An Analysis of the Street Tree Population of Greater Melbourne at the Beginning of the 21st Century

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Abstract. An audit of the street tree population of Melbourne, Victoria, Australia, was undertaken to establish its size and botanical composition as a reference point for future studies. The 31 independent municipalities that comprise metropolitan Melbourne were approached to provide information on their respective street tree populations. Where available, data from individual municipalities on population, area, and total street length were also collected. Of the 31 municipalities surveyed, 23 had undertaken some form of street tree inventory or audit. These individual data sets were combined into a single database. Data queries were then undertaken to obtain a range of information. A total of 922,353 trees, comprising 1127 taxa, were captured in this superset of data. Australian native plants made up the majority of the trees with 60% of the total. Of the Australian native taxa, wattles (*Acacia* spp.), gums or eucalypts (*Eucalyptus* spp.), paperbarks (*Melaleuca* spp.), bottlebrush (*Callistemon* spp.), and Queensland brush box (*Lophostemon confertus* [R. Br.] Peter G. Wilson and Waterhouse) comprised 394,730 individuals (43% of all trees). Of the exotic taxa, *Prunus* spp. were the most common with 86,227 individuals (9% of the total). Queensland brush box was the most common taxon surveyed with 61,959 individuals. Purple-leaf cherry plum (*Prunus cerasifera* Ehrh. 'Nigra') was the most common exotic taxon with 35,402 individuals. An analysis of the diversity of this population showed that it meets a set of minimum diversity criteria apart from the dominance of the Myrtaceae at the family level.

Key Words. Biodiversity; street tree history; street tree inventory; street trees.

Trees have been planted in the streets of suburban Melbourne since the mid-1800s and they constitute an important element of the heritage and landscape character of Melbourne. Apart from early recordings of street tree plantings in the 1850s, little street tree data has been compiled and documented. The advent of computerized tree inventories during the 1980s has allowed street tree data compilation and analysis, but not all municipalities within metropolitan Melbourne have undertaken an inventory. Twenty-three of the 31 metropolitan Melbourne municipalities have undertaken some form of street tree inventory; however, there has been no recent compilation of the street tree population of the Greater Melbourne area. This study was devised with the objective of taking a "snapshot" of the street tree population in Melbourne at the turn of the 21st century. This study will aid the improved management of street trees for the future and, importantly, will provide a historical point for a view of street trees in Melbourne that may be the basis of future research and planning.

BRIEF HISTORY AND OVERVIEW OF MELBOURNE

Melbourne was founded in 1835 and is the capital city of the state of Victoria, southeastern Australia, situated on Port Phillip Bay at the mouth of the Yarra River. The city proper occupies a relatively compact area of the northern bank of the Yarra, but Greater Melbourne sprawls around the shores of Port Phillip Bay and inland to the east and north. Greater Melbourne covers an area of approximately 8,800 km^2 (3,520 mi^2) and has a population of approximately 3.4 million people.

Greater Melbourne comprises 31 autonomous local governments that are responsible for delivering a wide range of economic, social, recreational, and property services as well as developing and maintaining essential community infrastructure.

According to the Köppen classification scheme, the climate of Melbourne is in the major group "temperate" and the classification group "no dry season; warm summer" (Bureau of Meteorology 2006).

The proximity of Port Phillip Bay directly influences metropolitan Melbourne's climate, tempering the hottest months (January and February when the average maximum temperature is 26°C [79°F]) with sea breezes. The average annual rainfall in the city of Melbourne is 656 mm (26.2 in) with the wettest months being from September to December.

The annual average temperature is 19.7°C (67.5°F) with the highest average temperature in February (25.7°C [78.3°F]) and the lowest average temperature in July (13.4°C [56°F]). Freezing injury is only experienced in subtropical and tropical taxa.

The soils of Melbourne are closely related to the underlying geologic material from which they have formed. To the north and west, basaltic parent material gives rise to clay soils. The sedimentary rock of the eastern suburbs results in loamy soils over clay subsoils. Marine deposits in the southeastern suburbs have given rise to sandy profiles (SGAP 1991).

HISTORY OF TREE PLANTING IN MELBOURNE

According to Spencer (1986), the use of planting material in Australia during the 19th and early 20th centuries was divided into two fairly distinct periods: 1850 to 1870 and the 1880s. The period 1850 to 1870 was distinguished by the use of fast-growing evergreens, primarily conifers and a small palette of native species, most notably southern blue gum (*Eucalyptus globulus* Labill.). These trees were promoted and used in both public and private plantations. The 1880s then saw a growing momentum toward the use of deciduous trees in streets. The Director of Royal Melbourne Botanic Gardens, Ferdinand Mueller, had a powerful influence on the selection of species for use as street trees in the new colony between 1850 and 1870. He was responsible for avenue plantings of silky oak (*Grevillea robusta* A. Cunn. Ex R. Br.) and flame-tree (*Brachychiton acerifolius* Macarthur and C. Moore) adjacent to the Royal Botanic Gardens. He also planted southern blue gum, for its rapid growth and drought tolerance, along St. Kilda Road and on the banks of the Yarra River (Spencer 1986).

The more common species of tree used in Europe were not neglected, and by 1864, experimental avenue plantings of plane (*Platanus* spp.) and ash (*Fraxinus* spp.) were performing well in the Melbourne climate and soils (Spencer 1986). Conifers were particularly common and nurseries of the time stocked a wide variety of conifers. In fact, the Royal Melbourne Botanic Gardens had become a propagation center for a large number of conifers and many were displayed in the Pinetum established by Mueller in the Gardens (Spencer 1986). Monterey pine (*Pinus radiata* D. Don) was also planted as experimental street tree plantings during the 1860s.

However, by the mid-1870s, the evergreen conifers and blue gums did not gain the popularity that the deciduous trees achieved as a result of their lack of seasonal variation. Subsequently, elms, planes, and poplars were commonly used, as were palms, including Canary Island date palm (*Phoenix canariensis* Hort. ex Chabaud) (Spencer 1986).

By 1900, a greater range of plants was being used; however, there was obviously a bias toward elms, primarily Dutch elm (*Ulmus × hollandica* Mill.) and English elm (*U. procera* Salisb.), because many fine examples of avenues of this genus can be seen in Melbourne and many regional centers dating from this time (Spencer 1986). After World War I, the rapid development of city suburbs, with narrow streets placed in bushland settings, demanded a different approach to tree selection (Spencer 1986). Among the new selections were red-flowering gum (*Corymbia ficifolia* [F. Muell.] K.D. Hill and L.A.S. Johnson), flowering cherry plums (*Prunus* spp.), Norfolk Island hibiscus (*Lagunaria patersonia* [Andrews] G. Don), jacaranda (*Jacaranda mimosifolia* D. Don), sweet pittosporum (*pittosporum undulatum* Vent.), and Queensland brush box (Spencer 1986). After World War II, native plants became more popular, and eucalypts, callistemons, and mel-

aleucas were more widely planted. Exotic, deciduous trees were not excluded and pin oak (*Quercus palustris* Muenchh.) was also used widely in streets from this time.

More recently, greater use has been made of honey locust (*Gleditsia* spp.) and ornamental pear (*Pyrus* spp.); however, London plane (*Platanus × acerifolia* [Aiton] Willd.) is still popular for avenue planting. Native tree taxa have also been extensively used to develop and extend wildlife corridors and to preserve Australian flora. Taxa such as lemon-scented gum (*Corymbia citriodora* [Hook.] K.D. Hill and L.A.S. Johnson), spotted gum (*C. maculata* [Hook.] K.D. Hill and L.A.S. Johnson), red-flowering gum (*C. ficifolia* [F. Muell.] K.D. Hill and L.A.S. Johnson), yellow gum (*Eucalyptus leucoxylon* F. Muell.), narrow-leaved peppermint (*E. nicholii* Maiden and Blakely), red ironbark (*E. sideroxylon* Wools), and red spotted gum (*E. mannifera* Mudie) have been widely planted (Spencer 1986).

TREE INVENTORIES

Complete tree inventories, and particularly computerized tree inventories, are a relatively recent introduction in municipal arboriculture. The City of Melbourne Tree Inventory of 1984, one of the first instigated in Australia, started with a rudimentary paper-based system and then progressed to the fully computerized geographic information system (GIS) in use today (Crowe 1992). This is the system generally currently favored by municipalities. There are many different types of street tree inventory, and most local governments have their own view of what exactly constitutes an inventory and what information should be collected. The purpose of this article is to determine which local governments have undertaken a street tree inventory and to collate and query that data so as to ascertain the dominant tree taxa used in the streets of Greater Melbourne at the beginning of the 21st century.

Materials and Methods

The cooperation and input of local government municipalities was a vital aspect of the project. All Melbourne metropolitan councils were approached to participate in the project. Of the 31 municipalities approached, 23 had completed some form of street tree data collection, three had undertaken part or incomplete street tree inventories and eight, primarily in urban fringe areas, had undertaken no street tree inventory (Figure 1). The data collected comprised tree populations from 62% (5,490 km^2) of the approximately 8,800 km^2 (3,520 mi^2) that make up greater Melbourne.

