

**2012 Breeding Bird Inventory and Black-throated Blue Warbler (*Setophaga caerulescens*)
Demography on the Rockwell Sanctuary, Albany, New Hampshire.**

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Abstract

A breeding bird inventory and demographic study on black-throated blue warblers was conducted on the Rockwell Sanctuary as part of on-going research at the Tin Mountain Conservation Center, in the White Mountains region of New Hampshire. Fifty-nine species of birds were detected on the sanctuary, and the four most common species were the ovenbird (*Seiurus aurocapilla*), red-eyed vireo (*Vireo olivaceus*), black-capped chickadee (*Poecile atricapillus*) and black-throated blue warbler (*Setophaga caerulescens*). An estimated population of 18 black-throated blue warblers inhabited the sanctuary, and one-third of nests monitored were successful in fledgling. The Tin Mountain Conservation Center will continue surveying breeding birds to maintain an avian faunal inventory of the Rockwell Sanctuary, and studying black-throated blue warbler demography to examine the dynamics of a typical interior forest species. Lastly, recommendations for efficient future data collection are offered.

Introduction

Bird populations are monitored to determine trends in local and landscape species richness, abundances and spatial distribution. Habitat structure may predict bird species richness, or the number of distinct species inhabiting an area, and abundance, or the number of individuals in a population (DeGraaf, et.al., 1997). In avian ecology, bird communities are heavily dependent on tree stand structure and other vegetative habitat variables. For example, mature forest bird communities consist of species that typically breed in mid to late successional forest stands, and early successional communities consist of those that breed in younger stands. Consequently, community population densities depend upon required habitat characteristics, such as patch size and nesting substrate availability (DeGraaf, et.al., 1997; Sillett, et.al., 2004).

The Tin Mountain Conservation Center, a non-profit environmental education facility located in Albany, New Hampshire, initiated a breeding bird census in the spring of 2006 to monitor bird populations on its property, the Rockwell Sanctuary. The census has been

conducted every following summer and survey efforts have increased in intensity; the first complete landscape cover and bird census surveys were conducted in 2010 and 2011. These two years formed the basis of the long-term breeding bird inventory at the Rockwell Sanctuary.

In addition to the breeding bird census, a focus on black-throated blue warbler demography was introduced to research on the sanctuary. The black-throated blue warbler (*Setophaga caerulescens*) is a sexually dimorphic, Neotropical migrant species that breeds in mature, temperate deciduous forests (Graves, 1997; Holmes, et.al., 1992; Holmes, et.al., 1996). Males are territorial and females brood multiple times in low-lying shrubs, such as small saplings, hobblebush (*Viburnum lantanoides*) and mountain laurel (*Kalmia latifolia*) (Holmes, et.al., 1992; Holmes, et.al., 1996; Sillett, et.al., 2004).

In 2012, we conducted a breeding bird census and studied black-throated blue warbler demography to carry on the long-term research conducted by the Tin Mountain Conservation Center on the Rockwell Sanctuary. We expect to inventory relatively unchanged species richness compared to study years prior because species are returning to, and are provided space to breed in, an undisturbed habitat. Depending upon the chosen management practice, we would expect species richness to change if the Rockwell Sanctuary were instead disturbed.

Because it is a common species and females nest close to the ground, the black-throated blue warbler lends itself as an accessibly studied indicator of habitat quality. We studied their population size and reproductive success on the sanctuary, and expect to find small densities of these birds and their nests. While black-throated blue warblers will utilize hobblebush and other low-lying vegetation to build nests, we expect the majority of the population of warblers on the sanctuary to inhabit a dense patch of mountain laurel in the northeast corner of the property.

Methods

Site description

The study area encompasses approximately 140 acres on the Rockwell Sanctuary in Albany, New Hampshire. The site is predominantly hardwood and mixed hardwood/softwood forests, composed largely of red oak, Eastern white pine and Eastern hemlock. A 14-acre patch of mountain laurel exists in the property's northeast corner under a pine, oak and aspen forest canopy. An understory component consists of small saplings, *Viburnum* species, ferns and other herbaceous vegetation.

Two ArcMap cover type maps of the sanctuary exist in the Tin Mountain Conservation Center bird project database: shapefile layer “Natural Communities” was created using a survey conducted in 2010 (Weis, 2010), and a second shapefile layer, “Cover Types” was created by a professional surveyor. The two cover type maps differ only slightly, and we were encouraged to use the latter in creating breeding bird spatial distribution maps.

Breeding Bird Census

Circular plot point count surveys were used to census bird species richness across the Rockwell Sanctuary (Map 1). Birds were recorded along transects at permanent plots established 300 by 300 feet apart. Skilled surveyors recorded birds and their distances and directions from plots at the same locations between April 23rd and July 9th, 2012. All surveys were conducted between 0630-1000 hours for five minutes at each plot on days without rain. Species estimated to be farther than 300 feet were excluded from analyses, as well as any flyovers.

Bird counts from April were used only to determine arrival dates for migrating birds but excluded from other analyses to avoid including birds still passing through to other breeding grounds. Overall sanctuary species richness and abundances of each species was calculated using point count data collected from the beginning of May to the final count on July 9, 2012. To determine habitat preference, the occurrences of selected interior forest and early successional habitat species were mapped over forest cover type using ArcMap 10 GIS program.

During a point count survey, the probability of detecting a bird decreases as the distance of a bird from a surveyor increases. Developed to adjust for biases in observer detection probability, estimated density and population sizes of the four most frequently detected species in the year 2012 were calculated using Distance 6.0 program (Forcey, et. al, 2006; Kissling and Garton, 2006); few female birds were included in analysis.

Black-throated Blue Warbler Demography

Abundance

Black-throated blue arrival dates and spatial distribution were analyzed using the breeding bird census counts outlined above. Estimated density and population size of black-throated blue warblers inhabiting the sanctuary was calculated using Distance 6.0 detection probability program; few female birds were included in analysis.

Male black-throated blue warblers were captured using a playback-mist netting technique and given a unique combination of aluminum and colored bands to render them identifiable in future observations. Bird age was determined by examining diagnostic plumage characteristics: on in-hand inspection, second year males have olive margins on the alula coverts and dull primary coverts, browner (less black) primaries and secondaries, and a reduced size of white spots on the rectrices (Graves, 1997).

To determine male territory sizes, banded warblers' territorial movement patterns were tracked using a Garmin GPSMAP 76 hand-held chartplotting receiver (Holmes, et.al, 1996). Waypoints were taken once per 5 minutes for 30 minutes or longer, depending on bird activity; if the bird rarely moved, more points were taken to attempt for a larger range. Territory perimeters were drawn around waypoints transferred into ArcMap 10.

Productivity

To determine reproductive success rates, we located nests and determined their fates by following females and intensive nest searching in a mountain laurel patch on the northeast corner of the sanctuary. Nest statuses were checked every one to three days during incubation (females were rarely disturbed if incubating), or more often if egg laying date and thus hatching date was unknown. A nest was considered abandoned if eggs were never laid in a fresh cup, a female stopped building a nest or if a female never returned to incubating between checks. A nest was considered depredated if either eggs or young disappeared between nest checks, or if the nest or its contents had been destroyed. Successful nests were those in which nestlings were fledged. Nestlings were weighed and fitted with aluminum bands on day 6 (hatch day = 0), the last day they could be handled without risking premature fledging. Nests were checked each day after banding to confirm fledgling had occurred (Holmes, et.al, 1996).

Results

Breeding Bird Census

In 2012, active bird behavior including birdsong and detectable movement was at its peak from the beginning of the breeding season in early May and decreased dramatically into early July. Each point was sampled 11 times over the duration of the survey, and the most species and

half of all individuals were detected in the month of May, while the fewest species and below 20 percent of all individuals were detected in July (Figure 1).

Fifty-nine species of birds were detected during the 2012 breeding bird inventory, compared to 48 species and 53 species in 2011 and 2010, respectively (Appendix (a); Figure 2). Beginning with the most abundant species, the four most common birds detected in 2012 were: ovenbird (*Seiurus aurocapilla*), red-eyed vireo (*Vireo olivaceus*), black-capped chickadee (*Poecile atricapillus*) and black-throated blue warbler (Figure 3). Study-year 2011 shared the same common species as year 2012, and the black-throated green warbler (*Setophaga virens*) was more common in 2010.

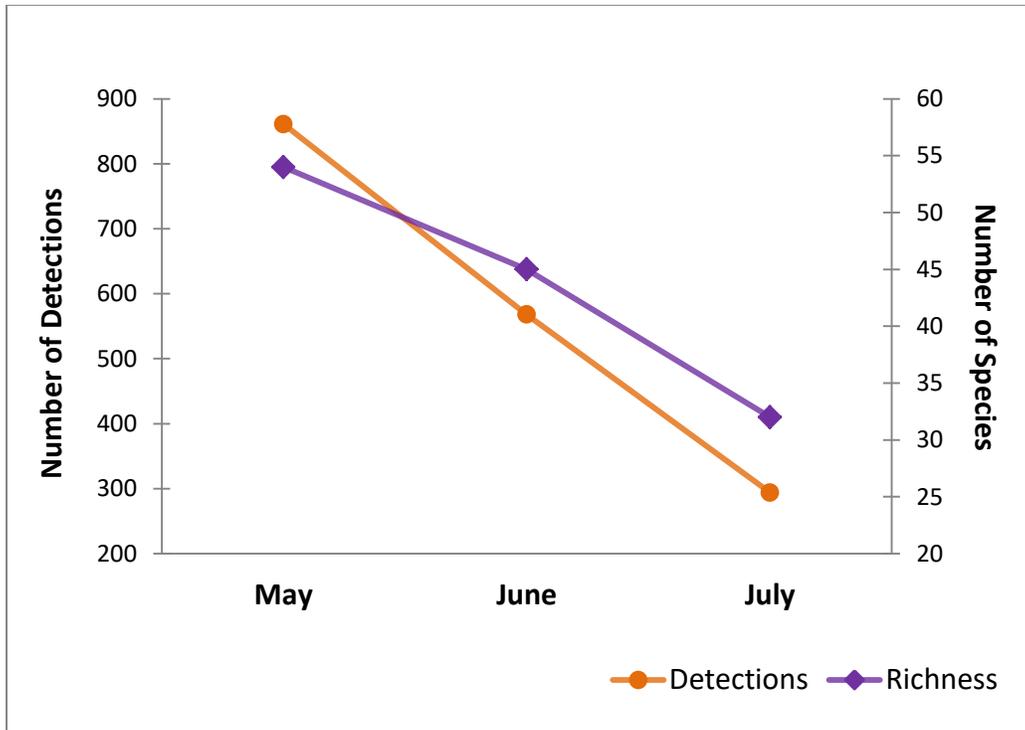


Figure 1. Species detections and richness in breeding birds surveyed calculated from point counts in 2012 on the Rockwell Sanctuary.

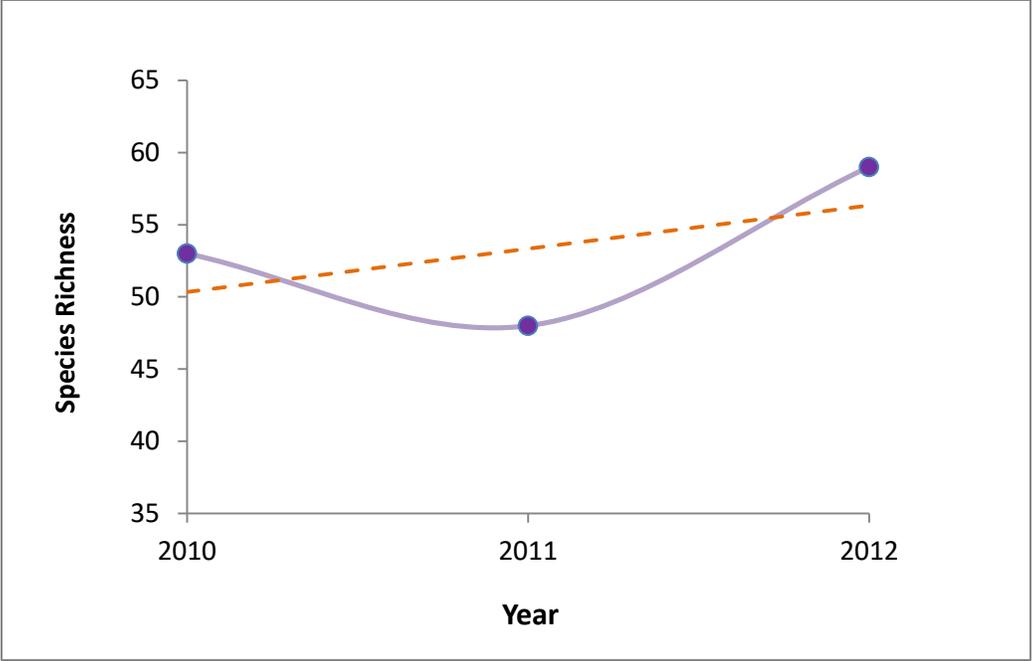


Figure 2. Overall species richness on the Rockwell Sanctuary from 2010 to 2012.

