

Tree collections of Auckland — biodiversity and management

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ABSTRACT

Urban vegetation has many recognised biological and human use values. Often described as the Urban Forest, this vegetation includes both remnant natural and designed vegetation, native and exotic species, parks, riparian and coastal areas, street trees, plant collections, civic spaces and many other components.

This paper draws from a Master's research project surveying the biodiversity and management practices associated with thirty-nine tree collections in the Auckland area. These tree collections make up a specific component of the overall urban vegetation mix of Auckland. In this paper, selected biodiversity highlights are illustrated from the collections surveyed, and a range of tree collection management factors such as databases, mapping, and management planning are discussed.

INTRODUCTION

In a world biosphere under continued pressure from urbanisation and population growth, preservation of genetic diversity (biodiversity) has been identified as a key goal of the global environmental movement (World Conservation Strategy, IUCN 1980). Biodiversity takes many forms. It includes native and exotic species, and also natural, rural and urban areas.

Global agreements between nations have brought political pressure on governments to provide scientific research expertise and funding for the preservation of indigenous plant and animal species in their own countries (Groombridge 1992). In New Zealand, surveying and analysis of natural ecosystems has led to strategic planning to protect a representative range of ecosystem types around the country, and to implement strategies for appropriate management of these areas (DOC & MfE 2000).

Movement of species around the world has occurred for a wide range of reasons including agricultural, medicinal and horticultural production, ornamental or amenity use and botanical collection (Given 1984). New Zealand relies heavily on exotic plants and animals for its world trade (Hammett 2000). These exported

individuals may serve as valuable stores of genetic material if their native counterparts become threatened. New Zealand has been suggested as a potential botanical Noah's Ark for conserving threatened temperate, and sub-tropical floras (Given 1986). Horticultural plant selection and breeding add another layer of complexity to global species biodiversity (Lowe 1989).

This paper draws on a recent research project (Clifflin 2001) and considers both native and exotic tree collections in urban Auckland. It seeks to characterise the biodiversity found, and consider the adequacy of the systems used to manage them.

Concepts for this project have been developed from urban forestry, plant collection, conservation and landscape management theory.

American authors have developed the term *Urban Forest* to include all urban vegetation. The components of the urban forest therefore include street trees, vegetation in parks and reserves, urban squares, around civic buildings, monuments and cemeteries, parking areas, riparian and coastal margins, utility easements, special areas, public and private land,

commercial sites, remnant native ecosystems, plantation forestry, gardens and so forth (Miller 1988; Phillips 1993; Grey 1996; Meunier et al. 1998). This is in contrast with European literature that limits the use of this term to large forested sites in or near urban areas, under public ownership. Privately owned land is generally not included (Clouston & Stansfield 1981; Konijnendijk 1997). The usefulness of the American concept of the Urban Forest has been considered for Auckland.

British authors use the term *Plant Collection* to refer to a group of plants representative of a genus group or sub genus group (Lowe 1989). In this study it is used more loosely initially, to mean a group of trees for which there exists a survey list of the trees that are present. This usage is brought into focus in the data analysis where the collections found are evaluated in terms of the narrower British definition.

The research question has three parts:

1. Is the Urban Forest concept useful for Auckland?
2. What biodiversity exists among Auckland tree collections?
3. What does a good management system for tree collections look like?

METHODOLOGY

The data for this research project was collected through a biodiversity survey of 39 tree collections, followed by a survey of 12 tree collection managers investigating current management practices for Auckland tree collections.

The biodiversity survey took a broad definition of a tree collection as a group of trees for which species data has been recorded, rather than the stricter definition in which the collection must fully represent a genus of trees, so as to include a broad base of data. The study then characterises the biodiversity found, analysing genera collections and the different types of collections identified. Current best management practices used by tree collection / urban forest managers in Auckland are then reviewed.

SUMMARY OF RESULTS

Urban Forest concept

A sense of the spatial character of the urban vegetation of Auckland may be gained from the colour enhanced satellite photography (Fig. 1). Auckland's large tracts of native forest in the nearby Waitakere and Hunua ranges are shown as a brown-red colour, and also large areas of other types of urban greenspace vegetation. There are major transport corridors along the motorways and railway lines. Rivers and creeks provide further green linkage throughout the city, as do the numerous parks and reserves, commercial and public institutions, streets and private gardens.

These observations support the use of the American concept of the 'Urban Forest' as a multi-faceted collection of types of vegetation. In the Auckland setting it is helpful to deal with all urban vegetation collectively and to consider its management in a holistic manner. This management is then able to cross land-ownership and territorial local-authority boundaries, as recommended by several American authors (Miller 1988; Grey 1996; Clark et al. 1997), and allows strategic planning for the urban vegetation collectively. The Urban Forest Concept allows for biological and botanical, as well as landscape and recreational planning objectives to be considered at a city-wide scale.

Biodiversity survey

In considering one component of Auckland's Urban Forest in its tree collections, a total of 1259 tree species and cultivars from 80 different families were reported in the biodiversity survey of 39 sites (Cliffin 2001).

Largest collections

With more than 900 species, the Auckland Regional Botanic Garden (ARBG) held nearly three times as many tree species as the next largest collection. Table 1 lists the top six collections in terms of species diversity and Fig. 2 shows how many taxa (species and cultivars) were reported in each of the 39 collections surveyed.

Elements that make up the collections

Collections were compared to recommended

Table 1 Six highest ranking tree collections in the Auckland area. Based on a survey of 39 sites and counts of the number of species in each collection.

Rank	Collection Name	Number of species
1	Auckland Regional Botanic Garden (ARBG)	918
2	Auckland City street trees	332
3	University of Auckland	194
4	Manukau City street trees	190
5	Auckland Domain	169
6	Cornwall Park	159

plant collection elements of a library, nursery, laboratory and herbarium, as well as the plant collection itself.

- All of the collection managers reported having a real live plant collection!
- Half of the collections had a library and half had a nursery. One-quarter had a full inventory of their collection
- Only Auckland University had a laboratory and herbarium associated with it. ARBG used the herbarium facilities at the Auckland Museum. Unitec had a laboratory and has more recently (in 2002) developed a herbarium.
- *Agathis montana*, a New Caledonian endemic kauri growing at ARBG
- *Castanopsis cuspidata*, the Japanese chinquapin growing on the Unitec campus
- *Dysoxylum pachyphyllum*, endemic to Lord Howe Island and growing at the University of Auckland
- A wide range of *Eucalyptus* species growing at Waikumete Cemetery and Cornwall Park
- *Jubaea chilensis*, the Chilean wine palm growing at the new park in Hillsborough (formerly Monte Cecilia)
- *Phytolacca dioica*, an Argentinean species growing at Albert Park.

Best represented species and genera in Auckland collections

The most commonly represented tree species was *Podocarpus totara*, followed by *Vitex lucens* and *Quercus robur*. Of the thirteen most common trees, nine were native and all but two were evergreen. The best represented genera are shown on Table 2.

In general the best represented genera are from the New Zealand native flora (e.g., *Agathis*, *Cordyline*, *Metrosideros*, *Phyllocladus*), with *Phoenix* and *Cupressus* being the best represented exotic genera.

The ARBG has the largest number of specialist genera collections. The acquisition policy of the ARBG has a strong influence on which genera are well represented in Auckland collections.

Rare tree species

Several rare and interesting trees were located among the Auckland collections, including:

Trade availability of tree species

44% of the trees reported in the survey were found to be available in more than three nurseries in New Zealand. 31% were available in between one and three nurseries and 25% of the trees were not available commercially. Botanical taxa are considered at risk of unavailability when available at less than three nurseries according to the British Plant Collection Scheme (Lowe 1989). This result highlights the need for species preservation management planning systems in New Zealand.

MANAGEMENT SURVEY

The following results are based on a survey of 12 tree collection managers while investigating current management practices for Auckland tree collections.

