

**WOODY VEGETATION AND FUEL SURVEY FOR
EVALUATING WILDFIRE HAZARD IN THREE
FREDERICKSBURG BATTLEFIELDS**

David A. Orwig and Marc D. Abrams

Technical Report NPS/MARFRSP/NRTR - 95/066

School of Forest Resources
4 Ferguson Building
The Pennsylvania State University
University Park, PA 16802-4301

Cooperative Agreement
4000-9-8004
Supplemental Agreement No. 14

July 1995

National Park Service
Northeast Field Area
Division of Resource Protection and Visitor Services
U.S. Custom House
200 Chestnut Street
Philadelphia, PA 19106

Abstract

Overstory and understory woody vegetation was surveyed during the summers of 1991-1994 in Fredericksburg, Chancellorsville, and Wilderness battlefields, Virginia to examine forest composition and structure in relation to stand age and edaphic features. All forested areas were delineated and assigned a forest type based on overstory importance values and then vegetation maps were produced for each battlefield. Late successional stands ranged from white oak (*Quercus alba*) and hickory (*Carya* spp.) dominated stands in Fredericksburg Battlefield, dry white oak - scarlet oak (*Quercus coccinea*) forests in Chancellorsville Battlefield, and white oak - tulip poplar (*Liriodendron tulipifera*) forests in Wilderness Battlefield. Young pioneer stands consisting primarily of Virginia pine (*Pinus virginiana*) and sweetgum (*Liquidambar styraciflua*) were common in all three battlefields although a higher incidence of loblolly pine (*Pinus taeda*) occurred in Wilderness Battlefield. Mid-successional stands contained various mixtures of pine and oak species as well as tulip poplar, hickory, blackgum (*Nyssa sylvatica*), and sweetgum. The study area experienced large-scale agriculture, logging, and subsequent land abandonment during the mid- to late 1800s which resulted in the present day composition of many stands. Radial growth analysis indicated that most stands in Fredericksburg and Chancellorsville were initiated within the last 150 years and experienced a pulse of recruitment following logging in the 1890s. In contrast, many stands in Wilderness Battlefield experienced peak recruitment around 1920, indicating that logging occurred during a later time period than other areas of the park. Fuel surveys conducted in representative stands of different forest types revealed low wildfire hazards throughout a majority of the park's hardwood stands. Areas of mature pine that are currently succumbing to natural mortality and windthrow disturbances represented higher wildfire risks with larger amounts of woody debris. Removal of downed fuels to reduce the hazard in these stands should be considered.

Table Of Contents

List Of Figures	iv
List Of Tables	vii
Acknowledgments	x
Introduction	1
Study area	1
Past land use	1
Methods	2
Fredericksburg Battlefield	5
Overview	6
Stand descriptions	9
Cover map key	12
Vegetative composition tables for Fredericksburg (F) Battlefield	15
Age-diameter figures for overstory trees in Fredericksburg (F) Battlefield	28
Fuel loads	36
Chancellorsville Battlefield	38
Overview	39
Stand descriptions	42
Cover map key	45
Vegetative composition tables for Chancellorsville (CV) Battlefield	47
Age-diameter figures for overstory trees in Chancellorsville (CV) Battlefield	60
Fuel loads	68
Wilderness Battlefield	70
Overview	71
Stand descriptions	74
Cover map key	79

Vegetative composition tables for Wilderness (W) Battlefield	81
Age-diameter figures for overstory trees in Wilderness (W) Battlefield . .	105
Fuel loads	118
Literature Cited	120
Appendix A	122

List Of Figures

1. Location of surveyed forest stands - Fredericksburg Battlefield . . .	8
2. Vegetation cover map of Fredericksburg Battlefield. . . .	13
3. Age-diameter relationship for Stand F1	29
4. Age-diameter relationship for Stand F2	29
5. Age-diameter relationship for Stand F3	30
6. Age-diameter relationship for Stand F4	30
7. Age-diameter relationship for Stand F5	31
8. Age-diameter relationship for Stand F6	31
9. Age-diameter relationship for Stand F7	32
10. Age-diameter relationship for Stand F8	32
11. Age-diameter relationship for Stand F9	33
12. Age-diameter relationship for Stand F10	33
13. Age-diameter relationship for Stand F11	34
14. Age-diameter relationship for Stand F12	34
15. Age-diameter relationship for Stand F13	35
16. Location of surveyed forest stands - Chancellorsville Battlefield . .	41
17. Vegetation cover map of Chancellorsville Battlefield. . . .	46
18. Age-diameter relationship for Stand CV1	61
19. Age-diameter relationship for Stand CV2	61
20. Age-diameter relationship for Stand CV3	62
21. Age-diameter relationship for Stand CV4	62
22. Age-diameter relationship for Stand CV5	63
23. Age-diameter relationship for Stand CV6	63
24. Age-diameter relationship for Stand CV7	64
25. Age-diameter relationship for Stand CV8	64

26. Age-diameter relationship for Stand CV9	65
27. Age-diameter relationship for Stand CV10	65
28. Age-diameter relationship for Stand CV11	66
29. Age-diameter relationship for Stand CV12	66
30. Age-diameter relationship for Stand CV13	67
31. Location of surveyed forest stands - Wilderness Battlefield	73
32. Vegetation cover map of Wilderness Battlefield	80
33. Age-diameter relationship for Stand W1	106
34. Age-diameter relationship for Stand W2	106
35. Age-diameter relationship for Stand W3	107
36. Age-diameter relationship for Stand W4	107
37. Age-diameter relationship for Stand W5	108
38. Age-diameter relationship for Stand W6	108
39. Age-diameter relationship for Stand W7	109
40. Age-diameter relationship for Stand W8	109
41. Age-diameter relationship for Stand W9	110
42. Age-diameter relationship for Stand W10	110
43. Age-diameter relationship for Stand W11	111
44. Age-diameter relationship for Stand W12	111
45. Age-diameter relationship for Stand W13	112
46. Age-diameter relationship for Stand W14	112
47. Age-diameter relationship for Stand W15	113
48. Age-diameter relationship for Stand W16	113
49. Age-diameter relationship for Stand W17	114
50. Age-diameter relationship for Stand W18	114
51. Age-diameter relationship for Stand W19	115

52. Age-diameter relationship for Stand W20	115
53. Age-diameter relationship for Stand W21	116
54. Age-diameter relationship for Stand W22	116
55. Age-diameter relationship for Stand W23	117

List Of Tables

1. Characteristics of surveyed forest stands of Fredericksburg (F) Battlefield	7
2. Stand F1 overstory and understory vegetative composition	15
3. Stand F2 overstory and understory vegetative composition	16
4. Stand F3 overstory and understory vegetative composition	17
5. Stand F4 overstory and understory vegetative composition	18
6. Stand F5 overstory and understory vegetative composition	19
7. Stand F6 overstory and understory vegetative composition	20
8. Stand F7 overstory and understory vegetative composition	21
9. Stand F8 overstory and understory vegetative composition	22
10. Stand F9 overstory and understory vegetative composition	23
11. Stand F10 overstory and understory vegetative composition	24
12. Stand F11 overstory and understory vegetative composition	25
13. Stand F12 overstory and understory vegetative composition	26
14. Stand F13 overstory and understory vegetative composition	27
15. List of fuel loads for various forest types within Fredericksburg (F) Battlefield	37
16. Characteristics of surveyed forest stands of Chancellorsville (CV) Battlefield	40
17. Stand CV1 overstory and understory vegetative composition	47
18. Stand CV2 overstory and understory vegetative composition	48
19. Stand CV3 overstory and understory vegetative composition	49
20. Stand CV4 overstory and understory vegetative composition	50
21. Stand CV5 overstory and understory vegetative composition	51
22. Stand CV6 overstory and understory vegetative composition	52
23. Stand CV7 overstory and understory vegetative composition	53

24. Stand CV8 overstory and understory vegetative composition	. .	54
25. Stand CV9 overstory and understory vegetative composition	. .	55
26. Stand CV10 overstory and understory vegetative composition	. .	56
27. Stand CV11 overstory and understory vegetative composition	. .	57
28. Stand CV12 overstory and understory vegetative composition	. .	58
29. Stand CV13 overstory and understory vegetative composition	. .	59
30. List of fuel loads for various forest types within Chancellorsville (CV) Battlefield		69
31. Characteristics of surveyed forest stands of Wilderness (W) Battlefield		72
32. Stand W1 overstory and understory vegetative composition	. .	81
33. Stand W2 overstory and understory vegetative composition	. .	82
34. Stand W 3 overstory and understory vegetative composition	. .	83
35. Stand W4 overstory and understory vegetative composition	. .	84
36. Stand W5 overstory and understory vegetative composition	. .	85
37. Stand W6 overstory and understory vegetative composition	. .	86
38. Stand W7 overstory and understory vegetative composition	. .	87
39. Stand W8 overstory and understory vegetative composition	. .	88
40. Stand W9 overstory and understory vegetative composition	. .	89
41. Stand W10 overstory and understory vegetative composition	. .	90
42. Stand W11 overstory and understory vegetative composition	. .	91
43. Stand W12 overstory and understory vegetative composition	. .	92
44. Stand W 13 overstory and understory vegetative composition	. .	93
45. Stand W14 overstory and understory vegetative composition	. .	94
46. Stand W15 overstory and understory vegetative composition	. .	96
47. Stand W16 overstory and understory vegetative composition	. .	97
48. Stand W17 overstory and understory vegetative composition	. .	98

49. Stand W18 overstory and understory vegetative composition	. . . 99
50. Stand W19 overstory and understory vegetative composition	. . . 100
51. Stand W20 overstory and understory vegetative composition	. . . 101
52. Stand W21 overstory and understory vegetative composition	. . . 102
53. Stand W22 overstory and understory vegetative composition	. . . 103
54. Stand W23 overstory and understory vegetative composition	. . . 104
55. List of fuel loads for various forest types within Wilderness (W) Battlefield	 119

Acknowledgments

The authors thank Rod Finkbiner, Chad Spencer, and Jay Westover for assisting in data collection. In addition, we thank John Karish and Mike Johnson for providing coordination, technical assistance, and helpful comments on earlier drafts of this report. Thanks also go to Elizabeth Rapagna for aiding in map production. This study was financially supported by the National Park Service (CA-4000-9-8004, supplemental agreement 14).

Introduction

Study area

Fredericksburg, Chancellorsville, and Wilderness battlefields are three of the four Civil War battlefields associated with the Fredericksburg and Spotsylvania National Military Park which comprise approximately 2700 ha (6672 acres) of forested and non-forested land. The study area is located 81 km (50 miles) southwest of Washington, D.C., in portions of Spotsylvania and Orange counties and the city of Fredericksburg, Virginia (38°15' - 38°17' N. Lat. and 77°27' - 77°45' W. Long.). The regional climate is warm continental with relatively mild winters and hot, humid summers. The mean annual temperature is 13 °C (55 °F), while the average of daily maximum and minimum temperatures during winter and summer are 2 °C and 23 °C, respectively (Elder 1985). Precipitation averages 102 cm (40 inches) annually and is well distributed throughout the year. The average frost-free period extends from April 23 to October 17, a total of 178 days (National Park Service 1986).

Past land use

Spotsylvania and Orange counties were inhabited by Native Americans prior to European settlement, which started in 1721 (Mansfield 1977; Felder 1982). The vegetation at the time of settlement was composed of a mixture of deciduous trees, mainly oak and hickory species (Braun 1950; Silver 1990). Following settlement, the landscape changed rapidly, as many of the forests were cleared for the lucrative tobacco industry or for the six local iron furnaces used for iron production (Cappon 1945; Mansfield 1977). Agricultural

lands became severely eroded due to poor cultivation practices and therefore much of the land was abandoned (Craven 1965). These lands eventually became reforested, but portions were logged again during the Civil War and in the early 1900s. The battlefield became a unit of the National Park System in 1927 and has since been relatively undisturbed (National Park Service 1986). Due to the diverse land use history of this study area, present day battlefields consist of a mosaic of forest stands in various stages of successional development.

Methods

During the summers of 1991 through 1993, a reconnaissance of Fredericksburg, Chancellorsville, and Wilderness battlefields was conducted with the aid of 1980 black and white aerial photograph reproductions (1" = 660'; 1 cm = 79 m). All distinct vegetational units from the photographs were traced onto acetate overlays which served as preliminary cover maps. Aerial estimation of the vegetational units was derived with a digital planimeter. Individual stands larger than 4 hectares (ha) and consisting of relatively homogeneous vegetation were chosen for formal inventory in each battlefield. Upon completion of the formal analysis, all remaining stands were assigned a forest type based on dominant vegetation observed during a later visual inspection.

Each stand was inventoried using 20, .02-ha circular plots systematically located along transects at 30 - 40 m intervals, depending on stand size. Large, contiguous stands were surveyed along a single transect oriented through the middle of the stand, while smaller stands were surveyed along two or three parallel transects oriented through representative portions at least 20 m from any distinct edge habitat. All overstory individuals (tree species ≥ 1.4 m in height (diameter breast height or dbh) and ≥ 8 cm in diameter at dbh) were counted by species and measured for dbh in each plot. Saplings (tree

species < 8 cm dbh and ≥ 1.4 m height) and seedlings (tree species <1.4 m tall) were tallied by species at each plot using nested (i.e. same plot center) circular plots of 9m² and 5m², respectively. Throughout this report, the term understory will refer to vegetation found in both the seedling and sapling layers. Shrub (multiple-stemmed, non-tree woody species) and herbaceous cover was visually estimated at each 5m² plot using cover classes established by Daubenmire (1959) as follows: Class 1: 0 - 5 %; Class 2: 6 - 25 %; Class 3: 26 - 50 %; Class 4: 51 - 75 %; Class 5: 76 - 100 %. Average total shrub and total herbaceous cover was determined in each stand by averaging the mid-points of the class values for each plot. Aspect and slope were recorded several times in each stand with a clinometer for general stand descriptions. Twenty permanent plots were established within one Chancellorsville Battlefield stand and four Wilderness Battlefield stands by using metal stakes with a corresponding aluminum tag to denote each plot. Stands were selected for long-term monitoring based on representative battlefield size, site conditions, and forest composition. Permanent plots are designated as (PP) on stand location maps.

Relative importance values (IVs) were calculated for overstory tree species in each stand (Cottam and Curtis 1956). In each stand:

$$\text{Relative density} = \frac{\text{\# of individuals of a particular species}}{\text{Sum of individuals of all species}} \times 100$$

$$\text{Relative frequency} = \frac{\text{\# of plots in which a species occurs}}{\text{Sum of plot occurrences of all species}} \times 100$$

$$\text{Relative dominance} = \frac{\text{Total basal area of a particular species}}{\text{Sum of basal areas of all species}} \times 100$$

$$\text{Relative IV} = (\text{Relative density} + \text{Relative frequency} + \text{Relative dominance})/3$$

Two randomly selected overstory trees per plot were bored at 1.4 m height for age determination and radial growth analysis. Tree ages were determined by measuring annual rings with a dissecting microscope. Age versus diameter graphs were then produced for each stand to examine age structure and species recruitment patterns.

During the summers of 1991 through 1993 fuel loading was estimated in representative forest (fuel) types within each battlefield to determine the natural residue loads present for different vegetation types. These stands are denoted by asterisks in stand location maps. Surveyed successional stages included Virginia pine (*Pinus virginiana*) - sweetgum (*Liquidambar styraciflua*), Virginia pine - oak, oak-Virginia pine, and white oak (*Quercus alba*). Fuel surveys were conducted along ten 10.6 m (35 ') transects per type by using the planar-intersect method as outlined by Brown (1974). This method involves counting intersections of dead and downed woody debris with a vertical sampling plane. Fuel was recorded according to type (pine or hardwood) and diameter size (0 - 2.54 cm, > 2.54 - 7.6 cm, and greater than 7.6 cm diameter). Fuel in the 0 - 2.54 cm (0 - 1") class was counted along the first 1.8 m (6 ') of each transect. Fuel in the > 2.54 - 7.6 cm (1 - 3") and > 7.6 cm (>3 ") classes was recorded in the first 3.7 m (12 ') and 10.6 m of the transect, respectively. Fuel >7.6 cm was measured for diameter and recorded as sound or rotten.

Fuel data were calculated in tons/acre according to Brown (1974) and then converted to fuel loading estimates in (kg/ha) for the various size classes of debris (1 ton/A = 2241 kg/ha). This information, along with fuel type, litter depths, and duff depths from the transects can aid in the prediction of potential fire intensity and severity. Data from the three battlefields were compared to photo series of similar forest types and conditions in eastern forests (Wilcox et al. 1982; Lynch and Horton 1983). These photo series are a compilation of photographs showing fuel residue levels in natural stands of different vegetation types and were used to determine the appropriate fire behavior fuel model for a particular site.

Fredericksburg Battlefield

Overview

Fredericksburg Battlefield is located in Spotsylvania County and in the southern portion of the city of Fredericksburg. This battlefield is located within the Coastal Plain physiographic province and consists of relatively flat to gently rolling terrain (slope < 15%) with elevations near sea level to 45 m above sea level (U. S. Geological Survey 1984). Bedrock of the area consists of the Brandywine terrace formed from sedimentary marine deposits during the Tertiary and Quaternary periods (Robinson et al. 1961). Soils are members of either the Aquualts-Wickham-Altivista association or the Dystrochrepts-Kempsville-Udults association, which range from deep, poorly drained sandy soils along drainageways and depressions to deep, well-drained sandy loams on forest upland sites. These soils have dominantly loamy or clayey subsoils and are categorized as being very strongly acid, and low in fertility (Elder 1985).

Thirteen stands comprising approximately 247 ha were surveyed for vegetational composition within Fredericksburg Battlefield (Table 1; Figure 1). This battlefield contained many oak stands with basal areas near or exceeding 30 m²/ha. White oak had the largest overstory IV in eleven of the thirteen stands. These Coastal Plain forests also contained the highest overstory hickory densities in the entire park, in some cases second only to oaks in IV. One stand in particular contained seven white oaks 90 - 105 cm dbh and up to 200 years of age (See stand F7 description). This stand experienced severe gypsy moth (*Lymantria dispar*.) defoliation during the summer of 1994 and if possible, should be protected from future attacks by aerial spraying. Mesic species including tulip poplar (*Liriodendron tulipifera*) and sweetgum also obtained local overstory abundance in many Fredericksburg stands. A total of 57 woody species were identified during the project period in this study area (Appendix A) and no rare plants identified by the park were found.

Table 1. Characteristics of surveyed forest stands of Fredericksburg (F) Battlefield.

Stand	Size (ha)	Overstory tree density (#/ha)	Tree Age ¹ (n = 38 - 40)		Average Cover			Forest Type ²
			yrs $\pm$ S.E.	Range (yrs)	Shrub%	Herb%	Slope%	
F1	16	556	76 $\pm$ 3	35 - 114	19.13	4.90	0	OH
F2	17	916	46 $\pm$ 1	37 - 65	9.88	11.00	0	PSG
F3	28	405	83 $\pm$ 4	34 - 186	11.12	2.50	2.2	OAK
F4	15	509	96 $\pm$ 3	40 - 123	9.00	11.50	5.15	OH
F5	9	721	64 $\pm$ 4	34 - 111	13.88	9.88	0	OH
F6	10	341	94 $\pm$ 3	35 - 123	16.25	5.63	5.25	OAK
F7	29	457	97 $\pm$ 6	37 - 197	19.75	4.75	6.45	OH
F8	21	432	85 $\pm$ 3	45 - 130	15.00	3.75	2.35	OH
F9	18	363	87 $\pm$ 3	48 - 137	13.38	5.00	6.50	OH
F10	10	474	77 $\pm$ 2	38 - 123	25.25	9.13	14.70	OP
F11	15	810	40 $\pm$ 1	26 - 60	5.63	12.75	0	PSG
F12	36	417	84 $\pm$ 3	40 - 126	14.88	3.75	6.60	OH
F13	23	568	87 $\pm$ 3	34 - 130	25.0	9.4	1.1	OBG

¹ Average-breast-height (1.4m) age of overstory trees in stand determined from radial growth analysis.

² Determined from overstory relative importance values (I.V. = {Relative density + Relative dominance + Relative frequency}/3).

OH = Oak - hickory, PSG = Pine - sweetgum, OP = Oak - pine, OBG = Oak - blackgum, OAK = white, scarlet and black oak.

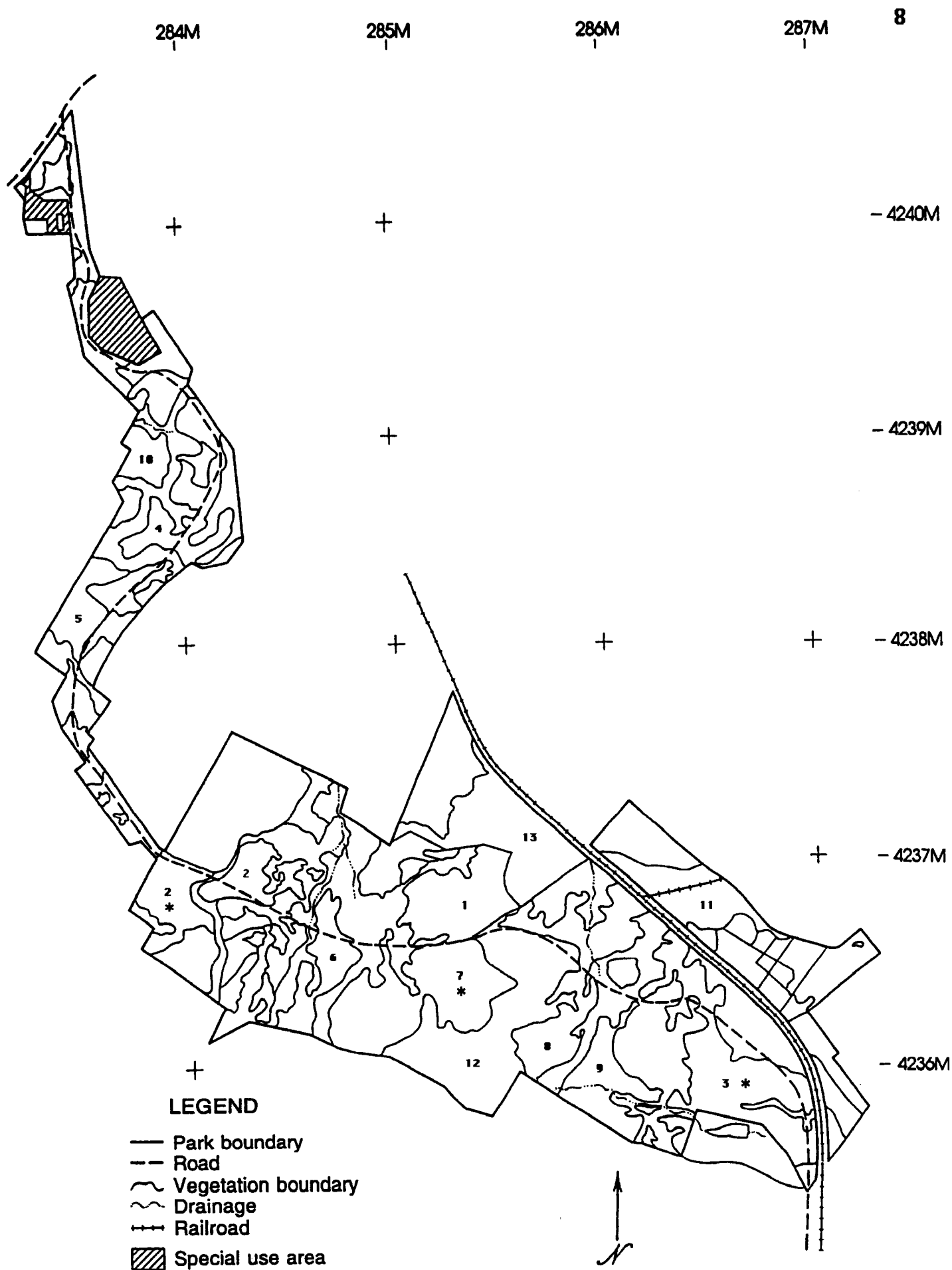


Figure 1. Location of surveyed forest stands - Fredericksburg Battlefield.

Stand Descriptions

The following includes general stand descriptions with predictions of future species composition.

Stand F1 was a mesic 16 ha oak-hickory stand (Table 2) located on the north side of Lee Drive adjacent to the newest tract of land (Bernard's Cabin area). The stand was initiated in the late 1800s and was dominated in the overstory by white oak and pignut hickory. Sweetgum, holly (*Ilex opaca*), red maple (*Acer rubrum*), and blackgum were also abundant in the overstory, sapling, and seedling layers. These species, as well as red oak (*Quercus rubra*) and beech (*Fagus grandifolia*), should comprise the overstory of the future forest.

Stand F2 was a 17 ha Virginia pine - sweetgum stand (Table 3) located just beyond the intersection of Lee Drive and Lansdowne Road. These two species comprise over 80% of the relative importance value in this stand which was initiated following agricultural abandonment in the late 1930s. As pine begins to mature and thin out, sweetgum, red maple, willow oak (*Quercus phellos*), and southern red oak (*Quercus falcata*) should become important overstory species. Club moss (*Lycopodium* spp.) and partridgeberry (*Mitchella repens*) were common ground-floor inhabitants.

Stand F3 was a 28 ha mature oak stand (Table 4) near the end of Lee Drive south of Prospect Hill. This dry-mesic stand was composed of large white oak, scarlet oak, and black oak trees in the overstory. One white oak was > 185 years old. Various oak species formed the seedling layer while dogwood, blackgum, and tulip poplar were frequent in the sapling layer and should share future overstory dominance with oak species. The ground layer was relatively open in this stand.

Stand F4 was a 15 ha mesic oak-hickory stand (Table 5) located along the northern portion of Lee Drive including the area near Pickett's Circle. This stand was

initiated in the mid- to late 1800s and was composed of white oak, pignut, and mockernut hickory in the overstory. In this stand, the latter two species were present in higher overstory concentrations than anywhere else in the park. Dogwood was an important understory species and the future forest overstory should consist of oak and hickory species, as well as blackgum and tulip poplar.

Stand F5 was a 9 ha oak-hickory stand (Table 6) found along the northern portion of Lee Drive near Deep Run north to the power line right-of-way. This mesic stand contained an overstory that included a 100 year-old white oak component and a 50 year-old red oak component which shared dominance with sweetgum, tulip poplar, and hickory species. Common understory species included dogwood, holly, and red maple. Future overstory composition should not change much except for an increase in blackgum and perhaps beech.

Stand F6 was a 10 ha oak stand (Table 7) situated along the southern portion of Lee Drive roughly 1/2 mile from stand F2. The overstory trees were an approximately even-aged cohort of large white oak, initiated in the late 1800s. Tulip poplar and especially sassafras are abundant in gaps, while dogwood and hickory IV should also increase in the future.

Stand F7 was a 29 ha oak-hickory stand (Table 8) located along the southern portion of Lee Drive on the south side of the road approximately 1 mile east of Lansdowne Road. This stand is one of the most impressive in the entire park, as it is an open stand with many large, old overstory white oaks (95 - 105 cm dbh and some older than 200 years). One particular spot contains 6 such individuals. This stand was almost completely defoliated in the summer of 1994 by gypsy moth and should be sprayed to try to save these historically significant and aesthetic trees. Dogwood, blackgum, and sassafras are frequent understory species. Future overstory composition should remain dominated by oak with a strong hickory component.

Stand F8 was a mesic 21 ha oak-hickory stand (Table 9) located along the southern portion of Lee Drive and includes land adjacent to the railroad tracks east of Bernard's Cabin, south to the southern boundary. This uneven-aged stand had an overstory of white oak, tulip poplar, and hickory species which should remain important. Blackgum and dogwood were important sapling layer species which should also remain abundant in the future.

Stand F9 was a 18 ha oak-hickory stand (Table 10) located along the southern portion of Lee Drive, on the south side of the road adjacent to stand F8. The overstory consisted of 90 - 105 year-old white oaks, as well as tulip poplar and hickory species. Blackgum and dogwood were the most abundant saplings, while white oak, hickory, and sassafras were the most abundant seedlings. Stand composition should not change appreciably in the future.

Stand F10 was a 10 ha oak-pine stand (Table 11) situated just south of the area which houses the Chief Ranger's Office. Slopes in excess of 30% were observed in this stand dominated by white and scarlet oaks, Virginia pine, and blackgum in the overstory. Sassafras and dogwood were the most abundant seedlings. Blackgum should increase with hickory in the overstory as pine species decline over time.

Stand F11 was a 15 ha even-aged stand (Table 12) that formed following agricultural abandonment in the late 1930s. This mesic area is located on the north side of the railroad tracks and is divided by an abandoned railroad passage. Common overstory species include Virginia pine, sweetgum, and willow oak. The latter two species, along with red maple and blackgum, will form the future forest overstory following pine decline with succession.

Stand F12 was a 36 ha oak-hickory forest (Table 13) found along the southern portion of Lee Drive adjacent to stand F7. This open stand was composed of an overstory of large white oak and mockernut hickory trees that became established in the late 1800s.

Blackgum and dogwood were the most abundant saplings and, together with hickory and oak species, dominated the seedling layer. No major changes in overstory composition are anticipated.

Stand F13 was a 23 ha stand (Table 14) recently added to the park in the Bernard's Cabin area. This mesic stand was comprised of a white oak, blackgum, and sweetgum overstory which should remain important in the future with red maple. Of interest in the seedling and sapling layers was the presence of sweetbay (*Magnolia virginiana*), fringetree (*Chionanthus virginicus*), and swamp chestnut oak (*Quercus michauxii*).

Cover map key

A vegetation cover map was made from delineations derived from the acetate overlay of 1980 aerial photograph reproductions and plot surveys (Figure 2). Vegetation cover types of forested areas were designated by the most important overstory species in surveyed stands (size > 4 ha) or, for non-surveyed stands, upon reconnaissance similarities with inventoried stands. Non-forested stands were characterized by the most abundant vegetation present upon visual inspection (e.g. scrub, agriculture). Stand designations were as follows: **CO** - stands composed primarily of chestnut oak (*Quercus prinus*) and various other oak species; **OH** - Oak -hickory stands which consisted of white oak, red oak (*Quercus rubra*), black oak (*Q. velutina*), southern red oak (*Q. falcata*), mockernut hickory (*Carya tomentosa*) and pignut hickory (*C. glabra*); **O** - oak stands dominated by various oak species present in **OH** stands as well as scarlet oak and post oak (*Q. stellata*); **PSG** - pine -sweetgum stands dominated by Virginia pine or loblolly pine and sweetgum, as well as secondary importance of red maple (*Acer rubrum*), blackgum, and willow oak (*Q. phellos*); **OP** - oak - pine stands which are comprised of a mixture of white, scarlet, and

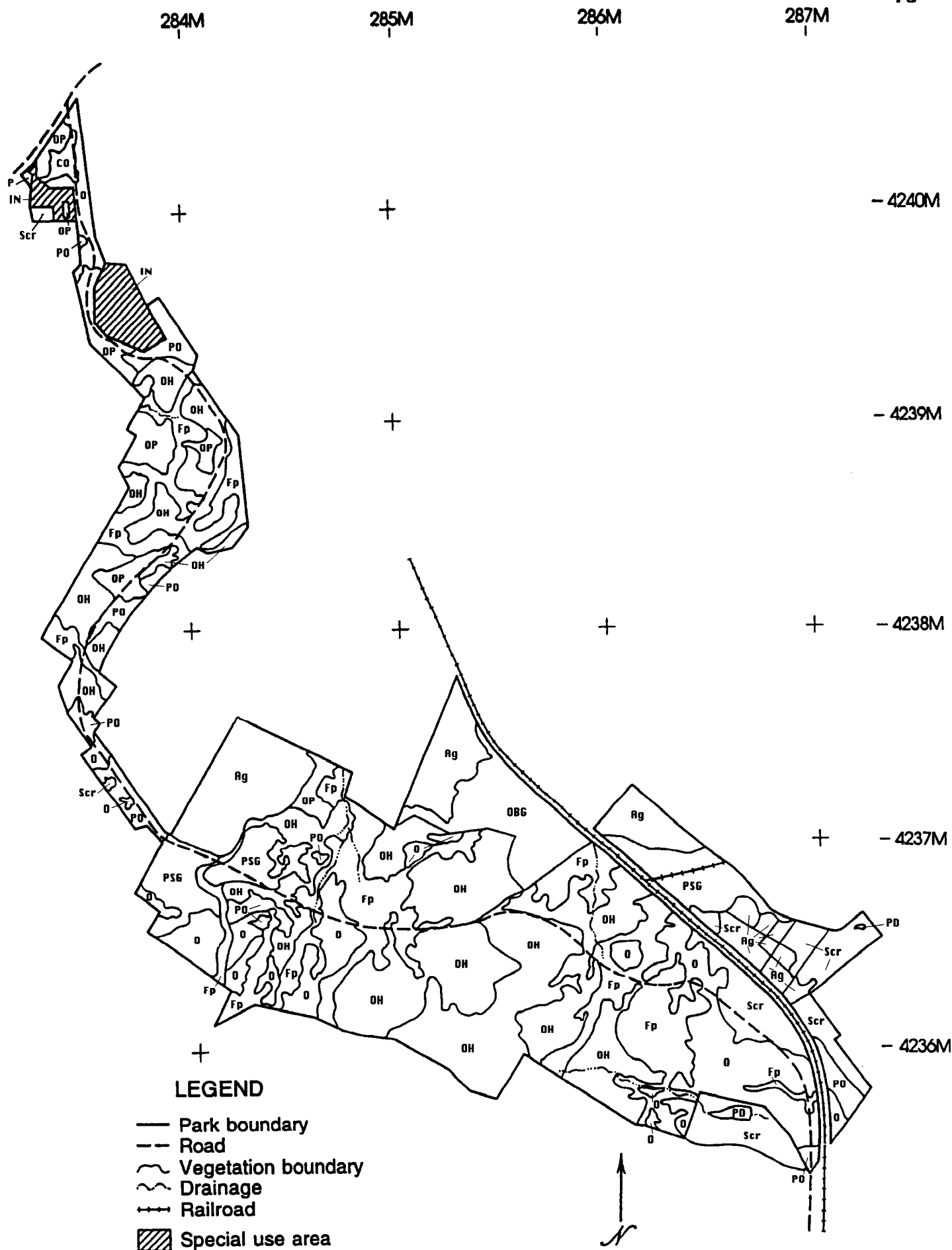


Figure 2. Vegetation cover map of Fredericksburg Battlefield.

black oaks with Virginia pine; and **OBG** - oak - blackgum stands which contain a mixture of white and willow oaks with blackgum, red maple, and sweetgum.

Areas designated as special use areas (**cross-hatched** symbol in Figure 2) consisted of scenic restorations (**SR**) - areas that were previously wooded but have been clearcut within the last 20 years and are mowed annually, and private inholdings (**IN**) - areas within the park boundary that are privately owned. Agricultural fields (**Ag**) are currently used as pasture or crops, while flood plains (**Fp**) are drainage areas that contained intermittent streams. Certain areas within flood plains generally consist of mesic species such as red maple, sweetgum, and blackgum, as well as tree species from adjacent stands. Vegetation described as scrub (**Scr**) is a mixture of woody vegetation such as sumac (*Rhus* spp.), eastern redcedar (*Juniperus virginiana*), dogwood (*Cornus florida*), and sweetgum which has developed following agricultural abandonment or other unknown disturbances within the last 20 years. Ponds are designated on the map as **PD**.

