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Title: Across the White Mountains, California to Explain Downslope Migration of Trees

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Abstract:
Shifting species distributions in montane ecosystems under a warming climate are generally assumed to be toward higher elevations, but the possibilities of lateral and downward shifts in complex terrain have received less attention. We modeled nighttime minimum temperatures across the White Mountains, eastern California based on hourly temperature recorded by inexpensive temperature loggers, a 10m Digital Elevation Model (DEM), and long-term weather station data. Thirty-five iButton Thermochrons recorded hourly temperatures from July 23 to October 6, 2006, and were distributed along elevation gradients on all aspects around a valley with strong night-time temperature inversions and a weather station. The overall lapse rate was calculated from three local weather stations: Bishop WSO Airport (1253m; 4110ft), White Mountain 1 (at 3094m; 10,151ft), and White Mountain 2 (at 3800m; 12,470ft). Using multiple least-squares regression, deviations from the local weather station were predicted by topographic position (the average elevation within 500m subtracted from the cell elevation), slope, and the absolute value of topographic position ($r2 = 0.92$). The results were extrapolated across the rest of the range using the same parameters embedded in the overall lapse rate. The models predict strong night-time temperature inversions (up to 7degrees C) in valleys and canyons across the range. Field observations and airphoto analysis show limber pine (*Pinus flexilis*) and bristlecone pine (*P. longaeva*) population migrating downward into the inversions. The temperature measurements and models explain this downslope migration as low temperature limitations in the cold valley bottoms are relieved under a generally warming climate. Range-wide maps provide testable hypotheses of minimum night-time temperatures.

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