Long-term Avian Research and Monitoring on Mt. Mansfield, Vermont

2017 Report to the Forest Ecosystem 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

Pat Folsom releases a banded male Blackpoll Warbler on Mt. Mansfield, 22 June 2017. Photo courtesy of Chuck Gangas.

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

Introduction

In 2017, we continued demographic monitoring of Bicknell's Thrush *(Catharus bicknelli)*, Swainson's Thrush *(C. ustulatus)*, Blackpoll Warbler *(Setophaga striata)*, Yellow-rumped (Myrtle) Warbler *(S. coronata coronata)*, White-throated Sparrow *(Zonotrichia albicollis)*, and other songbirds, completing our 26th consecutive field season on the Mt. Mansfield ridgeline. This report presents a brief summary of data collected.

We also conducted Year 2 of a complementary study to monitor potential phenological mismatching between insectivorous songbirds and other trophic groups. Climate change is expected to increase the risk of extinction for many species, yet the mechanisms through which climate affects populations of plants and animals remain unclear. One prominent explanation is the phenological-mismatch hypothesis, which argues that a warming climate advances the seasonal timing of key life-history events at lower trophic levels but not at higher trophic levels, leading to maladaptive phenologies. Birds, especially long-distance migrants, have been argued to suffer especially from this phenomenon. Their primary prey, arthropods, reach peak abundance earlier in warm years, whereas the annual cycle of birds is endogenously regulated in response to photoperiod, which is unaffected by climate change. Birds thus return from wintering grounds relatively late, miss the peak abundance of key prey species, and can raise fewer young. Evidence that phenological mismatches are becoming widespread, however, is meager. In 2016, we began to examine several key assumptions of this hypothesis on the Mt. Mansfield ridgeline. We attempted to document the phenology of a montane forest ecosystem at three trophic levels — plants, arthropods, and insectivorous birds — and to document how phenology is affected by local weather conditions, which we assume will provide insight into the link between climate and phenology. By tracking weather-driven variation in phenology, we seek to (1) test the assumption that phenology at lower trophic levels closely tracks local weather, especially temperature; (2) examine whether birds adjust the timing of reproduction accordingly; and (3) examine whether bird species with different life-history strategies respond differently. In particular, we seek to understand whether long-distance migrants like Bicknell's Thrush and Blackpoll Warbler, which are thought to have relatively rigid phenological schedules that respond primarily to photoperiod, respond differently to interannual variation in spring weather than do short-distance migrants like White-throated Sparrow and Yellow-rumped (Myrtle) Warbler, which may have greater flexibility in timing of arrival to the breeding grounds and subsequent initiation of reproductive activities (Knudsen et al. 2011). Despite many studies investigating the phenology of avian reproduction, very few have simultaneously tracked changes in phenology of prey species (Visser et al. 2011)

Methods

For the 26th consecutive breeding season, we used mist-netting and banding to monitor breeding bird species on an established study plot on the Mt. Mansfield ridgeline between c. 1155-1190 m (3800-3900 ft) elevation. As in previous years, we focused our efforts on five common target species: Bicknell's Thrush, Swainson's Thrush, Blackpoll Warbler, Yellow-rumped (Myrtle) Warbler, and White-throated Sparrow. Since 2012, as a means to more broadly assess population changes and the potential impacts of climatic warming, our efforts have encompassed the entire avian community.

We netted birds on 18 days between 1 June and 13 September 2017, using 10-30 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 late morning on the following day. Bicknell's Thrushes were captured both passively and through the use of vocal lures (recorded playbacks of 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. We recorded data on age, sex, breeding condition, fat class, ectoparasites, flight feather wear, and net site of capture. Standard metrics included wing chord, tail length, weight, and tarsal length. On males, we measured maximum width of the cloacal protuberance, if present, to the nearest 0.01 mm to gauge phenology of breeding condition. Additionally, a small blood sample was obtained from Bicknell's and Swainson's thrushes for long-term monitoring of mercury burdens. We collected 30–50 ul of blood in a 75 ul heparinized capillary tube by puncturing the cutaneous ulnar (brachial) vein with a 27.5 gauge needle. Capillary tubes were sealed on both ends with Critocaps, placed in labeled glass 7 cc vacutainers, and frozen within 24 hours.

We monitored arrival times of all breeding birds using automated recording devices (ARDs) to record vocalizations. We positioned 3 ARDs throughout the study site and set them to record for 2 hours around sunrise and 2 hours around sunset, times when songbirds vocalize most frequently. We deployed the ARDs on 27 April, a date that precedes the return of most breeding birds to this high-elevation site (ground is typically snow-covered through the first week of May). We removed the ARDs on July 12 and archived the audio data. Data analysis of recordings is underway to determine first arrival dates and to characterize the distribution of arrival dates for Bicknell's Thrush and other locally breeding species.

As part of our planned long-term study of avian phenology, we collected data to examine correlations between local weather and time-series that describe leaf-out and phenology of reproduction in insectivorous birds. We tracked leaf-out using time-lapse cameras that captured repeated photographs of deciduous trees. These cameras also captured the timing of loss of snowpack. Additionally, we used temperature logging iButtons to record ambient air temperature as well as snowpack loss. A pair of iButtons were located at each ARD station; one in a shaded box on the north side of a tree near breast height and one placed at the interface of bare ground and snowpack by drilling a small hole. Arthropod sampling was discontinued in 2017, due to funding constraints.

Results and Discussion

We accumulated 1,716 net-hours in 2017 (Table 1.1), with a mean of 95.3 ± 51.3 SD net-hours per day (range = 28–167). Our total of 413 mist net captures was comprised of 312 individuals of 30 species, including 263 new bandings, 52 returns from previous years, and 23 within-season recaptures (Table 1.2).

As usual, Bicknell's Thrush had a relatively high rate of return captures (n = 12; 30%) in 2017. High site fidelity combined with intensive use of playback lures likely plays a role in Bicknell's Thrush recapture rates. Since 1992, we have captured 332 adult Bicknell's Thrushes, 114 (34%) of these individuals in multiple years (3 in seven years, 5 in six years, 6 in five years, 12 in four years, 33 in three years, 55 in two years, and 218 in just a single year). We recaptured three thrushes in 2017 that were aged as second-year when first banded in 2011, making them seven years old. The oldest known Mansfield thrushes were a male and female, both aged as after-second-year when captured, making them at least 10 years old when last recaptured. All banding data from Mt. Mansfield (1992-2017) are available in supplemental file S1.

In 2017, mist net captures of adult Bicknell's Thrush continued to show a male-biased sex ratio, with 1.8 males captured for every female. This skewed sex ratio has been consistent throughout the 26 years of our study (all years = 2.19:1 male:female). Our complementary research on the species' Hispaniolan wintering grounds suggests that sexual habitat segregation may limit survivorship of females (Townsend

et al. 2011, 2015), and we have therefore focused on conserving female-dominated winter habitats (McFarland et al. 2018).

We collected blood samples from 43 Bicknell's Thrush, as part of our long-term monitoring of avian mercury burdens on Mt. Mansfield. Anthropogenic input of mercury into the environment has elevated risk to fish and wildlife, particularly in northeastern North America. We previously documented MeHg availability in a terrestrial montane ecosystem by examining a suite of insectivorous passerines and other trophic levels on Mt. Mansfield and elsewhere (Rimmer et al. 2005, 2009). Our recent (2014-2017) sampling of Bicknell's and Swainson's thrush will enable us to investigate changes in blood mercury burdens in these two congeners over an approximately 20-year period on Mt. Mansfield. We will combine those data with atmospheric wet mercury deposition data collected at the Proctor Maple Research Lab from 1993-2016 to investigate trends in thrush blood mercury concentrations and their relationship with locally-deposited atmospheric mercury.

The phenocam located on the Amherst Trail operated until 13 May with over half of the snowpack gone. The second camera located on the Sunset Trail showed some snow until ~15 May, although it was difficult to determine the exact date. Because the camera moved when the snowpack changed, this camera was only focused on a patch of Mountain Holly (*Betula cordifolia*), which on 11 June had leaves half grown and fully grown on about 19 June. If phenocams are to be deployed in the future, they should be mounted on poles held firmly in place, focused closely on the plant that is to be monitored, and a camera of sufficient quality to record fine details. Visual monitoring by a human (or in conjunction with a phenocam) might be preferable and feasible due to the late phenology of leaf-out on the ridgeline.

Deployment of temperature logging iButtons to record snowpack loss was successful (see supplemental file S2). The sensor on the Lakeview Trail consistently registered at freezing until 12 May at 0800 hrs when it rose above freezing and consistently remained so except for short-term weather events. A sensor located in a snowbank community on the Amherst Trail rose above freezing on 28 May at 1000 hrs. Using a network of these sensors to monitor snowpack loss could be accurate and economical, and it might allow for monitoring of large areas or arrays in the future.

Monitoring both long-distance migrants, such as Bicknell's Thrush, and short-distance migrants, such as White-throated Sparrow, will allow us to monitor and detect phenological mismatches, if any, in the future. The phenology mismatch hypothesis predicts that long-distance migrant birds, which may experience greater changes on their breeding than wintering grounds, will fail to adjust their arrival to breeding sites on earlier dates and may consequently miss the peak emergence of arthropods for provisioning young. This could lead to declines in productivity and eventually affect population-level changes. Only detailed phenological monitoring such as this will enable the elucidation of ecological changes across trophic levels, their population-level impacts, and the potential effects of a changing climate in causing them.

New Publications and Open Data During this Report Period

- Martinsen, Ellen S., Kent P. McFarland, and Christopher C. Rimmer. 2018. Documentation of a Hybrid Bicknell's Thrush (*Catharus bicknelli*) × Veery (*C. fuscescens*) Using Vocalization and Genetic Data. The Wilson Journal of Ornithology 130 (1): 70-80. http://wjoonline.org/doi/abs/10.1676/16-061.1
- Dornelas M, Antão LH, Moyes F, et al. 2018. BioTIME: A database of biodiversity time series for the Anthropocene. *Global Ecol Biogeogr*. 27: 760–786. https://doi.org/10.1111/geb.12729

Work Planned in 2018

- QA/QC entire banding database and submit for archival at FEMC.
- Analyze blood samples to examine temporal trends in mercury concentrations in Bicknell's Thrush and Swainson's Thrush on the Mt. Mansfield ridgeline, relate to PMRC atmospheric deposition data, and write a peer-reviewed paper for special issue of Ecotoxicology.
- Complete 27th consecutive year of weekly field monitoring using mist nets and banding during the 2018 breeding season.
- Complete analyses of survivorship of Bicknell's Thrush using mark-recapture data for publication in a peer-reviewed journal.
- Finalize revisions and resubmit peer-reviewed publication from geolocator tracking of Bicknell's Thrush throughout its annual cycle.

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Townsend, Jason, K P. McFarland, C. C. Rimmer, W. G. Ellison and J. E. Goetz. 2015. Bicknell's Thrush (*Catharus bicknelli*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America. doi:10.2173/bna.592

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Table 1.1. Daily net hours (hours per 12-m net) in 2017.

Date	Net Hours (hrs/12m net)
6-1-17	39.00
6-2-17	110.00
6-21-17	28.04
6-22-17	144.38
6-27-17	19.75
6-28-17	140.82
7-6-17	60.05
7-7-17	153.78
7-11-17	60.38
7-12-17	142.82
7-18-17	57.17
7-19-17	167.99
7-25-17	65.38
7-26-17	157.23
8-1-17	63.92
8-2-17	152.71
9-12-17	43.88
9-13-17	109.00
Total	**1,716.3**

Table 1.2. Numbers of individual birds captured on Mt. Mansfield in 2017, ranked by species abundance.

Species	No. Individuals Captured	Status
Bicknell's Thrush	53	Breeding
Dark-eyed Junco	48	Breeding
Myrtle Warbler	42	Breeding
Blackpoll Warbler	40	Breeding
White-throated Sparrow	29	Breeding
Swainson's Thrush	21	Breeding
Golden-crowned Kinglet	18	Breeding
Black-throated Blue Warbler	13	Transient
American Robin	11	Breeding
Ovenbird	4	Transient
Red-eyed Vireo	4	Transient
Ruby-crowned Kinglet	4	Breeding
Winter Wren	4	Breeding
Hermit Thrush	3	Transient
Black and White Warbler	2	Transient
Magnolia Warbler	2	Breeding
Yellow-bellied Flycatcher	2	Breeding
American Redstart	1	Transient
Black-capped Chickadee	1	Transient
Blackburnian Warbler	1	Transient
Blue Jay	1	Transient
Brown Creeper	1	Transient
Canada Warbler	1	Transient
Cedar Waxwing	1	Breeding
Downy Woodpecker	1	Transient
Purple Finch	1	Breeding
Rose-breasted Grosbeak	1	Transient
Sharp-shinned Hawk	1	Transient
Wood Thrush	1	Transient

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

Introduction

As part of the Vermont Forest Bird Monitoring Program, we conducted point counts at 30 study sites across Vermont in 2017, including sites on Mt. Mansfield and the Lye Brook Wilderness. This long-term monitoring is essential to assess trends in species presence, species richness, and relative abundance; the data can provide meaningful insights into how species respond to ecosystem change, which may include effects from invasive species, climate change, forest fragmentation, and more. This report briefly summarizes results from two study sites—Underhill State Park on the west slope of Mt. Mansfield and the Lye Brook Wilderness. Data from three montane forest sites on Mt. Mansfield are incorporated into Mountain Birdwatch, a long-term, regional monitoring program for ten species of high-elevation breeding birds.

Methods

Breeding bird surveys were conducted at permanent study sites located on the west slope of Mt. Mansfield in Underhill State Park (UNSP) and at the Lye Brook Wilderness Area (LBWA). These two study sites are part of VCE's long-term Forest Bird Monitoring Program (FBMP) which 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, Faccio et al. 2017).

Each study site contains five point count stations. Survey methods include unlimited distance point counts, based on the approach described by Blondel et al. (1981) and used in Ontario (Welsh 1995). Counts begin shortly after dawn on days where weather conditions are unlikely to reduce count numbers. Observers record all birds seen and heard during a 10-minute sampling period, divided into 2-, 3-, and 5-minute intervals. Surveys during 2016 represented the 26th year of data collection at UNSP and the 16th at LBWA, exclusive of years when no surveys were conducted (2003, 2005, and 2012 at UNSP, and 2012 and 2015 at LBWA).

Results

Surveys at the mid-elevation, northern hardwood study sites at Underhill State Park and Lye Brook Wilderness showed similar species composition, with a total of 50 and 49 species detected over all survey years, respectively. In 2017, the number of individual birds and species richness declined at both UNSP and LBWA, continuing the long-term downward trends for both these metrics (Fig. 2.1).

Long-term Trends

Underhill State Park – Total number of individuals and species richness decreased from 2016, with 53 individuals of 14 species recorded, including a Swainson's Thrush, the first since 2009. Among the nine most common species, five were above the 26-year mean, and four were below. Overall, counts of Ovenbird and Black-throated Green Warbler were the same as 2016; while the long-term trend for Hermit Thrush, Vermont's State bird, remained relatively flat (Fig 2.2.). These results reflect the broader, 26-year trends observed for these three species in the statewide Vermont FBMP dataset, in which both Black-throated Green Warbler and Ovenbird significantly increased, while Hermit Thrush showed no trend (Faccio et al. 2017). A single Canada Warbler was again detected in 2017; this species is declining at a rate

of 4.13% annually (r^2=0.634), representing the sharpest decline among the nine most commonly detected species.

