ARBORICULTURE AND URBAN FORESTRY EDUCATION IN THE UNITED STATES: RESULTS OF AN EDUCATORS SURVEY

By William Elmendorf[1], Todd Watson[2], and Sharon Lilly[3]

Abstract. In June 2002, a 2-day arboriculture and urban forestry educator summit was hosted by the International Society of Arboriculture (ISA) at The Morton Arboretum in Lisle, Illinois, U.S. During the energetic discussions, differences in opinions between educators became apparent regarding curriculum content such as urban soils, utility forestry, tree care safety, and land use planning. Differences were also apparent in discussions regarding important research topics and educational tools. Because of the limited number of educators at the summit, a broad mail survey effort was funded by ISA in 2003 to better define issues and determine whether there were important correlations between the attitudes of arboriculture and urban forestry educators. This survey asked arboriculture and urban forestry educators in the United States their opinions about the importance and adequate provision of many skills such as pruning, climbing, urban forest management, land use planning, and volunteer management. The survey also asked questions about the ISA Certified Arborist program, educational program components, the nature of outside relationships, important research topics, and educational tools. In both descriptive statistics and a chi-square test of independence, results of this study provided evidence that there were very consistent attitudes about arboriculture and urban forestry educational topics across participants. Our findings also indicated that the traditional educational topics of arboriculture (such as tree planting and pruning) were considered very important by almost all participants, while the broader educational topics of urban forestry (such as land use planning and volunteer management) were considered less, or not, important by many of the participants. These results may indicate a lack of understanding of the importance of multi-skills and broader educational topics in urban forestry by both arboriculture and urban forestry educators. This study's results also supported the importance of experience and the ISA Certified Arborist program in shaping positive attitudes about safety and the importance of understanding tree structure.

Key Words. Arboriculture; Certified Arborist; college; components; curriculum; education; educator; green industry; research; skills; student; university; urban forestry.

In the United States, trees and landscapes have been important since pre-Colonial times. The earliest community forest in America was established in 1640 in Newington, New Hampshire. Tree protection ordinances were enabled early on—for example, in 1637 at Watertown, Massachusetts; for the Boston Commons in 1661; and at Newark, New Jersey, in 1676 (Gerhold and Frank 2002). Early laws and city plans illustrate the importance of trees in this country (Campana 1999).

As U.S. cities and the tree care industry developed, educational efforts to increase arboriculture knowledge steadily grew and became more complex. With more work and sophisticated clients, a need arose in a growing industry for educated tree surgeons. This demand was highlighted in the early work, letters, and advertisements of Francis Bartlett, John Davey, and others (Felix 1987; Campana 1999; Gerhold and Frank 2002). John Davey, an English immigrant who founded the Davey Tree Expert Company, published the *Tree Doctor: The Care of Trees and Plants* in 1901, one of the first arboricultural texts. Chapters in Davey's book include wounded trees, nature's trees, crotched trees, planting too large a tree, forming the head too low, pruning trees, planting, blight, landscaping, flower beds and vines, and talk with boys and girls.

Individuals and companies alike have been involved in training employees and educating the public about the proper care of trees (Ryan 1981; Campana 1999). The F.A. Bartlett Tree Expert Company, which started as the firm Frost and Bartlett in 1907, and the Davey Tree Expert Company, incorporated in 1909, pioneered commercial arboriculture education in the United States. The International Society of Arboriculture (founded in 1924 at Stamford, Connecticut, and originally called the National Shade Tree Conference and later the International Shade Tree Conference) and the Tree Care Industry Association (originally founded in 1938 as the National Arborist Association) were created in part to help addresses and coordinate the research and educational needs of the arboriculture industry (Campana 1999). In the past century, the techniques and theories behind tree care have rapidly evolved and, as a result, have become more specialized and biologically oriented.

Although arboriculture has been practiced and identified for decades by various nomenclatures, the term "urban forestry" was not introduced until 1965 (Jorgensen 1970). Soon after, in 1972, Congress passed the Urban Forestry Act that amended the Cooperative Forestry Assistance Act

of 1950 to include, "the protection, improvement, and establishment of trees and shrubs in urban areas, communities, and open spaces." Around this same time, the Society of American Foresters created the Urban Forestry Working Group to address and define a new discipline (Deneke 1978). Also, the International Society of Arboriculture established an Urban Forestry Committee (Andresen 1981), which was later incorporated into the Society of Municipal Arborists. With the growing public landscapes of street trees and parks and an increased knowledge of the benefits of public vegetation, the need for an educated workforce of arborists evolved to include urban foresters educated in arboriculture. This dynamic was quickly realized by the USDA Forest Service, the International Society of Arboriculture, the National Arborist Society, and the Society of American Foresters.

The care of trees and other plants has been part of U.S. university curricula since the initial founding of colleges and universities. Although it is impossible to determine when courses began to be taught that dealt specifically with shade trees, George Stone, with the Massachusetts State Agricultural College, was one of the first to offer a formal course in shade tree management in the late 1800s (King 1977). Additional reports indicate that Karl Dressel at Michigan Agricultural College taught a course titled Arboriculture in the mid-1920s (Andresen and Williams 1975).

Coursework in arboriculture and urban forestry continues to grow, and the importance of a four-year degree from a recognized university has been identified by some as essential to properly prepare aspiring arborists and urban foresters (Chadwick 1941; Hirt 1974; Andresen 1977). In 1975, the Urban Forestry Committee of the International Society of Arboriculture conducted a survey of North American universities offering a four-year degree in forestry, ornamental horticulture, and landscape architecture (Andresen and Williams 1975; Andresen 1977). This survey identified 43 U.S. universities with professional, undergraduate arboriculture curricula and no universities providing a graduate curriculum in arboriculture (Andresen 1977). Undergraduate urban forestry curricula were offered at 17 U.S. universities, and graduate curricula were present at five of the universities surveyed. Six universities were planning undergraduate arboriculture curricula, and five were planning urban forestry curricula (Andresen 1975, 1977). In a 1980 survey, 11 universities had a course with urban forestry as the title (Andresen and Johnson 1982). An additional 11 schools were planning to develop arboriculture classes, and ten of the forestry schools were planning new urban forestry courses. By 1980, Andresen and Johnson (1982) discovered university catalogs listed 20 urban forestry courses.

Another survey was conducted in 1990 of forestry schools accredited by the Society of American Foresters. In this study, 25 universities had programs in urban forestry, with 18 being structured curricula (Hildebrandt et al. 1993). Of the universities surveyed, 30 had at least one undergraduate urban forestry course. Twenty-four schools offered individually tailored graduate degree programs, and six had structured graduate curricula in urban forestry.

Education is important in the arboriculture and urban forestry professions. In a survey undertaken in the U.S. Mountain West region in the early 1980s, employer perspectives on arboriculture and urban forestry education were solicited (McPherson 1984). Half of the respondents indicated that a 2-year education in arboriculture was the minimum necessary to enter the arboriculture profession. Less than one-third of the respondents indicated a minimum degree requirement of 4 years or more for arborists; however, half of the respondents required a minimum of a 4-year degree or more for an urban forester. In a recent Pennsylvania study, 70% of participating arboriculture firms indicated that a bachelor's degree was important for certain positions, and 40% desired either an associate's degree or certification (Penn-Del Chapter 2001).

There are curriculum and experiential differences among a 4-year university degree, a 2-year technical degree, and a certification program. The increased need for trained arborists has also placed a demand on 2-year technical and certification programs, and these programs continue to grow in importance. Although this trend may be different today, in a survey of 2-year technical programs, Coufal (1979) found that technicians were having greater success finding arboricultural employment than those with a baccalaureate degree. In a nationwide survey of arboriculture and urban forestry professionals, the proportion of minorities and white males making US$50,000 or more annually was actually less for those with a baccalaureate than those without. However, females appeared to make more with a 4-year degree than without (Kuhns et al. 2002).

The need for industry involvement and practical experience of students continues to be expounded by educators and practitioners (King 1977, 1979; Deneke 1978; Ryan 1981; Andresen and Johnson 1982; McPherson 1984). McPherson (1984) discovered that over 70% of industry professionals surveyed believed that graduates in arboriculture or urban forestry should have at least 6 months of supervised field experience before entering the workforce. Seventy percent of participating Pennsylvania arboriculture firms were willing to hire interns if they were available (Penn-Del Chapter 2001).

Public sector employers expect urban foresters to perform a wider range of planning and management skills than public or private sector employers of arborists (Tables 1 and 2).

Further, in McPherson's survey (1984), based on the percentages of respondents, over half of the public sector responses identified 31 skills required of graduating urban

Table 1. Examples of skills taught in urban forestry classes: A review of eight syllabi.

- arboriculture
- tree benefits and values
- street and park tree inventory
- street tree and other ordinances
- shade tree commissions
- tree management plans
- tree evaluation and removal
- work planning and budgeting
- funding
- conflict resolution
- public relations
- volunteer management
- land use planning and regulation
- preserving trees during development
- utility forestry

Table 2. Examples of skills taught in arboriculture classes: A review of eight syllabi.

- tree identification
- tree biology
- tree anatomy
- plant selection and planting techniques
- soils, fertilizing, and plant relations
- pruning young and mature trees
- CODIT and hazard tree evaluation
- diagnosis
- tree appraisal
- ropes, knots, and hitches
- tree climbing
- safety
- tree removal
- chain-saw operations and safety
- cabling and bracing
- lightning protection
- tree protection during development
- transplanting larger trees
- chipper and truck operations and safety.

foresters and 26 skills for graduating arborists (McPherson 1984). When public sector professionals were asked to select from a list of 38 skills required of graduates from arboriculture programs, planting techniques (96%), pruning and tree removal techniques (93%), insect and disease control (92%), fertilization techniques (91%), and plant materials (90%) were identified as the five most important. For graduates of urban forestry programs, public sector employees identified insect and disease control (90%), general botany (89%), shade and street tree selection (89%), plant materials (88%), and planting techniques (86%) as most important. When asked to identify the top five skills that were most frequently lacking in arboriculture graduates, private sector arborists identified pruning and tree removal techniques (47%), insect and disease control (32%), equipment operation (26%), public relations (26%), and safety procedures (21%). For urban forestry graduates, public sector urban foresters listed public relations (35%), budgeting (27%), public speaking (17%), writing (17%), and public administration (15%) as the top five skill deficiencies (McPherson 1984).

There has been considerable debate about the suitability of 4-year university programs to provide adequate instruction for and sufficient numbers of aspiring arborists and urban foresters (Deneke 1978; Ryan 1981; Andresen and Johnson 1982; McPherson 1984). Although somewhat dated, but on a more positive side, Andresen (1981), Andresen and Johnson (1982), and King (1980) stated that the current educational system was adequate to meet the demand of the arboriculture and urban forestry professions. However, the ability of educational institutions to provide an adequate workforce to the industry has been criticized in recent studies (Penn-Del Chapter 2001). Even with the current increase in the quality and quantity of university programs, it is reported that the demand for arboriculture and urban forestry graduates remains high, and in many areas of the United States, demand exceeds the supply of available graduates (Ryan 1981; Felix 1987; Rodbell 1993). Although 62% of participating Pennsylvania arboriculture firms indicated that they planned to increase employment, 65% indicated that a lack of qualified tree workers was the most critical concern facing the industry in Pennsylvania, and 77% indicated that finding qualified workers was a major problem for their firm (Penn-Del Chapter 2001). According to a 1990 survey, Hildebrandt (1993) found that 943 urban forestry students graduated from accredited forestry schools from 1980 to 1990. Of that number, 76% were employed in an arboriculture or urban forestry profession. For arboriculture and urban forestry graduates, the majority of today's jobs are in the private sector, which is comprised mostly of arborists (Hildebrandt 1993; Rodbell 1993; Miller 1994). In Hildebrandt's (1993) survey of urban forestry graduates, which did not include graduates of horticulture schools offering arboriculture curricula, 39% of the former students were employed as arborists. In a 1996 nationwide survey of urban forestry professionals, 30% were employed in arboriculture, 15% were municipal foresters, 8% were utility foresters, and 6% were employed by state forestry agencies. Half of those surveyed worked for private, for-profit companies (Kuhns et al. 2002).

