The American Redstart (*Setophaga ruticilla*), Insects, and Foliage on Douglas Lake, Michigan

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Abstract— This study investigated whether there is a correlation between American Redstart (*Setophaga ruticilla*) distribution and foliage density, as well as a correlation between insect density and American Redstart distribution in a deciduous forest on Douglas Lake, Michigan. Birds were counted by observing and listening to American Redstarts as they sang early on four mornings at ten selected points in this forest. At the same ten points, understory foliage density was scored and sticky traps were set up to collect insects, spanning eight days. A linear regression and scatter plot with a best fit line calculated by SPSS revealed a significant positive correlation ($R^2 = 0.76$) between the average number of American Redstarts at a given data collection point and its corresponding foliage density score, which supported the hypothesis that there would be more American Redstarts in areas with more foliage. The results concerning insects obtained from statistical analysis in SPSS did not support the hypothesis that there would be a positive correlation between arthropod density and American Redstart density. This information can be used in maintaining the habitat of the American Redstart and related species.

Abstract

This study investigated whether there is a correlation between American Redstart (*Setophaga ruticilla*) distribution and foliage density, as well as a correlation between arthropod density and American Redstart distribution in a deciduous forest on Douglas Lake, Michigan. Birds were counted by observing and listening to American Redstarts as they sang early on four mornings at ten selected points in this forest. At the same ten points, understory foliage density was scored and sticky traps were set up to collect insects, spanning eight days. A linear regression and scatter plot with a best fit line calculated by SPSS revealed a significant positive correlation (R^2 = 0.76) between the average number of American Redstarts at a given data collection point and its corresponding foliage density score, which supported the hypothesis that there would be more American Redstarts in areas with more foliage. The results concerning arthropods obtained from statistical analysis in SPSS did not support the hypothesis that there would be a positive correlation between arthropod density and American Redstart density. This information can be used in maintaining the habitat of the American Redstart and related species.

Introduction

The American Redstart is a common bird in northern Michigan, where it breeds primarily among deciduous, rather than coniferous forests (Sherry and Holmes 1997). The species exhibits delayed plumage maturation. Adult males in their first breeding season are olive-gray with yellow patches in the tail, wings, sides, and flanks, while older adult males are black with orange patches. Older adult males typically obtain resource-rich territories, including aquatic insects (Sherry and Holmes 1989, Smith et al. 2004). American Redstart density is affected not only by their preference for deciduous trees, but also by proximity to shore (Smith et al. 2004). At a finer scale, American Redstart density is affected by insect availability (Hunt 1996), resulting in higher American Redstart densities where there is more foliage and more insects (Baker 1944).

We investigated the American Redstart's niche in Michigan forests relative to food availability by

evaluating American Redstart density in relation to arthropod abundance in the understory foliage density and a portion of the air column in a mixed hardwood forest on the shoreline of Douglas Lake, Michigan. We predicted there would be a greater abundance of American Redstarts closer to the shore because we predicted there would be relatively higher densities of aquatic-borne arthropods producing a resource-rich zone, and thus higher quality habitat. We also expected to find a positive correlation between American Redstart density and foliage density. Results of this work will refine our knowledge of American Redstart habitat preference, especially in relationship to the potential additional insect availability provided by aquatic systems. These results should provide information that defines good redstart habitat and thus further conservation efforts for the American Redstart, and associated bird species.

Methods

Data were collected in a mature, mixed northern hardwood forest along Douglas Lake, Cheboygan County, Michigan at the University of Michigan Biological Station. We sampled vegetation structure, aerial and terrestrial arthropods, and avian abundance along five transects perpendicular to Douglas Lake. Transects were 100 m apart so that different territorial redstarts were counted at each point. Point count stations were established along each of the five transects 25 m and 85 m from the lake shore.

At each point count station we scored canopy cover, vegetation structure below 8 m, arthropod abundance, and bird abundance within a 25 m radius.

At each of the ten data collection points, nine foliage scores were taken: At the center point, at four equidistant points on the 25 m radius circle, and the four mid-way points (12.5 m). Nudds foliage density index was employed for foliage density scoring, excepting the following amendments. A PVC pole was used with two foot (0.61 m) high layers painted half white and half red. Layer 1 was 1-1.61 m, layer 2 was 1.61-2.22 m, layer 3 was 2.2-2.83 m, and layer 4 was 2.83-3.44 m. Foliage density data

collection began 1 m off of the ground because American Redstarts rarely forage below 1 m. At each point the pole was used, the foliage was scored on a scale of 1-5 (1=0-20%, 2=21-40% etc.) from 10 m away in a random direction to control for perspective and visibility in the forest. Additionally, a cylinder was held straight up at each data collection point and canopy cover was estimated and scored on the same scale of 1-5.