Lye Brook Wilderness Area – After relative abundance and species richness reached near-record levels in 2016, both metrics declined significantly in 2017, with relative abundance dropping to its second lowest level in the survey's 16-year history (n=42) and species richness its lowest (n=9) (Fig. 2.1). Among the nine most common species, counts of all nine declined from 2016, and only Red-eyed Vireo remained above its 16-year average. The long-term trend for Black-throated Blue Warbler showed a moderate decline of -2.03% per year (r^2 = 0.224) (Fig. 2.3), while Red-eyed Vireo showed a strong upward trend, increasing by 6.69% annually (r^2 = 0.311) (Fig. 2.3), mirroring the significant statewide trend exhibited by VCE's 25-year study (Faccio et al. 2017).

Discussion

Long-term trends of forest birds at both UNSP and LBWA suggest that the relative abundance of the total number of birds detected has declined slightly over the survey period. However, it should be noted that site-specific trend estimates must be interpreted with caution, as these data are from a limited geographic sample and can be greatly influenced by years with extreme high or low counts. Also, year-to-year changes in survey counts may simply reflect natural fluctuations in abundance, differences in detection rates of observers and/or species, variability of singing rates due to nesting stage, and/or a variety of dynamic factors, such as predator or prey abundance, overwinter survival, effects of diseases such as West Nile
Virus, and local habitat change.

Not surprisingly, most of the strongest population trends observed at both study sites—including the increasing trends of Black-throated Green Warbler at UNSP and Red-eyed Vireo at LBWA, and the declining trend of Canada Warbler at UNSP—reflect the broader statewide trends for these species during the 25-year study of the Vermont Forest Bird Monitoring Program (Faccio et al. 2017).

It is unknown which of the many anthropogenic stressors (e.g., habitat degradation and loss due to development, land use change, acid precipitation and other atmospheric pollutants, or changing climatic conditions) may be contributing to these population trends, but it is likely all have had impacts. In addition, migratory species, whether short- or long-distance Nearctic-Neotropical migrants, have declined across Vermont forests, while year-round residents showed no trend (Faccio et al. 2017). This suggests that migratory species face additional limiting factors, both on their wintering grounds and during migratory stopover that could be impacting populations. Continued data collection and comparison with survey data from other ecologically similar sites will be necessary to fully elucidate population trends of various species at these sites.

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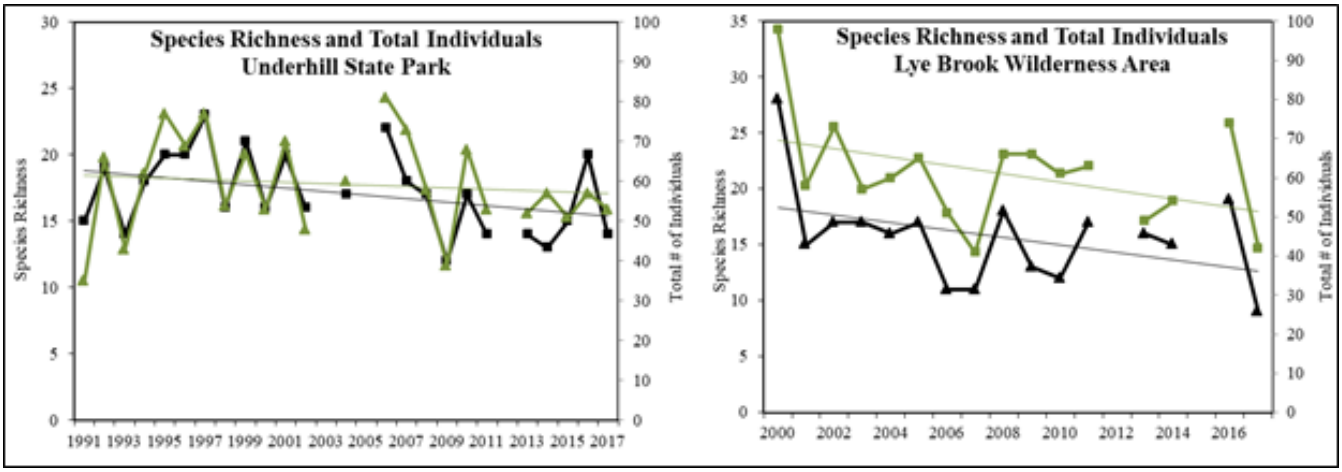

Figure 2.1. Annual totals and trends for species richness and total number of individuals detected at Underhill State Park, 1991-2017 (left), and Lye Brook Wilderness Area, 2000-2017 (right).

