TAKING IT TO THE STREETS: CELEBRATING A TWENTY YEAR HISTORY OF TREENET – Responding to the Urban Forest Challenge

G.M. Moore

School of Ecosystem and Forest Sciences, University of Melbourne, Burnley Campus
500 Yarra Boulevard RICHMOND 3121

Abstract

In celebrating twenty years since the founding of TREENET (**T**ree and **R**oadway **E**xperimental and **E**ducational **NET**work) and eighteen National Street Tree Symposia, it becomes clear that TREENET has been both follower and leader in providing a forum for the discussion of urban street tree management and has been effective in getting quality, data-rich information to those managing urban trees. In reviewing the content of symposium papers, water and water sensitive urban design is the clear dominant topic, followed by papers focusing on trees managed by local government authorities (LGAs), tree selection, hazard and risk, and climate change.

TREENET has tried to build bridges with disciplines, such as engineers, architects, planners, demographers, the medical profession, politicians and bureaucrats amongst others, but with questionable success. TREENET has urged the appropriate retention of street trees, but on a national basis 97% of the tree removal requests made to LGAs are approved and the canopy cover of the urban forest in most Australian cities is diminishing at a rate of about 1.0-1.5% per annum. Those interested in managing urban trees cannot claim success if the tree canopy cover in cities is declining.

If cities are to have appropriate canopy cover to meet the demands of climate change private open space must be part of the solution, despite the pressures of urban development. TREENET has rarely entered the territory of canopy cover on private open space – perhaps there is a vacuum of leadership that TREENET might fill. Often the most impoverished sectors of societies are the most disadvantaged in their access to treed open space. Accessibility to treed open space should be a right of all people living in urbanised areas and societies need to meet this right. It is possible that in not seeing the trees for the urban forest, the removal of specimen trees reduces the forest and so puts at risk the services that the trees provide.

In the future, climate change will probably be the greatest challenge to the urban forest in the next fifty years. It would be wiser to plan and pay for changes in canopy cover over a period of decades rather than try and retro fit an urban forest during a crisis. Popular cultivars may have narrow ranges of climatic tolerances, but the larger populations from whence they came often have a far greater diversity, range of tolerances and resilience. The target canopy cover for urban cities in Australia towns and cities, under climate change scenarios should not be less than 30%.

Introduction

It is now twenty years since the founding of TREENET (Tree and Roadway Experimental and Educational NETwork) and this is the eighteenth National Street Tree Symposium. We have had a great many papers and field day demonstrations over that time as TREENET pursued its dual themes of research and education. It is tempting to use such an occasion to look back at what has been done and achieved, but while this paper does some of that, its focus is to look critically at the present and perhaps more critically to the future.

For those interested in trees growing in cities, it soon becomes clear that in dealing with urban horticulture and arboriculture, the science is as much about people and politics as it is about the plants and trees. As you look back over the proceedings, it is not surprising that talks are overwhelmingly positive about the roles and benefits that trees provide in cities (Table 1). Allocating presentations to simple topics is fraught as some papers cover several topics and the allocation is subjective, but it does provide an overall sense of content.

As the review looks in greater depth at topics covered, water and water sensitive urban design is the clear dominant topic, and then come papers focusing on trees managed by local government authorities (LGAs), tree selection, hazard and risk, and climate change.

Other popular and recurring themes are heritage trees and Avenues of Honour (AoH), benefits of street trees, roots systems, trees and the law, safety and tree health. Some topics such as arboriculture, trees and water and LGA tree issues, appear in the symposia over the years and others such as climate change, sustainability, biodiversity, ecological services and trees and human health make their appearances on the programs from about half way through the period. It would appear that TREENET has been both follower and leader in providing a forum for the discussion of these important matters. TREENET has in any case been very effective in picking up trends and getting quality, data-rich information to those managing urban trees.

Table 1. A summary of topics presented at TREENET symposia and the year of their first and most recent appearance.