METHODOLOGY

In June 2002, a 2-day arboriculture and urban forestry educator summit was hosted by the International Society of Arboriculture at The Morton Arboretum in Lisle, Illinois. This summit provided an important opportunity for society staff, industry representatives, and university and college educators to discuss curriculum and research, barriers to teaching, and teaching techniques. During the energetic discussions, differences in attitudes among educators became apparent regarding curriculum content such as urban soils, utility forestry, tree care safety, and land use planning. Differences in opinions were also apparent in discussions regarding important research topics. The

summit also identified both a number of barriers to effective teaching and innovative and creative teaching tools.

Because of the limited number of educators attending the summit, a broad mail survey effort was funded by the International Society of Arboriculture to help the society, educators, and practitioners better understand the realities and needs of our educational efforts. As part of the survey effort, a committee was formed to review and finalize a self-administered mail survey instrument, and a professional survey instrument was prepared and sent to 192 educators in universities and colleges across the United States. The survey asked questions about participants' work duties and responsibilities (such as teaching in a university or 2-year college); their attitudes about the importance and adequate provision of arboricultural topics (such as fertilization, chain-saw operations, climbing, pruning, and rigging); their attitudes about the importance and adequate provision of urban forestry topics (such as land use planning, ordinances, and shade tree commissions); their ideas about important research topics; their ideas about successful teaching tools (such as internships and field studies); their attitudes about the ISA Arborist Certification program; their attitudes about institutional and organizational educational program components (such as adequate funding); and the nature of their partnerships and outside relations (such as their relationships with the green industry, municipalities, and others). Using a standard Dillman Mail Survey Technique, 136 surveys were returned for a response rate of 71%.

OPERATIONALIZATION OF VARIABLES

In addition to descriptive statistics, this study used five constructed variables to examine differences in attitudes among study participants on the topics of arboricultural practices, land use planning, safety, tree protection during construction, tree structure, and urban forest management. The variable "tree protection during construction" was a single 5-point Likert-type scale found in the original survey form. The variable "safety" was constructed by logically combining four 5-point Likert-type scales found in the original survey and testing with a reliability test. The scales for arboriculture practices, land use planning, and urban forest management were Likert-type composite scales and were constructed using factor analysis and reliability testing.

A factor is defined as a dimension or construct that can account for the correlation among variables or items, such as multiple scales used to answer a single question (Agresti and Finley 1986). Factor analysis is a data reduction technique first developed for use in psychology. It is used to identify and group variables with common latent structures. The technique is useful for revealing patterns of interrelationships among variables. Through this process, factor analysis contributes to construct validity (i.e., it helps identify items that measure what they are supposed to measure). The technique detects clusters of variables (underlying dimensions), each of which contain variables that are strongly interrelated or redundant. It is most often used (as in this study) to reduce large numbers of scales to smaller, but more robust, statistically independent variables (factors) that can be used in regression and other statistical techniques (Green et al. 2000).

The criteria established for the selection of factor items to be included in this study were a factor loading of 0.35 or higher; at least a 0.10 difference between the item's loading with its factor and each of the other factors; each factor including at least three items; and the ability to logically interpret and name the resulting factor (Green et al. 2000). The Likert-type scales discussed below were subject to principal component analysis using the varimax rotation program available in SPSSX.

Reliability analysis measures the extent to which a composite scale is able to measure a concept with similar results, in repeated applications, over different scale items (Green et al. 2000). High reliability increases the internal consistency of the construct. For this study, Cronbach's alpha, which range from 0 to 1.0, was used as a measure of the reliability of composite scales.

All five of these scales were used as dependent variables in a chi-square test of independence. Independent variables included in the chi-square test were Certified Arborist (yes or no); length of time in profession; residence (self reported: city, suburb, town); state (U.S. West, Midwest, South, and East); worked as an arborist (yes or no); and worked as an urban forester (yes or no). One criteria for the selection of independent variables was provision of enough cases for statistical analysis.

Arboricultural Practices

To assess differences in respondents' attitudes about arboricultural practices, a composite scale was used. Initially, 11 scales were used to answer one question ("Please circle the number that best describes your opinion of their importance in arboriculture education") using a 5-point Likert-type scale format (1 = very unimportant, 5 = very important). One component or dimension was extracted and used to reflect the respondents' attitude about arboricultural practices. The arboricultural practices variable was constructed from seven original survey scales: rigging, tree removal, cabling and bracing, lightening protection, tree climbing techniques, chain-saw operations, and heavy equipment operations. This factor had an eigenvalue of 4.81, explained 62% of the variation in the matrix, and had an acceptable alpha of 0.89.

Land Use Planning

To assess differences in respondents' attitudes about land use planning a composite scale was used. Initially, 19 scales

were used to answer one question ("Please circle the number that best describes your opinion of their importance in urban forestry education") using a 5-point Likert-type scale format as described above. One component or dimension was extracted to reflect the respondents' attitude about land use planning. The land use planning variable was constructed from four original survey scales: zoning, subdivision, and land use regulation, comprehensive land use plans, transfer of development rights, and watershed planning. This factor had an eigenvalue of 3.7, explained 34% of the variation in the matrix, and had an acceptable alpha of 0.88.

Safety

To assess differences in respondents' attitudes about safety, a composite scale was constructed by logically combining four related scales. Initially, the four scales were used to answer one question ("Please circle the number that best describes your opinion of their importance in arboricultural education") using a 5-point Likert-type scale format as described above. The safety variable was constructed from four original survey scales: safe work practices, OSHA standards, ANSI A300 standards, and ZI33.1 standards. This factor had an acceptable alpha of 0.85.

