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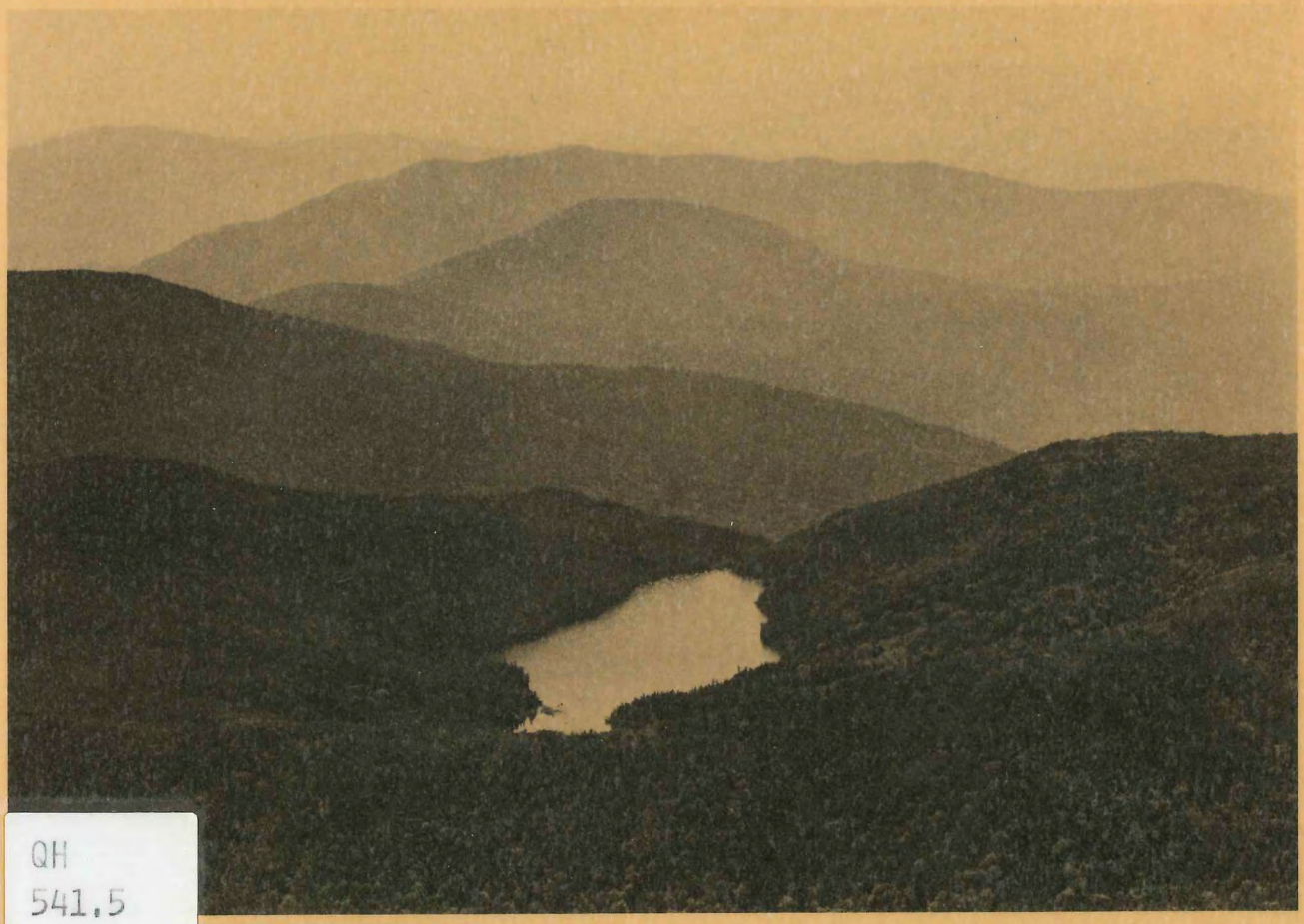

Bureau of Public Lands

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Old-Growth Forest, Subalpine Forest, and Alpine Areas in the Mahoosucs, Baldpates, and the Bigelow Preserve

by

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the Critical Areas Program of the State Planning Office
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ABSTRACT

H.P. 1193 - L.D. 1579, signed by Governor Brennan on May 24, 1983, directs the State Planning Office to inventory virgin timber stands and unique alpine habitats on state-owned lands.

We define unique features at two levels for the purposes of this report. Firstly, we include those geological, botanical, and zoological features that are rarely encountered on state-owned lands. Secondly, we include those features that are rarely encountered on any land in the State.

This report is the conclusion of work begun in Baxter State Park in 1984 and detailed in an earlier paper (Hudson, et al., 1985). This present report includes documentation of four old-growth forest sites not previously listed on the Register of Critical Areas, as well as an in-depth analysis of 15 forest stands within the subalpine forest. These stands combined with those investigated in Baxter State Park constitute the most complete analysis of subalpine forest yet undertaken in Maine. The subalpine forest of the Bigelow Preserve, the Mahoosuc range and the Baldpates should be recognized along with that in Baxter State Park in a special context when discussing Maine's old-growth forests. Four mountain tops within this summer's study area have already been recognized as unique features of Maine's landscape. We recommend all of the unique subalpine heath commuity of the Mahoosuc range be included with that acreage on Mahoosuc Mountain, Goose Eye and Mt. Carlo already listed with the Critical Areas Program. Significantly more work has been done in the Bigelow Preserve and in the Mahoosucs in recent years than is on record for Baxter State Park, and we summarize that work within the pages of this report.

The records and observations found herein, especially in the sites examined in detail, represent a baseline of scientific data that will allow meaningful evaluation of change with time when a similar study is conducted in 10 or 20 years. The forest stands examined in 1985 do not show the same levels of disturbance as that recorded and measured in Baxter State Park, and so these data also provide a timely comparison of subalpine forest across the slopes of Maine's highest mountains.

FOREWORD & ACKNOWLEDGEMENTS

The investigation of old-growth forest, subalpine forest, and alpine areas on state-owned lands in Maine comes to a close with this report. The most significant contribution that is made in these pages, once again, is the thorough analysis of subalpine balsam fir forest. These tracts of forest have long been overlooked as scrubby wastelands by foresters, and they have suffered the misnomer of subalpine spruce/fir for generations. We demonstrate that they are more properly described as virtually pure high elevation fir forests.

We are grateful to the State Planning Office for their support of Chewonki's efforts in conducting the work outlined in the folowing pages. Another group of students has had the opportunity to join in a study of high elevation forests, and they value the experience made possible by the State Planning Office.

Hank Tyler and Naomi Edelson of the State Planning Office reviewed drafts of this work and edited them with precision. Once again, any errors or omissions are ours. Susan Tolman and Dick Kelly of the State Planning Office prepared the maps for publication.

We thank Charlie Cogbill for his advice and council, as well as for his assistance in the field. Both he and Indy Burke have provided some of the photographs for this report. We also thank Liz Pierson for the summary report she prepared for the Legislature.

Hank Tyler has supervised this work from its inception. His clear recognition of deadlines helped to keep the ship on course.

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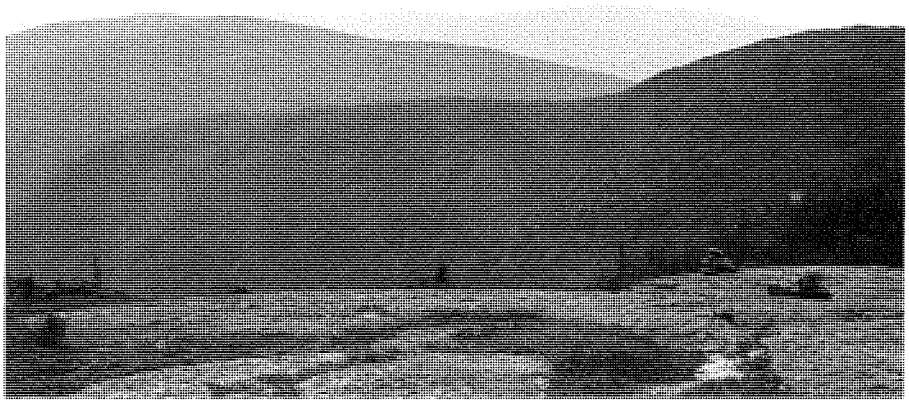
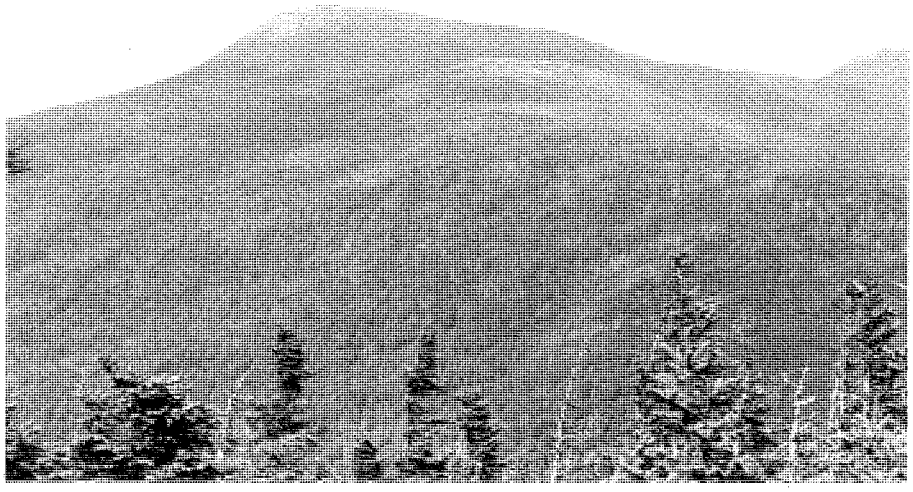
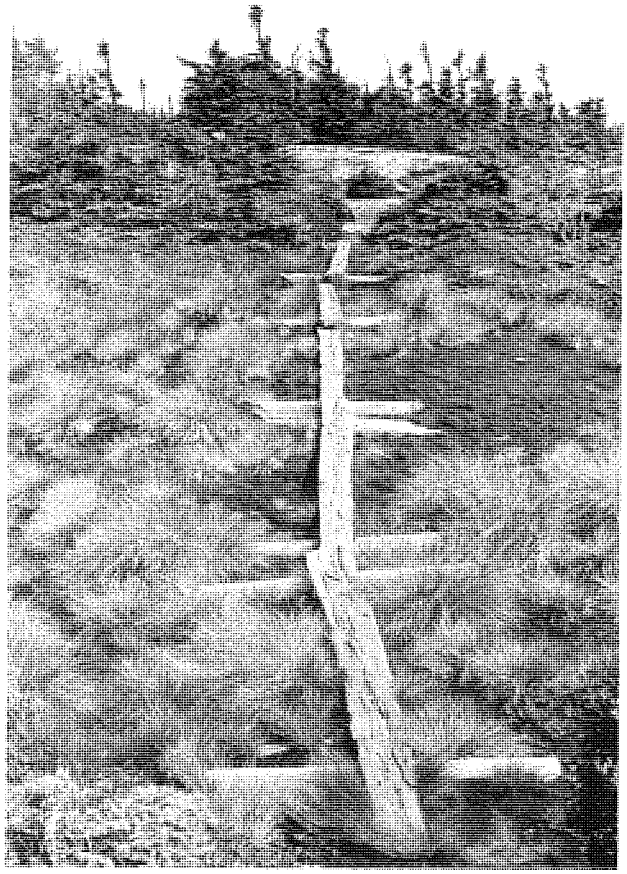


Scenic view from the Mahoosucs.
H. Tyler, photo



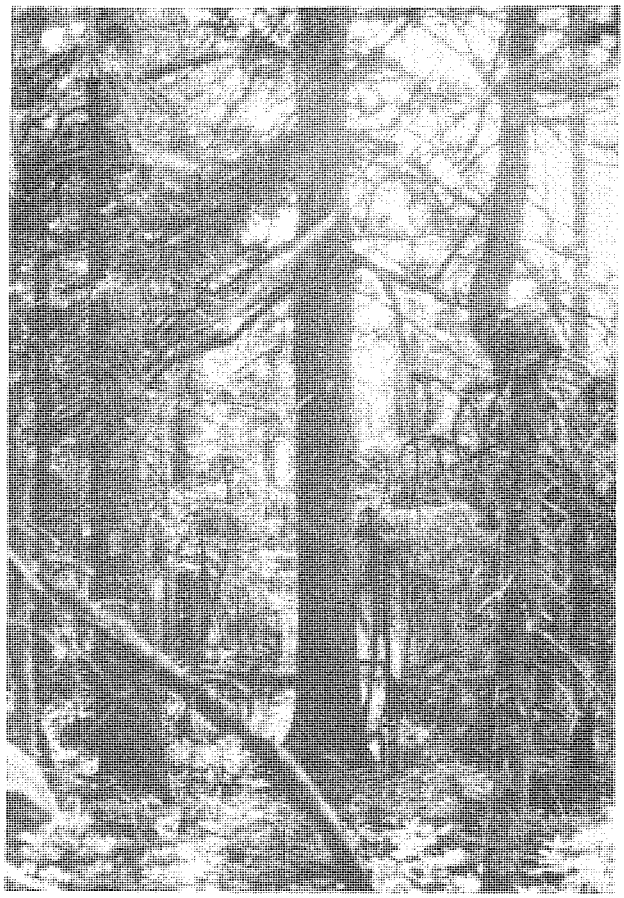
Goose-Eye Mountain in the Mahoosucs showing areas of alpine vegetation, subalpine heaths, and subalpine forests.

H. Tyler, photo



The Appalachian Trail crosses on alpine bog on Mt. Carlo in the Mahoosucs.

H. Tyler, photo



Old-Growth Balsam Fir and Red Spruce on Mahoosuc Mountain. The trees in this ten acre area reach a maximum age of 245 years.

D. Hudson, photo

Subalpine heath and subalpine forest on Mt. Carlo in the Mahoosucs.

H. Tyler, photo

Executive Summary and Recommendations

H.P. 1193 - L.D. 1579, signed by Governor Brennan in May 24, 1983, directs the State Planning Office to inventory virgin timber stands and unique alpine habitats on state-owned lands. A survey of old-growth forest, subalpine forest, and alpine areas in Baxter State Park was conducted during the summer, 1984 (Hudson et al., 1985). This present report presents work conducted on state-owned lands in the Bigelow Range, the Baldpates, and the Mahoosucs (Figures 1 & 2), and with this report we conclude the study of old-growth forest, subalpine forest, and alpine areas on state-owned lands.

General observations of old-growth forest, subalpine forest, and alpine areas.

Old-growth Forests

No stands of old-growth forest have been previously listed on the Register of Critical Areas for the Mahoosucs range, the Baldpates, and the Bigelow range (Burke, 1982; Caljouw and Roeske , 1981; Grena, 1981; State Planning Office, 1983), though previous investigators have suggested that three sites in the Bigelow Preserve (Caljouw and Roeske, 1981) and two sites in the Mahoosuc range (Burke, 1982) be recognized as old-growth. An additional old-growth site falls just outside the limits of the Bigelow Preserve, and it is included in this report because of its proximity to state-owned lands. We recommend that two sites in the Bigelow Preserve and one lying just outside be listed as old-growth critical areas, and we recommend that one site on Mahoosuc Mountain be listed as an old-growth critical area.

We recommend the listing as critical areas of tracts of subalpine forest in the Mahoosucs, Baldpates, and the Bigelow range, dominated in most cases by balsam fir, yet including some smaller tracts of red spruce and balsam fir.

Hudson, et al. (1985) argue that subalpine forests be included as a form of old-growth forest in Maine, and recommended as critical areas large tracts in Baxter State Park as prime examples of the forest type on state-owned lands in Maine. We present the same case as that presented for lands studied during the summer, 1985:

Subalpine Forest - old-growth?

The working definition of old-growth forest (Grena, 1981; State Planning Office, 1983) includes no altitudinal parameter, nor does it limit inclusion of tree species to any particular group of long lived trees of northeastern North America. In fact a simple and hard definition of old-growth forest "continues to be an unresolved necessity" (State Planning Office, 1983, p.2). Quoting directly:

> 'Four independent components contribute to the narrow traditional old-growth concept: 1) a long history without catastrophic disturbance giving aged trees; 2) influence of natural, not man-induced, conditions for the entire existence of the forest, including initiation; 3) a developmental process consistent with replacing of the present stand; 4) and singularly large trees or aesthetically robust structure to the forest. Criteria for

