ALTERNATIVE APPROACHES TO SUSTAINABLE URBAN VEGETATION MANAGEMENT

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Introduction

The Australian population is rapidly expanding, recently reaching 23 million. The majority of the population is focused around the urban centres, with some of the Australian cities amongst the fastest growing in the world. With expansion comes removal of existing vegetation and open space, resulting in serious consequences for the dependent biodiversity. The sustainable management of vegetation within the urban area has never been so important. This vegetation provides numerous benefits to the reliant biodiversity, but arguably more important, the people who live within communities nearby and visit these the areas where the vegetation resides.

Unfortunately many people view trees, and particularly large, old trees, as a real risk to life and property. Such views threaten the retention and sustainable management of this vegetation. But realistically, how many serious injuries or deaths of people occur within Australia each year from trees that fail? I could probably count them on one or two hands. The majority of these injuries and deaths would be within the tree-management industries (i.e. forestry, arboriculture, tree surgery) and not the general public who occupy the public open spaces. We accept risk every day when we drive our car, cross the road, play sport, swim in the ocean, eat fatty foods etc. The risks associated with these activities are far higher than those from tree failure. What is the point I am trying to make? Over-pruning and premature removal of vegetation, mostly due to the perceived risk of the vegetation to life and property, is not sustainable. It is often based on fear, and the idea that old or sick trees are high risk. If we make the correct choice about the vegetation we plant, adopt suitable methods for establishment, conduct formative pruning, carry out precise monitoring, undertake early and correct diagnosis of health disorders, and correctly manage these health disorders, we can sustainably manage and conserve this valuable vegetation, and in doing so, greatly reduce the costs and energy output associated with vegetation management. Rather than view vegetation as a risk, we should consider that such vegetation could greatly reduce the risks associated with extreme weather events. The climate has now changed and we are experiencing a greater incidence of extreme weather events. Healthy vegetation can greatly increase the resilience of the surrounding infrastructure and assets to extreme climatic events like frost and flooding. For example, the extensive root systems of large trees have a great capacity to minimise erosion and removal of top-soil, uptake excess water, and remove pollutants that are commonly associated with freak

flooding events. Healthy canopy cover can significantly reduce the Urban Heat Island Effect (UHIE), with vegetation measured in the example below approximately 7°C cooler than turfgrass, and 12°C cooler than soil and impervious layers (Fig. 1).