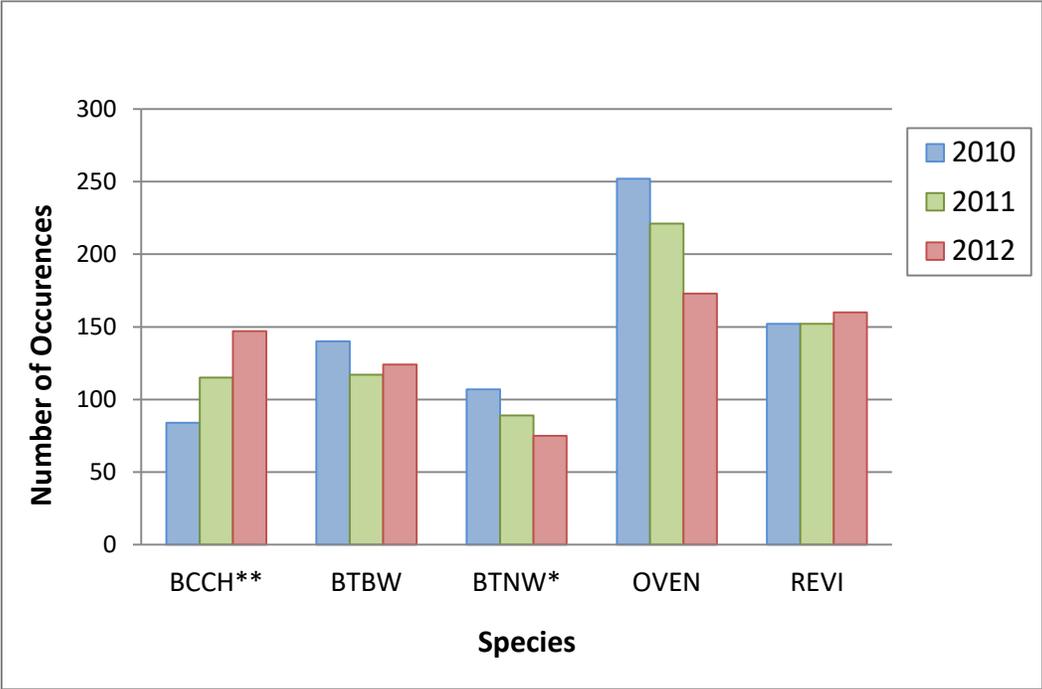


Figure 3. The four most common species detected on point count surveys in each year, 2010 to 2012. * indicates species only most common in year 2010; ** indicates species not included as most common in year 2010.

To infer habitat preferences of typical interior forest bird species, the spatial distributions of hermit thrushes and ovenbirds were mapped and showed a wide occupancy across the sanctuary's forest cover types (Map 2). Both species appeared least detected in the oak/pine/mountain laurel cover type, and were never detected in the open field cover type.

To infer habitat preferences of typical early successional and open space inhabiting species, the spatial distributions of chestnut-sided warblers (*Setophaga pensylvanica*), common yellowthroats (*Geothlypis trichas*), eastern bluebirds (*Sialia sialis*), indigo buntings (*Passerina cyanea*), chipping sparrows (*Spizella passerina*) and song sparrows (*Melospiza melodia*) were mapped over sanctuary forest cover types. The distribution of these species showed highest abundances in the open field cover type and detection into the northeast end of Chase Pond (Map 3). One common yellowthroat and one chestnut-sided warbler were detected in the cinnamon fern wetland, located in the southern portion of the sanctuary.

Black-throated Blue Warbler Demography

Abundance & Productivity

Black-throated blue warblers were first detected on the sanctuary on May 6, 2012. Their arrival date is consistent with past years, when they were first detected on May 7 and May 6 in 2010 and 2011, respectively. A total of 127 warblers were detected, and their occurrences were most densely distributed in the oak/pine/mountain laurel and oak/aspens cover types (Figure 4; Map 4).

The density of black-throated blue warblers inhabiting the sanctuary was highest in 2010 at one bird every 3.70 acres, with an estimated population of 37 birds (few females included; survey effort = 8, confidence interval = 0.102). In 2012, the density of warblers decreased to one bird every 7.29 acres, with an estimated population of 19 birds (few females included; survey effort = 11, confidence interval = 0.970).

Mist net banding and nest monitoring results for those years in which data was collected, 2011 and 2012, are summarized in Table 1. Nearly all nests were found in the oak/pine/mountain laurel sanctuary cover type; one nest was found but abandoned during the building stage in the pine/oak cover type (Map 5). One-third of nests were successful in fledging nestlings, of which we banded three nestlings from each.

