TREE CONDITION ASSOCIATED WITH TOPPING IN SOUTHERN ILLINOIS COMMUNITIES

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Abstract. Twenty-seven percent of trees surveyed in southern Illinois communities showed evidence of topping. Topped trees were nearly 3 times more frequently classified as likely to fail structurally than those individuals not subjected to topping. Frequency of broken branches in the crown, evidence of insect or disease infestation, and cavities in the bole were also greater in topped trees. While the design of this study did not allow determination of a cause-and-effect relationship, increased incidence of conditions associated with tree failure was observed in topped versus nontopped trees.

Key Words. Hazard formation; topping; tree health.

Topping, or "the drastic removal of large branches with little regard for location of the pruning cut" (Iles 1989), continues to be widely practiced in communities for clearing utility lines and reducing tree size despite education efforts and condemnation by trained arborists (e.g., Iles 1989; Fazio 1998). A recent survey of home owners in the U.S. Inland Northwest who allowed their trees to be topped addressed the widely held belief that topping is an innocuous and often necessary practice to reduce both tree crown size and danger to property (Fazio and Krumpe 1999). Many individuals surveyed believed that topping ultimately benefited tree health—underscoring the divergence in opinion between tree care professionals and many owners or stewards of urban trees.

Tree health problems associated with topping include disrupted root:crown balance, increased susceptibility to pathogens, decline in tree health, and formation of hazardous defects (Kaiser et al. 1986; Iles 1989; Watson 1991). Although anecdotal evidence regarding the damaging nature of topping is undisputed, we are unaware of any published data quantifying a relationship between topping status and risk of tree failure. Understanding the strength of this relationship may contribute to a more accurate assessment of the true costs associated with this practice.

The objective of this study is to compare the current condition of trees subjected to topping relative to nontopped individuals. Species variation and specific health problems associated with topping are also evaluated.

METHODS

This study was conducted in 4 southern Illinois communities (Anna, Herrin, Mt. Vernon, and Willisville) participating in a street tree inventory program managed through Southern Illinois University Carbondale (Karlovich 1999). Community size ranged from approximately 600 to 17,200 residents, with the responsibility for street tree maintenance under the jurisdiction of the Department of Public Works in all cases. Additionally, Mt. Vernon had an active tree board and Tree City USA status. Anna was a former Tree City USA at the time of this study. Patterns of tree care appeared to be typical of similar-sized communities throughout the U.S. Midwest.

An inventory was conducted from February through August 1998 on all trees within the effective city right of way, typically between street and sidewalk or a distance not exceeding 7.6 m (25 ft) of the street centerline where sidewalks are absent. Data collected included tree species, evidence of prior topping, and a description of symptoms of tree damage or stress, including presence of broken branches, evidence of insect infestation or disease, and presence of bole cavities. An assessment of tree condition, determined to be either good or poor, was made on the basis of present hazardous condition or likelihood of becoming hazardous in the near future. Trees classified as good met all of the following conditions:

- no more than minimal cracks or splits
- cavities not exceeding 30% of stem diameter
- no broken branches exceeding 20 cm (8 in.) diameter
- no more than minimal evidence of insects, disease, or parasitic plants

- less than one-third of root system exposed
- lean less than 30%

Failure to meet any one of the above criteria resulted in classification as poor condition. Data from all four communities were pooled as part of an effort to create a regionwide street tree database. Statistical analyses used a Chi-square test (SAS Institute 1989) with $\alpha < 0.05$.

RESULTS AND DISCUSSION

A total of 5,252 trees were surveyed. *Acer saccharinum* was the most commonly occurring species, accounting for 16.6% of all street trees (Table 1*). The 4 most frequently occurring *Acer* spp. together comprised 40.2% of all trees sampled. The 15 most frequently occurring species and genera accounted for roughly 75% of all trees measured and are considered for further analyses. Among these species, 27.5% of trees had been subjected to topping prior to the survey. *Gleditsia triacanthos* had a significantly higher likelihood of being topped than other species, reflecting a large-scale, one-time planting of this species in a commercial area where crown maintenance is particularly intensive.

