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Pierre Jutras, Shiv O. Prasher, and Pierre Dutilleul

Identification of Significant Street Tree Inventory Parameters Using Multivariate Statistical Analyses 53

Abstract. Street tree inventories are costly procedures that must be designed to optimally meet management and operational requirements. To assess the importance of several low-technology inventory parameters, a three-step multivariate statistical analysis was designed and tested on growth models of Norway maple (*Acer platanoides*), silver maple (*Acer saccharinum*), common hackberry (*Celtis occidentalis*), green ash (*Fraxinus pennsylvanica*), honeylocust (*Gleditsia triacanthos*), littleleaf linden (*Tilia cordata*), and Siberian elm (*Ulmus pumila*). The first step appraised and compared the significance of qualitative and quantitative parameters. Results revealed that using qualitative indices decreased the explanatory power of models. Accordingly, it was proposed that quantitative parameters be preferred for urban tree inventory. The second step aimed at reducing the volume of necessary information needed for urban tree growth estimation. Various simple and complex combinations of quantitative parameters were tested. Results were conclusive and species independent: the simplified models were statistically non-significant. The best model was composed of multiple parameters. The third step looked for the identification of an inventory parameter that could be used to assess any urban tree physiological stage. It was found that no single parameter can adequately delineate the complexity of all tree physiological stages. The optimal model is rather multidimensional.

Key Words. Correspondence Analysis; Principal Coordinate Analysis; Qualitative Inventory Parameters; Quantitative Inventory Parameters; Street Trees; Urban Tree Inventory.

Tomas Martinez-Trinidad, W. Todd Watson, Michael A. Arnold, and Leonardo Lombardini

Temporal and Spatial Glucose and Starch Partitioning in Live Oak 63

Abstract. Carbohydrate translocation, which follows anatomical and developmental patterns, is ruled by source-sink relations where energy-containing compounds are moved from sources of production to sinks of utilization. Seasonal carbohydrate concentrations in various tree parts were measured and compared in 10 cm (4 in) trunk diameter live oaks (*Quercus virginiana* P. Miller). Tissue samples from roots, trunks, twigs and leaves were collected from three-year-old field-grown trees on four dates throughout the 2005–2006 seasons. Laboratory analyses of glucose and starch were performed, and values were compared and contrasted according to sample location and time of year. Glucose levels were significantly higher in leaves during the winter ($P \leq 0.001$), while starch concentrations were significantly higher in root and trunk tissues during the spring and winter assessments ($P \leq 0.001$). Carbohydrate concentrations varied among tissues sampled within the tree. This study provides valuable information on the spatial and temporal partitioning of energy reserves, glucose and starch, in live oak so that arborists will have a better understanding of tree vitality, and the effects and environmental impacts of arboricultural treatments.

Key Words. Carbohydrates; *Quercus virginiana*; Source-Sink Relations; Sugar.

Brian Kane, Sergio Brena, and Wesley Autio

Forces and Stresses Generated During Rigging Operations 68

Abstract. Rigging is one of the most dangerous aspects of arboriculture, yet there are no robust studies of the forces and stresses generated during rigging. Compounding the inherent danger of rigging is the structurally-deficient condition of many trees that are removed using rigging. Red pines (*Pinus resinosa* Ait.) ($n = 13$) were removed using conventional techniques, and forces at the block and in the rope were measured as the top, and four subsequent pieces were rigged with a block and Port-A-Wrap. Stress in the trunk at breast height was calculated from strain measurements and each tree's modulus of elasticity. Multiple regression was used to determine which independent variables (mass of piece, fall distance and fall ratio, notch angle and depth) best predicted forces. Tops and pieces exhibited different relationships with mass, which was the best predictor of force at the block and tension in the rope. Other variables were not as important and exhibited counter-intuitive relationships with forces. There were few differences in stress generated when removing tops and pieces, which appeared to be due to greater deflection higher in the trunk when tops were removed.

Key Words. Rigging; Trunk Stress; Biomechanics.

Brian Kane and H. Dennis Ryan

Residual Strength of Carabiners Used by Tree Climbers 75

Abstract. Tree climbers increasingly use carabiners and apply them in situations for which they are not designed. Because failure of carabiners can result in serious injury or death, the following study tested how well carabiners endure the stress to which climbers subject them. This study distributed carabiners of four types (all manufactured by Petzl) to climbers in Massachusetts and New York, USA, and collected them a year later. Then, carabiners were broken in a universal testing machine and measured the maximum load, as well as surface roughness. No carabiners broke below their rated strength; and used carabiners were, with one exception, as strong as new carabiners. Surface roughness was a weak, but significant, predictor of strength. Findings are discussed in light of climber safety and the importance of conducting long-term studies.

Key Words. Carabiner; Strength; Tree Climbing.

Giovanni Sanesi, Emilio Padoa-Schioppa, Leonardo Lorusso

Luciana Bottoni, and Raffaele Laforteza

Avian Ecological Diversity as an Indicator of Urban Forest Functionality. Results from Two Case Studies in Northern and Southern Italy 80

Abstract. Greenspaces and forest trees contribute to a number of environmental functions in urban environments, such as the survival of urban-dwelling species (e.g., bird species). This paper analyzes the relationship between greenspace characteristics (structural and spatial attributes) and the diversity of avian ecology species. This provides research findings coming from two studies conducted in Italy. Using point-count method, a quantification was done of the abundance and diversity of bird species in a number of greenspaces having different structural attributes (e.g., vegetation type, tree height) and spatial characteristics (e.g., location, connectivity). Results showed positive correlations between greenspaces with a more diverse and mature forest vegetation and the number of specimens and species observed in the two studies. A positive correlation appeared also between distance to the city centre and richness and abundance of bird species. Finally, we discuss some of the main implications for enhancing the functional attributes of greenspaces by using avian ecological indicators to inform ecologically sound urban planning and design.

Key Words. Urban Environments; Point-Counts; Urban Biodiversity; Forest Birds; Italy; Ecological Indicators; Urban Greenspaces.

Cristina Nali and Giacomo Lorenzini

Residents' Perception of Tree Diseases in the Urban Environment 87

Abstract. Urban greenspaces are essential for the health and well-being of citizens and the presence of trees is a key element for the improvement of urban environments. But trees may become a factor of risk for the citizen when they are diseased, declining or dead. Common people are usually unaware of the intimate causes of plant diseases. Based on a balanced sample of 944 detailed interviews carried out in a structured format by university students, a survey was performed to monitor the perception of citizens of evergreen ornamental plants (*Quercus ilex*) killed by a root disease. Most of the interviewed were customary or moderate frequenters of the venue. Most of the respondents were able to recognize the differences between the dead tree and other conspecific normal individuals, and 86.2% were aware of the risks connected with the collapse of unhealthy trees. Differences amongst genders, age groups, educational levels, and occupation were observed concerning the supposed cause of the death (due to a fungal rot disease). Environmental pollution was indicated as the culprit mainly by young people. Surprisingly, 42.9% of respondents were unable (or unavailable) to give suggestions to administrators concerning the management of public greenery.

Key Words. Environmental Psychology; Declining Trees; Group Interviews; Greenspaces.

Christopher J. Luley, David J. Nowak, and Eric J. Greenfield

Frequency and Severity of Trunk Decay in Street Tree Maples in Four New York Cities 94

Abstract. A proportional random selection of street tree Norway, silver, and sugar maples, and other species among four diameter classes were surveyed in the U.S. New York cities of Albany, Buffalo, Rochester, and Syracuse for decay incidence and severity. Decay was determined by drilling sampled trees with a Resistograph and calculating the ratio of sound wood to radius. Overall, 58.3% of the sampled trees had some amount of decay and incidence was highest in sugar maples and in the largest size class trees. However, decay incidence was high (53.2%) even in the smallest diameter tree size class (30.5–45.7cm (12–18 in)). Decay severity was greatest in silver maple and in the largest diameter trees, although only 3.2% of the trees sampled had serious decay. The study shows that decay is common in street trees but is seldom severe. It also suggests that decay becomes established early in the life of street trees but is most severe in larger diameter trees and in trees that compartmentalize decay poorly such as silver maple. The frequency and severity of decay in the cities studied indicates that they need to continue to identify and manage trees with decay.

Key Words. Decay; Resistograph; Street trees; Maples; Hazard trees; Carbon loss

Francisco J. Escobedo, Christopher J. Luley, Jerry Bond, Christina Staudhammer,
and Charles Bartel

Hurricane Debris and Damage Assessment for Florida Urban Forests..... 100

Abstract. A random 10% sample of communities in highly-impacted counties from the 2004 and 2005 Florida, U.S. hurricane seasons were used to study tree debris generation and damage from seven hurricanes. Woody debris amounts in cubic meters (m³) (cubic yards; yd³) as well as rates and costs for cleanup, tree removal and pruning were obtained for these events. Average debris generation per 30.5 m (100 ft) of street segment ranged from 0.59 m³ (0.77 yd³) for low damage, 3.4 m³ (4.44 yd³) for moderate damage, and 17.47 m³ (22.85 yd³) for high damage levels; cost of removal and disposal averaged \$28.25 per m³ (\$21.47 per yd³). Most communities used unit costing to account for tree removal and pruning rates, averaging 2% and 28% of street trees, respectively. Tree canopy, wind speed, and percentage of urban developed land all had a significant effect on debris amount. Florida communities with a greater tree density generated decreased amounts of debris during the 2004 and 2005 hurricane season. These results can be used to help communities plan for hurricane management activities and estimate potential damages to their tree resource.

Key Words. Emergency Management; Hurricane; i-Tree; Tree Pruning; Tree Removal; Urban Forest Management; Wind Damage.

Wayne A. Geyer, Keith D. Lynch, and Charles J. Barden

Eastern Redcedar Seed Source Test in Western Kansas..... 107

Abstract. Sources of eastern redcedar (*Juniperus virginiana* L.) were established as a provenance test near Colby, Kansas, U.S. in 1980. Height, diameter, number of stems, crown density, branch angle, and general vigor were evaluated with ANOVA, cluster analysis, simple correlation, and regression analysis techniques. Clear source and cluster differences were found. Total height at 23 years ranged from 3.6 to 5.4 m (11.8 to 17.7 ft), dbh (diameter at breast height) ranged from 2.5 to 14.4 cm (1 to 5.7 in), and mean survival rate was 78%. Sources from the central plains grew best. Selection of fast-growing sources may begin at five years after field planting.

Key Words. Growth Characteristics; *Juniperus virginiana* L.; *Juniperus scopulorum*; Seed Sources.