Because each municipality used their own formats to collect data, there was considerable variation between the data and field types used in the 23 data sets that were available. This variation precluded a detailed tree health and age investigation and analysis, which would have provided useful information about the overall condition of the street tree re-
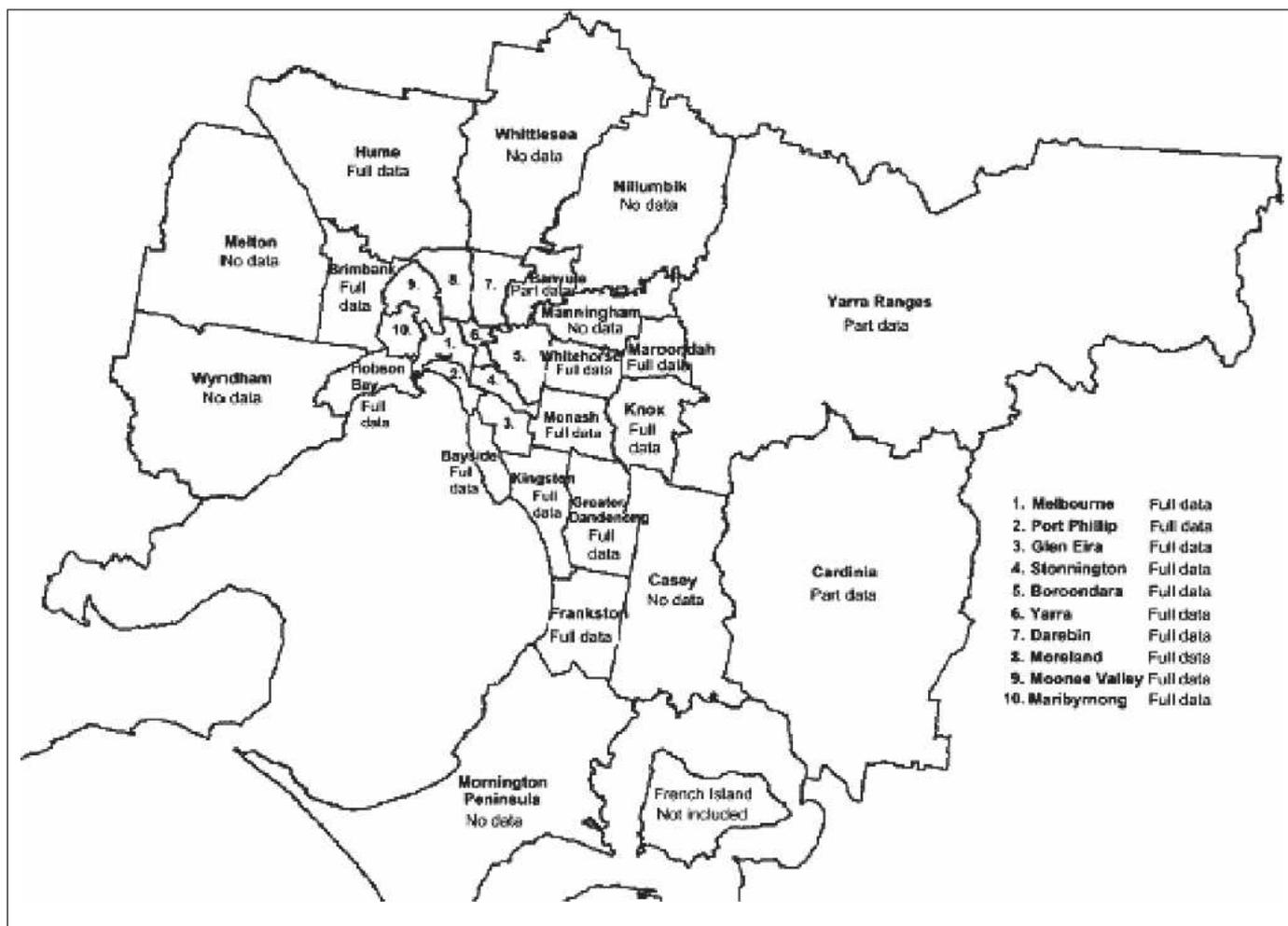
Figure 1. Municipalities of metropolitan Melbourne indicating which have undertaken street tree inventories. Adapted from Department of Infrastructure (2005). No scale shown.

source. Data from municipalities were also sought for overall street length (km), population, and area to compare against the street tree data (Table 1).

All of the data collected were provided in digital formats, either in database or spreadsheet files copied from the individual municipality's street tree inventory. To allow analysis to take place, these different formats had to be combined into a single set. This was done using Microsoft Excel. The process undertaken involved setting up a series of information fields and then copying the relevant information from each municipality into those fields. Once this task had been completed, the data were collapsed so that all records for any taxa became a single record. At that point data analysis, which included such items as the total number of trees for each taxon, plant type (e.g., shrub, large tree, etc.), and taxon origin, was carried out. The results of this analysis and the implications of these results are presented in the next sections of this article.

RESULTS

The information collected consisted of generic city information from each municipality as well as street tree "inventory" data. Collation of the data sets required considerable manipulation and reformatting to obtain the required information. A total of 922,353 trees were captured in this superset of street tree inventory data comprising approximately 1127 taxa.

Australian native taxa made up the majority of the trees with 555,867 specimens or 60% of all collected plants. Wattles (*Acacia* spp.), bottlebrush (*Callistemon* spp.), gum trees (*Eucalyptus* spp.), paperbarks (*Melaleuca* spp.), and Queensland brush box comprised 394,730 individuals or 43% of all collected plants. Of the exotic taxa, *Prunus* spp. were the most common with 86,227 individuals or 9% of the total. Queensland brush box was the most common taxon used in streets with 61,959 specimens. Purple-leaf cherry plum was the most common exotic taxon with 35,402 specimens. Table

Table 1. Details of municipalities.

Council	Population	Area (km²)	Street length (km)	Number of street trees	Tree inventory	Comment
Banyule City Council	118,000	63	613	72,000	Part data	
Bayside City Council	90,205	36	420	43,678	Full data	
Boroondara City Council	157,000	65	648	62,000	Full data	
Brimbank City Council	149,131	123	801	85,000	No data	
Cardinia Shire Council	45,083	1,280	1,420	21,000 (est.)	Part data	989 km unsealed roads
Casey City Council	181,599	395	1,117	No data	No data	
Darebin City Council	131,000	53	620	46,105	Full data	
Frankston City Council	112,062	142	618	43,544	Full data	
Glen Eira City Council	117,000	39	460	45,000	Full data	
Greater Dandenong City Council	132,000	130	560	15,522	Full data	
Hobsons Bay City Council	74,164	66	489	65,000	Full data	
Hume City Council	138,424	503	887	41,713	Full data	
Kingston City Council	135,251	91	540	28,003	Full data	
Knox City Council	141,200	114	204	68,690	Full data	
Manningham City Council	112,503	113	710	77,000 (est.)	No data	150 km sealed rural and 60 km unsealed
Maribyrnong City Council	61,145	31	302	28,500	Full data	
Maroondah City Council	96,000	61	469	48,985	Full data	
Melbourne City Council	52,000	37	308	18,592	Full data	
Melton Shire Council	39,109	528	659	18,000	No data	
Monash City Council	160,862	82	707	106,859	Full data	
Moonee Valley City Council	112,307	44	500	42,000	Full data	
Moreland City Council	129,677	51	492	62,000	Full data	
Mornington Peninsula Shire Council	120,000	720	1,890	70,000 (est.)	No data	
Nillumbik Shire Council	57,241	430	865	No data	No data	
Port Phillip City Council	73,092	21	245	25,868	Full data	
Stonnington City Council	84,300	26	308	32,968	Full data	
Whitehorse City Council	142,000	64	650	72,000	Full data	
Whittlesea City Council	115,352	487	653	36,000	No data	115 km unsealed
Wyndham City Council	86,525	542	635	30,000 (est.)	No data	
Yarra City Council	69,400	20	345	20,243	Full data	
Yarra Ranges Shire Council	143,230	2,472	2289	60,000 (est.)	Part data	931 km unsealed
Totals	*3,376,862*	*8,828*	*21,424*	*1,386,270**		

2 lists the 50 most common taxa and Table 3 lists the origins of those 50 taxa.

Issues regarding tree identification were highlighted in this process with 146 taxa classified to genus-level only. This category contained 91,255 plants or approximately 10% of the data. "Unknown taxon" was also prominent with 5,016 plants (0.6% of population).

The top 10 taxa in Table 2 include seven Australian native taxa and three exotic taxa. However, as indicated in Table 3, there is greater diversity of exotics than Australian natives. In this context, exotic refers to a tree taxon that has its origins in a country other than Australia and Australian native to a tree taxon originating from somewhere in Australia.

According to Table 3, the overwhelming majority of trees in the data are broadleaf species with 92%. Conifers follow with just 8%. Table 3 also indicates the greatest diversity of taxa was in exotics, yet they only make up approximately

18% of the individuals in the superset. Table 4 and Table 5 show the most common families and the major genera, respectively.

The family *Myrtaceae* makes up 52% all plants and also has the greatest diversity of genera at 8%. Rosaceae is also a significant family both in terms of number of plants and genus diversity. These 12 genera represent 515,679 plants or approximately 57% of the total population surveyed.

Table 6 shows the number and percentage of tree foliage type (evergreen, deciduous, etc.). This shows the importance of evergreen taxa in the Melbourne streetscape.

DISCUSSION

The overriding finding of this study is that Australian native tree taxa are a vital component of Melbourne's street landscapes. The ten most common species, as indicated in Table 2, include seven Australian and three exotic taxa. The family

Table 2. The 50 most common taxa in rank order.

Botanical name	Number	Percentage of total	Native/exotic
Queensland brush box (*Lophostemon confertus*)	61,959	6.9	N
Snow-in-summer (*Melaleuca linariifolia*)	46,837	5.2	N
Purple-leaf cherry plum (*Prunus cerasifera* 'Nigra')	35,402	3.9	E
Prickly-leaved paperbark (*Melaleuca styphelioides*)	31,049	3.4	N
Willow bottlebrush (*Callistemon salignus*)	27,427	3.0	N
London plane (*Platanus* × *acerifolia*)	25,870	2.9	E
Yellow gum (*Eucalyptus leucoxylon*)	20,677	2.3	N
Willow myrtle (*Agonis flexuosa*)	19,952	2.2	N
Desert ash (*Fraxinus angustifolia* spp. *angustifolia*)	19,614	2.2	E
Gum tree (*Eucalyptus* spp.)	18,099	2.0	N
Weeping bottlebrush (*Callistemon viminalis*)	17,422	1.9	N
Red-flowering gum (*Corymbia ficifolia*)	17,411	1.9	N
Pin oak (*Quercus palustris*)	16,114	1.8	E
Bottlebrush (*Callistemon* spp.)	15,939	1.8	N
Double-rose Cherry plum (*Prunus* × *blireana*)	14,315	1.6	E
Bracelet honey myrtle (*Melaleuca armillaris*)	14,000	1.5	N
Narrow-leaved peppermint (*Eucalyptus nicholii*)	13,431	1.5	N
Prunus spp.	12,865	1.4	E
Norfolk Island hibiscus (*Lagunaria patersonia*)	12,521	1.4	N
Sweet gum (*Liquidambar styraciflua*)	12,353	1.4	E
Cherry plum (*Prunus cerasifera*)	11,933	1.3	E
Lilly pilly (*Acmena smithii*)	11,707	1.3	N
Kanooka, water gum (*Tristaniopsis laurina*)	10,758	1.2	N
Spotted gum (*Corymbia maculata*)	10,526	1.2	N
White cedar (*Melia azedarach*)	10,059	1.1	E
Wallangara white gum (*Eucalyptus scoparia*)	9,829	1.1	N
Lemon-scented gum (*Corymbia citriodora*)	8,779	1.0	N
Red ironbark (*Eucalyptus sideroxylon*)	7,849	0.9	N
Sweet pittosporum (*Pittosporum undulatum*)	7,672	0.8	N
Silver birch (*Betula pendula*)	7,633	0.8	E
Smooth-barked apple (*Angophora costata*)	7,128	0.8	N
Oriental plane (*Platanus orientalis*)	6,834	0.8	E
Claret ash (*Fraxinus angustifolia* ssp. *oxycarpa* 'Raywood')	6,336	0.7	E
Plane (*Platanus* spp.)	5,853	0.6	E
Crimson bottlebrush (*Callistemon citrinus*)	5,783	0.6	N
Kings Park bottlebrush (*Callistemon* 'Kings Park Special')	5,777	0.6	N
Willow-leaved hakea (*Hakea salicifolia* [syn. *H. saligna*])	5,689	0.6	N
Prunus 'Wrightii'	5,678	0.6	E
Silky oak (*Grevillea robusta*)	5,061	0.6	N
Cootamundra wattle (*Acacia baileyana*)	5,056	0.6	N
Unknown species	5,016	0.6	—
Callery's pear (*Pyrus calleryana*)	5,001	0.6	E
Elm (*Ulmus* spp.)	4,961	0.5	E
Blackwood (*Acacia melanoxylon*)	4,857	0.5	N
Oleander (*Nerium oleander*)	4,801	0.5	E
Hakea (*Hakea* spp.)	4,301	0.5	N
Christmas berry (*Photinia* × *fraseri* 'Robusta')	4,217	0.5	E
Camphor laurel (*Cinnamomum camphora*)	4,071	0.5	E
Totals	*646,422*	*71.60*	

Myrtaceae makes up 467,282 plants (52% of the total population surveyed), most of which were of Australian origin, with only seven of the 28 genera in that family exotic (1,612 plants or 0.4% of plants; the exotic genera comprised members of the Myrtles, e.g., Temu [*Luma apiculate* {DC.} Burret] as well as *Meterosideros* spp.).

The importance of Australian native species is also illustrated by the presence of the genus *Eucalyptus*, which had the

Table 3. Origin of species.

Origin	Number of taxa	Percentage
Exotic broadleaf	600	53
Australian native broadleaf	439	39
Exotic conifer	75	7
Australian native conifer	12	1
Totals	*1,126*	*100*

largest number of taxa with 141 (13%) and also the largest percentage of individuals (also 13%). This figure does not include *Corymbia* spp., which were, until relatively recently, part of the genus *Eucalyptus*. *Corymbia* spp. contributes another nine taxa and a further 37,394 trees (4% of total plants).

