

SELECTION OF SONG PERCHES BY CERULEAN WARBLERS

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ABSTRACT. Cerulean Warbler (*Dendroica cerulea*) populations have experienced serious declines in recent decades. Due to limited research on this species, a better understanding of habitat use and territory site selection at the regional level is needed. Within the Pleasant Run Unit of the Hoosier National Forest, Morgan-Monroe State Forest, and Yellowwood State Forest, a total of 43 Cerulean Warbler territories were mapped during 2004 and 2005. Within each territory, crown height, diameter at breast height (dbh), and species were recorded for trees used as song perches. Dbh, height measurements, and species were also recorded for trees within a 0.04 ha circle at the center of each territory. Cerulean Warbler song-perch trees were larger and taller than surrounding trees within territories. In addition, certain species were selected as song-perch trees, whereas others were avoided.

Keywords: Cerulean Warbler, *Dendroica cerulea*, song-perch trees, territory, Indiana

The Cerulean Warbler is a species of conservation concern; Breeding Bird Survey (BBS) data have demonstrated an annual population decline of 3.7% between 1966–1996 (Hamel 2000a). Only five other North American breeding bird species showed greater declines. Until recently, very little study had focused on this species (Hamel 2000b). Because of its dependence on large tracts of mature deciduous forest for successful breeding, much of its decline is likely due to extensive loss and fragmentation of forest tracts for agricultural use (Oliarnyk & Robertson 1996; Hamel 2000a).

Robbins et al. (1992) demonstrated that the Cerulean Warbler is a canopy-dwelling species. Among closely related species, this small bird spends most of its time higher in the canopy than other wood warblers (Hamel 2000a). Some studies have suggested that Cerulean Warblers use larger trees as song perches (Lynch 1981; Robbins et al. 1992; Hamel 2000a). However, given the substantial variation in habitat across its breeding range (differences in tree species composition, size of available trees, and forest tract size) and in behavioral variables (territory size and site fidelity), inquiry into song-perch tree characteristics on the regional level is essential (Ha-

mel 2000a; Jones & Robertson 2001; Roth 2004). The purpose of this study was to determine if song-perch trees are larger and taller than surrounding trees within Cerulean Warbler territories in southern Indiana. Also, selection of specific tree species as song-perches was investigated.

STUDY AREA

This study took place from 1 May to mid-August of 2004 and 2005 in the Pleasant Run unit of the Hoosier National Forest, Yellowwood State Forest, and Morgan-Monroe State Forest in Brown, Morgan, Lawrence, and Jackson counties, Indiana (Fig. 1). Historically, the Cerulean Warbler was one of the most abundant breeding warblers in the Ohio and Mississippi river valleys (Hamel 2000a). As a part of that area, forest blocks used in this study are among the largest and most unfragmented in southern Indiana.

METHODS

Bird surveys.—In each of 10 study sites, presence of male Cerulean Warblers was determined by walking seven transects within a 1.96 km² plot, with seven sampling points per transect, each point 200 m apart (Fig. 2). Transect point locations were recorded in Universal Transverse Mercators (UTMs) coordinates using Global Positioning System (GPS) receivers. To reduce edge influences, surveys were conducted > 50 m from roads. Bird surveys began 1 May, and were completed by 30