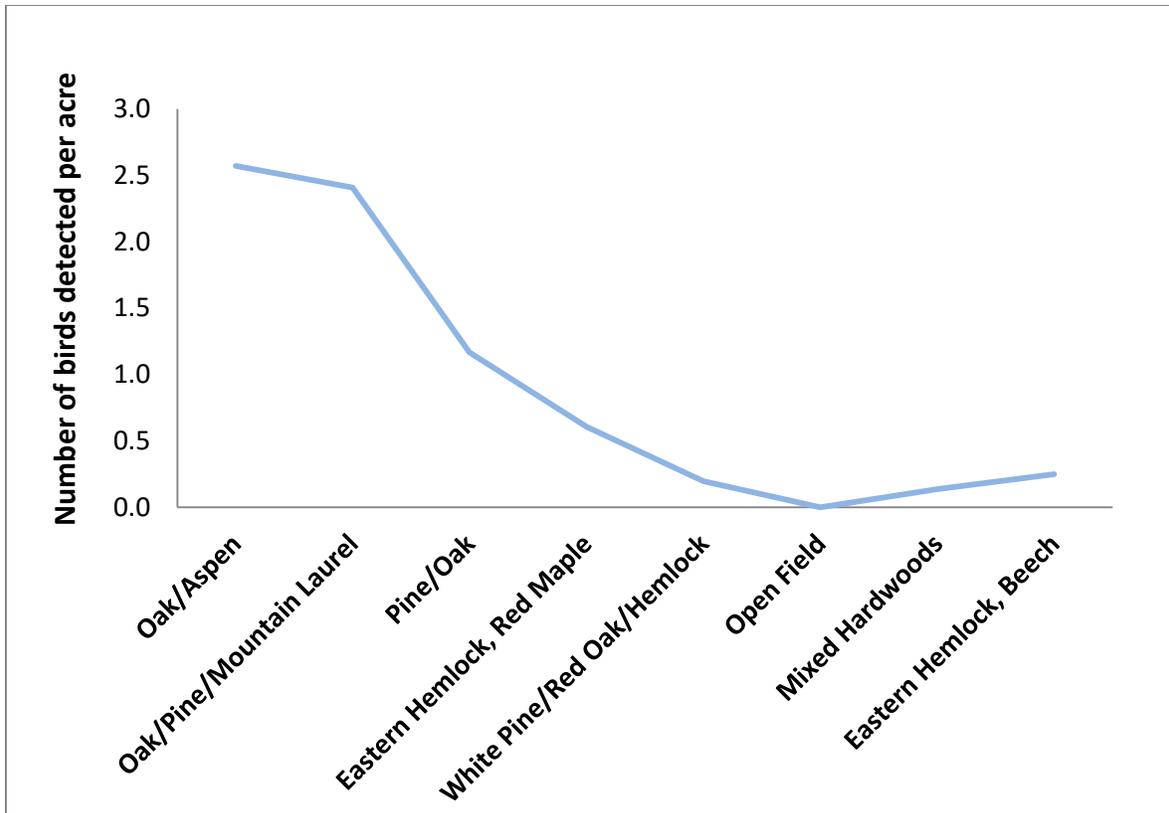


Figure 4. Density of black-throated warbler occurrences in each of Rockwell Sanctuary’s cover types.

Black-throated Blue Warbler Banding and Nest Monitoring		
	Year	
<u>Aluminum</u> <u>Banded</u>	<u>2011</u>	<u>2012</u>
Yearlings (SY)	0	3
Adults (ASY)	3	5
Recaptures	1	1
Nestlings	3	6
<u>Total banded</u>	6	14
<u>Nests</u>		
Abandoned	0	2
Depredated	0	2
Successful	1	2
<u>Total monitored</u>	1	6

Table 1. Banding and nest monitoring results conducted on the Rockwell Sanctuary in 2012.

Territory mapping was performed on only two adult male black-throated blue warblers due to constraints in time and intern-power. One black-throated blue warbler with the color band combination “Orange over Aluminum, Orange (O/A, O)” was tracked on the last day in May between 12:25 and 12:50 hours, and again on June 1st between 6:55 and 7:15 for a total of 11 waypoints. A second black-throated blue warbler with the color band combination “Black and Yellow over Aluminum, Light Green (BkY/A, LG)” was tracked on June 18th between 11:58 and 12:28 hours for a total of 3 waypoints. Warbler “O/A, O” patrolled a territory the size of 1.26 acres, and warbler “BkY/A, LG” patrolled a territory the size of 0.28 acres (Map 6).

Discussion

In this breeding bird survey, typical forest interior species were the most commonly detected, and a small population of an interior forest passerine was found in a demographic study of black-throated blue warblers. The factors that may influence these results will be discussed.

From April into mid-May, a normal peak in breeding bird activity was observed in northern New Hampshire as incoming spring migrants and year-round residents were pairing and competing for territories and departing wintering birds were preparing or already on the move more north. This activity rapidly fell into June and early July as breeding birds had paired and become busy with nesting behaviors, and most wintering species had left for the summer. More species breeding on the sanctuary were detected this year than in previous years, and the increase in richness may be attributed to surveyor skill in identifying birds aurally or visually (discussed later).

The black-throated blue warbler arrived on the Rockwell Sanctuary in the spring on time, in sync with arrival dates in past years recorded. An unusually mild winter in the Northern Hemisphere did not cause this Neotropical songbird to arrive earlier as was observed with some other species migrating into the United States in the spring of 2012 (Hurlbert and Liang, 2012). However, long-distance migrants must move quickly to their far-off breeding grounds and may not easily adapt to changes in their environment. Therefore, it will be interesting to observe future weather patterns and impacts on the arrival dates of black-throated blue warblers into the sanctuary.

The Rockwell Sanctuary is mostly covered in aging forest stands, encouraging numerous interior forest bird species to inhabit and utilize its resources. The ovenbird, red-eyed

vireo, and the black-capped chickadee are common members of mature forest bird communities, and this was reflected in our surveys. The breeding requirements of these birds were adequately satisfied on the sanctuary, resulting in high abundances of each: ovenbirds are ground nesters requiring a leaf-litter and some understory habitat component, and red-eyed vireos nest at high canopy heights. Black-capped chickadees are common in any community within a habitat rich in cavities to nest, such as dead trees. Black-throated blue warblers were also one of the most detected species in our survey of breeding birds because of their relationship with a dense, canopy-covered patch of mountain laurel on the property. While they may utilize other low-lying shrubs for nesting substrate, most pairs were established in the most optimal habitat here.

The habitat preferences of typical forest interior species and of early successional or open space species was illustrated with the mapped spatial distributions of ovenbirds, hermit thrushes and a variety of other selected birds. Both the ovenbird and the hermit thrush are common interior species requiring an aging forest structure to reproduce successfully, and their occurrences were indeed spread over the heavily forested sanctuary.

To contrast, species such as the chestnut-side warbler, common yellowthroat and sparrows selected for mapping require open woodland, scrub or grassland habitat and a shrub nesting substrate. These early successional or open space species were overall less detected relative to their interior forest counterparts, and inhabited only the open field and areas on the sanctuary with less canopy cover.

Our study of black-throated warbler demography on the Rockwell Sanctuary is very young with only 2 years of data collected, the last in which saw the most intense collection. In an intensive study of black-throated blue warbler demography, Holmes, et. al (1996) found that in high quality habitat characterized by dense shrubs, male and female black-throated blue warblers may occur together in densities of up to one bird per 1.47 acres, and birds return to higher quality sites at a higher rate than in habitats with a less dense shrub understory. As expected, our results did find a small density of one warbler per 7.29 acres on the sanctuary; however, our population estimates include only a small fraction of females and cannot be effectively compared.

Local population sizes and reproductive success of black-throated blue warblers may largely regulated by crowding and the density of neighbors. In a density-reduction experiment by Sillet, et. al (2004), reproductive success, territory size, and foraging time was increased on

territories in which neighbors were removed relative to control sites. In small-scale, high quality habitat, such as the 14-acre patch of dense mountain laurel on the Rockwell Sanctuary, territories, prey abundance and other resources are limited. We do not have enough data collected to make conclusions regarding the dynamics of black-throated blue warblers on our site, but it will be interesting to see whether crowding is affecting population and reproductive success from future analyses.

Many limits to interpreting point count survey analyses exist and adjusting for observer biases ranges widely. The number of birds counted is always a proportion of the true population as many birds go undetected whether as secretive females, as busy parents feeding young, or having become startled away by surveyors, and the limits to interpreting our data is briefly discussed.

