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Botanical Reconnaissance of The Bowl Research Natural Area

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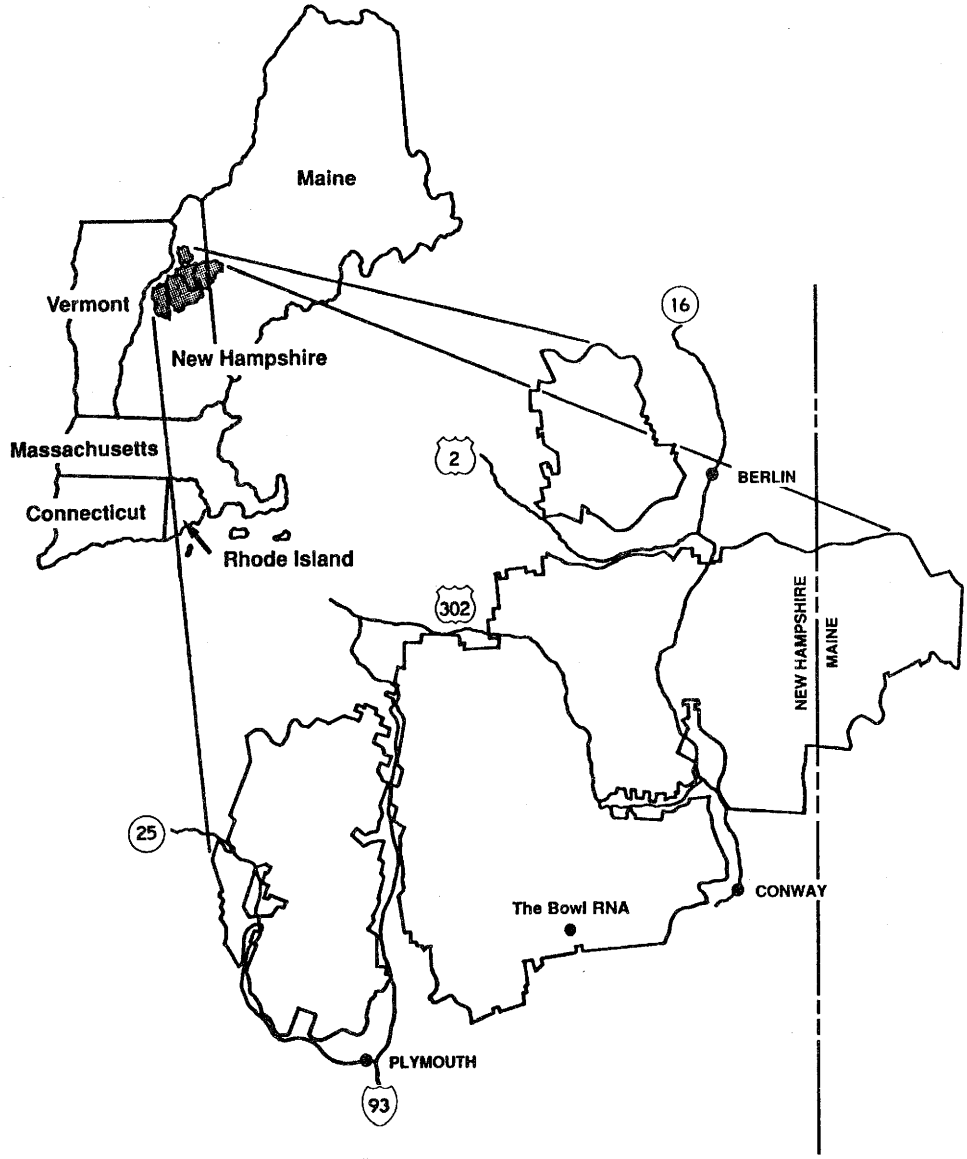

Abstract

The Bowl Research Natural Area is a 206-ha old-growth forest in the White Mountain National Forest of New Hampshire. Elevations range from approximately 580 m along Wonalancet Brook to 1,215 m at the summit of Mt. Whiteface. Vascular vegetation in four Ecological Land Types (ELT's) of the Bowl was characterized on 12 plots and during qualitative meander surveys. Several microhabitats within the ELT's, including sidehill seeps, ledges, canopy openings, and a well-traveled trail, were also inventoried. The vegetation structure and species composition for each ELT and microhabitat are described. Ninety-three species were recorded, including the state-protected plants *Dicentra canadensis*, and *Cypripedium* sp. Eight species found in seeps were observed nowhere else in the Bowl. Most species were observed at relatively low elevations in ELT 6 (Predominantly Softwoods on Steep Upper Mountain Side Slopes with Deep Bouldery Colluvium) where the greatest variety of microhabitats occurred.

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Foreword

The Forest Service Research Natural Areas Program maintains a network of 289 established areas and more than 300 candidate areas representing typical and unique natural ecosystems on national forests in the United States. These areas are managed in minimally disturbed conditions for research, monitoring, education, and to maintain natural diversity and ecological processes.

Within the 14-state territory of the Northeastern Forest Experiment Station, which includes seven national forests, six Research Natural Areas (RNA's) have been established and 29 candidate areas are being considered for establishment within the next few years. A few of these areas have been the scene of active field research for many years whereas others are virtually unstudied.

Although the RNA program began more than 65 years ago, research and monitoring on RNA's only began recently. As the Forest Service moves in the direction of ecological management, information on RNA's will serve a vital role in forest management.

In an effort to encourage and expedite research on RNA's, the Northeastern Forest Experiment Station is commissioning a series of botanical reconnaissance surveys for each of the established and candidate RNA's. The program began in 1991 with funding support from the RNA Matching Grant Program sponsored by the Chief of the Forest Service.

The first three reports in the series are:

Botanical Reconnaissance of
Mountain Pond Research Natural Area

Botanical Reconnaissance of
The Bowl Research Natural Area

Botanical Reconnaissance of
Nancy Brook Research Natural Area

Introduction

The Bowl Research Natural Area (RNA) is located in Waterville, New Hampshire. It is part of the Sandwich Range Wilderness Area of the White Mountain National Forest and lies at latitude 43°56'30", longitude 71°24'00" (Fig. 1). The RNA encompasses the 206-ha western drainage area of the West Branch of Wonalancet Brook, a perennial stream that flows in a southerly direction to the Swift River. Several perennial and intermittent tributaries flow within the drainage area, but no lakes or ponds are present. Elevations in the Bowl range from approximately 580 m along the brook to 1,215 m at the summit of Mt. Whiteface (Martin 1977). The steep cirque walls and deep ablation tills below were formed by glacial action during the Pleistocene period. Bouldery soils are thin or absent on the steep ledges near the mountain summits but more than 2 m deep at the base of the Bowl (Steve Fay, USFS, personal communication).

Mean monthly temperatures at nearby Pinkham Notch, elevation approximately 610 m, ranged from -9.2°C in January to 17.2°C in July for the 20-year period of record (Byers and Goodrich 1977). Temperatures decrease with increasing elevation. The average period between the last spring frost and the first fall frost is approximately 96 days in Errol, New Hampshire, approximately 95 km to the northeast (Carr et al. 1978). Mean annual precipitation at Pinkham Notch is approximately 145 cm, with total annual snowfall averaging 4.2 m (Byers and Goodrich 1977).

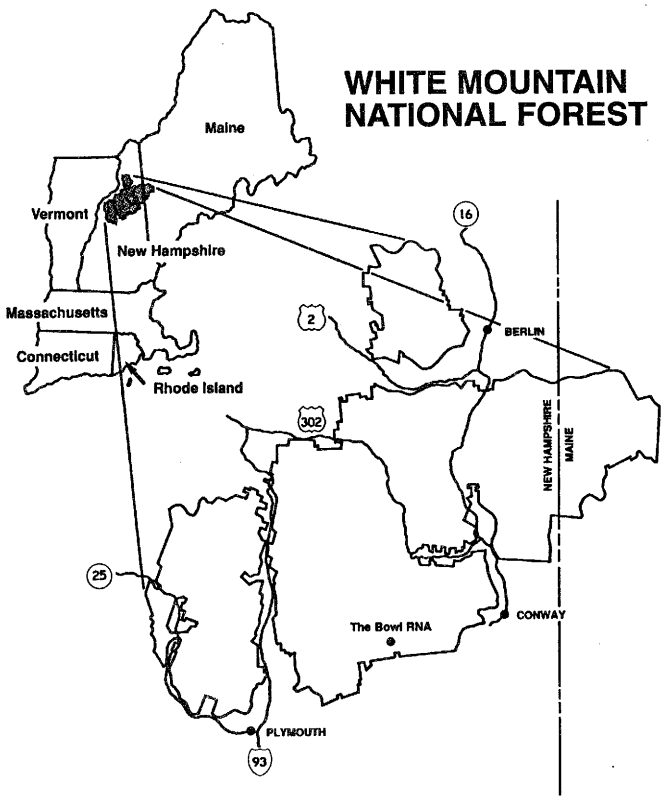

Figure 1.--Location of The Bowl Research Natural Area (adapted from Fig. 2, USDA For. Serv. 1986).

The Bowl RNA falls within the spruce-fir/northern hardwood forest climax type (Kuchler 1975). Society of American Foresters (SAF) forest types present include: 33-red spruce—balsam fir and 25-sugar maple—beech—yellow birch. The landscapes of the White Mountains have been classified into broad land type associations and smaller Ecological Land Type (ELT) units based on topographic position, glacial history, soils, and vegetation (Steve Fay, USFS, personal communication). Figure 2 illustrates the location of ELT's in the Bowl.

Early research indicated this drainage area escaped the logging that influenced development of much of the rest of the White Mountains (Leak 1973, Oosting and Billings 1951). This has made the Bowl a valuable research subject for the study of old-growth forest development, composition, and structure. The Bowl was formally established as a Research Natural Area in 1931, the first in the White Mountain National Forest.

The Bowl is managed by the Saco Ranger District to allow natural forest succession, non-motorized recreation, and monitored research. Tree harvesting is prohibited, and forest fires are suppressed (USDA For. Serv. 1986). The trails that ascend the surrounding rim are popular with hikers; however, no trails pass through the RNA, and human traffic is limited primarily to forest researchers. This report describes the results of a botanical reconnaissance conducted in 1991-92.

Methods

Vascular vegetation was assessed in four ELT's of the Bowl during four field visits in 1991 and 1992. Meander surveys were performed October 13-14, 1991; June 7, 1992; August 28-31, 1992, within the Bowl; and October 3, 1992, around the rim of the Bowl on the Rollins Trail. Temporary plots were set up and assessed during August 28-31, 1992. Plot locations are shown in Figure 2. A very small corner of the upper rim of the Bowl (comprising less than 1 percent of the Bowl's area) designated as ELT 14 (Softwood Upper Mountain Slopes with Deep Very Bouldery Angular Drift) was not actively sampled during this field study. Observations made during passage through it on the Rollins Trail did not include any unique species.

Meander Surveys

Qualitative vegetation surveys, termed meander surveys in this report, were performed in each ELT to catalog vegetation composition and to estimate the abundance of each species. During the meander surveys, a running list of species observed in each vegetation layer was compiled while traveling within an ELT. Most ELT's were visited multiple times in the course of sampling, and whenever possible, travel routes were varied to cover as much of the ELT as possible. More concentrated searches were performed in obvious microhabitats such as seeps, stream channels, large boulders, ledges, and the Appalachian Mountain Club hiking trails. In ELT 6 (Predominantly Softwoods on Steep Upper Mountain Side Slopes with Deep Bouldery Colluvium), two sidehill seeps were intensively surveyed because of their unique vegetation, as

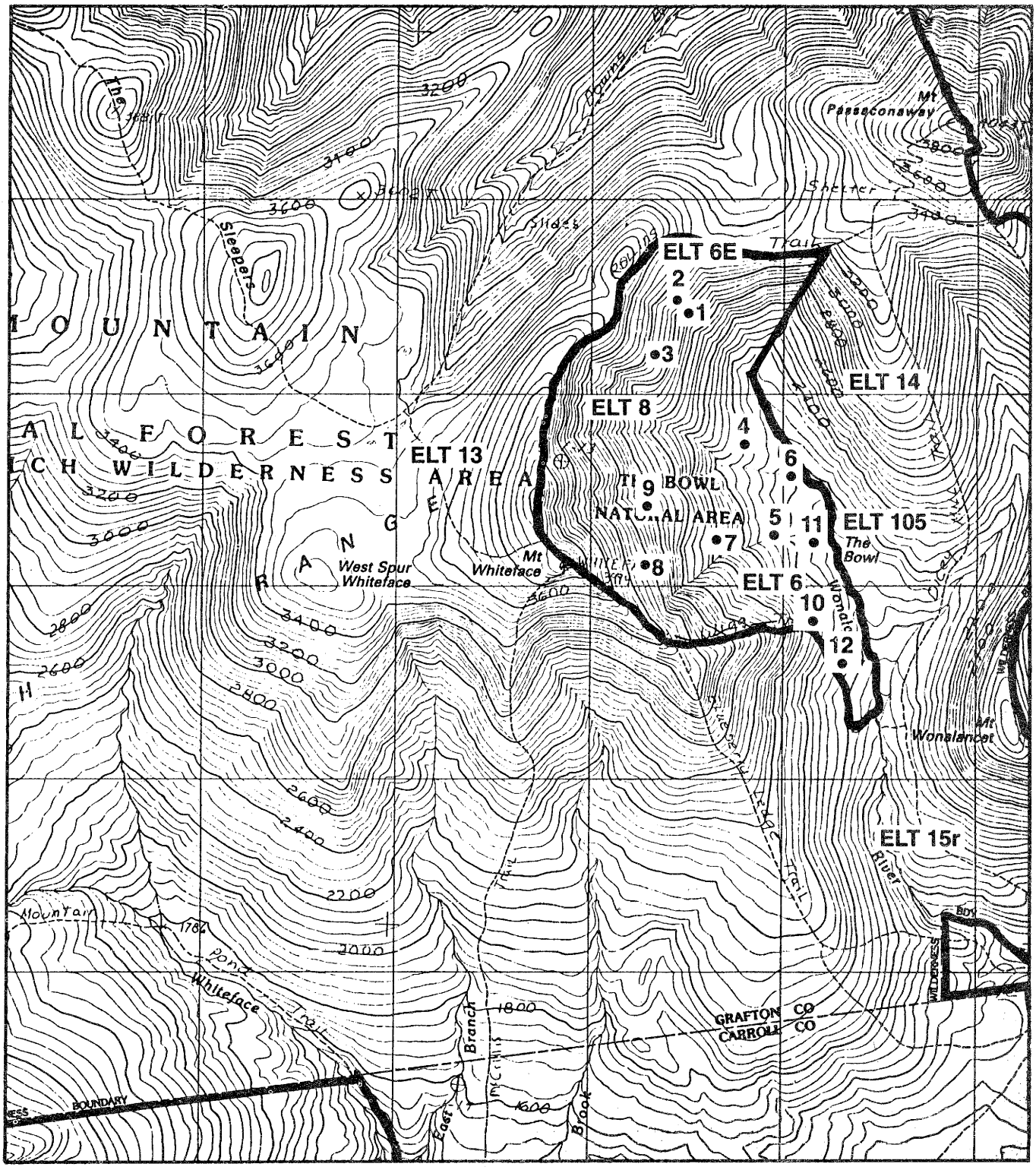

Figure 2.--Ecological Land Types (ELT's) of The Bowl and the location of vegetation plots sampled in August 1992.

was the base of a 50-foot ledge in ELT 6 south of the Wiggins trail. ELT 105 (Hardwood Mid and Lower Mountain Side Slopes with Very Deep Tills) and ELT 6 were sampled most thoroughly because travel routes to all ELT's passed through these two. ELT 6E (Softwood on High Mountain Slopes and Notch Floors with Deep Till) was least surveyed, as it was visited only once on August 29, 1992.

Plant species abundances were qualitatively estimated for each layer using the following categories: abundant (>25 percent cover), common (5-25 percent cover), uncommon (0.1-5 percent cover) and rare (<0.1 percent). Percentage of cover was defined as the cover of a species relative to the total vegetative cover within the layer. Although there are obvious limitations of such estimates in stands as large and varied as the ELT's in the Bowl, these data are useful in providing a general understanding of species abundance in each layer. Specimens of most tree species were found in all layers; estimates of tree seedlings in the herb layer were based on seedlings older than 1 year. Meander plot data are provided in Tables 1, 4, 7, and 10.

Vegetation Plots

Two to four non-overlapping sample plots were located in each ELT in August 1992, to collect quantitative data. General plot locations were subjectively located to sample typical habitats in the range of elevations, aspects, and cover types previously identified from aerial photographs and topographic maps, and during meander surveys. Once the general plot location was reached, one researcher would randomly designate a compass bearing and number of paces (10 to 100) to a plot center, to which the other researcher would then lead, in an effort to reduce bias in selecting the exact plot location.

In each sample plot, vegetation was sampled in four life-form layers: tree, sapling, shrub, and herb. The tree layer consisted of all trees ≥12.7 cm d.b.h. within a round 100-m^2 plot. For each tree, data collected included species, d.b.h., and approximate height. D.b.h. was measured with a diameter tape, and tree height was visually estimated. Percentage cover of saplings (species <12.7 cm d.b.h. but ≥ 6.1 m tall) and shrubs (woody species <6.1 m tall and ≥ 1.0 m tall) was estimated to the nearest 5 percent for each species within a round 20-m^2 plot in the center of the tree plot. Four 0.5-m^2 herb plots were sampled within each shrub plot. Herbs were defined as all herbaceous species and woody vegetation <1.0 m in height. Data recorded in herb plots included estimated percent cover of each species, and percentage of exposed substrate, which included soil, leaf litter, bare rock, or unvegetated logs. Slope, aspect, and general observations regarding surrounding overstory and understory composition and dead and down material were also recorded. Combined plot data for each ELT are provided in Tables 2, 3, 5, 6, 8, 9, 11, 12, and in Appendix A.

Nomenclature and Taxonomy

Nomenclature used in this report follows Gleason and Cronquist (1963). An exception is mountain paper birch (*Betula papyrifera* var *cordifolia*), which is considered a separate species, *B. cordifolia*, by Gleason and Cronquist. We used the hybrid name in recognition of current taxonomy and the difficultly in distinguishing this variety from paper birch (*B. papyrifera*) in the field.

Ecological Land Type Descriptions

Approximately 63 percent of the Bowl is classified as ELT 8 (Softwood Headwalls with Shallow Bouldery and Ledgy Soils), which extends from the ridgetops down to an elevation of 750 m. These are the steep headwalls with shallow soils dominated by spruce and fir. Below this are ELTs 6 (18 percent) and 6E (6 percent). Along Wonalancet Brook below ELT 6 is ELT 105, which represents approximately 13 percent of the Research Natural Area. Descriptions of the vegetation of these ELTs follow.

ELT 8

The bouldery slopes of ELT 8 (approximately 20 to 45 percent slopes) are generally northeast to southeast in aspect. In some locations, exposed bedrock forms almost vertical cliffs, and a few relatively flat knobs are also present. Several entrenched streambeds angle straight down the steep slopes. Vegetation structure and composition were fairly uniform within plots sampled in ELT 8, but varied between plots (Fig. 2). Although balsam fir (*Abies balsamea*) and red spruce (*Picea rubens*) dominated the tree, shrub, and herb layers of ELT 8 in most places, stands of paper birch and heart-leaved paper birch were also present on some of the steep slopes (Figs. 3 and 4) and may indicate past disturbances such as debris slides or avalanches. Mean tree d.b.h. within the four ELT 8 plots was between 15 and 18 cm for these three species, and the canopy decreased in height from approximately 15 m at Plot 3 to 8 m near the ridge top. American mountain-ash (*Sorbus americana*) at lower elevations and yellow birch (*Betula lutea*) were also observed in the tree layer. Logs and spruce snags representing the full range of tree diameters were quite common. Appendix A and Tables 2 and 3 include summaries of tree composition and size in the plots studied.

At the highest elevations of the Bowl in ELT 8 the forest canopy is low (approximately 8 m and less) and interrupted by openings of exposed bedrock ledges at the height of land. The slopes of the Bowl fall steeply from the rim. Balsam fir is the most abundant tree species at these elevations, with red spruce, mountain-ash, and heart-leaved paper birch also common.

The understory throughout ELT 8 is variously open or dense with regenerating softwoods. Hobblebush (*Viburnum alnifolium*) was the only common nontree shrub species, though a few other species were observed at the base of a steep ledge and near the rim, including northern wild raisin (*Viburnum cassinoides*) and mountain holly (*Nemopanthus mucronata*). Mosses covered the greatest percentage of the substrate in this ELT with an average cover of 54 percent. Common vascular herbaceous species included wood sorrel (*Oxalis montana*), spinulose shieldfern (*Dryopteris spinulosa*), shining clubmoss (*Lycopodium lucidulum*), and bluebead lily (*Clintonia borealis*). Creeping

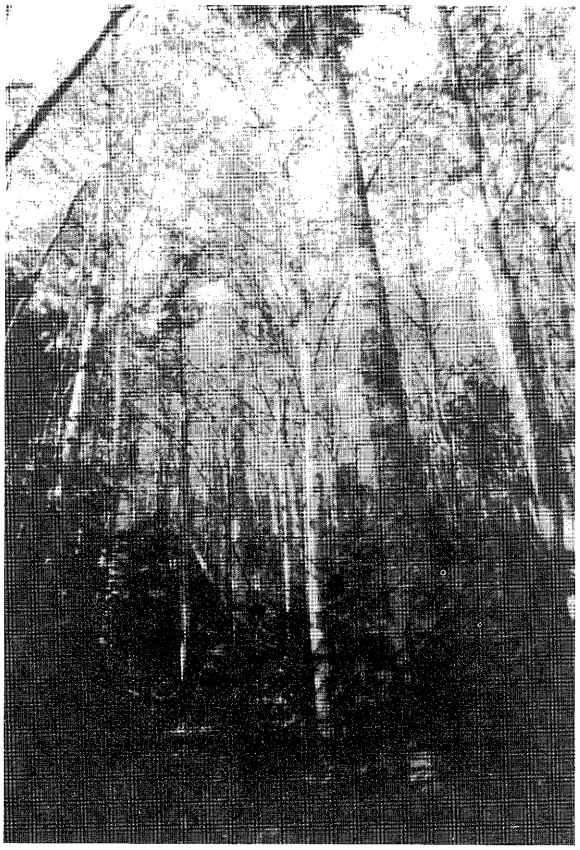

Figure 3.--Uniform canopy of heart-leaved paper birch in ELT 8. Dense softwood regeneration is occurring in the understory.

Figure 4.--Red spruce-balsam fir dominates most of ELT 8. Logs and snags are common.

snowberry (*Gaultheria hispidula*) was an alpine species not observed in the other ELT's during this field investigation. Tables 2 and 3 summarize the percentage of cover of species recorded from the vegetation plots. Table 1 is a complete listing of species observed during the field investigations of ELT 8.

The Rollins Trail. Several plant species were observed along the Rollins Trail which traverses the rim of the Bowl that were not observed in other portions of the Bowl. These species are native to the White Mountains; their presence may or may not be the result of the transport of seeds by trail users or the additional light provided by the narrow tree gap. These species included fringed sedge (*Carex crinita*), late sweet blueberry (*Vaccinium angustifolium*), and hay-scented fern (*Dennstaedtia punctilobula*). Several sedges and grasses found throughout the Bowl were most common between the rocks on the Rollins Trail.

ELT 6

ELT 6 is located below ELT 8 on slopes averaging 30 to 35 percent. According to the USDA Forest Service description of the ELT, soil variability is high, ranging from sandy loamy till more than 2.5 m deep to compacted till and bedrock. Many surface boulders of all sizes and numerous areas of exposed bedrock ledge were observed in ELT 6. Major stream channels were typically well defined and very scoured, indicating that high flows must occur. Flows during the four site visits were low to average in Wonalancet Brook. Several of the tributaries flowing through the Bowl had intermittent or no surface flow, yet water could be heard flowing belowground in the boulder-strewn portions of the channel.

Hardwoods dominated most of the ELT, though small stands of red spruce were present at the higher elevations. Large individual spruce trees and snags were scattered through the lower portion. Dominant hardwood species were sugar maple (*Acer saccharum*) and beech (*Fagus grandifolia*) (Table 4 and Fig. 5). In the vegetation plots, trees had an average d.b.h. of 24.3 cm and height of 16.8 m (Tables 5 and 6). Yellow birch was a common, large-diameter component; the largest specimen measured during the meander survey in ELT 6 was a yellow birch 91 cm in diameter. Other less common overstory trees included striped maple (*Acer pensylvanicum*), paper birch and mountain-ash.

The dominance of hardwoods observed in the ELT varies considerably from the climax spruce-fir forest association described by the USDA Forest Service. Although

Text continues on page 10.

Table 1.--Meander survey data summary from ELT 8

Scientific name	Common name	Abundance
	TREE LAYER	
Abies balsamea	Balsam fir	Abundant
Picea rubens	Red spruce	Abundant
Betula papyrifera	Paper birch	Common
Betula papyrifera var. *cordifolia*	Heart-leaved paper birch	Common
Betula lutea	Yellow birch	Uncommon
Sorbus americana	Mountain-ash	Uncommon
	SHRUB LAYER	
Picea rubens	Red spruce	Abundant
Abies balsamea	Balsam fir	Abundant
Viburnum alnifolium	Hobblebush	Common
Acer pensylvanicum	Striped maple	Common
Sorbus americana	Mountain-ash	Uncommon
Nemopanthus mucronata	Mountain holly	Rare
Viburnum cassinoides	Northern wild raisin	Rare
Amelanchier sp.	Shadbush	Rare
Prunus pensylvanica	Bird cherry	Rare
	HERB LAYER	
Abies balsamea	Balsam fir	Abundant
Oxalis montana	Wood sorrel	Common
Dryopteris spinulosa	Spinulose shieldfern	Common
Picea rubens	Red spruce	Common
Lycopodium lucidulum	Shining clubmoss	Common
Clintonia borealis	Bluebead lily	Common
Sorbus americana	Mountain-ash	Common
Betula papyrifera	Paper birch	Common
Trientalis borealis	Starflower	Uncommon
Carex debilis	White-edge sedge	Uncommon
Carex intumescens	Inflated sedge	Uncommon
Aster acuminatus	Woodland whorled aster	Uncommon
Eupatorium rugosum	White snakeroot	Uncommon
Monotropa uniflora	Indian-pipe	Uncommon
Solidago hispida	Hairy goldenrod	Uncommon
Thelypteris phegopteris	Northern beech fern	Uncommon
Acer pensylvanicum	Striped maple	Uncommon
Cornus canadensis	Bunchberry	Uncommon
Coptis trifolia	Goldthread	Uncommon
Polypodium vulgare	Rock polypody	Uncommon
Aster cordifolius	Heart-leaf aster	Rare
Deschampsia flexuosa	Common hairgrass	Rare
Cinna latifolia	Wood reedgrass	Rare
Carex trisperma	Three-seed sedge	Rare
Carex crinita	Fringed sedge	Rare
Carex sp.	Sedge	Rare
Vaccinium angustifolium	Late sweet blueberry	Rare
Rubus idaeus	Red raspberry	Rare
Dennstaedtia punctilobula	Hay-scented fern	Rare
Gaultheria hispidula	Creeping snowberry	Rare
Polystichum braunii	Braun's hollyfern	Rare

Table 2.--Summary of canopy data from ELT 8 vegetation plots (four plots)

Scientific name/ plot number	Common name	Average d.b.h.	Median d.b.h.	D.b.h. range	Average basal area	Basal area range	Average height	Height range
		cm	*cm*	*cm*	*m²/ha*	*m²/ha*	*m*	*m*
				TREE LAYER - BY SPECIES				
Abies balsamea	Balsam fir	18.0	17.8	12.7-35.6	19.4	2.4-41.2	12	5-18
Picea rubens	Red spruce	15.7	15.2	12.7-25.4	9.2	4.3-15.1	11	8-15
Betula papyrifera	Paper birch	16.2	15.2	12.7-20.3	2.7	0.0- 6.6	12	8-15
				TREE LAYER - BY PLOT				
Plot 3		19.3	20.3	12.7-35.6	51.7		15	12-18
Plot 7		16.8	17.8	12.7-20.3	25.1		12	9-14
Plot 8		15.5	15.2	12.7-20.3	19.4		9	5-12
Plot 9		15.7	14.0	12.7-25.5	28.8		10	6-12

Table 3.--Summary of understory data from ELT 8 vegetation plots

Scientific name	Common name	Average cover	Range of plots
		Percent	*Percent*
		SAPLING LAYER (four plots)	
Abies balsamea	Balsam fir	1.3	0.0- 5.0
		SHRUB LAYER (four plots)	
Abies balsamea	Balsam fir	15.0	0.0-60.0
Picea rubens	Red spruce	6.3	0.0-20.0
		HERB LAYER (sixteen plots)	
	Moss	54.4	15.0-97.5
	Bare ground	35.7	4.5-68.8
Abies balsamea	Balsam fir	9.4	0.3-24.0
Oxalis montana	Wood sorrel	2.2	0.0- 8.8
Dryopteris spinulosa	Spinulose shieldfern	1.9	0.0- 7.5
Betula sp.	Birch	1.1	T- 2.5
Lycopodium lucidulum	Shining clubmoss	0.8	0.0- 3.3
Picea rubens	Red spruce	0.7	T- 1.8
Acer pensylvanicum	Striped maple	0.4	0.0- 1.5
Sorbus americana	Mountain-ash	0.1	0.0- 0.5

T- Species was present in a 0.5-m² herb plot but represented less than 1 percent of the cover.

Table 4.--Meander survey data summary from ELT 6

Scientific name	Common name	Abundance
	TREE LAYER	
Fagus grandifolia	Beech	Abundant
Acer saccharum	Sugar maple	Abundant
Betula lutea	Yellow birch	Common
Sorbus americana	Mountain-ash	Uncommon
Betula papyrifera	Paper birch	Uncommon
Picea rubens	Red spruce	Uncommon
Abies balsamea	Balsam fir	Uncommon
Acer pensylvanicum	Striped maple	Uncommon
	SHRUB LAYER	
Viburnum alnifolium	Hobblebush	Abundant
Fagus grandifolia	Beech	Abundant
Acer pensylvanicum	Striped maple	Abundant
Picea rubens	Red spruce	Common
Sambucus pubens	Red-berry elderberry	Uncommon
Cornus alternifolia	Alternate-leaf dogwood	Uncommon
Ribes lacustre	Bristly black currant	Uncommon
Acer spicatum	Mountain maple	Uncommon
Diervilla lonicera	Bush honeysuckle	Rare
**Lonicera oblongifolia*	Swamp fly-honeysuckle	Rare
Amelanchier sp.	Shadbush	Rare
Lonicera canadensis	Fly-honeysuckle	Rare
	HERB LAYER	
Acer pensylvanicum	Striped maple	Abundant
Clintonia borealis	Bluebead lily	Abundant
Aster acuminatus	Woodland whorled aster	Common
Sorbus americana	Mountain-ash	Common
Erythronium americanum	Yellow trout lily	Common
Acer saccharum	Sugar maple	Common
Oxalis montana	Wood sorrel	Common
Dryopteris spinulosa	Spinulose shieldfern	Common
Abies balsamea	Balsam fir	Uncommon
Polystichum acrostichoides	Christmas fern	Uncommon
Viola sp.	Violet	Uncommon
Monotropa uniflora	Indian-pipe	Uncommon
Trillium undulatum	Painted trillium	Uncommon
Solidago hispida	Hairy goldenrod	Uncommon
Cinna latifolia	Wood reedgrass	Uncommon
Trillium erectum	Purple trillium	Uncommon
Epifagus virginiana	Beech-drops	Uncommon
Streptopus roseus	Twisted stalk	Uncommon
Betula lutea	Yellow birch	Uncommon
Sphagnum sp.	Sphagnum moss	Uncommon
Viola rotundifolia	Early yellow violet	Uncommon
Lycopodium lucidulum	Shining clubmoss	Uncommon
Prenanthes altissima	Rattlesnake root	Uncommon
Aster cordifolius	Heart-leaf aster	Uncommon
Eupatorium rugosum	White snakeroot	Uncommon
Fagus grandifolia	Beech	Uncommon
Smilacina racemosa	False Solomon's seal	Uncommon
Aralia nudicaulis	Wild sarsaparilla	Uncommon
Arisaema triphyllum	Jack-in-the-pulpit	Uncommon
Carex trisperma	Three-seed sedge	Uncommon

Continued

Table 4.--Continued

Scientific name	Common name	Abundance
Carex debilis	White-edge sedge	Uncommon
Carex sp.	Sedge	Uncommon
Thelypteris phegopteris	Long beech fern	Uncommon
Pyrola rotundifolia	Round-leaf wintergreen	Rare
Polypodium vulgare	Rock polypody	Rare
Dryopteris marginalis	Marignal shieldfern	Rare
Polygonatum pubescens	Solomon's seal	Rare
Adiantum pedatum	Maidenhair fern	Rare
Carex scabrata	Rough sedge	Rare
Galium sp.	Bedstraw	Rare
Rubus idaeus	Red raspberry	Rare
**Chrysosplenium americanum*	Watercarpet	Rare
Athyrium filix-femina	Lady fern	Rare
**Chelone glabra*	Turtlehead	Rare
Streptopus amplexifolius	Twisted stalk	Rare
**Scutellaria lateriflora*	Mad-dog skullcap	Rare
**Impatiens capensis*	Jewelweed	Rare
Athyrium thelypteroides	Silvery spleenwort	Rare
**Lycopus* sp.	Water-horehound	Rare
Epilobium glandulosum	Glandular willow-herb	Rare
**Galium triflorum*	Fragrant bedstraw	Rare
**Cicuta bulbifera*	Poison water-hemlock	Rare
Circaea alpina	Dwarf enchanter's nightshade	Rare
Gymnocarpium dryopteris	Oak fern	Rare

* Occurred in hillside seeps only.

Table 5.--Summary of canopy data from ELT 6 vegetation plots (three plots)

Scientific name/ plot number	Common name	Average d.b.h.	Median d.b.h.	D.b.h. range	Average basal area	Basal area range	Average height	Height range
		cm	*cm*	*cm*	*m^2/ha*	*m^2/ha*	*m*	*m*
				TREE LAYER - BY SPECIES				
Acer saccharum	Sugar maple	22.6	20.3	12.7-33.0	10.1	0.0-30.2	19	14-21
Fagus grandifolia	Beech	21.8	20.3	17.8-30.5	6.5	3.3- 9.7	16	15-20
Betula lutea	Yellow birch	45.7	45.7	27.9-63.5	12.6	0.0-31.7	18	15-21
Picea rubens	Red spruce	27.9	27.9		2.0	0.0- 6.1	15	
Abies balsamea	Balsam fir	22.9	22.9		1.4	0.0- 4.1	14	
Acer pensylvanicum	Striped maple	14.0	14.0	12.7-15.2	1.0	0.0- 3.1	12	
				TREE LAYER - BY PLOT				
Plot 4		33.0	25.4	17.8-63.5	44.3		17	15-21
Plot 5		21.1	20.3	12.7-30.5	23.0		14	12-15
Plot 10		22.4	20.3	12.7-33.0	33.5		19	14-21

Table 6.--Summary of understory data from ELT 6 vegetation plots

Scientific name	Common name	Average cover	Range of plots
		Percent	*Percent*
	SHRUB LAYER (three plots)		
Fagus grandifolia	Beech	15.0	10.0-25.0
Acer saccharum	Sugar maple	10.0	0.0-30.0
Acer pensylvanicum	Striped maple	7.0	0.0-20.0
Acer spicatum	Mountain maple	1.0	0.0- 3.0
Betula lutea	Yellow birch	T	0.0-T
	HERB LAYER (twelve plots)		
	Bare ground	72.0	62.5-78.0
Dryopteris spinulosa	Spinulose shieldfern	15.0	13.3-16.0
Fagus grandifolia	Beech	5.0	0.0-13.8
Lycopodium lucidulum	Shining clubmoss	2.5	0.0- 7.5
Acer saccharum	Sugar maple	1.8	0.0- 5.0
	Moss	1.6	0.0- 3.5
Acer pensylvanicum	Striped maple	1.4	0.8- 2.5
Oxalis montana	Wood sorrel	0.8	0.0- 2.3
Acer spicatum	Mountain maple	0.3	0.0- 1.0
Trillium erectum	Purple trillium	0.3	0.0- 1.8
Betula lutea	Yellow birch	T	0.0- T

T- Species was present in a 0.5-m^2 plot but represented less than 1 percent of the cover.

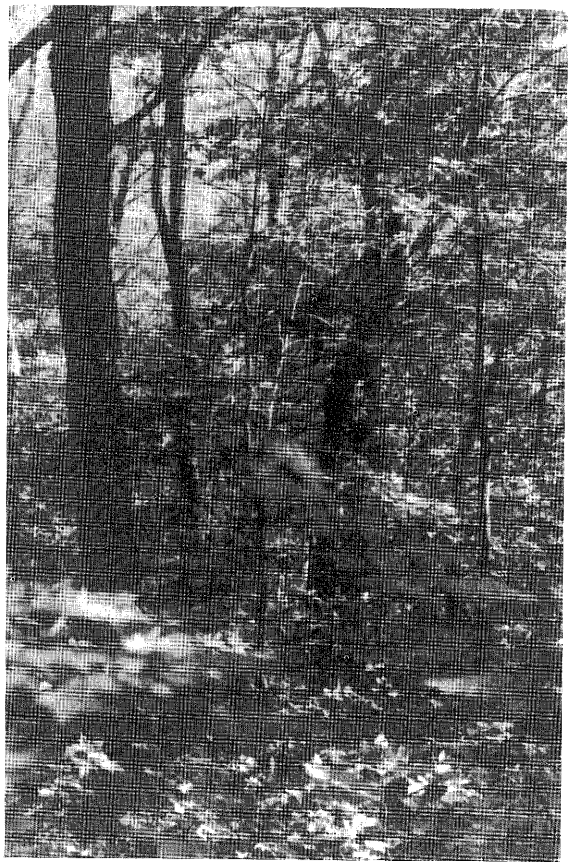

Figure 5.--Sugar maple-American beech stand on a steep slope in ELT 6.

softwoods become more common in the higher elevations of this ELT, the lower altitudes were clearly hardwood-dominated and included a significant amount of beech, which is not included in the USDA Forest Service description. This discrepancy may be partially due to inclusions of ELT 105, which the forest association description states may account for up to 25 percent of the ELT.

In the shrub layer, hobblebush, beech, and striped maple were abundant. Sugar maple was a common understory species, though regenerating yellow birch was infrequent. The herbaceous layer accounted for approximately 25 percent total cover, and was dominated by spinulose shieldfern, bluebead lily, and striped maple seedlings. Trout lily (*Erythronium americanum*) was common in the spring. Moss cover was much less abundant than in ELT 8. Litter and blowdowns were common with downed tree diameters generally larger than those observed in ELT 8.

Several distinct microhabitats were found in ELT 6: sidehill seeps and a ledge site.

Sidehill seeps. Along the lower boundary of ELT 6, a number of groundwater discharge sites occurred. Two of these seeps (Figs. 6 and 7) were visited repeatedly during every sampling period and are described here as representative of the seep community.

Seep slopes were approximately 5 percent, with surface soils of loose till and a 2- to 15-cm organic layer. Saturated conditions occurred during every site visit, and small braided channels below several of the seeps indicated that intermittent streams originated from these areas. The seeps were small in area, with the largest estimated to be 200 m^2.

No trees or shrubs occurred in the seeps, though a thick layer of shrubs typical of the forest community crowded the edges. *Sphagnum* moss was abundant under a dense herbaceous layer dominanted by jewelweed (*Impatiens capensis*). This composition was typical of most seeps with the exception of one near the southern edge of the Bowl that was dominated by dwarf enchanter's nightshade (*Circaea alpina*). Other common seep species included white snakeroot (*Eupatorium rugosum*), lady fern (*Athyrium filix-femina*), and wood reedgrass (*Cinna latifolia*). Eight species identified in the seeps were found nowhere else in the Bowl; these are indicated with an asterisk (*) in Table 4. Several species, including turtlehead (*Chelone glabra*), glandular willow-herb (*Epilobium glandulosum*), and swamp fly-honeysuckle (*Lonicera oblongifolia*) were rare even in the seeps.

Ledge site. A large ledge (Fig. 8) approximately 15 m in height and at 770 m elevation was located just south of the Wiggins trail. (This location is mapped as just outside the Bowl on some RNA maps). No other ledge was encountered in the Bowl that was even half this height. The base of the ledge was boulder-strewn, moderately steep, and moist. Although the general vegetation community was similar to that of the remaining ELT, it contained several species that formed an assemblage unique to this site. Maidenhair fern (*Adiantum pedantum*) was found only in this location (Fig. 9) and was associated with marginal woodfern (*Dryopteris marginalis*), a bedstraw (*Galium* sp.), dwarf enchanter's nightshade and lady fern. These species were rare throughout the Bowl and were found associated either with other ledges (marginal woodfern and the bedstraw) or seeps and streams (dwarf enchanter's nightshade and lady fern). The maidenhair fern is reported to occur in moist, circumneutral soils (Gleason and Cronquist 1963) and rich hardwoods (Fernald 1950). Without additional analysis of soils and other site features, the factors creating this unique habitat are unknown.

ELT 6E

At the north end of the Bowl, a portion of the cirque wall was typed as ELT 6E. Although rising in elevation to over 1,050 m and parallel to ELT 8, its character was more similar to that of ELT 6. Slopes were moderately steep, estimated in the field as 30 percent and variable. Its soils, according to the USDA Forest Service (Steve Fay, USFS, personal comunication), are typically 0.6 to 1.2 m of well-graded sandy loam till over 2.4 m of rocky till. Streams were intermittent and typically in poorly defined channels.

Dominant tree species were balsam fir, mountain-ash, paper birch, and heart-leaved paper birch (Table 7). In the vegetation plots (Tables 8 and 9) and in the meander

Figure 6.--Seep 1 (ELT 6) in June. Jewelweed and wood reedgrass are most evident.

Figure 7.--Seep 2 in August. Jewelweed is flowering.

Figure 8.--Steep cliffs south of the Wiggins Trail (ledge site) in ELT 6.

Figure 9.--Maidenhair fern at the base of the ledge site in ELT 6.

surveys, balsam fir was abundant, with an average d.b.h. of 18.3 cm and an average height of 13.8 m. The shrub layer was quite sparse in closed canopy areas, with an average cover of approximately 10 percent in the plots. Common species included balsam fir, red spruce, and striped maple. In numerous openings in the canopy, regenerating mountain-ash was dominant. The herb layer composed approximately 40 percent cover, and was dominated by balsam fir seedlings, splnulose woodfern, wood sorrel, and shining clubmoss. Mosses were abundant in cool moist patches under the canopy.

ELT 105

The base of the Bowl below about 750 m is characterized by deep ablational tills (Steve Fay, USFS, personal communication) and gentle slopes (generally 3 to 8 percent). Boulders are common, sometimes many meters in diameter. Aspect ranges from southeast at the northern end of the ELT to northeast near the outlet of the Bowl.

Some of the largest trees in the Bowl are yellow birch, which dominate the upper canopy in some portions of ELT 105. Yellow birch trees with d.b.h. of 78 cm and height of 25 to 30 m were recorded in two of the three vegetation plots (Tables 10 and 11 and Fig. 10). The third plot contained a 58-cm yellow birch snag. However, American beech was the most abundant tree in the overstory of the plots (Tables 10, 11, and 12). Large sugar maple are found throughout ELT 105, and an occasional eastern hemlock (*Tsuga canadensis*) occurs in the canopy along the Wonalancet Brook ravine. Saplings of these species and striped maple make up the lower canopy, with beech again dominating. Tables 10 and 11 summarize tree species composition and sizes.

Yellow birch is considered somewhat less shade tolerant than its hardwood associates (Leak 1975), and its seedlings favor exposed soils or moist logs, which are often associated with disturbances such as windthrow of trees. Researchers have speculated that the yellow birch overstory in the Bowl may be the result of a catastrophic disturbance hundreds of years ago (Forcier 1975, Martin 1977). Birch trees up to 267 years old have been recorded by Leak (1985).

The shrub layer in ELT 105 was patchy, less than 15 percent cover in the three plots sampled, and dominated by young beech, hobblebush, and young red spruce. Other shrub species included alternate-leaved dogwood (*Cornus alterniflora*), red-berried elder (*Sambucus pubens*), and two species of gooseberry (*Ribes lacustre; R. glandulosum*). The herbaceous ground cover averaged an estimated 30 percent in the vegetation plots. The most common species

Text continues on page 18.

Table 7.--Meander survey data summary from ELT 6E

Scientific name	Common name	Abundance
	TREE LAYER	
Betula papyrifera	Paper birch	Abundant
Sorbus americana	Mountain-ash	Abundant
Abies balsamea	Balsam fir	Abundant
Picea rubens	Red spruce	Common
Betula papyrifera var. *cordifolia*	Heart-leaved paper birch	Common
Betula lutea	Yellow birch	Uncommon
	SHRUB LAYER	
Abies balsamea	Balsam fir	Common
Picea rubens	Red spruce	Common
Acer pensylvanicum	Striped maple	Common
Viburnum alnifolium	Hobblebush	Uncommon
Betula lutea	Yellow birch	Uncommon
Acer spicatum	Mountain maple	Uncommon
Cornus alternifolia	Alternate-leaf dogwood	Rare
Lonicera canadensis	Fly honeysuckle	Rare
	HERB LAYER	
Dryopteris spinulosa	Spinulose shieldfern	Abundant
Oxalis montana	Wood sorrel	Abundant
Lycopodium lucidulum	Shining clubmoss	Abundant
Picea rubens	Red spruce	Abundant
Abies balsamea	Balsam fir	Abundant
Maianthemum canadense	Canada mayflower	Common
Clintonia borealis	Bluebead lily	Common
Aster acuminatus	Woodland whorled aster	Uncommon
Monotropa uniflora	Indian-pipe	Uncommon
Thelypteris phegopteris	Long beech fern	Uncommon
Streptopus roseus	Twisted stalk	Uncommon
Betula papyrifera	Paper birch	Uncommon
Solidago hispida	Hairy goldenrod	Uncommon
Trillium undulatum	Painted trillium	Uncommon
Acer pensylvanicum	Striped maple	Uncommon
Sorbus americana	Mountain-ash	Uncommon
Acer spicatum	Mountain maple	Uncommon
Carex sp.	Sedge	Uncommon
Pyrola rotundifolia	Round-leaf wintergreen	Rare
Cypripedium sp.	Lady slipper	Rare

Table 8.--Summary of canopy data from ELT 6E vegetation plots (two plots)

Scientific name/ plot number	Common name	Average d.b.h.	Median d.b.h.	D.b.h. range	Average basal area	Basal area range	Average height	Height range
		cm	*cm*	*cm*	*m²/ha*	*m²/ha*	*m*	*m*
				TREE LAYER - BY SPECIES				
Abies balsamea	Balsam fir	18.3	17.8	12.7-25.4	15.2		14	12-15
Betula papyrifera	Paper birch	15.9	15.2	12.7-25.4	8.4	8.1-8.6	12	11-12
Picea rubens	Red spruce	15.2	15.2	12.7-17.8	2.8	0.0-5.5	12	
Sorbus americana	Mountain-ash	16.5	16.5	15.2-17.8	2.2	1.9-2.5	12	
Betula lutea	Yellow birch	20.3	20.3		1.6	0.0-3.3	12	
Acer spicatum	Mountain maple	15.2	15.2		0.9	0.0-1.9	12	
				TREE LAYER - BY PLOT				
Plot 1		18.3	15.2	12.7-25.4	35.9		13	11-15
Plot 2		15.8	15.2	12.7-20.3	26.3		13	11-15

Table 9.--Summary of understory data from ELT 6E vegetation plots

Scientific name	Common name	Average cover	Range of plots
		Percent	*Percent*
		SAPLING LAYER (two plots)	
Abies balsamea	Balsam fir	1.5	0.0- 3.0
		SHRUB LAYER (two plots)	
Picea rubens	Red spruce	7.5	5.0-10.1
Abies balsamea	Balsam fir	1.5	0.0- 3.0
Betula lutea	Yellow birch	0.5	0.0- 1.0
		HERB LAYER (eight plots)	
	Bare ground	68.9	60.5-77.3
Abies balsamea	Balsam fir	15.0	10.0-20.0
Dryopteris spinulosa	Spinulose shieldfern	6.8	6.0- 7.5
Lycopodium lucidulum	Shining clubmoss	3.1	1.3- 5.0
	Moss	2.6	0.0- 5.3
Sorbus americana	Mountain-ash	2.0	1.0- 3.0
Betula papyrifera	Paper birch	0.6	T- 1.3
Acer pensylvanicum	Striped maple	0.4	0.0- 0.8
Maianthemum canadense	Canada mayflower	0.3	0.0- 0.5
Oxalis montana	Wood sorrel	0.3	0.0- 0.5
Carex sp.	Sedge	T	0.0- 0.3
Acer spicatum	Mountain maple	T	0.0-T

T - Species was present in a 0.5-m² herb plot but represented less than 1 percent of the cover.

Table 10.--Summary of canopy data from ELT 105 vegetation plots (three plots)

Scientific name/ plot number	Common name	Average d.b.h.	Median d.b.h.	D.b.h. range	Average basal area	Basal area range	Average height	Height range
		cm	*cm*	*cm*	*m²/ha*	*m²/ha*	*m*	*m*
				TREE LAYER - BY SPECIES				
Betula lutea	Yellow birch	55.9	57.2	30.5-78.7	37.3	0.0-56.1	27	24-30
Acer saccharum	Sugar maple	21.1	19.1	12.7-33.0	5.2	0.0-14.4	20	14-24
Fagus grandifolia	Beech	17.8	17.8	12.7-22.9	4.3	1.9- 7.0	15	12-21
				TREE LAYER - BY PLOT				
Plot 6		16.0	15.2	12.7-20.3	8.2		14	12-15
Plot 11		43.2	40.6	15.2-73.7	57.6		22	12-30
Plot 12		33.8	26.7	15.2-78.7	74.6		24	20-30

Table 11.--Summary of understory data from ELT 105 vegetation plots

Scientific name	Common name	Average cover	Range of plots
		Percent	*Percent*
		SAPLING LAYER (three plots)	
Fagus grandifolia	Beech	8.3	0.0-25.0
		SHRUB LAYER (three plots)	
Fagus grandifolia	Beech	9.3	3.0-15.0
Viburnum alnifolium	Hobblebush	1.7	0.0- 5.0
Acer pensylvanicum	Striped maple	7.0	0.0- 2.0
Picea rubens	Red spruce	T	0.0-T
		HERB LAYER (twelve plots)	
	Bare ground	70.0	58.8-81.3
Viburnum alnifolium	Hobblebush	15.0	0.0-25.0
Acer saccharum	Striped maple	3.6	1.0- 6.0
Oxalis montana	Wood sorrel	3.3	T-10.0
Acer pensylvanicum	Striped maple	1.8	T- 5.0
	Moss	2.8	0.0- 7.5
Dryopteris spinulosa	Spinulose shieldfern	1.7	0.0- 5.3
Lycopodium lucidulum	Shining clubmoss	1.3	0.0- 4.0
Maianthemum canadense	Canada mayflower	1.0	0.0- 3.0
Clintonia borealis	Bluebead lily	1.0	0.5- 1.3
Acer spicatum	Mountain maple	0.4	0.0- 1.3
Fagus grandifolia	Beech	0.2	0.0- 0.3
Medeola virginiana	Indian cucumber root	0.2	0.0- 0.5
Trientalis borealis	Starflower	0.1	0.0- 0.3
Monotropa uniflora	Indian-pipe	T	0.0-T
Betula lutea	Yellow birch	T	0.0-T

T - Species was present in a 0.5-m² plot but represented less than 1 percent of the cover.

Table 12.--Meander survey data summary from ELT 105

Scientific name	Common name	Abundance
	TREE LAYER	
Fagus grandifolia	Beech	Abundant
Betula lutea	Yellow birch	Common
Acer saccharum	Sugar maple	Uncommon
Tsuga canadensis	Hemlock	Uncommon
Acer pensylvanicum	Striped maple	Uncommon
	SHRUB LAYER	
Fagus grandifolia	Beech	Abundant
Viburnum alnifolium	Hobblebush	Abundant
Picea rubens	Red spruce	Common
Acer pensylvanicum	Striped maple	Uncommon
Ribes glandulosum	Skunk currant	Uncommon
Ribes lacustre	Bristly black currant	Uncommon
Cornus alternifolia	Alternate-leaf dogwood	Uncommon
Sambucus pubens	Red-berry elderbery	Uncommon
Taxus canadensis	Yew	Rare
	HERB LAYER	
Oxalis montana	Wood sorrel	Abundant
Lycopodium lucidulum	Shining clubmoss	Abundant
Clintonia borealis	Bluebead lily	Abundant
Dryopteris spinulosa	Spinulose shieldfern	Abundant
Acer pensylvanicum	Striped maple	Common
Acer saccharum	Sugar maple	Common
Erythronium americanum	Yellow trout lily	Common
Carex trisperma	Three-seed sedge	Uncommon
Carex intumescens	Inland sedge	Uncommon
Carex debilis	White-edge sedge	Uncommon
Carex sp.	Sedge	Uncommon
Monotropa uniflora	Indian-pipe	Uncommon
Betula lutea	Yellow birch	Uncommon
Fagus grandifolia	Beech	Uncommon
Maianthemum canadense	Canada mayflower	Uncommon
Solidago hispida	Hairy goldenrod	Uncommon
Abies balsamea	Balsam fir	Uncommon
Aster acuminatus	Woodland whorled aster	Uncommon
Streptopus amplexifolius	Twisted stalk	Uncommon
Thelypteris phegopteris	Northern beech fern	Uncommon
Trillium erectum	Purple trillium	Uncommon
Eupatorium rugosum	White snakeroot	Uncommon
Polypodium vulgare	Rock polypody	Uncommon
Epifagus virginiana	Beech-drops	Uncommon
Cinna latifolia	Wood reedgrass	Uncommon
Arisaema triphyllum	Jack-in-the-pulpit	Uncommon
Athyrium filix-femina	Lady fern	Uncommon
Uvularia sessilifolia	Sessile bellwort	Uncommon
Mitchella repens	Partridge-berry	Uncommon
Medeola virginiana	Indian cucumber root	Uncommon
Smilacina racemosa	False Solomon's seal	Uncommon
Trientalis borealis	Starflower	Uncommon
Aralia nudicaulis	Wild sarsaparilla	Uncommon
Acer spicatum	Mountain maple	Uncommon
Prenanthes altissima	Rattlesnake root	Uncommon

Continued

Table 12.--Continued

Scientific name	Common name	Abundance
Rubus pubescens	Dwarf raspberry	Rare
Viola sp.	Violet	Rare
Actaea rubra	Red baneberry	Rare
Aralia racemosa	Spikenard	Rare
Trillium undulatum	Painted trillium	Rare
Goodyera tesselata	Checkered rattlesnake plaintain	Rare
Circaea alpina	Dwarf enchanter's nightshade	Rare
Epilobium glandulosum	Glandular willow-herb	Rare
Dicentra canadensis	Squirrel corn	Rare
Gymnocarpium dryopteris	Oak fern	Rare
Anemone quinquefolia	Wood anemone	Rare
Actaea alba	White baneberry	Rare

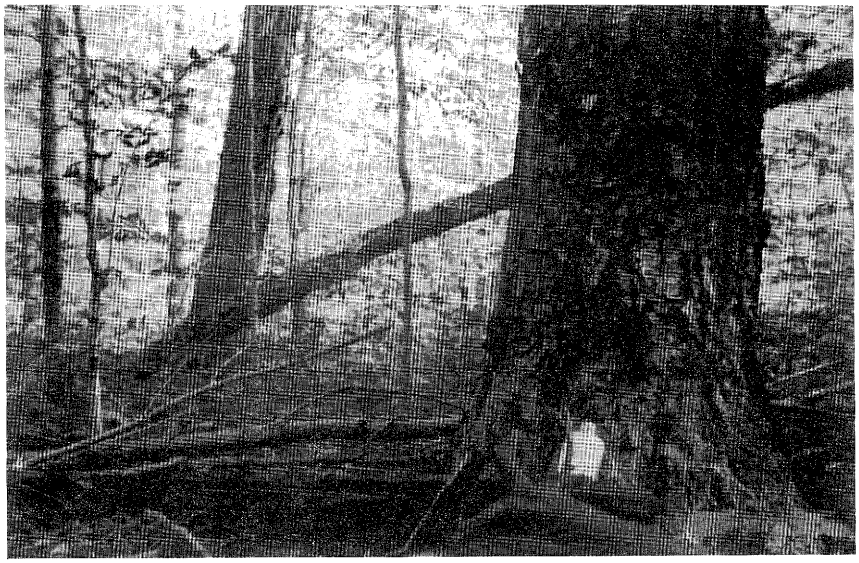

Figure 10.--A large Yellow birch dominates plot 11 in ELT 105.

observed during meander surveys were those also most common in ELT 8, including wood sorrel, spinulose shieldfern, shining clubmoss, and bluebead lily. In addition to these species and seedlings of the trees within the ELT, 38 other species were recorded in the herb layer. A list of species observed in ELT 105 during plot sampling and meander surveys and their estimated relative abundances is provided in Table 10.

Rare Species

Squirrel-corn (*Dicentra canadensis*)

Squirrel-corn is listed as state-threatened in the "Protected Plants of New Hampshire" (N.H. Dep. Resour. Econ. Develop. 1987), with a state element rank of S3 (more than 20 occurrences). A small stand of squirrel-corn was identified in the Bowl during the June 7, 1992, survey. The stand was located in ELT 105 along the border of the southernmost perennial tributary to Wonalancet Brook. It occurred on the side of a swale that appeared to be an overflow channel during high flows, though the squirrel corn was rooted in a rich organic soil that showed no evidence of scour.

Although a complete count of individuals was not made, approximately 6 to 8 plants were observed. None were in flower or fruit, but the pink grainy clumps of tubers were unmistakable. When the stand was revisited during the August 1992 survey, no specimens were found, presumably unobservable due to senescence or herbivory, or both.

Lady slipper (*Cypripedium* sp.)

All species of lady slipper are included in "Protected Plants of New Hampshire," and are ranked at a minimum as special concern species. A single, nonflowering specimen was identified in the Bowl on August 19, 1992. It occurred in the transition zone between ELT's 6E and 8, approximately halfway up the slope (estimated elevation 940 m), in a stand of large red spruce, balsam fir, and some hardwoods. The shrub and herbaceous layers were sparse and the lady slipper was quite isolated on a slight knob.

Additional Findings

Species Distribution

Ninety-three species were recorded in the Bowl over the four ELT's. Of these, a number of species were ubiquitous to all ELT's (Table 13), though their abundance varied widely among land types. The following discussion addresses species distribution across the ELT's; however, it should be kept in mind that the species listings for each ELT are very likely incomplete. Several species that were expected but not encountered might be found in a more exhaustive survey.

Ten tree species were recorded in the Bowl. Of these, only yellow birch, red spruce, and striped maple were found in all ELT's. Paper birch and balsam fir are also very likely ubiquitous, occurring in such small numbers in ELT 105 that we did not encounter them.

Of the 13 shrub species, only hobblebush occurred in all ELT's and of the remaining shrubs, most were restricted to only one or two land types. These data concur with the meander survey abundances (Tables 1, 4, 7, and 10) which indicate that, with the exception of hobblebush, all shrub species were uncommon. Seedlings of tree species accounted for a much greater proportion of the shrub layer.

Eight of the 70 herb species were found in all four ELT's: wood sorrel, spinulose shieldfern, bluebead lily, woodland whorled aster (*Aster acuminatus*), shining clubmoss, Indian-pipe (*Monotropa uniflora*), hairy goldenrod (*Solidago* hispida), and northern beech fern (*Thelypteris phegopteris*). The first five in this list were common or abundant in most of the ELT's, while Indian pipe, goldenrod, and northern beech fern were ranked uncommon in abundance in all the ELT's.

Forest Openings

Forest openings throughout the ELT's contained a number of species that were infrequent elsewhere. The openings were associated with blowdowns, streamsides, and large ledges, and displayed a variety of hydrologic regimes; so, it is likely that exposure to light was the key factor to which these species were responding. The hillside seeps and hiking trails described under "Ecological land type descriptions" are excluded from this discussion. Species commonly occurring in the openings included hairy goldenrod, woodland whorled aster, red raspberry (*Rubus idaeus*), long beech fern, and dwarf raspberry (*Rubus pubescens*) (Figs. 11 and 12).

Wildlife

Observations of wildlife and their sign were casually recorded during the botanical surveys. The list of species (Table 14) is not intended to be complete; for example, breeding birds were only partially recorded during the June 7, 1992, survey and small mammals are surely underrepresented. Although not a focus of the botanical survey, several species of wildlife may have a significant impact on the structure and composition of the vegetation.

Abundant moose (*Alces alces*) sign was observed throughout the study area. No individuals were seen but scat, browse marks, and trail networks were widespread, even at the top of ELT 8. Snowshoe hare (*Lepus americanus*) scat and browse were also quite common, as were bear claw scars on beech boles. One white-tailed deer (*Odocoileus virginianus*) was observed, though their usage of the area was not evident.

Text continues on page 22.