Topic	Number of Papers	Year of first appearance	Year of last appearance
Water and WSUD	25	2000	2016
Trees Managed by LGAs	22	2000	2016
Tree selection	20	2000	2016
Hazard and Risk	13	2002	2013
Climate change	15	2006	2016
Arboriculture	14	2000	2016
Heritage Trees and Avenues of Honour (AoH)	14	2004	2015
Benefits of Trees	10	2000	2016
Root systems	10	2001	2015
Trees and soils	9	2000	2016
Sustainability/biodiversity	9	2007	2016
Planting and establishment	9	2000	2016
Trees and human health	9	2006	2016
Trees and the law	8	2006	2016
Tree health	8	2001	2016
Ecological Services	7	2003	2016
Trees and safety	7	2002	2013
Engineering and pavement surfaces	7	2000	2015
Tree production systems	7	2001	2016
Trees and urban design	7	2000	2016

It would seem that TREENET has been at the vanguard of matters to do with water, water-sensitive design and permeable pavements and that the interest has been both regular and consistent. Soils, root systems and protection of trees on development sites have been other areas affecting street trees in which TREENET has played a leading role. The mantra of “right tree, right place, right time” has been a perennial focus of TREENET papers, especially in relation to LGA urban forestry.

It is interesting to note that the first papers on the benefits of street trees and human health and climate change in 2006 were followed by papers on sustainability in 2007, but that the first paper on ecological services was delivered in 2003. It is not a coincidence that the significant numbers of papers on climate change, sustainability and ecological services appeared as the party-political approach to climate change, prefaced on beliefs rather than data-led evidence dominated the climate change debate in Australia. TREENET can be proud of its role in taking a lead on these matters and making sure that climate change has been part of the agenda for urban forestry decision makers and planners.

TREENET has through its history tried to build bridges with other disciplines – not easily done between professions that are essentially silos. The symposia show these attempts with engineers, architects, planners, demographers, the medical profession, politicians and bureaucrats amongst others. There is clear evidence of effort, but little proof of success. However, it is gratifying to see whole sessions devoted to engineering, soils and pavements, where experts from other professions took both the lead and the symposium floor. It was delightful to see the first TREENET paper on the roles of trees in human heath dating back to 2006 and then the whole first session devoted to the topic in 2016 – real leadership! While TREENET educates and publishes research, the last presentation on education, arboriculture and urban trees was in 2005, which provides an opportunity for future leadership.

The fate of specimen trees and the state urban Forest

It is worth considering the states of individual specimen trees and of the urban forests in Australia after 20 years of TREENET. The quality of urban forest management, arboriculture and tree surgery has clearly improved in most, if not all States. There is a much greater degree of research based management than there was 20 years ago, but this is to be expected, as it has happened in most fields of human endeavour. TREENET has been an effective part of communicating on topics related to street trees and the urban forest more generally, as the symposia proceedings and in recent times the podcasts attest. Under its themes of education and research, access to these valuable TREENET resources remains freely available to anyone.

One of the questions that comes to mind at this time is whether the fate of individual specimen trees and the state of the urban forest have improved over the past twenty years and how improvement or progress might be measured. In the case of individual trees managed by LGAs the data are quite depressing. On a national basis 97% of the tree removal requests made to LGAs are approved; not necessarily at the first request, but eventually. The commonly voiced assertion that LGAs prevent citizens/owners from removing trees is not supported by the data, and many people assume that they will be denied a tree removal permit and so don't apply. They then claim that they have not been able to remove a tree. Success in protecting important urban trees in general seems to be mixed at best.

In Victoria an all too familiar scenario unfolds when significant trees are threatened with removal for urban development or are poorly managed during such development. The first hint of an impending issue is public awareness of the imminent removals that is often followed by local community objection to the responsible LGA. However, if the tree is not protected by inclusion under a planning overlay or other relevant LGA ordinance, there is little that can be done to protect the tree, even if the LGA and its officers are supportive of retention. In Victoria, and it is similar in some other states, a planning overlay (or equivalent) is the first step in the legal protection of urban trees and without it higher legal redress is usually unavailable.