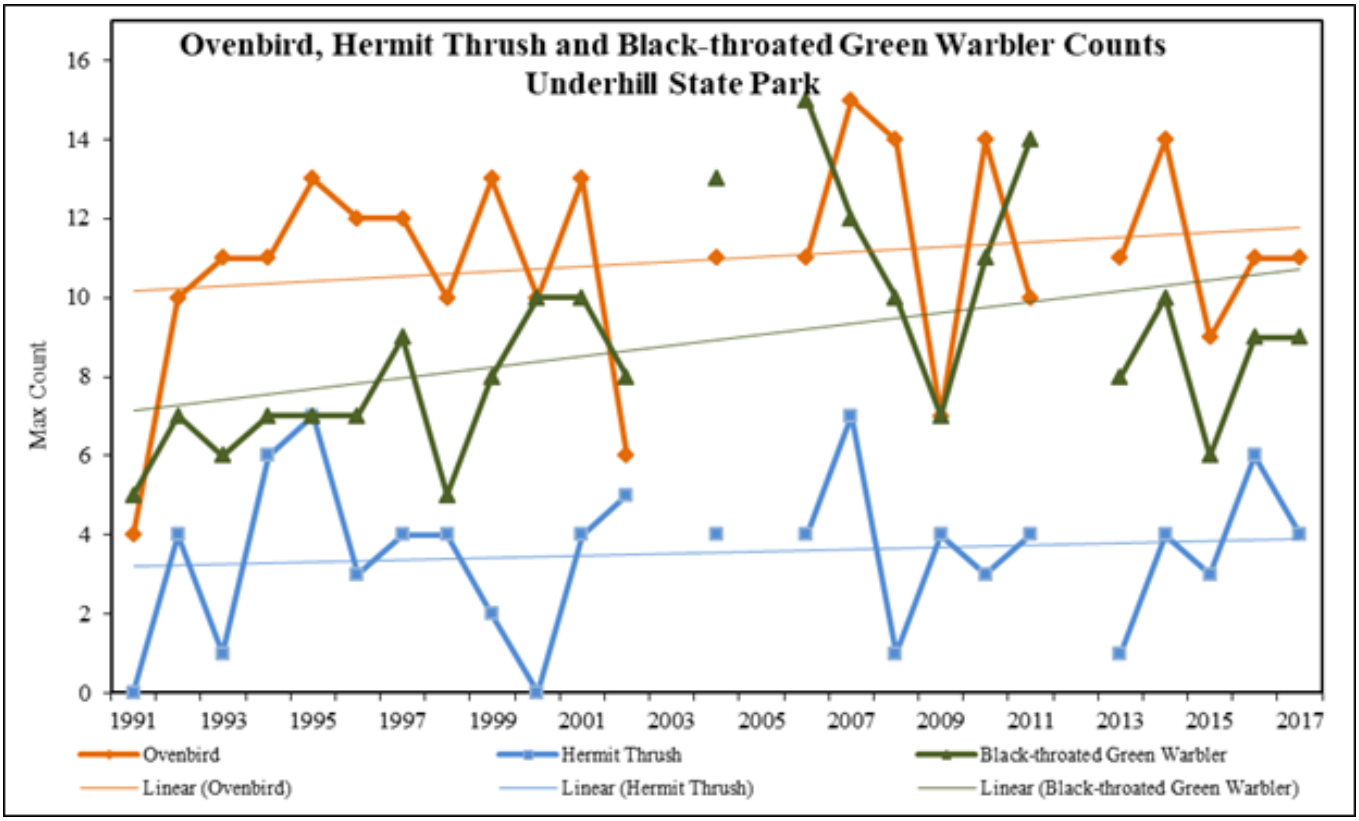

Figure 2.2. Twenty-six year data and trends for Ovenbird, Hermit Thrush, and Black-throated Green Warbler from annual surveys conducted at Underhill State Park, 1991-2017.

