Municipal Forest Benefits and Costs in Five US Cities

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ABSTRACT

Increasingly, city trees are viewed as a best management practice to control stormwater, an urban-heat–island mitigation measure for cleaner air, a CO_2-reduction option to offset emissions, and an alternative to costly new electric power plants. Measuring benefits that accrue from the community forest is the first step to altering forest structure in ways that will enhance future benefits. This article describes the structure, function, and value of street and park tree populations in Fort Collins, Colorado; Cheyenne, Wyoming; Bismarck, North Dakota; Berkeley, California; and Glendale, Arizona. Although these cities spent $13–65 annually per tree, benefits ranged from $31 to $89 per tree. For every dollar invested in management, benefits returned annually ranged from $1.37 to $3.09. Strategies each city can take to increase net benefits are presented.

Keywords: urban forest valuation, economic analysis, urban forest management

The urban forest is, in part, an artificial construction, and street and park trees are its most cultivated component. Although less numerous than trees on private land, street and park trees influence the lives—for better or worse—of many residents and are the subject of much concern. In the urban forest, they are the first to be inventoried, and it is this fact that allows for the comparison of five municipal forest populations presented here. The term "population" is used because the trees share common traits, such as similar regional climates. They all are planted and often managed in similar ways by the same institution. At the same time, in certain locales, street and park trees may have more in common with adjacent yard trees than with other street and park trees.

Municipal forest management decisions typically are driven by cost-based budgeting that strives to control expenditures while building better urban forests. The implications of decisions on the future stream of ecological services produced by the urban forest are seldom part of the equation. Yet, increasingly, city trees are viewed as a best management practice to control stormwater, an urban-heat–island mitigation measure for cleaner air, a CO_2-reduction option to offset emissions, and an alternative to costly new electric power plants. Measuring benefits that accrue from the current forest is the first step to altering forest structure in ways that will enhance future benefits.

The purpose of this article is to illustrate relationships between structure, function, and value and the usefulness of such analyses for municipal forest planning and management. Release of the computer program STRATUM (Street Tree Resource Analysis Tool for Urban Forest Managers) in 2006 will make it easy for communities of any size to describe urban forest benefits and management needs as a basis for developing management plans.

Methods

City Selection and Data Collection. Five cities were selected from among sites where the US Forest Service Pacific Southwest Research Station's Center for Urban Forest Research has conducted intensive sampling of public trees, developed growth curves, and used the numerical modeling program STRATUM to estimate annual municipal forest benefits and costs (McPherson and Simpson 2002, Maco and McPherson 2003). These five cities, Fort Collins, Colorado; Cheyenne, Wyoming; Bismarck, North Dakota; Berkeley, California; and Glendale, Arizona, were among the first studied as part of the STRATUM reference city program and were not intended to be representative of the United States. Park and street trees were included in the analyses for all cities except Bismarck, where park trees were not managed by the city's forestry department.

A sample of approximately 30–70 randomly selected trees from each of the most abundant species was surveyed in each city to (1) establish relations between tree age, size, leaf area, and biomass; (2) estimate growth rates; and (3) collect other data on tree health, site conditions, and sidewalk damage. Measurements were taken of dbh, tree and bole height, crown radius, tree condition and location, adjacent land use, and severity of pruning. Crown volume and leaf area were estimated from computer processing of digital images of tree crowns (Peper and McPherson 2003). Curve-fitting models were tested for best fit to predict dbh as a function of age for each species. Tree leaf area, crown diameter, and tree height were then modeled as a function of dbh.

Annual tree program expenditures reported by the community forestry divisions between 2003 and 2005 were compiled. Tree-related expenses captured by other departments for sidewalk and curb repair, leaf cleanup, and trip-and-fall claims were included also.

Calculations. Several structural measures were used in this study. Full street tree stocking assumed one tree for every 50 ft of street on both sides of the street. Importance values (IV) quantify the relative degree to which a species dominates a population and were calculated as the sum of relative abundance, crown projection area (CPA; area under tree dripline), and leaf area (LA) divided by three. "Typical" tree traits were calculated by dividing total CPA, LA etc. by total tree numbers.

Growth rate information was used to "grow" the tree population for 1 year. Population numbers were assumed to remain constant. The modeling approach directly connected benefits with tree size variables such as dbh and LA. Prices were assigned to each benefit through direct estimation and implied valuation of benefits as environmental externalities.

Numerical modeling techniques in the computer program STRATUM were used to calculate annual benefits. The methods have been described in previous publications (McPherson et al. 2000, 2005, Peper et al. 2004a, 2004b, Maco et al. 2005); therefore, this article summarizes the most salient points.

Energy Savings. Changes in building energy use caused by tree shade were based on computer simulations that incorporated building, climate, and shading effects (McPherson and Simpson 1999). Typical meteorological year weather data and building characteristics for each city were used. The distribution of street trees with respect to buildings was based on a field sample for each city. The dollar value of electrical energy and natural gas savings was based on marginal electricity and natural gas prices supplied by local utilities.

Atmospheric CO_2 Reductions. Sequestration, the net rate of CO_2 storage in above- and belowground biomass over the course of one growing season, was calculated with tree growth data and biomass equations for urban trees (Pillsbury et al. 1998). CO_2 released through decomposition of dead woody biomass was based on annual tree removal rates. To estimate CO_2 released due to tree maintenance activities, annual consumption of gasoline and diesel fuel reported by each community forestry division was converted into CO_2-equivalent emissions.

Reductions in building energy use result in reduced emissions of CO_2. Emission reductions were calculated as the product of energy savings and CO_2 emission factors for electricity and heating. Heating fuel was natural gas, and the fuel mixes for electrical generation varied by city. The value of CO_2 reductions was \$15/tn CO_2 based on the average of high and low estimates by CO2e.com (2002).

Air Quality Benefits. The hourly pollutant dry deposition per tree was expressed as the product of deposition velocity $V_d = 1/(R_a + R_b + R_c)$, pollutant concentration C, crown projection area (CPA), and a time step, where R_a, R_b, and R_c are aerodynamic, boundary layer, and stomatal resistances. Hourly deposition velocities for ozone (O_3), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and particulate matter of $<$10-micron diameter (PM_{10}) were calculated using estimates for the resistances R_a, R_b, and R_c for each hour throughout a "base year" (Scott et al. 1998). Hourly meteorological data and pollutant concentrations were obtained from local monitoring stations for years when pollutant concentrations were near average.

Energy savings result in reduced emissions of criteria air pollutants (volatile organic hydrocarbons [VOC], NO_2, SO_2, and PM_{10}) from power plants and space-heating equipment. These avoided emissions were calculated using utility-specific emission factors for electricity and heating fuels.

Emission of biogenic VOCs (BVOCs) was included in the analysis because of concerns about their impact on ozone formation. The hourly emissions of carbon as isoprene and monoterpene were expressed as products of base emission factors and leaf biomass factors adjusted for temperature (monoterpene) or for sunlight and temperature (isoprene). This approach did not account for the benefit associated with lowered summertime air temperatures and the resulting reduced hydrocarbon emissions from anthropogenic and biogenic sources.

The monetary value of tree effects on air quality should reflect the value that society places on clean air, as indicated by its willingness to pay for pollutant reductions. We used several approaches depending on the availability of local data. For Berkeley, where emission reduction credits are traded in a regional market, the price was based on the 3-year weighted average. In Glendale, control costs reported by the Maricopa Environmental Services Department were used. Lacking specific data for the other cities, air quality benefits were calculated as damage values using regression relationships between emission values, pollutant concentrations, and population numbers (Wang and Santini 1995).

Stormwater Runoff Reductions. A numerical interception model accounted for the amount of annual rainfall intercepted by trees, as well as throughfall and stem flow (Xiao et al. 2000). The volume of water stored in tree crowns was calculated from CPA, LA, and water depth on canopy surfaces. Hourly meteorological and rainfall data for years when total precipitation was close to the average annual amount were used.

Stormwater reduction benefits were priced by estimating costs of controlling stormwater runoff. Total expenditures for retention/detention basin land acquisition, construction, and annual maintenance and operation costs for 20 years were calculated. This life-cycle cost was divided by the volume of water stored in the basin over the 20-year period to calculate the control cost (dollars per gallon). The stormwater-runoff reduction benefit was the product of this price and the amount of annual rainfall interception attributed to the trees.

Aesthetics and Other Benefits. Many benefits attributed to urban trees are difficult to price (e.g., beautification, privacy, wildlife habitat, sense of place, and well-being). However, the value of some of these benefits can be captured in the differences in sales prices of properties with and without trees. Anderson and Cordell (1988) found that each large front-yard tree was associated with a 0.88% increase in sales price. In our analyses, aesthetic (A) benefits (dollars per tree per year) reflect differences in the contribution to residential sales prices of a large front-yard tree, the distribution of street and park trees, and the growth rates of trees in each city. These relationships are expressed for a single street tree as

$$A = L \times P$$

where L is the annual increase in tree LA and P is the adjusted price (dollars per square meter per LA):

$$P = (T \times C)/M$$

where T is the large tree contribution to home sales price = 0.88% × median sales price, C is the tree location factor (%) that depreciates the benefit for trees in nonresidential sites, and M is the large tree LA.

Table 1. General information on each city.

	Ft. Collins	Cheyenne	Bismarck	Berkeley	Glendale
City population	135,000	53,011	56,234	104,000	220,000
City area (sq mi)	49.4	22.9	27.5	18.1	59.0
Population density (pop/sq m)	2,731	2,318	2,048	5,752	3,729
Total street trees	16,409	8,907	17,821	30,779	13,184
Total street + park trees	30,943	17,010	17,821	36,485	21,481
Street tree stocking (% of full)	17.8	12.4	36.7	66.3	8.9
Park trees/ac	22.4	8.3		18.4	5.0
Trees/capita	0.23	0.32	0.32	0.35	0.10
Street pavement shaded (%)	11.1	4.9	22.5	27.6	1.8
Mature tree prune cycle (yr)	12	7	6	6	2
Average planting rate (per yr)	500	670	600	600	200
Average removal rate (per yr)	400	179	200	600	200

To capture the total value of annual benefits, the individuals benefits were summed.

Results

City Demographics, Stocking, and Canopy Cover. City populations ranged from about 55,000 in Cheyenne and Bismarck to 220,000 in Glendale (Table 1). Tree population density was greatest in Berkeley, where street tree stocking (66%), trees per capita (0.35), and percentage of street and sidewalk surface shaded (28%) were greatest. Higher public tree densities in Berkeley may reflect the increased abundance and role of public trees in more densely populated urban areas.

Street tree stocking (9%), park tree density (5/ac), trees per capita (0.1), and pavement shade (2%) were lowest in Glendale, where 60% of all inventoried street trees were in wide boulevards along major streets. Extreme aridity and caliche soils contribute to lower levels of canopy cover in deserts than in more temperate regions (Nowak et al. 1996).

Street tree stocking in Bismarck (37%) was near the mean of 38% reported for US cities (Kielbaso and Cotrone 1990). The number of trees per capita for the five cities presented here (0.1–0.35) were all below the 22-city average of 0.37 calculated by McPherson and Rowntree (1989). Managed park trees accounted for nearly 50% of all municipal trees in Fort Collins and Cheyenne, but only 16% in Berkeley. Densities of park trees as in Table 1 ranged from 8 to 22 trees/ac.

Average tree dimensions reflected each population's mix of species and age distribution. Average tree sizes and growth rates were greatest in Fort Collins and Bismarck and lowest in Glendale. For example, average leaf surface areas per tree were 3,226; 2,551; 2,409; 1,702; and 609 ft^2 in Fort Collins, Bismarck, Cheyenne, Berkeley, and Glendale, respectively. The average annual increase in LA ranged from 126 ft^2 in Fort Collins to 61 ft^2 in Glendale. Generally, increased benefits associated with shade, pollutant uptake, CO_2 sequestration, and rainfall interception are associated with greater leaf surface area.

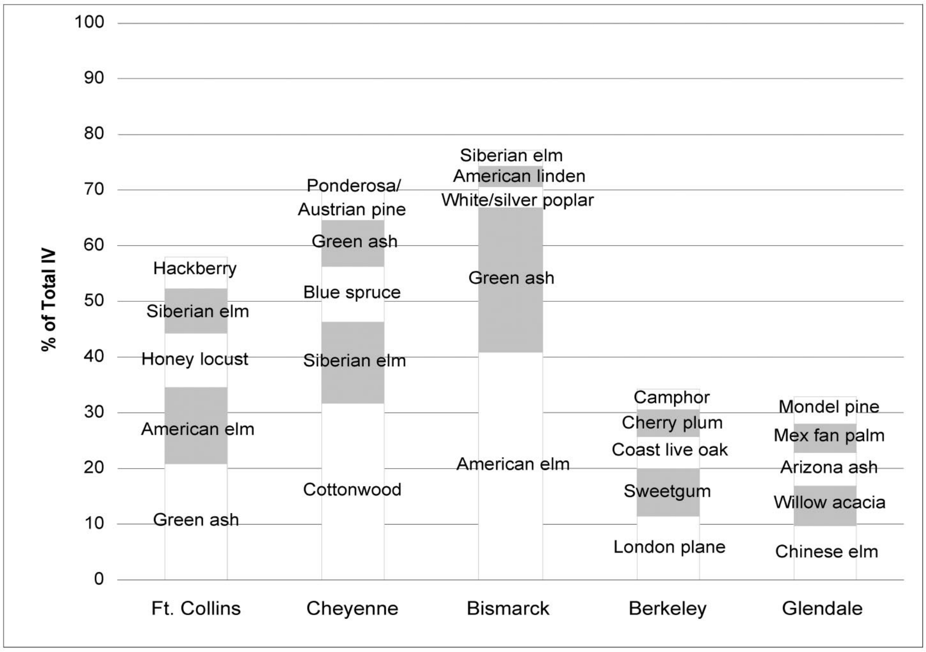

Figure 1. Relative IVs for the top five species in each population indicate how structural dominance is distributed.

IVs. Although these cities contained a rich assemblage of species, from 58 in Cheyenne to 279 in Berkeley, the street tree populations usually were dominated, by virtue of their size and numbers, by relatively few species. This was especially evident in Bismarck, Cheyenne, and Fort Collins, where IVs of the top five species accounted for 60–80% of total IV (Figure 1). These cities exhibited a pattern of codominance, where two species had IVs >10% and their sum exceeded 25% (McPherson and Rowntree 1989). American elm (*Ulmus americana*) and green ash (*Fraxinus pennsylvamica*) were codominants in Bismarck and Fort Collins, and cottonwood (*Populus spp.*) and Siberian elm (*Ulmus pumila*) codominated in Cheyenne. Although these species dominate because of their ability to survive the tests of time, they may not be the most desirable species. For example, cottonwood and Siberian elm are weedy, have invasive roots, and become weak-wooded with age. Similarly, American elm trees are threatened by *Ophiostoma ulmi* (*Ceratocystis ulmi*), and the emerald ash borer (*Agrilus planipennis*) has decimated ash trees in several Midwest states. A catastrophic loss of one or more of these species would leave large structural and functional gaps in the municipal forest.

Compared with cities with temperate climates, importance was distributed more

Economic benefits outweigh costs in all of these cities.

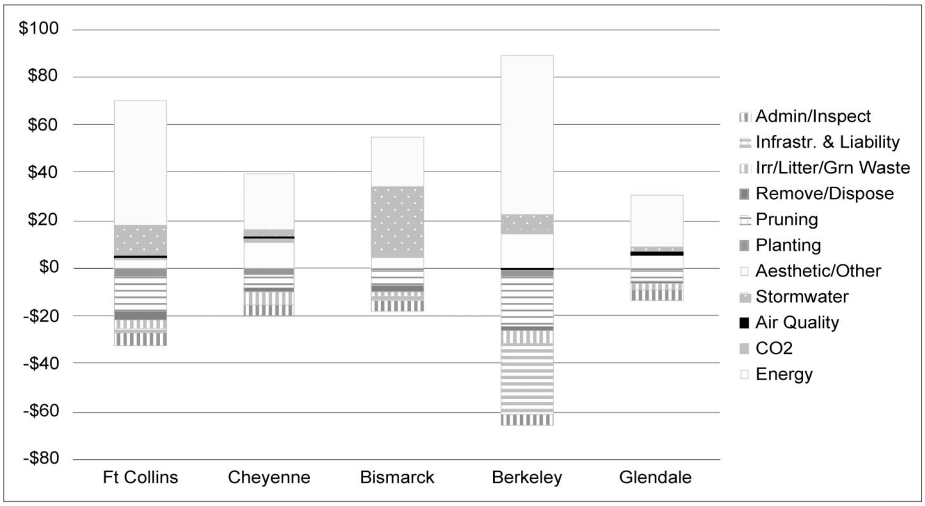

Figure 2. Average annual benefits and costs per tree in each city.

evenly among species in Berkeley and Glendale. From a management perspective, a more equitable distribution of importance indicates that the tree population may be more stable and the future stream of benefits more continuous.

Age Structure. The age structure of municipal urban forests influences population stability and management needs (Richards 1983). Using size as a proxy for age, Richard's "ideal" distribution places the largest fraction of trees in the smallest dbh class (40% with dbh < 6 in.) and the smallest fraction in the largest class. Size distributions of these five cities were within 15% of this ideal. Cheyenne had too few small, young trees and too many large trees. Small trees accounted for over 50% of Glendale's and Fort Collin's populations, and trees in the 18- to 24-in. dbh class were underrepresented. Populations in Berkeley and Bismarck closely matched the preferred distribution.

Municipal Forest Benefits and Expenditures. Total annual benefits ranged from \$665,856 (\$31/tree) in Glendale to \$3.25 million (\$89/tree) in Berkeley (Table 1 and Figure 2). Aesthetic and other benefits were the single greatest benefit, accounting for 59–75% of total annual benefits, except in Bismarck (38%). Aesthetic benefits were greatest in Berkeley (\$67/tree) and Fort Collins (\$52/tree) and lowest in Bismarck (\$21/tree). These results reflect the model's sensitivity to differences in median residential sales prices, which were \$525,000, \$212,000, and \$101,640 for Berkeley, Fort Collins, and Bismarck, respectively.

Stormwater runoff reduction accounted for 51% (\$496,227 or \$28/tree) of total annual benefits in Bismarck and 8–19% in the other cities. This result can be attributed to Bismarck's relatively high interception rates and price for runoff reduction. Average annual interception per tree was 2,985 gal in Bismarck, compared with only 362 gal in Glendale and 2,501 gal in Cheyenne. Trees in Bismarck and Cheyenne were relatively large, and annual rainfall was 15–16 in., compared with only 6 in. in Glendale. Community expenditures for stormwater management were minimal in Cheyenne, resulting in a very low price for runoff reduction (\$0.0013/gal) compared with Bismarck and Glendale (\$0.0093 and \$0.0048/gal, respectively).

Energy savings were particularly important in Berkeley (\$553,061, \$15/tree) and Cheyenne (\$186,967, \$11/tree). The close proximity of street trees to buildings in Berkeley resulted in substantial shading benefit during summer (95 kWh/tree). In Glendale, where summer cooling loads were much greater, trees provided virtually no shade to buildings because of their location along wide boulevards. Their cooling benefit (44 kWh/tree) largely was due to air-temperature reductions associated with evapotranspiration. Winter heating savings were substantial in Cheyenne (\$88,276, \$5/tree), where low temperatures and strong winds accentuated tree windbreak effects.

Annual atmospheric CO_2-reduction benefits and air quality benefits were relatively small, averaging \$1–2/tree. Per-tree CO_2-reduction benefits were greatest in Cheyenne (\$1.71, 228 lb) and Bismarck (\$1.53, 204 lb). In Cheyenne, average per tree avoided emissions (132 lb) from energy savings exceeded sequestered CO_2 (121 lb) because of, largely, high percentages of coal in electric power plant fuel mixes. CO_2 released due to mortality-related decomposition (19 lb) and tree-care activities (6 lb) in Cheyenne totaled 10% of CO_2 sequestered and avoided.

Air quality benefits were greatest in Glendale (\$32,571, \$1.52/tree), where the value of annual avoided emissions of SO_2 and other pollutants released from power plants averaged \$1.56/tree, direct pollutant uptake averaged \$0.69/tree, and emissions of VOCs totaled −\$0.73/tree. Emissions of VOCs were a cost because they are involved in ozone formation. In Berkeley, emissions of BVOCs from large numbers of high-emitting species such as eucalyptus (*Eucalyptus spp.*), sweetgum (*Liquidamber styraciflua*), plane tree (*Platanus acerifolia*), and coast live oak (*Quercus agrifolia*) resulted in a net air quality cost of −\$20,635 (−\$0.57/tree).

Annual municipal forest expenditures ranged from \$276,436 (\$12.87/tree) in Glendale to \$2.4 million (\$65/tree) in Berkeley (Table 2 and Figure 2). Annual costs per tree were \$17.77, \$19.28, and \$32.24 in Bismarck, Cheyenne, and Fort Collins, respectively. These amounts compare with an average of \$19/tree in California (Thompson and Ahern 2000) and values of \$4.62 (Desert Southwest region), \$6.30 (Mountain region), and \$6.48 (Northern Tier region) reported in a national survey (Tschantz and Sacamano 1994). One explanation for higher costs reported here is that nonprogram expenditures (e.g., sidewalk repair and litter cleanup) were not included in the California and national surveys.

Pruning was the single greatest expenditure in three cities, accounting for 27–43% of total annual costs (\$4–21/tree). Administration and inspection costs were the second largest expenditure, ranging from \$4 to \$5/tree. Surprisingly, only 2–14% of total annual expenditures were devoted to tree planting in these five cities. Tree removal and disposal costs were relatively high in Bismarck (\$2.81/tree, 16%) and Cheyenne (\$4.22/tree, 13%), where overmature ashes and elms were expensive to remove. Mitigating conflicts between tree roots and hardscape were extremely costly in Berkeley (\$29/tree), accounting for 45% of total annual expenditures. In Cheyenne, storm cleanup and tree-litter removal accounted for 30% (\$5.75/tree) of annual expenditures.

Yes, trees inhale CO2, but no, urban trees don't amount to much sequestration of CO2.

Table 2. Annual benefits and costs for each city

Total benefits	Ft. Collins	Cheyenne	Bismarck	Berkeley	Glendale
Energy	112,025	186,967	84,348	553,061	116,735
CO_2	40,454	29,134	27,268	49,588	12,039
Air Quality	18,477	11,907	3,715	−20,635	32,571
Stormwater	403,597	55,297	496,227	215,648	37,298
Property increase	1,596,247	402,723	367,536	2,449,884	467,213
Total benefits	2,170,799	688,029	979,094	3,247,545	665,856
Total costs					
Planting	111,052	45,913	5,880	95,000	21,100
Pruning	405,344	84,677	94,850	770,000	88,412
Remove/dispose	130,487	23,337	50,061	70,000	12,710
Im/liter/gm waste	94,394	97,840	38,241	195,000	65,813
Infrastructure and liability	72,200	0	21,490	1,062,000	3,000
Amin/inspect/other	184,161	76,130	106,118	180,000	85,401
Total costs	997,638	327,897	316,640	2,372,000	276,436
Net benefits	1,173,161	358,133	662,454	875,545	389,421
BCRs	2.18	2.09	3.09	1.37	2.41

BCR = benefit-to-cost ratio. Any BCR > 1 is good.

Net annual benefits ranged from $358,133 ($21/tree) in Cheyenne to $1.17 million in Fort Collins ($38/tree). The ratio of benefits to costs was greatest in Bismarck (3.09:1), indicating $3.09 in benefits returned for every $1 invested in management. Although total benefits were highest in Berkeley, relatively high management costs resulted in the lowest benefit-cost ratio (BCR), 1.37:1. BCRs were 2.09, 2.18, and 2.41 in Cheyenne, Fort Collins, and Glendale, respectively.

It is important to acknowledge that the benefit estimates reported here have a range of error not reported. Sources of error include measurement error, modeling error, and random error. If calculated, the confidence intervals that bound each BCR may have a greater range than reflected here solely because of differences among the cities.

Discussion

Measures of structure, function, and value can inform management. For example, Bismarck's BCR of 3.09 is closely coupled to the benefits produced by its codominant American elm and green ash trees. These two species accounted for 52% of all public trees, 67% of structural importance, and 72% of total annual benefits. Sustaining the health, longevity, and productivity of these trees is critical to perpetuating the current level of benefits. In the longer term, future benefits will depend on well-planned planting and training of a diverse mix of large trees to replace the elm and ash.

A similar situation exists in Cheyenne, where codominant cottonwood and Siberian elm account for 33% of all trees and 56% of total structural importance and annual benefits. Intensive care is required to prolong their lifespans. Although the Urban Forestry Division is planting large-growing trees such as linden (*Tilia spp.*), hackberry (*Celtis occidentalis*), and oak to maximize future benefits, quaking aspen (*Populus tremuloides*) is planted most frequently by homeowners along residential streets. Educating the public as to the importance of selecting long-lived, high-benefit–producing trees, and enforcing a planting ordinance with approved species for different planting locations are strategies that could pay dividends in the future if implemented now.

In Fort Collins, small, young trees (<6-in. dbh) make up 53% of the population and 23% of total benefits. Green ash and honey locust account for 14 and 11% of these young-tree benefits. Relying on relatively few species to produce future benefits is risky. Fort Collins is planting and evaluating a host of other species including varieties of white ash, oak, maple, and linden. As a result, their forest is becoming more diverse and, ultimately, more stable.

Glendale's municipal forest is quite complex, with a highly diverse mix of species and ages. Although many young trees are poised to replace the aging mulberry (*Morus alba*), ash, and eucalyptus (*Eucalyptus spp.*), new plantings are needed to increase stocking. Chinese elms (*Ulmus parvifolia*), relatively expensive trees to maintain, account for 16% of all recent plantings. Managers should strive to increase diversity and plant large-growing trees where feasible. Another way to increase Glendale's BCR is to reduce reliance on palms, which comprise 10% of the population. Average annual benefits from small palms, such as Mexican fan palm (*Washingtonia robusta*), 50% of all palms in Glendale, totaled only $6/tree. In comparison, benefits from small conifers, broadleaf evergreens, and deciduous trees were $13, $29, and $20/tree, respectively. Palms are very expensive to maintain, requiring annual inspection and pruning to remove fronds and fruit. By phasing out planting of palms and diversifying planting of more functionally productive species, Glendale can increase future benefits while reducing costs.

Berkeley's municipal forest is well stocked with a relatively large number of young trees. This distribution suggests that a strong young-tree–care program is imperative to insure that the trees transition into well-structured, healthy mature trees requiring minimal pruning. Reducing sidewalk repair expenditures is a cost-savings strategy for Berkeley. Many trees are located in cutouts and strips less than 4 ft wide. Species most associated with sidewalk heave are American elm (46% of elm trees were associated with sidewalk heave), camphor (*Cinnamomum camphora*, 37%), velvet ash (*Fraxinus velutina*, 33%), and sweetgum (32%). Expanding cutouts, meandering sidewalks around trees, and not planting shallow-rooting species are strategies that may be cost-effective when functional benefits associated with increased longevity are considered.

Conclusion

Although sometimes taken for granted, municipal forests are a dynamic resource and valuable community asset. The five cities reported here spent $13–65 annually per tree, but benefits returned for every dollar invested in management ranged from $1.37 to $3.09. Measuring the ecological services produced by city trees provides a sound basis for targeting management efforts to increase benefits and control costs. By tracking changes in BCRs, managers can assess how changes in tree-planting, pruning, removal, and preservation strategies influence taxpayers' return on investment.

This analysis suggests that several structural measures can be useful tools for urban forest planning and management. Knowledge of age structure and species composition can be helpful in projecting whether future benefits are likely to diminish or increase. Knowledge about existing stocking, species composition of recent transplants, and which species have proven well adapted over time can inform planting decisions. IVs, which identify species that dominate a population by virtue of their size and numbers, appear to be good indicators of functional importance.

Results from these five cities cannot be generalized to other cities because variability among cities is high. However, with the 2006 release of STRATUM as a component of the new i-Tree software suite, community foresters will be able to use the measures described here to better understand the structure, function, and value of their tree populations. STRATUM is an easy-to-implement tool that communities of any size can use to describe urban-forest benefits and management needs as a basis for developing management plans. Trained volunteers can conduct full or sample street tree inventories using handheld computers that are configured to streamline data entry. Once recorded and checked, tree inventory data are imported into STRATUM, where analyses are performed and tables, charts, and reports are produced. Starting in 2006, i-Tree software and manuals will be available from the web at no charge (Davey Resource Group, National Arbor Day Foundation, USDA Forest Service 2005), and toll-free technical support and training programs will be available. i-Tree makes the growing body of knowledge about urban forest science accessible to managers, thereby helping us indeed see the forest for the trees.

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