The legal framework that affects trees during urban development has changed several (many) times over the past 30 years, but urban trees are still being lost at an alarming rate. Local government registers only protect trees when they are included in planning codes and overlays. Heritage legislation in Victoria and some other states affords good protection to trees if they are listed, but there are only a small number of trees protected in this way (in Victoria there are about a dozen nominations, but some have many trees such as Avenues of Honour).

Attempting to protect a tree after development has been approved usually fails because appeals tribunals such as the Victorian Civil and Administrative Tribunal (VCAT) can only adjudicate on whether procedure has been followed not on the merits of protecting the trees, or for that matter on the quality of the trees. In Victoria, the best way of protecting trees is to protect them by inclusion on council planning overlays, but very few, if any LGAs take this action.

The chair of the National Trust of Australia's (Victoria) committee of the Register of Significant Trees has on several occasions over the past decade written to the Mayor and Chief Executive Officer of every local government in the State of Victoria advising them of the significant trees growing within their jurisdictions and requesting that significant trees should be protected under the planning instruments available to LGAs. There have been no responses to these requests. However, it is worth noting that while there is no legal protection afforded trees classified by the National Trust, by regularly sending lists of significant trees to relevant authorities such as those dealing with roads and services such as water, gas, electricity and communication inadvertent damage by those undertaking works, who may not be aware of the significance of the trees can be minimised. Furthermore, once classified there is a level of political protection and moral persuasion that sees significant protection given to many specimens such that there have only been seven known cases of classified trees being removed for development works in over thirty years (Table 2).

Table 2. Trees lost due to property development
from the National Trust of Australia's (Victoria) Register of significant Trees (from Moore and Hughes 2014)

Total number of registered entries	1300		
Total number of trees	23000		
Number of entries removed due to tree death	1007	Known Natural Cause	40 (40%)
		Property Development	7 (7%)
		Cause of death unknown	53 (53%)

Another mechanism for the protection of trees growing in private open space that may be available is through the placing of a statutory covenant on the property title. These covenants provide a security mechanism over land rather than the trees per se but could be used to protect defined areas of land which contain significant trees, where that meets the statutory objectives of the covenanting body. In this way there is protection of the open space in perpetuity and so the green space would be protected beyond the life span of the trees. This mechanism has long been possible, but is rarely used, probably for two reasons. The first is a fear that it could reduce property value, as buyers tend to be wary of covenants and second is a lack of precedent for using conservation covenants in this way, as they have conventionally been used to protect intact bushland. Linked to this is a concern that they may be legally ineffective in this circumstance.

Regarding this latter point, it is worth noting that in Victoria, Trust for Nature has been placing covenants on private land to protect environmental values for over thirty years, and thus far they have stood the test of time. A national investigation into covenants and other binding agreements on title found that less than 1% had been released (Hardy et al. 2016). There is evidence from overseas that clusters of properties under covenant (easement) in urban and semi-urban settings may attract a premium value, but this is untested in Australia. Perhaps TREENET might provide future leadership in private open space tree management.

In terms of the broader urban forest, one measure used in the assessment of urban forest success is tree canopy cover. A benchmarking study commissioned by Horticulture Australia was undertaken in 2014, using i-Tree of tree canopy cover in major Australian LGAs (Table 3),(Jacobs et al. 2014). It shows a disappointingly and unacceptably low cover in many cities, often with about half of the LGA managed regions having less than 20% cover and with the range for the greater cities often beginning as low as 3% to 10%.

