Virginia Journal of Science
Volume 58, Number 1
Spring 2007

Trees on K-12 School Campuses in Virginia

Jeffrey L. Kirwan, **P. Eric Wiseman**, and **John R. Seiler**
Department of Forestry, Virginia Tech, Blacksburg, VA 24061-0324

ABSTRACT

Trees and saplings growing on K-12 school campuses were investigated in 105 school districts across Virginia. There were 2812 trees (>12.5 cm stem diameter at 1.4 m above ground level) inventoried across all campuses. The mean and median campus tree population was 27 and 18, respectively. Loblolly pine (*Pinus taeda* L.) was the most abundant species, accounting for 11% of all inventoried trees. Red maple (*Acer rubrum* L.) was the most frequently inventoried species, present on 44% of the campuses. Sapling (trees with 2.5-12.5 cm stem diameter at 1.4 m above ground level) populations were similar to tree populations. The mean and median campus sapling population was 23 and 13, respectively. Flowering dogwood (*Cornus florida* L.) and red maple were the most abundant sapling species, each accounting for about 10% of all inventoried saplings. Flowering dogwood, red maple, Bradford pear (*Pyrus calleryana* Decne. 'Bradford'), willow oak (*Quercus phellos* L.), and ornamental cherry (*Prunus* spp.) were the most frequently inventoried sapling species, each present on more than 25% of the campuses. Across all campuses, species diversity was relatively low: less than 10 species accounted for over 50% of the inventoried trees and saplings. Prominent Virginia natives, in particular *Carya* and *Quercus* species, were under represented in the inventory.

INTRODUCTION

Urban forests are increasingly recognized for their ecological and societal benefits (Kane and Kirwan 2005). Trees in the urban forest improve air quality, protect watersheds, sequester carbon, and reduce energy consumption for heating and cooling buildings. In addition, properly designed and maintained urban vegetation has been linked to reduced crime (Kuo and Sullivan 2001), enhance cognitive development of children (Wells 2000), and job satisfaction (Kaplan *et al.* 1988).

As the U.S. population grows and becomes more urbanized, urban forests will play an increasingly important role in environmental sustainability and quality of life. From 1910 to 2000, the urban segment of the U.S. population increased from 28% to 80% (Hobbs and Stoops 2002). By 2030, 87% of the U.S. population (projected to exceed 370 million) will live in urbanized areas (UNESA 2004). The population of Virginia (currently about 7.5 million) is projected to reach 9.8 million by 2030 (U.S. Census Bureau 2005). In the Chesapeake Bay watershed alone, residential development is projected to consume 800,000 acres of land between 2003 and 2030 (Boesch and Greer 2003). This pattern and rate of population growth will place unprecedented strain on natural resources. Healthy, well-managed urban forests may be a key component of sustainable community growth.

In 1998, the Virginia Tech Department of Forestry began an outreach program to teach dendrology, forest biology, and forest management concepts to K-12 students and

other public audiences. The program was initiated to help address a nationwide decline in science achievement during the middle school years (Calsyn *et al.* 1999) and to help Virginia teachers meet their Standards of Learning (SOL) objectives (Board of Education 2003). The program has been delivered through a dedicated web site (http://www.cnr.vt.edu/dendro/forsite/contents.htm), classroom presentations by Virginia Tech undergraduate students, and internet-based scientific investigations conducted by K-12 students (Kirwan and Seiler 2005). Now in its eighth year, the outreach program has spanned across three states and reached nearly 15,000 K-12 students at 83 schools and numerous 4-H clubs.

As part of the outreach program, tree inventories were conducted on school campuses. From these inventories, school tree lists were compiled and placed on the program website. Dendrology fact sheets and an online dichotomous key developed by the Virginia Tech Department of Forestry were linked to the tree lists to facilitate student learning about tree identification and forest biology.

In compiling the tree lists, a wealth of information has emerged on the composition of campus tree populations. Trees are a valuable asset on school campuses. They not only provide important environmental benefits such as shade and storm water abatement, but are also a valuable, yet often overlooked, resource to teach students about ecology and stewardship. Perhaps more important, the composition of campus tree populations is arguably a reflection of local knowledge, attitudes, and values regarding trees on public property. In most localities, the same biological, socio-political, and economic forces that influence tree preservation and planting on school campuses similarly impact other public properties. For these reasons, campus tree inventories can provide insight into natural resource management and education efforts in Virginia. The purpose of this paper is to report key findings from these campus tree inventories and discuss the implications for future management and education efforts.