Table 13.--Summary listing of vascular plant species encountered in the Bowl, by ELT

Scientific name	Common name	ELT 8	ELT 6	ELT 6E	ELT 105
LYCOPODIACEAE					
Lycopodium lucidulum	Shining clubmoss	x	x	x	x
Gymnocarpium dryopteris	Oak fern		x		x
Thelypteris phegopteris	Northern beech fern	x	x	x	x
Dryopteris spinulosa	Spinulose shieldfern	x	x	x	x
Dryopteris marginalis	Marginal shieldfern		x		
Polystichum braunii	Braun's hollyfern	x			
Polystichum acrostichoides	Christmas fern		x		
Dennstaedtia punctilobula	Hayscented fern	x			
Athyrium thelypteroides	Silvery spleenwort		x		
Athyrium filix-femina	Lady fern		x		x
Adiantum pedatum	Maidenhair fern		x		
Polypodium vulgare	Rock polypody	x	x		x
TAXACEAE					
Taxus canadensis	Yew				x
PINACEAE					
Abies balsamea	Balsam fir	x	x	x	
Tsuga canadensis	Hemlock				x
Picea rubens	Red spruce	x	x	x	x
GRAMINAE					
Deschampsia flexuosa	Common hairgrass	x			
Cinna latifolia	Wood reedgrass	x	x		x
CYPERACEAE					
Carex trisperma	Three-seed sedge	x	x		x
Carex debilis	White-edge sedge	x	x		x
Carex scabrata	Rough sedge		x		
Carex crinita	Fringed sedge	x			
Carex intumescens	Inflated sedge	x			
Carex sp.	Sedge	x	x	x	x
ARACEAE					
Arisaema triphyllum	Jack-in-the-pulpit		x		x
LILIACEAE					
Erythronium americanum	Yellow trout lily		x		
Clintonia borealis	Bluebead lily	x	x	x	x
Smilacina racemosa	False Solomon's seal		x		x
Maianthemum canadense	Canada mayflower			x	x
Uvularia sessifolia	Bellwort				x
Streptopus amplexifolius	Twisted stalk		x		x
Streptopus roseus	Twisted Stalk		x	x	
Polygonatum pubescens	Solomon's seal		x		
Trillium erectum	Purple trillium		x		x
Trillium undulatum	Painted trillium		x	x	x
Medeola virginiana	Indian cucumber root				x
ORCHIDACEAE					
Cypripedium sp.	Lady slipper			x	
Goodyera tesselata	Checkered rattlesnake plantain				x

Continued

Table 13.--Continued

Scientific name	Common name	ELT 8	ELT 6	ELT 6E	ELT 105
BETULACEAE					
Betula lutea	Yellow birch	x	x	x	x
Betula papyrifera	Paper birch	x	x	x	
Betula papyrifera var. *cordifolia*	Heart-leaved paper birch	x		x	
FAGACEAE					
Fagus grandifolia	Beech		x		x
RANUNCULACEAE					
Anemone quinquefolia	Wood anemone				x
Actaea rubra	Red baneberry				x
Actaea alba	White baneberry				x
Coptis trifolia	Goldthread	x			
FUMARIACEAE					
Dicentra canadensis	Squirrel-corn				x
SAXIFRAGACEAE					
Chrysosplenium americanum	Watercarpet		x		
Ribes glandulosum	Skunk currant				x
Ribes lacustre	Bristly black currant		x		x
ROSACEAE					
Sorbus americana	Mountain-ash	x	x	x	
Amelanchier sp.	Shadbush	x	x		
Rubus pubescens	Dwarf raspberry				x
Rubus idaeus	Red raspberry	x	x		
Prunus pensylvanica	Bird cherry	x			
OXALIDACEAE					
Oxalis montana	Wood sorrel	x	x	x	x
AQUIFOLIACEAE					
Nemopanthus mucronata	Mountain holly	x			
ACERACEAE					
Acer spicatum	Mountain maple		x	x	
Acer pensylvanicum	Striped maple	x	x	x	x
Acer saccharum	Sugar maple		x		x
BALSAMINACEAE					
Impatiens capensis	Jewelweed		x		
VIOLACEAE					
Viola sp.	Violet		x		x
Viola rotundifolia	Early yellow violet		x		
ONAGRACEAE					
Epilobium glandulosum	Glandular willow-herb		x		x
Circaea apina	Dwarf enchanter's nightshade		x		x

Continued

Table 13.--Continued

Scientific name	Common name	ELT 8	ELT 6	ELT 6E	ELT 105
ARALIACEAE					
Aralia racemosa	Spikenard				x
Aralia nudicaulis	Wild sarsaparilla		x		x
UMBELLIFERAE					
Cicuta bulbifera	Poison water-hemlock		x		
CORNACEAE					
Cornus canadensis	Bunchberry	x			
Cornus alternifolia	Alternate-leaf dogwood		x	x	x
ERICACEAE					
Pyrola rotundifolia	Round-leaf wintergreen		x	x	
Monotropa uniflora	Indian-pipe	x	x	x	x
Gaultheria hispidula	Creeping snowberry	x			
Vaccinium angustifolium	Late sweet blueberry	x			
PRIMULACEAE					
Trientalis borealis	Starflower	x			x
LABIATAE					
Scutellaria lateriflora	Mad-dog skullcap		x		
Lycopus sp.	Water-horehound		x		
SCROPHULARIACEAE					
Chelone glabra	Turtlehead		x		
OROBANCHACEAE					
Epifagus virginiana	Beech-drops		x		x
RUBIACEA					
Galium sp.	Bedstraw		x		
Galium triflorum	Fragrant bedstraw		x		
Mitchella repens	Partridge-berry				x
CAPRIFOLIACEAE					
Diervilla lonicera	Bush honeysuckle		x		
Lonicera canadensis	Fly honeysuckle		x	x	
Lonicera oblongifolia	Swamp fly honeysuckle		x		
Sambucus pubens	Red-berry elderberry		x		x
Viburnum alnifolium	Hobblebush	x	x	x	x
Viburnum cassinoides	Northern wild raisin	x			
COMPOSITAE					
Eupatorium rugosum	White snakeroot	x	x		x
Solidago hispida	Hairy goldenrod	x	x	x	x
Aster cordifolius	Heart-leaf aster		x		
Aster acuminatus	Woodland whorled aster	x	x	x	x
Prenanthes altissima	Rattlesnake root		x		x

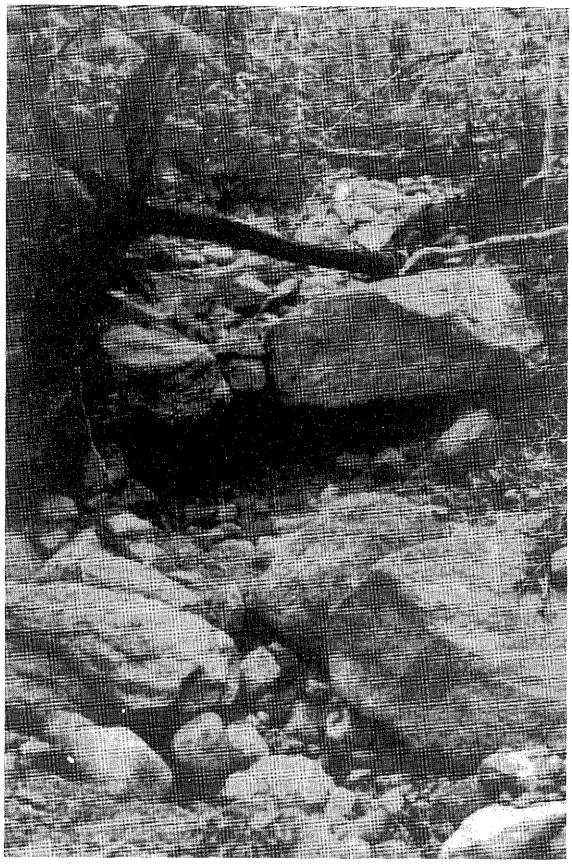

Figure 11.--One of the well-scoured intermittent Wonalancet Brook tributaries in ELT 105.

Recommendations

During these field investigations, several gaps in our vegetation data base were identified that, if explored, could provide insights into old-growth forest processes. One of the vegetation parameters that would be useful is a measure of patchiness in the herbaceous layer. Many differences were observed in the spatial distribution of herbaceous plants and seedlings, and concentrating on microhabitat differences may yield clues to the associations and distributions observed in this study.

We did not study lichens, mosses, or fungi; however, these life forms are well represented in the Bowl and are likely an important part of the community. A study of the plant and fungal communities associated with dead and down material specifically also would be of interest. Also, developing a standard system for assessing unvegetated ground, including leaf litter, dead woody material, boulders and ledge, would help describe ELT conditions more precisely.

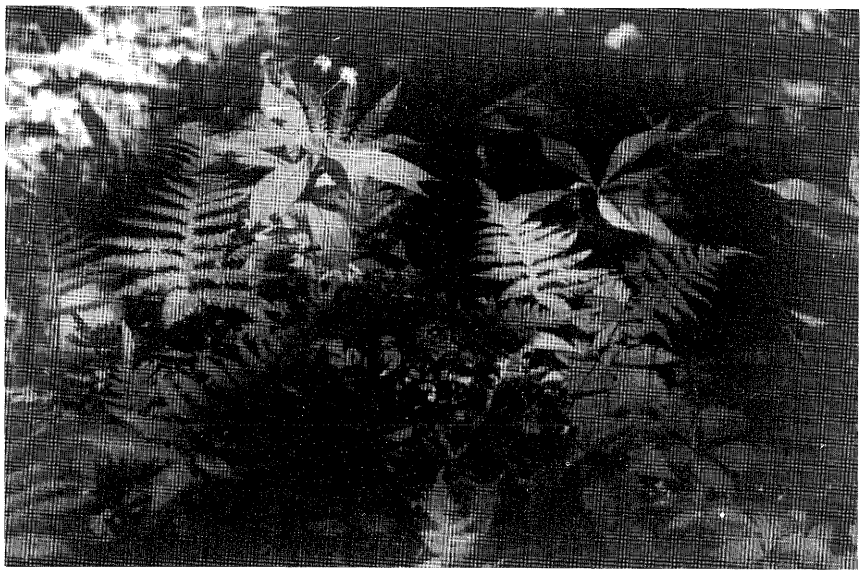

Figure 12.--Herbaceous species common to streamside habitats and other small openings include woodland whorled aster, northern beech fern, and dwarf raspberry.