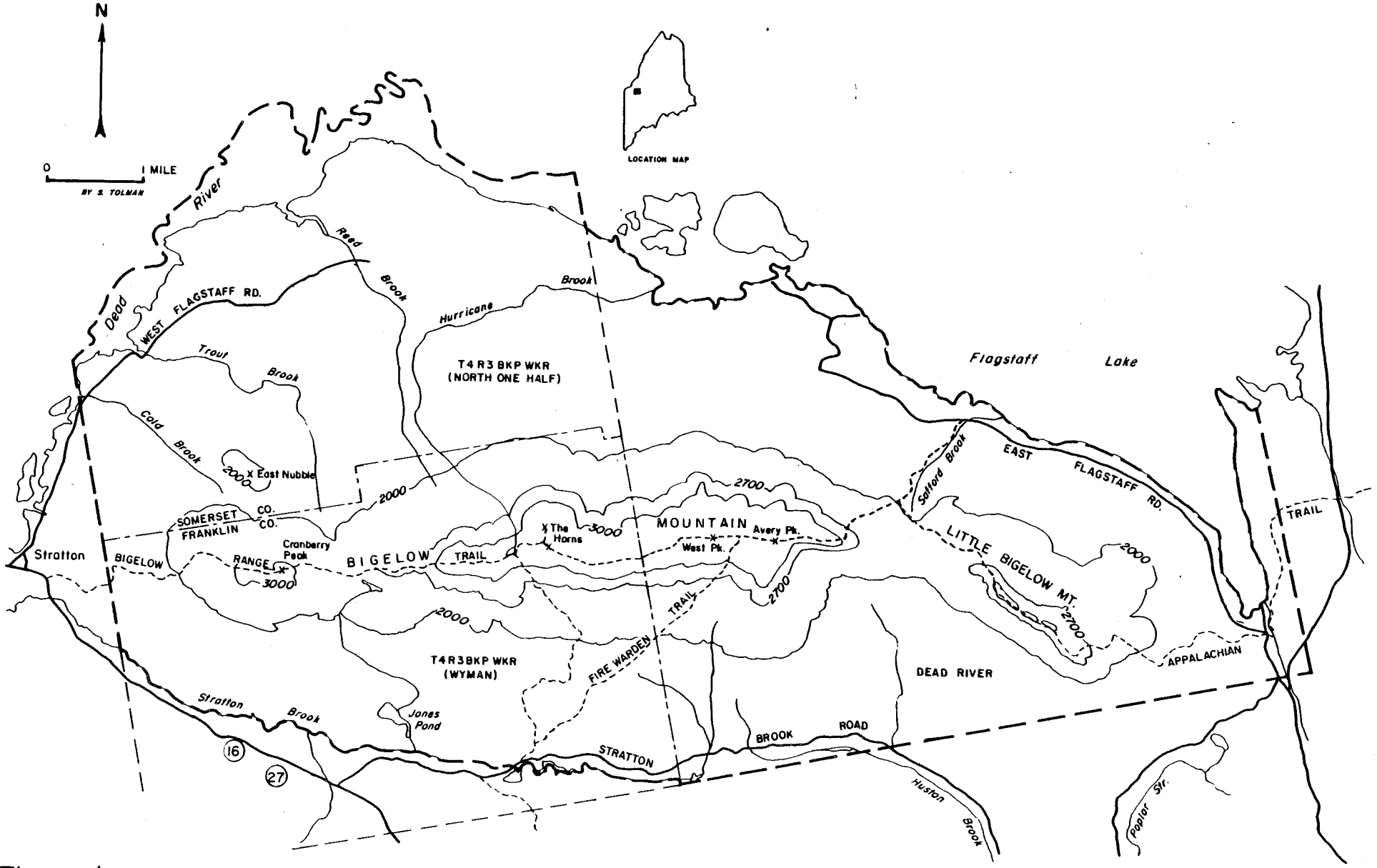


Figure I. Bigelow Preserve

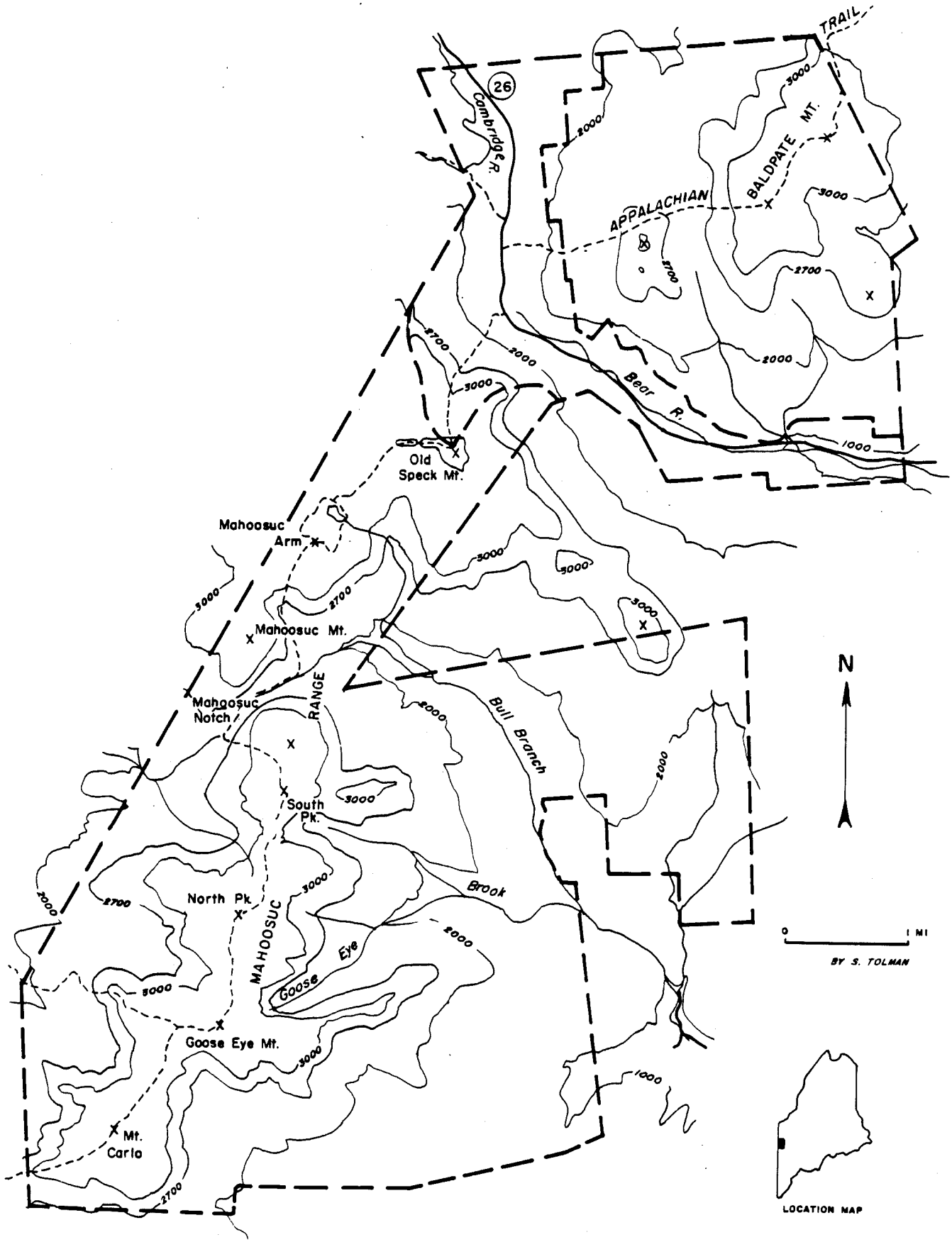


Figure 2. Mahoosuc Mountains and Baldpate Mountains Public Reserved Lands

identification of old-growth stands must account for the first three properties: age of origin, historic integrity, and developmental dynamics. The fourth component of impressive size, despite the common perception, is not an ecological condition necessarily indicative of old-growth forest (emphasis ours).

'A review of concepts associated with old-growth and regional examples described in associated terms (e.g. virgin, climax, overmature, primeval) leads to the following shared common characters of old-growth:

1) a coherent forest stand;
2) a long time without catastrophic disturbances;
3) influence of natural condition for its entire existence, including initiation; and
4) a structure consistent with replacement of the present stand (but not necessarily by the same species).

'In turn, each of these four theoretical concepts has led to four objective criteria necessary for old-growth:

1) minimum size homogeneous area capable of continuously supporting a forest stand;
2) minimum percentage of the maximum longevity reachable by the dominant tree species;
3) undetectable influence of humans; and
4) evidence indicating the presence of a subsequent generation.

'The first two criteria can be quantified, but it must be realized that the subjective separations are arbitrary on continuous measures and are realative to location. For sampling convenience and correspondence to concept of ageing, a minimum size of 5 acres and a minimum percentage of 50% maximum age, respectively, are suggested and used in the present study. The other stand criteria are subjective and qualitative, but for the most part based on, easily observed, unambiguous properties. For most species in the region, 150 years is adequately old and 50% of the 300-400 year maximum longevity observed in Maine." (State Planning Office, 1983, p. 3).'

Balsam fir, a dominant species of the boreal forest of Maine and the far north, is notably absent from previous reports of uncut timber land, primarily because it fails to meet two of the arbitrary requirements for old-growth stands. Fir is not a long lived species. Average stand ages are generally below one hundred years, and trees older than 150 years are rarely encountered. The heartwood of fir tends to rot with age, and this contributes to the incomplete nature of the record. Secondly, balsam fir rarely attains striking proportions of either girth or height. The fact that it is a short lived species is perhaps the major limiting factor to size, and the principal reason for excluding it from consideration in previous reports of old-growth forest in Maine.

Nevertheless, stands of uncut, undisturbed, old-growth balsam fir forests can be found in Maine, primarily near treeline. They are in almost every case coherent forest stands that have

escaped disturbance, and that have thrived under natural conditions throughout their existence with a structure consistent with replacement of the present stand. These forests are counterparts of fir-dominated boreal forests of higher latitude. In Baxter State Park, the subalpine forests comprise primarily fir, including some red and black spruce, and always a bit of heart-leaved paper birch. The mean age is not high, and yet stands with trees averaging 100 years or more can be found.

The authors contend that subalpine forests in Baxter State Park, and throughout Maine should be included in discussions of old-growth because they represent significant stands of undisturbed forest for one of Maine's dominant forest species. However, we do not recommend that the balsam fir subalpine forests be listed with the other undisturbed, uncut, stands of old-growth trees as old-growth forest, per se. Yet, it is only because these forests are composed of a species of tree that doesn't grow to poetic heights and ages that they have been previously overlooked by botanists searching out Maine's forest heritage. As measured by all other criteria, subalpine forests are old-growth forests (pages 1-3).

Subalpine forests of the Mahoosuc Range, the Baldpates, and the Bigelow Range.

The subalpine forests of the mountains studied during the summer, 1985, are not as diverse as those found in Baxter State Park. Two major types of subalpine forest are noted:

Krummholz

The dwarf black spruce and balsam fir trees that rarely exceed two feet in height are found at elevation throughout the ranges surveyed. The presence of krummholz is noted in site summaries, yet there is no attempt to evaluate the dynamics, composition, or growth of krummholz on the various mountain peaks.

Subalpine Balsam Fir and Red Spruce Forests

The subalpine forests of the Mahoosuc range, the Baldpates, and the Bigelow range did not escape lumbering in the past, and evidence can be found particularly in the Mahoosucs and in the Baldpates for cutting up to and above 3000 feet. Evidence of cutting can also be found above 3000 feet in the Bigelow range, but it is not as extensive nor as apparent as that found elsewhere in areas studied during the summer, 1985. Here also can be found evidence of a major forest fire, probably which consumed a large part of the forests of the Carrabassett Valley in 1908. Charcoal and fire scarred stumps, and charcoal in the soil can be found in the forest across the southern flank of the Bigelow range from west of Cranberry Peak to Avery Peak. The fire reached above 3000 feet in scattered places across the range, but apparently did not reach the summit ridge.

Subalpine forests have been undisturbed for many decades throughout the study area, and an intensive sampling was conducted in fifteen study plots to characterize the present-day forests. Forest growth, mortality, composition,

and herbaceous cover were all examined. The baseline data gathered in these permanent plots will allow a detailed comparison for future surveys or attempts to quantify the growth and change of subalpine forests in time. Together with the information gathered in Baxter State Park (Hudson, et al., 1985) these data provide the first characterization of subalpine forests in Maine.

A summary of data gathered in subalpine forests in the Mahoosucs range, the Baldpates, and in the Bigelow range is included herein. The reader should note that subalpine forest throughout the study area should be treated as a whole in terms of its status and any prescription for its preservation - the fifteen study plots are representative of the forest throughout these mountain ranges. Subalpine baslam fir forest appears at roughly 2700 feet in these mountains (it appears at roughly 2500 feet in Baxter State Park), and though there has been cutting well above 2700 feet, particulary in the Mahoosucs, we recommend that the same line be drawn to identify this forest type in the Mahoosucs, Baldpates, and the Bigelow range. Those tracts of forest recommended for critical area status as specialized tracts of old-growth forest in Maine are indicated as a shaded area on the maps provided (Figures 3 - 7). The total acreage presented is a conservative estimate of subalpine forest based on field inspection, but not determined by exhaustive calculation. The amount of field time required to gather the information needed to make a more precise calculation is not justified in light of the apparently slight upward adjustment of the figure presented here.

Alpine Areas in the Mahoosuc Range, the Baldpates, and the Bigelow Range.

Previous reports and studies provide valuable information on the alpine areas of the Mahoosucs (Burke, 1982; May & Davis, 1978), the Baldpates (Burke, 1982), and the Bigelow range (Caljouw and Roeske, 1981; Stone, 1980). The object of this present study is to offer observations and notes only where there appear to be significant deviation from existing knowledge of these areas.

The alpine areas at the summits of Bigelow, Goose Eye, Mt. Carlo and Mahoosuc Mountain have been previously listed on the Register of Critical Areas, and we recommend the addition of similar vegetation types occuring throughout the Mahoosuc range to the Register. Subalpine moist heath and bog communities on Fulling Mill and Mahoosuc Arm meet the criteria for critical area registration and should be listed.

Conclusions

Significant new information from the survey of subalpine forests is summarized below with existing data for alpine areas in the mountain ranges under investigation during the summer, 1985.

1. Old-growth Forest

Four old-growth forest sites in the Bigelow Preserve and the Mahoosucs are listed in the site evaluations. One of the four sites, Huston Brook white pine and cedar, does not occur on state-owned lands in the Bigelow Preserve, yet it falls just a fraction of a mile to the south of the boundary. We include it in the site evaluations, and in Table 1 below. The two sites in the Bigelow Preserve have been recognized previously, yet not listed (Caljouw & Roeske, 1981). The site on Mahoosuc Mountain has not been recognized in the past.

Table 1. Old-growth sites in the Bigelow Preserve and the Mahoosucs.

Locality & Forest Type	Elevation (ft)	Size (acres)	Age (yr)	Status
1. Little Bigelow sugar maple, beech and yellow birch	1800' - 1900'	20 +	150	Recommended
2. East Nubble red spruce and balsam fir	2100' - 2442'	25	120-250	Recommended
3. Huston Brook white pine and cedar	1100' - 1150'	5	250	Recommended
4. Mahoosuc Mtn. balsam fir and red spruce	3420'	10	230-250	Recommended

2. Subalpine Forest

Hudson, et al. (1985) state:

> Old-growth forest as defined by Grena (1981; State Planning Office, 1983) does not include the forest species that covers the vast majority of forested mountains in Maine. This oversight is presumably intentional because, at lower elevations, balsam fir is a successional species that rarely forms pure stands in undisturbed areas. Red spruce is far more likely to be the dominant species of the natural, undisturbed forests of the lowlands. Nevertheless, in the fragile, undisturbed ecosystem of the subalpine zone of Maine mountains, balsam fir predominates. Examination of cutting records and field examination show that this forest type is undisturbed. In general terms it is old-growth - not second growth, third growth, or successional forest. It is of value from an ecological standpoint primarily because it is undisturbed forest, of which very little remains in the State (page 6).

Once again, we argue in this report that the subalpine forests of the Mahoosuc range, the Baldpates, and the Bigelow range should be reviewed for special consideration by the Bureau of Public Lands and the Critical Areas Program of the State Planning Office as a special form of old-growth forest. Outside of Baxter State Park, these forest tracts comprise the greatest extent of subalpine forest on state-owned lands. The value of the timber in these large tracts of undisturbed forest at high elevation could not approach the cost of harvest by present forest practices. Therefore, the preservation of this unique forest habitat on the major mountain peaks of western Maine presents no apparent financial hardship to the State; at the same time it recognizes a fragile and dwindling resource in the northeastern United States. The characterization of forests presented in the body of this report should stimulate careful future monitoring of subalpine forest ecology.

The composition and characterization of subalpine forest in the Mahoosucs, the Baldpates, and in the Bigelow range is based on intensive sampling at fifteen locations. The data from the fifteen sites are summarized in Tables 3

& 4. The preliminary figure for the total acreage of subalpine forest is 9,430 acres (see Table 2 and the Site Evaluations of all mountains for a breakdown of this total).

3. Alpine Features

The alpine areas of the Mahoosuc range, the Baldpates, and the Bigelow range have been the subject of numerous studies and reports during the past decade. There is far more complete information available for the alpine areas in these mountain ranges than was previously available for Baxter State Park, in part because of the much smaller size of alpine habitat in these western mountains. The proximity of the Mahoosucs to the White Mountains and the activities of the Appalachian Mountain Club at Pinkham Notch have contributed significantly to the increased awareness of the fragile systems found there. Burke (1982) provides a detailed summary of plant communities found above treeline in the Mahoosucs, and extends her inventory to include the Baldpates. Earlier inventories have taken a broader look at alpine areas of Maine, including the more diverse areas of the Mahoosucs in their study (May & Davis, 1978). The mountains of the Bigelow Preserve have been studied carefully since the mid-1970s (Stone, 1980), and most recently, the alpine areas found there have been included in a resource inventory conducted by the Bureau of Public Lands and the Critical Areas Program (Caljouw & Roeske, 1981).

We have spent considerable time above treeline during the course of this investigation and we can make no new additions to the floras of these mountain peaks.

Recommendations

This study culminated in several recommendations for review.

Old-growth Forest:

Four sites listed in Table 1 should be added to the Register of Critical Areas. All sites meet the criteria for old-growth (State Planning Office, 1983), notably by their age, stature, and overall composition. These forest stands do not appear to be suffering the same degree of degradation as that measured in old-growth sites in Baxter State Park (Hudson, et al., 1985). The old-growth fir and red spruce on Mahoosuc Mountain is one of the highest elevation old-growth sites yet discovered in Maine (not including the vast acreage of subalpine balsam fir found across the upper flanks of Maine's highest mountains).

Subalpine Forest:

The subalpine stands studied in the Mahoosucs, Baldpates, and the Bigelow range are representative of that forest type found throughout the region. The total acreage recommended for listing in the Register of Critical Areas is 9,430 acres (Table 2).

The majority of subalpine forest is dominated by balsam fir that does not grow to tremendous proportions of height, girth or age. The real value of the subalpine forest is its relativly undisturbed state. Where this forest type has been disturbed by cutting, or by

Table 2. Subalpine forest in the Bigelow Preserve, Baldpates, & the Mahoosucs.

Locality & Type	Township	Size (acres)	Status
Little Bigelow Mountain	Dead River	235	Recommended
Bigelow Mountain			
Avery Peak	Dead River		Recommended
West Peak	Dead River		Recommended
The Horns	Wyman	*[2,425]	Recommended
Cranberry Peak	Wyman	285	Recommended
The Baldpates	Grafton	1,315	Recommended
Old Speck	Grafton		Recommended
Mahoosuc Arm	Grafton		Recommended
Mahoosuc Mountain	Grafton	[1,695]	Recommended
Fulling Mill	Riley		Recommended
Goose Eye Mountain	Riley		Recommended
Mt. Carlo	Riley	[3,475]	Recommended

* Numbers in brackets represent the total acreage of subalpine forest on contiguous mountain slopes (see Figures 1-5). Acreages appear next to the last mountain listed amongst a contiguous tract of forest.

Table 3. Composition of the tree stratum (>10cm dbh) for all stands. (mean values and SD).

	Basal Area (m2/ha)	Relative Dominance % (living or dead)	(all)	Density (N/ha)	Relative Density % (living or dead)	(all)	Importance Value (living or dead)	(all)
Abies b.(15)*	21.9 +17.6	65.9	50.5	835.3+481.5	69.0	51.3	67.5	50.9
Picea r.(13)	5.8 + 4.4	17.5	13.4	200.8+202.3	16.6	12.3	17.1	12.9
Betula p.(13)	5.0 + 3.2	15.0	11.5	147.7+ 95.1	12.2	9.1	13.6	10.3
Pyrus a.(3)	.53+ .25	1.6	1.2	26.7+ 11.5	2.2	1.6	1.9	1.4
dAbies b.(15)	6.6 + 3.1	65.3	15.2	309.3+170.1	74.3	19.0	69.8	17.1
dPicea r.(12)	2.5 + 2.3	24.8	5.8	65.8+ 56.0	15.8	4.0	20.3	4.9
dBetula p.(9)	.9 + 1.6	8.9	2.1	34.4+ 37.1	8.3	2.1	8.6	2.1
dPyrus a.(3)	.1	1.0	0.2	10	2.4	1.0	1.7	0.6

Abies b. = balsam fir; Picea r. = red spruce; Betula p. = heart-leaved paper birch; Pyrus a. = mountain ash.

d = dead

* The number in brackets is the number of sites in which a species occurred.

Table 4. Summary data for vegetation and site characteristics of 15 fir-spruce stands sampled in the Mahoosucs, Baldpates, & the Bigelow range, 1985.

	Elev.	Asp.	Slope	Canopy	Age	Basal Area		Dens.	Herb. Cover	Bryo. Cover	Exp. Rock	Dead Wood	Species Rich-ness
						Sap.	All						
	(ft)		(°)	(ft)	(yr)	(m2/ha)		#/ha	(%)	(%)	(%)	(%)	(#)
Avery	3500'	SSW	30	29.3+7.9	70 +23	6.8	32.2	2200	46	29	2	12	11
Horns	3500'	W	25	12.2+1.5	57 +11	25.2	42.0	5720					
Horns Pond	3000'	SW	12	28.4+6.8		25.8	81.6	6560	77	57	1	9	14
Cran. Pond	2480'	SW	19	48.0+23.7		18.8	50.7	4480	0.6	29	25	18	6
Bald-pate	2880'	E	12	35.3+3.5	60 +25	4.4	60.5	2300	51	10	0	21	14
Old Speck	4040'	ENE	3	27.5+7.1	64 +19	13.3	50.4	3680	84	15	4	14	10
Speck Pond	3275'	N	10	36.6+17.8	96 +17	16.2	62.1	3890	94	15	0	10	13
Mhsc Mtn.	3520'	N	0	30.0+11.9	91 +53	10.1	51.6	3130	47	29	0	12	10
Mhsc. Arm	3520'	SSW	4	41.0+9.1	104 +45	21.1	94.1	6030	38	47	4	22	10
Full. Mill	3040'	SSE	13	29.5+4.9	69 +21	12.1	54.3	3300	61	19	8	12	13
Sccss Goose	3700'	WNW	8	29.5+13.8	52 +14	4.9	65.2	3040	83	15	0	12	13
EW Goose	3624'	ENE	8	20.1+4.1	66 +20	17.3	45.6	4390	40	41	0	15	9
Goose Eye Sag	3380'	WSW	7	24.9+6.7	71 +25	17.8	38.0	4260	47	22	0	23	10
Carlo Col	3002'	NNW	12	37.1+9.0	71 +16	8.5	53.1	2610	98	0	0	14	13
Mt. Carlo	3112,	WSW	10	25.8+6.0	76 +11	17.0	51.2	4780	17	19	0	17	7

fire or rock slides, one can get a good measure of its fragility. Soil depths are minimal and are easily disturbed, resulting in slow or halted regeneration. These tracts of forest represent the largest areas of uncut and undisturbed forest in Maine, and they are a significant source of baseline information for understanding the development of high-elevation forest, the impact of spruce budworm in natural, undisturbed forests, and the impact of air pollution and acid deposition on high elevation forests.

Subalpine forests should be recognized throughout the state as a specialized ecosystem that can be readily disturbed. There is no threat of cutting above 2700 feet, but fire and human disturbance are a constant threat. The data collected in 1984 and 1985 represent a significant baseline. The same sites can be resampled in 10 to 20 years to measure growth and change. Detailed maps are deposited with the Critical Areas Program.

Alpine Features:

Alpine features in the Bigelow Preserve (Caljouw & Roeske, 1981; May & Davis, 1978), the Baldpates, and the Mahoosuc range (May & Davis, 1978; Burke, 1982) have been listed with the Critical Areas Program (Table 5).

No new sites for alpine areas have been identified in the Bigelow range.

We recommend vegetation types similar to the majority of that listed for the Baldpates, Goose Eye, and Mt. Carlo be listed in the Register of Critical Areas. Moist subalpine heath and bogs along Mahoosuc Arm, and Fulling Mill are extensive and as representative of the vegetation type as those areas previously recognized as unique and fragile in the Mahoosucs.

All alpine sites should continue to be monitored, particularly those along the Mahoosuc range and the Baldpates since they apparently suffer from greater foot traffic.

A complete and thorough ecological analysis of alpine plant communities should include these sites examined in 1985, since the previous work in the state is only of a preliminary and cursory nature (May & Davis, 1978).

Table 5. Alpine areas sampled during the summer, 1985, with summary of significant features.

Alpine Area	Township	Size (acres)	Alpine Species (n)	Special Features
§Bigelow Mountain		135 (includes		In addition to a small
Avery Peak	Dead	the area above	8	acreage of alpine plant
West Peak	River	3700' on Avery	8	communities, Bigelow is
		and West Peaks)		the home of the yellow-nosed vole. Boott's rattlesnake root is reportedly found on the mountain.
The Horns	Wyman	approx. 1	2	
Cranberry Peak	Wyman	none		No open summit
§The Baldpates	Grafton	167.5	10	Notable for a relatively diverse arctic/alpine flora below 3800'
Old Speck	Grafton	approx. 2	4	Scattered open ledges, no barren summit.
†Mahoosuc Arm	Grafton		4	Extensive moist heath and
§Mahoosuc Mountain	Grafton		4	alpine bogs
†Fulling Mill	Riley		4	
§Goose Eye Mountain	Riley	224	8	Largest alpine area outside Baxter State Park
§Mt. Carlo	Riley	25	5	Lowest elev. for Diapensia in the state.

§ Registered as a Critical Area for alpine features.
† Recommended as a Critical Area for alpine features.

THE PRESENT STUDY

Field work during the summer and autumn, 1985, was designed to complete the task set before the State Planning Office by the Legislature in 1983 - to inventory virgin timber stands and unique alpine habitats on State-owned lands. The large tract of State-owned land that comprises the Bigelow Preserve, a smaller tract on the northeast slopes of the Baldpates, and the substantial acreage in the Mahoosuc Range make up the study area (Figures 1 & 2).

This present work was conducted with the same goals and objectives of that in Baxter State Park (Hudson, et al., 1985) with minor changes. The alpine areas throughout the study area have been examined recently by a number of workers (Stone, 1980; Caljouw & Roeske, 1981; Burke, 1982), and their findings are summarized in the site by site evaluations.

No stands of old-growth timber have been recommended as critical areas as the result of previous inventories (State Planning Office, 1983). Three were proposed in earlier reports (Caljouw & Roeske, 1981; Burke, 1982), and one was located as a result of this summer's work. The evidence of past logging operations is more prominent at higher elevation in the forests investigated this summer than in those of the slopes of Mt. Katahdin and outlying peaks, and that evidence might help to explain the absence of significant old-growth timber. Needless-to-say, several exemplary stands of subalpine fir and spruce are reported here. They share virtually all the characteristics specified for old-growth (State Planning Office, 1983; Hudson, et al., 1985) except old age!

Methodology

Alpine Areas

The Alpine areas of the Bigelow Range, the Baldpates, and the Mahoosuc Range were examined on the ground. The current status of these areas was compared with detailed information in the literature. No attempt was made to characterize arctic/alpine commmunities on the mountain tops, though that work has been prepared in detail for at least the main summits of the Bigelow range (Stone, 1980). Preliminary analysis has also been provided for these and other peaks throughout the study area (May & Davis, 1978).

The list of alpine areas sampled on the ground includes (north to south):

Bigelow
- Avery Peak
- West Peak
- The Horns
- Cranberry Peak

Baldpates
- East & West Peak

Mahoosucs

Old Speck
Mahoosuc Arm
Mahoosuc Mtn.
Fulling Mill
North Peak
South Peak
Goose Eye Mtn.
Mt. Carlo

Subalpine Forests

We continue use of a nomenclature for forest classification and forest ecology outlined in Natural Old Growth Forest Stands of Maine (State Planning Office, 1983).

Each stand sampled in this survey was evaluated for composition by observation of the species making up the community of plants present. In addition, a 50 meter transect was laid out along the long axis of a 50 by 20 meter grid or tenth hectare plot within each stand. Every other meter square quadrat falling on the transect was evaluated for percent cover for a total of 25 quadrats in the sample. A 50 meter canopy intercept was walked along the same tape, recording the presence or absence of closed canopy. This measure helped to quantify the overall condition of the stand.

The age structure of the stands was determined by measurement of the trees' height and diameter, and observation of the extent of disturbance in the stand. A series of increment borings was taken in each stand, both to determine age structure, as well as to determine oldest age class. Cores were counted in the laboratory with the aid of dissecting microscopes.

The plot study within the tenth hectare area defined in part by the 50 meter tape used as the transect was conducted in each stand. A tally of all stems within the plot was completed, measuring diameter at breast height (dbh) with a calibrated tape.

Special Features

Mahoosuc Notch is listed as a Natural Area by the State Planning Office, having been rejected for status as a National Landmark in 1974. Burke (1982) reports that the rejection was inspired by fears that such publicity would attract more visitors to the area. The Notch is described herein as a record of its current condition.

Speck Pond and Horns Pond are small bodies of water, yet important as two of the few high elevation ponds in Maine. Both are vulnerable to human disturbance because of camping facilities along their shores. Cranberry Pond is found at lower elevation, but is also important as one of the few ponds found above 2000 feet in Maine mountains.

RESULTS of FIELD WORK - Summer 1985

The Bigelow Range

Little Bigelow Mountain

Quadrangle: Little Bigelow Mtn., Maine 15', 1956
Elevation: approximately 3300'
Date Field Checked: 2 September 1985, W. D. Hudson, Jr.

Summary of Significant Features

1. Old-growth Forest: a stand of white pine and cedar along the banks of Huston Brook due south of the Somerset and Franklin County line and outside of the Bigelow Preserve has been previously recommended as a Critical Area.

   A stand of sugar maple, beech, and yellow birch is found on the southern slopes of Little Bigelow Mtn. at 1900'. It is recommended as a Critical Area.

2. Subalpine Forest: Caljouw includes a small acreage of scrubland (here described as subalpine forest), in the total acreage calculated for the Bigelow Preserve. It is most striking on and below the steep ledges of the southern slope of the mountain, but is also found above 2700' on the north slope. It is recommended as a Critical Area.

1. Old-growth Forest

a). Little Bigelow sugar maple, beech and yellow birch

Town: Dead River
Forest Type: Northern Hardwoods
Stand Age: + 150 years
Stand Size: + 20 acres
Elevation: 1800 - 1900'
Status: Recommended as a Critical Area

The southern slope of Little Bigelow Mountain was surveyed on the ground to verify the condition of the stand described by Caljouw and Roeske (1981, p. 66). The stand was not included in the more complete analysis of subalpine forest conducted for the western portion of the Bigelow Preserve, but its relative condition was assessed for future consideration (Figure 3).

The maximum age class reported by Caljouw and Roeske (1981) is not extraordinarilly old for northern hardwood species, yet the relatively undisturbed upper portion of the stand merit its consideration for status as old-growth.

Quoting Caljouw and Roeske (1981):

"Between the steep southern slopes of Little Bigelow Mountain and the power line (Somerset/Franklin County Line), at roughly 1800

feet elevation, there exists a hardwood stand of sugar maple, beech and yellow birch. The trees within this stand are mature to overmature + 150 years old. The understory is sugar maple and beech. The stand is + 20 acres in size. Old-growth hardwood stands represent less than 2% of the Preserve's forest types, a relatively small proportion. Therefore this area is important from an interpretive standpoint since it is an exemplary forest type for the Preserve. As one approaches this site from the power line, signs of logging are evident at the southern fringe of this stand but upon approaching 1850 feet in elevation the terrain becomes increasingly rocky and (the) slope steeper and no signs of logging are evident in the stand." (p. 66)

We recommend that this site be registered as a Critical Area.

b) Huston Brook white pine and cedar and Waterfall

Town: T3 R2 BKP WKR (Jerusalem)
Forest Type: Mixed White Pine and Northern White Cedar
Stand Age: in excess of 250 years
Stand Size: < 2 acres
Stand Elevation: 1100 - 1150'
Status: Recommended as a Critical Area

The stand of white pine and cedar along the upper reaches of Huston Brook approximately 0.6 miles from the county line (power line) was first examined by John Grena in June, 1980. Since only two white pines were recognized as old-growth at the time, it was not recommended as a Critical Area (Figure 3).

Lisa Widoff and Terry McGovern returned to the site in November, 1983, and apparently delineated a much larger area of undisturbed pine and cedar forest along the banks of Huston Brook where a series of magnificent waterfalls are also found. The population of white pine in particular was found to exceed two trees, and girths in excess of 100 cm (dbh) made a definitive determination of age impossible. In addition, the rotten cores of the large cedar also prevented an accurate determination of age. The counted rings of partial cores of white pine exceeded 200 years, and an age for the two largest trees was estimated at between 250 and 300 years.

The combination of striking waterfalls and old-growth white pine and cedar in an area with a long history of cutting make this site particularly desireable for listing as a Critical Area. This stand falls just outside the boundary of the Bigelow Preserve, and therefore can not be included in this inventory. It is included here because of the general interest in identifying old-growth timber in the large area just to its northern boundary.

We recommend that this site be registered as a Critical Area.

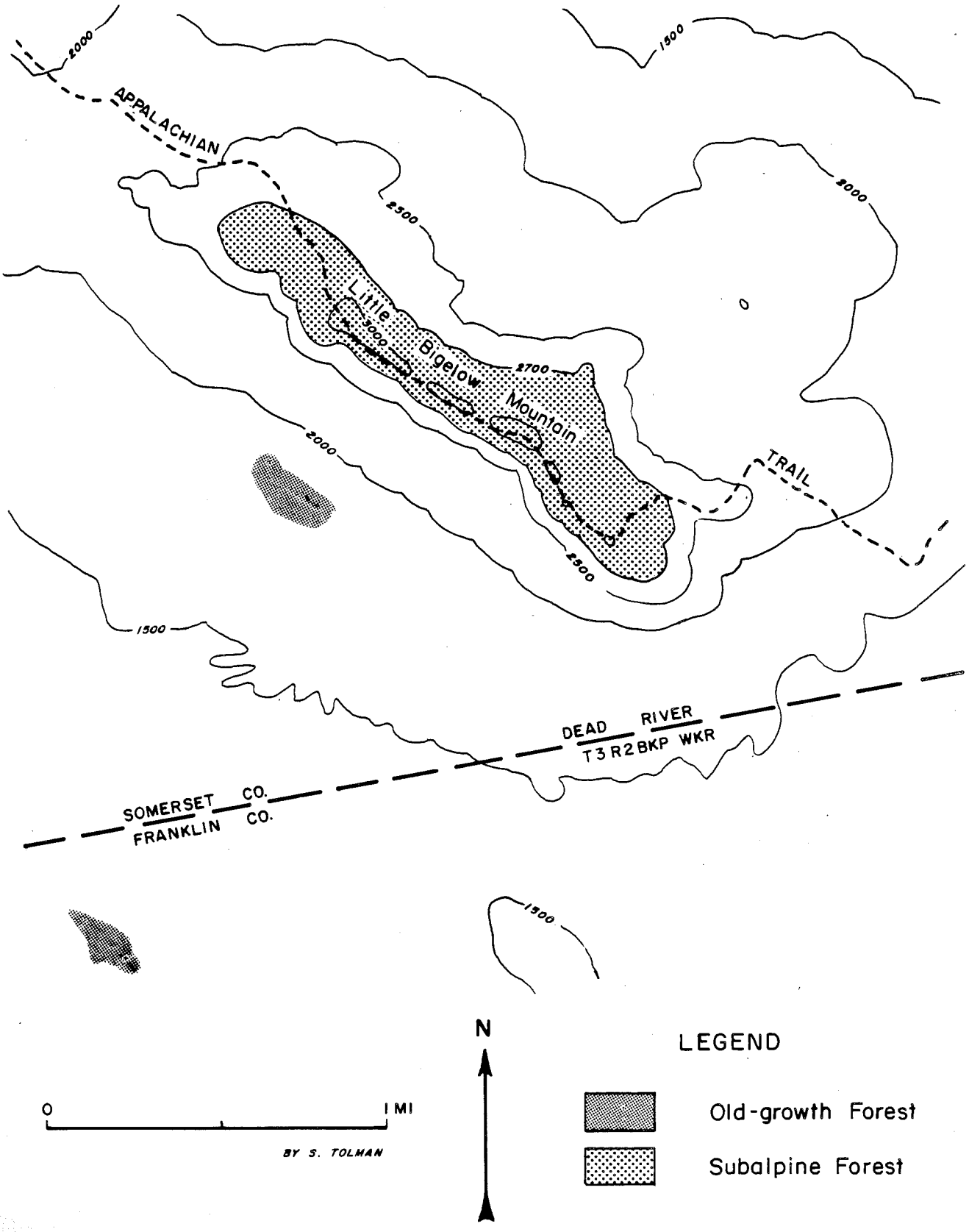


Figure 3. Little Bigelow Mountain

2. Subalpine Forest

Town: Dead River
Size: 235 acres
Elevation: 2700-3400'
Status: Recommended as a Critical Area

There is very little acreage above 2700 feet on the slopes of Little Bigelow Mountain, and the extent of subalpine balsam fir and red spruce is restricted to that point just below the steep southern ledges (approximately 2400 feet) across the narrow ridge to the more gentle northern slopes of the mountain (Figure 3).

Caljouw and Roeske (1981) characterized the forest above 2700 feet throughout the range in the following way:

> "Above 2700 feet the boreal forest becomes increasingly low, matted and scrub-like until the dominant forest association is krummholz. Balsam fir, red spruce (black spruce replaces red with increasing elevation), and paper birch are gnarled, stunted and often flagged. Growth rate decreases appreciably with elevation. These scrubland and krummholz forests have a life expectancy of 70-120 years. These forest types in the Preserve have never been logged. They are clear examples of the harsh growing conditions within a mountain ecosystem. Stresses such as high winds, increased atmospheric moisture, decreasing temperatures and snow depth, and shallow organic soils on steep slopes help dictate the life expectancy of these forests." (p. 65)

We choose to describe these forests as subalpine balsam fir forests, and though their upper reaches (approximately 3700 feet in the Bigelow Range) can be described in the very limiting terms of scrubland or krummholz, the vast majority of the continuous band of subalpine forest in the Preserve is not as apparently stark and lifeless as that described above. The soils in all sites sampled during this investigation were indeed shallow, but all are mineral soils, none organic. In addition, there is very little black spruce on the upper slopes of Bigelow below 3800 or 3900 feet, as implied by Caljouw and Roeske (1981). Stone (1980) found none in the krummholz on Avery Peak and nor did we during this investigation.

The forest in the shadow of Little Bigelow was not sampled as intensively as the others in the region owing to inclement weather, but its overall condition can be compared to the Avery Col and Horns Pond sites discussed below. This portion of the subalpine forest is most striking for the precipitous terrain along the southern rim of Little Bigelow Mtn. We include it in the overall acreage recommended as a Critical Area.

Myron H. Avery Peak

Town: Dead River
Quadrangle: Stratton, Maine 15', 1956
Elevation: 4088'
Date Field Checked: 3 September 1985, W. D. Hudson, Jr.

Summary of Significant Features

1. Alpine Features: The vegetation of Avery Peak was studied in detail by Alton Stone (Stone, 1980). The flora is not diverse, yet includes at least four arctic/alpine plants (so determined by their overall distribution): alpine bilberry, Bigelow's sedge, fir clubmoss, and alpine sweetgrass. Four other species found here are considered rare in Maine & New England: boreal bentgrass, highland rush, mountain sandwort, and probably Boott's rattlesnake root. The later is currently under study for addition to the Federal Endangered Species List. Stone probably located one specimen during his investigation, and though it was not seen in 1985, it should continue to be sought. The peak is listed with the Register of Critical Areas.

2. Subalpine Forest: The steep northern and southern slopes of Bigelow reveal evidence of logging and fire to 3000' and above. However, the balsam fir/red spruce dominated forest above this elevation is characteristic of mostly undisturbed sites studied in Baxter State Park.

1. Alpine Features

Size: 135 acres (includes West Peak, and the subalpine forest and krummholz above 3700' around the two summits)
Elevation: 3700-4088'
Status: Registered as a Critical Area (April 20, 1979)

The alpine area of the summit of the Bigelow Range is markedly smaller than at comparable elevations in Baxter State Park or the White Mountains of New Hampshire (Figure 4). As a result it has been more thoroughly studied in the past 10 years than any other mountain top in Maine. Stone (1980) provides a detailed analysis of the alpine vegetation, and proposes a detailed community classification. The abstract of Stone's thesis, Avery Peak on Bigelow Mountain, Maine: The Flora and Vegetation Ecology of a Subalpine Heathland (1980), summarizes his exhaustive study:

> "The vegetation of a subalpine heathland located on the summit of Avery Peak, on Bigelow Mountain in Maine, was sampled by 230 random and 65 predetermined quadrat placements. The summit vegetation is dominated by species of ericaceous dwarf shrubs. On the basis of mean cover value Ledum groenlandicum, Vaccinium uliginosum var. alpinum and V. Vitis-Idaea var. minus were the dominant species. Heath species had a total mean cover of about 60% on the mountain summit.
>
> "Variation in the composition of the summit vegetation, though

continuous, can be assigned to nine communities. An ordination of the sample quadrats by the Bray-Curtis method, a constellation diagram of association values and an analysis of transects by the direct gradient method showed the vegetation structure to be predominantly one of gradients, although in each method noda could be identified corresponding to community types. A review of previous vegetation studies from other treeless summits in this region show a similarity in vegetation across these summits. Heath commmunities are the most prevalant vegetation type and a classification of heath communities is proposed.

"Several environmental parameters possibly affecting species distributions and community structure were investigated. One species, Carex Bigelowii, showed a possible correlation with steepness of slope, preferring sites with low (< 5°) slopes. One species, Empetrum nigrum showed a preference for shallow soils (< 10 cm.). The distribution of Agrostis borealis was restricted to sites with disturbed soils. Carex Bigelowii was the only species which showed a correlation with absolute elevation, being located only in the summit area.

"The distributions of several species were correlated with aspect. Ledum groenlandicum dominated the vegetation of the north slope of Avery Peak (Avery Peak is distinctly divided into slopes of north and south aspect) but was only infrequently found on the south slope. The distributions of herbaceous species including Carex Bigelowii, Potentilla tridentata, Juncus trifidus, Agrostis borealis, Hierochloe alpina and boreal herbaceous species were virtually restricted to the south facing slope. The distinct dichotomy in the vegetation was related, through literature survey to the intrinsic differences in temperature, moisture, and insolation between slopes of north aspect and those of south aspect. It was also related to prevailing wind patterns and resulting exposure.

"Species distributions also showed a correlation with the differences in relative elevation produced by high and low points in the local topography. A vegetation gradient was observed from krumholz (located in a low col) through dwarf shrub heath to Carex Bigelowii-Juncus trifidus-dwarf shrub heath (located at the summit point). This vegetation gradient was related to an exposure gradient of increasing wind speed, decreasing snow depth and decreasing temperatures with elevation, along the gradient.

"A total of 24 vascular species were found in the subalpine zone of Avery Peak. Four of these species were concluded to be arctic species based upon range descriptions from Polunin (1940), Posrsild (1955, 1964) and Hulten (1958, 1964). Of these four species (Carex Bigelowii, Lycopodium Selago var. appressum, Hierochloe alpina, and Vaccinium uliginosum var. alpinum) only V. uliginosum var. alpinum contributed significantly to the vegetation cover. It is concluded that even though arctic species are present on Avery Peak, the summit vegetation should be viewed as a regionally distinctive heath formation rather than as a southern extension of the arctic tundra vegetation. Furthermore, heath vegetation similar to that found on Avery Peak is a climax vegetation

type on regional summits between ca. 1,250 m. and ca. 1,800 m. where wind or other factors have eliminated tree growth."

A copy of Stone's thesis is on file with the Critical Areas Program. It provides a valuable baseline for future analysis of the fragile alpine vegetation of Avery Peak.

Caljouw and Roeske (1981, pp. 57-63) and May & Davis (1978, pp. 33-36) also discuss the arctic/alpine commmunities of Bigelow. The work of the former is the most recent, and no changes in the local distribution or condition of the arctic/alpine flora can be made at this time.

2. Subalpine Forest

Size: 2425 acres (includes that area around the Horns and the main peaks of Bigelow)
Elevation: 2700-3900'
Status: Recommended as a Critical Area

The subalpine forest of this eastern flank of the Bigelow range was sampled just below Avery Col (Figure 4). The forest is predominantly balsam fir. Heart-leaved paper birch is more prevalent than red spruce. This forest type first appears on the lower slopes of Bigelow at approximately 2400', and it can be seen as a clear and unbroken band of forest from approximately 2700' to near the summit of the range.

A small sample of trees were cored in the Avery Col plot. The mean age is 69.8 years (64.7 yr for balsam fir and 85 yr for red spruce). No tree older than 91 years was counted in the plot. There are pockets of a few blowdowns in this area, but no extensive windthrow was observed. The trees do not show either extensive insect damage or leaf yellowing.

Thirteen species of vascular plants were recorded in the plot. The frequency and cover (%) of the plants appears in brackets: wild sarsaparilla [15, 8.3], whorled-wood aster [55, 10.6], wood sorrel [60, 23.8], Canada mayflower [70, 11.7], bluebead lily [70, 5.8], brownish sedge [5, 2], spinulose woodfern [45, 13.6], starflower [30, 3], long beech fern [10, 6], indian pipe [5,2], and skunk currant [5,2]. The herbaceous cover (see Table 4) is consistent with that measured throughout the region, but significantly greater than the mean values measured in Baxter State Park.

The subalpine forest above 2700 feet on Bigelow is a largely undisturbed stand of high elevation forest of which a few isolated tracts can be found on the steeper, more remote slopes of Maine's higher mountains. Caljouw and Roeske (1981) describe it as boreal (northern) forest, and it comprises timber of little or no merchantable quality, yet high intrinsic value as exemplary stands of specialized forest. Boreal forests of higher latitude are dominated by a different suite of tree species, and so these subalpine forests should be recognized as a regional forest type. We recommend that they be listed as a Critical Area along with the acreage proposed for Baxter State Park (Hudson, et al., 1985).

West Peak

Town: Dead River
Quadrangle: Stratton, Maine 15', 1956
Elevation: 4150'
Date Field Checked: 3 September 1985, W. D. Hudson, Jr.

Summary of Significant Features

1. Alpine Features: The southern slope West Peak supports a heath dominated by three-leaved cinquefoil and highland rush. In this association grow alpine goldenrod and Boott's rattlesnake root, in addition to plants found more commonly on Avery Peak (eight arctic/alpine species). The alpine area of West Peak is smaller than that of Avery, and it is included within the limits listed as a Critical Area.

   A small population of the yellow-nosed vole is presumed to inhabit the upper reaches of subalpine forest, krummholz and the treeless area of West and Avery Peaks.

2. Subalpine Forest: The slopes of West Peak support subalpine forest dominated by balsam fir below the fringe of krummholz that rings the summit. This area is part of the continuous band of relatively undistrubed forest that extends along the Bigelow Range.

1. Alpine Features

Size: 135 acres (includes Avery Peak, which makes up the bulk of this Critical Area, and the subalpine forest and krummholz around the two peaks)
Elevation: 3700-4150'
Status: Registered as a Critical Area (April 20, 1979)

Caljouw and Roeske (1981) submitted that the greatest threats to the small treeless area of West Peak (Figure 4) were foot traffic and over-collecting. The Ridge Trail passes directly through the small alpine area, and mountain sandwort is dominant in the bare, gravelly disturbed ground of the trail. Highland rush and Bigelow's sedge are found more commonly in moist depressions among rocks and the open ledges of the southern slopes of the Peak. Here also are found alpine goldenrod and Boott's rattlesnake root, along with boreal bentgrass and alpine sweetgrass.

The condition of the vegetation on West Peak remains unchanged compared with that reported particularly by Caljouw and Roeske (1981) and earlier by May and Davis (1978). Boott's rattlesnake root should continue to be monitored because of its current status on the Federal Endangered Species list, and the rest of the alpine community should be examined more critically to enable a more quantitative as well as qualitative comparison with Avery Peak (Stone, 1980). Ideally, such work should coincide with an examination of plant communities on all of Maine's major summits.

2. Subalpine Forest

Size: 2425 acres (includes that area around the Horns and the main peaks of Bigelow)
Elevation: 2700-3700'
Status: Recommended as a Critical Area

The subalpine forest of this eastern end of Bigelow is characterized by the Avery Col plot described above. This relatively steep and rocky terrain extends westward to the Horns, and beyond the Horns to Cranberry Peak. We recommend that all of this forest above 2700 feet be recognized as a Critical Area.

The altitudinal boundary between the mixed northern hardwoods dominated by sugar maple, beech, and yellow birch, and including red maple, white ash, white birch, hop hornbeam and others, and the subalpine forests of balsam fir and red spruce is perhaps more striking on the north slopes of Bigelow. The "bushwhack" hike from any point along the shore of Flagstaff Lake to the ridge top reveals a similar succession of forest types. The line of demarcation is most readily observed from the ridge in the fall.

Caljouw and Roeske (1981) reported that yellow-nosed voles had been trapped in two locations on Bigelow in 1976. Both sites lie in the col between West and Avery Peaks and are described as occurring in the low scrub-like subalpine forest. Traps were not set during this current inventory, yet it is assumed that this rare mammal continues to survive at high elevation in the Bigelow range.

The Horns

Town: T4 R3 BKP WKR (Wyman)
Quadrangle: Stratton, Maine 15', 1956
Elevation: 3831' (South Horn), 3800' (North Horn)
Dates Field Checked: 18 & 19 September 1985, W. D. Hudson, Jr.

Summary of Significant Features

1. Alpine Features: The treeless area of the twin summits of the Horns together does not exceed 1 acre. They are properly described as heath balds. Horns Pond is a glacial tarn. Its association with the Horns to the east and a large outcrop to the north create a spectacular alpine setting.

2. Subalpine Forest: The forest was sampled at two points in the area of the Horns, one at relatively high elevation on the western slope of South Horn, and one on the south slope of the ridge below Horns Pond. The forest is consistent with that found throughout the range.

1. Alpine Features

Size: < 1 acre
Elevation: 3831'
Status: Not Recommended as a Critical Area

The top of the South Horn is reached either from the east by the Appalachian Trail that crosses a low point in the ridge between West Peak and the Horns or from Horns Pond to the west (Figure 4).

A small bald wraps around the south and southwestern portion of the summit of the South Horn. Alpine bilberry, mountain cranberry, and velvet-leaf blueberry are among the heaths found on the bald. Three-leaved cinquefoil is found growing with highland rush and crinkled bentgrass, and several bryophytes and lichens on dry southwestern ledges below the ring of krummholz near the peak.

The sag between South Horn and North Horn supports a low growth of balsam fir with scattered red spruce. Black spruce is not found here. The dwarf shrub heath community on the North Horn includes black crowberry among the heaths characteristic of the South Horn. This heath bald is no more than 1/10 an acre in extent.

The Horns are interesting geological formations along the Bigelow Range. Good views of the western and eastern portions of the Bigelow Preserve are afforded particularly from the North Horn. The leanto site at Horns Pond provides easy access for those who choose to explore the area.

The alpine area of the Horns is not recommended as a Critical Area because it lacks a significant alpine flora.

2. Subalpine Forest

a) Horns

Size: 2425 acres (includes the forest around the Horns as well as that around the main peaks of Bigelow)
Elevation: 2700-3800' (sampled at 3500')
Status: Recommended as a Critical Area

The forest at 3500 feet on the western slope of the South Horn is similar to that found on the steep exposed slopes of the mountains northwest of Mt. Katahdin. Balsam fir is the predominant tree species, and over 60% of the basal area of all species is saplings. The canopy is approximately 10 - 15 feet. Tree growth is dense with 5720 stems per hectare.

A full sample of trees was not cored at this site, though four balsam fir were sampled. A mean age of 56.5 years is not inconsistent with ages determined for similar sites in Baxter State Park, yet is younger than subalpine forest sites sampled in the Mahoosuc Range.

We recommend that this portion of the subalpine forest that extends above 2700 feet throughout the Bigelow Range be listed as part of that

larger Critical Area.

b) Horns Pond

Size: 2425 acres (includes the forest around the Horns as well as that around the main peaks of Bigelow)
Elevation: 2700-3800' (sampled at 3000')
Status: Recommended as a Critical Area

The subalpine forest on the south slope below Horns Pond has all of the physical features of old-growth forest with numerous tip-ups, pits and mounds (indicative of historic blow-downs), and an undisturbed forest floor. The canopy is at least twice and in many places three times that of the dwarf forest at higher elevation on South Horn.

Balsam fir is the predominant species, accounting for 85% of the basal area. Though saplings and trees less than 4 inches dbh account for 67% of the basal area of balsam fir, trees growing to 12 inches dbh are scattered throughout the plot. Red spruce accounts for only 10% of the basal area in the stand, but virtually none of it is measured in saplings and small trees. Unlike the forests of the higher slopes of Mt. Katahdin, scattered yellow birch are found to 3000 feet and above.

Thirteen species of herbaceous vascular plants were found within the 1/10th hectare plot. Frequency and cover (%) are included in brackets for the following species: bunchberry [32, 8], whorled-wood aster [20, 10.4], wood sorrel [100, 35.3], intermediate woodfern [92, 33.3], blue bead lily [24, 9], large-leaved goldenrod [12, 8.3], wild sarsaparilla [12, 5], three-seeded sedge [8, 2], goldthread [4, 1], indian pipe [8, 4], and drooping wood sedge [4, 3].

Just outside of the plot was found a boggy wetland that included blue flag, small white violets, swamp black currant, and rattlesnake grass growing in a mat of sphagnum.

The vegetation around Horns Pond is characteristic of other high elevation ponds in Maine. A variety of grasses, rushes and sedges can be found in wet places in and around the leanto clearing and around the shores of the pond, in addition to a number of weed species like Kentucky bluegrass and path sedge, including mountain hairgrass, Canada bluegrass, blue joint, drooping woodreed, false melic, long-haired sedge, drooping wood sedge, three-seeded sedge, and wool grass. Squashberry grows along the pond shores, and a number of aquatic plants can be recorded for the pond, including water lily, water celery, species of pondweed, and Merlin's grass.

c) Horns Pond Cutoff red spruce

A dramatic stand of red spruce is encountered at 1950 feet along the Horns Pond Cutoff Trail leading from Horns Pond to the Warden's Trail. The trees approach and exceed 100 feet and exceed 20 inches (52.3 cm) dbh. Evidence of fire is found throughout the stand, and a rich herbaceous flora includes elements from the northern hardwood forest of lower slopes.

Nine of the large trees that occupy an area less than 4 acres were

cored. None of the trees is older than 90 years!

This spectacular growth of red spruce should be monitored in the coming decades. It might provide an interesting view of the younger stages of a developing forest, and provide an interesting contrast to forest stands of similar stature, but much greater age, growing at the same elevation in Baxter State Park (notably Wassataquoik Mountain red spruce, and Howe Brook red spruce and balsam fir).

Cranberry Peak

Town: T4 R3 BKP WKR (Wyman)
Quadrangle: Stratton, Maine 15', 1956
Elevation: 3213'
Date Field Checked: 17 September 1985, W. D. Hudson, Jr.

Summary of Significant Features

1. Alpine Features: numerous outcrops above Cranberry Pond provide good views of the western end of Carrabasset Valley and the northwest corner of the Bigelow Preserve.

2. Subalpine Forest: the forest at this western end of the ridge is dominated by red spruce, unlike the higher slopes of Bigelow. The terrain is rocky and strewn with boulders, and the vegetation is noticeably depauperate.

1. Alpine Features

There is no treeless area on Cranberry Peak (Figure 4). The flora typical of the boreal forest grows to the ridge top. Numerous outcrops provide excellent views of the surrounding valleys, Cranberry Pond, and East Nubble, but there is nothing of the vegetation that is truly alpine in nature.

2. Subalpine Forest

Size: 285 acres
Elevation: 2700-3213'
Status: Recommended as a Critical Area

Caljouw & Roeske (1981) determined that there are 263 acres of subalpine forest (scrubland) along Cranberry Ridge and Pond Peak. The forest was sampled on the slopes of Pond Peak to the north northeast of Cranberry Pond. The most striking feature of the forest at this location was the virtual lack of herbaceous vegetation.

The terrain around and above Cranberry Pond is rocky and scattered with numerous large boulders. The soil is shallow, and charcoal can be found throughout the upper horizon.

This is an uneven aged stand dominated by black spruce. The largest trees in the stand are 18.9 in dbh and 60 feet tall. They are all in apparently good health with little or no sign of insect or other damage. Fifty percent of the basal area in the stand is red spruce, followed by

balsam fir and white birch. There is healthy regeneration of all species, notably spruce.

Only five species of vascular plants were found along the sample transect, though five more were found at the far corner of the plot (whorled-wood aster, blue bead lily, dwarf raspberry, rock polypody, and intermediate wood fern). Frequency and cover (%) appear in brackets for each of the following species: velvet-leaf blueberry [12, 3.7], lowbush blueberry [8, 1.5], bunchberry [4, 2], starflower [4, 2], Canada mayflower [4, 1].

This western end of the subalpine forest in the Bigelow Range is not as extensive as that around the higher peaks, and it is different in character as described above. Nevertheless, we recommend that it be included in the total acreage of subalpine forest identified as a unique resource within the Bigelow Preserve.

East Nubble

Town: T4 R3 BKP WKR (North One Half)
Quadrangle: Stratton, Maine 15', 1956
Elevation: 2442'
Date Field Checked: 16 September 1985, W. D. Hudson, Jr.

Summary of Significant Features

1. Old-growth hemlock and yellow birch, Old-growth balsam fir and red spruce: the western and southwestern slopes of East Nubble support a growth of softwood species that are relatively undisturbed and can be characterized as old-growth.

1a. East Nubble hemlock and yellow birch

Size: 5 acres
Elevation: 1900'
Status: Not Recommended as a Critical Area

There is very little forest below 2700 feet in the Bigelow Preserve that has escaped either fire or the saw. One such stand has been identified on the south slope of Little Bigelow, and two stands have been identified on East Nubble. All three were previously identified by Caljouw and Roeske (1981) as the result of field work.

The small stand of hemlock and yellow spruce on the western slope of East Nubble at approximately 1900 feet has indeed been cut over in the recent past. There is little evidence on the ground characteristic of old-growth timber (tip-ups, pits and mounds), presumably because of the history of cutting.

The value of this stand lies in its close proximity to the next, and both stands' proximity to the ridge trail leading from Stratton across the range to the intersection with the Appalachian Trail. A comparison on the ground of this stand and the one just above it would provide a visitor to the Preserve with a good lesson in the character of disturbed and

undisturbed old-growth (Caljouw & Roeske, 1981).

Because of significant past disturbance, there is no need to list this stand as a Critical Area.

1b. East Nubble red spruce and balsam fir

Size: 25 acres
Elevation: 2100-2442'
Status: Recommended as a Critical Area

At 2100 feet on the western slope of East Nubble is found a large stand of red spruce and balsam fir that have been aged at 120-250 years (Caljouw & Roeske, 1981). This stand has not been cut, and there appears to be no major evidence of past fire in the soil or on the ground.

This stand does not fall within the boundary of subalpine forest described by the 2700 foot contour line, yet it shares much of the character of higher elevation stands along the eastern portion of the ridge. The steepness of slope accentuates the undisturbed nature of the stand. Recently fallen trees and well rotted stumps and trunks criss-cross the forest floor. It is this physical condition of the floor of the forest that is perhaps the most illustrative and exemplary feature of old-growth. The proximity of this stand of spruce and balsam fir to the partially disturbed and logged site at lower elevation on the East Nubble provide an ideal comparison for students of forest ecology.

We recommend that this site be listed as a Critical Area, and we concur with earlier proposals that its proximity to the established ridge trail be exploited for interpretive purposes.