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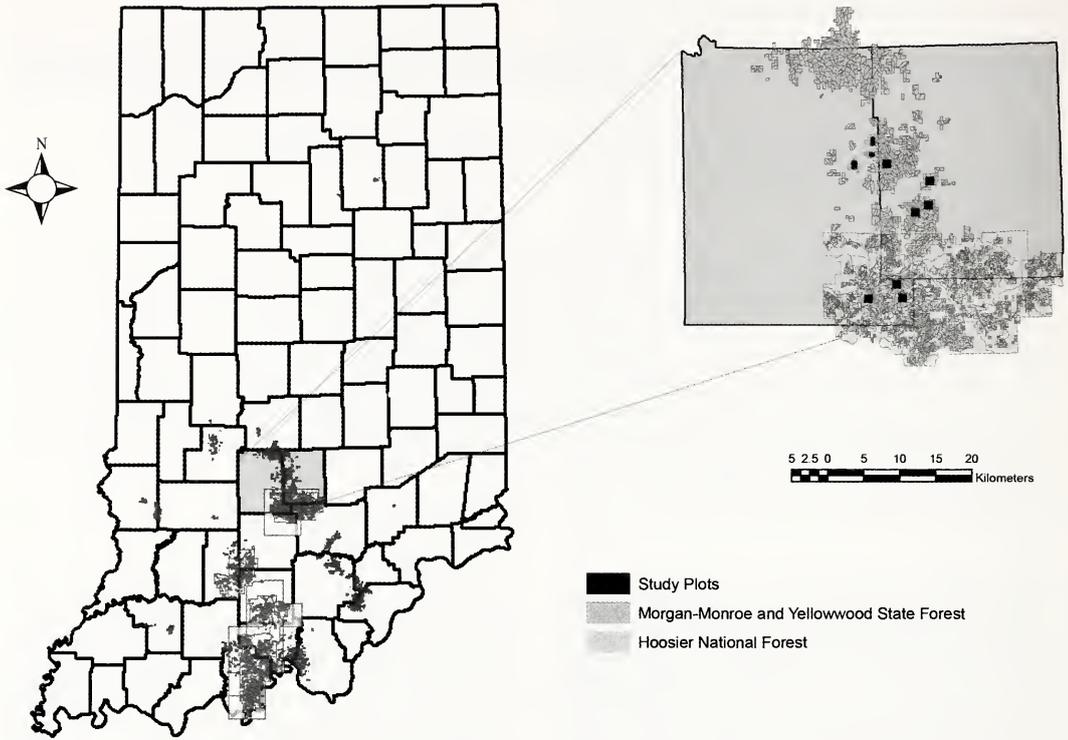


Figure 1.—County map of Indiana showing forest areas where Cerulean Warblers (*Dendroica cerulea*) were surveyed during 2004 and 2005.

May. Surveys were conducted between 0530–1030 h, excluding rainy days (presence of precipitation), when cessation or reduction of vocalizing may occur. At each survey point, 3 minutes of listening for Cerulean Warbler vocalizations commenced, followed by a 15 second playback of a conspecific male song in each of the cardinal directions to elicit a vocal response. This was followed by an additional three minutes of listening before moving to the next survey point (Falls 1981). The compass bearing and distance of detected males was estimated from the nearest transect point.

Territory mapping.—Most male Cerulean Warblers were relocated after initial detection during surveys because they maintain territories during the breeding season (Hamel 2000a). Once surveys provided the initial location of a male, territories were mapped by flagging a minimum of 5 trees in which males vocalized and perched. Singing from territory boundaries is the primary means of defending a territory and attracting potential mates (Hamel 2000a). For the purpose of this study, trees in which males vocalize are called song-

perch trees. A territory is defined as the area within the perimeter of song-perch trees. UTM's of song-perch trees were recorded for ease in returning to the territory and calculating the territory center.

Vegetation measurement and analysis.—From early July to mid-August 2004 and 2005, vegetation was sampled within each of 43 territories, using the methods of James & Shugart (1970) outlined below. In territories, a 0.04 ha circular plot was marked at the approximate center of the territory. Diameter at breast height (dbh) and height were recorded for each tree in the plot with $\text{dbh} \geq 10$ cm, and species for each tree with $\text{dbh} \geq 3$ cm. A Nikon Laser 440™ compact rangefinder was used to determine tree heights. Dead trees were measured in the same manner as live trees. Dbh, height, and species were also recorded for all song-perch trees.

Dbh, height, and species were compared between trees from territory sample plots and song-perch trees. Results were calculated using all individual trees, as well as means calculated by territory. *t*-tests were used for com-

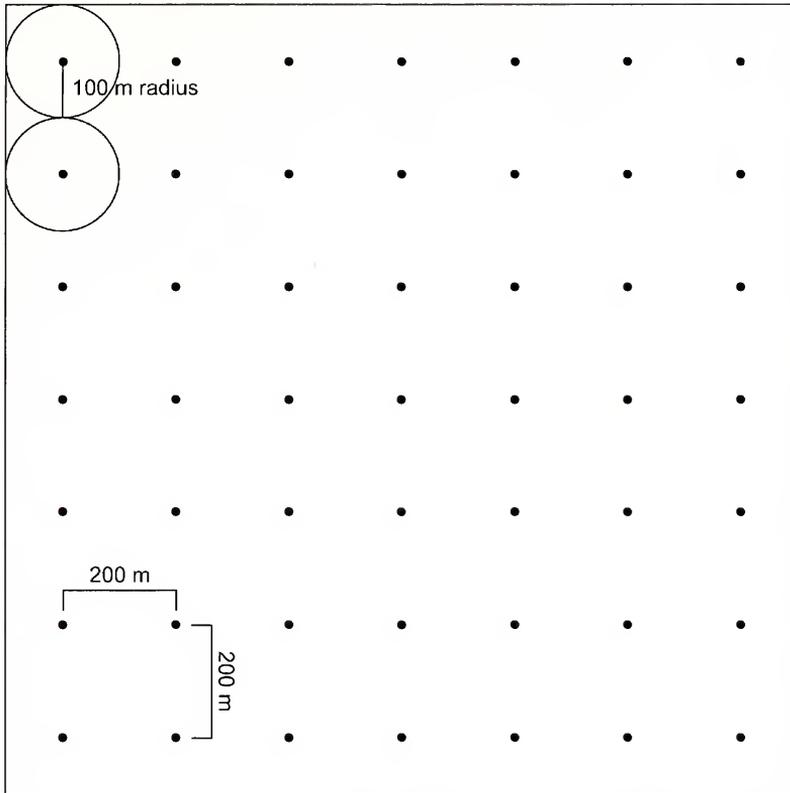


Figure 2.—The protocol utilized for Cerulean Warbler (*Dendroica cerulea*) surveys within ten study sites located in southern Indiana during the summers of 2004 and 2005. Seven transects, 200 m apart, were surveyed. Each transect contained seven points.

parison of individual trees, and paired *t*-tests were used for comparison of means. Chi-square analysis was used to compare tree species diversity between trees from sample plots and song-perch trees. Level of significance was set at $P = 0.05$.

RESULTS

Statistical analyses were computed using pooled data from 2004 and 2005. Mean values are reported as mean \pm 1 SD. Mean number of Song-perch trees was 13.8 trees per territory (range 5–27). Cerulean Warblers used significantly larger ($\bar{x} = 43.0 \pm 14.1$ cm, $n = 594$, $P < 0.001$, $t = 19.26$) and taller ($\bar{x} = 26.9 \pm 4.11$ m, $n = 591$, $P < 0.001$, $t = 18.10$) trees for song perches than the average trees available within territories ($\bar{x} = 27.4 \pm 15.6$ cm, $n = 751$; $\bar{x} = 21.5 \pm 6.04$ m, $n = 604$, dbh and height, respectively) (Figs. 3, 4). Comparison of means by territory reflected the same pattern; perch trees were larger ($\bar{x} =$

44.3 ± 6.3 cm, $n = 43$) and taller ($\bar{x} = 27.0 \pm 2.2$ m, $n = 43$) than surrounding trees ($\bar{x} = 27.7 \pm 3.71$ m, $n = 43$; $\bar{x} = 21.6 \pm 2.0$ m, $n = 43$, dbh and height, respectively) within territories (Figs. 5, 6).

Of the 39 tree species (including snags) present in territories, 12 were used more often than expected as song-perch trees (Table 1). Six species were used with less frequency than expected as song-perch trees (Table 1). Pawpaw (*Asimina triloba*), blue beech (*Carpinus caroliniana*), Ironwood (*Ostrya virginiana*), and grape (*Vitis* spp.), were never observed being used as song perches by Cerulean Warblers. Notably, 116 of 595 song perch trees in our study were white oak, and 105 were bitternut hickories. These two species made up 37% of all song perch trees in the study.