A greater than average likelihood of being in poor condition was observed among the 3 most commonly occurring trees species, with *A. saccharinum* more than twice as likely to be in poor condition relative to the entire street tree population (Table 1). *Juniperus virginiana, Liquidambar styraciflua, Malus* spp., and *Pinus strobus* were more frequently in good condition than the average species, with 3% or fewer surveyed being in poor condition. Better condition among these species may be attributed in part to small branch size and overall small stature precluding some hazard-forming conditions.

Topped trees were 192% more likely ($P < 0.001$) to be classified as poor condition than those not subjected to topping. (Table 2). All species for which more than 3% of the population were in poor condition showed a numerically greater likelihood of being in poor condition when topped. No significant difference was observed from the mean response to topping, suggesting that adaptability to this practice does not differ among species.

The occurrence of dead branches of any size was 40% more likely in topped trees (Table 3). More frequent occurrence of dead branches in topped trees may be attributed to poor attachment and therefore greater vulnerability to breakage among the adventitious and epicormic sprouts resulting from topping. The only species differing significantly from the mean response was *J. virginiana*, for which topped trees were more than 5 times more likely than nontopped trees to contain dead branches. The high visibility of dead branches in this evergreen species may have contributed to this value.

Insects, disease, and parasites were 77% more likely to occur in topped than in nontopped trees, with no significant differences observed between species (Table 4). Decreased tree vigor resulting from crown:root imbalance and slowed wound closure believed to be associated with improperly pruned trees may contribute to this phenomenon (Iles 1989). Two species, *A. negundo* and *Ulmus americana*, did show large numeric but statistically nonsignificant differences compared to the sample population as a whole. Eight species showed a numerically neutral or positive response to topping, suggesting that conclusions may be changed with a larger sample size.

Topped trees had a 143% greater likelihood to have large cavities than did nontopped trees (Table 5). *Acer saccharum* and *Quercus imbricaria* both showed significantly less likelihood than the average species in the occurrence of cavities, although both had a greater than 50% increased likelihood of cavity occurrence in topped trees. These differences may reflect interspecific variation in the ability to compartmentalize wounds. Research to determine the relationship between topping, species, the extent of cavity formation, and structural failure would be helpful in developing more objective measures of hazardous condition.

CONCLUSIONS

Although the nature of the study does not permit the establishment of a cause-and-effect relationship, a correlation between conditions associated with hazard tree formation and topping is quantified. These data suggest that topped trees are more likely to be,

*Tables for this article begin on page 90.

or become, unsafe. This suggests that topped trees should be subjected to more frequent and careful observation in tree risk management programs.

Species comparisons in this study are subject to the inherent bias generated by episodes of popularity and disfavor among planted street trees. For example, popularity of *Acer* spp. during a time prior to the widespread planting of *G. triacanthos* may result in the more recent choices looking better, due in part to the greater vigor of younger, compared to older, trees. The relative condition or incidence of hazards in the species and genera discussed here apply only to this region or others with similar community forest demographics.

The information presented in this paper should be viewed as a step in the objective evaluation of topping and its role in community forest management. Community forestry professionals may use this information or make similar analyses using their own data to demonstrate to individuals or municipalities the value of seeking tree management alternatives to topping. A combination of several data sets at the regional level using similar sampling criteria would both decrease sampling error associated with a small population and broaden the inference space of this study.

LITERATURE CITED

Fazio, J.R. 1998. Don't top trees. Tree City USA Bulletin #8. The National Arbor Day Foundation, Nebraska City, NE. 7 pp.

Fazio, J.R., and E.E. Krumpe. 1999. Underlying beliefs and attitudes about topping trees. J. Arboric. 25:193–199.

