CERULEAN WARBLER RESPONSE TO SILVICULTURAL MANIPULATIONS ON MANAGED FORESTLAND IN DESHA CO., ARKANSAS, THIRD YEAR RESULTS

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Abstract—Cerulean Warbler is a Nearctic-Neotropical migratory bird in need of management attention for which only rudiments of a silvicultural prescription exist. Since 1992, we have monitored breeding populations of this and other canopy-dwelling warbler species on a 54-ha site in Desha County, AR, owned and managed by Anderson-Tully Co. for production of high quality sawtimber. We instituted an experiment in 2002 to assess the response of this species to alternative silvicultural treatments. We split the site in two plots of equal area and with similar histories of use by Cerulean Warblers, and we randomly assigned one of two prescriptions to each plot. The treatments were 1) a standard Company prescription designed to favor development of sawtimber trees and 2) a "Cerulean Warbler prescription" (CWP), designed to favor development of large sawtimber trees for use as song perches by male Cerulean Warblers and large shade-tolerant trees in the midstory as potential Cerulean Warbler nest trees. Harvesting was completed in winter 2004. Survey of Cerulean Warbler response in 2006 indicated that the birds have begun breeding on portions of the CWP plot. At least three males, two of whom attracted females, established and defended territories on and adjacent to the CWP plot.

INTRODUCTION

Applying a silvicultural prescription that produces habitat for a wildlife species of concern is one important way to incorporate nontimber values into management of forest lands. Using such a prescription, a silviculturist can conduct specific interventions in the forest with a clear understanding of their outcomes. Wildlife species of conservation concern are increasingly the primary objectives in certain forest management situations.

Cerulean Warbler is a small, insectivorous, Nearctic-Neotropical migratory songbird (Hamel 2000b). The species is of considerable conservation concern (Birdlife International 2004, 2006, COSEWIC 2003) because of population declines registered since 1966 at approximately 3 percent per year (Link and Sauer 2002, Jones and others 2004). Because of declines and a recognition that habitat loss is the primary causal factor, the species recently was evaluated for inclusion on the list of threatened and endangered species (U.S. Fish and Wildlife Service 2006). Current population levels indicate that such listing is not now warranted (U.S. Fish and Wildlife Service 2006), but no specific mechanism to reverse the declines has been demonstrated (Buehler and others 2008). These birds are the focus of an international effort, which is known as the Cerulean Warbler Technical Group, to develop a management strategy that produces habitats and enhances populations while integrating these goals into normal economic activity (Hamel and others 2004). The species is universally recognized as occupants of mature hardwood stands, and as preferentially using large sawtimber trees for nesting purposes and singing. Male and female Cerulean Warblers use the forest in slightly different ways, however, such that males are relatively more dependent upon large, shade intolerant canopy trees for singing, and females are relatively more dependent upon use of moderate-sized midstory trees of more shade tolerant species for nesting (Barg and others 2006, Hamel 2003, Hamel 2006, Hamel and Rosenberg 2007).

Since 1992, we have been studying a population of Cerulean Warblers on managed forest land in Desha County, AR. Our work allowed us to characterize Cerulean Warbler use of tree species, crown class, and shade tolerance of canopy trees, features of structure and composition amenable to manipulation through silvicultural means. We used this pretreatment work to develop an alternative prescription designed to improve habitat for Cerulean Warbler and to compare it with a standard prescription on the same study site (Hamel and others 2006). In this paper we report on response of the birds to treatments after three growing seasons.

