

EFFECTS OF ENVIRONMENTAL STRESS AND BUNCHGRASS  
COMPETITION ON *PINUS PONDEROSA* SEEDLINGS

A Dissertation

Presented in Partial Fulfillment of the Requirements for the  
Degree of Doctor of Philosophy

With a

Major in Forestry, Wildlife, and Range

In the

College of Graduate Studies

University of Idaho

By

Peter F. Kolb

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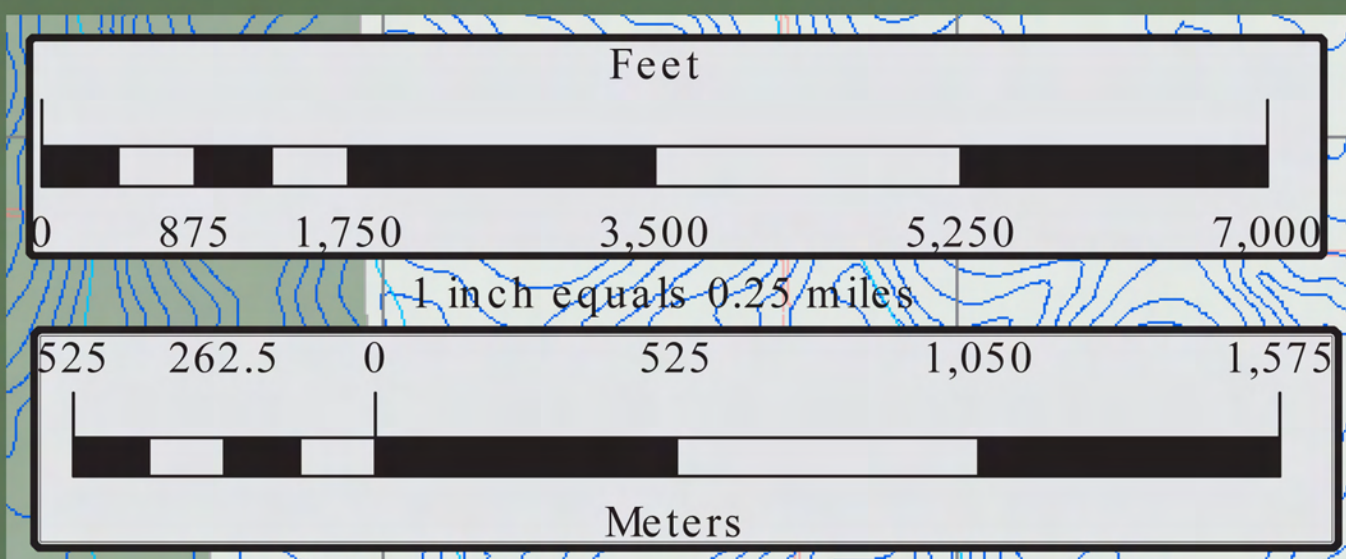
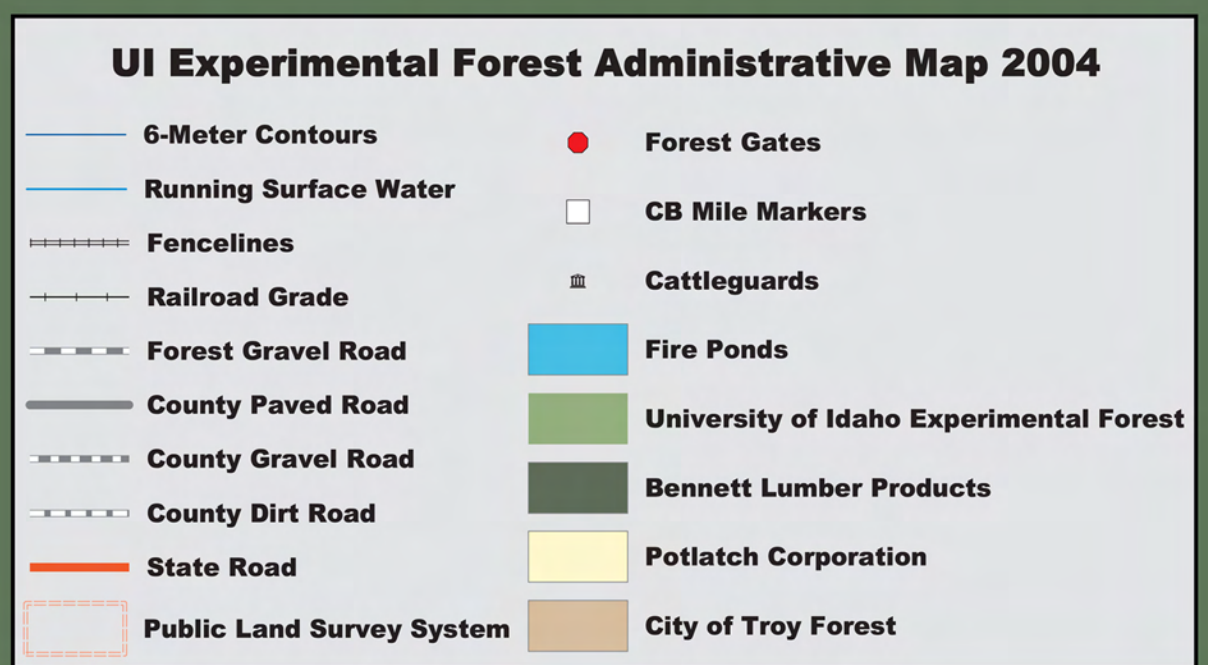
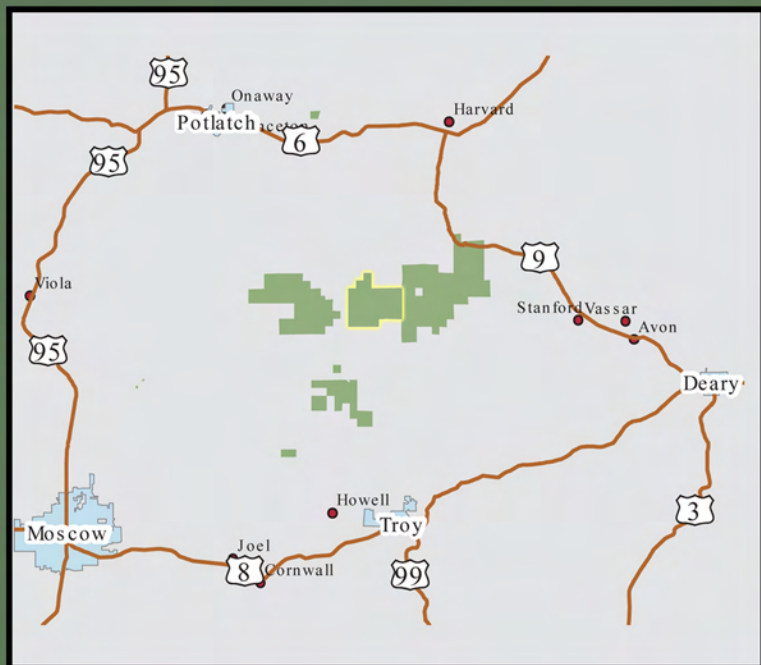
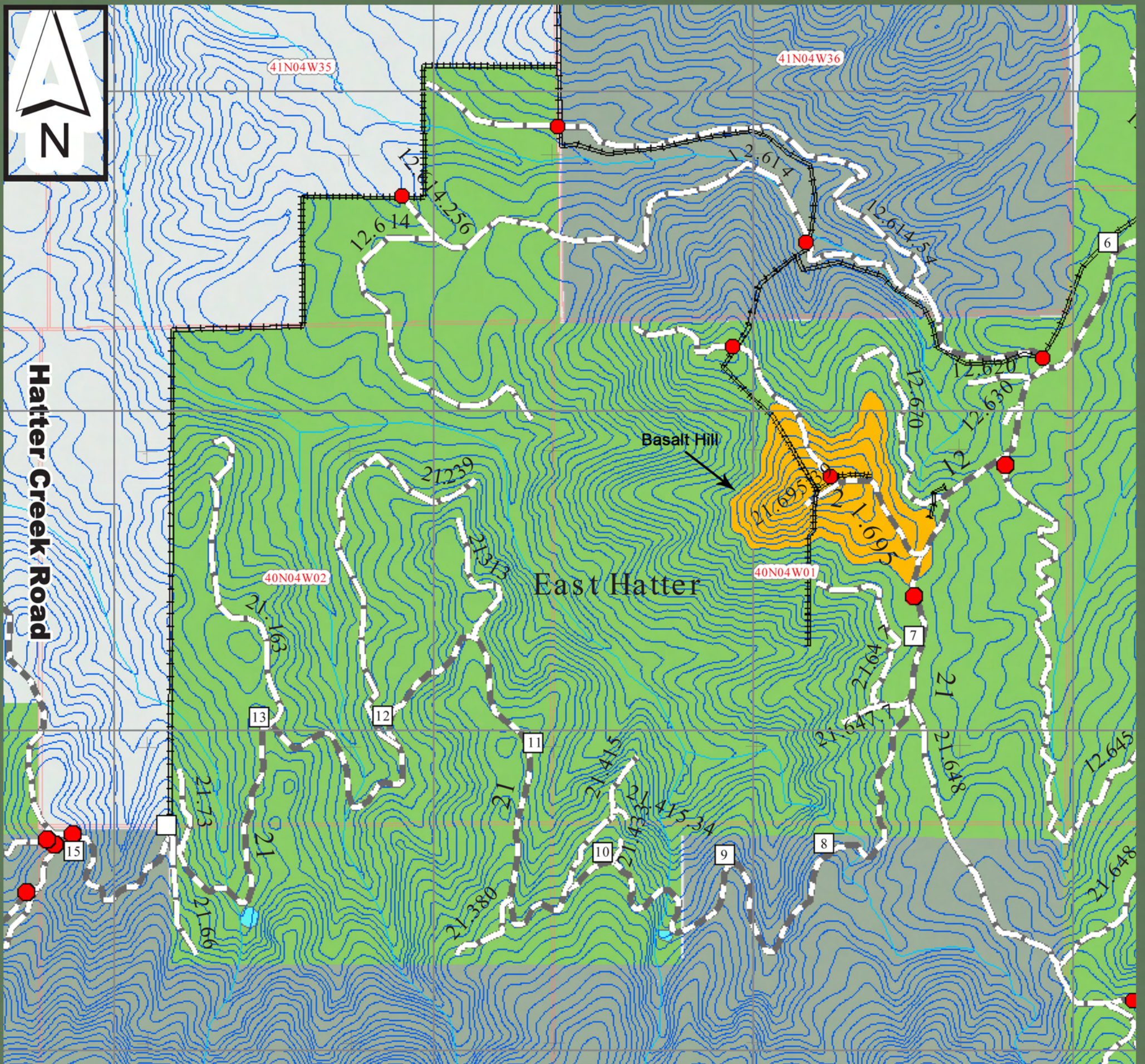
Major Professor: Ron Robberecht, Ph.D.

## Abstract

Interspecific competition between the bunchgrass *Agropyron spicatum* (Pursh.) Scrib. & Smith, and seedlings of *Pinus ponderosa* (Dougl.) Lawson was examined within a pine/bunchgrass community. Canopy separation techniques and root exclusion tubes were used to determine the effects of bunchgrass competition on pine seedlings. Shoot interference from bunchgrass did not significantly affect pine seedling survival. In contrast, bunchgrass root exclusion increased survival of *P. ponderosa* seedlings. Physiological responses of *P. ponderosa* seedlings to water and high-temperature stress were also measured in the field and in a controlled greenhouse environment. Mortality significantly increased during periods with soil water potentials less than -1.5 MPa and soil surface temperatures greater than 60°C. *Pinus ponderosa* seedlings grown in the greenhouse developed physiological and morphological characteristics that indicated adaptation to dry environments. Drought-stressed seedlings exhibited higher root:total plant biomass ratios, and had significantly lower cell wall elasticity than watered seedlings, although osmotic potentials decreased to -2.5 MPa in all seedlings. Root:total plant biomass ratios greater than 0.78, along with rapid root growth to soil depths of 1m and greater, may have increased the ability of *P. ponderosa* seedlings to extract soil water. Calculated heat exchange rates showed that high transpiration rates maintained seedlings stem temperatures below 63°C, which was determined to be the lethal temperature threshold in the field. Root exclusion experiments and modeled heat exchange both indicated that soil water availability strongly influenced *P. ponderosa* seedling survival on dry sites with high soil surface temperatures.

## Study Site

This study was conducted at Basalt Hill on the University of Idaho Experimental Forest (46°52'N, 116°47'W, 1100 m above sea level), 52-km northeast of Moscow, Idaho in a seral *Pinus ponderosa*/*Agropyron spicatum* community composed of a mature *P. ponderosa* overstory of approximately 50 trees per hectare with a bunchgrass understory interspersed with shrubs and herbs. The soil is an Uvi-Spokane association (Barker 1981) silt loam approximately 0.5 m in depth overlying decomposing granite.



# East Hatter Creek Unit



## Location of Complete Research:

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Other Sources: