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URban Biotopes of Aotearoa New Zealand (URBANZ) II: Floristics, biodiversity and conservation values of urban residential and public woodlands, Christchurch

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Abstract

Urban forests are increasingly valued for multiple benefits such as amenity, cultural values, native biodiversity, ecosystem services, and carbon sequestration. Urban biodiversity in particular, is the new focus although global homogenisation is undermining regional differentiation. In the northern hemisphere (e.g., Canada and USA) and in the southern hemisphere, particularly in countries like South Africa, Australia, South America and New Zealand, local biodiversity is further impacted by historical colonisation from Europe. After several centuries, urban forests are now composed of synthetic and spontaneous mixtures of native species, and exotic species from around the temperate world (e.g., Europe, North and South America, South Africa, Asia). As far as we are aware no-one has carried out in-depth study of these synthetic forests in any Southern Hemisphere city. Here we describe the composition, structure, and biodiversity conservation imperatives of urban temperate forests at 90 random locations in Christchurch city, New Zealand.

We document considerable plant diversity; the total number of species encountered in the 253 sampled urban forest patches was 486. Despite this incredibly variable data set, our ability to explain variation in species richness was surprisingly good and clearly indicates that total species richness was higher in larger patches with greater litter and vegetation cover, and taller canopy height. Species richness was also higher in patches surrounded by higher population densities and closer to very large native forest patches. Native species richness was higher in patches with higher soil pH, lower canopy height, and greater litter cover and in patches closer to very large native forest patches indicating dispersal out of native areas and into gardens. Eight distinct forest communities were identified by Two-Way INdicator SPecies ANalysis (TWINSPAN) using the occurrence of 241 species that occurred in more than two out of all 253 forest patches.

Christchurch urban forest canopies were dominated by exotic tree species in parklands and in street tree plantings (linear parkland). Native tree and shrub species were not as common in public spaces but their overall density high in residential gardens. There was some explanatory power in our data, since less deprivation resulted in greater diversity and density, and more native species, which in turn is associated with private ownership. We hypothesise that a number of other factors, which were not well reflected in our measured environmental variables, are responsible for much of the remaining variation in the plant community structure, e.g., advertising, peoples choice. For a more sustainable

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asset base of native trees in New Zealand cities we need more, longer-lived native species, in large public spaces, including a greater proportion of species that bear fruit and nectar suitable for native wildlife. We may then achieve cities with ecological integrity that present multiple historical dimensions, and sequester carbon in legible landscapes.
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Keywords: Native/exotic species; New Zealand; Parkland; Urban forest; Woodland

Introduction

Urban forests are increasingly valued for multiple benefits such as amenity and cultural values, native biodiversity and other ecosystems services, and carbon sequestration (Konijnendijk et al., 2005). Urban biodiversity in particular, is the new focus for implementing the Convention on Biological Diversity (Anonymous, 2008). However, globalisation trends are causing cities and towns to become homogenised with species from around the world which undermines regional differentiation (Stewart et al., 2007). This is particularly apparent in countries like the USA, Canada, Australia, and New Zealand that were colonised from Europe and the process is continuing with unprecedented mobilisation of the world's people (Stewart et al., 2007). European settlers applied to these diverse lands the exact same principles of urban design and land use practice, and landscape and planting design principles, not to mention their tried and tested species that they had employed in Europe (Ignatieva and Stewart, in press). Many southern hemisphere colonial cities, such as Christchurch (New Zealand), Cape Town (South Africa), and Adelaide (Australia), were planned from Europe and the land cleared of native vegetation before city establishment. Some cities (e.g., Canberra, Australia) were planned for special reasons (as the capital city of Australia in this case). As a result of the land clearances and imported urban planning precepts many colonial cities have little native forest remaining. Small patches of forest have been preserved in some cities, for example, Kings Park in Perth, Australia, Riccarton Bush in Christchurch, New Zealand, and Claudelands Bush in Hamilton, New Zealand.

The use of similar design structures, landscape architecture styles, plant material, and construction materials has resulted in the creation of common vegetation units, habitats, or urban biotopes as they have been termed in Europe. These include lawns, woodlands, shrubberies, hedges, flowerbeds, herbaceous borders, roadside and railway verges, walls, and paving cracks. So, after several centuries since colonisation urban biotopes such as forests and woodlands are now composed of mixtures of native and exotic species from around the temperate world (e.g., Europe, North and South America, South Africa, Asia). As in Europe these are now synthetic communities of planted and spontaneous species. Thus, the New Zealand Christmas tree (pohutakawa, *Metrosideros excelsa* Sol. ex Gaertn.) along sidewalks and *Pittosporum tenuifolium* Sol.ex Gaertn. in woodlands, can be seen in San Francisco, USA and the pin oak (*Quercus palustris* Muenchh.) from the north-eastern USA is prevalent in New Zealand woodlands and parks.

Urban ecology is a young science in New Zealand and yet ecological principles are as valid in cities as they are in primeval wilderness, and indeed should be better understood to manage the increasing environmental and social problems in burgeoning cities. The invasion and naturalisation of exotic species in New Zealand is unique and a serious conservation issue. The native flora of New Zealand is 80%+ endemic and highly susceptible to displacement by invasive exotic species that perform well in the benign climate. Thus, we place particular emphasis in this paper on the issue of native vs. exotic species when considering species richness and biodiversity.

This paper is the second in a series describing the structure, composition, biodiversity conservation imperatives, and management implications of urban ecosystems in New Zealand (also see de Neef et al., 2008; Stewart et al., in press). Here we characterise urban forests in Christchurch city, the second largest urban environment in the country, and ask the following questions:

(1) What is the composition and species diversity of urban woodlands and parklands?
(2) What is the mix of native and exotic species?
(3) What environmental and social factors determine woodland and parkland composition?
(4) What are the conservation values and management implications for these urban forests?

Methods

Field sampling

We sampled restoration forest, planted native woodland, gardens, residential woodland, park and street woodlands, and plantation forest (conifer, eucalypt, other hardwoods), but not natural or primary forest

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