MODELING THE EFFECTS OF CLIMATE CHANGE ON WHITEBARK PINE ALONG THE PACIFIC CREST TRAIL (1A)

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The Pacific Crest Trail (PCT), one of eight National Scenic Trails, stretches 2,650 miles from Mexico to the Canadian border. At high elevations along this trail, within Inyo and Sierra National Forests, populations of whitebark pine (Pinus albicaulis) have been diminishing due to infestation of the mountain pine beetle (Dendroctonus ponderosae) and are threatened due to a changing climate. Understanding the current and future condition of whitebark pine is a primary goal of forest managers due to its high ecological and socioeconomic importance, and it is currently a candidate for protection under the Endangered Species Act (ESA). Using satellite imagery, we analyzed the rate and spatial extent of whitebark pine tree mortality from 1984 to 2011 using the Landsat-based Detection of Trends in Disturbance and Recovery (LandTrendr) program. Climate data, soil properties, and biological features of the whitebark pine were incorporated in the Physiological Principles to Predict Growth (3-PG) model to predict future rates of growth and assess its applicability in modeling natural whitebark pine processes. Finally, the Random Forest algorithm was used with topographic data alongside recent and future climate data from the IPCC A2 and B1 climate scenarios for the years 2030, 2060, and 2090 to model the future distribution of whitebark pine. LandTrendr results indicate mountain pine beetle related mortality covering 14,940 km2 of forest, 2,880 km2 of which are within whitebark pine forest. By 2090, our results show that under the A2 climate scenario, whitebark pine suitable habitat may be reduced by as much as 99.97% by the year 2090 within our study area. Under the B1 climate scenario, which has decreased CO2 emissions, 13.55% more suitable habitat would be preserved in 2090.

Key words: whitebark pine, bark beetle, 3-PG, Random Forest, LandTrendr