A COMPARISON OF ATMOSPHERIC EXPOSURE CONDITIONS AT HIGH- AND LOW-ELEVATION FORESTS IN THE SOUTHERN APPALACHIAN MOUNTAIN RANGE

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ABSTRACT. Two research sites were established at 300 m and 1800 m elevations in the southern Appalachian Mountains for the study of effects of atmospheric deposition on forest element cycles. Meteorological and chemical data are collected continuously and on an event basis to compare the rates of wet and dry deposition to indigenous conifer forests. Climatic data confirm the expected differences in atmospheric exposure conditions between sites: precipitation, wind speed, and cloud/fog immersion time increase with elevation by factors of 2 to 50. Chemical data collected during the winter indicate comparable concentrations of most constituents in air and rain, while cloudwater contains higher concentrations of acidity and acid anions than does fog water. All of these factors combine to create much higher deposition loading to the mountain site. Differences in dry deposition are reflected in significantly higher net throughfall fluxes in the high elevation spruce stand.

1. INTRODUCTION

The role of the atmosphere in forest element cycling has received increased interest since the discovery of widespread damage to forests in Europe and North America. The importance of atmospheric deposition in forest decline is unknown; however, there is circumstantial evidence that deposition may be involved. One common characteristic of many reported declines is their tendency to occur initially, more frequently, and more severely at high elevation sites (Schutt and Cowling, 1985). Forests at high elevations must adapt to generally more severe climatologic conditions than their lower elevation counterparts. In addition, these same conditions are expected to result in higher atmospheric deposition rates than occur in forests at lower elevations (Lovett, 1984a).

Mountainous terrain is conducive to orographic precipitation, high wind speeds, and cloud immersion, and is commonly populated by

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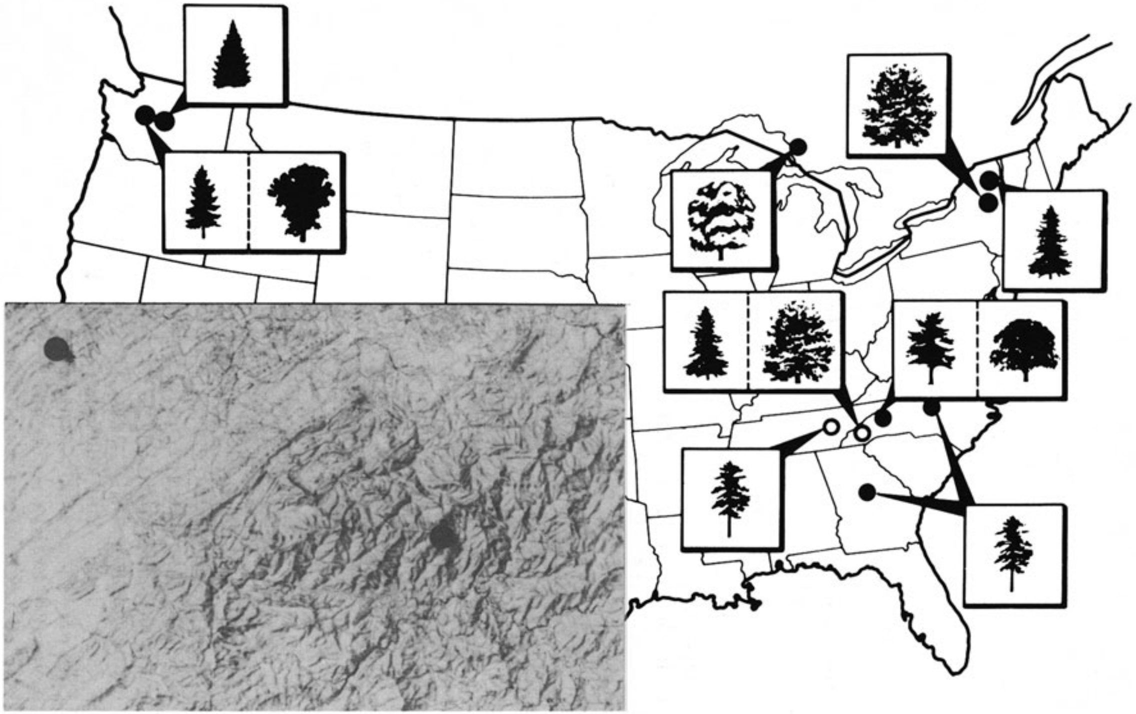

Figure 1. Location of Integrated Forest Study sites in North America showing the local terrain of the sites discussed in this paper (inset). The intensive deposition sites include the following (clockwise from left); Douglas fir, Thompson Forest, Washington; mixed deciduous, Huntingdon Forest, New York; spruce/fir, Whiteface Mountain, New York; loblolly pine, Duke Forest, North Carolina; red spruce, Smoky Mountains, North Carolina; white pine, Coweeta, North Carolina; loblolly pine, Grant Forest, Georgia; and loblolly pine, Oak Ridge, Tennessee. There is an additional site not shown: Norway spruce, Nordmoen, Norway. The sites described in this paper are indicated by the open circles.