METHODS

Study Site

Our study area was a 54.5 ha site (33° 44' N, 91° 9' W, hereafter Study Grid) on the Desha Delta Hunt Club in Desha County, in southeastern AR (Hamel 1998, Hamel and others 2006, Woodson and others 1995). The site is part of a 130-ha compartment (hereafter Treatment Area) within a larger, contiguous ownership of Anderson-Tully Co., which manages it for production of high quality sawtimber. It is located in the Mississippi Alluvial Valley, in the batture land of the Mississippi River, on sandy loam soil with ridge and swale topography near the River's bank. The site is typical of riverfront hardwood ecosystems in the Lower Mississippi Valley. Prior to our study, in 1991, a harvest treatment according to standard Company prescription (SCP) was conducted within the compartment. In that year, Staten and colleagues located Cerulean Warblers on the tract as part of another study (Hamel 1998, Hamel and others 1998). Pretreatment sampling (Hamel and others 1998, Hamel and others 2006) included marking the area at the intersections of a 50 by 50 m grid (N = 230 intersections). In 2002, the Treatment Area was scheduled for entry in the normal rotation on Company lands. We used this opportunity to implement an unreplicated experiment to assess response of the species to alternative silvicultural treatments. Harvesting

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was done by partial cutting during the nonbreeding period for Cerulean Warblers; it began in winter 2002 and was completed in winter 2004. We subdivided the Study Grid into north and south subplots. By coin flip, the north subplot was selected to receive the CWP, and the south subplot received the SCP.

Silvicultural Treatments

Standard prescription—The SCP applied to the southern plot, including the southern half of the Study Grid, was a partial cutting prescription with elements of improvement cutting, thinning, and regeneration cutting. It involved cutting in the overstory to reduce mortality, improve species composition and spacing, and increase growth of the residual stand. It further involved cutting in the midstory to remove poorly formed shade tolerant species in order to release advance regeneration and encourage the establishment and growth of additional shade intolerant regeneration of desirable species. The prescription was implemented by marking stems to be removed in the stand. Other stems, including all elm (*Ulmus americana* L.), sugarberry (*Celtis laevigata* L.) and boxelder (*Acer negundo* L.) stems, were cut unless they were of superior form and quality. The SCP and initial effects of its application to the southern plot are documented in Hamel and others (2006).

Cerulean Warbler prescription—Applied to the northern half of the Treatment Area and Study Grid, the CWP was developed based on findings of Hamel (2003). This prescription recognized the importance of tall sawtimber trees as song perch trees of male Cerulean Warblers, and that large, often shade tolerant, trees can be important for nest trees. This partial cutting prescription was a modification of the SCP, involving elements of improvement cutting, thinning, and regeneration cutting. The CWP differed from the SCP in that fewer trees were removed from the shade tolerant midstory. Before timber marking began, researchers and foresters trained together on identification of shade tolerant midstory trees desirable for potential nest trees. Such potential nest trees were specially indicated by painting an "X" on them and they were excluded from the timber harvest. The CWP and initial effects of its application within the northern subplot are documented in Hamel and others (2006).

Post-harvest monitoring

Vegetation sampling—Samples of vegetation have been measured on the Study Grid in 1993, 2002, 2005, and 2007. We here summarize results of the 2007 sampling session and make brief comparisons to those made in 2005 and earlier. Detailed comparison of the pretreatment (1993 and 2002) and initial post-treatment samples (2005) are available in Hamel and others (2006). In 2007, we randomly selected 30 grid intersection points in both the SCP and CWP subplots. Gridpoints sampled in 2005 were not resampled in 2007. At each point, canopy trees were selected for inclusion in the sample using a 30 BAF English (6.9 BAF metric) angle gauge. Each selected tree was identified to species and its height measured in m, diameter at breast height measured in cm, crown class determined, and presence of vines in its canopy noted. We further recorded the distance and azimuth from gridpoint to each tree. We randomly selected ten locations at which Cerulean Warblers were observed and made identical vegetation measurements at each of them.

Cerulean Warbler sampling—A map of territories (spotmap census) of Cerulean Warbler and other warbler species present on the Study Grid (Bibby and others 1992) was conducted in 2006 as in 2004 and annual pretreatment surveys. Biennial spotmap censuses are anticipated in the future. Singing Cerulean Warblers were located and the locations marked using GPS devices.

Data analysis

We tested the hypothesis that no differences existed in basal area and density of trees and saplings on the two subplots after three growing seasons using analysis of variance. We used the techniques of Goelz (1995) to determine stocking on the subplots and compared those to each other, and to use by Cerulean Warbler, using analysis of variance. Distribution of observed Cerulean Warbler territories on the Study Grid in pretreatment surveys 1992 through 2001 was visually compared to the first sample post-treatment (2004) and current (2006) map. Statistical tests were carried out using SAS (SAS Institute 1999-2000) with statistical significance accepted at $P = 0.05$. Where sample sizes were too small to possess sufficient power to conduct rigorous statistical comparisons, we present graphical results without further comment in this progress report.

RESULTS AND DISCUSSION

During pretreatment surveys, 1992 through 2001, Cerulean Warbler territories were widely distributed throughout the Study Grid. In 2004, three Cerulean Warbler territories were located at the extreme northern edge of the CWP subplot. In 2006, as in 2004, a small number of singing male Cerulean Warblers established territories at the northern edge of the CWP subplot of the Study Grid, but entirely within the area treated by the CWP (fig. 1). In 2006, unlike 2004 (Hamel and others 2006), we repeatedly observed female Cerulean Warblers using the CWP subplot, in association with two of the singing male territories. However, we did not find a nest. As in 2004, no Cerulean Warbler use was detected in the SCP subplot. Even more than in 2004, Cerulean Warbler use in 2006 was concentrated in areas in which no territories were observed in the pretreatment period.

Vegetation measurements taken in 2007, unlike those sampled in 2005 (Hamel and others 2006), did not differ between CWP and SCP subplots (table 1, Tree Density: $F_{1, 59} = 0.15$, $P = 0.70$, $R^2 = 0.002$; Tree Basal Area: $F_{1, 59} = 3.90$, $P = 0.05$, $R^2 = 0.06$). We believe this reflects the limited sample size we were able to achieve for this report rather than a lack of difference. We illustrate our opinion graphically using the stocking data. Stocking levels for both treatments are demonstrated to be lower than those in the pretreatment samples (fig. 2). However, comparison of random samples from 2005 and 2007 produced conflicting results. While both samples yielded stocking levels lower than those in the pretreatment samples, the results are not internally consistent. Our 2007 samples are too small for adequate power to detect differences between the CWP and SCP subplots. For this reason we pooled stocking values for gridpoints sampled 2005 with those for gridpoints sampled

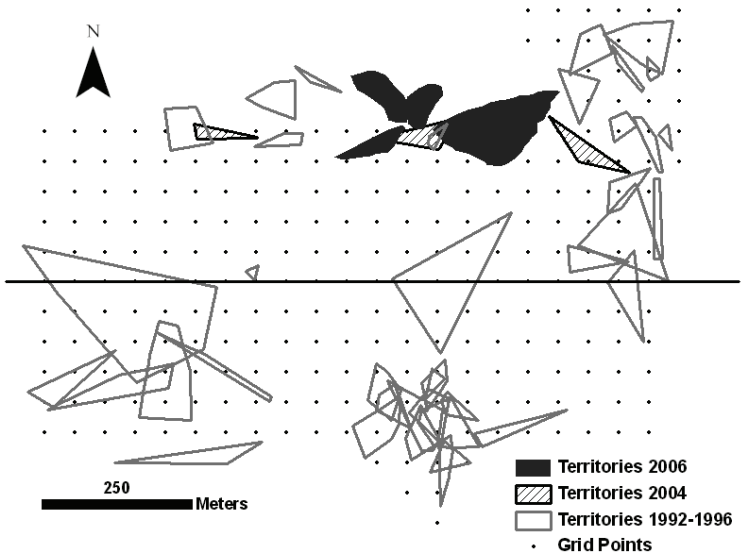

Figure 1—Distribution of Cerulean Warbler territories on Desha Delta Hunt Club Cerulean Warbler Study Grid, Desha Co., AR. Dark horizontal line indicates boundary between Cerulean Warbler prescription area to the North, and Standard company prescription area to the South.

2007 and present the results as single values for each of the treatments (fig. 2).

Stocking levels of 2007 plots made in Cerulean Warbler territories were comparable to those from plots made around Cerulean Warbler nests in the pretreatment sample, indicating a greater consistency in Cerulean Warbler use of the Study Grid pre- vs post-treatment than in different samples taken at random from portions of the area treated by either prescription. Stocking levels for nests in the pretreatment sample and for Cerulean Warbler territories in the 2007 post-treatment sample are both within the range suggested by Kahl and others (1985; 65 to 85 percent) as indicative of good Cerulean Warbler habitat in Missouri uplands.

CONCLUSIONS

To date, our results suggest that silvicultural treatments such as our CWP can produce breeding habitat for this species. Stand stocking may be a useful measure for describing and comparing Cerulean Warbler habitat. Our short-term goals for this experiment are to: (1) evaluate regeneration in 2009 after five growing seasons; (2) increase vegetation sampling effort in future monitoring activities; (3) find Cerulean Warbler

Table 1—Tree density and basal area on Desha Delta Hunt Club Cerulean Warbler study grid, pre- and post-treatment. Values for Cerulean Warbler prescription area and Standard company prescription area show samples measured at all (pretreatment) or randomly selected (2005, 2007) intersection points of the Study Grid. Values for Cerulean Warbler use reflect points centered under nests or song perches as indicated. Values reflect mean ±1 S.E.

Treatment area	Pretreatment	2005	2007
Cerulean Warbler prescription area	N=137	N=26	N=30
Basal area, sq. ft. per acre	138.3 ± 5.1	120 ± 12.2	103 ± 10.2
Trees per acre	170.3 ± 11.2	56 ± 5.4	159.7 ± 21.1
Standard company prescription area	N=123	N=26	N=30
Basal area, sq. ft. per acre	118.4 ± 5.1	64.6 ± 9.1	76 ± 9.1
Trees per acre	141 ± 9.3	64.6 ± 17.7	173.9 ± 29.3
Cerulean Warbler use	N=18 nests	-	N=10 song perches
Basal area, sq. ft. per acre	100 ± 10.2	-	96 ± 8.7
Trees per acre	132.7 ± 9.5	-	102.2 ± 14.7

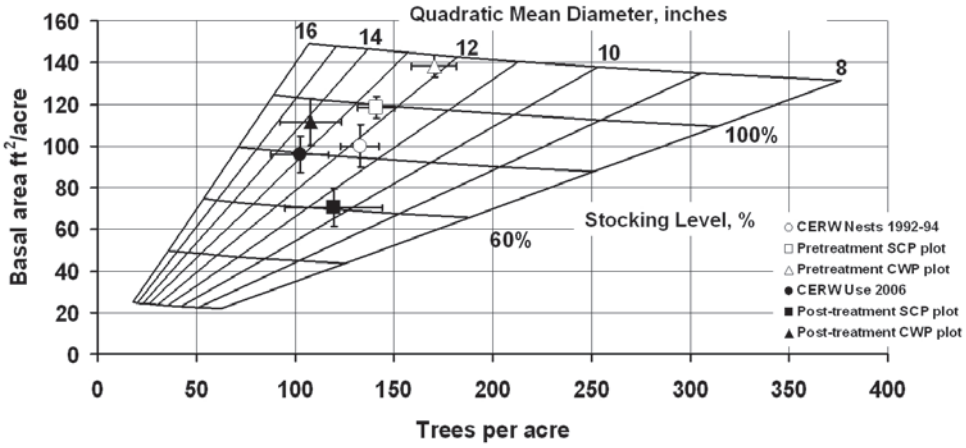

Figure 2—Density and basal area of trees measured on plots in Desha Delta Hunt Club Cerulean Warbler Study Grid, depicted on stocking chart of Goelz (1995). Open symbols refer to pretreatment conditions; closed symbols indicate pooled results of post-treatment sampling 2005 and 2007. Error bars indicate 1 S.E. about the mean values which are plotted. Triangles indicate Cerulean Warbler prescription area, squares indicate Standard company prescription area, and circles indicate Cerulean Warbler use.

nests; and (4) estimate economic difference between the treatments and thereby to evaluate relative cost of the CWP and the SCP.

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