



# Resident Knowledge and Support for Private Tree By-Laws in the Greater Toronto Area

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**Abstract.** Urban municipalities across North America are developing policies to protect and manage not only public trees but also the numerous trees located on private property. One approach is the creation of private tree by-laws or ordinances that regulate tree removal on all private property through a permitting process. These regulations can successfully protect the private urban forest, particularly larger trees, but their success is dependent on landowners' willingness to comply given the difficulties of enforcement. This study examines residents' awareness and support for private tree by-laws in three cities in the Greater Toronto Area (Ontario, Canada) through a written survey that targeted neighborhoods with high tree canopy—places most likely to have trees regulated under the private tree by-laws. Basic awareness about by-laws varied across the five study neighborhoods, and support for specific components of the by-law, including size and number of trees regulated, tree replacement requirements, and permit fees was also mixed. While a larger number of survey respondents felt that their city should not regulate trees on private land than had supported the current by-law, this was still not a majority of responses. Participants with more trees on their property or who had planted trees were significantly more supportive of the regulations, while several socio-demographic characteristics were also significantly related to level of support for the by-laws. The management implications of these results are discussed.

**Key Words.** By-Law; Canada; Municipal Policy; Ordinance; Private Urban Forest; Residential Landscape; Toronto; Urban Forestry.

In recent years, numerous municipalities across North America have adopted plans to protect and grow the urban forest (Ordóñez and Duinker 2013). While municipal programs and regulations to plant and protect street trees have long existed (Elmendorf et al. 2003), more recent efforts have focused on private property, based on the substantial number of privately-owned trees in most cities (Summit and Sommer 1998; Pearce et al. 2015). Thus, programs encouraging landowners to plant new trees are increasingly common, often tied to “million tree” initiatives or ambitious canopy cover goals (Young 2010).

As larger trees are generally able to provide more ecosystem services, a growing number of North American municipalities have also adopted stand alone private tree protection regulations to ensure that existing healthy trees are not prematurely removed (Kielbaso et al. 1988; Rines et al. 2011). Increasingly these private tree protection measures apply to all private property; regulations are not limited to

development applications or sub-division of previously undeveloped land, but apply to trees on existing residential, commercial, and other urban land uses (Conway and Urbani 2007).

There are a number of potential pitfalls that can hamper the success of private tree protection regulations, including the difficulty of enforcement, with violations typically identified after the fact and only if a member of the public reports a regulated tree has been removed (Conway and Urbani 2007). As a result, Coughlin et al. (1988) suggest about half of violations go unnoticed, and if landowners are found to have incorrectly removed trees, penalties usually involve reprimanding the landowner rather than requiring the trees be replaced. A survey of southern Ontario, Canada, municipalities confirmed this trend, with most municipalities not actively enforcing the requirement for a permit to remove trees, so residents who are unaware of the regulation, or who are uninterested in complying, can potentially violate it with little consequence (Conway and Urbani 2007).

Given the lack of enforcement, the effectiveness of such regulations are dependent on landowners' awareness and willingness to following the permitting process, and more generally, their interest in retaining large trees on their property. This study explores residents' awareness and support for municipal private tree by-laws in three Canadian municipalities as a way to consider the type of outreach needed to ensure widespread compliance. The study municipalities, Toronto, Mississauga, and Brampton, represent highly populated cities located in southern Ontario. Residents in each municipality were surveyed to determine 1) basic knowledge-levels associated with the regulations, 2) the extent of support for different components of the by-laws, and 3) participant socio-demographic characteristics associated with by-law knowledge and support to help identify outreach and education strategies to increase awareness and support for private tree protection.

### **REGULATING PRIVATE TREES**

Stand-alone tree regulations, often called tree ordinances in the United States and tree by-laws in Canada, which protect street trees or other public trees from damage or removal, are widespread and have existed for at least a century in North America (Cooper 1996; Stevenson et al. 2008; Zhang et al. 2009). Starting in the 1970s, municipal tree ordinances that protected trees on private property during subdivision, or other land development, were adopted in many areas (Coughlin et al. 1988; Cooper 1996; Kielbaso et al. 1988; Dickerson et al. 2001). Recent surveys of several U.S. states indicate more than half of local municipalities now have regulations protecting trees during land development (Elmendorf et al. 2003; Rines et al 2011; Templeton and Rouse 2015). While historically rare in North America, an increasing number of municipalities also protect trees on already developed private property, including residential property (Conway and Urbani 2007).

Municipal regulation of trees on developed private property has taken two forms: 1) protection of specific trees, based on cultural heritage or noteworthy specimens or 2) blanket protection of all trees over a certain size (Wyse et al. 2015). Heritage or noteworthy tree protection

regulations are the more common approach in North America, while blanket tree protection regulations are relatively common in urban municipalities in Europe and also exist in several Australian cities (Schmied and Pillman 2003; Gilbert and Brack 2007; Kelly 2013). In recent years, adoption of a blanket private tree by-laws has become more common in Ontario and other urban municipalities in the U.S. and Canada.

Blanket tree protection regulations typically require that the property owner apply for a permit before trees over a given size (or number) can be removed, replace any tree(s) approved for removal, pay a fee associated with the permit application, and possesses the authority to levy monetary fines against violators (Coughlin et al. 1988). Ideally, tree replacement requirements should specify that equivalent species be planted following a pre-determined planting schedule (Cooper 1996).

Several case studies suggest blanket private tree regulations have positive impacts on the urban forest (Landry and Pu 2010; Sung 2012; Sung 2013). For example, a study conducted by Sung (2012) in Texas, U.S., comparing mean height of trees in areas that had private tree protection policies to trees in areas without such protections, calculated that tree heights were on average 0.58 m taller when a regulation was in place. Urban heat island effects are also less pronounced in areas that have a tree protection ordinance (Sung 2013). In Tampa, Florida, U.S., locations with tree protection regulations have higher canopy cover, as compared to those without blanket tree protections, and also experienced increases in canopy cover after adopting the regulation (Landry and Pu 2010).

While blanket private tree regulations can have a positive impact on the urban forest, Conway and Bang (2014) found that residents generally do not support the idea of a regulation that limits tree removal on private property. Specifically, support levels are lower for this type of policy than volunteer programs encouraging tree planting. Beyond surveying municipalities to determine if they have private tree regulations and studies examining the impacts of the regulations on characteristics of the urban forest itself, the authors were not able to identify any studies exploring residents' knowledge or support for specific private tree regulations. Yet, knowledge and support

by property owners is key to ensuring tree removals are limited given the common absence of proactive enforcement (Conway and Urbani 2007).