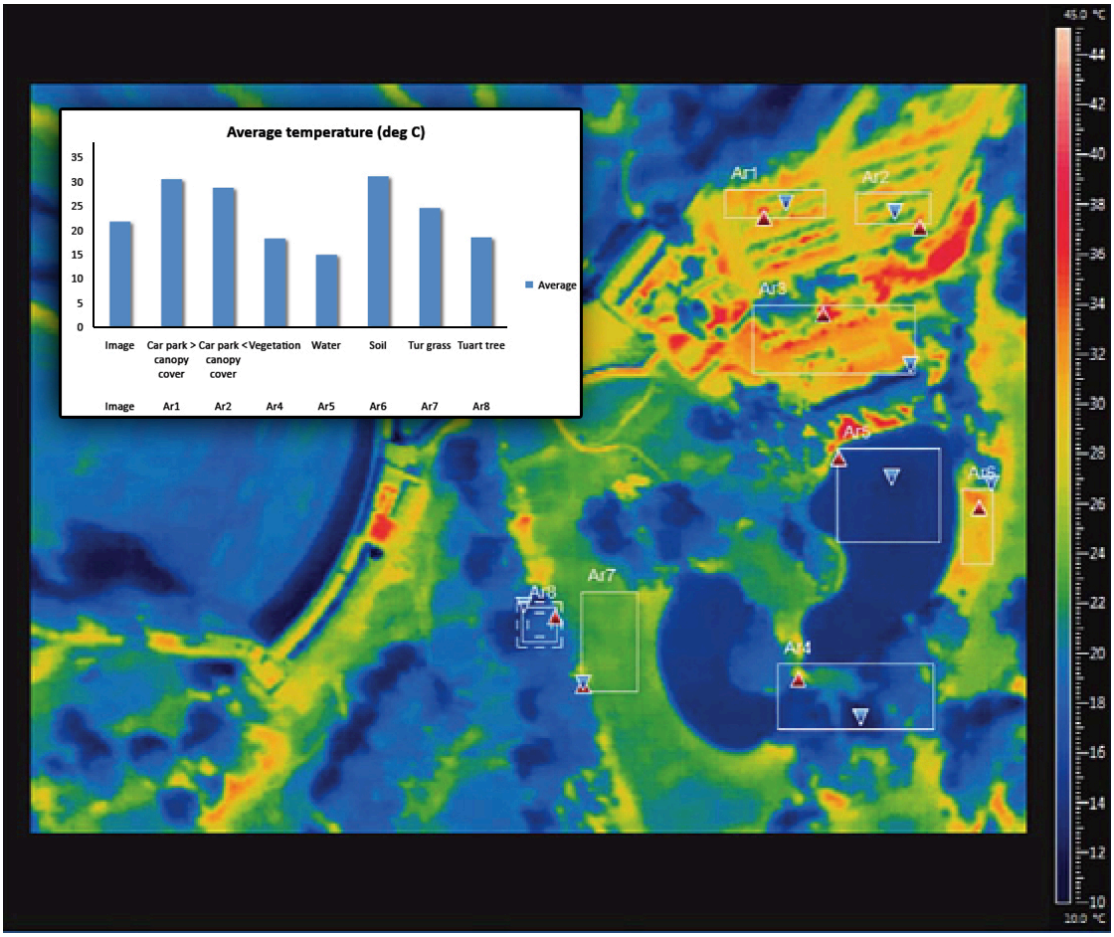

Fig. 1. Airborne high-resolution thermal image acquired over an urban site within Perth with relative temperatures graphed (insert).

At present, for many reasons, the majority of stakeholders are not adopting a sustainable approach to vegetation management, and in doing so, are greatly contributing to having a negative impact upon the environment, and wasting valuable dollars and resources that could be better spent on other, more sustainable activities. We have the capability to make changes, and the obligation to act responsibly and ensure our vegetation is managed sustainably for the enjoyment of future generations. Let's now discuss this in more detail.

Mapping and Monitoring

How many of you know what portion of your asset is occupied by vegetation? What amount of vegetation has been lost/gained annually over the past decade? How has the health of your vegetation changed each year? If there has been a decline in the health of your vegetation, what is the spatial and temporal pattern of this decline? How has your vegetation responded to treatment? How is your management of turf

impacting upon tree health? These are all questions that can be answered using a combination of remotely-sensed and *in-situ* techniques. Over recent years we have been acquiring and analysing high-resolution (0.01m to 0.5m) imagery using specialised sensors fixed to airborne platforms (i.e. fixed wing, UAV). These sensors are very sensitive to subtle changes in vegetation growth and condition, and allow us to answer many of the questions that are listed above. By combining this precise vegetation monitoring technology with our knowledge on the ground, we can adopt a pro-active approach to the development of sustainable vegetation management strategies. The image below shows the results of different types of analysis of airborne multi-spectral imagery over urban locations throughout Perth, WA. Figure 2 quantifies the amount of woody vegetation (coloured in khaki) as 18.4% canopy cover, and Fig. 3 shows how the vegetation health over a golf course has changed over a one year period, with red showing loss, white stable, and blue gain. The year was one of the driest on record and caused widespread decline in health of vegetation throughout Perth.

Fig. 2. Canopy cover quantified from analysis of airborne multi-spectral imagery (0.5m resolution).

