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Research paper

New urban developments that retain more remnant trees have greater bird diversity

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HIGHLIGHTS

- Bird diversity in new housing developments which retained remnant trees.
- More birds were observed on streets that had retained remnant trees.
- Retaining more trees increased the bird diversity on vegetated streets.
- Streets with retained mature trees had similar species composition to urban parks.
- We recommend retaining large trees in new developments to help increase bird diversity.

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ABSTRACT

The rapid expansion of urban landscapes has significant consequences for wildlife. Habitat loss and fragmentation cause significant loss of species richness. While remnant fragments of habitat are important areas for conservation, the urban matrix between fragments is also critical. Increasing the suitability of the matrix for wildlife can increase the diversity of wildlife that utilise urban landscapes and increases the potential for dispersal among fragments. We investigated the effectiveness of retaining remnant trees during for increasing the species richness and abundance of birds in new urban housing developments. We measured species richness and abundance in four habitat types: non-vegetated streets, vegetated streets, recreational parks and bush sites. We discovered that the number of bird species observed was lowest on the non-vegetated streets and highest within the bush fragments. Species richness on vegetated streets was intermediate between non-vegetated streets and parks. The abundance of birds was highest within recreational parks and we observed significantly more birds on vegetated streets than non-vegetated streets. Additionally, we found the number of species and total abundance of birds was positively associated with the total number of retained mature trees within a vegetated street. The dominant feeding guild and species composition varied between the different habitat types. Our findings suggest that increasing the number of retained mature trees in new housing developments may be an effective means of increasing the number of bird species that utilise the urban matrix.

1. Introduction

Urban areas are rapidly expanding due to an increasing human population and this often requires the extensive clearing of native forests for new housing and infrastructure (Angel, Sheppard, & Civco, 2005). Urban expansion commonly has negative consequences for biodiversity including local loss of flora and fauna species and changes in wildlife assemblages (Evans, Newson, & Gaston, 2009; McKinney, 2002; van Heezik, Smyth, & Mathieu, 2008). Housing developments make up a large portion of new urban landscape and they are often reported to retain very low species diversity (Sewell & Catterall, 1998; White et al., 2005). However, there is increasing awareness that we can retain some of the biodiversity within these developments if conservation is considered an important goal (Mason, 2006). Retaining mature remnant native trees in small recreation areas and on street verges is one strategy increasingly being used to create "greener" developments. However, the usefulness of this strategy for retaining fauna species diversity is largely unknown.

Remnant vegetation is important for the conservation of urban wildlife as it can still provide abundant resources such as food and

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shelter for many species. Fragments of vegetation offer the highest species diversity in the urban landscape because many species are unable to survive within the urban matrix (Crooks, Suarez, & Bolger, 2004). However, retaining small amounts of native vegetation or even isolated trees in areas of the urban matrix, such as new housing developments, can help increase connectivity among vegetated fragments and provide habitat for some species (Fernandez-Juricic, 2000). Although highly mobile organisms such as birds or bats are the species most likely to utilise these isolated trees, other species could also benefit.

Bird communities are sensitive to urbanisation and species richness generally declines in urban centres resulting in generalist and urban adapted species assemblages (Chace & Walsh., 2006; Devictor et al., 2007; Lim & Sodhi, 2004; van Heezik et al., 2008). Bird diversity is positively associated with retaining native vegetation within the urban matrix (Chace & Walsh., 2006; Evans et al., 2009; Fontana et al., 2011; Sewell & Catterall, 1998; White et al., 2005). High-density housing developments typically retain very few mature native trees during construction, instead planting juvenile trees on street verges after housing construction, which can take many years to mature. In recently developed non-vegetated suburbs, bird diversity is low compared to older suburbs that have mature, planted trees (Sewell & Catterall, 1998; White et al., 2005). Retaining vegetation is likely to benefit species which are able to utilise the resources these trees provide, food and shelter. White et al. (2005) found older suburbs with mature native vegetation to have a greater diversity of feeding guilds than recently developed suburbs and suburbs with exotic vegetation. However, some feeding guilds were still entirely absent from the suburbs with mature native vegetation. Recently, Stagoll (2010), used habitat associations between bird species and habitat features to make recommendations to increase the conservation value of future urban developments in Australia. One of these recommendations was the retention of scattered trees to help increase the available habitat for woodland species. Our study will test the effectiveness of this recommendation in new urban housing developments.