## MATERIALS AND METHODS

### Study Areas

Residential awareness and support for private tree by-laws were explored in the Ontario municipalities of Toronto, Mississauga, and Brampton (Figure 1). Toronto has a highly developed downtown core, as well as older, medium- and high-density residential neighborhoods. The cities of Mississauga and Brampton have expansive areas of relatively new residential housing in a mix of multi-family buildings and medium-density single-family homes, as well as a few older town centers. Canopy cover varies between the study municipalities (City of Toronto 2010; TRCA 2011), in part because of differences in construction age; most new construction in Mississauga and Brampton occurred on previously deforested agricultural land. However, in all three municipalities, the majority of canopy cover is located on privately-owned land. The municipalities fall within the Great Lakes mixed forest zone. Based on i-Tree studies in 2007 and 2008, species composition was relatively similar across the three municipali-

ties; Norway maple (*Acer platanoides*), white ash (*Fraxinus americana*), and white spruce (*Picea glauca*) were the most prevalent species (City of Toronto 2010; TRCA 2011), although emerald ash borer has decimated ash trees in recent years.

Toronto, Mississauga, and the Region of Peel have management goals for protecting and growing the urban forest in the coming decades, and each point to the central role of residents in achieving these goals (TRCA 2011; City of Toronto 2013; OMTM 2018). Brampton, on the other hand, does not have city-level canopy cover or tree planting goals, nor does it have a program encouraging landowners to plant trees on their property; and while the Peel Regional Urban Forestry Strategy includes Brampton, there are no specific urban forestry growth plans in place at the City of Brampton. Thus, the three cities have varied urban forms, urban forest characteristics, and different types of urban forestry initiatives. One commonality, however, is the presence of private tree by-laws.

### By-Laws

The three private tree by-laws all regulate tree injury and removal on private property, but this study focuses only on tree removal. The details of the private tree removal regulation vary across the municipalities, with trees regulated

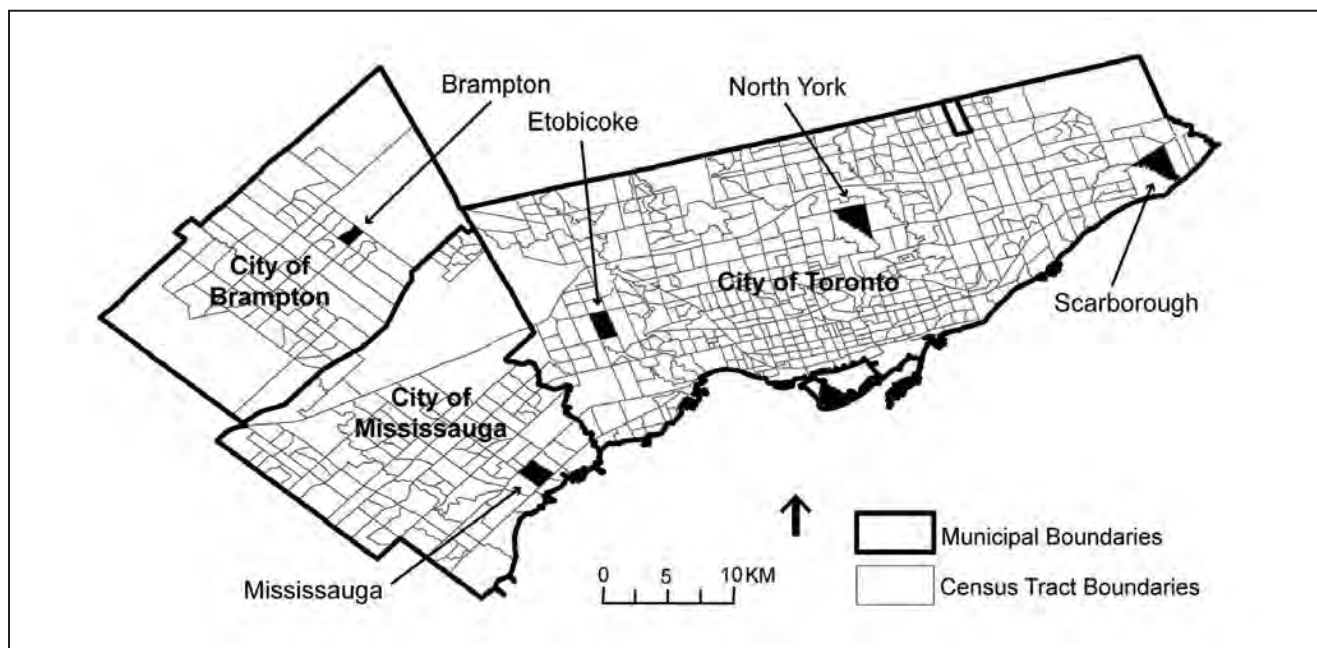


Figure 1. Study neighborhoods in the cities of Toronto, Mississauga, and Brampton in southern Ontario, Canada.

under the by-law differing by size, location, and number, while tree replacement requirements and permit fees also vary (Table 1). Toronto and Brampton require a permit for removal of trees greater than 30 cm DBH (measured at 1.37 m above ground), or larger than the 15 cm minimum size in Mississauga. However, Mississauga allows up to three trees removed in a calendar year before a permit is required. Toronto has a 1:1 replacement requirement, while Mississauga's tree replacement rules vary by the size of the tree removed. Brampton's tree replacement requirements are determined on a case-by-case basis.

Across the municipalities, the permit process for tree removal requests outside major construction projects involves a short application submitted to the urban forestry unit. A site visit from a municipal arborist may occur after the permit application is submitted. Only Toronto requires an arborist report and a landscaping plan that identifies where replacement trees will be planted on the property as part of the permit application, while the other two municipalities may request them. Toronto also requires a (minimum) 14-day period of public notice if the visiting arborist determines the tree is in good health and not a hazard to nearby structures.

It must also be noted that while the same by-laws regarding tree removal requests apply during major construction and redevelopment, as do additional by-laws (e.g., those specifying tree protection zones), tree retention and planting is often part of negotiations that occur dur-

ing the planning approval process (e.g., site approval, zoning variances, and building permits).