Vegetative composition tables for Fredericksburg (F) Battlefield

Table 2. Stand F1 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	5
<i>Carpinus caroliniana</i>	2
<i>Carya glabra</i>	11
<i>Carya tomentosa</i>	2
<i>Cornus florida</i>	1
<i>Fagus grandifolia</i>	5
<i>Ilex opaca</i>	9
<i>Liquidambar styraciflua</i>	8
<i>Liriodendron tulipifera</i>	3
<i>Nyssa sylvatica</i>	6
<i>Quercus alba</i>	30
<i>Quercus coccinea</i>	2
<i>Quercus falcata</i>	5
<i>Quercus phellos</i>	2
<i>Quercus rubra</i>	7
<i>Quercus stellata</i>	1
<i>Quercus velutina</i>	1
Total tree density (#/ha) = 556	
Total overstory basal area (m ² /ha) = 25.5	

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	4736	377
<i>Carpinus caroliniana</i>	1077	108
<i>Carya spp.</i>	2476	108
<i>Cornus florida</i>	1831	162
<i>Fagus grandifolia</i>	862	54
<i>Ilex opaca</i>	1292	698
<i>Juniperus virginiana</i>	108	--
<i>Liquidambar styraciflua</i>	2046	431
<i>Liriodendron tulipifera</i>	216	--
<i>Prunus serotina</i>	108	--
<i>Nyssa sylvatica</i>	862	161
<i>Quercus alba</i>	8932	--
<i>Quercus falcata</i>	432	--
<i>Quercus phellos</i>	862	--
<i>Quercus rubra</i>	1937	108
<i>Quercus stellata</i>	753	--
<i>Quercus velutina</i>	216	--
Totals	28746	2207

Table 3. Stand F2 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	4
<i>Juniperus virginiana</i>	2
<i>Liquidambar styraciflua</i>	17
<i>Liriodendron tulipifera</i>	3
<i>Nyssa sylvatica</i>	5
<i>Pinus taeda</i>	1
<i>Pinus virginiana</i>	65
<i>Prunus serotina</i>	1
<i>Quercus alba</i>	1
<i>Quercus phellos</i>	1

Total tree density (#/ha) = 916

Total overstory basal area (m²/ha) = 32.5

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	10438	378
<i>Carya</i> spp.	108	--
<i>Fagus grandifolia</i>	108	54
<i>Ilex opaca</i>	970	--
<i>Juniperus virginiana</i>	108	54
<i>Liquidambar styraciflua</i>	14631	647
<i>Liriodendron tulipifera</i>	754	--
<i>Nyssa sylvatica</i>	6136	108
<i>Pinus virginiana</i>	28835	--
<i>Prunus serotina</i>	2046	--
<i>Quercus alba</i>	538	54
<i>Quercus falcata</i>	647	162
<i>Quercus phellos</i>	5275	538
<i>Quercus rubra</i>	431	--
<i>Quercus stellata</i>	431	--
<i>Quercus velutina</i>	323	54
<i>Sassafras albidum</i>	323	--
Totals	72102	2049

Table 4. Stand F3 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	1
<i>Carya glabra</i>	8
<i>Carya tomentosa</i>	6
<i>Cornus florida</i>	5
<i>Fagus grandifolia</i>	1
<i>Liquidambar styraciflua</i>	6
<i>Liriodendron tulipifera</i>	2
<i>Nyssa sylvatica</i>	6
<i>Pinus virginiana</i>	1
<i>Quercus alba</i>	37
<i>Quercus coccinea</i>	13
<i>Quercus falcata</i>	3
<i>Quercus stellata</i>	1
<i>Quercus velutina</i>	11

Total tree density (#/ha) = 405

Total overstory basal area (m²/ha) = 29.1

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	647	54
<i>Carya spp.</i>	1615	--
<i>Chionanthus virginicus</i>	108	--
<i>Cornus florida</i>	1938	540
<i>Liquidambar styraciflua</i>	216	108
<i>Liriodendron tulipifera</i>	862	377
<i>Nyssa sylvatica</i>	3014	647
<i>Prunus serotina</i>	108	--
<i>Quercus alba</i>	8178	54
<i>Quercus coccinea</i>	12159	--
<i>Quercus falcata</i>	216	--
<i>Quercus phellos</i>	216	--
<i>Quercus velutina</i>	1830	--
<i>Sassafras albidum</i>	5919	108
Totals	37026	1888

Table 5. Stand F4 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	2
<i>Betula nigra</i>	1
<i>Carya glabra</i>	13
<i>Carya tomentosa</i>	17
<i>Cornus florida</i>	8
<i>Fagus grandifolia</i>	1
<i>Liquidambar styraciflua</i>	7
<i>Liriodendron tulipifera</i>	12
<i>Nyssa sylvatica</i>	4
<i>Quercus alba</i>	22
<i>Quercus coccinea</i>	5
<i>Quercus falcata</i>	2
<i>Quercus stellata</i>	3
<i>Quercus velutina</i>	3

Total tree density (#/ha) = 509

Total overstory basal area (m²/ha) = 26.8

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	1184	108
<i>Carpinus caroliniana</i>	216	--
<i>Carya</i> spp.	13450	216
<i>Chionanthus virginicus</i>	215	--
<i>Cornus florida</i>	5057	701
<i>Diospyros virginiana</i>	323	--
<i>Fagus grandifolia</i>	216	--
<i>Ilex opaca</i>	432	--
<i>Juniperus virginiana</i>	216	--
<i>Liquidambar styraciflua</i>	539	54
<i>Liriodendron tulipifera</i>	647	54
<i>Nyssa sylvatica</i>	1830	484
<i>Prunus serotina</i>	1401	--
<i>Quercus alba</i>	14095	108
<i>Quercus coccinea</i>	1292	--
<i>Quercus falcata</i>	538	--
<i>Quercus phellos</i>	432	--
<i>Quercus stellata</i>	108	--
<i>Quercus velutina</i>	431	--
<i>Sassafras albidum</i>	646	54
Totals	43268	1779

Table 6. Stand F5 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	2
<i>Carya glabra</i>	8
<i>Carya tomentosa</i>	9
<i>Cornus florida</i>	*
<i>Fagus grandifolia</i>	6
<i>Liquidambar styraciflua</i>	13
<i>Liriodendron tulipifera</i>	10
<i>Nyssa sylvatica</i>	4
<i>Pinus virginiana</i>	3
<i>Quercus alba</i>	22
<i>Quercus coccinea</i>	2
<i>Quercus falcata</i>	2
<i>Quercus phellos</i>	2
<i>Quercus rubra</i>	14
<i>Quercus stellata</i>	*
<i>Quercus velutina</i>	*

* denotes IV < 1

Total tree density (#/ha) = 721

Total overstory basal area (m²/ha) = 26.9

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	3553	108
<i>Carpinus caroliniana</i>	754	--
<i>Carya spp.</i>	5811	162
<i>Cornus florida</i>	3335	269
<i>Fagus grandifolia</i>	1078	--
<i>Ilex opaca</i>	754	162
<i>Liquidambar styraciflua</i>	2259	215
<i>Liriodendron tulipifera</i>	108	--
<i>Magnolia virginiana</i>	323	--
<i>Nyssa sylvatica</i>	1723	432
<i>Prunus serotina</i>	1401	--
<i>Quercus alba</i>	4628	--
<i>Quercus coccinea</i>	108	--
<i>Quercus phellos</i>	324	--
<i>Quercus rubra</i>	755	--
<i>Quercus stellata</i>	216	--
<i>Quercus velutina</i>	216	--
Totals	27346	1348

Table 7. Stand F6 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Carya glabra</i>	5
<i>Carya tomentosa</i>	5
<i>Cornus florida</i>	6
<i>Fagus grandifolia</i>	1
<i>Liquidambar styraciflua</i>	1
<i>Liriodendron tulipifera</i>	8
<i>Nyssa sylvatica</i>	7
<i>Quercus alba</i>	51
<i>Quercus coccinea</i>	6
<i>Quercus falcata</i>	2
<i>Quercus prinus</i>	4
<i>Quercus velutina</i>	5

Total tree density (#/ha) = 341

Total overstory basal area (m²/ha) = 33.4

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	647	162
<i>Carya spp.</i>	3017	270
<i>Chionanthus virginicus</i>	108	--
<i>Cornus florida</i>	8502	270
<i>Ilex opaca</i>	--	--
<i>Liquidambar styraciflua</i>	216	--
<i>Liriodendron tulipifera</i>	1293	--
<i>Nyssa sylvatica</i>	3335	756
<i>Prunus serotina</i>	323	--
<i>Quercus alba</i>	11190	54
<i>Quercus coccinea</i>	2798	--
<i>Quercus falcata</i>	108	--
<i>Quercus phellos</i>	216	--
<i>Quercus prinus</i>	968	--
<i>Quercus velutina</i>	756	--
<i>Sassafras albidum</i>	10223	324
Totals	43700	1836

Table 8. Stand F7 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Carya glabra</i>	6
<i>Carya tomentosa</i>	7
<i>Cornus florida</i>	10
<i>Juglans nigra</i>	1
<i>Liriodendron tulipifera</i>	8
<i>Nyssa sylvatica</i>	8
<i>Quercus alba</i>	40
<i>Quercus coccinea</i>	4
<i>Quercus falcata</i>	1
<i>Quercus rubra</i>	2
<i>Quercus stellata</i>	4
<i>Quercus velutina</i>	9
<i>Sassafras albidum</i>	1
Total tree density (#/ha) = 457	
Total overstory basal area (m ² /ha) = 28.2	

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	1185	--
<i>Carya spp.</i>	4376	--
<i>Cornus florida</i>	3228	1239
<i>Ilex opaca</i>	108	--
<i>Liriodendron tulipifera</i>	431	--
<i>Nyssa sylvatica</i>	2152	593
<i>Prunus serotina</i>	108	54
<i>Quercus alba</i>	7425	--
<i>Quercus coccinea</i>	1078	--
<i>Quercus phellos</i>	323	--
<i>Quercus rubra</i>	108	--
<i>Quercus stellata</i>	323	--
<i>Quercus velutina</i>	2261	108
<i>Sassafras albidum</i>	9252	323
Totals	32358	2317

Table 9. Stand F8 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Carya glabra</i>	9
<i>Carya tomentosa</i>	9
<i>Cornus florida</i>	9
<i>Ilex opaca</i>	1
<i>Juniperus virginiana</i>	1
<i>Liquidambar styraciflua</i>	2
<i>Liriodendron tulipifera</i>	10
<i>Nyssa sylvatica</i>	7
<i>Pinus echinata</i>	1
<i>Quercus alba</i>	35
<i>Quercus coccinea</i>	3
<i>Quercus rubra</i>	8
<i>Quercus stellata</i>	2
<i>Quercus velutina</i>	6

Total tree density (#/ha) = 432 Total overstory basal area (m²/ha) = 29.3

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	1937	--
<i>Carya spp.</i>	5597	108
<i>Cornus florida</i>	2691	162
<i>Diospyros virginiana</i>	--	54
<i>Ilex opaca</i>	108	--
<i>Juniperus virginiana</i>	539	--
<i>Liquidambar styraciflua</i>	538	162
<i>Liriodendron tulipifera</i>	1399	--
<i>Nyssa sylvatica</i>	1721	540
<i>Prunus serotina</i>	432	--
<i>Quercus alba</i>	10544	108
<i>Quercus coccinea</i>	862	108
<i>Quercus falcata</i>	108	--
<i>Quercus phellos</i>	324	--
<i>Quercus rubra</i>	1185	54
<i>Quercus stellata</i>	108	--
<i>Quercus velutina</i>	1507	--
<i>Sassafras albidum</i>	646	--
Totals	30246	1296

Table 10. Stand F9 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Carya glabra</i>	4
<i>Carya tomentosa</i>	8
<i>Cornus florida</i>	4
<i>Liquidambar styraciflua</i>	1
<i>Liriodendron tulipifera</i>	15
<i>Nyssa sylvatica</i>	5
<i>Quercus alba</i>	42
<i>Quercus coccinea</i>	3
<i>Quercus falcata</i>	1
<i>Quercus rubra</i>	9
<i>Quercus stellata</i>	2
<i>Quercus velutina</i>	6
Total tree density (#/ha) = 363	
Total overstory basal area (m ² /ha) = 28.6	

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	2261	216
<i>Carya</i> spp.	4520	--
<i>Cornus florida</i>	3659	647
<i>Diospyros virginiana</i>	539	--
<i>Liriodendron tulipifera</i>	970	--
<i>Nyssa sylvatica</i>	1293	970
<i>Prunus serotina</i>	324	--
<i>Quercus alba</i>	8394	--
<i>Quercus coccinea</i>	1292	--
<i>Quercus phellos</i>	108	--
<i>Quercus rubra</i>	862	54
<i>Quercus velutina</i>	216	--
<i>Sassafras albidum</i>	6134	162
Totals	30572	2049

Table 11. Stand F10 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	1
<i>Carya glabra</i>	5
<i>Carya tomentosa</i>	4
<i>Cornus florida</i>	1
<i>Fagus grandifolia</i>	3
<i>Juglans nigra</i>	1
<i>Liquidambar styraciflua</i>	2
<i>Liriodendron tulipifera</i>	2
<i>Nyssa sylvatica</i>	10
<i>Pinus virginiana</i>	11
<i>Quercus alba</i>	35
<i>Quercus coccinea</i>	15
<i>Quercus rubra</i>	2
<i>Quercus stellata</i>	1
<i>Quercus velutina</i>	8

Total tree density (#/ha) = 474

Total overstory basal area (m²/ha) = 30.8

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	539	--
<i>Carya spp.</i>	2692	108
<i>Castanea pumila</i>	215	--
<i>Cornus florida</i>	5809	538
<i>Fagus grandifolia</i>	215	--
<i>Liquidambar styraciflua</i>	--	108
<i>Nyssa sylvatica</i>	1829	431
<i>Prunus serotina</i>	1831	--
<i>Quercus alba</i>	1613	--
<i>Quercus coccinea</i>	2260	--
<i>Quercus falcata</i>	108	--
<i>Quercus phellos</i>	323	--
<i>Quercus rubra</i>	216	--
<i>Quercus velutina</i>	970	--
<i>Sassafras albidum</i>	3874	162
Totals	22494	1347

Table 12. Stand F11 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	9
<i>Juniperus virginiana</i>	4
<i>Liquidambar styraciflua</i>	23
<i>Liriodendron tulipifera</i>	1
<i>Nyssa sylvatica</i>	7
<i>Pinus echinata</i>	1
<i>Pinus taeda</i>	3
<i>Pinus virginiana</i>	39
<i>Quercus alba</i>	1
<i>Quercus falcata</i>	1
<i>Quercus phellos</i>	13

Total tree density (#/ha) = 810

Total overstory basal area (m²/ha) = 27.6

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	10437	539
<i>Carya</i> spp.	108	--
<i>Cornus florida</i>	108	--
<i>Ilex opaca</i>	1076	--
<i>Juniperus virginiana</i>	108	162
<i>Liquidambar styraciflua</i>	5273	432
<i>Nyssa sylvatica</i>	2584	216
<i>Pinus virginiana</i>	3552	--
<i>Prunus serotina</i>	216	--
<i>Quercus alba</i>	216	--
<i>Quercus phellos</i>	3230	--
<i>Sassafras albidum</i>	216	108
Totals	27124	1457

Table 13. Stand F12 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Carya glabra</i>	3
<i>Carya tomentosa</i>	13
<i>Cornus florida</i>	9
<i>Fagus grandifolia</i>	1
<i>Liquidambar styraciflua</i>	1
<i>Liriodendron tulipifera</i>	9
<i>Nyssa sylvatica</i>	7
<i>Quercus alba</i>	38
<i>Quercus coccinea</i>	4
<i>Quercus rubra</i>	4
<i>Quercus stellata</i>	4
<i>Quercus velutina</i>	7

Total tree density (#/ha) = 417 Total overstory basal area (m²/ha) = 27.9

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	1185	108
<i>Carpinus caroliniana</i>	108	--
<i>Carya</i> spp.	8501	54
<i>Cornus florida</i>	7747	486
<i>Diospyros virginiana</i>	216	--
<i>Liquidambar styraciflua</i>	108	--
<i>Liriodendron tulipifera</i>	216	--
<i>Nyssa sylvatica</i>	1614	969
<i>Prunus serotina</i>	216	--
<i>Quercus alba</i>	6565	54
<i>Quercus coccinea</i>	1722	--
<i>Quercus phellos</i>	108	--
<i>Quercus rubra</i>	216	54
<i>Quercus velutina</i>	1509	--
<i>Sassafras albidum</i>	4199	--
Totals	34230	1725

Table 14. Stand F13 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	14
<i>Carpinus caroliniana</i>	1
<i>Carya glabra</i>	1
<i>Carya tomentosa</i>	1
<i>Cornus florida</i>	1
<i>Ilex opaca</i>	1
<i>Liquidambar styraciflua</i>	16
<i>Liriodendron tulipifera</i>	3
<i>Nyssa sylvatica</i>	16
<i>Pinus virginiana</i>	1
<i>Quercus alba</i>	32
<i>Quercus coccinea</i>	4
<i>Quercus phellos</i>	8
<i>Quercus rubra</i>	1
<i>Sassafras albidum</i>	1

Total tree density (#/ha) = 568

Total overstory basal area (m²/ha) = 30.9

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	4411	485
<i>Carya spp.</i>	323	--
<i>Chionanthus virginicus</i>	108	54
<i>Cornus florida</i>	323	--
<i>Diospyros virginiana</i>	216	--
<i>Fagus grandifolia</i>	108	--
<i>Ilex opaca</i>	539	--
<i>Liquidambar styraciflua</i>	5058	270
<i>Liriodendron tulipifera</i>	108	--
<i>Magnolia virginiana</i>	538	108
<i>Nyssa sylvatica</i>	2476	216
<i>Pinus virginiana</i>	108	--
<i>Prunus serotina</i>	646	--
<i>Quercus alba</i>	10759	54
<i>Quercus coccinea</i>	1184	--
<i>Quercus michauxii</i>	324	--
<i>Quercus phellos</i>	2584	--
<i>Quercus rubra</i>	108	--
<i>Sassafras albidum</i>	108	--
Totals	30029	1187

Age-diameter figures for overstory trees in Fredericksburg (F) Battlefield

KEY

<u>SYMBOL</u>	<u>SPECIES</u>
ASP	Bigtooth aspen
BEECH	American beech
BG	Blackgum
BO	Black oak
CO	Chestnut oak
DOG	Dogwood
ERC	Eastern redcedar
HICK	Hickory spp.
HOLLY	American holly
LOB	Loblolly pine
MH	Mockernut hickory
PH	Pignut hickory
PO	Post oak
RM	Red maple
RO	Red oak
SB	Sweet birch
SG	Sweetgum
SLP	Shortleaf pine
SO	Scarlet oak
SRO	Southern red oak
TP	Tulip poplar
VP	Virginia pine
WO	White oak
WILLO	Willow oak

Figure 3. Age-diameter relationship for Stand F1

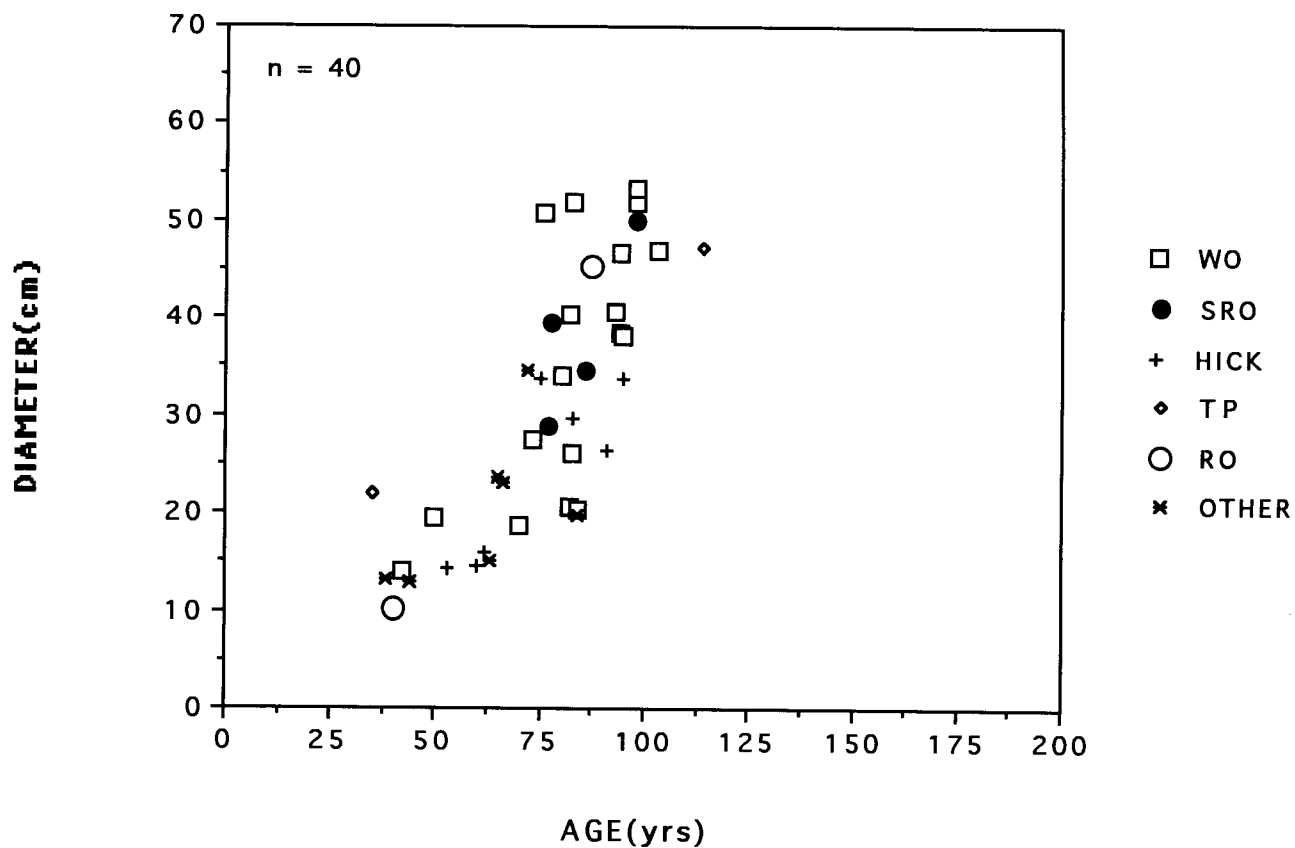


Figure 4. Age-diameter relationship for Stand F2

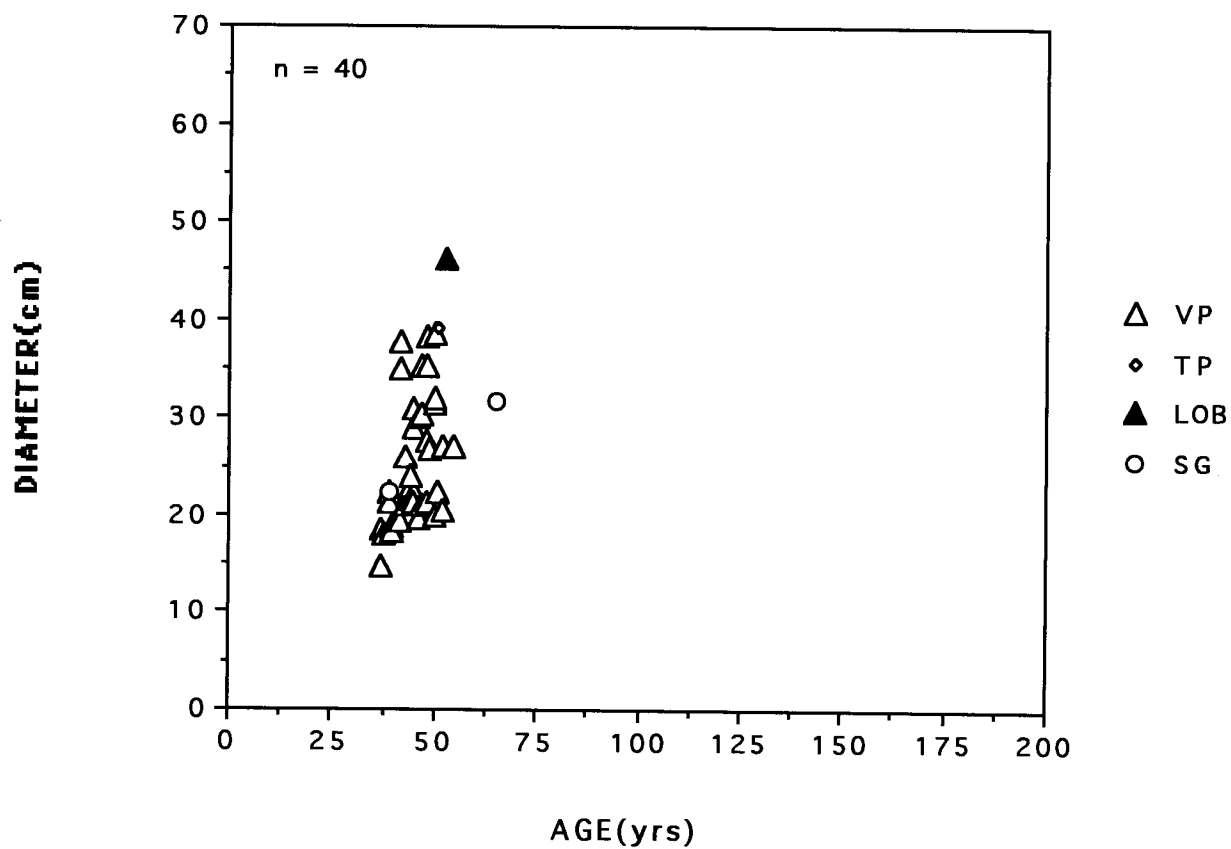


Figure 5. Age-diameter relationship for Stand F3

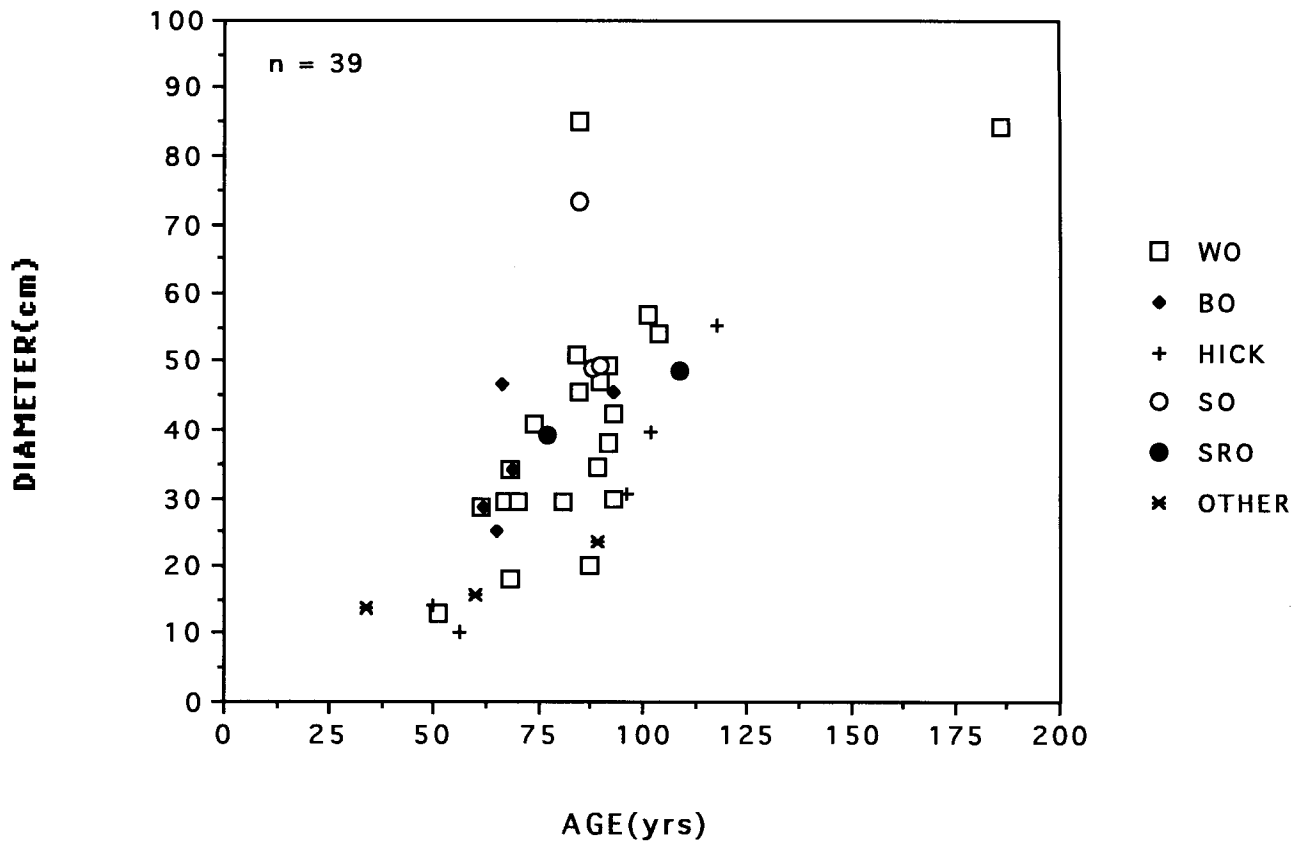


Figure 6. Age-diameter relationship for Stand F4

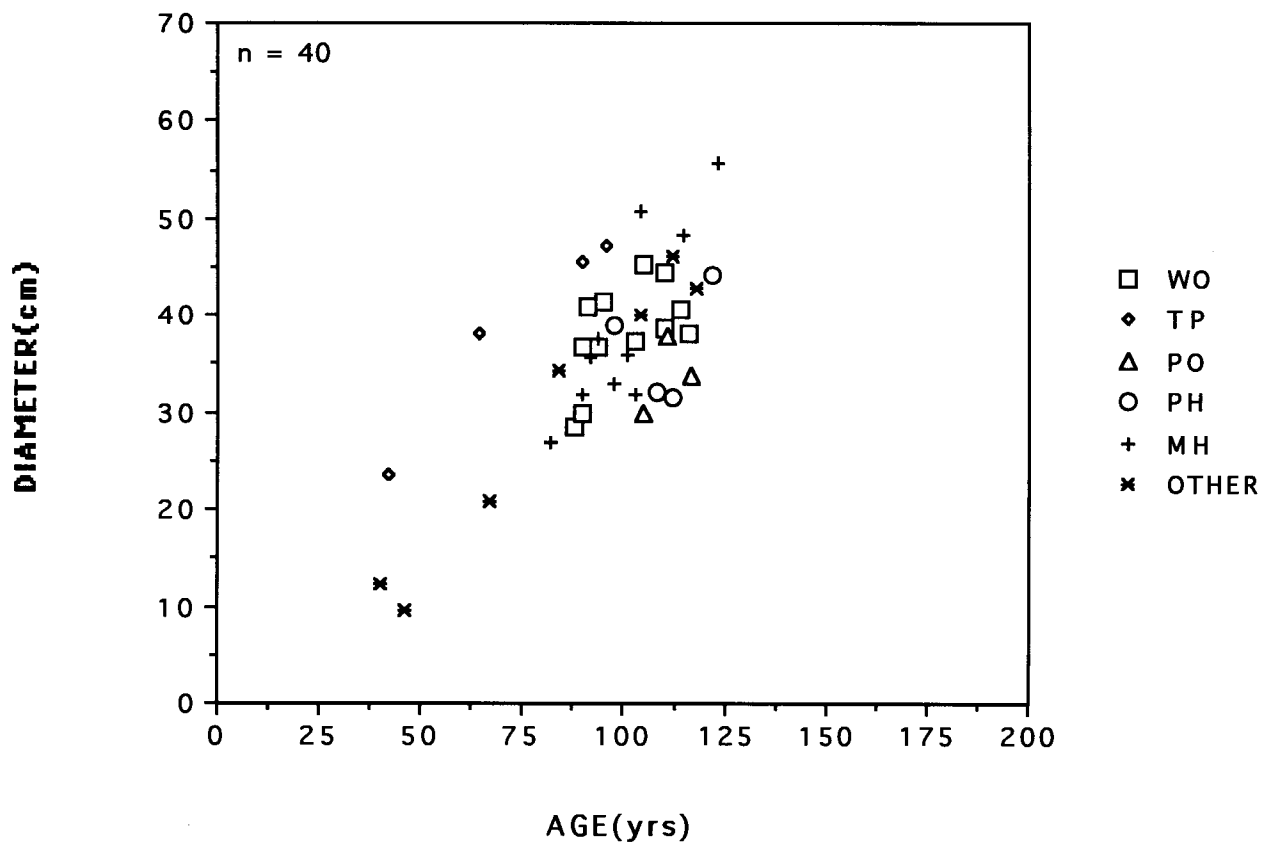


Figure 7. Age-diameter relationship for Stand F5

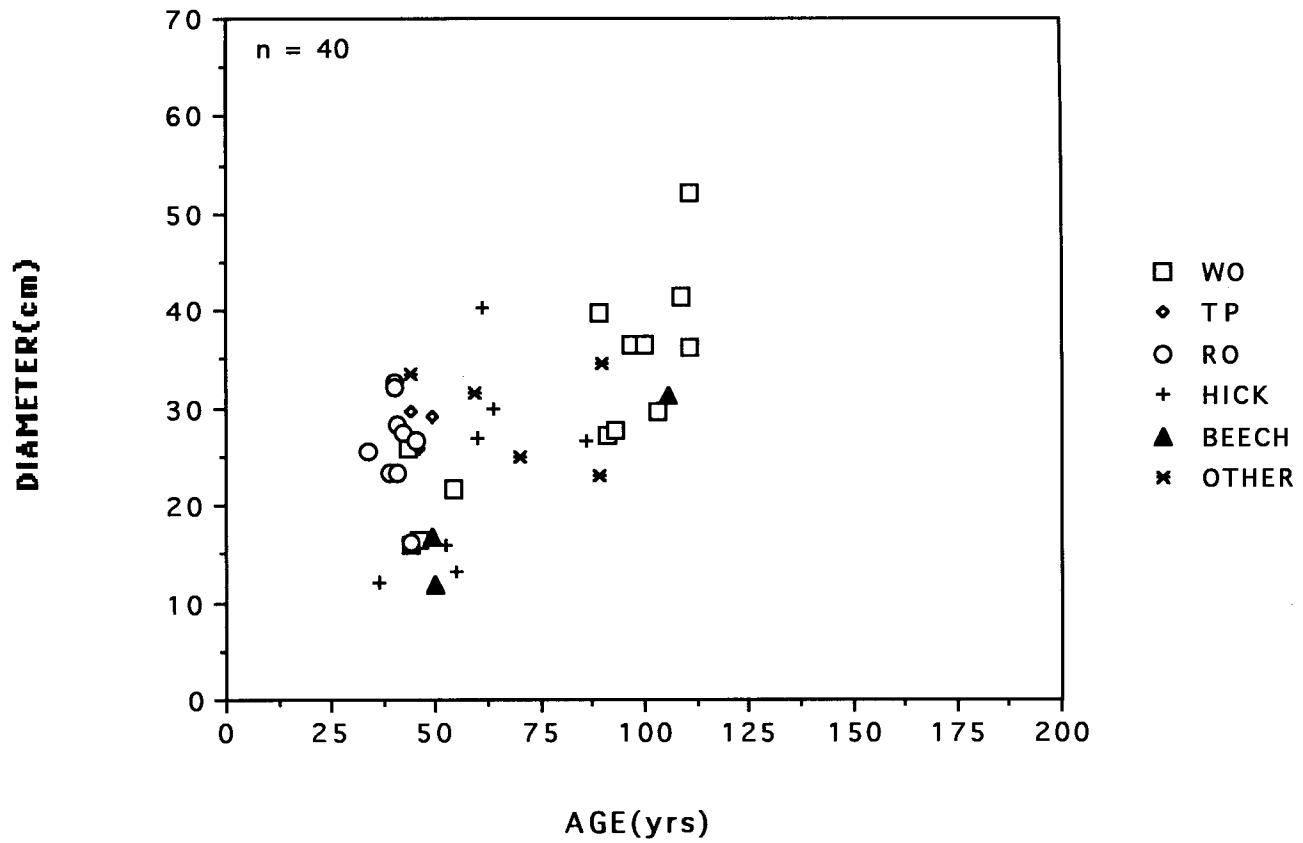


Figure 8. Age-diameter relationship for Stand F6

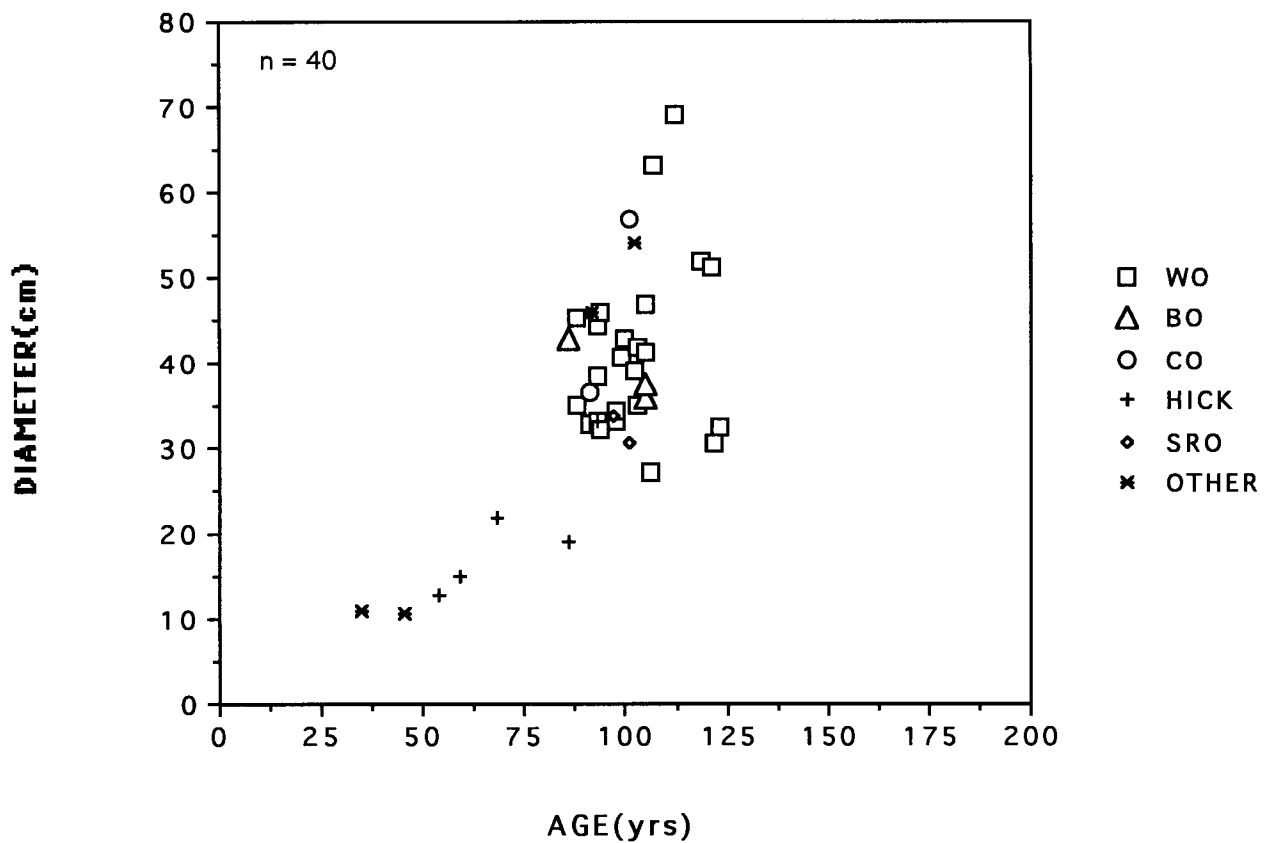


Figure 9. Age-diameter relationship for Stand F7

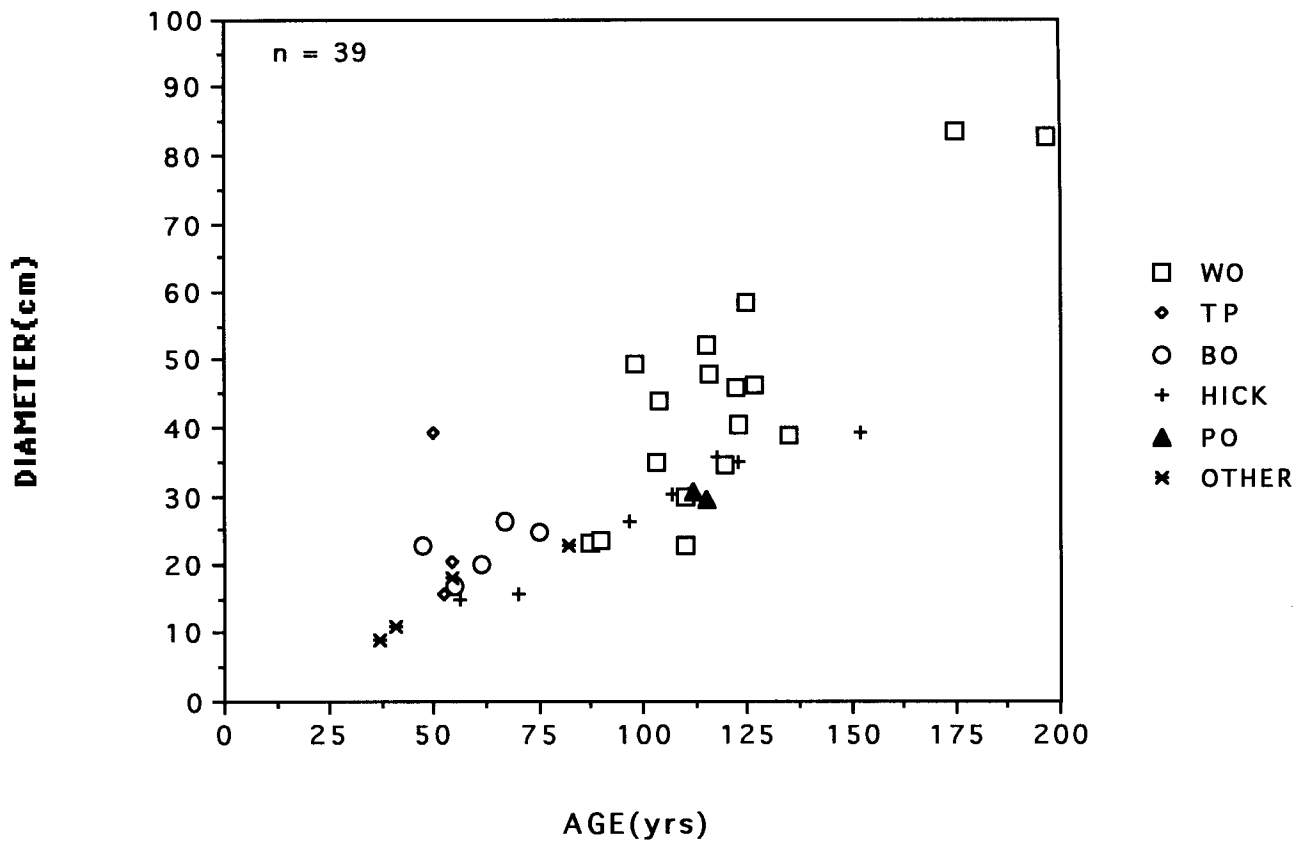


Figure 10. Age-diameter relationship for Stand F8

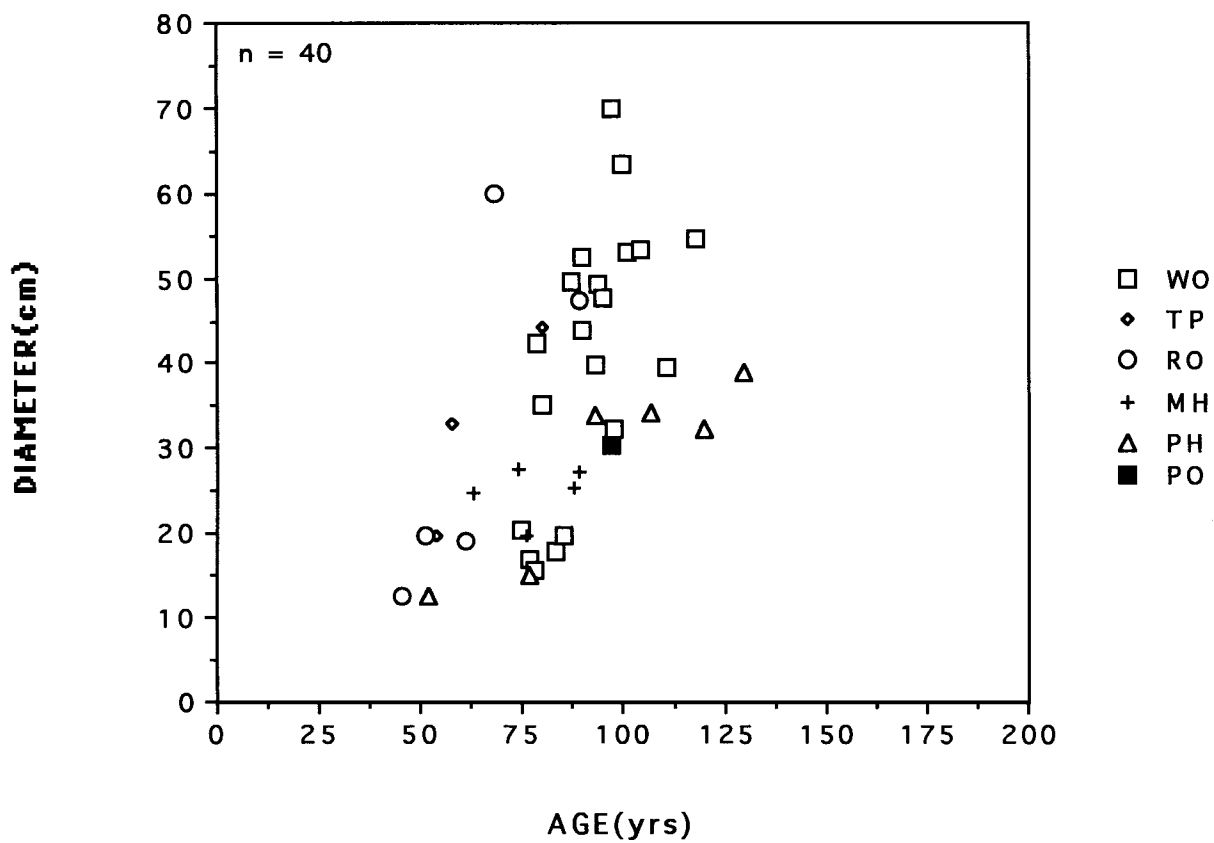


Figure 11. Age-diameter relationship for Stand F9

33

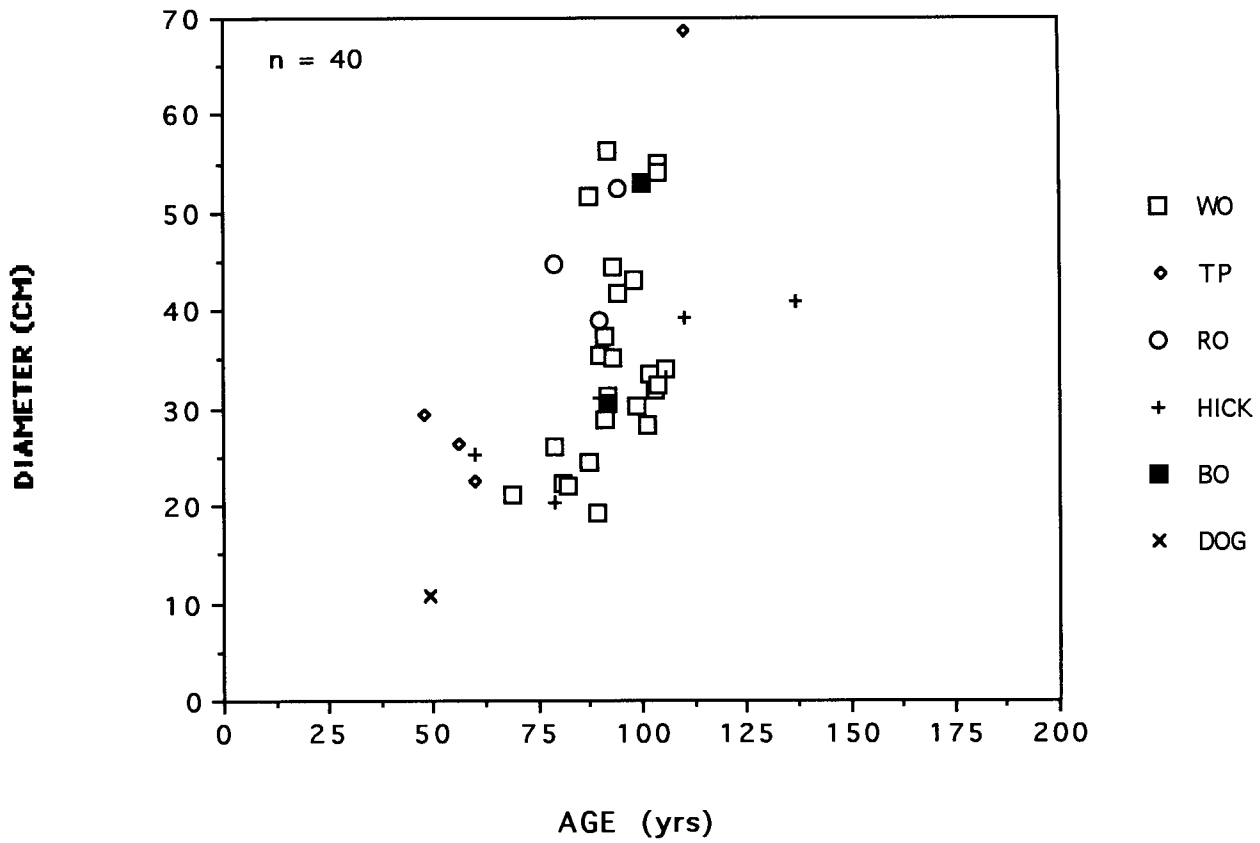


Figure 12. Age-diameter relationship for Stand F10

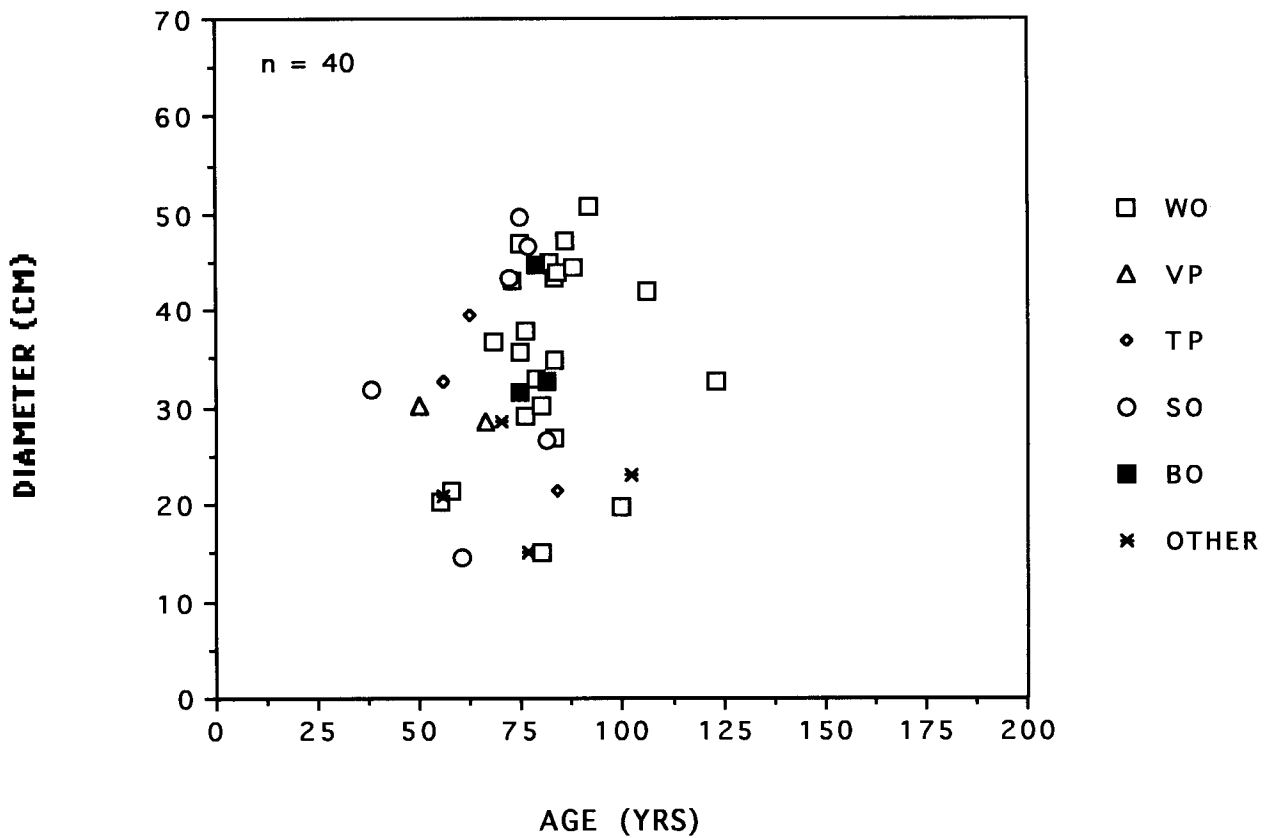


Figure 13. Age-diameter relationship for Stand F11

34

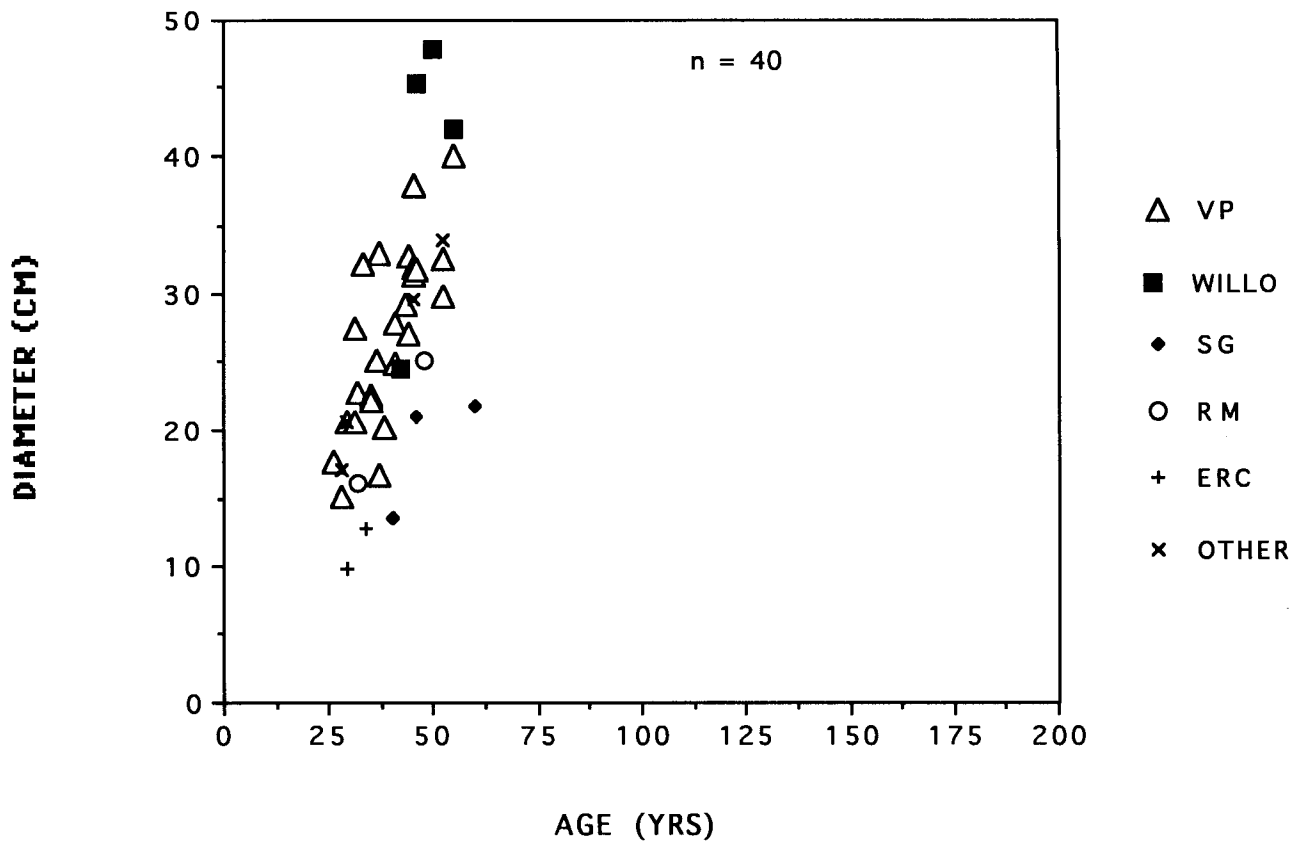


Figure 14. Age-diameter relationship for Stand F12

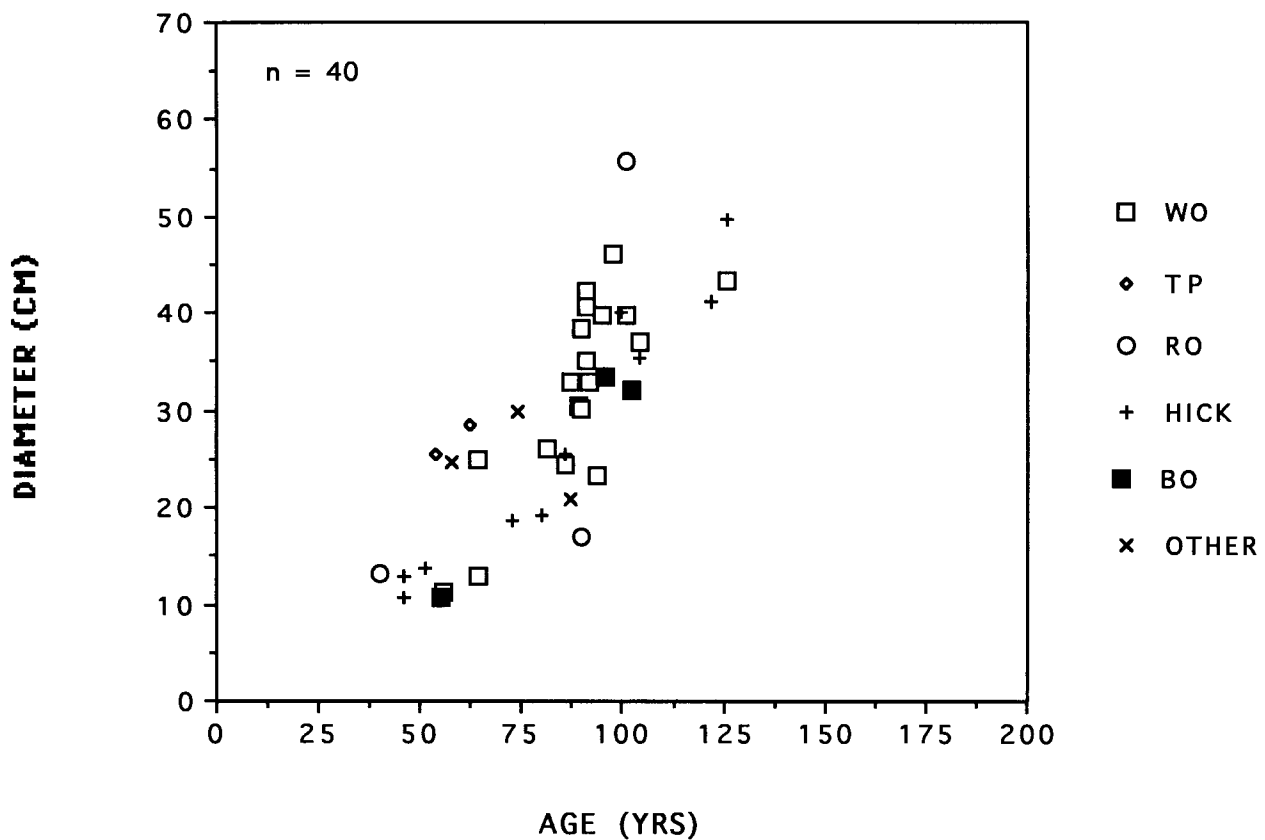
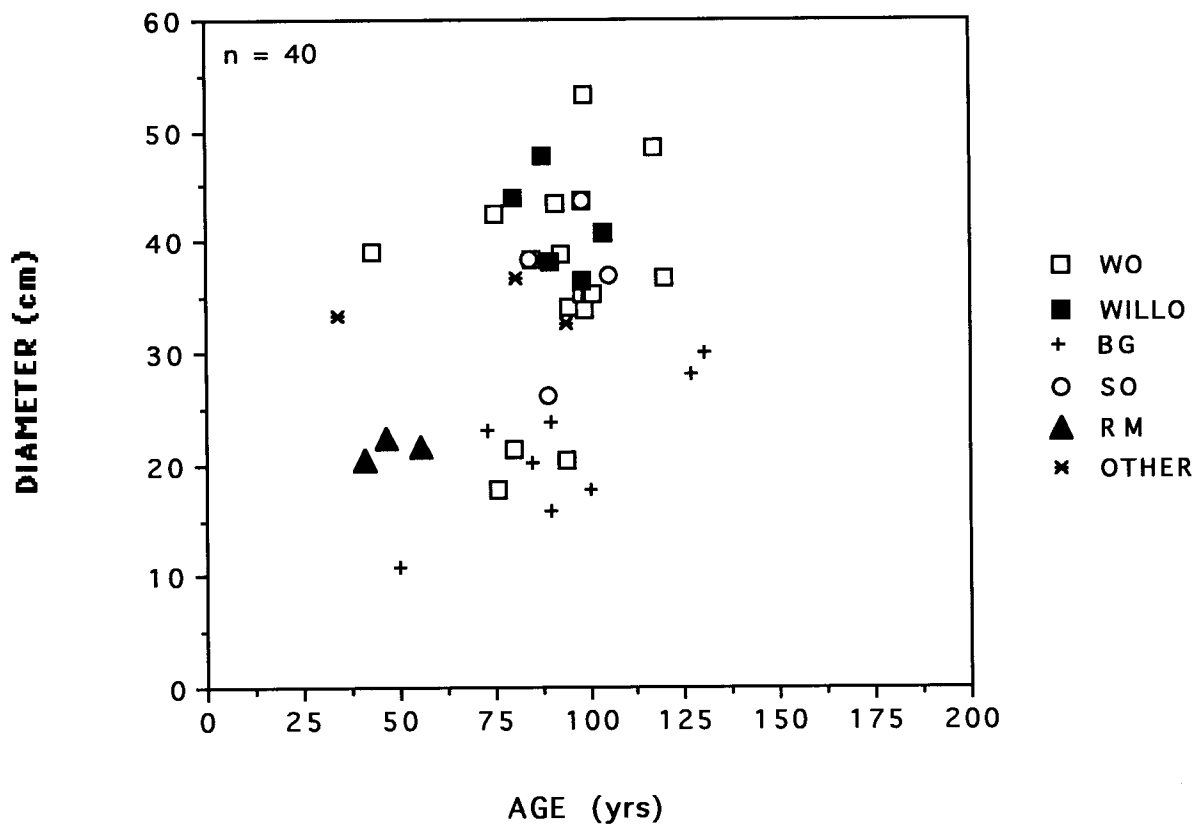


Figure 15. Age-diameter relationship for Stand F13



Fuel loads

Fuel loads were estimated in three representative stands within Fredericksburg Battlefield (Figure 1; asterisks indicate fuel loading sampling locations). Due to the predominance of oak forest with low ground cover and a scarcity of large fuel build-ups observed during battlefield-wide reconnaissance and inventory, fewer stands were chosen for hazard estimation in this portion of the park. The three stands chosen consisted of fuel loads which correspond to Fire Behavior Fuel Model 9 (Table 15). These models predict slow burning ground fires with low flame heights (Wilcox et al. 1982; Lynch and Horton 1983). Fuel quantities (12,929 - 15,842 kg/ha; 2241 kg/ha = 1 ton/A) in the mature oak and oak - hickory stands were lower than the average values found in photo series guides for similar mature forests in the northeast (15,013 - 21,063 kg/ha). In addition, Fredericksburg oak fuel loads were considerably lower than mean oak loads found in similar forests within Richmond National Battlefield Park (RNBP) (27,530 - 28,517 kg/ha; Helm 1993). The Virginia pine - sweetgum stand contained fuel loads (20,839 kg/ha) which were lower than photo series guides and RNBP levels (40,558 and 39,724 kg/ha, respectively; Lynch and Horton 1983; Helm 1993).

Due to these low loads, the majority of stands within Fredericksburg Battlefield are not a threat for holocastic wildfires. Stand F2, located just beyond Lansdowne Road, is a pine stand starting to break up successional, and due to mortality and/or windthrow, heavier fuel loads may accumulate in the future. Removal of downed trees may be appropriate if large fuel build-ups occur.

Table 15. List of fuel loads for various forest types within Fredericksburg (F) Battlefield.

Forest Type ¹	Stand	Fuel loading							Fuel Model
		Overstory Age ² (yrs.)	Basal area (m ² /ha)	0-.63 cm (kg/ha)	.63-2.54 cm (kg/ha)	2.54-7.6 cm (kg/ha)	>7.6 cm (kg/ha)	Total (kg/ha)	
PSG	F2	46	32	450	3704	3511	13174	20839	9
Oak	F3	97	28	432	1618	2032	8600	12682	9
OH	F7	83	29	303	1107	3050	11383	15843	9

¹ PSG = Virginia pine - sweetgum; OH = white oak - hickory; and OAK = white, scarlet, and black oaks.

² Average breast height (1.4 m) age of overstory trees from radial growth analysis.

Chancellorsville Battlefield

Overview

Chancellorsville Battlefield is located in the northern portion of Spotsylvania County. The battlefield is found within the Piedmont Plateau physiographic province, and the majority of stands are located on flat to slightly sloping terrain (slope < 5%) at elevations of 80 to 107 m above sea level (U.S. Geological Survey 1978). Bedrock of the area is comprised mainly of granite, granite gneiss, and hornblende gneiss of the Paleozoic and Precambrian ages (Elder 1985). Soils are members of the Nason-Tatum-Catharpin association and consist of deep, well-drained soils with a dominantly clayey subsoil. These soils are typically silt loams, low in fertility, and strongly acid or very strongly acid (Elder 1985).

Thirteen stands comprising approximately 126 ha were surveyed for vegetational composition in Chancellorsville Battlefield (Table 16; Figure 16). Overall, this battlefield had the most xeric (i.e. driest) landscape, including low overstory basal area (typically 25 m²/ha or less) and a high average shrub cover. The land-use history of continuous massive harvesting for charcoal production to fuel the Catharine Furnace within this battlefield is reflected in the present-day forest conditions (Harrison 1990; Orwig and Abrams 1994). Sixty-seven woody species were found within this study area during the project period (Appendix A) and no rare plants identified by the park were found. White oak, scarlet oak (*Quercus coccinea*), and Virginia pine were abundant overstory species throughout the battlefield. Additional dry-site species such as black oak (*Quercus velutina*) and post oak (*Quercus stellata*) also obtained high local overstory importance within this battlefield while mesic (moist-site) species such as dogwood (*Cornus florida*) and tulip poplar generally obtained low overstory importance. Permanent plots were established in Stand CV11 for long-term monitoring (Figure 16, PP denotes this stand). Plot locations are on file with the natural resource manager.

Table 16. Characteristics of surveyed forest stands of Chancellorsville (CV) Battlefield.

Stand	Size (ha)	Overstory tree density (#/ha)	<u>Tree Age¹ (n = 38- 40)</u>		<u>Average Cover</u>		Slope%	Forest Type ²
			(yrs) $\pm$ S.E.	Range	Shrub%	Herb%		
CV1	10	761	65 $\pm$ 3	30 - 100	66.25	2.5	0	PO
CV2	8	306	94 $\pm$ 3	48 - 145	61.5	2.5	0	OP
CV3	18	482	93 $\pm$ 3	36 - 163	31.12	2.5	0	OAK
CV4	12	556	82 $\pm$ 2	34 - 99	35.25	2.5	2.4	OAK
CV5	8	526	85 $\pm$ 4	45 - 160	23.38	2.5	0	OP
CV6	8	524	89 $\pm$ 4	40 - 164	15.63	3.13	4.8	OAK
CV7	8	583	80 $\pm$ 6	27 - 169	25.88	2.15	2.15	OAK
CV8	17	563	85 $\pm$ 5	31 - 120	19.25	3.13	4.65	OAK
CV9	8	867	54 $\pm$ 2	40 - 87	12.25	11.38	2.00	PSG
CV10	12	667	70 $\pm$ 7	28 - 215	43.38	4.25	0	OP
CV11	5	637	75 $\pm$ 5	32 - 169	34.75	0.13	0.55	OP
CV12	6	568	87 $\pm$ 5	32 - 150	36.38	0.13	3.0	OP
CV13	6	1277	42 $\pm$ 3	24 - 84	12.13	9.0	0.8	PINE

¹ Average breast height age of overstory trees in stand determined from radial growth analysis.

² Determined from overstory importance values (I.V.= {Relative density + Relative dominance + Relative frequency}/ 3).

OP = Oak - pine, PO = Pine - oak, PSG = Pine - sweetgum; and OAK = white and scarlet oak.

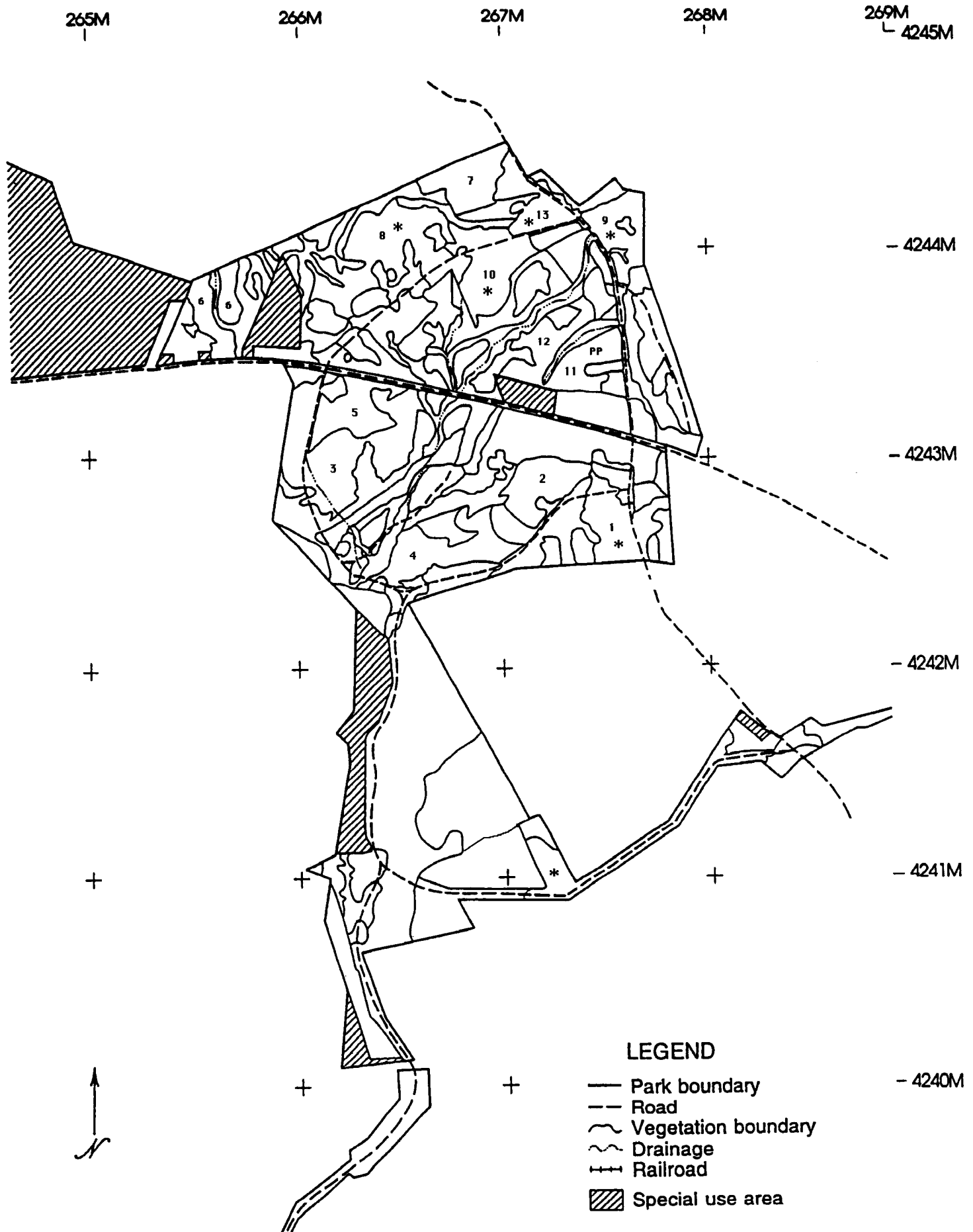


Figure 16. Location of surveyed forest stands - Chancellorsville Battlefield.

Stand descriptions

The following includes general stand descriptions with predictions of future species composition.

Stand CV1 was a 10 ha pine-oak stand (Table 17) located near the end of Slocum Drive in the southeastern portion of the battlefield. The stand is comprised of a large diameter, 90 year-old white oak component and a younger Virginia pine component, indicating previous wooded pasture land. White oak and blackgum obtained the highest sapling densities in the area, there was abundant ericaceous ground cover including huckleberry (*Gaylussacia baccata*), blueberry (*Vaccinium* spp.), and laurel (*Kalmia latifolia*). An occasional blackjack oak (*Quercus marilandica*) was also present in this forest.

Stand CV2 was a 8 ha oak-pine stand (Table 18) situated on the north side of Slocum drive. The overstory consisted of large, widely spaced white and scarlet oaks that were 80 - 150 years old. Early successional Virginia pine and sweetgum were present in gaps and sassafras was abundant in the sapling layer. A large ericaceous ground-layer component was present. Composition should not change drastically in the future.

Stand CV3 was a 18 ha oak stand (Table 19) found on the east side of Stuart Drive. Major overstory trees were initiated in the late 1800s and consisted of white oak, sweetgum, and scarlet and southern red oak. An overstory pine component also existed in this stand but it was beginning to decline due to wind damage. Blackgum was an abundant sapling, while red maple and sassafras were present in high seedling densities.

Stand CV4 was a 12 ha oak stand (Table 20) located just north of the intersection of Slocum Drive, Sickles Drive, and Stuart Drive. This forest was initiated at the turn of the century and was comprised of white oak and scarlet oak in the overstory and blackgum, red maple, and sassafras in the seedling and sapling layers. Allegheny chinkapin (*Castanea*

pumila) was also a common sapling-layer inhabitant. No major overstory changes are anticipated in the future.

Stand CV5 was a 8 ha oak-pine stand (Table 21) found east of Stuart Drive just south of Route 3. This flat area contained an uneven-aged overstory consisting of white oak, scarlet oak, and Virginia pine. Red maple and white pine were also locally abundant in the overstory. Virginia pine should decline in the future and give way to oaks, red maple, and blackgum.

Stand CV6 was a 8 ha oak-stand (Table 22) situated north of route 3 in the western portion of the battlefield, west of a private inholding. Overstory composition was predominantly 100 year-old white, black, scarlet, and southern red oaks, which should continue to be important in the future along with blackgum, tulip poplar, and perhaps red maple.

Stand CV7 was a 8 ha oak stand (Table 23) located in the northern tip of the battlefield, north of Bullock Road. This forest contained an uneven-aged overstory component of white oak, scarlet oak, and black oak. A younger cohort of overstory oak species became established in the early 1950s as a result of unknown canopy disturbance. Blackgum, red maple, dogwood, and hickory species were abundant in the understory layers.

Stand CV8 was a 17 ha oak stand (Table 24) situated on the north side of Bullock Drive just beyond the bog area below the water tower. This dry mesic stand was composed of an uneven-aged overstory of white oak, scarlet oak, tulip poplar, sweetgum, and hickory species. Red maple, dogwood, sweetgum, and white oak were abundant in the sapling layer and should continue to be important in the future.

Stand CV9 was a 8 ha pine-sweetgum forest (Table 25) found at the intersection of Bullock Drive and Ely's Ford Road. This even-aged stand was composed of Virginia pine and sweetgum in the overstory which became established following agricultural

abandonment around 1930. Pines should continue to dominate another 20 -30 years at which time white and scarlet oaks, tulip poplar, blackgum, and red maple will increase in overstory importance.

Stand CV10 was a 12 ha oak-pine stand (Table 26) located on the south side of Bullock Drive, northeast of the Chancellorsville Visitor Center. The forest overstory was composed of 100 - 140 year-old white and southern red oaks and 30 - 50 year-old Virginia pine which came in following unknown disturbance events. Oaks should continue to have the highest overstory IV, along with red maple and blackgum.

Stand CV11 was a 5 ha oak-pine stand (Table 27) situated west of Ely's Ford Road, north of the site of the former Chancellor House. This stand consisted of overstory white oak and Virginia pine ranging in age from 30 - 175 and 45 - 60 years old, respectively. Blackgum and sassafras were abundant in the seedling and sapling layers and should continue to be abundant in this forest.

Stand CV12 was a 6 ha oak-pine stand (Table 28) found north of Route 3 northwest of the open field which surrounded the former Chancellor House. Portions of this forest experienced a fire in the early 1980s and contained high overstory importance of white oak, scarlet oak, and Virginia pine. The former two species were also common in the understory and should continue to be important in the future along with blackgum, sweetgum, and sassafras.

Stand CV13 was a 6 ha pine stand (Table 29) formed following agricultural abandonment of fields at different times during the 1930s - 1950s. Furrows were still present in portions of the stand. Red maple and sweetgum were abundant in the sapling layer and their overstory IV should increase with various oak species as a result of pine mortality over the next 20 - 30 years.

Cover map key

A vegetation cover map was made from delineations derived from the acetate overlay of 1980 aerial photograph reproductions and plot surveys (Figure 17). Vegetation cover types of forested areas were designated by the most important overstory species in surveyed stands (size > 4 ha) or, for non-surveyed stands, upon reconnaissance similarities with inventoried stands. Non-forested stands were characterized by the most abundant vegetation present upon visual inspection (e.g. scrub, agriculture). Stand designations were as follows: **O** - oak stands dominated by white and scarlet oaks, as well as red oak (*Quercus rubra*), black oak (*Q. velutina*), southern red oak (*Q. falcata*), and post oak (*Q. stellata*); **P**- stands dominated by Virginia pine in the overstory and **PSG** - pine -sweetgum stands dominated by Virginia pine or loblolly pine and sweetgum. Both **P** and **PSG** stands contained red maple (*Acer rubrum*), blackgum, and willow oak (*Q. phellos*); **OP** - oak - pine stands which are comprised of a mixture of white, scarlet, and black oaks with Virginia pine; and **PO** - pine - oak stands which contain a mixture of Virginia pine and various oak species. Map symbols are consistent with those described for Fredericksburg Battlefield. All cross-hatched symbols in the vegetation cover map represent private inholdings.



Figure 17. Vegetation cover map of Chancellorsville Battlefield.

Vegetative Composition of Chancellorsville Battlefield

Table 17. Stand CV1 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	3
<i>Ilex opaca</i>	1
<i>Liquidambar styraciflua</i>	9
<i>Nyssa sylvatica</i>	1
<i>Pinus echinata</i>	3
<i>Pinus taeda</i>	4
<i>Pinus virginiana</i>	37
<i>Quercus alba</i>	24
<i>Quercus coccinea</i>	8
<i>Quercus falcata</i>	4
<i>Quercus marilandica</i>	1
<i>Quercus stellata</i>	3
<i>Quercus velutina</i>	1

Total tree density (#/ha) = 761

Total overstory basal area (m²/ha) = 24.5

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	754	54
<i>Liquidambar styraciflua</i>	108	54
<i>Nyssa sylvatica</i>	1723	378
<i>Pinus virginiana</i>	108	--
<i>Quercus alba</i>	1186	269
<i>Quercus coccinea</i>	3120	--
<i>Quercus falcata</i>	647	--
<i>Quercus marilandica</i>	216	--
<i>Quercus phellos</i>	753	--
<i>Quercus stellata</i>	216	--
<i>Sassafras albidum</i>	108	--
Totals	8939	755

Table 18. Stand CV2 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Carya glabra</i>	1
<i>Ilex opaca</i>	1
<i>Liquidambar styraciflua</i>	6
<i>Liriodendron tulipifera</i>	1
<i>Nyssa sylvatica</i>	3
<i>Pinus echinata</i>	1
<i>Pinus virginiana</i>	10
<i>Quercus alba</i>	51
<i>Quercus coccinea</i>	17
<i>Quercus falcata</i>	3
<i>Quercus stellata</i>	4
<i>Quercus velutina</i>	1

Total tree density (#/ha) = 306

Total overstory basal area (m²/ha) = 20.6

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	1077	377
<i>Diospyros virginiana</i>	323	--
<i>Juniperus virginiana</i>	108	--
<i>Liquidambar styraciflua</i>	431	108
<i>Liriodendron tulipifera</i>	--	54
<i>Nyssa sylvatica</i>	755	216
<i>Pinus virginiana</i>	108	--
<i>Quercus alba</i>	4197	--
<i>Quercus coccinea</i>	4412	--
<i>Quercus falcata</i>	431	--
<i>Quercus phellos</i>	108	--
<i>Quercus stellata</i>	108	--
<i>Sassafras albidum</i>	5165	432
Totals	17223	1187

Table 19. Stand CV3 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	4
<i>Carya glabra</i>	1
<i>Cornus florida</i>	1
<i>Ilex opaca</i>	1
<i>Juniperus virginiana</i>	1
<i>Liquidambar styraciflua</i>	11
<i>Liriodendron tulipifera</i>	2
<i>Nyssa sylvatica</i>	9
<i>Pinus virginiana</i>	7
<i>Quercus alba</i>	43
<i>Quercus coccinea</i>	8
<i>Quercus falcata</i>	8
<i>Quercus stellata</i>	2
<i>Quercus velutina</i>	2
<i>Sassafras albidum</i>	2

Total tree density (#/ha) = 482

Total overstory basal area (m²/ha) = 22.9

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	9146	270
<i>Amelanchier arborea</i>	1076	--
<i>Fagus grandifolia</i>	108	--
<i>Ilex opaca</i>	432	--
<i>Liquidambar styraciflua</i>	--	54
<i>Nyssa sylvatica</i>	1079	969
<i>Quercus alba</i>	2476	108
<i>Quercus coccinea</i>	3766	--
<i>Quercus falcata</i>	324	--
<i>Quercus phellos</i>	108	--
<i>Quercus velutina</i>	215	--
<i>Sassafras albidum</i>	9898	54
Totals	28628	1455

Table 20. Stand CV4 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	1
<i>Amelanchier arborea</i>	1
<i>Carya glabra</i>	3
<i>Carya tomentosa</i>	1
<i>Fagus grandifolia</i>	1
<i>Ilex opaca</i>	2
<i>Juniperus virginiana</i>	6
<i>Liquidambar styraciflua</i>	9
<i>Liriodendron tulipifera</i>	4
<i>Nyssa sylvatica</i>	4
<i>Pinus virginiana</i>	1
<i>Quercus alba</i>	37
<i>Quercus coccinea</i>	22
<i>Quercus falcata</i>	3
<i>Quercus stellata</i>	2
<i>Quercus velutina</i>	2
<i>Sassafras albidum</i>	2

Total tree density (#/ha) = 556

Total overstory basal area (m²/ha) = 24.1

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	647	323
<i>Amelanchier arborea</i>	1507	--
<i>Castanea pumila</i>	754	108
<i>Cornus florida</i>	--	108
<i>Diospyros virginiana</i>	215	--
<i>Juniperus virginiana</i>	--	54
<i>Liquidambar styraciflua</i>	431	323
<i>Nyssa sylvatica</i>	1615	1186
<i>Pinus virginiana</i>	431	--
<i>Quercus alba</i>	1293	162
<i>Quercus coccinea</i>	3658	--
<i>Quercus falcata</i>	323	--
<i>Quercus phellos</i>	216	--
<i>Quercus rubra</i>	108	--
<i>Sassafras albidum</i>	11729	324
Totals	22927	2588

Table 21. Stand CV5 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	9
<i>Carya glabra</i>	2
<i>Carya tomentosa</i>	1
<i>Cornus florida</i>	1
<i>Ilex opaca</i>	2
<i>Juniperus virginiana</i>	1
<i>Liquidambar styraciflua</i>	2
<i>Nyssa sylvatica</i>	4
<i>Pinus echinata</i>	1
<i>Pinus strobus</i>	6
<i>Pinus virginiana</i>	15
<i>Quercus alba</i>	35
<i>Quercus coccinea</i>	13
<i>Quercus falcata</i>	3
<i>Quercus marilandica</i>	1
<i>Quercus stellata</i>	4
<i>Quercus velutina</i>	2

Total tree density (#/ha) = 526

Total overstory basal area (m²/ha) = 24.6

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	17969	216
<i>Amelanchier arborea</i>	323	--
<i>Castanea pumila</i>	108	--
<i>Cornus florida</i>	108	54
<i>Diospyros virginiana</i>	323	--
<i>Ilex opaca</i>	323	54
<i>Liquidambar styraciflua</i>	215	--
<i>Liriodendron tulipifera</i>	215	--
<i>Nyssa sylvatica</i>	754	540
<i>Pinus strobus</i>	755	--
<i>Quercus alba</i>	15171	54
<i>Quercus coccinea</i>	4090	--
<i>Quercus falcata</i>	754	--
<i>Quercus phellos</i>	323	--
<i>Quercus velutina</i>	324	54
<i>Sassafras albidum</i>	8932	54
Totals	50687	1026

Table 22. Stand CV6 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	4
<i>Carya glabra</i>	2
<i>Carya tomentosa</i>	1
<i>Cornus florida</i>	1
<i>Ilex opaca</i>	1
<i>Liquidambar styraciflua</i>	7
<i>Liriodendron tulipifera</i>	10
<i>Nyssa sylvatica</i>	8
<i>Pinus virginiana</i>	2
<i>Quercus alba</i>	44
<i>Quercus coccinea</i>	7
<i>Quercus falcata</i>	5
<i>Quercus phellos</i>	1
<i>Quercus stellata</i>	5
<i>Quercus velutina</i>	1
<i>Sassafras albidum</i>	1

Total tree density (#/ha) = 524

Total overstory basal area (m²/ha) = 27.1

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	8932	54
<i>Amelanchier arborea</i>	646	--
<i>Carpinus caroliniana</i>	538	--
<i>Carya</i> spp.	648	--
<i>Chionanthus virginicus</i>	324	--
<i>Cornus florida</i>	1399	216
<i>Fagus grandifolia</i>	108	54
<i>Ilex opaca</i>	108	108
<i>Liquidambar styraciflua</i>	1831	54
<i>Liriodendron tulipifera</i>	645	--
<i>Nyssa sylvatica</i>	4949	1561
<i>Prunus serotina</i>	646	--
<i>Quercus alba</i>	18401	54
<i>Quercus coccinea</i>	2583	--
<i>Quercus falcata</i>	647	54
<i>Quercus phellos</i>	756	--
<i>Quercus stellata</i>	108	--
<i>Quercus velutina</i>	108	--
<i>Sassafras albidum</i>	11082	54
Totals	54459	2209

Table 23. Stand CV7 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	5
<i>Carya glabra</i>	4
<i>Carya tomentosa</i>	6
<i>Cornus florida</i>	2
<i>Juniperus virginiana</i>	3
<i>Liquidambar styraciflua</i>	5
<i>Liriodendron tulipifera</i>	3
<i>Nyssa sylvatica</i>	5
<i>Pinus virginiana</i>	3
<i>Quercus alba</i>	34
<i>Quercus coccinea</i>	17
<i>Quercus falcata</i>	2
<i>Quercus stellata</i>	2
<i>Quercus velutina</i>	9
<i>Sassafras albidum</i>	1

Total tree density (#/ha) = 583 Total overstory basal area (m²/ha) = 17.6

Species	Understory density (#/ha)	
	Seedling	Sapling
<i>Acer rubrum</i>	6028	162
<i>Carya spp.</i>	862	216
<i>Cornus florida</i>	538	377
<i>Diospyros virginiana</i>	430	--
<i>Ilex opaca</i>	324	--
<i>Juniperus virginiana</i>	216	--
<i>Liquidambar styraciflua</i>	538	54
<i>Liriodendron tulipifera</i>	108	54
<i>Nyssa sylvatica</i>	862	969
<i>Pinus virginiana</i>	216	--
<i>Prunus serotina</i>	323	--
<i>Quercus alba</i>	9146	--
<i>Quercus coccinea</i>	7963	54
<i>Quercus falcata</i>	862	--
<i>Quercus velutina</i>	108	108
<i>Sassafras albidum</i>	3443	108
Totals	31967	2102

Table 24. Stand CV8 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	3
<i>Carya glabra</i>	6
<i>Carya tomentosa</i>	5
<i>Cornus florida</i>	2
<i>Fagus grandifolia</i>	*
<i>Ilex opaca</i>	1
<i>Juniperus virginiana</i>	1
<i>Liquidambar styraciflua</i>	7
<i>Liriodendron tulipifera</i>	9
<i>Nyssa sylvatica</i>	6
<i>Pinus virginiana</i>	4
<i>Quercus alba</i>	31
<i>Quercus coccinea</i>	11
<i>Quercus falcata</i>	5
<i>Quercus stellata</i>	4
<i>Quercus velutina</i>	5

* denotes IV < 1.

Total tree density (#/ha) = 563

Total overstory basal area (m²/ha) = 24.5

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	1937	270
<i>Carya spp.</i>	5597	--
<i>Cornus florida</i>	2691	216
<i>Diospyros virginiana</i>	--	54
<i>Ilex opaca</i>	108	54
<i>Juniperus virginiana</i>	539	--
<i>Liquidambar styraciflua</i>	538	270
<i>Liriodendron tulipifera</i>	1399	--
<i>Nyssa sylvatica</i>	1721	54
<i>Prunus serotina</i>	432	--
<i>Quercus alba</i>	10544	216
<i>Quercus coccinea</i>	862	--
<i>Quercus falcata</i>	108	--
<i>Quercus phellos</i>	324	54
<i>Quercus rubra</i>	1185	--
<i>Quercus stellata</i>	108	--
<i>Quercus velutina</i>	1507	--
<i>Sassafras albidum</i>	646	162
Totals	30246	1350

Table 25. Stand CV9 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	4
<i>Cornus florida</i>	2
<i>Diospyros virginiana</i>	1
<i>Ilex opaca</i>	2
<i>Juniperus virginiana</i>	1
<i>Liquidambar styraciflua</i>	14
<i>Liriodendron tulipifera</i>	1
<i>Nyssa sylvatica</i>	3
<i>Pinus echinata</i>	1
<i>Pinus virginiana</i>	57
<i>Quercus alba</i>	6
<i>Quercus coccinea</i>	2
<i>Quercus falcata</i>	3
<i>Quercus phellos</i>	1
<i>Quercus stellata</i>	1
<i>Sassafras albidum</i>	*

* denotes IV < 1

Total tree density (#/ha) = 867

Total overstory basal area (m²/ha) = 34.1

Species	Understory density (#/ha)	
	Seedling	Sapling
<i>Acer rubrum</i>	14635	269
<i>Carpinus caroliniana</i>	--	54
<i>Castanea pumila</i>	862	--
<i>Cornus florida</i>	431	162
<i>Diospyros virginiana</i>	539	--
<i>Fagus grandifolia</i>	108	--
<i>Ilex opaca</i>	1832	54
<i>Juniperus virginiana</i>	108	--
<i>Liquidambar styraciflua</i>	3122	108
<i>Liriodendron tulipifera</i>	--	162
<i>Nyssa sylvatica</i>	538	808
<i>Pinus virginiana</i>	3766	--
<i>Prunus serotina</i>	2367	--
<i>Quercus alba</i>	756	216
<i>Quercus coccinea</i>	3338	54
<i>Quercus falcata</i>	1400	--
<i>Quercus phellos</i>	3230	--
<i>Quercus stellata</i>	2691	--
<i>Sassafras albidum</i>	5381	216
Totals	45104	2103

Table 26. Stand CV10 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	9
<i>Carya glabra</i>	2
<i>Carya tomentosa</i>	1
<i>Cornus florida</i>	1
<i>Liquidambar styraciflua</i>	7
<i>Liriodendron tulipifera</i>	1
<i>Nyssa sylvatica</i>	4
<i>Pinus echinata</i>	2
<i>Pinus virginiana</i>	24
<i>Populus grandidentata</i>	1
<i>Quercus alba</i>	27
<i>Quercus coccinea</i>	7
<i>Quercus falcata</i>	3
<i>Quercus marilandica</i>	*
<i>Quercus phellos</i>	1
<i>Quercus stellata</i>	4
<i>Quercus velutina</i>	5

* denotes IV < 1

Total tree density (#/ha) = 667 Total overstory basal area (m²/ha) = 23.3

Species	Understory density (#/ha)	
	Seedling	Sapling
<i>Acer rubrum</i>	4843	270
<i>Amelanchier arborea</i>	108	--
<i>Carya spp.</i>	108	--
<i>Castanea pumila</i>	646	--
<i>Ilex opaca</i>	432	--
<i>Liquidambar styraciflua</i>	--	162
<i>Nyssa sylvatica</i>	2583	916
<i>Pinus virginiana</i>	323	--
<i>Prunus serotina</i>	538	--
<i>Quercus alba</i>	2046	216
<i>Quercus coccinea</i>	3982	108
<i>Quercus falcata</i>	108	--
<i>Quercus phellos</i>	647	--
<i>Quercus stellata</i>	323	--
<i>Quercus velutina</i>	861	--
<i>Sassafras albidum</i>	5166	215
Totals	22714	1887

Table 27. Stand CV11 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	7
<i>Liquidambar styraciflua</i>	11
<i>Nyssa sylvatica</i>	7
<i>Pinus echinata</i>	1
<i>Pinus virginiana</i>	30
<i>Quercus alba</i>	32
<i>Quercus coccinea</i>	5
<i>Quercus falcata</i>	1
<i>Quercus marilandica</i>	1
<i>Quercus phellos</i>	3
<i>Quercus stellata</i>	3
<i>Quercus velutina</i>	1

Total tree density (#/ha) = 637

Total overstory basal area (m²/ha) = 21.9

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	755	162
<i>Amelanchier arborea</i>	861	--
<i>Liquidambar styraciflua</i>	216	108
<i>Nyssa sylvatica</i>	1830	1294
<i>Pinus virginiana</i>	753	162
<i>Prunus serotina</i>	108	--
<i>Quercus alba</i>	1616	269
<i>Quercus coccinea</i>	1399	--
<i>Quercus falcata</i>	323	--
<i>Quercus phellos</i>	216	54
<i>Quercus velutina</i>	216	--
<i>Sassafras albidum</i>	6778	378
Totals	15071	2427

Table 28. Stand CV12 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	1
<i>Carya glabra</i>	5
<i>Carya tomentosa</i>	1
<i>Liquidambar styraciflua</i>	9
<i>Nyssa sylvatica</i>	3
<i>Pinus virginiana</i>	11
<i>Quercus alba</i>	36
<i>Quercus coccinea</i>	14
<i>Quercus falcata</i>	6
<i>Quercus stellata</i>	3
<i>Quercus velutina</i>	9

Total tree density (#/ha) = 568

Total overstory basal area (m²/ha) = 23.1

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	2153	108
<i>Carya spp.</i>	324	--
<i>Castanea pumila</i>	216	--
<i>Diospyros virginiana</i>	108	--
<i>Juniperus virginiana</i>	--	54
<i>Liquidambar styraciflua</i>	216	162
<i>Nyssa sylvatica</i>	1724	1132
<i>Prunus serotina</i>	108	--
<i>Quercus alba</i>	11729	162
<i>Quercus coccinea</i>	4734	108
<i>Quercus falcata</i>	324	--
<i>Quercus velutina</i>	216	--
<i>Sassafras albidum</i>	7531	162
Totals	29383	1888

Table 29. Stand CV13 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	11
<i>Cornus florida</i>	2
<i>Liquidambar styraciflua</i>	11
<i>Liriodendron tulipifera</i>	4
<i>Nyssa sylvatica</i>	3
<i>Pinus echinata</i>	1
<i>Pinus virginiana</i>	52
<i>Populus grandidentata</i>	*
<i>Quercus alba</i>	6
<i>Quercus coccinea</i>	5
<i>Quercus falcata</i>	3
<i>Quercus phellos</i>	1
<i>Quercus stellata</i>	1
<i>Quercus velutina</i>	*
<i>Sassafras albidum</i>	*

* denotes IV < 1

Total tree density (#/ha) = 1277

Total overstory basal area (m²/ha) = 28.4

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	3551	701
<i>Amelanchier arborea</i>	1185	--
<i>Carya</i> spp.	647	--
<i>Castanea pumila</i>	431	--
<i>Cornus florida</i>	431	108
<i>Diospyros virginiana</i>	861	--
<i>Fagus grandifolia</i>	108	--
<i>Ilex opaca</i>	2369	270
<i>Juniperus virginiana</i>	323	--
<i>Liquidambar styraciflua</i>	6133	594
<i>Liriodendron tulipifera</i>	108	54
<i>Nyssa sylvatica</i>	1616	162
<i>Pinus virginiana</i>	1291	54
<i>Prunus serotina</i>	540	--
<i>Quercus alba</i>	1615	108
<i>Quercus coccinea</i>	2261	216
<i>Quercus falcata</i>	1184	--
<i>Quercus phellos</i>	3766	--
<i>Quercus stellata</i>	1830	54
<i>Quercus velutina</i>	108	--
<i>Sassafras albidum</i>	753	108
Totals	31111	2429

Age-diameter figures for overstory trees in Chancellorsville (CV) Battlefield

KEY

<u>SYMBOL</u>	<u>SPECIES</u>
ASP	Bigtooth aspen
BEECH	American beech
BG	Blackgum
BO	Black oak
CO	Chestnut oak
DOG	Dogwood
ERC	Eastern redcedar
HICK	Hickory spp.
HOLLY	American holly
LOB	Loblolly pine
MH	Mockernut hickory
PH	Pignut hickory
PO	Post oak
RM	Red maple
RO	Red oak
SB	Sweet birch
SG	Sweetgum
SLP	Shortleaf pine
SO	Scarlet oak
SRO	Southern red oak
TP	Tulip poplar
VP	Virginia pine
WO	White oak
WILLO	Willow oak

Figure 18. Age-diameter relationship for Stand CV1

61

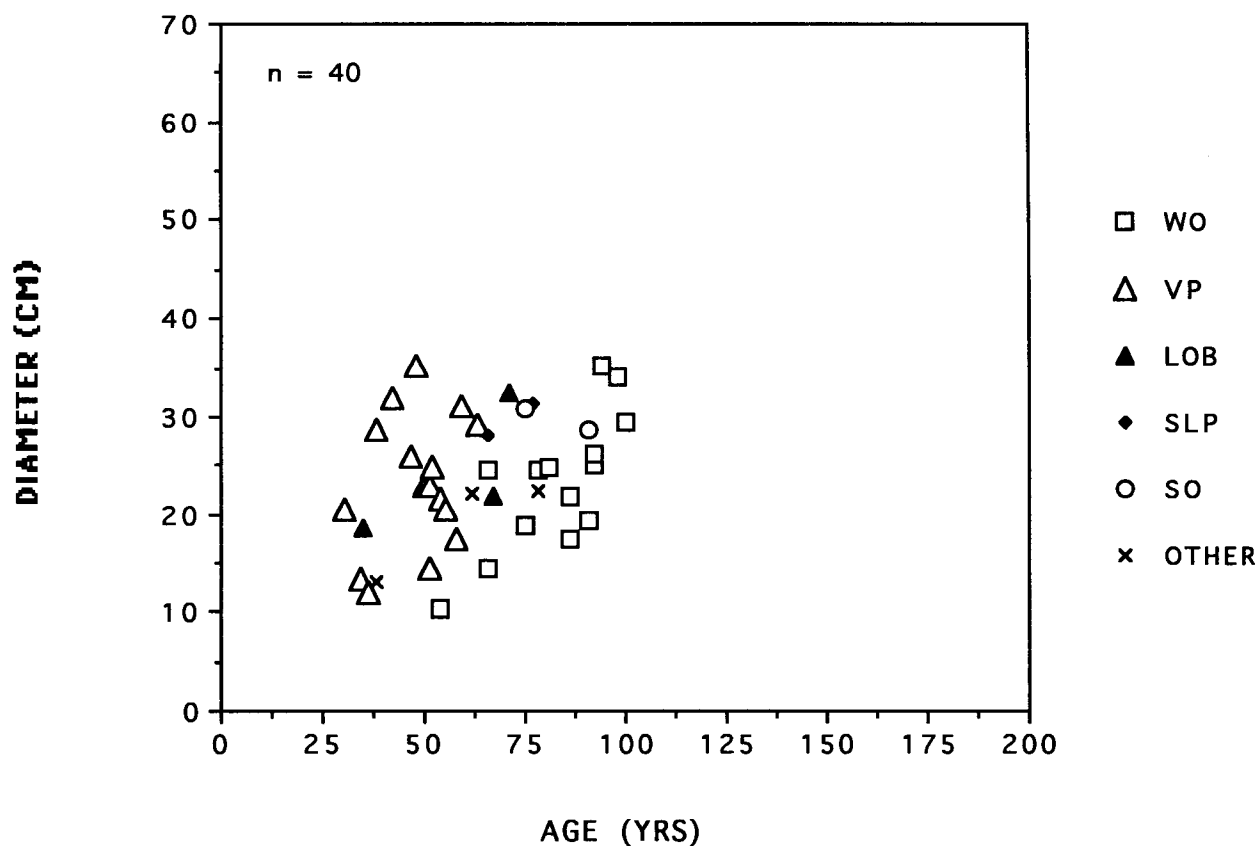


Figure 19. Age-diameter relationship for Stand CV2

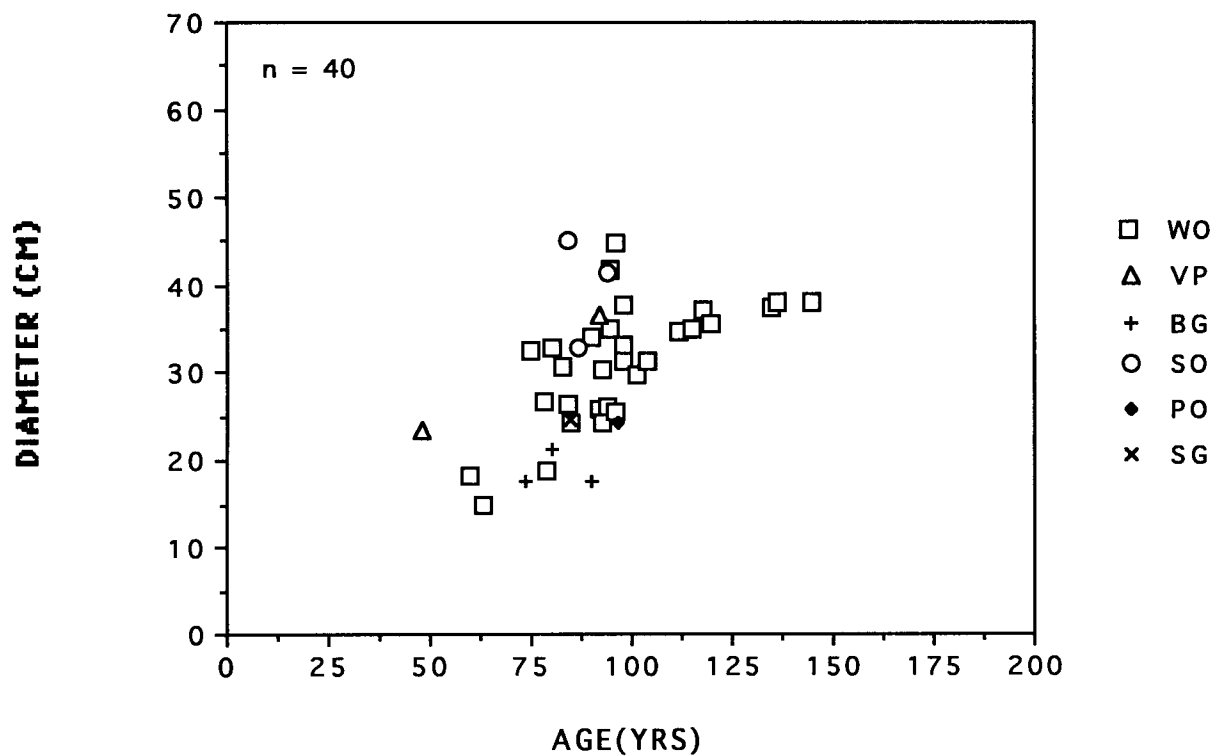


Figure 20. Age-diameter relationship for Stand CV3

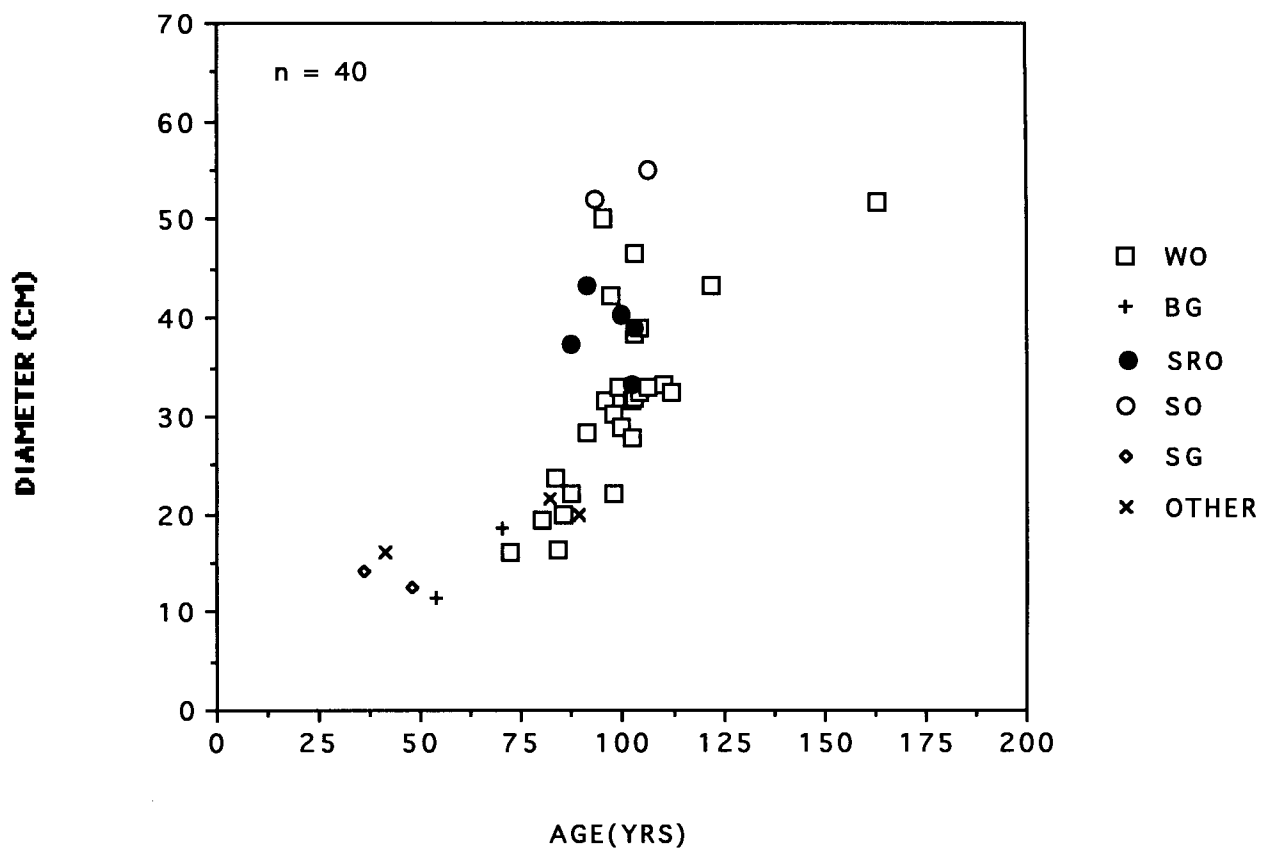


Figure 21. Age-diameter relationship for Stand CV4

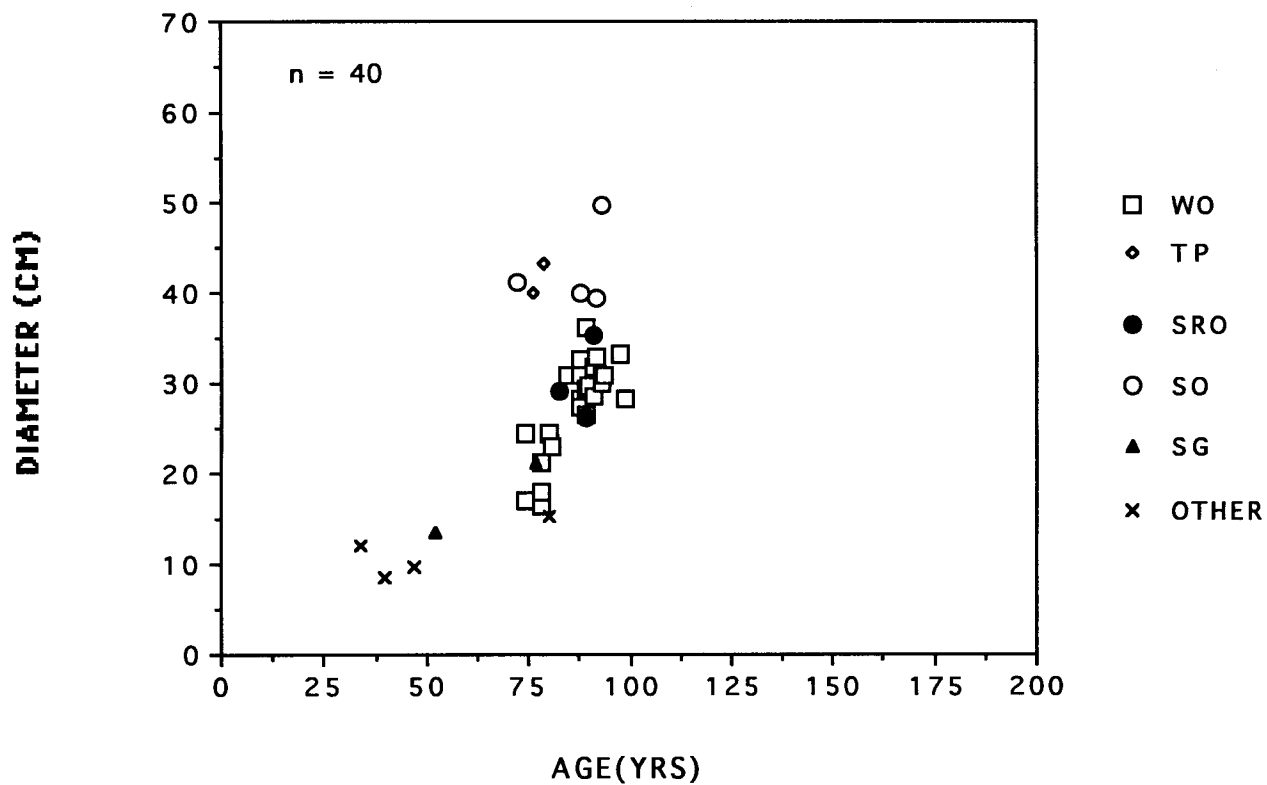


Figure 22. Age-diameter relationship for Stand CV5

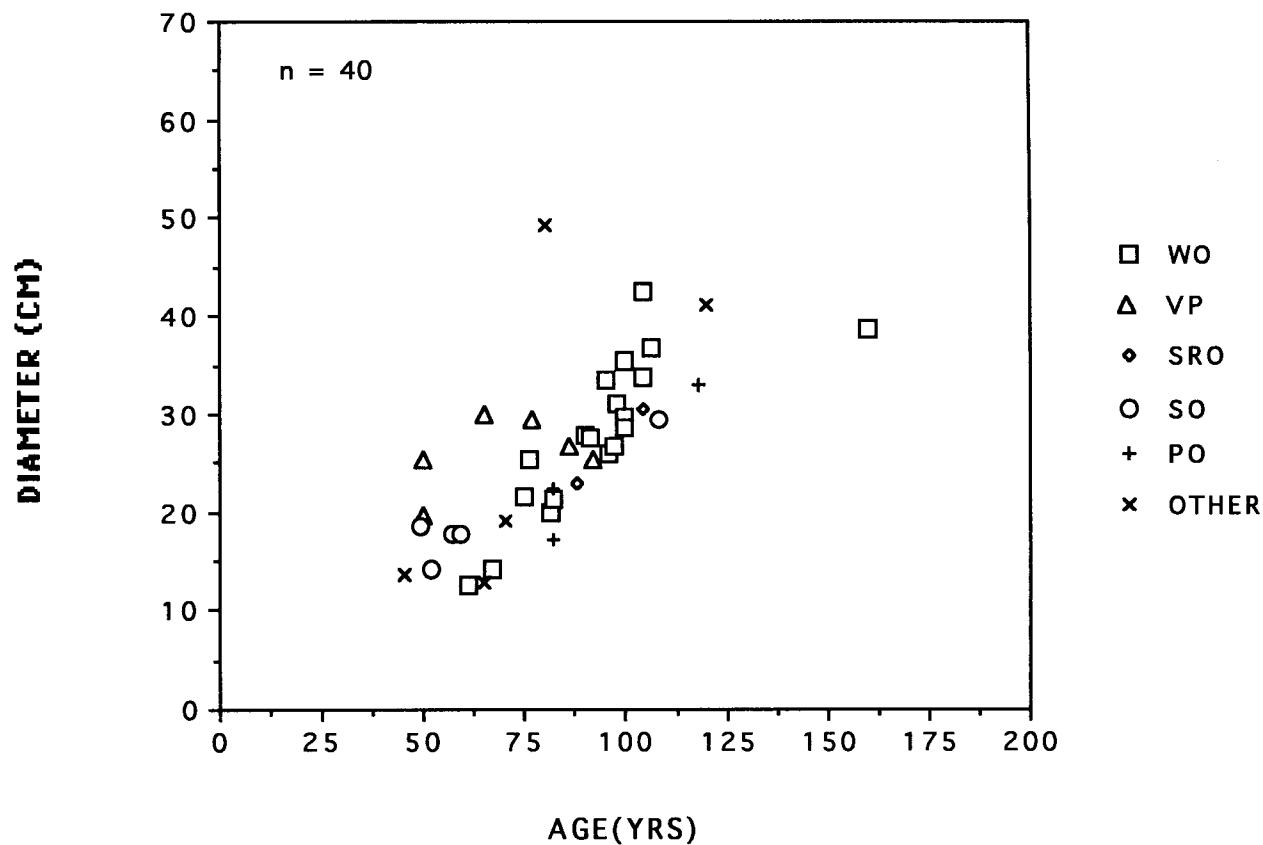


Figure 23. Age-diameter relationship for Stand CV6

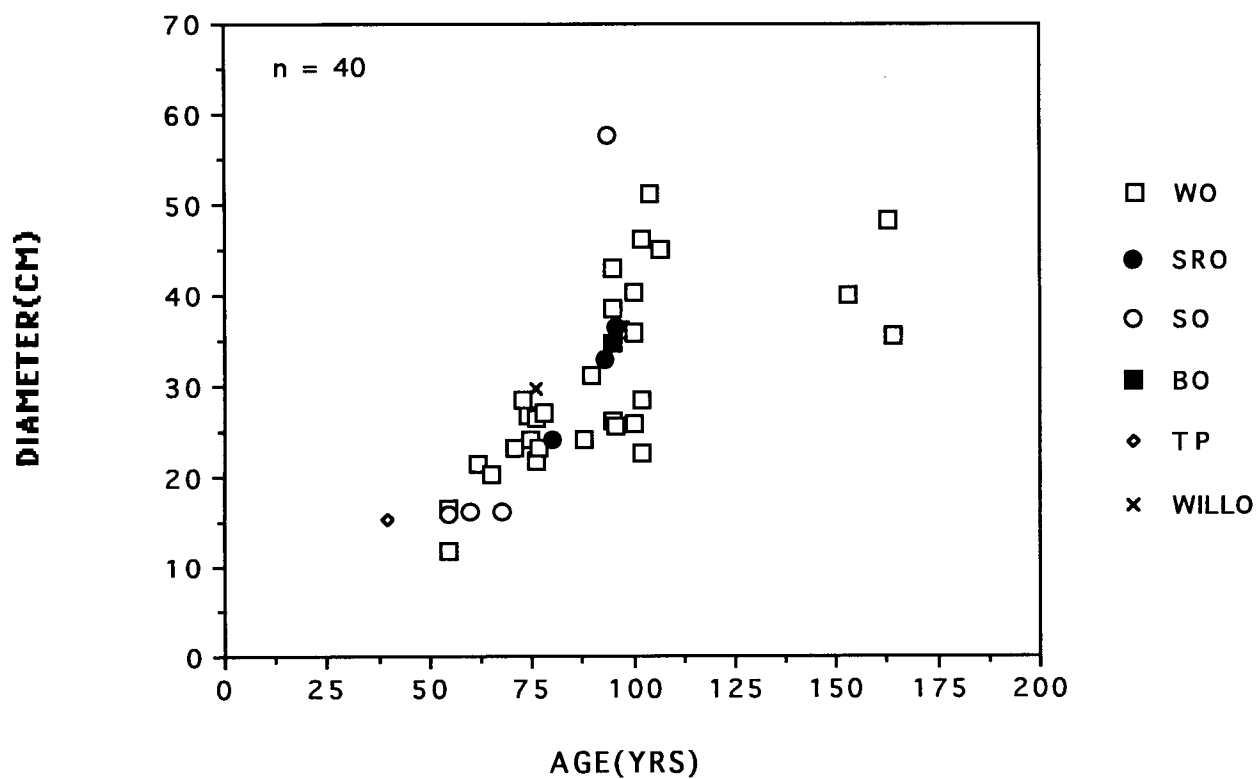


Figure 24. Age-diameter relationship for Stand CV7

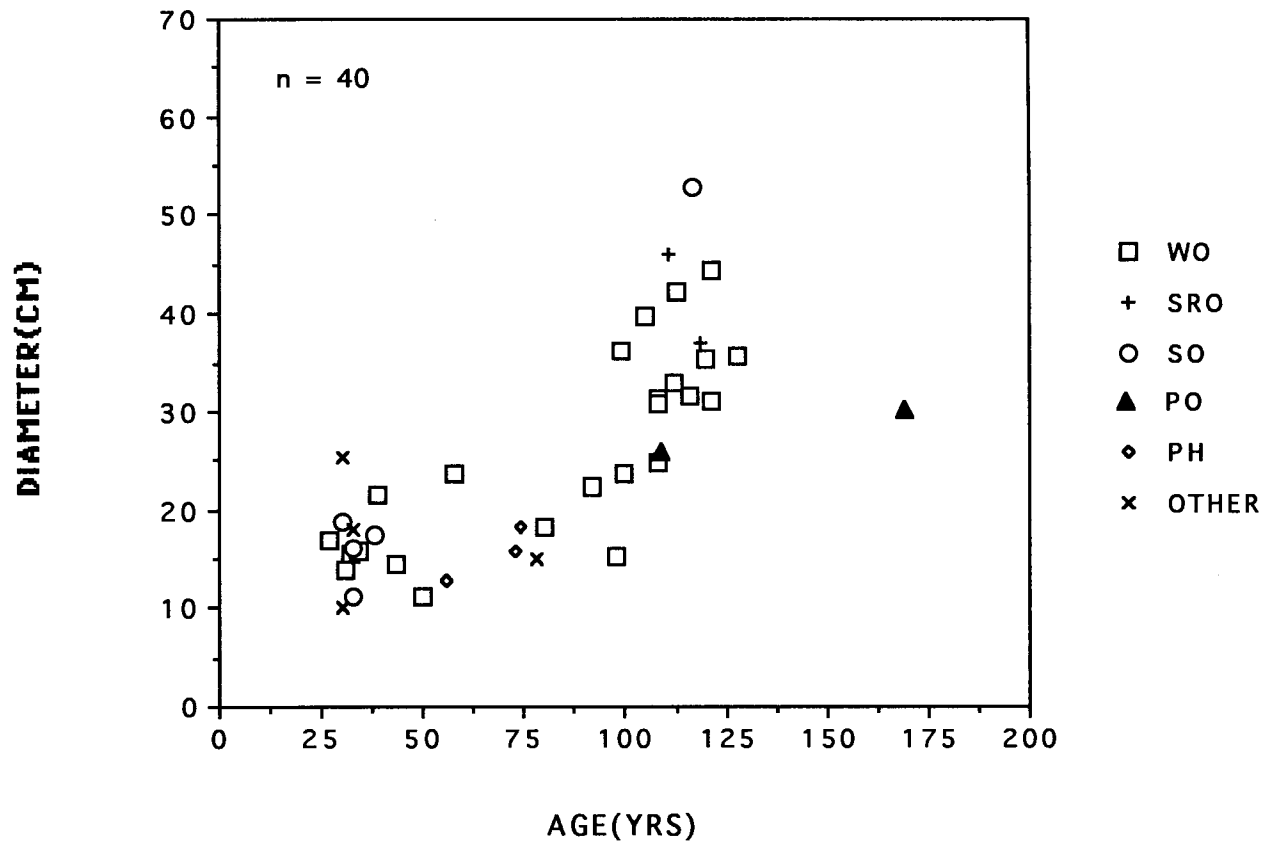


Figure 25. Age-diameter relationship for Stand CV8

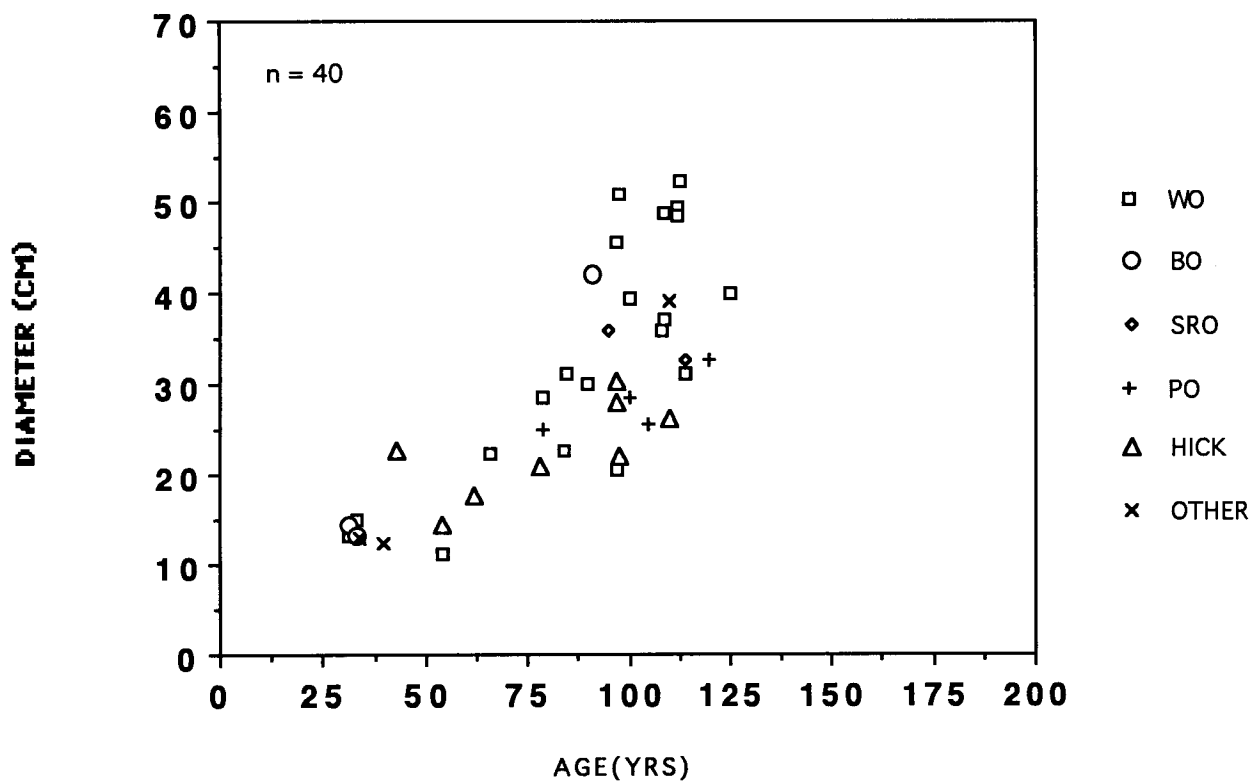


Figure 26. Age-diameter relationship for Stand CV9

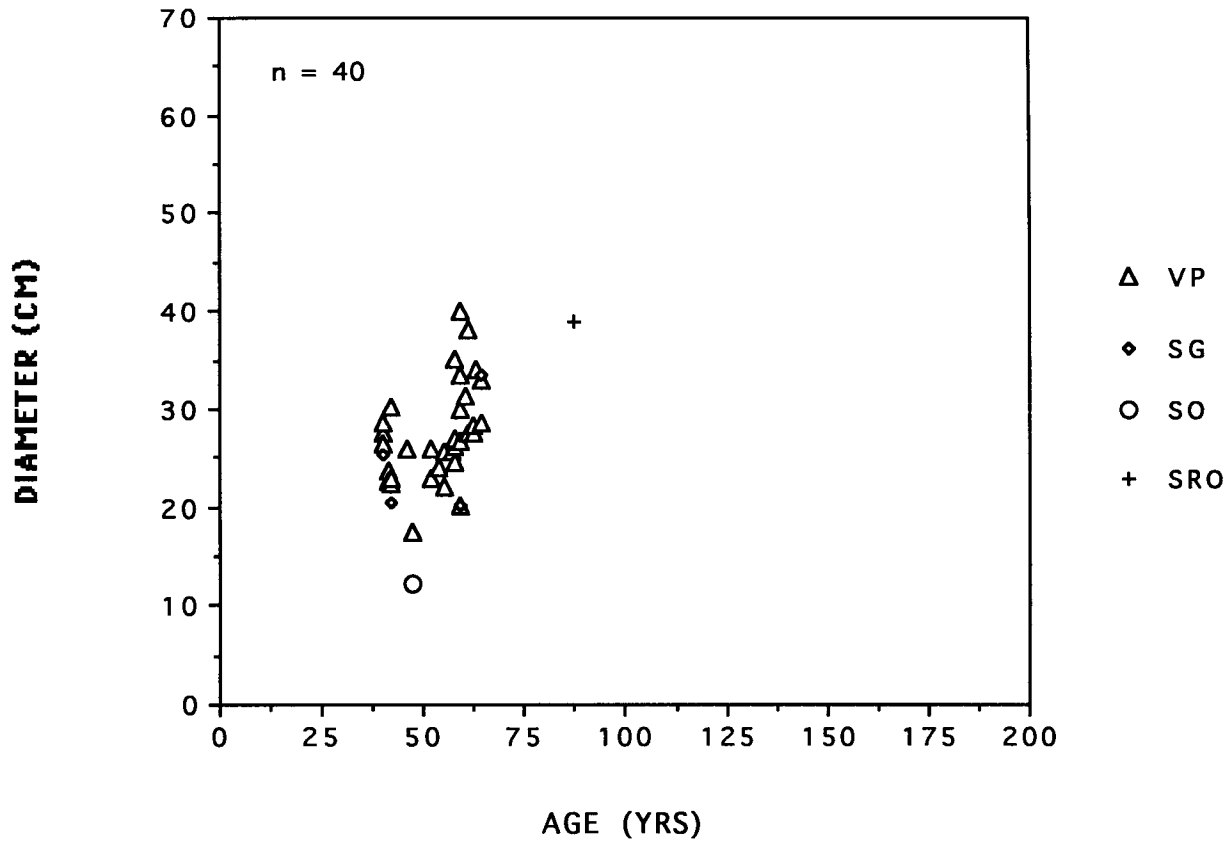


Figure 27. Age-diameter relationship for Stand CV10

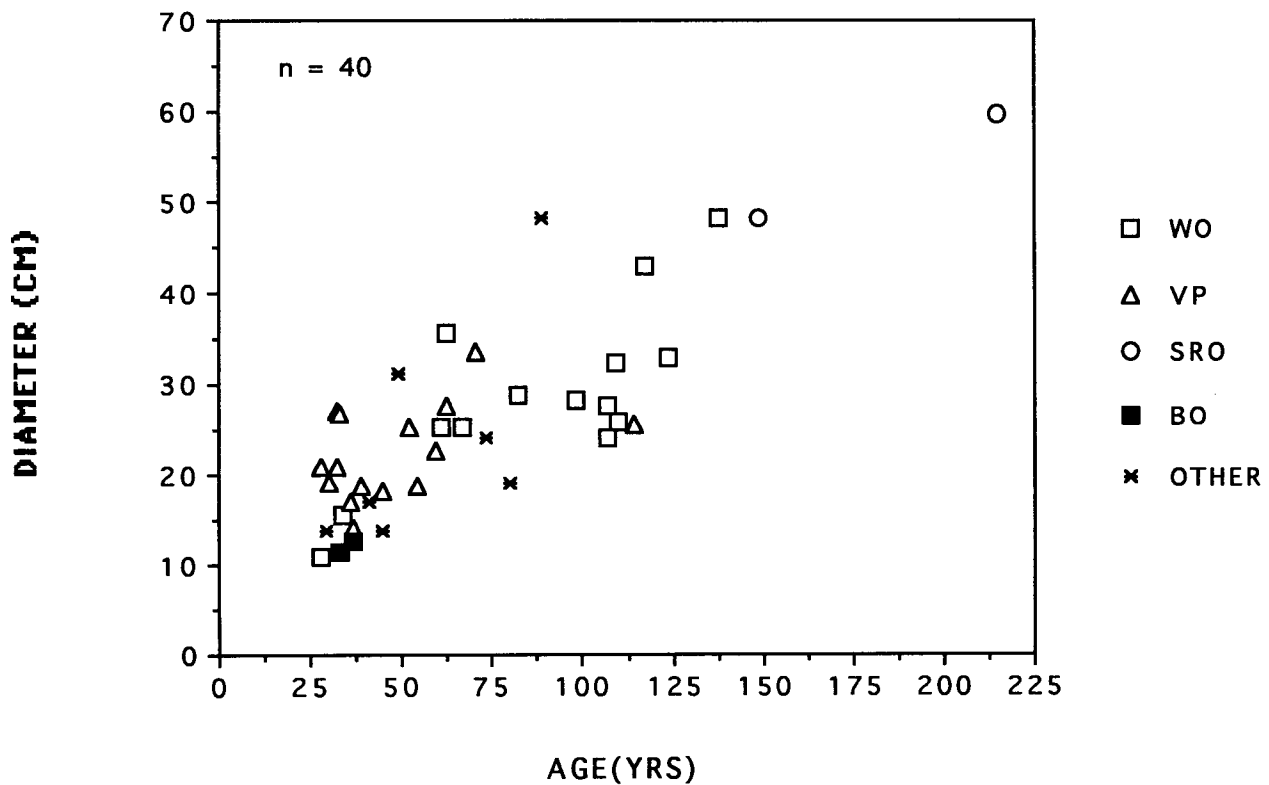


Figure 28. Age-diameter relationship for Stand CV11

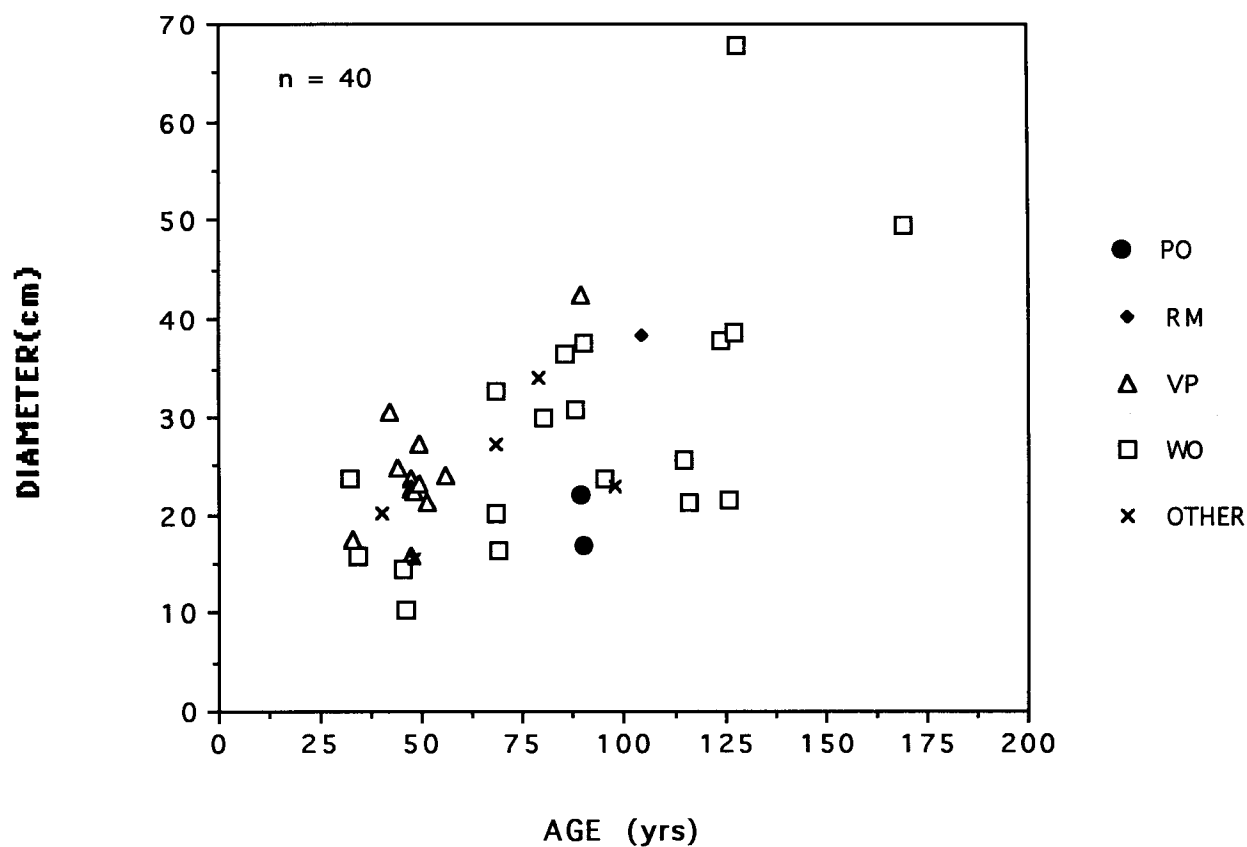


Figure 29. Age-diameter relationship for Stand CV12

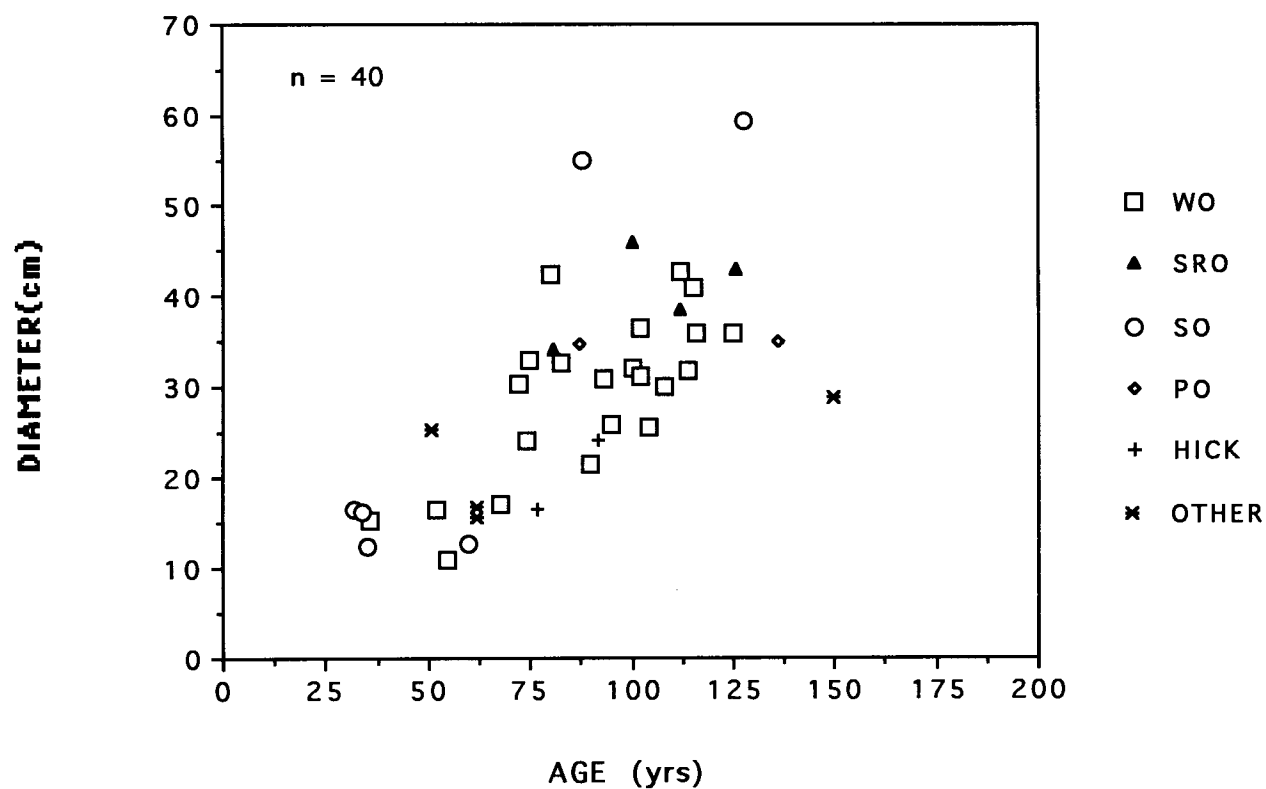
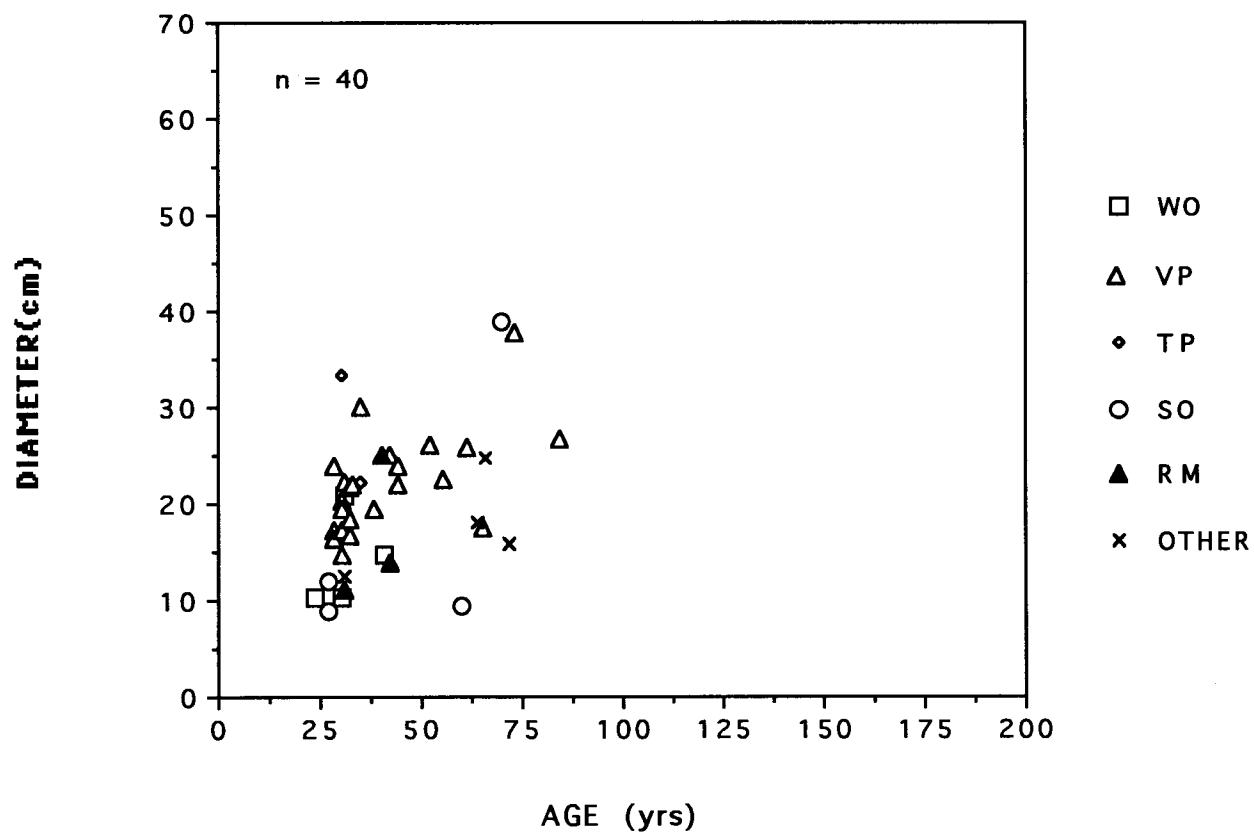


Figure 30. Age-diameter relationship for Stand CV13



Fuel loads

Fuel loading was estimated in six representative stands including the Maury birthplace site within this portion of the park (Table 30; Figure 16 - asterisks indicate fuel loading sampling locations). The majority of representative stands were chosen from the more flammable pine and pine-oak mixtures to evaluate the overall fuel hazard in this battlefield. Many stands within Chancellorsville Battlefield consisted of fuel loads which correspond to Fire Behavior Fuel Model 9, which predict slow burning ground fires with low flame heights. Mature oak fuel loads (16,569 kg/ha) were similar to the average values found in photo series for similar oak stands in the northeast (15,022 - 21,076 kg/ha; Wilcox et al. 1982) and lower than RBNP values (Helm 1993). Pine and pine-oak loads (15,448 - 16,188 kg/ha) were considerably lower than values found in similar photo series and at RBNP (33,611 - 37,347 kg/ha). However, the Maury birthplace site along Furnace Road contained higher quantities of downed Virginia pine fuel > 7.6 cm (Fuel model 10) as a result of natural stem mortality and subsequent wind disturbances. Model 10 predicts more intense ground fires with a potential for torching of trees. Because of its proximity to a picnic area (i.e. frequent charcoal fires), and a young loblolly pine (*Pinus taeda*) stand, removal of some of the downed trees in the area should be considered. This battlefield, due to the high ground cover of blueberry (*Vaccinium* spp.), has a higher risk of ground fires than other battlefields under extremely dry conditions. Stands CV9 and CV13 should be monitored in the future because they currently have high overstory pine densities that will eventually thin and lead to higher fuel loads and subsequent fire hazards.

Table 30. List of fuel loadings for various forest types within Chancellorsville (CV) Battlefield.

Forest Type	Stand	Fuel loading							Fuel Model
		Overstory Age* (yrs.)	BA (m ² /ha)	0-.63 cm (kg/ha)	.63-2.54 cm (kg/ha)	2.54-7.6 cm (kg/ha)	>7.6 cm (kg/ha)	Total (kg/ha)	
Pine	CV13	42	28	1099	5314	3273	6525	16188	9
Pine	Maury Birthplace ¹	--	--	1099	2937	3520	17982	25448	10
OAK	CV8	85	24	852	2556	1704	11457	16569	9
PO ²	CV1	65	24	1054	3655	2242	8498	15448	9
PSG	CV9	54	34	740	3139	4529	10426	18811	9
OP ²	CV10	70	23	381	1861	3273	3722	9215	8

KEY: Pine =Virginia pine; OAK = white oak; PO = pine-oak; PSG = Virginia pine - sweetgum; OP = oak-pine.

* Average breast height (1.4 m) age of overstory trees in stand from radial growth analysis.

¹ The Maury site was not formally inventoried for vegetative composition as it was smaller than 4 ha.

² Stand classification took place after fuel survey. Fuel amounts vary in these mid- successional types according to amount of downed pine and subjective placement of fuel transects within each stand.

Wilderness Battlefield

Overview

Wilderness Battlefield is located in the western portion of Spotsylvania county and the eastern portion of Orange county. The battlefield is situated within the Piedmont Plateau physiographic province and includes flat to gently rolling topography (slopes < 10 %) at elevations of 100 to 120 m above sea level (U.S. Geological Survey 1978). Bedrock of the area is comprised mainly of sericite schist (Carter et al. 1971) and soils are members of the Nason-Tatum-Manteo association. These soils are deep, well-drained, very strongly acid soils with a clayey subsoil and low fertility (Carter et al. 1971).

Twenty-three stands comprising approximately 278 ha were surveyed for vegetational composition within Wilderness Battlefield (Table 31; Figure 31). This study area contained a variety of land types ranging from young, early successional stands to mature forests and also included present-day agricultural land. The northern portions of the battlefield contain some of the largest and oldest trees in the entire park. Sixty-eight woody species were found within this area during the project period (Appendix A) and no rare plants identified by the park were found. White oak and tulip poplar were the two most important overstory hardwood species while Virginia pine and loblolly pine were the most abundant overstory conifer species. Blackgum (*Nyssa sylvatica*) and sweetgum were also locally important within the overstory of this battlefield. Permanent plots were established in four representative stands for long-term monitoring (Figure 31, PP denotes these stands). Plot locations are on file with the natural resource manager.

Table 31. Characteristics of surveyed forest stands of Wilderness (W) Battlefield.

Stand	Size (ha)	Overstory tree density (#s/ha)	Tree Age ¹ (n = 38 - 40) (yrs) $\pm$ S.E.	Range	Shrub%	Herb%	Slope%	Forest Type ²
W1	10	568	78 $\pm$ 3	41 - 127	9.3	0.6	3.7	OP
W2	15	751	65 $\pm$ 3	36 - 79	8.1	1.6	4.7	OTP
W3	23	645	63 $\pm$ 2	40 - 100	7.5	1.6	4.3	OTP
W4	15	823	66 $\pm$ 1	42 - 76	9.8	2.8	2.4	PO
W5	10	363	106 $\pm$ 4	68 - 185	5.9	0.3	4.0	CO
W6	16	953	56 $\pm$ 4	29 - 95	17.3	0.1	6.0	OP
W7	12	632	66 $\pm$ 6	25 - 155	11.0	4.0	6.2	OTP
W8	18	373	115 $\pm$ 6	68 - 261	12.8	2.8	2.0	OBG
W9	6	1089	40 $\pm$ 1	25 - 51	15.3	9.4	1.0	PSG
W10	5	835	51 $\pm$ 3	31 - 94	28.3	11.4	0.0	RMSG
W11	6	855	47 $\pm$ 4	23 - 125	14.4	5.0	2.0	PO
W12	9	815	63 $\pm$ 4	29 - 98	15.5	11.0	3.4	OSG
W13	10	813	49 $\pm$ 3	22 - 106	14.4	9.5	0.3	OP
W14	21	568	62 $\pm$ 3	21 - 100	10.9	6.3	6.2	OAK
W15	15	598	60 $\pm$ 3	19 - 88	8.6	23.1	9.3	OTP
W16	13	578	72 $\pm$ 4	26 - 120	5.5	19.3	9.8	OTP
W17	7	333	100 $\pm$ 5	60 - 167	17.0	3.4	7.9	OTP
W18	15	410	94 $\pm$ 4	60 - 177	36.0	0.4	4.3	OP
W19	13	437	69 $\pm$ 3	40 - 137	16.4	15.1	9.8	OTP
W20	18	669	65 $\pm$ 4	30 - 146	15.8	2.8	3.4	OTP
W21	7	751	56 $\pm$ 2	28 - 102	13.0	5.1	4.5	PO
W22	8	719	55 $\pm$ 4	27 - 128	17.6	0.3	3.6	PO
W23	6	469	86 $\pm$ 5	59 - 218	16.3	2.3	10.9	OTP

¹ Average breast height age of overstory trees in stand determined from radial growth analysis.

² Determined from overstory importance values (I.V.= {Relative density + Relative dominance + Relative frequency}/ 3).

OP = Oak - pine, OTP = Oak - tulip poplar, PO = Pine - oak, CO = Chestnut oak, OBG = Oak - blackgum, PSG = Pine - sweetgum, RMSG = red maple - sweetgum, OSG = Oak - sweetgum, and OAK = white oak.

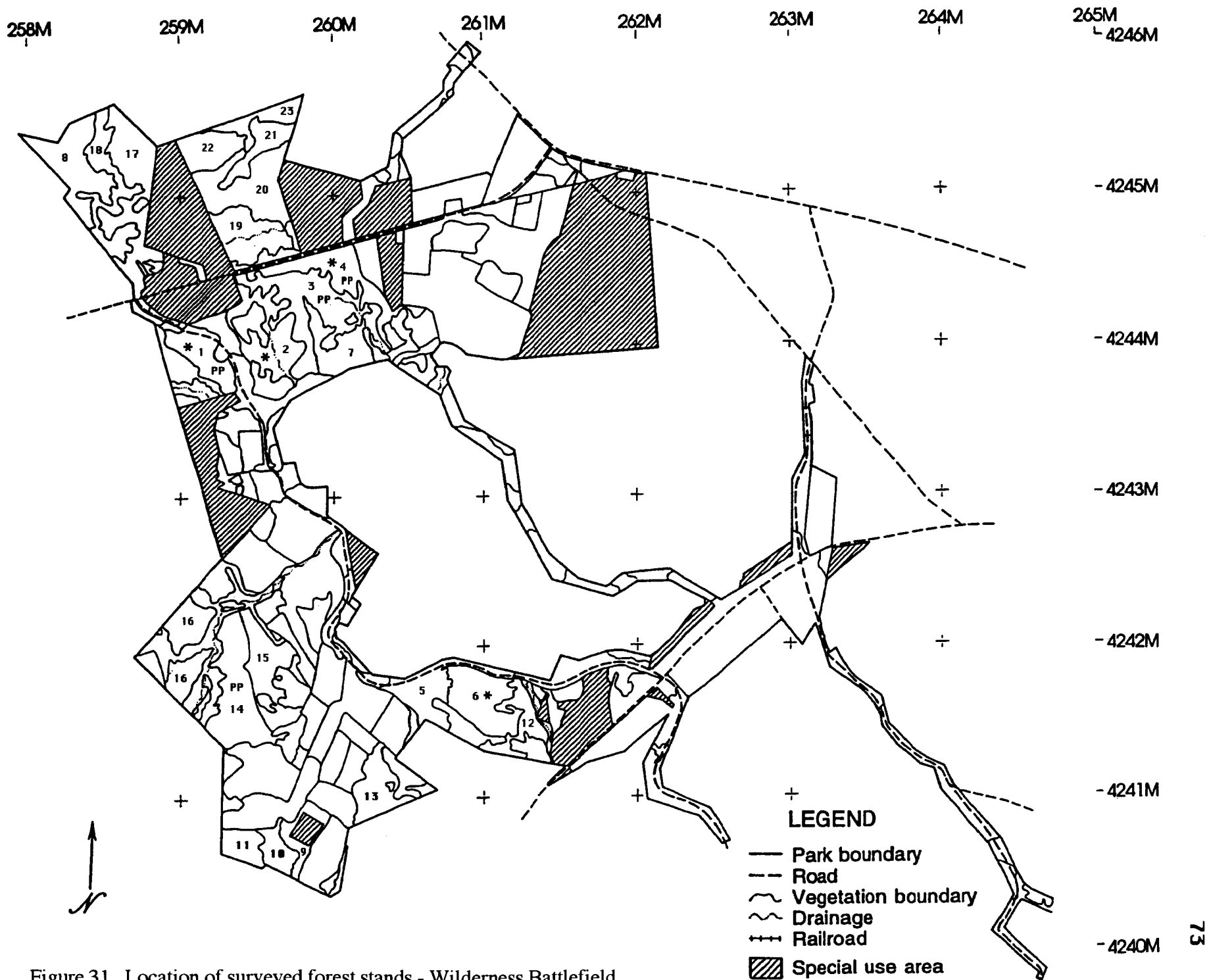


Figure 31. Location of surveyed forest stands - Wilderness Battlefield.

Stand descriptions

The following includes general stand descriptions with predictions of future species composition.

Stand W1 was a 10 ha oak-pine stand (Table 32) located along Hill-Ewell Drive, southeast of Saunder's Field. The overstory consisted of a mixture of white oak, Virginia pine, tulip poplar, and red maple. Dogwood, holly, blackgum, and red maple were abundant sapling layer species that should increase in importance following the mortality of pine species.

Stand W2 was a 15 ha oak-tulip poplar stand (Table 33) situated east of Hill-Ewell Drive. This forest was composed of an even-aged overstory component of white and southern red oak along with tulip poplar that became established in the early 1920s following logging. Blackgum and dogwood were abundant saplings and seedlings and red maple had the highest seedling densities.

Stand W3 was a 23 ha oak-tulip poplar stand (Table 34) south of Route 20. This stand was initiated in the late 1920s after logging and consisted of white, scarlet, and black oaks, as well as tulip poplar in the overstory. Dogwood and blackgum were abundant in the sapling layer and should share future forest overstory importance.

Stand W4 was a 15 ha pine-oak stand (Table 35) located along the south side of Route 20. The even-aged overstory was initiated in the early 1920s following agricultural abandonment. White oak and tulip poplar were common overstory species along with Virginia pine. Dogwood and blackgum were abundant in the seedling and sapling layers. Oak species and tulip poplar will become more important in the overstory as succession proceeds from pine to hardwoods.

Stand W5 was a 10 ha chestnut oak stand (Table 36) located south of the lower portion of Hill-Ewell Drive. This was an ecologically unique stand in the park due to the high abundance of overstory chestnut oak (IV > 50%) ranging in age from 60 - 125 years.

This open forest contained low sapling densities of oak and hickory species and high seedling densities of white oak, chestnut oak, and sassafras.

Stand W6 was a 16 ha oak-pine forest (Table 37) located along the southern portion of Hill-Ewell Drive adjacent to stand W5. This stand was initiated around 1910 and experienced unknown small-scale disturbances in the 1950s. The forest overstory consisted of white oak and Virginia pine along with sweetgum and chestnut oak. Composition will remain a mix of oak species because pine species will start to diminish in importance as succession proceeds.

Stand W7 was a 12 ha oak-tulip poplar stand (Table 38) adjacent to the northern part of Wilderness Run Lake. Overstory composition included an even-aged 70 year-old component of white oak and tulip poplar. This mesic stand contained abundant blackgum, red maple, and dogwood saplings and seedlings. Ironwood (*Carpinus caroliniana*), redbud (*Cercis canadensis*), and persimmon (*Diospyros virginiana*) seedlings were also common in this stand.

Stand W8 was a 12 ha stand (Table 39) dominated by white oak, blackgum, and pignut hickory in the overstory. The area was located in the northwest corner of the battlefield, adjacent to Lake of the Woods development. This stand is historically important because it contained trees older than 250 years (oldest in the park). Blackgum, dogwood, and red maple were ubiquitous in the seedling and sapling layers. Overstory composition should not change considerably in the future and the stand should be protected from gypsy moth defoliation if possible.

Stand W9 was a 6 ha pine-sweetgum stand (Table 40) initiated in the early 1950s that contained abundant overstory loblolly and Virginia pines. This area is surrounded by agricultural land north of Plank Road in the southcentral portion of the battlefield. The stand is near an inholding and the future overstory composition should contain sweetgum, pine, and oak species in the future.

Stand W10 was a 5 ha red maple-sweetgum forest (Table 41) located adjacent to stand W9 and dissected by a farm road. The two primary species comprised > 40% of the overstory IV although loblolly pine was also a common overstory species. Of interest is the presence of bigtooth aspen (*Populus grandidentata*), indicative of disturbance 40 - 50 years ago due to its extreme shade intolerance. Sweetgum, red maple, and oak species should continue to be important overstory inhabitants.

Stand W11 was a 6 ha pine-oak stand (Table 42) adjacent to stand W10 in the southcentral portion of the battlefield and surrounded by agricultural land. Loblolly and Virginia pine shared overstory importance with white oak and most of the overstory became established in the 1940s. Red maple, tulip poplar, and oak species obtained high densities in the seedling and sapling layers and should form the future overstory following pine decline.

Stand W12 was a 9 ha oak-sweetgum stand (Table 43) situated along the southern portion of Hill-Ewell Drive adjacent to stand W6. White oak, chestnut oak, and sweetgum made up > 50 % of the overstory IV and became established in the late 1800s and early 1900s. Red maple, sweetgum, and blackgum were abundant in the seedling and sapling layers and should contribute significantly to future forest composition.

Stand W13 was a 10 ha oak-pine stand (Table 44) located in the south-central portion of the battlefield, northeast of a private inholding. This seasonally wet forest was surrounded by agricultural fields and appeared to have been a wooded pasture which may have been abandoned during the late 1950s. The overstory was a mix of 70 year-old white oak and 25 year-old loblolly and Virginia pines mixed with red maple. Sweetgum and oak species were present in high understory densities and should increase in the overstory in the future. Greenbriar (*Smilax* spp.) was locally abundant in the stand.

Stand W14 was a young 21 ha oak stand (Table 45) in the southwestern portion of the battlefield. This stand was previously logged during the 1940s - 1950s and

contained a diverse mix of white, scarlet, southern red, and red oaks, as well as hickory and red maple in the overstory. Young pine and cedar (*Juniperus virginiana*) were present in canopy gaps. A high abundance of saplings included ironwood, dogwood, tulip poplar, blackgum, and black cherry (*Prunus serotina*).

Stand W15 was a 15 ha oak-tulip poplar stand (Table 46) situated adjacent to stand W14. The forest was initiated around 1920. White oak and several hickory species, including red hickory (*Carya ovalis*), shared overstory importance with tulip poplar. The seedling and sapling layers were very dense and included ironwood, dogwood, holly, black cherry, and beech which should share future overstory importance with oak species.

Stand W16 was a 13 ha forest (Table 47) found in the western corner of the battlefield adjacent to the border of Orange and Spotsylvania counties. This stand was surrounded by flood plains and was composed of an uneven-aged overstory mixture of white oak, tulip poplar, and hickory. Of interest was the local importance of beech (*Fagus grandifolia*) and high seedling densities of ironwood and blackgum.

Stand W17 was a 7 ha oak-tulip poplar stand (Table 48) located in the northern portion of the battlefield near the Lake of the Woods stables. Large, scattered white oaks up to 160 years old shared the overstory with a 75 year-old cohort of red and black oaks. Blackgum and tulip poplar were also common overstory inhabitants, while red maple, dogwood, and blackgum were ubiquitous in the understory.

Stand W18 was a 15 ha oak-pine stand (Table 49) found in the northern portion of the battlefield between stands W8 and W17. This uneven-aged forest consisted of Virginia pine, blackgum, and a mix of oak species in the overstory that approached 175 years of age. Sassafras and blackgum were present in high understory densities and should share future overstory importance with oak species.

Stand W19 was a 13 ha stand (Table 50) initiated around 1920 situated in the newly acquired 50 ha tract north of Route 20, just west of a 1994 clearcut. This open stand

was dominated by an overstory of white oak and tulip poplar. Of interest was the presence of sweet birch (*Betula lenta*) in the overstory and understory. Dogwood, red maple, blackgum, and oak species obtained high seedling densities.

Stand W20 was a 18 ha oak-tulip poplar stand (Table 51) located north of stand W19 in the newly acquired tract of land. The uneven-aged overstory contained white oak and hickory species ranging from 25 - 115 years old with a younger component of tulip poplar. Overstory composition should remain relatively stable with an increase in red maple and blackgum.

Stand W21 was a 7 ha stand (Table 52) located near the northeast corner of the new tract adjacent to Lake of the Woods. This early to mid- successional stand was composed of Virginia pine, white oak, and hickory species in the overstory with pockets of bigtooth aspen in gaps. A diverse understory was present in this forest, which should experience an increase in overstory oak species and tulip poplar in the future.

Stand W22 was a 8 ha pine-oak stand (Table 53) which developed following abandonment of land in the earlier part of the twentieth century. Virginia pine shared overstory importance with white oak and scarlet oak while understory layers were inhabited by high densities of red maple, blackgum, and sassafras.

Stand W23 was a 6 ha oak-tulip poplar stand (Table 54) found in the northern portion of the new tract of land adjacent to Gold Rush Lane in Lake of the Woods development. Very large trees of white oak, hickory species, and blackgum were present with tulip poplar. This stand contained the tallest trees in the entire park, high basal area, and several trees older than 150 years. Overstory composition should remain stable in the future.

Cover map key

A vegetation cover map was made from delineations derived from the acetate overlay of 1980 aerial photograph reproductions and plot surveys (Figure 32). Vegetation cover types of forested areas were designated by the most important species in surveyed stands (size > 4 ha) or, for non-surveyed stands, upon reconnaissance similarities with inventoried stands. Non-forested stands were characterized by the most abundant vegetation present upon visual inspection (e.g. scrub, agriculture). Stand designations were as follows: **OTP** - Oak -tulip poplar stands which consisted of white oak, red oak (*Quercus rubra*), black oak (*Q. velutina*), southern red oak (*Q. falcata*), mockernut hickory, and tulip poplar; **O** and **OSG**- oak stands dominated by various oak species present in OTP stands as well as scarlet oak, post oak (*Q. stellata*), and sweetgum; **P** - Virginia pine dominated stands; **PSG** and **RMSG**- pine -sweetgum and pine-red maple stands dominated by Virginia pine or loblolly pine, sweetgum, and red maple, along with blackgum, and willow oak (*Q. phellos*); **OP** and **PO** - oak pine and pine-oak stands, respectively, which are comprised of a mixture of white, scarlet, and black oaks with Virginia pine; **OBG** - oak - blackgum stands which contain a mixture of white and willow oaks with blackgum, red maple, and sweetgum; and **CO** - Chestnut oak dominated stand containing lower importance of white oak and blackgum. Map symbols are consistent with those described for Fredericksburg Battlefield.

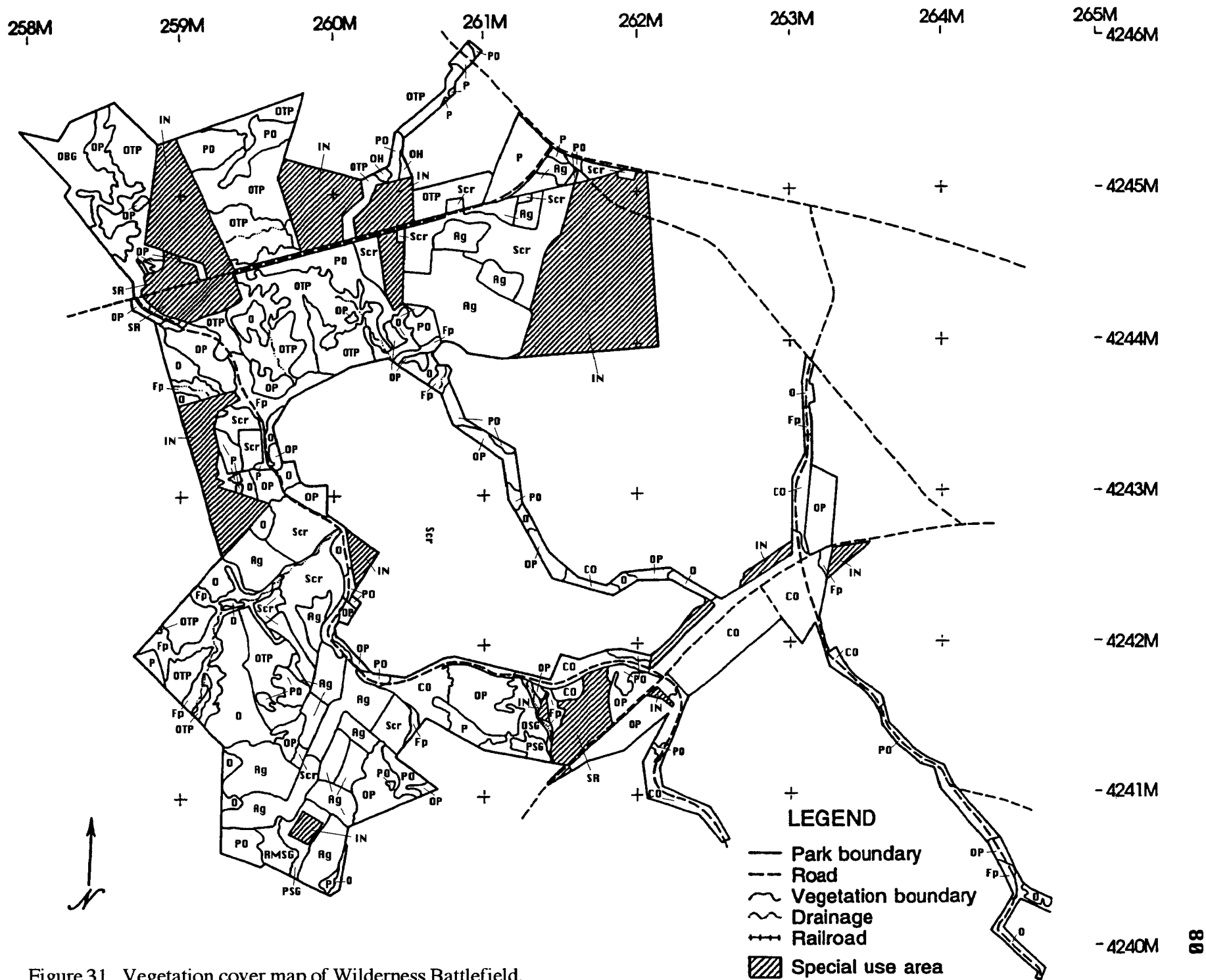


Figure 31. Vegetation cover map of Wilderness Battlefield.

Vegetative Composition of Wilderness (W) Battlefield

Table 32. Stand W1 overstory and understory vegetative composition.

Species	Overstory Relative IV (* denotes IV < 1)	
<i>Acer rubrum</i>	10	
<i>Carpinus caroliniana</i>	1	
<i>Carya glabra</i>	7	
<i>Cornus florida</i>	*	
<i>Fraxinus pennsylvanica</i>	2	
<i>Ilex opaca</i>	8	
<i>Juniperus virginiana</i>	*	
<i>Liriodendron tulipifera</i>	10	
<i>Nyssa sylvatica</i>	3	
<i>Pinus echinata</i>	1	
<i>Pinus virginiana</i>	10	
<i>Quercus alba</i>	28	
<i>Quercus coccinea</i>	3	
<i>Quercus falcata</i>	6	
<i>Quercus phellos</i>	1	
<i>Quercus rubra</i>	3	
<i>Quercus stellata</i>	4	
<i>Quercus velutina</i>	3	
Total tree density (#/ha) = 568	Total overstory basal area (m ² /ha) = 23.7	
Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	9038	539
<i>Carpinus caroliniana</i>	6995	--
<i>Carya spp.</i>	4413	54
<i>Chionanthus virginicus</i>	108	--
<i>Cornus florida</i>	4519	270
<i>Fagus grandifolia</i>	323	--
<i>Fraxinus pennsylvanica</i>	215	--
<i>Ilex opaca</i>	2154	324
<i>Liriodendron tulipifera</i>	755	162
<i>Nyssa sylvatica</i>	3658	270
<i>Pinus strobus</i>	108	--
<i>Prunus serotina</i>	216	--
<i>Quercus alba</i>	11944	54
<i>Quercus coccinea</i>	216	--
<i>Quercus falcata</i>	1184	--
<i>Quercus phellos</i>	647	--
<i>Quercus rubra</i>	1829	--
<i>Quercus stellata</i>	323	--
<i>Sassafras albidum</i>	3551	54
Totals	52196	1727

Table 33. Stand W2 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value	
<i>Acer rubrum</i>	4	
<i>Carya glabra</i>	7	
<i>Carya tomentosa</i>	*	
<i>Cornus florida</i>	2	
<i>Fagus grandifolia</i>	1	
<i>Fraxinus pennsylvanica</i>	*	
<i>Ilex opaca</i>	*	
<i>Liriodendron tulipifera</i>	19	
<i>Nyssa sylvatica</i>	1	
<i>Pinus echinata</i>	2	
<i>Pinus virginiana</i>	11	
<i>Populus grandidentata</i>	1	
<i>Quercus alba</i>	13	
<i>Quercus coccinea</i>	6	
<i>Quercus falcata</i>	15	
<i>Quercus prinus</i>	1	
<i>Quercus rubra</i>	6	
<i>Quercus stellata</i>	3	
<i>Quercus velutina</i>	7	
* denotes IV < 1		
Total tree density (#/ha) = 751 Total overstory basal area (m ² /ha) = 33.5		
Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	16031	162
<i>Amelanchier arborea</i>	215	--
<i>Carpinus caroliniana</i>	2045	54
<i>Carya spp.</i>	3121	162
<i>Castanea pumila</i>	323	--
<i>Cornus florida</i>	3874	431
<i>Diospyros virginiana</i>	108	--
<i>Fraxinus pennsylvanica</i>	431	--
<i>Ilex opaca</i>	432	--
<i>Liriodendron tulipifera</i>	969	162
<i>Nyssa sylvatica</i>	3015	646
<i>Pinus virginiana</i>	216	--
<i>Quercus alba</i>	2693	--
<i>Quercus coccinea</i>	970	--
<i>Quercus falcata</i>	1184	--
<i>Quercus prinus</i>	108	--
<i>Quercus rubra</i>	646	--
<i>Quercus stellata</i>	431	--
<i>Sassafras albidum</i>	538	--
Totals	37350	1617

Table 34. Stand W3 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	9
<i>Carya glabra</i>	4
<i>Carya tomentosa</i>	3
<i>Cornus florida</i>	4
<i>Fraxinus americana</i>	1
<i>Fraxinus pennsylvanica</i>	*
<i>Liriodendron tulipifera</i>	25
<i>Nyssa sylvatica</i>	1
<i>Pinus echinata</i>	1
<i>Pinus virginiana</i>	3
<i>Populus grandidentata</i>	1
<i>Quercus alba</i>	20
<i>Quercus coccinea</i>	13
<i>Quercus falcata</i>	7
<i>Quercus phellos</i>	1
<i>Quercus prinus</i>	1
<i>Quercus stellata</i>	1
<i>Quercus velutina</i>	7

* denotes IV < 1

Total tree density (#/ha) = 645

Total overstory basal area (m²/ha) = 24.7

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	16680	270
<i>Carpinus caroliniana</i>	1399	--
<i>Carya spp.</i>	1508	54
<i>Cornus florida</i>	9684	647
<i>Diospyros virginiana</i>	108	--
<i>Fraxinus pennsylvanica</i>	862	108
<i>Ilex opaca</i>	324	--
<i>Juniperus virginiana</i>	539	--
<i>Liriodendron tulipifera</i>	1293	108
<i>Nyssa sylvatica</i>	2263	916
<i>Pinus virginiana</i>	108	--
<i>Quercus alba</i>	3123	54
<i>Quercus coccinea</i>	2262	--
<i>Quercus falcata</i>	432	--
<i>Quercus phellos</i>	108	--
<i>Quercus prinus</i>	--	54
<i>Quercus rubra</i>	108	--
<i>Quercus stellata</i>	540	--
<i>Sassafras albidum</i>	2368	--
Totals	43709	2211

Table 35. Stand W4 overstory and understory vegetative composition.

Species	Overstory Relative IV (* denotes IV < 1)
<i>Acer rubrum</i>	2
<i>Carya glabra</i>	2
<i>Carya tomentosa</i>	2
<i>Cornus florida</i>	6
<i>Fraxinus americana</i>	*
<i>Fraxinus pennsylvanica</i>	1
<i>Ilex opaca</i>	*
<i>Liriodendron tulipifera</i>	12
<i>Nyssa sylvatica</i>	3
<i>Pinus echinata</i>	2
<i>Pinus taeda</i>	1
<i>Pinus virginiana</i>	43
<i>Prunus serotina</i>	*
<i>Quercus alba</i>	11
<i>Quercus coccinea</i>	8
<i>Quercus falcata</i>	2
<i>Quercus stellata</i>	2
<i>Quercus velutina</i>	1
Total tree density (#/ha) = 823	Total overstory basal area (m ² /ha) = 35.3

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	3555	108
<i>Amelanchier arborea</i>	1184	--
<i>Carya</i> spp.	2047	54
<i>Castanea pumila</i>	108	--
<i>Cornus florida</i>	15708	1077
<i>Diospyros virginiana</i>	216	--
<i>Fraxinus pennsylvanica</i>	3769	162
<i>Ilex opaca</i>	323	162
<i>Juniperus virginiana</i>	108	--
<i>Liriodendron tulipifera</i>	646	162
<i>Nyssa sylvatica</i>	5166	862
<i>Pinus virginiana</i>	1076	--
<i>Prunus serotina</i>	538	--
<i>Quercus alba</i>	1723	--
<i>Quercus coccinea</i>	3661	--
<i>Quercus falcata</i>	863	--
<i>Quercus phellos</i>	108	--
<i>Quercus stellata</i>	969	--
<i>Quercus velutina</i>	539	--
<i>Sassafras albidum</i>	2800	--
Totals	45107	2587

Table 36. Stand W5 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Carya glabra</i>	3
<i>Carya tomentosa</i>	2
<i>Cornus florida</i>	1
<i>Juniperus virginiana</i>	1
<i>Nyssa sylvatica</i>	7
<i>Pinus virginiana</i>	1
<i>Quercus alba</i>	28
<i>Quercus coccinea</i>	3
<i>Quercus falcata</i>	1
<i>Quercus prinus</i>	52
<i>Quercus velutina</i>	1

Total tree density (#/ha) = 363 Total overstory basal area (m²/ha) = 26.7

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	646	54
<i>Carya spp.</i>	1402	108
<i>Cornus florida</i>	1614	108
<i>Diospyros virginiana</i>	108	--
<i>Ilex opaca</i>	108	--
<i>Liriodendron tulipifera</i>	215	--
<i>Nyssa sylvatica</i>	1724	162
<i>Pinus virginiana</i>	323	--
<i>Prunus serotina</i>	539	--
<i>Quercus alba</i>	9038	54
<i>Quercus coccinea</i>	3550	--
<i>Quercus phellos</i>	108	--
<i>Quercus prinus</i>	11407	108
<i>Quercus velutina</i>	108	54
<i>Sassafras albidum</i>	11298	--
Totals	42188	648

Table 37. Stand W6 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value	
<i>Acer rubrum</i>	3	
<i>Carya glabra</i>	3	
<i>Carya tomentosa</i>	*	
<i>Cornus florida</i>	*	
<i>Ilex opaca</i>	1	
<i>Juniperus virginiana</i>	1	
<i>Liquidambar styraciflua</i>	10	
<i>Liriodendron tulipifera</i>	1	
<i>Nyssa sylvatica</i>	2	
<i>Pinus taeda</i>	6	
<i>Pinus virginiana</i>	21	
<i>Populus grandidentata</i>	1	
<i>Quercus alba</i>	21	
<i>Quercus coccinea</i>	9	
<i>Quercus falcata</i>	2	
<i>Quercus phellos</i>	1	
<i>Quercus prinus</i>	10	
<i>Quercus stellata</i>	1	
<i>Quercus velutina</i>	6	
* denotes IV < 1		
Total tree density (#/ha) = 953 Total overstory basal area (m ² /ha) = 22.5		
Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	7102	378
<i>Amelanchier arborea</i>	753	--
<i>Carya spp.</i>	755	54
<i>Diospyros virginiana</i>	323	54
<i>Ilex opaca</i>	1077	108
<i>Juniperus virginiana</i>	108	54
<i>Liquidambar styraciflua</i>	431	539
<i>Liriodendron tulipifera</i>	108	--
<i>Nyssa sylvatica</i>	3337	809
<i>Pinus virginiana</i>	108	54
<i>Prunus serotina</i>	108	--
<i>Quercus alba</i>	1400	54
<i>Quercus coccinea</i>	2153	54
<i>Quercus falcata</i>	324	--
<i>Quercus phellos</i>	108	--
<i>Quercus prinus</i>	5273	108
<i>Quercus stellata</i>	216	--
<i>Quercus velutina</i>	646	54
<i>Sassafras albidum</i>	3229	162
Totals	27559	2482

Table 38. Stand W7 overstory and understory vegetative composition.

Species	Overstory Relative IV (* denotes IV < 1)	
<i>Acer rubrum</i>	3	
<i>Carya glabra</i>	4	
<i>Carya tomentosa</i>	3	
<i>Cornus florida</i>	3	
<i>Fagus grandifolia</i>	2	
<i>Fraxinus pennsylvanica</i>	1	
<i>Ilex opaca</i>	*	
<i>Juniperus virginiana</i>	3	
<i>Liriodendron tulipifera</i>	15	
<i>Nyssa sylvatica</i>	4	
<i>Pinus virginiana</i>	4	
<i>Prunus serotina</i>	*	
<i>Quercus alba</i>	35	
<i>Quercus coccinea</i>	8	
<i>Quercus falcata</i>	3	
<i>Quercus phellos</i>	*	
<i>Quercus rubra</i>	5	
<i>Quercus stellata</i>	2	
<i>Quercus velutina</i>	4	
Total tree density (#/ha) = 632	Total overstory basal area (m ² /ha) = 25.9	
Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	4091	323
<i>Carpinus caroliniana</i>	861	54
<i>Carya</i> spp.	3229	108
<i>Castanea pumila</i>	538	--
<i>Cercis canadensis</i>	1184	--
<i>Cornus florida</i>	3444	216
<i>Diospyros virginiana</i>	323	--
<i>Fraxinus pennsylvanica</i>	862	54
<i>Ilex opaca</i>	108	--
<i>Juniperus virginiana</i>	646	54
<i>Liriodendron tulipifera</i>	2155	54
<i>Nyssa sylvatica</i>	1185	216
<i>Prunus serotina</i>	216	--
<i>Quercus alba</i>	9361	--
<i>Quercus coccinea</i>	1291	--
<i>Quercus falcata</i>	1077	--
<i>Quercus rubra</i>	755	--
<i>Quercus stellata</i>	431	--
<i>Quercus velutina</i>	216	--
<i>Sassafras albidum</i>	1399	--
Totals	33372	1133

Table 39. Stand W8 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	4
<i>Carya glabra</i>	11
<i>Cornus florida</i>	9
<i>Juniperus virginiana</i>	1
<i>Liriodendron tulipifera</i>	5
<i>Nyssa sylvatica</i>	12
<i>Pinus echinata</i>	1
<i>Pinus virginiana</i>	1
<i>Quercus alba</i>	35
<i>Quercus coccinea</i>	8
<i>Quercus falcata</i>	2
<i>Quercus rubra</i>	3
<i>Quercus stellata</i>	1
<i>Quercus velutina</i>	7

Total tree density (#/ha) = 373

Total overstory basal area (m²/ha) = 28.0

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	7749	540
<i>Amelanchier arborea</i>	1614	--
<i>Carya spp.</i>	6886	108
<i>Castanea pumila</i>	215	--
<i>Cornus florida</i>	5703	324
<i>Diospyros virginiana</i>	108	--
<i>Juniperus virginiana</i>	108	--
<i>Liriodendron tulipifera</i>	540	216
<i>Nyssa sylvatica</i>	7103	754
<i>Pinus virginiana</i>	108	--
<i>Prunus serotina</i>	2046	--
<i>Quercus alba</i>	2692	--
<i>Quercus coccinea</i>	2584	--
<i>Quercus falcata</i>	216	--
<i>Quercus rubra</i>	430	--
<i>Quercus velutina</i>	646	--
<i>Sassafras albidum</i>	5918	161
Totals	44666	2103

Table 40. Stand W9 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	12
<i>Cornus florida</i>	*
<i>Diospyros virginiana</i>	1
<i>Juniperus virginiana</i>	3
<i>Liquidambar styraciflua</i>	26
<i>Liriodendron tulipifera</i>	4
<i>Nyssa sylvatica</i>	4
<i>Pinus taeda</i>	22
<i>Pinus virginiana</i>	18
<i>Populus grandidentata</i>	8
<i>Prunus serotina</i>	1
<i>Quercus alba</i>	1
<i>Quercus phellos</i>	1

* denotes IV < 1

Total tree density (#/ha) = 1089

Total overstory basal area (m²/ha) = 33.5

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	2476	378
<i>Amelanchier arborea</i>	430	--
<i>Carpinus caroliniana</i>	323	--
<i>Carya</i> spp.	431	--
<i>Chionanthus virginicus</i>	108	--
<i>Cornus florida</i>	1614	108
<i>Fraxinus</i> spp.	538	--
<i>Ilex opaca</i>	216	--
<i>Juniperus virginiana</i>	108	162
<i>Liquidambar styraciflua</i>	17002	539
<i>Liriodendron tulipifera</i>	108	--
<i>Nyssa sylvatica</i>	647	431
<i>Pinus virginiana</i>	324	108
<i>Prunus serotina</i>	1616	--
<i>Quercus alba</i>	1077	--
<i>Quercus coccinea</i>	648	--
<i>Quercus falcata</i>	1830	54
<i>Quercus phellos</i>	1187	215
<i>Quercus stellata</i>	1508	--
<i>Quercus velutina</i>	108	--
<i>Sassafras albidum</i>	970	--
Totals	33269	1995

Table 41. Stand W10 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	22
<i>Diospyros virginiana</i>	1
<i>Juniperus virginiana</i>	2
<i>Liquidambar styraciflua</i>	19
<i>Liriodendron tulipifera</i>	10
<i>Nyssa sylvatica</i>	7
<i>Pinus taeda</i>	10
<i>Pinus virginiana</i>	3
<i>Populus grandidentata</i>	4
<i>Quercus alba</i>	9
<i>Quercus coccinea</i>	2
<i>Quercus falcata</i>	2
<i>Quercus phellos</i>	5
<i>Quercus stellata</i>	*
<i>Quercus velutina</i>	1
<i>Sassafras albidum</i>	1

* denotes IV < 1

Total tree density (#/ha) = 835

Total overstory basal area (m²/ha) = 26.5

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	3014	161
<i>Carya</i> spp.	216	--
<i>Castanea pumila</i>	108	--
<i>Chionanthus virginicus</i>	215	--
<i>Diospyros virginiana</i>	215	54
<i>Ilex opaca</i>	108	--
<i>Juniperus virginiana</i>	--	54
<i>Liquidambar styraciflua</i>	9039	324
<i>Liriodendron tulipifera</i>	1399	--
<i>Nyssa sylvatica</i>	1722	269
<i>Pinus virginiana</i>	108	--
<i>Prunus serotina</i>	1184	--
<i>Quercus alba</i>	2154	216
<i>Quercus coccinea</i>	108	--
<i>Quercus falcata</i>	539	--
<i>Quercus phellos</i>	2260	--
<i>Quercus stellata</i>	430	--
<i>Sassafras albidum</i>	646	54
Totals	23465	1132

Table 42. Stand W11 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	9
<i>Carya glabra</i>	*
<i>Juniperus virginiana</i>	1
<i>Liquidambar styraciflua</i>	5
<i>Liriodendron tulipifera</i>	11
<i>Nyssa sylvatica</i>	3
<i>Pinus echinata</i>	2
<i>Pinus taeda</i>	28
<i>Pinus virginiana</i>	10
<i>Quercus alba</i>	15
<i>Quercus coccinea</i>	7
<i>Quercus falcata</i>	1
<i>Quercus marilandica</i>	*
<i>Quercus palustris</i>	1
<i>Quercus phellos</i>	4
<i>Quercus stellata</i>	2
<i>Quercus velutina</i>	1

* denotes IV < 1

Total tree density (#/ha) = 855

Total overstory basal area (m²/ha) = 28.8

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	3121	1077
<i>Carya spp.</i>	432	108
<i>Castanea pumila</i>	215	--
<i>Chionanthus virginicus</i>	215	--
<i>Cornus florida</i>	--	215
<i>Diospyros virginiana</i>	108	--
<i>Fraxinus spp.</i>	108	--
<i>Liquidambar styraciflua</i>	1185	--
<i>Liriodendron tulipifera</i>	1077	270
<i>Nyssa sylvatica</i>	754	915
<i>Pinus virginiana</i>	754	--
<i>Prunus serotina</i>	216	--
<i>Quercus alba</i>	2046	378
<i>Quercus coccinea</i>	753	108
<i>Quercus phellos</i>	756	--
<i>Quercus falcata</i>	432	54
<i>Quercus rubra</i>	540	54
<i>Quercus velutina</i>	--	108
<i>Sassafras albidum</i>	4842	162
Totals	17554	3449

Table 43. Stand W12 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	4
<i>Carya glabra</i>	3
<i>Cornus florida</i>	1
<i>Ilex opaca</i>	*
<i>Liquidambar styraciflua</i>	17
<i>Liriodendron tulipifera</i>	5
<i>Nyssa sylvatica</i>	4
<i>Pinus echinata</i>	1
<i>Pinus taeda</i>	5
<i>Pinus virginiana</i>	6
<i>Populus grandidentata</i>	1
<i>Quercus alba</i>	21
<i>Quercus coccinea</i>	7
<i>Quercus falcata</i>	2
<i>Quercus phellos</i>	*
<i>Quercus prinus</i>	15
<i>Quercus stellata</i>	1
<i>Quercus velutina</i>	5

* denotes IV < 1

Total tree density (#/ha) = 815

Total overstory basal area (m²/ha) = 27.2

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	11084	539
<i>Carya spp.</i>	970	54
<i>Chionanthus virginicus</i>	216	--
<i>Cornus florida</i>	1076	54
<i>Diospyros virginiana</i>	1077	--
<i>Ilex opaca</i>	539	108
<i>Juniperus virginiana</i>	108	54
<i>Liquidambar styraciflua</i>	7963	378
<i>Nyssa sylvatica</i>	2799	377
<i>Pinus virginiana</i>	108	--
<i>Prunus serotina</i>	215	--
<i>Quercus alba</i>	2692	--
<i>Quercus coccinea</i>	3230	54
<i>Quercus falcata</i>	108	--
<i>Quercus prinus</i>	4197	--
<i>Quercus stellata</i>	323	--
<i>Quercus velutina</i>	970	--
<i>Sassafras albidum</i>	2153	--
Totals	39828	1618

Table 44. Stand W13 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	19
<i>Carya glabra</i>	1
<i>Cornus florida</i>	1
<i>Liquidambar styraciflua</i>	11
<i>Liriodendron tulipifera</i>	1
<i>Nyssa sylvatica</i>	9
<i>Pinus echinata</i>	*
<i>Pinus taeda</i>	18
<i>Pinus virginiana</i>	6
<i>Quercus alba</i>	16
<i>Quercus coccinea</i>	2
<i>Quercus falcata</i>	1
<i>Quercus phellos</i>	10
<i>Quercus prinus</i>	1
<i>Quercus stellata</i>	2
<i>Quercus velutina</i>	*

* denotes IV < 1

Total tree density (#/ha) = 813

Total overstory basal area (m²/ha) = 24.5

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	4951	915
<i>Amelanchier arborea</i>	969	--
<i>Carpinus caroliniana</i>	430	--
<i>Carya</i> spp.	108	--
<i>Cornus florida</i>	108	--
<i>Diospyros virginiana</i>	108	--
<i>Ilex opaca</i>	324	54
<i>Juniperus virginiana</i>	--	54
<i>Liquidambar styraciflua</i>	13880	971
<i>Liriodendron tulipifera</i>	108	--
<i>Nyssa sylvatica</i>	1401	378
<i>Quercus alba</i>	2154	324
<i>Quercus falcata</i>	108	--
<i>Quercus phellos</i>	862	484
<i>Quercus stellata</i>	108	--
<i>Sassafras albidum</i>	108	--
Totals	25727	3180

Table 45. Stand W14 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	9
<i>Carpinus caroliniana</i>	2
<i>Carya glabra</i>	5
<i>Carya ovalis</i>	2
<i>Carya tomentosa</i>	1
<i>Cornus florida</i>	2
<i>Fagus grandifolia</i>	3
<i>Fraxinus americana</i>	1
<i>Ilex opaca</i>	2
<i>Juniperus virginiana</i>	5
<i>Liriodendron tulipifera</i>	8
<i>Nyssa sylvatica</i>	4
<i>Pinus echinata</i>	1
<i>Pinus strobus</i>	1
<i>Pinus taeda</i>	*
<i>Pinus virginiana</i>	6
<i>Prunus serotina</i>	2
<i>Quercus alba</i>	20
<i>Quercus coccinea</i>	5
<i>Quercus falcata</i>	8
<i>Quercus rubra</i>	7
<i>Quercus stellata</i>	2
<i>Quercus velutina</i>	2

* denotes IV < 1

Total tree density (#/ha) = 568 Total overstory basal area (m²/ha) = 18.2

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	8070	1185
<i>Amelanchier arborea</i>	215	--
<i>Carpinus caroliniana</i>	9146	861
<i>Carya</i> spp.	2799	485
<i>Chionanthus virginicus</i>	323	--
<i>Cornus florida</i>	3121	861
<i>Fagus grandifolia</i>	216	--
<i>Fraxinus</i> spp.	1184	162
<i>Ilex opaca</i>	1509	216
<i>Juniperus virginiana</i>	1614	--
<i>Liriodendron tulipifera</i>	3444	646
<i>Nyssa sylvatica</i>	3550	540
<i>Pinus virginiana</i>	108	54
<i>Prunus serotina</i>	1829	431
<i>Quercus alba</i>	5057	485
<i>Quercus coccinea</i>	1078	162

Table 45. Stand W 14. (continued)

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Quercus falcata</i>	970	--
<i>Quercus phellos</i>	216	--
<i>Quercus rubra</i>	323	--
<i>Quercus stellata</i>	431	--
<i>Quercus velutina</i>	108	54
<i>Sassafras albidum</i>	1398	54
<i>Ulmus rubra</i>	108	--
Totals	46817	6196

Table 46. Stand W15 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value	
<i>Acer rubrum</i>	8	
<i>Carpinus caroliniana</i>	6	
<i>Carya glabra</i>	8	
<i>Carya ovalis</i>	3	
<i>Carya tomentosa</i>	1	
<i>Cornus florida</i>	3	
<i>Fagus grandifolia</i>	1	
<i>Fraxinus pennsylvanica</i>	1	
<i>Ilex opaca</i>	6	
<i>Juniperus virginiana</i>	3	
<i>Liriodendron tulipifera</i>	19	
<i>Nyssa sylvatica</i>	4	
<i>Pinus virginiana</i>	2	
<i>Quercus alba</i>	23	
<i>Quercus coccinea</i>	5	
<i>Quercus falcata</i>	1	
<i>Quercus michauxii</i>	1	
<i>Quercus prinus</i>	1	
<i>Quercus rubra</i>	1	
<i>Quercus velutina</i>	2	
Total tree density (#/ha) = 598 Total overstory basal area (m ² /ha) = 21.0		
Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	2798	538
<i>Amelanchier arborea</i>	1831	--
<i>Carpinus caroliniana</i>	12051	1668
<i>Carya spp.</i>	2475	216
<i>Celtis occidentalis</i>	2583	--
<i>Cornus florida</i>	8179	2154
<i>Fagus grandifolia</i>	215	108
<i>Fraxinus spp.</i>	863	--
<i>Ilex opaca</i>	1615	323
<i>Juniperus virginiana</i>	647	108
<i>Liriodendron tulipifera</i>	4090	1454
<i>Nyssa sylvatica</i>	1400	54
<i>Prunus serotina</i>	861	216
<i>Quercus alba</i>	9036	162
<i>Quercus coccinea</i>	539	--
<i>Quercus falcata</i>	216	--
<i>Quercus phellos</i>	216	--
<i>Quercus prinus</i>	323	--
<i>Quercus rubra</i>	323	--
Totals	50261	7001

Table 47. Stand W16 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value	
<i>Acer rubrum</i>	3	
<i>Carpinus caroliniana</i>	5	
<i>Carya glabra</i>	6	
<i>Carya ovalis</i>	2	
<i>Carya tomentosa</i>	3	
<i>Cornus florida</i>	4	
<i>Fagus grandifolia</i>	7	
<i>Fraxinus pennsylvanica</i>	2	
<i>Ilex opaca</i>	1	
<i>Juniperus virginiana</i>	5	
<i>Liquidambar styraciflua</i>	1	
<i>Liriodendron tulipifera</i>	16	
<i>Nyssa sylvatica</i>	4	
<i>Pinus virginiana</i>	4	
<i>Prunus serotina</i>	2	
<i>Quercus alba</i>	23	
<i>Quercus coccinea</i>	5	
<i>Quercus falcata</i>	1	
<i>Quercus rubra</i>	2	
<i>Quercus velutina</i>	3	
Total tree density (#/ha) = 578	Total overstory basal area (m ² /ha) = 21.0	
Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	3875	1024
<i>Amelanchier arborea</i>	323	--
<i>Carpinus caroliniana</i>	13666	1023
<i>Carya</i> spp.	4413	324
<i>Cornus florida</i>	6565	701
<i>Diospyros virginiana</i>	215	--
<i>Fagus grandifolia</i>	646	108
<i>Ilex opaca</i>	1617	--
<i>Juniperus virginiana</i>	970	162
<i>Liquidambar styraciflua</i>	108	162
<i>Liriodendron tulipifera</i>	1291	1184
<i>Nyssa sylvatica</i>	1291	593
<i>Prunus serotina</i>	754	54
<i>Quercus alba</i>	5596	216
<i>Quercus falcata</i>	754	--
<i>Quercus phellos</i>	108	--
<i>Quercus rubra</i>	969	162
<i>Quercus stellata</i>	755	--
<i>Sassafras albidum</i>	1614	108
Totals	45530	5821

Table 48. Stand W17 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	8
<i>Carpinus caroliniana</i>	1
<i>Carya glabra</i>	5
<i>Carya tomentosa</i>	1
<i>Cornus florida</i>	5
<i>Fraxinus pennsylvanica</i>	1
<i>Juniperus virginiana</i>	1
<i>Liriodendron tulipifera</i>	14
<i>Nyssa sylvatica</i>	10
<i>Pinus virginiana</i>	4
<i>Quercus alba</i>	34
<i>Quercus coccinea</i>	7
<i>Quercus rubra</i>	7
<i>Quercus velutina</i>	4

Total tree density (#/ha) = 333

Total overstory basal area (m²/ha) = 28.7

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	14741	648
<i>Amelanchier arborea</i>	108	--
<i>Carpinus caroliniana</i>	216	--
<i>Carya</i> spp.	7208	54
<i>Castanea pumila</i>	431	--
<i>Chionanthus virginicus</i>	968	54
<i>Cornus florida</i>	4734	539
<i>Diospyros virginiana</i>	216	--
<i>Fraxinus</i> spp.	2261	--
<i>Juniperus virginiana</i>	108	--
<i>Liriodendron tulipifera</i>	2799	--
<i>Nyssa sylvatica</i>	13450	1939
<i>Pinus virginiana</i>	108	--
<i>Prunus serotina</i>	1293	--
<i>Quercus alba</i>	6242	--
<i>Quercus coccinea</i>	1831	--
<i>Quercus falcata</i>	324	--
<i>Quercus rubra</i>	862	--
<i>Quercus velutina</i>	216	--
<i>Sassafras albidum</i>	5273	54
Totals	63389	3288

Table 49. Stand W18 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	2
<i>Carya glabra</i>	3
<i>Nyssa sylvatica</i>	15
<i>Pinus echinata</i>	2
<i>Pinus taeda</i>	1
<i>Pinus virginiana</i>	24
<i>Quercus alba</i>	31
<i>Quercus coccinea</i>	15
<i>Quercus falcata</i>	2
<i>Quercus stellata</i>	3
<i>Quercus velutina</i>	3
<i>Sassafras albidum</i>	1

Total tree density (#/ha) = 410

Total overstory basal area (m²/ha) = 26.2

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	3551	162
<i>Amelanchier arborea</i>	108	--
<i>Carya spp.</i>	4089	108
<i>Cornus florida</i>	108	--
<i>Fagus grandifolia</i>	--	54
<i>Liriodendron tulipifera</i>	215	--
<i>Nyssa sylvatica</i>	5382	1506
<i>Pinus virginiana</i>	754	--
<i>Quercus alba</i>	2260	54
<i>Quercus coccinea</i>	6133	--
<i>Quercus falcata</i>	754	--
<i>Quercus rubra</i>	323	--
<i>Quercus velutina</i>	324	162
<i>Sassafras albidum</i>	9577	378
Totals	33578	2424

Table 50. Stand W19 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	5
<i>Betula lenta</i>	3
<i>Carpinus caroliniana</i>	1
<i>Carya glabra</i>	7
<i>Carya ovalis</i>	2
<i>Carya tomentosa</i>	6
<i>Cercis canadensis</i>	1
<i>Cornus florida</i>	1
<i>Juglans nigra</i>	1
<i>Liriodendron tulipifera</i>	16
<i>Nyssa sylvatica</i>	2
<i>Pinus virginiana</i>	2
<i>Quercus alba</i>	39
<i>Quercus coccinea</i>	3
<i>Quercus falcata</i>	3
<i>Quercus rubra</i>	5
<i>Quercus velutina</i>	4

Total tree density (#/ha) = 437

Total overstory basal area (m²/ha) = 26.9

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	6886	216
<i>Amelanchier arborea</i>	430	--
<i>Aralia spinosa</i>	108	--
<i>Betula lenta</i>	108	108
<i>Carpinus caroliniana</i>	969	--
<i>Carya</i> spp.	3661	162
<i>Cercis canadensis</i>	1722	--
<i>Cornus florida</i>	8499	432
<i>Fraxinus</i> spp.	3768	54
<i>Ilex opaca</i>	108	--
<i>Juniperus virginiana</i>	108	--
<i>Liriodendron tulipifera</i>	1938	216
<i>Nyssa sylvatica</i>	5487	1077
<i>Prunus serotina</i>	1400	54
<i>Quercus alba</i>	5058	--
<i>Quercus coccinea</i>	432	--
<i>Quercus falcata</i>	323	--
<i>Quercus phellos</i>	215	--
<i>Quercus rubra</i>	1829	108
<i>Quercus velutina</i>	323	--
<i>Sassafras albidum</i>	1938	--
Totals	45310	2427

Table 51. Stand W20 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	7
<i>Carya glabra</i>	4
<i>Carya tomentosa</i>	7
<i>Cornus florida</i>	1
<i>Liriodendron tulipifera</i>	19
<i>Nyssa sylvatica</i>	2
<i>Pinus echinata</i>	2
<i>Pinus taeda</i>	3
<i>Pinus virginiana</i>	6
<i>Populus grandidentata</i>	2
<i>Quercus alba</i>	29
<i>Quercus coccinea</i>	3
<i>Quercus falcata</i>	3
<i>Quercus prinus</i>	3
<i>Quercus rubra</i>	3
<i>Quercus stellata</i>	2
<i>Quercus velutina</i>	4

Total tree density (#/ha) = 669

Total overstory basal area (m²/ha) = 24.3

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	13234	54
<i>Amelanchier arborea</i>	2044	--
<i>Carpinus caroliniana</i>	430	--
<i>Carya</i> spp.	3231	54
<i>Cornus florida</i>	3551	486
<i>Diospyros virginiana</i>	108	--
<i>Fraxinus</i> spp.	324	--
<i>Ilex opaca</i>	431	54
<i>Liriodendron tulipifera</i>	431	108
<i>Nyssa sylvatica</i>	9899	1507
<i>Pinus virginiana</i>	108	--
<i>Prunus serotina</i>	538	--
<i>Quercus alba</i>	8286	54
<i>Quercus coccinea</i>	1186	--
<i>Quercus falcata</i>	647	--
<i>Quercus phellos</i>	216	--
<i>Quercus prinus</i>	1184	--
<i>Quercus rubra</i>	323	--
<i>Quercus stellata</i>	108	--
<i>Quercus velutina</i>	971	54
<i>Sassafras albidum</i>	1723	108
Totals	48973	2479

Table 52. Stand W21 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value	
<i>Acer rubrum</i>	3	
<i>Carpinus caroliniana</i>	1	
<i>Carya glabra</i>	5	
<i>Carya tomentosa</i>	4	
<i>Cornus florida</i>	1	
<i>Fagus grandifolia</i>	1	
<i>Fraxinus pennsylvanica</i>	2	
<i>Ilex opaca</i>	1	
<i>Juniperus virginiana</i>	1	
<i>Liquidambar styraciflua</i>	1	
<i>Liriodendron tulipifera</i>	14	
<i>Nyssa sylvatica</i>	3	
<i>Pinus echinata</i>	1	
<i>Pinus virginiana</i>	33	
<i>Populus grandidentata</i>	1	
<i>Quercus alba</i>	10	
<i>Quercus falcata</i>	14	
<i>Quercus phellos</i>	1	
<i>Quercus stellata</i>	2	
Total tree density (#/ha) = 751	Total overstory basal area (m ² /ha) = 31.5	
Understory Species	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	4628	54
<i>Carpinus caroliniana</i>	1077	--
<i>Carya</i> spp.	4521	--
<i>Cercis canadensis</i>	216	--
<i>Cornus florida</i>	4412	538
<i>Diospyros virginiana</i>	216	--
<i>Fagus grandifolia</i>	108	54
<i>Fraxinus</i> spp.	1077	--
<i>Ilex opaca</i>	1401	270
<i>Juniperus virginiana</i>	216	108
<i>Liriodendron tulipifera</i>	431	54
<i>Nyssa sylvatica</i>	4091	378
<i>Pinus virginiana</i>	216	--
<i>Prunus serotina</i>	1293	--
<i>Quercus alba</i>	2046	--
<i>Quercus coccinea</i>	324	--
<i>Quercus falcata</i>	1723	--
<i>Quercus phellos</i>	754	--
<i>Quercus rubra</i>	323	--
<i>Quercus stellata</i>	2152	--
<i>Sassafras albidum</i>	323	54
Totals	31548	1510

Table 53. Stand W22 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	1
<i>Carya glabra</i>	1
<i>Carya tomentosa</i>	1
<i>Cornus florida</i>	2
<i>Liriodendron tulipifera</i>	5
<i>Nyssa sylvatica</i>	3
<i>Pinus echinata</i>	1
<i>Pinus virginiana</i>	44
<i>Populus grandidentata</i>	1
<i>Quercus alba</i>	21
<i>Quercus coccinea</i>	11
<i>Quercus falcata</i>	1
<i>Quercus stellata</i>	3
<i>Quercus velutina</i>	6
<i>Sassafras albidum</i>	1

Total tree density (#/ha) = 719

Total overstory basal area (m²/ha) = 24.7

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	7103	54
<i>Carya</i> spp.	2156	162
<i>Castanea pumila</i>	215	--
<i>Chionanthus virginicus</i>	216	--
<i>Cornus florida</i>	1399	--
<i>Diospyros virginiana</i>	323	--
<i>Ilex opaca</i>	108	--
<i>Liriodendron tulipifera</i>	--	54
<i>Nyssa sylvatica</i>	4951	1078
<i>Quercus alba</i>	4413	216
<i>Quercus coccinea</i>	3339	54
<i>Quercus falcata</i>	647	--
<i>Quercus phellos</i>	1186	--
<i>Quercus rubra</i>	108	--
<i>Sassafras albidum</i>	5704	269
Totals	31868	1887

Table 54. Stand W23 overstory and understory vegetative composition.

Species	Overstory Relative Importance Value
<i>Acer rubrum</i>	5
<i>Carya glabra</i>	4
<i>Carya tomentosa</i>	2
<i>Cornus florida</i>	2
<i>Fraxinus americana</i>	1
<i>Ilex opaca</i>	1
<i>Liriodendron tulipifera</i>	14
<i>Nyssa sylvatica</i>	10
<i>Pinus virginiana</i>	3
<i>Populus grandidentata</i>	1
<i>Quercus alba</i>	29
<i>Quercus coccinea</i>	4
<i>Quercus falcata</i>	9
<i>Quercus rubra</i>	7
<i>Quercus velutina</i>	7

Total tree density (#/ha) = 469

Total overstory basal area (m²/ha) = 35.6

Species	Understory density (#/ha)	
	<u>Seedling</u>	<u>Sapling</u>
<i>Acer rubrum</i>	9794	486
<i>Amelanchier arborea</i>	861	--
<i>Carpinus caroliniana</i>	431	--
<i>Carya</i> spp.	3984	54
<i>Cercis canadensis</i>	754	--
<i>Chionanthus virginicus</i>	539	--
<i>Cornus florida</i>	5272	701
<i>Diospyros virginiana</i>	215	--
<i>Fraxinus</i> spp.	1937	108
<i>Ilex opaca</i>	108	54
<i>Liriodendron tulipifera</i>	1400	108
<i>Nyssa sylvatica</i>	7317	755
<i>Prunus serotina</i>	863	--
<i>Quercus alba</i>	3876	--
<i>Quercus coccinea</i>	538	--
<i>Quercus falcata</i>	431	--
<i>Quercus rubra</i>	539	--
<i>Quercus stellata</i>	108	--
<i>Quercus velutina</i>	432	--
<i>Sassafras albidum</i>	1078	--
Totals	40477	2266

Age-diameter figures for overstory trees in Wilderness (W) Battlefield

KEY

<u>SYMBOL</u>	<u>SPECIES</u>
ASP	Bigtooth aspen
BEECH	American beech
BG	Blackgum
BO	Black oak
CO	Chestnut oak
DOG	Dogwood
ERC	Eastern redcedar
HICK	Hickory spp.
HOLLY	American holly
LOB	Loblolly pine
MH	Mockernut hickory
PH	Pignut hickory
PO	Post oak
RM	Red maple
RO	Red oak
SB	Sweet birch
SG	Sweetgum
SLP	Shortleaf pine
SO	Scarlet oak
SRO	Southern red oak
TP	Tulip poplar
VP	Virginia pine
WO	White oak
WILLO	Willow oak

Figure 33. Age-diameter relationship for Stand W1

106

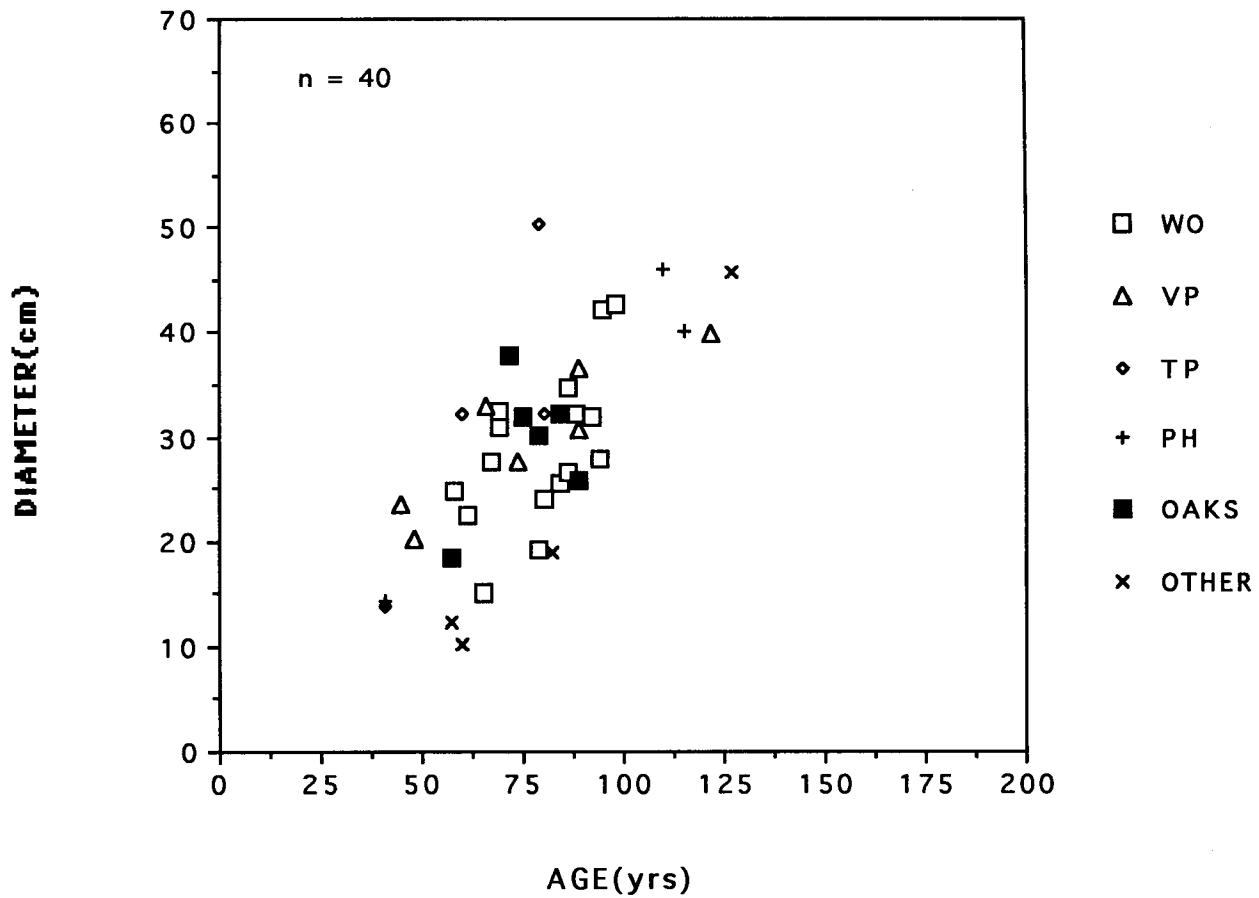


Figure 34. Age-diameter relationship for Stand W2

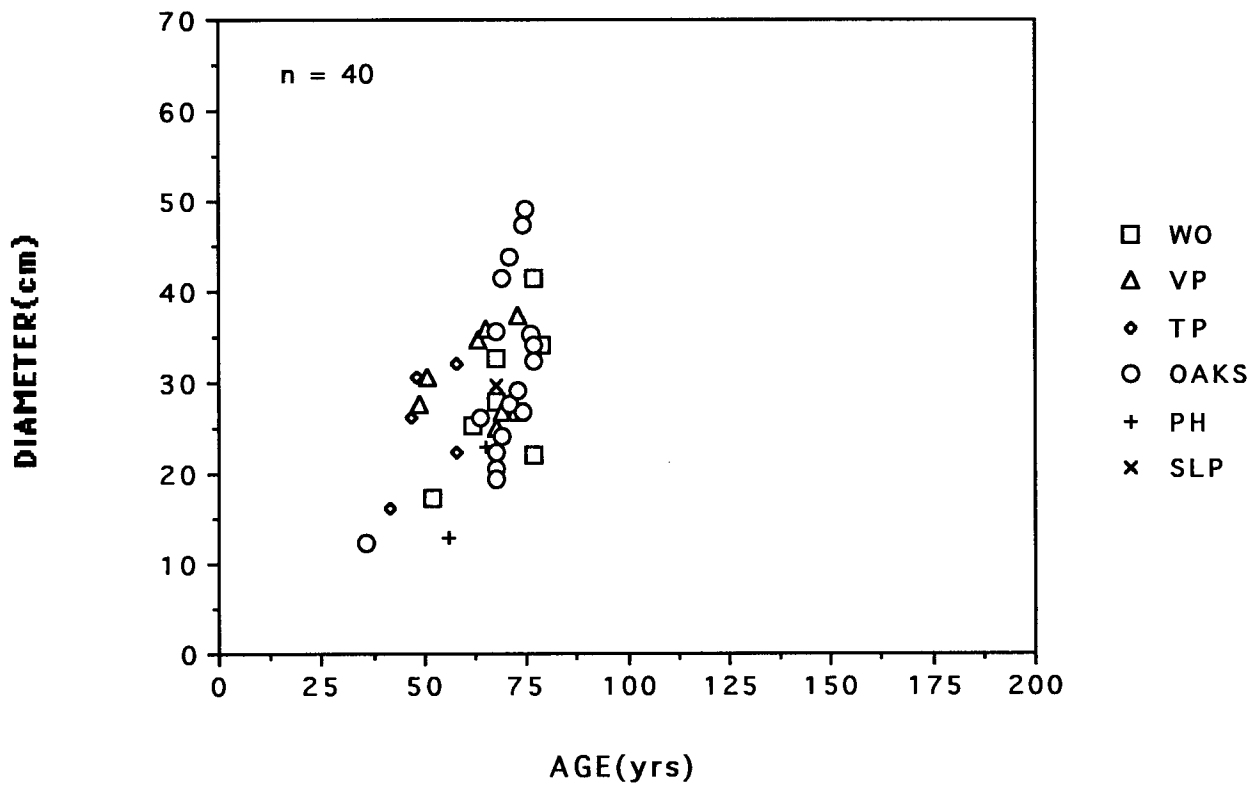


Figure 35. Age-diameter relationship for Stand W3

107

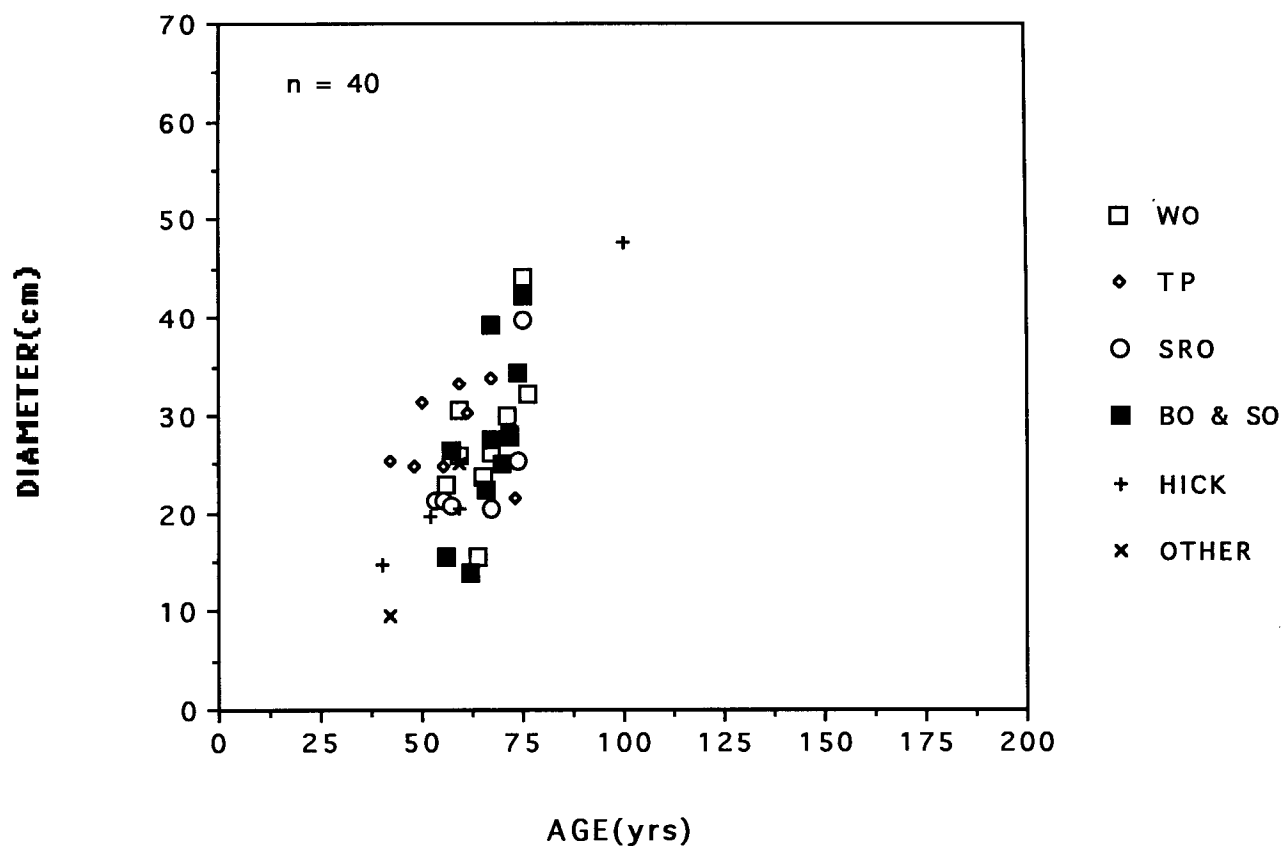


Figure 36. Age-diameter relationship for Stand W4

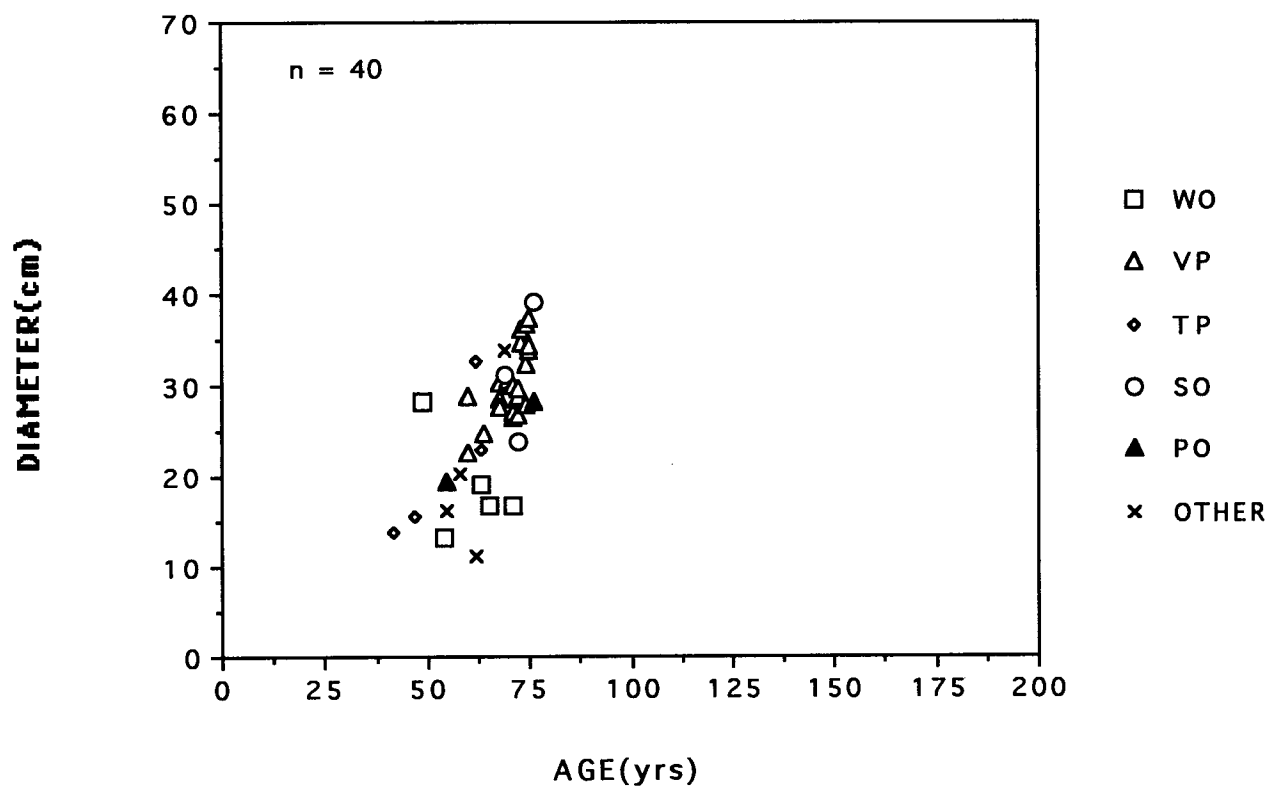


Figure 37. Age-diameter relationship for Stand W5

108

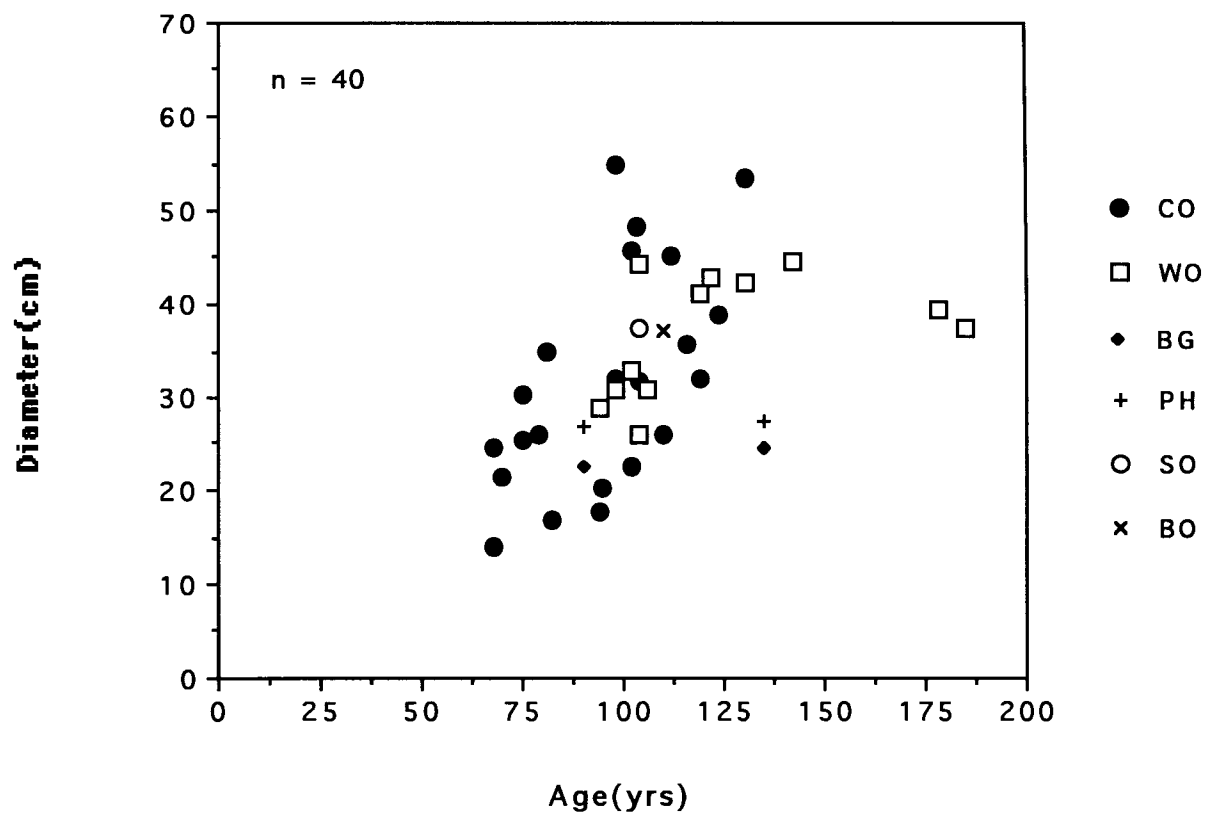


Figure 38. Age-diameter relationship for Stand W6

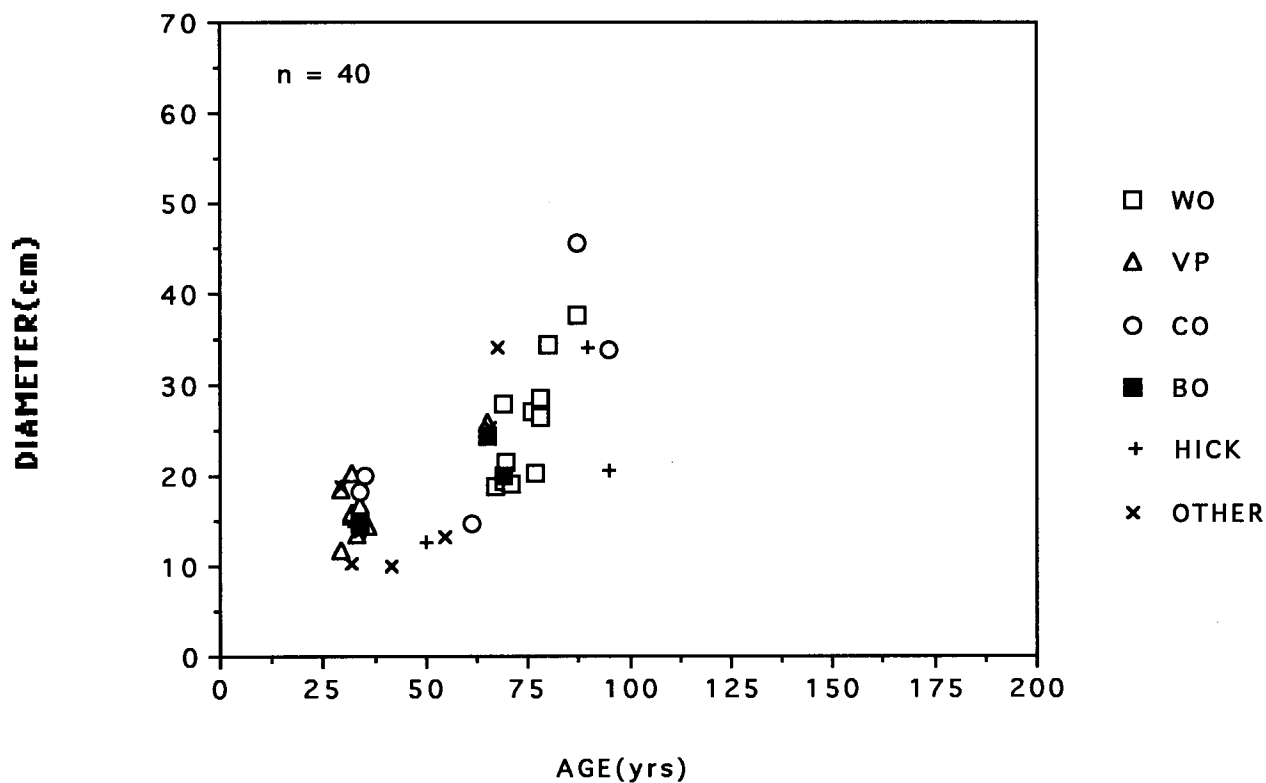


Figure 39. Age-diameter relationship for Stand W7

109

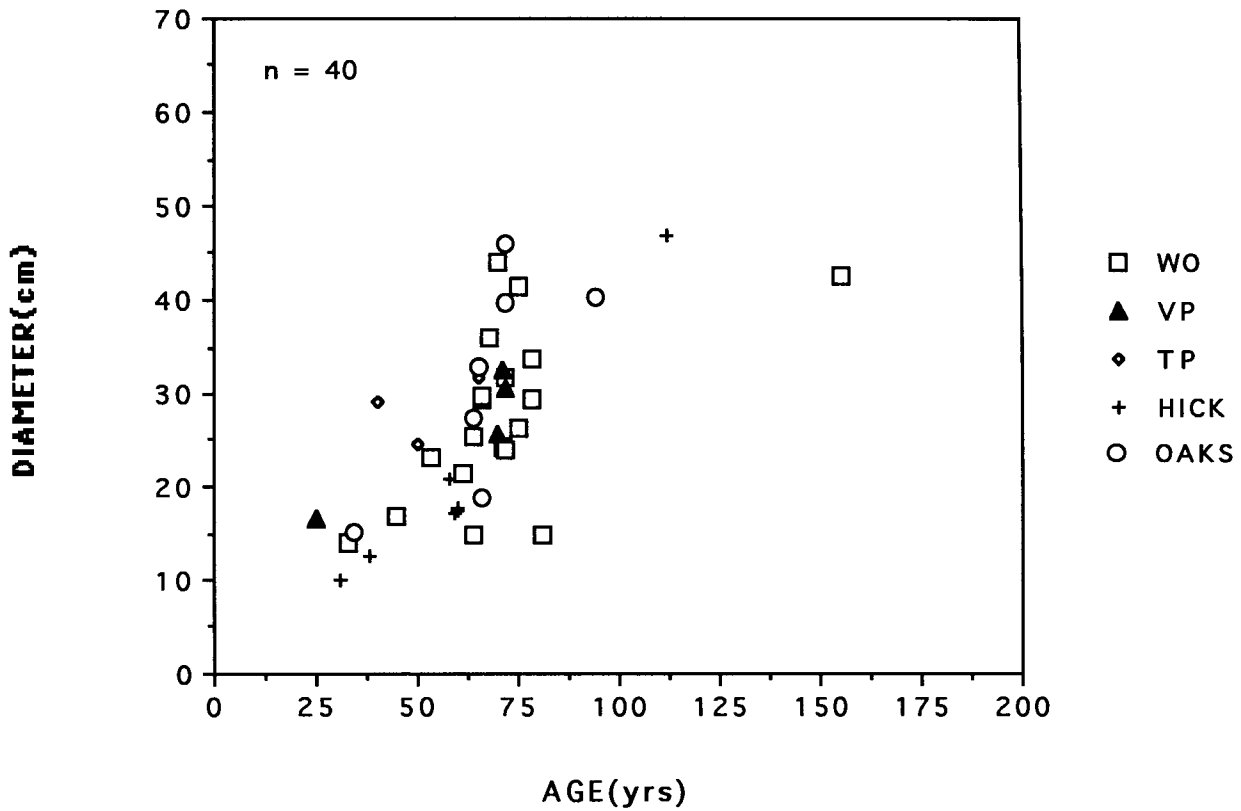


Figure 40. Age-diameter relationship for Stand W8

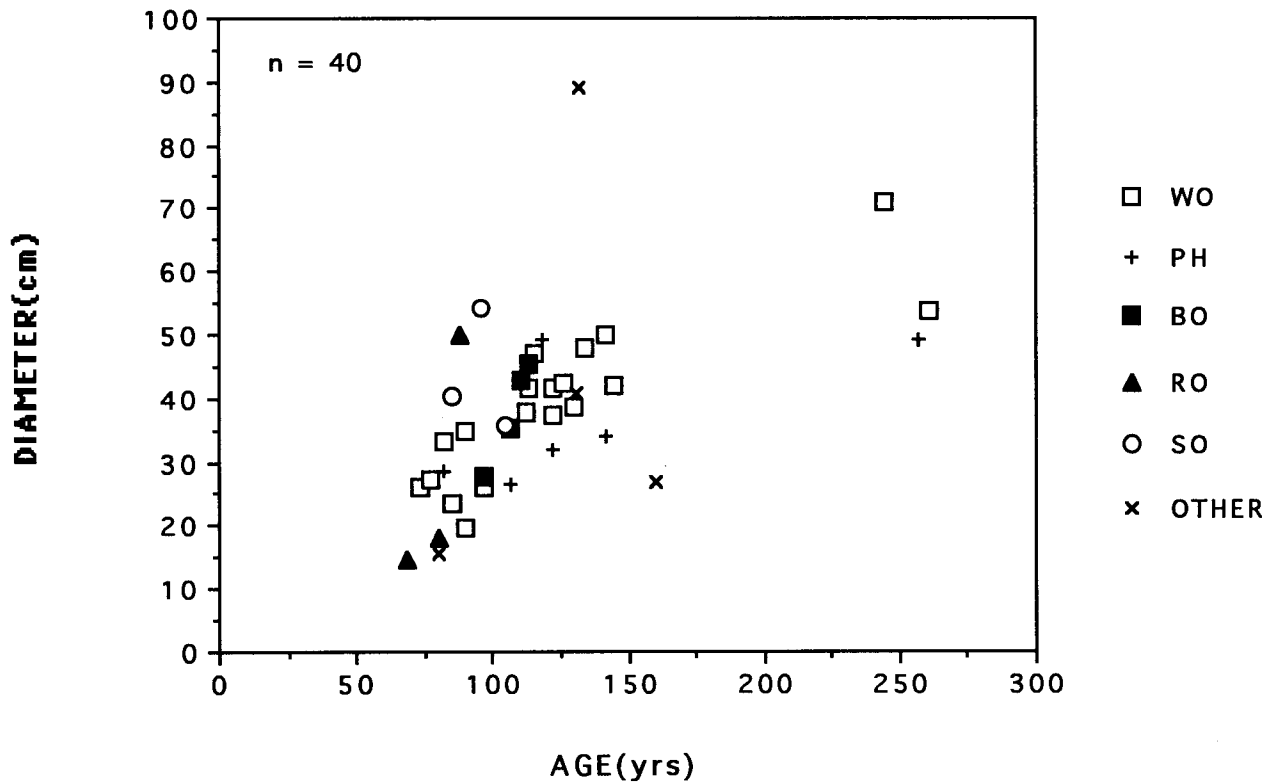


Figure 41. Age-diameter relationship for Stand W9

110

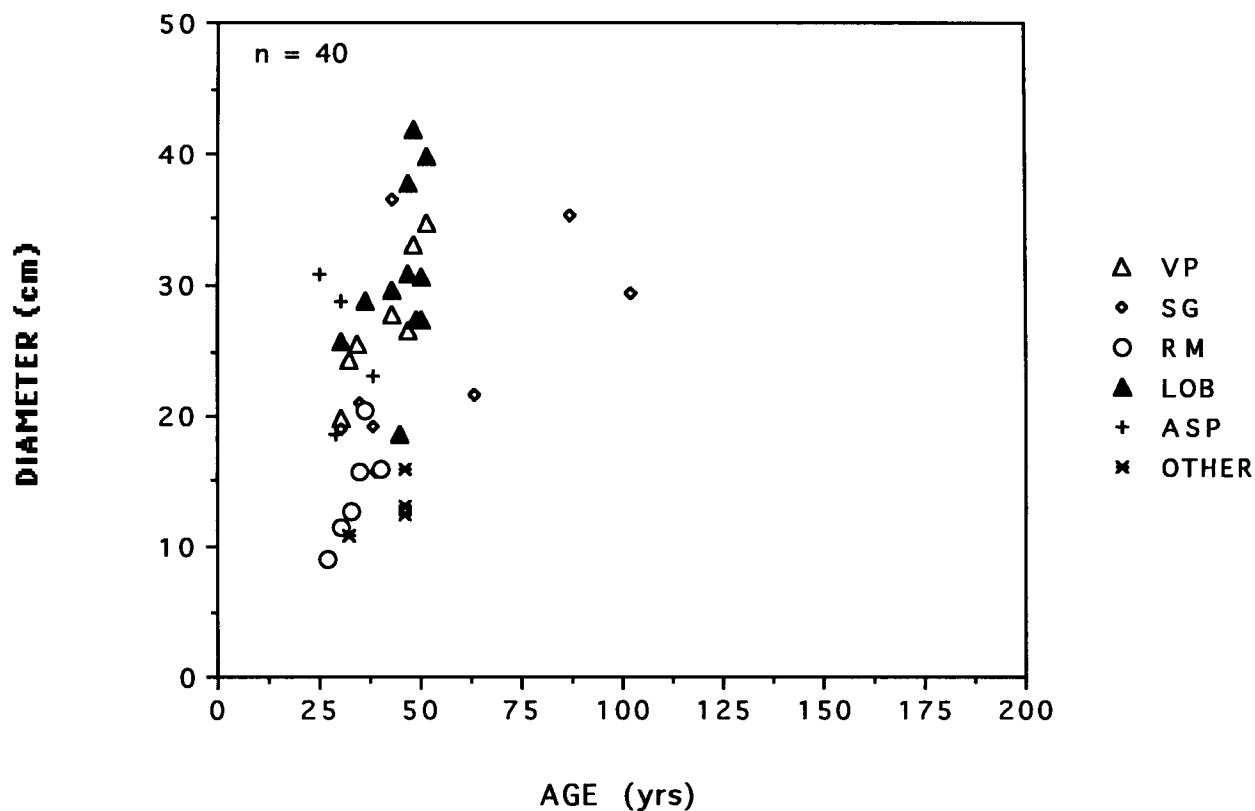


Figure 42. Age-diameter relationship for Stand W10

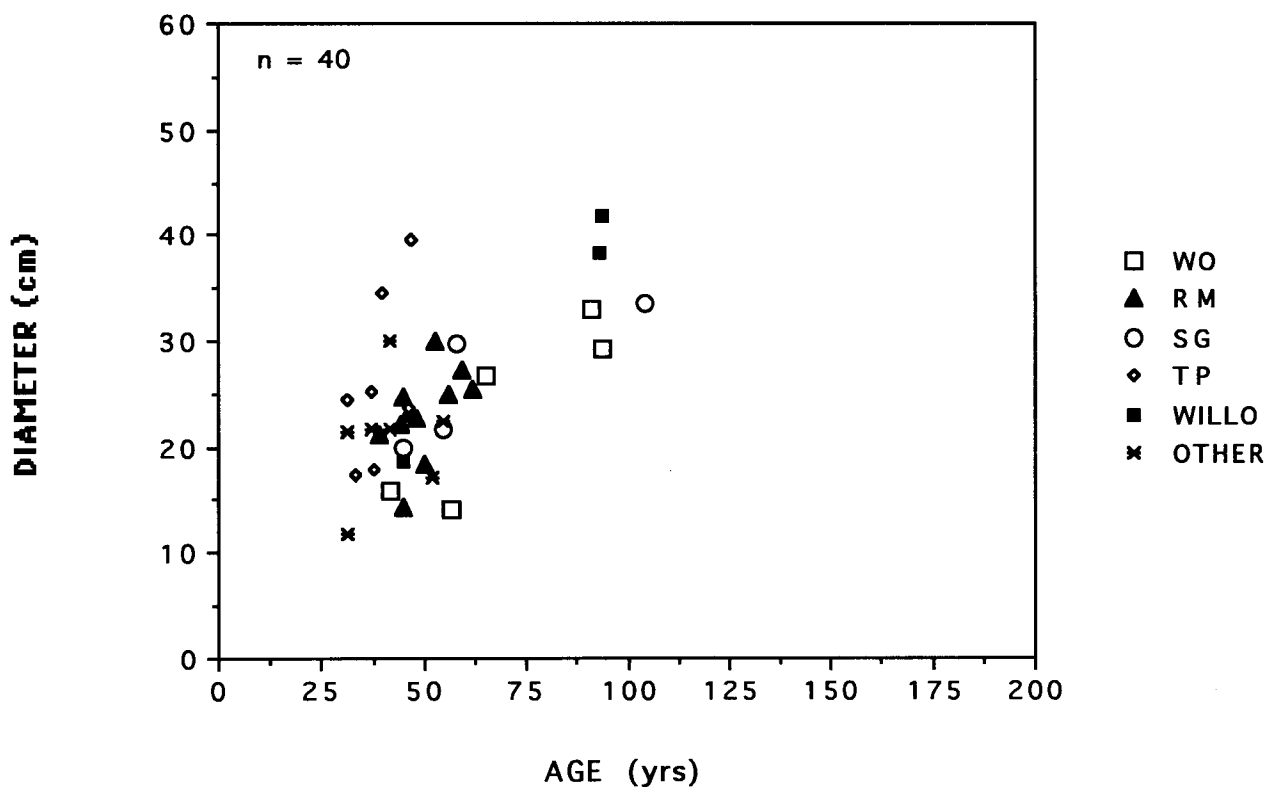


Figure 43. Age-diameter relationship for Stand W11

111

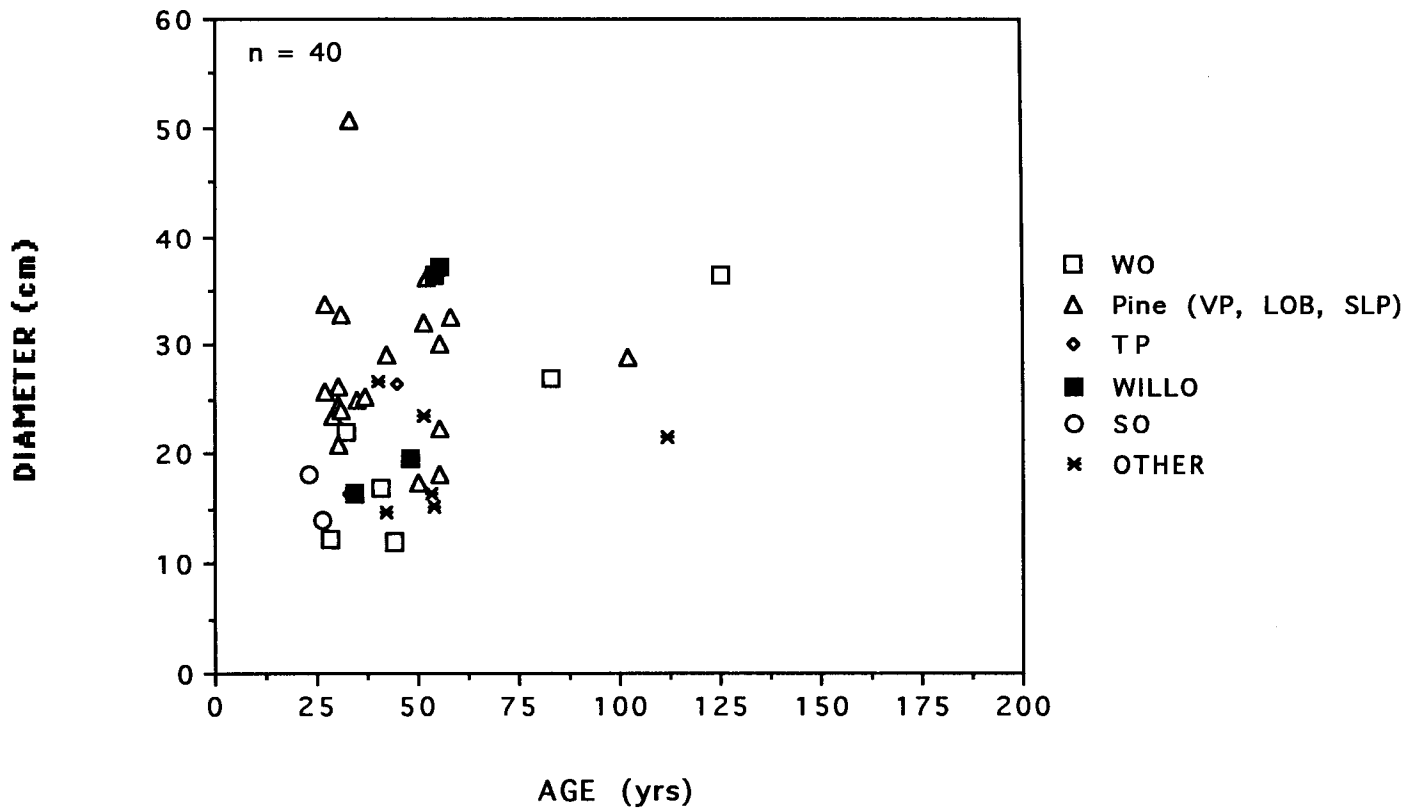


Figure 44. Age-diameter relationship for Stand W12

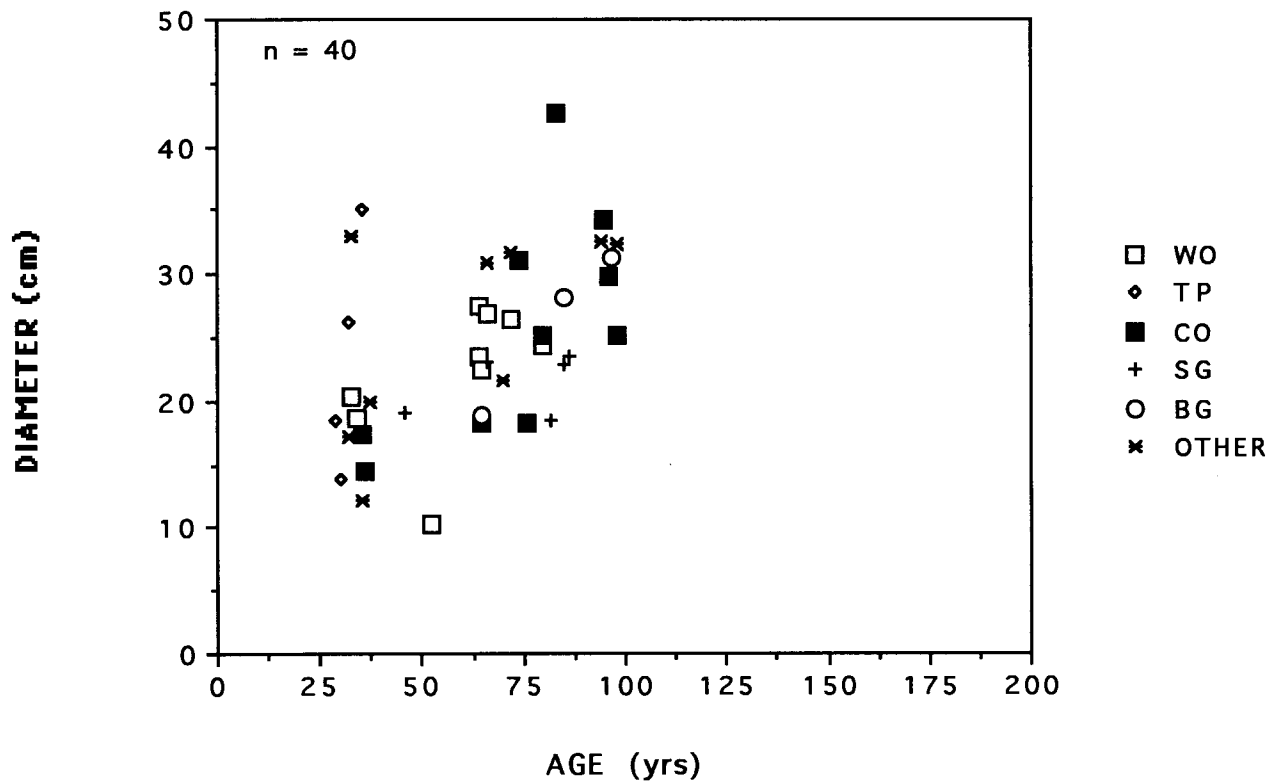


Figure 45. Age-diameter relationship for Stand W13

112

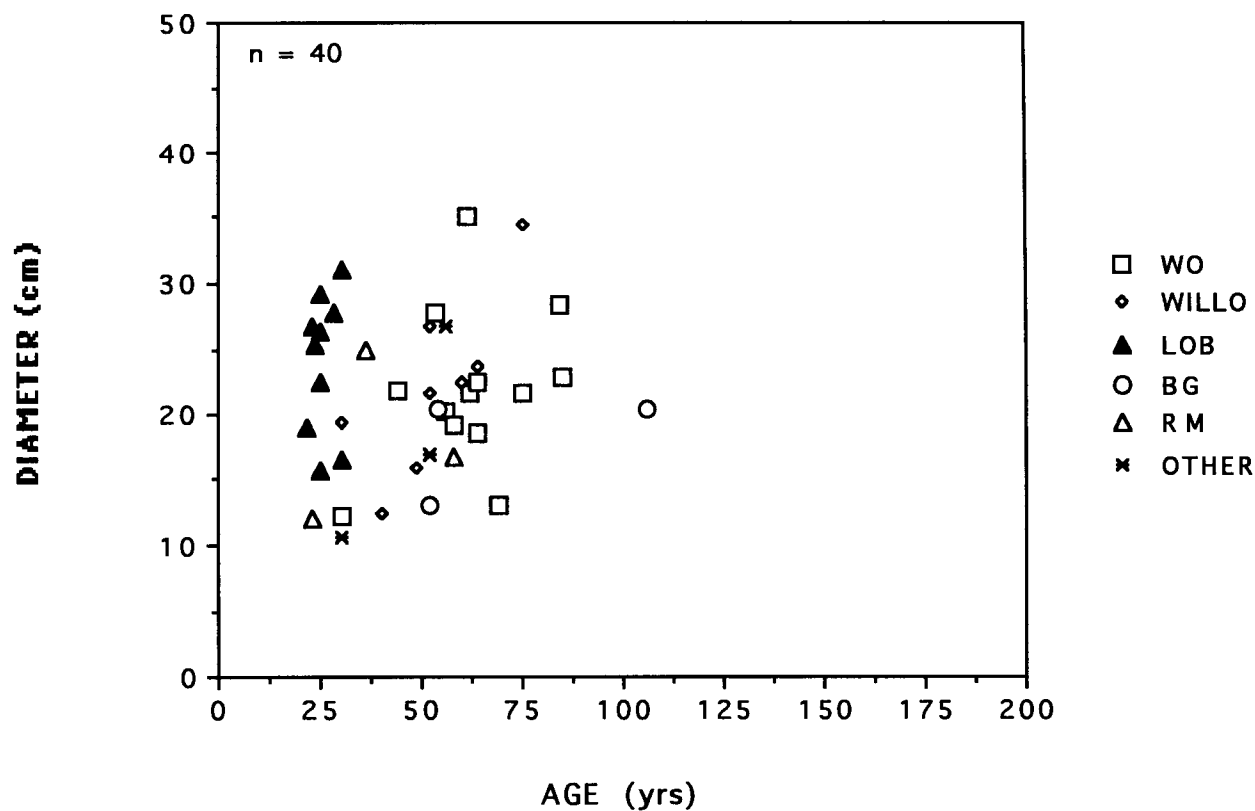


Figure 46. Age-diameter relationship for Stand W14

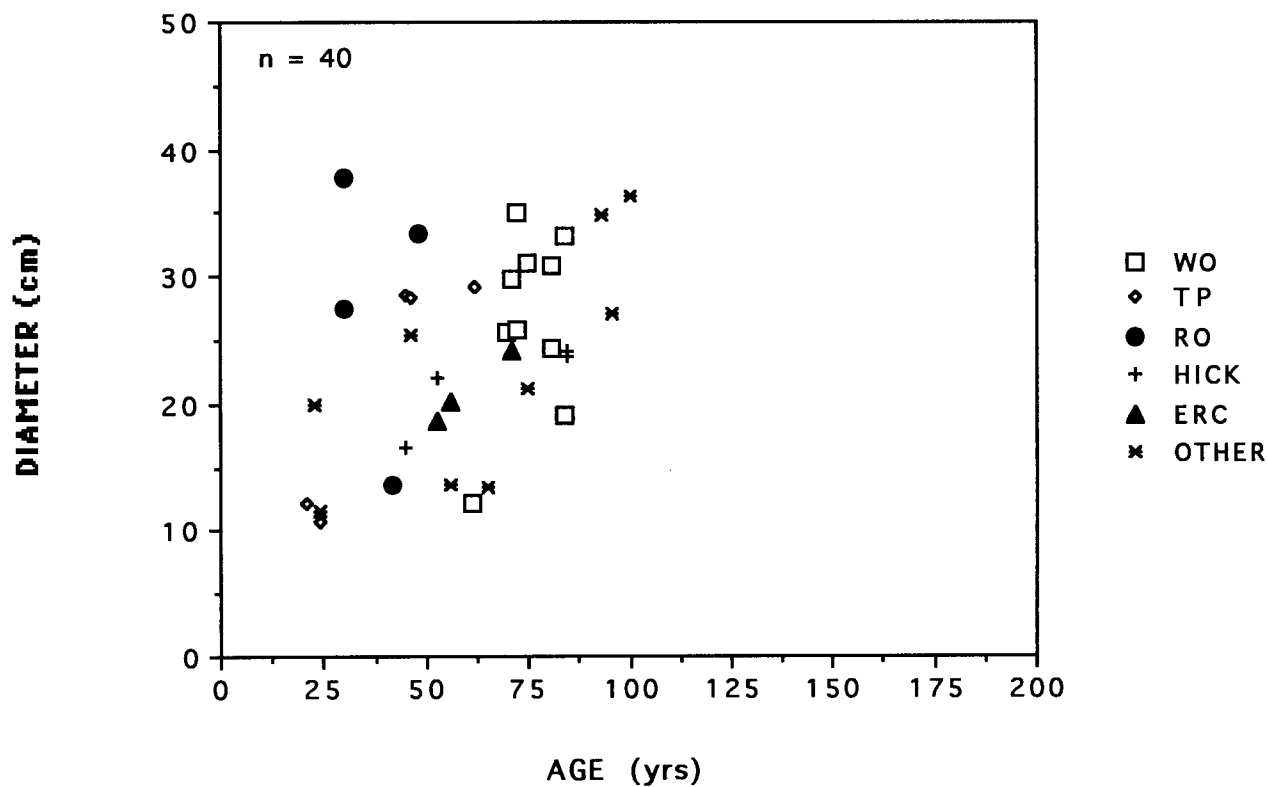


Figure 47. Age-diameter relationship for Stand W15

113

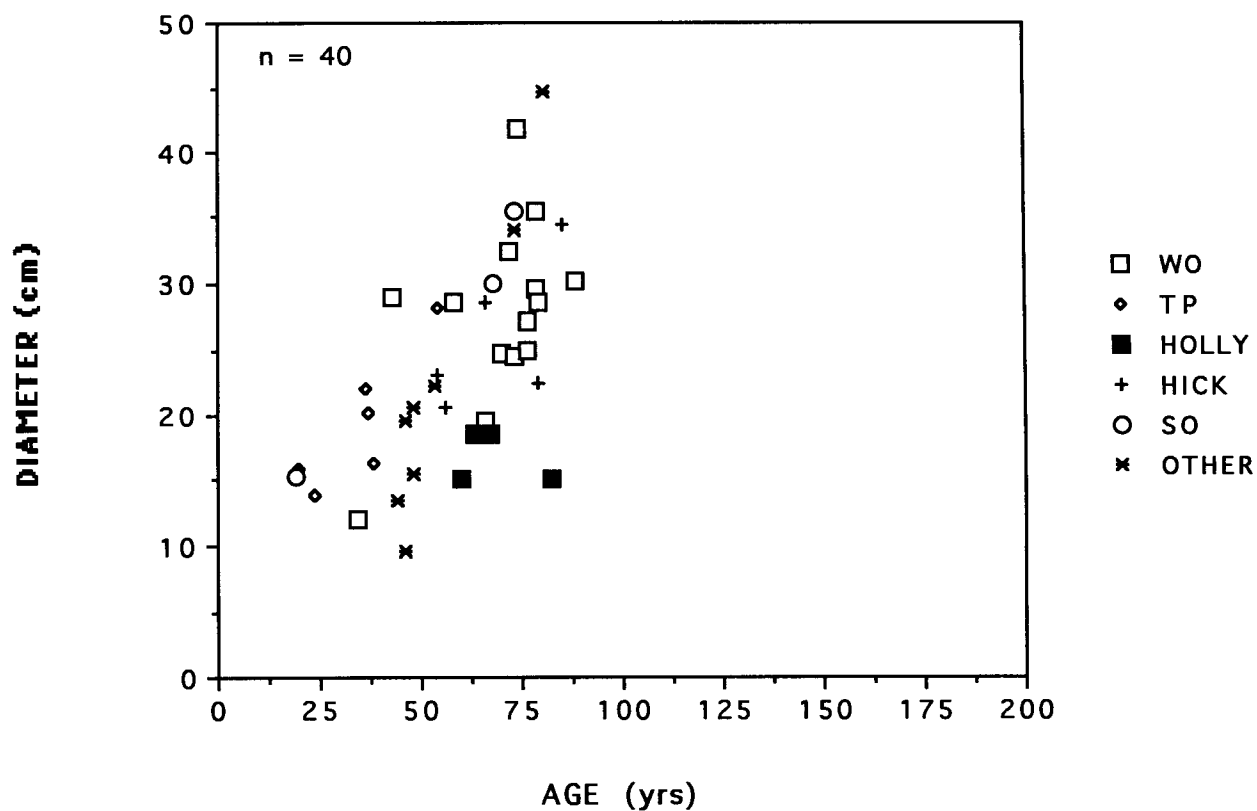


Figure 48. Age-diameter relationship for Stand W16

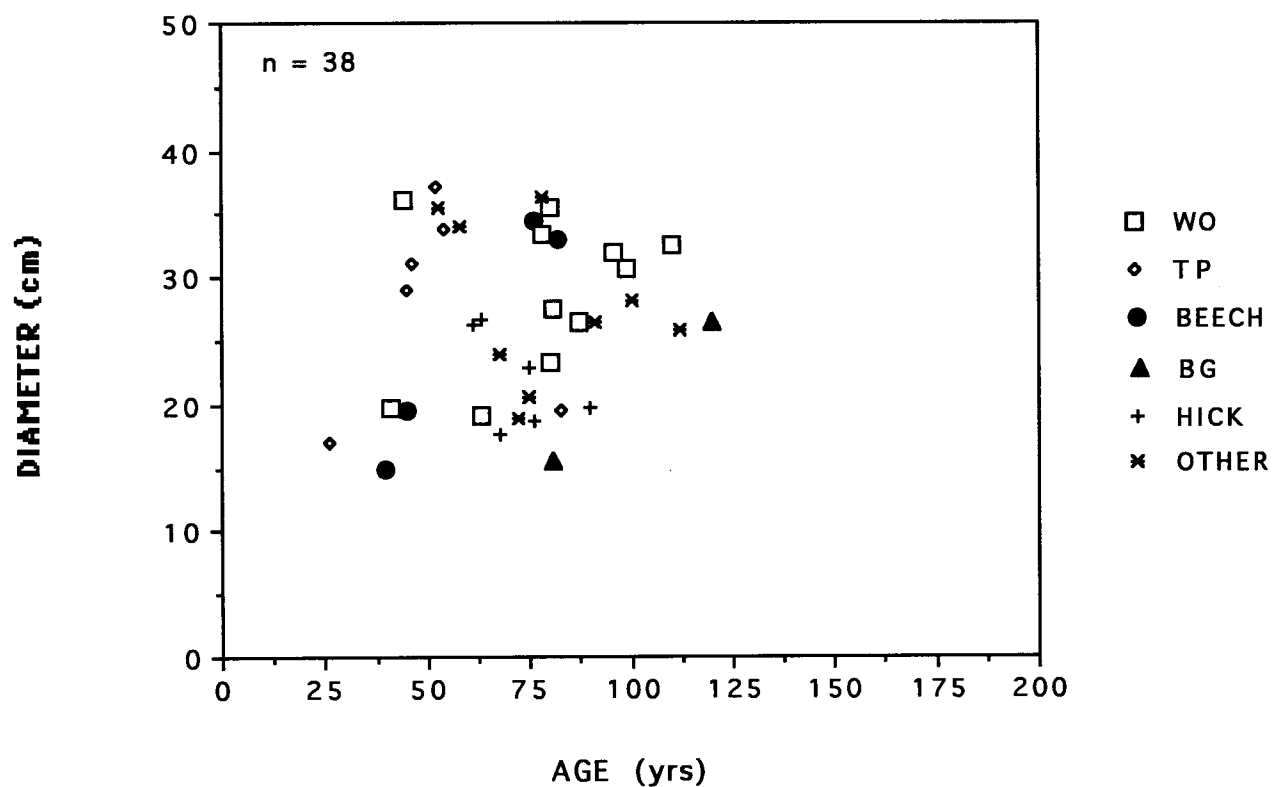


Figure 49. Age-diameter relationship for Stand W17

114

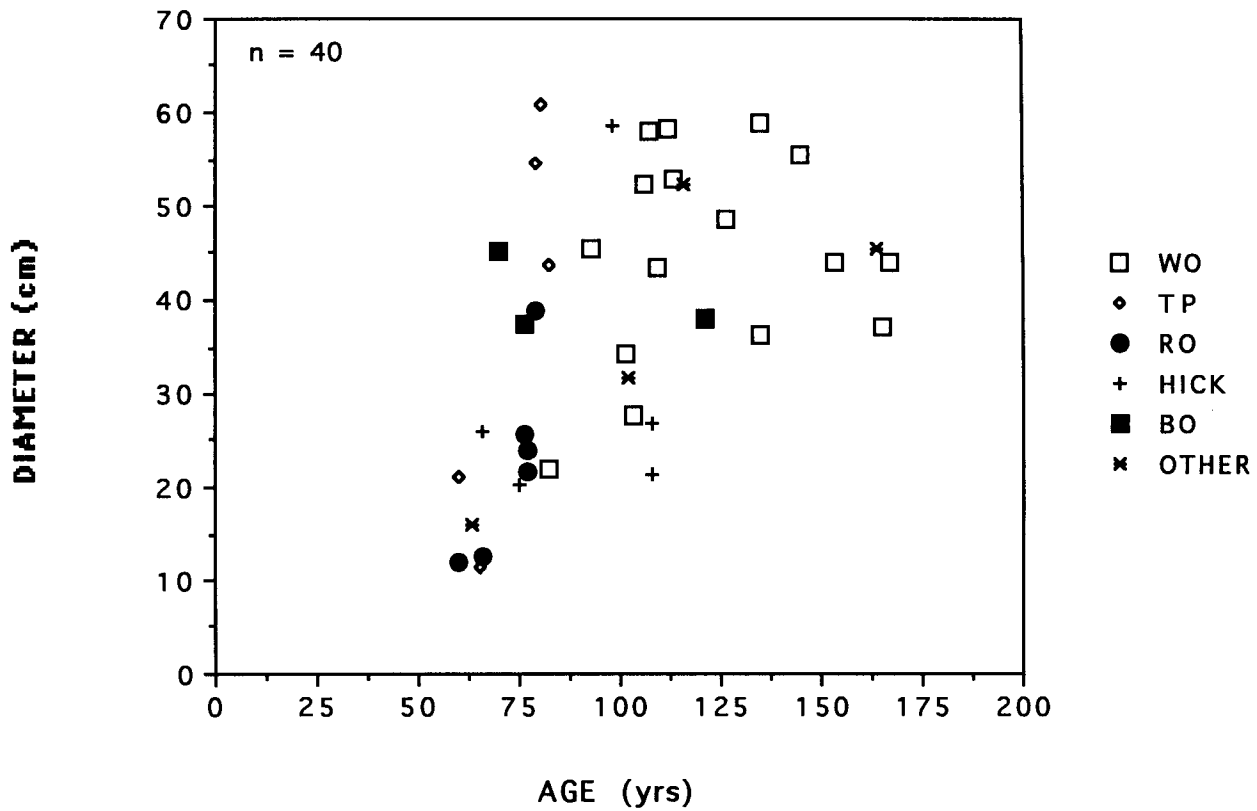


Figure 50. Age-diameter relationship for Stand W18

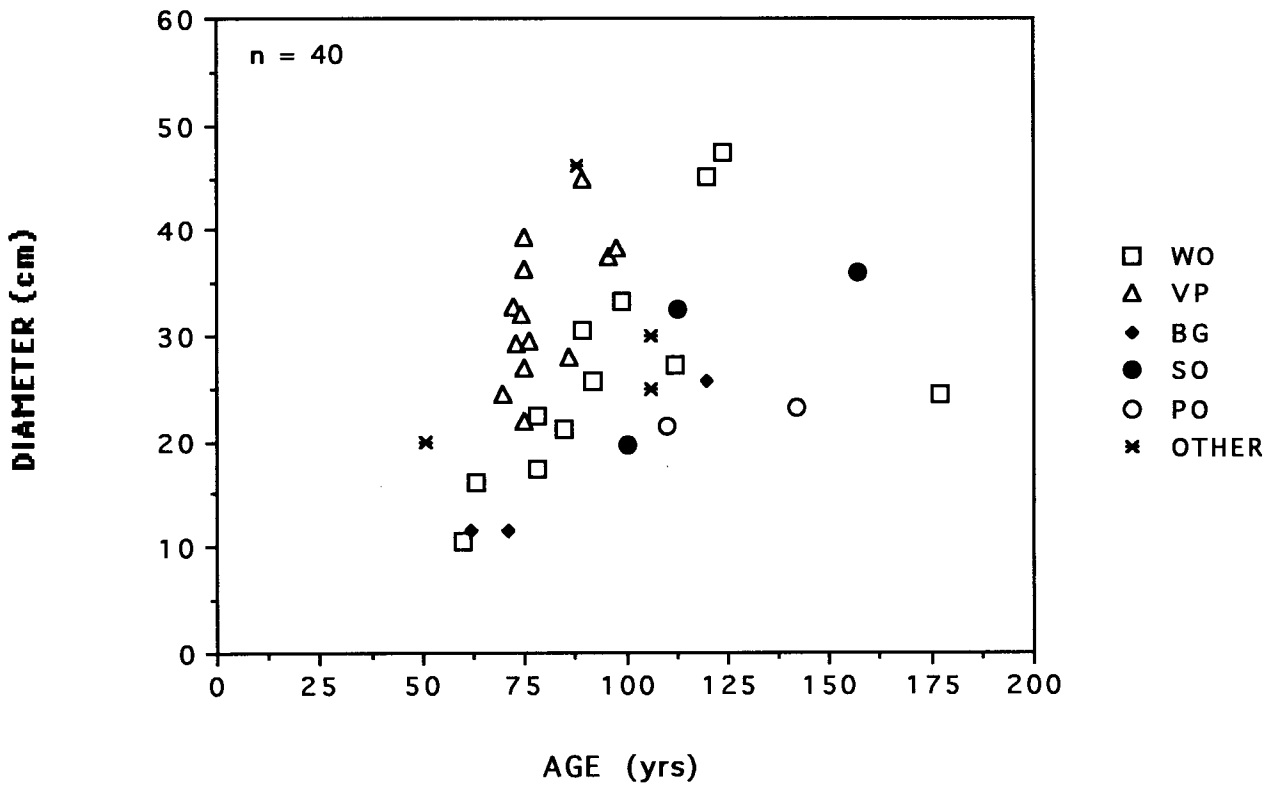


Figure 51. Age-diameter relationship for Stand W19

115

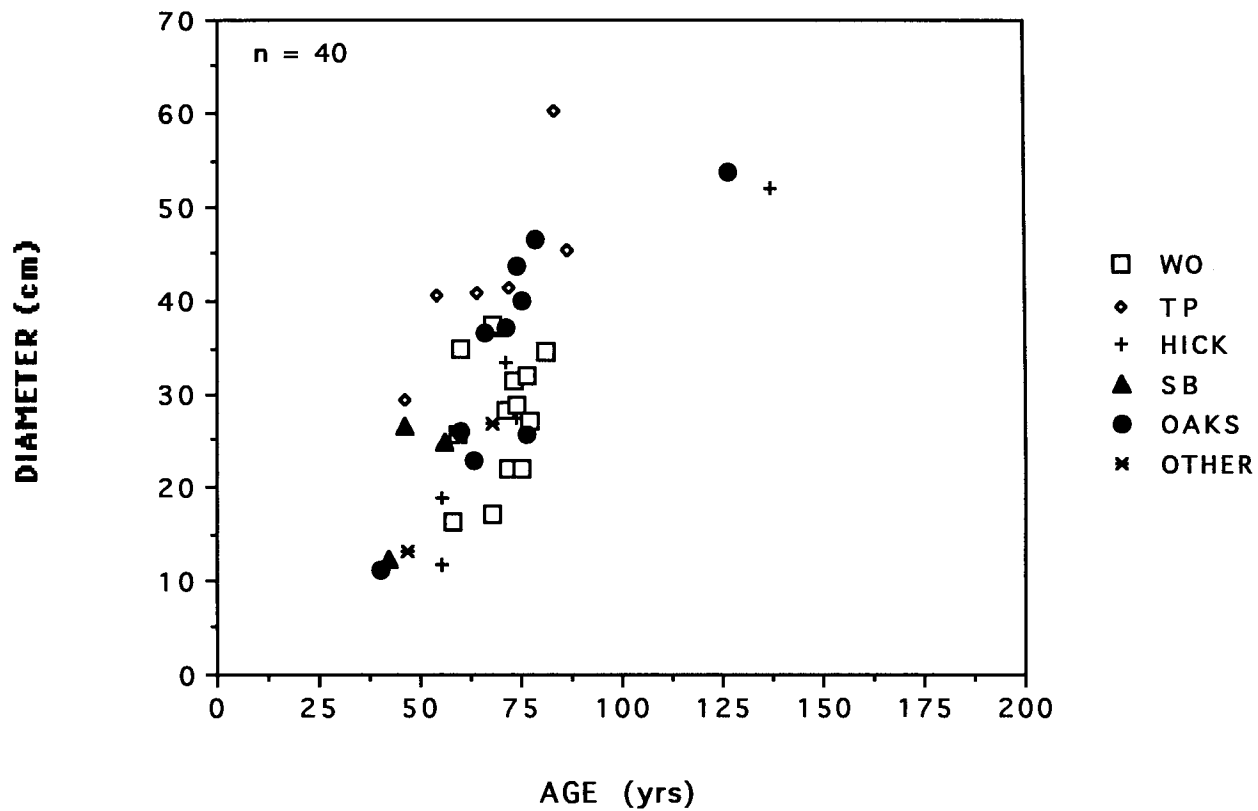


Figure 52. Age-diameter relationship for Stand W20

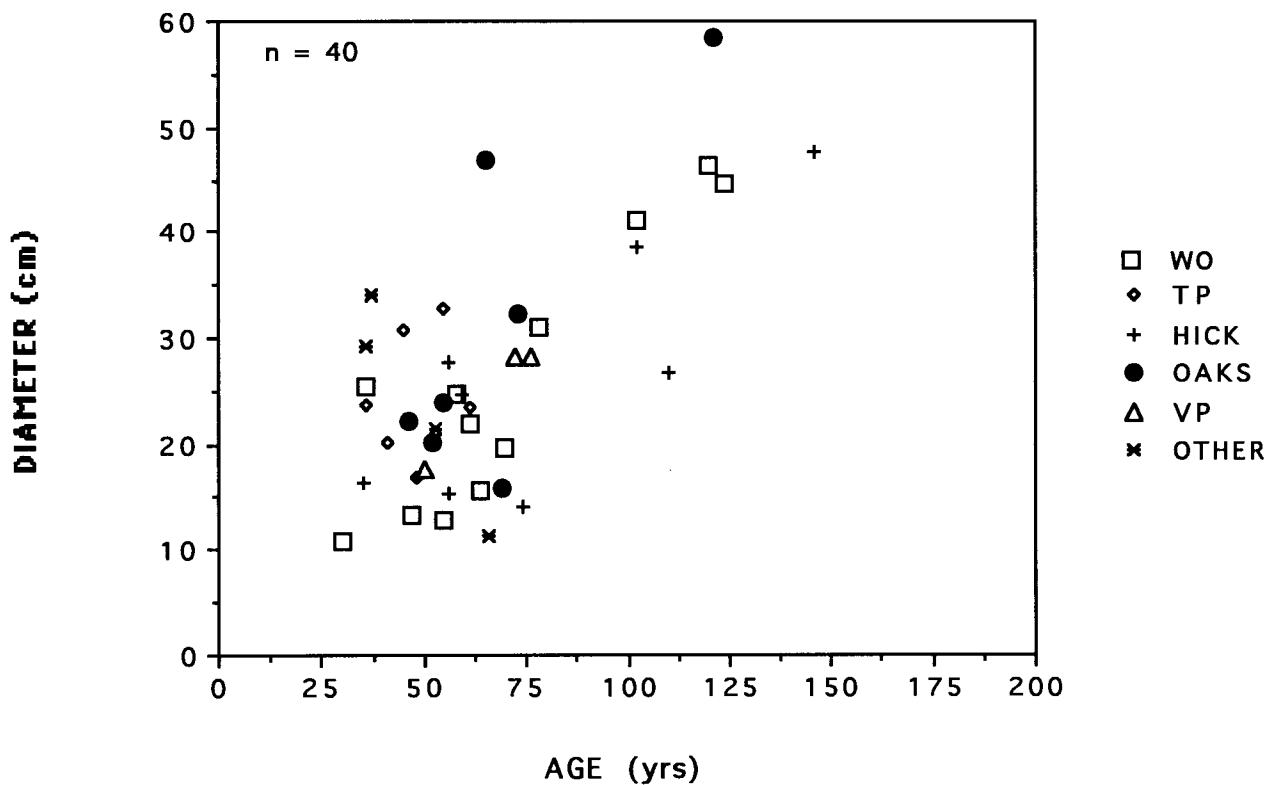


Figure 53. Age-diameter relationship for Stand W21

116

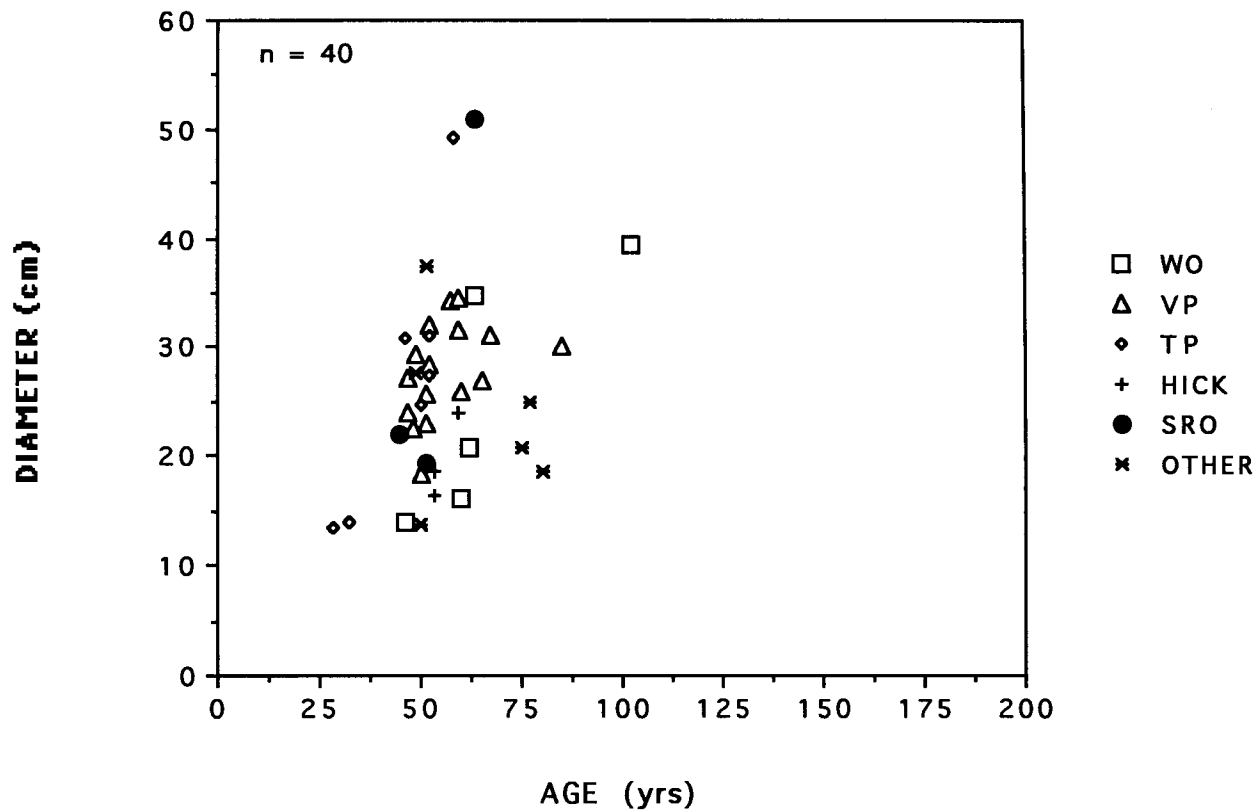


Figure 54. Age-diameter relationship for Stand W22

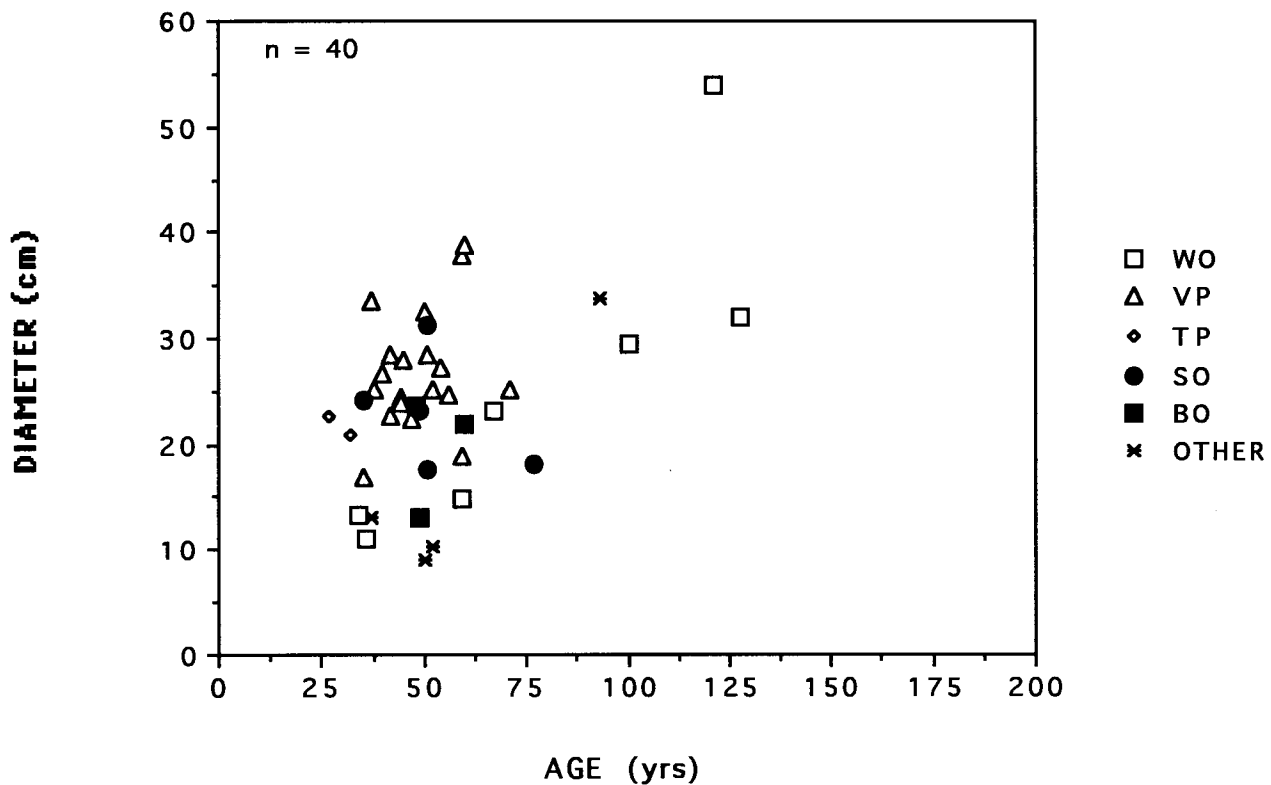
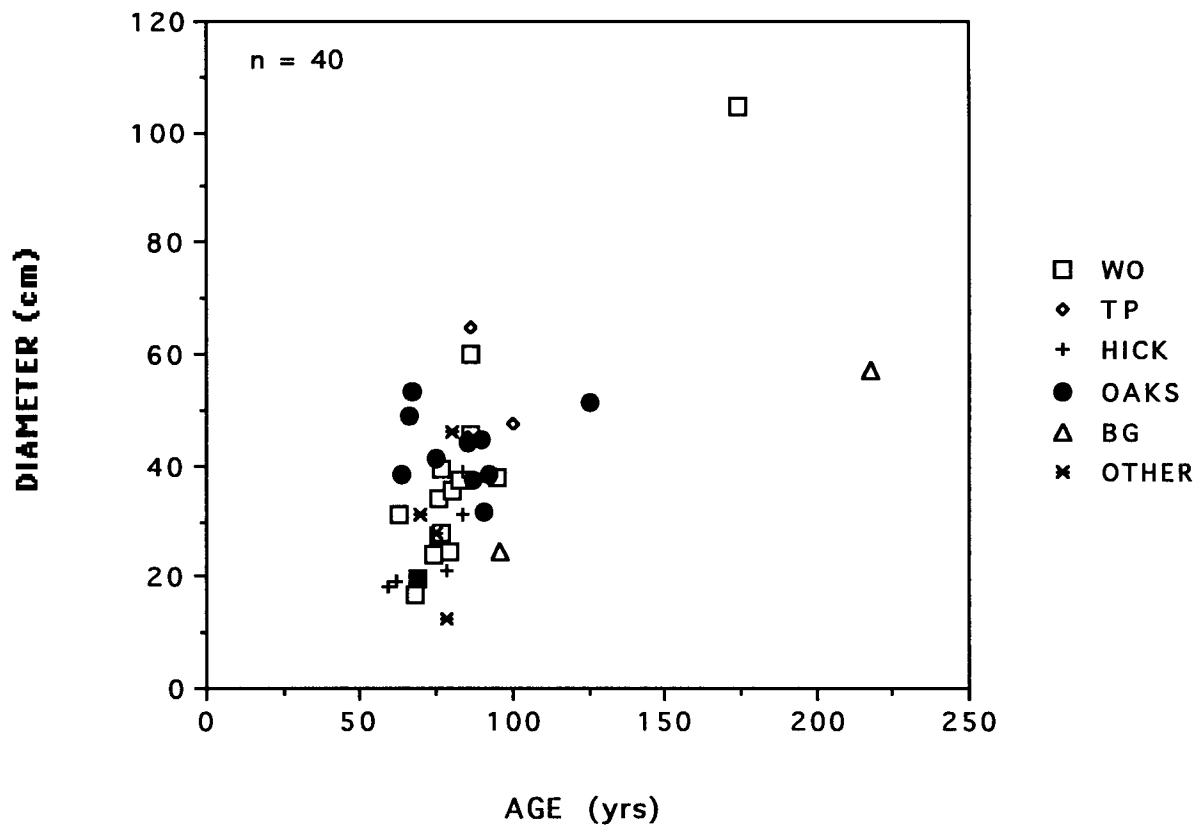


Figure 55. Age-diameter relationship for Stand W23



Fuel loads

Fuel loading was estimated in four representative stands within Wilderness Battlefield (Table 55; Figure 31, asterisks indicate fuel loading sampling locations). Due to the preponderance of oak species, as well as the interspersed agricultural land with relatively low fire hazards, fewer stands were chosen for fuel hazard estimation within this battlefield. Fuel loads in oak - pine and pine - oak stands (14,955 - 31,076 kg/ha) were below the average loads found in similar stands characterized in photo series guides with fuel models 8 and 9 (32,939 - 33,611 kg/ha; Lynch and Horton 1983). Wildfire hazard in this battlefield remains low during normal climatic conditions due to the relatively small amounts of fine fuel (< 7.6 cm) typically found in many of these stands. The exception is stand #4 located along the south side of Rt. 20 (Figure 9). This stand is a Virginia pine forest currently in a transition stage from pine to hardwoods, and therefore fuel loads are heavier and represent a more severe fuel model 10. The chance for crown fires remains low due to the hardwood understory, although removal of extremely dense fuel build-ups could be appropriate in the future. We believe that most of the pine - oak mixtures found in the park will succeed rapidly to a hardwood component and therefore should not pose a severe threat to the park or surrounding community under normal conditions. The majority of oak stands within the park (except in Chancellorsville Battlefield) contain depauperate ground vegetation, further lowering the threat of widespread fire occurrence.

Table 55. List of fuel loadings for various forest types within Wilderness (W) Battlefield.

Forest Type ¹	Stand	Fuel loading							Fuel Model
		Overstory Age ² (yrs.)	BA (m ² /ha)	0-.63 cm (kg/ha)	.63-2.54 cm (kg/ha)	2.54-7.6 cm (kg/ha)	>7.6 cm (kg/ha)	Total (kg/ha)	
OP	W1	78	24	717	2735	5090	11009	19551	9
OP	W6	56	22	650	2354	4260	7690	14955	8
PO	W4	66	35	987	3318	4507	22264	31076	10
OTP	W2	65	33	807	3139	4014	2511	10471	8

¹ Stand classification took place after fuel survey. Fuel amounts vary in these mid- successional types according to amount of downed pine and subjective placement of fuel transects within each stand. OP = white oak - Virginia pine; PO = Virginia pine - white oak; OTP = white oak - tulip poplar.

² Average breast height (1.4 m) age of overstory trees from radial growth analysis.

Literature Cited

- Brown, J.K. 1974. Handbook for inventorying downed woody material. USDA Forest Service Gen. Tech. Rep. INT-16. 24p.
- Cappon, L.J. 1945. Iron works at Tuball: terms and conditions for their lease as stated by Alexander Spottswood. Virginia Polytechnic Institute and State University Press, Blacksburg, VA.
- Carter, J.B., Wills, J.W., and Cummins, W.E. 1971. Soil survey of Orange County, Virginia. USDA and Virginia Agr. Exp. Stn. Washington, D.C.
- Cottam, G. and Curtis, J.T. 1956. The use of distance measures in phytosociological sampling. *Ecology* 37: 451 - 460.
- Craven, A.O. 1965. Soil exhaustion as a factor in the agricultural history of Virginia and Maryland, 1606 - 1860. Peter Smith, Gloucester, MA.
- Daubenmire, R. 1959. A canopy-coverage method of vegetation analysis. *Northwest Sci.* 33:43-66.
- Elder, Jr. J.H. 1985. Soil survey of Spotsylvania County, Virginia. USDA and Virginia Agr. Exp. Stn. 171p.
- Felder, P.S. 1982. Forgotten companions: The first settlers of Spotsylvania County and Fredericksburg town. Historic Publications of Fredericksburg. Fredericksburg, VA, .
- Harrison, N. G. 1990. Chancellorsville Battlefield Sites. H. E. Howard, Inc., Lynchburg, VA.
- Helm, A.C. 1993. The relationships between the forest fuels and vegetation of Richmond National Battlefield Park, Virginia. M.S. Dissertation. Virginia Polytechnic Institute and State University, Blacksburg, VA.
- Lynch, Christine M., and Horton, L.J. 1983. Photo series for quantifying forest residues in: Loblolly pine, Eastern white pine, Pitch pine, and Virginia pine. NA-FR-25.

- Broomall, PA: USDA, Forest Service, Northeastern Area, State and Private Forestry, and PA DER, Bureau of Forestry.
- Mansfield, J.R. 1977. A history of early Spotsylvania . Green Publishers, Orange, VA
- National Park Service. 1986. General management plan, Fredericksburg and Spotsylvania National Military Park, Virginia. Denver Service Center, NPS, U.S. Department of the Interior, Denver, CO.
- Orwig, D.A. and Abrams, M.D. 1994. Land-use history (1720-1992), composition, and dynamics of oak-pine forests within the Piedmont and Coastal Plain of northern Virginia. *Can. J. For. Res.* 24: 1216 - 1225.
- Robinson, G.H., Devereux, R.E., and Obenshain, S.S. 1961. Soils of Virginia. *Soil Sci.* 92: 129 - 142.
- Silver, T. 1990. A new face on the countryside. Cambridge University Press, New York.
- U.S. Geological Survey. 1984. Fredericksburg. 7 1/2' Series. U.S. Geological Survey, Reston, VA.
- U.S. Geological Survey. 1978. Chancellorsville. 7 1/2' Series. U.S. Geological Survey, Reston, VA.
- Wilcox, F., McCarty, J., and Bungard, B. 1982. Photo series for quantifying forest residues in the northern hardwood type, oak-hickory type. NA-FR-22. Broomall, PA: USDA, Forest Service, Northeastern Area, State and Private Forestry, and PA DER, Bureau of Forestry.

Appendix A

Woody Species List

List of common and scientific names of woody species identified within
Fredericksburg (F), Chancellorsville (CV), and Wilderness (W) Battlefields.

Common name	Scientific name	Battlefield
Ailanthus	<i>Ailanthus altissima</i>	F W
Alder, Hazel	<i>Ulnus serrulata</i>	W
Allegheny chinkapin	<i>Castaneapumila</i>	CV W
Arrowood	<i>Viburnum dentatum</i>	F CV W
Ash, green	<i>Fraxinus pennsylvanica</i>	CV W
Ash, white	<i>Fraxinus americana</i>	F CV W
Aspen, bigtooth	<i>Populus grandidentata</i>	F CV W
Beech, American	<i>Fagus grandifolia</i>	F CV W
Birch, river	<i>Betula nigra</i>	F CV W
Birch, sweet	<i>Betula lenta</i>	W
Blackgum	<i>Nyssa sylvatica</i>	F CV W
Blackhaw	<i>Viburnum prunifolium</i>	W
Blueberry	<i>Vaccinium</i> spp.	F CV W
Buckthorn	<i>Rhamnus cathartica</i>	CV W
Cherry, black	<i>Prunus serotina</i>	F CV W
Cherry, mahaleb	<i>Prunus mahaleb</i>	W
Chestnut, American	<i>Castaneadentata</i>	F CV W
Chokeberry	<i>Aronia prunifolium</i>	CV
Chokecherry, common	<i>Prunus virginiana</i>	F CV
Cottonwood, eastern	<i>Populus deltoides</i>	W
Devil's-walkingstick	<i>Aralia spinosa</i>	F CV
Dogwood, flowering	<i>Cornus florida</i>	F CV W
Elm, American	<i>Ulmus americana</i>	W
Elm, slippery	<i>Ulmus rubra</i>	CV W
Fringetree	<i>Chionanthus virginicus</i>	F CV W
Grape	<i>Vitis</i> spp.	F CV W
Greenbriar	<i>Smilax</i> spp.	F CV W
Hackberry	<i>Celtis occidentalis</i>	F CV W
Hawthorne	<i>Crataegus</i> spp.	F CV
Hazlenut, American	<i>Corylus americana</i>	F CV W
Hemlock, eastern	<i>Tsuga canadensis</i>	F CV W
Hickory, bitternut	<i>Carya cordiformis</i>	F CV
Hickory, mockernut	<i>Carya tomentosa</i>	F CV W
Hickory, pignut	<i>Carya glabra</i>	F CV W
Hickory, red	<i>Carya ovalis</i>	W
Holly, American	<i>Ilex opaca</i>	F CV W
Honeysuckle, Japanese	<i>Lonicera japonica</i>	CV W
Honeysuckle, swamp	<i>Rhododendron viscosum</i>	F
Hornbeam	<i>Carpinus caroliniana</i>	F CV W
Laurel, mountain	<i>Kalmia latifolia</i>	F CV W
Locust, black	<i>Robinia psuedoacacia</i>	F CV W
Maple, red	<i>Acer rubrum</i>	F CV W
Mulberry, red	<i>Morus rubra</i>	F CV W
Oak, black	<i>Quercus velutina</i>	F CV W
Oak, blackjack	<i>Quercus marilandica</i>	CV W

Species list (con't.).

Common name	Scientific name	Battlefield
Oak, chestnut	<i>Quercus prinus</i>	F W
Oak, northern pin	<i>Quercus palustris</i>	W
Oak, post	<i>Quercus stellata</i>	F CV W
Oak, red	<i>Quercus rubra</i>	F CV W
Oak, scarlet	<i>Quercus coccinea</i>	F CV W
Oak, southern red	<i>Quercus falcata</i>	F CV W
Oak, swamp chestnut	<i>Quercus michauxii</i>	F W
Oak, white	<i>Quercus alba</i>	F CV W
Oak, willow	<i>Quercus phellos</i>	F CV W
Pepperbush, sweet	<i>Clethra alnifolia</i>	W
Persimmon	<i>Diospyros virginiana</i>	F CV W
Pine, eastern white	<i>Pinus strobus</i>	CV W
Pine, loblolly	<i>Pinus taeda</i>	F CV W
Pine, shortleaf	<i>Pinus echinata</i>	F CV W
Pine, Virginia	<i>Pinus virginiana</i>	F CV W
Poison Ivy	<i>Toxicodendron radicans</i>	F CV W
Redbud	<i>Cercis canadensis</i>	F CV W
Redcedar, eastern	<i>Juniperus virginiana</i>	F CV W
Sassafras	<i>Sassafras albidum</i>	F CV W
Serviceberry	<i>Amelanchier arborea</i>	F CV W
Silktree	<i>Albizia julibrissin</i>	F CV W
Sourwood	<i>Oxydendrum arboreum</i>	CV
Spicebush	<i>Lindera benzoin</i>	CV W
Staggerbush	<i>Lyonia mariana</i>	CV
Stewartia, Virginia	<i>Stewartia malacodendron</i>	CV
Sumac, staghorn	<i>Rhus typhina</i>	F CV
Sumac, winged	<i>Rhus copallina</i>	CV W
Sumac, poison	<i>Rhus vernix</i>	CV
Sweetbay	<i>Magnolia virginiana</i>	F CV
Sweetgum	<i>Liquidambar styraciflua</i>	F CV W
Sycamore	<i>Platanus occidentalis</i>	F CV W
Trumpet creeper	<i>Campsis radicans</i>	CV
Tulip poplar	<i>Liriodendron tulipifera</i>	F CV W
Viburnum, maple-leaf	<i>Viburnum acerifolium</i>	F CV W
Virginia creeper	<i>Parthenocissus quinquefolia</i>	F CV W
Walnut, black	<i>Juglans nigra</i>	F W



As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural and cultural resources. This includes fostering wise use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people. The department also promotes the goals of the Take Pride in America campaign by encouraging stewardship and citizen responsibility for the public lands and promoting citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.