Table 14.--Wildlife species and sign observed in the Bowl

Scientific name	Common name	Observation
	AMPHIBIANS	
Plethodon cinereus	Redback salamander	Sighting
Bufo a. americanus	Eastern American toad	Sighting
Hyla c. crucifer	Northern spring peeper	Sighting
Rana sylvatica	Wood frog	Sighting
	BIRDS	
Accipitridae	Accipiter	Sighting
Strix varia	Barred owl	Heard
Sphyrapicus varius	Yellow-bellied sapsucker	Sign
Picoides villosus	Hairy woodpecker	Sighting
Dryocopus pileatus	Pileated woodpecker	Sign
Cyanocitta cristata	Bluejay	Sighting
Corvus corvax	Common raven	Sighting
Parus atricapillus	Black-capped chickadee	Sighting
Parus hudsonicus	Boreal chickadee	Sighting
Sitta canadensis	Red-breasted nuthatch	Heard
Sitta carolinensis	White-breasted nuthatch	Sighting
Certhia americana	Brown creeper	Heard
Regulus satrapa	Golden-crowned kinglet	Sighting
Catharus sp.	Thrush	Heard
Hylocichla mustelina	Wood thrush	Heard
Turdus migratorius	American robin	Sighting
Vireo olivaceus	Red-eyed vireo	Heard
Dendroica caerulescens	Black-throated blue warbler	Heard
Dendroica virens	Black-throated green warbler	Heard
Dendroica fusca	Blackburnian warbler	Heard
Setophaga ruticilla	American redstart	Sighting
Seiurus aurocapillus	Ovenbird	Heard
Junco hyemalis	Dark-eyed junco	Sighting
	MAMMALS	
Lepus americanus	Snowshoe hare	Sign
Tamias striatus	Eastern chipmunk	Sighting
Tamiasciurus hudsonicus	Red squirrel	Sighting
Ursus americanus	Black bear	Sign
Odocoileus virginianus	White-tailed deer	Sighting
Alces alces	Moose	Sign

Literature Cited

Byers, G.L.; Goodrich, D.L. 1977. **Selected climates of New Hampshire.** Res. Rep. No. 60. Durham, NH: New Hampshire Agricultural Experiment Station, University of New Hampshire: 58 p.

Carr, A.; Chauner, M.E.; Hylton, W.H.; Smyser, S.W.; Stoner, C.; Stoner, M.; Yepson, R.B., Jr. 1978. **The encyclopedia of organic gardening.** Emmaus, PA: Rodale Press, Inc. 1236 p.

Fernald, M.L. 1950. **Gray's manual of botany.** 8th ed. New York: American Book Company. 1632 p.

Forcier, L.K. 1975. **Reproductive strategies and co-occurrence of climax tree species.** Science. 189: 808-810.

Gleason, H.A.; Cronquist, A. 1963. **Manual of vascular plants of northeastern United States and adjacent Canada.** Boston, MA: PWS Publishers. 810 p.

Kuchler, A.W. 1975. **Potential natural vegetation of the coterminous United States.** Spec. Publ. 36. New York: American Geographical Society.

Leak, W.B. 1973. **Species and structure of a virgin northern hardwood stand in New Hampshire.** Res. Note NE-181. Upper Darby, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 4 p.

Leak, W.B. 1975. **Age distribution in virgin red spruce and northern hardwoods.** Ecology. 56(6): 1451-1454.

Leak, W.B. 1985. **Relationships of tree age to diameter in old-growth northern hardwoods and spruce-fir.** Res. Note NE-329. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 4 p.

Martin, C.W. 1977. **Distribution of tree species in an undisturbed northern hardwood--spruce-fir forest, the Bowl, New Hampshire.** Res. Note NE-244. Upper Darby, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 6 p.

New Hampshire Department of Resources and Economic Development. 1987. **Protected plants of New Hampshire.** Natural Heritage Inventory. Res.- N. 306 Plant Listing. Concord, NH: New Hampshire Department of Resources and Economic Development.

Oosting, H.J.; Billings, W.D. 1951. **A comparison of virgin spruce-fir forests in the northern and southern Appalachian system.** Ecology. 32(1): 84-103.

U.S. Department of Agriculture, Forest Service. 1986. **Land and resource management plan, White Mountain National Forest.** Milwaukee, WI: U.S. Department of Agriculture, Forest Service, Eastern Region. 304 p.

Appendix A--Vegetation Plot Data

Site location: The Bowl - ELT 8, NH
Data collected by Lee E. Carbonneau, Sarah D. Allen,
on 08-29-31-1992

Common name/ Scientific name	D.b.h.	Basal area	Height
	cm	*cm²*	*m*
TREE LAYER			
Balsam fir/	12.7	122.6	12
Abies balsamea	12.7	122.6	7
	12.7	122.6	9
	12.7	122.6	11
	12.7	122.6	9
	12.7	122.6	12
	12.7	122.6	12
	12.7	122.6	9
	12.7	122.6	5
	15.2	187.1	11
	15.2	187.1	12
	15.2	187.1	14
	15.2	187.1	11
	17.8	245.1	9
	17.8	245.1	14
	17.8	245.1	12
	17.8	245.1	11
	20.3	329.0	15
	20.3	329.0	15
	20.3	329.0	15
	20.3	329.0	15
	20.3	329.0	12
	20.3	329.0	12
	22.9	406.4	15
	22.9	406.4	15
	25.4	503.1	12
	27.9	612.8	18
	35.6	1,006.2	15
Total		7,741.1	
Average	18.0	276.4	12
Red spruce/	12.7	122.6	11
Picea rubens	12.7	122.6	12
	12.7	122.6	9
	12.7	122.6	9
	12.7	122.6	11
	15.2	187.1	11
	15.2	187.1	14
	15.2	187.1	11
	15.2	187.1	9
	15.2	187.1	8
	15.2	187.1	8
	15.2	187.1	9
	15.2	187.1	8
	17.8	245.1	11
	17.8	245.1	11
	17.8	245.1	11
	20.3	329.0	12
	25.4	503.1	15
Total		3,677.2	
Average	15.8	204.3	11
Paper birch/	12.7	122.6	15
Betula papyrifera	12.7	122.6	15
	15.2	187.1	8
	20.3	329.0	11
	20.3	329.0	11
Total		1,090.3	
Average	16.2	218.1	12

Continued

Site location: The Bowl - ELT 6, NH
Data collected by: Lee E. Carbonneau, Sarah D. Allen,
on 08-30-1992

Common name/ Scientific name	D.b.h.	Basal area	Height
	cm	*cm²*	*m*
TREE LAYER			
Sugar maple/	12.7	122.6	17
Acer saccharum	17.8	245.1	14
	17.8	245.1	21
	20.3	329.0	21
	25.4	503.1	20
	30.5	722.4	20
	33.0	851.4	21
Total		3,018.7	
Average	22.5	431.2	19
Beech/	17.8	245.1	15
Fagus grandifolia	17.8	245.1	15
	20.3	329.0	20
	22.9	406.4	15
	30.5	722.4	15
Total		1,948.0	
Average	21.9	389.6	16
Yellow birch/	27.9	612.8	15
Betula lutea	63.5	3,167.0	21
Total		3,779.8	
Average	45.7	1,889.9	18
Red spruce/	27.9	612.8	15
Picea rubens			
Balsam fir/	22.9	406.4	14
Abies balsamea			
Striped maple/	12.7	122.6	12
Acer pensylvanicum	15.2	187.1	12
Total		309.7	
Average	14.0	154.9	12

Site location: The Bowl - ELT 6E, NH
Data collected by: Lee E. Carbonneau, Sarah D. Allen, on 08-30-1992

Common name/ Scientific name	D.b.h.	Basal area	Height
	cm	*cm²*	*m*
	TREE LAYER		
Balsam fir/ *Abies balsamea*	12.7	122.6	14
	12.7	122.6	12
	15.2	187.1	12
	15.2	187.1	14
	15.2	187.1	14
	17.8	245.1	14
	20.3	329.0	14
	20.3	329.0	15
	20.3	329.0	14
	25.4	503.1	15
	25.4	503.1	15
Total		3,044.8	
Average	18.3	276.8	14
Paper birch/ *Betula papyrifera*	12.7	122.6	11
	12.7	122.6	12
	12.7	122.6	12
	15.2	187.1	12
	15.2	187.1	12
	15.2	187.1	11
	17.8	245.1	12
	25.4	503.1	12
Total		1,677.3	
Average	15.9	209.7	12
Red spruce/ *Picea rubens*	12.7	122.6	12
	15.2	187.1	12
	17.8	245.1	12
Total		554.8	
Average	15.2	184.9	12
Mountain-ash/ *Sorbus americana*	15.2	187.1	12
	17.8	245.1	11
Total		432.2	
Average	16.5	216.1	12
Yellow birch/ *Betula lutea*	20.3	329.0	12
Mountain maple/ *Acer spicatum*	15.2	187.1	12

Site location: The Bowl - ELT 105, NH
Data collected by: Lee E. Carbonneau, Sarah D. Allen, on 08-30-1992

Common name/ Scientific name	D.b.h.	Basal area	Height
	cm	*cm²*	*m*
	TREE LAYER		
Yellow birch/ *Betula lutea*	30.5	722.4	24
	40.6	1,302.9	24
	73.7	4,269.9	30
	78.7	4,889.1	30
Total		11,184.3	
Average	55.9	2,796.1	27
Sugar maple/ *Acer saccharum*	12.7	122.6	14
	15.2	187.1	21
	22.9	406.4	20
	33.0	851.4	24
Total		1,567.3	
Average	20.1	391.9	20
Beech/ *Fagus grandifolia*	12.7	122.6	14
	15.2	187.1	12
	17.8	245.1	15
	20.3	329.0	12
	22.9	406.4	21
Total		1,290.2	
Average	17.8	258.0	15

Carbonneau, Lee E.; Allen, Sarah D. 1995. **Botanical reconnaissance of The Bowl Research Natural Area.** Gen. Tech. Rep. NE-189. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 26 p.

The Bowl Research Natural Area is a 206-ha old-growth forest in the White Mountain National Forest of New Hampshire. Elevations range from approximately 580 m along Wonalancet Brook to 1,215 m at the summit of Mt. Whiteface. Vascular vegetation in four Ecological Land Types (ELT's) of the Bowl was characterized on 12 plots and during qualitative meander surveys. Several microhabitats within the ELT's, including sidehill seeps, ledges, canopy openings, and a well-traveled trail, were also inventoried. The vegetation structure and species composition for each ELT and microhabitat are described.

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