To be presented at annual meeting of the Swiss Needle Cast Cooperative, Corvallis, OR on December 3, 2014

Regional effects of Swiss needle cast disease and climate on growth of Douglas-fir in western Oregon

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Abstract

The fungal pathogen, *Phaeocryptopus gaeumannii*, occurs wherever Douglas-fir is found but disease damage is believed to be limited to the Coast Range and is of no concern outside this region (Shaw et al., 2011). However, knowledge remains limited on the spatial distribution of Swiss Needle Cast (SNC) impacts in the Pacific Northwest. We examined the spatial distribution of SNC impacts on mature Douglas-fir trees using time series intervention analysis of intra-annual tree ringwidth chronologies from the west slope of the Coast Range to mid- and high-elevations on the west slope of the Cascade Mountains of Oregon. All sampled stands experienced significant radial growth reductions in Douglas-fir that could not be accounted for by current and previous-year seasonal climatic factors. The spatiotemporal patterns of growth impact from SNC disease were synchronous across the region, displayed periodicities of 25-30 years, and were strongly correlated with winter and summer temperatures and summer precipitation. Our findings show that SNC impacts occur wherever Douglas-fir is found in western Oregon and is not limited to the coastal fog zone. In the 20th century, SNC impacts at low- to mid-elevations were least severe during the warm phase of the Pacific Decadal Oscillation (PDO, 1924-1945) and most severe in 1984-1986, following the cool phase of the PDO (1945-1977). At high elevations on the west slope of the Cascade Mountains, SNC impacts were the greatest in the 1990s and 2000s due to warmer winter temperatures associated with climate change. Our findings of a 25-35 year disease impact cycle combined with aerial surveys indicating record acreage exhibiting disease symptoms for the past four years suggest that the next peak impact will occur in 2014-2016, following the last peak in 1984-1986. Warmer winters will increase disease severity at higher elevation, north along the coast from northern Oregon to British Columbia, and inland sites where current winter temperatures limit fungal growth, as predicted in Lee et al. (2013).