Warning signals of adverse interactions between climate change and native stressors in British Columbia forests

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ABSTRACT

We examine the direct effects of multiple disturbance agents on individual tree development and stand productivity in a broad sample of 15–40-year-old managed forests across north central BC. Our primary interest was to establish a baseline assessment of damage in these forests and, especially, to focus on the degree to which biotic and abiotic stressors cause physical damage and diffuse mortality. Based on extensive climate data for the study area and the ecology of the disturbance agents we explore possible interactions between individual stressors and climate. Mean annual temperature increased by over 1 °C in the last century and annual precipitation increased by 8%, with that in the summer increasing by 18%. Disturbance agents were a central driver of mortality, growth and physical damage and their combined impact in lodgepole pine stands was as much as four times greater than expected particularly in the dominant trees most counted upon for stand productivity and timber supply. Climate-mediated disturbances accounted for five of the top six damage agent categories in terms of percent of basal area impacted but the lack of long-term disturbance monitoring data, a global information gap, limits our ability to conclusively link high damage rates to climatic changes. Current yield models used in forestry, along with the timber supply review process, typically do not account for these processes and interactions and often ignore the effect of multiple slow stressors that are having a cumulative impact on growth rates, physical damage and mortality in managed stands. Unless these impacts are accounted for in models, their yield projections will be increasingly unreliable as climate continues to change. In the absence of long-term monitoring data, extensive surveys of current stand conditions, with an emphasis on the incidence and type of damage, as well as traditional tree growth measurements, provides the best chance of closing the information gap and capturing the data needed to make timely informed forest management decisions in an era of rapid climate change.