8-1978

Comparison of Forest Cover Prior To and Following Disturbance in Two Areas of the Great Smoky Mountains National Park

Weaver H. McCracken III
University of Tennessee - Knoxville

To the Graduate Council:

I am submitting herewith a thesis written by Weaver H. McCracken III entitled "Comparison of Forest Cover Prior To and Following Disturbance in Two Areas of the Great Smoky Mountains National Park." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Forestry.

Edward R. Buckner, Major Professor

We have read this thesis and recommend its acceptance:

Ronald Hay, Edward E. C. Clebsch

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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Accepted for the Council:

L. Evans Roth

Vice Chancellor
Graduate Studies and Research

COMPARISON OF FOREST COVER PRIOR TO AND FOLLOWING DISTURBANCE IN TWO AREAS OF THE GREAT SMOKY MOUNTAINS NATIONAL PARK

A Thesis

Presented for the

Master of Science

Degree

The University of Tennessee, Knoxville

Weaver H. McCracken III

August 1978

ACKNOWLEDGMENTS

The completion of this thesis was the result of the hard work and self-giving of many people, to whom I express my sincere appreciation. I am certainly indebted to Dr. Edward R. Buckner for his guidance and capable leadership in the preparation of this thesis. Special thanks are extended to Dr. Ronald L. Hay and Dr. Edward E. C. Clebsch for both their interest and many helpful suggestions, and to Mike Erwin and Janet Howell for their help with field work and manuscript preparation.

I am especially appreciative of the opportunity to have been involved in this project, which was generously made possible through the funding support of the Great Smoky Mountains National History Association. Thanks are also extended to those employees of the Great Smoky Mountains National Park, who rendered their assistance.

To my wife, Sylvia, I owe a continuing debt of gratitude for her loving patience, understanding and assistance during the preparation of this thesis.

Special thanks to Arnold Thompson, a true mountain man and friend, who helped make this study an enriching personal experience.

ABSTRACT

Prelogging forest cover and the nature and intensity of logging disturbance for two areas in the Great Smoky Mountains National Park were characterized using written records, photographs, interviews and, where available, virgin stands on similar sites. Present seral position and stand character were determined from fixed-area plots established on sites for which previous forest cover and intensity of disturbance had been determined.

A low- to mid-elevation hardwood forest occupying a north-facing drainage on the Tennessee side of the Park was determined to have been mixed mesophytic in character prior to logging and was most intensively disturbed by skidder logging near drainage bottoms. Succession reverted to early pioneer stages where logging was followed by gardening and where skidder damage was intensive, generally the most productive sites. Upper slope and higher-elevation sites were generally less disturbed and appear to be returning more rapidly to stable mid- to late-seral stages.

Yellow-poplar was unusual among the species studied, in being one of the largest dominants in the original forests, while being the most aggressive "pioneer" on the best sites following intensive disturbance.

In spruce-fir forests at upper elevations, spruce, although less tolerant than fir, was the dominant species in mixed, old-growth stands. This was due to the large size and longevity of spruce compared to the smaller size and shorter life span of fir. Logging disturbance appeared

to favor spruce except on exposed sites and at higher elevations where climatic extremes favored fir.

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CHAPTER I

INTRODUCTION

The forest ecosystem in the Great Smoky Mountains is one of the most complex to be found in the temperate zone of the northern hemisphere. Most of the area was heavily impacted by farming in valleys at lower elevations and intensive logging along upper drainages and at higher elevations. These impacts have destroyed or altered the original forests and sites so completely that the character of the original vegetation has been largely obscured.

A common assumption is that the original forest cover was a complex matrix of stable climax communities with connecting gradients caused by changing site variables, such as elevation, edaphic factors (soil type and depth), aspect, exposure and slope position.

The present forest cover over most of the Park is either a distinct seral stage or a complex composite of several stages that reflect interaction between the site factors mentioned, original forest cover and the nature of and degree to which original forests were altered by disturbance.

The purpose of this study was to determine, through whatever means were still available: (1) the character (composition and structure) of the original forests on selected areas, and (2) the nature of, and degree to which the disturbance altered stand and site conditions. These two parameters should be the primary determinants of the present seral stage. An inventory of present stand composition and structure on study

areas should provide a better understanding of stand dynamics that affect forest succession on the sites, and following the impacts involved.

Since English units were used in the conversations of recorded oral history significant to this study, they have been used throughout this thesis.

CHAPTER II

OBJECTIVES

The objectives of this study were to:

1. Determine the character and seral position of the "original" forest cover for selected areas in the Great Smoky Mountains National Park (GSMNP).
2. Document the nature of the disturbing influences that altered or removed the "original" forest cover.
3. Characterize the present forest cover and determine its seral position.

CHAPTER III

DESCRIPTION OF THE STUDY REGION (GREAT SMOKY MOUNTAINS AND VICINITY)

I. LOCATION AND PHYSIOGRAPHY

The Great Smoky Mountains (GSM, GSMNP, or Park) encompass approximately 800 square miles or 512,000 acres along the border of Tennessee and North Carolina. It is 54 miles long and 19 miles wide at its greatest width (King and Stupka, 1950). Parts of Haywood and Swaine Counties in North Carolina and Blount, Cocke, and Sevier Counties in Tennessee are included in the Park.

Although geologically old, the topography of the area is rugged, characterized by high mountains comprised of narrow ridges and steep-sloped, V-shaped valleys. As is characteristic of old landscapes, cliffs, bare rock faces and talus or skree slopes are seldom seen. Steep-sided mountain peaks are not to be found; more often, crests are dome-shaped, possessing sufficient soils and organic materials to support an extensive vegetative cover (Burchfiel, 1941). The area has abundant water power with more than 600 miles of streams and waterways. Elevations within the Park vary from under 1,000 feet to 6,642 feet.

II. CLIMATE

The GSM are characterized by cool temperatures and high precipitation, especially at higher elevations. Temperatures decrease

at a mean rate of 2.23 degress F. per 1,000 foot rise in elevation, resulting in a 10 to 15 degree F. temperature difference between the foothills and higher peaks (Shanks, 1954a). Cold weather prevails from January through March, with temperatures warming at lower elevations by April. Higher areas remain cold into May. According to Shanks (1954a), spring temperatures may require six to eight weeks to climb from the mountain base to the summit.

Precipitation varies more with altitude than with season. However, September is usually the driest month, and July and August commonly have the greatest precipitation. Precipitation at the base of the mountains is little different from that of the adjacent valleys; but it increases sharply with altitude and at the lower limits of the spruce-fir zone has increased by 50 percent. The average annual precipitation varies from 50 to 60 inches in the lower valleys to over 80 inches at the higher gaps (records of the National Park Service, Gatlinburg, Tennessee; and the Tennessee Valley Authority, Knoxville, Tennessee).

Lightning fires are rare, being limited usually by rain and high relative humidity which characteristically accompanies this phenomenon. Man-caused fires are larger and more intense than those caused by lightning (Barden, 1974). Although most common to ridge tops and exposed areas, windthrow also occurs in coves and on slopes as a result of tornadoes or unusually strong winds. Heavy rains, especially in the higher elevations, have caused both flash floods in individual watersheds and massive flooding throughout the mountains. Glaze, caused by rain freezing as it strikes the tree branches, is one of the more destructive natural forces acting upon the forest, especially at higher elevations.

Occasional severe ice storms have degraded stand quality, producing effects which were evident for a century or more, or until damaged stems were removed (Ashe, 1918; Rhoades, 1918; Abell, 1934).

III. VEGETATION

The forests of the GSM contain a wider variety of both woody and herbaceous plants than any comparable area in temperate North America. There are approximately 1,300 species of flowering plants, of which 130 are native trees (Whittaker, 1956). Widely used classification systems include the 15 associations of Whittaker (1956) and the six broad physiognomic types of Shanks (1954b). Shanks subdivides the forest cover of the GSMNP as follows (Figure 1): (1) cove forests cover 67,350 acres below 4,500 feet and are characterized by sheltered sites and deep soils; (2) hemlock forests occupying 7,696 acres, usually along streams up to 3,000 feet, but on exposed slopes and lead ridges from 3,000 to 4,500 feet (Whittaker (1956) noted that hemlock may form more than 80 percent of the stand canopy although, due to its large size, may only account for 20 to 30 percent of the stems); (3) closed oak forests found on intermediate to dry slopes at low and middle elevations where moisture is sufficient to maintain a continuous canopy; (4) open oak and pine stands occurring on shallow, rocky soils, on dry, exposed ridges and slopes—on such sites tree canopies may never close; (5) northern hardwoods occupying 70,921 acres above 4,500 feet and dominated by beech and yellow birch, and (6) red spruce and Fraser fir dominate the 35,491 acre boreal zone. This zone is similar to the red spruce-balsam fir association of Canada. The Fraser fir component of this association is

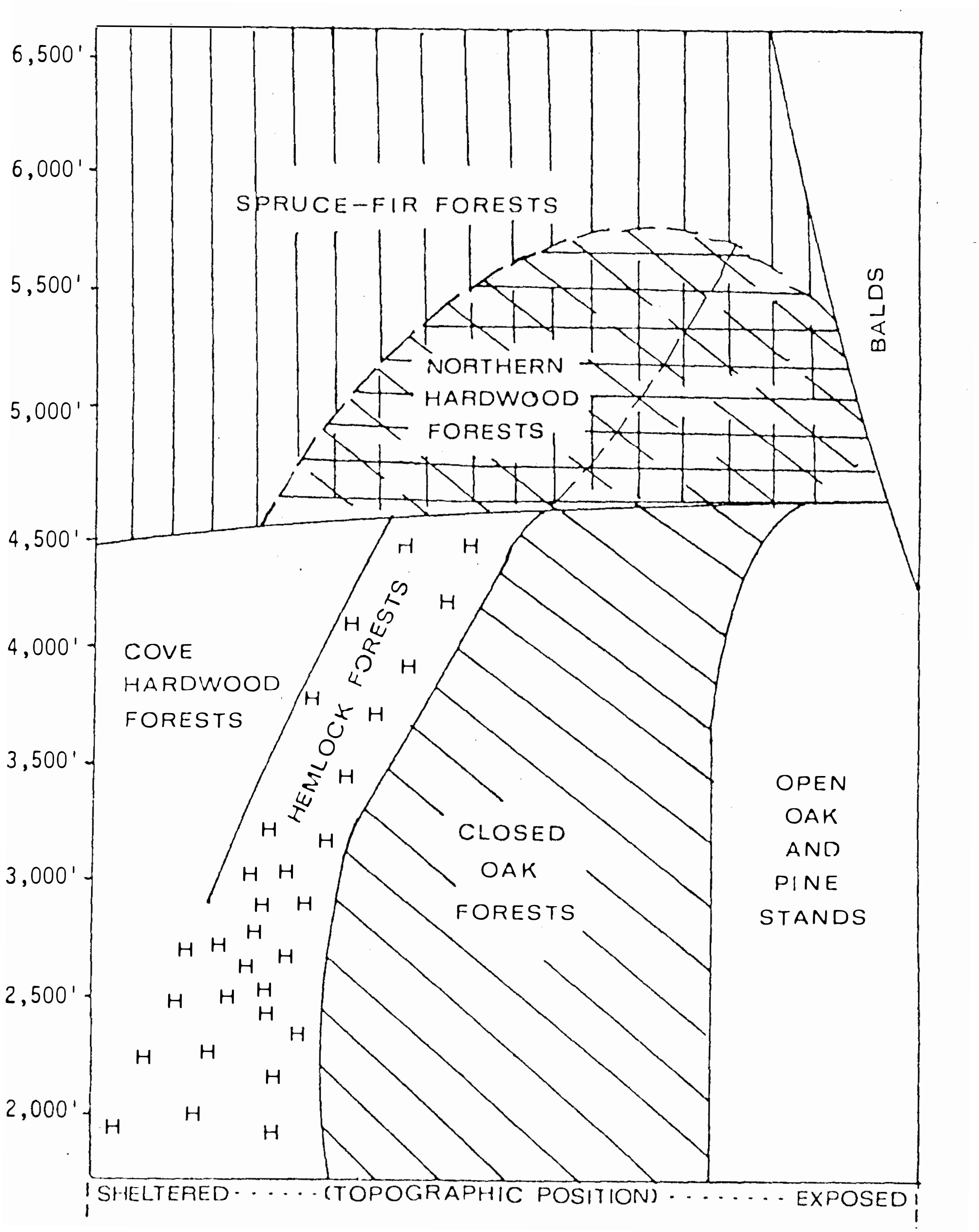

Figure 1. Vegetation pattern of the Great Smoky Mountains (Shanks, 1954b).

threatened by the balsam woolly aphid. A significant percentage of the fir has already been killed and there is little hope that the remainder can be saved (Hay, Eager and Johnson, 1976).

IV. CULTURAL DISTURBANCES

Agriculture

White settlers initially built their farms in the valleys and coves of the region, sometimes maintaining the fields originally cleared by Indians (Browder, 1973). By 1850 the best valley bottoms were occupied, forcing homesteaders farther up slope. Continued farming of steep mountain land led to soil erosion and subsistence agriculture. Trees were generally cleared by "ringing"—killing the tree by stripping a ring of bark several inches wide from around the tree trunk (Ayres and Ashe, 1905).

Livestock grazed and browsed freely in the woodlands. Provision of "fresh green" was insured by annually burning the woods (Morley, 1913). Livestock numbers were usually limited by the farmer's ability to grow sufficient fodder for over-wintering. However, there is evidence of one large landowner who, prior to 1850, held title to 30,000 acres on the East Fork of Little River in the Great Smoky Mountains and used the land for summer grazing, while over-wintering his herd in a valley outside the mountain area (Armstrong, typewritten). This pattern was not, however, typical of the mountain farmers.

Early Logging

Through the mid-nineteenth century, lumbering was concentrated in the Lake States and in the northeastern regions of the United States (Lambert, 1961). Though its value was recognized, the timber of the Southern Appalachians was not economically attractive because of its remoteness and the lack of railroads in the region (Colton, 1890; Hale, 1883). The earliest logging within the Great Smoky Mountains was not for commercial purposes. Trees were cut to provide the essential resources of the early mountain culture: houses, furniture, fuelwood and to clear farmland.

Several small mills were in operation prior to 1880. Timber was cut, sawed, and the lumber hauled to nearby markets by wagon over poor roads. An estimate of the volume cut by these mills was not available.

By 1880, the valley systems on both sides of the Great Smoky Mountains had railroads. Farsighted speculators began purchasing the heavily timbered mountain lands in anticipation that railroad accessibility would make lumbering economical (Arthur, 1914).

The 1880's marked the beginning of large-scale, commercial lumbering in the Great Smoky Mountains. Water power was used to transport logs in the first serious effort at marketing timber to other than local users. Yellow-poplar was the only species floated to downstream mills. Thompson (p.c.)[1] recalled that "blue poplar" had wood of bluish hue, and was less buoyant than "white" poplar and thus less suitable for river driving. In contrast, "white poplar" was buoyant, easily sawed

[1] "p.c." refers to personal communications.

and worked, and was valuable and available in commercial quantities along the streams.

Two methods were used in getting the timber downstream. On Big Creek, logs were simply rolled into the stream with canthooks, where high water from heavy rains in the high country washed them downstream (Godshalk, 1970). This was probably the first method ever used in river-driving within the region. Splash dams (Figure 2) were used to float logs on the Little River and in later years, on Big Creek. These dams were strategically located to produce the most power when the impounded water was released. Logs were laid in the creek bed below the dam and when flood gates were opened, sufficient water was released to float them downstream.

Characteristically, yellow-poplar timbers were cut and floated downstream where they were caught by a boom at the mill site. On Big Creek, logs were floated down the Pigeon River to a mill in Newport, Tennessee (Dykeman, 1955), while most of the logs cut on the headwaters of the Little River were floated to a mill in Rockford, Tennessee (Lambert, 1961; Thompson, p.c.).

The number of basins logged in this fashion within the Great Smoky Mountains is not known. However, Little River was recognized as the best stream for river-driving in the Tennessee portion of the Great Smoky Mountains (Ayres and Ashe, 1905).

Timber harvesting during this period caused little change in stand structure except along streams. Splash logging did extensive damage to the stream bed itself. During the same period, Schenck (1974) noted the

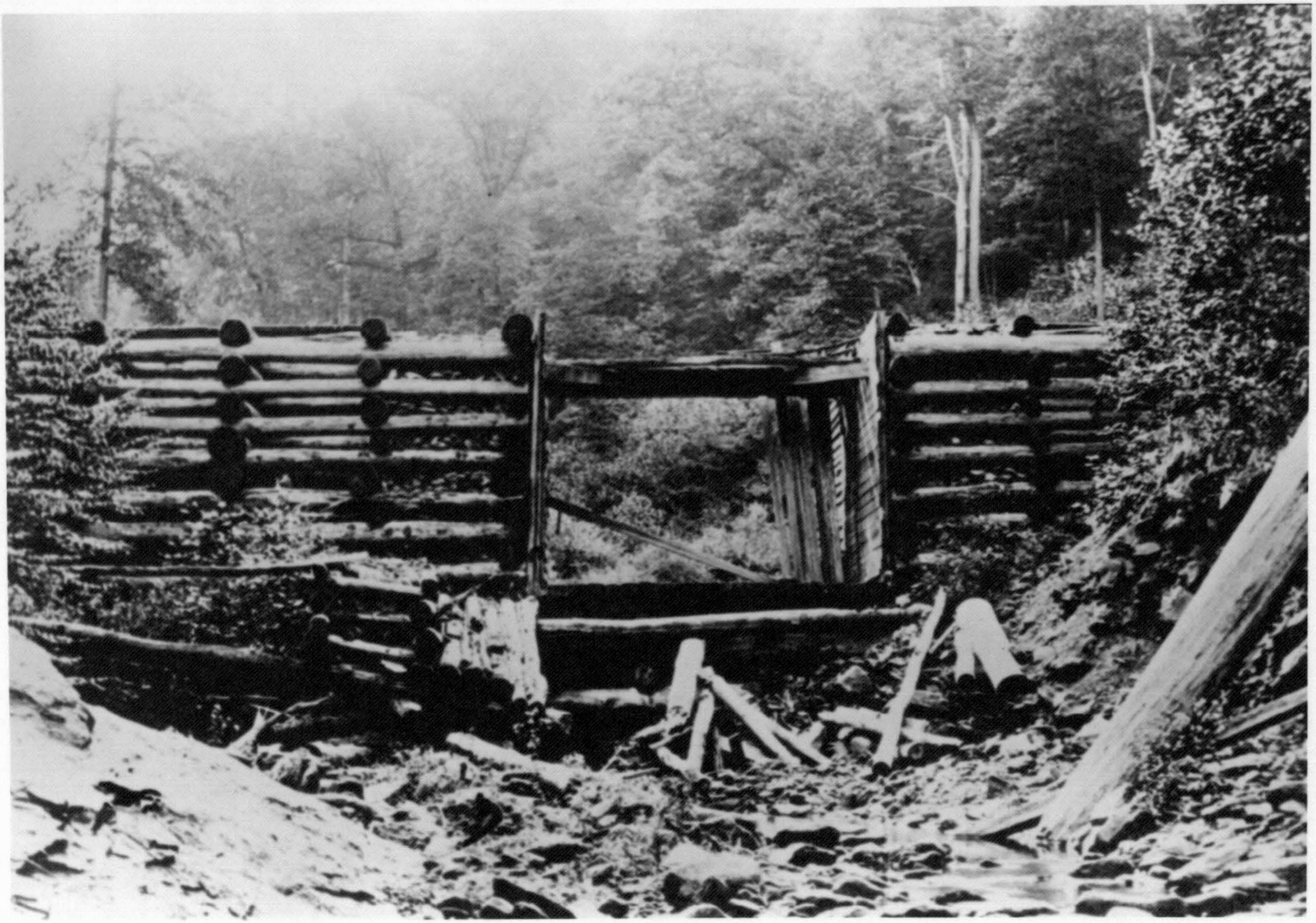

Figure 2. Splash dams were used on streams to develop a water head sufficient for river-driving of sawlogs in the Southern Appalachians.

damage of his splash-logging operations on Big Creek in Pisgah Forest, North Carolina.

> Oh those splashings! The bed of Big Creek, arched with rhododendrons, green with moss-covering rocks, replete with brook trout, was made a ruined one, a veritable arroyo of torn shores and skimmed stones.

Large-Scale, Mechanized Logging

In the latter half of the nineteenth century, steam-powered equipment began to appear in lumbering operations, facilitating an expanded industry. The first steam-powered skidders were patented in 1883 (Bryant, 1923). This, along with the availability of large tracts of virgin timber and access to a nationwide railroad system via spur lines, made large-scale, mechanized lumbering in the Great Smoky Mountains attractive to investors.

Systematic logging of all merchantable timber over entire watersheds in the GSM region began around 1900. Over the next 40 years, most accessible areas containing merchantable timber were logged. The incentives were purely economical, and cutting was done with no consideration for forest regeneration, wildlife, or water quality. Cutting included ". . . everything that you could make a board of . . ." (Trentham, p.c.). Most operators considered this to be around 12 inches DBH (McNeill, p.c.). The overhead costs determined the volumes cut and removed.

Despite the mechanization of most other operations, timber-felling remained a manual job. The last logs removed in 1938 were cut using a crosscut saw (Thompson, p.c.; Henry, p.c.). "Timber fellers" were skilled in their selection of a site for felling a big tree, since damaged stems often cost a man his job (Franklin, p.c.).

Of the four types of steam-powered equipment employed—locomotives, overhead skidders, log loaders, and steam shovels—the overhead skidder did the most to change the forest environment. The earliest steam skidders, which were not used extensively in the region, employed cable winches to drag the logs along the ground. These were referred to as "groundhog" skidders (Thompson, p.c.), and, in principle, were quite similar to the present-day high lead systems—the chief difference being that the "groundhog" employed no boom.

The "Clyde" skidder was the model most widely used in the GSM region. It sat on short spur tracks beside the main line with a cable running from a boom on the skidder to a spar tree on a ridge up to 1000 yards away. A carriage referred to as a "buggy" moved along the overhead cable (Thompson, p.c.). The log-pickup cable ran from the skidder, through a pulley on the carriage to the ground. When the overhead system was first used, it lacked a locking mechanism for holding the logs at the carriage while being pulled toward the skidder. Logs were pulled laterally into the cable an average distance of 50 feet on either side of the overhead system. Damage to the residual trees and soil scarification was extensive especially just below the overhead cable (Thompson, p.c., Figure 3).

Once a locking system was devised to hold logs near the carriage, the overhead cable was located such that the logs could be retrieved with minimal dragging. However, low ridges, high places, and convex-shaped slopes between the spar tree and the skidder were severely disturbed, as were log landings.

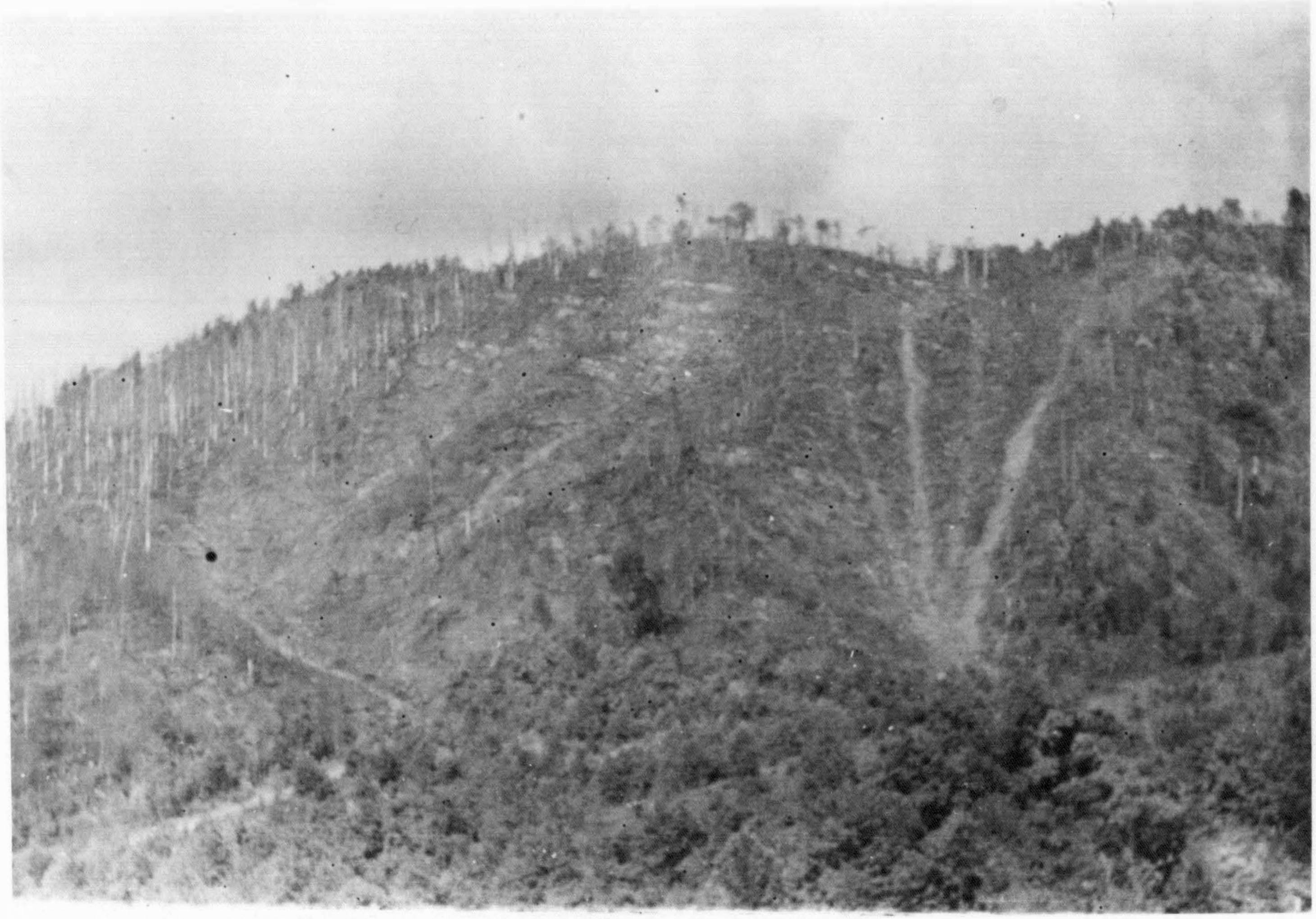

Figure 3. View of an area skidded by an overhead cableway system. The skidder sat at the downslope convergence of the skidlines, which mark former overhead cable positions.

Teams of horses or oxen were used to skid timber that could not be reached with skidder cables. Though the "teamed" logs maintained contact with the ground, damage was confined to narrow skidways (Figures 4 and 5). Such damage was minimal compared to that from overhead skidding.

The heavy fuels that accumulated following logging increased the likelihood of severe fires. Cinders from the boilers of heavy machinery made fire a constant threat during dry weather. A large acreage burned during the summer of 1925, as three years of below-normal precipitation resulted in a drought of "extraordinary severity." Precipitation was only one-third of the normal that season, which, combined with the heavy logging slash that had accumulated, resulted in a disastrous fire season (Hursh and Haasis, 1931).

Figure 4. Closeup of team skidpath showing local disturbance to the forest floor. Mineral soil was exposed and erosion enhanced.

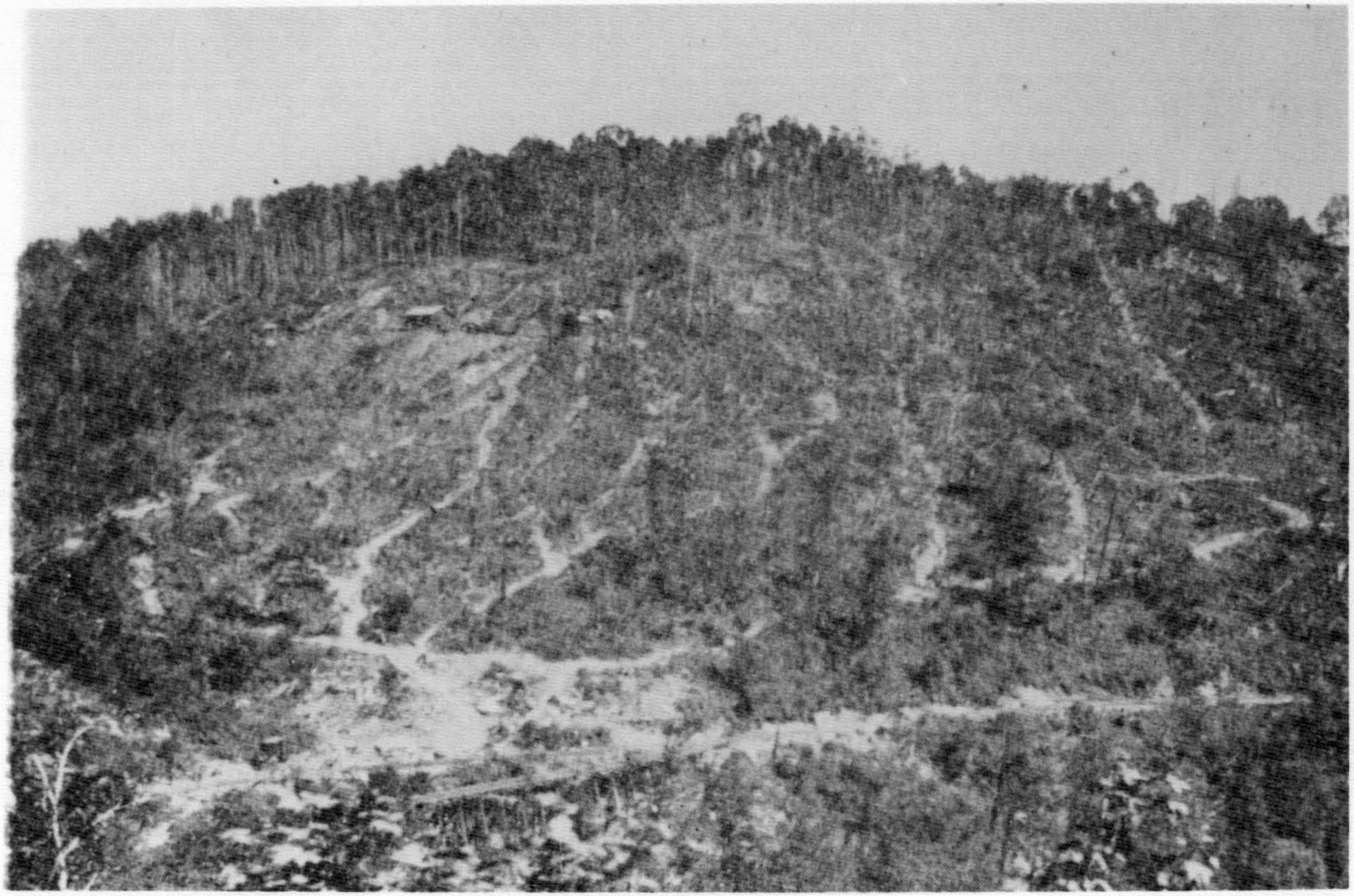

Figure 5. Team skidpaths were irregular with disturbance more confined to narrow paths than overhead skidders.

