Garden Club of America Centennial Tree Project: George Ward Park Urban Tree Monitoring

Preserving the Past and Growing the Future

1) **Descriptive studies of tree growth, longevity, and mortality 2) Roles of site design and tree selection on tree growth and longevity, and 3) Roles of tree and site management on tree growth and longevity.**

Guiding Principles for Urban Tree Monitoring Protocols:

- **Keep it simple**

  Protocols should be straightforward and accessible to practitioners and managers, and relevant to organizations that rely on interns and volunteers for data collection.

- **Make it flexible and easily applied by a diversity of users**

  Urban forestry practitioners collect monitoring data for a variety of purposes, so the protocols must be adaptable to different management needs.

- **Seek input from practitioners**

  To ensure that the protocols will be relevant to citizens, municipalities, non-profit organizations, and other users, the protocol development process should seek frequent input from practitioners.

- **Answer key research questions**

  There must be clear uses for the data generated from this monitoring network to answer key research questions about urban tree growth, health, mortality, and longevity.

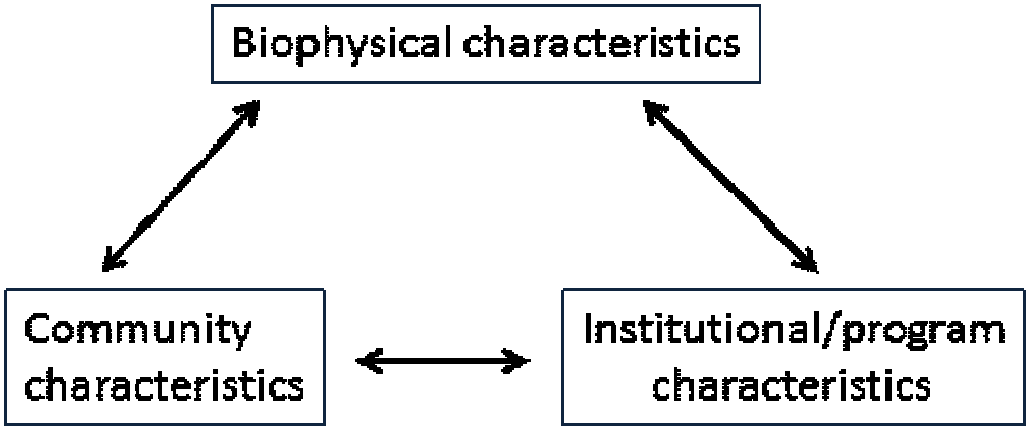
- **Promote management objectives**

  Data collected should be useful for local practitioners to manage their urban forest resources.

GOALS OF URBAN TREE MONITORING PROTOCOLS

1. **Provide technical guidance for long-term data collection in urban forests, ensuring that data generated by local monitoring programs is scientifically rigorous.**
2. **Provide urban forestry practitioners with methods for monitoring that can be adapted to local management needs and organizational capacities, ensuring that the data generated is useful to practitioners.**
3. **Develop a national network of local urban forestry organizations collecting longitudinal data on tree growth and mortality in the same manner. Sharing of these data will facilitate comparisons across programs and cities and strengthen local programs from "lessons learned."**
4. **Use generated data to objectively determine the range of typical urban tree growth, mortality, and performance for age/size classes, species, and site interacting factors influence tree growth and longevity. The monitoring protocols will be a focused set of variables to address specific research and management objectives, rather than a "laundry list" of all possible variables.**

Figure 2.



Conceptual model for urban forests as socio-ecological systems

(adapted from Mincey & Vogt in preparation, Mincey et al. in preparation).

Table 3. Explanatory variables related to urban tree growth, health, and mortality.

Explanatory variables	Example metrics
Biophysical characteristics	
Tree	species, size, health rating, specific pest/disease issues
Site	location type, land use, ground cover, soil properties, maintenance, climate
Community characteristics	
Demographics	socioeconomic status, education level
Neighborhood cohesion	community support networks, neighborhood association involvement
Institutional/program characteristics	
Education and outreach	tree care education, ties to local community
Resources	staffing, funding, time investment

Examples of research questions to drive tree monitoring studies:

1. What are the typical mortality rates for urban trees?

- **What is the shape of the urban tree mortality and survivorship curves? That is, how do mortality rates vary by age and size class?**
- **What effect do the following risk factors have on tree mortality rates?**
    - **Species (or more specifically, species functional groups, e.g., drought tolerant)**
    - **Geographic region, climate**
    - **Location type and land use**
    - **Soil quality**

2. What are the typical growth rates for urban trees?

- **How do annual diameter at breast height (DBH), tree height, and crown diameter growth rates vary by species, climate zone, age, and size class?**
- **What effect do the following risk factors have on tree growth rates?**
    - **Geographic region**
    - **Location type and land use**
    - **Soil quality**

3. How is tree health affected by the above site factors?

- **Health outcomes to consider: categorical health rating, crown foliage metrics (e.g., % dieback), presence/absence of specific pest and disease issues**

4. What planting rates are necessary to achieve a stable or increasing population size and canopy cover, given observed rates of tree growth and mortality?

5. What is the functional performance of the urban forest over time?

- **How do observed tree growth and mortality rates affect projected and observed ecosystem services?**

5. **How accurate are data collected by volunteers or interns with varying levels of training?**

MANAGEMENT OBJECTIVES

Research questions feed directly into management considerations for urban forest practitioners. Examples of management objectives are:

1. **Evaluate the success of urban forest programs and planting projects in terms of tree growth and mortality.**
2. **Support sustainable urban forest management by projecting the necessary level of tree planting to increase population size and canopy cover.**
3. **Improve urban tree survival, health, and growth by adjusting program operations in reaction to observed trends in growth and mortality.**
4. **Improve urban forest ecological literacy by engaging volunteers, student interns, and local residents in data collection.**

INITIAL PLAN FOR PROTOCOL STRUCTURE

1. Minimum data set

- **Basic information about tree characteristics, mortality status, and health status, including accurate tree location information and dates of data collection**
- **To participate in the monitoring network, an organization would need to commit to collecting *at least* the minimum data set**

A. Date

- **Baseline data: date of tree planting (for monitoring a planting cohort) or date of inventory (for repeated census/inventory)**
- **Monitoring data: date of field work**

B. Location

- **Location information should be sufficiently detailed and accurate for the following purposes: 1) reliably locating trees during future monitoring years, and 2) post-hoc classification of tree location for land use and US census tract data**
- **Need to decide which of the following location records to emphasize most, possibly require at least two forms of location information for every tree**
- **GPS coordinates**
- **Address (with coding for multiple trees in front of the same address, possibly also with street facing and side of street)**
- **Reference objects (technique used in i-Tree Eco, distance and orientation to a permanent object in the landscape, e.g., fire hydrant, building corner)**
- **Site map**
- **Google Earth map / Google Maps placemarks**
- **Tree and/or plot location pictures**
- **Tree tags and/or permanent plot markers**

C. Tree species

- **Species information should be recorded with scientific names: genus, species, and cultivar (if known)**

- **If any of the above information is not known: genus only is preferable to nothing; for completely unknown trees, field crews should at least note deciduous/evergreen and conifer/broadleaf (or MACLASS / PACLASS categories from i-Tree)**
- **Use species codes from i-Tree**
- **Species data then can be classified by functional groups (e.g., native vs. non-native, water usage level or drought tolerance level)**

D. Mortality status

- **Alive (Mature)**
- **Sapling (3-15 years)**
- **Standing dead**
    - **Strict definition of standing dead: absence of green leaves and live buds; trees that are in extremely poor health and dying should be categorized as alive (tree health condition rating is a separate metric)**
- **Removed**
    - **Applies only to trees observed alive or standing dead at the last observation**
- **Unknown**
    - **Trees that were observed during the previous monitoring check, but which currently have unknown status due to a) inaccessible property, or b) unclear notes from past years**

E. Diameter at Breast Height (DBH)

- **Use standard DBH protocols (from Urban Forest Data Standards, FIA, i-Tree)**

- **Include specific instructions for multi-stem trees, branching or other obstructions on the trunk**
- **Exact height of DBH must be recorded (if 4.5 ft could not be used due to branching or obstruction)**
- **Emphasize use of accurate tools to measure DBH growth over time (use DBH tape or caliper, instead of Biltmore stick or estimates from a "windshield survey")**
- **We should explore the potential for more accurate approaches to DBH growth used in non-urban forest plots, at least on a subset of trees: a) marking height of DBH recording for future re-measurement, b) dendrometer bands**

F. Health condition rating

- **Not certain if this should be in the minimum data set, or should instead be in the supplemental tree characteristics data set**
- **The Protocol Drafting Team will need to agree on a standard health condition rating (e.g., 1=dying to 4=excellent)**
- **Each rating category should be clearly defined in terms of observed foliage and wood condition**
- **We should compare/contrast health condition ratings from i-Tree Streets, Urban Forest Data Standards, other urban forest researchers, and techniques currently employed by practitioners with ongoing monitoring programs**
- **Consider alternatives to health condition rating, such as % canopy missing or % canopy dieback (from i-Tree Eco)**

G. Location type

- **Not certain if this should be in the minimum data set, or should instead be in the supplemental site characteristics data set**
- **May follow the location type categories already defined by i-Tree Eco, i-Tree Design**

H. Land use

- **Not certain if this should be in the minimum data set, or should instead be in the supplemental site characteristics data set**
- **May follow the land use categories already defined by i-Tree Streets**

2. Supplemental data sets

- **The supplemental data sets are optional for participating organizations; participants can choose which satellite data sets to use based upon their management objectives and available resources. The protocols should offer guidelines for the expected time, resources, and training required to collect each of the supplemental data sets.**
- **See Table 3 for a list of variables that could be included for the supplemental data sets.**

A. Tree

B. Site

C. Program

D. Community

CITED REFERENCES:

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Lindenmayer, D.B., and G.E. Likens. 2010. The science and application of ecological monitoring. Biological Conservation 143: 1317-1328.

Mincey, S.K. & J.M. Vogt. In preparation. The influence of watering strategy on collective action and survival and growth of community-planted trees. (Manuscript in revision for Arboriculture & Urban Forestry)

Mincey, S.K., M. Hutten, B.C. Fischer, T. Evans, S. Stewart, & J.M. Vogt. In preparation. Structuring institutional analysis for urban ecosystems: A key to sustainable urban forest management. (Manuscript in revision for Urban Ecosystems)

Roman, L.A., McPherson, E.G., Scharenbroch, B.C., & J. Bartens. Identifying common practices and challenges for local urban tree monitoring programs across the United States. (Manuscript in revision for Arboriculture & Urban Forestry)

Urban Forest Data Standards: www.unri.org/standards