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Scoping Paragraph: Impact of Plant-Pathogen Dynamics on Climate Change-Driven Tree Migration in the Great Smoky Mountains NP

The GSMNP contains some of the highest, most diverse terrain in the eastern US, and is one of the most biodiverse places on the planet. However, it and surrounding areas in the Appalachian mountain region have been hit by several devastating insect outbreaks over the years. These have caused almost complete loss of the American chestnut and Fraser fir, and now eastern hemlock seems to be headed in that direction. These massive tree losses have not only had an impact on nutrient cycling and carbon storage, but have also opened up canopy gaps, facilitating the potential establishment of other species. In these gaps, observations of altitudinal tree migration are likely, given the Park's many sharp environmental gradients in temperature and precipitation due to topography, and that tree density changes due to warming temperatures have already been observed in similar high-elevation forests worldwide.

What might be the impact of hemlock woolly adelgid (HWA) infestations on climate change-driven tree migration? To explore this question, I propose to map both existing hemlock stands and probable areas of HWA infestation using satellite data (as outlined in Bonneau 2003). In areas that have likely experienced recent warming (as determined using 1 km-resolution Daymet data), I will look for where these infestations overlap with sharp ecotones between hemlock and other vegetation cover that are due to gradients in temperature or precipitation. Next, through field work at these study sites, I will document vegetation cover along ecotone transects in both HWA-infested and HWA-free areas, to see what effect plant-pathogen dynamics has had on tree regrowth, and whether there have been any significant shifts in the range of hemlock or other lower-elevation plants.