Table 3. Tree cover in Local Government Areas (LGA) of Australian cities (modified from Jacobs et al. 2014)

	# of LGAs	# < 20% cover	Range of cover (%) for City
Greater Sydney	20	8	12.1 – 59.3
Greater Melbourne	19	10	3.1 – 77.2
Greater Perth	19	12	9.1 - 62.8
Greater Adelaide	17	9	11.9 – 43.7
Greater Brisbane	5	1	16.3 – 78.9
Canberra	7	3	10.3 – 75.5
Hobart and Launceston		0	31.4 – 65.7
Darwin		0	27.7 - 28.8

In the benchmarking study, Jacobs et al. (2014) identified a number of LGAs with the potential to increase canopy cover through conversion of hard surfaces (Table 4). They also identified LGAs with the opportunity to increase canopy cover through the conversion of land that was grassed or bare ground. In several, if not many instances the same LGAs appeared in both lists. The data presented here excludes, the central city and peri-urban LGAs, but several are older and/or inner city suburbs. A number of these LGAs also present with higher rates of heat wave related mortality and poorer health status of residents. The low canopy cover and higher hard surface/bare ground characteristics could be used by TREENET and other organization to target areas of cities for programs for increasing tree canopy cover. The data can also be used to prioritize tree planting in LGAs or sections of cities with low canopy cover and to establish funding allocations within budgets.

Table 4. Selected Local Government Areas (LGA) of Australian cities with high hard surface, grass and bare ground cover with a high potential for increasing canopy cover (modified from Jacobs et al. 2014)

LGAs	State	Hard Surface Cover (%)	Grass-Bare Ground Cover (%)	Potential for increasing canopy cover
Maribyrnong	Victoria	58.2	30.8	High
Moonee Valley	Victoria	52.8	31.0	Very high
Port Adelaide	South Australia	55.1	30.4	High
Charles Sturt	South Australia	54.8	27.5	Very high
Rockdale	New South Wales	58.1	25.0	High
Botany Bay	New South Wales	55.4	29.7	High
Freemantle	Western Australia	65.1	18.4	Medium-High
Vincent	Western Australia	65.9	16.6	Medium-High

It is clear from these and other data that the tree cover of Australian cities is by no means as dense as many people might think, or perhaps wish.

Even in places such as Brisbane, Hobart or Launceston where canopy cover is higher and ranges begin at higher minimums, there are significant parts of the city with less than 20% cover. By comparison, it is worth noting that London has been classified as a forest by United Kingdom authorities. Its canopy cover is approximately 20%, but other vegetation cover is about 32% which give a total of vegetated cover of about 52% (Mayor of London 2015). Australian vegetation classification systems would describe the city as woodland (Specht 1970; Auslig 1990). The City of Greater London has a goal of raising its cover to 25% by 2025.

Tree canopy cover has varied little (<1%) in London over the period 2003-2015. It is interesting to see if things are similar in Australian cities (Table 5). The work of Mullaly (2000) in Balwyn and Richmond, Victoria reported a decline in canopy cover between 1993 and 2000 of about 8% in Balwyn but little change in Richmond. The loss of cover in Balwyn was predominantly from private open space, particularly developed land, while in Richmond the loss of tree canopy cover of about 2% on private land was compensated for by an increase in canopy cover of about 2% on public land. In revisiting these two sites, using Google maps rather than the stereo-microscopy of aerial photographs that Mullaly (2000) used, estimates of canopy cover were made based on 2017 images. In Richmond, the area surrounded by Victoria, Church, Somerset and Burnley streets was selected and in Balwyn, the area bounded by Severn Street, Doncaster, Burke and Belmore roads. They were chosen as they were part of Mullaly's (2000) study.

Table 5. Changes in tree canopy cover in Balwyn and Richmond, Victoria (modified and expanded from Moore 2009).

LAND TYPE	OWNERSHIP OF LAND	BALWYN		RICHMOND	
Developed Land		CHANGE 1993-2000	CHANGE 2000-2017	CHANGE 1993-2000E	CHANGE 2000-2017
	PRIVATE	-8.24	-15.0	-1.84	-6.0
	PUBLIC	1.20	-1.0	-0.43	0.0
	TOTAL	-7.04	-16.0	-2.27	-6.0

The estimates of canopy cover and loss are by no means as accurate as those undertaken by Mullaly (2000), and they should be seen as being no more than indicative. The canopy cover in Balwyn appears to have continued to decline over the period 2000 to 2016 with cover being about 15% less on private land and up to 1% less on public land (Table 5). Richmond too has lost canopy of about 6% on private land but cover on public land appears to have remained unchanged for the areas sampled. These data cannot be extended to the loss of canopy cover for the suburbs overall without further and more detailed sampling. They do suggest a loss of canopy, however, and the need for more extensive research and data collection which might be facilitated TREENET, perhaps in collaboration with other organizations.

From these data, it seems reasonable to conclude that in terms of urban forest management, the battle for the minds of LGA officers in defending and extending the urban forest on public land is being won, but the same cannot be said for LGAs in dealing with development and planning on private land. The canopy cover on private open space is diminishing at an alarming rate as urban development and renewal takes place. Backyards have disappeared and front yards are often so small that they cannot accommodate a tree. Roads are so narrow that nature strips are now essentially car parking infra structure and trees planted in them soon disappear. The battle between tree cover and development seems to be a losing one.

In many cities tree management officers in LGAs realize only too well that if they are to have an appropriate canopy cover to meet the demands of a changing climate, they cannot achieve the target on public land – there is simply insufficient space.

Private open space must be part of both the solution and the future, but how do you maintain canopy cover in the face of increasing urban development where house blocks are smaller, houses bigger and houses on larger sites are being demolished for multiple dwellings. TREENET has rarely entered the territory of canopy cover on private open space – perhaps there is a vacuum of leadership in this space that TREENET might fill.

While the benefits of street trees and the urban forest on the sustainability of cities, the importance of urban trees in human health and the economic benefits that urban trees provide seems to be better understood by more people in decision making positions in society, the tree canopy cover is being lost in the course of urban development at a rate of about 1.0-1.5% per annum. Those interested in managing urban trees cannot claim progress, let alone success, if the tree canopy cover in cities is declining. There is a great need to protect what cover there is in LGAs and to provide more cover in the LGAs that are currently deficient but again this seems to be a battle that is being lost.

Citizens, arboriculture and the urban forest

It is usually assumed that the benefits of the urban forest are shared equally by the citizens of a city, region or town: But this far from the reality. In many Australian cities different parts of the city are differentially affected by the heat island effect (UHI) due to significant differences in tree canopy cover. In Melbourne, for example, the UHI is more pronounced for those living in the west and north-western parts of the city and this correlates with higher rates of heatwave related deaths, generally poorer health and shorter life expectancies in these places.

Accessibility to treed open space is a multidimensional construct (Wang et al. 2013) that is affected by the physical distance that people live and work from the treed open space, and other variables such as socio-economical status, educational background and population density among others. Often the most impoverished sectors of societies are the most disadvantaged in their access to treed public and private open space, which in turn is associated with problems such as obesity, physical and mental health and social problems (De Vries 2003; Maas et al. 2006; MacIntyre et al. 2008).

It seems logical that accessibility to treed open space should be a right of all people living in urbanised areas and that to be both economically and environmentally sustainable societies need to ensure that they meet this right. To realise the recreational, health, environmental, social and other benefits that people can derive from the use of the open space, LGAs have to ensure access to it (Ahendt 2004; Giles-Corti et al. 2005; Cohen et al. 2007). The paradox is obvious in that the sectors of society most in need of treed open space to counter their general disadvantage are those least likely to have access to it.

In Australia, the field of arboriculture has developed within the broader discipline of horticulture, and particularly amenity, environmental or ornamental horticulture. In other parts of the world and notably the United States of America, arboriculture has its roots within the discipline of forestry. Over the past decade the terms arboriculture and urban forestry have often been used as synonyms in Australian urban tree management, but arboriculture and urban forestry come from different traditions that are underpinned by different, and sometimes conflicting, philosophies (Moore 2009). Urban forestry comes from a forestry tradition of managing groups of trees for their production values, while arboriculture comes from a horticultural tradition that focuses on the tree as a specimen.

Both arboriculture and urban forestry present valid and important frameworks within which to manage urban trees. On some issues relating to urban trees the objectives of both frameworks are identical, on others they are different but complementary and on yet other matters, such as the importance of an individual specimen tree they may be quite different.

