Final Report

on the

Health and Incidence & Severity of Decay
of
Street Tree Maples in Four Upstate New York Cities

to the

New York State DePartment of Environmental Conservation
Division of Lands and Forests
Bureau of Private Lands
Urban and Community Forestry

Albany, New York

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Table of Contents

Executive Summary 3
Introduction 4
Methods 5
Results 6
Discussion 14
Appendix A 16

Acknowledgments

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Executive Summary

A random selection of street tree maples (Norway, silver, and sugar) and a random selection of "other species" in four diameter classes between 12 and 30+ inches were surveyed in Albany, Buffalo, Rochester, and Syracuse, New York for tree health, and decay incidence and severity. Based on city inventory data, maple species comprise over 54% of the total tree population, and Norway maple alone is over 36% of the total tree population. Many of these maples are mature to over mature as they have served as replacements for trees killed by Dutch Elm Disease.

Tree Health

In brief, the survey results indicate:

- Trees in Rochester were in better condition trees compared to the other three cities.
- On average, trees in were rated in fair or worse condition.
- Larger diameter trees were in the poorest condition.
- Over 50% of the large diameter Norway maples were rated in poor condition.
- Sugar maples had the most dieback and highest percentage of poor condition tree across all tree diameter classes.
- The selection of other species were rated in the best tree health condition across all diameter class.

Decay Incidence & Severity

In brief, the survey results indicate:

- Rochester had the nearly the lowest incidence of decay, and the least percentage of severely decayed trees.
- Decay incidence was found to be 57% overall and generally increased with increasing diameter class.
- Decay incidence was over 50% even in smallest diameter trees (12-18 inches). However, only 2.5% of all trees were found to have severe decay (more than 70% of the radius decayed).
- Incidence of severely decayed trees was greatest for silver maples and Norway maples.
- Incidence of severely decayed trees was lowest for sugar maple and other species.
- The incidence of severely decayed trees also increased with diameter class.

Study Implications

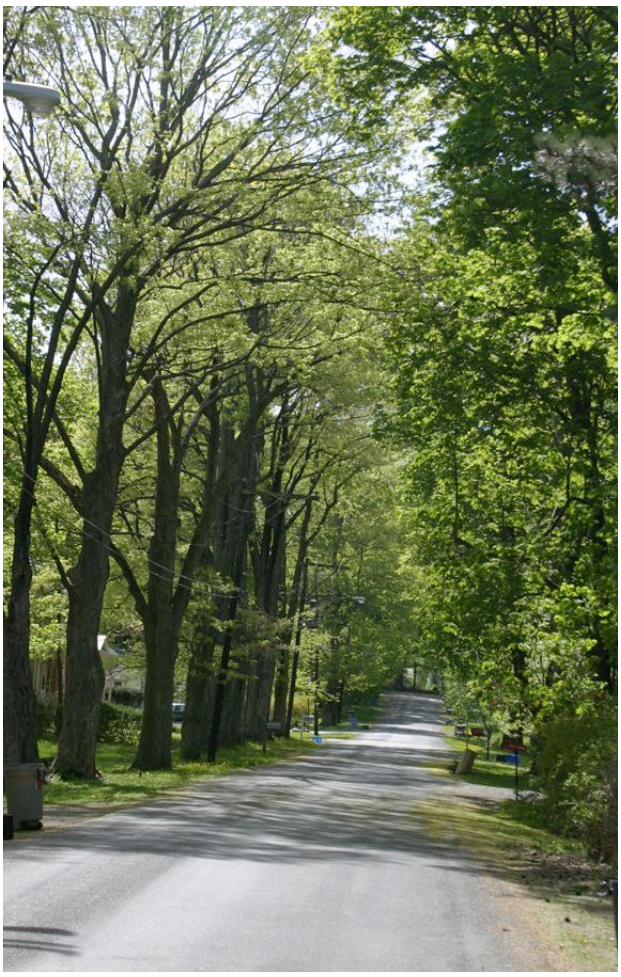
- Larger diameter maples (greater than 25 inches in diameter) of all species will likely require increased levels of inspection, removal, and replacement going into the future due to their poor condition and increased amounts of decay.
- The random selection of "other species" in the study was in better condition and had lower severity of decay, suggesting the diversity is a buffer against decay, and for tree health.
- Well funded urban street tree programs like Rochester's may result in trees that are in better condition and have less decay. However, the influence of other factors such as weather events may also be important.

Introduction

Across New York State maple species are the most common street tree. It is not unusual for Norway (*Acer platanoides*), silver (*A. saccharinum*), sugar (*A. saccharum*), red (*A. rubrum*), and other less popular maple species, to comprise over 50% of the street tree population in many cities and smaller communities.

Many of the maples on urban streets today were planted to replace the American elms that were lost as a result of the Dutch Elm Disease epidemic that started in 1930s. Therefore, a significant portion of this maple population is mature, and the health and structural stability, as affected by wood decay, is in question. Further, the State's maple population is threatened by the presence of the Asian Longhorned Beetle now infesting New York City and Long Island. In addition to an aging maple population, upstate communities will be faced with a significant management issue if the insect spreads north.

This study was initiated to determine the health status, and incidence and severity of wood decay in street tree maples and other species in Albany, Buffalo, Rochester, and Syracuse, New York. The project will provide a benchmark for the condition of maples in these cities, and an evaluation of the potential risk associated with wood decay. The study will also allow a general assessment of the impact of urban tree management practices on tree health and decay in these cities.



A sugar maple lined street in an upstate New York community. Maples comprise over 50% of the street tree population in many upstate cities and communities.

Methods

The sample for the study was taken from street tree inventory data provided by the cities of Albany, Buffalo, Rochester, and Syracuse. It was comprised of a random selection of 480 trees per city, and included 30 Norway, silver, and sugar maples, and a random selection of "other species", in each of four diameter at breast height (DBH) classes (12-18, 19-24, 25-30, and 30+ inches).

Field data were collected between June and October, 2007. Overall tree health was rated using one of five categories. Trees rated in very good condition had no structural or biological health problems, trees in good condition had no major structural or biological issues but may have had one or more minor problems, trees in fair condition had one major structural or several minor biological or structural health conditions, trees in poor condition had several major biological or structural health conditions, and trees in very poor condition had significant biological or structural conditions such that they would be expected to continue to decline in the near future. Crown condition was also evaluated using several parameters (Table 1).

Decay incidence and severity were measured visually using indicators of decay, by sounding with a 6 ounce Sears Craftsman hammer with a hard plastic head, and with the use of a Resistograph F400 (imlusa.com). The Resistograph uses a 3 mm diameter drill bit to record mechanical resistance to the drill bit on chart paper. The tool provides a measurement of the thickness of the outer shell of wood in a tree.

All trees were tested for decay by drilling three times at 4.5 feet (BH or breast height) off the ground using the Resistograph. A second series of three drillings was made on each tree at the location assessed to have the greatest amount of decay based on visual assessment and sounding. If no decay indicators were present, the tree was drilled only three times at the BH location. Decay testing was performed only on the main trunk above the roots to a height of 10 feet. Roots and scaffold branches were not tested for decay.

