Kemp-Jennings, S., D. L. Peterson, and A. G. Bunn. 2021. Temporal Variability in Climate-Growth Response of Mountain Hemlock at Treeline in Washington and Oregon. Northwest Science Vol 94, in press.

Abstract

Climate-growth relationships in altitudinal treeline forests are particularly informative because they represent the upper limit of a species range where growth is often especially sensitive to climatic variation. Radial growth response to climatic variables typically ranges from energy limited to water limited. In the Pacific Northwest region of North America, treeline forests are typically energy limited. Results from a recent study (Marcinkowski et al. 2015) indicate a change in climate-growth relationships over time in treeline mountain hemlock (*Tsuga mertensiana*) in northern Washington state. Here, we investigate whether these same relationships hold across 700 km of the range of treeline mountain hemlock in Oregon and Washington. Using cores from trees > 200 years old, we examined temporal and spatial variability of climate-growth relationships since the early 20th century. Results indicate 1) a potential weakening of energy limitation in forest growth at treeline, 2) a nonstationary growth response to climate variables through time, and 3) different patterns of growth response to climate from north to south. Climate-growth relationships were generally similar between different aspects in the same geographic location, with some exceptions. Correlations between climate variables and radial growth differ over time (ranging from significantly positive to significantly negative), indicating the non-stationary nature of climate-growth relationships. These results identify where changes in growth-limiting variables may be occurring at treeline. Additional changes in the effects of climate change on growth at treeline are expected, and may be temporally complex.

Keywords: energy limited, mountain hemlock, subalpine, tree growth, treeline

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