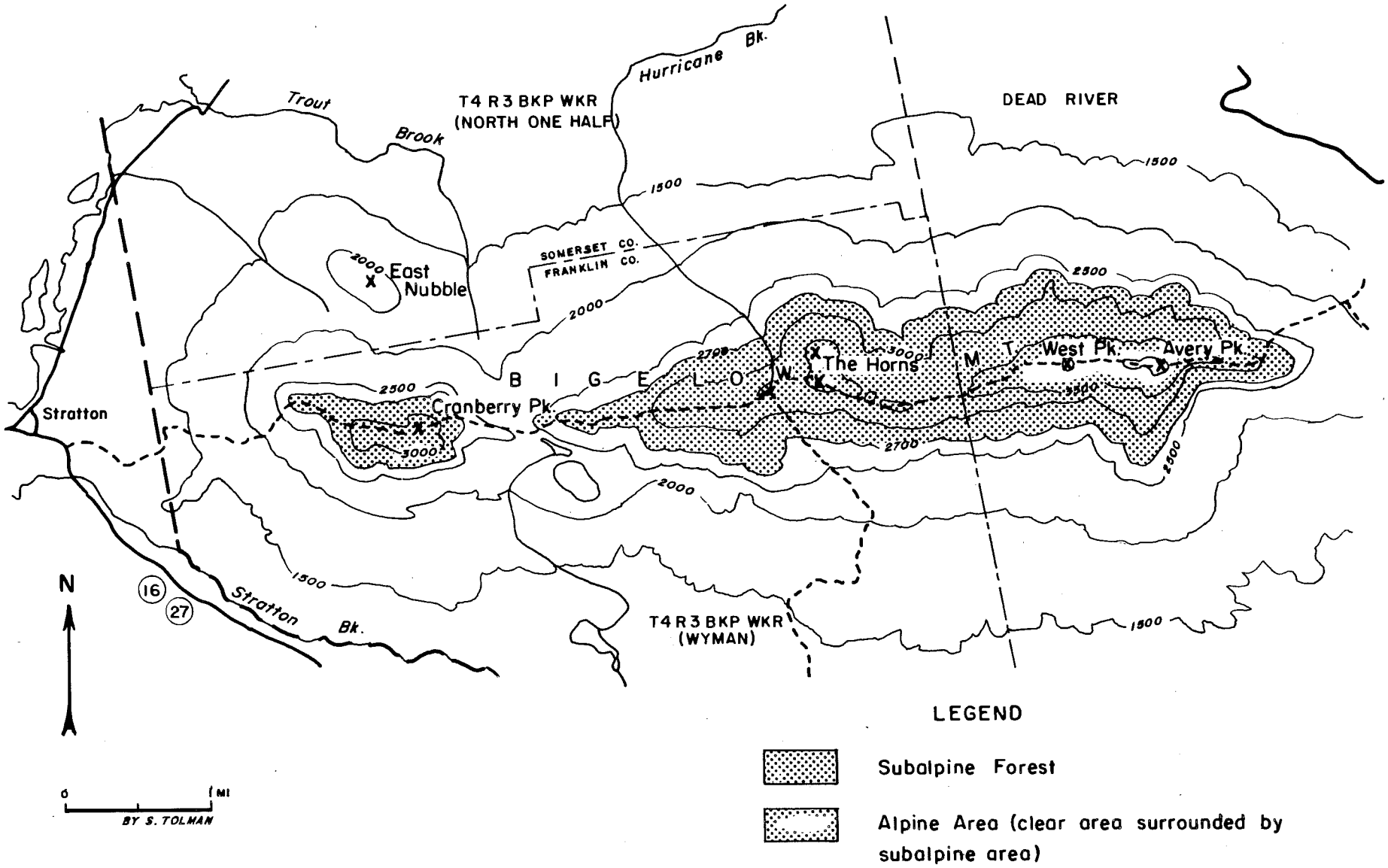


Figure 4. Bigelow Mountain

The Baldpates

Town: Grafton
Quadrangle: Old Speck Mtn., Maine 15', 1943
Elevation: 3812'
Date Field Checked: 23 July 1985, D. Parrella, M. Calderara, S. Stanger
2 October 1985, W. D. Hudson, Jr.

Summary of Significant Features

1. Alpine Features: The East and West Peaks of the Baldpates and the intervening col are already recognized as Critical Areas. Though the acreage is small, a number of arctic/alpine species can be found there. One species, cloudberry (Rubus chamaemorus) was reported from the small alpine bogs found in the sag beween the peaks in 1897. Its presence on the mountain can not be verified in 1985.

2. Subalpine Forest: The subalpine forest surrounding the Baldpates is not exceptional as an example of the forest type in Maine. The northeast and northern quarters in particular have been cut over in the recent past.

1. Alpine Features

Size: 267.5 acres
Elevation: 3500-3812'
Status: Registered as a Critical Area (16 December 1977)

The East and West Peaks of the Baldpates and the intervening col have been recognized as a significant alpine resource in Maine for a century (Figure 5). The area was reviewed by May and Davis (1978) in their comprehensive survey of alpine tundra vegetation in Maine. Burke (1982) also spent considerable time above treeline in 1981 while conducting the most recent natural area inventory of the Mahoosucs. Burke (1982) also relied on the floristic work of Campbell and Eastman (1980) whose Flora of Oxford County, Maine is a useful resource for anyone interested in present and historical records of the vegetation.

The East Peak has the largest area of dwarf shrub heath and barren ledge. Boreal bentgrass, Bigelow's sedge, highland rush, mountain sandwort, Diapensia, and alpine goldenrod can all be found here, growing in depressions and cracks between large sections of exposed bedrock. Boott's rattlesnake root was not found growing on the Baldpates where it was sought in suitable habitat. The population of Diapensia on the summit of the East peak should continue to be monitored. Hudson examined it first in 1972, and there does not appear to have been significant degradation since that time. Burke (1982) is concerned that increased traffic across the Peak might threaten the small population.

A number of heath species can be found on both East and West Peaks and in the sag between them. Black crowberry, mountain cranberry, alpine bilberry, velvet-leaf blueberry, and lowbush blueberry all grow here. Labrador tea is most prominent in the moist heath between the peaks. Two small alpine bogs in this area support a variety of species, including

cotton grass or Hare's tail, leatherleaf, bog laurel, and bog cranberry. The cloudberry was collected here in 1897 by J. Allen, but it has not been reported since that time. The species is abundant in similar habitats in the Mahoosucs, yet it does not extend any further east than Mahoosuc Arm.

2. Subalpine Forest

Size: 1315 acres
Elevation: 2700-3500'
Status: Recommended as a Critical Area

The subalpine forest on the northern flank of the Baldpates was sampled at 2880 feet. Past cutting reached at least this elevation and perhaps even higher on these slopes of the mountain. The history of past fire is not as clearly evident on the ground or in the soil. Windthrow is significant, and there is a notable dieback of balsam fir in the stand. A significant percentage of basal area consists of standing dead fir.

The stand sampled is an uneven-aged mix of balsam fir, red spruce, heart-leaved paper birch, and mountain ash. Over 50% of the basal area is made up of balsam fir, and only a small percentage of this area comprises seedlings. Red spruce and heart-leaved paper birch both share just over 12% of the basal area, and they too have well distributed age classes throughout the stand. It should be noted that similar stands throughout Baxter State Park have substantially greater recruitment of saplings, perhaps in response to a forest stand more heavily damaged by insects and other enviromental factors.

Fifteen trees were cored in the plot. The mean age for the stand is 59.9 years (55.1 for balsam fir and 67 for red spruce). The oldest tree cored was a red spruce of 136 years.

Thirteen species of vascular plants were recorded along the transect. Frequency and cover (%) appear in brackets for the following species: wood sorrel [76, 46.8], blue bead lily [20, 15.6], intermediate wood fern [56, 15.4], bristly clubmoss [36, 8.8], starflower [16, 2.8], wild sarsaparilla [8, 18], interrupted fern [4, 4], long beech fern [4, 8], painted Trillium [4, 4], whorled-wood aster [4,10], and bunchberry [4, 2]. There is not a well developed bryophyte community at this elevation. The greatest cover measured was 50% in one quadrat and the mean cover for the transect was 10%.

Historical cutting apparently reached higher on this mountain and in the Mahoosucs than in the Bigelow Preserve. It may have reached as high as 3000 feet in several places. Nevertheless, the subalpine forest of these mountains remains largely undisturbed, and we recommend that the forest above 2700 feet be recognized as an exemplary forest type in Maine.

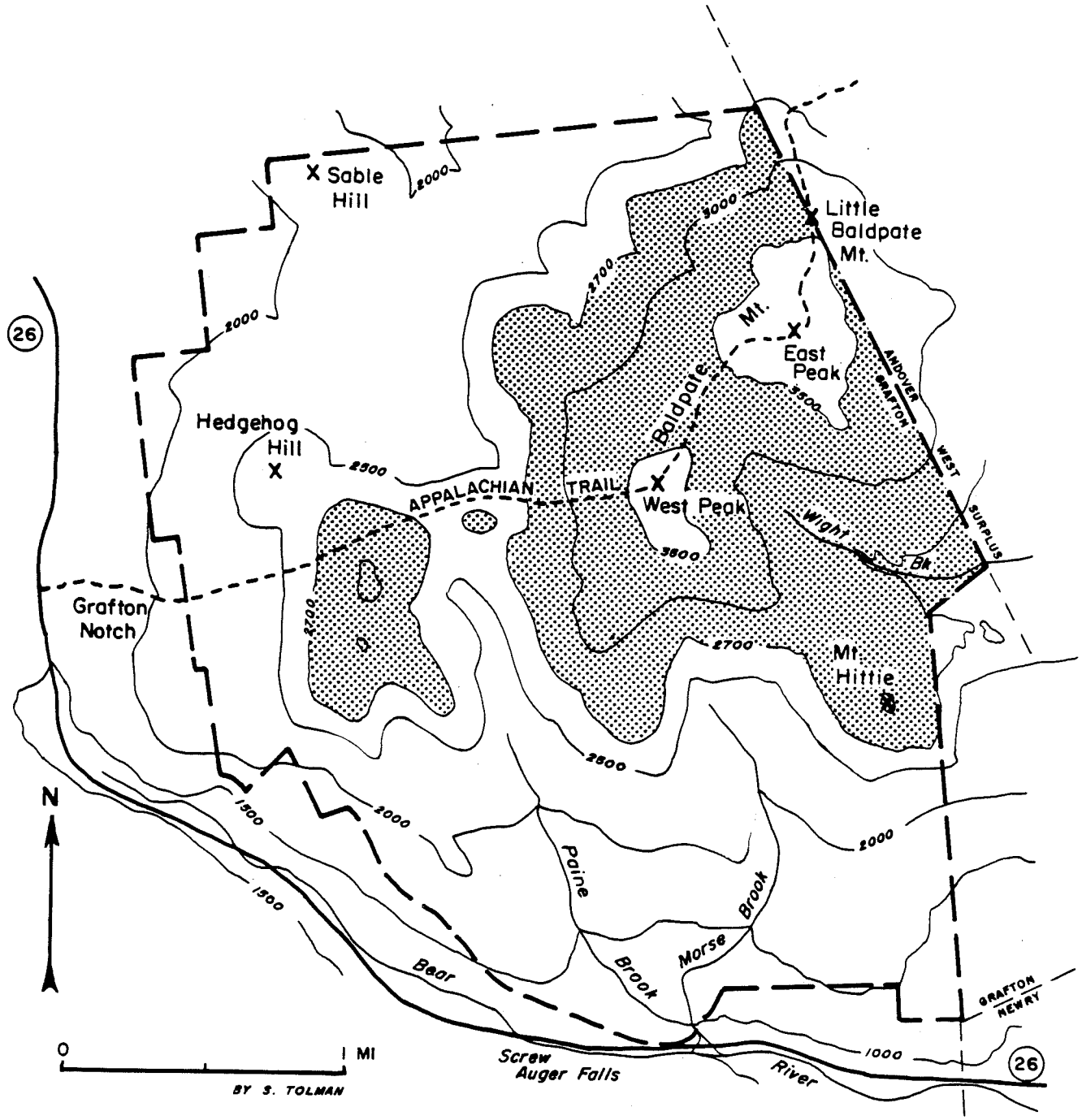


Figure 5. The Baldpates

Old Speck Mountain

Town: Grafton
Quadrangle: Old Speck Mtn., Maine 15', 1943
Elevation: 4180'
Dates Field Checked: 11 July 1985, D. Parrella, J. Ewing, K. Wolf
4 October 1985, W. D. Hudson, Jr.

Summary of Significant Features

1. Alpine Features: the summit of Old Speck is forested, and only a few exposed northern ledges support alpine vegetation, highland rush and mountain sandwort, apart from patches of alpine heathland.

2. Subalpine Forest: the forest of the slopes of Old Speck was sampled in two places. Both sites are representative of subalpine balsam fir. The Old Speck subalpine stand is particularly interesting as it extends to the summit and is not interrupted by any development of heath or barren ground vegetation.

1. Alpine Features

The summit of Old Speck (Figure 6) was not considered in the survey of alpine tundra vegetation conducted by May and Davis (1978) because it lacks a treeless summit and therefore does not support barren ground or tundra vegetation. Nevertheless, Burke (1982) pointed out that at least two rare plants can be found on exposed ledges, mountain sandwort and highland rush, and the summit should be recognized for these features.

Elements of subalpine heath (Labrador tea, velvet-leaf blueberry, black crowberry, and alpine bilberry) can be found in open places as well, but the development of heath is in no way comparable to that found on Mahoosuc Arm, Mahoosuc Mountain, or in the southern extension of the Range beyond Mahoosuc Notch.

We do not recommend that the summit of Old Speck be designated a Critical Area.

2. Subalpine Forest

Size: 1695 acres (includes Old Speck, Mahoosuc Arm, & Mahoosuc Mtn.)
Elevation: 2700-4180'
Status: Recommended as a Critical Area

The subalpine forest of Old Speck (Figure 6) is in a particularly good position to be viewed by travelers since it extends directly to the summit. Two plots were sampled in 1985, one approximately .3 miles from the summit on a northeasterly slope, and one at lower elevation near Speck Pond on a slightly northwesterly slope.

These two stands are both uneven-aged, supporting a large sapling cohort that is one quarter of the basal area of living stems. There is

little windthrow in the Old Speck site, though the larger trees are overmature and dying. Considerable blowdown can be found at the lower elevation site, and it appears that much of the oldest cohort is now on the ground, since larger standing deadwood is lacking in the sample. These sites are both dominated by balsam fir, and red spruce is lacking entirely from the higher elevation plot on Old Speck. Heart-leaved paper birch is more prevalent at lower elevation where red spruce is also found. Only two age classes of red spruce were tallied in the Speck Pond plot: saplings and one 137 year old tree of 48 cm dbh.

Twenty trees were cored on top of Old Speck. The mean age for the stand is 65.9 years (65.2 for balsam fir and 70 for birch). The balsam fir in particular are represented by a large number of trees older than 100 years, yet the stand does not appear overmature. There is a clear continuous distribution of age classes among the trees greater than 10 cm dbh. Sixteen trees were cored above Speck Pond and here the mean age is significantly greater (95.6 years: 92.4 years for balsam fir and one spruce at 137 years). A large number of saplings are being recruited presumably in response to the wave of blowdown. Those trees that remain standing in the plot are healthy and are well distributed in age and size classes across the tally.

The herbaceous vegetation in both stands provides close to the greatest cover of any of the 15 plots sampled in 1985. Frequency and cover (%) for the following species appears in bracket: wood sorrel [84, 20.7], wild sarsaparilla [16, 10.3], intermediate wood fern [100, 45.4], blue bead lily [52, 6.3], starflower [56, 4.6], bristly clubmoss [8, 7], large-leaved goldenrod [48, 7.5], bunchberry [32, 3.4], skunk currant [12, 17.3], and goldthread [4, 2]. The most striking feature of the herbaceous cover is the clear dominance of wood fern in the plot.

The Speck Pond stand herbaceous flora includes 12 species counted along the transect: intermediate wood fern [88, 37.3], blue bead lily [80, 13.4], wood sorrel [96, 38.4], large-leaved goldenrod [24, 4.8], bristly clubmoss [20, 20.6], wild sarsaparilla [4, 10], bunchberry [60, 9.4], Canada mayflower [4, 2], whorled-wood aster [24, 24.6], goldthread [4, 4], goldthread [4, 4], long beech fern [4, 4], and starflower [12, 2.7]

These stands are notable as virtually pure balsam fir subalpine forest and are representative of a large part of this forest type in the Mahoosucs. We recommend the inclusion of these acres in the total acreage proposed as a Critical Area. The area extends to the summit of Old Speck and includes all of the exposed ledge that support the growth of two species of rare alpine plants.

Speck Pond is the highest elevation tarn lake in Maine (3530 feet). It is reported to be 36 feet deep (Burke, 1982), and averages 16 feet deep throughout its 9 acre area. It is a stratified pond that flushes 1.88 times per year. Speck Pond is vulnerable to disturbance because of a high use camping area located on its eastern shore. It has been designated a Natural Area by the State Planning Office.

Mahoosuc Arm

Town: Grafton
Quadrangle: Old Speck Mtn., Maine 15', 1943
Elevation: 3777'
Date Field Checked: 10 July 1985, D. Parrella, J. Ewing, K. Wolf

Summary of Significant Features

1. Subalpine Heath and Bog: a large acreage of moist subalpine heath and bog extends along Mahoosuc Arm through which passes the Appalachian Trail. Considerable effort has been made to protect the fragile ecosystem by bridging. The origin and development of the subalpine peatlands in particular is not fully understood and should be the focus of future investigations.

2. Subalpine forest: the forest on the south slope of Mahoosuc Arm grows in a wetter, more poorly drained soil than that found on Old Speck or near Speck Pond. It supports a larger component of red spruce, and has a particularly sparse herbaceous cover.

1. Subalpine heath and bog

Size: 145 acres
Elevation: 3500-3777'
Status: Recommended as a Critical Area

Burke (1982) describes concisely the character of the subalpine heaths and bogs that are found at mid-elevation in the Mahoosucs (Figure 6). These treeless areas are dominated by ericaceous shrubs including labrador tea, leatherleaf, blueberries, and cranberries. We spent little time evaluating these heaths since the results of that work appear in other places (Burke, 1982; Worley, 1981; Campbell & Eastman, 1980 and Fahey, 1976). We quote briefly from Burke (1982):

> "The moist subalpine heath is dominated by ericaceous shrubs, and is characterized by a moist, nutrient-poor soil containing poorly decomposed organic matter. Fahey (1976) refers to this vegetation type as "heath balds", because they occur as open areas on moderately exposed ridgetops in the Mahoosucs. The dominant species and microtopography within the heath vary significantly such that several species associations which grade in and out of one another are recognizable within the moist subalpine heath.
>
> "One of these species associations is a prostrate scrub community dominated by alpine bilberry, cranberry, crowberry and lichens. This association develops in fairly dry areas, and grades in and out of the dry alpine barren vegetation type. It characteristically occurs on the edge of bare rock, and has a soil layer no thicker than 10 cm.
>
> "The most extensive species association within this vegetation type is a mixture of the taller ericaceous species, sheep laurel, Labrador tea, rhodora, and leatherleaf. Dwarf black spruce and balsam fir are present to a lesser extent. Lichens, cloudberry, and

hare's tail are all intermixed. This association develops in moist areas, grading freely in and out of both krummholz and surrounding spruce-fir forest. Soils are from 10-25 cm." (p.26)

Fahey (1976) draws the conclusion that these balds have a much clearer affinity with those in the southern Appalachians than with similar northern maritime heathlands.

We recommend that the subalpine heath and bog of Mahoosuc Arm recognized as a Critical Area.

2. Subalpine Forest

Size: 1695 acres (includes Old Speck, Mahoosuc Arm, & Mahoosuc Mtn.)
Elevation: 2700-3777'
Status: Recommended as a Critical Area

The forest of Mahoosuc Arm (Figure 6) differs notably from that sampled near Speck Pond and on Old Speck because of a major component of red spruce. Speck Pond lacked entirely all age classes of spruce between sapling and the maximum age class recorded (137 years). The Mahoosuc Arm stand has a stong component of spruce that is evenly distributed between all age classes.

Two-thirds of the basal area of live wood in this stand is balsam fir (43.8 m2/ha). Red Spruce and heart-leaved paper birch make up preportionately less of the total of 65 m2/ha (12.7 m2/ha of spruce and 8.4 m2/ha of birch). Though there is substantial blowdown in a patch on the slope above the stand, there is very little within it, and there is no clear evidence of past fire on the ground or in the soil.

Sixteen trees were cored in the plot. The mean age is 94.0 years (86.9 years for balsam fir, 117.8 years for spruce, and 146.5 years for birch). The oldest balsam fir cored had a rotten center and 124 years were easily counted. Its estimated age approaches 150 years. The spruce is well represented across a wide range of size classes, yet there is a clear jump in age class from 95 years to 245 years. The maximum age class for both spruce and fir is declining, yet the fir appears to have a more uniform age distribution within the site.

Growth during the past five years is comparable to that measured in the previous five years with some trees showing a decline and others showing an increase. This condition is not comparable to that observed in Baxter State Park in 1984. A marked decline in growth during the past five years is clearly evident in the Baxter stands.

The herbaceous cover in the Mahoosuc Arm stand is the least of all sampled plots, and the bryophyte cover the greatest of any plots sampled in the Mahoosuc Range. Frequency and cover (%) for the herbaceous flora appears in brackets: bunchberry [12, 6], wood sorrel [52, 20.6], goldthread [44, 12.8], blue bead lily [20, 8.2], starflower [20, 6.8], drooping wood sedge [16, 6.5], whorled-wood aster [40, 26.7], intermediate wood fern [24, 15.3], wild sarsaparilla [4, 7], and Canada mayflower [4, 2].

We recommend that this portion of the subalpine forest of the Mahoosuc Range be included in the overall acreage designated as a Critical Area.

Mahoosuc Mountain

Town: Grafton
Quadrangle: Old Speck Mtn., Maine 15', 1943
Elevation: 3480'
Date Field Checked: 6 August 1985, D. Parrella, M. Calderera, J. Stone

Summary of Significant Features

1. Subalpine Heath and Bog: undisturbed subalpine heath and bog are found on the south and southwestern slopes of Mahoosuc Mountain. They are far from the trail and are unlikely to be bothered by human disturbance.

2. Old-growth Forest: this is the only substantiated tract of old-growth balsam fir and red spruce located in the Mahoosuc Range. It lies higher on the slope of the mountain than the exemplary stand of softwood (subalpine balsam fir and red spruce) identified by Burke (1982).

3. Subalpine Forest: Burke (1982) identified a prominent stand of balsam fir and red spruce along the mid elevation northeasterly slope of Mahoosuc Mountain. This portion of the forest was not sampled in detail in 1985.

1. Subalpine heath and bog

Size: 32 acres
Elevation: approximately 3300-3480'
Status: Registered as a Critical Area (June 14, 1984)

The moist subalpine heath that grows along the southern slopes of Mahoosuc Mountain have been recognized as an undisturbed example of this subalpine vegetation type in the Mahoosucs (Burke, 1982). A general description of the character of the vegetation is excerpted above (see notes under Mahoosuc Arm). A more detailed description is found in Burke's (1982) report.

We concur that these heath balds should be recognized as Critical Areas, as part of the effort to identify significant features of the montane environment of Maine.

2. Mahoosuc Mountain old-growth balsam fir and red spruce

Forest Type: balsam fir and red spruce
Stand Age: 245 years (maximum age class)
Stand Size: approx. 10 acres
Elevation: 3420'
Status: Recommended as a Critical Area

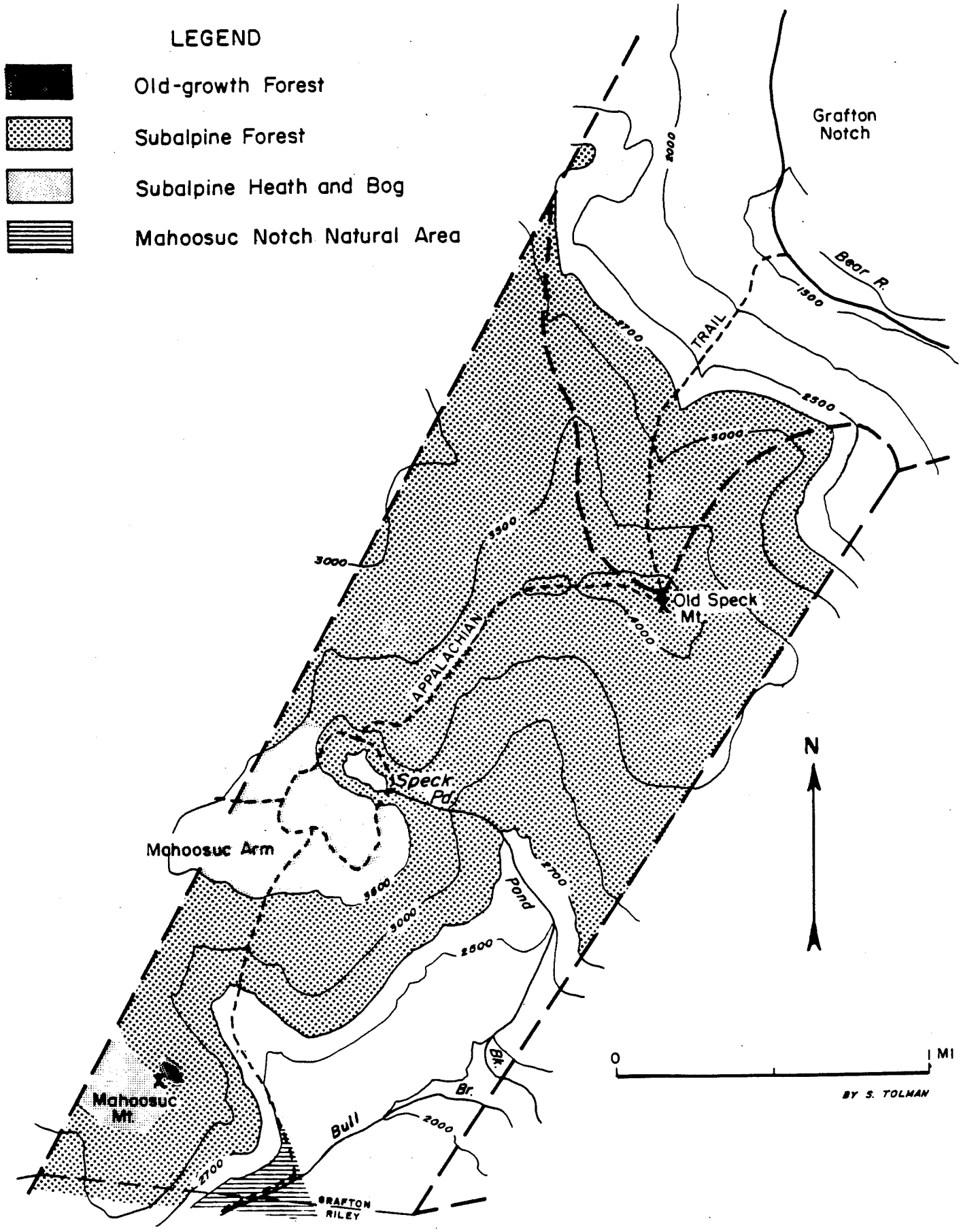


Figure 6. Old Speck and Mahoosuc Mountains

The upper elevation north and northeasterly slope of Mahoosuc Mountain supports a well developed growth of balsam fir and red spruce. The stand is found on a relatively flat plateau below the heath balds at the summit of the mountain.

Unlike the mid- and upper elevation stands sampled on Old Speck and Mahoosuc Arm, this stand does not have a large cohort of saplings. Considerable windthrow laces the stand, but no area has been opened to allow for vigorous regeneration of saplings. This is an even-aged stand that is virtually all fir and spruce. Half of the basal area of live wood is attributed to balsam fir (16 m2/ha) and half to red spruce (13.5 m2/ha). Mortality is considerable in the stand, but the overall appearance is not of a forest in decline. Dead trees are being replaced at a regular and continuous interval by seedlings and saplings.

Fifteen trees were cored in the plot. Seven red spruce range in age from 43 years to 231 years. Eight balsam fir range from 36 to 101 years. The mean age for the stand is 91.2 years (117.7 years for red spruce and 68 years for balsam fir). Growth during the last five years has been uniformly greater than that during the previous five years. This stand is not apparently in decline.

Herbaceous cover is comparable to that of other stands in the Mahoosucs, with the exception that wood fern is not as prominent a member of the plant community. Frequency and cover (%) are included in brackets for the following nine species: wood sorrel [80, 27.7], intermediate wood fern [8, 9], snowberry [24, 5.8], starflower [48, 4.8], goldthread [76, 16.8], three-seeded sedge [20, 7.2], bunchberry [12, 11.7], blue bead lily [32, 17], and Canada mayflower [4, 2].

We recommend this stand be designated as a Critical Area for old-growth because it is an even-aged mature forest with a strong maximum age class and an even distribution of younger trees. The forest floor bears all of the characteristics of old-growth, and the stand is in a region of the Range that is relatively free of human disturbance.

Mahoosuc Notch

Towns: Grafton & Riley
Size:
Elevation: approx. 2200-2500'
Status: listed as a Natural Area with the Critical Areas Program,
Recommended as a Critical Area.

The Mahoosuc Notch was proposed as a National Landmark in 1974, but was passed over on the grounds that its recognition would attract greater traffic to the area.

Mahoosuc Notch is reached most directly by ascending the trail that leads northeast from Success Pond Road in New Hampshire. Otherwise, the route through the Notch requires at least one overnight. The Notch is approached from the north by the Appalachian Trail that passes over Old Speck and along the ridge from Speck Pond to the shoulder of Mahoosuc Mountain. The trail descends sharply to the south at roughly 2400' and skirts Mahoosuc Mountain through an exemplary stand of mixed hardwood

(Burke, 1982) until it reaches the floor of the Notch at approximately 2200'.

The floor of the Notch is strewn with large boulders and steep walls ascend on the northwest to Mahoosuc Mountain and on the southeast to Fulling Mill. The cool damp nature of the place allows snow and ice to persist into August beneath large boulders and in recesses. The floor does not have a firm base of soil, and thin, mossy accumulations of organic matter cover over cracks and spaces between the boulders. The hike through the Notch is not easy, and can be particularly awkward with a full pack. The way is often impassable through May and early June, and snow shoes are of little use over the uneven terrain.

The south end of the Notch reaches to approximately 2500 feet where the trail turns east up an even grade to the shoulder between Fulling Mill and South Peak. The forest at this end of the Notch is more characteristic of the subalpine forests described for the main part of the Mahoosuc Range.

Fulling Mill and South Peak

Town: Riley
Quadrangle: Old Speck Mtn., Maine 15', 1943
Elevation: 3445'
Date Field Checked: 25 July 1985, D. Parrella, S. Stanger, M. Calderera

Summary of Significant Features

1. Subalpine Heath and Bog: moist subalpine heath is found on the southwestern flank of Fulling Mill and in the sag between South Peak and Fulling Mill. It is a typical habitat for cloudberry, and supports a large population of this species.

2. Subalpine Forest: the forest was sampled on the southeast slope of South Peak. There is considerable windthrow on this steep slope, but there is only a small amount of standing dead wood.

1. Subalpine heath and bog

Size: 138 acres
Elevation: approx. 3200-3400'
Status: Recommended as a Critical Area

Burke (1982) notes that the vegetation of the heath balds on Fulling Mill are more homogeneous moist subalpine heath than those on either Mahoosuc Arm and Mahoosuc Mountain and those on Goose Eye, yet they do support the growth of some subalpine bog species in wetter, boggy depressions. Cloudberry is the notable rare species in these associations.

Sheep laurel, Labrador tea, Rhodora, and leatherleaf grow here as well as alpine bilberry, black crowberry, cranberry, and lichens in suitable drier habitats. Dwarf white pine is scattered through this community. Burke (1982) points out that it is the highest elevation for

this species in the Range.

The Goose Eye arctic/alpine Critical Area should be extended to include the plant communites on the north slope of South Peak and the south slope of Fulling Mill. The associations found here are comparable in size and character to the moist subalpine heaths and bogs already recognized and listed as important elements of the vegetation of both Goose Eye and Mt. Carlo.

2. Subalpine Forest

Size: 3475 acres (includes Fulling Mill, Goose Eye, & Mt. Carlo).
Elevation: 2700-3400'
Status: Recommended as a Critical Area

The stand sampled on South Peak is more diverse than any other sampled throughout the Range during 1985. Balsam fir and red spruce dominant the stand, but heart-leaved paper birch and mountain ash appear in measurable numbers as well.

The terrain at 3040 feet on South Peak is rocky and uneven and traversed by a number of ledges and hollows. The presence of mountain ash in appreciable quantity may be a reflection of the broken terrain. The soil is shallow (13.3 cm), and only a few stems of fir and spruce exceed one foot in diameter.

The total basal area of live wood is 46 m2/ha (27.6 m2/ha of fir, 10.9 m2/ha of spruce, 6.5 m2/ha of birch, .8 m2/ha of mountain ash, and .2 m2/ha of mountain maple). Saplings do not account for than 1/5 of the basal area of live wood, and there is a continuous distribution of age classes throughout most of the stand. Only a few larger diameter trees (42, 48 cm dbh) stand apart from the bulk that do not exceed 35 cm dbh.

Eleven trees were cored in the plot. The mean age is 69.2 years (65.7 years for fir and 76 years for spruce). No tree was found that was older than 96 years.

Thirteen species of herbaceous vascular plants were found along the transect, the most prominent being wood sorrel. Frequency and cover (%) for all appear in brackets: wild sarsaparilla [56, 6], intermediate wood fern [40, 18.5], wood sorrel [96, 22], bunchberry [24, 16.3], goldthread [28, 11], blue bead lily [72, 16.8], starflower [28, 3.4], snowberry [8, 2], large-leaved goldenrod [12, 2.3], Canada mayflower [12, 2], whorled-wood aster [32, 11.9], painted Trillium [4, 2], and long beech fern [4, 12].

Goose Eye Mountain

Town: Riley
Quadrangle: Old Speck Mtn., Maine 15', 1943
Elevation: 3794'
Dates Field Checked: 2, 3 & 16 July 1985, D. Parrella, M. Calderera, K. Wolf

Summary of Significant Features

1. Alpine Features: Goose Eye supports one of the most extensive arctic/alpine associations aside from Mt. Katahdin in Maine. It is already on the Register of Critical Areas. May and Davis (1978) identified 2 tundra species from the flora (Bigelow's sedge, Carex bigelowii; and Diapensia, Diapensia lapponica). Burke (1982) reports that Lapland Rosebay has neither been collected nor confirmed since it was first reported. Burke (1982) added boreal bentgrass, Agrostis borealis, alpine clubmoss, Lycopodium selago, and sweet grass, Hierochloe alpina to the alpine flora, as well as bastard toadflax to subalpine flora. She was unable to verify the presence of Boott's rattlensnake root, Prenanthes boottii. Neither it nor Lapland rosebay were verified in 1985.

2. Subalpine Forest: the forest around Goose Eye was sampled in three locations. Old-growth red spruce was not found on the western slopes as predicted, and in general the evidence of cutting on these slopes can be found higher than 2700 feet.

1. Alpine Features

Size: 224 acres
Elevation: approx. 3450-3794'
Status: Registered as a Critical Area (16 December 1977)

Goose Eye is a rich station for arctic alpine vegetation in Maine, not withstanding its relatively low elevation. At least eight species of arctic/alpine plants, and numerous heaths also characteristic of bogs, can be found here. In addition to several forms of subalpine heath and bog that stretch along the exposed ridge, the most well developed dry herb-lichen alpine barrens in the Mahoosuc Range can be found here. Diapensia, mountain sandwort, Bigelow's sedge, highland rush, alpine bilberry, sweet grass, boreal bentgrass, and lichens can all be found in various associations above 3500 feet. This association grades in and out of both moist subalpine heath as well as krummholz.

The north ridge of Goose Eye provides a number of low, protected areas where moist shrub heath and wet sedge-moss subalpine heath or subalpine bogs form a complex array of high elevation plant communities. Burke (1982) provides detailed information on this natural area in a previously published document.

Boott's rattlesnake root, Prenanthes boottii, was sought on the upper ridge of Goose Eye from where it was previously reported, but no evidence of it was found in 1985. Cogbill (personal communication) determined that only low rattlesnake root, Prenanthes trifoliolata, was found by him on Goose Eye in 1985 during extensive investigation of the flora.

2. Subalpine Forest

Size: 3475 acres (includes Fulling Mill, Goose Eye, & Mt. Carlo).
Elevation: approx. 2700-3700'
Status: Recommended as a Critical Area

Three stands of subalpine forest were sampled on Goose Eye in 1985. We were directed by Terry McGovern and others to search out a magnificent stand of red spruce high on the Goose Eye Trail leading from Success Pond. That stand was apparently hit severely by the hurricane in 1938. No remnant of it remains today, perhaps because it was removed by a salvaging operation.

The plots were set down on the western, northeastern, and southwestern slopes of the mountain. These are all relatively young stands.

The plot sampled on the Goose Eye-Success Pond Trail is an even-aged stand with no windthrow and a small recruitment of saplings among the youngest age class. In contrast, the site below the sag between the east and west summits of Goose Eye and the site between Goose Eye and Mt. Carlo are both dominated by balsam fir saplings. Red spruce occurs at higher elevation in East-West Goose site, but very little spruce was found in the sag between Goose Eye and Mt. Carlo, or in the plot on the Goose Eye-Success Pond Trail.

The mean age for each of the plots did not exceed 71.4 years (Goose Eye-Success, 51.9; East-West Goose, 65.6; and Goose Eye Sag, 71.4). No trees over 100 years old were cored in any site. In both the high elevation sites there is little difference in growth between the last five years and the five years previous to that. Trees cored in the sag do show differences in growth pattern, but there is no consistent variation. Many trees show no difference, a few show retarded growth, and a few show accelerated growth.

The plot at 3700 feet on the Goose Eye-Success Pond Trail had the greatest overall herbaceous cover. Twelve species were found along the transect. Frequency and cover (%) for the following species appears in brackets: intermediate wood fern [92, 32.7], wood sorrel [96, 40.8], large-leaved goldenrod [20, 5.6], bunchberry [36, 6.4], blue bead lily [20, 8.4], starflower [40, 4.9], interrupted fern [8, 8], bristly clubmoss [16, 5.3], three-seeded sedge [4, 8], whorled-wood aster [28, 15.9], and goldthread [[4, 4].

The two other plots support far fewer herbs, and overall cover is half that of the Goose Eye-Success Pond Trail site. Frequency and cover (%) for the East West Goose site appear in brackets: starflower [48, 6.4], wood sorrel [48, 15.6], goldthread [92, 9.8], Canada mayflower [28, 4.4], interrupted fern [6, 5.5], bunchberry [80, 10.7], blue bead lily [60, 5.3], and snowberry [24, 19.8]. Similar figures for the plants found along the transect in the Goose Eye Sag also appear in brackets: wood sorrel [84, 26.9], wild sarsaparilla [44, 20.5], large-leaved goldenrod [4, 8], intermediate wood fern [48, 16.5], bunchberry [32, 5.4], starflower [16, 4.5], goldthread [28, 16.6], three-seeded sedge [4, 8], blue bead lily [20, 8], and bristly clubmoss [4, 6].

Mt. Carlo

Town: Riley
Quadrangle: Shelburne, New Hampshire - Maine 7 1/2', 1970
Elevation: 3565'
Dates Field Checked: 30 June, 1 July 1985, W. D. Hudson, Jr., D. Parrella, M. Calderera, K. Wolf

Summary of Significant Features

1. Alpine Features: Mt. Carlo has been previously registered as a Critical area because of the moist shrub heath, subalpine bog, and other alpine vegetation that occurs at the summit.

2. Subalpine Forest: the forest on the slopes of Mt. Carlo was sampled in two locations: in Carlo Col and on the south slope of the mountain .3 mile east of the New Hampshire-Maine border.

1. Alpine Features

Size: 25 acres
Elevation: 3565'
Status: Registered as a Critical Area (June 14, 1984)

The moist heath and subalpine bog at the summit of Mt. Carlo supports a healthy growth of cloudberry, for which it has previously been recognized. Diapensia grows in the gravelly margins of the trail that passes over the summit, and here it is not doing well. Signs of heavy traffic prevail, and the Diapensia cushions have not escaped damage. Several clumps have been shattered and torn. The presence of both plants is the principle reason for the listing of this alpine area as a Critical Area in 1984.

In addition to cloudberry and Diapensia, the summit supports a diverse heath flora including alpine bilberry, mountain cranberry, bog cranberry, lowbush blueberry, sheep laurel, bog laurel, Labrador tea, and leatherleaf. Black crowberry, mountain sandwort, cotton grass, and highland rush also grow on the top of Mt. Carlo.

