HARDWOOD STEM INJURY AND MORTALITY IN SURFACE FIRES

Matthew B. Dickinson[1†] and Anthony S. Bova[2]

In surface fires, hardwood stems are heated primarily by flames.When the heat flux to those stems is sufficiently great or prolonged, necrosis of phloem and live sapwood tissues results. We are developing models of hardwood stem injury and mortality along several fronts. In collaboration with the Missoula Fire Sciences Laboratory, we are developing a stem injury and mortality model. A version of this model designed for fire managers is called FireStem (www.firelab.org). Estimating heat flux to stems is critical as an input to any stem heating model, but accurate estimates are difficult and expensive to obtain. To address this problem, we are developing an inverse heating methodology to estimate net stem heat flux that requires minimal instrumentation and has the additional advantage of using the tree stem itself as a sort of heat flux sensor. Once stem heating can be predicted, it is necessary to have a tissue necrosis model. Two approaches are being pursued for developing predictive models of tissue necrosis. In one, equations whose form is determined by heat transfer principles are parameterized by data on fire behavior, heat flux, and tissue necrosis. In a more biophysically realistic approach (that used in FireStem), tissue necrosis models are linked with the stem heating model. For small stems, heating may be roughly equal around stems, but uneven heating is the general result where fires burn on slopes or in wind. Field data and modeling are being used to improve our understanding of uneven heating so that it can be incorporated in stem injury and mortality models.

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[1]Ecologist and [2]Physical Scientist, USDA Forest Service, Northern Research Station; [†]Corresponding author, 359 Main Road, Delaware, OH 43015, 740-368-0093, email: mbdickinson@fs.fed.us.