Aerial insect sampling was assessed by placing 12.5 cm by 10.1 cm sticky traps at the center of each point count station. Each trap was placed 1.5 m above the ground to coincide with the foraging height of American Redstarts that was observed along the Grapevine Trail. Sets of sticky traps were up from the 22nd to the 26th of July, 2009, and the 26th to the 31st of July, 2009. Insects observed on the traps were classified by order or family and recorded. Insects considered to have aquatic larvae (those in the taxa Diptera, Chironomidae, Simuliidae, and Trichoptera) were analyzed separately from all other aerial insects that we assumed were terrestrial in origin.

Aquatic and terrestrial arthropods were sampled in the same locations used for bird sampling. Foliage arthropods were sampled by counting the number of invertebrates on the upper and lower surfaces of the foliage of each plant intercepted at breast height along each of the 25 m transects in each cardinal direction. All foliage arthropod sampling was performed in one day to avoid variation in insect density due to factors such as weather differences and hatch dates. Sampling for foliage insects took place on the 26th and 29th of July 2009. Numbers and approximate size (mm) of arthropods were recorded; size was recorded in three size classes (small < 5 mm, medium 5-15 mm, large > 15 mm).

To determine the density of singing male American Redstarts as a function of distance from Douglas Lake, we spot mapped the location of American Redstarts within 25 m radius point count stations. At each data collection point, observers listened and watched for ten minutes and recorded the approximate location of American Redstarts and any other bird species heard or seen. We attempted to locate all of the American Redstarts by sight that were heard in the point count stations to determine if

the American Redstarts heard were SY (second year) males or ASY (after second year) males. Data were collected on 12th, 14th, 16th, and 17th of July between 05:45 and 07:15 EDT. Observers were rotated between data collection days to avoid observer bias. The data for American Redstart density were averaged for each of the ten sites to avoid counting the same bird twice and skewing the data.

We ran regressions in SPSS to find correlations between: Average number of American Redstarts and average density scores, both for ten sites; and average number of American Redstarts and each of the four foliage layers. We used the *Mann Whitney U* test in SPSS to look for relationships between: Mean distance from shore and mean number of American Redstarts; total number of insects and distance from the shore; number of terrestrial arthropods and distance from the shore; number of aquatic insects and distance from the shore; and number of aerial insects and distance from the shore. Finally, SPSS was used to calculate a Pearson correlation between American Redstart distribution and aerial arthropods.

Results

The density of male American Redstarts was variable among the ten different study sites, with average densities ranging from 0 to 3.5 birds per site; however, the overall density of American Redstarts did not significantly differ related to distance from the shore (Mann-Whitney; U = 273.5; p = 0.441). The average understory vegetation score per site ranged from 1.42 to 3.25. The distribution of male American Redstarts correlated positively with understory vegetation density. Linear regression analysis showed that the correlation between American Redstart distribution and understory vegetation density is significant (R-squared = 0.76).

The total amount of arthropods close to shore is significantly greater than the total amount of arthropods far from shore (Mann-Whitney; U = 0.00; p = 0.009). We found that terrestrial arthropod density decreased with distance from the shore (Mann-Whitney; U = 0.00; p = 0.009), but aquatic arthropod density did not significantly decrease with distance from the shore (Mann-Whitney; U = 9.5; p

= 0.525). There are significantly more aerial insects away from shore than close to shore (Mann-Whitney; U = 2.5; p = 0.036). Pearson correlation showed there to be a significant negative correlation between the distribution of male American Redstarts and aerial insects (Pearson correlation = -0.727; p = 0.017).

Discussion

Understory Vegetation Density

The significant correlation between American Redstart distribution and understory vegetation density supports the original hypothesis that there would be a positive correlation between understory vegetation density and the distribution of American Redstart males. This supports the results of other studies that have shown that American Redstarts are associated with deciduous forest containing high percentages of shrub cover (Collins et al. 1982). The same study also found that American Redstarts were associated with forest edges, which this study did not take into account because all but one of the study sites were located well within the forest edge. Part of site 6 was located very near a forest edge and no American Redstarts were found there during any of the four counts. A study conducted by Crawford (et al. 1981) found that in hardwood forests American Redstarts were obligate canopy dwellers. The lack of variation in canopy cover in this study over the ten study sites neither supports nor rejects this finding. However, the lack of a significant correlation between American Redstart distribution and canopy cover suggests that canopy cover does not affect American Redstart distribution in this population.