During our survey, detection probability fell as we were knowingly estimating bird distances without complete accuracy, and fell even more so as the breeding season progressed and fewer birds were active relative to the month of May. These biases result in very low population estimates. Also, while the point count sampling area was most likely adequate in surveying breeding birds across the sanctuary, doubling individuals is a limiting concern for data interpretation, as well. Doubling, or having detected same individuals more than once at a plot, may have occurred more often during surveys in 2010 and 2011, and therefore may particularly explain why the estimated population size of black-throated blue warblers were larger in previous years.

Future Recommendations

The intensity of the research performed in 2012 positively increased the number of species detected, the number of black-throated blue warblers banded and nests monitored. If future research on this project will desire similar outcomes, recruiting skilled avian surveyors and dedicating clear times to complete particular objectives is emphasized.

In conducting the breeding bird census in future years, recruiting two skilled avian surveyors in bird aural and visual identification is recommended. Knowing the differences between the vocalizations of complex or similar sounding birds, such as the red-eyed vireo and blue-headed vireo, can dramatically change the abundance of species and overall richness detected. Knowledge about habitat preference and typical breeding ranges is also helpful in determining which species can be affirmatively detected in the field.

Recruiting avian surveyors with mist netting and nest searching experience is highly recommended to conduct safe and efficient banding and nest monitoring. Currently unknown to the sanctuary (only one recapture in each year 2011, 2012), information on site fidelity and annual return rates can be determined if an abundance of male black-throated blue warblers is banded every research season. Nest searching in mountain laurel is time consuming and should not be performed intermittently between point count surveys – more nests will be found if time is dedicated to following females, including re-nests after nest failures and second nests after successfully fledging a first, or intensively searching the habitat.

Finally, more time should be dedicated to territory mapping if male territory sizes and an estimated abundance of males on the property is desired. Overall, if there are too many tasks and too few experienced surveyors to complete them, the result may be more fragmented and less carefully collected data.

Acknowledgements

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Appendix (a): Breeding bird point count survey results from years 2010 to 2012; definitions of species four-letter codes can be found in Appendix (b). FOY = first of year date a species was detected on the property in 2012, obtained with April counts. The last date a bird was detected was noted if the date was before July 1. Breeding Status refers to species range maps in Albany, NH: B = breeding, Y = year-round, W = wintering. Total species occurrences and species richness were calculated only from May 1 to July 9. * indicates the four most common birds in a given year.

Species	2012 FOY Date	Last Date Detected ~	Breeding Status	Counts from May 1 - July 9					
				Total Species Occurrences			Total Species Richness		
				2012	2011	2010	2012	2011	2010
AMCR	4/24		B	38	10	31	59	48	53
AMGO	4/24		B	66	11	9			
AMRE			B	0	5	13			
AMRO	4/24		B	16	9	2			
BADO			B	0	1	0			
BAWW	5/2		B	16	24	23			
BCCH	4/24		B	147*	115*	84			
BEKI	4/25	4/25	B	0	0	0			
BHCO			B	0	0	1			
BHVI	4/26		B	52	0	10			
BLBW	5/14		B	26	17	24			
BLJA	4/24		B	95	69	39			
BRCR	4/30		B	13	0	3			
BTBW	5/6		B	127*	117*	140*			
BTNW	4/30		B	75	89	107*			
BWHA	4/25		B	4	0	3			
CAGO	4/25		B	6	2	2			
CEDW	5/28		B	15	2	6			
CHSP	4/25		B	10	8	4			
CNSW	5/5		B	6	4	8			
COGR			B	0	0	3			
COHA	4/30	4/30	B	0	0	0			
COLO			B	0	0	1			
COME			Y	0	1	0			
CORA	6/25		B	6	0	0			
COYE	5/5		B	15	1	18			
DEJU	4/25	5/2	W	1	0	0			
DOWO	4/25		B	12	15	1			
EABL	5/16		B	7	0	0			
EAKI	5/16		B	7	0	1			

Appendix (a): continued.

