Jessica Gorchow
Taylor Forrest
Angela Rondon-Begazo

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Insectiverous Song Bird Distribution near Bodies of Water

A case study on Red-eyed Vireos near Douglas Lake in Pellston, Michigan

Abstract

Populations of birds are often limited by food abundance (Martin 1987) and other studies have shown a correlation between insect abundance and relative bird density (Holmes and Sherry 1988, Iwata et al. 2003). Consequently we predicted that Red-eyed Vireo (*Vireo olivaceus*) densities will be higher near the shore of Douglas Lake, Pellston Michigan, than further inland from the lake because there is likely to be a larger and more diverse population of insects, both aquatic and terrestrial, compared to areas further from lake, where insect populations are likely to be mostly terrestrial. However, we did not find a significant difference between the density of Red-eyed Vireos at shoreline and inland sites. However, our results must be interpreted cautiously given methodological limitations associated with our work.

Introduction

Food often limits populations of birds in temperate habitats (Martin 1987). For example, Williamson (1971) investigated how small insectivorous birds, including Red-eyed Vireo, utilize a common space for foraging in the deciduous woodland of Maryland and found that foraging movement patterns likely resulted from exposure to varied food types and were also related to environmental changes. A long term study by Holmes and Sherry (1988) examined changes in abundance of 19 forest-dwelling, mostly migratory, bird species breeding in New Hampshire found that the Red-eyed Vireo population positively correlated with an irruption of caterpillars that occurred in the first 2-3 years of their study. They found that the abundant mid-summer food source correlated with high survivorship and high returns of birds in subsequent years. Rodenhouse (1986) also found that summer food may limit temperate forest birds by demonstrating that the abundance and availability of food significantly affect the following: frequency of re-nesting, second-brood attempts, nestling starvation, growth rates, fledging and hatching success, and to some extent clutch size of breeding passerines.

However, food limitation may be less severe for foliage gleaning passerines where aquatic insects supplement insect availability on foliage. How breeding, insectivorous songbirds respond to the influx of aquatic insects is little known. Aquatic insect abundances decline with increasing distance from a body of water (Petersen et al., 1999; Delettre & Morvan, 2000; Power & Rainey, 2000; Iwata et al., 2003). Iwata et al. (2003) hypothesized that large, meandering rivers generally had higher numbers of aquatic insects emerging per unit area of forest, which could maintain greater populations of birds during spring compared to populations further from the water. They found that an increase in aquatic insect density by stream meanders increased the abundance of insectivorous birds in the study area.

Based on these studies we predicted that Red-eyed Vireo (*Vireo olivaceus*) densities will be higher near the shore of Douglas Lake, northern Michigan, than further inland from the lake because there is likely to be a larger and more diverse population of insects, both aquatic and terrestrial, compared to areas further from lake, where insect populations are likely primarily terrestrial. Our work will provide further insight regarding the complex interactions that govern the distribution of insectivorous songbirds in northern hardwood forests during the breeding season.

We selected the Red-eyed Vireo for this study because it is very common in mixed northern hardwood forests (Sibley 2000), they forage primarily on insects (Chapin 1925), including Lepidoptera, Coleoptera, Diptera, and Hemiptera (Cimprich et al. 2000), on foliage (Williamson 1971, Stokes 1979) and they are easily detectable because of their frequent vocalizations (Sibley, 2000).

Methods

Red-eyed Vireos were sampled in mixed northern hardwood forest near the shore of Douglas Lake, Emmet County, Michigan (Latitude: 44.92, Longitude: -84.45). The forest has a canopy height ranging from 9 to 15 meters and is composed coniferous and deciduous trees including *Populus grandidentata, Pinus strobus, Acer rubrum, Fagus grandifolia, Acer saccharum, Fagus grandifolia, Quercus rubra, Betula papyrifera,* and *Pinus* seedlings (Moore, 1980).

To determine abundance of Red-eyed Vireos, we established 22 point count stations for sampling, 12 along the shoreline of Grapevine Point and 10 inland. We followed the Point-Count protocol as described in Huff et al (2000) with a few modifications required for the purposes of our particular study. We placed the centroids of our stations 200 meters apart along the shoreline. However, due to landscape limitations at Grapevine Point, such as size and change in type of ecosystem, each inland station's centroid was separated by only 60 meters from the centroid of each shoreline station rather than the minimum 125 meters apart recommended in the Huff protocol (Huff, 2000). However, we thought that this may be a sufficient distance for observing a change in distribution of insects based on the protocol used in Iwata et al (2003), which found a significant, negative relationship in the dry mass (milligrams) of emergent aquatic insect collection between distances of 0 to 60 meters from the stream. Each point count station had a 25-meter radius with their centroids 200 meters apart from each other. Each centroid was marked with a flag placed in the ground and the perimeter of the plots were marked by flagging tape tied to trees located 25 meters from the centroid flag in each of the four cardinal directions. We placed each shoreline centroid approximately 18 meters (60 feet) from the shore. The inland station centroids were placed 78 meters away from the shore (60 meters from the centroid of their paired shoreline study plot).

Red-eyed Vireos were counted at all 22 sites. We conducted our surveys during the second week on 8 and 10 June 2011 from 05:30 -10:00. (UMBS Census Protocol). Study plots 1, 2, 5, 13, and 17 were sampled on 8 June 2011 between 06:54 - 07:30 while the remaining plots were sampled on 10 June between 07:05 - 09:56. While we had intended to conduct all sampling on June 8, 2011 in order to control for weather conditions, a severe storm, unsuitable for conducting point counts, prevented us from finishing the sampling on the eighth, thus requiring the second sampling day.

Each point count was conducted by two observers; observers were randomly grouped and assigned point count stations randomly. Both observers of each team conducted point counts simultaneously on individual data sheets (Appendix). Team members then compared their results and reconciled differences immediately after finishing each point count.

Abundance of aerial insects was estimate by order of magnitude, 1-10, 11-100, 101-1000, (Ewert, personal communication, June 4, 2011) within a 1-meter radius from the centroid of the study plot during a 10 second period.

Results

The density of Red-eyed Vireo between shoreline and upland sites fluctuated between each site, ranging from zero to three Red-eyed Vireos in each site. The average abundance of Red-eyed Vireo at the shoreline was 1.6 compared to 1.5 birds per site at upland sites (Table 1). The average insect density was 1.17 in the shoreline and 1.0 in the upland sites (Table 2). It was determined by using skewness and Kurtosis measures that the distribution of the Red-eyed Vireo point counts and insect density in the shoreline were normally distributed, however, the insect population in the upland area was not normally distributed. Normality was assessed by comparing normalized measures of skewness and Kurtosis to the standard normal distribution. A paired t-test showed that the difference between the density of shoreline and upland birds was not significant, as the two-tailed p-value was 0.72 (Table 3). No pattern between shoreline and upland bird densities was found as illustrated by a bar chart (Figure 1). In brief, no statistical significance was found between the abundance of Red-eyed vireo in shoreline or upland areas.

Table 1 - Relative Red-eyed Vireo abundance at Grapevine Point based on 25 m radius point counts.

Relative abundance of Red-eyed Vireo									
	N	Minimum	Maximum	Mean	Std. Error	Skewness		Kurtosis	
						Statistic	Std. Error	Statistic	Std. Error
Shoreline	12	0	3	1.6	0.9962	-0.2740	0.637	-0.654	1.232
Upland	10	0	3	1.5	1.0801	0	0.687	-1.032	1.334

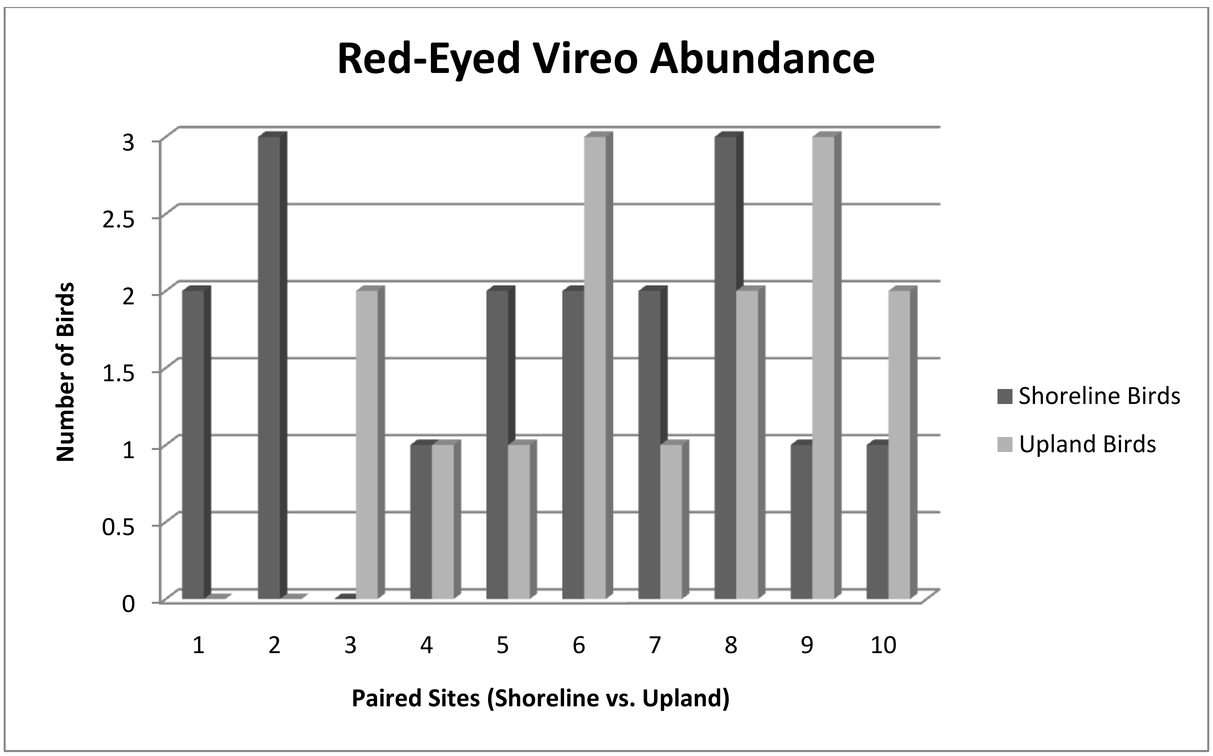
Table 2 - Insect abundance at Grapevine Point

Relative Abundance of Insect									
	N	Minimum	Maximum	Mean	Std. Error	Skewness		Kurtosis	
						Statistic	Std. Error	Statistic	Std. Error
Shoreline	12	1	2	1.2	0.39	2.055	0.637	2.640	1.232
Upland	10	1	2	1	0	-	-	-	-

Table 3 – Comparison of abundance of Red-eyed Vireos between shoreline and upland sites.

Paired T-test of Shoreline and Upland Statistics								
	Paired Differences							
	Mean	Std. Dev.	Std. Error	95% C.I. of Difference		t	Degrees of freedom	Significance (1 tailed)
				Lower	Upper			
Shoreline – Upland	.20	1.69	0.5333	-1.007	1.4065	0.375	9	0.356

Figure 1 - Red-eyed Vireo density showed no pattern among any of the stations tested



Discussion

We found no patterns between Red-eyed Vireo density or insect abundance and their distance from the shore of Douglas Lake. However, because there was no statistical significance in any of our results we can neither confirm nor refute our hypothesis. Our study, therefore, does not provide further insight regarding the complex interactions that govern the distribution of insectivorous songbirds in northern hardwood forests during the breeding season. These inconclusive results are most likely the result of weaknesses in the experimental design and execution of the data collection.

Several potential problems likely inhibited the quality of our data. Firstly, there was a lack of control for other variables in both execution of the data collection and in the experimental design. Splitting the data collection into two different days with some plots sampled in one weather condition and the other plots sampled in drastically different weather conditions removed experimental control over weather as a variable. The first day of our study was warm (26 – 28 degrees Celsius), pre-thunderstorm conditions with thunder heard in the distance, while the second day of our study was significantly cooler (10 – 11 degrees Celsius). We also did not control for differences in vegetation density or strata, which may have been a confounding variable affecting the density of Red-eyed Vireos and/or insect abundance.

The sample size of our study was small which limits our ability to detect distributional patterns. . It may be that our inland stations were too close to the shoreline stations since their centroids were 60 m apart versus the recommended minimum of 125 m (Huff et al. 2000). We believed the 60 m from the water was sufficient given the methods outlined in Iwata et al. (2003) but insect abundance and species composition likely differ between Douglas Lake and stream systems in Japan. If aquatic insects disperse further from Douglas Lake than some Japanese streams then our experimental design may have been inadequate to evaluate how Red-eyed Vireos respond to the influx of aquatic insects.

Results are not consistent with Iwata et al. (2003) who found that large, meandering rivers generally had higher numbers of aquatic insects emerging per unit area of forest, which allows for a higher population density of insectivorous birds as compared to that found further from the shore of the river.

As assessment of insect abundance can vary with the sampling method used Hutto (1990), additional work to best distinguish aquatic from terrestrial insects would be informative and then how to best quantify their distribution is needed.

Further evaluation of insectivorous bird density in relation to proximity of water is needed. This would best be done with improved methodology. First of all, the size of our selected area, Grapevine Point, was extremely constraining due to the change of forest to open habitat, bog ecosystem, and the boundaries of Douglas Lake. Because the area of hardwood deciduous forest was limited in size, we were unable to establish a sufficient number of point count stations or sufficient space between them. Future studies should expand the site scope to include other natural areas around Douglas Lake beyond Grapevine Point, controlling for habitat type. Additionally, we observed that aquatic insect hatches were distributed further inland than initially anticipated. Therefore, we recommend that inland point count stations be separated by a greater distance from the shoreline than the 60 m employed in our study. Future studies should consider a minimum distance of 125 m and should scout the area to insure sufficient distance away from aquatic insect hatching sites.

We also recommend using a more accurate and continuous metric for observing insect density data as opposed to the categorical estimations that we used in our study. An improved method would include setting insect traps or providing measurements of Red-eyed Vireos foraging time, an implication of greater insect abundance (Hutto 1990).

A strength of our study was that it was conducted in the first two weeks of June, during which has previously shown correlation between migrating bird species densities and insect densities allows for prime access to migrating bird species and mating behaviors that include foraging, as well as the time correlation with aquatic insect hatches (Graber and Graber 1983, Martin and Karr 1986). We recommend that a similar study in Douglas Lake area be conducted at the same as this study was conducted.

Our results were not conclusive, perhaps due to a combination of our sample size, selected study site, and sampling methods. Although our results are not consistent with Iwata et al, (2003), Our study provides a foundation for further investigation of insectivorous bird distributions related to their distance from water within the Douglas Lake area.

