

Examining Breeding Habitat of *Setophaga caerulescens* (Black-throated Blue Warbler) in Northeastern Forests

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Introduction

Background

- Setophaga caerulescens* (the Black-throated Blue Warbler or "BTBW") is a small forest dwelling member of the family Parulidae
- Breeds primarily in undisturbed mixed deciduous-coniferous forests [1]
- Nests low to ground in thick shrubs [1]
- Potential to double-brood in productive years [1]
- Current climate models predict breeding range will decrease in the next 50 years [2]



Figure 1: Male BTBW in breeding plumage
Source: Cornell Lab of Ornithology

Objectives & Hypotheses

- Compare BTBW occupancy on two forested sites; one where selective and small gap timber harvests have been conducted and the other where timber harvest has not occurred.
- Determine the effect selective timber harvest and Mountain Laurel (*Kalmia latifolia*) presence have on BTBW breeding season occupancy
- We hypothesize that the site with selective harvest (Bear Paw) would show greater BTBW occupancy



Figure 2: Range of BTBW
Source: Cornell Lab of Ornithology

Point Counts

- TMCC performed occupancy surveys for BTBW as part of an ongoing long term songbird monitoring project
- 44 total points spaced 150 meters apart
 - 28 points in Bear Paw Timberland
 - 16 Points in Rockwell Sanctuary
- Three replicate surveys each year between May-July, 2012-2020
- Surveys completed between 30 minutes before sunrise and 3 hours after sunrise
- 5 minute survey, auditory and visual detection, 50m search radius

Vegetation Surveys

- Performed in August of each year
- Three sub plots associated with each point count station
- Groundcover, mid-story, and canopy measurements taken to assess vegetative structure and composition

Data Analysis and Modeling

- We estimated probability of occupancy at each point with single-species occupancy models using the R package 'unmarked' [3]
- Detection and occupancy level covariates were measured during each survey and used to inform our occupancy model
 - ψ_i – the probability that BTBW is present at site i
 - p_{ij} – the probability BTBW will be detected at site i and time j while present
- All data is fitted to the standard occupancy model [3] based on zero-inflated binomial models and covariates are selected to inform our study's primary model
- Significance threshold of $p < .05$ for each covariate to remain used in modeling
- Model selected hierarchically using Akaike Information Criterion (AIC)

Detection covariates (p)	Influence observer's ability to detect an individual BTBW during survey
Low temperature	Daily low temperature sourced from NOAA
Average temperature	Daily avg. temperature sourced from NOAA
Date	Survey date converted to Julian format
Occupancy covariates (ψ)	Influence probability that a BTBW actually occupied a survey point
Site	Rockwell or Bear Paw
Basal area (ft ² /ac)	Total area of all tree stems at 1.3m height
Canopy cover (%)	Percent of sky covered by vegetation above survey point
Average DBH of trees (in.)	Average DBH of all trees above 4 in DBH in sample plot
Sapling ground cover (%)	Percent of ground covered by sapling vegetation in sample plot
Mountain laurel presence	Was mountain laurel detected on veg survey?
Within laurel grove	Is the point within 50m of Rockwell's mountain laurel grove boundaries

Table 2: Detection and Occupancy level covariates used within occupancy model. Note that "Mountain Laurel Presence" will change points each year based on vegetation surveys, while "Within Laurel Grove" is assigned to the same points each year.

Results

Site	Number of Surveys	Number of Detections	Detection Ratio
Rockwell Sanctuary	432	107	0.25
Bear Paw Timberlands	729	275	0.38
Total	1161	382	0.33

Table 3: Comparison of surveys and detections across our survey

Modeling Results

- Most parsimonious model included: p (survey day low temperature) ψ (Site + Sapling Cover + Mountain Laurel Presence + Point Within Mountain Laurel Grove)

- Bear Paw Timberland has higher occupancy probability versus the Rockwell Sanctuary when controlling for vegetative characteristics
- Both Sapling Ground Cover and Average DBH of trees within sample area show a positive correlation with occupancy probability when isolated

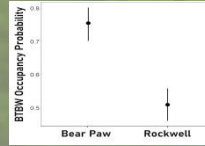


Figure 4: Predicted BTBW occupancy at both sites with 95% CI

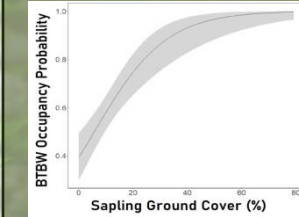


Figure 5: Predicted BTBW occupancy within our model against sapling ground cover

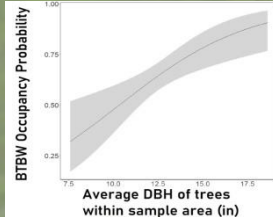


Figure 6: Predicted BTBW occupancy within our model against average DBH of trees in sample plot

Discussion

- Occupancy models suggest that BTBW occupancy is more likely in areas with high sapling cover, presence of Mountain Laurel, and within Bear Paw (the harvested site)
- Selective timber harvest appears to positively correlate with BTBW occupancy probability
- BTBW occupancy is positively associated with mountain laurel where present
- Increasing sapling cover (along with high canopy cover) is likely to increase the probability of BTBW occupancy

Next Steps

- Use abundance and spatial distribution modeling to better understand how selective timber harvest is affecting population of BTBW as well as other species over time
- TMCC will continue to survey both sites during the breeding season
- Monitor forest vegetative characteristics over time
- Monitor forest BTBW occupancy over time
- Study harvest levels within Bear Paw to compare finer distinctions in harvest type at the stand level, especially considering single and group selection individually
- Use future years of monitoring data to study post-harvest age and its effect on BTBW occupancy

Literature Cited

- [1] Holmes, Richard T., et al. "Multiple brooding and productivity of a Neotropical migrant, the Black-throated Blue Warbler (*Dendroica caerulescens*), in an unfragmented temperate forest." *The Auk* 109.2 (1992): 321-333.
- [2] BirdLife International. 2018. *Setophaga caerulescens*. The IUCN Red List of Threatened Species. 2018. <https://doi.org/10.2305/IUCN.LK.2018.2.RLTS.T27221673A131888443.en>. Downloaded on 24 February 2021.
- [3] MacKenzie, D.L., Nichols, J.D., Lachman, G.B., Droege, S., Andrew Royle, J., and Langtimm, C.A. (2002). ESTIMATING SITE OCCUPANCY RATES WHEN DETECTION PROBABILITIES ARE LESS THAN ONE. *Ecology*, 83: 2248-2255. Cornell Lab of Ornithology. 2019. All About Birds. Cornell Lab of Ornithology. Ithaca, New York. <https://www.allaboutbirds.org> Accessed on [2/25/2021].

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Methods & Materials

Study Area

- Study occurred at Tin Mountain Conservation Center's (TMCC) Rockwell Sanctuary and Bear Paw Timberland located in Carroll County, New Hampshire
- Landscape defined by rocky soil and hilly terrain
- Elevation of ~150 m at each site



Figure 3: Aerial image of study area captured summer 2016 by USGS NAIP

Bear Paw Timberland

- 459 Acres
- Mixed northern hardwood / hemlock pine forest
- Managed using single tree and group selection timber harvest
- Cuts occurred in 2008, 2010, 2011, 2012

Rockwell Sanctuary

- 146 Acres
- Mixed northern hardwood / hemlock pine forest
- Managed for recreational and educational use
- No timber harvest
- Home to northernmost Mountain Laurel grove in North America

Table 1: Comparison of Bear Paw Timberland and Rockwell Sanctuary