There were other Australian native tree taxa that contributed significant numbers to the total tree population. For example, only three *Melaleuca* species were found: bracelet

Table 4. Rank order of families with more than 100 individuals.

Family	No. of genera	Percentage total genus	Number of individuals	Percentage total individuals
Myrtaceae	28	8.4	467,282	52.0
Rosaceae	15	4.5	110,712	12.3
Oleaceae	7	2.1	41,156	4.6
Platanaceae	1	0.3	40,728	4.5
Mimosaceae	3	0.9	30,126	3.3
Proteaceae	13	3.9	24,501	2.7
Fagaceae	4	1.2	23,692	2.6
Ulmaceae	3	0.9	19,890	2.2
Pittosporaceae	4	1.2	15,101	1.7
Malvaceae	7	2.1	14,044	1.6
Hamamelidaceae	3	0.9	12,991	1.4
Betulaceae	2	0.6	12,679	1.4
Cupressaceae	8	2.4	10,350	1.2
Meliaceae	2	0.6	10,085	1.1
Casuarinaceae	2	0.6	9,026	1.0
Aceraceae	1	0.3	6,963	0.8
Fabaceae	20	6.0	6,087	0.7
Apocynaceae	2	0.6	4,804	0.5
Caesalpiniaceae	6	1.8	4,598	0.5
Lauraceae	3	0.9	4,446	0.5
Salicaceae	2	0.6	4,324	0.5
Bignoniaceae	4	1.2	3,755	0.4
Moraceae	3	0.9	2,907	0.3
Pinaceae	7	2.1	2,324	0.3
Anacardiaceae	5	1.5	2,053	0.2
Sterculiaceae	2	0.6	2,032	0.2
Arecaceae	13	3.9	1,933	0.2
Lythraceae	1	0.3	1,613	0.2
Sapindaceae	4	1.2	1,007	0.1
Totals	*175*	*52.50*	*891,209*	*99.00*

Table 5. Major tree genera based on species/variety diversity.

Genus	Number of taxa/cultivars	Percentage of taxa	Number of individuals
Eucalyptus spp.	141	13	121,320
Acacia spp.	49	4	29,895
Melaleuca spp.	30	3	103,456
Grevillea spp.	30	3	6,651
Prunus spp.	26	2	86,227
Callistemon spp.	21	2	78,100
Acer spp.	20	2	6,963
Quercus spp.	18	2	23,436
Hakea spp.	17	2	14,698
Fraxinus spp.	13	1	36,502
Cupressus spp.	13	1	4,978
Malus spp.	13	1	3,453
Totals	*391*	*36*	*515,679*

honey myrtle (*Melaleuca armillaris* Gaertn. Sm.), snow-in-summer (*M. linariifolia* Sm.), and prickly-leaf paperbark (*M. styphelioides* Sm.), but these three taxa contribute 10% of the total plants. *Lophostemon* is represented by only two taxa (Queensland brush box and its variegated variant), but comprised 7% of total plants and it was the most common street tree taxon in the surveyed population.

Considering the importance of Australian native tree taxa within the street landscapes of Melbourne, it is interesting to note that very little genetic improvement or other selection research has been undertaken on this material. The majority of native taxa used in street tree planting are propagated from seed with clonal propagation only common in the genera *Agonis*, *Callistemon*, *Acmena,* and *Syzygium*. This situation is in contrast to that of exotic deciduous taxa where, according to recent nursery supply lists, the vast majority of new tree introductions into Australia for the purpose of street tree planting are virtually all cultivars, many with plant-breeding rights (PBR) protection and most from North America. This suggests potential for improvement and for the identification and propagation of clonal material of native species for this market, but the small size of the potential market and the fact that many Australian trees are difficult to propagate asexually are impediments to this.

Potential contenders for improvement are Queensland brush box, spotted gum, red ironbark, yellow gum, smooth-barked apple (*Angophora costata* [Gaertn.] Britt.), Wallangara white gum (*Eucalyptus scoparia* Maiden), and ka-

Table 6. Number and percentage of tree taxon foliage types.

Foliage	Total	Percentage
Evergreen	788	71
Deciduous	324	29

nooka (*Tristaniopsis laurina* [Smith] Peter G. Wilson and Waterhouse) because these taxa have good characteristics for street tree planting and are present in sufficient numbers to allow suitable selections to be made from extant populations.