Collection age

As Fig. 3 illustrates, new tree collections have been started in Auckland every quarter century since European settlement. It is comforting to know that new tree planting is happening

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Fig. 1 Satellite image of Auckland highlighting urban greenspace vegetation in the city and native forest in the adjacent ranges.

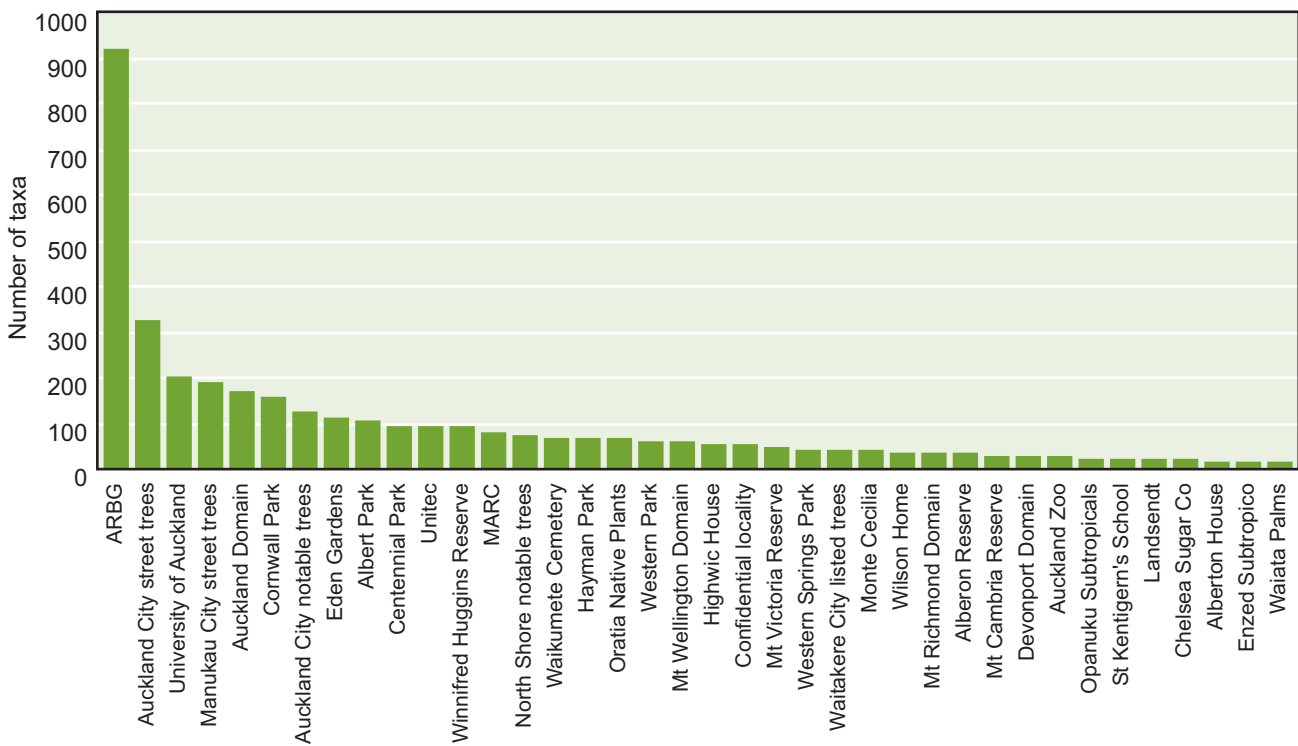


Fig. 2 Number of taxa in Auckland tree collections.

regularly in Auckland. According to Brian Gould (pers. comm. 2000), Auckland City plants 2000 new and replacement trees every year plus 30 000 native plants for revegetation projects.

Collection objectives/goals

The most common collection goal identified by managers was to provide amenity value for visitors, followed by protecting or improving the plant collections (Fig. 4).

Fig. 4 lists some of the other collection goals reported. It was surprising that only three managers had collection improvement or plant acquisition goals in mind as they answered this question. This perhaps reflects the recreation focus necessary for public collections to attract funding.