We recommend in this report that similar sites and vegetation types throughout the Mahoosuc range as are found on Goose Eye and on Mt. Carlo be recognized as fragile and unique in Maine. The moist heath and subalpine bog formations of Mahoosuc Mountain and Fulling Mill are far more extensive than those found on Mt. Carlo, though they do not support the growth of Diapensia.

2. Subalpine Forest

Size: 3475 acres (includes Fulling Mill, Goose-Eye, & Mt. Carlo).
Elevation: 2700-3565'
Status: Recommended as a Critical Area

Balsam fir forest occurs at higher elevation in Carlo Col than elsewhere in the Mahoosucs. C. Cogbill (personal communication) encountered subalpine balsam fir at 3050 feet, whereas it is found at

approximately 2700 feet elsewhere along the range. We made a similar observation and sampled the subalpine forest at 3002 feet (several hundred feet beneath the col.

The forest on the south side of the col, approximately 0.3 miles from the Maine-New Hampshire border, was sampled a slightly higher elevation (3112 feet).

The forest in both places is dominated by balsam fir, yet the Mt. Carlo site shows significantly greater mortality of fir than that measured in Carlo Col. The basal area of living fir in the Carlo Col site is 29.7 m2/ha, while that same figure for the Mt. Carlo site is 19.8 m2/ha. Dead fir in both sites measures just the opposite. In Carlo Col only 6.3 m2/ha of dead fir was tallied, whereas 18.9 m2/ha of standing dead fir was tallied on Mt. Carlo. The differences may be attributed to a wave of blowdown that crosses the plot on Mt. Carlo. Here the regeneration of fir is dramatic.

These stands of subalpine forest are not dramatically old, yet they are relatively uneven-aged. Both support a large cohort of saplings (1300-1500/ha), and an apparently large maximum age class. The oldest fir aged in either plot was 93 years. The mean age in both sites exceeds 70 years, yet the variation around that mean as measured by the standard deviation is not great. A similar age structure obtains for red spruce. The stands on these slopes may have suffered dramatic deforestation that released the present group of old trees and allowed them to grow into the present canopy.

The Carlo Col site is one of few sampled in 1985 that shows a clear decline in growth during the past five years. There is no outwardly apparent sign of forest decline or disease, yet this site should be monitored in the coming years for signs of the widespread dieback observed in Baxter State Park.

The herbaceous flora of the Mt. Carlo site is depauperate. Little sunlight falls to the forest floor across a wide area of the plot. The frequency and cover (%) of seven species encountered in quadrats along the transect appear in brackets: bunchberry [8, 2], Canada mayflower [40, 6.4], wood sorrel [36, 9.7], whorled-wood aster [4, 4], goldthread [28, 3.4], intermediate wood fern [24, 15.5], and blue bead lily [20, 10.4]. The herbaceous flora of the Carlo Col site includes 13 species, and like several other stands sampled along Mahoosuc range, there is a large population of wood fern growing here. Frequency and cover (%) for all apecies appears in brackets: intermediate wood fern [96, 40.5], wood sorrel [100, 39.6], large-leaved goldenrod [20, 2.8], blue bead lily [56, 6.2], bristly clubmoss [56, 13.1], long beech fern [20, 15.6], starflower [12, 3.7], inflated sedge [12, 3.7], three-seeded sedge [16, 11.8], whorled-wood aster [24, 8.2], bunchberry [12, 2.7], painted Trillium [4, 4], and mountain wood fern [8, 7.5].

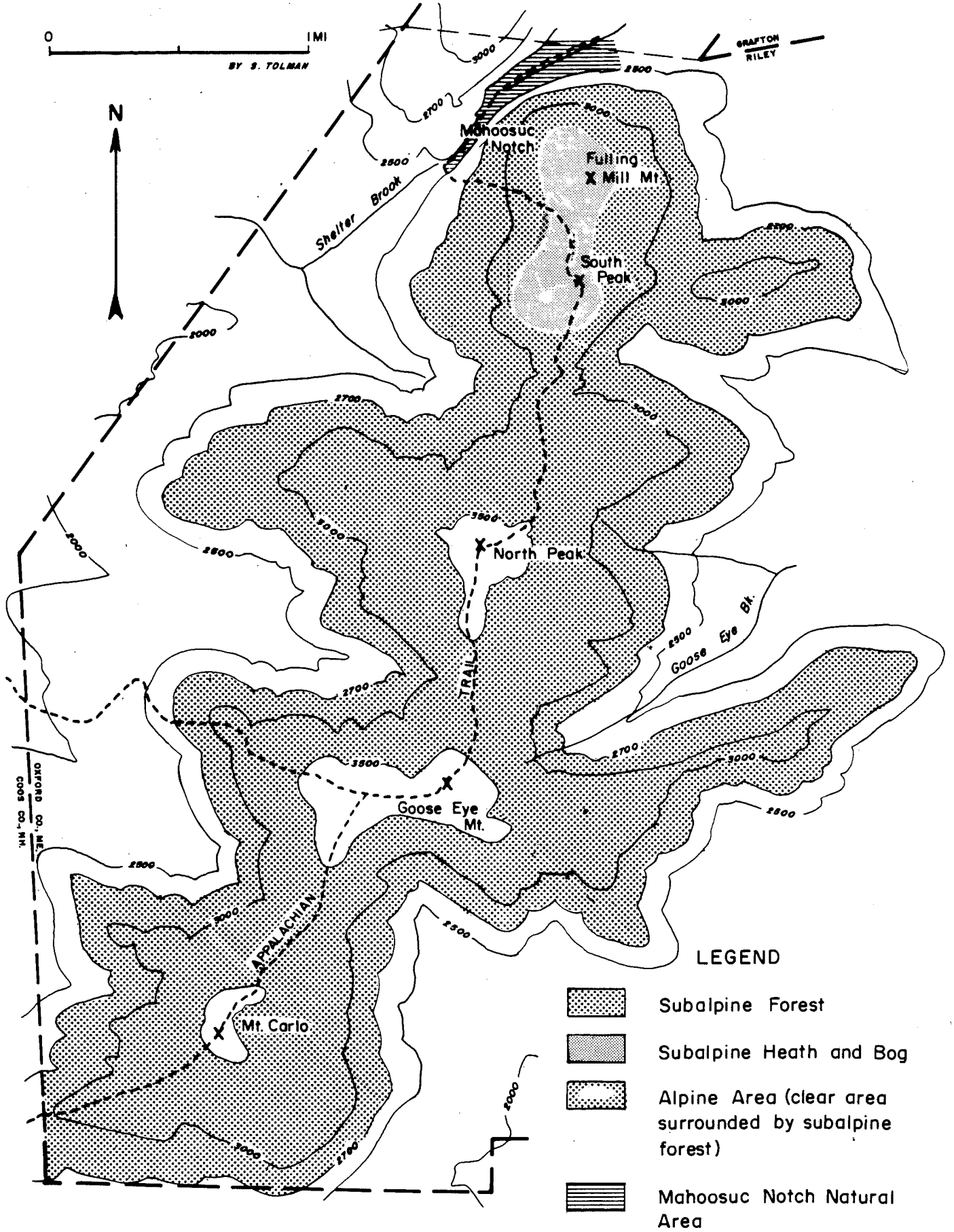


Figure 7. Fulling Mill Mountain, Goose Eye Mountain, and Mount Carlo

Literature Cited

Burke, I. 1982. The Mahoosuc Mountains, Oxford County, Maine: A Natural Areas Inventory and Management Statement. State Planning Office, Augusta, Maine.

Caljouw, C. & S. Roeske. 1981. A Natural Resource Inventory and Critical Areas Survey of Bigelow Preserve. State Planning Office, Augusta, Maine.

Campbell, C.S. and L.M. Eastman. 1979. Contributions to the vascular flora of Oxford County, Maine. Rhodora 80:309.

_____ 1980. Flora of Oxford County, Maine. Life Sciences and Agricultural Experiment Staton, Univ. of Maine at Orono, Tech. Bull. 99.

Fahey, T.J. 1975. The vegetation of a heathbald in Maine. Bull. Torr. Bot. Club 103:23-29.

Grena, J. 1981. A preliminary report on natural old-growth forest stands in Maine. Critical Areas Program of the State Planning Office, Augusta, ME.

Hudson, W.D., Jr, R. Cannarella, L. Garnett, and K. Huntington. 1985. Old-growth Forest, Subalpine Forest, and Alpine Areas in Baxter State Park. State Planning Office, Augusta, Maine.

May, D.E. and R.B. Davis. 1978. Alpine tundra vegetation on Maine mountains and its relevance to the Critical Areas Program of the State Planning Office. Planning Report No. 36, State Planning Office, Augusta, Maine.

State Planning Office. 1983. Natural old-growth stands in Maine and its relevance to the Critical Areas Program of the State Planning Office. Planning Report No. 79, Augusta, Maine.

Stone, A.D. 1980. Avery Peak on Bigelow Mountain, Maine: The Flora and Vegetation Ecology of a Subalpine Heathland. Dissertation. Univ. of Vermont, Burlington, Vt., USA.

Worley, I.A. 1981. Maine Peatlands: their abundance, ecology, and relevance to the Critical Areas Program of the State Planning Office. Planning Report No. 73. State Planning Office, Augusta, Maine and Bull. 687, Vt. Agric. Exp. Sta.

References

Adamus, P.R. 1978. The natural regions of Maine. Critical Areas Program, Augusta, Maine.

Antevs, E. 1932. Alpine zone of Mt. Washington Range. Merrill and Webber, Auburn, Maine.

Avery, M.H. 1945. Maine's second mountain. Appalachia 99:308-319.

Billings, W.D. and H.A. Mooney. 1968. The ecology of arctic and alpine plants. Biol. Rev. 43:481-529.

Bliss, L.C. 1963a. Alpine plant communities of the Presidential Range, New Hampshire. Ecology 44:678-697.

_____ 1963b. Alpine zone of the Presidential Range. L.C. Bliss; Urbana, Il.

_____ 1966. Plant productivity in alpine microenvironments on Mt. Washington, New Hampshire. Ecol. Monog. 36:125-155.

_____ 1969. Alpine community patterns in relation to environmental parameters. In: K.N.H. Greenridge (ed.), Essays in plant geography and ecology. Nova Scotia Museum. Halifax.

_____ and G.G. Woodwell. 1965. An alpine podzol on Mt. Katahdin, Maine. Soil Sci. 100:274.

Bockheim, J.G. and R.A. Struchtemeyer. 1969. Alpine soils on Saddleback Mountain, Maine. Maine Agricultural Station Technical Bulletin 35:1-16.

Braun, E.L. 1950. Deciduous forests of eastern North America. Blakiston,

Philadelphia.
Chernovetsky, J. 1979. Effective management of an uncontrolled hiking system - the Mahoosuc Range. Dissertation. Penn. State, College Station, Pa., USA.
Critical Areas Program. 1981a. Preliminary Critical Area Survey of the Appalachian Trail in Maine. State Planning Office, Augusta.
_____ 1981b. Rare Vascular Plants of Maine. State Planning Office, Augusta.
Damman, A.W.H. 1964. Some forest types of central Newfoundland and their relation to environmental factors. For. Sci. Monog. 8.
_____ 1972. The effects of vegetation change on the fertility of a Newfoundland forest site. Ecol. Monog. 41:253-270
DiNunzio, M. 1972. A vegetational survey of the alpine zone of the Adirondack Mountains, New York. Dissertation. State Univ. of Forestry, Syracuse, New York, USA.
Doyle, R.G. (Ed.) 1967. Preliminary geologic map of Maine. Maine Geological Survey, Augusta.
ur, P.G., Jr. 1969. Evaluation of Mahoosuc Notch for eligibility for National Landmark designation. unpub. Natural History Survey, August, 1969.
Fernald, M.L. 1907. The soil preferences of certain alpine and subalpine plants. Rhodora 9:149-193.
_____ 1970. Gray's Manual of Botany (8th ed., corrected). D. von Norstrand, New York.
Forbes, C.B. 1958. Baldpate Mt., Grafton, Maine. Appalachia 32:234-239.
Gall, D.A. 1978. An evaluation of soils on the north and south slope of Cranberry Peak, Bigelow Mountain, Maine. Dissertation. Univ. of Maine, Orono, Maine, USA.
Gimingham, C.H. 1972. The ecology of heathlands. Chapman and Hall, London.
Gleason, H.A. and A. Cronquist. 1963. Manual of the Vascular Plants of Northeastern United States and Adjacent Canada. D. von Nostrand, New York.
Griggs, R.F. 1946. The timberlines of North America and their interpretation. Ecology 27:275-289.
Hanstedt, T. 1975. Mountain areas in Maine. Report No. 1. Critical Areas Program, State Planning Office, Augusta.
Harries, H. 1961. Alpine vegetation in the Presidential Range, New Hampshire in relationship to wind, snow cover and moving water. Bull. Ecol. Soc. Amer. 42:108.
_____ 1965. Soils and vegetation of the alpine belt of the Presidential Range. Dissertation. Rutgers Univ., Ne Bruswick, N.J., USA.
Harris, S. 1964. Mountain flowers of New England. Appalachian Mountain Club, Boston.
Harshberger, J.W. 1911. Phytogeographic Survey of North America. Engelmann, New York.
_____ 1919. Alpine fellfields of eastern North Ammerica. Geogr. Rev. 7:233-255.
_____ 1929. Preliminary notes on American snow patches and their plants. Ecol. 10:275-281.
Harvey, L.H. 1903a. An ecological excursion to Mt. Katahdin. Rhodora 5:41-52.
_____ 1903b. A study of the physiographic ecology of Mount Katahdin, Maine. U. Maine Studies #5.
_____ 1909. The floristic composition of the vascular flora of Mt. Katahdin, Maine. Mich. Acad. Sci. 11:37-47.
Hulten, E. 1937. Outline of the History of Arctic and Boreal Biota during the Quaternary. Stockholm.
_____ 1958. The Amphi-Atlantic Plants and Their Phytogeographic

Connections. Almquist & Wiksell, Stockholm.
_____ 1963. Phytogeographic connections of the north Atlantic. In A. Love & D. Love (Eds.). North Atlantic Biota and Their History. pp. 45-72. Pergammon Press, London.
_____ 1964. The Circumpolar Plants, Part I. Almquist & Wiksell, Stockholm.
_____ 1971. The Circumpolar Plants, Part II. Almquist & Wiksell, Stockholm.
Love, D. 1970. Subarctic aad subalpine: where and what? Arct. and Alp. Res. 2(1):63-73.
Marchand, P. 1972. Wind and the winter exposed plant. Rhodora 74:528-531.
_____ 1977. Subalpine bogs of the Mahoosucs - Physical Characteristics and Vegetation Development. Center for Northern Studies, Contr. 11, Wolcott, VT.
Martin, R.L. 1975. The yellow nosed vole in Maine. Maine Geogr. 8:9-12.
Monhan, R.S. 1933. Timberline. Appalachia 19:401-426.
Moore, P.D. and D.J. Bellamy. 1974. Peatlands. Springer-Verlag, New York.
Nicholson, S. and J.T. Scott. 1969. Slope aspect variation in the vascular plant species composition in the treeless community near the summit of Whiteface Mt., New York. In. Vegetation-environment relations at Whiteface Mountain in the Adirondack Mountains. Report 92, Atmospheric Research Center. State University of New York at Albany.
Rieger, S. 1974. Arctic soils. In: J.D. Ives amd R.G. Barry (eds.), Arctic and alpine environments. Methuen and Co., London.
Saviello, T.B. and R.A. Struchtemeyer. 1974. Soil and topographic features that predict the fragility of mountain systems in Maine. Dissertation. Univ. of Maine, Orono, Me., USA.
Savile, D.B.O. 1972. Arctic adaptations in plants. Mono. 6, Plant Research Inst., Ottawa.
Shaw, C.H. 1909. The causes of timberlines on mountains:the role of snow. Plant World 12:169-180.
Siccama, T.G. 1968. Altitudinal distribution of forest vegetation in relation to soil and climate on the slopes of the Green Mountains. Dissertation. Univ. of Vermont, Burlington, Vt., USA.
Small, E. 1972. Ecological significance of four critical elements in raised sphagnum peat bogs. Ecology 53:498-503.
Spencer, E., S. Surgenor, and R. Leonard. 1976. Backcountry research: The Mahoosuc laboratory. Appalachia 41(1):101-109.
Sprugel, D.G. 1974. Natural disturbance and ecosystem responses in wave-regenerated Abies balsamea forests. Dissertation. Yale University, New Haven, CT. USA
_____ 1976. Dynamic structure of wave-regenerated Abies balsamea forests in northeastern United States. J. of Ecology 64:889-911.
_____ 1984. Density, biomass, and nutrient-cycling changes during stand development in wave-regenerated balsam fir forests. Ecol. Monographs. 54(2):165-186.
_____ and F.H. Bormann. 1981. Natural disturbance and steady state in high-altitude balsam fir forests. Science 211:390-393.
Steele, F.L. 1961. Virgin Forests in the White Mountains. Appalachia, June, 1961.
Stern, R. 1976a. Biological significance of proposed trade area. Report to Appalachian Mountain Club, Gorham. Dec. 23, 1976.
_____ 1976b. Vegetation response to hiking pressure in boreal forest and heath balds in N.H. and Maine. Report to the Appalachian Mountain Club, Gorham.
_____ 1977. Plant communities of the Mahoosuc Range. Report to the

Appalachian Mountain Club, Gorham. November, 1977.

_____ 1979. Geocaulon lividum in the Mahoosuc Range. Rhodora 81:825.

Tarr, R.S. 1899. Glaciation of Mount Katahdin, Maine. Bull. Geol. Soc. of Am. 11:433-448.

Tiffney, W.N., Jr. 1972. Snow cover and the Diapensia lapponica habitat in the White Mountains, New Hampshire. Rhodora 74:358-377.

Vogelmann, H.W. 1974. Evaluation of the Bigelow Range, Somerset and Franklin Counties, Maine for eligibility for Registered National Landmark. Burlington, Vermont.

Warren-Wilson, J. 1959. Notes on wind and its effects in arctic-alpine vegetation. J. of Ecology 47:415-427.

Westveld, S. 1956. Natural forest vegetation zones of New England. Jour. of Forestry. 54(5):332-338.

Wynn-Edwards, V.C. 1937. Isolated arctic floras in eastern North America. Trans. Soc. Canada 31:320-351.

Appendix I. The vascular flora of the Bigelow Preserve and the Mahoosuc Range.

The following list of vascular plants is a compilation of the floras presented in previous inventories of the Bigelow Preserve (Caljouw & Roeske, 1981) and the Mahoosuc Range (Burke, 1982). The length of this list can be attributed to the work of Caljouw & Roeske (1981), who spent considerable time at low elevation in the Bigelow Preserve.

Burke (1982) lists two rare alpine species in her flora of the Mahoosuc Range for which there is no explanation in the text: Sibbaldia procumbens and Carex rariflora. The former has been previously noted from only one station on Mt. Washington in New Hampshire. The later was reported for Mt. Katahdin in 1856, but has not been seen there or anywhere else in Maine or New England since that time (Hudson, et al., 1985). Their presence in the Mahoosucs was not verified in 1985. They are included here with a caution. If they can be located and verified from the Mahoosucs they would rank amongst the rarest vascular plants in New England.

Nomenclature follows the 8th Edition (corrected) of Gray's Manual (Fernald, 1950). We have organized the families in the order placed them by Cronquist in The Integrated System of Classification of Flowering Plants (1981).