DISCUSSION

Within our study, only a handful ($\sim 2\%$) of song-perch trees within territories were < 15

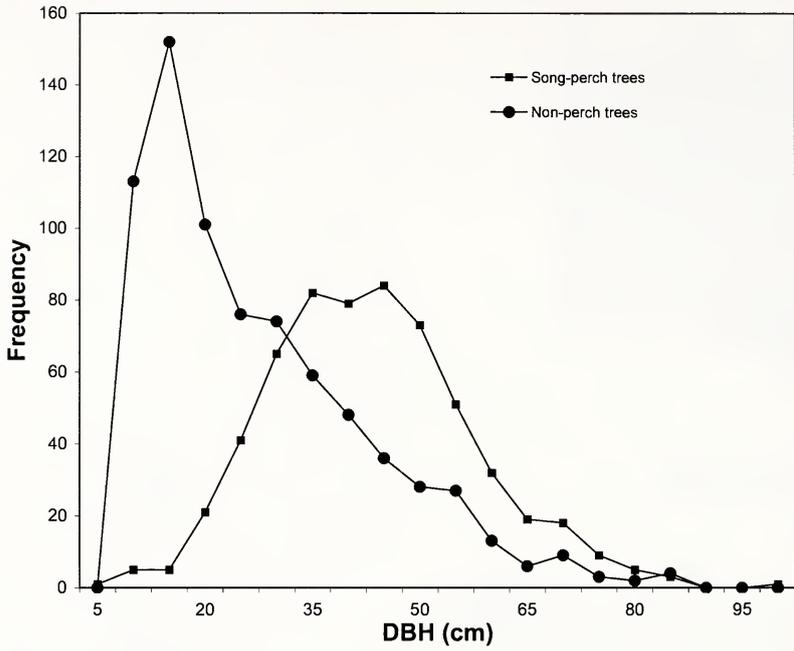


Figure 3.—Comparison of non-perch and perch tree dbh values within Cerulean Warbler (*Dendroica cerulea*) territories in southern Indiana during 2004 and 2005.

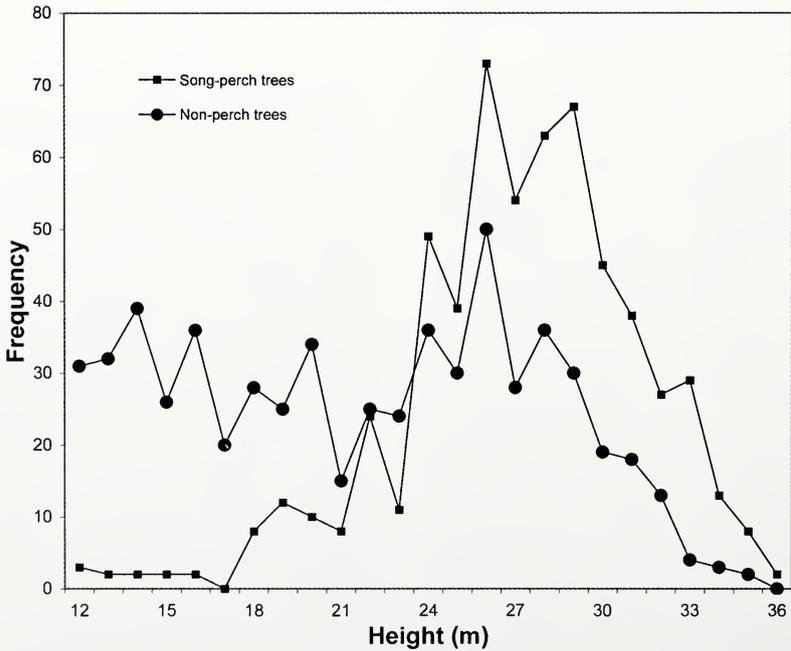
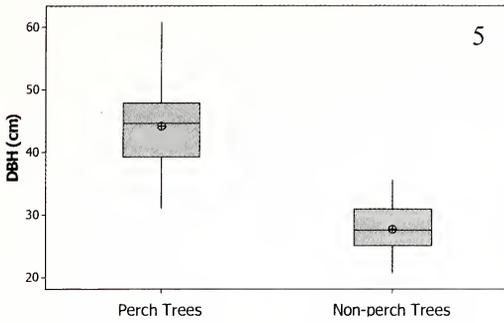


Figure 4.—Comparison of non-perch and perch tree height values within Cerulean Warbler (*Dendroica cerulea*) territories in southern Indiana during 2004 and 2005.