Specialist collections of offshore island trees and sub-tropical fruiting trees (Mt Albert Research Centre) and palms (Waiata Reserve) were identified, which reflect Auckland's climatic characteristics. Most collections represented a wide range of tree types.

MANAGEMENT PLANS

As Fig. 5 illustrates:

- One-third of the collection managers had management plans for their collection
- One-quarter reported there was a management plan in progress
- This leaves just under half of the managers with no management plans at all.

Loss or lack of skilled and knowledgeable staff and lack of financial resources were the two most commonly reported factors limiting the effectiveness of management plans.

PUBLIC INPUT INTO MANAGEMENT PLANNING

- The most common source of public input reported was informal feedback to staff
- Questionnaires and public representatives on boards were next most common
- Public consultation during management planning process was least used by two managers
- Two managers reported that public input was not applicable to their collection.

THREATS

Restructuring of staff or loss of knowledgeable staff were most commonly ranked as the most severe threat to tree collections, followed by lack of financial resources.

INFORMATION MANAGEMENT

- Half the collection managers used computerised plant information systems
- The University of Auckland and the Auckland Regional Botanic Gardens use International Transfer Format (ITF) database systems, compatible with botanic gardens around the world
- Eden Gardens and Unitec reported using asset registers to record and manage plant records. Cornwall Park had a tree maintenance spreadsheet inventory system.

The managers who used these more detailed management systems were generally managers of the larger collections, and also reported high levels of tree maintenance.

PROFESSIONAL CONSULTANTS

- One-quarter of the tree collection managers had access to all the consultants listed
- Two-thirds indicated access to three or more types of consultants
- Professional consultants listed were horticulturist, arborist, botanist, landscape architect, resource manager or planner, other tree collection managers through network organisations.

DISCUSSION

For Auckland as a whole, the concept of the Urban Forest is useful for making the best use of the values of all vegetation in the city. It is extremely useful for individual collection managers to appreciate their contribution to the overall picture. Networking between managers is critical for the success of this approach. New technologies such as GIS databases are powerful analysis tools for broad-scale spatial planning of biological and human use values, which may be maximised when city vegetation is planned as a whole.

The biodiversity survey undertaken for 39 collections reveals a wealth of tree species

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Table 2 Best represented genera in Auckland tree collections.

Genus	Number of species and cultivars found in collections			Number of species in genus (from Brickell 1999)	% of spp. in genus found in Auckland collections	Collection with the best representation of each genus
	Total (spp. + cv.)	spp.	cv.			
<i>Magnolia</i>	122	27	95	150	18	ARBG
<i>Prunus</i>	74	23	51	200	12	ARBG
<i>Acer</i>	59	28	31	150	19	ARBG
<i>Eucalyptus</i>	51	51	0	500	10	Cornwall Park/ Waikumete
<i>Metrosideros</i>	46	17	29	50	34	ARBG
<i>Pinus</i>	44	39	5	120	33	ARBG
<i>Cupressus</i>	28	11	17	24	46	ARBG
<i>Betula</i>	24	19	5	60	32	ARBG
<i>Sophora</i>	22	10	12	50	20	ARBG
<i>Malus</i>	21	9	12	35	26	ARBG
<i>Podocarpus</i>	21	15	6	100	15	ARBG
<i>Quercus</i>	18	17	1	600	3	ARBG
<i>Picea</i>	17	8	9	30–40	20–27	ARBG
<i>Populus</i>	16	9	7	35	26	Street
<i>Ficus</i>	15	13	2	800	2	ARBG
<i>Fraxinus</i>	14	10	4	65	15	ARBG
<i>Cordyline</i>	13	7	6	15	47	Oratia
<i>Salix</i>	13	8	5	300	3	Auckland City street plantings
<i>Erythrina</i>	12	10	2	100	10	ARBG
<i>Robinia</i>	11	2	9	20	10	ARBG
<i>Gleditsia</i>	10	3	7	14	21	ARBG
<i>Michelia</i>	10	7	3	45	16	ARBG
<i>Araucaria</i>	9	8	1	18	44	ARBG/Domain
<i>Acacia</i>	8	8	0	1100	<1	Manukau Street
<i>Aesculus</i>	8	5	3	15	33	ARBG
<i>Agathis</i>	8	8	0	13	62	ARBG
<i>Phoenix</i>	8	8	0	17	47	ARBG
<i>Bauhinia</i>	6	6	0	250	2	ARBG
<i>Abies</i>	5	5	0	50	10	ARBG
<i>Archontophoenix</i>	5	4	1	2	200*	ARBG
<i>Tilia</i>	5	4	1	20–45	9–20	ARBG
<i>Brachychiton</i>	4	4	0	30	13	Domain
<i>Phyllocladus</i>	4	4	0	5	80	Cornwall/Oratia

