ARBORICULTURAL ABSTRACTS

USING AVIRIS DATA AND MULTIPLE-MASKING TECHNIQUES TO MAP URBAN FOREST TREE SPECIES

Q. Xiao, S.L. Ustin, and E.G. McPherson

Tree type and species information are critical parameters for urban forest management, benefit cost analysis, and urban planning. However, traditionally, these parameters have been derived based on limited field samples in urban forest management practice. In this study, we used high-resolution Airborne Visible Infrared Imaging Spectrometer (AVIRIS) data and multiple-spectral masking techniques to identify and map urban forest trees. Trees were identified based on their spectral character difference in AVIRIS data. The use of multiple-masking techniques shifts the focus to the target land cover types only, thus reducing confounding noise during spectral analysis. The results were checked against ground reference data and by comparison to tree information in an existing geographical information system (GIS) database. At the tree type level, mapping was accomplished with 94% accuracy. At the tree species level, the average accuracy was 70% but varied with both tree type and species. Of the four evergreen tree species, the average accuracy was 69%. For the 12 deciduous tree species, the average accuracy was 70%. The relatively low accuracy for several deciduous species was due to small tree size and overlapping among tree crowns at the 3.5 m spatial resolution of AVIRIS data. This urban forest tree species mapping method has the potential to increase data update intervals and accuracy while reducing costs compared to field sampling or other traditional methods. (Int. J. Remote Sensing. 2004. 25(24):5637–5654)

MOLECULAR DIVERSITY OF *FRANKIA* IN ROOT NODULES OF *ALNUS INCANA* GROWN WITH INOCULUM FROM POLLUTED URBAN SOILS

K.P. Ridgway, L.A. Marland, A.F. Harrison, J. Wright, J.P.W. Young, and A.H. Fitter

The establishment and growth of trees can be compromised by soil contamination, which can reduce populations of key microbial symbionts. We describe the colonization of gray alder (*Alnus incana*) by *Frankia* from 10 urban soils with varying degrees of organic and inorganic pollution. Principal components analysis (PCA) of soil chemical profiles showed a separation of remediated and unremediated soils. *Alnus incana* seedlings were used as trap plants to capture the microsymbiont from soil. After 6 months' growth, nodulation was lowest on trees grown with the most contaminated soils. Plant biomass was positively correlated with root nodule biomass and negatively correlated with polycyclic aromatic hydrocarbon (PAH) concentration. DNA was isolated from nodules for the analysis of *Frankia* genetic diversity. The polymerase chain reaction (PCR) was used to amplify the 16S-23S intergenic spacer (IGS) of *Frankia* ribosomal DNA. PCR products were subject to restriction digestion yielding 10 restriction fragment length polymorphism (RFLP) types from 72 nodules analysed. Our results demonstrate that each soil supports a distinct nodulating *Frankia* community. Partial 16S sequencing placed most strains in *Frankia* clusters 1a and 1b, which are typically *Alnus incana*-infecting, but sequences from several nodules obtained from a gasworks soil belonged to cluster 3, normally associated with *Elaeagnus*. These results show for the first time that polluted soils can be an effective source of *Alnus incana*-infective *Frankia*. Inoculation with site-adapted *Frankia* under greenhouse conditions could thus be an appropriate strategy to increase the symbiotic capacity of *Alnus incana* and to improve its chances of survival and growth when planted on polluted soils. (FEMS Microbiol. Ecol. 2004. 50(3):255–263)

EXPLORING FUNCTIONAL DEFINITIONS OF MYCORRHIZAS: ARE MYCORRHIZAS ALWAYS MUTUALISMS?

Melanie D. Jones and Sally E. Smith

Mycorrhizas are considered to be classic mutualisms. Here, we define mutualism as a reciprocal increase in fitness of the symbionts, and we review the evidence for mycorrhizal mutualism at the community, whole-plant, and cellular scales. It is difficult to use results of most mycorrhizal studies because (1) fungal contribution to nutrient uptake is not accurately estimated, (2) increased growth is not necessarily correlated with increased plant fecundity or survival, especially in communities, and (3) benefits that occur only at certain times of year, or under specific extreme conditions, may not be detected. To produce the nonmycorrhizal controls required to study mutualism in the field, soil microflora and fauna must be severely perturbed; therefore, it is virtually impossible to evaluate effects of mycorrhizas on plant fitness under realistic conditions. Using the evidence available, we conclude that mycorrhizas can occupy various positions along the continuum from parasitism to mutualism, depending on the specific plant and fungal genotypes and their abiotic and biotic environments. Although we discuss the possibility of defining mycorrhizas by some physiological characteristic, we conclude that mycorrhizas should be defined on a structural or developmental basis and that any requirement to demonstrate mutualism be eliminated. (Can. J. Bot./Rev. Can. Bot. 2004. 82(8):1089–1109)

ATTITUDES TOWARD URBAN GREEN SPACES: INTEGRATING QUESTIONNAIRE SURVEY AND COLLABORATIVE GIS TECHNIQUES TO IMPROVE ATTITUDE MEASUREMENTS

