STREET TREE DIVERSITY MAKING BETTER CHOICES FOR THE URBAN LANDSCAPE

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Arguably the loss of the American elm (Ulmus americana) from our city streets gave rise to the current high level of interest and activity in the field of urban forestry and urban greening. These magnificent trees succumbed to Dutch elm disease in the United States over a period of forty-odd years beginning in the 1930's. Because this one species was so prevalently planted (it is estimated that 45% of all street trees in Chicago in 1971 were elms), its demise left a gaping hole which city foresters have been filling ever since (Dreistadt, S.H., et al. 1990).

The devastation caused by Dutch elm disease also called attention to the dangers of planting monocultures, or extensive plantings relying on only a very few species. These prevalent plantings become increasingly vulnerable by encouraging the build-up of pests and diseases.

Unfortunately, the lessons of the American elm are just recently being heeded. But during and directly after the loss of the elm, a replacement was sought to fill in the gaps left by dead elms. Instead of looking for a diversity of tree species, many municipalities repeated the mistake of the past by overplanting a few species. In the 1960's, Gleditsia triacanthos, honeylocust, was thought to be a tough urban contender being fairly tolerant of drought, high pH soils, and salt and is easy to transplant. Only recently are we seeing a build-up of insect pests on Gleditsia (honeylocust plant bug and spider mite to name just two) which can be associated with the vastly increased food supply (Bassuk et al. 1988). Sugar maples (Acer saccharum) which were also over-planted in the Northeastern U.S. are now experiencing a decline. Cities with 20% -50% sugar maple are having to replace vast numbers each year as these trees die. Still, the emphasis among some parks departments and city foresters has ken to find the 'perfect urban tree' which can withstand the multitude of environmental stresses encountered by street trees. Overplanting of Norway maples, green ash, little leaf linden, London plane and others seem to be another manifestation of the same problem. Not only is this short-sighted, but it does not take into consideration the fact that the urban environment is really a series of heterogenous microclimates. One need only to look at the non-uniform growth of identical cultivars of street trees to see that differences in environmental variables such as drainage, soil fertility, pH, salt and the amount of rooting space can create widely differing site conditions within a very short space. Proper site assessment should precede plant selection if street tree plantings are to be successful. The match-up of site limitations with tree adaptability is commonly called the "right plant in the right place". By carrying out site assessments, good plant selection will make more of an impact and diversity should be encouraged.

Having made the case for diversity, it is interesting to note that our urban centers are actually repositories for a wide range of diverse plant materials. Most cities seem to have upwards of 100 or more species on the street, with some milder climates having the greatest number of diverse species (Table 1). However, for many cities, a very few species still make up the greatest percentage of the population, so that the danger of monocultural plantings remains real. It is interesting to compare the number of woody species found in native habitats such as an example from Cattaraugus County, in western New York (Table 2). Very few species colonize these habitats. Adding all of them together would only total 54 (Eaton et al. 1987.). However, a significant difference between natural areas and urban street tree plantings is the former's ability to regenerate. If a disease or insect should decimate the species within such a natural area, regeneration would assure that barren spaces would not exist for any appreciable length of time. In the urban environment, which is heavily managed and interfered with, this regeneration would necessitate the active removal and replacement of the trees.

HOW CAN WE QUICKLY GATHER INFORMATION ABOUT SPECIES HEALTH AND DIVERSITY WITHIN THE URBAN ENVIRONMENT?

Typically, the way in which we have gathered information about street trees has been by the use of street tree inventories – a laborious cataloguing of all trees on all streets. We have developed a new technique using a randomized sample that will provide statistically reliable data on such questions as species makeup, total number of trees, number of unplanted spaces, diameter size class, and general tree health and maintenance.

This is based on technology used by such polling organizations as Nielsen and Gallup. The basic premise of the technique is that in a large population, a random selection of approximately 2000 individuals should provide meaningful data. The important point is that each of the 2000 sample individuals should have an equal chance of being chosen. What makes this technique exciting is that the sample size remains the same regardless of the size of the city or

Table 1 Survey of Cities with Street Tree Inventories

City	Number of Species Making up 65% – 70% of Total Street Tree Population	Total number of Species/Cultivars Found in the Street Tree Population
*Worcester, MA	1	79
*Mobile, AL	2	63
Poughkeepsie, NY	2	65
Orlando Hills, IL	3	--
*Ravenna, OH	3	56
*Franklin, IN	4	64
Ithaca, NY	4	103
*Forest Park, OH	5	56
*Providence, RI	5	98
Rochester, NY	5	- -
*Rockford, IL	5	137
Syracuse, NY	5	- -
**Eureka, CA	6	64
**Lancaster, CA	6	140
*Novi, MI	8	84
**Santa Barbara, CA	8	158
*Arlington Co, VA	9	94
**Manteca, CA	9	85
*Falls Church, VA	11	97
*Lakeland, FL	11	97
**Santa Ana, CA	11	179
**Pasadena, CA	12	253
**Redondo Beach, CA	12	182
**Sunnyvale, CA	12	202
**West Hollywood, CA	12	120
**Monrovia, CA	13	127
**Riverside, CA	14	284
**San Buenaventura, CA	16	169
**Palo Alto, CA	18	258
*Vancouver, BC	19	500
**Encinita, CA	26	229

*Information provided by ACRT, Inc., Kent, OH 44240

**Information provided by Gold Coast Environmental Services, Inc., Irvine, CA 92714

Table 2. Woody Species in Natural Habitats/ Cattaraugus County, New York

Beech/Birch/Maple/ Hemlock Forest	5 species
Bottomlands	10 species
Oak Forests	13 species
High Terraces species	13
Conglomerate Boulders	13 species
TOTAL 54	

street tree population. We have recently conducted surveys of Ithaca, Syracuse, Rochester and Brooklyn, New York containing 5,600, 33,000, 48,000 and 111,000 trees respectively using this technique. Accuracy was excellent compared back to full inventories conducted previously.

Described simply, a city is divided into zones so that the 2000~tree sample can be assured of a good distribution throughout the city. A pre -sample is conducted to determine the distribution of tree numbers on each block and the estimated percentage of street trees within each zone. The final sample is then made so that we can come close to our desired 2000~tree sample. Actual data are taken by a team driving around in a car so that the survey is typically completed in one to two days.

We can see by our results that a very few species make up the vast majority of trees in these cities although the overall breadth of species is often quite impressive. (Tables 3-5)

HOW CAN BETTER PLANT SELECTION HELP OVERCOME SITE LIMITATIONS ?

There are many environmental variables which contribute to the early mortality of urban trees; however, the problems of soil compaction, poor drainage and aeration, high soil pH, road salt and limited rooting space arc common to numerous sites and can have severe consequences on tree growth. In poorly drained sites, plant selection can be very effective in overcoming these problems. Such trees as Quercus bicolor, Nyssa sylvatica, and Taxodium distichum are tolerant of standing water. There are more trees that can tolerate high pH soils than those that require acid soils; however, some of our most popular trees such as Acer rubrum and Quercus palustris are intolerant of this ubiquitous urban phenomenon and disproportionately make this condition apparent. Some underused but very promising street trees that tolerate soil pH's in the 7.5 – 8.5 range or even higher are Tilia tomentosa, Quercus macrocarpa **Quercus** muhlenbergii, and Corylus **colurna.**

Salt tolerance both aerial and soil borne, is a feature of Acer

Table 3 Species Percentages From a 1989 Sample Inventory Compared With a Full 1978 Inventory of Syracuse, NY

SPECIES	1989 SAMPLE	1978 INVENTORY*
Acer platanoides	**31.6%**	31.2%
Acer saccharinum	**11.9%**	16.1%
Acer saccharum	**7.1%**	7.8%
Gleditsia triacanthos	8.1%	5.1%
Malus sp.	5.7%	4.9%
Tilia cordata	7.4%	3.0%
Platanus x acerifolia	2.9%	2.8%
Picea sp.	0.6%	2.5%
Fraxinus sp.	5.1%	2.5%
Acer rubrum	5.6%	2.3%
Acer negundo	1.4%	2.2%
Pyrus calleryana	0.9%	–
Zelkova serrata	0.9%	1.7%
Aesculus sp.	0.2%	1.1%
Exotic maples (A. campestre, A. ginnala)	0.8%	1.0%
Tilia americana	0.2%	1.0%
Prunus sp.	0.8%	0.9%
Celtis occidentalis	0.7%	0.8%
Catalpa sp.	1.0%	0.8%
Ulmus sp.	0.2%	0.8%
Populus sp.	0.2%	0.8%
Juniperus sp.	0.05%	0.8%
crataegus sp.	0.5%	0.8%
carpinus sp.	0.9%	0.7%
Ginkgo biloba	1.2%	0.7%
Betula sp.	0.4%	0.5%
Liriodendron tulipifera	0.6%	–
Quercus sp.	0.6%	–
Ostrya sp.	0.4%	
salix sp.	0.2%	0.596
.Sophora japonica	1.2%	0.5%
Sorbus sp.	0.2%	0.2%
Platanus occidentalis	0.1%	4.7%
Other	1.4%	4.7%
Total Number of Trees	33,453	39,030

* N. Richards, Syracuse University, Syracuse, NY

Table 4. Species percentages from a 1990 sample inventory compared with a full 1987 inventory of Ithaca, NY

SPECIES	1990 SAMPLE	1987 INVENTORY
Acer platanoides	33.7%	33.1%
Acer saccharum	17%	19.0%
Gleditsia triacanthos	9.4%	8.8%
Acer saccharinurn	6.0%	5.9%
Acer rubrum	5.6%	5.2%
Malus spp.	2.5%	2.5%
Platanus x acerifolia	1.2%	0.3%
Ginkgo biloba	2.7%	2.2%
Fraxinus pennsylvanica	1.8%	1.8%
Pyrus calleryana	1.9%	1.5%
Tilia cordata	0.9%	1.7%
Quercus rubra	1.6%	1.7%
Quercus palustris	1.5%	0.7%
Zelkova serrata	0.6%	0.7%
Acer negundo	0.6%	0.7%
Aesculus hippocastanum	0.6%	0.5%
Ailanthus altissima	0.1%	0.2%
Others	13.3%	11.0%
Total Number of Trees	5700	5541

pseudoplatanus and Robinia pseudoacacia. Robinia has many good features which help it to overcome urban stresses. Once established it is both drought and flooding tolerant, fixes its own nitrogen and is tolerant of high pH soils. However, its association with borers makes it an unpopular choice. Three named cultivars of Robinia pseudoacacia were selected by the United States Soil Conservation Service for borer resistance. Up until now, lack of propagation success has limited their dissemination. In the spring of 1990, we successfully rooted softwood cuttings of these clones and hope to test them for wider distribution in the near future.

WHAT ARE THE LIMITS OF PLANT SELECTION?

There is one problem, however, that we cannot select for and that is lack of rooting space. Because of the way in which sidewalks and roads are constructed, their base materials are severely compacted making street tree root growth often contained within the typically 4' x 4' opening in which they are planted. Recent work has begun to show how much rooting space is necessary for tree growth. However, the reality of urban construction often precludes this with notable exceptions.

Where landscape architects have planted trees in large open volumes of

Table 5. Species percentages from a 1990 sample inventory compared with a full 1988 inventory of Rochester, NY

SPECIES	1990 SAMPLE	**1988** PARTIAL INVENTORY
Acer platanoides	**27.5%**	**26.6%**
Acer platanoides 'Columnare'	**2.2%**	**0.8%**
Acer platanoides 'Crimson King'	3.8%	4.5%
Acer platanoides 'Schwedleri'	1.7%	2.5%
Fraxinus pennsylvanica	11.0%	11.3%
Gleditsia triacanthos	10.9%	10.7%
Tilia cordata	8.1%	7.9%
Acer saccharum	4.6%	4.0%
Acer saccharinum	4.1%	6.2%
Platanus x acerifolia	3.2%	3.8%
Liquidambar styraciflua	2.4%	1.9%
Pyrus calleryana	2.3%	1.2%
Malus spp.	2.1%	0.6%
Acer rubrum	1.7%	1.9%
Sophora japonica	1.4%	2.6%
Tilia americana	1.3%	0.1%
Ginkgo biloba	0.9%	1.5%
Quercus rubra	0.9%	1.8%
Others	9.9%	11.1%
Total Number of Trees	48,000	No Estimate

soil with plenty of shared rooting space, tree growth and health have been dramatically superior to trees in contained root zones (Kuhns, L.J. 1985.). These empirical examples point out the need for engineering for rooting space within the urban sidewalk environment. Our latest project serves to address this need: how to meet engineers' requirements yet still provide a medium that allows for root growth, air and water movement into the soil.

There appear to be four factors that are needed to assure street tree success: site assessment, plant selection, site modification where necessary and proper planting techniques. By not following through with any one of these, the entire planting may be in jeopardy. However, by zeroing in on these factors, success in urban greening could become a more plausible and common reality.

LITERATURE CITED

Bassuk N.L. and Jaenson, R.J. 1988. Ithaca Street Tree Survey. Department of Public works, Ithaca, NY.77pp.

Dreistadt, S.H., Dahlsten, D.L. and Frankie, G.W. 1990. Urban Forests and Insect Ecology. Bio Science 40(3) 192-198.

Eaton, S.W. and Schrot, E.F. 1987. A Flora of the Vascular Plants of Cattaraugus County, NY. Bulletin of The Buffalo Society of Natural Sciences. Vol 31.

Kuhns, L.J. 1985. Creative Site Preparation. METRIA: 5. Selecting and Sites for urban trees. pp. 92-94.