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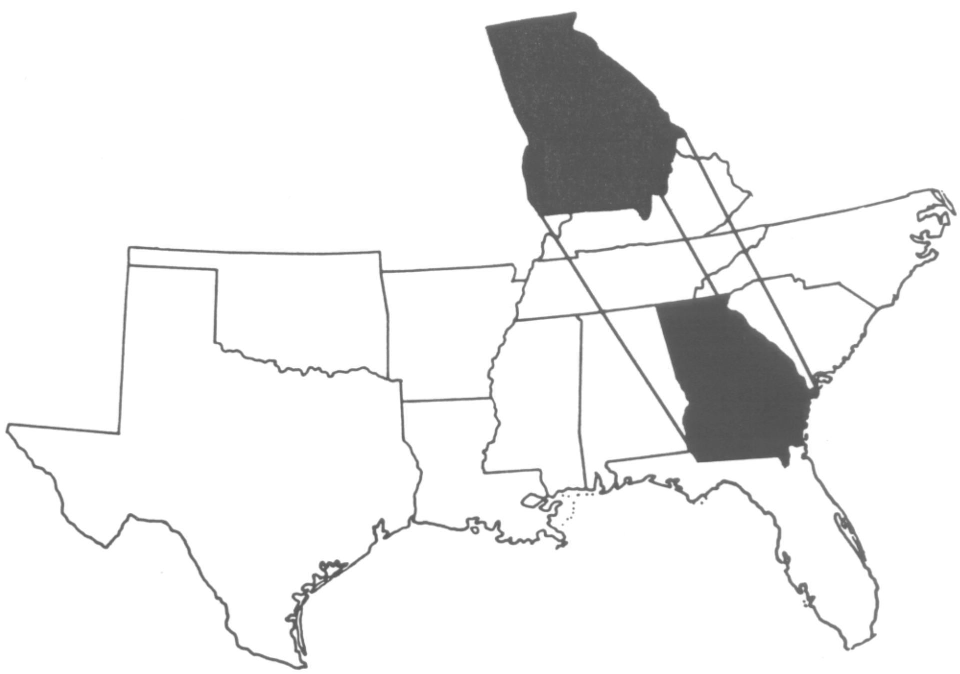
Tree Survival on Wooded Lots Following Home Construction

By
Jane Barrows - Broaddus and L. M. Anderson



About The Authors

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ACKNOWLEDGMENT

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ABSTRACT

This report describes tree mortality around housing construction within two rapidly expanding urban centers in the Piedmont region of Georgia. Thirty-one subdivisions with approximately 3,800 trees in them were surveyed in September 1985. In addition, 879 trees around recently built single- and multi-family units were examined three times over a 23-month period to identify factors that produced injury or death of trees and factors that seemed to promote survival. Of the 3,800 trees, survival exceeded 80% for hardwoods and 95% for pines. The surveys of the 879 trees indicated that construction disturbances adversely affected the general health of many of the trees: 24% deteriorated during the observation period and 57% had symptoms of stress. Homeowners removed 99 trees (11%), not all of them stressed or dead, during the study. Based on these observations, we prepared a list of recommendations builders can use to increase survival and improve the vitality of trees affected by residential construction in Georgia.

INTRODUCTION

As urban development spreads from the cities of Georgia into the woods and fields of surrounding rural areas, trees left by builders become an instant "urban forest" (Figure 1). The decision to preserve, thin, or remove all existing trees affects the builders' construction costs and the prices they can command for their product. Builders usually decide which trees to remove from construction sites. Developers and builders, therefore, wield great influence on the urban forest because they determine the composition of the forest in and around new residential areas (Figure 2), and their activities significantly influence the condition of these trees.

Strong economic incentives exist for leaving trees on residential lots. Seila and Anderson (1982, 1984) studied the costs of tree removal on construction sites in Athens, Georgia, and found that construction costs were often reduced by clearing only the areas essential for the construction of the house, drive, and septic tank.

Wooded lots and homes with landscape trees generally command higher prices in the single-family residential market (Payne 1973.)

Figure 1. As cities into rural areas, trees left by builders become the basis of the urban forest.