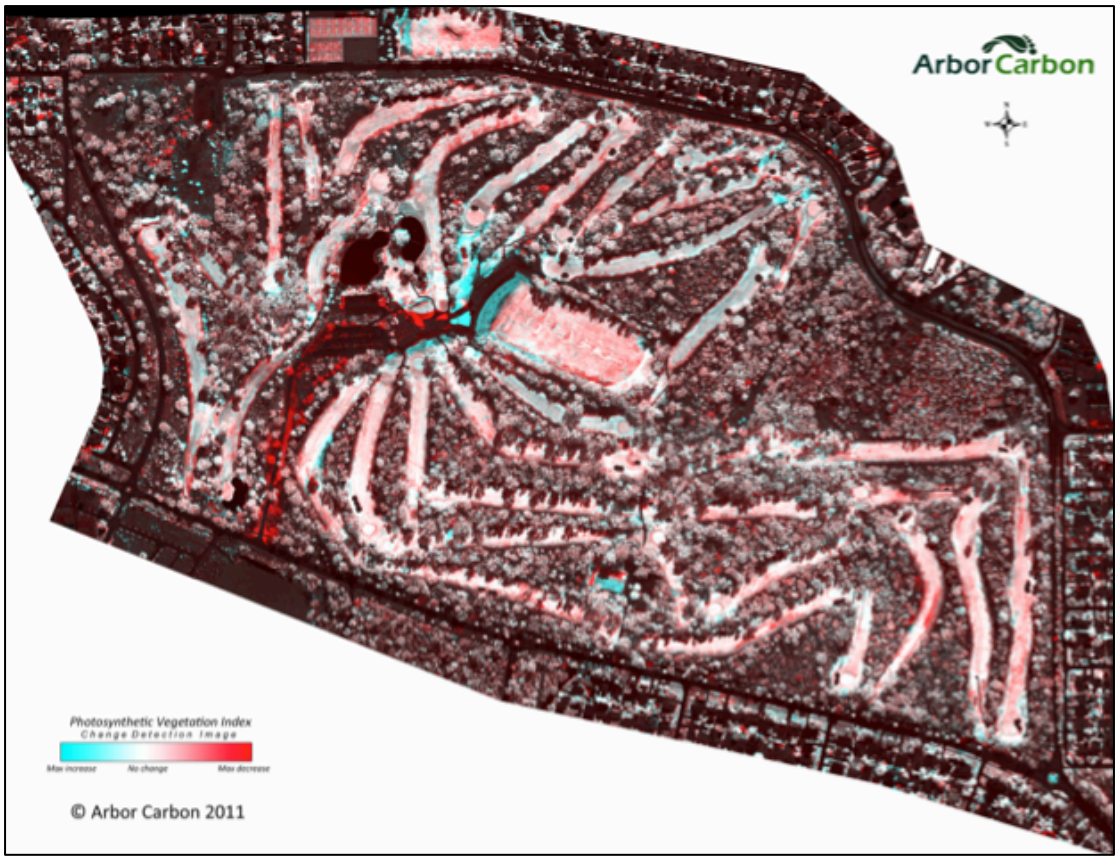

Fig. 3. Change in vegetation health over a one-year period. Red indicates loss, white stable, and blue gain.

Causes of native tree decline

Factors causing the premature decline in health of trees can be categorised as predisposing, inciting or contributing. Trees growing in turfed, urban environments, and particularly native Australian trees, are already predisposed to premature decline in health, due to sub-optimal soil conditions, a lack of beneficial soil microbes, radiant heat from impervious surfaces, a lack of soil volume for roots etc. Many other factors in these environments can incite or trigger the premature decline in health of vegetation, including mechanical damage, over-pruning, extreme climatic events (i.e. drought, frost, hail, flooding, cyclone), groundwater drawdown, pesticides, pathogens, pests etc. As trees begin to decline in health, their susceptibility to other contributing factors increases and these factors can exacerbate the decline to the point of death. Such factors include pathogens, pests, over-pruning, excess irrigation or fertiliser. We very commonly observe vegetation managers increasing application of water or fertiliser, and excess removal of the canopy following observation of decline symptoms. If inciting factors like root pathogens, pests, or decay fungi are present, these actions can favour these factors by improving conditions for infection and development of disease, or increasing stress thereby reducing the ability of the vegetation to resist further attack. Over the past two years during surveys of declining trees in many parks, gardens, reserves and

golf courses throughout the Perth urban area, we have discovered nine different species of the root pathogen *Phytophthora* associated with disease symptoms. *Phytophthora* is considered to be one of the most important genera of pathogens of trees worldwide. These species have been identified using a combination of traditional and DNA-based techniques. Figure 4 shows a phylogenetic tree of the species we isolated, with three new to science and one a new record for Australia. Interestingly, some of these species have only previously been found in nurseries, raising questions about how they were introduced into the parks we surveyed. We have now adopted a program to manage these potential pathogens.