Of the exotic trees, various ornamental *Prunus* cultivars make up the largest group with 9% of the total tree population. These are mostly forms of cherry plum (*Prunus cerasifera* Ehrh). Planes are also a popular street tree as a result of their urban tolerance. They are a common avenue tree in Melbourne CBD and many inner city streets. Oaks (*Quercus*), ash (*Fraxinus*), and elms (*Ulmus*) are also common. Elms (*Ulmus*) in Australia have not been exposed to Dutch elm disease and consequently they form significant, world-renowned mature avenues leading into the city of Melbourne (Spencer et al. 1991).

Biodiversity

Maintaining a diverse urban forest has significant ecologic implications as well as potentially minimizing dramatic loss of trees as a result of pest and disease outbreaks associated with monoculture systems (Bassuk 1990). As urban consolidation continues, the streetscape can become important open space for the conservation, enhancement, and sustainability of Australia's genetic resources.

For example, the Maryland Department of Natural Resources has developed a methodology for assessing biodiversity in existing street tree populations (Galvin 1999). That methodology sets target levels for taxon diversity within a street tree population using the guidelines suggested by Santamour (1990) that there should be no more than 30% of any one family, 20% of any one genus, or 10% of one species in an urban tree population.

In this study, Myrtaceae comprises 52% of the total plants. This exceeds the 10:20:30 rule. However, Myrtaceae does have the greatest diversity of genera at 8%. Myrtaceae is one of the most characteristic Australian families, providing the dominant taxa in most Australian vegetation communities except for treeless areas, rainforests, and those communities of arid and semiarid regions dominated instead by *Acacia* (Mimosaceae) (ANBG 2004). The high percentage of this family in streets could be seen as being analogous to natural Australian plant communities, especially in the southern part of the continent, and may not be a point for concern. As an example of this pattern, metropolitan Melbourne covers land that contains a number of different native vegetation types, including a range of forests and woodland/savannahs. The overstorey of these treed landscapes, with only very minor exceptions, was entirely composed of *Eucalyptus* spp. (Savio 2001).

Eucalyptus is the most common genus with 13% of total trees which fits within the 30:20:10 rule. The most common species, Queensland brush box, at approximately 7% of the population, also fits within the 30:20:10 philosophy.

The survey contains 76 taxa that are indigenous to the Greater Metropolitan Melbourne area (SGAP 1991). These taxa, which include yellow gum, red ironbark, red box (*Eucalyptus polyanthemos* Schauer), narrow-leaved peppermint (*E. radiata* Sieber ex DC.), manna gum (*E. viminalis* Labill.), blackwood (*Acacia melanoxylon* R. Br.), and lightwood (*A. implexa* Benth.), accounted for 41,853 individuals (approximately 4.5% of the surveyed population). The use of indigenous vegetation in urban settings has become one of the foci of moves toward more sustainable horticulture (Dunnett and Clayden 2000). Restoring landscapes to the point of long-term sustainability is also a primary objective of the Victorian state government's native vegetation framework (Department of Sustainability and Environment 2002). Finding species with indigenous distribution in this survey appears encouraging, but many of these taxa have wide distributions and the records did not indicate the exact provenance of any of the trees. It is highly probable that many of them were propagated from seed sourced outside of Melbourne. The use of locally indigenous selections of street tree species could be increased. This would increase diversity of these populations but, by fragmenting the street tree population further, would make other activities such as genetic improvement more expensive to implement.

CONCLUSIONS

Street tree population data were collected from each of the 23 municipalities of Greater Melbourne that had conducted surveys. This data were combined into one superset of data for analysis. A total of 922,353 trees were captured in this superset of street tree inventory data comprising approximately 1127 taxa. Australian native taxa made up the majority of the trees. Wattles (*Acacia* spp.), bottlebrush (*Callistemon* spp.), gum trees (*Eucalyptus* spp.), paperbarks (*Melaleuca* spp.), and Queensland brush box comprised 394,730 specimens, or 43% of all plants. Of the exotic taxa, *Prunus* spp. were the most common with 86,227 specimens, or 9% of the total plants.

The family Myrtaceae is the most represented comprising 52% of the total plants, with family member Queensland brush box being the most common taxon. The genus *Eucalyptus* had the largest number of taxa and also the largest percentage of individuals. This exceeds the diversity guidelines suggested by Santamour (1990); however, this figure could be considered analogous to natural plant communities found in southeastern Australia.

Considering the importance of Australian native tree taxa within the street landscapes of Melbourne, it is interesting to note that only a small percentage of total trees (4.5%) used in streets could be indigenous to metropolitan Melbourne and that very little genetic improvement or other selection research has been undertaken on native plant trees used in streets. There is potential both for increased use of indigenous

material and for the improvement of native plants for use as street trees.

This study and report has provided a brief insight into the tree taxa in use within metropolitan Melbourne at the turn of the 21st century. It is hoped this information will form a cornerstone to any future study and comparison of street trees in Melbourne.

