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Research Paper

Restricted home ranges reduce children's opportunities to connect to nature: Demographic, environmental and parental influences

Kathryn L. Hand[a,*], Claire Freeman[b], Philip J. Seddon[a], Mariano R. Recio[a], Aviva Stein[b], Yolanda van Heezik[a]

[a] Zoology Department, University of Otago, P.O. Box 56, Dunedin 9054, New Zealand
[b] Geography Department, University of Otago, P.O. Box 56, Dunedin 9054, New Zealand

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ABSTRACT

While many studies have documented the decline in the extent of children's independent movements, none have explicitly evaluated the impact of this change in behaviour on opportunities to connect with nature. We estimate and compare the biodiversity values within urban children's home ranges, and relate exposure to biodiversity to children's perceptions and use of their neighbourhoods. We interviewed 178 children aged 9–11 years in three New Zealand cities. While children often had biodiverse areas present within 500 m of their home, their restricted home range size meant many of these natural areas fell outside of the range of their daily movements. Children's declining independent mobility, strongly influenced by parental restrictions, appears to limit their freedom to use diverse and natural habitats within their urban neighbourhood, with use instead focused on private gardens and formal greenspaces. Development of a connection to nature in urban areas must therefore take place primarily in private gardens, which are threatened by urban planning approaches that promote dense residential developments with public rather than private greenspace.

1. Introduction

Rapid urbanisation has been blamed for causing a growing disconnection between humans and the natural world (Aaron & Witt, 2011; Maller et al., 2009), which in turn is linked to negative effects on our individual, societal and environmental well-being (Bratman, Hamilton, & Daily, 2012; Orr, 1994). Urbanisation transforms natural landscapes by replacing green vegetation with built structures and impervious surfaces (Turner, Nakamura, & Dinetti, 2004). Over the past 200 years, recognition of the importance of urban greenspace has varied, leading to large differences between cities in the amount and configuration of greenspace and natural areas (Fuller & Gaston, 2009; McDonnell & Hahs, 2008). Today the benefits of urban greenspaces are being recognised, leading to the need for better assessments of the quantity, quality, and accessibility of biodiversity in urban areas (Barbosa et al., 2007; Kaźmierczak, Armitage, & James, 2010).

Typically nature is distributed patchily across neighbourhoods, leading to inequalities in accessibility for urban residents, with biodiversity provision usually biased towards the more affluent areas (Pauleit, Ennos, & Golding, 2005; Turner et al., 2004; Whitford, Ennos, & Handley, 2001). Accessibility of greenspaces depends on several factors, such as whether areas are open to the public, within walking or cycling distance, or perceived as safe to visit (Harrison, Burgess, Millward, & Dawe, 1995). A large proportion of greenspace can be locked up in private property (Mathieu, Freeman, & Aryal, 2007). Access to biodiversity varies depending on individual demographic characteristics and mobility, with use declining with increasing distance from home and with decreasing greenness of the site (Coombes, Jones, & Hillsdon, 2010; Dunton, Almanza, Jerrett, Wolch, & Pentz, 2014). Recommendations for how accessible greenspaces should be within urban areas vary, with minimum distances of 900 m (~15 min walking), recommended by the European Environment Agency (Stanners & Bourdeau, 1995), compared to 300 m (5 min walking), advocated by English Nature (Handley et al., 2003). The latter was met for only 36.5% of households in Sheffield, UK (Barbosa et al., 2007). While availability of greenspace can be high, accessibility at an individual level can be poor (Kaźmierczak et al., 2010).

Compared to adults, children often experience lower accessibility to greenspaces due to parental restrictions on their freedom to travel independently and urban barriers such as major roadways (Carver, Timperio, & Crawford, 2008; Freeman & Quigg, 2009; Veitch, Salmon, & Ball, 2008; Villanueva et al., 2012). Parent's concerns for safety are a

* Corresponding author. Present address: 18 South Hayes Copse, Landkey, Barnstaple, EX32 OUZ, United Kingdom.
E-mail addresses: Kathryn.hand@forestry.gsi.gov.uk (K.L. Hand), cf@geography.otago.ac.nz (C. Freeman), philip.seddon@otago.ac.nz (P.J. Seddon), mariano.recio@gmail.com (M.R. Recio), aviva.stein@otago.ac.nz (A. Stein), yolanda.vanheezik@otago.ac.nz (Y. van Heezik).

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key driver of children's declining independence, particularly in the case of the dangers of traffic (Karsten, 2005; Timperio, Crawford, Telford, & Salmon, 2004). These factors have caused a significant decline in children's scale of independent movement over the past few generations (Hillman, 1993; Kyttä, Hirvonen, Rudner, Pirjola, & Laatikainen, 2015). This decline is especially pronounced in urban areas (Kyttä, 1997; O'Brien, Jones, Sloan, & Rustin, 2000; van der Spek & Noyon, 1997). Consequently, many neighbourhood greenspaces are now unreachable for local children, despite being close to homes and seen as accessible when first designed.

A lack of contact with nature has been proposed to be facilitating the development of a Nature Deficit Disorder in children (Louv, 2008), whereby an inability to interact with nature has detrimental effects on children's health and knowledge of the natural world. Independent use of space supports the development of a diversity of skills in children (Matthews, 2001; Tranter & Pawson, 2001; Wells, 2000), and greener, more natural environments are thought to facilitate this development and learning (Fjørtoft & Sageie, 2000; Samborski, 2010). The reduction in opportunities for children to interact with nature could be in part due to the declining ability of children to explore and interact with nature in their neighbourhood on their own (Freeman, 1995; Pyle, 2002).

