

ACADIA NATIONAL PARK
RESOURCE MANAGEMENT DIVISION

THE ECOLOGY OF SUB-ALPINE PLANT COMMUNITIES
OF THE SUMMITS OF ACADIA NATIONAL PARK

A draft proposal submitted by:

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August 28, 1991

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INTRODUCTION

The flora of mountain summits in Acadia National Park is mostly known, although most recent work focuses on documenting presence of individual species rather than characterizing plant communities associated with the summits (Greene, 1990; Feeley and Drury, 1980; Wise, 1970; Rand and Redfield, 1894)). Two works documenting plant communities of Mount Desert Island have been published. Moore and Taylor (1927) described various plant associations in relation to successional stages of plant community development; and Kuchler (1956) developed a vegetation map of southeastern Mount Desert Island.

No studies have quantitatively sampled summit vegetation in Acadia National Park or investigated factors affecting their distribution. A better understanding of community ecology of summit vegetation will greatly assist the National Park Service in providing for long-term preservation of the summit flora.

Recreational use of alpine and sub-alpine mountain areas increased dramatically in the 1970's in New York, Vermont, New Hampshire, and Maine (Doucette and Kimball, 1990). In many areas hikers using recreational trails often wander off the trails, trampling vegetation and causing extensive erosion (Synder, 1974; Willard and Marr, 1970). Many alpine and sub-alpine plants cannot withstand extensive trampling and for this reason summit plant communities have been degraded (ref). Visitor impact has altered species composition within summit plant communities throughout New England (Johnson, pers. comm.). Conversely, A 24-year comparison of the vegetation in a permanent plot receiving no visitor impact on an Adirondack mountain summit showed that species composition did not change significantly (Ketchledge and Leonard, 1984).

The National Park Service is concerned that visitor use of some summit areas may be adversely affecting the flora which includes sub-alpine and alpine species rare in Maine or rare in the Park. (Acadia National Park Natural Resource Management Plan, 1990). Table 1 lists summit species rare or uncommon in Acadia National Park, including all state listed species.

On Cadillac Summit, for example, one of the most visited sites in the Park, visitors often stray from the concrete path around the summit and roam freely across the summit. Visitors have also created "social" trails by building cairns around many

of the summits. This is especially apparent on Penobscot and Sargent mountains where many visitors leave Park-designated trails to follow social trails, trampling vegetation and hastening erosion.

SUMMIT PLANT SPECIES RARE OR UNCOMMON IN ACADIA NATIONAL PARK

Table 1.

SPECIES	STATE/LOCAL STATUS
1. <u>Amelanchier bartramiana</u>	Locally Rare
2. <u>Asplenium tricomane</u> s	Locally Rare
3. <u>Calamagrostis stricta</u> subsp. <u>inexpansa</u>	Threatened
4. <u>Carex buxbaumii</u>	Locally Rare
5. <u>Carex houghtonii</u>	Locally Rare
6. <u>Corema conradii</u>	Watch List
7. <u>Cystopteris fragilis</u>	Locally Rare
8. <u>Juncus secundus</u>	Locally Rare
10. <u>Lycopodium selago</u>	Special Concern
11. <u>Minuartia groenlandica</u>	Watch List
12. <u>Oryzopsis canadensis</u>	Locally Rare
13. <u>Oryzopsis pungens</u>	Locally Rare
14. <u>Prunus depressa</u>	Locally Rare
15. <u>Quercus ilicifolia</u>	Locally Rare
16. <u>Selaginella rupestris</u>	Locally Rare

adapted from Greene 1990

This list includes species that are not significantly rare at state or federal levels but that were identified as rare by Rand and Redfield (1894), overlooked by them and reported by Stebbins (1929), or shown by Greene (1990) to be less common than previously believed.

OBJECTIVES

The objectives of this study are to: 1) characterize summit vegetation in terms of community associations and map distribution of these communities; 2) identify factors which affect the composition and distribution of summit vegetation; 3) determine if summit vegetation is being affected by recreational use; and 4) examine management alternatives which might alleviate human pressures on affected areas.

