Birds in a Developing Area: The Need for Habitat Protection at the Landscape Scale[1]

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Abstract

We used fixed-distance point counts to monitor bird populations from 1994-1998 in a rapidly urbanizing region of southwestern Missouri. Prior to the early 1990s, the rural landscape was a mosaic of forest, dolomite glades, and pasture but development proceeded rapidly in the 1990s with increased promotion of Branson, Missouri as a vacation and retirement destination. Point count data were collected in areas with native vegetation intact and that are not likely to be developed as the region continues to urbanize (undeveloped sites), and at a 375-ha residential/golf development (developed site). Eleven of 18 regularly-recorded species showed declines, five of them significant, on the developed site relative to their trends on the undeveloped sites. Each of those five species was associated with forest or forest edge habitats. Only one species showed a significant decrease on the undeveloped sites. Notably, some forest species were reduced in the developed site even though patches of forest and other native vegetation remained. We suggest that a regional conservation strategy be developed so that the needs of all species of forest avifauna can be met as urbanization continues its advance on native habitats.

Key words: development, forest birds, Missouri, monitoring, point counts, population trends, urbanization.

Introduction

Individuals of a given species of bird typically are attracted to a breeding site by the structure of the habitat within that site (Cody 1968, Wiens 1969, James 1971), the areal extent of the habitat available (Forman et al. 1976, Galli et al. 1976, Askins et al. 1987, Herkert 1994, Winter and Faaborg 1999) or a combination of patch area and within-patch structure (Robbins 1980, Ambuel and Temple 1983, Lynch and Whigham 1984, Blake and Karr 1987). In landscapes where forests are highly fragmented, smaller woodlots often are dominated by ecological generalists (Martin 1981, Ambuel and Temple 1983, Blake 1983). This pattern appears to be exacerbated when isolation among forests patches is increased and where habitat structure in the surrounding matrix is in sharp contrast to the forest patch (Blake and Karr 1987, Freemark and Collins 1992). Individuals nesting in isolated tracts of forest in the Midwestern United States have been shown to suffer much higher rates of brood parasitism and nest predation than individuals nesting in landscapes that are extensively forested (Donovan et al. 1995, Robinson et al. 1995, Robinson 1996). However, population trends can still appear stable in tracts where reproductive success is below that needed to sustain the population over time, presumably as a result of immigration of individuals to the site (Brawn and Robinson 1996).

In the Midwestern United States, assessments of factors that can affect the relative abundance of birds have taken place primarily in areas where large scale conversions of land from native to non-native vegetation occurred many decades ago. The objective of this study was to assess changes in the relative abundance of birds in a region that had a high percentage of native vegetation in the early 1990's, but was then subjected rather suddenly to ongoing and rapid urbanization. We compare bird species' population trends at a new development site with those in tracts of undisturbed native habitat in the surrounding counties.

Methods

Study Area

This study was conducted in a rapidly urbanizing region of the Ozark Highlands near Branson, Missouri. The greater Branson area is a tourist destination which currently attracts approximately six million people each year to its country music shows and theme parks, and to the recreational opportunities provided by three

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large reservoirs on the White River (Branson/Lakes Area Chamber of Commerce, pers. comm.). Although the level of tourism was increasing prior to the early 1990s, dramatic increases occurred after the television news magazine, "60 Minutes", aired a segment on Branson in early 1991. Estimates of the number of guests spending one or more nights in the area increased from 2.2 million in 1991 to 4.8 million during the 1998 season (Jerry Henry, Corporate Director of Research, Silver Dollar City, Inc., pers. comm.). In addition to the increase in tourism, many people moved to the area in search of employment, development and retirement opportunities. Between 1990 and 1996, the three-county area surrounding Branson was the fastest growing region of the state, with population increases of 37.5 percent, 35.6 percent and 30.2 percent in Christian, Stone and Taney counties, respectively (Missouri Department of Economic Development). Increases in both tourist and resident populations were associated with a boom in both commercial and residential development as demands for services and infrastructure skyrocketed.

The potential natural vegetation of the study area is oak-hickory (*Quercus* sp.-*Carya* sp.) and oak-hickory-pine (*Quercus* sp.-*Carya* sp.-*Pinus echinata*) forest interspersed with limestone and dolomite glades (Thom and Wilson 1980, McNab and Avers 1994). Glades typically occur on drier south and southwest facing slopes and are dominated by little bluestem (*Andropogon scoparius*) and other native grasses (Nelson 1987). In the early 1990s, the landscape in the Branson area still was comprised of forests and glades, but in some areas pastures replaced native vegetation on ridgetops and bottomlands (*fig. 1*).

Study Sites and Design

We surveyed birds in the undeveloped sites with intact native forest and glade vegetation from 1995 through 1998 using 10-min, 50-m radius point counts. A total of 130 points was surveyed, clustered in 16 routes of eight to nine points each. Points were approximately 250 m apart. The 16 routes were distributed among six locations in the greater Branson area, with two or three routes per area (*fig. 1*). All but two routes were on public land. Four routes, one from each of four different areas, were surveyed three times between 25 May and 30 June. The remaining routes were surveyed once per season. Because survey points were clustered within routes, we used the route as the primary sampling unit, thereby avoiding pseudoreplication.

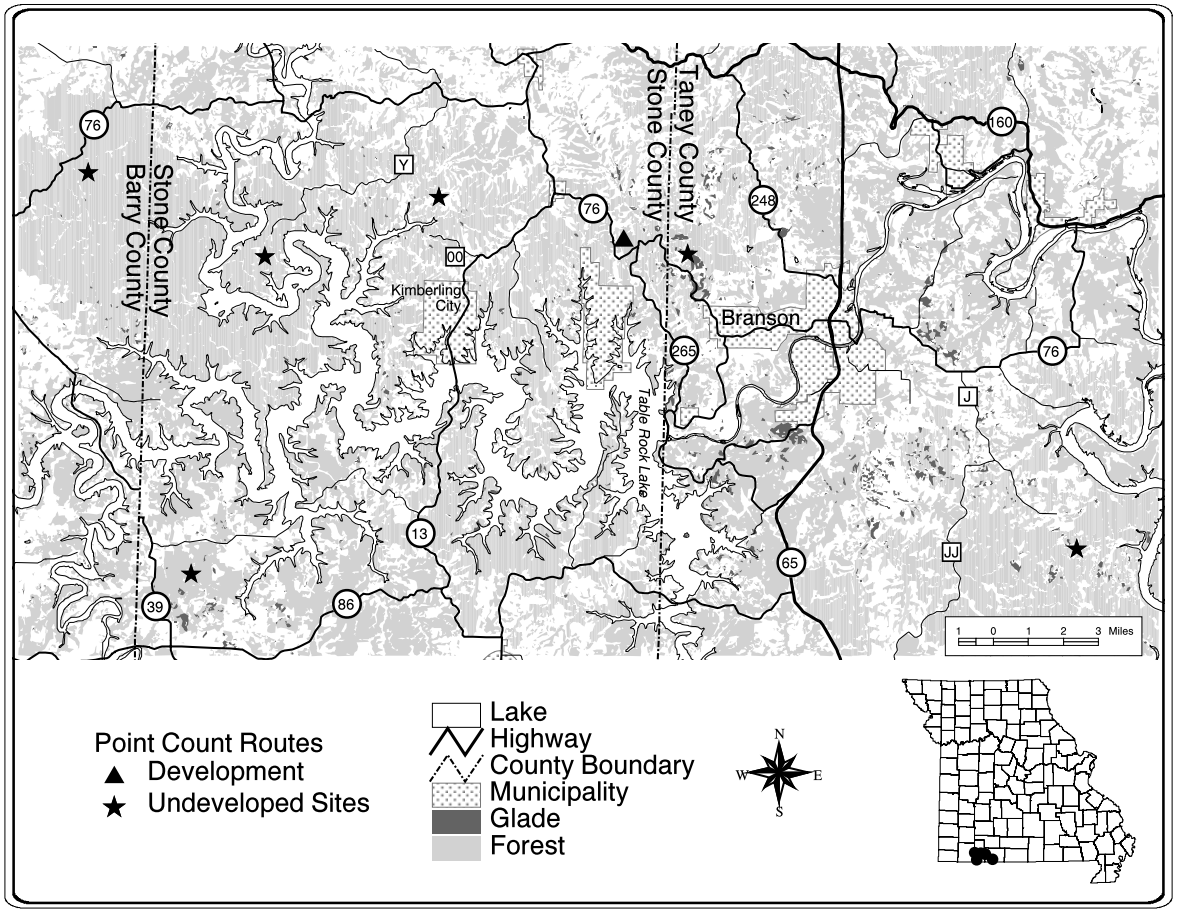

Figure 1— Locations of study sites in the greater Branson, Missouri area.

Thirty-two points, also placed approximately 250 m apart, were surveyed three times per season from 1994 through 1998 at a 375-ha residential/golf development. The development plan included an 18-hole golf course, condominiums, and approximately 200 residential lots ranging in size from 0.5 to 2 acres. In 1993, the land was still a mosaic of forest and glade with small patches of pasture interspersed. Bulldozing for the golf course and road system began in the spring of 1994, roughly commensurate with the beginning of our monitoring there. The condominiums, golf course, clubhouse and many homes were completed by 1998.

The development is designed so that all residential lots adjoin "common property." Most of these areas consist of narrow strips of native vegetation less than 50 m in width, although some larger patches of forest and glade are adjacent to or dispersed throughout the development. All of our census points were located in areas of common property or forest immediately adjacent to the development. Points were treated as independent because they were evenly distributed across the study area. Thus the sample size was the number of points.

Statistical Analyses

Trends were calculated for each primary sampling unit (routes in the undeveloped site; points in the developed site). Proportional change in the trend line between 1994 and 1998 was used as the estimated change during the study. Significance of the changes was determined using a one-sample t-test of the null hypothesis that the mean of the slopes was equal to zero. The changes were compared using $\bar{d} = \bar{y}_d - \bar{y}_u$, where $\bar{y}_d$ and $\bar{y}_u$ are the mean changes at the developed and undeveloped sites, respectively. The significance of the difference was determined with a t-test for independent samples testing the null hypothesis that the mean of the differences was zero. Trends were assessed for the eighteen most commonly recorded species.

Trends likely to occur on the developed site, in the absence of any treatment effect, were also assessed by obtaining Breeding Bird Survey trend estimates (Sauer et al. 2000) for the Ozark-Ouachita province, which the study area was in, for the period 1980-2002.

Results and Discussion

Eleven of the 18 species declined or increased less on the developed site relative to their trends on the undeveloped sites (*table 1*). Five of these species showed significant declines on the developed site while one of them showed a significant decline on the undeveloped site. Three of the differences in trends were significant (P = 0.00, 0.00, 0.02), and two were suggestive (P = 0.12, 0.12). None of the other species showed significant, or close to significant changes, on either the developed or undeveloped site. Breeding Bird Survey data indicate that the five species showing strongest evidence of declines at the developed site have exhibited stable or increasing trends across the Ozark-Ouachita Plateau region as a whole during the period 1980-2002 (Sauer et al. 2003).

Each species that declined significantly at the developed site is associated with deciduous forest or forest-edge habitat (Probst and Thompson 1996, Fitzgerald et al. unpublished data). Immigration did not compensate for the declines of these forest-associated species at the developed site, suggesting the habitat structure has become inadequate to attract individuals of those species. A shift in the structure of the bird community could be occurring as a result.

In conclusion, this study indicates that even a development that leaves some native vegetation intact and is adjacent to larger acreages of native habitat may not be adequate to sustain forest bird communities characteristic of the southwestern Missouri Ozarks. We therefore encourage regional, county and other land use planners to identify, protect and enhance sites that can support all forest-associated species characteristic of their region. Given that forest tracts larger than 10,000 ha may be needed to meet the needs of all area-sensitive bird species, to accommodate natural disturbances within tracts, and to foster levels of reproductive success adequate to support self-sustaining forest bird populations (Rotenberry et al. 1993, Robinson et al. 1995, Robinson 1996), we suggest that the identification and preservation of large habitat blocks become a conservation priority in the greater Branson area.

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Table 1— *Change in mean number of birds recorded on the developed and undeveloped sites. The panels (divided by a dotted line) show species that decreased (upper) and increased (lower) in the developed site relative to the undeveloped site. Within panels, species are arranged by P-values for the difference in trends*[1].

	Developed site			Undeveloped site			Difference	
Species	**1994**	**1998**	**Change (%)**	**1994**	**1998**	**Change (%)**	**Estimate (%)**	**P**
Acadian Flycatcher (*Empidonax virescens*)	0.38	0.10	-74**	0.36	0.30	-17	-57	0.00
Black-and-white Warbler (*Mniotilta varia*)	0.33	0.04	-88**	0.27	0.22	-19	-69	0.00
Indigo Bunting (*Passerina cyanea*)	0.78	0.42	-46*	0.18	0.19	+6	-52	0.02
Red-eyed Vireo (*Vireo olivaceus*)	0.34	0.18	-47	0.77	0.64	-17	-30	0.12
Northern Parula (*Parula americana*)	0.33	0.15	-55*	0.15	0.13	-13	-42	0.12
Northern Cardinal (*Cardinalis cardinalis*)	0.16	0.20	+25	0.09	0.20	+111	-86	0.24
Blue-gray Gnatcatcher (*Polioptila caurelea*)	0.99	0.41	-59**	0.63	0.35	-44*	-15	0.28
Summer Tanager (*Piranga rubra*)	0.16	0.08	-47	0.23	0.16	-30	-17	0.48
Yellow-billed Cuckoo (*Coccyzus americanus*)	0.02	0.05	+150	0.04	0.13	+202	-52	0.84
American Crow (*Corvus brachyrhynchos*)	0.12	0.11	-8	0.08	0.08	0	-8	0.88
Eastern Wood-pewee (*Contopus virens*)	0.07	0.13	+83	0.04	0.08	+100	-17	1.00
Great-crested Flycatcher (*Myiarchus crinitus*)	0.08	0.12	+60	0.06	0.07	+8	+52	0.38
Brown-headed Cowbird (*Molothrus ater*)	0.22	0.22	0	0.21	0.14	+33	+33	0.38
White-breasted Nuthatch (*Sitta carolinensis*)	0.04	0.16	+290	0.07	0.14	+100	+190	0.43
Eastern Tufted Titmouse (*Parus bicolor*)	0.18	0.27	+50	0.30	0.35	+17	+33	0.48
Blue Jay (*Cyanocitta cristata*)	0.02	0.08	+300	0.06	0.08	+33	+267	0.51
Carolina Chickadee (*Parus carolinensis*)	0.15	0.12	-20	0.12	0.09	-26	+6	0.92
Downy Woodpecker (*Picoides pubescens*)	0.08	0.13	+63	0.08	0.12	+50	+13	1.00

[1]Entries under 1994 and 1998 are the mean values for the trend lines fitted to the primary sampling units (points in the developed area; routes in the undeveloped area) using linear regression.
* = P <0.05; ** = P < 0.01.

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