MATERIALS AND METHODS

From 2000 to 2005, the lead author, with assistance from local students, teachers, and extension agents, conducted tree inventories on K-12 school campuses across Virginia. Tree inventories were conducted at schools where outreach educational programs were conducted or where there was a request to compile a school tree list. To obtain a broad geographical representation, inventory data from only one school campus in each of 105 school districts were analyzed in this study (Appendix 1). In school districts where more than one campus was inventoried, the school that was first in alphabetical order was selected for this study. The majority of tree inventory data used in this study was collected at public elementary schools (91 of 105 campuses). The balance came from middle school (10), high school (1), or combined (2) campuses. One private elementary school campus was also inventoried.

The inventories were limited to trees growing in maintained campus areas. Boundary line trees and trees in campus natural areas were not inventoried. The species and stem diameter at breast height (DBH-measured 1.4 m above ground level) were determined for each inventoried tree. For multi-stemmed trees that divided below 1.4 m, the individual stem diameters were summed. Trees ≤ 12.5 cm DBH were designated as saplings in the inventory. Trees <2.5 cm DBH were not inventoried.

Species abundance, frequency, and importance metrics were calculated using the combined inventory data. Each metric was calculated separately for trees and saplings. Species abundance was calculated as the number of plants of a given species divided by the total number of plants in the inventory. Species frequency was calculated as the number of campuses where a species was inventoried divided by the total number of campuses inventoried. Abundance and frequency values were multiplied by 100 and expressed as percentages.

Species importance was calculated as the sum of the abundance and frequency percentages. The importance metric was developed as a simple way to communicate both the preponderance and geographic distribution of a species. A high importance value does not necessarily imply that a species has high ecological or economic value. Rather, the importance metric reveals patterns in tree preservation and tree planting on school campuses that are not discernable from the abundance and frequency metrics alone.

TABLE 1. Statistics describing tree (>12.5 cm stem diameter at 1.4 m above ground level) and sapling (trees with 2.5-12.5 cm stem diameter at 1.4 m above ground level) populations inventoried on 105 Virginia school campuses during 2000-2005.

	Campus Plant Count	Campus Species Richness
Trees		
Minimum	0	0
25th Percentile	8	3
Median	18	6
Mean	27	7
75th Percentile	39	9
Maximum	162	23
Total	2812	100
Saplings		
Minimum	0	0
25th Percentile	6	3
Median	13	5
Mean	23	6
75th Percentile	25	8
Maximum	196	22
Total	2431	103

RESULTS

Trees

There were 2812 trees inventoried across the 105 school campuses (Table 1). The mean and median campus tree population was 27 and 18, respectively. Three campuses each had over 100 inventoried trees (Figure 1). Conversely, nine campuses had no inventoried trees. About one-fourth of the campuses had eight or fewer inventoried trees.

There were 100 tree species, representing 52 genera, inventoried across the 105 school campuses. On average, there were seven different species on each campus.

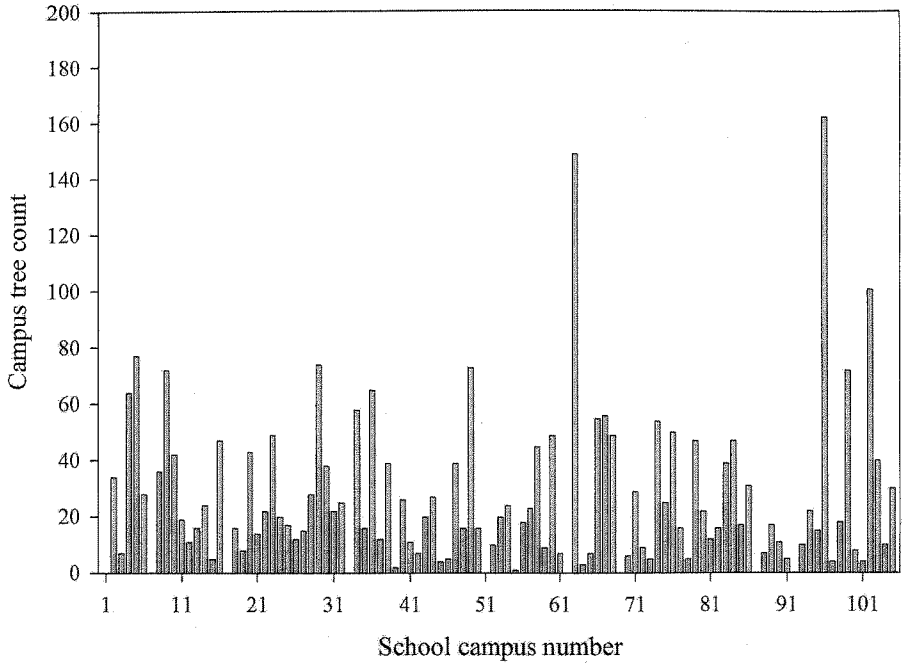

FIGURE 1. Total number of trees (>12.5 cm stem diameter at 1.4 m above ground level) inventoried on each of 105 Virginia school campuses during 2000-2005. Refer to appendix 1 for a complete list of school districts and names.

