

Final Report

MAR-34

Identification and Mapping
of Vegetation Communities
in Shenandoah National
Park, Virginia

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ABSTRACT

Forest type mapping of Shenandoah National Park (SHEN) was completed over a 4 year period, 1983-1987. The project was designed to produce a detailed map of the dominant forest types as a current baseline inventory of Park forest resources. Cover type stands (minimum size 1-2 hectares (3-5 acres)) were delineated from color infrared (CIR) 35mm slides provided by the Virginia Commission of Game and Inland Fisheries (VCGIF). Approximately 50% of the stands were field checked, the remainder were identified from the slides. Stands were systematically chosen for plot sampling based on topographic representation and the amount of difficulty identifying forest cover types from slides. Plots were placed randomly within stand boundaries. Two thousand seven hundred and fifty-two .04 hectare (1/10 acre) plots were distributed throughout the 77,900 hectares (192,500 acres) of the Park. Seven dominant cover types were identified and tested for accuracy using discrete multivariate analysis. Overall accuracy for the 7 forest types averaged 70%. These types include Quercus prinus (chestnut oak), which covered 49% of the Park land area, Liriodendron tulipifera (yellow poplar) covers 16%, Quercus rubra/Fraxinus americana/Tilia americana (red oak/ash/basswood or cove hardwood) covers 15%, Quercus rubra/Quercus alba (red oak/white oak) 10%, Pinus spp. (pine) 6%, Robinia pseudo-acacia (black locust) 4%, and Tsuga canadensis (eastern hemlock) <1%. Evergreen understory (>25% canopy coverage), primarily Kalmia

latifolia (mountain laurel), was identified in the Central District. Unique forest stands not described in the main types include white birch, bog areas, and other outstanding natural features. Successional transition was recorded in those stands which appeared to have one forest type replacing another. Black locust and pine were among those type frequently being replaced. Major factors influencing succession include fire, past human disturbance, and insect damage. Five hundred eighty old homesites occur throughout the Park, primarily on the fertile and gradually sloping land near the Park boundary. An abundance of soft mast was found at those homesite locations visited, creating pockets of highly valuable food sources for wildlife.

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INTRODUCTION

Identifying forest cover types and describing their distribution is necessary to more completely understand Park ecosystem dynamics. The main objective of the vegetation mapping project is to produce an accurate, detailed map describing the dominant forest cover types in Shenandoah National Park (SHEN). The first forest cover map was developed soon after the Park's establishment by Park foresters; L. Y. Berg and R. B. Moore. With aid from the CCC they were able to map the entire Park from 1933 to 1941. A detailed report summarizing their findings and a color coded map was produced (Berg and Moore 1941); accuracy levels are not known but it has been credited with being an excellent inventory of the forest at that time. After 30 years of forest succession this map was considered outdated and Dr. Hanawalt (1974) from the University of Virginia revised the old maps. This revision was based on theorized forest succession and was not checked in the field. In 1981, a forest type map was developed from the interpretation of multispectral data taken by Landsat (Cibula 1981); however, careful evaluation of this map showed it to be unreliable for the cover types common to this area (Teetor 1985).

In 1983, vegetation mapping was initiated as part of the 3 year research project studying the population and habitat ecology of Ursus americanus (black bear) in the Central District, 31,385 hectares (77,550 acres) (Vaughan, et al 1983). In addition to

wildlife habitat assessment, a forest cover map is needed as the primary element in the multi-element Geographic Information System (GIS), a computerized map system. The need for an accurate map is especially critical since the discovery of a Lymantria dispar (gypsy moth) infestation in the North District of the Park in 1984. At the completion of the Central District map in 1985, Park managers decided to continue mapping the remaining 46,520 hectares (114,950 acres) in the North and South Districts.

This report will include a general description of methods, forest cover types, accuracy test results, unique forest areas, successional transition, and the influence of old homesite activity on the forest structure. Detailed reports of the data collected in each District, accuracy tests, and slide coverage are available for review at the Resource Management Office, Shenandoah National Park, VA.

METHODS

Color Infrared (CIR) 35 mm slides, provided by the Virginia Commission of Game and Inland Fisheries, were taken for the Central District during June-October, 1983, and in September, 1984. Winter imagery was taken in February, 1984 to identify evergreen understory species (> 25% canopy coverage), primarily Kalmia latifolia (mountain laurel). Slide interpretation, ground truthing, and mapping were conducted by technicians

employed by Virginia Polytechnic Institute and State University (VPI) with assistance from Park Service volunteers using techniques derived from the VCGIF (Martin 1982) and the U. S. Forest Service (USDA 1970). Methods used for mapping the Central District are outlined in a separate report (Garner et.al. 1983).

North District slides were taken in October, 1984, September, 1985, and August, 1986. South District slides were taken in September, 1984 and 1985, and August, 1986. Slide interpretation, ground truthing, and mapping for the North and South Districts were conducted by the Resource Management staff at SHEN as described in the District summaries (Teetor 1985 and Teetor 1986). Imagery was obtained using a single engine aircraft flying approximately 1 mile above ground level. Each slide covers roughly 180 hectares (450 acres) with 60% overlap and 30% sidelap. Multiple flights were required for complete coverage of each District due to gaps between the original flight lines. Approximately 6330 slides (5500 summer and 830 winter) were taken to provide complete coverage.

Forest cover types were delineated from slides at a scale of 1:12,000 (1" = 1000') and verified on the ground. Stands were systematically chosen for plot sampling based on topographic representation and the amount of difficulty identifying forest cover types from slides. Plots were placed randomly within stand boundaries. Two thousand seven hundred and fifty-two .04

hectare (1/10 acre) plots were distributed throughout the 77,900 hectares (192,500 acres) of the Park. Of these, 835 (30%) were sampled in the North District, 1320 (48%) in the Central, and 597 (22%) in the South. The majority were done in the Central District as this area was mapped over a two year period. The North and South Districts were each mapped in one year.

To verify the dominant forest cover, approximately 50% of the outlined stands were field checked or ground truthed, the remaining were identified from slides. A minimum stand size of 1-2 hectares (3-5 acres) was determined to be the smallest unit that could be accurately identified from the slides. During ground truthing the forest was divided into 4 height strata: the overstory, consisting of the dominant tree species; the sub-canopy of tree saplings and tall shrub species, such as Acer rubrum (red maple); the understory or shrub strata consisting of species like Cornus florida (flowering dogwood), Lindera benzoin (spicebush), and Kalmia latifolia (mountain laurel); and the ground cover strata consisting of species like Vaccinium spp., ferns, and grasses (Barbour et.al. 1980). Daubenmire's coverage classes were used to estimate the percent canopy coverage for each species in the .04 hectare (1/10 acre) plots (Daubenmire 1968).

A variety of data was collected at each sample site (Appendix 1). The Central District data were collected specifically to describe black bear habitat. Data forms and collection methods

were altered slightly for the North and South Districts primarily by reducing the amount of species data collected at each site.

Forest cover type codes describe the dominant forest associations of cover types as defined originally by the Society of American Foresters (SAF 1980). These SAF codes were adapted by the VCGIF to create a list of recognized variants found commonly in Virginia. Variants of the major types were added to increase the descriptive value of the forest cover type codes (Fies 1983).

Forest cover type distribution is described in terms of categorized values of slope, elevation, and aspect. The purpose of grouping the data was to allow for general statements to be made about forest type distribution. It was assumed that variations between discrete and continuous data were not significantly different; and the categories contain enough detail to adequately reflect forest type distribution in a way that is meaningful for Park managers.

Each forest type was analyzed in terms of the observed versus expected topographic distribution. Observed distribution describes where each individual forest type was most commonly found, based on an analysis of the plot data collected for that forest type. The expected distribution was calculated by analyzing all of the plot data regardless of the forest cover

type. The expected data represents where the forest type would be expected to occur if no specific topographic features were preferred. A visual comparison was made between the expected and observed data to determine if any site specific preferences existed.

At the initiation of this project several discrepancies arose in data collection which were corrected as the project progressed. Slope data collected in the Central District was one such category. Slope was initially measured in percent and later in degree and there was no way to accurately determine where one method started and the other ended, therefore, no slope data for the Central District was incorporated into the summary. Age class estimation techniques were designed to provide general information about forest age classes. An increment bore was used initially to determine stand age but this was phased out after the first 8 months of the project since it was found to be excessively time consuming and a large number of samples had to be done to accurately assign an age classes. Therefore, once stand age characteristics were identified and recognized, estimates of tree size, site conditions, and knowledge of tree growth rates were used to define stand age.

A3] percentage values used in this report are based on frequency of occurrence for the individual variable being analyzed. Frequency of occurrence was derived from how many of the data plots (N) out of the total number of plots represent the variable being analyzed, these values are shown as (N/Total #).

Throughout the forest, cover type summaries, the total number of data plots for each category varies depending* on how much of the data was considered uniform and accurate. Percentages were rounded to the nearest integer, therefore, they may not always add up to 100%. Area figures were calculated based on a .2 hectare (1/2 acre) cell size by the Geographic Information System (GIS) at SHEN.

At the completion of the mapping" process tests were conducted to determine the forest cover map accuracy. A series of accuracy transects were distributed randomly throughout each District. Stops were made at regular intervals along each transect. At each stop the dominant forest cover type was recorded. These values were then directly compared to the cover type identified by the CIR map at the same location. If the forest type identified on the ground was the same, or within 40 yards (1/8" at 1:12,000 scale) of what the CIR map identified, it was considered accurate. Results of these comparisons were then analyzed using discrete multivariate analysis (Congalton 1983).

RESULTS AND DISCUSSION

Forest Cover Types

Forest type distribution can usually be attributed to specific factors which limit species growth patterns. In SHEN, environmental factors such as elevation, geology and soil

moisture have some influence, but other disturbances often overlay their direct effects (Harmon 1983). Prior land use plays a major role; much of the Park was cleared, logged, or burned before its establishment. Data relating to specific sites is not readily available, therefore the influence of these controlling factors has not been assessed; however, some general factors are discussed for each forest type.

Fifty-five different forest types were identified during ground truthing in the North District, 50 in the Central and 43 in the South. At the conclusion of the accuracy tests (Garner 1985, Teetor 1985, and Teetor 1986) the overall number of mapped forest types were reduced because of the inability to distinguish slight variations in cover types from the slides, for example chestnut oak/red oak from pure chestnut oak. Therefore, the total number of forest types which were mapped at acceptable levels of accuracy were 6 in the North District, 7 in the Central and 5 in the South. The field data is considered accurate and may be used to increase the total number of accurately mapped forest types if additional plots are checked or if another interpretation method is used at a later date. Commonly misidentified types were combined into major cover type classes.

A list of the major cover types and associated variants is described in Table 1. Additional information included in Table 1 are the SAF codes, the total number of plots sampled in each

forest type, percent occurrence for the major cover types and the percent of each variant occurring within the major cover type class. A complete listing of scientific names is included in Appendix 2. Table 2 describes the accuracy and distribution for the forest cover types in each District and the entire Park. This table is designed to serve as a concise summary of the findings of this study in regards to the major forest cover type classes. Total figures do not include other type categories such as rock, open, and miscellaneous.

The following discussions provide detailed descriptions of each major cover type, accuracy test results, unique forest areas, successional trends, and old homesite activities.

Table 1. List of 7 final map forest cover types with common variants included in Shenandoah National Park, VA. 1987.

SAF Code	Major Cover Types	# of Plots	% Total Plots	% Cover Type Plots**
4400	<u>Chestnut Oak</u>	953	35	
4401 -	Chestnut Oak/Red Oak *	463		49
4400 -	Chestnut Oak	164		17
5211 -	Hickory/Oak	157		17
4406 -	Chestnut Oak/Pitch Pine	57		6
4402 -	Chestnut Oak/White Oak	25		3
5101 -	Chestnut Oak/White Pine/Red Oak	22		2
4403 -	Chestnut Oak/Scarlet Oak	18		2
4404 -	Chestnut Oak/Black Oak/Scarlet Oak	6		<1
4405 -	Chestnut Oak/Yellow Poplar	4		<1
5213 -	Hickory	3		<1
	- Bear Oak/Pitch pine/Chestnut Oak	1		<1
5500 -	Red Oak +	19		2
5201 -	Red Oak/White Oak +	8		<1
5212 -	Scarlet Oak/Pitch Pine +	5		<1
5206 -	Black Oak/Red Oak +	1		<1
02 -	Bear Oak +	1		<1
5700	<u>Yellow Poplar</u>	441	16	
5700 -	Yellow Poplar *	166		38
5702 -	Yellow Poplar/Oak *	163		37
5902 -	Yellow Poplar/White Ash	73		17
5903 -	Yellow Poplar/Birch	18		4
5901 -	Yellow Poplar/White Oak/Sugar Maple	9		2
5701 -	Yellow Poplar/Virginia Pine	6		1
5900 -	Yellow Poplar/White Oak/Red Oak	4		<1
5800 -	Yellow Poplar/Hemlock	2		<1
2001	<u>Red Oak/Basswood/Ash</u>	621	23	
2001 -	Red Oak/Basswood/Ash *	364		57
2202 -	White Pine/Hemlock/N. Hardwoods *	75		12
2002 -	White Ash *	52		8
2000 -	White Pine/Red Oak/Red Maple	24		4
10800 -	Red Maple	21		3
10801 -	Red Maple/Oak	21		3
2700 -	Sugar Maple	18		3
2203 -	White Pine/Hemlock/Oak	18		3
2600 -	Sugar Maple/Basswood	11		2
5904 -	Black Birch	6		1
9402 -	Sycamore	3		<1
2500 -	Sugar Maple/Beech/Yellow Birch	3		<1
1800 -	White Birch	2		<1
2003 -	Basswood	2		<1
6000 -	Beech/Sugar Maple	1		<1

Table 1. (continued)

SAF Code	Major Cover Types	# of Plots	% Total Plots	% Cover Type Plots**
5500	<u>Red Oak</u>	300	11	
5500	- Red Oak *	147		49
5201	- Red Oak/White Oak *	126		42
5300	- White Oak	16		5
5204	- White Oak/Black Oak/Chestnut Oak	5		2
11000	- Black Oak	2		<1
5200	- White Oak/Black Oak/Red Oak	1		<1
5202	- White Oak/Black Oak	1		<1
5206	- Black Oak/Red Oak	1		<1
2100	<u>Pine</u>	186	7	
4507	- Pitch Pine/Chestnut Oak	52		28
7800	- Virginia Pine/Oak	38		20
7900	- Virginia Pine	28		15
4500	- Pitch Pine	22		12
2102	- White Pine/Oak	19		10
4505	- Pitch Pine/Scarlet Oak	8		4
2100	- White Pine	7		4
7901	- Table Mtn. Pine	6		3
2101	- White Pine/Yellow Poplar	5		3
4501	- Pitch Pine/White Pine	4		2
5100	- White Pine/Chestnut Oak	4		2
4506	- Pitch Pine/Black Oak	2		1
4502	- Pitch Pine/Virginia Pine	2		1
4603	- Eastern Red Cedar/Pine/Hardwood	2		1
4504	- Pitch Pine/Shortleaf Pine/Sc. Oak	1		<1
5000	<u>Black Locust</u>	203	7	
5000	- Black Locust *	185		91
11001	- Black Walnut	13		6
2800	- Black Cherry/Maple	3		2
2801	- Black Cherry	1		1
2802	- Black Cherry/Oak	1		1
2300	<u>Eastern Hemlock</u>	24	1	
2300	- Eastern Hemlock *	17		71
2401	- Hemlock/Yellow Birch	7		29

* - Indicates major associations within each of the 7 major types.

** - % Cover type plots = the percent composition of each variant within the major cover type class.

+ - Red oak forest types which were included with chestnut oak only for those plots identified as red oak in the South District. These were lumped because of CIR slide interpretation problems.

Table 2. Summary of accuracy test results and composition of each forest type by District and Parkwide, as determined by the vegetation mapping project, Shenandoah National Park, VA. 1983-1987.

COVER TYPE	DISTRICT	TOTAL #	TOTAL #	% TOTAL	TOTAL #	% TOTAL	ACCURACY
		HECTARES	ACRES	AREA	PLOTS	PLOTS	
Chestnut Oak	North	8,900	21,995	43%	286	34%	70%
	Central	12,580	31,080	40%	410	31%	63%
	South	16,620	41,070	65%	257	43%	82%
	Park	38,100	94,145	49%	953	35%	72%
Yellow Poplar	North	3,155	7,790	15%	140	17%	51%
	Central	6,770	16,730	22%	216	16%	82%
	South	2,150	5,310	8%	85	14%	88%
	Park	12,070	29,830	16%	441	16%	74%
Red Oak/ Ash/ Basswood	North	4,135	10,220	20%	208	25%	64%
	Central	4,295	10,615	14%	288	22%	68%
	South	3,155	7,795	12%	125	21%	60%
	Park	11,585	28,630	15%	621	23%	64%
Red Oak	North	2,440	6,020	12%	90	11%	51%
	Central	4,990	12,325	16%	210	16%	76%
	South	-	-	-	-	-	-
	Park	7,425	18,345	10%	300	11%	64%
Pine	North	670	1,650	3%	48	6%	50%
	Central	990	2,440	3%	66	5%	79%
	South	2,705	6,690	11%	86	14%	61%
	Park	4,365	10,780	6%	200	7%	63%
Black Locust	North	1,355	3,350	7%	53	6%	75%
	Central	930	2,300	3%	108	8%	77%
	South	915	2,260	4%	42	7%	62%
	Park	3,200	7,910	4%	203	7%	71%
Hemlock	North	5	10	<1%	2	<1%	-
	Central	440	1,095	1%	21	2%	72%
	South	-	-	-	1	<1%	-
	Park	445	1,105	<1%	24	<1%	72%
TOTAL	North	20,660	51,035	100%	827	99%	60%
	Central	31,000	76,585	99%	1,319	100%	74%
	South	25,545	63,125	100%	596	99%	71%
	Park	77,190	190,745	100%	2,742	100%	70%

Note: An "-" indicates that no data were available. The "ACCURACY" column refers to the accuracy test results for each forest type in each District.

Chestnut Oak (SAF Code - 4400)

This forest type dominates the Park, covering 49%, or roughly 38,100 hectares (94,145 acres). Found usually on dry primary and secondary ridges, it was sampled in 953 (35%) of the plots. Characteristically, the ridges are dry and rocky with thin soil structure and little available moisture. Soil moisture appears to be a controlling factor for this forest type, in that excessive moisture does not support chestnut oak forest growth. Chestnut oak forests and oak forests in general have historically been logged or burned which has caused even aged stands primarily between 40 and 100 years of age. Common variants of this type are listed in Table 1, and include chestnut oak/red oak which dominates 463 of the 953 (49%) chestnut oak plots, pure chestnut oak which occurs in 17% or 164 of the 953 chestnut oak plots, and Carya spp. (hickory)/oak 17% or 157 of the 953 chestnut oak plots. Associated species include red oak, white oak, hickories, Pinus virginiana (Virginia pine), Pinus rigida (pitch pine), Pinus strobus (white pine), red maple, basswood, ash, and locust. The observed distribution of chestnut oak and its variants in relation to slope, elevation, and aspect compared to the expected values is described in Figures 1, 2, and 3. Chestnut oak was found most frequently on slopes between 11 and 20 degrees which is above the level expected for this range. Fewer than expected occur below 11 degrees. Above 20 degrees little to no variation was found between the observed and expected values. The highest occurrence of chestnut oak forests were found at elevations

Figure 1. Expected versus observed distribution of chestnut oak forests in relation to slope, in the North District, Shenandoah National Park, VA. 1985.

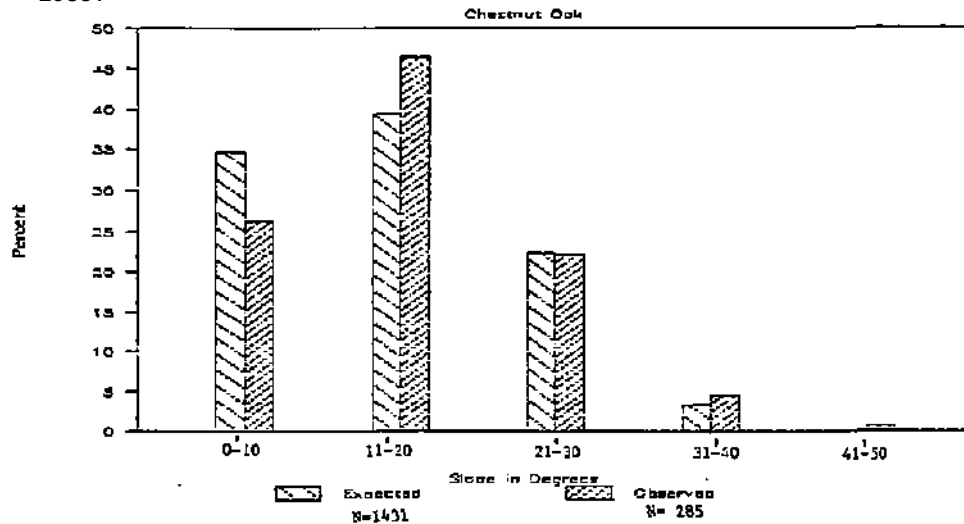


Figure 2. Expected versus observed distribution of chestnut oak forests in relation to elevation, in the North and Central Districts, Shenandoah National Park, VA. 1983-1985.

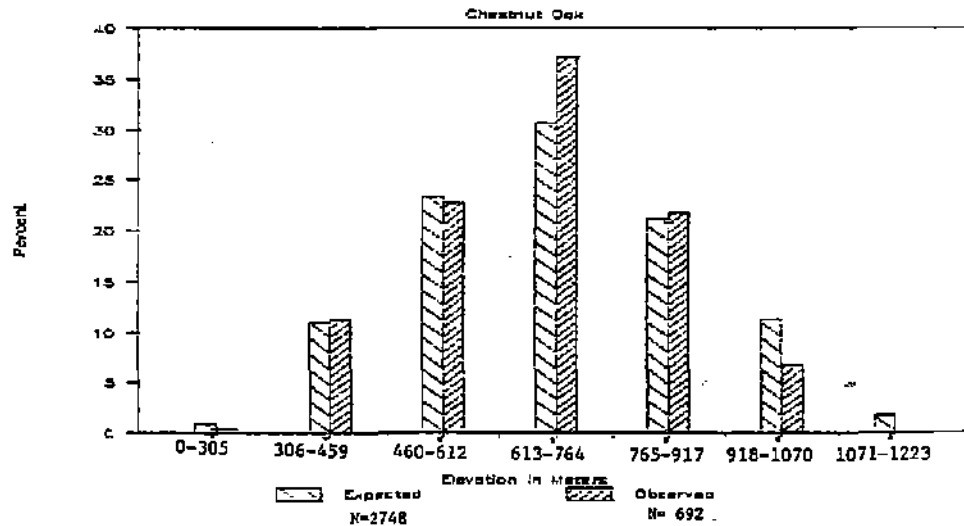
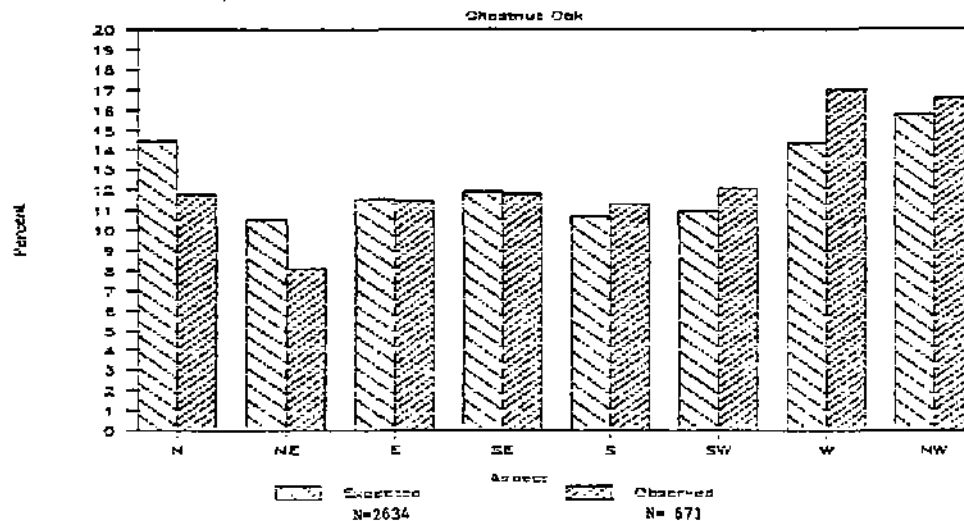


Figure 3. Expected versus observed distribution of chestnut oak forests in relation to aspect, in the North and Central Districts, Shenandoah National Park, VA. 1983-1985.



Note: "N" equals number of plots.

between 612 meters (2000 ft.) and 764 meters (2500 ft.).

Chestnut oak forests occurred frequently on all aspects but were most common on southwest, northwest, and west facing slopes.

Dominant understory species were recorded in 690 of the chestnut oak plots. Dogwood dominated in 21% or 142 of the chestnut oak plots, mountain laurel in 19% (N=129), red maple in 9% (N=61), and Acer pennsylvanica (striped maple) also in 9% (N=59). Soft mast species were recorded in 559 of the plots sampled in chestnut oak forests. Dominant soft mast species include Vaccinium spp. which occurred in 39% or 215 plots, Vitus spp. (grape) in 11% (N = 61), and Sassafras albidum (sassafras) in 9% (N=49). A commonly encountered dry site chestnut oak community includes oak, mountain laurel, and vaccinium.

Poplar (SAF Code - 5700)

Poplar and its variants were dominant over 12,070 hectares (29,830 acres, 16%) of the Park. Four hundred forty-one plots (16%) out of 2752 were sampled to describe this forest type (Table 1). Common associates include locust, ash, hickory, red oak, and chestnut oak. The most common variant is poplar/oak which was encountered in 37% (N=163) of the poplar plots. The distribution of poplar in relation to slope, elevation and aspect is described in Figures 4, 5 and 6. Poplar forests were found most frequently at elevations below 764 meters (2500 ft.), in moist gradually sloping drainages and hollows. Poplar appears to prefer north and northwest aspects. Poplar is a very prolific species which disperses quickly from seed. Many large

Figure 4. Expected versus observed distribution of yellow poplar forests in relation to slope, in the North and South Districts, Shenandoah National Park, VA. 1985-1987

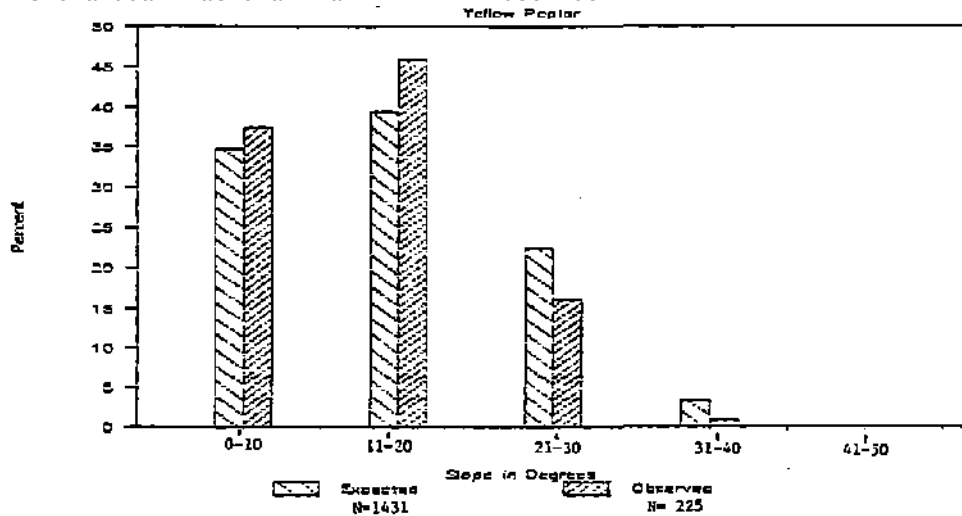


Figure 5. Expected versus observed distribution of yellow poplar forests in relation to elevation, in all districts of Shenandoah National Park, VA. 1983-1987.

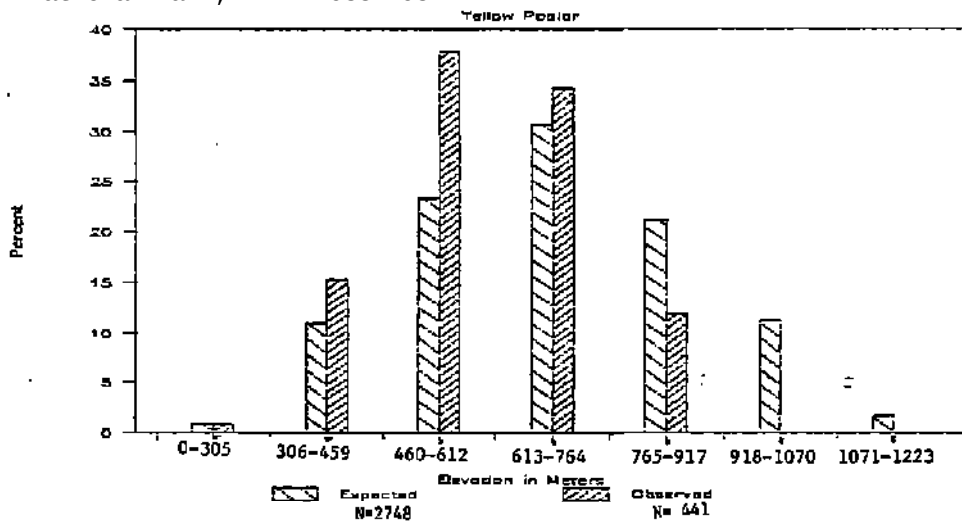
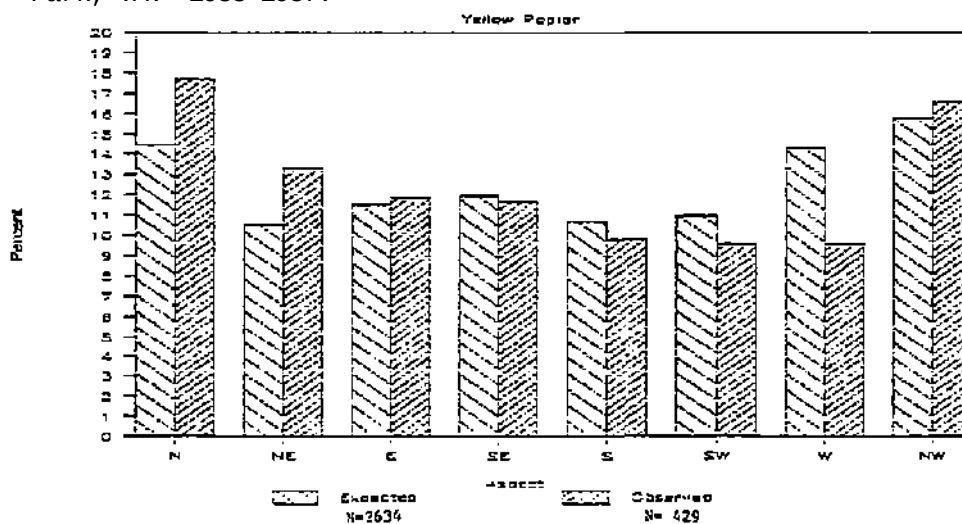


Figure 6. Expected versus observed distribution of yellow poplar forests in relation to aspect, in all districts of Shenandoah National Park, VA. 1983-1987.



Note: "N" equals number of plots.

old trees are present throughout the Park which may have influenced the distribution of this type. Forty-seven percent or 199 of the 422 aged plots were estimated to be between 40 and 100 years of age, 10% (41/422) were less than 40 years of age. The remaining 43% (182/422) were in the mixed age class. No stands appeared to be greater than 100 years of age, though many individual trees were considerably older. Understory species were identified in 433 of the 441 poplar plots. Dominant species include dogwood which was identified in 29% (N=127) of the poplar plots, spicebush in 23% (N=99), red maple in 10% (N=42), striped maple in 7% (N=28) and Hamamelis virginiana (witch hazel) in 6% (N=27). Understory densities were usually moderate, with the exception of spicebush which can be quite dense particularly in drainage areas. Soft mast species occurred in 372 of the 441 plots in poplar forests. These included grape which was identified in 35% or 130 poplar plots and sassafras (17%, N=64).

Red oak/ash/basswood (SAF Code - 2001)

Red oak/ash/basswood occurs over 11,585 hectares (28,630 acres), or 15% of the Park, and was sampled in 23% (N=621) of the 2752 plots. This type has been defined as the cove hardwood class which consists of a variety of species. Common associates include poplar, Betula lenta (black birch), hickory, locust, and chestnut oak. Variants are listed in Table 1. The most common variant is White Pine/Hemlock/Northern Hardwoods which occurred in 12% or 75 out of the 621 plots. Red oak/ash/basswood

frequently occupies the numerous dry, rocky drainages throughout the Park, predominately on north, northeast and southeast facing slopes, at elevations above 612 meters (2000 ft.) In addition, many areas along Skyline Drive that were once cleared and then replaced by locust, are now being succeeded by ash. The distribution of red oak/ash/basswood in relation to slope, elevation and aspect is described in Figures 7, 8 and 9. Forty-one percent or 245 out of the 591 aged plots were estimated to be between 40 and 100 years of age. Nine percent (N=52) were estimated to be less than 40 years of age. Two plots were estimated to be greater than 100 years of age, one on Jones Mountain in the Central District and the other on Weaver Mountain in the South District. The remaining 49% (N=292) are classified as mixed age stands. Dominant understory associates were identified in 611 of the cove hardwood plots and include striped maple which occurred in 16% or 100 plots, witch hazel found in 16% (N=98), spicebush in 13% (N=80) and dogwood which was identified in 8% or 48 of the cove hardwood plots. Commonly associated soft mast species include Vitis SPP. (grape) which occurred in 19% or 102 of the 535 poplar plots identified with soft mast, Rubus spp. (raspberries, blackberries, dewberries) found in 9% (49/535), and Prunus serotina (black cherry) located in 8% (45/535) .

Red Oak (SAF Code - 5500)

Red oak was identified as the dominant forest type over 7,425 hectares (18,345 acres), 10% of the Park, and was sampled in 300

Figure 7. Expected versus observed distribution of red oak/ash/basswood forests in relation to slope, in the North and South Districts, Shenandoah National Park, VA. 1985-1987.

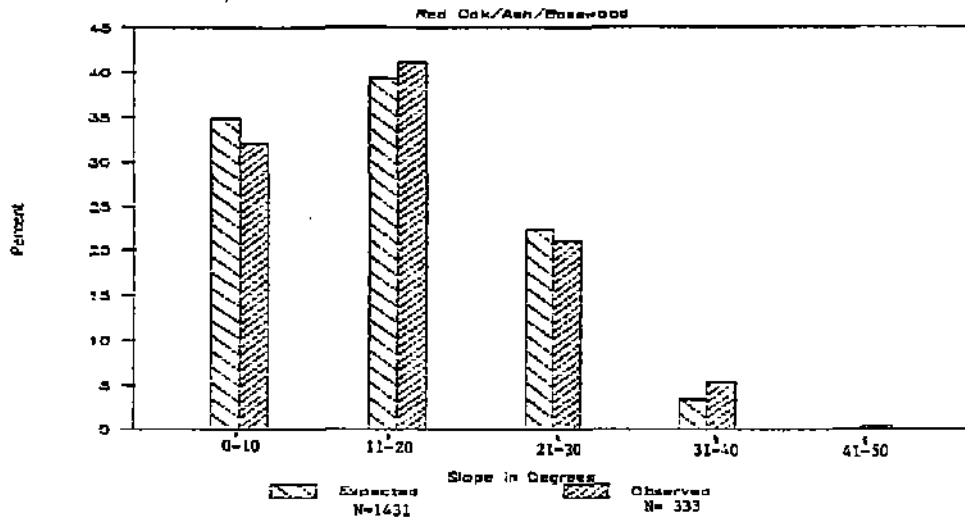


Figure 8. Expected versus observed distribution of red oak/ash/basswood forests in relation to elevation, in all districts of Shenandoah National Park, VA. 1983-1987.

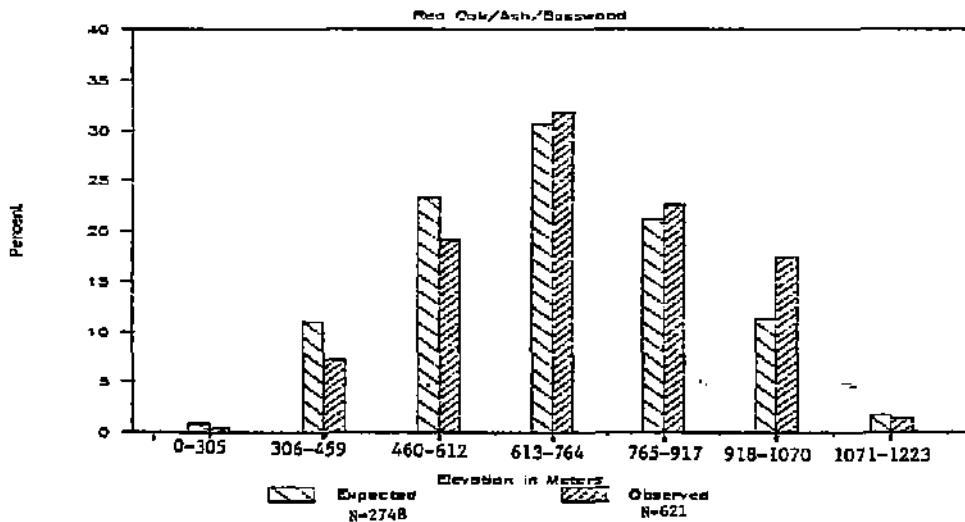
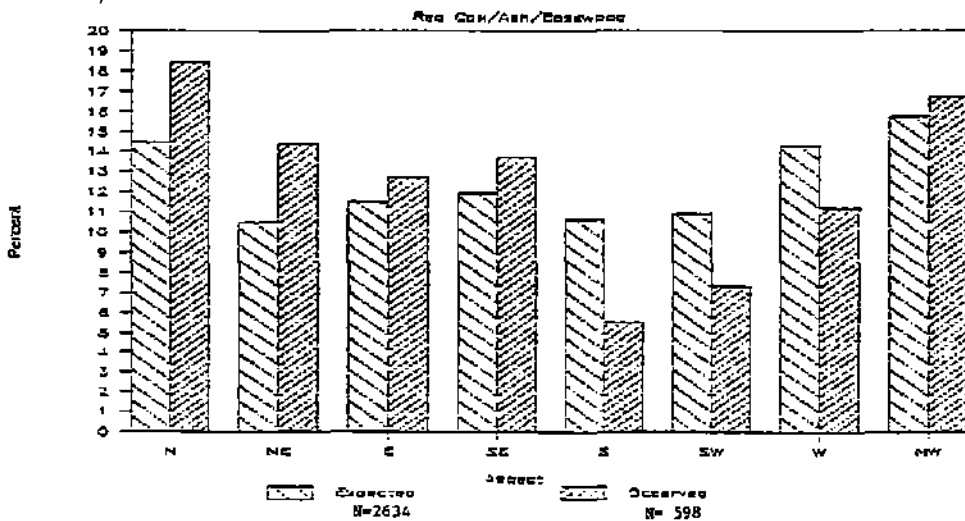


Figure 9. Expected versus observed distribution of red oak/ash/basswood forests in relation to aspect, in all districts of Shenandoah National Park, VA. 1983-1987.