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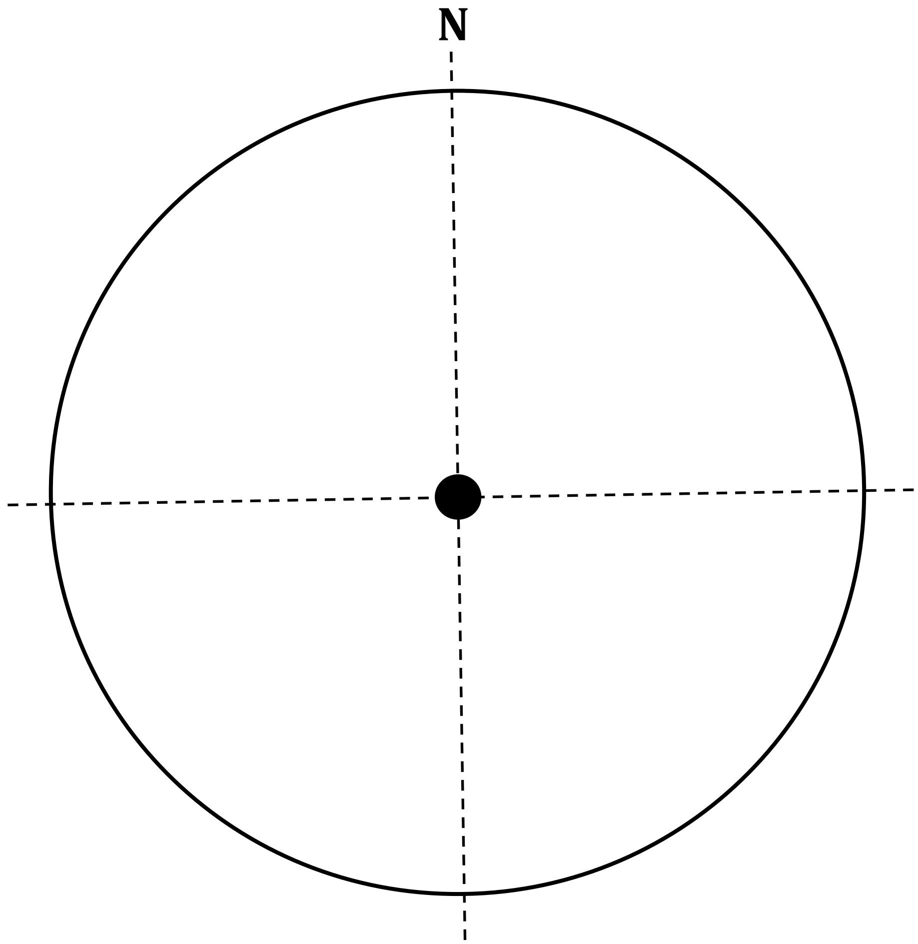
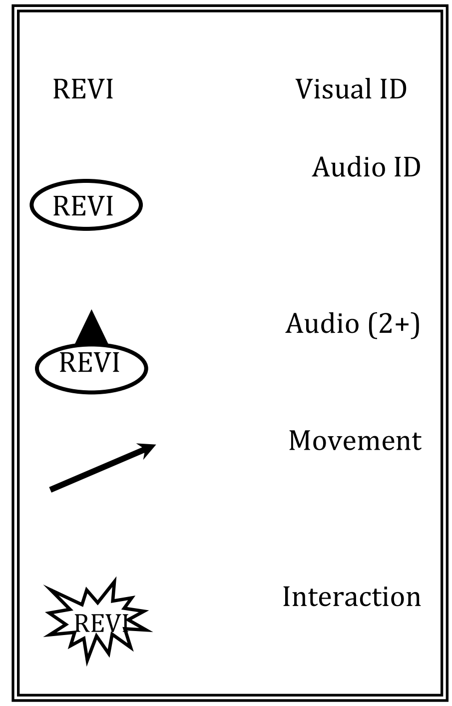
Appendix – Data Collection Sheet





Plot #	
Start Time:	
Date:	
Observers:	
Weather: Temperature, Sky, Wind	

Period (Minutes)	Number of REVI Observations
1-3:20	
3:21-6:40	
6:41-10:00	
Final Observation Count	

Insect Observation (1m from flag)	
Order of Magnitude (# of Individuals)	**✓ Check**
0-10	
11-100	
101-1000	

Other Species Observed: