Reducing Hazard in the Urban Forest: The California Tree Failure Report Program

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Tree mechanical failures occur wherever trees exist. Trunk breaks, brunch breaks, or blowovers happen in forests, wildland recreation areas, and in urban landscapes. When trees fall or break in urban landscapes, the result may be personal injury and/or property damage. Trees standing next to highways, school yards, picnic grounds, homes, or other "targets" are of particular concern. In addition, the tree itself may be lost or significantly diminished in value. A mature tree in the urban forest provides multiple benefits, such as shade, habitat, and aesthetic enhancement. Such a loss takes time to replace.

Hazard tree management is an increasingly important component in longterm planning and day-to-day management of urban forests. To strengthen our understanding of what constitutes a hazard tree, we need systematic and objective information about common patterns of tree failure, including environmental conditions, structural defects, or management practices associated with the failure, as well as species profiles for high-incidence tree species. The goal of our research is to provide such systematic information, to better prevent or reduce the incidence of tree failures in urban landscapes.

To collect quantitative information on tree failures, we developed the California Tree Failure Report Program (CTFRP), a reporting program involving arborists and urban foresters statewide (Costello and Berry, 1991). With funding from the Elvenia Slosson Foundation, over the past two years we have expanded and consolidated the CTFRP. There are now more than 1350 reports entered in the CTFRP database, a 70% increase in two years. Over 250 horticultural professionals statewide participate as cooperators in the program, up from about 100 in 1992.

The specific research and educational activities of the program are as follows:

Research

A. Failure Profiles

Statistical profiles of individual species can be constructed from the CTFRP database, when a large enough number of reports for a given species have been received. Such profiles can provide tree care professionals with specific information which can improve management practices and reduce hazard. We have now constructed statistical profiles from CTFRP data for two species: *Pinus radiata* (Monterey pine), and *Quercus agrifolia* (Coast live oak). A manuscript on Monterey pine is in press, J. Arboriculture (R. Edberg, A.M. Berry and L. R. Costello, Patterns of failure in urban trees: Monterey pine). Our profile findings are summarized below:

Monterey pine. Branch breakage of two types accounted for the majority of failures in Monterey pine. First, long, mature limbs broke at some distance away from the point of attachment, suggesting an intrinsic problem with wood strength. This breakage pattern (stubs) was observed both in planted park situations and in natural stands. The second type of breakage was associated with very large diameter,

upright branches. Trees growing singly, rather than in stands, appeared more likely to develop such an architecture. We attribute the development of large-diameter, upright branching to a combination of factors in the urban forest in addition to spacing, including tree age, over-fertilization, and genetic background (most planted Monterey pines are derived from a seed source intended for christmas-tree growers, or pulp in New Zealand, so early growth and biomass accumulation rather than mature form would be favored).

Coast live oak. While few failures of Monterey pine were associated with decay, over 80% of Coast live oak failures were noted with decay, often extensive. In other (non-oak) hardwoods, decay was associated with only about 50% of failures. Yet in terms of age-class, oaks do not have a different failure pattern from other hardwoods, i.e., oaks are not failing at an older stage (hence more advanced decay) relative to other hardwoods. Thus the data seem to suggest that decay is a major source of structural problem in oaks. Interestingly also, oak failures occur most often in March, yet unlike other hardwoods, many oak failures (40-55%) are not wind-related. The complete analysis of Coast live oak failure patterns is still in progress.

B. Cost of Tree Failures

Costs associated with property damage, clean-up and repair for failures reported in the CTFRP database ranged from 0 to $100,000. The average cost for 550 cases (all cases listing costs in 1993) was $1650, with a standard deviation of $6485. The most costly species was *Pseudotsuga menziesii* (Douglas fir), with a mean failure cost of $27,606. The least costly tree was *Liquidambar styraciflua* (Sweetgum), which averaged $110 per failure for clean-up. Most of the Douglas firs reported were from altered, natural stands. Further calculations of failure costs based on updated data are in progress.

C. Cooperator Reports on Specific Topics

We prepared reports on specific topics for 19 individuals and organizations in 1992-94, including UC Cooperative Extension personnel, Golden Gate Park, City of Davis, US Forest Service, private consultants, and attorneys. Requests ranged from very specific questions (incidence of pitch canker in the failure database) to broader considerations (trunk failure patterns in Eucalyptus) to questions regarding operations (database structure).

Educational Objectives

Part of our purpose in the CTFRP program is to educate horticultural professionals regarding tree hazard assessment in urban forestry. Our annual CTFRP meeting is an educational workshop, with expert speakers on topics related to tree hazards and mechanical failures. The meeting is well-attended, with participants from a wide range of agencies, including city and state agencies, national park and national forest employees. We have also presented data from the CTFRP at many conferences, including regional and international meetings of the International Society of Arboriculture (ISA), UC Cooperative Extension workshops, the western regional meeting of US Forest Service disease and pest managers, and industry and public shows.

We have now begun to explore with ISA the possibility of extending the concept of tree failure reporting beyond California. There are several possible ways to utilize tree failure reporting, including a central national database, regional networks, or in local management of urban forests, by individual agencies who might integrate such a monitoring module with hazard assessment and tree inventory databases.

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