"N" equals number of plots.

of the 2752 plots (11%). Red oak was considered a separate forest type in the North and Central Districts, and lumped in with chestnut oak in the South District. The primary reason being that pure red oak stands were accurately identified in the North and Central Districts. In the South District, however, red oak could not be accurately identified, and was usually associated with chestnut oak, and therefore lumped with this type. Data relating to the red oak type is compiled from plots sampled exclusively in the North and Central Districts. Nineteen plots identified red oak as the dominant cover in the South District, and were analyzed with the chestnut oak plots. Major variants of red oak are listed in Table 1. The most commonly occurring variant is red oak/white oak which dominates 42% (N=126) of the red oak plots, generally on the more gradual slopes. White oak, hickory, ash, chestnut oak, poplar, and black birch are common associates. Red oak is widely distributed throughout the North and Central Districts mainly in areas which have more available moisture and a gradual slope (< 10 degrees), than the dry slopes and ridges where chestnut oak dominates. Red oak is found most frequently at elevations above 764 meters (2500 ft.). Examples of this distribution were observed as large pure stands on Saddleback Mountain, Stony-Mountain, Hawksbill Mountain, Skyland, Thorofare Mountain, Mount Marshall and scattered along much of the area adjacent to Skyline Drive. The distribution of red oak in relation to slope, elevation and aspect is described in Figures 10, 11, and 12. South aspects appear to be preferred by red oak forests.

Figure 10. Expected versus observed distribution of red oak forests in relation to slope, in the North District, Shenandoah National Park, VA. 1985.

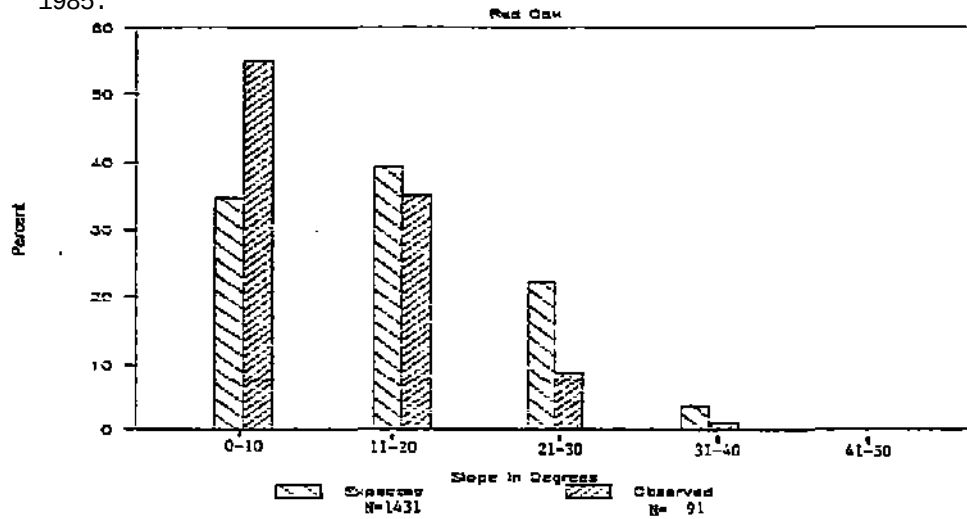


Figure 11. Expected versus observed distribution of red oak forests in relation to elevation, in the North and Central Districts, Shenandoah National Park, VA. 1983-1985.

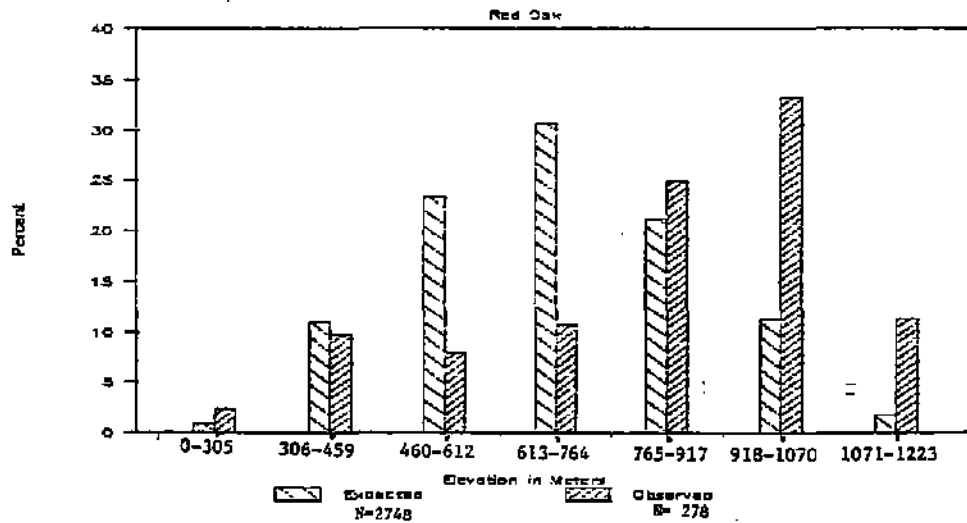
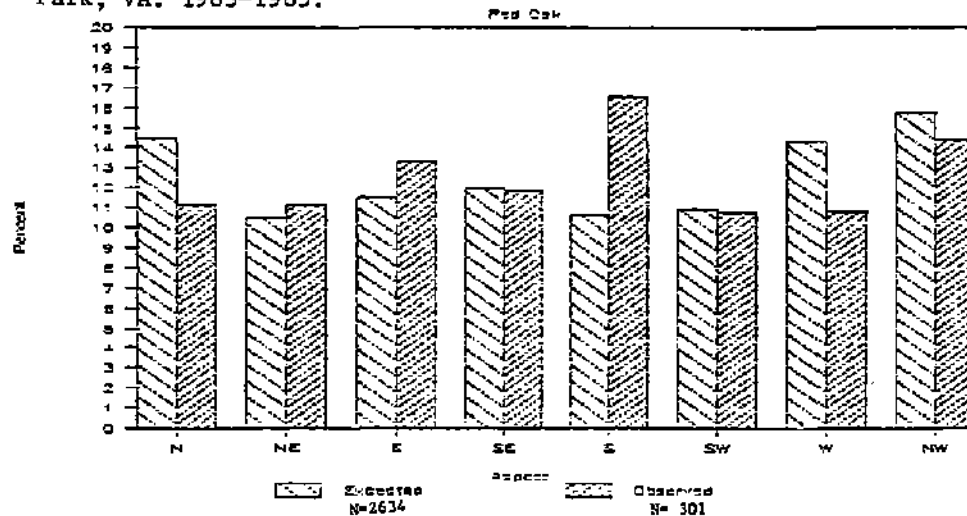


Figure 12. Expected versus observed distribution of red oak forests in relation to aspect, in the North and Central Districts, Shenandoah National Park, VA. 1983-1985.



In terms of stand age 9% or 23 of the 264 aged plots were classified as less than 40 years of age. Fifty-one percent or 135 of the 264 aged red oak plots were classified as being between 40 and 100 years of age, and 39% (103/264) were in the mixed age class. No plots were estimated to be greater than 100 years of age. Dominant understory species were identified in 294 of the red oak plots. Understory associates include witch hazel which was observed in 14% or 42 of the 294 plots, red maple in 11% (33/294), dogwood in 11% (33/294), mountain laurel in 9% (27/294) and striped maple in 9% (27/294) of the red oak plots. Soft mast was identified in 233 out of 300 red oak plots. Dominant soft mast species include Rubus spp. 12% (28/233), Vaccinium spp. 12% (27/233), and Viburnum spp. 12% (27/233).

Pine (SAF Code - 2100)

Pine types were distributed throughout the Park and comprise 4365 hectares (10,780 acres), or 6%, of the total Park area. Two hundred plots (7%) were sampled to describe this forest type. Distribution of pine is affected by several factors, fire being a primary influence. Generally, fires are more severe on low and mid-elevation ridges on southern and western aspects, and pine occurs extensively in these areas. Canopy coverage ranges from complete to sparse depending on the amount of downed and dying trees. Common associates include Virginia pine, locust, white oak, chestnut oak, red oak, pitch pine, and white pine. Variants are listed in Table 1. White pine, Virginia

Figure 13. Expected versus observed distribution of pine forests in relation to slope, in the North and South Districts of Shenandoah National Park, VA. 1985-1987.

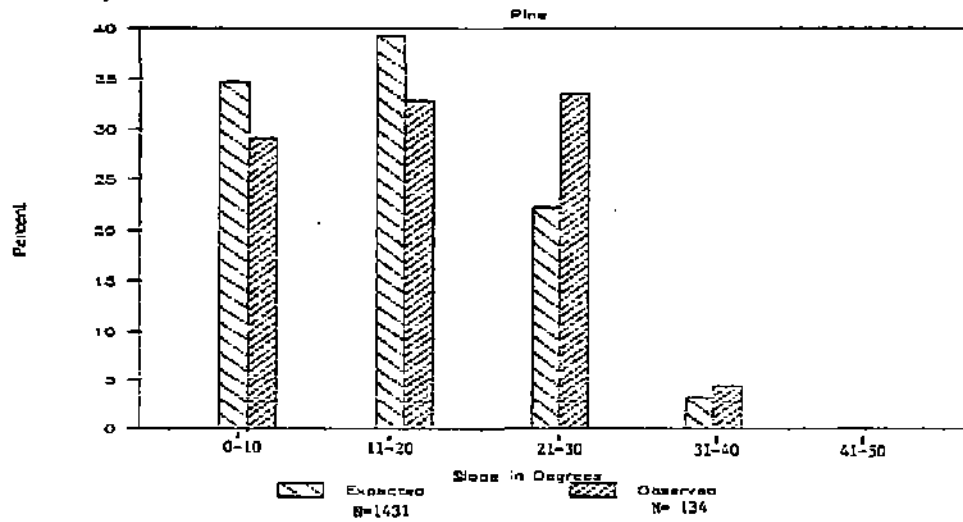


Figure 14. Expected versus observed distribution of pine forests in relation to elevation, in all districts of Shenandoah National Park, VA. 1983-1987.

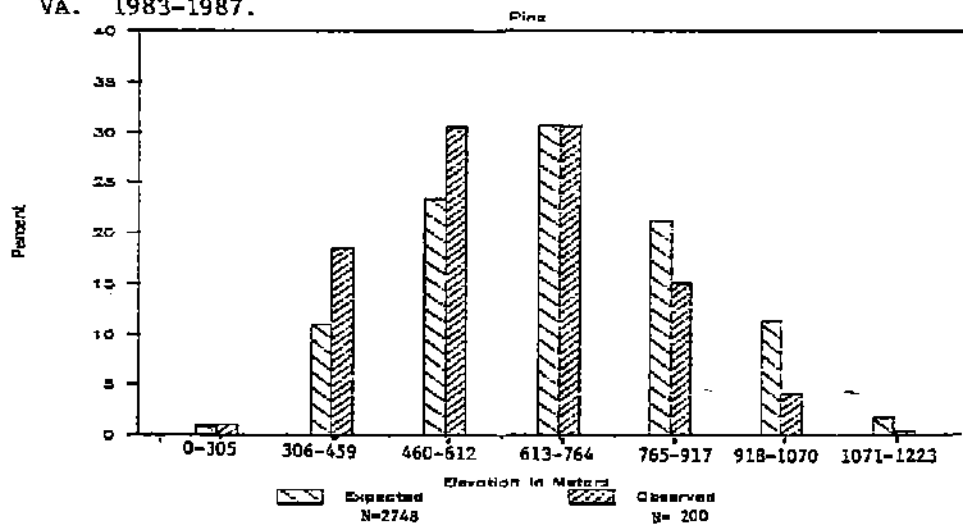
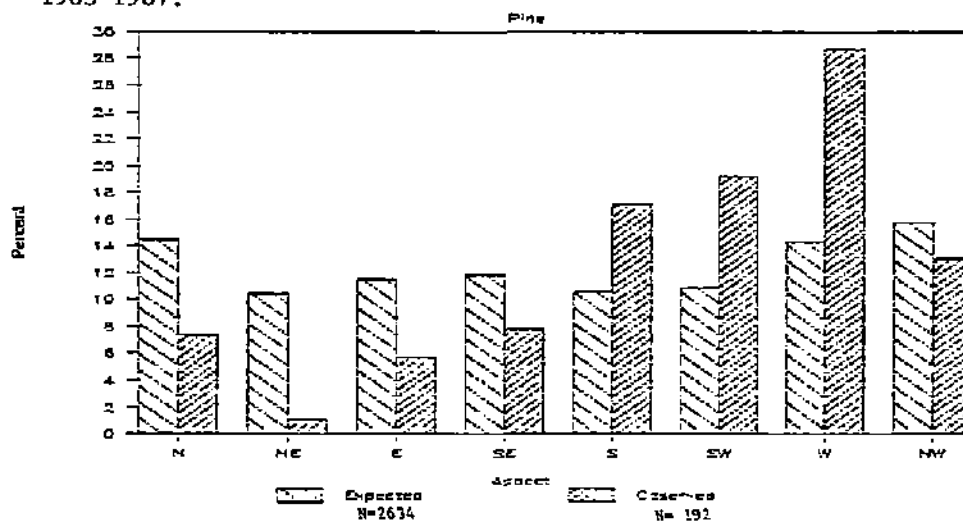


Figure 15. Expected versus observed distribution of pine forests in relation to aspect, in all districts of Shenandoah National Park, VA. 1983-1987.



ote: "N" equals number of plots.

pine, and pitch pine are the most common species, oak species are often associated with these pine types. White pine is often associated with old homesites. The distribution of pine in relation to slope, elevation, and aspect is described in Figures 13, 14, and 15. Pine was found most frequently on slopes greater than 20 degrees and elevations below 612 meters (2000 ft.). Twenty-two percent or 43 of the 197 aged pine plots were estimated to be mixed age. Nineteen percent (37/197) were less than 40 years of age, and 59% (116/197) are estimated to be between 40 and 100 years of age. One plot, on Pignut Mountain in the North District, was estimated to be greater than 100 years of age. Understory species were identified in 195 of the pine plots. Dominant understory associated with pine include mountain laurel which occurred in 44% or 85 out of the 195 plots, dogwood in 12% (23/195), red maple 10% (20/195), and Quercus ilicifolia (bear oak) also in 10% (19/195). The mountain laurel and bear oak are usually very dense. Soft mast was identified in 186 of the 200 pine plots. Soft mast species associated with pine include Vaccinium spp. which was identified in 62% (116/186) of the pine plots, grape in 8% (15/186), and sassafras in 6% (11/186).

Black Locust (SAF Code - 5000)

Black locust, and its variants dominate 3200 hectares (7,910 acres), or 4% of the Park. Two hundred three plots (7%) were sampled in this forest type. Common associates include red maple, poplar, hickory, black cherry, and ash. Locust is not

distributed in any particular topographic area of the Park, but instead is found in those areas previously classified as open restocking or grassland (Berg and Moore 1941). In addition, due to successional transition, locust is often shaded out by a variety of other species and should be considered extremely unstable. The distribution of locust in relation to elevation and aspect is described in Figures 16, 17, and 18. Most of the area cleared before the Park's establishment was at upper elevations and on gradual slopes and this is currently where locust predominates. Specifically at slopes ≤ 10 degrees and elevations above 764 meters (2500 ft.). Aspect does not appear to effect the distribution of locust forests. Sixty-two percent or 112 of the 181 aged locust plots were estimated to be less than 40 years of age. Eleven percent (N=20) of the aged plots were between 40 and 100 years of age, and the remaining 27% (49/181) were in the mixed age class. Dominant understory species were identified in 182 of the 203 locust plots. Dogwood was the dominant understory in 14% (N=26) of these plots, spicebush dominated in 14% (25/182), and red maple in 9% (16/182). Soft mast was identified in 195 of the 203 black locust plots. Dominant soft mast species include Rubus spp. which occurred in 20% (39/195) of the locust plots, grape in 15% (30/195), black cherry in 15% (30/195), and Malus spp. (apple) in 13% (25/195) of the 203 plots.

Figure 16. Expected versus observed distribution of black locust forests in relation to slope, in the North and South Districts, Shenandoah National Park, VA. 1985-1987.

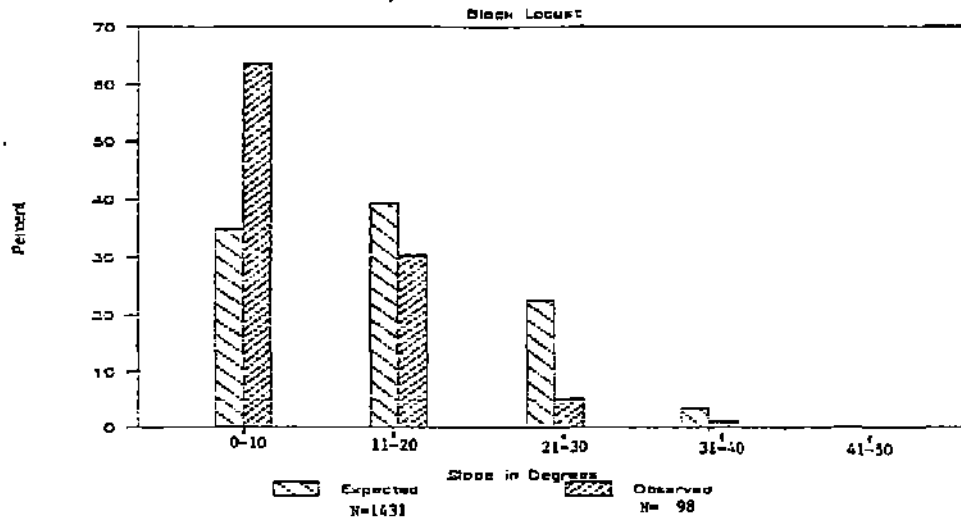


Figure 17. Expected versus observed distribution of black locust forests in relation to elevation, in all districts of Shenandoah National Park, VA. 1983-1987.

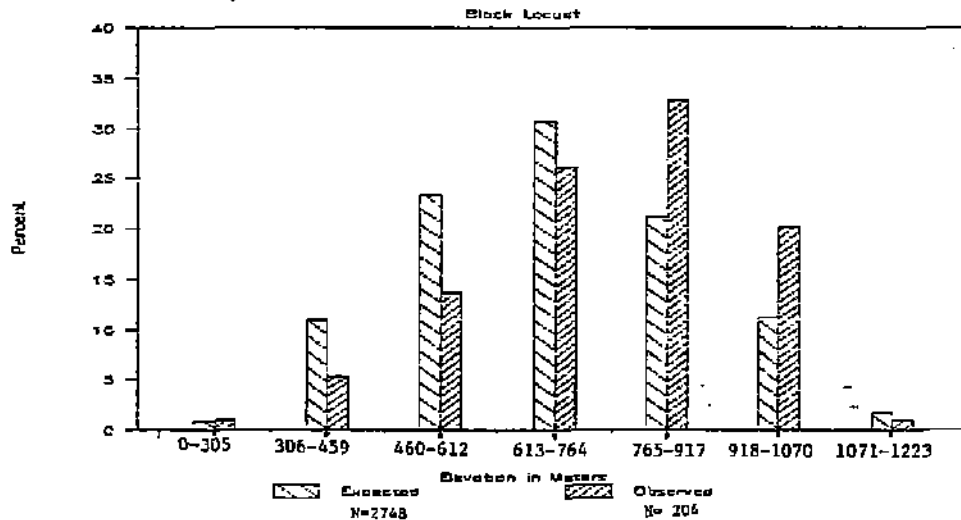
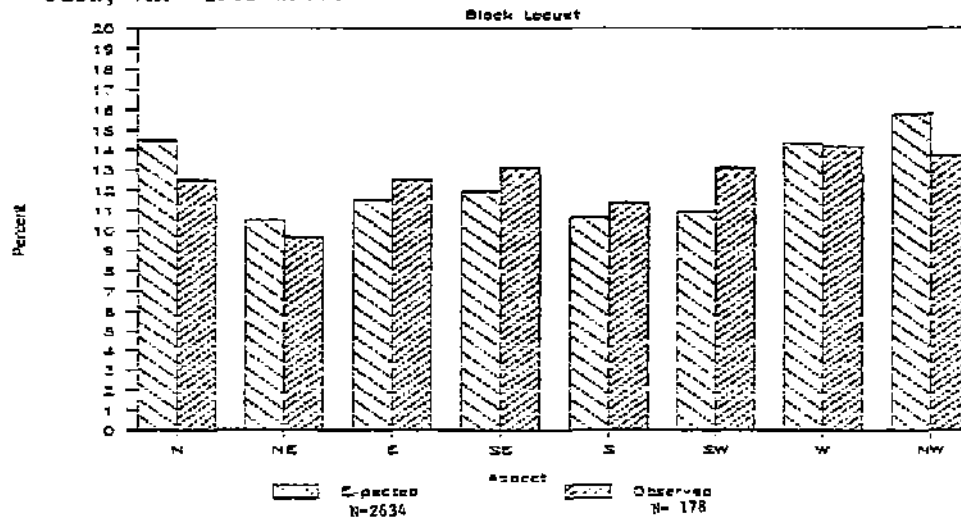


Figure 18. Expected versus observed distribution of black locust forests in relation to aspect, in all districts of Shenandoah National Park, VA. 1983-1987.



Note: "N" equals number of plots.

Hemlock (SAF Code - 2300)

Hemlock forests occurs over less than 1% of the Park covering 445 hectares (1105 acres). This type was most abundant in the Central District where it covers 440 hectares (1095 acres) of the total Parkwide. Twenty-four plots (<1%) were sampled in hemlock stands. Associates include red oak, basswood, and yellow birch. Variants of this type are listed in Table 1. Generally hemlock is distributed in moist drainages or on north facing slopes above drainage areas, although aspect distribution varied considerably. Slope, elevation and aspect data are described in Figures 19, 20, and 21. These 3 graphs do not compare the observed versus expected data as this small sample size and may not be representative. The Limberlost area is one of the few stands in the Central District greater than 100 years of age. Two plots were estimated to be less than 40 years of age, eight between 40 and 100 years of age, and 9 mixed age plots. Canopy coverage is very dense. Understory species occurred in 10 of the 23 hemlock plots. Dominant understory species include witch hazel 22% (N=5) and hemlock saplings 22% (N=5). In general, pure or nearly pure hemlock stands tend to exclude other tree or understory species because of their dense canopy and thick low branching. Soft mast was identified in 8 out of 23 stands (35%). Soft mast species include Nyssa sylvatica (black gum) (9%, N=2) and Viburnum spp. (9%, N=2). Hemlock was not widely distributed in the North District. two stands were found in the upper section of Big Devil's Stairs and in Frazier Hollow. Other Hemlock found in the North District is

Figure 19. Hemlock forest type distribution in relation to slope, in the North District, Shenandoah National Park, VA. 1985.

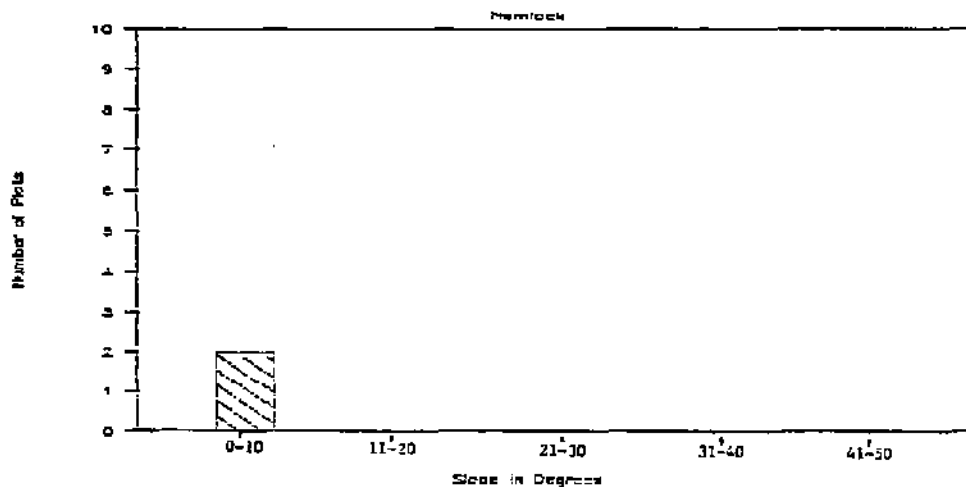


Figure 20. Hemlock forest distribution in relation to elevation, in all districts of Shenandoah National Park, VA. 1983-1987.

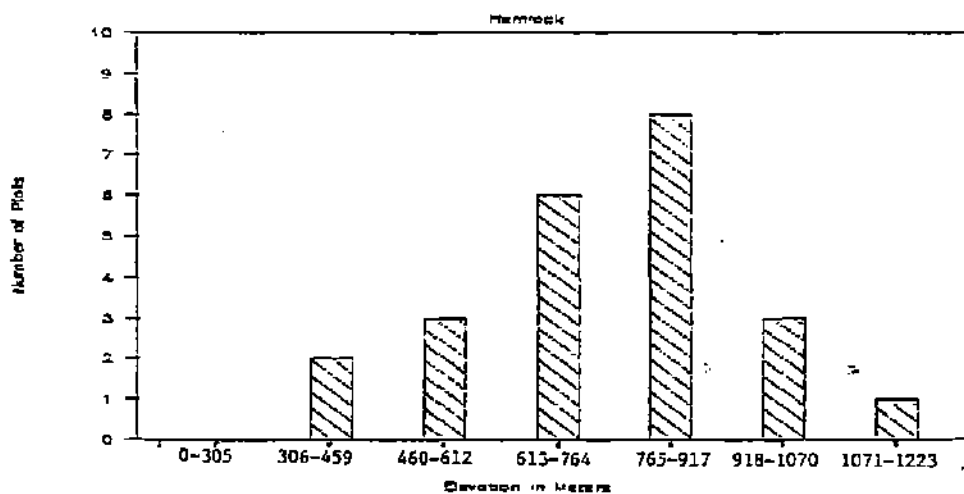
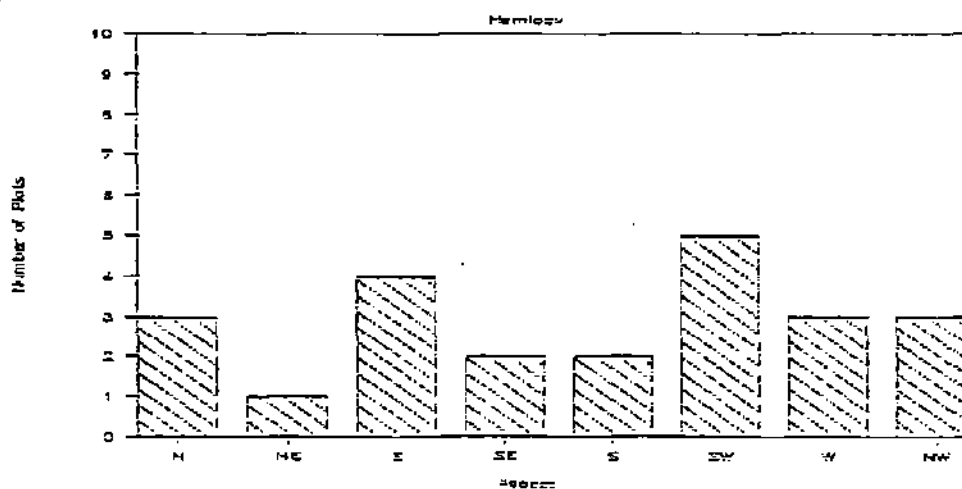


Figure 21. Hemlock forest distribution in relation to aspect, in all districts of Shenandoah National Park, VA. 1983-1987.



scattered in the area south of Pass Mountain Overlook off of the Drive. A stand in the South District is located just north of Loft Mountain campground at the headwaters of Ivy Creek.

Accuracy

A major part of the project involved testing the accuracy of the maps in each Park District. The Central District was mapped and tested during 1984 (Garner 1985), and the techniques developed were duplicated for the North and South Districts. A total of 45 transects were distributed randomly throughout the Park, covering 172.5 km (103.5 mi). Each transect averaged 3.8 km (2.3 mi) with 19-2 stops, for a total of 863 stops. At each stop the dominant forest cover type was recorded. These values were then directly compared to the cover type identified by the CIR map at the same location. If the forest type identified on the ground was the same, or within 40 yards ($1/8"$ at 1:12,000 scale) of what the CIR map identified, it was considered accurate. Results of these comparisons were then analyzed using discrete multivariate analysis (Congalton 1983).

Initially the overall accuracy level was expected to be as high as 80%. However, at the conclusion of the testing period results were lower than expected, averaging 70% (Table 2). Methods were identical, and the slide quality was comparable, for each District. In the North District, low accuracy for the pine type may be a result of inadequate sampling. Only two

stops identified pine as the dominant type and with a larger sample the accuracy may increase. Hemlock was not encountered along the transects in the North and South Districts and therefore accuracy for this type could not be evaluated. In the South District the red oak group had to be lumped with chestnut oak since the test results indicated that this type could not be accurately identified from the CIR slides.

Problems in evaluating the forest cover center on the extreme species diversity currently found in the Park. The 7 major types, when identified as dominate in the stand, describe the overall dominant forest cover, however some variation does occur. As forest succession proceeds, species begin competing for dominance, and variations in site conditions and historical land use have an influence on the canopy. Therefore, all stand outlines of the dominant cover types have potential pockets, less than 3 acres in size, of the other major cover types within them. The vegetation map represents a general description of the forest cover and standing alone does not completely describe the forest due to the limitations imposed by the mapping technique. However, the data collected during ground truthing were analyzed and the resulting summary reports (Teetor 1985, Teetor 1986, and Teetor 1987) provide an increase in the detail of the forest cover type descriptions. These reports used in combination with the map should provide Park researchers and managers with a useful and informative map product.

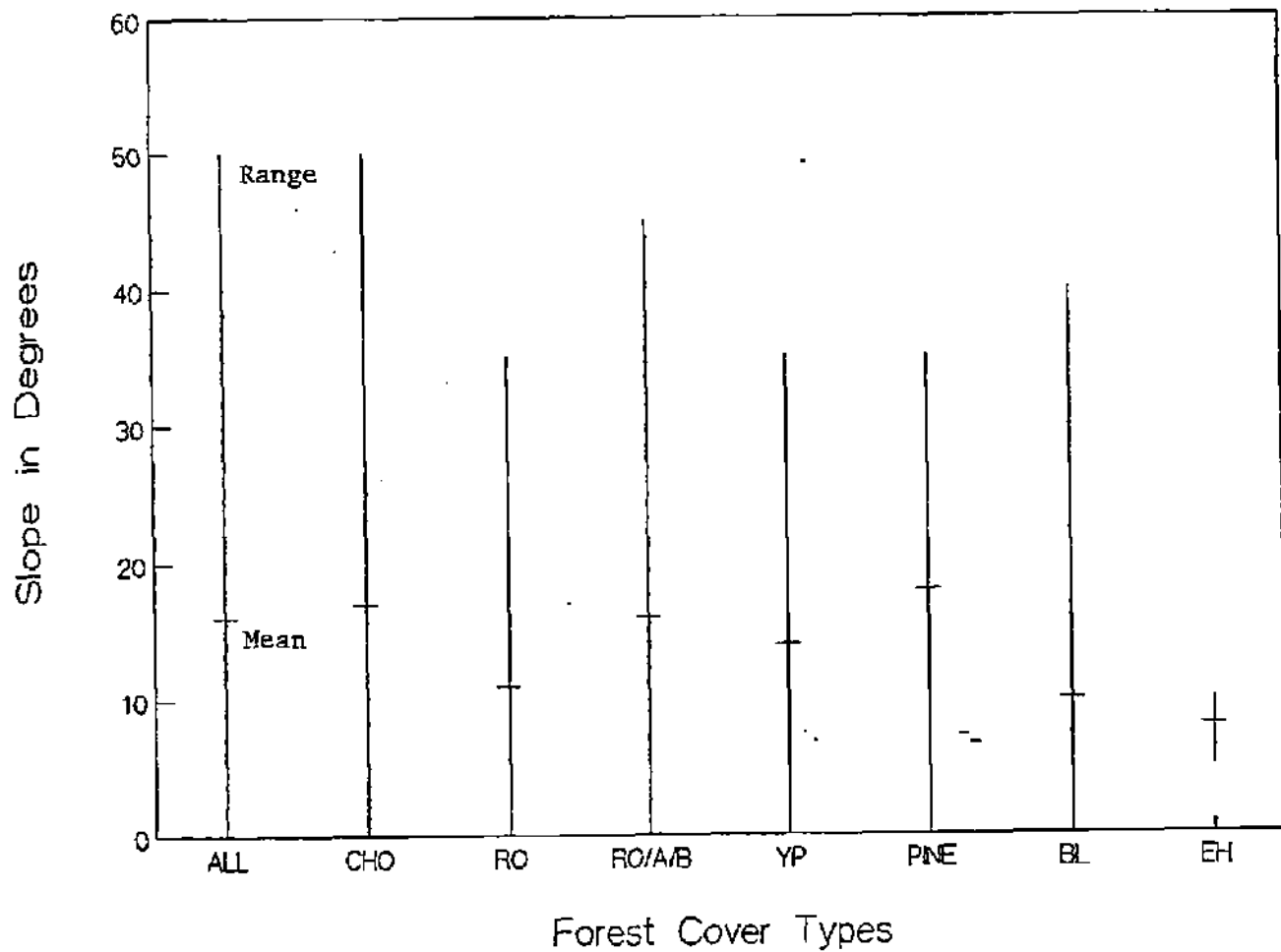
Efforts to evaluate forest types in terms of topographic ranges have indicated that only broad generalizations can be made. Specific site conditions have some effect on cover type distribution but are by no means limiting, and distribution overlap between cover types is considerable. Figures 22 and 23 describe the range in slope and elevation for each forest cover type, the horizontal bar along each range indicates the mean.

Unique Forest Areas

In addition to the major forest cover types, many unique areas exist throughout the Park. In the North District, these include a grassland-shrub community in the Happy Creek drainage, several small white birch stands on Neighbor Mountain, and 2 bog areas in the North Fork of the Thornton River drainage.

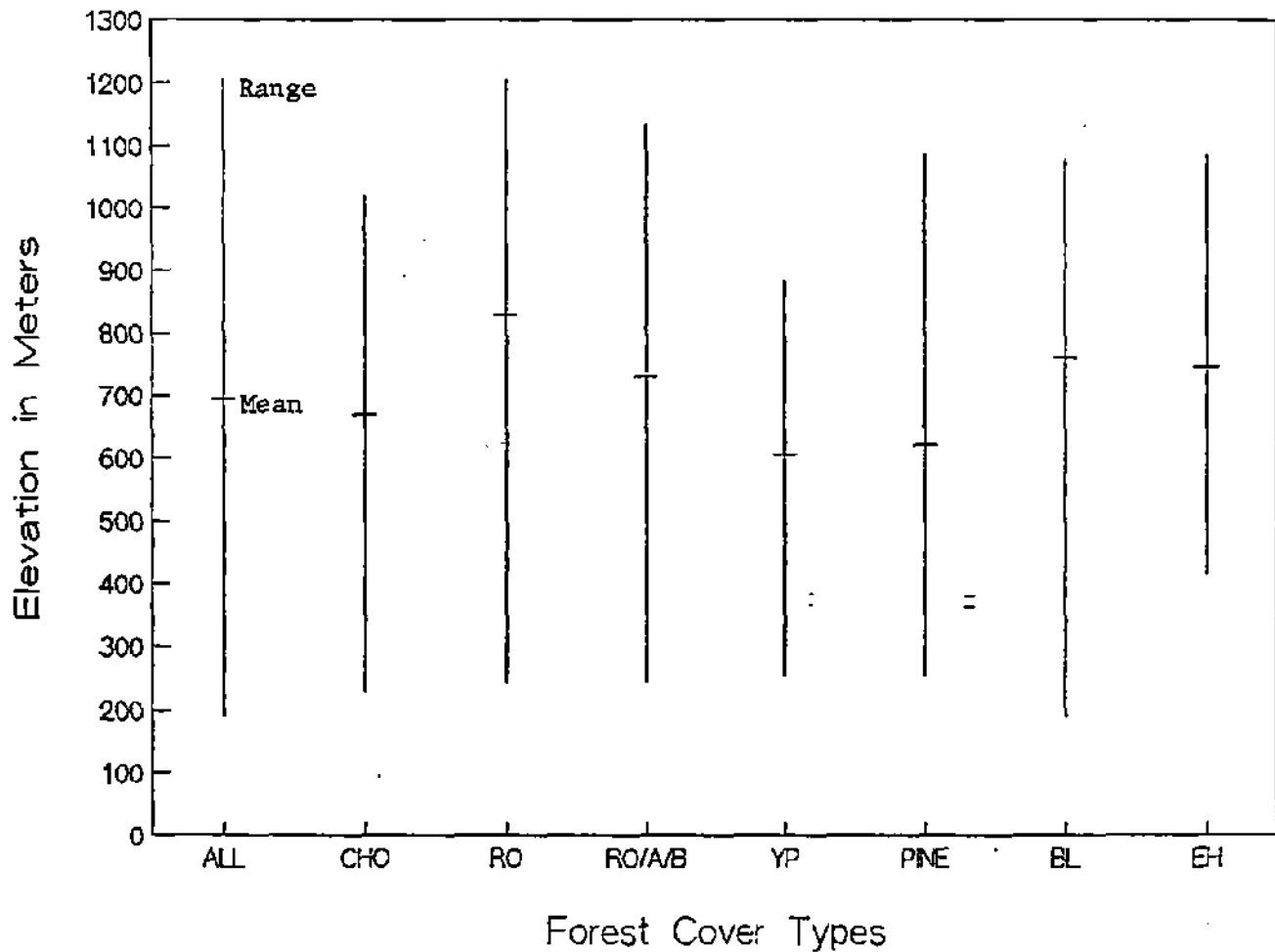
In the Central District, the summit of Saddleback Mountain is nearly flat forming a broad expanse of gradually sloping terrain. Standing and fallen trunks of the once abundant american chestnut are still visible there. Fagus grandifolia (American beech), not often found in the Park, was located in Hensley Hollow as well as in lower White Oak Canyon. Populus grandidentata (bigtooth aspen) was found along the Appalachian Trail on the south side of Bearfence Mountain, on the north side of Jones Mountain above the Staunton River, and on Old Rag's western aspect. A large sugar maple stand occurs along the

Figure 22. Comparative slope range and mean for 7 dominant forest types and the entire data base in the North and South Districts of Shenandoah National Park, VA. 1983-1987.



- ALL - all forest types combined
- CHO - chestnut oak forest type
- RO - red oak forest type
- RO/A/B - red oak/ash/basswood forest type
- YP - yellow poplar forest type
- PINE - pine forest type
- BL - black locust forest type
- EH - eastern hemlock forest type

Figure 23. Comparative elevation range and mean for 7 dominant forest types and the entire data base in all districts of Shenandoah National Park, VA. 1983-1987.



- ALL - all forest types combined
- CHO - chestnut oak forest type
- RO - red oak forest type
- RO/A/B - red oak/ash/basswood forest type
- YP - yellow poplar forest type
- PINE - pine forest type
- BL - black locust forest type
- EH - eastern hemlock forest type

Meadow School Fire Road; this is the single largest stand of sugar maple in the Park. Isolated pockets of white birch were found in drainage heads at upper elevations with northern aspects on Grindstone and Smith Mountains. Jones Mountain, in the Central District, is the location of an area called Lost Wilderness. In this area is a stand of possibly virgin timber consisting of red oak, white oak, white ash, and sugar maple. Also found in this area is a very old stand of mountain laurel. Long Ridge south of Big Meadows has several small open shrubfields scattered with locust, Virginia pine, and sumac with a grass understory. These areas are not maintained and therefore represent an unusually open canopy condition not often observed in the Park. In the Laurel Prong drainage, just upstream from Camp Hoover, is the only known location of *Rhododendron maxima*.

Several unique areas exist around the Big Meadows area. These are described in detail in the Resource Management Plan and in the Meadow Management Plan (Haskel], 1987). Additional outstanding natural features are described in the General Management Plan (1981). The marsh located west of the Meadow is another unusual phenomenon, natural spring's have made this a unique environment for a variety of wetland plant species found nowhere else in the Park. Nearby to the swamp is the only known location of grey birch. Scattered along the eastern edge of the meadow and near the swamp are some Abies balsamea (balsam fir) and Picea rubens (red spruce) planted by the COC. Red spruce is

also located on Hawksbill Mountain, Stony Man Mountain, and in Limberlost. Limberlost is a stand of virgin hemlock and represents the largest continuous stand of hemlock in the Park.

A unique situation exists in the South District. There is a small, presumably man made pond on Pond Ridge. This pond was no doubt quite large when first dug and will probably eventually fill in. The open area surrounding the pond would be an interesting area to study in terms of forest succession as it is surrounded by dry site conditions not normally associated with cleared or disturbed sites. Unique forest stands in the South District include small pockets of white birch located on Furnace Mountain and in upper Paine Run. Another forest type which occupied many of the dry slopes and ridges in the 1930's is bear oak. Presently this type occurs mainly as an understory species associated with oak and pine stands. However, several small stands were observed throughout the southern sections of the District; for the most part these stands consist of dense thickets of bear oak interspersed with pitch pine.

Additional unique areas are located along Hawksbill Creek and Gap Run. Apparently sections of the stream flood plains were cleared for homesites or agricultural use prior to the Park's establishment. Due in part to the relative dryness of these areas succession has proceeded very slowly, most are

characterized by open grasslands with scattered black walnut, Rubus spp., and red cedar. Detailed descriptions of each unique feature can be found in the District summaries (Teetor 1985, Teetor 1986, Teetor 1987), and in the Park's general management plan (1981).

Successional Stages

Succession was recorded in those stands which appeared to have one forest type replacing another. The majority of stands found to be involved in some type of successional transition were dominated by black locust. Locust has been identified as one of the earliest invaders of the open restocking and grassland areas (Berg and Moore 1941; Lippford 1984). Since the 1940's succession has continued to the point where now many of the locust stands sampled are being replaced. The species that replace the outgoing forest type are influenced by factors such as site conditions and prior land use. The trees remaining after logging or land clearing may act as seed trees thereby influencing the dominant species, independent of site conditions.

Succession is an important dynamic catalyst which constantly effects and changes the forest structure. Variations in forest type distribution in the Park, can be predominately attributed to historic land use. Most of the land cleared for farming was

located on moist fertile soils with gradual slopes. Currently, the majority of forest types found in these areas include poplar, locust, and various cove hardwoods. Red oak/ash-/basswood appears to be well established in its niche of the drier rocky drainage areas, and poplar dominates the moist concave areas and stream bottoms.

Logging occurred throughout the Park, with efforts concentrated on the west side of Skyline Drive. Oak and pine forests have regenerated in these areas where the soil is thin, dry, and rocky. Pine distribution is also influenced by fire, which occurs most frequently on western aspects. Fires will continue to influence the forest and set back the successional process. Another influence that will greatly affect the forest in the next decade is the gypsy moth. At this time the moth is well established in the North District, and is migrating southward. This insect will most assuredly disrupt the oaks, a preferred species, as trees are defoliated and die.

Homesites

The Park had approximately 580 homesites located within the boundary prior to government acquisition. Old homesites were identified from 1929 USGS topography maps. General homesite characteristics were described by Garner (1986). Roughly 80% of the old homes were located on the east side of the mountain. Abandoned road beds were often associated with homesites or

logging practices. Many homesites are located near the Park boundary where the land is fertile and gradually sloping. Details of homesite locations may be obtained by reading the individual District and compartment summaries (Teetor 1985, Teetor 1986, Teetor 1987). Homesites are of particular interest for their effect on the forest cover. Associated with all homesites is an abundance of soft mast, including apple orchards. Much of the area around homesites was cleared, thinned, or otherwise altered from its natural state through human activity. These alterations have returned the forest to the early stages of forest succession, exhibiting significant diversity with a great deal of edge being created as succession proceeds. The resulting land area is excellent in terms of its ability to support wildlife populations, and is potentially at a peak in terms of forest diversity.

CONCLUSION

The forests of Shenandoah National Park are diverse and the distribution of species is broad, creating complex interactions among the various communities. This report provides Park managers with a description of the forest community as it was encountered throughout the vegetation mapping project. Further analysis of the data can provide information relating to species importance, interrelationships of forest types, and a more detailed description of the habitat available for wildlife

species. Additional applications include developing models with the help of the GIS that will aid in predicting what effects factors such as gypsy moth defoliation, changes in successional patterns, and increases in recreation demands will have on Park resources.

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APPENDIX 1

Location (UTM): _____

Slide No.: _____

[illegible]

Tree sp.	Cover class	#/plot	Rel.dens. %
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			

[illegible][illegible]

Instructions for completing Forest Inventory Data Form

1. Date - day, month, year.
2. Area - General area to be ground truthed on this date.
 - 2a) Location - Include UTM identification for plot. Additional plot UTM numbers should be put on back of Data Form.
 - 2b) Slide No. - Number of slide taken of timber stand. Identify film rolls as well.
 Example: #39 (slide) - 2 (roll).
3. Compartment - The Central District of the Shenandoah National Park has been divided into manageable units relating to stream drainage patterns. Use appropriate number for area.
4. Stand - The area defined by a specific forest type. Stands are numbered consecutively throughout the area to be mapped.
- ^• Forest Type - A category of forest defined by vegetation (composition) and/or locality (environmental) factors. Criteria is based on the Forest Service Silvicultural Examination and Prescription Handbook, The Society of American Foresters (198C), and CAPS forest cover types.
6. Plot - Samples taken within each stand to determine cover type information. Two to 4 plots per stand are adequate, number consecutively for each stand. Area 1/10 acre - radius - 10.93 meters.
7. Habitat Components - Primarily vegetation structure as it reflects local topoeadaphic conditions and site history.
 - 1) 3urn
 - 2) Cutting Unit:
 - a. Border areas-overlooks, etc.
 - b. Virginia Game Management areas.

- 3) Meadow (tree/shrub canopy cover <30%):
 - a. Wet
 - b. Dry
upland/lowland
 - 4) Orchards: Associated with old homesites.
 - 5) Ridge Top.
 - 6) Road.
 - 7) Riparian Zones: Associated with hollows, upper drainages, rivers, streams, etc.
 - 8) Slab Rock: Sparsely timbered to no timber.
 - 9) Talus.
 - 10) Agricultural border areas.
 - 11) Shrub fields (tree canopy cover <30%): Associated with power and telephone line corridors.
 - 12) Grass field: Associated with power and telephone line corridors.
 - 13) Timber (tree canopy > 30%):
 - a. Closed-canopy timber
(canopy cover > 60%)
 - b. Open-canopy timber
(canopy cover 30% - 60%)
8. Hard Mast BA - Using 10 factor prism, count hard mast species within plot; multiply by 10.
- Hard Mast species - Oak (Quercus spp.), Hickory (Carya spp.), Beech (Fagus gradifolia), Walnut/Butternut (Juglans spp.), Hornbeam (Carpinus carolinaia), Hop Hornbeam-Ironwood (Ostrva

9. Water Rate - Measurement of stream flow.

- 0 - none or inaccessible
- 1 - intermittent-streams that go dry
- 2 - permanent-year round
- 3 - large and permanent enough for waterfowl

10. Elevation - Altimeter reading at plot site in feet
(altitude).

11. Canopy Cover - Estimate using densiometer (% foliage cover)

12. Slope/Aspect - Taken in the direction water would flow
(estimate using clinometer and compass).

13. ~~K~~ev area - Distinctive or unusual areas within a stand.

- 1 natural openings
- 2 maintained openings
- 3 waterholes/sinkholes
- 4 key mast area - 5 acres or larger, indicate hard or soft
- 5 beaver ponds, swamps, marshes
- 6 orchards
- 7 grape thickets
- 8 Crataegus spp. clumps
- 9 Bear use areas--ascribe under remarks
- 10 house site
- 11 rock walls and piles
- 14 caves, rock shelters, or overhangs
- 22 bluffs

14. Stand Age - Estimate using increment bore, refer to Berg and Moore (1941).
15. Tree species - All overstory tree types within plot, use common or scientific name.
16. Cover class - Refers to canopy coverage class as developed by Daubenmire (1988).
17. Number per plot - Individual count of each tree species in plot.
18. Relative density (%) - A percentage value assigned to an individual number of tree species divided by the total tree count in the plot (independent of cover class).
19. Understory spp. - The small tree and shrub species that make up the second and third stratification of the forest community.
20. Code - Number assigned to understory species for computer input.
- 21) Soft Mast spp. - All species not included under hard mast.
- 22) Variety - Three or more soft mast species within a plot.
- 2 3) Remarks - On back of sheet, comments concerning overall picture of community; i.e., bear sign, abundance of mast, logging roads or anything else unusual.

- ²⁴) Description of plot location - General remarks concerning plot site relative to roads, ridges, etc.

[illegible]

Code 5 3=a

0=none or inaccessible
1=intermittent (streams that go dry)
2=permanent (year round)
3=large and permanent (enough for waterfowl)

FOREST COVER
Inventory Field Data Form

Date: _____ Name(s) of Field Crew: _____
 District: South Compartment: _____ Commentary attached (check): _____
 Area(s): _____

STAND NUMBER									
PLOT NUMBER									
STAND AGE (CODE 11)									
TRACT TYPE (CODE 8)									
FOREST TYPE (CODE 9)									
% CANOPY COVER (CODE 4)									
DOMINANT SPP. (CODE 9)									
% DOMINANT SPP. (CODE 12)									
NUMBER DOM. SPP.									
SUBDOM. SPP. (CODE 9)									
% SUBDOM. SPP. (CODE 12)									
NUMBER SUBDOM. SPP.									
OTHER SPECIES (CODE 9)									
% OTHER SPP. (CODE 12)									
NUMBER OTHER SPP.									
HARD MAST BA									
SOFT MAST VAR. (CODE 3)									
SOFT MAST AVL. (CODE 4)									
DOM. SOFT MAST (CODE 7)									
DOM. UNDERSTORY (CODE 7)									
% DOM. UNDST. (CODE 12)									
UNDERSTORY DENS. (CODE 4)									
BROWSE AVAIL. (CODE 4)									
WATER INFLUENCE (CODE 5)									
WILDLIFE OCC. (CODE 10)									
REGENERATION (CODE 4)									
REGEN. SPP. (CODE 7)									
SUCC. TRANS. (CODE 1)									
SLOPE									
ELEVATION									
ASPECT									

Code 1
 0=absent
 1=present

Code 3
 0=no
 1=yes

Code 4
 0=none
 1=little to none
 2=some
 3=abundant

Code 5
 0=none or inaccessible
 1=intermittent (streams that go dry)
 2=permanent (year round)
 3=large and permanent (enough for waterfowl)

Instructions for completing FOREST COVER - Inventory Field Data Form

- 1) Date - day, month, year
- 2) Name(s) of field crew - data collector(s)
- 3) District - enter North, South, or Central
- 4) Compartment - The districts have been divided into manageable units relating to stream drainage patterns. Use appropriate number for area.
- 5) Commentary attached - use back of page or blank sheet for comments relating to area. Check if remarks are included.
- 6) Area(s) - general description of area walked i.e. drainage, mountain, ect. example: white oak canyon, Pass Mtn.
- 7) Stand Number - The area defined by a specific forest type. Stands are numbered consecutively throughout the area to be mapped.
- 8) Plot Number - Samples taken within each stand to determine cover type information. One to 4 plots per stand are adequate, number consecutively for each stand. Area 1/10 acre - radius 10.93 meters.
- 9) Stand Age - roughly estimate stand age based on tree DBH and forest type. Enter appropriate code, (code 11)
- 10) Tract Type - Primarily vegetation structure as it reflects local topoedaphic conditions and site history, (code 8)
- 11) Forest Type - A category of forest defined by vegetation (composition) and/or locality (environmental) factors. Criteria is based on The Society of American Foresters (1980) handbook. Enter appropriate code, (code 9)
- 12) % Canopy Cover - Estimate amount of leaf coverage above plot site. Enter appropriate code (code 4).
- 13) Dominant Species - The species of tree which makes up the largest portion of the plot. Enter code 9. Example: If the forest type is code 2001=red oak/basswood/ash, and red oak makes up 40%, basswood 25%, and ash 10%, enter 5500=red oak.
- 14) % Dominant Species - Enter Daubenmire classification code (CODE 12). See example for Dominant Species.
- 15) Number Pom. Spp. - Count the number of stems of the dominant species present in the plot .

- 16) Subdominant Species - The species of tree which makes up the second largest portion of the plot. Enter code 9. In reference to the above example 2003=basswood.
- 17) % Subdominant Species - Enter Daubenmire classification code.
- 18) Number Subdom. Spp. - Count the number of stems of the subdominant species present in the plot.
- 19) Other Species - The third most dominant species in the sample plot. Enter a code 9 value.
- 20) % Other Species - Enter Daubenmire classification code.
- 21) Number Other Spp. - Count the number of stems of the other dominant species present in the plot.
- 22) Hard Mast Basal Area - Using a 10 factor prism, count the hard mast species within the plot, multiply by 10. Hard mast species - Oaks (Quercus spp.), Hickory (Carya spp.), Beech (Fagus gradifolia), Walnut/Butternut (Juglans spp.), Hornbeam (Carpinus caroliniana), Hop Hornbeam-Ironwood (Ostrya virginiana), American Chestnut (Castanea dentata).
- 23) Soft Mast Variety - Enter a 0 or 1 (Code 3) for soft mast variety. Enter code 1 only if there are 3 or more species of soft mast producers in the stand (see code 7* for species list). Do not include trees or shrubs that are too small to produce mast (e.g. sassafras seedlings).
- 24) Soft Mast Availability - Enter soft mast availability (code 4). Please note that this is a measure of the potential number of mast producing plants, not one of variable annual production.
- 25) Dominant Soft Mast Species - Enter (code 7*) to indicate dominant soft mast species.
- 26) Dominant Understory species - Enter the dominant understory species (code 7).
- 27) % Dominant Understory Species - Enter the Daubenmire code for the understory covered by the dominant species.
- 28) Understory Density - Enter the understory density (code 4).
- 29) Number Dominant Understory - Count the number of stems of the dominant understory species present in the plot.
- 30) Browse Availability - Enter the browse availability (code 4). Browse is defined as the current annual growth of woody shrubs that would be eaten by deer under non-starving conditions. Browse species are identified by a check mark in the understory species list (code 7).

- 31) Water Influence - Enter an appropriate description of the water resource within the tract or stand (code 5).
- 32) Wildlife Occurrence - Enter code 10 in reference to species observations or sign encountered. Include description of findings in commentary.
- 33) Regeneration - Enter code 4 in reference to seedling or sapling growth of tree species.
- 34) Regen. Spp. - Enter code(s) in reference to species identified as regenerating.
- 35) Successional Transition - Enter code 1 if stand is undergoing a successional change (e.g. if locust is being taken over by red oak/basswood/ash).
- 36) Slope - Using a clinometer estimate the slope, in degrees, taken in the direction water would flow.
- 37) Elevation - Altimeter reading at plot site in feet.
- 38) Aspect - Using compass estimate the aspect, in degrees, taken in the direction water would flow.

CODE 7 * = SOFT MAST SPECIES + = BROWSE SPECIES

0= none	*19= coralberry	*39= apple
1= azalea	20= conifer	39= mtn. holly +
2= bear oak	*21= chokeberry	*40= pear
* 3= black gum +	22= serviceberry	*41= peach
4= dogwood +	23= rhododendron	42= spicebush
5= maple species	24= sourwood +	*43= elderberry
6= mtn. laurel	25= alder	*44= sweet cherry
7= oak sprouts +	*26= persimmon	*45= black cherry +
* 8= sassafras +	27= holly	*46= plum
* 9= sassafras +	28= redbud	*47= pokeweed
*10= vaccinium +	29= sumac	*48= grape +
11= viburnum +	*30= blackberry	*49= squawroot
12= birch	31= witch hazel	*50= Rubus spp. +
13= pine	*32= cherry	*51= Ribes spp. +
14= honeysuckle	33= other	52= elm
15= fern	34= maple/dogwood	53= hophornbeam
16= beech	35= striped maple	54= boxelder
17= ash	36= red maple	55= hawthorn +
18= grass	37= sugar maple	56= hornbeam
		57= hackberry
		58= hickory sapl.

CODE 8

1= forest	17= burn
6= powerline	18= cutting unit-overlook
7= permanent road	19= orchard
10= stream (riparian area)	20= ridgetop
13= cliff, talus slope, bluff	21= agricultural border area
14= grazed woodland	22= old homesite area
15= shrubland	23= pasture border area
	26= logging area

CODE 10

1= deer	3= turkey	5= bobcat
2= bear	4= grouse	6= other

CODE 11

1= 140 years 2= 40-100 years 3= >100 years 4= Mixed Age

CODE 12

0= absent	2= 6-25%	5= 76-95%
1= rare to 1%	3= 26-50%	6= 96-100%
1= 1-5%	4= 51-75%	

CODE 9

2000= wh. pine/red oak/red maple	5100= wh. pine/chestnut oak
2001= red oak/basswood/ash	5101= chestnut oak/white pine/red oak
2002= white ash	5200= white oak/black oak/red oak
2100= eastern wh. pine	5201= white oak/red oak
2101= wh. pine/yellow poplar	5202= white oak/black oak
2102= wh. pine/oak	5203= white oak/scarlet oak
2200= wh. pine/hemlock	5204= white oak/black oak/chestnut oak
2202= wh. pine/hemlock/n. hardwoods	5206= black oak/red oak
2203= wh. pine/hemlock/oak	5207= black oak/scarlet oak
2300= eastern hemlock	5208= black oak/scarlet oak/chestnut oak
2400= hemlock/yellow birch	5209= scarlet oak
2500= sugar maple/beech/yellow birch	5210= scarlet oak/chestnut oak
2600= sugar maple/basswood	5211= hickory/oak
2700= sugar maple	5212= scarlet oak/pitch pine
2800= black cherry/maple	5300= white oak
2801= black cherry	5500= red oak
2802= black cherry/oak	5501= red oak/chestnut oak
4400= chestnut oak	5700= yellow poplar
4401= chestnut oak/red oak	5701= yellow poplar/virginia pine
4402= chestnut oak/white oak	5702= yellow poplar/oak
4403= chestnut oak/scarlet oak	5800= yellow poplar/hemlock
4404= chestnut oak/black oak/scarlet oak	5900= yellow poplar/white oak/red oak
4405= chestnut oak/yellow poplar	5901= yellow poplar/white oak/sugar maple
4406= chestnut oak/pitch pine	5902= yellow poplar/white ash
4500= pitch pine	5903= yellow poplar/birch
4501= pitch pine/white pine	6000= beech/sugar maple
4502= pitch pine/virginia pine	7800= virginia pine/oak
4503= pitch pine/table mtn. pine	7900= virginia pine
4505= pitch pine/scarlet oak	7901= table mtn. pine
4506= pitch pine/black oak	10800= red maple
4507= pitch pine/chestnut oak	10801= red maple/oak
4600= eastern redcedar	10900= hawthorn
4601= e. redcedar/pine	11000= black oak
4602= e. redcedar/hardwood	5904= black birch
4603= e. redcedar/pine/hardwood	2401= yellow birch
5000= black locust	5213= hickory
2003= basswood	11001= black walnut
	9402= sycamore

APPENDIX 2

SHENANDOAH NATIONAL PARK
TREES AND SHRUBS

Common Name/Scientific Name

Family Pinaceae

Balsam Fir
Abies balsamea

Eastern Hemlock
Tsuga canadensis

Red Spruce
Picea rubens

Eastern White Pine
Pinus strobus

Virginia ("Scrub") Pine
P. virginiana

Pitch Pine
P. rigida

Table-Mountain Pine
P. pungens

Family Juniperus

Eastern Red Cedar
Juniperus virginiana

Family Salicaceae

Willow spp.
Salix spp.

Quaking Aspen
Populus tremuloides

Bigtooth Aspen
P. grandidentata

Eastern Cottonwood
P. deltoides

Family Juglans

Butternut
Juglans cinerea

Black Walnut
J. nigra

Bitternut Hickory
Carya cordiformis

Shagbark Hickory
C. ovata

Mockernut Hickory
C. tomentosa

Pignut Hickory
C. glabra

Sweet Pignut Hickory
C. ovalis

Common Name/Scientific Name

Family Betulaceae

American Hazelnut
Corylus americana

Eastern Hophornbeam
Ostrya virginiana

Sweet ("Black") Birch
Betula lenta

Gray Birch
B. populifolia

Speckled Alder
Alnus rugosa

Beaked Hazelnut
C. cornuta

American Hornbeam ("Ironwood")
Carpinus caroliniana

Yellow Birch
B. alleghaniensis

Paper ("White") Birch
B. papyrifera

Hazel Alder
A. serrulata

Family Fagaceae

American Beech
Fagus grandifolia

Allegheny Chinquapin
C. pumila

Post Oak
Q. stellata

Northern Red Oak
Q. rubra

Black Oak
Q. velutina

Blackjack Oak
Q. marilandica

American Chestnut
Castanea dentata

White Oak
Quercus alba

Chestnut Oak
Q. prinus

Scarlet Oak
Q. coccinea

Bear ("Scrub") Oak
Q. ilicifolia

Shingle Oak
Q. imbricaria

Family Ulmaceae

American Elm
Ulmus americana

Hackberry
Celtis occidentalis

Slippery Elm
U. rubra

Red Mulberry
Morus rubra

Family Magnoliaceae

Umbrella Magnolia
Magnolia tripetala

Yellow-poplar ("Tuliptree")
Liriodendron tulipifera

Common Name/Scientific Name

Family Lauraceae

Sassafras
Sassafras albidum

Common Spicebush
Lindera benzoin

Family Saxifragaceae

Wild Hydrangea
Hydrangea arborescens

Roundleaf Gooseberry
Ribes rotundifolium

Family Hamamelidaceae

Witch-hazel
Hamamelis virginiana

Family Platanaceae

American Sycamore
Platanus occidentalis

Family Rosaceae

Broadleaf Spiraea
Spiraea latifolia

Dwarf Spiraea
S. corymbosa

Common Apple
Pyrus malus

American Crabapple
P. coronaria

Red Chokeberry
P. arbutifolia

Black Chokeberry
P. melanocarpa

American Mountain-ash
Sorbus americana

Downy Serviceberry
Amelanchier arborea

Allegheny Serviceberry
A. laevis

Hawthorn
Crataegus spp.

Thimbleberry
Rubus odoratus

Wine Raspberry
R. phoenicolasius

Black Raspberry
R. occidentalis

Blackberry
R. allegheniensis

Ninebark
Physocarpus opulifolius

Common Name/Scientific Name

Family Rosaceae (continued)

Swamp Rose
Rosa palustris

American Plum
Prunus americana

Pin ("Fire") Cherry
P. pensylvanica

Black Cherry
P. serotina

Carolina Rose
R. carolina

Common Peach
P. persica

Mazzard ("Sweet Cherry")
P. avium

Common Chokecherry
P. virginiana

Family Caesalpiniaceae

Eastern Redbud
Cercis canadensis

Black Locust
Robinia pseudoacacia

Family Rutaceae

Common Hoptree
Ptelea trifoliata

Family Simaroubaceae

Allanthus ("Tree-of-heaven")
Ailanthus altissima

Family Anacardiaceae

Staghorn Sumac
Rhus typhina

Shining ("Winged") Sumac
R. copallina

Poison Ivy
R. radicans

Smooth Sumac
R. glabra

Fragrant Sumac
R. aromatica

Poison Oak
R. toxicodendron

Family Aquifoliaceae

Mountain Winterberry ("Holly")
Ilex montana

Common Winterberry
I. verticillata

Common Name/Scientific Name

Family Aceraceae

Mountain Maple
Acer spicatum

Striped Maple
A. pensylvanicum

Sugar Maple
A. saccharum

Red Maple
A. rubrum

Family Rhamnaceae

New Jersey Tea
Ceanothus americanus

Family Tiliaceae

American Basswood
Tilia americana

White Basswood
T. heterophylla

Family Hypericaceae

Shrubby St. John's-wort
Hypericum spathulatum

Family Thymelaceae

Leatherwood
Dirca palustris

Family Cornaceae

Black Tupelo (Blackgum)
Nyssa sylvatica

Flowering Dogwood
Cornus florida

Roundleaf Dogwood
C. rugosa

Red-panicle Dogwood
C. racemosa

Alternate-leaf Dogwood
C. alternifolia

Family Ericaceae

Rosebay Rhododendron
Rhododendron maximum

Catawba Rhododendron
R. catawiense

Pinxter-flower
R. nudiflorum

Early Azalea
R. roseum

Common Name/Scientific Name

Family Ericaceae (continued)

Minnie-bush
Menziesia pilosa

Mountain laurel
Kalmia latifolia

Maleberry
Lyonia ligustrina

Black Huckleberry
Gaylussacia baccata

Tall Deerberry
Vaccinium stamineum

Early Low Blueberry
V. vacillans

Late Low Blueberry
V. angustifolium

Southern Low Blueberry
V. pallidum

Common Highbush Blueberry
V. corymbosum

Family Ebenaceae

Common Persimmon
Diospyros virginiana

Family Oleaceae

White Ash
Fraxinus americana

Black Ash
F. nigra

Family Scrophulariaceae

Royal Paulownia ("Princess-tree")
Paulownia tomentosa

Family Rubiaceae

Common Buttonbush
Cephalanthus occidentalis

Family Caprifoliaceae

Northern Bush-honeysuckle
Diervilla lonicera

Canada Honeysuckle
Lonicera canadensis

Japanese Honeysuckle
L. japonica

Coralberry
Symphoricarpos orbiculatus

Blackhaw
Viburnum prunifolium

Shortstalk Arrowwood
V. rafinesquianum

Common Name/Scientific Name

Family Caprifoliaceae (continued)

Southern Arrowwood
V. dentatum

Northern Arrowwood
V. recognitum

Mapleleaf Viburnum
V. acerifolium

Common Elderberry
Sambucus canadensis

Red-berried Elder
Sambucus pubens