Tree Preservation During Construction

To assess differences in respondents' attitudes about tree preservation during construction, a single 5-point Likert-type scale found in the original survey was used. Initially, this scale was used to answer the survey question ("Please circle the number that best describes your opinion of their importance in arboricultural education") using a 5-point Likert-type scale format as described above.

Tree Structure

To assess differences in respondents' attitudes about tree structure, a composite scale was used. Initially, 19 scales were used to answer one question ("Please circle the number that best describes your opinion of their importance in arboricultural education") using a 5-point Likert-type scale format as described above. One component or dimension was extracted to reflect the respondents' attitudes about tree structure. The tree structure variable was constructed from five original survey scales: tree anatomy and physiology, decay and compartmentalization, tree condition risk management, plant disease identification and treatment, and tree pruning. This factor had an eigenvalue of 1.8, explained 63% of the variation in the matrix, and had an acceptable alpha of 0.84.

Urban Forest Management

To assess differences in respondents' attitudes about urban forest management, a composite scale was used. Initially, 19 scales were used to answer one question ("Please circle the number that best describes your opinion of their importance in urban forestry education") using a 5-point Likert-type scale format as described above. One component or dimension was extracted to reflect the respondents' attitudes about urban forestry. The urban forest management variable was constructed from five original survey scales: community tree management plans, urban forest management, shade tree commission role and function, street and park tree inventory systems, and street tree ordinances. This factor had an eigenvalue of 3.36, explained 31% of the variation in the matrix, and had an acceptable alpha of 0.91.

DESCRIPTIVE RESULTS

Demographics

Eighty-one percent (105) of the respondents were male, and 19% (24) were female. The oldest respondent was 73, the youngest 28. The mean age was 48. Four respondents indicated they had a 2-year degree, 15 a 4-year college degree, 47 a master's degree, and 63 a Ph.D. Eighty-eight percent (119) indicated they were white. One person listed African American and one person listed Asian. No persons indicated they were Hispanic or Latino. Eleven percent of the respondents were from Pennsylvania, 9% from New York, 7% from Illinois, 6% from Wisconsin, 6% from California, and 5% from Ohio. Fourteen states had only one respondent. Forty-seven percent of the respondents indicated that they taught in cities, 12% in suburbia, and 44% indicated they taught in towns. Twenty-seven percent taught at a 2-year college, 39% taught undergraduate students at a university, 30% taught graduate students at a university, and 43% had extension responsibilities. Forty percent indicated they had worked in the field for 1 to 9 years, 33% indicated 10 to 20 years, and 27% indicated 20+ years. Thirty-five percent indicated the majority of their work involved arboriculture, 28% urban forestry, and 64% both arboriculture and urban forestry. Forty-five percent indicated they had worked as a practicing arborist, and 38% indicated they had worked as a practicing urban forester. Forty-one percent indicated that they were Certified Arborists.

Attitudes About Arboricultural and Urban Forestry Educational Topics

Tables 3 and 4 provide a summary of the importance ranking of arboriculture and urban forestry educational topics. Reviewed together, the top five arboricultural and urban forestry educational topics considered very important by respondents were tree planting (98% important), tree pruning (97%), tree selection (95%), tree soil/water relations (93%), and tree structure/decay (92%). Other educational topics considered very important by respondents were plant insect identification (92%), tree identification (90%), preserving trees in construction (89%), tree risk management (88%), tree anatomy and physiology (88%), tree nutrition (85%), safe work practices (85%), ethics (84%), and urban forest management (80%).

Table 3. Arboriculture and urban forestry educational topics considered very important or important.

Very important	Respondents in agreement (%)	Important	Respondents in agreement (%)
Tree planting	98	ANSI standards	79
Tree pruning	97	Herbicide/pesticide application	78
Tree selection	95	Bidding/estimate	78
Tree soil and water relations	93	Public relations	76
Tree structure and decay identification	92	Public speaking	75
Plant insect identification	92	Landscape design	78
Tree identification	90	Benefits and values	75
Preserving trees during construction	89	Climbing practices	73
Tree risk management	88	Chain-saw operations	73
Tree anatomy and physiology	88	OSHA standards	73
Tree nutrition	85	Street tree ordinances	73
Safe work practices	85	Computer science	73
Ethics	84	Personnel management	73
Urban forest management	80	Tree inventory	71
		Small business management	70

Table 4. Arboriculture and urban forestry educational topics considered less important or not important.

Less important	Respondents in agreement (%)	Not important	Respondents in agreement (%)
Conflict resolution	59	Volunteer management	49
Land use planning	58	Watershed planning	49
Zoning	57	Business law	49
Contract administration	57	Public relations	48
Utility line clearance	55	Spanish	44
Rigging	54	Transplanting large trees	41
Cabling and bracing	53	Heavy equipment operations	37
Habitat restoration	53	Lightning protection	33
Park management	52	Statistics	37
Stormwater management	51	Urban fire ecology	36
Role of tree commissions	50		

Attitudes About Adequate Provision of Arboricultural and Urban Forestry Educational Topics

Tables 5 and 6 provide a summary of attitudes about the adequate provision of arboriculture and urban forestry topics. The top five arboriculture and urban forestry education topics in terms of adequate provision in education were tree establishment and installation (90% strongly agreed adequately provided), tree identification (89%), pruning (88%), tree selection (87%), and tree nutrition and fertilization (86%). Other topics that respondents strongly agreed were adequately provided were plant insect and disease identification and treatment (82%), tree soil and water relationships (82%), and tree anatomy and physiology (81%). Topics that respondents agreed were not being adequately provided included personnel management (33% agreed), watershed planning (33%), utility pruning (33%), land use planning (32%), conflict resolution (29%), and heavy equipment operations (26%).

Attitudes About ISA Certification Test

Seventy-two percent of the respondents agreed that the ISA Certified Arborist test was a valid and reliable test. Eighty-seven percent thought that certification helped provide unifying standards, and 89% replied that certification raised the level of professionalism. Seventeen percent agreed that certification negatively impacted people, and 13% agreed that licensure by states would be better than by ISA.