*Inconsistent reference data.

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represented in the Auckland region. It provides an inventory of tree species in Auckland tree collections, enabling ongoing biodiversity monitoring and analysis.

Tree collection management systems have been investigated. Effective tree collection management is characterised by:

- Clear strategic goal setting
- Computerised plant information systems used to monitor the collection effectively in terms of makeup, location and maintenance, therefore providing a vital feedback loop for testing the effectiveness of management practices
- Provision of appropriate staff and financial resources
- Management plans
- Understanding of complex operating environments.

Current management theory and practice such as described above is in evidence in both public and private Auckland tree collections. However, there is a clear need for more general uptake of best practice by managers.

End quote:

'Trees reach up and link man with the sky. In a city they transcend the noise, confusion and disorder. Silently, they provide a resting place and refuge from the chaos of urban life. In the quiet early morning hours of dawn, in the rush of late afternoon business, city trees proudly stand protecting us from the loss of our humanity.'
Nadel et al. (1977).

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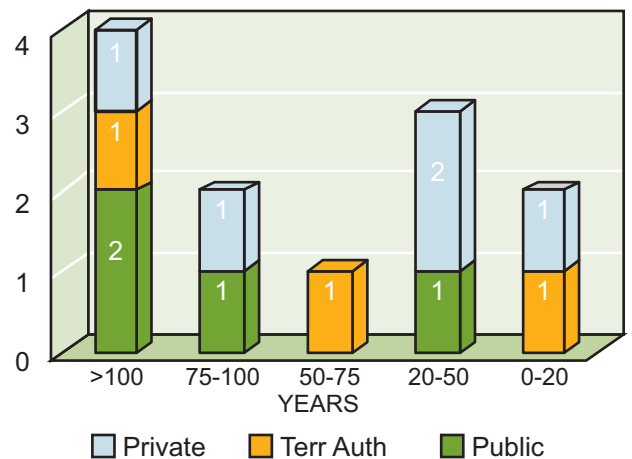


Fig. 3 Age of Auckland Tree Collections.

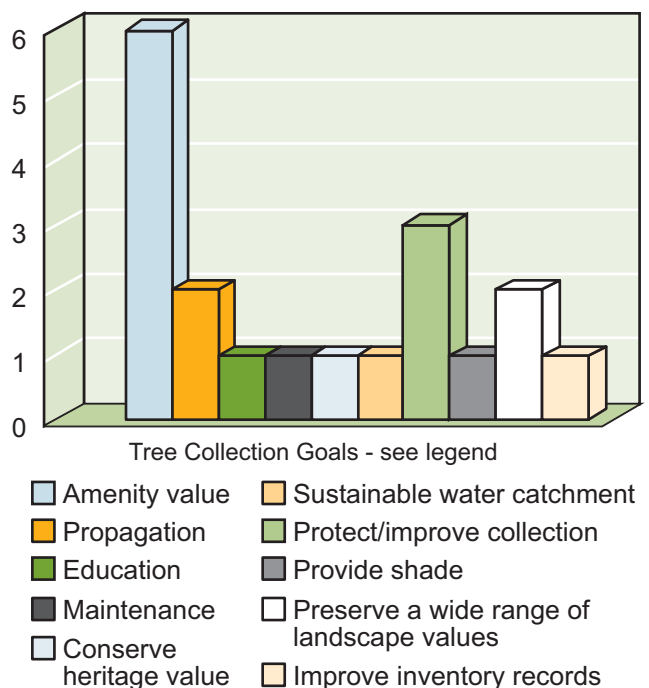


Fig. 4 Goals reported for Auckland tree collections.