Iles, J. 1989. The case against tree topping. Grounds Maint. 24(6):51,74.

Kaiser, C.A., M.L. Witt, J.R. Hartman, RE. McNeil, and W.C. Dunwell. 1986. Warning: Topping is hazardous to your tree's health. J. Arboric. 12:50–52.

Karlovich, D.A. 1999. Conditions associated with hazardous defects in urban street trees of selected southern Illinois communities. Unpublished M.S. thesis, Southern Illinois University Carbondale, IL. 84 pp.

SAS Institute. 1989. SAS User's Guide: Statistics. SAS Institute, Cary, NC.

Watson, G. 1991. Attaining root:crown balance in landscape trees. J. Arboric. 17:211–215.

Acknowledgments. Funding for this research was provided by the Illinois Department of Natural Resources Division of Forest Resources in cooperation with the USDA Forest Service. Special thanks to Southern Illinois University Carbondale students and volunteers who collected much of the data used in this study.

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Table 1. Frequency of occurrence and topping status of most common tree species in 4 southern Illinois communities. Within a column, * indicates a value significantly greater and † significantly less than the mean species.

Species	Frequency	Percentage topped	Percentage in poor condition
Acer rubrum	569	32	33*
A. saccharum	555	31	30*
A. saccharinum	871	40	44*
A. negundo	128	23	30
Fraxinus spp.	81	12	10
Gleditsia triacanthos	15	81*	3
Juglans nigra	83	25	16
Juniperus virginiana	170	7	1†
Liquidambar styraciflua	423	20	3†
Malus spp.	167	0	2†
Pinus strobus	199	15	1†
Prunus serotina	76	9	30
Quercus palustris	207	6	10
Q. imbricaria	97	16	12
Ulmus americana	94	14	23
Total	**3,876**	**27**	**20**

Table 2. Topping status associated with poor condition trees for most commonly occurring tree species in 4 southern Illinois communities. Percentage difference reflects the increased likelihood of poor condition occurrence associated with topping. No significant differences between species were observed.

Species	Topped trees in poor condition (%)	Nontopped trees in poor condition (%)	Percentage difference
Acer rubrum	55	23	139
A. saccharum	54	20	170
A. saccharinum	45	21	114
A. negundo	53	23	130
Fraxinus spp.	20	8	150
Gleditsia triacanthos	3	3	0
Juglans nigra	37	1	3,700
Juniperus virginiana	0	1	–100
Liquidambar styraciflua	4	3	33
Malus spp.	—	2	—
Pinus strobus	0	1	–100
Prunus serotina	43	29	48
Quercus palustris	23	9	156
Q. imbricaria	13	12	8
Ulmus americana	53	17	212
Total	**38**	**13**	**192**

Table 3. Topping status associated with the occurrence of deal branches greater than 20 cm (8 in.) diameter for most commonly occurring tree species in 4 southern Illinois communities. Percentage difference reflects the increased likelihood of dead branches associated with topping. A* indicates a value significantly greater than the mean species.

Species	Topped trees with dead branches (%)	Nontopped trees with dead branches (%)	Percentage difference
Acer rubrum	70	59	19
A. saccharum	73	51	43
A. saccharinum	81	66	23
A. negundo	63	56	13
Fraxinus spp.	50	59	–15
Gleditsia triacanthos	69	30	130
Juglans nigra	62	55	13
Juniperus virginiana	76	13	485*
Liquidambar styraciflua	47	49	–4
Malus spp.	0	8	–100
Pinus strobus	3	7	–57
Prunus serotina	96	61	57
Quercus palustris	77	69	12
Q. imbricaria	73	76	–4
Ulmus americana	71	61	16
Total	**70**	**50**	**40**

Table 4. Topping status associated with the occurrence of insects, disease, or parasites for most commonly occurring tree species in 4 southern Illinois communities. Percentage difference reflects the increased likelihood of disease, insects, and parasites associated with topping. No significant differences were noted between species.

