

# CRITICAL ACID LOAD LIMITS IN A CHANGING CLIMATE: IMPLICATIONS AND SOLUTIONS

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The federal agencies of the United States are currently developing guidelines for critical nitrogen load limits for U.S. forest ecosystems. These guidelines will be used to develop regulations designed to maintain pollutant inputs below the level shown to damage specified ecosystems. By traditional definition, an ecosystem is considered to be at risk when nitrogen loads exceed a critical level. The excess over the critical load is termed the exceedance, and a larger exceedance is often considered to pose a greater risk of damage to an ecosystem. This definition of critical loads applies to acute or chronic individual stress impacts, but does not work well when an ecosystem is subjected to multiple environmental stresses. For example, the mountains of western North Carolina received some of the highest rates of nitrogen deposition in the eastern United States, but these nitrogen deposition levels are still considered to be below the critical load rate. The area experienced a moderate three year drought from 1999-2002. In 2001, white pine and spruce trees began to die in large numbers in the area. The initial evidence confirmed that the affected trees were killed by the southern pine beetle (SPB). This insect species is not normally successful at colonizing these tree species because heavy oleoresin production exudes the boring beetles from impacted trees. Subsequent investigations revealed that the relative ratio of aboveground to belowground biomass was high compared to ratios of same species from lower nitrogen deposition areas. I believe that elevated nitrogen deposition reduced the root biomass, reduced the tree water-uptake potential, reduced oleoresin production, and caused the trees to become more susceptible to insect colonization during the drought period. If multiple stress (i.e., drought and insects) impacts are included, then the forests in this area were in exceedance of their critical nitrogen threshold. Recent advances in ecosystem modeling of multiple stress impacts on forest ecosystems allow for more complex analysis of multiple stress scenarios. This paper explores how multiple environmental stress impacts can be assessed using computer models to determine variable critical load limits. The implications for improved forest management and pollutant regulation will also be presented.

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