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The conservation value of urban riparian areas for landbirds during spring migration: Land cover, scale, and vegetation effects

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ABSTRACT

Urbanization changes bird community structure during the breeding season but little is known about its effects on migrating birds. We examined patterns of habitat use by birds at the local and landscape level during 2002 spring migration at 71 riparian plots along an urban gradient in Cincinnati, Ohio, USA. Using linear regression, we examined variation in relative density, species richness, and evenness of four migratory guilds associated with natural land covers and building area at four scales (50, 100, 250, 500 m radial buffers). We also examined the influence of local vegetation using multiple regression models. As building area increased, riparian forests tended to be narrower and have fewer native trees and shrubs. In general, native birds were positively associated with tree cover (within 250–500 m of stream) and native vegetation, and negatively with building area (within 250 m); exotic species responded inversely to these measures. Short-distance migrants and permanent residents displayed the weakest responses to landscape and vegetation measures. Neotropical migrants responded strongest to landscape and vegetation measures and were positively correlated with areas of wide riparian forests and less development (>250 m). Resident Neotropical migrants increased with wider riparian forests (>500 m) without buildings, while en-route migrants utilized areas having a wide buffer of tree cover (250–500 m) regardless of buildings; both were positively associated with native vegetation composition and mature trees. Consequently, developed areas incorporating high native tree cover are important for conserving Neotropical migrants during stopover.

1. Introduction

Globally, urbanization is one of the leading drivers of native species extirpation at the continental (Czech et al., 2000) and regional scales (e.g., Blair, 2001). Urbanization alters and fragments natural habitats through the removal of native vegetation and the introduction of exotic species and novel infrastructure (e.g., buildings, pavement and roads). In general, urban areas support fewer species than natural areas (see Marzluff, 2001); many species that do persist are typically widespread or exotic (Blair, 2001). However, several studies highlight the capacity of certain land-uses within urban areas to harbor native species (e.g., Blair, 1996) suggesting that better-designed urban landscapes could sustain more

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biodiversity in the future. Consequently, urban areas need not be viewed as 'ecological sacrifice zones' by conservationists, but ought to be viewed as opportunities to enhance regional biodiversity (Rosenzweig, 2003).

People have historically settled near streams and rivers for access to drinking water, food, irrigation, transportation, and industry. Given this close association, it is not surprising that riparian areas are among the most threatened of landscapes (Groffman et al., 2003). In addition to their benefit to people, riparian areas also support a high diversity of plants and animals (Naiman et al., 1993). These areas also provide important habitat for migrating birds during the spring and fall (Ohmart, 1994; Skagen et al., 1998, 2005; Yong et al., 1998). This is of particular interest for conservation because of recent declines in some species, especially Neotropical migrants (Robbins et al., 1989; Peterjohn et al., 1995).

The effect of urbanization on riparian bird communities during the breeding season is a relatively recent area of research (e.g., Rottenborn, 1999; Green and Baker, 2003; Hennings and Edge, 2003; Miller et al., 2003; Rodewald and Bakermans, 2006). Habitat characteristics at both the local and landscape scale influenced Western riparian breeding bird communities (Rottenborn, 1999; Miller et al., 2003; Smith and Wachob, 2006). In particular, distance to the nearest urban structure (buildings or bridges) negatively influenced species richness and overall density (Rottenborn, 1999). In Northwestern USA, riparian bird communities of forested parks responded to the intensity of human disturbance at different scales around a stream (Hennings and Edge, 2003). Further, native vegetation composition of riparian forests was an important resource for Western native bird communities (Mills et al., 1989; Rottenborn, 1999; Hennings and Edge, 2003). Native vegetation was correlated with increasing species richness and relative density in these riparian systems (Mills et al., 1989; Rottenborn, 1999); exotic vegetation often lacks the structural and dietary benefits required by many native animal species (Reichard et al., 2001). Additionally, fragmentation and urban intrusion near stream corridors lead to an increase in brood parasitic birds and other predators, such as stray cats and raccoons, and these negatively affect native breeding bird species (Robbins et al., 1989; Gering and Blair, 1999; Reichard et al., 2001; Lepczyk et al., 2004).

Migratory songbirds, because they have complex life histories and range over a wide area, pose a unique challenge to conservation (Levin, 1992; Moore et al., 1995; Hostetler, 2001). Recent research suggesting that some Neotropical landbird populations are limited during their migratory journey, and not on their breeding or wintering grounds (Sillett and Holmes, 2002), raises the importance of managing stopover habitat for long-distance migratory species. Mechanisms affecting riparian birds during the breeding season may also operate during migration. For example, Yong et al. (1998) noted that loss of native vegetation can negatively influence populations of Wilson's warblers (*Wilsonia pusilla*) during the stopover period. Furthermore, as during the breeding season, forest patch mosaics that are close together or connected by corridors might be best for migrants (Petit, 2000). Insectivorous migrant songbirds in Western states prefer riparian habitats for refueling (Johnson et al., 1977; Stevens et al., 1977), but were more abundant in contiguous upland forest patches when compared to riparian forests in Columbus, Ohio (Rodewald and Matthews, 2005). In contrast, others report that Midwestern USA migrants concentrate in forested riparian areas during spring and fall (Winker et al., 1992; Weisbrod et al., 1993). Individual species also differ in the selection of habitat based on patch sizes from spring to summer (Hostetler and Holling, 2000). Given the potential differences between breeding and stopover habitat selection, identifying the types of habitats most important during migration, and how land-use decisions are changing these habitats, is a critical but overlooked aspect to conservation planning (Moore et al., 1995).

Many existing urban studies that have examined the effects of different habitats have ignored community variation across multiple scales (Hostetler and Holling, 2000; Hostetler and Knowles-Yanez, 2003; Mayer and Cameron, 2003). Ecological responses can vary depending on the scale in question (Wiens, 1989; Levin, 1992). Metropolitan areas are comprised of a complex mosaic of different land-uses including dense development, parks, lower-density suburbs, and smaller city centers (Alberti et al., 2001). Consequently, the variation in responses across spatial and temporal scales could be quite dynamic. Studies focusing on these landscape mosaics at varying scales within urban areas will aid in developing management practices that enhance habitat value through better design (Hostetler, 2001).

The purpose of this study was to examine the relationship between urbanization and bird community composition of Midwestern USA riparian areas during migration. Since different species respond to landscape structure at varying scales, we took a multi-scale approach, investigating how local and landscape attributes affect avian relative density, richness, and evenness of four migratory guilds and exotic species. Specifically, we explored (1) how land cover at four different spatial scales (50, 100, 250, and 500 m radii around a plot) affects the distribution of avian community diversity and composition and (2) how local vegetation influences habitat selection during the migratory season, in order to predict the effect development patterns might have on migrating bird communities along urban riparian areas.

2. Methods

2.1. *Study region*

The 4243 ha study area within the urbanizing Mill Creek watershed (42,994 ha) is located on the geologically homogeneous Pre-Wisconsinan Drift Plains within the greater Cincinnati metropolitan area (39.2° N 84.5° W) (Fig. 1). Pre-European settlement vegetation was comprised of Beech-Maple and mixed-mesophytic forests (Braun, 1950). The area represents one of the fastest growing areas in Ohio, with more than half a million people living and working in the watershed (US Census Bureau, 2000) and has been designated one of the most polluted and threatened urban rivers in the US (American Rivers, 1997).

2.2. *Study design*

We sampled birds, vegetation, and environmental variables across a gradient of human settlement intensity following