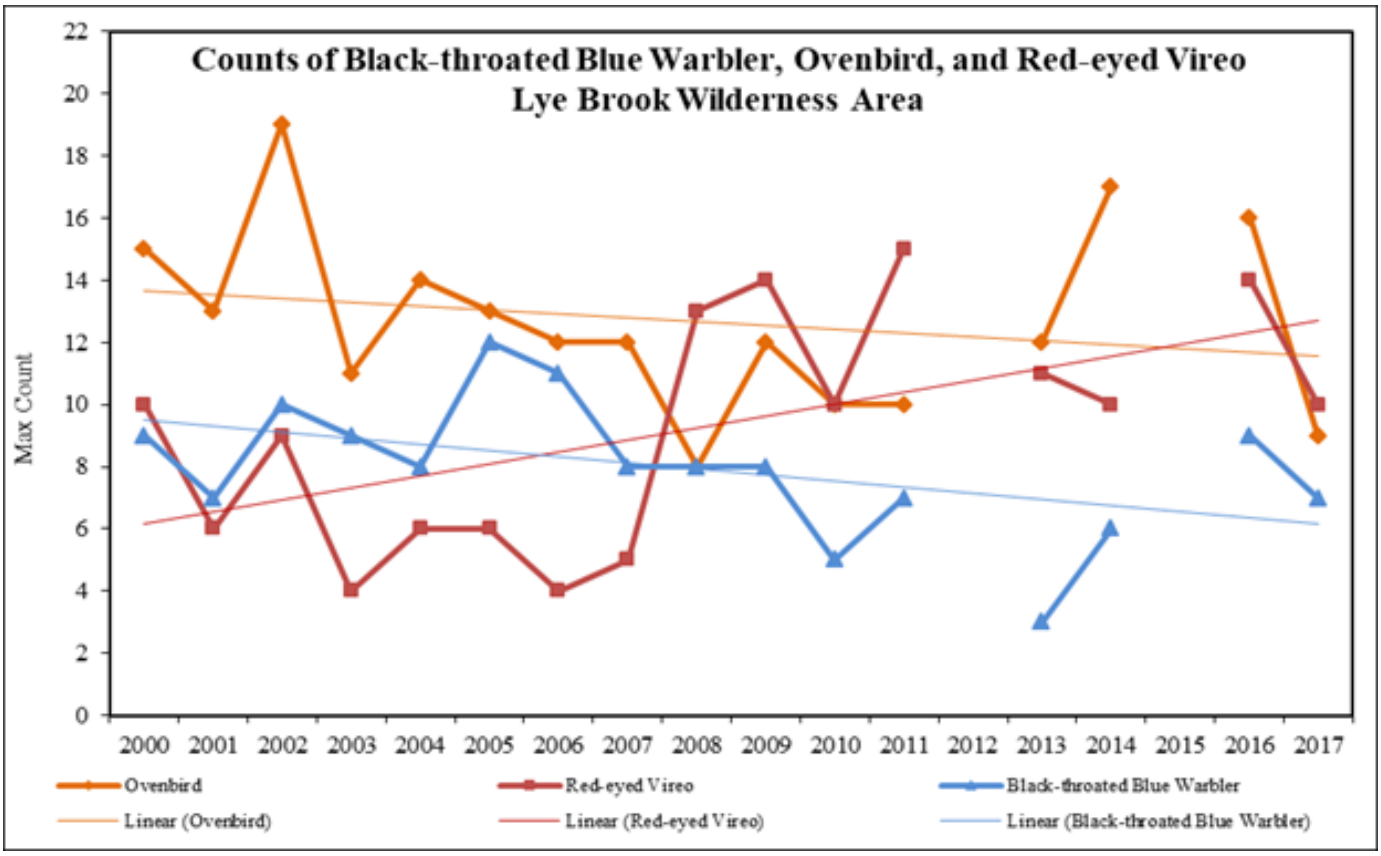

Figure 2.3. Sixteen-year data and trends for Black-throated Blue Warbler, Ovenbird, and Red-eyed Vireo from annual surveys conducted at Lye Brook Wilderness Area, 2000-2017.