BACKGROUND

Considerable work has been done elsewhere in New England describing plant communities and associated species on mountain summits (Cogbill and Hudson, 1990; Vogelmann et al., 1989; May and Davis, 1978; Bliss, 1963). A landmark work of this type in the Northeast was by Bliss (1963), who identified 9 community types occurring in the Presidential Range Alpine Area of New Hampshire and explained factors contributing to their formation, composition and distribution. ***see deleted paragraph. These include edaphic factors (e.g. soil depth, moisture and chemistry), climatic factors (e.g. summer humidity, fog, snow depth, wind speed, wind direction), and geographic factors (e.g., slope, aspect, elevation) (Bliss, 1963). Anthropogenic factors such as the impact of recreational use may significantly alter the distribution and composition of these communities (Doucette and Kimball, 1990; Streeter, DATE).

May and Davis (1978) used Bliss's community classification to describe alpine tundra communities on 8 mountains in Maine. Cogbill and Hudson (1990) studied areas above treeline on Mt. Katahdin and described five community types and typical associated species, essentially revising the work done on Katahdin by May and Davis (1978).

Mountain summits in Acadia National Park are significantly lower in elevation than those in the aforementioned studies, however they support unique plant communities including species best described as sub-alpine, although some alpine species also occur there. These include Lycopodium selago (alpine clubmoss), Minuartia groenlandica (mountain sandwort), Scirpus cespitosus (deer grass) and Vaccinium vitis-idaea var. minus (mountain cranberry) (Greene, 1990).

Moore and Taylor (1927) described various plant associations on Mount Desert Island and measured environmental factors relating to their presence. They write, "We have endeavored merely to measure with simple instruments some of the climatic and soil factors, and to describe the vegetation, with particular reference to the different types of forest and the plants associated with each type". Their work contains a vegetation map of the island with 8 types of forest communities, marsh, bog and

rock communities, and burns. They also investigated developmental or successional trends in the island's plant communities. They list an association 13 "pioneer herb and low shrub" species, in order of their frequency, inhabiting "drier rocky sites". They also describe an association of "secondary herbs and low shrubs" often found in conjunction with the pioneer community. Both these types of plant associations are dominant on the summits of Mount Desert Island today.

Kuchler (1956) mapped the southeastern portion of Mount Desert Island "in an attempt to contribute to solutions" to various problems arising in the rapidly evolving field of vegetation mapping. He focused on vegetation classification and how to accurately map plant communities. He mapped the area from Somes Sound east and from what is now Rt. 233 south at 1:25,000 and recorded the physiognomy and floristic composition of each plant community present. He classifies many of the mountain summits in this region as sub-alpine. The work contains 3 color maps: a vegetation map, a physiognomic map and a combined physiognomic and vegetation map. A transparent map of species grouped into communities is also included and can be overlayed onto the color maps. Corresponding plant lists, field observations and notes on plant community distribution are included.

STUDY DESIGN

a. Site Selection

There are 34 summits over 300 feet in elevation in Acadia National Park. On Mount Desert Island 7 mountains summits rise over 1,000 feet in elevation. We will study these 7 highest summits on MDI, 2 summits in the Park on Isle au Haut, and the 1 summit on Schoodic Peninsula. These are:

Mt. Desert Island

- Bernard Mt. (326.44 m/1071 ft.)
- Cadillac Mt. (466.34 m/1540 ft.)
- Champlain Mt. (322.48 m/1058 ft.)
- Dorr Mt. (387.1 m/ 1270 ft.)
- Pemetic Mt. (391.36 m/1284 ft.)
- Penobscot Mt. (363.93 m/1194 ft.)
- Sargent Mt. (418.49 m/1373 ft.)

Schoodic Peninsula

- Schoodic Head (134.11 m/440 ft.)

Isle au Haut

- Duck Harbor Mt. (91.44 m/300 ft.)
- Jerusalem Mt. (123.44 m/405 ft.)

Species and communities present and apparent level of visitor use (light, moderate, heavy) will be collected on the ten summits listed above. Champlain, Cadillac and Pemetic summits will be the focus of more intensive investigations of natural and anthropogenic causes of distribution patterns of plant communities. A meteorology station will be installed on Cadillac summit to collect climatic data including wind speed and direction, relative humidity, precipitation, and temperature.

b. Species Lists and Preliminary Distribution Maps

We will characterize and describe vegetation communities on each of the ten summits and compile list of all vascular plant species found above the 300 m (1000 ft.) contour line for the Mount Desert summits and 75 m (229 ft.) for Schoodic Peninsula and Isle au Haut. Preliminary distribution maps of the plant communities will be developed through initial visits to the sites. Additional site visits will be made during periods of flowering to finalize species lists and mapping.

c. Belt Transects

Four line transects will be established on Cadillac, Champlain, and Pemetic summits to determine the distribution and composition of plant communities, the factors which influence their distribution and evaluate where visitor impact occurs. Transects, permanently for relocation (marked by drilling a small plug in the rock and painting it), will run from the summit (highest elevation or a permanently marked point nearby) north, south, east and west (true direction) and end either at the 300 m contour or 20 m into treeline (forest vegetation but not a forest pocket). Transects will generally divide summits into quarters (see appendix 1). Species present, cover class (including extent of bare rock and gravel), soil depth and type will be measured within each m^2 every fifth meter starting at m 0 along the right side as you look down the transect from the summit a distance of 500m. Presence of a Park-designated trail within each m^2 will be

noted as well as the level of visitor impact defined as none, light or heavy (see sample data sheet appendix 2). From the 500m mark to the 300m contour line the same measurements will be taken every 25th meter. In addition, soil samples will be collected, one at each summit and one at the 500 m mark on each transect, and chemically analyzed to determine soil composition. Lastly, photographs will be taken from the 4 principal compass bearings, looking down the transects.

d. Long-Term Monitoring Plots

A pair of 10 x 10 m plots, permanently marked for relocation, will be established in each identified major community type on each of the three summits to monitor visitor impact and long-term change in an intensive manner. Each pair of plots will be positioned away from the line transects, one straddling an existing Park designated trail, the second, a control plot positioned at the same elevation and aspect, but away from significant visitor impact. Each plot will be carefully mapped. Both natural and anthropogenic data will be collected within 10 m² plots within the larger plots. Natural factors include: species, number of stems and height; edaphic factors include: soil depth, moisture and type; and climatic factors include: wind speed and direction, precipitation, presence of ice, snow depth and date of snow melt. Anthropogenic factors measured will include: visitor impact, and changes within the plot. (need to be more specific here re anthropogenic data?)

ANALYTICAL METHODS

An ordination analysis (ref.) will be conducted to verify community associations and a standard regression analysis will be used to describe relationships between edaphic, geographic, and visitor use data and the distribution and composition of plant species within communities. Mary - can you fill this in more? Then we will talk with Halterman at UMO.

GIS MAPPING

The Park's geographic information system (GIS) which uses an ARC-INFO digital format will be used to define and map summit areas and associated plant communities and species present. A vegetation map delineated from color infra-red aerial photos (1979) is already in the GIS. We will ground truth this data and relate it to plant communities present on the summits. Transects and permanent plot locations will be entered into the GIS. Field data will be stored in a d-Base format which can interface with ARC-INFO. Scale?

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DELETE THIS? : These types include: 1) a Diapensia type found on exposed sites with little winter snow and include Diapensia lapponica, Juncus trifidus, Vaccinium uliginosum, Solidago culteri; 2) a dwarf shrub heath with Juncus trifidus, Potentilla tridentata, Vaccinium vitis-idaea var. minus; 3) a dwarf shrub heath where deep snow melts with Vaccinium uliginosum, Ledum groenlandicum, Vaccinium vitis-idaea var. minus, and Cornus canadensis; 4) a dwarf shrub heath where snow melts late in the season with Deschampsia flexuosa, Vaccinium caespitosum, Solidago macrophylla, Carex bigelowii; 5) a sedge-rush-dwarf shrub heath with Carex bigelowii, Potentilla tridentata, Vaccinium vitis-idaea var. minus, Juncus trifidus; 6) sedge-dwarf shrub heath with Carex bigelowii, Arenaria groenlandica, Vaccinium vitis - idaea var. minus, Juncus trifidus; 7) a sedge meadow at the highest elevations with Carex bigelowii, Arenaria groenlandica; 8) streamsides with Salix uva-ursi, Geum peckii, Carex scirpoidea, Scirpus cespitosus, and 9) bogs at lower elevations with Carex bigelowii, Scirpus cespitosus, Betula glandulosa, Kalmia polifolia.