The concept of urban canopy cover is a classic application of an urban forestry paradigm as well as a classic forestry analytical technique. However, there is need for caution as in focusing on the urban forest it is easy for the importance of the individual specimen to be minimized and undervalued, which could see the removal of individual trees as long as the forest is maintained.

In focusing on the services and functions that trees provide as part of the urban forest, it is important that the individual specimen tree is neither forgotten nor over-looked. In not seeing the trees for the urban forest, it is possible that in failing to see the removal of specimen trees the forest as a whole is reduced as a consequence. The arboricultural focus on the specimen ensures that the forest is undiminished, but the reverse is not necessarily true in that focusing on the urban forest does not guarantee the preservation of individual trees. While the semantics of the meaning of arboriculture and urban forestry may not be of interest to urban tree managers, the consequences for tree management and urban tree populations could be. The differences in the philosophies supporting arboriculture and urban forestry are important and while the disciplines often aspire to the same goals in the face of climate change and urban development, the approaches should be applied knowledgeably and in the appropriate environmental context.

It is interesting to consider the TREENET Avenues of Honour (AoH) project in terms of it symbolism in linking citizens and the urban forest. Right from its inception, the AoH project was lauded as being timely and relevant to the commemorations surrounding World War One (1914-1918). The project uncovered hundreds of unknown, forgotten and decrepit AoH and communities rallied to protect and restore these heritage treasures. Communities in rural towns and suburbs came together to commemorate and to celebrate the purposes of the AoH.

David Lawry OAM worked tirelessly and innovatively to fulfill the vision of the project and would have been unable to do so without the support of one individual and generous sponsor, but TREENET was unable to attract one cent of government spending to allow the full completion of the project. Apart from the annual symposia, the AoH project represents TREENET's greatest expenditure of its funds to an activity. The expenditure provided some wonderful resources including knowledge of many forgotten AoH and a popular and very useful website. But the question has to be asked, "How could such a worthy project fail to attract funding?" Was it because it involved trees? How often are trees and open space sacrificed in the name of development, the economy or higher priorities?

Looking to the Future – TREENET and the Urban Forest

In looking to the future, it is clear that climate change and its many and varied consequences will probably be the greatest challenge to the urban forest and those managing it in the coming fifty years. In the parts of Australia hardest hit by climate, the urban forest and public open space will play a major role in contributing to the resilience and sustainability of the urban ecosystems and the communities dependent upon them. It would be wiser to plan and pay for the changes in canopy cover required over a period of decades rather than to try and retro fit an urban forest at a time of crisis. If the record of the past is anything to go on the latter is the more likely scenario – change will be too little and too late and of course the economic costs will be much greater.

In the face of climate change, there is great interest and speculation about the future of urban trees and the urban forest. How important to urban infrastructure will canopy cover be? What species will be capable of surviving and thriving during climate change? Should urban tree managers be proactive in shaping tree planting lists for climate change? In considering some of these questions, it is important to remember that while many urban trees have been bred and selected for city use, they often come from species with much broader natural ranges. Popular cultivars may have narrow ranges of climatic tolerances, but the larger populations from whence they came often have a far greater diversity, range of tolerances and resilience.

Table 6: Characteristics of a eucalypt displacement series from wetter to drier environments (Pate and McComb 1981)

Characteristics of eucalypt species altered as the environment dries
Greater root:shoot ratio
Increasing root:shoot ratio in response to water stress
Slower stomatal response to decreasing xylem water potential
Slower decline in leaf turgidity with increased water stress
Lower rate of transpiration in wetter soils

It is important to consider the role of the normal distribution curve as it relates to plant characteristics and the contribution that it plays in the resilience of species through natural selection and subsequent evolution. Many common urban trees come from populations that have wide and extensive natural distributions, suggesting a wide range of species characteristics and tolerances. Some eucalypt species, *Acmena smithii, Lophostemon confertus* and *Tristaniopsis* species show a wide-range of environmental tolerances. Careful provenance selection and breeding, which source specimens growing on appropriate soils but from lower rainfall and/or warmer regions could ensure that there are suitable intraspecific selections to meet urban planting demands.