Decay indicators were divided into two groups – positive indicators and potential indicators. Positive indicators were fungal conks, external cavities, and visual evidence of decayed wood. Potential indicators generally fall into two categories of the presence of wounds (for example pruning wounds, missing bark, cankers) or tree response to internal decay (such as bulges, cracks, ribs).

Parameter	**Rating**				
Overall Condition	Very Good	Good	Fair	Poor	Very Poor
Percent of Crown Missing	Amount of crown missing in 5% categories				
Crown Density	Light passage through the crown in categories				
Crown Dieback	Amount of branch dieback in 5% categories				

Table 1.
Health parameters measured in the street tree study.

Results

Maple Population

A total of 1,849 trees in the four cities were evaluated for tree condition and tested for decay. Sample trees were most difficult to obtain in Albany because of its smaller tree population, and for sugar maple because of its relative scarcity compared to the other maple species (Table 2). Small diameter silver maples are also relatively rare as most cities are no longer planting this species.

Maples greater than 12 inches in diameter comprise a significant portion of the street tree population in each city (Table 2). For all four cities combined, Norway, silver, and sugar maples comprise 49.6% of the population, and all maple species together makeup 54.2% of the population.

Tree Species and Percent of Total Population

City	Norway Maple	Silver Maple	Sugar Maple	Other Maple	Honey-locust	Linden Species	Ash Species	London Planetree	Other Species	Total Trees
Rochester	39.2	4.1	3.5	2.1	13.1	10.4	6.7	5.0	15.9	29,172
Buffalo	22.1	13.8	0.6	6.0	1.0	25.1	1.6	4.0	25.76	16,383
Syracuse	31.3	15.6	5.5	4.7	8.8	4.9	5.9	3.8	19.5	14,766
Albany	51.8	6.3	4.7	5.4	12	6.9	4.6	0.5	7.8	7,258
Total	36.1	9.9	3.6	4.6	8.7	11.8	4.7	3.3	17.2	67,579

Table 2.
Percent of street tree maples and other tree species in Albany, Buffalo, Rochester, and Syracuse that are 12 inches DBH and greater based on street tree inventory data from the respective cities. ***(Note: The street tree inventory in Albany is only partially complete.)***

Tree Condition

The overall condition of maples in the four cities showed that trees in Rochester were in substantially better condition than the other three cities (Figure 1). Trees in Albany, Buffalo, and Syracuse on average were rated in slightly lower than fair condition, while trees in Rochester averaged slightly better than fair condition.

By species, sugar maple was rated in the poorest condition, while "other species" were in substantially better condition than all the maples (Figure 2). Sugar maple also had substantially more crown dieback than the other maples, and "other species" had the least dieback (Figure 3).

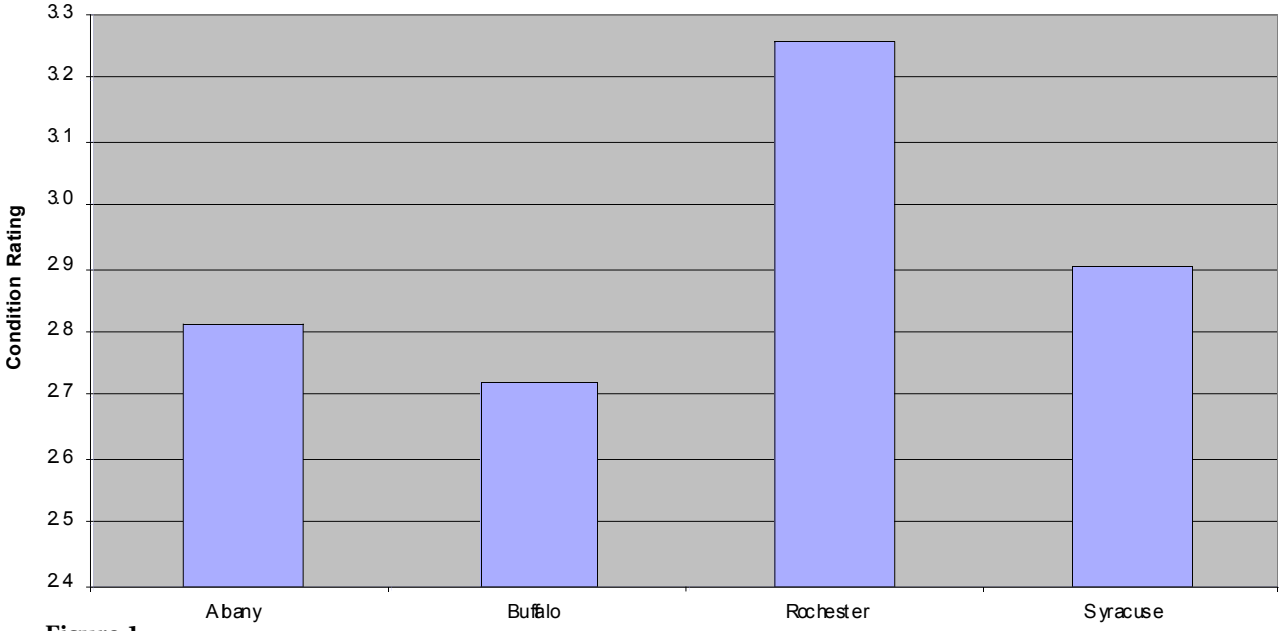


Figure 1.
Average condition by city rating for all tree species where 1 = very poor, 2= poor, 3 = fair, 4= good, and 5 = very good.

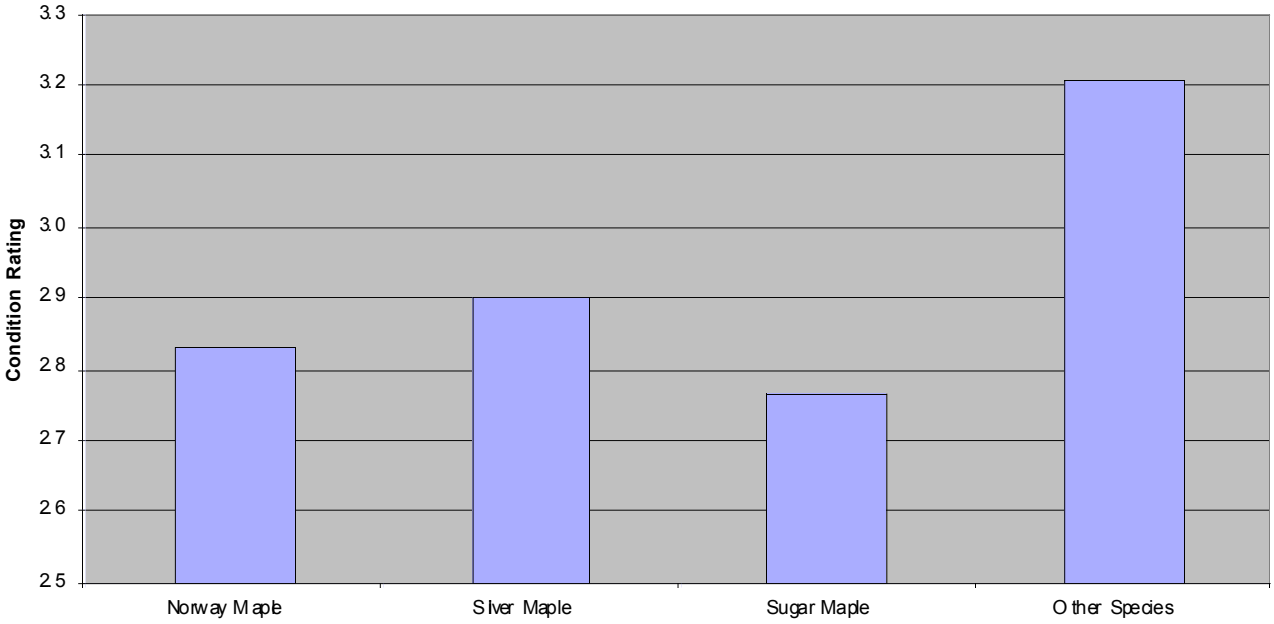


Figure 2.
Average condition by tree species for all trees where 1 = very poor, 2= poor, 3 = fair, 4= good, and 5 = very good.

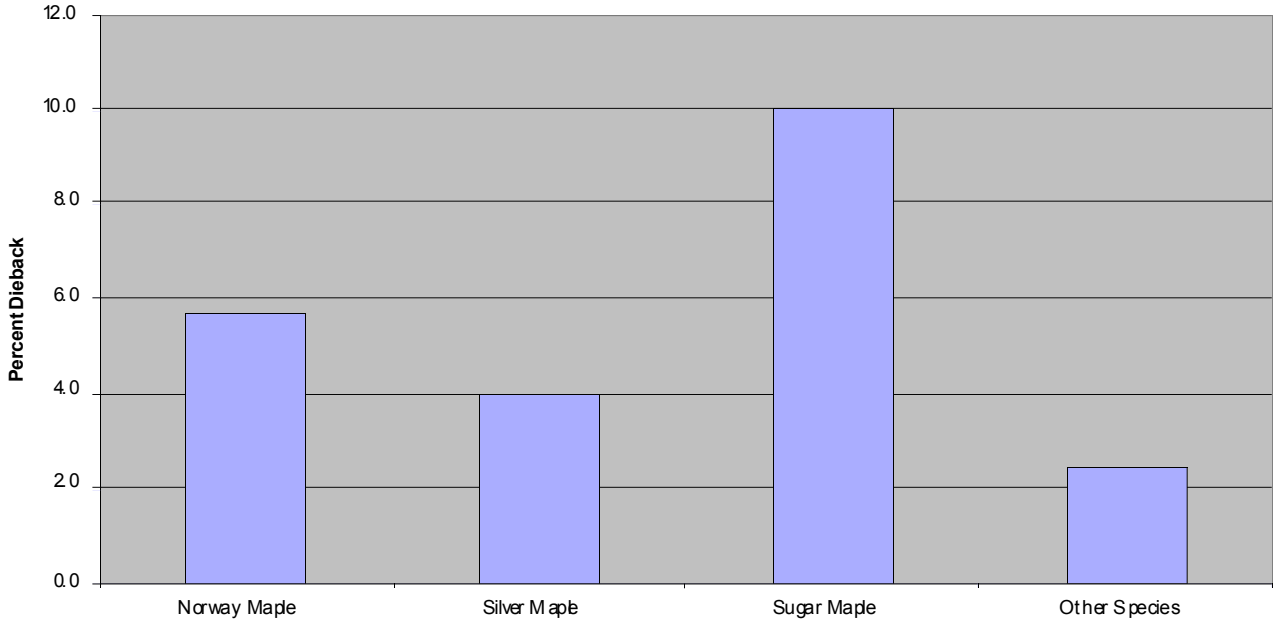


Figure 3.
Percent crown dieback by tree species.

Decline symptoms on a large diameter sugar maple. Many of the large diameter maples were found in the study to be in poor condition.

The percentage of trees rated in poor condition increased as tree diameter class increased (Figure 4). Nearly 30% of the trees that were 25 inches in diameter or greater were in poor condition, and less than 25% were in good condition.

By diameter class, nearly 50% of the 30+ inch diameter Norway maples were in poor condition, and over 80% of those trees that were 25 inches or greater were in poor or worse condition (Appendix A, Figure 1). The majority of silver maples were rated in fair condition in all diameter classes, although 30% of the 30+ inch diameter trees in poor or worse condition (Appendix A, Figure 2). Over 30% of the sugar maples were rated in poor or worse condition in all diameter classes (Appendix A, Figure 3). "Other species" had the lowest percentage of poor condition trees and the highest percentage of trees rated in good condition in all the diameter classes when compared the to maple species (Appendix A, Figure 4).

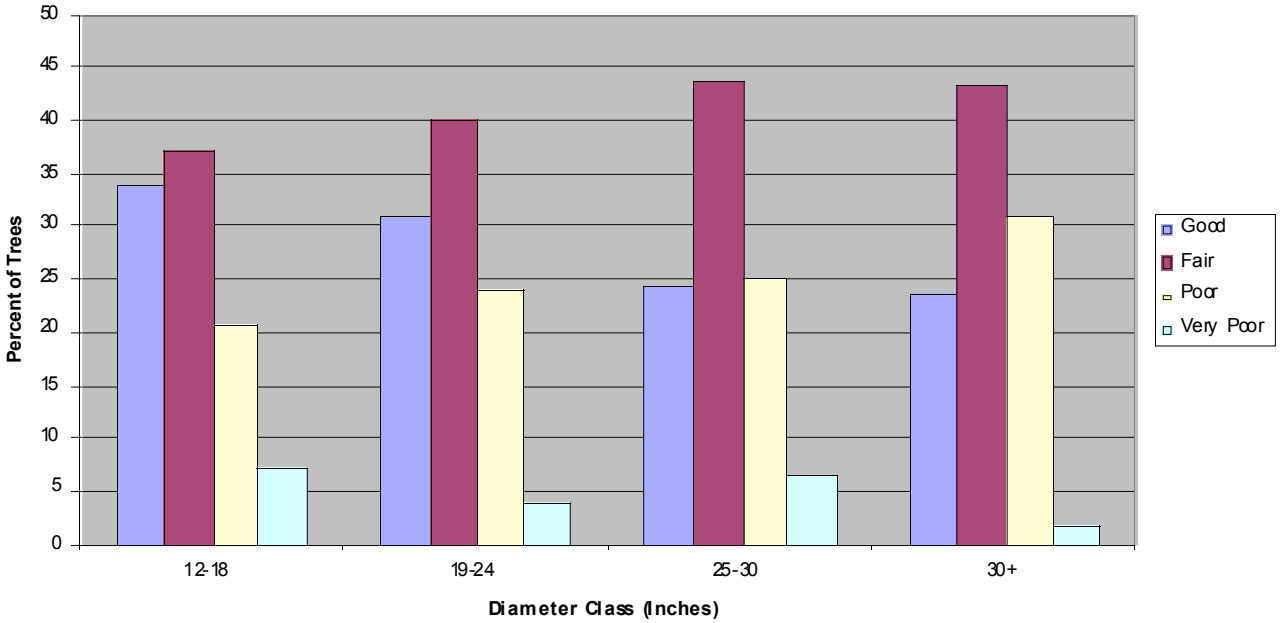


Figure 4.
Percent of all trees in each diameter class that were rated in good, fair, poor, or very poor condition.

