



Research Letters

Use of small Atlantic Forest fragments by birds in Southeast Brazil



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ABSTRACT

Small forest fragments may play a major role in fragmented areas, but there is scarce empirical data to test this hypothesis. To understand in which context birds can use small Atlantic Forest fragments, we tested the presence of 11 bird species in 30 small fragments (4–10 ha), in a range of matrices (eucalyptus-pasture), and in different landscape configurations. The results showed that landscape composition is a good predictor for presence of birds in small fragments and their use can be further associated with matrix type. Considering the number of species, and the species *Chiroxiphia caudata*, we found a pattern in which models that consider the matrix composition are the most plausible. Relative importance of the variables indicates that matrix is the most important single variable among the selected species (five among eight). This suggests that small fragments are effective for increasing connectivity, mainly in landscapes with a higher percentage of permeable matrix.

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Introduction

Habitat loss and fragmentation are the most important threats to biodiversity (Fahrig, 2003; Fischer and Lindenmayer, 2007). These threats are generally anthropogenic, and result in reduction of native vegetation, low landscape connectivity and habitat isolation. Additionally, species more sensitive to the effects of fragmentation become more susceptible to environmental and demographic stochasticity (Fahrig, 2003). As well, intra- and interspecific competition for resources are affected (Fischer and Lindenmayer, 2007), genetic variability decreases and long-term metapopulation persistence is reduced (Hanski and Gilpin, 1997). All of these processes may cause local extinctions.

Landscape connectivity can influence the dynamics of species in fragmented environments. Increasing habitat fragmentation leads to increased distances between the patches, and when the matrix is impermeable reduces the functional connectivity (Baum et al., 2004). Thus, the landscape composition can play a role facilitating or impeding the species' movements depending of the species' capacity to use the landscape structures (Baum et al., 2004). Conversely, to reduce the effects of fragmentation is to improve connectivity between fragments, through forest corridors,

stepping-stones (Baum et al., 2004) or small patches, although this last approach as a connecting structure is still poorly understood (Turner and Corlett, 1996; Renjifo, 2001; Schleuning et al., 2011).

Fragments smaller than 20 ha are generally unable to support viable populations of birds in the long-term given the scarcity of resources (Bierregaard and Lovejoy, 1989), but they can reduce the functional distances between larger habitat remnants (Ribeiro et al., 2009). These forest fragments may also benefit species able to cross the inter-habitat matrix (Fischer and Lindenmayer, 2002) and migratory birds, by providing temporary shelter and food (Robbins et al., 1992). The use of small remnants may be strongly influenced by the landscape context and how the species perceive different landscape elements (Uezu et al., 2008). Moreover, in fragmented areas a matrix composed of more complex structures, such as exotic plant species, can facilitate species movement in the landscape compared to open areas (e.g. pasture), even for less sensitive species (Renjifo, 2001). Thus, in more connected landscapes (Baum et al., 2004) or in a matrix with higher permeability (Uezu et al., 2008), small fragments may play a major role, although there is still scarce empirical data to test this hypothesis.

Our study focuses on the value of small Atlantic Forest fragments for birds in anthropogenic landscapes. The Atlantic Forest is one of the most threatened biodiversity hotspots (Myers et al., 2000), and has a total of 217 bird species are endemic to this biome and at least 98 species are threatened by extinction (Bencke et al., 2006). We expect that birds use small fragments more when the fragments

