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Mountain pine beetle infestation impacted by water availability

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Vegetation pattern and landscape structure intersect to exert strong control over ecohydrological dynamics at the watershed scale. The hydrologic implications of vegetation disturbance (e.g. fire, disease etc.) depend on the spatial pattern and form of environmental change. Here we investigate this intersection at Tenderfoot Creek Experimental Forest (TCEF), Montana with a focus on the mountain pine beetle (Dendroctonus ponderosae) epidemic currently affecting the Rocky Mountains. We calibrated QuickBird remote sensing imagery with a leaf-level spectral library of local vegetation. We used this spectral library to determine optimal vegetation indices for differentiating stages of beetle infestation within the 37 km2 TCEF watershed. These indices formed the basis of a three-component mixing model to quantify the extent and magnitude of beetle infestation across the TCEF watershed. We compared disturbance patterns to spatially distributed topography and vegetation variables derived from a LiDAR-based digital elevation model (DEM) of TCEF. We determined that certain landscape characteristics (low vegetation density, south facing slopes, steep slopes, locations with small contributing areas, and locations with lower values of the topographic wetness index (TWI)) were significantly more likely to exhibit the effects of beetle infestation. Our efforts to monitor vegetation mortality across space and time provide a context for assessing landscape susceptibility to initial mountain pine beetle infestation via feedbacks between biodiversity and hydrological patterns and further research into understanding how outbreak (i.e. landscape scale infestation) patterns may affect watershed ecohydrology via altered water and biogeochemical cycles.