For genera, such as Eucalyptus and Acacia, there may be the option of selecting different but closely-related species from within the genus where displacement series of species exist that occupy a broad range of habitats. A displacement series consists of related species, which replace each other over an ecotone that could be related to aridity, rainfall, soil nutrition, altitude or temperature (Figure 1),(Pate and McComb 1981; Fensham and Holman 1999; Shepherd et al. 2008; Holman, Hughes and Fensham 2011). Of particular interest for informing tree selection for climate change are displacement series of increasingly arid or warmer environments. Species show characteristics (Table 6) that adapt them to the drier conditions or generally more stressful environments, which could then be used as a guide for which species might be successful for urban planting in drier conditions.

It is clear that urban trees will continue to be a vital component of urban infrastructure. Tree selection will be increasingly important in ensuring that the species and varieties and selected will be successful not only in establishing but in persevering over the appropriate time spans demanded of urban trees. Tree breeding and selection have been recurring themes of TREENET symposia, but leadership will be required if the full potential of native and exotic tree species for urban forest use is to be realised. The temptation to use what is available and easily produced must be resisted, and resources will have to be allocated to breeding and selection programs, especially for native tree species.

Figure 1. Displacement series for eucalypt genera/subgenera and some Acacia species (after Moore 2016).

Characteristic	Milder Environment	Harsher Environment
Eucalypt Subgenera/genera	Monocalyptus →	Corymbia → Symphyomyrtus
Monocalyptus Displacement series in Victoria's Central Highlands	*E.regnans* →	*E.obliqua* *E.sieberi* *E.radiata*
Monocalyptus Displacement series in Victoria's Southern Highlands	*E.delegatensis* →	*E.fastigata* *E.radiata* *E.dives* *E.pauciflora*

Characteristic	Milder Environment	Harsher Environment
Tolerance of soil moisture levels within *Acacia* species	*A dealbata* → *A. mearnsii* dense canopy → sparse/open canopy	
Tolerance of aridity within *Acacia* species	*A catenulata* → *A. aneura* larger phyllodes → smaller phyllodes	

The history of human intervention in ecosystem management, especially over longer time frames has not been characterized by success. While the idea of pre-selecting species for urban use with climate change in mind has real appeal, it must be based on comprehensive data for particular species and undertaken with great caution.

In concluding a question that might be posed to all interested in TREENET and its themes of research and education "Is 30% is an arboricultural magic number for those looking for some simple messages in relation to the urban forest?"

- In the Australian Vegetation Community Classification systems, a forest is defined by a tree canopy cover of, or greater than 30% (Specht 1970; Auslig 1990).
- To maximise the benefits of tree cover in terms of the many and varied environmental and other services provided a canopy cover of, or greater than, 30% is required.
- When people are considering the purchase of a suburban house there is an increase in property value when trees are present, until the cover is 30% or greater. Higher than 30% sees a decrease in value of the property (Plant 2016).
- The target canopy cover for urban cities in Australia towns and cities, under climate change scenarios should not be less than 30%.

Acknowledgements

The critical reading and suggestions made by Dr Doug Robinson, Victoria Marles and Fiona Smith, Trust for Nature is greatly appreciated. Dr Erin Moore, linguist is thanked for her reading of the early manuscript, as is Glenn Williams, TREENET, for reading a final draft of this paper. Their assistance was much appreciated.

References

Ahendt, R. 2004. Linked landscapes: creating greenways corridors through conservation division design strategies in the northeastern and central United States. Landscape and Urban Planning, 68: 241-269.

Auslig, 1990 Vegetation atlas of Australia, Volume 6, Australian Surveying and land Information Group, Canberra.

Cohen, D.A., McKenzie, T.L., Sehgal, A., Williamson, S., Golinelli, D. and Lurie, N. 2007. Contribution of public parks to physical activity. American Journal of Public Health, 97, 509-514.