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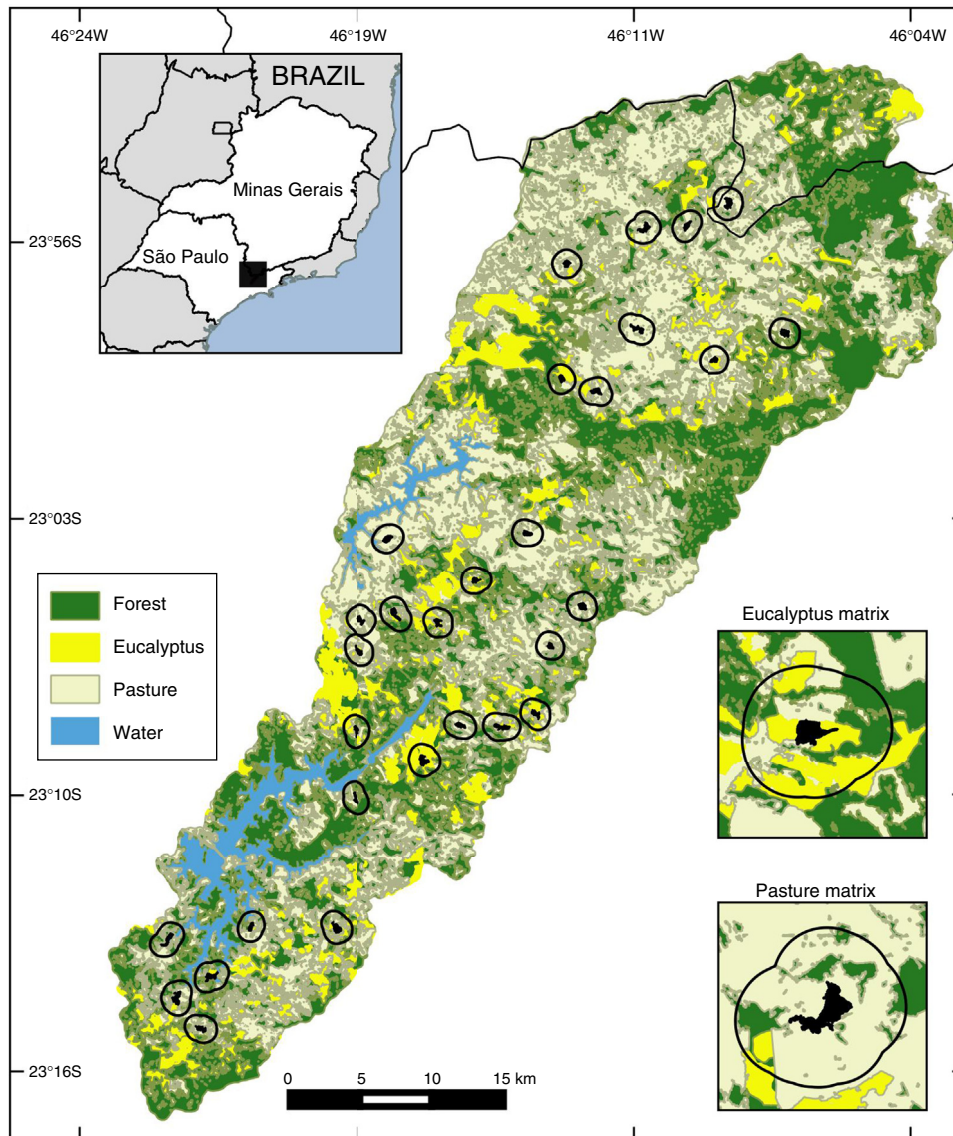


Fig. 1. Map of the study area and 30 selected Atlantic Forest fragments. The bottom right insets are examples of a small fragment inserted in a higher percentage of eucalyptus matrix and a higher percentage of pasture matrix.

are connected and embedded in a more permeable matrix. Our aim is to understand in which landscape context, level of connectivity, matrix type and percentage of forest, the small fragments (4–10 ha) are being used by 11 bird species.

Materials and methods

The study was conducted in the Atlantic Forest (*ombrófila densa* type) in the Cantareira-Mantiqueira mountainous corridor, specifically in the Atibainha and Cachoeira watersheds – Nazaré Paulista, Piracaia and Joanópolis municipalities (São Paulo state), and Camanducaia municipality (Minas Gerais state). Altitudes are 700–2000 m with a wet season during September–March and a drier season during April–August. We mapped the region using ArcGIS and a mix of hi-resolution images (WorldView, QuickBird, OrbView) from 2010 to 2011 into four categories: pasture, water, forests and eucalyptus plantations. The land cover map coupled with field observations allowed us to identify that approximately 33% of the Atibainha and Cachoeira watersheds landscape were comprised of Atlantic forest (mainly in secondary forest) and 27% of commercial plantations (mainly eucalyptus).

Landscapes were defined using 500 m buffers around the small forest fragments (Fig. 1). We selected 30 small fragments, embedded in a gradient of two types of non-habitat (pasture and eucalyptus matrix) and in different percentages of forest cover. Ten of these small fragments were connected to other fragments by narrow forest strips of less than one hectare, and 20 were not connected (open areas under 5 m were disregarded). The vegetation of the selected forest fragments shows intermediate and advanced successional stages with similar internal structures at altitudes between 800 and 1080 m.

We selected 11 forest bird species representing a wide range of species that occur in the region, having dissimilar diet, stratum habitat, home-range sizes, abilities to move through the matrix and sensitivities to habitat loss and fragmentation (Stotz et al., 1996). Moreover, selected species are not rare, endangered or migratory and exhibit a territorial behavior responding to playback, which could influence the chances of detecting these species in small forest fragments (see supplementary data Table S1 for more information on the species). Previous visits were made to three forests fragments (>100 ha) to confirm the presence of the species in the region.

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