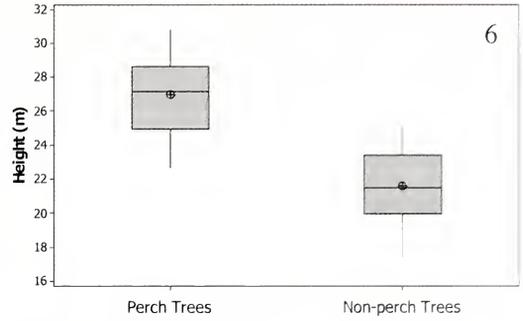


Figures 5, 6.—Comparison of non-perch and perch tree mean dbh and height by Cerulean Warbler (*Dendroica cerulea*) territory in southern Indiana during 2004 and 2005. 5. Means \pm SD of Song-perch tree vs Non-perch tree dbh values; 6. Means \pm SD of Song-perch tree vs Non-perch tree height values.

m, and these were associated with canopy gaps or clearings. The vast majority of song-perch trees were relatively mature trees that were larger than those around them. Cerulean Warblers have long been known as canopy-dwelling birds (Robbins et al. 1992; Hamel 2000a). Robbins et al. (1992) noted that Cerulean Warblers were more often found in trees with larger dbh, and spent most of their time above the middle of the tree. In this study, song-perch trees had significantly larger dbh and height. Dbh and height are related, but there is much variation possible across individual trees, which gives value to comparison of both variables (Morey 1936).

Cerulean Warblers may also be selecting territories based on the presence of ideal song-perch trees. This will not always be apparent, as they will sing while foraging, preening, and in flight. However, when singing is the focus, they often choose and make return visits to exposed perches from which they sing (Hamel 2000a; KJ pers. obs.). Taller and larger trees may offer more high-quality song perches conducive to vocal projection. In a study of Golden-winged Warblers (*Vermivora chrysop-tera*), song-perch trees were significantly larger than expected; and it was suggested that this song perch selection enhanced the birds' ability to display vocally and visually in mate attraction (Rossell 2001).

Much of the research on Cerulean Warbler habitat has focused largely on canopy structure, with less attention to tree species composition (Hamel 2000a, Jones and Robertson



Figures 5, 6.—Continued.

2001, Weakland and Wood 2005). Oliarnyk (1996) and Hamel (2000b) reported no preference in Cerulean Warblers for tree species in nesting or foraging in Ontario and Tennessee populations, but song-perch tree preferences were not investigated. Among 13 species of foliage-gleaning birds in floodplain forests in southern Illinois, the Cerulean Warbler was the second most selective bird, closely following the Yellow-throated Warbler (*Dendroica dominica*), in tree species usage (Gabbe et al. 2002).

Gabbe et al. (2002) found that Cerulean Warblers in Illinois showed the strongest preference for shellbark hickory (*Carya laciniosa*) and bitternut hickory (*Carya cordiformis*). Tree species that were most strongly avoided were red maple (*Acer rubrum*) and blue beech. Shellbark hickory had such a low density overall in our study area, its usage by Cerulean Warblers cannot be compared to the study in southern Illinois. We also found that males selected bitternut hickories as song perches together with white oaks. Red maples were avoided, and blue beeches were never used for song perches. It appears that Cerulean Warblers are adaptable in their use of tree species across their breeding range, but where breeding areas have tree species in common. Cerulean Warblers appear to be fairly consistent in species selection.