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Résumé. Un inventaire de la population des arbres de rues de Melbourne en Australie a été réalisé afin de déterminer sa dimension et sa composition botanique comme point de référence pour des études futures. Les 31 municipalités indépendantes présentes dans la zone métropolitaine de Melbourne ont été approchées pour fournir de l'information sur leur population respective d'arbres de rues. Lorsque disponible, des données ont été recueillies au niveau de chaque ville en regard de la population, de la superficie totale et du kilométrage de rue. Des 31 municipalités enquêtées, 23 avaient effectuées un certain inventaire ou une caractérisation de leurs arbres de rues. Des croisements de données ont été effectués afin de pouvoir obtenir un certain degré d'informations. Un total de 922353 arbres regroupés au sein de 1127 espèces et cultivars ont été capturés au sein de cet amalgame de données. Les végétaux indigènes à l'Australie constituaient la majorité des arbres avec plus de 60% du nombre total. Les espèces appartenant à *Acacia* spp., *Eucalyptus* spp., *Melaleuca* spp., *Callistemon* spp. et *Lophostemon confertus* comptaient au total 394730 arbres (43% de tous les arbres). Parmi les espèces introduites, celles du genre *Prunus* spp. était les plus nombreuses avec 86227 individus (9% du total). Le *Lophostemon confertus* était l'espèce la plus présente avec 61959 individus. Le *Prunus cerasifera* 'Nigra' était le cultivar introduit le plus commun avec 35402 individus. Une analyse de la diversité de cette population a montré qu'elle atteignait un ensemble minimum de critères de diversité, et ce à part la dominance au niveau de la famille par celle des *Myrtaceae*.

Zusammenfassung. Eine Prüfung der Straßenbaumpopulation von Melbourne, Australien, wurde durchgeführt, um die Größe und botanische Zusammensetzung als Referenz für zukünftige Studien

zu erhalten. Die 31 unabhängigen Gemeinden vom Großraum Melbourne wurden aufgerufen, Informationen über ihre Straßenbaumpopulation zu liefern. Wo es erhältlich war, wurden auch Daten von individuellen Gemeinden über die Populationen, Flächen und totale Straßenlänge erhoben. Von den 31 untersuchten Gemeinden hatten bereits 23 ein Baumkataster oder Studie durchgeführt. Diese individuellen Informationen wurden zu einer einzigen Datenbasis zusammengefasst. Die Datenabfragen wurden unternommen, um eine Reihe von Informationen zu erhalten. In diesem Superset von Daten wurden insgesamt 922.353 Bäume aus 1.127 Arten erfasst. Die einheimischen australischen Bäume machten den Großteil mit 60% aus. Die nativen australischen Arten (*Acacia* spp.), (*Eucalyptus* spp.), (*Melaleuca* spp.), (*Callistemon* spp.) und (*Lophostemon confertus*) machen 394.730 Individuen bzw. 43% aus. Von der exotischen Art *Prunus* gab es 86.227 Individuen (9%) und von den einheimischen Arten war *Lophostemon* mit 61.959 Individuen vertreten. *Prunus cerasifera* als Einzelpflanze war mit 35.402 Exemplaren vertreten. Eine Analyse der Diversität dieser Population zeigte, dass sie.

Resumen. Se realizó un inventario de la población de árboles en Melbourne, Victoria, Australia para establecer su tamaño y composición botánica como un punto de referencia para futuros estudios.

Las treinta y un (31) municipalidades independientes que comprenden la zona metropolitana de Melbourne proporcionaron información de sus árboles. Donde estuvieron disponibles, los datos de municipalidades individualidades sobre población, área y longitud total de las calles también fue colectada. De las treinta un comunidades encuestadas, veintitrés (23) han llevado a cabo alguna forma de inventario o auditoría de los árboles. Estos datos fueron combinados en una sola base de datos. Se llevaron a cabo consultas para obtener un rango de información. Un total de 922,353 árboles, comprendiendo 1,127 taxa, fueron capturados en esta base de datos. Las plantas nativas de Australia hicieron la mayoría de los árboles con un 60% del total. De la taxa nativa de Australia *Acacia* spp., *Eucalyptus* spp., *Melaleuca* spp., *Callistemon* spp. y *Lophostemon confertus* (R. Br.) comprendieron 394,730 individuos (43% de todos los árboles). De los taxa exóticos *Prunus* spp. fue el más común con 86,227 individuos (9% del total). *Lophostemon confertus* fue el más común taxon con 61,959 individuos. *Prunus cerasifera* Ehrh. 'Nigra' fue el taxon exótico más común con 35,402 individuos. Un análisis de la diversidad de esta población mostró que se encuentra en un criterio mínimo de diversidad, aparte de la dominancia de la familia *Myrtaceae*. ein Minimum von Diversitätskriterien erfüllt, außer der Dominanz von Myrtaceae.