CHALLENGES ASSOCIATED WITH MONITORING URBAN TREES

AND THE BENEFITS OF COLLECTING BASELINE DATA AT PLANTING

FEATURE

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Dean Bell, Postgraduate Researcher in Urban Forestry at the Centre for Sustainable Planning and Environments (University of the West of England) and Associate member of the Institute, explains how monitoring urban trees is essential to learning how urban forests and our planting initiatives change over time and how to optimise their use and effectiveness we must initiate data collection at planting.

Internationally, cities are setting politically-driven planting targets in light of tree-based ecosystem services. Planting efforts also go far beyond the urban forestry profession, with global organisations, community groups, and enthusiasts – to name but a few, contributing to new plantings.

Whilst these initiatives are welcomed, establishing trees in hard landscapes presents significant challenges, and progressively adverse growing conditions often result in high mortality rates (Hilbert et al., 2019). Considering this, it raises questions as to how many of the planting initiatives are being assessed in respect of successful establishment and longevity. As a profession, we are often interested in understanding how our tree populations are performing in terms of growth and survival. In reviewing planting initiatives, several corresponding questions come to the fore, e.g. what percentage of the cohort have survived/died? How much have the trees grown since planting? Did the new tree pit strategy increase health and resilience? The list goes on.

> "Lacking data at planting is a significant barrier in our ability to make inferences about tree success and the according reasons."
> *Vogt et al., 2015*

To answer these questions we need robust data. For instance, how can we truly assess changes in tree growth without knowledge of the precise tree size at planting? How can we conclude that one planting method is superior over another if the planting records do not state which method was used? How can we accurately assess tree survival rates during the establishment phase if the date of planting is unknown? Simply put, with great difficulty – if at all.

Moreover, we cannot tell how decisions at planting are impacting the success of planting efforts, and in the absence of records, it remains unknown whether particular strategies influence tree growth and survival. Fundamentally, lacking data at planting is a significant barrier in our ability to make inferences about tree success and the according reasons (Vogt et al., 2015).

Vogt et al. (2015) state that, in practice, "little if any data are collected on trees planted in the urban landscape at the time of planting". My experience concurred with this when seeking case study sites for my PhD research assessing tree growth and survival in hard landscapes, where I had a modest criteria pertaining to available planting records.

It is important to note here that the data which is sought at planting differs from the data collected when undertaking a single, "snapshot" inventory at a given point in time in the following years post-planting. Such inventories have different objectives and are extremely useful for many aspects of urban forest management, although can quickly become outdated in the dynamic urban landscape (van Doorn et al., 2020). Data collected at planting serves several purposes, but importantly, it provides baseline records to facilitate future monitoring starting chronologically from the time of transplanting in the landscape.

Monitoring street trees planted in engineered tree pit solutions to assess their impact on growth and survival. Credit: Dean Bell.

Credit: GreenBlue Urban Ltd

Baseline records provide the opportunity for longitudinal monitoring in the field: i.e. repeated observations of the same individual trees. Longitudinal studies are essential for research on tree demography - the study of population dynamics - including analysis of change over time in growth and survival (van Doorn et al., 2020). Indeed, tree monitoring is considered a key element of sustainable urban forest management (Clark et al., 1997), and can provide critically needed empirical evidence for managers (e.g. Roman et al., 2014). Although relatively new to urban forestry, longitudinal monitoring studies (with varying objectives) are typically commonplace in rural forests.

By combining baseline records and monitoring into urban forest management, we are able to begin assessing the temporal dynamics of urban tree planting cohorts, whilst reporting quantitative performance metrics related to growth and survival (among others). This would undoubtedly contribute to reversing the currently high failure rates of our urban plantings and amplify our knowledge base on factors corresponding with successful establishment. Thereafter, we will be better equipped to design appropriate planting strategies, based on empirical evidence applicable to the geographical setting.

Further, as the quantity of data from monitoring efforts increases, so does its application to wider urban forest management. For example, by tracking population dynamics and understanding determinants of tree growth and survival, we can modify site conditions to foster desired tree performance, target maintenance routines and pruning cycles, and detect emerging threats from stressors such as climate change and pests and diseases. Repeated observations of survival/mortality status and measurements of tree biometrics will generate additional data on tree growth and allometry. This will enable the much needed production of both species- and locality-specific growth rates, whilst improving the accuracy of urban forest population projections and ecosystem services models. This is important, as altering growth and mortality rate assumptions in these models significantly affects the extent of projected delivery (Widney et al., 2016; Ko et al., 2015; Morani et al., 2011; McPherson et al., 2008), reinforcing the importance of empirical data.

This article does not have capacity to discuss monitoring protocols or variables for inclusion in baseline records. Readers are referred to van Doorn et al. (2020) who lay the foundations for practitioner-driven longitudinal studies of tree growth and survival, and suggest a "Minimum Data Set" for monitoring urban trees whose population cycles are anthropogenically controlled.

In summary, monitoring urban trees is essential to learning how urban forests and our planting initiatives change over time. Inventories conducted in years post-planting do not provide the full picture, and to optimise their use and effectiveness we must initiate data collection at planting. I recognise, and fully appreciate, that local authorities in particular are subject to ongoing austerity measures, and that gathering longitudinal data will invariably require additional time and resources. However, the concomitant benefits in informing urban forest management – not all of which have been discussed here - are vast, and not only promote sustainable urban treescapes but also provide opportunities to advance key areas of urban forestry and arboricultural science.

References

Clark, J.R., Matheny, N.P., Cross, G., Wake, V. (1997) A model of urban forest sustainability. *Journal of Arboriculture.* 23, pp. 17–30.

Hilbert, D.R., Roman, L.A., Koeser, A.K., van Doorn, N.S. (2019) Urban tree mortality – a literature review. *Arboriculture & Urban Forestry.* 45 (5), pp. 167–200.

Ko, Y., Lee, J.H., McPherson, E.G., Roman, L.A. (2015) Long-term monitoring of Sacramento shade program trees: tree survival, growth and energy-saving performance. *Landscape and Urban Planning.* 143, pp. 183–191.

McPherson, E.G., Simpson, J.R., Xiao, Q., Wu, C. (2008) *Los Angeles 1-million tree canopy cover assessment.* General Technical Report PSW-207, Albany, CA: USDA Forest Service, Pacific Southwest Research Station.

Morani, A., Nowak, D.J., Hirabayashi, S., Calfapietra, C. (2011) How to select the best tree planting locations to enhance air pollution removal in the MillionTreesNYC initiative. *Environmental Pollution.* 159 (5), pp. 1040-1047.

Roman, L.A., Battles, J.J., McBride, J.R. (2014) The balance of planting and mortality in a street tree population. *Urban Ecosystems.* 17, pp. 387-404.

Van Doorn, N.S., Roman, L.A., McPherson, E.G., Scharenbroch, B.C., Henning, J.G., Ostberg, J.P., Muller, L.S., Koeser, A.K., Milles, J.R., Hallet, R.A., Sander, J.E., Battles, J., Boyer, B.J., Fristensky, J.O., Mincey, S.K., Peper, P.J., Vogt, J.M. (2020) *Urban tree monitoring: a resource guide.* General Technical Report PSW-266. Albany, CA: USDA Forest Service, Pacific Southwest Research Station.

Vogt, J., Watkins, S.L., Widney, S., Fischer, B. (2015) The need to standardize at-planting data. *Arborist News.* 24 (6), pp. 26–31.

Widney, S., Fischer, B.C., Vogt, J. (2016) Tree mortality undercuts ability of tree-planting programs to provide benefits: results of a three-city study. *Forests.* 7, p. 65.