In all cases, the decision to issue a tree removal permit is ultimately made by urban forestry staff, but in Toronto, the local city council member is consulted and must support the landscaping plan before a permit is issued. Mississauga and Brampton do not have any public notification requirements nor do they have city councilor consultation as part of their standard application decisions. In all three municipalities, violators can be fined (varying amounts based on specific circumstances) and/or required to plant replacement tree(s).

Each municipality treats dead, terminally diseased, or hazardous trees slightly differently, but none require the full permit application process, nor require the planting of replacement trees. Brampton's website is the only one that states reasons for tree removal permit rejections: requests based on trees whose leaves or other debris are creating a maintenance problem, or whose roots are causing damage to paved surfaces or buried pipes.

The three municipalities have information about their by-laws on their websites under urban forestry (or similar) pages. Beyond the website and basic information that residents' can request through 3-1-1 non-emergency municipal services, there is no ongoing education campaign that specifically focuses on the private tree by-laws in any of the municipalities. In a 2016 article in *The Toronto Star*, a city representative said that only about one-half of reports of illegal tree removal are followed-up by city staff due to lack of personnel (Rider

**Table 1. Private tree protection by-law summary for each study area municipality. All currency is in Canadian dollars (CAD\$).**

	Toronto	Mississauga	Brampton
By-law (date examined version was adopted)	Municipal Code, Chapter 813, Article III (2004)	Private Tree Protection By-law 0254-2012 (2012)	Tree Preservation By-law 317-2012 (2012)
Regulated trees	Trees > 30cm DBH	More than three trees > 15 cm DBH within a calendar year	Trees > 30 cm DBH and >2 m from occupied building
Replacement requirements	One replacement tree for each tree removed	One replacement tree for each tree < 50 cm removed, and two replacement trees for each tree > 50 cm removed	May be required; determined on a case-by-case basis
Permit fee	\$100 per tree; \$300 per tree if part of a construction project	\$355 for three trees; \$80 for each additional tree	\$50

2016). The article also reported that Toronto permit approval rates were 96%, while the approval rate is not public in the other two municipalities.

### Residents' Knowledge and Support

Researchers explored residential property owners' basic awareness and level of support for private tree by-laws through a written survey of residents in five neighborhoods during the summer of 2014, using a multi-contact approach. Specifically, one neighborhood in both the Cities of Mississauga and Brampton, as well as neighborhoods in the Etobicoke, North York, and Scarborough regions of Toronto, were targeted. The three Toronto neighborhoods were part of three distinct municipalities until 1998, are separately managed within the Department of Parks, Forestry, and Recreation, and thus have different urban forestry histories. However, Toronto's private tree by-law and other urban forestry policies apply equally across the city.

The five study neighborhoods were chosen with the goal of targeting high-canopy areas dominated by single-family homes as part of a larger study examining tree management in high-canopy urban environments (Conway and Yip 2016). These neighborhoods include properties where larger trees that are regulated by the tree protection by-laws are more likely to occur, as compared to lower-canopy areas. While the target neighborhoods chosen had above-average canopy cover, the urban forest growth plans recently adopted within the study municipalities, and many other North American municipalities, hold the potential for higher canopy cover to become the norm in more residential neighborhoods. Thus, surveying the targeted areas will help assess knowledge and support in the places where regulations are most applicable, and high-

light strategies for education about the tree by-laws that can be applied in other neighborhoods.

Specifically, each study neighborhood represents a census tract where greater than 80% of housing is composed of single-family homes, and the percent canopy cover is in the municipality's top quartile for neighborhood canopy cover (Table 2). Neighborhoods were then selected that had little public land and a relatively even distribution of canopy cover across residential property. However, the relatively new development and sparse canopy across the City of Brampton translates into a lower canopy cover selection criterion.

A written survey was sent to 400 randomly selected residents in each of the five neighborhoods in the summer of 2014. The survey had several sections, as it was part of a larger project that examined resident attitudes and actions related to urban trees. For this paper, researchers focused on the questions asking if residents knew the by-law existed, and inquired about the level of support for three aspects of the regulations specific to their municipality (i.e., number and size of trees included in the by-law, requirement for replacement trees, and cost of a permit application; Appendix A). To gauge support, respondents were asked to indicate if each component of their municipality's by-law was too strict, appropriate, not strict enough, or should not exist at all. The survey provided specific details about the current regulation, so respondents were informed of their municipality's by-law prior to indicating their level of support for it. Researchers also asked about residents' recent tree planting and removal activities, as well as basic socio-demographic information (e.g., age, income, education level).

Potential survey participants were initially sent an invitation letter, informing them of a survey would be mailed shortly and that they also had the

**Table 2. Summary demographics of survey participants and tree conditions.**

Neighborhood	Number of responses (response rate <sup>2</sup> )	Neighborhood canopy cover (%)	Average property-level tree count	Respondents' individual characteristics			Respondents' household characteristics	
				Male (%)	University degree or higher (%)	Immigrants to Canada (%)	Median income (CAD\$)	Fully-detached houses (%)
Etobicoke	245 (63%)	44	7	56	72	29	150,000–179,000	100
North York	197 (51%)	50	9	63	83	47	120,000–149,000	98
Scarborough	237 (60%)	49	8	53	51	41	90,000–119,000	97
Mississauga	208 (54%)	44	13	63	55	26	90,000–119,000	99
Brampton	188 (49%)	17	4	55	39	47	60,000–89,000	58

<sup>2</sup> The response rate is calculated using the total number of successfully delivered surveys.

option of completing the survey online. The survey was mailed a few days later. If needed, a reminder letter was sent two weeks later, and second copies of the surveys were mailed two weeks after the reminder letter. This multi-contact approach was used to increase the response rate (Dillman 2007).

Simple summaries of responses were calculated. Researchers also examined differences between neighborhoods, municipalities, and several household characteristics to explore if and how experiences or socio-demographics may influence knowledge and support. Specifically observed were the number of trees on the property, number of trees planted and removed by the household, as well as respondents' length of residency in their current house, their education level, gender, and immigration status. Researchers hypothesized that those with more trees, and residents who had recently removed a tree, would be more likely to know about the by-law, while those who had recently planted a tree would be more supportive of the by-law given their recent investment. It was also hypothesized that longer-term residents would be more knowledgeable about the existence of the by-law due to typically higher levels of community engagement (Williams and Stewart 1998; Romig 2010), but that long-time residents would actually be less supportive of the specific components of the by-law because the regulations are relatively new, restricting rights landowners previously had.

Researchers were also interested in the relationship between by-law knowledge and support and education and income levels given the attention both characteristics have received in studies exploring the patterns of the urban forest and general support for urban forestry (Schwarz et al. 2015). Because respondents' education level (presence/absence of university degree) was strongly correlated with household income (Cramer's  $V$  0.219,  $P < 0.001$ ), only education level was examined, with the hypothesis that respondents with higher education-levels would be more likely to know about the by-law and have stronger support for the current version or a stricter by-law. Differences by gender were also examined, as previous research suggests women may be more supportive of urban forestry policy (Jones et al. 2012). Finally, researchers considered differences between immigrants and non-immigrants

based on the hypothesis that newcomers may be less familiar with local municipal by-laws. These relationships were examined using cross-tabulations for the categorical variables (length of residency, education-level, gender, immigration-status), with Cramer's  $V$  as the test statistic, and t-tests and ANOVAs, using Bonferroni's *post hoc* test for continuous variables (number of trees, trees planted, trees removed), with an alpha of 0.05. All tests were completed in SPSS®.

## RESULTS

Overall, 1,075 of the 2,000 surveys were completed, while 81 were never successfully delivered. This represents an overall response rate of 56%, varying from 47% in Brampton to 61% in Scarborough (Table 2). The overwhelming majority of respondents were homeowners in all five neighborhoods (96% to 99%), and live in single, detached houses (97% to 100%) in four of the five neighborhoods. The exception is the Brampton neighborhood, where 58% of respondents live in detached houses, with the remaining respondents living in semi-detached or fully-attached homes (e.g., townhouses).

Just over half of respondents have resided at their current address for over 20 years, and 62% of respondents were born in Canada. Immigrants included in the study were born in over 70 different countries, with 20 respondents simply stating they were born outside of Canada. The median household income varies between the neighborhoods (Table 2), while all neighborhoods included households above and below the metropolitan areas' average household income of CAD \$95,326 (Statistics Canada 2015a). The percent of respondents who completed at least a university degree also varied across the neighborhoods (Table 2). The survey data is in line with the census data for the neighborhoods (Statistics Canada 2015a; Conway and Yip 2016); however, the representativeness of the 2011 survey is unclear (Statistics Canada 2015b).

In all study neighborhoods except for Brampton, a slight to moderate majority of respondents indicated that they had previously known about their municipality's private tree by-law (Table 3). The Etobicoke and Scarborough neighborhoods were significantly less likely to have

respondents unaware of the by-law, while the Brampton neighborhood respondents had a significantly lower number with knowledge of the by-law (Cramer's  $V$  0.149,  $P < 0.001$ ). Based on survey responses, common sources of knowledge about the by-laws were local newspapers, arborists who were hired to remove trees, construction contractors completing renovations that required removal of trees, community groups (e.g., residents' associations), and neighbors.

Respondents were significantly more likely to know about the by-law if they had more trees on their property or had removed trees since taking up residency in their current house (Table 4). The number of trees planted was not significantly related to by-law awareness. Additionally, those with a university degree, and residents born in Canada had a significantly higher rate of knowledge, while those who had lived in their house less than two years were less likely to know about the by-law (Table 5).

In terms of specific components of the by-law, in four of the five study neighborhoods, "Tree removal on private property should not be regulated by the city" was the most common response to whether the minimum tree size and number requiring a permit for removal was appropriately defined in their municipality's by-law (Figure 2a).

**Table 3. Basic knowledge that private urban tree protection by-law exists.**

Neighborhood	Aware the by-law existed (%)
Etobicoke	71
North York	56
Scarborough	70
Mississauga	62
Brampton	44

**Table 4. T-test results for survey respondents' awareness of their municipality's by-law in relation to the number of trees of their property, total number of trees planted while in current house, and total number of trees removed while in current house.<sup>z</sup>**

Response	Total trees on property	No. of trees planted	No. of trees removed
Yes	9.0	4.6	2.7
No	7.0	4.0	1.9
T-test statistic ( $P$ -value)	2.491 (0.013)	1.005 (0.315)	3.700 (<0.0001)

<sup>z</sup> The sample size is 1,075.

The second most common component was "Number and size as defined is appropriate." However, no option was selected by more than 50% of respondents, suggesting divergent opinions exist. Scarborough had the highest percentage of residents that believed regulating private tree removal was not a municipal responsibility (50%), and the three Toronto neighborhoods had the highest number of respondents who felt that the by-law was too strict (18% to 21%). The Mississauga neighborhood differed from the other four, with respondents significantly more likely to support the current standards as compared to the other municipalities (Table 5), although these standards are more lenient than Brampton and Toronto's by-laws and support-levels were still below 50%.

The pattern of most respondents (i.e., more than 60%) choosing either the no regulation option or the current regulation is appropriate option held for the tree replacement requirement and permit costs (Figure 2b; Figure 2c). For tree replacement requirements, the most common answer in three neighborhoods was that the current regulation is appropriate, while this was the most common answer in only one neighborhood for permit costs. Similar to tree size and number requirements, Mississauga respondents were significantly more likely to support the current regulation and less likely to support not regulating private tree removals than respondents in other municipalities (Table 5). However, no option was selected by more than 50% of respondents in Mississauga or the other neighborhoods.

Support for more stringent requirements regarding the number and size of trees regulated, replacement requirements, and cost of a permit was associated with households that had significantly more trees on their property, as compared to those respondents who did not think there should be any regulation (Figure 3). Additionally, respondents who stated the current by-law replacement requirements were too lenient had planted a significantly higher number of trees, on average, as compared to those who felt the by-law was too strict (Figure 4). Surprisingly, the number of trees recently removed was not significantly related to the type of support associated with size ( $P = 0.483$ ), tree replacement ( $P = 0.416$ ), or permit cost requirements ( $P = 0.415$ ).