Attitudes About Educational Components, Partners, and Outside Relations

When describing their relationships with the green industry, 59% agreed that practical skills and classroom theory were well balanced, 74% of the participants thought that academics and practitioners worked together, 93% answered they had good relationships with industry, 81% agreed that industry representatives assisted in teaching, and 34% replied that industry supported them though funding. When asked about organizational realities within their institutions,

Table 5. Respondents who strongly agree or agree that provision of arboricultural and urban forestry educational topics is adequate.

Strongly agree is adequate	Respondents (%)	Agree is adequate	Respondents (%)
Tree establishment and installation	90	Structural decay and compartmentalization	77
Tree identification	89	Landscape design	71
Pruning	88	Herbicide and pesticide safety	71
Tree selection	87	Tree preservation during construction	69
Tree nutrition and fertilization	86	Tree benefits	68
Plant insect and disease identification	82	Trees, people, and ecology	67
Tree, soil, and water relationships	82	ANSI A300 standards	67
Tree anatomy and physiology	81	Tree condition and risk management	66
		Safe work practices	64
		ZI33.1 standards	62

Table 6. Respondents who agree less or do not agree that provision of arboricultural and urban forestry educational topics is adequate.

Agree less	Respondents (%)	Do not agree	Respondents (%)
Tree climbing	59	Public relations	48
Cabling/bracing	57	Tree removal	47
Chain-saw operations	55	Tree management plans	46
Urban forest management	54	Ethics	46
OSHA	53	Park management	45
Tree appraisal	53	Lightning protection	45
Street and park tree inventory	51	Integrated Vegetation Management	45
Street tree ordinances	51	Transplanting large trees	43
		Role and function of tree commissions	41
		Small business management	40
		Volunteer management	39
		Urban wildlife	37
		Rigging	37
		Zoning and subdivision ordinances	35
		Urban fire ecology	35
		Personnel management	33
		Watershed planning	33
		Utility pruning	33
		Land use planning	32
		Conflict resolution	29
		Heavy equipment operation	26

55% of the participants replied that departments worked together, 52% answered there was enough funding to teach successfully, 66% replied that their was enough funding for research, 31% agreed that legalities were a problem in teaching, and 57% agreed that arboriculture and urban forestry could be taught together. When questioned about their students, 32% replied that student recruitment was successful, 51% agreed that students became gainfully employed, and 59% responded that student internships were important.

When describing other outside relationships, 17% of the participants agreed that municipalities were successful in managing their trees, 13% replied that trees and parks were being adequately considered in development, 72% agreed technical assistance to municipalities and volunteer groups was important, 49% thought utility forestry had improved, and 19% replied that the benefits of vegetation were understood by people.

Important Research Topics and Educational Techniques

Research topics identified by participants in order of importance were (1) tree health, (2) tree pruning, (3) benefits of urban forestry, (4) social and economic aspects of urban forestry, (5) tree structure and mechanics, (6) disease and insect control, and (7) plant selection.

Important educational techniques in order of importance were (1) field trips, (2) lectures, (3) Web sites and

computer-based training, (5) internships, and (6) practical problem solving. Workshops were also mentioned as a way to educate both educator and practitioner.

RESULTS OF CHI-SQUARE TEST OF INDEPENDENCE

Arboricultural Practices

Overall, 70% of respondents agreed that arboricultural practices were an important educational topic. When looking at the relationships between dependent and independent variables, there were no significant differences for any variables (Table 7).

Land Use Planning

Overall, 40% of the respondents agreed that land use planning was an important educational topic. When looking at the relationships between dependent and independent variables, there were two significant relationships (Table 7): participants teaching at a university were more likely than others to agree that land use planning was an important educational topic (49% vs. 28%, significant at the $P = 0.05$ level), and participants teaching in cities were more likely than those in suburbia and towns to agree that planning was an important educational topic (58% vs. 20% vs. 29%, significant at the $P = 0.01$ level).

Safety

Seventy percent of the respondents agreed that safety was an important educational topic. When looking at the relationships between dependent and independent variables, there were two significant relationships (Table 7): Certified Arborists were more likely than others to agree that safety was an important educational topic (85% vs. 55%, significant at the .01 level), and participants who had worked as practicing arborists were more likely than others to say safety was an important educational topic (78% vs. 59% significant at the 0.05 level).

Tree Preservation During Development

Eighty-nine percent of respondents agreed that tree preservation in development was an important educational topic. When looking at the relationships between dependent and independent variables, there were no significant differences for any variables (Table 7).

Tree Structure

Eighty-four percent of the respondents agreed that tree structure was an important educational topic. When looking at the relationships between dependent and independent variables, there was one significant relationship (Table 7): participants who had worked as practicing arborists were more likely than others to agree tree structure was an important educational topic (90% vs. 79%, significant at the $P = 0.01$ level).

Urban Forestry Management

Fifty-three percent of respondents agreed that urban forestry management was an important educational topic. When looking at the relationships between dependent and independent variables, there was one significant relationship (Table 7): participants who worked as urban foresters were more likely than others to say urban forest management was an important educational topic (75% vs. 47%, significant at the $P = 0.01$ level).

CONCLUSIONS AND DISCUSSION

Arboriculture and urban forestry education is dominated by white males. Only 19% of the participants were women, and two people out of 136 indicated that they were from a minority group. The issue of increasing both female and minority involvement in arboriculture and urban forestry education is not a new one and continues to be addressed by academic administrators and advisory boards. Given growing ethnic populations and a growing interest and desire of inner-city residents to take part in arboriculture and urban forestry education, this study supports the conclusion that an important minority peer group is missing in this field (Johnston and Shimada 2004; Kuhns et al. 2002).

Hildebrandt (1993) reported that 76% of graduates were employed and, although, there continues to be great industry excitement about both student recruitment and employment (Penn-Del Chapter 2001), this survey provides some conflicting information. Thirty-two percent of the respondents agreed that student recruitment was successful, and 51% agreed that students became gainfully employed after graduation. Higher recruitment of students continues to be a concern and goal in institutions of higher education, especially those associated with natural resources. Perhaps the issue in placement is in the definition of "gainful employment" and the difference between a management or sales position versus a technician or laborer, where many graduates traditionally start in arboriculture.