The forest in which this study was conducted contained a dirt path, approximately 2 m wide and 10-15 m away from the shore that was included in study sites 1-5. This may have created edge effects that affected American redstart distribution (Collins et al. 1982).

To further investigate why understory vegetation density correlates positively with American Redstart distribution, a study involving the distribution of insects with respect to vegetation density may

be useful. More food resource abundance may affect American Redstart habitat choice. Lesser rates of predation may also affect American Redstart habitat choice (Hunt 1996). Merlins (*Falco columbarius*) were sighted in the same forest, although none were sighted inside of any of the ten study sites. An investigation into the affect of understory vegetation density on Merlin predation rates of forest songbirds could more thoroughly explain why more American Redstarts are found in denser understory.

Arthropod Density

The observed results of arthropod sampling did not support the proposed hypothesis that if more arthropods are found closer to the shoreline of Douglas Lake, due to a more pronounced presence of aquatic insects, then American Redstart males will choose territories closer to the shoreline rather than further away. However, we found that arthropod density was positively correlated with distance from the shore, but aquatic insects showed no correlation with distance. The density of aerial insects was negatively correlated with distance from the shore, and density of American Redstarts showed a negative correlation when compared to density of aerial insects. The mean number of Redstarts was higher near the shore which coincides with the highest density of terrestrial arthropods, a potential prey source. Nevertheless, Redstarts showed no significant differences in distribution at 25 m versus 85 m from the shoreline, thus no generalizations regarding their distribution relative to short distances from large inland lakes across northern Michigan landscape can be made.

There are several possible explanations for the observed results. The time of year in which Redstart counts were made (mid-July) was not ideal, since territorial boundaries start to break down in the later months of summer (Hickey 1940). Therefore the locations of Redstarts in our data may not reflect ecological conditions at the time territories are established. Also, the numbers of aquatic insects caught on the sticky traps were lower than expected for the points closest to the shoreline of Douglas Lake. It was expected that there would be significantly more aquatic borne insects in points 25 m from the shoreline than in points 85 m from the shoreline due to emergences of aquatic insects from Douglas

Lake. However, there was no significant difference in aquatic insect numbers between points 1-5 and points 6-10. The possible explanations for the lack of aquatic insects near the shoreline include the unseasonably cold weather that could have deterred emergence of aquatic insects and the patchiness of aquatic insect hatches (Ward and Stanford 1982). The sticky traps were left out of eight consecutive days and may not have been out at the time of an aquatic insect hatch.

Previous studies suggest that abundance of aquatic insects near a shoreline is a major determining factor in territory choice in American Redstart males. In a study by Smith et al. (2004), it was found that American Redstarts preferred areas nearer to the shore of Lake Huron, where they would benefit from the influx of aquatic borne insects during aquatic insect hatches. Studies also show that more land birds are found near a shoreline, closer to midge abundant habitats, rather than areas of similar foliage further away from the shore (Smith et al. 2004).

An ideal study, conducted on American Redstart distribution based upon territory selection against a gradient of aquatic insects would take place during the time birds are selecting territories, after arrival from spring migration, during early May (Smith and Moore 2004).

References:

Collins, F.L., James F.C., and Risser P.G. 1982. Habitat Relationships of Wood Warblers (Parulidae) in Northern Central Minnesota. Oikos 39:50-58.

Crawford, H.S., Hooper, R.G., and Titterington, R.W. 1981. Songbird Population Response to Silvicultural Practices in Central Appalachian Hardwoods. The Journal of Wildlife Management 45:680-692.

Hickey, J. J. 1940. Territorial aspects of the American Redstart. The Auk 57: 255-256.

Hunt, P.D. 1996. Selection by American Redstarts along a Successional Gradient in Northern Hardwoods Forest: Evaluation of Habitat Quality. The Auk 113:875-888.

Smith, R. J. and F. R. Moore. 2005. Arrival timing and seasonal reproductive performance in a long-distance migratory land bird. Behavioral Ecology and Sociobiology 57: 231-239.

Smith, R. J., M. J. Hamas, D. N. Ewert, and M. E. Dallman. 2004. Spatial foraging differences in American

Redstarts along the shoreline of northern Lake Huron during spring migration. Wilson Bulletin 116: 48-55.

Ward, J. V. and J. A. Stanford. 1982. Thermal responses in the evolutionary ecology of aquatic insects. Annual Review of Entomology 27: 97-117.