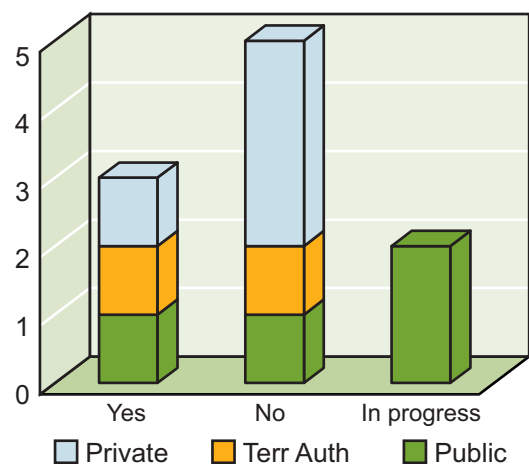


Fig. 5 Management plans for Auckland tree collections.

REFERENCES

- Brickell, C. *ed.* 1999: The Royal Horticultural Society A-Z encyclopaedia of garden plants. 2nd ed. London, Covent Garden Books. 1080 p.
- Clark, J. R.; Matheny, N. P.; Cross, G.; Wake, V. 1997: A model of urban forest sustainability. *Journal of Arboriculture* 23(1): 17–29, 31 January 1997.
- Cliffin, P. 2001: Rediscovering the Urban Forest: tree collections in Auckland. Unpublished MAppSc. thesis, Massey University, Palmerston North, New Zealand. 304 p.
- Clouston, B.; Stansfield, K. *ed.* 1981: Trees in towns: maintenance and management. London, Architectural Press. 168 p.
- Department of Conservation (DOC) and the Ministry for the Environment (MfE) 2000: The New Zealand biodiversity strategy: our chance to turn the tide. Wellington, Department of Conservation and Ministry for the Environment. 144 p. Available at <http://www.biodiversity.govt.nz/picture/doing/nzbs/contents.html>.
- Given, D. R. 1984: Botanic gardens and the conservation of threatened plants. *Annual Journal of the Royal New Zealand Institute of Horticulture* 12: 47–51.
- Given, D. R. 1986: The Banks Memorial Lecture, botanic gardens and conservation — the road from Las Palmas. *Annual Journal of the Royal New Zealand Institute of Horticulture* 14: 3–9.
- Grey, G. 1996: The Urban Forest: comprehensive management. New York, Wiley. 156 p.
- Groombridge, B. *ed.* 1992: Global biodiversity: status of the Earth's living resources: a report. London, Chapman & Hall and the World Conservation Monitoring Centre. 585 p.
- Hammett, K. 2000: Dumbing down. *The New Zealand Gardener*. March 2000. Pp. 36–37.
- International Union for Conservation of Nature and Natural Resources 1980: World Conservation Strategy: living resource conservation for sustainable development. Gland, Switzerland: IUCN. 48 p.
- Konijnendijk, C. C. 1997: A short history of urban forestry in Europe. *Journal of Arboriculture* 23(1): 31–39, 31 January 1997.
- Lowe, A. 1989: The way ahead. *The Garden* 114(8): 364.
- Meunier, I. M.; de Silva, J. A.; dos Santos, C. M. 1998: Evaluation of the planning and monitoring of the urban forest in Recife, Pernambuco, Brazil. *Journal of Arboriculture* 24(6): 333–337, November 1998.
- Miller, R. W. 1988: Urban forestry: planning and managing Greenspaces. New Jersey, Prentice Hall. 404 p.
- Nadel, I. B.; Oberlander, C. H.; Bohm, L. R. 1977: Trees in the city. Pergamon Press, New York. 94 p.
- Phillips, L. E. Jr. 1993: Urban trees: a guide for selection, maintenance and master planning. New York, McGraw Hill. 273 p.