**0.003**	**-0.36**
Purple Finch	**2**	**4**	**1**	**2**	**3**	**2**	**2**	**1**	**4**	**2**	**3**	**4**	**4**	**2**	**1**	**2**	**2**	**4**	**2.50**	**1.10**	**0.016**	**1.14**
White-winged Crossbill					8		1	1											0.56	1.94		
Pine Siskin		1			1		2	1			11						5		1.17	2.82		
Evening Grosbeak		2																	0.11	0.49		
Species Richness [a]	13	16	15	11	14	15	17	14	15	13	15	12	15	14	11	13	13	11	13.72	1.74		
Number of Individuals [a]	54	94	69	49	71	78	94	76	78	56	80	61	61	63	56	62	62	60	67.17	12.44		

[a] Does not include counts of Red Squirrel

* $P = 0.033$

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, 1995-2008.

	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	'06	'07	'08	Mean	SD	r^2	Annual Trend (%)
Eastern Chipmunk													1		0.08	0.28		
Red Squirrel					4		1		7				4		1.23	2.28		
Sharp-shinned Hawk				1							1				0.15	0.38		
Mourning Dove						1	1								0.15	0.38		
Ruby-throated Hummingbird						1									0.08	0.28		
Hairy Woodpecker	1														0.08	0.28		
Pileated Woodpecker							2								0.15	0.55		
Yellow-bellied Flycatcher	**4**	**4**	**4**	**3**	**3**	**4**	**2**	**4**	**4**		**3**	**2**	**4**	**3**	**3.38**	**0.77**	**0.117**	**-1.60**
Blue-headed Vireo												1			0.08	0.28		
Red-eyed Vireo				1											0.08	0.28		
Blue Jay	1										1	1		4	0.54	1.13		
Common Raven		4	3	4		4	2						1	1	1.46	1.71		
Black-capped Chickadee	1												1		0.15	0.38		
Red-breasted Nuthatch	7		2		6		2		2		4		5	1	2.23	2.49		
Winter Wren	**8**	**3**	**7**	**10**	**9**	**10**	**5**	**5**	**9**		**10**	**11**	**6**	**8**	**7.77**	**2.42**	**0.058**	**2.00**
Golden-crowned Kinglet				1	3	1		3			2	1		2	1.00	1.15		
Ruby-crowned Kinglet	3		3			3			1		1	1			0.92	1.26		
Bicknell's Thrush	**5**	**6**	**7**	**5**	**5**	**6**	**2**	**8**	**1**		**8**	**2**	**5**	**5**	**5.00**	**2.20**	**0.038**	**-1.74**
Swainson's Thrush	**6**	**15**	**9**	**5**	**3**	**4**	**8**	**11**	**10**		**8**	**5**	**9**	**7**	**7.69**	**3.25**	**0.005**	**-0.66**
Hermit Thrush	1		3												0.31	0.85		
American Robin		2	2	2	1	1	1	1	3		4	5	2	2	2.00	1.35		
Cedar Waxwing				1			1				1				0.23	0.44		
Nashville Warbler		1	3	2	1	3		3	4		3	2	3	2	2.08	1.26		
Northern Parula									1						0.08	0.28		
Magnolia Warbler	2	4	4	2	3	5	4	2	4		2	3	1	2	2.92	1.19		
Black-throated Blue Warbler	1														0.08	0.28		
Yellow-rumped Warbler	**5**	**6**	**4**	**5**	**7**	**11**	**9**	**11**	**8**		**4**	**8**	**8**	**6**	**7.08**	**2.36**	**0.056**	**2.12**
Blackpoll Warbler	**9**	**9**	**15**	**8**	**3**	**8**	**7**	**8**	**8**		**8**	**10**	**4**	**6**	**7.92**	**2.90**	**0.144**	**-2.62**
White-throated Sparrow	**22**	**11**	**12**	**9**	**8**	**7**	**7**	**10**	**10**		**7**	**4**	**8**	**4**	**9.15**	**4.54**	**0.514**	**-5.16***
Dark-eyed Junco	**9**	**5**	**3**	**2**	**5**	**2**	**5**	**4**	**4**		**7**	**5**	**1**	**4**	**4.38**	**2.18**	**0.060**	**-2.35**
Purple Finch	2	1	4	4	2	4	4		6					2	2.46	1.90		
White-winged Crossbill	8		2		1		6								1.31	2.63		
Pine Siskin	12		1		7								1		1.62	3.66		
Species Richness [a]	19	13	18	17	16	17	18	12	15		17	15	16	16	16.08	1.98		
Number of Individuals [a]	107	71	88	65	67	75	69	82	82		74	61	62	59	74.00	13.28		

[a] Does not include counts of Eastern Chipmunk or Red Squirrel

* $P = 0.006$

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, 1991-2008.

