Urban Trees Capture and Store Carbon

James Steenberg
2021-01-13

Urban forests, carbon, and climate change are something that I consider often – and often I consider them from a critical perspective. Ever since urban forests and their management by municipalities began to pick up steam a few decades ago here in Canada, there has been a growing understanding and even appreciation of the beneficial ecosystem services that city trees and woodlands provide to people. This is undoubtedly a good thing for people and trees alike.

However, in the recent past I've been perplexed by the fact that carbon sequestration and storage are placed so high at the top of the list of urban forest benefits. I'm not disputing that every living tree sequesters and removes carbon dioxide (CO_2) from the atmosphere through photosynthesis and stores it in its woody biomass for years, decades, or even centuries (see the photos for excellent examples of this: a solitary elm along Bedford Road, and an old stand of hemlocks in Hemlock Ravine Park). Equally important is that the removal of carbon from the atmosphere by forests is an ace up the sleeve of our global-climate-change mitigation efforts. In fact, ecosystems that are natural carbon sinks are the only way it's empirically feasible to meet the net-negative emissions reduction targets that we are striving towards.

But let's look at the numbers. While over 80% of Canadians live in cities, less than 1% of Canada's land area is urban and there are fewer trees and less canopy cover in urban areas than forested ones on a per-hectare basis. Nova Scotia has even fewer urban areas on average, totalling just under 34 thousand ha or 0.6% of the province (as an aside, this urban area holds ~ 60% of the population, making Nova Scotia among the most rural places in Canada). In a recent study done by some of our HTP team members for Environment and Climate Change Canada, we found that urban forests across Canada remove roughly 4.1 thousand t of CO_2 from the atmosphere annually[1]. Conversely, Canada has 347 million ha of forests (10% of the world's forests) that remove 140 million t of CO_2 annually[2]. A recent study at Dalhousie's School for Resource and Environmental Studies found that Halifax's urban forest stores roughly 380 thousand t of carbon, compared to the approximate storage of 250 million t in Nova Scotia's 4.2 million ha of hinterland forest[3]. In summary, while urban forests sequester and store carbon, the numbers are a drop in the bucket of what can be achieved in Nova Scotia or Canada and what is needed globally to combat climate change.

So why all the hype? Why do so many cities rank carbon so high on the urban forest benefits list, even above psychological and wellbeing benefits that research has shown matters most to the people of Halifax and other Canadian Cities[4,5]? I have both a cynical theory and an awesome optimistic theory. Cynical first: urban forest carbon is relatively easy to measure compared to these other less-tangible benefits, like the psychological and wellbeing ones. More often than not, when cities do urban forest assessments, they include carbon and place an inflated price on that carbon. Additionally, carbon is a hot topic – a hot topic that can cool global warming! – so it only makes political sense for cities and city councils to stand behind carbon, even if the numbers are small.

Now for the awesome optimistic theory. I've said it before and I'll say it again: urban forests punch way above their weight class when it comes to carbon. Yes, I have only seven trees on my small Halifax property that store a meagre 1.8 t of CO_2 compared to the approximate 10.5 t of CO_2 per year that my house emits (heat and electricity only). But these numbers do not include the 'invisible carbon' that urban trees can prevent from being emitted to the atmosphere that hinterland trees cannot.

Urban trees growing next to houses and buildings help to reduce the carbon footprint of these structures above and beyond what the trees themselves can achieve. Conifers that hold their needles throughout the winter reduce home heating needs significantly by blocking cold winter winds when situated between a house and the direction of prevailing winter winds. Broadleaved deciduous trees that cast a heavy shade during the summer heat but then drop their leaves and let in a bit of the sun's winter warmth reduce air conditioning bills and help to further reduce winter heating. A quick analysis using a tool developed by the USDA Forest Service[6] showed that with strategically placed trees, my house could reduce a quarter of its energy used for environmental control.

Moving from the household level to the neighbourhood and city level, the urban forest canopy helps to ameliorate urban heat islands. Paved surfaces and the density of the built environment can increase ambient air temperatures in cities by 10 degrees or more on a hot summer day, well above what some climate change projections have in store for the year 2100. Evapotranspirative cooling – cooling associated with water vapour released from trees and the evaporation of water from vegetated surfaces – can cool air temperatures from 1 to5^{o} C [Ed. Note: please see post #12 on cooling the city environment]. Paved surfaces like parking lots under tree shade can be 11-25^{o} C cooler than unshaded ones at daily peak temperatures. Imagine the reduced carbon emissions from an urban building in 25^{o} C summer heat compared to 30^{o} C, or from an idling car in a parking space that is a couple dozen degrees cooler than its neighbour in full sun. Urban forest canopies also intercept stormwater during big rain events (do we have those in Halifax?) and reduce the amount of carbon emissions associated with treating wastewater in cities like ours that have combined storm-sewer systems.

To conclude, let's not bolster our urban forest carbon numbers unnecessarily. Instead, let's count them appropriately and look also to the many unseen carbon benefits they provide because they are growing in the dense urban environment. Certainly, more research is needed in this area to fully understand and communicate the benefits. Urban forests may not completely cancel out the greenhouse gases emitted by cities, but they are a tool in the toolbox and, with other emissions reduction work, they can help us achieve the net negative emissions that we so desire.

References

[1] Ristow, M., Steenberg, J. W. N., & Duinker, P. N. (2019). An updated approach for assessing Canada's urban forest carbon and sequestration. Ottawa, ON: Environment and Climate Change Canada.

[2] Environment and Climate Change Canada. (2020). National inventory report 1990 – 2019: Greenhouse gas sources and sinks in Canada (Part 1). Ottawa, ON: Environment and Climate Change Canada.

[3] Foster, D, & Duinker, P. N. (2017). The HRM urban forest in 2016. Halifax, NS: Dalhousie University.

[4] Duinker, P. N., Ordóñez, C., Steenberg, J. W. N., Miller, K. H., Toni, S. A., & Nitoslawski, S. A. (2015). Trees in Canadian cities: Indispensable life form for urban sustainability. Sustainability, 7(6), 7379-7396.

[5] Steenberg, J. W. N., Duinker, P. N., & Nitoslawski, S. A. (2019). Ecosystem-based management revisited: Updating the concepts for urban forests. Landscape and Urban Planning, 186, 24-35.

[6] USDA Forest Service. (2019). i-Tree Design v6.0. Available from http://design.itreetools.org/


7'6" MAXIMUM CLEARANCE 7'6"