				Counts from May 1 - July 9		
Species	2012 FOY Date	Last Date Detected ~	Breeding Status	Total Species Occurrences		
				2012	2011	2010
EAPH	5/2		B	13	4	11
EWPE	5/13		B	24	14	25
GBHE			B	0	1	0
GCFL	5/15		B	21	10	8
GCKI	6/5	6/5	W	1	0	0
GRCA	5/22	5/22	B	1	1	2
HAWO	4/24		B	17	6	1
HETH	4/24		B	91	82	56
HOME			B	0	0	1
INBU	5/21	5/21	B	1	0	0
LOWA	4/25	6/25	B	7	7	3
MALL	4/25	6/5	B	2	0	0
MAWA	5/5		B	13	13	18
MODO	4/30	5/21	B	1	4	6
NAWA	5/5	6/5	B	4	8	2
NOFL	4/24		B	12	3	3
NOPA	5/6	5/6	B	1	1	0
NOWA	5/22	5/22	B	2	0	0
OVEN	5/5		B	173*	221*	252*
PISI	4/24	5/14	W	20	0	0
PIWA	4/24		B	117	74	61
PIWO	4/24		B	9	5	0
PUFI	4/25	6/5	W	2	1	0
RBGR	5/5		B	13	0	1
RBNU	4/24		B	56	0	6
WBNU	4/25		B	24	31	50
RCKI	4/25	5/5	B	2	0	0
REVI	5/14		B	160*	152*	152*
RSHA	4/25	4/25	B	0	0	0
RTHU	7/9	7/9	B	3	0	1
RUGR	4/30	5/22	B	8	7	2
RWBL	4/25	6/11	B	3	3	1
SCTA	5/13		B	33	16	46
SOSP	4/29		B	3	0	0
SSHA			B	0	0	1
TRES	4/25	6/25	B	12	3	13

Appendix (a): continued.

				Counts from May 1 - July 9		
Species	2012 FOY Date	Last Date Detected ~	Breeding Status	Total Species Occurrences		
				2012	2011	2010
TUTI	4/25	4/30	B	0	6	13
WITU	4/29	4/29	B	0	0	8
VEER	5/21		B	29	27	36
WIWR	4/25	4/29	B	0	2	0
WODU			B	0	1	0
WOTH	4/25	5/16	B	4	18	7
WTSP	4/30	5/5	Y	11	0	0
YBSA	4/25		B	65	25	52
YRWA	4/24		B	18	15	5

Appendix (b): List of all species detected in years 2010 through 2012 and their 4-letter codes; 75 species total.

AMCR	American crow
AMGO	American goldfinch
AMRE	American redstart
AMRO	American robin
BADO	Barred owl
BAWW	Black-and-white warbler
BCCH	Black-capped chickadee
BEKI	Belted kingfisher
BHCO	Brown-headed cowbird
BHVI	Blue-headed vireo
BLBW	Blackburnian warbler
BLJA	Blue jay
BRCR	Brown creeper
BTBW	Black-throated blue warbler
BTNW	Black-throated green warbler
BWHA	Broad-winged hawk
CAGO	Canada goose
CEDW	Cedar waxwing
CHSP	Chipping sparrow
CNSW	Chestnut-sided warbler
COGR	Common grackle
COHA	Cooper's hawk
COLO	Common loon
COME	Common merganser
CORA	Common raven
COYE	Common yellowthroat
DEJU	Dark-eyed junco
DOWO	Downy woodpecker
EABL	Eastern bluebird
EAKI	Eastern kingbird
EAPH	Eastern phoebe
EWPE	Eastern wood pewee
GBHE	Great blue heron
GCFL	Great-crested flycatcher
GCKI	Golden-crowned kinglet
GRCA	Grey catbird
HAWO	Hairy woodpecker
HETH	Hermit thrush

HOME	Hooded merganser
INBU	Indigo bunting
LOWA	Louisiana waterthrush
MALL	Mallard duck
MAWA	Magnolia warbler
MODO	Mourning dove
NAWA	Nashville warbler
NOFL	Northern flicker
NOPA	Northern parula
NOWA	Northern waterthrush
OVEN	Ovenbird
PISI	Pine siskin
PIWA	Pine warbler
PIWO	Pileated woodpecker
PUFI	Purple finch
RBGR	Rose-breasted grosbeak
RBNU	Red-breasted nuthatch
WBNU	White-breasted nuthatch
RCKI	Ruby-crowned kinglet
REVI	Red-eyed vireo
RSHA	Red-shouldered hawk
RTHU	Ruby-throated hummingbird
RUGR	Ruffed grouse
RWBL	Red-winged blackbird
SCTA	Scarlet tanager
SOSP	Song sparrow
SSHA	Sharp-shinned hawk
TRES	Tree swallow
TUTI	Tufted titmouse
WITU	Wild turkey
VEER	Veery
WIWR	Winter wren
WODU	Wood duck
WOTH	Wood thrush
WTSP	White-throated sparrow
YBSA	Yellow-bellied sapsucker
YRWA	Yellow-rumped warbler