De Vries, S., Verheij, V., Groenewegen, P. and Spreeuwenberg, P. 2003. Natural environments healthy environments: An exploratory analysis of the relationship between greenspace and health. Environment & Planning A, 35(10), 1717-1731.

Fensham, R.J. and Holman, J.E.1999. Temporal and spatial patterns in drought-related tree dieback in Australian savanna. Journal of Applied Ecology, 36, 1035–1050.

Hardy, M., Fitzsimons, J., Bekessy, S. and Gordon A. 2016 An Agreement Forever. Australasian Science, November, 48

Holman, J.E., Hughes, J. M. and Fensham, R.J. 2011, Origins of a morphological cline between Eucalyptus melanophloia and Eucalyptus whitei. Aust J Bot, 59, 244-252.

Giles-Corti, B., Broomhall, M., Knuiman, M., Collins, C., Douglas, K., Ng, K., et al. 2005. Increasing walking: How important is distance to, attractiveness, and size of public open space? American Journal of Preventive Medicine, 28(2S2), 169-176

Jacobs, B., Mikhailovich, N. and Moy, C. 2014. Benchmarking Australia's urban tree canopy: an i-Tree assessment, prepared for Horticulture Australia Limited by the Institute for Sustainable Futures, University of Technology Sydney.

Maas, J., Verheij, R. A., Groenewegen, P. P., De Vries, S., and Spreeuwenberg, P. 2006. Green space, urbanity, and health: How strong is the relation? Journal of the Epidemiology of Community Health, 60(7), 587-592.

MacIntyre, S., MacDonald, L. and Ellaway, A. 2008. Do poorer people have poorer access to Local resources and facilities? The distribution of local resources by area deprivation in Glasgow, Scotland. Social Science and Medicine, 67, 900-914.

Mayor of London. 2015. Measuring tree canopy over in London. Greater London Authority.

Moore, G.M. 2009. Urban Trees: Worth More Than They Cost Lawry D, J Gardner and S Smith Editors,

Proceedings of the Tenth National Street Tree Symposium, 7-14, University of Adelaide/Waite Arboretum, Adelaide, ISBN 978-0-9805572-2-0.

Moore, G.M. and Hughes, S. 2014. The National Trust of Australia (Victoria), Register of Significant Trees: Now Protecting Community Assets and Heritage with Smart Phone Technology. Arboricultural Journal 36(1), 3-17

Moore, G.M. 2016. Urban tree management strategies for climate change. The Botanic Gardener,45:13-18 Editor Janelle Hatherley, Botanic Gardens of Australia and New Zealand.

Mullaly, J. 2000. Aerial Photographic Analysis of the Urban Forest, Honours Thesis, Burnley College, University of Melbourne.

Pate, J.S. and McComb, A.J. 1981. The biology of Australian plants, University of Western Australia Press.

Plant, L.J., Morrison, T. and Rambaldi, A. 2016. Street Trees: paying their way in property value benefits in Groening G. Moore G. M. J. P. Rayner and E.E.F. Moore (Editors), 13-24. Proceedings of the V International Conference on Landscape and Urban Horticulture and International Symposium on Sustainable Management in the Urban Forest in Symposium Proceedings of the XXIX International Horticultural Congress on Sustaining Lives, Livelihoods and Landscapes. International Society of Horticultural Science, Leuven, Belgium

Shepherd, M. Kasem, S. Ablett, G. Ochieng, J. and Crawford, A. 2008. Genetic structuring in the spotted gum complex (genus Corymbia, section Poltaria). Australian Systematic Botany, 21, 15–25.

Specht, R.L. (1970) Vegetation. Pages 44–67 in Leeper, G.W. (ed.), "Australian Environment", 4th edn. Melbourne University Press, Melbourne.

Wang, D., Mateo-Babiano, I. and Brown, G. 2013. Rethinking Accessibility in Planning of Urban Open Space

Using an Integrative Theoretical Framework. Final Paper Submitted to State of Australian Cities Conference