CARBON REFIXATION IN PHOTOSYNTHETIC BARK OF WESTERN WHITE PINE BRANCHES

A Thesis

Presented in Partial Fulfillment of the Requirements for the

Degree of Master of Science

With a

Major in Forest Resources

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College of Graduate Studies

University of Idaho

By

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Major Professor: John D. Marshall, Ph. D.

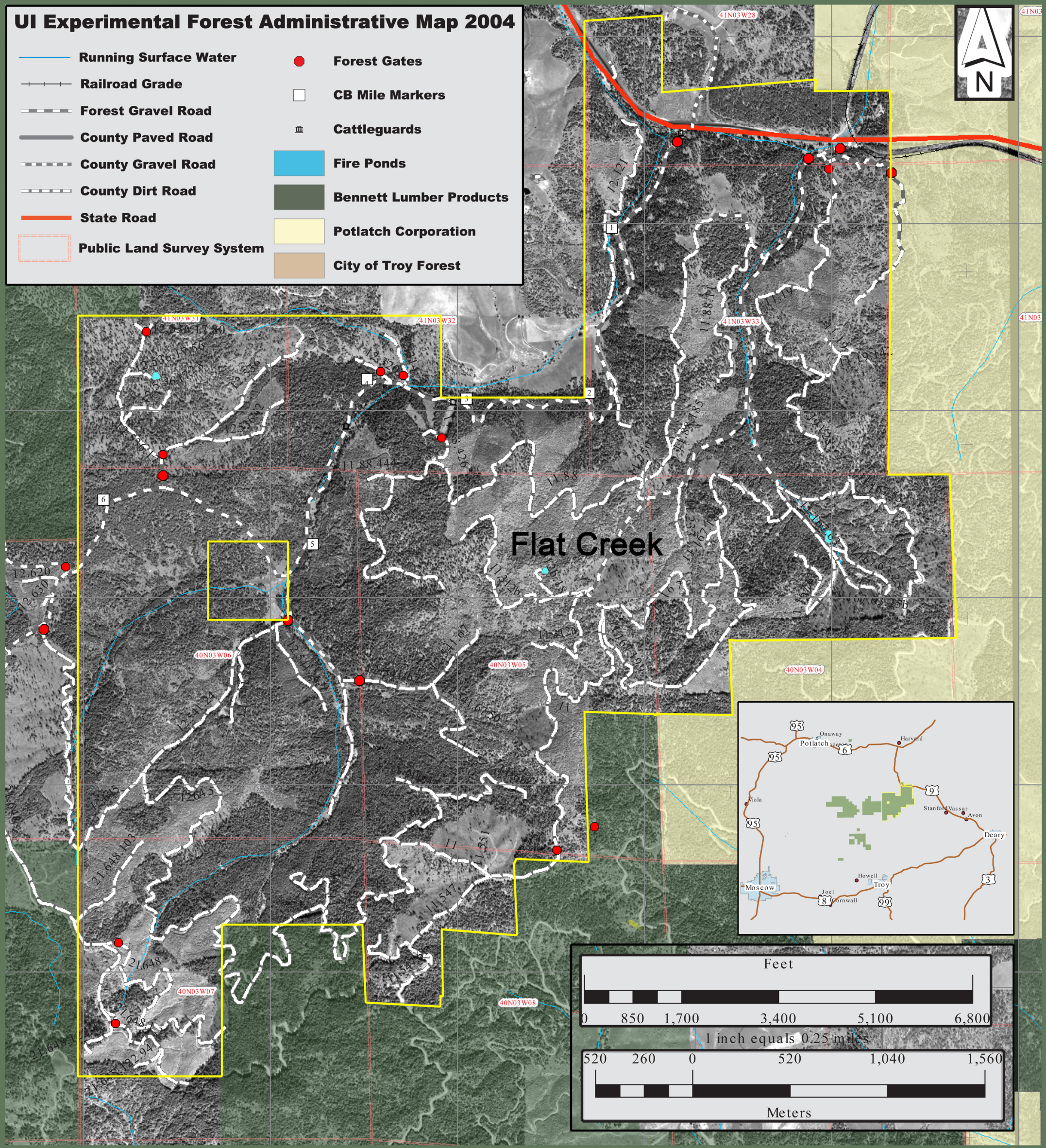
ABSTRACT

I conducted a methodological experiment related to measuring gas exchange in woody tissues using removable cuvettes. The question addressed was whether the volume of respiring tissues should be measured between the midpoints of gaskets used to attach the cuvettes to tissue sections, or between the gasket interior edges. The simple experiment suggested that the gasket midpoints were the correct position for determining the tissue volume actually contributing to a respiration measurement.

I investigated the functional controls over light-dependent refixation of respired CO_2 in photosynthetic bark of western white pine (*Pinus monticola* Dougl. Ex D. Don) branches. Gross photosynthesis increased with increasing intensity of photo synthetically active radiation (PAR) to >2000μmol $m^{-2}s^{-1}$ and with increasing bark surface temperature from 15 to >45°C. Maximum observed refixation rates were 76±3% (mean ± SE) of dark respiration. At a given temperature and irradiance, dark respiration rate was the physiological parameter that correlated most strongly with gross photosynthesis (R=0.89, p<0.0001, n=43). Dark respiration rates varied 20-fold among branches. Over this range, refixation averaged 55±2% of dark respiration at 25°C and 1000 μmol PAR $m^{-2}s^{-1}$. However, refixation was not correlated with internal CO_2 concentrations in illuminated branches; these concentrations remained fairly constant. Specific bark area, bark conductance to water vapor, bark chlorophyll a/b ratio, and bark nitrogen concentration varied pronouncedly with canopy depth in mature trees. Results are summarized in a simple model of refixation driven by light, temperature, and dark respiration rate.

Study Site

This study took place on the University of Idaho Experimental Forest on the Flat Creek Unit in January of 1998, and was conducted on open grown Douglas fir.


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
N
41N03W28
41N03W31
41N03W32
41N03W33
40N03W06
40N03W05
40N03W04
40N03W07
40N03W08
Flat Creek
Onaway
Potlatch
Harvard
Viola
Stanford
Vassar
Avon
Deary
Moscow
Howell
Troy
Joel
Cornwall
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

Flat Creek

Location of Complete Research:

Author & Title: Cernusak, Lucas A.
Carbon Refixation in Photosynthetic Bark of Western White Pine Branches

University of Idaho Library:

Call Number- QK882.C47 1999

College of Natural Resources:

Department- Forest Resources

Other Sources: