Submission to: Inquiry into health impacts of air pollution in Victoria

Greg Moore 31st March 2021

Introduction

Definitions of pollution are varied, but one which is both comprehensive and indicative of human impact is:

> Pollution is the unfavourable alteration of our surroundings wholly or largely as a by-product of human actions, through direct or indirect effects of changes in energy patterns, radiation levels, chemical and physical constitution and abundances of organisms (Presidents Science Advisory Committee, 1965).

It is sometimes difficult to define a pollutant, but for the course of this submission a pollutant is defined as:

> A substance that adversely affects something that human's value, provided it is in concentrations high enough to do so.

Apart from localised regions, usually within the inner-city regions of Australian cities, such as Melbourne, and isolated major accidents, pollution levels are rarely high enough to cause acute health problems for people, but subtle or chronic effects may occur at much lower concentrations. In Australia, the coastal positions of major cities, relatively small population densities and prevailing winds combine to minimize wide-scale pollution events. When damage does occur, however, the causes are often difficult to identify and remedies difficult to prescribe.

The general role of trees in mitigating pollution damage

The role of urban trees in reducing and managing pollution in cities is well known. As long ago as 1994, the city of New York estimated the value of the city's trees in removing pollutants at US$10 million per annum. In a rare Australian study by economists, it was estimated that a single Adelaide street tree removed air pollution valued at $34.50 per annum (Killicoat, Puzio and Stringer, 2002). It could be argued that because of the multiple functions and services performed by the trees in the urban forest that they are the cheapest and most effective way of dealing with urban pollution in Victoria's major cities.

In a study of particulate matter on the leaves of trees growing on the intersection of Grattan Street and Royal Parade, Melbourne, particulates were measured using a simple wipe technique. Leaves on trees at various distances from the intersection were wiped with dry filter paper, then water-moistened paper and finally alcohol soaked papers. Using the three wipes removes most of the particulate matter from the leaf surfaces. The collected papers, as well as the leaves, were scanned into a computer and processed in Photoshop. The relative PM concentration presented in this research was expressed as a percentage based on the leaf area. It was found that particulate matter on the leaves was higher in the trees closest to the intersection, but was negligible on trees 100m from the corner (Figure 1) and on trees growing in nearby parks.

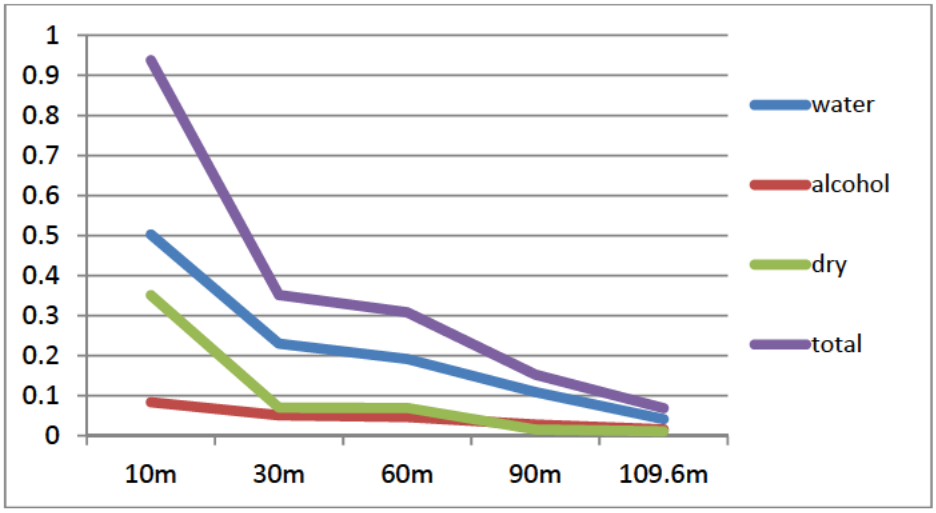

Figure 1. Relative amounts of particulate matter on elm leaves growing on trees at various distances from the intersection of Royal Parade and Grattan Streets, Melbourne.

The role of street trees in the removal of particulate matter and dust from roads is one of the reasons behind the massive tree planting that is taking place along highways and urban roads in China – mitigating the UHI effect is another. Different species of trees have different capacities both for the uptake of pollutants into leaf tissues and for the adsorption of particulate matter onto the leaf surfaces. In the Melbourne study, it was found that the hairy surface of plane tree leaves was generally more effective in accumulating particulate matter of the leaf surface than either elm or eucalypt leaves (Figure 2), but all three species adsorped PM closest to the intersection. However, it should be noted that this study investigated PM only and that evergreens such as eucalypts are effective in up-taking other pollutants.

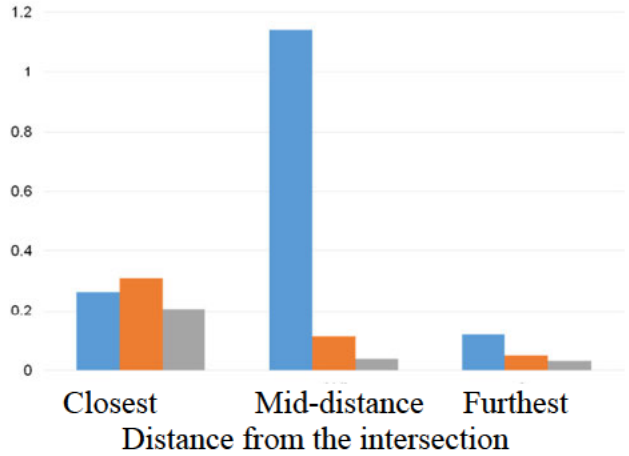

Figure 2. Relative amounts of particulate matter on elm (grey), eucalypt (orange) and platanus (blue) leaves growing on trees at various distances from the intersections, Melbourne (Modified from Guo, 2016)

During the summer of 2019-20 as bushfires raged across Australia, several cities including Melbourne experienced high levels of particulate matter (PM) pollution from smoke. It came as a surprise to many Australians that cities, such as Sydney, Melbourne and Canberra had for several consecutive days the world's poorest air quality. Trees are important contributors to improved urban air quality by filtering chemical and PM pollution from the air (Moore

2017). Both deciduous and evergreen species make their contribution, which is often overlooked when people are considering benefits provided by urban trees. How often does the much-criticised London plane (*Platanus x acerfolia*) get recognition for its capacity to remove PM from air? The tree can cause irritation at certain times of the year, usually for short periods, but this cost may be justified in terms of the benefits that the species provides.

Other tree and pollution- related benefits of urban trees

The role of trees in humidifying air should also be considered when considering the effects of pollutants on human health. The increase in humidity due to the transpirational water losses of urban trees can reduce the impacts of dry air that exacerbate some respiratory and breathing conditions. Evapotranspiration not only humidifies air, but also cools trees and the air and environment around them, provided there is sufficient soil moisture for stomata to remain open. Trees need water and at times of drought people think that trees should not be irrigated. However, their shade and cooling means that soils do not dry as quickly and that air temperatures are lower and so in many ways trees efficiently use the water that is provided. This is another example of the multiple and cumulative benefits of urban trees (Moore 2020).

The role of trees in mitigating the impact of winds can also be an advantage in dealing with air pollution. In a Canadian Study, removing all the trees around homes resulted in a doubling of wind speed and increased wind pressure that is responsible for up to a third of a building's energy consumption. Removing all the trees around buildings can increase a building's energy consumption by up to 10% in winter and 15% in summer. Bare branches play a role so deciduous trees also reduce pressure loading on buildings year round – it's not only evergreens that are important (Giometto et al. 2017).

Variability in tree responses to pollutants

The uptake, adsorption and sensitivity of trees to pollutants varies. Some tree species uptake significant amounts of pollution and other s are less efficient at doing so. Some are sensitive to pollutants while others are quite tolerant and many trees show seasonal, age and dormancy related variation in their pollution sensitivities. Evergreen species are generally regarded as being better at removing pollutants from the air than deciduous species, probably because they do so all year round, but deciduous trees may have higher tolerances as they dump pollutant loads with each leaf fall. The sensitivities and tolerances of many Australian native trees to pollutants are still unknown (Moore 2016).

