Biological Conservation

Volume 131, Issue 4, September 2006, Pages 566-574

Are urban forests ecological traps for understory birds? An examination using Northern cardinals

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https://doi.org/10.1016/j.biocon.2006.03.003 ↗

Abstract

Many studies have reported increased numbers of certain synanthropic species in urbanizing landscapes, but few have evaluated if urban habitats constitute ecological traps for these

species. The Northern cardinal (*Cardinalis cardinalis*) was used as a model species to evaluate if urban riparian forests might act as ecological traps for understory-nesting birds. Cardinals were surveyed within 2-ha riparian forest plots within rural (n=6) and urban (n=6) landscapes in Ohio USA during breeding and non-breeding seasons 2003–2005. Cues used by cardinals to select habitats were identified based on measurements surrounding 219 nests and in 106 randomly-located plots and 96 systematically-located plots. Productivity of 161 cardinal pairs and survival of 180 adults were monitored from late March–September, 2003–2005. Cardinals were 1.7× (in the breeding season) to nearly 4× (in non-breeding season) more abundant in urban than rural forests, and the results suggest that these differences in abundance stemmed from urban-associated changes in habitat and microclimate features used by cardinals to select habitats. Most notably, cardinals were strongly associated with dense understory vegetation and warmer minimum January temperatures, both of which were promoted as urban development increased within the landscapes surrounding riparian forests. Although other studies suggest mismatches between the habitat cues used by cardinals and how those features affect nesting success (e.g., higher nest predation in exotic shrubs), these results provide no evidence that urban forests were acting as ecological traps for cardinals. Instead, cardinals in urban and rural forests had similar numbers of nesting attempts, young fledged over the breeding season, and apparent annual survival rates. Thus, these findings do not support for the idea that urban forests in central Ohio represent ecological traps for synanthropic understory birds.

Introduction

Urbanization is one of the most ubiquitous and profound changes underway in landscapes around the world, yet its ecological consequences are not entirely understood. Most previous studies have focused on general patterns of diversity and community structure within urban habitats (Emlen, 1974, Lancaster and Rees, 1979, Beissinger and Osborne, 1982, Blair, 1996, Clergeau et al., 1998, Miller et al., 2003). One commonly observed pattern is that many resident species increase with urbanization, whereas many migratory species tend to decrease (Beissinger and Osborne, 1982, Mills et al., 1989, Blair, 1996, Germaine et al., 1998). Ultimately, these tendencies can homogenize avian communities among geographically distinct urban areas (McKinney, 2006). Such changes in avian communities are attributed to a variety of factors including altered food resources, changes in nesting substrates, and altered species interactions (Lancaster and Rees, 1979, Jokimaki and Suhonen, 1998, Rottenborn, 1999, Marzluff et al., 2001). However, few studies have explicitly examined which of these factors may be responsible for increased abundances of certain native species and what the demographic consequences of urbanization might be to populations (Bolger, 2001). Consequently, ecologists have few data to evaluate if these synanthropic species may truly benefit from these urban habitats or, conversely, if urban habitats represent ecological traps, whereby individuals actively select habitats that ultimately reduce their fitness (Gates and Gysel, 1978, Purcell and Verner, 1998, Schlaepfer et al., 2002, Weldon and Haddad, 2005). Human-associated modifications to

habitats and landscapes, in particular, can create such mismatches between habitat selection and reproductive success when individuals select habitat features reflecting historic conditions rather than current ones (Schlaepfer et al., 2002). Ecological traps can result in population sinks, therefore they have serious implications for how habitat for wildlife is managed, especially when habitats may be used by species of conservation concern (Kokko and Sutherland, 2001).

The central aims of this study were (1) to assess possible causes of increased densities of resident birds in urban forests and (2) to evaluate if urban forests represented ecological traps for understory-nesting birds. The Northern cardinal (*Cardinalis cardinalis*) was used as a model species because Northern cardinals are positively associated with urbanizing landscapes (Rodewald and Bakermans, 2006), suggesting that they benefit from urban land uses. However, some research suggests that cardinals nesting in urban forests may experience greater rates of nest depredation than those in more rural forests, particularly when they use exotic shrubs as nesting substrates (Borgmann and Rodewald, 2004, Leston, 2005). In this way, it was theorized that urban forests might represent ecological traps for Northern cardinals and other synanthropic species. Others have suggested that exotic plants may act as ecological traps because they profoundly affect foraging and nesting resources. Indeed, higher rates of nest predation were observed for birds nesting in exotic Amur honeysuckle (*Lonicera maackii*; Schmidt and Whelan, 1999, Borgmann and Rodewald, 2004), common buckthorn (*Rhamnus cathartica*; Schmidt and

Whelan, 1999), multiflora rose (*Rosa multiflora*; Borgmann and Rodewald, 2004), Japanese barberry (*Berberis thunbergii*; Schmidt et al., 2005), and salt-cedar (*Tamarix ramosissima*; Reichard et al., 2001), as well as in exotic European tree plantations (Remes, 2003). Although a variety of reasons may explain the pattern of increased vulnerability of nests in exotic plants, several studies suggest that exotic plants influence the placement of nests both within a habitat patch and within the nesting substrate in ways that increase predator detection, access, and efficiency (Schmidt and Whelan, 1999, Borgmann and Rodewald, 2004, Schmidt et al., 2005).

In an effort to evaluate if forests in urbanizing landscapes acted as ecological traps, the following hypotheses were tested: (1) increased density of cardinals in urbanizing landscapes primarily results from urban-associated local changes in food and habitat features that cardinals use to select habitats; and (2) selection of these urban forests is associated with reduced apparent annual survival and reproductive productivity.

Section snippets

Study system

Twelve study sites were located in riparian forest within the Scioto River Watershed in central Ohio (ca. 40N 00′ 83W 00′). Forests were located in and around the Columbus metropolitan area, which has population of approximately 1.6 million (U.S. Census Bureau, 2000). Surrounding rural communities consist of farming communities with extensive agricultural lands and farms surrounding small towns and villages. Study sites were comprised of mature forest habitat ⩾250m long and >100m wide (range…

Results

Cardinals were approximately 1.7× more abundant at urban forests (2.6±0.32 SE) than rural forests (1.5±0.21 SE) in the breeding season ($F_{1,11}$=7.81, P=0.019). During the winter, cardinals were nearly 4× more abundant at urban (2.0±0.26 SE) than rural (0.5±0.10 SE) forests ($F_{1,11}$=27.2, P=0.0004). Cardinal use of forests seemed to be at least partially a function of local habitat features ($F_{11,313}$=4.28, P<0.001). In particular, cardinals selected nest sites with up to 2× times the density of…

Do urban forests contain more features used by cardinals to select habitats?

As expected, cardinals occupied urban forests in greater numbers in both breeding and non-breeding seasons. Findings from this study suggest that cardinals were more abundant in urban forests

because the habitat characteristics and microclimate features used as habitat selection cues by cardinals were promoted in urban forests. In particular, cardinals appeared to select sites with dense understory vegetation and warm winter temperatures, and these variables were positively related to the…

Acknowledgements

This research has been partially supported with grants from the National Science Foundation (DEB-0340879 to A.D. Rodewald), Ohio Division of Wildlife, Ohio Agricultural Research and Development Center, the Ohio State University Swank Program in Rural–Urban Policy, and the Ohio State University School of Environment and Natural Resources. We are grateful for insights and previous work of graduate students who contributed to the research: K.A. Atchison, M.H. Bakermans, K.L. Borgmann, and D.P.…

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