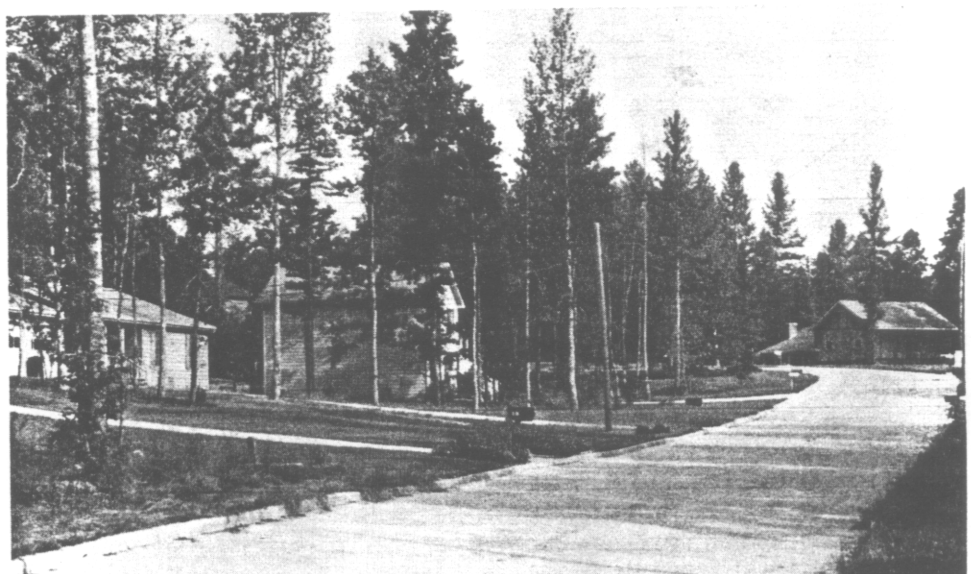

Figure 2. Developers and builders determine the composition of the forest cover in subdivisions.

Anderson and Cordell (1985) documented a 3 to 5% increase in the sale price of single-family houses in Athens, Georgia, associated with the presence of trees in the landscaping. In metropolitan Atlanta, builders reported that a wooded lot increased the price of the average house by 7% or more (Seila and Anderson 1984).

The Problem.

Although builders in the Piedmont region of Georgia recognize the advantages of leaving trees on the lot, many urban foresters feel that builders are less aware of the impact of construction activities on trees. Seila and Anderson (1984) found that, as a general rule, builders defined "preservation of trees" during construction as simply not cutting them down. Although this passive preservation keeps costs down for the builder, preservation without precaution against injury increases the risk of tree mortality in the years immediately after construction. Injuries to trees from construction include wounding the trunk by equipment, burial of roots under fill dirt, poisoning of roots with chemicals, severing of roots when trenches for utilities are laid, and other abrupt changes in the trees' environment, such as exposure to full sun or to altered drainage (Figure 3).

Construction damage is now the major cause of urban tree mortality (Cordell and Berisford 1980, Dewers 1979, Yingling et al. 1979) (Figure 4). New homeowners lose twice by paying a higher price for a tree-shaded yard, and then paying for removal of dead or dying trees. Trees left close to the house are especially costly to remove. Further, because sizeable trees in poor condition are more likely to be hazardous, construction damage increases the risk of tree-related accidents and property loss (Anderson and Eaton 1986).

Study Goals

The primary goals for this study were to identify low-cost practices that promote tree survival and to develop guidelines that are reasonable for builders and subcontractors to adopt. To accomplish these goals, we surveyed entire subdivisions and individual lots within the subdivisions to collect information about the effect of construction damage on tree survival.

Each survey was conducted with specific objectives in mind. The subdivision surveys determined the age and price of residences, the forest type, and the ratio of dead to live trees for entire neighborhoods. The individual house surveys identified the condition of trees within specific disturbance zone catagories, their species, and spatial arrangements. Information gathered from both surveys was then analysed to obtain objective and systematic data on the extent of tree damage from construction and to determine which factors influence tree survival.

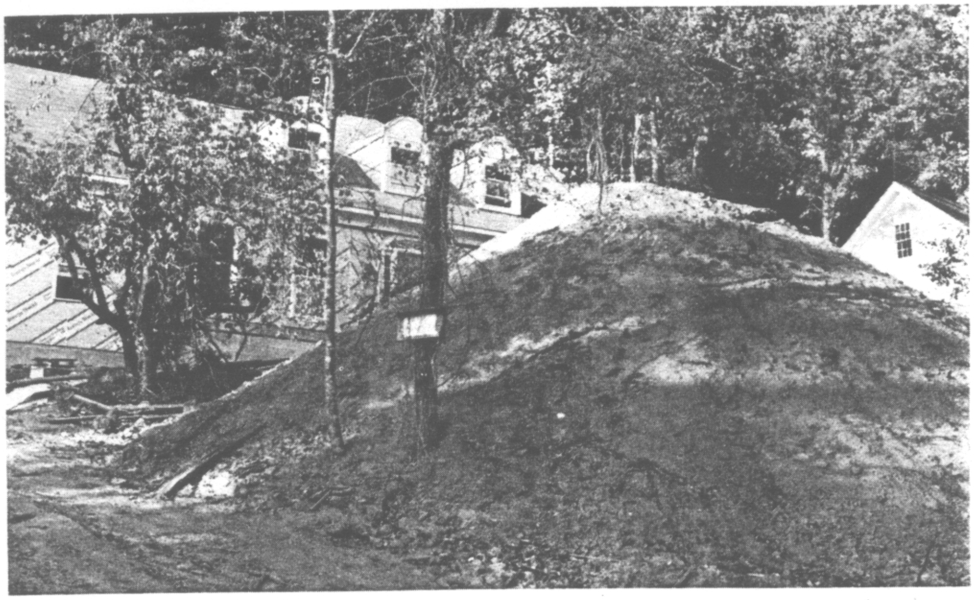

Figure 3. Injuries to trees, such as burial of roots under fill dirt, increase the risk of tree mortality in the years immediately following construction.

Figure 4. This photograph, taken in late summer, illustrates how trees located on single-family residences suffer mortality (black arrows) and poor condition resulting from construction disturbances in the small land area left for them.

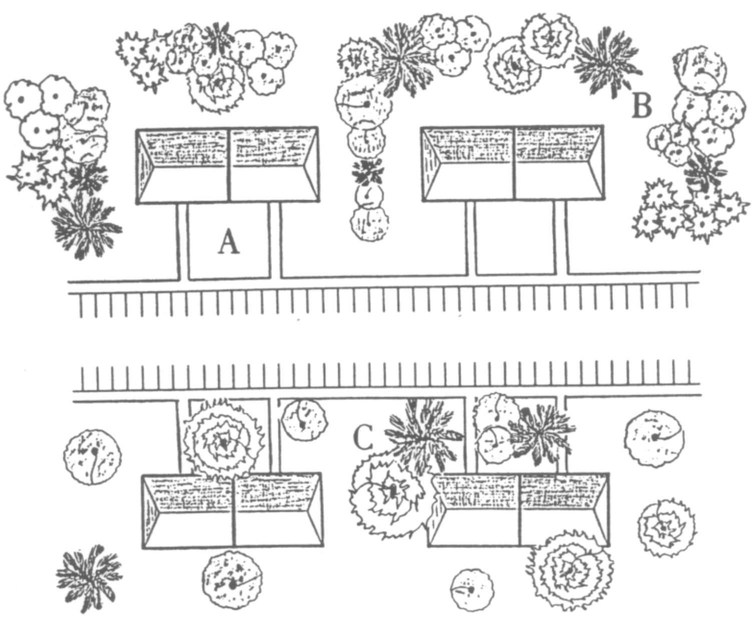

Figure 5. For multi-family residences with setbacks less than 30 feet from the street, we recommend (A) clearing trees within 15 feet of walkways and buildings, but (B) leaving borders of trees outside major construction disturbances. Large trees (>20 in dbh) left close to the residence (C) are more likely to die and be more expensive to remove than smaller trees (<20 in dbh) 15 feet beyond the residence or construction disturbance. The same recommendations apply to single-family residences.

PROCEDURES

Subdivision Survey

Residential subdivisions were surveyed in September 1985. Twenty-three of the subdivisions were single-family units and eight were multi-family units. Nine sites were in Clarke County and 22 in Gwinnett County, Georgia. Compiled information included:

1) Name of subdivision
2) Builder or real estate agent
3) Street name
4) Price category (under $80,000/unit, $80,000 to $125,000/unit, and over $125,000/unit)
5) Age category of the subdivisions in general (under construction to 1 year old, 2 to 3 years old, and 4 to 7 years old)

All residences within each subdivision (or on a street within a large tract) were surveyed. The probable type of forest cover on the site before construction (pine, hardwood, mixed pine/hardwood, or none) was determined both from trees left on the lot and from trees in undisturbed border areas. In each yard, we counted the number of living and dead conifers and hardwoods between the front face of the unit and the street.

Individual House Survey

Upon completion of the subdivision survey, we selected residences within each subdivision for a more detailed survey. Sample residences were examined three times-- September 1985, May 1986, and August 1987.

We chose one-third of our samples from each type of forest cover on the lots. Within each forest type, we selected sample sites at random. From 2 to 10 residences were sampled, depending upon the size of the subdivision, for a total of 116.

For each residence selected, a diagram of the front yard was drawn to indicate, in rough scale, the location of all trees, living or dead, that were at least 4 inches dbh (diameter 4 1/2 ft above ground). The following information was recorded on each diagram:

1) Setback (distance from front face of house to street)
2) Location of driveway and any other apparent grading, fill, drainage, or trenches
3) Location of trees in relation to structures, street, drive, and any other disturbances
4) Location of stumps
5) Identification of front yard tree closest to residence with visual estimate of its distance from structure

Each tree on the diagram was identified by number, with the following information recorded:

1) Species
2) Dbh
3) Density category (whether the tree was part of a cluster or stand of trees of any size, including those less than 4 inches dbh, or was standing alone)
4) Disturbance zone category (within 15 ft vs. beyond 15 ft of construction disturbance). This distance was based on the recommendations of Yingling et al. (1979) for removal of trees near road cuts
5) Condition category (no apparent injury; percentage of dead branches or dieback in the crown, calculated according to Horsfall and Barratt's (1945) system for estimating disease incidence; wounds; sprouting of green shoots on trunks and main branches, i.e., epicormic branching; and dead).

RESULTS

Subdivision Survey

We collected data on 3,831 trees on 434 lots in the 31 subdivisions. The characteristics of the subdivisions are summarized in Table 1.

The original forest cover on most lots was a mixed pine-hardwood type (49%), with 23% having a predominantly hardwood cover and 13% a predominantly pine cover. Portions of some subdivisions were built on farm pasture land and therefore had no trees (15%). Most of the residences in the subdivisions surveyed were either under construction or less than 1 year old (85%), 6% were 2 to 3 years old, and 9%, 4 to 7 years old.

The average selling prices were $113,000 for a single-family residence and $89,000 for a multi-family residence.

From the analysis of the data (chi-square, $\underline{P}$ <0.05), we could make the following general statements about the trees in the subdivisions:

1) The percentage of mortality was highest (14%) for hardwoods on lots 2 to 3 years after construction. Mortality of conifers (2%) was not associated with residence age.
2) Mortality of hardwoods was highest on lots for multi-family residences (12%) and lowest for single-family residences costing more than $125,000 (6%). Mortality of conifers was also lowest (1%) for the latter type of residences.
3) Type of forest cover was not associated with type of residence (single vs. multi-family) or with its price.

Individual Lot Survey

We collected data on 974 trees on 116 lots. We identified 24 native conifer and hardwood species. All but 10% of these trees fell into four genera--oak (Quercus), pine (Pinus), sweetgum (Liquidambar), and yellow-poplar (Liriodendron). We observed too few individual trees in other genera to draw conclusions about them. The total number of trees in these four genera was 879.

A summary of tree survival and condition is given in Table 2. In September 1985, we found that 27% of the trees surveyed were in poor condition. By May 1986, this percentage increased to 55% In August 1987, we observed a slight improvement in the trees' condition (50% trees showing symptoms of stress).

Between the first and second surveys, 27 of the 879 study trees (3%) were removed by homeowners. Sixteen of the removed trees were rated as stressed and 11 as healthy at the time of the first survey. The healthy trees that were removed were all loblolly pine (Pinus taeda L.).

Between the second and third surveys, homeowners removed 72 trees (8%), 41 hardwoods and 31 pines. Most of the cut trees (88% of hardwoods and 83% of pines) were rated either dead or in poor condition at the time of the second survey.

From the analysis of data (chi-square, P=0.05), we could make the following general statements about the trees on the lots:

1) Oaks and yellow-poplars fared the poorest in terms of percentage of survival and condition after construction. Of the hardwoods, sweetgums performed best. Best survival and subsequent condition, however, occurred in conifers (mostly loblolly pine).
2) Trees located in multi-residence lots or within 15 ft of a structure or disturbance had the highest rate of mortality and highest percentage of survivors in poor condition.
3) Survival and condition of trees in a clump or group of three or more were slightly better than those of single trees.
4) Detrimental effects of construction were apparent in the first 3 years after building; they were less prevalent on lots between 4 and 7 years old. Trees in poor condition 3 years after construction neither declined nor improved markedly.
5) The best survival was among small trees, <10 in dbh. The condition of trees >20 inches dbh often worsened with time. Oaks were most prevalent within this group.

We observed that builders followed no special practices to protect trees on construction sites. This applied to sites for both multi- and single-family residences, even those costing more than $125,000 per unit. We saw no barricades around any trees. Numerous wounds on tree trunks indicated that no special supervison was exercised to protect trees from careless equipment operators.

CONCLUSIONS

This study demonstrated that even without protection from construction damage, tree survival in general was high for both hardwoods (>80%) and conifers (>95%). These data indicate that leaving trees on residential lots during construction is justified. However, the poor condition of many of the surviving trees indicates a need to improve builders' tree preservation practices. Currently, many homeowners have to remove at least some of the trees left on wooded lots shortly after construction.

The exceptionally dry winter and spring of 1986 may have accentuated the stresses on trees caused by construction. We attributed the recovery of approximately 5% of the trees surveyed in August 1987 to the increased rainfall of that year.

The higher percentage of survival and better condition of trees around single-family homes priced above $125,000 were probably due to the size of the lots. The largest yards, as determined by setback, were in this category. Survival was probably improved by the existence of larger disturbance-free zones in these yards.

Although our data indicated that clusters of trees fared slightly better than single trees, we concur with Yingling et al. (1979) that leaving clusters of trees improves their chances of survival.

Guidelines

On the basis of information given in this paper, we suggest the following guidelines for leaving trees on residential construction sites:

1) For multi- and single-family residences with setbacks of 30 ft or less, leave clusters of trees inside which construction disturbances are minimized, rather than leaving individual freestanding trees. (Figure 5).
2) On lots with setbacks more than 30 ft, establish disturbance-free zones at least 15 ft away from construction activities.
3) Consider clearing trees >20 in dbh if they are within 15 ft of construction, trenching, or grading activity, unless the builder is willing to provide some physical protection for the roots and trunks.

4) Within disturbance zones or close to the unit, careful choice of species will improve the trees' chances of survival. Pines are more tolerant of construction activity than are hardwoods. Among the hardwoods, sweetgums are more tolerant of disturbance than oaks and yellow-poplars.

Our final general observation is that the fate of individual trees at construction sites is not predictable with certainty. For example, we occasionally observed trees apparently in good condition despite what must have been significant disruption of their root systems. Conversely, we occasionally observed dead or dying trees apparently uninjured and far from detectable disturbances. Our suggestions are therefore intended only to help builders improve the odds that the trees they leave on residential lots will not have to be removed by the homeowner within 3 years after purchase.

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Table 1. Summary of Subdivision Characteristics

Feature	Total	Average	10% of Cases Were: Below	Above
Single-Family Residences				
Price of houses		$113,800	$60,000	$186,000
Houses/subdivision	364	16	8	25
Trees/lot	3,317	9	2	30
Tree survival (%)		93	59	100
Hardwood survival (%)		88	50	100
Conifer survival (%)		98	67	100
Multi-family Residences				
Price of units		$89,000	$60,000	$100,000
Units/subdivision	70	9	1	17
Trees/unit	301	7	2	15
Tree survival (%)		92	50	100
Hardwood survival (%)		86	40	100
Conifer survival (%)		98	60	100

Table 2. Survival of Trees on Residential Lots

Location	No	Percent Survival[1]	Percent Exhibiting Stress[2] Sept 1985	May 1986	Aug 1987
Type Tract					
Single-family	717	95	29	47	40
Multi-family	162	79	47	67	70
Distance from Disturbance					
Within 15 ft	437	89	38	68	66
Outside 15 ft	442	95	21	42	42
Relationship to Other Trees					
Freestanding	437	91	32	59	58
In a Stand	442	93	27	51	55
Tree Species					
Sweetgum	152	96	6	45	42
Pine	439	93	20	47	41
Oak	233	89	54	74	69
Yellow-poplar	55	89	27	63	62

[1] Survival based on mortality and does not account for removal of healthy trees by homeowners.

[2] The following symptoms indicated stress: leaves off-color, sprouting of shoots on trunk and main branches, wilt, and 10 to 90% branch dieback (>90% was rated as dead).

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