**Table 5. Cross-tabulation results of private tree by-law knowledge and support, for the size and number of trees regulated, tree replacement requirements, and cost of the application. Cramer's V-test statistic and related P-value are given.<sup>2</sup>**

Household variable	Knowledge of by-law	Level of support		
		Size and number of tree regulated	Tree replacement requirements	Cost of permit application
Knowledge of by-law		V = 0.132, <i>P</i> < 0.0001 No knowledge of by-law more likely 'no regulation' than those with knowledge	V = 0.122, <i>P</i> < 0.0001 No knowledge of by-law more likely 'no regulation' than those with knowledge	V = 0.126, <i>P</i> < 0.001 No knowledge of by-law more likely 'no regulation' than those with knowledge
Municipality	V = 0.161, <i>P</i> < 0.0001 Brampton more unaware; Mississauga more likely to know	V = 0.272, <i>P</i> < 0.0001 Mississauga more 'as is' than 'no regulation'; Brampton and Toronto more no regulation than 'as is'	V = 0.187, <i>P</i> < 0.0001 Brampton more 'no regulation' than 'as is'; Mississauga and Toronto more 'as is' than 'no regulation'	V = 0.201, <i>P</i> < 0.001 Mississauga more 'as is' than 'no regulation'; Brampton and Toronto more 'no regulation' than 'as is'
Gender	No significant relationship	V = 0.122, <i>P</i> = 0.006 Males more likely than females to choose 'as is'	No significant relationship	V = 0.106, <i>P</i> = 0.026 Males more likely than females to choose 'as is'
Education level	V = 0.134, <i>P</i> = 0.0001 University degree or above, more likely to know about by-law	V = 0.091, <i>P</i> = 0.010 University degree or above more likely to 'as is'	V = 0.111, <i>P</i> < 0.0001 University degree or above more likely to choose	V = 0.100, <i>P</i> = 0.001 University degree or above more likely to choose 'as is'
Length of residency	V = 0.124, <i>P</i> = 0.007 Two years or shorter, more likely to not know about by-law	V = 0.086, <i>P</i> = 0.080 Twenty years or longer, more likely to choose 'no regulation'	V = 0.107, <i>P</i> = 0.001 Twenty years or longer, more likely to choose 'no regulation'	V = 0.098, <i>P</i> = 0.008 Twenty years or longer, more likely to choose 'no regulation'
Immigration status	V = 0.142, <i>P</i> = 0.001 Born in Canada were more likely to know about by-law	No significant relationship	No significant relationship	No significant relationship

<sup>2</sup> The sample size is 1,075 for all comparisons.

Residents with no prior knowledge of the by-law were significantly more likely to select "Tree removal on private property should not be regulated by the city" than residents who had prior awareness (Table 5). Gender was also a significant factor in the level of support for the size of trees regulated and cost of the permit, with males having relatively greater support for the by-law as currently written (Table 5). Respondents who had completed a university degree were less likely to be against municipal regulation of private tree removal and more likely to be supportive of the current regulation. Length of residency was significantly related to lack of support for all three examined aspects of the regulations, with residents living in their current house for 20 or more years significantly more likely to select the not regulating private trees option. Immigration status was not significantly related to level of support for the different by-law components.

## DISCUSSION

Forty-four to 71% of respondents from each neighborhood were aware that their municipality had a private tree protection by-law, which indicates information about the by-laws is reaching many residents. Brampton and the Toronto neighborhood of North York had the lowest awareness-levels. These were also the two neighborhoods with the highest percent of respondents who identified as immigrants, which is associated with low knowledge levels. Another explanation for the lower awareness in Brampton is that there is relatively little urban forestry outreach occurring by either the municipality or an NGO. However, the lower knowledge level in Brampton does not necessarily mean that residents are more likely to violate the by-law, as there are fewer regulated trees in Brampton. In 2011, it was estimated that only 6% of Brampton's trees were regulated (i.e., over 30 cm DBH),



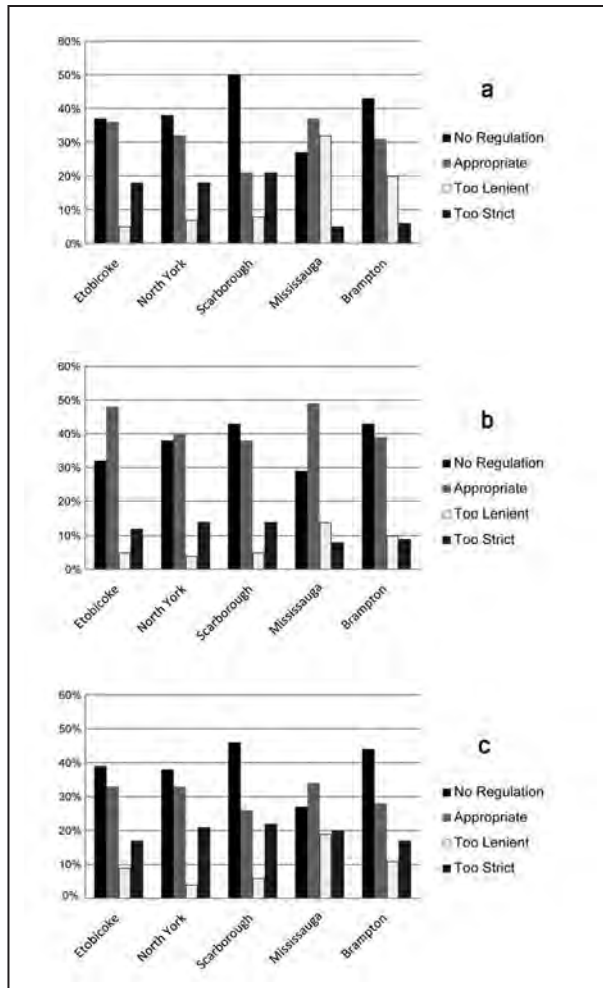


Figure 2. Level of support for specific components of private tree protection by-laws: a) size and number of trees regulated, b) replacement requirements, and c) permit cost.

while 16% are in Toronto; there are also lower tree densities in Brampton (City of Toronto 2010; TRCA 2011), making Brampton residents less likely to have a tree that is covered by the by-law.

Violators of private tree regulations are hard to identify and are infrequently penalized, as the process relies on individuals taking the initiative to report activity they believe violates the by-law to their municipality (through 3-1-1 services) to prompt an investigation (Conway and Urbani 2007). Thus, awareness of private tree by-laws' existence is key to their success. The survey asked respondents to indicate if they knew their municipality had a private tree protection by-law, and did not quiz them on the details of the regulation. Researchers took this approach, in part, because it was assumed that any general awareness of the by-law would trigger the resident to learn more if they did want to remove a tree, while a complete lack of knowledge may mean that a resident would not realize when they were in violation.