Two campuses were notable for having over 20 species (Figure 2). About one-fourth of the campuses had three or fewer species.

Loblolly pine (*Pinus taeda* L.) was the most abundant tree species in the inventory, accounting for 11% of the total tree population (Table 2). Loblolly pine, white pine (*Pinus strobus* L.), red maple (*Acer rubrum* L.), and Bradford pear (*Pyrus calleryana* Decne. 'Bradford') combined to account for 33% of the total tree population. The most frequently inventoried tree species was red maple, which was present on 44% of the campuses. Other common species were Bradford pear, flowering dogwood (*Cornus florida* L.), white pine, willow oak (*Quercus phellos* L.), and pin oak (*Quercus palustris* Muenchh.). Each of these species was present on about 30% of the campuses. Several tree species that are common in Virginia's native forests were scarce on school campuses. Pignut hickory (*Carya glabra* (Mill.) Sweet), American beech (*Fagus grandifolia* Ehrh.), blackgum (*Nyssa sylvatica* Marsh.), and black oak (*Quercus velutina* Lam.) were each present on less than 10% of the campuses.

Red maple had the highest importance value of all inventoried tree species, despite the fact that it accounted for only 7% of the total tree population (Table 2). Red maple's high importance value was strongly influenced by its occurrence on nearly half of the campuses. Other species with high importance values were Bradford pear, white pine, and flowering dogwood. Like red maple, these species were very common on school campuses.

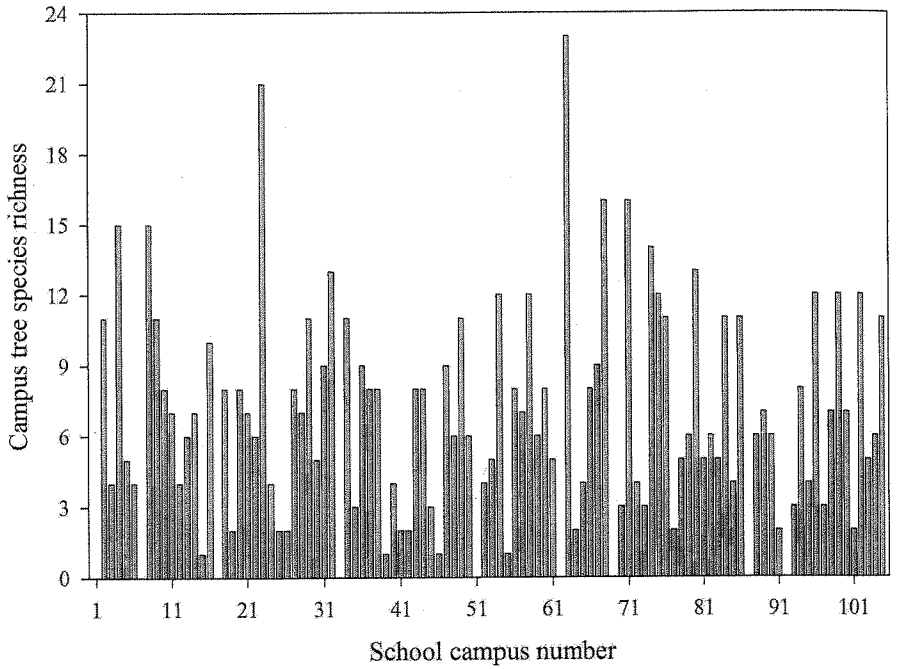

FIGURE 2. Total number of tree (>12.5 cm stem diameter at 1.4 m above ground level) species inventoried on each of 105 Virginia school campuses during 2000-2005. Refer to appendix 1 for a complete list of school districts and names.

Saplings

The tree and sapling populations were similar. There were 2431 saplings inventoried across the 105 school campuses (Table 1). The mean and median campus sapling population was 23 and 13, respectively. One campus had nearly 200 inventoried saplings whereas six campuses had none (Figure 3). About one-fourth of the campuses had six or fewer inventoried saplings.

There were 103 sapling species, representing 55 genera, inventoried across the 105 school campuses. Similar to the tree population, there was an average of six sapling species on each campus. The maximum number of sapling species on a single campus was 22 (Figure 4). About one-fourth of the campuses had three or fewer species.

Flowering dogwood and red maple were the most abundant sapling species, each accounting for about 10% of the total sapling population (Table 3). Eight species accounted for 50% of the total sapling population. The most frequently inventoried sapling species was flowering dogwood, which was present on more than half of the campuses. Other common species were red maple, Bradford pear, willow oak, and ornamental cherry (*Prunus* spp.). Each of these species was present on more than 25% of the campuses.