The degree to which nature is both available and accessible to urban children is therefore critical to understanding the role of the urban environment in any disconnection to nature in children (Freeman, Heezik, Hand, & Stein, 2015; Louv, 2008). However, the impact of children's declining mobility on their ability to access greenspace and gain opportunities to connect to nature has not been assessed. In this study we apply to children concepts and methodologies commonly used to determine home range size and habitat-use in wildlife; we take into account the biodiversity values of different land covers, and evaluate children's exposure to biodiversity at the scale of individual movements.

We use a multi-scale approach, assessing how much biodiversity is available and accessible at both a neighbourhood and home range scale for children in three New Zealand cities. We ask the following questions: (1) how large are children's independent home ranges, in terms of the total area encompassed by their movements, and how much of this total area is accessible to them; (2) how much biodiversity is present and accessible to children at the scale of their neighbourhoods, and their accessible home range; and (3) what social and demographic factors influence exposure to biodiversity at the scale of children's neighbourhoods and home ranges?

2. Methods

2.1. Recruitment of children and interviews

Children were recruited from nine schools selected using socio-economic and ethnicity data available through the New Zealand Government's school reports, located in three urban centres in New Zealand: Auckland, Wellington and Dunedin (populations 1,415,550, 471,315 and 127,500 respectively). All schools were situated within residential suburbs, and the three schools in each city were attended by children of low, medium and high socioeconomic status. Schools were selected to be located within areas with similar availability of public greenspace so that children's responses to greenspace could be assessed independent of availability of public greenspaces.

In each school about 20 children aged 9–11 years were interviewed, providing sample sizes of 60, 62, and 65 for Wellington, Dunedin and Auckland respectively. Interviews were conducted as part of a larger study on children's natural neighbourhoods (Freeman et al., 2015). To evaluate independent home ranges, we asked children to identify on an aerial map of their neighbourhood the places around their homes that they visited independently or with peers (i.e. not with adults; see Freeman et al., 2015 for methodology). The children then placed at least 30 dots in these areas indicating the places they go to most frequently, and provided explanations as to exactly where they were placing their dots. They were reminded to avoid placing dots on buildings and in places where an adult must accompany them. After the interview the dots were reviewed in relation to the information provided and removed if they fell outside the area the child stated they could go by themselves, or if the child was identifying an indoor space.

We also asked children open-ended questions relating to their perception of their neighbourhoods (is your neighbourhood safe?; do you have friends nearby?; what is your neighbourhood like?), mobility (how do you get to school?) and any restrictions placed on them regarding their independent movements (what do your parents say about where you can and can't go?; are you allowed to go exploring?). Prompts to questions were only used if the child was struggling and as a prelude to further discussion. Responses were coded by a single researcher. We also calculated an independence score, which ranged from none (i.e. no independence); to medium range (i.e. home surrounds/street and freedom within the suburb but limited to specified journeys/destinations) to high (i.e. freedom within the suburb and specified destinations outside suburb).

2.2. Home range estimation

Children's home ranges were defined as the area which encapsulated the child's most used spaces, with use being independent of an accompanying adult (but it could be with another child). We estimated home range areas using Minimum Convex Polygons (MCPs) which create a polygon drawn around a focal subject's location points. MCPs were one of the earliest methods to estimate home ranges in studies of wildlife, and they remain one of the most commonly used due to their broad applicability and simplicity (Burgman & Fox, 2003). We treated the placed dots as analogues of GPS locations that would have been obtained from a tracked animal and drew 100% Minimum Convex Polygons using Hawth's Analysis Tools extension (Beyer et al., 2010) within ArcGIS (v10; ESRI, 2013). Fig. 1 displays these home range boundaries for children of the three different schools in Auckland. We used at least 30 dots per child, as this is the minimum sample size recommended in wildlife studies (Millspaugh & Marzluff, 2001). Nine children who placed less than 30 dots were removed from the analysis, giving a final sample size of 178. We also calculated the maximum distance from home children usually travelled as the Euclidean distance (straight line) of the furthest location point from home.

We characterised the nearby-neighbourhood of each child as the area a child could be expected to be able to use independently. This was defined as a 500 m radius circle around the child's home (an example is shown in Fig. 2a), which was the median maximum distance from home travelled by children in a pilot study undertaken in Dunedin prior to the main study. A standard distance for all children was defined for nearby neighbourhood to allow comparison between children's immediate neighbourhood surroundings irrespective of the mobility of each individual child. Children in the larger study had a median maximum distance travelled from home of 473m, supporting this 500 m as a buffer size.

2.3. Defining availability and accessibility

Since the urban environment is largely dominated by private property, we further classified home ranges and nearby-neighbourhoods into "accessible", which included all areas within the boundary which the child had access to; i.e. public and private spaces that the child was allowed to visit independently, such as a friend's garden. All greenspaces (excluding gardens) were first assumed to be accessible unless proven otherwise, and then each child's map was adjusted after visiting the site to reflect accessibility on the ground. The available home range included all land covers present within the home range boundary, whereas the accessible home range only those the child had access to (see Fig. 2).