As with all environmental stresses, plants vary in their responses to and tolerances of pollution and certain species or cultivars have been developed for their pollution resistance. The effects of pollutants on trees depend on their concentrations and the species of tree. The environmental conditions and the exposure to the pollutant can all influence tree responses.

The role of trees in reducing soil-borne pollution should not be under-estimated. It may not be a direct effect, but one facilitated by the presence of trees that provides a healthy soil micro-fauna and flora. While the direct effects of the pollutant that can cause injury to trees, there may be indirect effects due to the altering the physical components, such as soil aeration, or the biological components, like mycorrhizal fungi, of the environment. The effects of pollution frequently result from a complex set of interactions and the relationships are often subtle and difficult to determine.

Canopy decline and the capacity of the urban forest to mitigate pollution

Sadly, despite knowing the value of tree canopy cover in reducing the urban heat island (UHI) and reducing airborne pollution, in most Australian cities canopy cover is declining. In Melbourne, the loss is at a rate of 1-1.5% per annum, mainly due to the removal of trees on private land – front and back yards - for more intense housing development. Studies from North American cities have also identified that private development leads to an annual 1% decrease in urban tree canopy cover area above private land. This can be a serious concern for cities and towns anticipating population increase and future densification (Moore 2020).

In more detailed analyses of canopy changes, lower and more subtle rates of canopy loss were reported. Croeser et al. (2020) found a 1% decrease in Melbourne canopy over eight years due to the churning of trees on public land. Older, bigger trees were lost near development sites but were compensated for by new plantings. Furthermore, many of the trees lost were relatively young specimens, which threatens achieving future canopy cover targets. Other studies have found that different regions or sectors within a city show rise and falls in canopy cover, but the overall trend is a reduction (Moore 2020).

The subdivision of older dwelling sites involves the loss of mature trees on private open space, but there is an assumption that these losses will be compensated by street tree planting. However, this is fantasy – the large old house and block transform into several townhouses with multiple driveways which leave little, if any, space in the nature strip for the planting of trees of sizeable canopy. There is a spiral into further canopy decline. There is insufficient public open space in many Australian municipalities to achieve a 30% tree canopy cover without having a contribution from trees growing on private open space.

As urban canopy cover declines, it is staggering that trees are removed because of minor nuisance or infrastructure damage. Trees that have provided ecological and environmental services such as the removal of air-borne pollutants and substantial economic benefit for decades are removed when they cause damage to infrastructure that could be rectified for a few hundred dollars. Where are the cost:benefit analyses in these cases? Perhaps worse are thoughtless tree removals based on a whim, ignorance or prejudice precipitated when private property changes hands. Private land owners should understand that they too have a responsibility for managing trees for the greater community good – cooler cities and better quality air.

The health and social benefits of active and passive recreation are well-known and the venues for such activities are normally public open spaces under local government control. It is easy to think that such activities and facilities are likely to bolster urban green space and provide opportunities for greater canopy cover. However, more club rooms, car parks and hard surfaces are seeing a gradual erosion of green space, even within older parks and recreation reserves. Furthermore, with the increase in the demand for sports ovals and pitches, especially with the massive increases in women's sport, there is enormous pressure on public open space to remove trees for more playing surfaces and to build facilities. This is not an argument against fostering greater participation in active and passive recreation, but rather a concern that there does not seem to be any strategy for increasing or even preserving open green space in light of these pressures and the demands of climate change. How is it possible, given rising temperatures that state planning laws continue to ignore the value of trees and open space so that we are losing them from Melbourne at the very time we need them most?

Conclusion

The impact of decreases in canopy cover will be widespread and include a loss of shade, a higher UHI effect, increased cost to the State's health system and a reduced capacity for the urban forest to deal with PM and other pollutants.

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