# WATER RELATIONS AND THE EFFECTS OF SHADE ON UNEVEN-AGED MANAGEMENT

A Thesis

Presented in Partial Fulfillment of the Requirements for the

Degree of Master of Science

With a

Major in Forest Resources

In the College of Graduate Studies

University of Idaho

By

Greg Estoll

May 2001

Major Professor: Kathleen Kavanagh, Ph.D.

## ABSTRACT

Competition, in the form of shade, severely limits the growth and survival of understory trees in uneven-aged forests. Light is obviously reduced under shaded conditions, but other factors like water and nutrient supply may also be especially limiting to tree productivity and survival. This study was established to test the hypothesis that water limits tree productivity under shade through a decreased leaf specific hydraulic conductivity and maximum stomatal conductance. Fifty-two ponderosa pine and twenty Douglas-fir saplings were identified and studied under a range of light conditions from sun to shade.

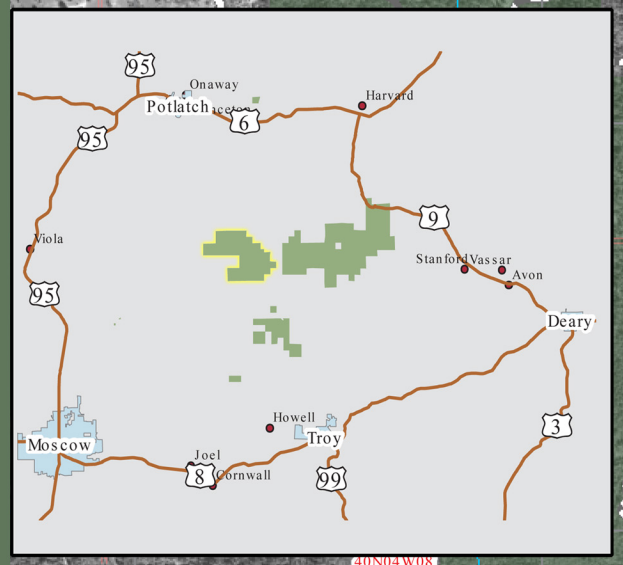
For ponderosa pine and Douglas-fir, maximum stomatal conductance was found to decline with increasing shade. Leaf specific conductivity, predrawn water potential, and productivity, measured as three-year height and basal area increment, also significantly declined with increasing shade for ponderosa pine. Predrawn water potential and leaf specific conductivity were also strongly related to stomatal conductance, as expected in terms of water supply and demand.

Productivity was positively related to leaf specific conductivity and negatively related to shade for both species. Leaf specific conductivity is a measure of the hydraulic sufficiency of a tree to supply water to transpiring foliage, so it follows that trees with a low leaf specific conductivity are less able to maintain stomatal conductance and transpiration with a given pressure gradient. Thus, they have reduced carbon assimilation and lower productivity as a result. The quantification of productivity can be directly related to the level of shade for practical forest management.


## Study Area

The study area was located in the West Hatter Creek Unit of the University of Idaho Experimental Forest outside of Viola, Idaho (46˚50’ N, 116˚51’ W) at an elevation of approximately 950 meters. The slope is 10-30% with a SSE-S facing aspect.

# West Hatter Creek




## UI Experimental Forest Administrative Map 2004

- Running Surface Water
- Railroad Grade
- Forest Gravel Road
- County Paved Road
- County Gravel Road
- County Dirt Road
- State Road
- Public Land Survey System
- Forest Gates
- CB Mile Markers
- Cattleguards
- Fire Ponds
- Bennett Lumber Products
- Potlatch Corporation
- City of Troy Forest

Feet

0 850 1,700 3,400 5,100 6,800

1 inch equals 0.25 miles

520 260 0 520 1,040 1,560

Meters

N

# Location of Complete Research:

Author & Title: Estoll, Greg
Water Relations and the Effects of Shade on Uneven-Aged Management

University of Idaho Library:

Call Number- SD358.8.I2E88 2001

College of Natural Resources:

Department- Forest Resources

Other Sources: