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BUILDING RENOVATION IMPACTS ON URBAN TREES – INSIGHTS FROM OPEN DATA

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Lessons from the Field

While I was doing my degree in Toronto I learned some valuable lessons about how to design a field research project. Some of those lessons were unquestionably about what not to do when designing such a project. My goal was to field-test an urban forest vulnerability assessment framework I had been developing [1]. The intent of the framework was to assess a slew of different social and ecological factors that might explain tree decline and mortality.

The residential neighbourhood where I was working had an existing tree inventory that I was able to re-measure to obtain tree mortality rates and changes in tree condition. I took the ill-advised approach of trying to measure a bit of everything to see what might turn up. The project had some value in the end, but many of my findings were either unexciting (e.g., aggregate census data does a bad job of predicting individual tree mortality) or somewhat predictable (e.g., trees on built-up, busy commercial streets are more likely to die).

But I also learned some other important and more positive lessons. The first was to keep your eyes open and be willing to pursue new avenues of research based on unexpected and interesting observations in the field. I was hoping to discover strong evidence of social causes and correlates of tree decline and mortality. While the census data failed to shed much light, I did notice one consistent pattern. When revisiting and re-measuring trees from the initial inventory, I kept finding that where once stood a mature tree there was now a new driveway, front porch, or home addition.

Figure 1 Left – Potential damage to mature trees during renovation activities (Image: J. Steenberg). Right – City of Toronto building permits (Image: Toronto Star).

Project 1: Neighbourhood-Scale Field Research

The emergent hypothesis was that one of the more prominent causes of tree mortality in this neighbourhood was home renovation activities. We proceeded to test this hypothesis using household-level building permit data for the neighbourhood [2]. Property owners must apply through municipal government to make any changes to their buildings. Fortunately for us, the government maintains these building permit records and makes them available through their open data program.

Our research found that tree mortality was more likely where building permits existed for a property. We also found that the number of tree mortality incidents on a given street section increased with the number of permits. In other words, it seems likely that building renovation activities are an important and understudied source of disturbance for residential urban forests. This research also explored tree planting rates and possible effects of rented versus owned housing, which is not discussed here.

Project 2: Spatio-Temporal Analysis of the City

I was able to continue and expand this research further to look at the entire City of Toronto during my postdoctoral fellowship at Dalhousie University [3]. Again, we leveraged building permit data from the city and also used a combination of historical air photos, census data, and a spatial statistics tool called geographically weighted regression. As with the previous study, we matched individual trees between two time periods to identify mortality/removals and any relationship with building permits, but this time using the high-resolution air photos from 2003 and 2014.

Sure enough, tree mortality was significantly higher across the entire city on properties with one or more building permit. Interestingly, Toronto does have tree protection zone standards in place, which require temporary fencing around private trees during construction activities. Our findings point either to the need for better enforcement or – what's more likely – better coordination between urban forestry and urban planning.

Figure 2 An example of tree mortality identified in 2014 on a property with associated building permits (Image: Steenberg et al., 2018). Note that the 2003 air photos were leaf-off, which was a limitation of the study that is explained in the publication.

There is some nuance when expanding this research from a field project in single residential neighbourhood to the entire extent of Canada's largest city. The geographically weighted regression revealed some counter-intuitive relationships between affluence, canopy cover, and renovation activity. For one, the relationship between canopy cover and renovation activity is spatially variable across the urban landscape (see the map below). Moreover, other research suggests that more affluent neighbourhoods have higher rates of residential tree planting [2,4]. It may be that in these neighbourhoods were renovation activity is far more frequent, tree mortality associated is being offset over time by higher planting rates. This could, in part, explain why the most affluent Toronto neighbourhoods had the highest canopy cover and the most permits.

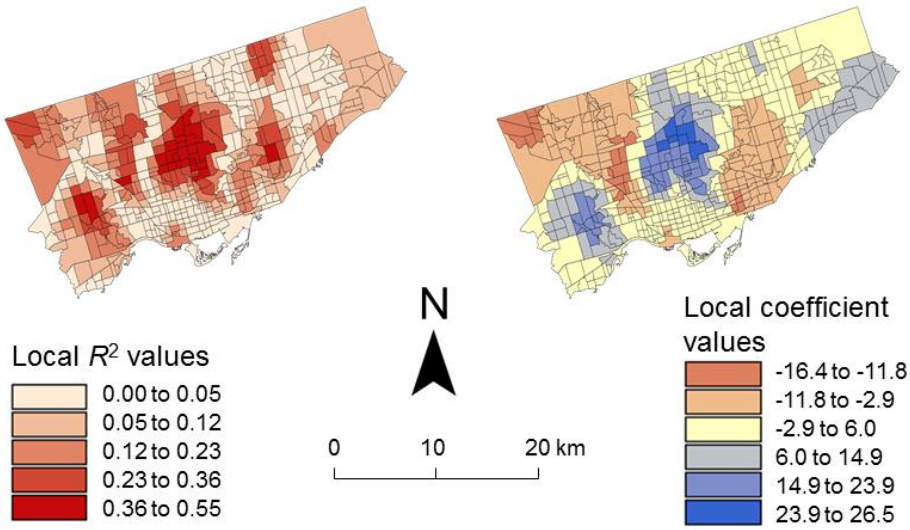

Figure 3 Results of the geographically weighted regression mapped for Toronto. In the map on the left, a darker red colour indicates a stronger relationship between the number of building permits and percent canopy cover. In the map on the right, blue indicates that canopy and permits are positively associated and red indicates that they are negatively associated

Investing in urban housing stock can be important for a city's overall sustainability (e.g., energy efficiency), but it is important this does not come at the cost of urban trees and the range of beneficial ecosystem services they provide. While our research suggests that renovation activities might be a threat to adjacent trees, the building permit process might also be a valuable point of intervention for educating residents about the benefits and vulnerabilities of trees on their property.

Open Data and Urban Forests

Lastly, a final important lesson for me from these initially happenstance – or serendipitous? – research projects was the importance of leveraging novel sources of data for advancing urban forest research and practice. Cities are complex environments where a mix of social and ecological processes shape urban forest ecosystems and their vulnerability. This often makes it difficult if not impossible to identify emerging threats to urban trees.

Cities collect massive amounts of data that have impressive spatial and temporal resolution, such as 16 years of daily, city-wide, parcel-level building permit data. These datasets are increasingly being made available to the public through open data programs and can give insight into urban forests for researchers and practitioners that just would not be possible with traditional research approaches.

Interested in learning more about the relationship between building renovation, housing type, and urban trees? Write and send us your questions.

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