Species	Topped trees with with disease insects, or parasites (%)	Nontopped trees with with disease insects, or parasites (%)	Percentage difference
Acer rubrum	27	17	59
A. saccharum	28	18	56
Ac. saccharinum	31	19	63
A. negundo	40	13	208
Fraxinus spp.	0	1	–100
Gleditsia triacanthos	2	3	–33
Juglans nigra	4	5	–20
Juniperus virginiana	0	1	–100
Liquidambar styraciflua	1	6	–83
Malus spp.	0	2	–100
Pinus strobus	3	3	0
Prunus serotina	28	19	47
Quercus palustris	23	23	0
Q. imbricaria	20	17	18
Ulmus americana	41	18	128
Total	**23**	**13**	**77**

Table 5. Topping status associated with the occurrence of cavities in excess of 30% bole diameter for most commonly occurring tree species in 4 southern Illinois communities. Percentage difference reflects the increased likelihood of bole cavity occurrence associated with topping. A † indicates a value significantly less than the mean species.

Species	Topped trees with cavities (%)	Nontopped trees with cavities (%)	Percentage difference
Acer rubrum	64	35	83
A. saccharum	60	37	62†
A. saccharinum	62	32	94
A. negundo	57	21	171
Fraxinus spp.	42	13	223
Gleditsia triacanthos	42	17	147
Juglans nigra	44	5	780
Juniperus virginiana	0	1	−100
Liquidambar styraciflua	10	36	−72
Malus spp.	0	10	−100
Pinus strobus	0	1	−100
Prunus serotina	8	16	−50
Quercus palustris	22	19	16
Q. imbricaria	39	26	50†
Ulmus americana	31	14	121
Total	**51**	**21**	**143**

Résumé. Vingt-sept pour cent des arbres qui ont survécu dans les communautés méridionales de l'Illinois montraient des indices évidents d'écimage. Les arbres écimés étaient trois fois plus nombreux à être classés comme dangereux ou en voie de l'être que les autres non écimés. La fréquence de branches cassées dans la cime, les signes d'infestation d'insectes ou de maladies et les cavités dans le tronc des arbres étaient aussi plus nombreux chez les arbres écimés. Même si la conception de cette étude ne permettait pas de déterminer une relation de cause à effet, un accroissement de l'incidence des conditions associés à la formation d'arbres dangereux était observable sur les arbres écimés versus ceux non écimés.

Zusammenfassung. 72 % der untersuchten Bäume in südlichen Gemeinden von Illinois sind irgendwo gekappt. Gekappte Bäume konnen 3mal so häufig als gefährlich oder bedrohlich klassifiziert werden als die ungekappten Exemplare. Die Häufigkeit von gebrochenen Ästen in der Krone, Anzeichen von Insekten oder Krankheitsbefall und Stammhöhlungen waren bei gekappten Bäumen auch größer. Während das Design der Studie keine Bestimmung eines Grundes und der beeinträchtigten Beziehungen zuläßt, stiegen die Hinweise auf einen Zusammenhang der Bedingungen und den bedrohlichen Baumformen, die bei gekappten versus ungekappten Bäumen beobachtet werden konnten.

Resumen. Veintisiete por ciento de los árboles estudiados en comunidades del sureste de Illinois mostraron evidencias de desmoche. Los árboles desmochados fueron clasificados más evidentemente como peligrosos o propensos a ser peligrosos que los árboles individuales no sometidos al desmoche. La frecuencia de ramas rotas en la copa, la evidencia de infestación de insectos y enfermedades y las cavidades en el tronco fueron también mayores en los árboles desmochados. Mientras el diseño de este estudio no permitió una determinación de una relación causa-efecto, la incidencia de las condiciones asociadas con la formación de árboles de riego fue observada en árboles desmochados contra árboles no desmochados.