The urban environments of south-east Queensland, Australia, are rapidly undergoing extensive expansion (Garden et al., 2006). New housing developments make up a significant proportion of the landscape, similar to many cities worldwide. We aimed to determine the effectiveness of retaining trees along street verges, median strips and within recreational parks in new, <5 year old, high-density suburban housing developments. Specifically we addressed the following questions: (1) does retaining remnant trees in recreational parks and on streets within recent developments help to maintain species diversity and abundance? (2) Does the retention of a greater number of trees help increase the number of species and abundance of birds utilising the environment? (3) Which feeding guilds benefit more from retaining remnant trees? (4) How does species composition vary among the four location types (referred to as habitat types from here)? We assessed these questions with a combination of bird and vegetation surveys in four habitat types: parks, vegetated streets, non-vegetated streets and nearby bushland habitat as a control.

2. Methods

2.1. Study areas

This study was conducted in the Brisbane, Gold Coast and Redlands Local Government Areas (LGAs) of south-east Queensland, Australia between September 2008 and April 2009. These LGAs contain some of the fastest growing urban areas in Australia. We conducted bird and vegetation surveys in new housing estates (<5 years old), comparing streets with differing amounts of retained native vegetation as well as urban recreational parks. In addition, we conducted these surveys in nearby continuous bush areas to provide a comparison with relatively undisturbed communities. In total, 94 transects were surveyed across these four broad habitat types.

Descriptions of these four habitat types are as follows:

1. Large remnant bush land sites ($n = 13$ transects) were located on the fringe of the examined urban landscapes, these transects acted as controls to compare species richness and composition with the urban habitats. The smallest bush site was approximately 150 ha, however most transects were within continuous forest that was over 900 ha.
2. Recreational parks within housing developments ($n = 29$ transects) consisted of communal green spaces and were characterised by open areas of maintained lawn and landscaped gardens, often with planted native shrubs. The number of remnant trees varied considerably with most sites retaining some large remnant trees.
3. Non-vegetated urban streets ($n = 39$ transects) were along streets and footpaths within housing developments. These transects included the street verges, private gardens and front lawns, which were all mown grass. Many of these streets had small (<2 m height) planted trees both within gardens and on the street verges, however no mature trees or vegetation was retained.
4. Vegetated streets ($n = 14$ transects) are similar to the non-vegetated urban streets, with mown lawn and private gardens however developers have retained a number of relatively large remnant trees. The number of trees varied greatly among transects.

Due to the relatively small number of housing developments that had retained large remnant trees and the small number of large bush remnants in close proximity to urban landscapes, a number of transects of the same habitat type were completed within the same development or bush fragment. In these cases, all transects were spaced by a minimum distance of 200 m and treated as independent for analysis. For example, a large housing development may have had two vegetated street transects and a recreational park transect and a non-vegetated street transect.

2.2. Bird and vegetation surveys

All surveys were conducted by two observers, B. J. B. and S. I. F. Transects were alternated so that each was surveyed by both observers on separate occasions. Each transect was surveyed on either 3 or 4 occasions depending on weather and logistical constraints. Surveys were conducted on mornings of clear weather, between 30 min and 3 h after sunrise. Along each 100 m transect, we recorded all birds that were seen or heard within 15 m either side of the transect line (approximately the visible distance in the front yards of houses from the centre of road). Fifteen minutes was allocated to slowly walk each transect while recording the species and number of birds heard and/or observed within the transect. We also recorded habitat use for all birds that were observed. Birds that were heard in transect but not observed were excluded from analyses; these birds were almost entirely restricted to the large bush habitats where visibility was most greatly reduced. We recorded if birds were perching, foraging, nesting or otherwise utilising the environment and what part of the environment was being utilised; retained trees, planted trees or built infrastructure such as houses, fences, roofs etc. Aquatic species and all birds seen flying over transects without landing within the transect area were excluded from analyses. Data were recorded using handheld PDAs loaded with CyberTracker software, v3.238 (CyberTracker, Cape Town, SA, www.cybertracker.org).