

# Mountain Biogeography Project

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## Objectives

This study is designed to address three primary objectives. The first is to gather, through field sampling and existing literature, basic biogeographic data for Mt. Mansfield, resulting in a plant association map. The second objective is to begin long term monitoring of selected physical environmental parameters on the mountain and detailed floristic data, within ten long term study sites. The third objective is to conduct a series of experimental research projects designed to further understanding of the contemporary physical environments and biotic distributions on Mt. Mansfield.

## Methods

The research began in June, 1991 and continues, the expected duration of the project being many years. Field sampling of the flora follows two plans. Within the 50 x 50 meter long-term study sites, floristic data, as frequency for all species, are gathered in a restricted randomized array of fixed quadrats at least every second year for the period of the study. Observations of soil properties, local geomorphology, and microclimatic conditions are also to be monitored as possible in long term sites.

The sampling design for the broader biogeographic investigation of the floristic composition of the vegetation of the summit and western slopes of Mt. Mansfield follows a random sampling scheme stratified by elevation. The vegetation of the summit (alpine tundra) area is to be examined within a randomized quadrat array of higher sample frequency, so that the results are suitable for both ecological analyses and mapping purposes.

Spatial control is comprised of site markers for fixed quadrats, and GPS data at each vegetation sample site. These data, phrased as UTM and VT state plane coordinates, provide the linkage required for remote sensing image analysis, which is the basis for the extended plant association mapping, beyond intensively sampled areas of the mountain.

## Provisional Results

### *Biogeographic Data*

Higher vascular plants (357 vouchers) and the cryptogamic flora (98 vouchers) from the montane forest on the western slopes of Mt. Mansfield were sampled using a restricted random model. At twenty one sites, located at 200 foot AMSL elevation intervals on existing trails, belt transects of twenty five square meters were positioned upslope from the trail, and begun at a five-meter distance from the trail. Within each transect, comprehensive presence/absence data were collected for all visible species of the higher vascular flora and also for cryptogams. At two random locations along each transect, quadrats of one square meter were positioned and frequency data for all visible species gathered; 42 quadrats were assessed in this manner. At a third random location on each belt transect, a ten-meter diameter sample area for tall shrubs and trees was positioned; the data acquired in these samples included stem counts by species for each dbh class, by quarters.

Determinations of all but a few higher vascular vouchers has been completed. Determinations of cryptogam vouchers are complete. All herbarium collections and vouchers are housed in the Geography Department at Middlebury College.

### *Long Term Studies.*

The locations of seven of the ten long term monitoring sites planned for the summit and western side of the mountain have been determined, although the corner markers and UTM coordinates will not be established until late May, 1992. One site has been authorized at the University of Vermont Proctor Maple Research Center and its location at about 1400 feet AMSL will serve as the base of the transect. Two sites have been fixed in the Alpine tundra zone, with approval of the University of Vermont (Natural Areas Program) near the chin and just below the west chin. Four additional sites have been located in the upper and lower krummholz zone on Sunset Ridge. The locations of these and three additional long term sites will be determined by GPS survey early in the 1992 field season.

### *Experimental Research.*

Three experimental projects were undertaken this year: 1) to examine the freezing temperatures and microclimate in the krummholz zone, 2) to determine the coniferous foliar and soil nutrient status on an elevation gradient on the western slopes of Mansfield, and 3) to measure variations with elevation, of the accretion of rime ice on Sunset Ridge.

1) Research designed to clarify the relations between the freezing of *Abies balsamea* tissues and ambient air temperature was conducted in the krummholz zone on the west chin through the fall and early winter. Internal twig temperatures and corresponding air temperature controls were monitored from October through December at 6-second intervals, to identify the freezing exotherm and monitor its response to cyclic temperatures through the season of cold hardening.

2) Soil and tree foliar nutrient characteristics were sampled in late October, 1991 at 38 locations along the Sunset Ridge trail, with replicates at 200 foot intervals, and numerous elemental analyses conducted using an inductively coupled plasma spectrometer. Paired with soil samples in collection and analyses, were foliar tissues from *Picea rubens* and *Abies balsamea*. Resulting data, which are provisional, (being part of a senior thesis in progress) indicate a strong correspondence with soil depth and development, site elevation, and other site specific environmental conditions, in both foliar tissues and soils.

3) Rime ice accretion was monitored weekly (almost) at four winter test sites on an elevation gradient on Sunset ridge through the beginning and middle part of winter. Six collectors at each site were harvested of ice as frequently as conditions permitted. The research first produced a unique collector design, and then yielded data that, from provisional analysis, both demonstrate an elevation gradient in the severity of rime ice accretion, and also show that patterns of accretion are highly sensitive to synoptic climatic variations.