Beyond basic awareness, there is mixed evidence whether residents appreciate the importance of the by-laws. Residents with more trees on their properties, and in some cases those who had planted trees, are associated with stronger support for the current version or a stricter by-law, suggesting that many of the private trees in the study area are valued and will be retained (Figure 4). The relationship with planting trees found here is related

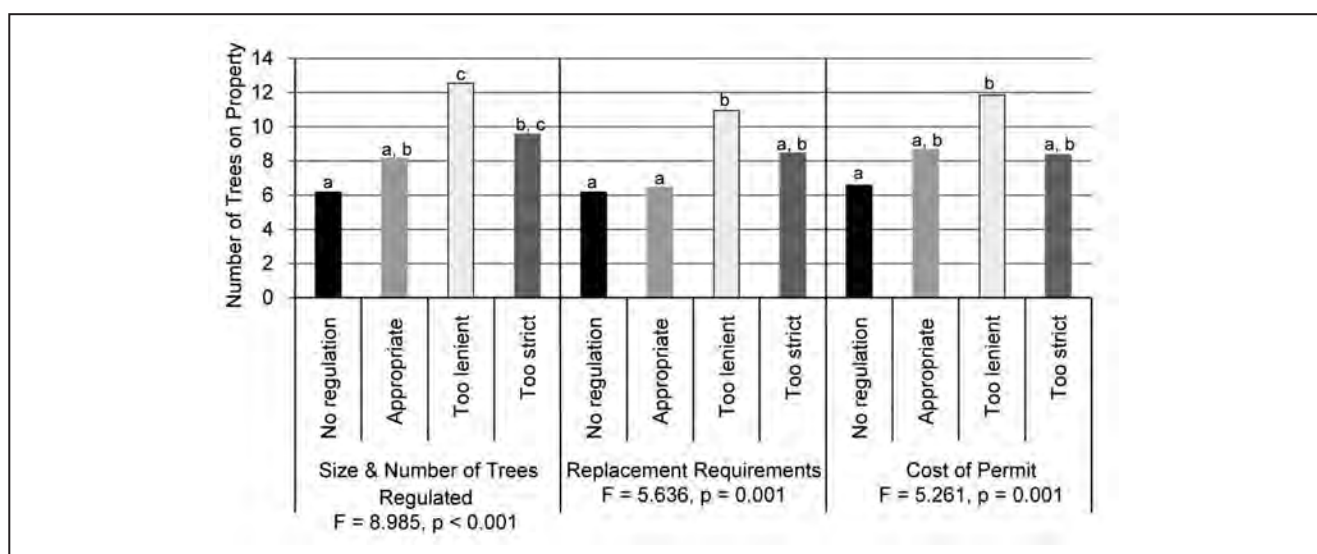


Figure 3. Average number of trees on respondents' property by level of support for specific components of by-laws. Different letters indicate values that are significantly different at alpha = 0.05.

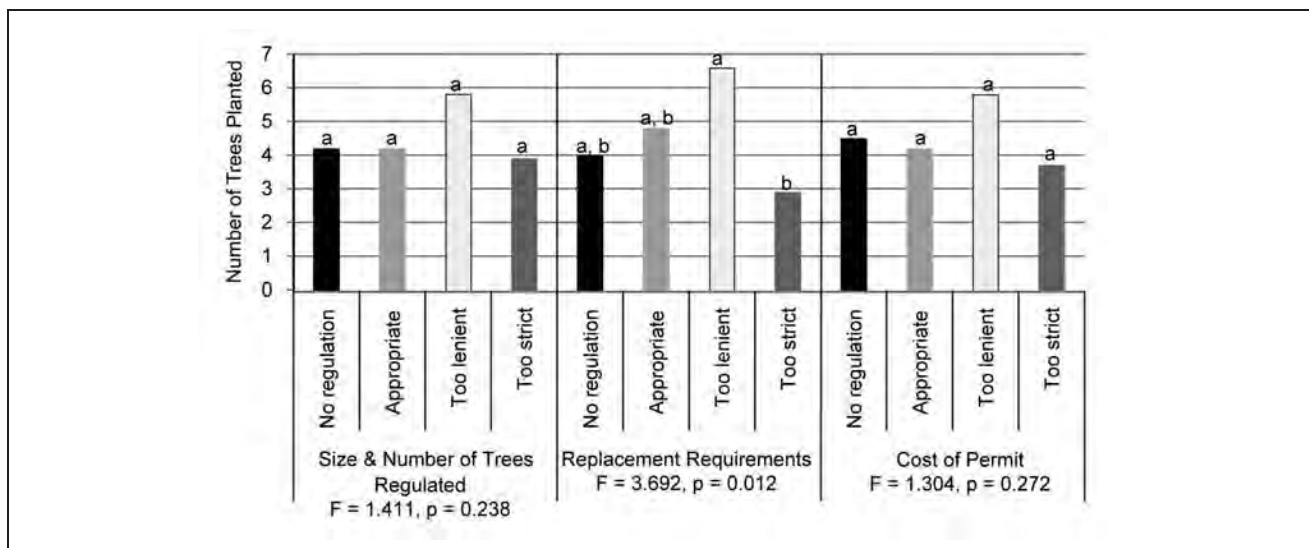


Figure 4. Average number of trees planted by respondents by level of support for specific components of by-laws. Different letters indicate values that are significantly different. Different letters indicate values that are significantly different at alpha = 0.05.

to previous studies that indicate hands-on experiences planting trees increases the level of satisfaction respondents feel with their own yard trees (Summit and Sommer 1998). Thus, programs encouraging tree planting may indirectly lead to fewer tree removals.

In this study, previously removing trees was not significantly related to basic awareness of a by-law, raising the possibility that tree(s) had been removed in at least some situations where the homeowner needed to apply for a permit. Additionally, those who were not previously aware of the by-laws were less supportive of their existence, indicating some residents are at least initially resistant to the idea of regulating private trees, possibly because they do not appreciate the benefits such trees can provide.

Support for the current regulations—broken down by number and size of regulated trees, replacement requirements, and permit costs—was lower than the level of awareness of the by-law, and frequently lower than the number of respondents who selected that the municipality should not regulate private trees. This raises questions about whether awareness of the by-law will necessarily translate into abiding by it, as awareness did not translate into support.