As was observed for the trees, saplings of native forest species were uncommon on school campuses. The widespread Virginia natives, red mulberry (*Morus rubra* L.),

TABLE 2. Trees (>12.5 cm stem diameter at 1.4 m above ground level) inventoried on 105 Virginia school campuses during 2000-2005. Only species with an importance value greater than five are individually listed.

Species	Count	Abundance (%)[a]	Presence[b]	Frequency (%)[c]	Importance[d]
Acer rubrum	198	7	46	44	51
Pyrus calleryana	190	7	35	33	40
Pinus strobus	250	9	32	30	39
Cornus florida	107	4	35	33	37
Pinus taeda	301	11	24	23	34
Quercus phellos	138	5	29	28	33
Quercus palustris	84	3	29	28	31
Acer saccharum	115	4	26	25	29
Liquidambar styraciflua	97	3	24	23	26
Prunus serotina	43	2	22	21	22
Quercus alba	122	4	19	18	22
Quercus falcata	48	2	20	19	21
Juniperus virginiana	52	2	19	18	20
Platanus occidentalis	46	2	13	12	14
Acer saccharinum	39	1	12	11	13
Robinia pseudoacacia	55	2	11	10	12
Magnolia grandiflora	23	1	12	11	12
Ilex opaca	37	1	11	10	12
Fraxinus americana	32	1	10	10	11
Liriodendron tulipifera	38	1	9	9	10
Acer platanoides	34	1	9	9	10
Prunus spp. (ornate cherry)	25	1	9	9	9
Picea abies	19	1	9	9	9
Malus spp. (crab apple)	14	<1	9	9	9
Pinus virginiana	24	1	8	8	8
Celtis occidentalis	38	1	7	7	8
X *Cupressocyparis leylandii*	60	2	6	6	8
Juglans nigra	32	1	7	7	8
Gleditsia triacanthos	40	1	6	6	7
Prunus cerasifera	9	<1	7	7	7
Quercus nigra	17	1	6	6	6
Quercus velutina	13	<1	6	6	6
Carya tomentosa	12	<1	6	6	6
Cercis canadensis	12	<1	6	6	6
Nyssa sylvatica	10	<1	6	6	6
Malus spp. (common apple)	22	1	5	5	6
All other species	416	15	-	-	-

[a]Percentage of the total tree inventory accounted for by the listed species.
[b]Number of campus where the species was inventoried.
[c]Percentage of all campuses where the species was inventoried.
[d]Abundance (%) + Frequency (%)

serviceberry (*Amelanchier* spp.), common persimmon (*Diospyros virginiana* L.), and Virginia pine (*Pinus virginiana* P. Mill.), were each present on less than 5% of the campuses. With the exception of willow and pin oak, saplings of the native oak and hickory species were extremely uncommon (each less than 3% frequency).

Flowering dogwood had the highest importance value among inventoried saplings

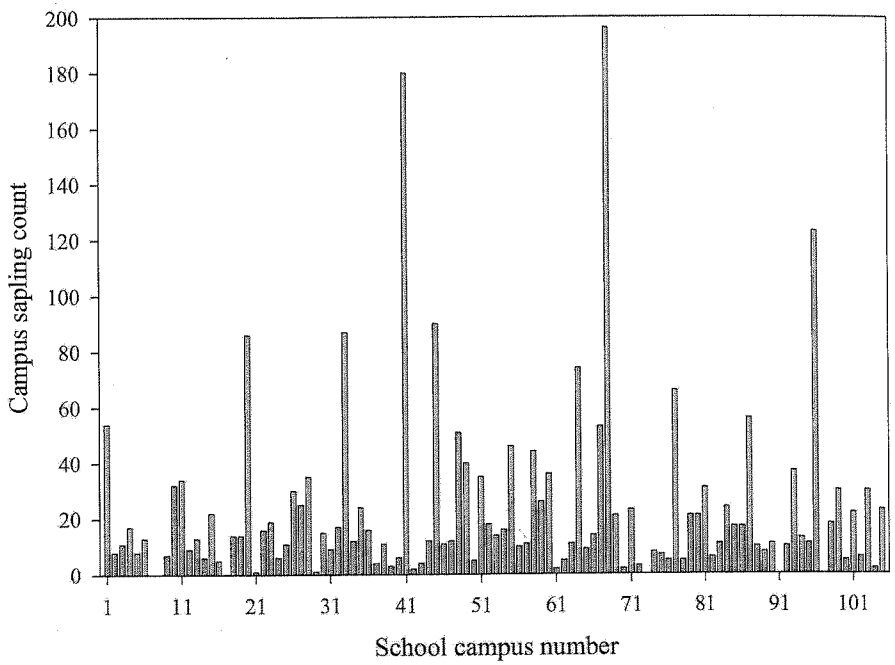

FIGURE 3. Total number of saplings (trees with 2.5-12.5 cm stem diameter at 1.4 m above ground level) inventoried on each of 105 Virginia school campuses during 2000-2005. Refer to appendix 1 for a complete list of school districts and names.

due to its widespread occurrence on campuses. Other highly important sapling species included red maple, Bradford pear, willow oak, and ornamental cherry. Like flowering dogwood, these species also had a wide geographic distribution.

DISCUSSION

The results of this study indicate there is substantial variability in the size and diversity of tree populations on Virginia K-12 school campuses. Although tree and sapling count data were not adjusted for campus acreage, the data raise concern for inadequate tree populations on school campuses. Particularly alarming was the fact that one-fourth of the schools inventoried had less than nine trees and seven saplings. While some of these schools may be located on small or highly urbanized parcels that preclude large tree populations, additional social and economic constraints are likely involved. Specifically, limited public interest and understanding about trees combined with strained municipal budgets may be leading to poor tree preservation, planting, and maintenance efforts on school campuses.

Age diversity in the tree population is a fundamental principle of urban forestry. Low age diversity threatens urban forest stability when there are inadequate numbers of young trees to replace mature trees as they die (Richards 1983). In this study, saplings, on average, accounted for 44% of the total tree population on individual campuses (data not shown). Interestingly, this demographic is consistent with

TABLE 3. Saplings (trees with 2.5-12.5 cm stem diameter at 1.4 m above ground level) inventoried on 105 Virginia school campuses during 2000-2005. Only species with an importance value greater than five are individually listed.

Species	Count	Abundance (%)[a]	Presence[b]	Frequency (%)[c]	Importance[d]
Cornus florida	240	10	62	59	69
Acer rubrum	214	9	38	36	45
Pyrus calleryana	132	5	35	33	39
Quercus phellos	117	5	26	25	30
Prunus spp. (ornate cherry)	110	5	26	25	29
Pinus strobus	139	6	17	16	22
Ilex cornuta	136	6	16	15	21
Malus spp. (crab apple)	36	1	18	17	19
X *Cupressocyparis leylandii*	92	4	14	13	17
Cercis canadensis	31	1	16	15	17
Prunus cerasifera	56	2	14	13	16
Quercus palustris	43	2	14	13	15
Platanus occidentalis	31	1	13	12	14
Pinus taeda	152	6	7	7	13
Juniperus virginiana	32	1	12	11	13
Ilex x *attenuata*	53	2	11	10	13
Ilex opaca	49	2	11	10	12
Acer saccharum	70	3	9	9	11
Thuja occidentalis	80	3	8	8	11
Fraxinus pennsylvanica	48	2	8	8	10
Betula nigra	21	1	9	9	9
Prunus subhirtella	9	<1	9	9	9
Cornus kousa	19	1	8	8	8
Zelkova serrata	25	1	7	7	8
Liquidambar styraciflua	16	1	7	7	7
Magnolia grandiflora	16	1	7	7	7
Unknown species	16	1	7	7	7
Acer saccharinum	7	<1	7	7	7
Sassafras albidum	13	1	6	6	6
Gleditsia triacanthos	35	1	5	5	6
Liriodendron tulipifera	11	<1	6	6	6
Prunus serotina	8	<1	6	6	6
All other species	374	15	-	-	-

[a]Percentage of the total tree inventory accounted for by the listed species.
[b]Number of campus where the species was inventoried.
[c]Percentage of all campuses where the species was inventoried.
[d]Abundance (%) + Frequency (%)

Richard's commonly implemented age diversity model, which recommends that 40% of an urban tree population consist of trees <20 cm DBH. However, a number of schools are at risk of low tree populations in the future. About one-fifth of the inventoried schools have less than half the number of saplings required by Richard's benchmark (data not shown).

Overall species diversity observed on school campuses was substantial. More than 100 species of trees and saplings were documented across the state. However, the over-abundance of some species is cause for concern. Seven species accounted for nearly

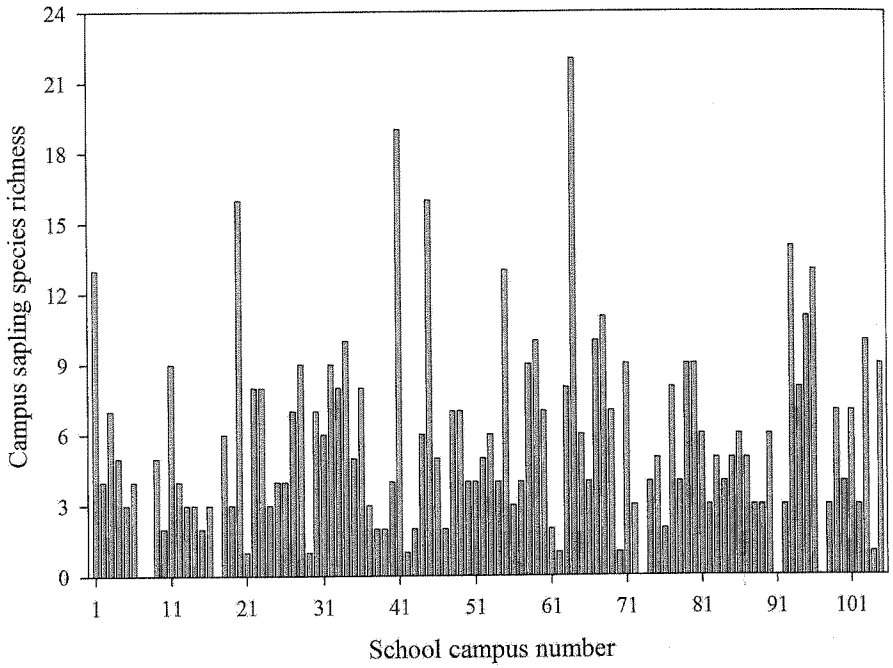

FIGURE 4. Total number of sapling (trees with 2.5-12.5 cm stem diameter at 1.4 m above ground level) species inventoried on each of 105 Virginia school campuses during 2000-2005. Refer to appendix 1 for a complete list of school districts and names.

half of the inventoried trees and saplings, which indicates campus landscapes are reliant on too few species. Urban forest stability is threatened when taxon-specific pests or disorders arise in tree populations dominated by a few species (Richards 1983). In such cases, a dramatic decline in the tree population can quickly occur as trees succumb to the emerging threat. The economic, social, and environmental implications can be severe.

In the U.S., a number of urban forest catastrophes resulting from taxon-specific problems have occurred. During the early 20th century, American elms (*Ulmus americana* L.) were decimated by Dutch elm disease, caused by the fungus *Ophiostoma ulmi* (Buism.) Nannf. (Nannini *et al.* 1998). At present, native ash species (*Fraxinus* spp.) are being extirpated by Emerald ash borer (*Agrilus planipennis* Fairmaire) throughout the upper Midwest (USDA 2006). To prevent such catastrophes, scrupulous municipalities often follow Santamour's species diversity model, which states that urban forests should be composed of no more than 10% of any single species, 20% of any single genus, and 30% of any single family (Galvin 1999).

Across the state, only loblolly pine exceeded the 10% species composition benchmark for trees; however, this demographic is misleading because over half of the loblolly pines were inventoried on just two campuses. While loblolly pine is clearly over-abundant on these two campuses, it is not a state-wide concern. Only the genus

Pinus exceeded the 20% genera benchmark, but *Acer* (14%) and *Quercus* (18%) were heavily planted on campuses as well. The family benchmark was not exceeded, although Pinaceae (24%) and Fagaceae (18%) were well represented across the state. Clearly, outreach efforts are needed to encourage greater tree species diversity on Virginia school campuses.

In the sapling population, taxonomic demographics were more diverse than in the tree population. This is likely due to the greater diversity of small-stature, ornamental species available in the nursery trade and the tendency for larger size classes to be dominated by a few long-lived, highly adaptable species (Richards 1983). Flowering dogwood accounted for 10% of the inventoried saplings, which was the only diversity benchmark exceeded in the sapling population. The abundance and frequency of flowering dogwood was not surprising because it is the state flower of Virginia and is a popular landscape tree.

The lower abundance of Bradford pear in the sapling population is encouraging and may reflect its declining popularity as a landscape tree due to its propensity for storm damage. The abundance and frequency of red maple in the sapling population may be cause for concern though. Red maple is a very popular landscape tree because it is attractive, easily propagated, and highly adaptable to diverse urban environments. However, these characteristics often lead to species over-use, and many urban foresters believe that red maple may be the next U.S. urban forest catastrophe. In one Maryland municipality, red maple accounted for over one-third of the entire urban forest population (Galvin 1999). Red maple use should be tempered on Virginia school campuses.

Only one of the ten most important tree species, Bradford pear, was not a Virginia native. Interestingly, this list is a close reflection of the ten most common trees in Virginia's native forests: white oaks, red oaks, yellow pines, yellow-poplar (*Liriodendron tulipifera* L.), maples, hickories, sweetgum (*Liquidambar styraciflua* L.), white pine, American beech (*Fagus grandifolia* Ehrh.), and blackgum (*Nyssa sylvatica* Marsh.) (VDEQ 2005). Some of the native species may be under represented on campuses because they are not readily available in commerce. For example, in 2005, only one nursery wholesaled American beech and none wholesaled hickories in Virginia (VNLA 2005). This is understandable because these two species are difficult to propagate and are often undesirable as landscape trees. However, white oaks, yellow-poplar, and blackgum are highly suitable for landscape use (Appleton and Chaplin 2001) and are increasingly available in commerce (VNLA 2005). These species should be better utilized on Virginia school campuses.

Non-native species were much more important within the sapling population. Five of the ten most important sapling species were non-native. Most of these species were small-stature ornamentals, which is a segment of the nursery trade dominated by introduced species. With the possible exception of Bradford pear, the non-natives species in the sapling population are dependable urban landscape plants.

Tree planting projects have played an important role in campus greening and youth education in Virginia for many years. The Virginia Department of Forestry (DOF) has been distributing seedlings to schools and civic groups since 1952 (Bart Bartholomew, Virginia Department of Forestry, Charlottesville, VA, personal communication). Loblolly pine and white pine, which are DOF nursery-grown species, were among the most abundant and common species on school campuses. Current DOF efforts to expand native hardwood species production should positively affect campus species diversity if a means of low-cost distribution can be implemented.

This research has provided insight into the abundance and diversity of landscape trees on Virginia K-12 school campuses. The most alarming observation was the number of schools with very small tree populations. Inadequate tree populations are often the result of poor tree preservation, tree planting, or tree maintenance efforts. While the specific causes were not identified in this study, it is important to consider the consequences of inadequate campus tree populations. First, campuses do not fully benefit from the environmental services provided by trees such as storm water abatement and energy conservation. Second, the opportunity to demonstrate the fundamental concepts of urban forest stewardship to children is missed. Building awareness and advocacy in children is particularly important because they will make choices in their adult lives that impact future urban forests and thus long-term environmental sustainability. Preventing these consequences requires educating school administrators, local politicians, and the public about urban forestry and emerging urban forest issues.

ACKNOWLEDGMENTS

The authors wish to thank John Peterson for assisting with the identification of tree and sapling species. Dr. Kirwan conceived the idea for this investigation, developed the survey methodology, and conducted the campus tree inventories. Drs. Kirwan, Wiseman, and Seiler analyzed the inventory data and prepared the final report.

LITERATURE CITED

Appleton, B. L. and L. T. Chaplin. 2001. The New York/Mid-Atlantic Gardener's Book of Lists. Taylor Trade Publishing, New York. 200pp.

Board of Education. 2003. Standards of learning currently in effect for Virginia public schools. <http://www.pen.k12.va.us/VDOE/Superintendent/Sols/home.shtml> (15 January 2007).

Boesch, D. F. and J. Greer (eds.). 2003. Chesapeake Futures: Choices for the 21st Century. Edgewater (MD): Chesapeake Research Consortium, Inc. STAC Publication 03-001.

Calsyn, C., P. Gonzales and M. Frase. 1999. Highlights from TIMSS: the third international mathematics and science study. <http://nces.ed.gov/pubs99/1999081.pdf>(15 January 2007).

Galvin, M. F. 1999. A methodology for assessing and managing biodiversity in street tree populations: a case study. Journal of Arboriculture 25(3):124-128.

Hobbs, F. and N. Stoops. 2002. Demographic trends in the 20th century: census 2000 special reports. <http://www.census.gov/prod/2002pubs/censr-4.pdf> (15 January 2007).

Kane, B. C. and J. L. Kirwan. 2005. Value, benefits, and costs of urban trees. Virginia Cooperative Extension Publication 420-181. Blacksburg, VA.

Kaplan, S., J. Talbot and R. Kaplan. 1988. Coping with daily hassles: the impact of nearby nature on the work environment. Saint Paul (MN): USDA Forest Service, North Central Forest Experiment Station, Urban Forestry Unit Cooperative

Agreement. Project Report No. 23-85-08.

Kirwan, J. L. and J. R. Seiler. 2005. Using undergraduate students and the internet to enhance middle school science education. North American Colleges and Teachers of Agriculture Journal 49(1):52-56.

Kuo, F. E. and W. C. Sullivan. 2001. Environment and crime in the inner city; does vegetation reduce crime? Environment and Behavior 33(3):343-367.

Nannini, D. K., R. Sommer and L. S. Meyers. 1998. Resident involvement in inspecting trees for Dutch elm disease. Journal of Arboriculture 24(1):42-46.

Richards, N. A. 1983. Diversity and stability in a street tree population. Urban Ecology 7:159-171.

UNESA (United Nations Department of Economic and Social Affairs). 2004. World urbanization prospects: the 2003 revision. <http://www.un.org/esa/population/publications/wup2003/WUP2003Report.pdf> (15 January 2007).

U.S. Census Bureau. 2005. Interim projections of the total population for the United States and states: April 1, 2000 to July 1, 2030. <http://www.census.gov/population/projections/SummaryTabA1.pdf> (15 January 2007).

USDA (United States Department of Agriculture). 2006. Emerald ash borer. <http://www.emeraldashborer.info> (15 January 2007).

VDEQ (Virginia Department of Environmental Quality). 2005. Virginia's forest resources. <http://www.vanaturally.com/guide/forests.html> (15 January 2007).

VNLA. 2005. 2005 Guide to Virginia Growers. Available from: Virginia Nursery and Landscape Association, Inc., Christiansburg, VA.

Wells, N. M. 2000. At home with nature: effects of "greenness" on children's cognitive functioning. Environment and Behavior 32(6):775-795.

APPENDIX 1: Virginia school campuses where tree inventories were conducted during 2000-2005.

Number	District	School	Number	District	School
1	Accomack	Metompkin[a]	37	Gloucester	Achilles
2	Albemarle	Hollymead	38	Goochland	Rbt. Harford
3	Alexandria	Lyles-Crouch	39	Grayson	Baywood
4	Alleghany	Sharon	40	Greene	Greene Co.
5	Amelia	Amelia	41	Greensville	Greensville
6	Amherst	Amelon	42	Halifax	Scottsburg
7	Appomattox	Appomattox	43	Hampton	Armstrong
8	Arlington	H-B Woodlawn MS[b]	44	Hanover	Battlefield Park
9	Augusta	Beverley Manor	45	Henrico	Echo Lake
10	Bath	Valley	46	Henry	Axton
11	Bedford	Boonsboro	47	Highland	Highland
12	Bland	Bland EMHS[c]	48	Isle of Wight	Carrsville
13	Botetourt	Colonial	49	James City	Norge
14	Brunswick	Totaro	50	King & Queen	King & Queen
15	Buchanan	Russell Prater	51	King George	Sealston
16	Buckingham	Dillwyn	52	King William	Acquinton
17	Campbell	Rustburg	53	Lancaster	Lancaster MS
18	Caroline	Bowling Green	54	Lee	Jonesville MS
19	Carroll	Gladesboro	55	Loudoun	Ball's Bluff
20	Charles City	Charles City Co. MHS[d]	56	Louisa	Th. Jeffereson
21	Charlotte	Bacon District	57	Lunenburg	Victoria
22	Chesapeake	B.M. Williams	58	Lynchburg	Sheffield
23	Clarke	Powhatan[e]	59	Madison	Waverly Yowell
24	Craig	McCleary	60	Mathews	Lee-Jackson
25	Culpeper	A.G. Richardson	61	Mecklenburg	Boydton
26	Cumberland	Cumberland	62	Middlesex	Middlesex
27	Danville	Glenwood Magnet	63	Montgomery	Margaret Beeks
28	Dickenson	Clintwood	64	Nelson	Rockfish River
29	Dinwiddie	Midway	65	New Kent	New Kent MS
30	Essex	Tappahannock	66	Newport News	McIntosh
31	Fairfax	Beech Tree	67	Norfolk	Bay View
32	Fauquier	M.M. Pierce	68	Northampton	Kiptopeke
33	Fluvanna	Central	69	Northumberland	Northumberland
34	Franklin	Burnt Chimney	70	Nottoway	Nottoway MS
35	Frederick	Rbt. E. Aylor MS	71	Orange	Gordon-Barbour
36	Giles	Eastern	72	Page	Grove Hill

[a]All schools are public elementary schools unless designated otherwise.
[b]MS: middle school.
[c]EMHS: combined elementary, middle, and high school campus.
[d]MHS: combined middle and high school campus.
[e]Powhatan is a private K-8 school.

Appendix 1: (continued).

Number	District	School	Number	District	School
73	Patrick	Blue Ridge	90	Shenandoah	Ashby Lee
74	Petersburg	Walnut Hill	91	Smyth	Atkins
75	Pittsylvania	Stony Mill	92	Southampton	Ivor
76	Portsmouth	Churchland MS	93	Spotsylvania	Berkeley
77	Powhatan	Pocahontas	94	Stafford	Stafford
78	Prince Edward	Prince Edward	95	Suffolk	Mount Zion
79	Prince George	Harrison	96	Surry	Surry
80	Prince William	Nokesville	97	Sussex	Chambliss
81	Pulaski	Critzer	98	Tazewell	Graham
82	Rappahannock	Rappahannock Co.	99	VA Beach	Kempsville HS
83	Richmond	Richmond Co.	100	Warren	A.S. Rhodes
84	Richmond City	John B. Cary	101	Washington	Greendale
85	Salem	G.W. Carver	102	Westmoreland	Montross MS
86	Rockbridge	Central	103	Wise	Coeburn MS
87	Rockingham	Fulks Run	104	Wythe	Speedwell
88	Russell	Copper Creek	105	York	Coventry
89	Scott	Dungannon MS			

[a]All schools are public elementary schools unless designated otherwise.
[b]MS: middle school.
[c]EMHS: combined elementary, middle, and high school campus.
[d]MHS: combined middle and high school campus.
[e]Powhatan is a private K-8 school.