Although two different survey instruments and the attitudes of two different groups of people are used, it is interesting to compare the results of this 2003 study to McPherson's 1984 study. In McPherson's study, the top five most important skills in arboriculture were planting techniques, pruning and tree removal, insect and disease control, fertilization techniques, and plant materials. In this 2003 study, the top five arboriculture topics were tree planting, tree pruning, tree selection, tree and soil relations, and tree structure and decay. The top five arboriculture skills identified in McPherson's study as most frequently lacking in education were pruning and tree removal techniques, insect and disease control, equipment operations, public relations, and safety considerations. The 2003 study identified education about pruning and plant insects and

Table 7. Relationships of dependent and independent variables in chi-square test of importance (percentage).

	Certified Arborist		Worked as arborist		Worked as urban forester	
Variable	Yes	No	Yes	No	Yes	No
Arboriculture	73	59	68	62	69	63
Planning	39	42	36	45	42	39
Safety	85	55*	78	59*	76	64
Tree preservation	90	87	88	90	85	83
Tree structure	89	81	90	79**	85	83
Urban forest	61	48	56	51	75	47**

	Years in arboriculture			Teaching		Residence			Region			
Variable	1–10	11–20	21–30	University	2-year college	City	Suburb	Town	West	Midwest	East	South
Arboriculture	65	62	67	60	67	64	57	72	60	60	73	76
Planning	42	33	42	49	28*	58	20	29**	27	42	39	54
Safety	67	62	79	63	81	73	78	66	57	68	83	70
Tree preservation	89	81	97	90	89	92	81	91	86	92	90	88
Tree structure	83	76	93	85	80	88	75	84	77	91	85	85
Urban forest	56	50	54	57	42	60	33	56	64	54	57	44

*Significant to $P = 0.01$ level.
**Significant to $P = 0.05$ level.

diseases as being adequately provided and in equipment operations and public relations as not adequately provided. There was weak agreement that safety was adequately provided. The comparison of these two studies provides evidence that there is fairly consistent agreement about important arboricultural topics and their provision, or lack of, over the past 19 years. It demonstrates some amount of cohesiveness within attitudes about arboriculture education.

In McPherson's 1984 study, the top five important skills in urban forestry were insect and disease control, general botany, tree selection, plant materials, and planting techniques. In this 2003 study, the top five urban forestry topics were urban forest management, benefits and values of trees, street tree ordinances, landscape design, and tree inventory. The top five urban forestry skills identified as most frequently lacking in education in McPherson's study were public relations, budgeting, public speaking, writing, and public administration. The 2003 study identified land use planning, zoning and subdivision ordinances, urban fire ecology, urban wildlife, and tree commissions as most frequently lacking. Although there is ambiguity because of the two survey instruments being compared, these results may provide some insight into the dynamic and changing nature of urban forestry education and the profession.

This study provides evidence that educators perceive good relationships between the green industry and arboriculture and urban forestry educators in terms of teaching assistance and practical training. It also demonstrates that more funding of teaching and research opportunities is desired from both the green industry and universities by educators.

It is very apparent in the opinions of respondents that there continue to be problems with the management of public street and park trees, in providing quality information to municipalities about tree care, and with the improvement of utility forestry. As in past studies, there is strong agreement that the benefits of trees and other vegetation are not understood by the general public.

The chi-square tests of independence showed very consistent attitudes across respondents. There were no significant differences for the variables arboricultural practices and tree preservation. Living in a city and teaching at a university were significant indicators for the land use planning. The positive attitudes about land use planning are most likely conditioned by the growth and change that is occurring both in many suburban areas and in the desirable places where universities are located. Experience was an important indicator for safety and tree structure (worked as an arborist) and for urban forest management (worked as urban forester). There was strong agreement with respondents that the ISA Certified Arborist test was meaningful and relevant, and being a Certified Arborist was a significant positive indicator for the safety variable. The importance of work experience and of the ISA certification program in shaping proper attitudes is supported at some level by these results.

Although the importance of gaining supervised field experience continues to be desired by both industry and municipal organizations, the use of internships was ranked fifth in importance by participants in educational methods. We agree with McPherson (1984) that the importance of students gaining practical and expert experience as part of their educational experience must not be overlooked.

In both the descriptive statistics and in the constructed variables of land use planning and urban forestry management, the educational topics involved in urban forestry were much less important to respondents than the more traditional educational components of arboriculture. The topic "urban forestry management" was the most important urban forestry topic, ranking 14th in importance in arboriculture and urban forestry topics. It is interesting to note that this finding is in agreement with the conclusions of the 2001 Review of Higher Education on Urban Forestry in Europe (Randrup et al. 2001). The following conclusions were made in that study of 70 educational institutions in 24 European countries: (1) urban forestry is based on a broad spectrum of disciplines, without any of these being dominant; (2) biology, forestry, horticulture, landscape architecture, and landscape ecology are central disciplines; and (3) despite the multidisciplinary character, emphasis on social science and aesthetics has been low. The lessons and opportunities of arboriculture and urban forestry education in Europe should be considered, especially with the success of groups such as ISA and the Society of American Foresters in coordinating educational opportunities in this United States (Konijnendijk et al. 2000).

Arboriculture is closely related and integral, but not identical, to urban forestry. Although there are problems with providing and funding educational topics and student recruitment in arboriculture, there seems to be consistent and cohesive agreement with what educational topics are important for this profession. A concept of urban forestry that has gained acceptance in the United States and in Europe is of a profession encompassing the planning, design, establishment, and management of trees and forest stands (Nilsson and Randrup 1997). Within this concept, public policy processes are complex, and there are a large number of public and private sector actors, substantial public involvement, and higher system dynamics (Konijnendijk 1997). Hildebrandt (1993) discussed the multidisciplinary character of urban forestry, and Deneke (1978), Andresen and Johnson (1982), and Rodbell (1993) discussed the need for an interdisciplinary curriculum incorporating courses from associated professions. A multidisciplinary character for urban forestry education is one of the primary strengths of the discipline, but this study

provides evidence that many of the broader educational topics important to this profession are not considered important. These findings may provide insight into the traditional and conservative attitudes of the profession and indicate a lack of understanding of the importance of the multi-skills and broader educational topics crucial to urban forestry by both arboriculture and urban forestry educators.

LITERATURE CITED

Agresti, A., and B. Finley. 1986. Statistical Methods for the Social Sciences. Dellen, San Francisco, CA. 536 pp.

Andresen, J.W. 1977. University arboricultural education in North America. J. Arboric. 3(2):27–32.

———. 1981. Current trends in North American university arboricultural education. J. Arboric. 7(10):253–257.

Andresen, J.W., and B.M. Williams. 1975. Urban forestry education in North America. J. For. 73(12):786–790.

Andresen, J.W., and C. Johnson. 1982. Is urban forestry education ready for the future?. J. For. 80(10):658–659.

Ball, J. 1987. Technical arboricultural education. Arbor Age 7(8):16, 18.

Campana, R.J. 1999. Arboriculture: History and Development in North America. Michigan State University Press, East Lansing, MO. 443 pp.

Chadwick, L.C. 1941. Arboriculture education. Arborist's News 6(7):49–51.

Coufal, J.E. 1979. How many technical schools and students? How much employment? J. For. 77(2):99–101.

Deneke, F.J. 1978. Urban forestry education interdisciplinary programs]. J. Arboric. 4(7):154–156.

Felix, R. 1987. Arboriculture: A career in search of employees. Am. Nurseryman 165(3):59–67.

Gerhold, H., and S. Frank. 2002. Our Heritage of Community Trees. Pennsylvania Urban and Community Forestry Council, Mechanicsburg, PA. 73 pp.

Green, S., N. Salkind, and T. Akey. 2000. Using SPSS for Windows: Analyzing and Understanding Data. Prentice Hall, Upper Saddle River, NJ. 195 pp.

Hildebrandt, R.E., D.W. Floyd, and K.M. Koslowsky. 1993. A review of urban forestry education in the 1990s. J. For. 91(3):40–42.

Hirt, R.R. 1974. Opportunities in arboriculture. Arborist's News. 39(11):169–175.

Johnson, M., and L. Shimada. 2004. Urban forestry in a multicultural society. J. Arboric. 30(3):185–191.

Jorgensen, E. 1970. Urban forestry in Canada,, pp. 43a–51a. In Proceedings of the 46th International Shade Tree Conference.

King, G. 1977. Principles of education in arboriculture. J. Arboric. 3(7):137–140.

———. 1979. Education in arboriculture. J. Arboric. 5(7):159.

Konijnendijk, C. 1997. A short history of urban forestry in Europe. J. Arboric. 23(1):31–39.

Konijnendijk, C., T. Randrup, and K. Nilsson. 2000. Urban forestry research in Europe: An overview. J. Arboric. 26(3): 152-161.

Kuhns, M.R., H.A. Bragg, and D.J. Blahna. 2002. Involvement of women and minorities in the urban forestry profession. J. Arboric. 28(1):27–34.

McPherson, E.G. 1984. Employer perspectives on arboriculture education. J. Arboric. 10(5):137–142.

Miller R.W. 1994. Urban forestry education: Traditions and possibilities. J. For. 92(10):26–27.

Nilsson, K., and T. Randrup. 1997. Urban and periurban forestry, pp. 97–110. In Forest and Tree Resources: Proceedings of the XI World Forestry Congress, Vol. 1., 13–22 Oct. 1997, Antalya, Turkey.

Penn-Del Chapter of ISA. 2001. Arboriculture: The State of the Industry. The Pennsylvania Delaware Chapter of the International Society of Arboriculture, Bedminster, PA. 10 pp.

Randrup, T., C. Konijnendijk, and F. Andersen. 2001. Review of higher education on urban forestry in Europe. Report of COST Action E12. European Communities, Luxembourg. 229 pp.

Rodbell, P.D. 1993. Back to the books. Urban For. 12(6):11.

Ryan, H.D.P. III. 1981. Arboricultural education: Is there a problem? J. Arboric. 7(7):183–185.

[1*]*Assistant Professor of Community Forestry*
108 Ferguson Building
Penn State School of Forest Resources
University Park, PA 16802, U.S.

[2]*Assistant Professor of Urban and Community Forestry*
Texas A&M University
Department of Forest Science
College Station, TX 77843, U.S.

[3]*Director of Educational Goods and Services*
International Society of Arboriculture
P.O. Box 3129
Champaign, IL 61826, U.S.

Résumé. En juin 2002, un sommet d'éducation de deux jours sur l'arboriculture et la foresterie urbaine a été tenu par l'International Society of Arboriculture (ISA) à l'Arboretum Morton à Lisle en Illinois. Au cours des discussions énergiques, des différences dans les opinions entre les éducateurs sont devenues apparentes en ce qui regarde le contenu du curriculum sur divers sujets tels que les sols urbains, la foresterie autours des réseaux électriques, les mesures de sécurité pour l'entretien des arbres et l'utilisation du territoire. Des différences se sont aussi faites jour dans les discussions relatives à d'importants sujets de recherches et d'outils d'éducation. En raison du nombre limité d'éducateurs présents lors du sommet, un vaste effort de sondage a été mis sur pied par l'ISA en 2003 afin de mieux définir les enjeux et de déterminer s'il y avait des corrélations importantes entre les attitudes en arboriculture et les éducateurs en foresterie. Ce sondage questionnait les arboriculteurs et les éducateurs en foresterie urbaine des États-Unis à propos de leurs opinions concernant l'importance et la provision adéquate de plusieurs talents tels que l'élagage, les techniques de montée, la gestion de la forêt urbaine, l'utilisation du territoire et la gestion du bénévolat. Le sondage posait aussi des questions sur le Programme de certification des arboriculteurs de l'ISA, des composantes du programme éducatif, la nature des relations externes, les sujets de recherches majeurs et les outils éducatifs. Les résultats de cette étude ont permis d'observer qu'il y avait à l'évidence des opinions similaires envers les divers sujets en arboriculture et en foresterie urbaine parmi les divers répondants, et ce à la fois dans les statistiques descriptives et les tests d'indépendance de chi-carré. Les résultats ont aussi indiqué que les sujets traditionnels d'éducation en arboriculture – tels que plantation des arbres et élagage – étaient considérés comme très important par la plupart des participants, tandis que la majorité des sujets en foresterie urbaine – tels que planification de l'utilisation du territoire et gestion du bénévolat – n'étaient considérés que comme peu ou pas important par plusieurs participants. Ces résultats pourraient indiquer un manque de compréhension de l'importance de larges et diversifiés domaines d'éducation en foresterie urbaine, et ce auprès des éducateurs en arboriculture et en foresterie urbaine. Les résultats de cette étude ont aussi supporter l'importance de l'expérience et du programme de certification des arboriculteurs de l'ISA pour modeler des attitudes positives envers la sécurité et l'importance de la compréhension de la structure de l'arbre.

Zusammenfassung. Im Juni 2002 lud die ISA zu einem zweitägigen Treffen von Arboristen und Forstausbildern in das Morton Arboretum in Lisle, Illinois ein. Während der Energiegeladenen Diskussion wurden die verschiedenen Meinungen unter den Ausbildern über den Inhalt des Lehrplans bezüglich Böden, Nutz-Forstwirtschaft, Sicherheit bei der Baumpflege und Landnutzungsplanung deutlich. In der Diskussion kamen auch die Differenzen bezüglich wichtiger Forschungsthemen und Ausbildungsmittel zum Ausdruck. Wegen der begrenzten Anzahl von Ausbildern in diesem Zusammentreffen wurde eine breit gestreute Postumfrage durch die ISA im Jahre 2003 durchgeführt, um die Themen besser zu definieren und zu bestimmen, wo wichtige Korrelationen zwischen der Einstellung der Arboristen und der Forstausbilder liegen. Diese Umfrage fragte Ausbilder in der Baumpflege und Forstwirtschaft in den USA über ihre Meinung zur Wichtigkeit und angemessenen Bereitstellung von vielerlei Fähigkeiten, wie Rückschnitt, Klettern, Stadtforstmanagement, Landnutzungsplanung und Management von Freiwilligen. Der Fragebogen enthielt auch Fragen über das Baumpflegeprogramm der ISA, Programmkomponenten der Ausbildung, den Stand der Außenbeziehungen, wichtige Forschungsthemen und Ausbildungsmittel. Mittels einer deskriptiven Statistik und eines unabhängigen Chi²-Tests bewiesen die Ergebnisse dieser Untersuchung, dass hier sehr wohl einheitliche Meinungen bezüglich der Ausbildungsthemen bei Arboristen und Forstleuten unter den Teilnehmern bestehen. Unsere Ergebnisse zeigten auch, dass die traditionellen Ausbildungsthemen der Arboristen (Klettern und Rückschnitt) von allen Teilnehmern als sehr wichtig betrachtet wurden, während die breiteren Ausbildungsthemen der Forstwirtschaft (Landnutzungsplanung und Freiwilligenmanagement als weniger oder nicht wichtig von den Teilnehmern eingestuft wurden. Diese Ergebnisse können einen Mangel an Verständnis für die Bedeutung vielfältiger Fähigkeiten und breiterer Ausbildungsthemen der Forstwirtschaft bei sowohl den Ausbildern der Baumpflege wie auch der Forstwirte verdeutlichen. Die Ergebnisse dieser Studie unterstützen auch die Bedeutung von Erfahrung und des ISA-Baumpflegeprogramms, indem sie eine positive Einstellung hin zu Sicherheit und dem Verständnis der Baumstruktur aufzeigt.

Resumen. En Junio de 2002 la Sociedad Internacional de Arboricultura (ISA) patrocinó un evento de dos días sobre educación en Arboricultura y Dasonomía Urbana en el Morton Arboretum, en Lisle, Illinois. Durante las discusiones, las diferencias de opinión entre los educadores se orientaron hacia aspectos de contenido de currículo tales como suelos urbanos, servicios en líneas aéreas, seguridad en el cuidado de los árboles y planeación del uso del suelo. Las diferencias fueron también aparentes en discusiones con relación a aspectos importantes de investigación y herramientas educativas. Debido al número limitado de educadores en el evento, la ISA realizó un número de encuestas en 2003 para definir mejor los temas y determinar si existían correlaciones importantes entre las actitudes de los educadores de arboricultura y dasonomía urbana. Esta encuesta averiguó a los educadores en los Estados Unidos sus opiniones acerca de la importancia y provisión adecuada de muchas habilidades tales como poda, trepa, manejo del bosque urbano, planeación de uso del suelo y manejo de voluntarios. La encuesta también preguntó acerca del Programa de Arboristas Certificados de la ISA, componentes del programa educativo, la naturaleza de las relaciones exteriores, tópicos importantes de investigación y herramientas educativas. Tanto en estadísticas descriptivas y en pruebas de independencia de Chi-cuadrado, los resultados de este estudio prueban la evidencia de que las actitudes fueron muy consistentes hacia los tópicos de la arboricultura y la dasonomía urbana a través de los participantes. Nuestros hallazgos también indicaron que los tópicos educativos tradicionales de arboricultura (tales como plantación de árboles y poda) fueron considerados muy importantes por casi todos los participantes, mientras que los amplios temas educativos de la dasonomía urbana (tales como planeación de uso del suelo y manejo de voluntarios) fueron considerados menos, o no, importantes por muchos de los participantes. Estos resultados indican un vacío sobre el entendimiento de la importancia de multi-habilidades y más amplios tópicos en dasonomía urbana tanto para educadores de arboricultura como de dasonomía urbana. Los resultados también soportaron la importancia de la experiencia y del Programa de Arboristas Certificados de la ISA en la modelación de actitudes positivas hacia la seguridad y la importancia del conocimiento de la estructura del árbol.