Common Name	'91	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	'06	'07	'08	Mean	SD	r^2	Annual Trend (%)
Eastern Chipmunk							3		5					1			1		0.63	1.41		
Red Squirrel							1		3		1					1	1		0.44	0.81		
Broad-winged Hawk							1												0.06	0.25		
Mourning Dove									1					1					0.13	0.34		
Yellow-bellied Sapsucker		2		1	1		1	1	1		3			2		2	3	2	1.19	1.05		
Downy Woodpecker							1										1	1	0.19	0.40		
Hairy Woodpecker				1			1	1	2										0.31	0.60		
Northern Flicker			1																0.06	0.25		
Pileated Woodpecker	2	1	1			1													0.31	0.60		
Least Flycatcher																	2		0.13	0.50		
Eastern Phoebe												1							0.06	0.25		
Blue-headed Vireo	1	2				1	1			1				1		2	1	1	0.69	0.70		
Red-eyed Vireo	**3**	**4**	**4**	**6**	**9**	**8**	**7**	**6**	**10**	**8**	**8**	**7**		**5**		**7**	**8**	**6**	**6.63**	**1.93**	**0.136**	**2.42**
Blue Jay	2	1		1		2	2		1	1	2	1		1			1	1	1.00	0.73		
American Crow																1		1	0.13	0.34		
Common Raven				4	1				1		1			1					0.50	1.03		
Black-capped Chickadee		1	1		2	3	3		3	1	1					2	1	3	1.31	1.20		
Red-breasted Nuthatch							1												0.06	0.25		
White-breasted Nuthatch							1							1					0.13	0.34		
Brown Creeper				1					1	1		1		1		1	1		0.44	0.51		
Winter Wren		**6**	**2**	**1**	**5**	**3**	**4**	**6**	**4**	**4**	**3**	**3**		**3**		**4**	**2**	**1**	**3.19**	**1.72**	**0.007**	**-0.79**
Golden-crowned Kinglet								1								1			0.13	0.34		
Veery	1	1								1									0.19	0.40		
Swainson's Thrush		1		2	4	3		1	4	2	2					1			1.25	1.44		
Hermit Thrush		**4**	**1**	**6**	**7**	**3**	**4**	**4**	**2**		**4**	**5**		**4**		**4**	**7**	**1**	**3.50**	**2.22**	**0.022**	**2.05**
Wood Thrush	1	1																	0.13	0.34		
American Robin	1				3	3	3	4	2	1	2	1		2			1		1.44	1.31		
Magnolia Warbler	1				1											1			0.19	0.40		
Black-th. Blue Warbler	**4**	**9**	**5**	**6**	**7**	**8**	**6**	**5**	**6**	**5**	**5**	**5**		**11**		**15**	**8**	**11**	**7.25**	**2.98**	**0.319**	**6.99***
Yellow-rumped Warbler			2	2		2	3	3	1	1	3	2				1		1	1.31	1.14		
Black-th. Green Warbler	**5**	**7**	**6**	**7**	**7**	**7**	**9**	**5**	**8**	**10**	**10**	**8**		**13**		**15**	**12**	**10**	**8.69**	**2.85**	**0.657**	**8.78****
Blackburnian Warbler											1	1				1			0.19	0.40		

Common Name	'91	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	'06	'07	'08	Mean	SD	r^2	Annual Trend (%)
Blackpoll Warbler						1	2												0.19	0.54		
Black-and-White Warbler		3	2	2	4	2	3	2	1	3	4	2		1		2	3		2.13	1.20		
American Redstart		4			1	1													0.38	1.02		
Ovenbird	**4**	**10**	**11**	**11**	**13**	**12**	**12**	**10**	**13**	**10**	**13**	**6**		**11**		**11**	**15**	**14**	**11.00**	**2.78**	**0.189**	**2.49*** **
Mourning Warbler																	1	1	0.13	0.34		
Canada Warbler	**3**	**4**	**4**	**6**	**2**	**4**	**4**	**2**	**2**	**3**	**2**	**2**						**1**	**2.44**	**1.71**	**0.648**	**-5.41****
Scarlet Tanager					1				1							1			0.19	0.40		
White-throated Sparrow	2		2	1	1		1					1				1		1	0.63	0.72		
Dark-eyed Junco		**3**	**1**	**3**	**4**	**3**	**5**	**2**	**2**	**1**	**2**	**2**		**1**		**5**	**5**	**2**	**2.56**	**1.55**	**0.068**	**3.93**
Rose-breasted Grosbeak	4	2		1	3	1	2		1							1			0.94	1.24		
Purple Finch						1		1			1					1	1		0.31	0.48		
White-winged Crossbill											2								0.13	0.50		
Pine Siskin					1						1								0.13	0.34		
American Goldfinch	1													1					0.13	0.34		
Species Richness [a]	15	19	14	18	20	20	23	16	21	16	20	16		17		22	18	17	18.25	2.59		
Number of Individuals [a]	35	66	43	62	77	69	77	54	67	53	70	48		60		81	73	58	62.06	13.00		

[a] Does not include counts of Red Squirrel or Eastern Chipmunk

* $P = 0.023$

** $P \leq 0.0002$

*** $P = 0.092$

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, 2000-2008.