CHAPTER IV

METHODOLOGY

The scope of this study did not permit detailed examination of all of the major forest types and/or drainages within the Park. The first six months were devoted to identifying study areas (forest types or drainages) for which sufficient information was available to permit the necessary reconstruction of original conditions. Guidelines established early in the selection process were that at least two areas having contrasting forest types and topography, but disturbed in a similar manner to permit comparison, should be involved. Within these constraints the most desirable areas were considered to be those for which the most information was available. Sources considered to be of the greatest value in making these determinations were:

(1) individuals who had lived or visited in the region and recalled the vegetation and/or disturbances at specific locations (usually people who had been involved in logging the area);

(2) photographs of known locations that showed the original vegetation and/or the nature of the disturbance that altered it;

(3) written materials from which species composition and stand structure could be determined.

The search for information sources resulted in subdividing the Park into previous ownership units (Figures 6 and 7). Although changes in ownership were common, especially during the speculative period just prior to intensive logging, these units generally remained intact up to

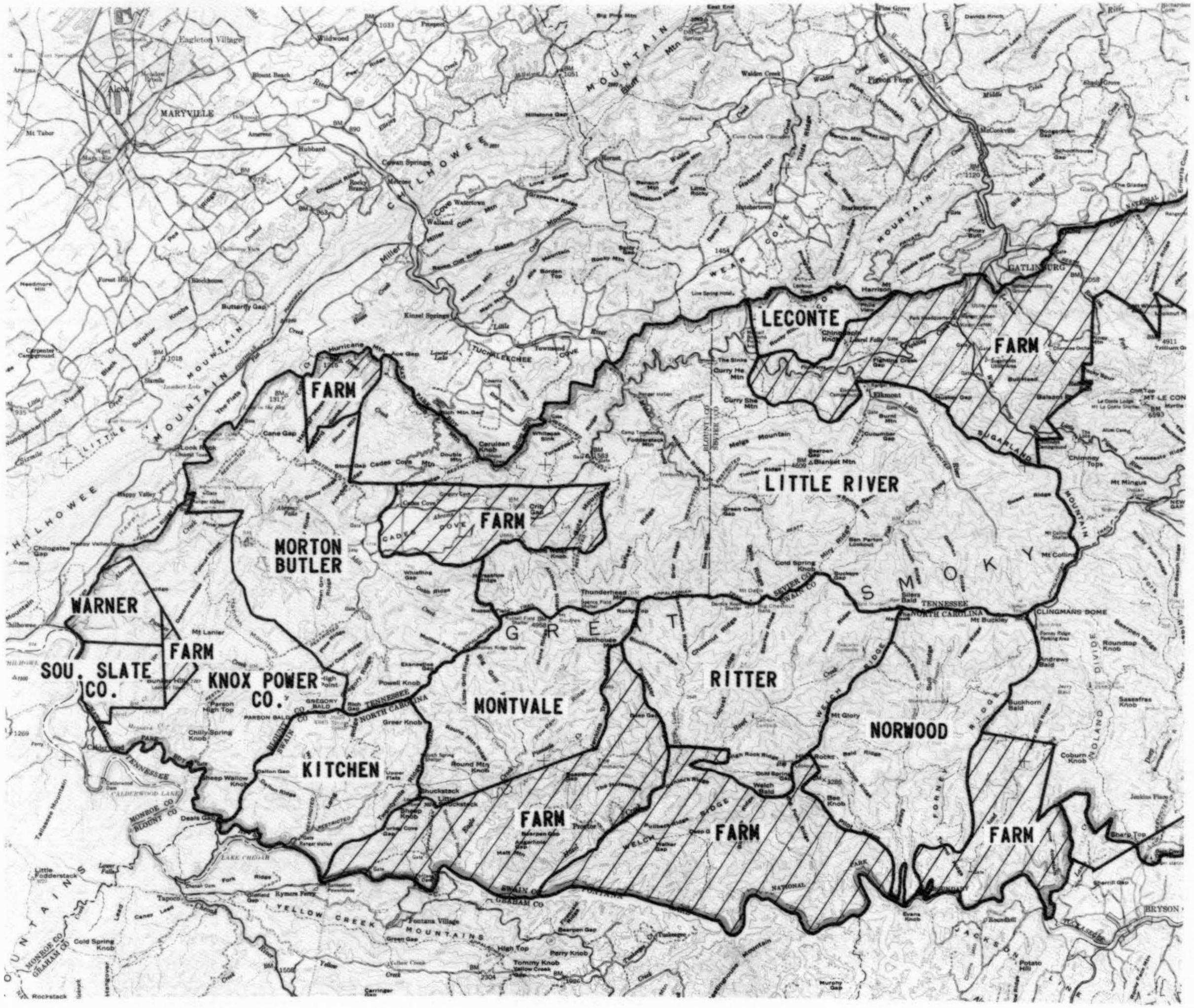

Figure 6. Western portion of the Great Smoky Mountains showing lumber company boundaries prior to Park establishment.

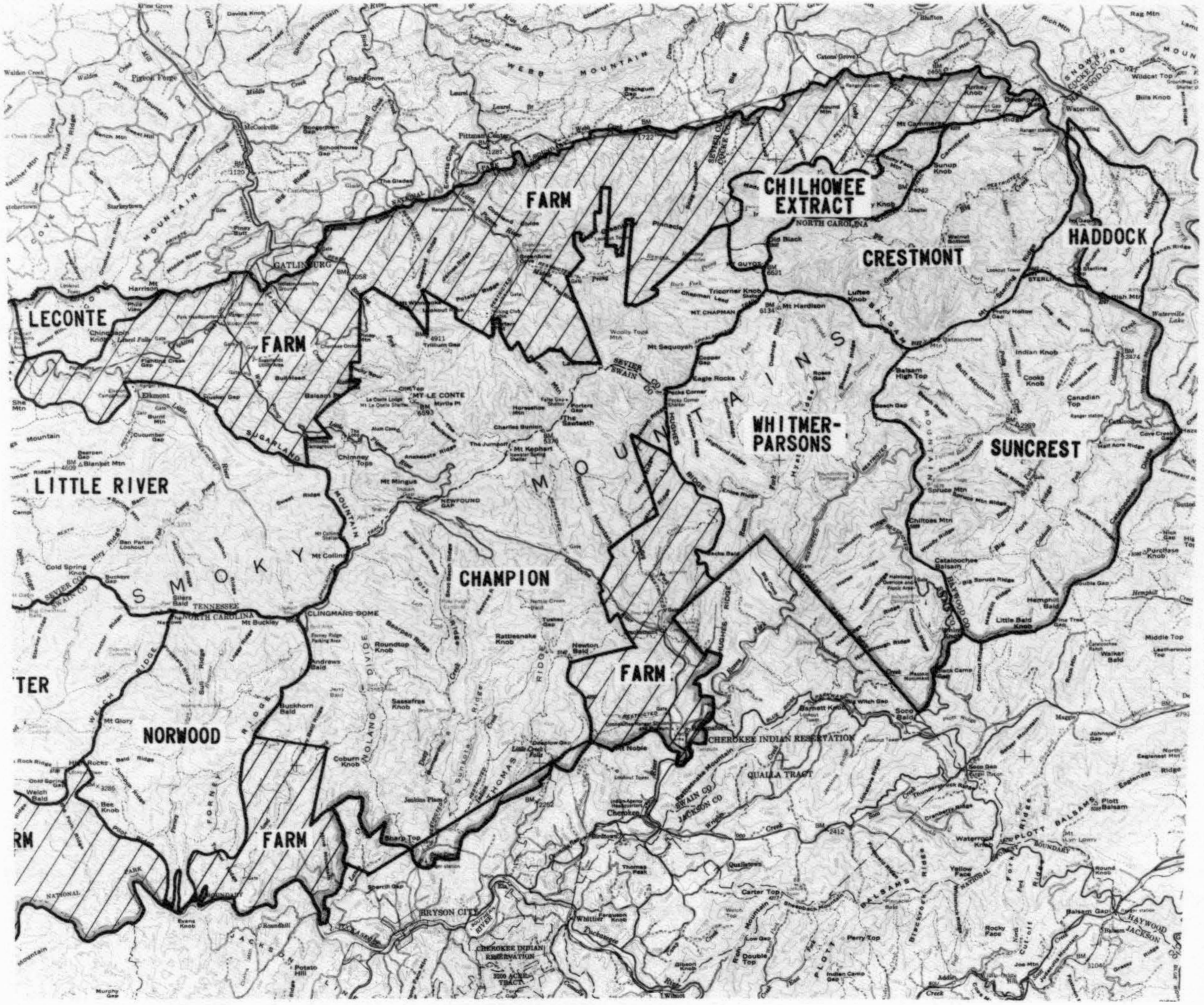

Figure 7. Eastern portion of the Great Smoky Mountains showing lumber company boundaries prior to Park establishment.

the time of Park establishment. Unit boundaries were usually watershed boundaries and effectively divided the region into logging chances.

I. SELECTION OF STUDY AREAS[1] AND STUDY LOCATIONS

The guidelines used to identify suitable study areas were:

1. Number of people available for reconstructing an oral history.
2. Continuity of coverage and degree to which individuals agreed in their characterization of conditions.
3. Availability of photographs or maps of potential sites which supported interview information.
4. Absence of confounding disturbances; i.e., secondary disturbances that would alter successional trends.
5. Accessibility of the area.[2]

The two areas that appeared to best meet selection criteria were: (1) Middle Prong of the Little River (Figure 6), and (2) the Cataloochee Balsam section of the Balsam Mountains (Figure 8). The Middle Prong area represented a low- to mid-elevation hardwood forest on the north (Tennessee) side of the Smoky Mountains where they are oriented essentially east-west. The Balsam Mountains are oriented north-south

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[1]For the purposes of this study, land units were arranged in the following order of decreasing size: (GSM region, areas within the region (commonly a drainage system), locations within areas (e.g., area logged from a single skidder setting), and sites within locations on which plots were established.

[2]Much useful information was gathered from older individuals who had been employed in the logging activities. Due either to ill health or age, most were unable to hike to remote mountain sites. Since their input was necessary in developing study history, potential study sites were limited to ones which could be reached by roads.

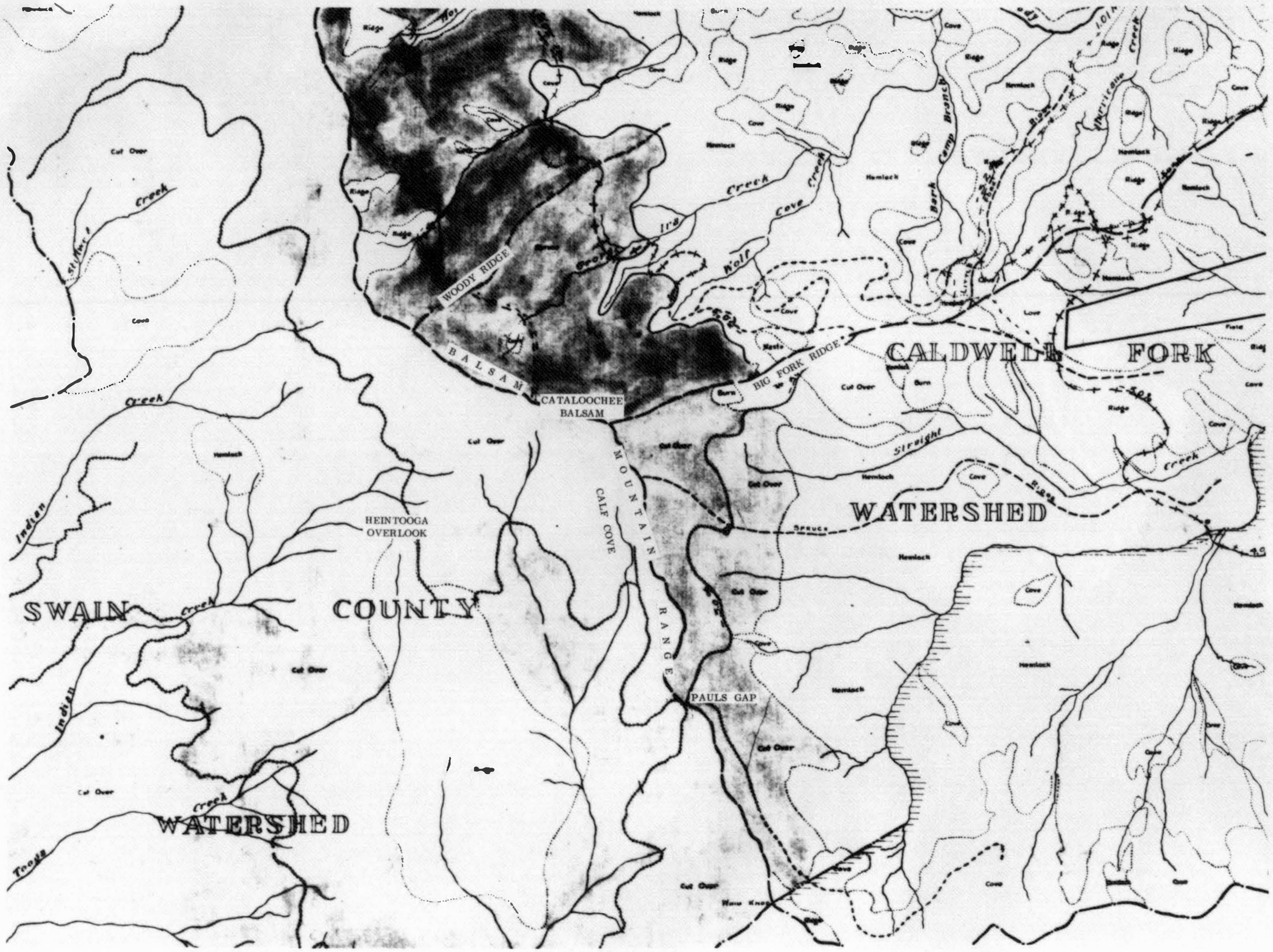

Figure 8. Cataloochee Balsam study areas were located on Big Fork Ridge and Woody Ridge. The darker area above Big Fork Ridge was noted as uncut red spruce forest, while the lighter shaded area below was "cutover" red spruce forest.

in the Cataloochee Balsam section and the higher peaks are just under 6,000 feet in elevation.

Several photographs showing logging and pre-logging stand conditions at known locations were available for the Middle Prong study area. Since this was the last drainage logged on the Tennessee side of the Park, numerous people familiar with early conditions were still available and could describe details more clearly than on older logging chances. A maintained road along Middle and Lynn Camp Prongs enabled easy access to this study area (Figure 6, page 19). Study locations on the Middle Prong were: (1) Skidder 5 setting, (2) the falls above Old Tremont, and (3) Log Ridge Branch. Locations 1 and 2 were in COVE forests and 3 was in a mid-elevation transition between a COVE and HEMLOCK forest (Figure 9).

Oral history on the Cataloochee Balsam study area was less detailed than for the Middle Prong due to the absence of roads and the earlier period in which it was logged. To compensate for the longer time period, care was taken to assure that the information used was from more than a single source. Photographs of logging activities in the Cataloochee Balsam area were found but could not be linked to specific locations. A boundary map showing cutting lines and timber types was used to identify the cutting line at the time lands were condemned for Park establishment. Study locations in the Cataloochee Balsam area were: (1) Woody Ridge, a virgin spruce-fir stand, and (2) Big Fork Ridge, a cut-over spruce-fir stand. Both study locations were in the spruce-fir zone (Figure 8).

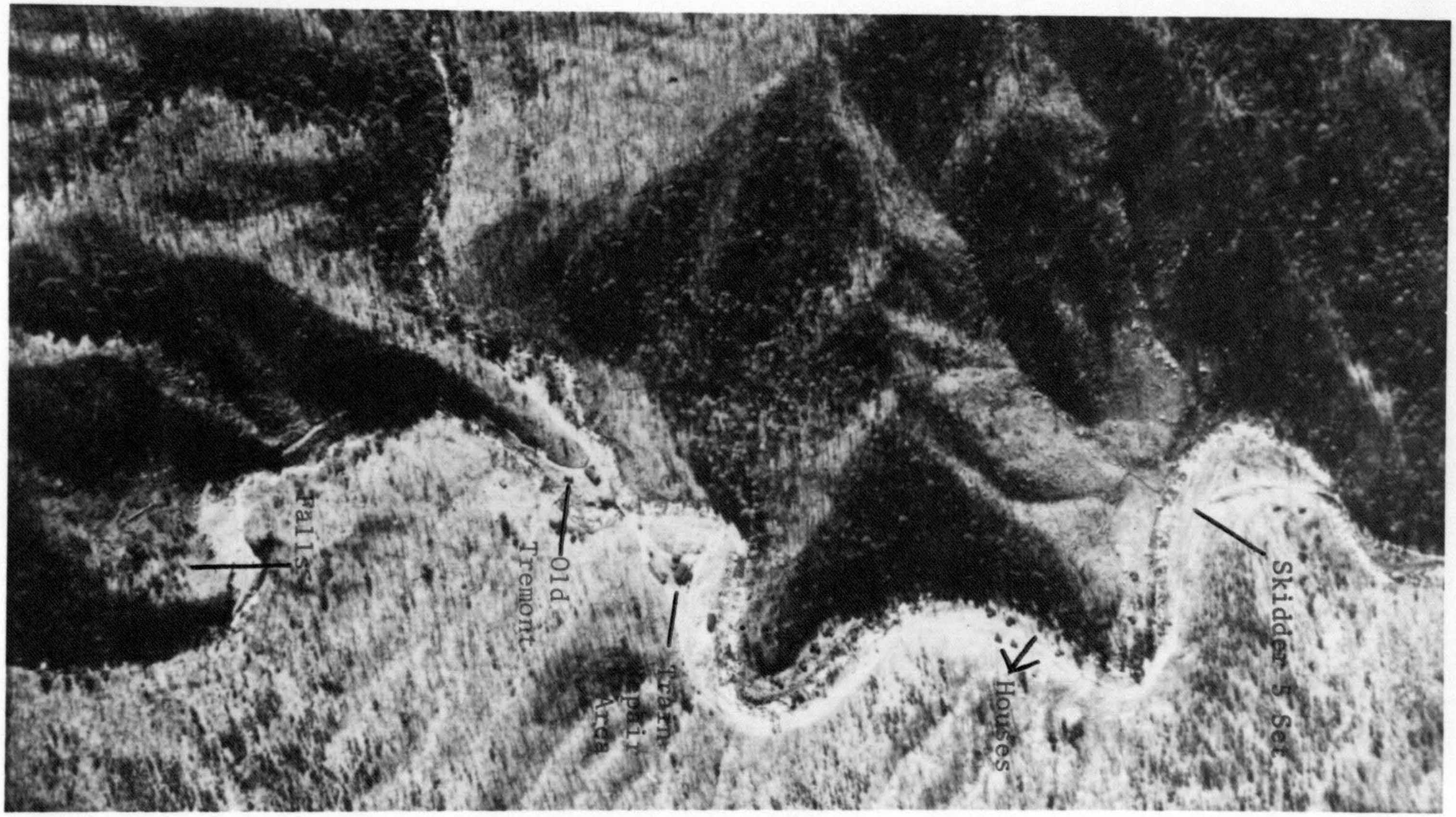

Figure 9. A 1926 aerial view of Old Tremont area at the convergence of Lynn Camp and Thunderhead Prongs on the Middle Prong of Little River showing study areas at Skidder 5 Set and the Falls. Other features are easily visible on cutover sites.

II. CHARACTERIZING ORIGINAL[3] STANDS AND THE NATURE AND DEGREE OF DISTURBANCE

Four methods were used to reconstruct original stand conditions and characterize the nature of the logging disturbance.

Interviews

An interview format was developed using guidelines developed with personnel from the Department of History at the University of Tennessee. The intent of the study was explained to each interviewee prior to asking for permission to tape the interview. There were no refusals, though many requested that certain comments be omitted from the recorded conversation. A small, portable, cassette recorder was used with a separate or condenser microphone. The small microphone was held casually and inconspicuously to encourage an informal and relaxed conversation. Interviews did not follow a rigid format. The general outline of questions asked is Appendix A, and a list of the persons interviewed is Appendix B.

The degree to which interviews were useful varied widely. Some were enthusiastic and eager to volunteer information; others were cooperative and adhered to pertinent issues, while a few rambled and had difficulty answering stated questions. Experience gained in the earlier interviews was helpful in guiding later conversations. Occasionally, photographs, news clippings, or other records were produced to better tell stories. However, pictures showing actual site disturbance

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[3]Here used for forest conditions prior to impacts from European settlers.

were rare. At times, interviewees would volunteer to return to or lead hikes into logged areas. When considered of value to the study, these trips were made, and where possible, a taped record kept (Appendix B).[4] Most on-site interviewing was done in close proximity to roads and points having easy access, although hikes into more remote areas were occasionally made. Detailed accounts of stand conditions prior to logging disturbance as well as good descriptions of the logging operations were often obtained. Care was taken in the interview process not to suggest answers, but rather encourage an unbiased response. When possible, information was cross-referenced to more than one source.

The insights gained from the interview method were of great value in reconstructing the original forest cover.

Written Materials

An extensive search was made for appropriate materials in the library and archives at Park Headquarters in Gatlinburg, Tennessee, State Archives in Nashville, libraries, and special collections of counties and educational institutions in areas surrounding the Park. Included were diaries, memoirs, surveys, newspaper and magazine articles, geneological records, property ownership titles, and other historical documents. Indian legends were of little value as they generally do not contain reliable descriptions of forest conditions.

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[4]Tapes are on deposit in the Archives of the GSMNP. These on-site descriptions generally contain accounts of the forests of specific areas.

Photographs

Photographs of value in reconstructing original stand composition and character were rare. More common were photographs of logging operations. These were found primarily in the Park Archives, journal publications, and in private collections. Those of particular value to this study were of identifiable locations on the selected study areas. Photographs of three specific locations on the Middle Prong taken while logging was in progress helped establish these as study sites. However, stand conditions on areas similar to study locations were used to substantiate the general nature of "original" stands prior to cutting.

Several dozen photographs were duplicated during the search for this type of documentation. These have been grouped according to appropriate subject headings and submitted to the Archives of the GSMNP.

Locating Virgin Stands

Virgin stands comparable to those logged were not present on Middle Prong. Similar stands were believed to exist on Indian Creek and Ramsey Prong on the north end of the Park and in Joyce Kilmer Memorial Forest south of the Park. Sampling was done in Joyce Kilmer to characterize a virgin stand considered to be pioneer following some natural disturbance. For the Cataloochee Balsam study area, a lumber company map[5] enabled locating the cutting line in existence at the time of land condemnation for Park establishment. A virgin spruce-fir stand was located and studied, as will be described for characterizing present

[5]Copies of this map have been submitted to the Archives of the GSMNP.

stand conditions. Comparison was made with plot data from a cutover spruce-fir stand having similar elevation, topography and aspect.

III. CHARACTERIZING PRESENT STAND CONDITIONS

On cutover areas present stands are composed of regeneration that became established following cutting and/or residual stems that were present at the time of cutting. To fully evaluate the impact of the disturbance on succession, the seral position of the present stand was established by determining the seral position of the species present in the various canopy levels.

Plots

Plots were established to document the present stand composition and structure on study sites for which the original stand condition and the nature of disturbance were known. Plot location was dictated by pictorial, verbal or written documentation of stand conditions prior to disturbance and/or the nature of the disturbing influence. This resulted in intensive study of very small areas. Plot size varied with larger plots used where stand conditions were heterogeneous. In general, 1/5-acre plots were used to sample upper canopy trees, 1/10-acre plots for subcanopy trees, and mil-acre plots for regeneration.

In a virgin spruce-fir stand in the Cataloochee area, plots were used to infer previous conditions in cutover areas.

Data Analysis

Reliable documentation of the nature and degree of disturbance was a primary requirement of the study plan. Such documentation was generally

available for such restricted areas that replicated sampling permitting statistical analysis was not possible. Plot data were used to determine the composition and structure of present stands, and this was related to the original stand structure (when known), the nature and intensity of the disturbance, and the recovery period.

Where possible, stump samples were identified to document composition prior to logging. This was especially valuable in the spruce-fir type in the Cataloochee area where cutting dates and response to release were determined from increment cores obtained from residual trees. Only chestnut stumps remained in the Middle Prong area due to faster decay rates at this elevation.

CHAPTER V

RESULTS AND DISCUSSION

I. MIDDLE PRONG OF LITTLE RIVER STUDY AREA

Original Forests of Middle Prong

Oral descriptions of the "original" forest cover on the Middle Prong suggested that it was a stable Mixed Mesophytic community (Braun, 1950). Early residents and loggers who lived and worked in the area recalled that dominant species were chestnut (*Castanea dentata* March.), beech (*Fagus grandifolia* Ehrh.), yellow-poplar (*Liriodendron tulipifera* L.), black cherry (*Prunus serotina* Ehrh.), hemlock (*Tsuga canadensis* L., Carr), butternut (*Juglans cinerea* L.), and various oaks, with buckeye (*Aesculus octandra* Marsh.) and basswood (*Tilia heterophylla* Vent.), more common at higher elevations. Chestnut, yellow-poplar and hemlock were the largest trees, often exceeding five feet in diameter, while the remainder of the saw timber averaged two and a half to three and a half feet in diameter (Figure 10) (Brackin, Sutton, Thompson, and McNeill, p.c.). Chestnut was the most frequent large tree, variously described as occurring "all over" the drainage and "present on every acre" (Brackin, Myers, Sutton, McNeill, Franklin and Thompson, p.c.). Yellow-poplar was distributed throughout hardwood forests at mid- to low-elevations, but was of greater frequence and dominance in moist coves and on fertile flats adjacent to streams. It commonly occurred as clumps of large trees in mature stands (Thompson and Sutton, p.c.).

Figure 10. Overhead skidder log landing on Little River showing average log size was between two and a half and three and a half feet in diameter.

Recollections of "a good mix of hardwoods" and "mixed timber" (Thompson and Franklin, p.c.) alluded to a forest cover that was so diverse that no species stood out as dominant. In discussing the mixed mesophytic association, Braun (1950) states that, "because of the large number of dominants of this climax, the composition and relative abundance of the dominants vary greatly from place to place." The great variety of sites within the Middle Prong drainage provided an array in which suitable sites for almost every faciation of the mixed mesophytic association might have been found.

Thompson (p.c.) recalled cutting six species on one site, five of which are dominants of the mixed mesophytic association (Braun, 1950).[1] Included were basswood and buckeye which Braun refers to as, "perhaps the most characteristic canopy trees of the mixed mesophytic association . . ." These two components were more common in the higher elevation cove forests. Early residents recalled, and species composition on similar, unlogged watersheds indicate, that high-elevation forests were not as diverse as those on lower sites (Sutton, p.c.). At lower elevations, chestnut and hemlock were described as the largest trees in the original forests as they were in Braun's (1950) description of the dry, upslope segregate of the mixed mesophytic association. Since rainfall was lowest at the lower elevations along Middle Prong,

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[1]The nine broad dominants of the mixed mesophytic association listed by Braun are American beech, yellow-poplar, sugar maple (*Acer saccharum* March.), American chestnut, sweet buckeye, red oak (*Quercus rubra* L.), white oak (Quercus alba L.), hemlock, and silver-bell (*Halesia carolina* var. *monticola* Rehd.). Basswood is also included in the Southern Appalachian Highlands.

shallow soils on excessively drained ridges at low elevations would be the driest sites, on which yellow pines and chestnut were described as dominant, with hemlock restricted to sheltered drainage bottoms that were cool and moist.

Yellow pines were rare except on the drier southern and western aspects of the lower ridges where they often formed pure stands (McNeill, Sutton, and Thompson, p.c.). Downstream from Walker Valley (the present site of Tremont Environmental Center), timber was described as having been poor and of little value; therefore, it was left uncut (Sutton and Thompson, p.c.).

A heavy litter layer at the time of cutting suggested no recent fires (Franklin, p.c.). The absence of black locust in the original stand (Thompson, p.c.) was evidence of the absence of the disturbance needed to maintain such intolerant species in the forest.

Further evidence of a stable, probably climax, mixed mesophytic community on the Middle Prong was the record of total lumber manufactured by the Little River Lumber Company between 1903-1939, a period in which all cutting was on the various tributaries of Little River within the GSMNP. Because each prong has generally the same aspect and physiognomy, site conditions and original species composition should have been similar. The cut percentages by species for all drainages during this period were:

**Ash	1%	*Maple	4%
*Basswood	5%	*Oak	4%
**Birch	2%	*Yellow-Poplar	11%
*Buckeye	3%	White Pine	3%

**Cherry	1%	Yellow Pine	2%
*Silverbell	1%	*Hemlock	52%
		Other	3%

Every hardwood listed is either one of the nine dominants (*) or the eight listed as abundant (**) by Braun (1950) in describing the mixed mesophytic association. Although cucumber magnolia is missing, it was tallied and sold as yellow-poplar (Thompson, p.c.). Since cutting was not selective, but rather, everything larger than 12 inches DBH, Lambert's listing appears to establish mixed mesophytic association in its many segregates as the "original" forest cover in the Middle Prong basin.

The Yellow-Poplar Enigma

The importance of yellow-poplar as a dominant tree in old-growth stands on the Middle-Prong appeared inconsistent with its silvical requirements. It is intolerant, yet site demanding, making it an aggressive pioneer on fertile sites that were drastically disturbed. That it was a common component, and the largest tree in the original forests was well documented by the oral record. The earliest commercial logging in the Smoky Mountains, around 1880, was exclusively for yellow-poplar.

The presence of yellow-poplar in the original forests appeared to be related to two factors: its size and the way it dies. Rapid growth throughout a long life span, resulting in the most massive tree in eastern North America, is characteristic of the species. Record measurements are approximately 12 feet in diameter, 198 feet high and an

average crown spread of 122 feet (American Forests, 1973; Harlow and Harrar, 1969). Beck and Della-Bianca (1972) recorded a site index at 50 years of 130 in second-growth stands on good mountain sites.

Tolerant trees that characteristically compose climax forests on good sites develop as random individuals from seeds that chance to germinate where the tree can survive long enough to reach the more favorable upper-canopy environment (Oliver and Stephens, 1977). Upon reaching physiological maturity, they commonly die as standing trees and fall to the ground slowly, piece-by-piece, doing little to disturb the site or damage the tolerant understory trees that will replace them.

Such was not the fate of the massive yellow-poplar. On good sites it continued to grow until its crown was well above the average upper canopy level. In this position a large crown developed, producing the phytosynthate needed to keep it growing through a long life span, but also making it susceptible to windthrow. In falling, these massive trees not only created a large opening in the overstory, but destroyed both overstory and understory trees over an area approaching a half acre. Impact with the ground disturbed the soil surface and exposed mineral soil to full sunlight. Warmed soil and full sunlight, for at least a portion of the day, fulfilled the regeneration requirement for this "pioneer" species.

Descriptions of its occurrence in original stands on the Middle Prong support this theory. It was described as larger in average diameter but less frequent than associate species and occurred as "clumps" of large trees in mature stands composed largely of

shade-tolerant species characteristic of climax stands (McNeill, Thompson, Trentham, and Gregory, p.c.).

Disturbance on the Middle Prong

The first mountain farmers moved into the lower valleys of the Middle Prong around 1859, generally settling along the flats adjacent to streams (Maryville College publication, mimeograph). Their only impact on the forest surrounding their cultivated land was the cutting of a few choice timbers for farm construction. Commercial logging involving river-driving began in the 1880's. Lambert (1961) estimates that, ". . . farmers and small mill operators (of the area) . . . cut from 25,000 to 250,000 feet of lumber each season" over the entire park area.

The J. L. English Company operated splash dams at the mouth of Marks Creek and in Spruce Flats sometime between 1880 and 1900. They were the first large-scale commercial loggers on the river (McNeill and Gregory, p.c.), cutting primarily yellow-poplar because it was a relatively buoyant, high quality wood (Lambert, 1961; Thompson, p.c.). Other desirable timber species grew close to streams but were usually left because they were not sufficiently buoyant for river-driving. An exception was the removal of the best black cherry, black walnut and ash from the lower elevations by team or wagon down primitive roads.

There was no commercial logging on the Middle Prong between 1900 and 1925. In 1925, the Little River Company moved its operations from the East Prong to Middle Prong (Lambert, 1961). Cutting was continuous between 1925 and 1938. In December 1938, the last load of logs was hauled to the mill at Townsend (Henry, p.c.). During this 13-year

period, the most advanced logging systems available were used to harvest the merchantable timber in the Middle Prong drainage. Trees and stands left were either below the merchantable size limits (less than 12 inches), of low quality, or of undesirable species (Figure 11). Residual trees were usually damaged by the logging operation.

Although cutting was still done with a crosscut saw, steam-powered skidders, log loaders and locomotives typified operations of the Little River Lumber Company. Railroads followed the valley bottoms and narrow stream beds. Spur lines were constructed into areas having valuable timber. When grades became too steep for the railroads, tramlines were constructed and a winch-powered car called a "Sary Parker" was used to remove timber (Shields, p.c.). Using their own power, these small skidders moved up tramways to new "settings." Loaded cars were lowered to the main track by the Sary Parker. Some team skidding was done in the drainage, usually in areas not suitable for steam skidders, too small to justify a skidder set, or small areas beyond working range of a skidder setting.

Study Locations on the Middle Prong

Photographic documentation was used to establish three study locations on the Middle Prong.

Skidder 5 study location. This study location was the area logged from a single setting of a steam skidder, approximately one mile below Old Tremont (Figure 9, page 24). Although most of the study site was on the steep, (slope 35 percent), northwest-facing foot slope of Defeat

Figure 11. View of a skidded area on Little River showing cutting line above which timber of lower, nonmerchantable quality was left uncut.

Ridge, a "flat" (small flood plain) on the south side of Middle Prong was included. The entire area was "sheltered" due to its northern aspect and footslope location. Elevation ranged from approximately 1,800 feet at the skidder setting to over 2,500 feet near the spar-tree settings on the ridge.

1. Reconstruction of pre-logging stand. Former loggers recalled that a high-quality stand of mixed hardwoods occupied the Skidder 5 study site prior to logging (Brackin, Culp, Sutton, and Thompson, p.c.). Their average diameter was between two and a half and three and a half feet (Figure 10, page 31). Specific information on volume, size and stand structure was not available. Species cut was described as ". . . a good mix of hardwoods . . . maple (probably sugar), basswood, buckeye, yellow-poplar, cucumber, peawood (silverbell) . . ." (Thompson, p.c.).

The ridgetop did not support quality timber (Brackin, Sutton, and Thompson, p.c.). "Scrubby" stands of yellow pines, small hardwoods, shrubs, and "grapevines" (probably *Vitis*) were visited by loggers only to locate spar trees and attach the cable used to log the slopes below. Occasionally large Virginia, pitch, shortleaf, and/or table mountain pine near the ridgetop were harvested for sawtimber which suggested that most trees were under 12 inches in diameter (McNeill, Sutton, and Thompson, p.c.).

2. Nature of disturbance. The Little River Company's Skidder 5 (Clyde Overhead) operated at this location for several months in late 1925 and early 1926 (Thompson, Trentham, Sutton, Brackin, and Franklin, p.c.). The skidder operated from a railroad spur on the north side of

Middle Prong skidding logs across the river from a north-facing slope on the south side of the river. Spar trees were located along a ridge line to the south of the skidder setting. Logs were skidded down the irregular slope across the river and dropped by the railroad landing.[2] Sutton (p.c.) recalled that logs were generally suspended in the air as they were pulled toward the skidder minimizing disturbance to the litter layer. After logging was completed, the litter layer was relatively undisturbed but residual trees were badly mutilated (Thompson, Sutton, and Brackin, p.c.). Thompson (p.c.) described sites where overhead skidders had operated as "all torn up" and having "nothing left standing" after logs were removed (Figure 12). All commercial timber was removed from this setting. There are no records of fires during or after logging.

The three to four acre "flat" adjacent to the stream was used for vegetable gardening by employees of the lumber company. Early aerial photography indicates it was fenced. Thompson and Sutton (p.c.) recalled that this was necessary to keep out deer and ranging livestock. Such garden plots were common adjacent to most logging camps in the GSM region.

3. Present stand conditions. Study plots were established on two sites at the Skidder 5 location to characterize present stand structure: (1) on the flood plain used for gardening following logging (hereafter called "garden flat"), and (2) the north-facing slope south of the garden flat (hereafter called "slope"). Both areas were moist and sheltered

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[2]The present gravel access road along Middle Prong follows the old railroad grade.

Figure 12. Panoramic view of overhead skidder operation and resultant disturbance to the forest.

with deep, well-drained soils. Such sites are among the most productive in the Park. Although one area was sloping (average slope approximately 35 percent) and the other flat, the primary difference that might influence stand composition and structure was the different degrees of disturbance. Cultivation should have assured that overhead competition was completely removed and mineral soil uniformly exposed at the surface, conditions that favor pioneer vegetation. While verbal descriptions and an aerial photograph suggested that woody vegetation on the slope was largely eliminated, claims were that the litter layer was left intact and broken hardwood stems generally sprouted profusely and/or recovered rapidly on good sites.

A. Upper canopy. Yellow-poplar and black locust were the only species present in the upper canopy on both sides (Figures 13 and 14). Yellow-poplar was more important on the garden flat where it comprised 87 percent of the stems compared to 66 percent on the slope (relative basal areas of 91 and 65 percent, respectively). Uniform exposure of mineral soil to full sunlight on the garden flat probably resulted in abundant yellow-poplar regeneration.

B. Subcanopy. At the garden flat 13 species were represented in the subcanopy. Sassafras and red maple were the most abundant, accounting for, respectively, 21 and 24 percent of the stems and 52 and 19 percent of the basal area. Yellow-poplar accounted for 14 percent of the stems and 12 percent of the basal area, while 9 other species comprised 39 percent of the stems and 16 percent of the basal area.

As the stem density-basal area ratio indicated, sassafras stems were large, while red maple were small. Sassafras was probably in the

Figure 13. Tall, straight second-growth yellow-poplar accompanied by occasional black locust characterized the sites on which all of the original cover was removed and the soil surface scarified.

Figure 14. Lower slopes having rich, deep soils supported stands which were dominantly high-quality yellow-poplar. The scene is facing downslope on Skidder 5 Set with the road (former railroad bed) in the background. Overhead cables ran from a point downslope adjacent the road up the slope to a higher ridge behind the picture position.

upper canopy for several years following stand establishment, but faster growth of yellow-poplar and black locust soon relegated it to the understory where, being intermediate in tolerance, it was being slowly suppressed. Red maple, having wind disseminated seed and being relatively tolerant, was probably an invader species that became slowly established in the understory of the pioneer stand. It will likely increase in importance in the subcanopy at the expense of sassafras and yellow-poplar. The low representation of yellow-poplar was due to its intolerance; it does not live long once it drops into the understory. Black locust, being highly intolerant, dies even more rapidly when suppressed and was essentially absent in the subcanopy.

In contrast to the garden flat, on the slope only five species were represented in the subcanopy, with yellow-poplar accounting for 87 percent of the stems and 66 percent of the basal area. The large stem to basal area ratio suggested that the numerous small trees were overstory residuals that were in the process of being killed by suppression. The absence of a significant component of tolerant trees (Table 1) suggested that this subcanopy will remain more open than that at the garden flat.

C. Regeneration. Eight species were represented in regeneration on the garden flat and six on the slope. Red maple accounted for 45 percent of the regeneration on the garden flat and sassafras 29 percent. Regeneration on the slope was 50 percent sassafras, 22 percent sugar maple, and 11 percent for both red maple and sweet birch. Except for sassafras, for which repeated rootsprouting and dieback is common, the regeneration was composed of relatively tolerant trees that will likely

Table 1. Absolute and Relative Stem Densities and Basal Areas by Canopy Position at the Skidder 5 Location on Middle Prong.

Canopy Level	Garden Flat				Species	Slope			
	Elevation 1800'					Elevation 2,000'			
	Slope >5%					Slope 35%			
	Aspect NW					Aspect N 40°W			
	# Stems /A.	%	Basal Area/A.	%		# Stems /A.	%	Basal Area/A.	%
Upper	16	(13)	13	(9)	Black Locust	40	(34)	50.9	(35)
Canopy	104	(87)	125	(91)	Yellow-Poplar	76	(66)	95.4	(65)
. Total	120	100	138	100	Total	116	100	146.3	100
Subcanopy	10	(2)	4.9	(11)	Black Locust	5	(3)	2.6	(7)
	60	(14)	5.2	(12)	Yellow-Poplar	130	(87)	30.6	(82)
	90	(21)	22.7	(52)	Sassafras	—			
	30	(7)	0.6	(1)	Northern Red Oak	—			
	100	(24)	8.2	(19)	Red Maple	5	(3)	0.5	(1)
	10	(2)	0.1	—	Yellow Birch	5	(3)	2.0	(5)
	20	(5)	0.2	(1)	Hercules Club	—			
	10	(2)	0.1	—	Hickory	—			
	40	(10)	0.4	(1)	Dogwood	—			
	10	(2)	0.1	—	Silverbell	5	(3)	1.6	(4)
	10	(2)	0.1	—	Stripped Maple	—			
	20	(5)	0.9	(2)	Cucumber Magnolia	—			
	10	(2)	0.1	—	Hemlock	—			
Total	420	96	43.6	99	Total	150	99	37.3	99
Regeneration	1125	(29)			Sassafras	1000	(50)		
	125	(3)			Northern Red Oak	111	(6)		
	1750	(45)			Red Maple	222	(11)		
	125	(3)			Hercules Club	—	—		
	125	(3)			Hickory	—	—		
	125	(3)			Dogwood	—	—		
	375	(10)			Silverbell	222	(11)		
	125	(3)			Stripped Maple	—	—		
	—	—			Sugar Maple	444	(22)		
Total	3875	99			Total	1999	100		

NOTE: Within each canopy class species are arranged in the order of increasing tolerance.

be dominants in the next generation. Greater species diversity and absolute density at the garden flat and the higher relative importance of sugar maple on the slope suggested that the garden flat will go through a longer and more complex mid-successional stage, while the slope will progress more rapidly toward a climax condition.

D. Discussion. Present stand structure on these two areas indicated that both were disturbed sufficiently for the complete dominance of pioneer species in the first seral stage. However, a much greater variety of species that are characteristic of intermediate successional stages was present in the subcanopy of the garden flat. The greater abundance of highly tolerant trees characteristic of climax forests in the regeneration on the slope suggested a rapid return to the climax condition. This trend was even more apparent when the prolific rootsprouts of sassafras, which do not compete successfully in the understory, were not considered.

Falls on Lynn Camp Prong above Old Tremont. This location was upstream from and approximately 100-300 feet higher (elevation 2,100 feet) than the Skidder 5 location, and was logged by a Clyde overhead skidder situated downstream from the photographic position used for Figure 15. Following logging, a small "level" area (to right of cleared slope in Figure 9, page 24) was used for gardening by loggers.

1. Reconstruction of pre-logging stand. Ramer Brackin (p.c.), who helped skid logs from this location, remembered the timber as "mixed," but with no black cherry. Numerous large chestnut stumps still present in the area attested to its importance in the original stand. Present

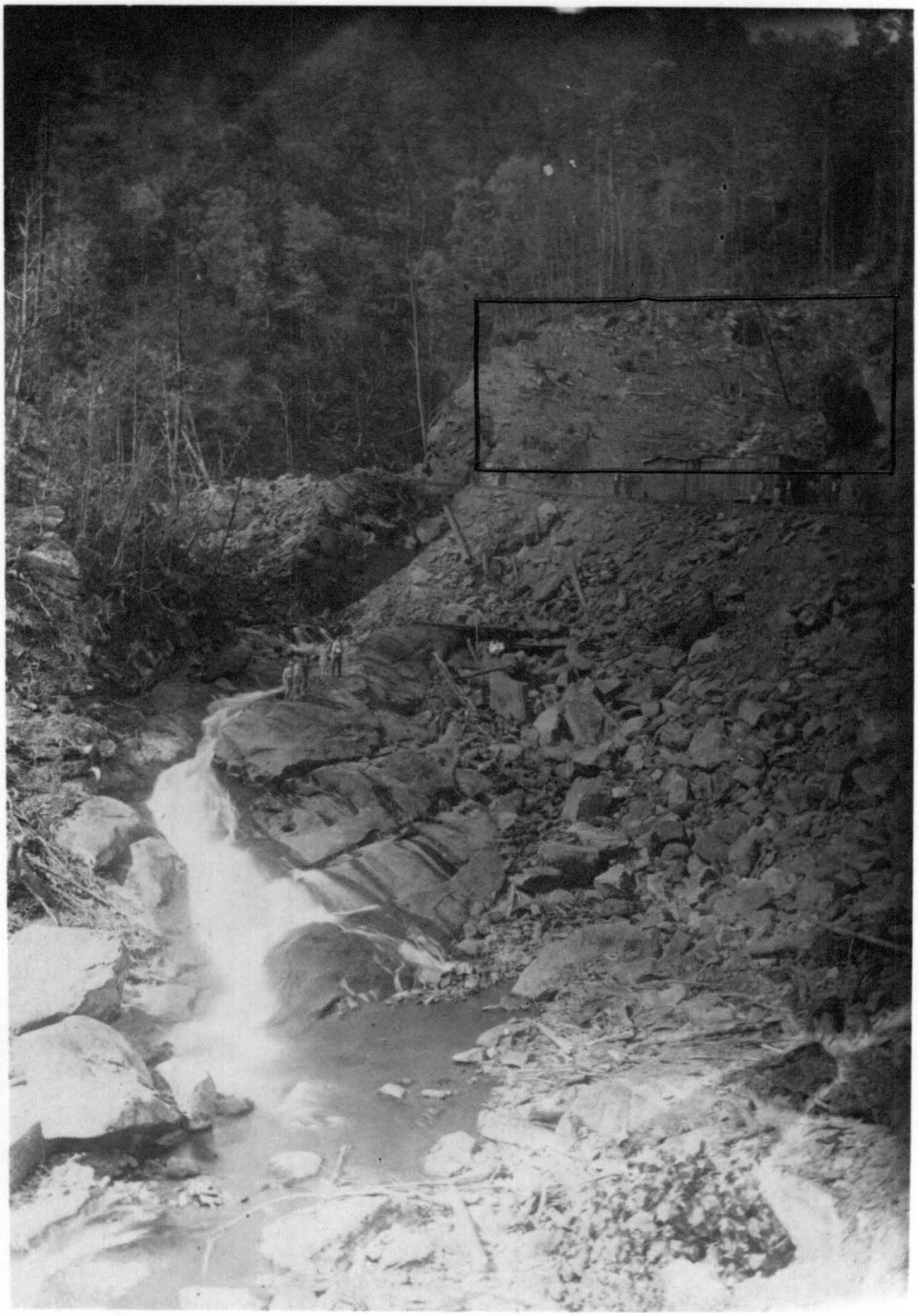

Figure 15. Falls above Old Tremont showing area at right where logs were cut and skidded. Boxed area was the site of the slope plots. Note the near complete removal of forest cover.

stand conditions and a sheltered, northwest aspect suggested that this was on the mesic extreme of the sites to which chestnut was native.

Although several people interviewed were involved in logging this area, they could not provide additional detail on stand conditions prior to logging. Topography, aspect, elevation and present conditions indicated that the forest cover was similar to that at the Skidder 5 location.

2. Nature of disturbance. All merchantable timber was removed from the Falls section of Lynn Camp Prong between 1926 and 1930. The exact date of timber removal from the location pictured in Figure 15 was not known. Following logging, the few gentle slopes close to the railroad were generally used as garden plots until logging stopped in 1938. Logging equipment and methods were essentially the same as at the Skidder 5 setting except that study sites were not in the path of the primary skidder line, as was the case at the Skidder 5 location. Former loggers recalled that the soil surface was little disturbed by logging but most residual trees were broken (Brackin and Franklin, p.c.; Figure 15).

Other than brush burning to clear the "flats" for gardening, there have been no fires in this area since logging.

3. Present stand conditions. As was the procedure at the Skidder 5 location, two areas were studied to contrast present stand conditions where: (1) a west-facing slope (40 percent slope) was logged in the manner described, and (2) a more gentle (15 percent slope) north-facing slope was used for gardening for several years following logging.

A. Upper canopy. Six species were represented in the upper canopy on the slope at a density of 230 stems per acre (93 sq. ft. B.A.), while on the garden "flat" the upper canopy was composed entirely of yellow-poplar and black locust at a density of 110 stems per acre (99 sq. ft. B.A.) (Table 2). Black locust was absent from the upper canopy on the slope where approximately 20 percent of the stems were sufficiently tolerant to represent intermediate successional stages. As was true on the garden flat at the Skidder 5 location, the overstory on the garden site was composed entirely of intolerant species, which suggested rapid and uniform establishment of pioneer trees on a completely cleared area. Greater species diversity on the slope which included heavy-seeded species (e.g., oak) more characteristic of later seral stages, as well as intolerant pioneer species, suggested a stand of mixed origin: seedlings and sprouts. The intolerant trees in the overstory probably originated from seeds as sprouting stock should not be present in an undisturbed stand. The numerous small stems on the slope (230/A = 93 sq. ft. B.A.) compared to fewer but larger trees on the garden "flat" site (110/A = 99 sq. ft. B.A.) suggested that stand structure developed more rapidly in pioneer stands developing from seeds on a uniformly disturbed site rather than in mixed stands from both seeds and sprouts.

A. Subcanopy. As was true at the Skidder 5 location, species diversity in the subcanopy was greater on the garden site, 12 species compared to 7 on the slope (Table 2). Yellow-poplar accounted for 41 percent of subcanopy basal area on the garden "flat" and only 18 percent on the logged slope, the reverse of its subcanopy role at the Skidder 5 location. Subcanopy basal area was greater on the garden "flat"

Table 2. Absolute and Relative Stem Densities and Basal Areas by Canopy Position at the Falls Location on Middle Prong.

	Garden Flat					Slope			
	Elevation			2100'		Elevation			2100'
	Slope			15%		Slope			40%
	Aspect			N20°W		Aspect			S10°W
Canopy Level	# Stems /A.	%	Basal Area/A.	%	Species	# Stems /A.	%	Area/A.	%
Upper Canopy	15	(14)	10.9	(11)	Black Locust	—	—	—	—
	95	(86)	87.8	(89)	Yellow-Poplar	100	(43)	71.2	(77)
	—		—		Sassafras	10	(4)	1.7	(2)
	—		—		Northern Red Oak	10	(4)	5.0	(5)
	—		—		Red Maple	30	(13)	4.1	(4)
	—		—		Yellow Birch	70	(30)	9.3	(10)
	—		—		Sourwood	10	(4)	1.4	(2)
Total	100	100	98.7	100		230	98	92.7	100
Subcanopy	90	(17)	17.0	(48)	Yellow-Poplar	25	(5)	4.3	(16)
	20	(4)	2.8	(8)	Sassafras	—		—	
	10	(2)	—		Sweet Gum	25	(5)	2.8	(10)
	10	(2)	2.7	(8)	Sycamore	—		—	
	60	(12)	2.7	(8)	Red Maple	325	(59)	8.8	(32)
	20	(4)	—		Black Gum	50	(9)	0.8	(3)
	20	(4)	2.1	(6)	Black Cherry	—		—	
	30	(6)	1.8	(5)	Yellow Birch	100	(18)	9.0	(33)
	10	(2)	0.1	—	Holly	—		—	
	50	(10)	1.2	(3)	Sourwood	—		—	
	20	(4)	0.2	(1)	Hickory	—		—	
	10	(2)	0.1	—	Dogwood	—		—	
	170	(33)	4.8	(14)	Silverbell	25	(5)	1.8	(7)
Total	520	102	35.5	101		550	101	27.5	101
Regeneration	222	(3)			Yellow-Poplar	—	—		
	1000	(14)			Sassafras	—	—		
	111	(2)			White Pine	—	—		
	111	(2)			Sweetgum	—	—		
	556	(8)			N. Red Oak	1500	(41)		
	2333	(33)			Red Maple	500	(14)		
	111	(2)			Black Cherry	500	(14)		
	111	(2)			Yellow Birch	—	—		
	111	(2)			Hickory	167	(5)		
	1111	(16)			Dogwood	—	—		
	556	(8)			Silverbell	—	—		
	667	(9)			Stripped Maple	—	—		
	111	(2)			Hemlock	1000	(27)		
Total	7111	103				3667	101		

NOTE: Within each canopy class species are arranged in the order of increasing tolerance.

(36 sq. ft./A.) compared to the logged slope (28 sq. ft./A.), with the large residual yellow-poplar component which accounted for most of the difference. Except for numerous silverbells on the garden "flat" site, the subcanopy on the slope contained a greater representation of tolerant trees, which suggested that the next overstory generation will represent a later seral stage than will be true on the garden "flat." Large numbers of residual yellow-poplar trees in the subcanopy and a wide diversity of other species ranging from tolerant to intolerant suggested that the pioneer overstory does not create heavy shade. An erratic subcanopy distribution on the slope suggested considerable variation in the degree to which the site was disturbed.

C. Regeneration. Regeneration on the garden "flat" (7,111 stems/A.) was much more abundant than on the slope (3,666 stems/A.). This possibly reflected greater opportunity for seeds to germinate beneath the pioneer stand that dominated the garden "flat" than on the more shaded forest floor characteristic of later seral stages. Approximately half of the regeneration on the garden "flat" was sassafras and red maple, while on the slope, northern red oak and hemlock, representing mid- and late-seral stages, were most abundant.

D. Discussion. Present stand structure and species composition indicated the more complete elimination of the original forest cover on the slope at the Skidder 5 location than was the case on the slope at the Falls location. This seemed in keeping with the apparent logging pattern: the slope site at Skidder 5 was directly in the path of the return cable over which most of the logs removed from the slope had to pass, a situation that would be highly destructive of residual trees.

The absence of tolerant trees from sprouts may be related to skidder operation into the spring months, eliminating those sprouts that originated immediately following logging.

In contrast, the slope at the Falls appeared to have been some distance from main cable lines, harvested logs having been snaked laterally out of the stand toward a main line with minimal disturbance to the site. This would have resulted in heterogeneous conditions ranging from disturbed soil with full sunlight reaching mineral soil favoring pioneer regeneration, to areas where, although all standing trees appear to have been removed (Figure 15, page 48), sprouts were the common form of regeneration.

Log Ridge Branch location. The Log Ridge Branch location was approximately two miles upstream from, and 700-1100 feet higher (elevation 2,800-3,200 feet) than the Falls location. The study sites were on a steep (55 percent slope) tributary drainage (Log Ridge Branch) of Lynn Camp Prong. Both study sites were on lower-slope positions and were sheltered by higher ridges to the southwest.

1. Reconstruction of pre-logging stand. Although specific descriptions of pre-logging conditions on the study sites were not available, Trentham (p.c.) recalled that chestnut was the dominant tree in the drainage. Figure 16, taken while logging was in progress, suggested a mixed hemlock-hardwood stand which agreed with recollections of loggers (Trentham and Brackin, p.c.). At this elevation, yellow birch would be the likely hardwood associate of hemlock in an old-growth stand.

Figure 16. Upper slope of Log Ridge Branch, one side cut and bucked, where hemlock appeared to be a component of the stand.

2. Nature of disturbance. The degree to which logging removed the woody overstory was evident from Figure 16. Skidding of the bucked logs shown in the foreground caused some further disturbance to the soil surface. Later logging extended well above the cutting line evident on the picture. Timber harvesting continued up this drainage (Log Ridge Branch) for several miles and was accessible by a spur line that was constructed along the slope in the upper left of Figure 16. A cable system was used to pull empty cars up and lower loaded cars down the steep track.

Site conditions following logging were characterized as high elevation, mesic, completely open and with a disturbed litter layer, but with no alteration of the soil profile.

3. Present stand conditions. Two study sites were established, the upper slope site in the foreground of Figure 14 (page 44), and the lower slope site located several hundred yards below and adjacent to the mouth of Log Ridge Branch.

A. Upper canopy. Although approaching the upper elevation at which it is commonly found on the west side of the Smoky Mountains, yellow-poplar comprised over one third of the upper canopy stems on both sites and over 50 percent of the basal area (Table 3). The large basal area-stem density ratio suggested that these were the largest trees in the upper canopy. The few sassafras in the upper canopy were probably remnants of a much larger initial population that was suppressed by yellow-poplar. Two invader species, red maple and yellow birch, were components of the upper canopy. On the upper site they accounted for 65 percent of the stems and 45 percent of the basal area. They were

Table 3. Absolute and Relative Stem Densities and Basal Areas by Canopy Position at the Log Ridge Branch Location on Middle Prong.

	Upper Slope					Lower Slope			
	Elevation 3200'					Elevation 2800'			
	Slope 55%					Slope 55%			
	Aspect S40°W					Aspect S20°W			
Canopy Level	# Stems /A.	%	Basal Area/A.	%	Species	# Stems /A.	%	Basal Area/A.	%
Upper Canopy	60	(30)	46.3	(50)	Yellow-Poplar	90	(41)	98.3	(65)
	10	(5)	4.3	(5)	Sassafras	40	(18)	12.0	(8)
	—		—		N. Red Oak	10	(5)	12.9	(9)
	90	(45)	29.7	(32)	Red Maple	20	(9)	9.9	(7)
	40	(20)	12.5	(13)	Yellow Birch	50	(23)	16.0	(11)
					Sourwood	10	(5)	2.4	(2)
Total	200	100	98.2	100		220	101	151.5	102
Subcanopy	400	(35)	11.0	(31)	Red Maple	200	(71)	17.0	(78)
	450	(39)	19.5	(56)	Yellow Birch	40	(14)	4.5	(21)
	—		—		Holly	20	(7)	0.2	(1)
	—		—		Sourwood	10	(4)	0.1	(1)
	100	(9)	1.5	(4)	Witchhazel	—		—	
	—		—		Silverbell	10	(4)	0.1	(1)
	200	(17)	3.0	(9)	Hemlock	—		—	
Total	1150	100	35.0	100		280	100	21.9	102
Regeneration	Not Present in Measurable Amounts				Sassafras	2000	(80)		
					Holly	167	(7)		
					Witchhazel	333	(13)		
Total						2500	100		

NOTE: Within each canopy class species are arranged in the order of increasing tolerance.

less important on the lower site where they accounted for 32 percent of the stems and 13 percent of the basal area. Red maple was more important on the upper site and yellow birch on the lower.

B. Subcanopy. Red maple and yellow birch were the primary arborescent species in the subcanopy on both upper and lower sites, comprising 74 and 85 percent of the stems, and 87 and 97 percent of the basal area, respectively. Their importance in the subcanopy was the reverse of that in the overstory, red maple being more important on the lower site while yellow birch was more important on the upper site, where the hemlock component was also significant. Species diversity was also greater on the lower positions (Table 3). Yellow-poplar, the overstory dominant, was absent in the subcanopy.

C. Regeneration. A dense rhododendron thicket dominated the lowest canopy level at the upper site (Figure 17), while the three species regenerating at the lower position did not represent potential upper canopy dominants.

D. Discussion. A rapid return to a late seral condition in which composition is dominated by yellow birch and hemlock appeared to be the trend on the upper position. Greater species diversity in the understory and the absence of a significant component of highly tolerant trees suggested a longer period in which intermediate seral stages are dominant on the lower position. This seemed consistent with the apparent degree of logging disturbance. The lower plots were near the confluence of Log Ridge Branch and Lynn Camp Prong, where the spur line intersected the main logging railroad, an area which was subject to greater disturbance than the upper plots located along the spur track.

Figure 17. Second growth stand on upper slope of Log Ridge Branch where dense undergrowth was precluding regeneration.

Present Stand Conditions on the Middle Prong

Present stand conditions on the three study locations on Middle Prong indicated that yellow-poplar dominated the regeneration that became established following cutting, in many instances forming almost pure stands over areas which had supported stands of mixed mesophytic species. On the better sites (garden flats and lower slopes at both Skidder 5 and the Falls locations), yellow-poplar, along with a few black locust, dominated present upper-canopies. Where soils were thinner and drier and at higher elevations (upper slope at the Falls site and on Log Ridge), yellow-poplar regeneration was less aggressive and upper-canopy space was shared with several more tolerant species. There was wide variation in the seral position of both understory species and regeneration on the various sites. Those sites that were not cultivated appear to have had a larger representation of the more stable, climax species in the understory.

Despite increasing species diversity, second growth stands on the Middle Prong contained only four of the eight mixed mesophytic species listed in the mill talley at the Townsend mill. Both basswood and buckeye were missing. Their absence, along with a high percentage of trees classed as intolerant and intermediate in tolerance (Baker, 1949), suggested that the pioneer yellow-poplar will be replaced by an association representing a mid-successional stage.

II. THE CATALOOCHEE BALSAM STUDY AREA

The Cataloochee Balsam study area was on a section of the Balsam Mountain range oriented in a north-south direction and between 5,500 and

5,800 feet (Figure 8, page 22), well above the lower limit of the spruce-fir zone. Intensive logging utilizing some of the largest and most modern equipment of that day was in progress in this area when the condemnation order of January 21, 1928 halted tree felling. Large red spruce were the primary incentives for logging this rugged terrain, but the larger Fraser fir were cut when found close to merchantable spruce.

Several loggers involved in these early operations still lived in the east Tennessee and Western North Carolina areas, and were willing to describe the forest conditions and logging operations as they remembered them. Aside from these accounts, there was little information available on this region.

Original Forests of the Cataloochee Balsam Area (Woody Ridge Location)

There were no permanent settlements at this elevation on the Cataloochee Balsam Mountains. Their remoteness and the abundant and well-distributed rainfall supported the claim that this area was largely undisturbed prior to logging, either directly by man or from wildfires; blow-downs were few and small in area.

Loggers referred to red spruce (*Picea rubens* Sarg.), the largest and most valuable species removed in the early logging operations, as "He Balsam" and its less valuable associate, Fraser fir (*Abies fraseri* (Pursh) Poir.), as "She Balsam" (Miller, Rolen, Wiggins and Bradley, p.c.). Although red spruce reaches its optimum development in the Park (American Forestry Association record tree is found here), average diameters were between two and three feet (Miller, Bradley, Rolen and Hannah, p.c.). Fir was generally smaller than spruce (Wiggins, p.c.)

and, being highly tolerant, was the primary species regenerating in undisturbed stands. Stump samples from cutover stands indicated that loggers cut both spruce and fir; however, only the biggest and best fir in close proximity to harvested spruce were cut.

Two study sites were established in a virgin spruce-fir stand on Woody Ridge, one on the ridgetop and the other on the southeast slope. On both sites red spruce was the dominant overstory tree, accounting for 43 percent of the stems and 49 percent of the basal area on the ridge, and 51 percent of the stems and 74 percent of the basal area on the slope (Table 4). Yellow birch (Betula alleghaniensis Britton) comprised 28 percent of the upper canopy on the ridgetop and 6 percent on the slope. Occasional fire cherry (Prunus pensylvanica L.) and serviceberry (Amelanchier Laevis Wieg.) formed a lower-level upper canopy in openings created by windthrow (Figure 18).

The relative importance of red spruce and Fraser fir in the subcanopy was almost the exact reverse of their importance in the upper canopy. Fraser fir accounted for 79 percent of the stems and 65 percent of the basal area on the ridge, and 59 percent of the stems and 72 percent of the basal area on the slope. Although Fraser fir was the more important subcanopy component, red spruce was present in sufficient numbers to attain an upper canopy position as the shorter-lived fir died. Once in the upper canopy, the long-lived red spruce (400+ years) dominates the overstory through several generations of fir. Fir accounted for more than 50 percent of the regeneration on both sites but was more important on the ridgetop.

Table 4. Absolute and Relative Stem Densities and Basal Areas by Canopy Position on Woody Ridge (Virgin Site) Near Cataloochee Balsam.

	Ridgetop					Slope			
	Elevation 5400'					Elevation 5300'			
	Slope 33%					Slope 60%			
	Aspect N20°W					Aspect 580°E			
Canopy Level	# Stems /A.	%	Basal Area/A.	%	Species	# Stems /A.	%	Basal Area/A.	%
Upper Canopy	—	—	—	—	Fire Cherry	4	(3)	3.2	(1)
	20	(22)	48.6	(28)	Yellow Birch	8	(6)	14.0	(6)
	—	—	—	—	Serviceberry	4	(3)	3.7	(2)
	40	(43)	84.4	(49)	Red Spruce	72	(51)	172.8	(74)
	32	(35)	40.8	(23)	Fraser Fir	52	(37)	41.0	(17)
Total	92	100	173.8	100		140	100	234.7	100
Subcanopy	—	—	—	—	Yellow Birch	5	(3)	1.4	(3)
	—	—	—	—	Serviceberry	10	(5)	3.7	(7)
	20	(21)	11.2	(35)	Red Spruce	65	(33)	8.7	(17)
	76	(79)	21.0	(65)	Fraser Fir	115	(59)	36.1	(72)
Total	96	100	32.2	100		196	100	59.9	99
Regeneration	1250	(23)			Red Spruce	20750	(46)		
	4250	(77)			Fraser Fir	24250	(54)		
Total	5500	100				45000	100		

NOTE: Within each canopy class species are arranged in the order of increasing tolerance.

Figure 18. Upslope view of virgin red spruce which was characteristic of the south slope of Woody Ridge.

Descriptions provided by loggers involved in harvesting timber in the Cataloochee Balsam area generally supported the stand character established by plot data from the virgin stand. Three species accounted for over 90 percent of the upper canopy cover at this elevation: red spruce (50-70 percent), Fraser fir (20-40 percent) and yellow birch (10-30 percent). The importance of yellow birch appeared to increase on north-facing slopes. Although beech (Fagus grandifolia) became important near gaps and fire cherry temporarily fills openings, these species were relatively unimportant.

In contrast to the stand dynamics at work in hardwood forests at lower elevations, in spruce-fir forests the more tolerant components of the subcanopy and regeneration do not become the dominant trees in the overstory. Fraser fir was the most tolerant component of the spruce-fir forest (as is the fir component in most spruce-fir forests) and dominated both the subcanopy and regeneration. Classical concepts of succession would suggest that it would become the overstory dominant in later seral stages. This was not the case in the spruce-fir forest due to the longevity and size of old-growth red spruce. Although somewhat less tolerant than Fraser fir, red spruce was sufficiently tolerant to regenerate and maintain its position as a subcanopy secondary to Fraser fir. As the shorter-lived fir dies, red spruce attains upper-canopy status throughout several generations of fir that may vie for upper canopy positions but never become dominant. At higher elevations where favored by climatic extremes, fir generally becomes dominant.

Disturbance in the Cataloochee Balsam Area

Highly mechanized logging was apparently the first significant impact on the forests of the Cataloochee Balsam area (Figure 19). Mooney (1892) claimed that the Cherokee Indians were not interested in these ridges and seldom visited them. The limited grazing of grassy woods and balds by livestock from settlements in surrounding valleys did little to alter stand composition and structure (Palmer and Rolen, p.c.). Rolen (p.c.) recalled selective logging for black cherry on Flat Creek (a tributary of Raven Fork that drains the south slopes of the Cataloochee Balsam) just below the spruce-fir zone during the late 1800's.

Railroads were constructed into the area in 1925 by the Suncrest Lumber Company (Bradley, Rolen, Siler, Smith and Wiggins, p.c.). The felling of merchantable trees progressed rapidly between 1925 and notification on January 21, 1928 of the condemnation of lands for Park establishment, which precluded further cutting (Bradley, p.c.). Log removal and mill operation continued until the early 1930's as the Company had cut considerably ahead of its skidder operation in anticipation of the condemnation order.

Both overhead and team skidding were used in this area; however, the overhead skidders were of the Lidgerwood type, heavier than the Clyde and capable of retrieving logs a mile away. In contrast to the usual location of railroad lines along drainage bottoms, in the Cataloochee Balsam operations tracks ran near and roughly parallel to the crest of the Balsam Mountain range. This required the pulling of logs upslope, with the overhead cable line anchored to a lower ridge, often more than a mile away. This arrangement resulted in the lifting

Figure 19. Cutover land on the Cataloochee Balsam area showing that the greatest impact was on areas immediately adjacent the railroad.

of most logs directly off the ground with minimal damage to residual trees. Some logs dangled as much as 400 feet above the valley floor in route to the log deck at the skidder (Rolen, p.c.).

Despite the high rainfall at this elevation, erosion was probably less following logging than on Middle Prong. Skid lines radiating upslope from a skidder located in the drainage bottom, as on the Middle Prong, created skid channels that concentrated water at the skidder location, causing severe erosion. In contrast, skid lines radiating downslope, as was the case in the Cataloochee Balsam area, dispersed water, minimizing erosion. Despite heavy cutting, residual trees were generally left undamaged and the litter layer intact (Miller, Rolen, Wiggins and Siler, p.c.).

The area upslope from the railroad was usually team skidded due to the small area involved and the absence of prominent points to which to attach the cable (Bradley and Rolen, p.c.).

Residual logging slash was generally less at the Cataloochee Balsam operations than in lower elevation hardwood stands, due to the excurrent growth form of spruce and fir, enabling a pulpwood operation that utilized the tops of trees harvested for lumber.

Present Condition of Cut-Over Stand (Big Fork Ridge Location)

Plot data from ridgetop and slope sites in the cut-over stand on Big Fork Ridge were similar, as was true in the virgin stand on Woody Ridge (Table 5). This possibly reflected an eroding of the influence of aspect and exposure as temperatures decrease and cloud cover and rainfall increase with the increasing elevation in the Park.

Table 5. Absolute and Relative Stem Densities and Basal Areas by Canopy Position on Big Fork Ridge (Cutover Site) Near Cataloochee Balsam.

	Ridgetop					Slope			
	Elevation		5400'			Elevation			5300'
	Slope		40%			Slope			68%
	Aspect		N35°E			Aspect			S60°E
Canopy Level	# Stems /A.	%	Basal Area/A	%	Species	# Stems /A.	%	Basal Area/A.	%
Upper Canopy	10	(7)	3.5	(2)	Fire Cherry	25	(17)	8.2	(5)
	30	(21)	44.5	(29)	Yellow Birch	30	(20)	46.4	(29)
	—	—	—	—	Serviceberry	5	(13)	2.3	(1)
	5	(4)	1.9	(1)	Mountain Ash	—	—	—	—
	60	(43)	77.1	(50)	Red Spruce	90	(60)	101.1	(64)
	35	(25)	26.6	(17)	Fraser Fir	—	—	—	—
Total	140	100	153.6	99		150	100	157.9	99
Subcanopy	150	(43)	7.3	(35)	Yellow Birch	90	(21)	4.2	(8)
	10	(3)	0.1	(1)	Serviceberry	20	(5)	0.7	(1)
	30	(9)	1.3	(6)	Mtn. Maple	30	(7)	4.6	(9)
	100	(29)	8.7	(41)	Red Spruce	290	(66)	41.2	(78)
	60	(17)	3.6	(17)	Fraser Fir	10	(2)	2.0	(4)
Total	350	101	21.0	100		440	101	52.7	100
Regeneration	—	—			Yellow Birch	375	(33)		
	375	(14)			Red Spruce	625	(56)		
	2250	(86)			Fraser Fir	125	(11)		
Total	2625	100				1125	100		

NOTE: Within each canopy class species are arranged in the order of increasing tolerance.

Upper canopy. Red spruce was the most important and largest upper canopy tree on both sites, accounting for approximately 50 percent of the stems and a somewhat larger percentage of the basal area (Table 5). Fraser fir was absent from the upper canopy on the slope, but comprised 25 percent of the stems and 17 percent of the basal area on the ridge. Yellow birch was more important than Fraser fir on both sites, accounting for approximately 30 percent of the stems and 45 percent of the basal area, which suggested large, residual stems that were present prior to logging. The absence of a significant fire cherry component, considered a pioneer on disturbed areas, was probably due to the deep, organic horizon at the soil surface that remained essentially intact.

Subcanopy. Red spruce was also the subcanopy dominant, accounting for 29 percent of the stems and 41 percent of the basal area on the ridge, and 66 percent of the stems and 78 percent of the basal area on the slope. Stem to basal area ratios indicated that red spruce had larger-than-average stem diameters (Table 5). Both yellow birch and Fraser fir were more important subcanopy components on the ridge, suggesting continuation of an upper canopy mixture of all three dominants, while on the slope red spruce may account for even more of the overstory in the next generation. Mountain maple and serviceberry were in the subcanopy on both sides but were not potential components of the overstory.

Regeneration. Fraser fir accounted for 86 percent of the regeneration on the ridge, the remainder being red spruce. In keeping with its importance in sub- and upper-canopy positions, red spruce accounted for

56 percent of the regeneration on the slope, followed by yellow birch (33 percent) and Fraser fir (11 percent).

Discussion. Red spruce was the most important species in all canopy positions on both sites except regeneration on the ridge. This reflected the greater competitive ability of red spruce following disturbance at this elevation where there was an ample seed source for all potential dominants. The importance of yellow birch in the upper canopy was magnified by a few large residuals from the original stand. It was abundant in the subcanopy on the ridge but absent in regeneration that was dominated by fir. Fir comprised only 17 percent of the subcanopy, suggesting a cyclic regeneration pattern that results in an "even-aged by species groups" age structure for some period following this type of disturbance. Red spruce dominated all three canopy levels on the slope, possibly reflecting the sheltered southeast aspect.

Forest Succession in the Cataloochee Balsam Area

The dynamics of stand development and succession in red spruce-Fraser fir stands at elevations in the Great Smoky Mountains, where climate is favorable to both components, appeared consistent with that described for spruce-fir associations in other areas (Hanley, Schmidt and Blake, 1975). Fraser fir was more tolerant, yet red spruce was generally the upper canopy dominant in both disturbed and undisturbed stands. Being more tolerant, it responds more to the openings created by disturbance than does Fraser fir. In old-growth stands it is sufficiently tolerant to remain in the understory until the death of shorter-lived Fraser fir enables it to move into the overstory, where its larger stature and

longer life-span make it the largest and most abundant overstory tree. Logging favored red spruce, especially on more sheltered positions; fir was dominant only in the regeneration class on the exposed ridge.

CHAPTER VI

SUMMARY AND CONCLUSIONS

I. ORIGINAL FORESTS

Original forest cover on the major low- to mid-elevation drainages on the Tennessee (north-facing) side of the Park was probably similar in composition and structure and appeared to be mixed mesophytic in character. Stands on mid- and lower-slope positions were composed of relatively tolerant, climax species except for yellow-poplar, an intolerant pioneer that was perpetuated as a dominant tree on the best sites by local disturbances: usually windthrow of very large yellow-poplar or hemlock. Ridges and upper slope positions, especially those having an exposed southwesterly aspect, were dominated by open oak or yellow pine stands.

In the spruce-fir zone, where edaphic and climatic conditions were favorable to both species, red spruce was generally the dominant overstory tree in old-growth stands even though Fraser fir was more tolerant.

II. DISTURBANCES TO THE ORIGINAL FORESTS

For harvesting hardwoods at mid- to low-elevations, railroads and skidders were generally located along drainage bottoms with major impacts along streams and especially in fertile coves, where skidders could reach large volumes of high quality timber. The original forest cover

was completely removed or destroyed close to skidder settings and in small "flats" where logging was followed by gardening. The soil profile was not appreciably altered except in conjunction with gardening or farming activities.

In the spruce-fir zone, logging was from railroads located near, and parallel to, ridgecrests with little disturbance to streams. Soil profiles were generally not disturbed as there were no settlements previous to logging and very little gardening in association with the logging communities.

III. PRESENT VEGETATION AND ITS SERAL POSITION

Hardwood logging resulted in intensive disturbance to the original vegetation on some of the most productive sites in the Park (coves and lower-slope positions), often without altering inherent productivity (soil profiles were not altered). Such areas now support pure evenaged stands of site-demanding pioneer species—primarily yellow-poplar. At higher elevations and on upper slopes where yellow-poplar was less aggressive, and where logging impact was less intense, second growth stands were more complex mixtures of many seral stages.

As was true in old-growth forests, red spruce was the dominant tree in second growth stands in the spruce-fir zone, especially on protected sites. Although more tolerant than spruce, and the dominant understory component on undisturbed sites, Fraser fir was secondary to red spruce in the upper-canopy except at the highest elevations and on exposed sites.

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APPENDIXES

APPENDIX A

QUESTION GUIDE

FOREST COVER AND STAND VOLUME ESTIMATES PRIOR TO AND FOLLOWING DISTURBANCE IN THE GREAT SMOKY MOUNTAINS NATIONAL PARK AND SURROUNDING AREAS

In a casual manner the following questions and areas of interest should be covered in interviewing persons regarding stand composition, factors of disturbance (logging operations, farming, fire, etc.), replacement species and subsequent changes in vegetation in the Great Smoky Mountains National Park and surrounding areas. The objective of the study should be made clear to the interviewee at the outset. It may be advantageous to record portions of (or the entire) interview. Do so only with the full knowledge and consent of the interviewee.

A. Personal/Background

(1) Name, address, phone, etc.
(2) Where born—raised (native or did they move in to find employment, particularly with logging interests?)
(3) Did they live in the area of interest or work there on a daily, seasonal or some other basis?
(4) What areas in the Park are they familiar with (have these areas pointed out on base maps; try to relate to local names).
(5) Do they have pictures of any of these areas, prior to, during, or since disturbance? If so, will they allow them to be duplicated?
(6) Do they know of others who could be a significant source of information, pictures, etc.?

B. Area Information/Stand Composition/Disturbance

(7) To what extent and where have forest fires burned in the Park? What was its role in determining species composition, maintaining grassy balds, etc. Did most of them accompany logging operations?
(8) When and where were the earliest settlers or homesteaders in the area with which you are familiar? What areas were cleared and for what reason?
(9) Can you describe the vegetation on the area (watershed) with which you are familiar (with respect to species, size, character stand, ground litter, etc.)? In particular, how were key species, such as yellow-poplar, basswood, cucumber magnolia,

distributed (individuals, clumps, large groups, entire stands)? Determine how these less tolerant species became established. How large were the yellow-poplar that were cut? Maximum size/age? Average size/age? What species occurred with yellow-poplar? Compare associates at various ages.

(10) What percent of trees cut had buttrot?

APPENDIX B

TABLE A-1

LISTING OF PERSONS CONTACTED TO OBTAIN INFORMATION ON FOREST CONDITIONS IN THE GREAT SMOKY MOUNTAINS NATIONAL PARK PRIOR TO PARK ESTABLISHMENT

	Contact Method[1]	Name	Location	Position or Reason Knowledgeable of Park Conditions
1.	I-T	Charlie Dunn	Townsend, TN	Former Chief Ranger, TN side
2.	I-T	Audley Whaley	Pigeon Forge, TN	Former Ranger, G¯MNP
3.	I-T	Curt McCarter	Gatlinburg, TN	Former employee, Little River Lbr. Co.
4.	I	Dutch Roth	Gatlinburg, TN	Early Park-area pictures (primarily of hiking)
5.	I	Liston Patterson	Sevierville, TN	Father was early Sevierville photographer, no pictures, supplied leads
6.	I	Arthur Stupka	Gatlinburg, TN	Naturalist/Biologist GSMNP
7.	P	Mrs. Joe Sharp	Sevierville, TN	Materials on Sevier County history
8.	P	A. O. Delozier	Sevierville, TN	Former purchasing agent for Park Commission
9.	I	Cap Price	Tellico, TN	District Ranger, USFS
10.	P	Dean Stone	Maryville, TN	Editor of Maryville Times
11.	I	James B. Shelton	Maryville, TN	Early pictures of Elkmont & Tremont lumbering operations
12.	P	Franz Gregory	Maryville, TN	Father was land agent for Little River Lumber Co. (LRLC)
13.	P	Oliver Gilland	Maryville, TN	Former woods employee of LRLC

[1]I = personal interview; T = conversation taped; P = phone contact only, and L = letter only.

TABLE A-1 (continued)

	Contact Method	Name	Location	Position or Reason Knowledgeable of Park Conditions
14.	P	Millard McCaughley	Maryville, TN	Area resident and former employee in logging activities (woods)
15.	I-T	Dr. Robt. Lambert Head, Dept. of History Clemson University		Former logging history researcher for GSMNP
16.	I-T	William A. Bradley	Waynesville, NC	Former woods sup't. for Suncrest Lumber Co.
17.	I-T	Paul Adams	Crab Orchard, TN	Former operator of LeConte Lodge
18.	I-T	Walter Bearden	Asheville, NC	Former woods sup't. for Ritter Lumber Co.
19.	I-T	John Morrell	Pigeon Forge, TN	Former GSMNP employee
20.	I-T	Orlie Trentham	Pigeon Forge, TN	Longtime area resident
21.	I-T	S. P. McNeill, Sr.	Townsend, TN	Former bookkeeper for LRLC
22.	I-T	Earl Franklin	Townsend, TN	Former LRLC & GSMNP employee (woods)
23.	I-T	Arnold Thompson	Townsend, TN	Former LRLC employee (woods)
24.	I-T	Raymer Brackins	Townsend, TN	Former LRLC employee (woods)
25.	I-T	Joe Barnes	Townsend, TN	Former LRLC employee (woods)
26.	I-T	Lon Badgett	Townsend, TN	Former LRLC employee (woods)
27.	I-T	Horace Trentham	Townsend, TN	Former LRLC employee (woods)
28.	P	Paul Fink	Jonesboro, TN	Early hiker in area; kept journal
29.	I-T	Mark Hannah	Maggie Valley, NC	Former Park ranger on Cataloochee
30.	I-T	Elbert Wilkie	Asheville, NC	USFS, logged in Graham County, NC
31.	P	L. N. Davis	Waynesville, NC	Former bookkeeper at Ravensford
32.	P	Doyle Brock	Robbinsville, NC	Employee at Bemis Lumber Co.
33.	P	Beecher Colvin	Tellico, TN	USFS employee
34.	I	Earl Cady	Knoxville, TN	Forestry Extension, UT

TABLE A-1 (continued)

	Contact Method	Name	Location	Position or Reason Knowledgeable of Park Conditions
35.	I	Dr. A. J. Sharp	Knoxville, TN	Professor of Botany, UT; familiar with early GSMNP history
36.	I	Bob Barker	Andrews, NC	Collected materials on logging, long-time resident of area
37.	P	Swede Owenby	Pigeon Forge, TN	Past Park Ranger
38.	I	T. A. Hargrove	Canton, NC	Employed by Champion Paper; access to early Company operations history and photos
39.	I	Gudger Palmer	Canton, NC	Employed by Canton Paper; former resident of Cataloochee
40.	I	Frank Miller	Waynesville, NC	Former employee of Suncrest Lumber Co.; did vegetational mapping as former GSMNP employee
41.	P	Dan Adams	Maryville, TN	Long-time area resident
42.	I	Hope Townsend Mays	Maryville, TN	Descendant of W. B. Townsend of LRLC
43.	I	Pink Sutton	Townsend, TN	Former employee of LRLC (woods)
44.	I	Carl Abbott	Townsend, TN	Ran commissary and post office at Old Tremont
45.	I	Roy Myers	Townsend, TN	Worked on train for LRLC
46.	I	Charlie Myers	Townsend, TN	Former resident of Cades Cove
47.	I	Houk Myers	Townsend, TN	Postmaster of Townsend—furnished leads
48.	P	Jim Rudd	Townsend, TN	Long-time resident of Townsend
49.	P	Luther McMahan	Townsend, TN	Worked as yard foreman for LRLC
50.	P	Maynard Ledbetter	Townsend, TN	Worked in woods for LRLC
51.	P	Kara Gregory	Townsend, TN	Long-time resident of Townsend
52.	I	Mrs. Sam Henry	Townsend, TN	Collected information and pictures on area logging

TABLE A-1 (continued)

	Contact Method	Name	Location	Position or Reason Knowledgeable of Park Conditions
53.	I	Asa Sparks	Maryville, TN	Some logging pictures
54.	I	Arlie Thompson	Maryville, TN	Furnished leads
55.	I-T	Roy Jolly	Mt. Rest, SC	Worked in woods for Champion; cruised timber
56.	I	R. C. Senior	Robbinsville, NC	Films showing some logging operations
57.	L	Harley Jolly Head, Dept. of History Mars Hill College		Has done historical work for Park
58.	I	May Holtzclaw	Canton, NC	Past secretary to Mr. Rubin Robertson, past president, Champion Papers
59.	I	Elizabeth Timmons	Maryville, TN	Employed by Maryville Times; collected historical materials
60.	I	Carson Brewer	Knoxville, TN	Writes for Knoxville News Sentinel
61.	P	W. E. Abbott	Townsend, TN	Logged parts of Smokies
62.	P	Clark Farmer	Townsend, TN	Long-time area resident
63.	P	Inez Burns	Maryville, TN	County historian for Blount Co.
64.	P	John Foster	Knoxville, TN	Operated train for LRLC
65.	I	Mark Postalwate	Sevierville, TN	Editor of Sevierville News-Record
66.	I	Dr. Randolph Shields Head, Botany Dept. Maryville College		Past resident of Cades Cove; collected historical materials
67.	P	Lem Owenby	Elkmont, TN	Worked in woods for LRLC
68.	I	Isaac Hurst	Cosby, TN	Worked in woods for Suncrest Lumber Co.
69.	I	Shan Davis	Townsend, TN	Logged small tracts in Townsend
70.	P	John Anthony	Maryville, TN	Vice-President of Blount Nat. Bank; executor of W. B. Townsend estate

TABLE A-1 (continued)

	Contact Method	Name	Location	Position or Reason Knowledgeable of Park CConditions
71.	L	W. T. Rolen	Bryson City, NC	Former Park Ranger
72.	I	Dr. Leroy Graf Head, Dept. of History Univ. of TN		References concerning historical research techniques
73.	P	Jim Ball	Sevierville, TN	Furnished leads
74.	P	Dan Caylor	Townsend, TN	Long-time area resident
75.	I	Ray Patty	Maryville, TN	Furnished leads
76.	I	Fred Rawlings	Sevierville, TN	Furnished leads
77.	P	J. H. Keener	Canton, NC	Worked as woods foreman for Champion
78.	P	Eddie Thompson	Knoxville, TN	Father & grandfather took pictures in Park; he presently operates Snap Shop
79.	P	Carmen Julien	Chattanooga, TN	Employed by TVA; aided in securing aerial coverage
80.	P	Kelly Burnett	Bryson City, NC	Long-time area resident
81.	P	Joe Murphy	Knoxville, TN	Father was superintendent of LRLC
82.	P	Lindsay Young	Knoxville, TN	Knoxville lawyer whose family were early residents of Elkmont
83.	L	Gibron P. Vance	Abingdon, VA	Collected materials on early logging history
84.	I-T	John Smith	Waynesville, NC	Long-time resident of Western NC; worked in office of Suncrest and Ravensford Lumber Companies
85.	I-T	Albert Siler	Waynesville, NC	Worked in woods for Suncrest Lumber Co.
86.	I-T	Dave Wiggins	Waynesville, NC	Worked in woods for Suncrest Lumber Co.
87.	P	Dan Culp	Maryville, TN	Worked in woods for Little River Lumber Co.
88.	I	Carlos Campbell	Maryville, TN	Familiar with early history of GSM area

VITA

Weaver H. McCracken, III, was born in New Orleans, Louisiana, on March 24, 1949, where he attended primary and secondary schools and was graduated from Mid-City Baptist High School in June 1967. Undergraduate work was done at Louisiana State University in Baton Rouge and at the University of Tennessee, Knoxville, from which the Bachelor of Science degree in Forestry was received in June 1973.

He entered the Graduate School of the University of Tennessee in September 1973, and is a candidate for the Master of Science degree, with a major in Forestry and a minor in Ecology.

He is a member of Theta Xi, Alpha Zeta, and Xi Sigma Pi Fraternities.

He is happily married to the former Sylvia Domm of Knoxville, Tennessee. He and his wife are Christians involved in professional ministry, and members of Lake Forest Presbyterian Church.