Thirty percent of trees in territories were sugar maples, yet only 2.4% of song perch trees were of this species. On the other hand, white oaks and bitternut hickories represented only 5.1% and 3.7% of trees within territories, respectively, but 19.5% and 17.6% of song perch trees were of those species. The appearance of tree species selectivity in our study area may be due to a relationship be-

Table 1.—Thirty-eight tree species and snags identified within Cerulean Warbler (*Dendroica cerulea*) territories in southern Indiana during 2004 and 2005 in the Hoosier National Forest, Yellowwood State Forest, and Morgan-Monroe State Forest. An “X” indicates significantly higher than expected frequencies of tree species in Cerulean Warbler territory sample plots vs. song-perch trees. An asterisk indicates exclusive occurrence within the category.

Tree species	Scientific name	Territory sample plots	Song-perch trees
Red maple	<i>Acer rubrum</i>	X	
Sugar maple	<i>Acer saccharum</i>	X	
Downy Juneberry	<i>Amelanchier arborea</i>		
Hercules-club	<i>Aralia spinosa</i>		
Pawpaw	<i>Asimina triloba</i>	X*	
Blue beech	<i>Carpinus caroliniana</i>	X*	
Bitternut hickory	<i>Carya cordiformis</i>		X
Pignut hickory	<i>Carya glabra</i>		X
Shagbark hickory	<i>Carya ovata</i>		X
Eastern redbud	<i>Cercis canadensis</i>		
Flowering dogwood	<i>Cornus florida</i>	X	
American beech	<i>Fagus grandifolia</i>	X	
White ash	<i>Fraxinus americana</i>		
Green ash	<i>Fraxinus pennsylvanica</i>		X
Honey locust	<i>Gleditsia triacanthos</i>		
Black walnut	<i>Juglans nigra</i>		X
Eastern red cedar	<i>Juniperus virginiana</i>		
Spicebush	<i>Lindera benzoin</i>		
Tulip poplar	<i>Liriodendron tulipifera</i>		X
Black gum	<i>Nyssa sylvatica</i>	X	
Ironwood	<i>Ostrya virginiana</i>	X*	
Short-leaf pine	<i>Pinus echinata</i>		
Eastern white pine	<i>Pinus strobus</i>		
Sycamore	<i>Platanus occidentalis</i>		X
Big-toothed aspen	<i>Populus grandidentata</i>		
Black cherry	<i>Prunus serotina</i>		
White oak	<i>Quercus alba</i>		X
Chinquapin oak	<i>Quercus muehlenbergii</i>		X
Chestnut oak	<i>Quercus prinus</i>		X
Red oak	<i>Quercus rubra</i>		X
Black oak	<i>Quercus velutina</i>		X
Winged sumac	<i>Rhus copallina</i>		
Black locust	<i>Robinia pseudoacacia</i>		
Sassafrass	<i>Sassafrass albidum</i>		
Basswood	<i>Tilia americana</i>		
American elm	<i>Ulmus americana</i>		
Red elm	<i>Ulmus rubra</i>		
Grape species	<i>Vitis spp.</i>	X*	
snag	—	X	

tween species and size parameters. Sugar maples may not have been used in proportion to their abundance because many of them were not canopy trees, and being a canopy-dwelling species, Cerulean Warblers would not encounter them. However, even in territories where sugar maples made up the majority of canopy trees, some males avoided them completely

during our observations. The only sugar maples recorded as song perch trees were concentrated in the territories of what appeared to be a few exceptional birds, most of which were unpaired. Further study addressing tree species importance, or at least importance of certain crown types associated with groups of species, would be worth pursuing.

This study demonstrated that in southern Indiana, Cerulean Warblers are utilizing the largest and tallest trees in their territories as song perches. These trees may offer individuals some advantage in territory defense and mate attraction, acoustically and/or visually. Cerulean Warblers in southern Indiana also used tree species disproportionately to their availability, just as they have been demonstrated to do in Illinois (Gabbe et al 2002). Exploration of more specific aspects of song perch selection (e.g. documentation of perch heights relative to tree heights, approximate girth of perch branches or twigs, foliage cover on perch) throughout the breeding range would be helpful in deepening our understanding of the specific habitat needs of Cerulean Warblers (Robbins et al. 1992).

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