The Mississauga neighborhood was the exception—support for the current regulation was greater than the number that selected no regulation should exist—possibly because the City of Mississauga, in 2012, sought to update their pri-

ivate tree regulation. As part of the process, several versions of the private tree by-law were proposed. Along with standard public consultations, several community groups became very active in the debate, arguing for adoption of a relatively strict by-law that would regulate removal of any single tree greater than 15 cm DBH. While this version was not passed by the city council, it generated public discussion about the need for stricter protection of private trees. Although not examined in the current study, these discussions may have raised residents' appreciation for the private tree by-law, as compared to survey participants outside of Mississauga, as well as explain the relatively high number of participants who feel the adopted number and size requirements are too lenient. This case suggests public discussion and debate about private tree protection regulations and the benefits of large trees may lead to greater support for tree protection, illustrating the value of urban forestry outreach by municipalities and community groups.

The need for greater public outreach to increase knowledge about urban forestry is often identified by practitioners in response to ongoing concerns that the general public has a limited understanding of urban forests, which translates into low public support for management (Wolf and Kruger 2010; Driscoll et al. 2015). How to effectively engage in educational outreach is often unclear (Dwyer et al. 2002).

Summit and Sommer (1998) emphasized the need for local community group involvement and communication of personal benefits associated with trees to encourage desired behavior, in their case, tree planting. However, generating support for regulations that restrict activities on private property is likely more difficult, as it may be at odds with residents' ideas about property rights and landscaping goals, which are often an expression of closely held cultural and social norms (Zagorski et al. 2004; Nielson and Smith 2005; Wolf 2008; Larson et al. 2010). Future research is needed to more fully explore these and other potential reasons some residents are not supportive of private tree regulations.

Examination of Toronto's cosmetic pesticide ban, which restricts the use of pesticides on residential yards, may provide insight into outreach for the private tree by-laws. Outreach and education efforts associated with the pesticide by-law included radio and other advertisements, a website, print brochures and facts sheets, and information available at community events over a five-year period (2004–2008; Cole et al. 2011). This campaign was more extensive than any current or recent outreach associated with the three private tree regulations. By 2008, 69% of residents surveyed were aware of the pesticide by-law (Cole et al. 2011), similar to the knowledge levels of three of the five neighborhoods in this study, but much higher than the level of knowledge in the Brampton and North York neighborhoods. This suggests an active education program over multiple years using a variety of outreach tools can raise knowledge levels.

Alternatively, Brampton has a website with information about the private tree by-law. When the study authors called 3-1-1 services in Brampton, several of the phone operators reached were not aware of the municipality's private tree regulation, suggesting the information is not even available to frontline personnel.

Finally, like the private tree by-laws, enforcement of the pesticide regulation relies on individuals reporting violators of the pesticide ban to the city. Gibson-Wood et al. (2012) found that most participants in their study were unwilling to report a neighbor who violated the ban, highlighting both the weakness of this enforcement approach and the importance of residents appreciating the benefits

of stopping the behavior regulated by the by-law to minimize violations, and more generally, reduce undesired behavior. Thus, outreach for the private tree by-laws needs to include information about how retention of larger trees provides benefits to residents. Moreover, since permit approval rates are very high, at least in Toronto, greater appreciation for large trees is needed to reduce the number of residents considering tree removal in the first place.

The results of the private tree by-law analysis point to the importance of reaching new residents, particularly immigrants, as they were less knowledgeable about the existence of these by-laws. This could include multi-language flyers sent to all recently sold homes, as well as partnerships with community groups that work with newcomers. However, support from new residents and immigrants for key components of the by-laws is no different than support from medium-term residents, suggesting that these groups' low level of awareness does not translate into higher resistance to such by-laws.

Alternatively, long-term residents had relatively good awareness levels, but were less supportive of their specific components, suggesting the need to target all residents through education campaigns to increase appreciation for the benefits of retaining large trees.

General awareness for municipal urban forestry efforts and tree protection programs is often related to individuals' level of income and education (Lorenzo et al. 2000; Jones et al. 2012), and the current study found similar results for by-law knowledge and support. Gender was another socio-demographic variable related to level of by-law support. Jones et al. (2012) argued that since women tend to be more supportive of environmental protection efforts, they might also be more aware of urban forestry policies, but Zhang et al. (2007) found no relationship between gender and support for urban forestry efforts. In the current study, males were more likely to be supportive of current regulations' size and number requirements, as well as the cost of the permit, but it is unclear why this was the case.

This study was limited in a couple of respects. Since researchers selected older neighborhoods with relatively high canopy cover, results may not be representative of all residents in the municipality—although it does provide an understanding of how to focus future educational outreach efforts. As

well, neighborhoods with a higher percentage of single family, fully-detached on-the-ground houses were selected, so our results may not be representative of other types of landowners. Finally, we did not explore if residents have (knowingly or accidentally) violated the by-law or previously applied for a tree removal permit, and whether these are related to awareness or level of support.

Given the limited enforcement and high rate of permit approvals, at least in Toronto, the primary role of private tree by-laws may be as tools to educate urban landowners about the value of retaining large trees (and replacement plantings, when removals do occur), rather than as a way to limit most tree removals. The uneven levels of knowledge and relatively low support for the current regulations highlight the need for better outreach to ensure residents understand the purpose of the by-laws, and more broadly, the benefits of large trees within the urban forest. This could be addressed through a multiyear, multimedia campaign, as well as through ongoing programs targeting new homeowners and newcomers to Canada.

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**Résumé.** Les communautés urbaines nord-américaines développent des politiques afin de protéger et de gérer, non seulement les arbres publics, mais également les nombreux arbres croissant sur le domaine privé. Une approche privilégiée est la création de règlements ou d'ordonnances régissant l'abattage des arbres privés par le biais d'une procédure d'autorisation de permis. Ces réglementations peuvent protéger la forêt urbaine privée avec succès, particulièrement pour les arbres les plus gros, mais leur réussite dépend de la bonne volonté des propriétaires à s'y conformer considérant les difficultés inhérentes à leur mise en application. Cette recherche examine la conscientisation et le soutien des résidents pour les règlements visant les arbres privés dans trois villes de la grande région métropolitaine de Toronto (Ontario, Canada) via le recours à une enquête écrite ciblant des quartiers comportant une canopée importante —des zones davantage susceptibles de faire l'objet de règlements concernant les arbres privés. La sensibilisation de base à l'endroit des règlements variait parmi les cinq quartiers considérés ainsi que le soutien à l'endroit d'éléments spécifiques des règlements, dont la dimension et le nombre d'arbres visés, les exigences pour le remplacement des arbres abattus et la tarification des permis. Bien qu'un nombre plus élevé de répondants affirmèrent que leur ville ne devait pas réglementer les arbres privés par rapport à ceux soutenant les règlements en vigueur, ce n'était pas le cas de la majorité des réponses. Les répondants dont la propriété comportait plus d'arbres ou qui avaient planté des arbres, ont manifesté un soutien plus significatif de la réglementation, tandis qu'il fut constaté que plusieurs critères sociodémographiques avaient une influence sur le degré de soutien aux-dits règlements. Les implications de ces résultats sur la gestion sont examinées.

**Zusammenfassung.** In ganz Nordamerika entwickeln die urbanen Verwaltungen Richtlinien zum Schutz und Management nicht nur von öffentlichen Bäumen, sondern auch für die zahlreichen Bäume, die auf privatem Grund stehen. Die Kreation von einer Baumschutz-Verordnung oder eines Gesetzes für private Bäume, welches die Baumfällung auf allen privaten Grundstücken durch einen Bewilligungsprozeß regelt, ist ein Ansatz. Diese Verordnungen können erfolgreich die privaten urbanen Baumstandorte, insbesondere größere Bäume schützen, aber ihr Erfolg ist abhängig von der Einwilligung des Landeigentümers, die gegebenen Schwierigkeiten der Umsetzung zu befolgen. Diese Studie untersucht die Bewusstheit der Anwohner und deren Support für eine Baumschutzsatzung in drei größeren Städten in der Region um Toronto (Ontario, Kanada) durch eine schriftliche Umfrage, die hauptsächlich Nachbarschaften mit einer hohen Baumdichte im Visier hatte. Die grundsätzliche Wahrnehmung solcher Satzungen variierte innerhalb der fünf untersuchten Nachbarschaften und der Support für einige spezielle Komponenten dieser Satzungen, einschließlich der Größe und Anzahl der betroffenen Bäume, die Anforderungen für eine Ersatzpflanzung und die Gebührenordnung bei Vergehen war ebenfalls gemischt. Während eine größere Anzahl von Teilnehmern der Befragung meinte, dass ihre Stadt nicht private Bäume regulieren sollten, war das doch nicht die Mehrheit der Antworten. Teilnehmer der Umfrage mit mehr Bäumen auf ihrem Grundstück oder diejenigen, die Bäume gepflanzt hatten, waren deutlich mehr unterstützend für eine Baumschutzsatzung, während verschiedene sozio-demographische Charakteristika auch signifikant mit dem Grad an Unterstützung für die Baumschutzsatzung verbunden waren. Die Auswirkungen dieser Ergebnisse auf das Management werden diskutiert.

**Resumen.** Los municipios urbanos de América del Norte están desarrollando políticas para proteger y gestionar no solo los árboles públicos, sino también los numerosos árboles ubicados en propiedades privadas. Un enfoque es la creación de estatutos de árbol privado u ordenanzas que regulan la eliminación de árboles en toda propiedad privada a través de un proceso de permisos. Estas regulaciones pueden proteger con éxito el bosque urbano privado, particularmente árboles más grandes, pero su éxito depende de la disposición de los propietarios a cumplir debido a las dificultades de su acatamiento. Este estudio examina la conciencia y el apoyo de los residentes para los estatutos de árboles privados en tres ciudades del área metropolitana de Toronto (Ontario, Canadá) a través de una encuesta escrita que apunta a vecindarios con dosel arbóreo elevado: lugares con mayor probabilidad de tener árboles regulados bajo el árbol privado. La conciencia básica sobre los estatutos variaba en los cinco barrios de estudio y el apoyo para componentes específicos de la ordenanza, incluido el tamaño y la cantidad de árboles regulados, los requisitos de reemplazo de árboles y los aranceles de permisos también eran mixtos. Mientras que un mayor número de encuestados consideró que su ciudad no debería regular los árboles en tierras privadas que lo que ya había apoyado la normativa actual, ésta todavía no fue la mayoría de las respuestas. Los participantes con más árboles en su propiedad o que habían plantado árboles estuvieron significativamente más en apoyo de las regulaciones, mientras que varias características socio-demográficas también se relacionaron significativamente con el nivel de apoyo a los estatutos. Se discuten las implicaciones para la gestión de estos resultados.

## **APPENDIX A: RELEVANT PORTIONS OF SURVEY FOCUSING ON TREE PROTECTION BY-LAWS AND RESPONDENTS SOCIO-DEMOGRAPHICS.**

### **SURVEY PART II. TREES ON YOUR PROPERTY**

1. How many trees are on your property and the city owned boulevard in front of your house?

\_\_\_\_\_

2. How many trees have you planted in:

The past year? \_\_\_\_\_

The last five years? \_\_\_\_\_

Since moving to your current house? \_\_\_\_\_

3. How many trees have you removed in:

The past year? \_\_\_\_\_

The last five years? \_\_\_\_\_

Since moving to your current house? \_\_\_\_\_

### **SURVEY PART IV TREE PROTECTION BY-LAW**

1. Have you previously heard of [your city's] Private Tree by-law?  YES  NO

If yes, how did you learn about the by-law? \_\_\_\_\_

[Your city'] Private Tree by-law states [details of the relevant city's by-law].

2. Please indicate your support for the by-law's requirement to apply for a permit to [relevant city's size and number requirements]:

- I believe the way the tree number and size is currently defined is appropriate
- I think the by-law should be stricter, lowering the size of trees exempt
- I think the by-law should be relaxed, with [city appropriate alternative]
- I do not think tree removal on private property should be regulated by the city.

3. Please indicate your support for the by-law's requirement to plant [relevant city's replacement requirements]:

- I believe the replacement tree requirement as currently written is appropriate
- I think the by-law should be stricter, with [city appropriate alternative]
- I think the by-law should be relaxed, with no replacement tree(s) require
- I do not think tree removal on private property should be regulated by the city

4. Please indicate your support for the [relevant city's permit costs]:

- I believe the current application fee is appropriate
- I think the by-law should be stricter, with a higher application cost
- I think the by-law should be relaxed, with a lower application cost
- I do not think tree removal on private property should be regulated by the city