Family Genus/Species		Big 1985		Mahs 1985	
Equisetaceae					
Equisetum arvense	field horsetail	x	x		
Lycopodiaceae					
Lycopodium selago	fir clubmoss	x	x	x	x
Lycopodium clavatum	running clubmoss	x	x	x	x
Lycopodium complanatum	ground cedar	x	x	x	x
Lycopodium obscurum	ground pine	x	x		
Lycopodium lucidulum	shining clubmoss	x	x	x	
Lycopodium annotinum	bristly clubmoss	x	x	x	x
Isoetaceae					
Isoetes sp.	Merlin's grass	x			
Isoetes muricata	Merlin's grass		x		
Ophioglossaceae					
Botrychium matricariaefolium	grape fern	x			
Botrychium simplex	grape fern	x			
Botrychium virginianum	rattlesnake fern	x			
Osmundaceae					
Osmunda regalis	royal fern	x	x		
Osmunda cinnamomea	cinnamon fern	x	x		
Osmunda claytoniana	interrupted fern	x	x	x	x
Polypodiaceae					
Adiantum pedatum	maidenhair	x			
Dennstaedia punctilobula	hay-scented fern	x	x	x	x
Dryopteris campyloptera	mountain wood fern				x
Dryopteris cristata	crested fern	x			

Family / Genus/Species		Big 1985		Mahs 1985	
Dryopteris intermedia	intermediate wood fern	x	x		
Dryopteris marginalis	marginal wood fern	x	x		
Dryopteris novaboracensis	New York fern	x	x		
Dryopteris phegopteris	long-beech fern	x	x	x	x
Dryopteris spinulosa	spinulose wood fern	x	x	x	x
Dryopteris thelypteris	marsh fern	x	x		
Matteucia struthiopteris	ostrich fern	x			
Onoclea sensibilis	sensitive fern	x	x		
Polypodium virginianum	Polypody	x	x	x	x
Polystichum acrostichoides	Christmas fern	x	x		
Ptiridium aquilinum	bracken	x	x	x	x
Pinaceae					
Abies balsamea	balsam fir	x	x	x	x
Juniperus communis	ground juniper	x	x		
Larix laricina	larch	x	x	x	x
Picea mariana	black spruce	x	x	x	
Picea rubens	red spruce	x	x	x	x
Picea glauca	white spruce	x			
Pinus resinosa	red pine	x	x		
Pinus strobus	white pine	x	x	x	
Thuja occidentalis	eastern red cedar	x	x		
Nymphaeaceae					
Nuphar variegatum	bullhead lily	x	x	x	x
Nymphaea odorata	water lily	x			
Ranunculaceae					
Actaea rubra	red baneberry	x			
Anemone quinquefolia	wood anemone	x			
Coptis groenlandica	goldthread	x	x	x	x
Ranunculus acris	common buttercup	x			
Ranunculus reptans	creeping spearwort	x			
Thalictrum polygamum	tall meadow rue	x	x	x	x
Pappavaraceae					
Corydalis sempervirens	pale corydalis	x			
Hamamelidaceae					
Hamamelis virginiana	witch hazel	x	x		
Ulmaceae					
Ulmus americana	American elm	x	x		
Urticaceae					
Laportea canadensis	wood nettle	x			
Myricaceae					
Comptonia peregrina	sweet fern	x	x		
Fagaceae					
Fagus grandifolia	American beech	x	x		
Quercus rubra	red oak	x	x		
Betulaceae					
Betula allegheniensis	yellow birch	x	x	x	x
Betula papyrifera	paper birch	x	x	x	x

Family Genus/Species		Big 1985		Mahs 1985	
Betula papyrifera var. *cordifolia*	heart-leaved paper birch	x	x	x	x
Betula populifoia	gray birch	x	x		
Corylaceae					
Alnus crispa	mountain alder			x	x
Alnus rugosa	speckled alder	x	x		
Corylus cornuta	beaked hazelnut	x	x		
Ostrya virginiana	hop-hornbeam	x	x		
Chenopodiaceae					
Chenopodium album	pigweed	x			
Caryophyllaceae					
Arenaria groenlandica	mountain sandwort	x	x	x	x
Paronychia argyrocoma var. *albimontana*	silverling			x	x
Polygonaceae					
Polygonum aviculare	knotweed	x	x		
Polygonum hydropiper	common smartweed	x			
Polygonum sagittaum	tearthumb	x			
Rumex acetosella	sheep sorrel	x	x		
Hypericaceae					
Hypericum canadense	St. John's wort	x			
Hypericum ellipticum	St. John's wort	x			
Hypericum mutilum	St. John's wort	x			
Hypericum perforatum	St. John's wort	x			
Hypericum virginicum	marsh St. John's wort	x		x	
Tiliaceae					
Tilia americana	basswood	x	x		
Sarraceniaceae					
Sarracenia purpurea	pitcher plant	x			
Droseraceae					
Drosera intermedia	spatulate-leaved sundew	x			
Drosera rotundifolia	round-leaved sundew	x	x	x	x
Violaceae					
Viola adunca	hooked violet			x	
Viola cucullata	marsh blue violet			x	
Viola incognita	unknown violet				x
Viola pallens	pale violet	x			
Viola renifolia	kidney-leaved violet	x			
Viola rotundifolia	round-leaved violet	x			
Viola septentrionalis	northern blue violet	x			
Salicaceae					
Populus balsamifera	balsam poplar	x			
Populus grandidentata	large-leaved poplar	x	x		
Populus tremuloides	quaking aspen	x	x		
Salix bebbiana	Bebb's willow	x	x		
Salix discolor	large pussy willow	x			
Salix lucida	shining willow	x			
Salix sericea	silky willow	x			

Family Genus/Species		Big 1985		Mahs 1985	
Cruciferae					
Capsella bursa-pastoris	beggar's purse	x	x		
Cardamine pensylvanica	bittercress	x			
Ericaceae					
Andromeda glaucophylla	bog rosemary	x			
Chamaedaphne calycullata	leatherleaf	x	x	x	x
Epigaea repens	trailing arbutus	x	x		
Gaultheria hispidula	snowberry	x	x	x	x
Gaultheria procumbens	wintergreen	x	x	x	x
Kalmia angustifolia	sheep laurel	x	x	x	x
Kalmia polifolia	bog laurel	x	x	x	x
Ledum groenlandicum	Labrador tea	x	x	x	x
Rhododendron canadense	Rhodora	x	x	x	x
Vaccinium angustifolium	low sweet blueberry	x	x	x	x
Vaccinium cespitosum	dwarf bilberry	x	x		
Vaccinium corymbosum	highbush blueberry	x	x		
Vaccinium macrocarpon	large cranberry	x			
Vaccinium myrtilloides	velvet-leaf blueberry	x	x	x	x
Vaccinium oxycoccus	bog cranberry	x	x	x	x
Vaccinium uliginosum	alpine bilberry	x	x	x	x
Vaccinium vitis-idaea	mountain cranberry	x	x	x	x
Empetraceae					
Empetrum atropurpureum	purple crowberry	x	x		
Empetrum nigrun	black crowberry	x	x	x	x
Pyrolaceae					
Chimaphila umbellata	pipsissewa	x			
Moneses uniflora	one-flowered wintergreen	x			
Monotropa uniflora	Indian pipe		x	x	x
Pyrola asarifolia	pink wintergreen	x			
Pyrola elliptica	shinleaf	x	x		
Pyrola secunda	one-sided pyrola	x			
Diapensiaceae					
Diapensia lapponica	Diapensia			x	x
Primulaceae					
Lysimachia ciliata	loosestrife	x			
Lysimachia quadrifolia	loosestrife	x			
Lysimachia thyrsifolia	tufted loosestrife	x			
Trientalis borealis	star flower	x	x	x	x
Crassulaceae					
Sedum purpureum	live-forever	x			
Saxifragaceae					
Chrysosplenium americanum	water-mat	x	x		
Mitella nuda	miterwort	x			
Ribes glandulosum	skunk currant	x	x	x	x
Ribes lacustre	swamp black currant			x	x
Tiarella cordifolia	foamflower	x			
Rosaceae					
Agrimonia gryposepala	cocklebur	x			

Family Genus/Species		Big 1985		Mahs 1985	
Amelanchier bartramiana	mountain juneberry	x	x	x	x
Amelanchier laevis	shadbush	x			
Dalibarda repens	false violet	x			
Geum rivale	avens	x			
Fragaria virginiana	wild strawberry			x	
Potentilla argentea	silvery cinquefoil	x			
Potentilla arguta	tall cinquefoil	x			
Potentilla norvegica	rough cinquefoil	x	x		
Potentilla palustris	marsh five-finger	x			
Potentilla simplex	old-field cinquefoil	x			
Potentilla tridentata	three-leaved cinquefoil	x	x	x	x
Prunus pensylvanica	wild red or pin cherry	x	x	x	x
Prunus virginiana	chokecherry	x	x		
Pyrus americana	mountain ash		x	x	x
Pyrus decora	mountain ash	x		x	
Pyrus floribunda	purple chokeberry	x			
Rubus chamaemorus	cloudberry			x	x
Rubus idaeus	raspberry	x	x	x	x
*Sibbaldia procumbens	Sibbaldia			x	
Spiraea latifolia	meadow sweet	x	x	x	x
Spiraea tomentosa	steeple-bush	x	x		
Leguminosae					
Trifolium agrarium	hop clover	x	x		
Trifolium pratense	red clover		x		
Vicia cracca	tufted vetch	x			
Onagraceae					
Circaea alpina	enchanter's nightshade	x	x		
Epilobium angustifolium	fireweed	x	x	x	x
Epilobium glandulosum	willowherb	x			
Epilobium palustre	marsh willowherb			x	
Oenothera biennis	evening primrose	x	x		
Oenothera perennis	evening primrose	x			
Cornaceae					
Cornus alternifolia	green osier	x	x		
Cornus canadensis	bunchberry	x	x	x	x
Cornus amomum	red willow	x			
Cornus rugosa	round-leaved dogwood	x			
Cornus stolonifera	red osier	x	x	x	
Santalaceae					
Geocaulon lividum	northern Commandra			x	x
Aquifoliaceae					
Ilex verticillata	black alder	x	x		
Nemopanthes mucronata	mountain holly	x	x	x	x
Aceraceae					
Acer pensylvanicum	striped maple	x	x	x	x
Acer rubrum	red maple	x	x	x	x
Acer saccharum	sugar maple	x	x	x	x
Acer spicatum	mountain maple	x	x	x	x

Family Genus/Species		Big 1985		Mahs 1985	
Anacardiaceae					
Rhus typhina	velvet sumac	x			
Oxalidaceae					
Oxalis montana	common wood-sorrel	x	x	x	x
Araliaceae					
Aralia nudicaulis	wild sarsaparilla	x	x	x	x
Umbelliferae					
Carum carvi	caraway	x			
Cicuta bulbifera	water hemlock	x			
Daucus carota	wild carrot	x	x		
Hydrocotyle americana	water pennywort	x			
Sium suave	water parsnip	x			
Gentianaceae					
Menyanthes trifoliata	bog bean	x			
Asclepiadaceae					
Asclepias incarnata	swamp milkweed	x			
Solanaceae					
Solanum dulcamara	nightshade	x	x		
Verbenaceae					
Verbena hastata	blue vervain	x			
Labiatae					
Lycopus uniflorus	water horehound	x	x		
Lycopus virginicus	water horehound	x			
Mentha arvensis	mint	x			
Prunella vulgaris	heal-all	x	x	x	x
Scutellaria epilobifolia	common skullcap	x			
Callitrichaceae					
Callitriche palustris	water starwort	x	x		
Plantaginaceae					
Plantago major	common plantain	x	x		
Scrophulariaceae					
Chelone glabra	balmony or turtlehead	x			
Lindernia dubia	false pimpernel	x			
Melampyrum lineare	cow-wheat			x	x
Veronica americana	American brooklime	x			
Veronica officinalis	common speedwell	x	x		
Veronica serpyllifolia	thyme-leaved speedwell	x			
Orobanchaceae					
Epifagus virginiana	beech drops	x			
Oleaceae					
Fraxinus americana	white ash	x	x		
Fraxinus nigra	black ash	x			
Lentibulariaceae					
Utricularia cornuta	bladderwort	x			
Campanulaceae					
Campanula aparinoides	marsh bellflower	x			
Campanula rotundifolia	harebell	x			
Lobelia dortmanna	water lobelia	x			

Family Genus/Species		Big 1985		Mahs 1985	
Lobelia inflata	Indian tobacco	x	x		
Rubiaceae					
Cephalanthus occidentalis	buttonbush	x			
Galium asprellum	rough bedstraw	x			
Galium tinctorium	bedstraw	x			
Mitchella repens	partridge berry	x	x		
Caprifoliaceae					
Diervilla lonicera	bush honeysuckle	x	x	x	x
Linnaea borealis	twinflower	x	x	x	x
Lonicera villosa	mountain fly honeysuckle			x	
Sambucus canadensis	common elder	x	x		
Sambucus pubens	red-berried elder	x	x	x	x
Viburnum alnifolium	hobblebush	x	x	x	x
Viburnum edule	squashberry		x	x	
Viburnum cassinoides	wild raisin	x	x	x	x
Viburnum lentago	sweet viburnum	x			
Viburnum recognitum	arrowwood	x	x		
Viburnum trilobum	highbush cranberry	x	x		
Compositae					
Achillea millifolium	yarrow	x	x		
Anaphalis margaritacea	pearly everlasting			x	x
Artemesia vulgaris	common mugwort	x			
Aster acuminatus	whorled-wood aster	x	x	x	x
Aster cordifolius	heart-leaved aster	x			
Aster macrophyllus	large-leaved aster	x			
Aster nemoralis	bog aster	x	x		
Aster radula	aster	x			
Aster spp.	aster			x	
Bidens frondosa	beggar's tick	x			
Chrysanthemum leucanthemum	ox-eye daisy	x	x		
Cirsium vulgare	bull thistle	x	x		
Eupatorium maculatum	Joe-pye weed	x	x		
Gnaphalium uliginosum	low cudweed	x			
Hieracium auranticum	orange hawkweed	x	x		
Hieracium paniculatum	hawkweed	x			
Hieracium scabrum	hawkweed	x			
Lactuca biennis	lettuce	x			
Megalodonta beckii	water marigold	x			
Prenanthes altissima	tall rattlesnake root			x	x
Prenanthes boottii	Boott's rattlesnake root	x		x	
Solidago cutleri	alpine goldenrod	x	x	x	x
Solidago macrophylla	large-leaved goldenrod		x	x	x
Tussilagp farfara	coltsfoot	x			
Alismataceae					
Alisma subcordatum	water plantain	x			
Sagittaria cuneata	wapato	x			
Sagittaria latifolia	duck potato	x			

Family Genus/Species		Big 1985		Mahs 1985	
Zosteraceae					
Potomogeton epihydrus	pondweed	x			
Potomogeton perfoliatus	pondweed	x			
Potomogeton sp.	pondweed		x		
Araceae					
Acorus calamus	sweetflag	x			
Calla palustris	wild calla	x			
Iridaceae					
Sisyrinchium montanum	blue-eyed grass	x			
Iris versicolor	blue flag	x	x		
Eriocaulaceae					
Eriocaulon septangulare	duckgrass	x			
Juncaceae					
Juncus brevicaudatus	short-tailed rush	x	x	x	x
Juncus bufonius	toad rush	x			
Juncus canadensis	Canadian rush	x		x	
Juncus effusus	soft rush	x			
Juncus pelocarpus	rush	x			
Juncus tenuis	path sedge	x	x		
Juncus trifidus	highland rush	x	x	x	x
Luzula parviflora	small-flowered woodrush			x	
Luzula acuminata	woodrush	x			
Cyperaceae					
Carex arctata	drooping wood sedge	x	x	x	x
Carex bigelowii	Bigelow's sedge	x	x	x	x
Carex brunnescens	brownish sedge	x	x		
Carex cannescens	silvery sedge	x	x	x	
Carex crinita	long-haired sedge	x			
Carex debilis	slender-stalked sedge	x	x	x	
Carex deflexa	sedge	x			
Carex disperma	two-seeded sedge	x			
Carex flava	yellowish sedge	x			
Carex intumescens	inflated sedge	x	x	x	x
Carex lurida	sallow sedge	x			
Carex pauciflora	few-flowered sedge	x		x	
Carex paupercula	very depauperate sedge	x	x	x	x
Carex plantaginea	plantain-like sedge	x			
*Carex rariflora	few-flowered sedge			x	
Carex retrorsa	sedge	x			
Carex scoparia	sedge	x			
Carex stipata	sedge	x			
Carex trisperma	three-seeded sedge	x	x	x	x
Carex viridula	sedge	x			
Eleocharis acicularis	spike rush	x			
Eleocharis palustris	spike rush	x			
Eriophorum angustifolium	cotton grass	x			
Eriophorum spissum	cotton grass	x	x	x	x
Eriophorum virginicum	cotton grass	x			

Family Genus/Species		Big 1985		Mahs 1985	
Scirpus atrocinctus	wool grass	x	x	x	x
Scirpus cespitosus	deer's hair			x	x
Scirpus rubrotinctus	bulrush	x			
Scirpus validus	bulrush	x			
Gramineae					
Agrostis alba	white bentgrass	x			
Agrostis borealis	boreal bentgrass	x	x	x	x
Agrostis tenuis	Rhode Island bent	x			
Brachyeletrum erectum	bearded short husk			x	
Bromus ciliatus	brome grass	x			
Calamagrostis canadensis	blue joint	x	x	x	x
Cinna arundinacea	wood reedgrass	x			
Cinna latifolia	drooping woodreed		x		
Dactylis glomerata	orchard grass	x			
Danthonia spicata	poverty grass	x	x		x
Deschampsia flexuosa	crinkled hairgrass	x	x	x	x
Elymus sp.	wild rye			x	
Glyceria canadensis	rattlesnake grass	x	x		
Hierocloe alpina	sweet grass	x	x	x	x
Leersia oryzoides	rice cutgrass	x	x		
Oryzopsis asperifolia	mountain rice	x	x		
Panicum boreale	northern panic grass	x	x		
Phleum pratense	timothy	x	x		
Poa compressa	Canada bluegrass		x		
Poa pratensis	Kentucky bluegrass	x	x		x
Sparganiaceae					
Sparganium angustifolium	bur-reed	x	x		
Sparganium chlorocarpum	bur-reed	x			
Typhaceae					
Typha latifolia	cattail	x	x		
Pontederiaceae					
Pontederia cordata	pickerelweed	x	x		
Liliaceae					
Clintonia borealis	blue bead lily	x	x	x	x
Lilium canadense	Canada lily	x			
Maianthemum canadense	Canada mayflower	x	x	x	x
Medeola virginiana	Indian cucumber root	x	x	x	x
Polygonatum pubescens	Solomon's-seal	x	x		
Smilacina racemosa	false spikenard	x	x	x	x
Streptopus amplexifolius	white mandarin	x	x	x	x
Streptopus roseus	rose-twisted stalk	x	x	x	x
Trillium erectum	stinking Benjamin	x	x	x	x
Trillium undulatum	painted Trillium	x	x	x	x
Uvularia sessilifolia	wild oats	x	x	x	x
Orchidaceae					
Calopogon pulchellus	grass pink	x			
Corallorhiza maculata	spotted coral-root	x			
Cypripedium acaule	mocassin flower	x	x		

Family

Genus/Species		Big 1985		Mahs 1985	
Goodyera repens	dwarf rattlesnake plantain	x	x	x	x
Goodyera tesselata	rattlesnake plantain	x			
Habenaria hyperborea	northern green orchis	x			
Habenaria viridis	frog orchis	x			
Listera auriculata	auricled twayblade	x			
Listera convallariodes	broad-lipped twayblade	x			
Listera cordata	heartleaf twayblade	x			
Pogonia ophioglossoides	beard flower	x			
Spiranthes cernua	nodding lady's tresses	x			

* Recorded by Burke (1982), Appendix 1, but with no discussion in the text, nor any reference to photographs or vouchers. If verified, these two plants would count amongst the rarest in New England.