A MICROCOMPUTER-BASED PARK TREE INVENTORY SYSTEM

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Abstract. Many communities have special parks that contain trees which receive as much or more care than do most street trees. Planning and managing vegetation in these areas is complex and can benefit from use of computerized tree inventory systems. This report outlines how park trees can be located and inventoried using a coordinate grid system. It also describes a computer program for park tree inventories designed to operate on a microcomputer, and field tested at the State Arboretum of Utah in Logan.

Urban foresters recognize that computerized tree inventory systems are valuable and often indispensable tools for planning and management. Most agree that start-up and operational costs are outweighed by long term benefits associated with rapid data retrieval and data reduction made possible by microcomputers. Benefits commonly cited in the literature include improvements in work scheduling, budget planning, responsiveness to public inquiries, tree species selection, and assessment of alternative planning and management options. To date, most computerized tree inventory systems operate on mini- or mainframe computers and are limited to processing only street tree data. This article describes a microcomputer-based inventory system for park trees. Park trees are defined as trees located in large open spaces such as arboreta, cemeteries, school grounds, golf courses, campgrounds, and municipal parks, gardens, and squares.

Park Trees

Park trees are an often neglected but important component of the urban forest. Giedraitis and Kielbaso (1982) report that nationally, an average of 26% of city tree care budgets is for park trees (61% for street trees). Many cities have special parks and places that contain numerous specimen trees and extensive landscape plantings that receive heavy use and more maintenance inputs on a per stem basis than do streetside trees. These parks are the "pride of the community," and judicious vegetation management is critical to providing amenities the public demands. Use of a computerized park tree inventory system is warranted for these types of parks because of: 1) high maintenance costs due to the heavy use these parks receive, 2) important functions and amenities their vegetation can perform, and 3) large public demand for pleasant and safe recreational environments. Implementation of such a system is also justified by the need to provide tree care as efficiently as is possible in the face of growing competition among municipal agencies for operating funds (4). Systematic vegetation management saves money in the long term (2) and is most easily implemented with assistance of computers (5).

The chief challenge associated with implementation of park tree inventories lies in accurately locating individual trees in large open spaces. Trees cannot be located by address, as street trees often are. In addition, if there are no nearby buildings or walks to act as reference points, the task of locating park trees in the field is tedious and time consuming. One solution to this problem is to overlay the park base map with a coordinate grid system. Trees are first located through use of aerial photos and existing plans. This base map is updated during the tree inventory. Trees can then be easily located by crews through use of X-Y coordinates and the grid base map.

Microcomputers

Barker (1983) notes that the recent development of microcomputers and supporting software has greatly expanded the potential for hands-on use of computers for tree inventory and management work. The major disadvantage of microcomputers is that they process information at a slower rate than mainframes. However, there are several advantages. The major advantage is that they are relatively inexpensive. Second, the information they contain is often more easily accessed. There is no need to wait to get on a terminal, or wait for the output. An important corollary is that an easily accessed machine is likely to be used more extensively than one that is not as "personal." For these reasons, and the fact that a park tree database will seldom contain over 10,000 trees, a computer program called Park Tree Inventory System (PTIS) was developed for the microcomputer. Before describing the program a summary of steps taken to collect and input park tree data for PTIS is presented.

Data Collection and Input

A case study inventory was conducted at the State Arboretum of Utah at Utah State University (USU) in Logan, Utah, during the summer and fall of 1983. The 2366 trees were inventoried (100%) in four work areas. The total area inventoried was 25 acres.

Mapping. Steps outlined below describe how trees were mapped and located in the field (also see McPherson, 1984).

1. Obtain or draw a base map(s) of the area to inventory. Draw to the same scale as vegetation data.
2. Obtain vegetation data. This may be in the form of existing planting plans or aerial photographs.
3. Check the scales of base map and vegetation data. They should be the same.
4. Decide whether to divide the area into smaller work areas. If maintenance crews are responsible for designated areas, then each area can be mapped separately. Alternatively, large areas can be divided into work areas defined by major sidewalks or roads.
5. Determine the appropriate grid cell size. Large grid cells may contain many trees. This makes identification of individual trees difficult. A 50 ft^2 grid was used in Central Park, NY (6) and a 20 ft^2 cell size was used at the USU campus. This cell size worked well because of the relatively small size of the study site, and the close spacing of trees in one work area. When selecting grid cell size, consider the variability in spacing of trees throughout the work area, the overall size of the area, and the expected amount of mapping error.
6. Draw the grid on mylar, which can then be overlayed on base maps, or draw it directly on the base map. Figure 1 shows the X-Y grid coordinates. The origin (X=0, Y=0) is in the southwest corner of the map.
7. Locate trees on the base map using aerial photographs, existing tree plans, or field measurements. Make prints to verify and update tree locations while conducting the inventory.

Although the mapping process appears complicated, it actually can be completed quickly if base maps and vegetation data are present at the appropriate scales. These are readily available in most cities.

Recording tree data. Data collected should pertain to the stated objectives of the inventory and should be recorded in a computer compatible format. Objectives of the USU case study inventory required information of sufficient detail to describe the structure, value and condition of the tree resource, and to estimate future maintenance costs required to substantially improve these aspects of the arboretum. Thus, a PTIS compatible recording format was developed to record the following:

1. *Work area and sheet number* — for cross-referencing
2. *Species name* — a six letter code (e.g., *Acer rubrum* 'Gerling' = ACRUGE)
3. *Grid coordinate location* — X-Y values, respectively
4. *Height* — to nearest 5 ft.
5. *Dbh* — to nearest 1 in.
6. *Age* — estimated age class
7. *Planting area* — land cover types
8. *Location code* — 0-99 for value calculation
9. *Condition code* — 0-99 for value calculation
10. *Pruning needs* — heavy, light
11. *Pruning operations* — raise bottom, thin, etc.
12. *Removal* — new, in 2 yrs
13. *Staking/bracing* — remove, adjust, add
14. *Insect control* — yes, no
15. *Disease control* — yes, no
16. *Fertilization* — standard fertilizer, soil amendment
17. *Irrigation* — more, less
18. *Visibility control* — four obstruction classes
19. *Root control* — five damage categories
20. *New tree planting area* — four cover types
21. *New tree size* — three size categories

The inventory was conducted by landscape architecture students ($5/hr.). An average of 17 trees were inventoried per man hour, or one tree per 3.5 minutes. The estimated cost per tree was $0.30.

Data input. Students also assisted with data input ($5/hr.). Data were transferred from tally sheets to the computer database at a rate of one tree per minute. The average data processing cost was $0.017 per tree.

Park Tree Inventory System

PTIS is a park tree inventory database system designed to contain information about ornamental or shade trees in a park or arboretum environment. It utilizes dBASE II (Ashton-Tate, Culver City, CA 90230). dBASE II is a popular relational database management program that allows the user to create and manipulate a database to store and retrieve information. Users of PTIS must have a copy of dBASE II operating on their computer system.

Although PTIS was written to meet the specific requirements of the USU tree inventory, it was designed to be easily modified. The program can be used by persons with little experience with dBASE II or computers. A general understanding of dBASE II commands will allow the user to more fully utilize the system's capabilities.

PTIS was developed for the IBM-PC (128k bytes of memory), but should run on any microcomputer capable of running dBASE II version 2.4.

A PTIS database consists of a number of records, each containing all the information collected for a specific tree. A standard floppy disk will hold over 1000 tree records. Four databases were used in the USU park tree inventory, one for each work area.

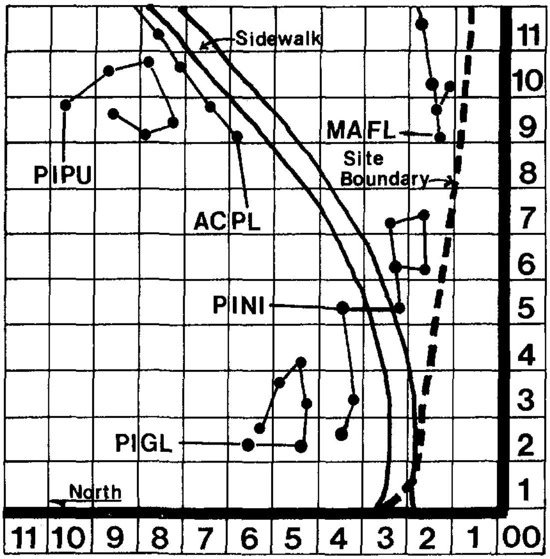

Figure 1. A map with grid overlay shows tree species and locations. X coordinates run south to north and Y coordinates run west to east.

PTIS options. PTIS displays a master menu that allows selection of one of nine options. These options are briefly summarized below.

HELP provides general information on the program and specific instruction on the operation of each option.

INPUT allows the user to add new records to the database using the full screen editing capabilities of dBASE II.

EDIT permits corrections to be made to previously entered records. Specific tree records can be obtained directly if the tree's identification number (SYSID) is known. Otherwise, the user can locate the erroneous tree record by providing species, work area, X and Y coordinates, dbh, and height. Records that meet requested criteria are displayed on the screen.

SEARCH enables the user to perform more sophisticated searches. Output can be directed to the printer for paper copy.

BROWSE utilizes the dBASE browse feature to edit the database.

HISTORY/UPDATE provides a record of operations performed on trees in the database. The Update procedure begins by locating the desired tree record and displaying the SYSID, work area, location, species name, dbh, and condition code. Condition code and dbh can be changed to reflect the effects of tree care operations on tree value, which is recalculated for each tree. Information on the crew, operation performed (e.g., pruning, fertilization), and further description can be entered (e.g., heavy pruning, liquid fertilizer). The date of operation(s) and time required to perform tasks are also requested.

REPORT provides summaries of database and tree record outputs. Summaries can include all or any specified part of the database. Output is displayed on the screen and can be printed on paper. Database summaries are programmed to provide specific information by species and dbh. The user can select from five database summaries.

Species Summary provides summary information on number, percent of total, average dbh, height, condition, value, total value of species, and percent of total value by species.

Species Composition and Age displays number,

Table 1. Park tree inventory system. Database summary for 'Oldmain' work area.

	Diameter distribution					
	under 2"	*2-6"*	*7-10"*	*11-20"*	*21-30"*	*over 30"*
Whole database	4	209	94	214	114	48
Pruning needs:						
heavy	0	3	0	15	12	12
light	1	38	32	97	56	19
Removal needs:						
now	1	5	1	4	2	1
2 years	0	14	6	28	6	1
Insect	0	76	35	63	27	9
Disease	0	18	9	8	3	2
Staking:						
remove	0	0	0	0	0	0
adjust	0	0	0	0	0	0
add	0	0	0	0	0	0
Cavity/wound	0	6	0	1	0	2
Fertilization:						
standard	0	1	0	0	0	0
pH control	0	6	1	2	2	1
Root:						
girdling	0	0	0	1	3	2
heaving	0	0	0	0	0	1
damaged	0	0	0	0	0	1

percent of total, number by age class, average age, dbh, and height by species.

Condition and Value provides information on number, percent of total, number by condition class, average condition and value, total value, and percent of total value by species.

Maintenance Needs presents counts of trees needing pruning, removal, fertilization, insect, and disease control by species.

Maintenance Needs by dbh provides maintenance by dbh class because maintenance costs are strongly correlated with tree diameter Table 1 shows number of trees needing specific maintenance operations for six dbh classes. Number of trees that need pruning, removal, insect control, disease control, staking, cavity/wound repair, fertilization, and root control are listed.

Three types of tree record output reports are available.

Individual Records provides species, work area X coordinate, Y coordinate, dbh, height, and value information for the specified tree record. If the SYSID is not known a SEARCH can be conducted.

Species Records presents the same information described above for each tree of the desired species. The report can also list only trees of the desired species that have a specified maintenance need, are located in a certain area, are greater than a specified size, etc.

Tree History Records lists the history data for a specified tree. Output consists of all operations performed on the tree and supplemental data recorded in the history database.

UTILITY contains a number of miscellaneous functions that provide additional information and flexibility to the user. For example, records of removed trees can be marked for deletion from the database without being deleted. The user knows what trees have been removed, and can still perform counts and searches to acquire more information on these trees.

Conclusion

PTIS provides urban foresters with a useful tool for inventorying, planning, and managing parkland vegetation. The system is now being modified to run on dBASE III and interface with graphics software so that tabular data can be translated into charts and graphs for presentation purposes. Modifications are also being made to accept street tree data. PTIS is available at nominal cost. Inquires about PTIS should be addressed to the third author.

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ABSTRACT

SHOUP, S.C. and C.E. WHITCOMB. 1984. **Activated charcoal does not prevent Hyvar X damage.** Am. Nurseryman 159(7): 41-43.

Hyvar X (bromacil) is frequently used as a total vegetation control herbicide at high rates and has a half-life of more than one year. There have been numerous reports of Hyvar X damage to landscape and street tree plantings. Recommended rates of activated charcoal have not been effective in eliminating further herbicide injury to plants in the heavy clays of central Oklahoma. One purpose of this study was to determine if activated charcoal could deactivate Hyvar X if applied to soil at rates higher than recommended. Another objective was to determine if there are any detrimental effects to landscape plants from applying activated charcoal. This study shows that on a heavy clay soil, activated charcoal at the rate of 5 pounds per 100 square feet is not effective as a short-term solution to injury caused by Hyvar X. Although high rates of incorporated charcoal reduced the rate of development of injury, all test plants eventually died in all plots treated with Hyvar X, even after one year.