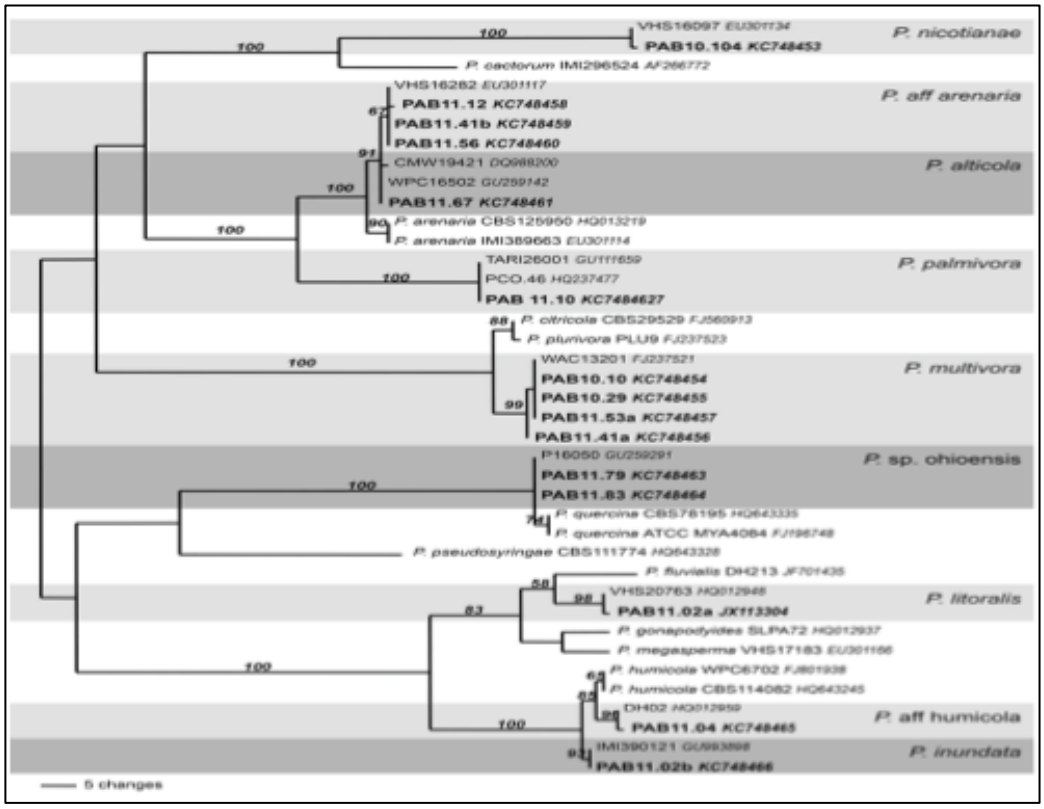

Fig. 4. Phylogenetic tree of *Phytophthora* species isolated from declining native trees in the Perth urban area.

Diagnosis of vegetation health disorders

Accurate diagnosis of the causes of decline in vegetation health, particularly in the urban environment, is challenging. Almost every situation is different, and as a result, so too can be the causal factors. It is first important to gain an understanding of the history of a site and what predisposing factors are present, and what factors may have incited or triggered a decline event. This knowledge can be sourced from the site manager or previous site managers, and also from historical environmental data (i.e. airborne imagery, climate records etc.). It is then important to know the biology of the host and pest/pathogen, consider the limitations of the environment within which they occur, and identify the signs and symptoms associated with the decline. Collection of physiological measurements may be required, and soil, foliage

and/or root samples. This is where experience can be important, and this can reduce the number/range of samples collected and therefore reduce costs for analysis. Laboratory analysis is undertaken and data analysis to identify anomalies. The puzzle can then be pieced together to form an accurate diagnosis.

Sustainable vegetation management

Sustainable management of vegetation health disorders can only be successfully achieved if the cause(s) of the disorder are accurately diagnosed. Inaccurate diagnosis can result in incorrect management and this can be costly with unfortunate outcomes. Pruning is often a last resort as it may cause the re-allocation of valuable plant resources to respond to the wounding, at expense of defense against the causal factor(s). Sometimes we are unable to treat the predisposing or inciting factor (i.e. flooding, frost, hail etc.), so we are required to manage the inciting or contributing factor(s). Trees are incredibly resilient and can often respond favourably and rapidly to such treatments. Over the past few years we have treated a wide range of disorders of vegetation using a combination of cultural, soil and systemic treatments with very good results (Fig. 5). This form of management has many positive outcomes, including the conservation of the tree, enhanced aesthetics and biodiversity values, increased benefits to people (i.e. increased shade, reduced air pollution), and finally, reduced costs and energy output for pruning, removal and replacement.

Fig. 5. Results of treatment of a tuart (*Eucalyptus gomphocephala*) suffering from severe insect attack.

Conclusion

The alternative approach to vegetation management discussed within this paper does not require the allocation of large funds, or radical change to the way that we conduct our day to day activities. It does however require superintendents and environmental/parks coordinators to think more holistically about vegetation health, identify and understand the importance of this vegetation, and be open to new ideas and methods that are not widely used within the industry. The benefits of such an approach far outweigh the costs if we consider this holistically, and we must strive to always improve our approach to vegetation management, so that we stay one step ahead of the new and emerging factors impacting upon vegetation health. We have the capability, and have an obligation to act responsibly and manage our vegetation sustainably.