Using historical change to predict future distribution of high elevation forests in northern New England.

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ABSTRACT

We propose to investigate the effects of regional climate change, acid deposition, and their interaction on the dynamics and distribution of montane forests in northern New England (RFP Focus 2). Regional climate has warmed by 1.5°C over the last 30 years alone and these trends are expected to continue in response to anthropogenic emissions of greenhouse gases. Concurrent anthropogenic acid deposition may interact with and compound climate change effects on forests. Despite these known environmental changes, population- and community-level responses of the region's tree species remain largely unquantified.

Our proposed project will take place at four montane sites across Vermont that span a natural gradient in susceptibility to acid deposition across sites and an elevational gradient across northern hardwood and high elevation conifer forests within each site. In addition, we will include calcium addition plots at Hubbard Brook Experimental Forest (NH).

We will use these nested gradients (elevation gradient within an acid susceptibility gradient) to determine whether recent changes in forest composition and the growth rates of our focal tree species are primarily controlled by i) climate, ii) calcium status and vulnerability to acid deposition in addition to climate, or iii) the interactions of both i) and ii).

We will distinguish between these hypothesized mechanisms by examining current and historic forest dynamics in plots stratified over elevational and acid susceptibility gradients. At each site, we will place study plots across an elevational range that encompasses deciduous northern hardwood forests (550 m a.s.l.), high elevation conifer forests (950 m a.s.l.), and the deciduous-conifer ecotone (DCE; 700 to 800 m a.s.l.). We propose to use these study plots to (1) quantify historical shifts of major forest types through resurveys of historic forest plots and comparison of historic and current aerial photographs and satellite images. We will (2) attribute past shifts to proximate climatic and acid-deposition factors and their interactions using dendrochronological methods. Lastly, we will (3) forecast changes in forest distribution in response to projected climate change using a biogeographic model based on biophysical variables.

The potential for interactions between climate and anthropogenic acidification to influence the growth and dynamics of forests is largely unknown. Our multidisciplinary approach will synthesize results from a variety of spatial and temporal scales, clarifying individual effects and synergistic interactions of climate change and acid deposition on the region's forests, and provide forecasts of forest composition for a range of future climate states.