Common Name	'00	'01	'02	'03	'04	'05	'06	'07	'08	Mean	SD	r^2	Annual Trend (%)
Eastern Chipmunk	2			1						0.33	0.71		
Red Squirrel	1	1								0.22	0.44		
Ruffed Grouse	1					2				0.33	0.71		
Mourning Dove		1								0.11	0.33		
Yellow-Billed Cuckoo									1	0.11	0.33		
Barred Owl	1									0.11	0.33		
Chimney Swift	2									0.22	0.67		
Ruby-throated Hummingbird									1	0.11	0.33		
Yellow-bellied Sapsucker	**5**	**6**			**2**		**2**	**2**	**5**	**2.44**	**2.35**	**0.024**	**-4.29**
Downy Woodpecker	1		1							0.22	0.44		
Hairy Woodpecker	2	1	2					1	1	0.78	0.83		
Unidentified Woodpecker	3									0.33	1.00		
Northern Flicker									1	0.11	0.33		
Pileated Woodpecker	1		3	1	4	1	1		2	1.44	1.33		
Eastern Wood-Pewee				1						0.11	0.33		
Yellow-bellied Flycatcher							1			0.11	0.33		
Least Flycatcher	2									0.22	0.67		
Great Crested Flycatcher				1						0.11	0.33		
Blue-headed Vireo		1	4	1		1				0.78	1.30		
Red-eyed Vireo	**10**	**6**	**9**	**4**	**6**	**6**	**4**	**5**	**13**	**7.00**	**3.04**	**0.000**	**0.24**
Blue Jay		3		1		1			2	0.78	1.09		
Common Raven					1	1				0.22	0.44		
Black-capped Chickadee	1	1		2			1	2	1	0.89	0.78		
White-breasted Nuthatch						1	1			0.22	0.44		
Brown Creeper	1									0.11	0.33		
Winter Wren	**7**		**1**		**3**	**1**			**2**	**1.56**	**2.30**	**0.174**	**-10.59**
Ruby-crowned Kinglet						1				0.11	0.33		
Veery					1					0.11	0.33		
Swainson's Thrush	2		1	3	2		2	1	1	1.33	1.00		
Hermit Thrush	**4**	**2**	**6**	**5**	**4**	**4**	**4**	**5**	**6**	**4.44**	**1.24**	**0.196**	**5.81**
American Robin	1		1		3			1	1	0.78	0.97		
Cedar Waxwing	1								1	0.22	0.44		
Northern Parula				3	1					0.44	1.01		
Magnolia Warbler	1		3							0.44	1.01		
Black-throated Blue Warbler	**9**	**7**	**10**	**9**	**8**	**12**	**11**	**8**	**8**	**9.11**	**1.62**	**0.013**	**0.76**
Yellow-rumped Warbler	2	1				0				0.33	0.71		
Black-throated Green Warbler	**8**	**10**	**4**	**6**	**8**	**9**	**12**	**3**	**11**	**7.89**	**3.06**	**0.022**	**2.36**
Blackburnian Warbler	5									0.56	1.67		
American Redstart	2	1	3	1		4				1.22	1.48		
Ovenbird	**15**	**13**	**19**	**11**	**14**	**13**	**12**	**12**	**8**	**13.00**	**3.00**	**0.428**	**-4.32***
Canada Warbler	1									0.11	0.33		
Scarlet Tanager	1		3	2	2	2			1	1.22	1.09		
White-throated Sparrow	2		2	4		2				1.11	1.45		
Dark-eyed Junco	**2**	**3**	**1**	**1**	**1**	**4**		**1**		**1.44**	**1.33**	**0.198**	**-8.57**
Rose-breasted Grosbeak	2	1								0.33	0.71		
Species Richness [a]	28	15	17	17	16	17	11	11	18	16.67	4.97		
Number of Individuals [a]	98	58	73	57	60	65	51	41	66	63.22	15.95		

[a] Does not include counts of Red Squirrel or Eastern Chipmunk

* $P = 0.056$