Shivanand Balram and Suzana Dragicevic

Attitudes influence behavior toward urban green spaces. But determining attitudes toward urban green spaces is not well operationalized in urban planning research. A study was conducted in the West Island, Montréal, Canada, to elaborate the design and development of a valid and reliable instrument to measure the dimensions of citizen attitudes toward urban green spaces. The use of qualitative and quantitative phases in the instrument design strengthened the operationalization of the attitude concept. In the qualitative stage, a novel approach integrating collaborative geographic information system (GIS) techniques and informal interviews generated complementary insights about the spatial and nonspatial factors influencing attitude towards urban green spaces. Affinity analysis aggregated the issues into three homogeneous categories that guided the construction of questionnaire items. A self-administered mail-back questionnaire was developed and distributed to 322 households using a multistage cluster sampling strategy; 179 questionnaires were returned (55.6%). In the quantitative phase, factor analysis and reliability analysis were applied to the items set to create a valid attitude measurement scale. The analysis shows that households are characterized by a two-factor attitude structure toward urban green spaces: behavior and usefulness. It is concluded that urban green spaces attitude is a multi-dimensional construct. The implications for green spaces planning are outlined. (Landsc. Urban Plann. 2005. 71:147–162)

DEVELOPMENT OF A DISEASE SEVERITY RATING SCALE FOR PLANE TREE ANTHRACNOSE

María-Luisa Tello, Cristina Redondo, Laura Gaforio, Silvina Pastor, and Eloy Mateo-Sagasta

Anthracnose caused by the fungus *Apiognomonia veneta* (Sacc. et Speg.) H hnel., is the most important and frequent disease affecting mature ornamental plane trees (*Platanus* × *hybrida* Brot.= *P.* × *acerifolia* (Ait.)Willd.) of central Spain. Symptoms of the disease are leaf vein and petiole necrosis, bud death, defoliation, proliferation of shoots growing in whorls, short internodes, cankers, necrotic lesions, and twigs and branches growing in angles. Based on our previous experience, a disease severity rating scale (DSRS) has been established, consisting of six levels: 0 = healthy, 1 = initial, 2 = low, 3 = medium, 4 = high, and 5 = dead. In order to achieve a better and more efficient measure of disease intensity, we tried to quantify this visual scale using mathematical criteria. In 2000, 610 mature trees up to 200 years old, divided into four age classes, were selected and systematically evaluated using a visual estimation based method. The trees were located in central Spain, mainly in two periurban areas of the town of Aranjuez (south of Madrid) and in three urban areas of Madrid city. Trees were observed in late spring, summer, and winter. We recorded visual estimation of disease severity, foliage cover, healthy new shoots, dead branches, shoot growth in whorls, and branch growth in angles. The statistical relationship between the parameters, disease severity, and all the variables recorded (defoliation, healthy new shoots, etc.) has been evaluated. "Leaf density," "dead branches," and "healthy shoots" were the variables that help to discriminate better between the different levels of the DSRS. A clearer definition of the different phases of disease severity will facilitate the application of possible control methods and the prediction of the behavior of other *Platanus* spp. (Urban For. Urban Green. 2005. 3:93–101)

PATTERNS IN HYDRAULIC ARCHITECTURE AND THEIR IMPLICATIONS FOR TRANSPORT EFFICIENCY

Katherine A. McCulloh and John S. Sperry

We evaluated whether patterns in hydraulic architecture increase transport efficiency. Five patterns are identified: area-preserving branching; variable trunk versus twig sap velocity; distally decreasing leaf specific conductivity (K_L) and conduit diameter; and a decline in leaf specific conductance (k_L) of the entire plant with maturation. These patterns coexist in innumerable combinations depending on the ratio of distal/proximal conduit number (F). The model of West and colleagues does not account for this diversity, in part by specifying $F = 1$ and requiring a specific conduit taper derived from the incorrect premise that k_L is constant with plant size. We used Murray's law to identify the conduit taper that maximizes k_L for a given vascular investment. Optimal taper requires the ratio of distal/proximal conduit diameter to equal the ratio of distal/proximal K_L. The smaller these ratios, the greater the k_L. Smaller ratios are achieved by an increase in F. Conductivity and diameter ratios < 1 and F 1 in plants are therefore consistent with maximizing conducting efficiency. However, the benefit of increasing F requires area-increasing conduit branching, potentially leading to mechanical instability of trees. This trade-off may explain why tree stems were relatively inefficient with F near 1 and limited conduit taper compared with vine stems or compound leaves with $F > 1$ and greater taper. Within trees, the anatomies of a coniferous and a diffuse-porous species were less efficient than those of a ring-porous species, presumably because the latter allows conduit area to increase distally without also increasing total xylem area. This is consistent with decelerating sap velocities from trunk to twigs in ring-porous trees versus accelerating velocities in other types. In general, the observed architectural patterns are consistent with the maximization of transport efficiency operating within mechanical constraints. (Tree Physiol. 2005. 25:257–267)