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Effect of Pruning on Crown Motion

As the human population grows—and continues to move towards an increasingly urban living environment—the need for expertly-managed green space in the urban environment increases. Trees and urban forests have been positively linked to improved personal wellbeing, crime reduction, and healthy city environments (Kuo and Sullivan, 2001). Municipal authorities are increasingly realizing the benefits of urban forests, and substantial efforts are being made to manage this resource in a positive way. It is the responsibility of urban foresters and arborists to prescribe procedures for the development and maintenance of the urban forest. Practical understanding based on sound theoretical knowledge is needed to develop best management practices that meet the needs of all invested parties. This project will help to close the gap between the theoretical component of tree biomechanics as has been developed in the literature, and the practical applications in arboriculture.

Arborists have long been prescribing pruning treatments to reduce the potential for limb or tree failure, yet little is known about the actual mechanical effects of these treatments. We have yet to develop quantitative effects of pruning on branch loading and motion in a typical urban environment. While substantial work has been done to develop theoretical models of stem and branch motion, the change in loading and resulting change in motion from pruning need further examination. This project sets out to examine the effects of pruning in an in-situ environment, where mature trees in an urban environment were pruned by qualified arborists as part of routine maintenance.

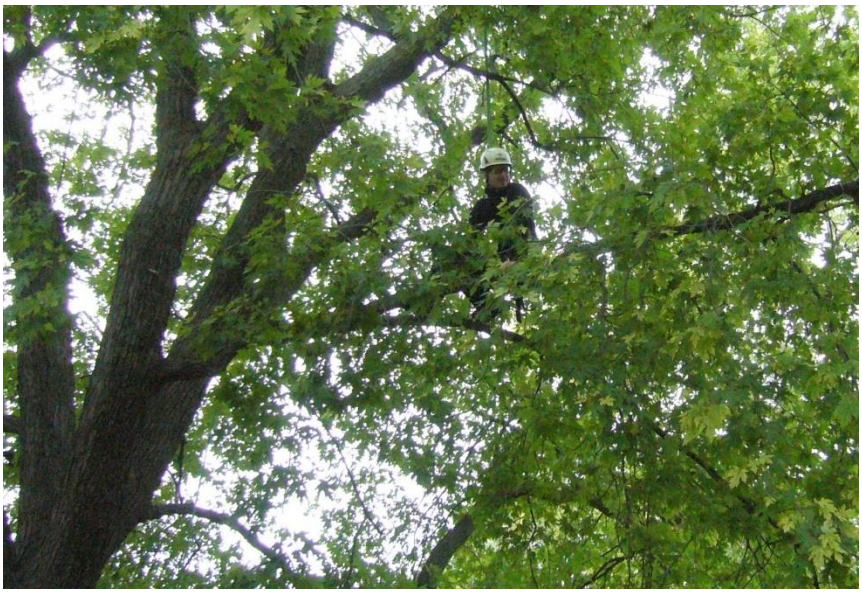
During September 2012, six silver maple (*Acer saccharinum*) trees (10 individual limbs) in the borough of Notre-Dame-de-Grâce (NDG), Montreal, were fitted with data-logging accelerometers, activated by anemometers mounted on the subject limb. The accelerometers measured and recorded acceleration in 3 axes at 12 Hz, while simultaneously logging the wind speed recorded from the anemometers at 1 Hz. Typical installation shown (Fig. 1).

Fig. 1 Typical accelerometer installation

Anemometers were mounted on PVC pipe standards on the subject limb. Typical installation shown (Fig. 2).

Fig. 2 Typical anemometer installation

Data was collected over a control period of eight days, following which each limb was pruned of approximately 15% foliage with one of the two methods (reduction pruning or thinning). Pruning was carried out by two arborists from the borough of NDG under the direction of the research team. Pruning followed typical industry practices.



Figs. 3, 4 Arborists from borough of NDG

Following pruning, data continued to be collected for several weeks, with the intent to log similar wind conditions before and after the pruning episode.

Preliminary analysis for 4 trees and 4 branches (16 total wind movements/events) shows strong results. The time-series data is being analyzed in R (R core development team, 2008), after importing the raw acceleration files, the magnitude of the net acceleration is transformed with a Fast Fournier transformation (FFT) and subsequently analyzed for peak magnitude of acceleration and typical frequency. More in-depth wavelet transforms are pending.

Our results for silver maple confirmed previous findings for *Acer rubrum* (Smiley and Kane, 2006) and *Quercus virginiana* (Gilman et al., 2008): reduction pruning appears to reduce overall magnitude of acceleration, and therefore potential loading on the stem (decrease in average magnitude of oscillations) across similar wind events. Further to this, we found an increase in the frequency in some stems (more detailed results pending).

Furthermore, our initial analysis suggests that crown thinning may increase the magnitude of acceleration and, possibly, subsequent wind loading on the stem, to some degree. Compared with similar wind events in the control phase, several limbs show an increase in average magnitude of oscillations following thinning. While this has been suggested in theory (James, 2006), to the authors' knowledge it has not yet been shown in real-world conditions.

Further analysis of all limbs is required to confirm findings, and is expected to be complete prior to presentation of the project at the 2013 International Society of Arboriculture conference in Toronto.

References

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