Decay Incidence

Decay incidence, or the percent of sample trees with decay, was marginally different among the cities, diameter classes, and species based on Resistograph testing (Figures 5-7). Decay incidence generally increased with diameter class size. However, even small diameter class trees had a decay incidence over 50% (Figure 7). Overall, decay incidence was 57.9% (Figure 6). Decay incidence was lowest in silver maples and "other species" and was highest in Norway and sugar maples (Figure 7).

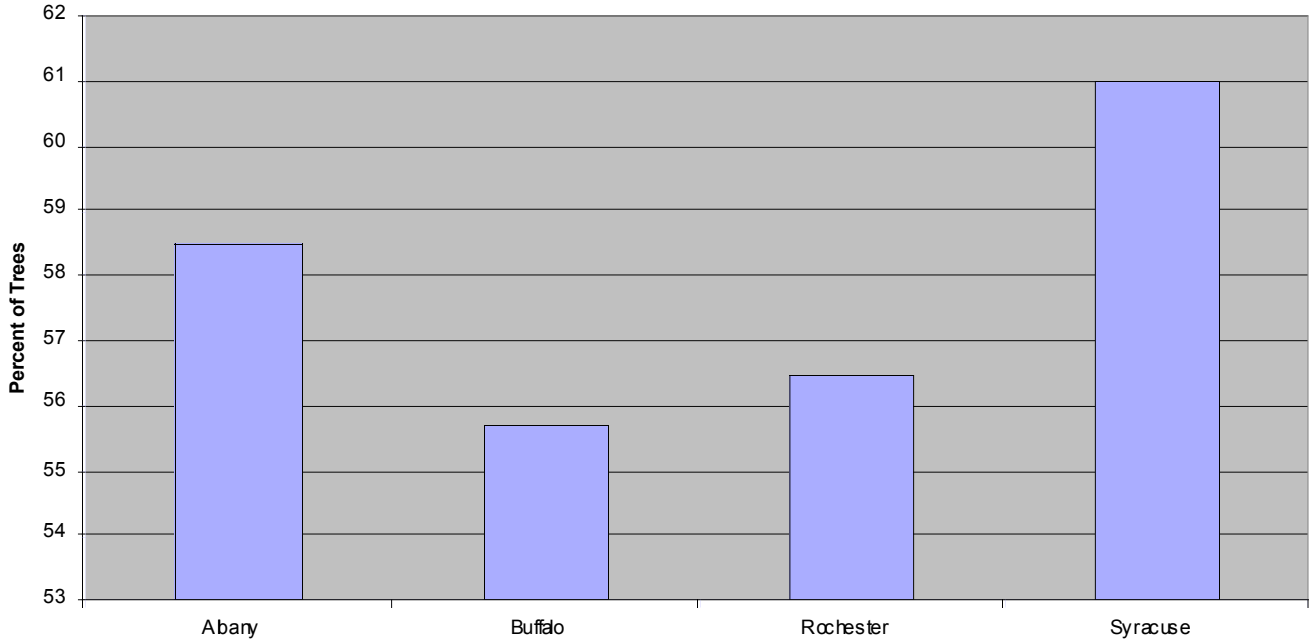


Figure 5.
Percent of sample with decay in Albany, Buffalo, Rochester, and Syracuse based on Resistograph testing at both breast height and decay indicators.

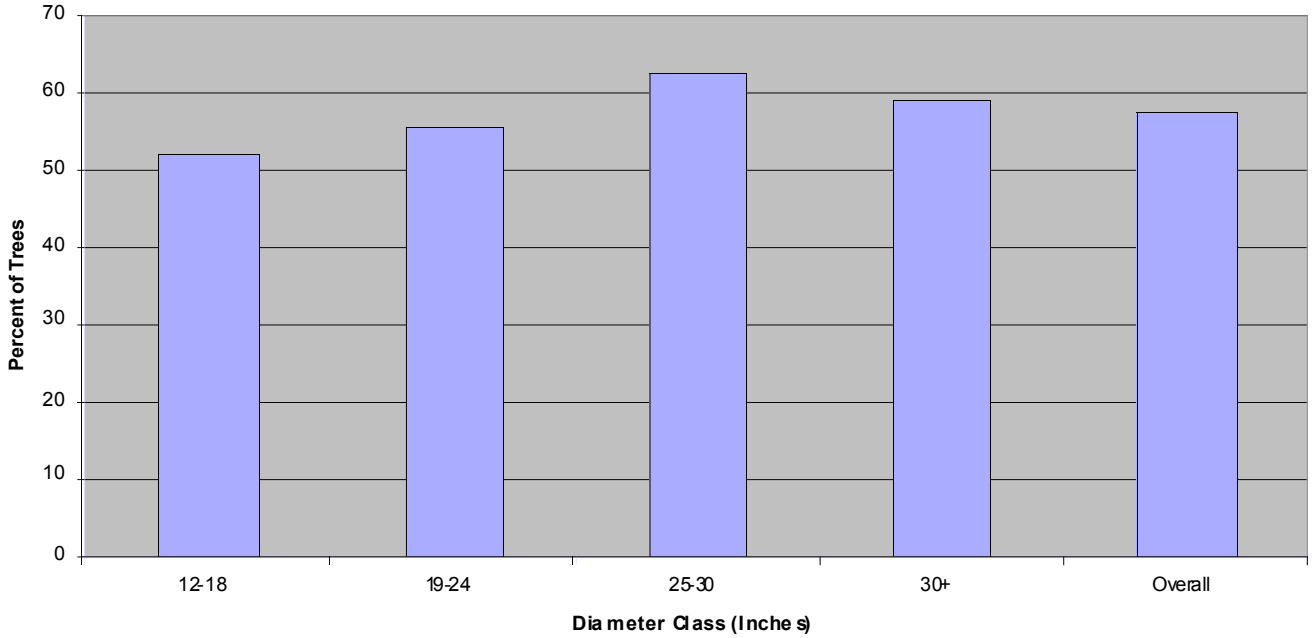


Figure 6.
Percent of sample with decay in four diameter classes based on Resistograph testing at both breast height and decay indicators.

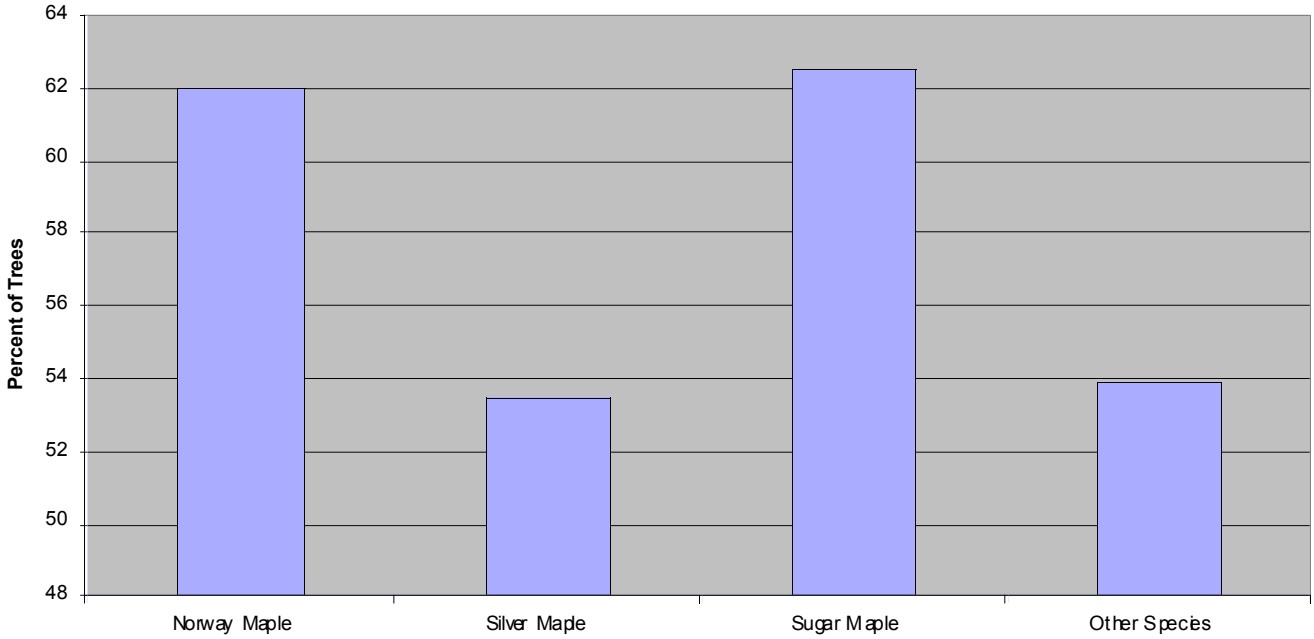


Figure 7.
Percent of sample with decay in Norway, silver, and sugar maples and other species based on Resistograph testing at both breast height and decay indicators.

Norway maple is over 36% of the total tree population when averaged over the four sample cities. Further planting of this species is not recommended.

Decay Severity

Decay severity was considerably different among cities, diameter classes, and species. The number of trees with severe decay (over 70% of the radius decayed) was lowest in Rochester, while Buffalo had highest incidence of trees with advanced decay (Figure 8). Overall, trees with the most severe decay was less than 3% of the total sample.

The most trees with severe decay were in the larger diameter classes, and relatively few trees with severe decay were present in the smallest diameter class (Figure 9). Silver maple had the most trees with severe decay, while the random selection of other trees in the study had the lowest percentage of severely decayed trees (Figure 10).

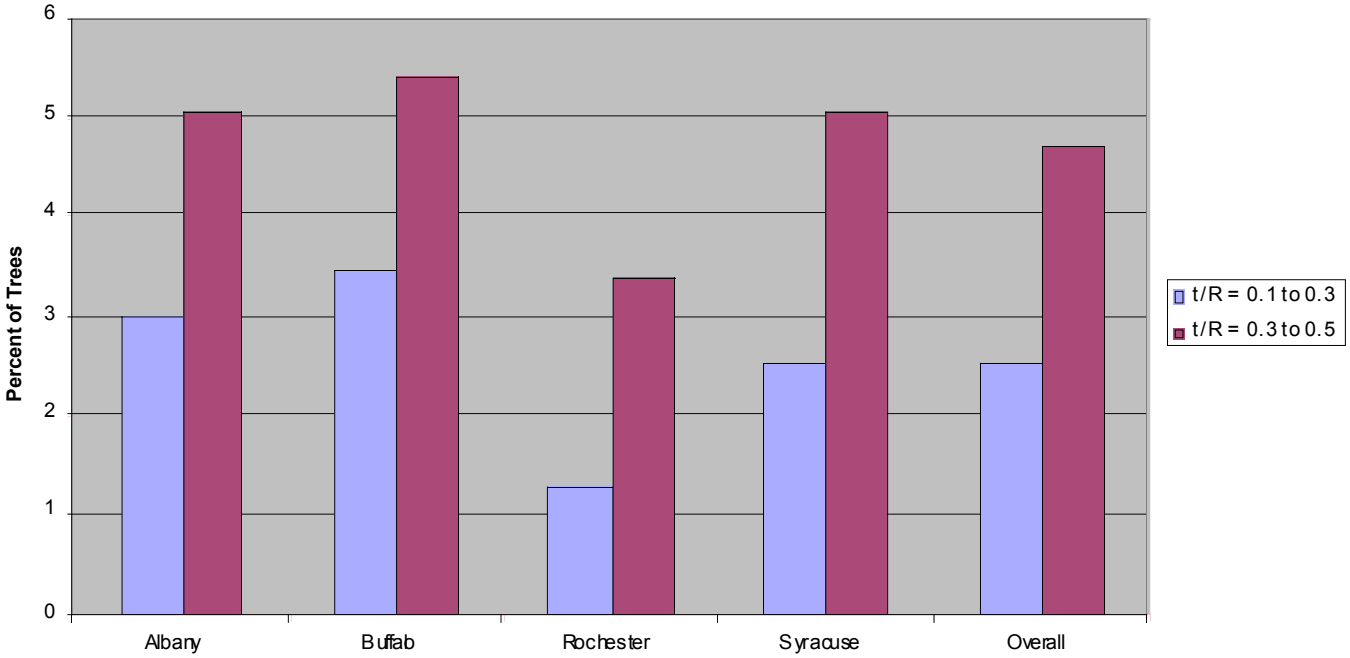


Figure 8.
Percentage of trees in Albany, Buffalo, Rochester, and Syracuse with substantial decay expressed as t/R (t = amount of sound wood and R = radius without bark or the proportion of the radius of the tree remaining with sound wood).

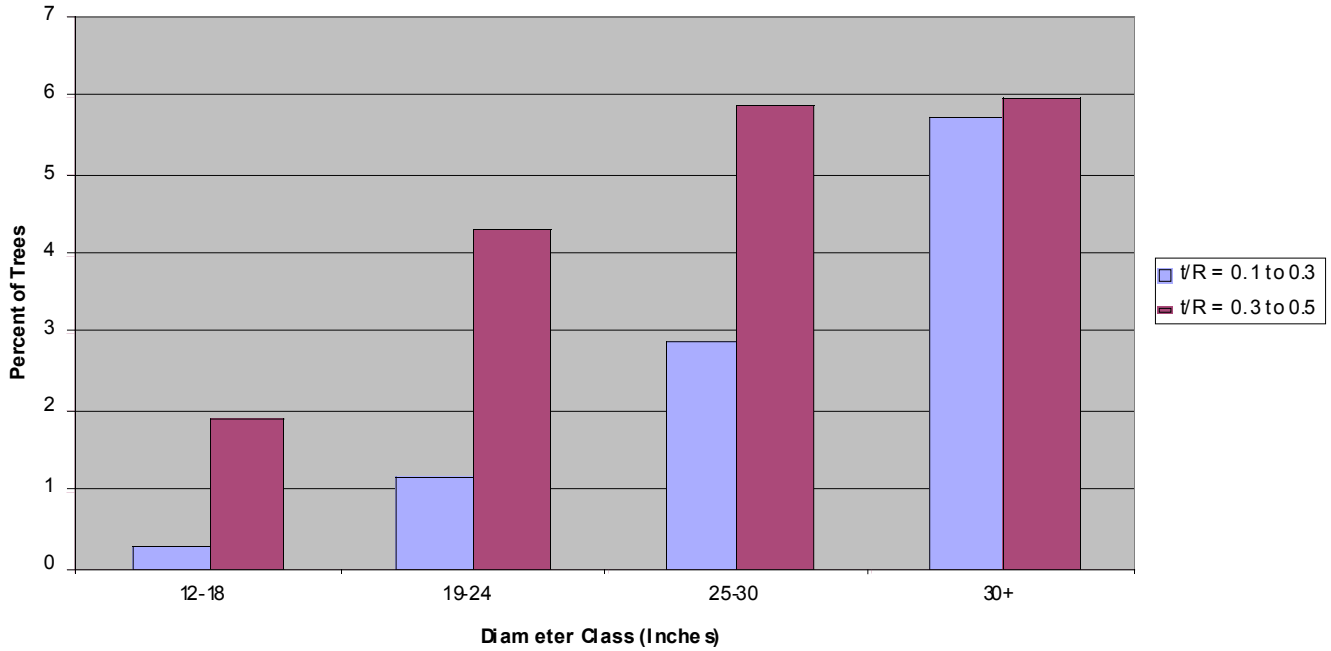


Figure 9.
Incidence of trees in each diameter class with substantial decay expressed as t/R (t = amount of sound wood and R = radius without bark or the proportion of the radius of the tree remaining with sound wood).

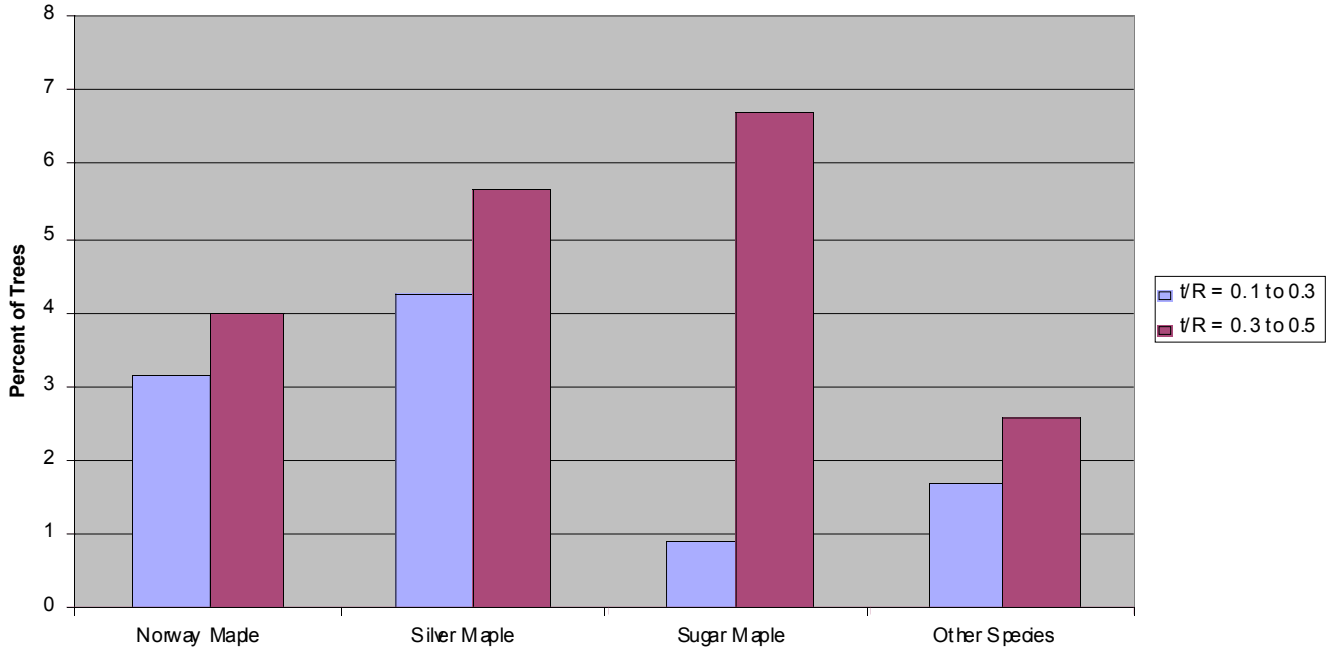


Figure 10.
Incidence of trees by species with substantial decay expressed as t/R (t = amount of sound wood and R = radius without bark or the proportion of the radius of the tree remaining with sound wood).

Discussion

Tree Population and Condition
Based on the street tree inventory data from Albany, Buffalo, Syracuse, and Rochester, maples are the predominate genus all these cities. Norway maple is by far the most common urban street tree. Given that Norway maple represents over 30% of the total population of trees greater than 12 inches in these cities, and is over 50% of the maples in some individual cities, further planting of this species as a street tree should be limited. Further, the potential damage from Asian Longhorned Beetle in these and other upstate cities could be significant.

This study showed that a substantial proportion of the larger diameter maples are in poor condition. In particular, the majority of the large diameter Norway maples are in poor condition, and over 30% of the sugar maples in all diameter classes were rated in poor condition. Overall, silver maple – a species is known to be more tolerant of urban conditions – was in slightly better condition than Norway or sugar maples. These large diameter maples will likely require inceased inspection, maintenance, removal, and replacement proceeding into the future.

The random selection of "other species" was in best condition overall and by diameter class. This may suggest that more diversity in urban forest street tree plantings can provide buffering to the health of the street tree population. Similarly, "other species" also had nearly the lowest incidence of decay and, the least number of severely decayed trees.

Decay Incidence and Severity
Decay incidence was surprisingly high. Over 57% of the trees had at least some decay as tested with the Resistograph. A study of trees in street trees in New Jersey and park trees in New York City's Central Park, Tate (J. Arb. 1986 12:73-74) found a decay incidence of 12% and 16%, respectively. However, that study used an increment borer and only tested trees in one location on the trunk.

Despite this high incidence of decay, relatively few trees were found to have serious amounts of decay. However, estimates of carbon storage by urban trees would likely be offset to some degree by decay because wood decay fungi release carbon dioxide as they enzimatically digest the wood of living trees. More study is needed to determine the volume of wood decayed in urban trees and the impact of decay on carbon storage.

The incidence of decay generally increased with tree diameter class, although the smallest diameter class trees also had a decay incidence of over 50%. Decay severity in small diameter trees was low despite the frequency of decay. This is an interesting result as it raises questions on the origins of this decay, and if the decay continues to develop and spread within these smaller trees as they mature.

The majority of trees had minor amounts of decay. Decay severity was lowest in Rochester, in small diameter trees, and in the random selection of "other species". Trees with more than one-third of its radius remaining as sound wood are generally considered at reduced risk for trunk failure even if decay is present. Therefore, despite the high incidence of decay in street tree maples and other species, these trees are likely not at elevated risk of failure.

The trees with more than two-thirds of their radius decayed (or t/R = 0.3 or less) could be at elevated risk for trunk failure. However, other equally important factors, such as crown size and exposure, tree height, wood strength, and presence of other defects, directly affect the potential for any tree to fail. This survey showed that 2.5% of the trees tested had severe decay (t/R = 0.1 to 0.3), and nearly 5% had moderate levels of decay (t/R = 0.3 to 0.5). These trees may require additional inspection, and arboricultural treatment because of the amount of decay present. Data from the study has been provided to each city to allow them to make further inspection and to determine if inspection, pruning, or removal is necessary.

The study also showed that larger diameter trees, and silver and Norway maples had the highest percentage of severely decayed trees, while sugar maple and "other species" had the lowest. Therefore, increased inspection of larger diameter trees, and inspection of silver and Norway maples in particular maybe warranted.

Tree Condition and Decay Severity in Sample Cities

The number of severely decayed trees was measurably different in the four cities where sampling occurred. Trees in Rochester had nearly the lowest incidence of decay and the least number of severely decayed trees. This could be attributed to a number of factors. The urban forest in Rochester was severely impacted by an ice storm in 1991 and high winds in 1998. Both events could have reduced the number of severely decayed trees as a result of tree failures in these events. Buffalo sustained a severe early season snow storm in 2006, and urban trees in Syracuse also were heavily damaged by wind in 1998. The culling effect of these weather events on severely decayed trees could be one factor contributing to differences among the cities in the study.

Rochester also has one of the longest standing tree maintenance and inspection programs in the State and Northeast. The effect of this program on overall tree condition and incidence of severely decayed tree may be suggested in this survey. Trees in Rochester were in the best overall condition, had nearly the lowest incidence of decay, and had the lowest number of severely decayed trees. Tree maintenance programs in Syracuse and Buffalo have suffered in recent history due to the lack of funding. Forestry operations in Albany have been understaffed and funded in recent history. Providing funding for tree maintenance, and maintaining an active tree maintenance program may be one means to improve the overall health of urban street trees in New York State cities.

APPENDIX A.

Health condition of Norway, Silver, Sugar and Other Species by Diameter Class

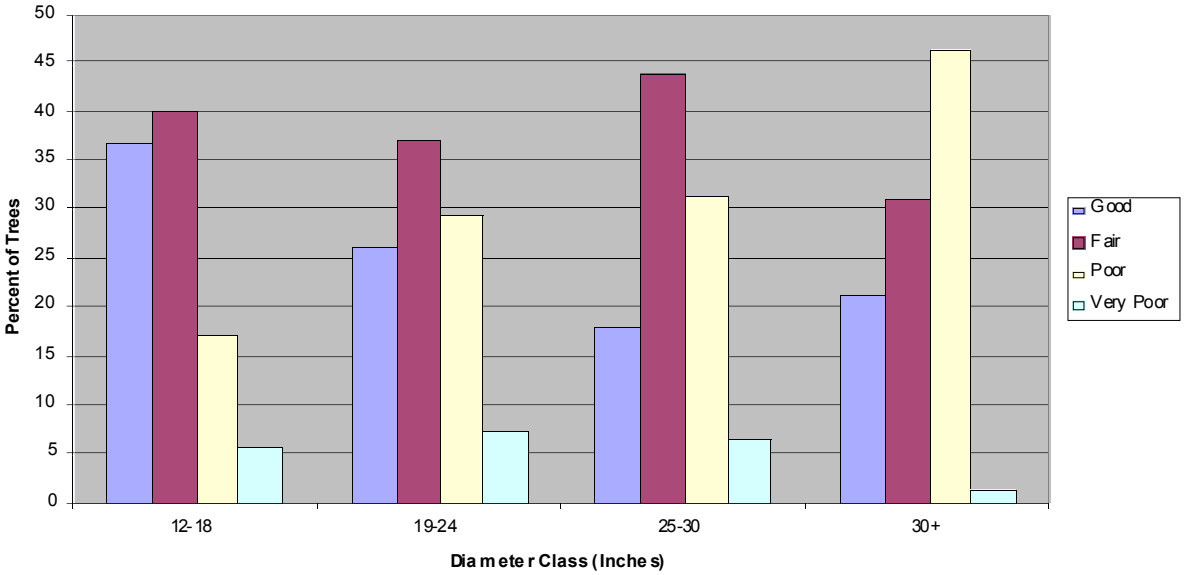


Figure 1.
Percent of Norway maple in four diameter classes that were in good, fair, poor, and very poor condition.

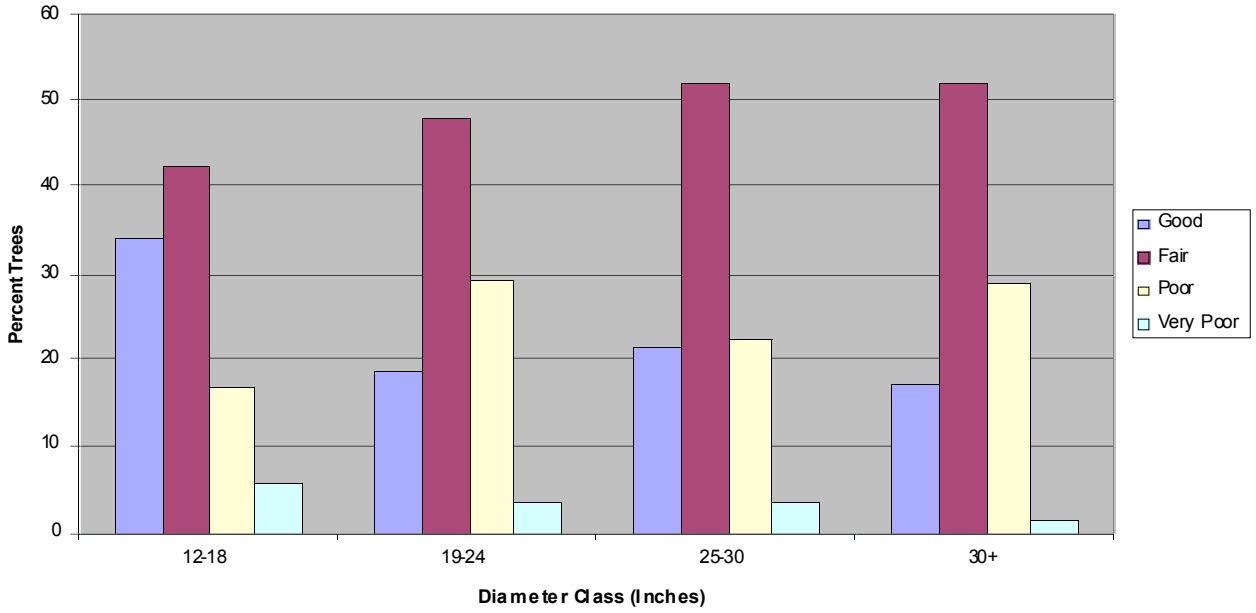


Figure 2.
Percent of silver maple in four diameter classes that were in good, fair, poor, and very poor condition.

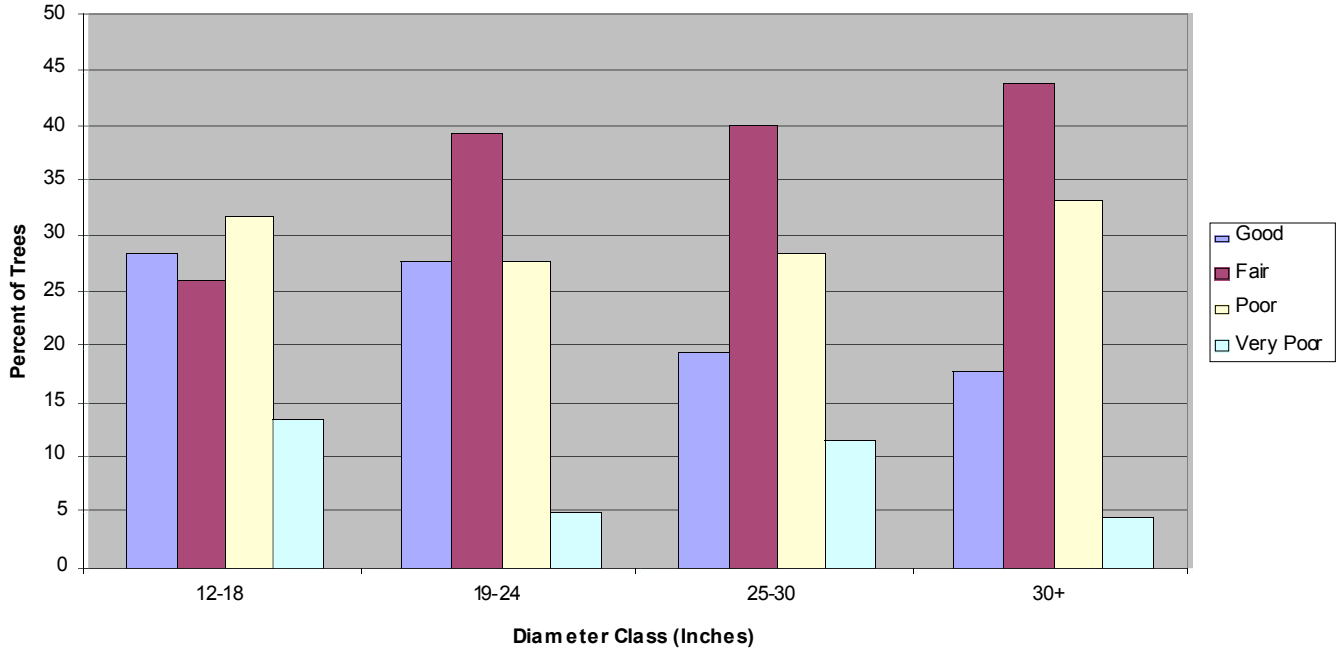


Figure 3.
Percent of sugar maple in four diameter classes that were in good, fair, poor, and very poor condition.

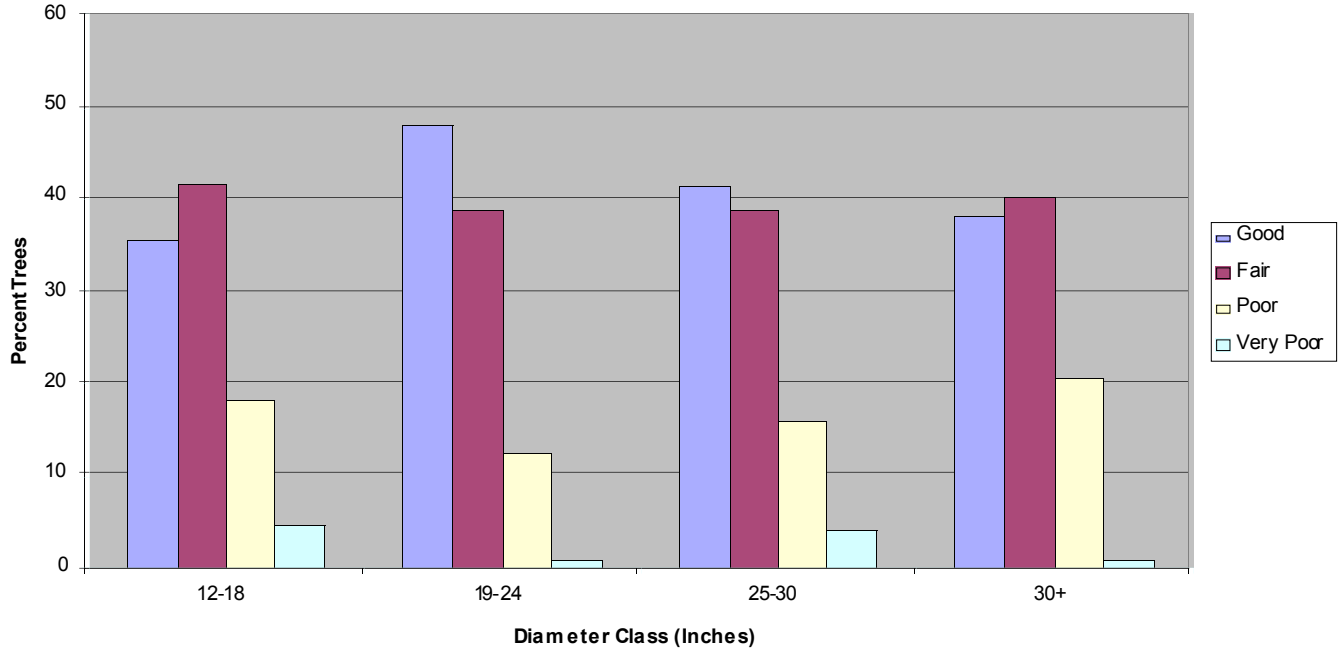


Figure 4.
Percent of other species in four diameter classes that were in good, fair, poor, and very poor condition.