2001 - 2000 Small Grants Brown

Progress report for "Remote detection of sun and shade leaf area for three tree species in the Cascade Brook Watershed in Black Rock Forest, NY"

Prepared by K.J. Brown, 14 March 2001

The goals for this project were to explore the use of remotely sensed techniques for determining species specific leaf area for the mixed deciduous forests in the Cascade Brook Watershed (CBW) of Black Rock Forest. In particular, the goal was to detect the *Quercus rubra*, *Quercus prinus*, and *Acer rubrum* components of the forest vegetation. These three species were of interest because they represent the majority of the basal area in the forest stands of CBW (Turnbull *et al.*, in press).

In order to test this technique, both remotely sensed images and ground-based estimates of leaf area must be measured. In our research, we chose to make both close (<10 m) and more distant remote measures of canopy reflectance (> 30 m) so determine the scale-dependent nature of species detection. This was done by using a six-camera CCD array from both a film industry helicopter as well as a 20 meter cherry picker (camera constructed by Dr. milt Smith , Univ. of WA, operated by Stephanie Bohlman, Univ. of WA and K.J.Brown). Measures of the species-specific spectral reflectance were also necessary, to determine species differences in both leaf and canopy reflectance. This was done by using a Li-Cor 1800 spectroradiometer to measure leaf-level spectral reflectance.

To date, the following data have been collected:

CCD 6-band spectral images of 'hi' and 'low' CBW sites from helicopter, week of 21 June 2000 CCD 6-band spectral images of 'hi' and 'low' CBW sites from cherry picker, week of 21 June 2000
Spectral library of *Q. rubra*, *Q. prinus*, *A. rubrum* leaves and bark, leaf litter and rock outcrops
Ground-based leaf area index measurements using both the LAI-2000 plant canopy analyzer and leaf litter traps in the autumn.

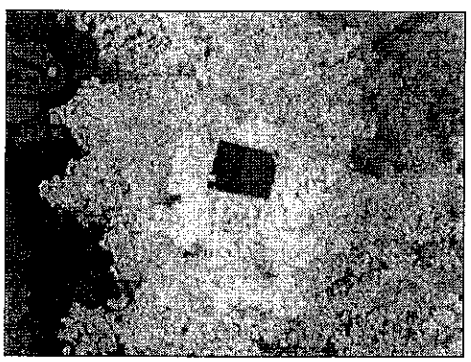

Figure 1. Sample CCD image of spectral reflectance panel and *Acer rubrum* foliage, where the brightness of each pixel is a measure of the reflectivity of that material at 550 nm. Image acquired from cherry picker, 22 June 2000, by K.J.Brown and S. Bohlman.

Results and Future analyses

Leaf area index (LAI) values for the growing season were found to be 5.03 (as an average of both research sites, 4.18 = 'high', and 5.89 = 'low') (Table 1). The proportion of species-specific leaf area changed dramatically from the drier and higher elevation high site (with chestnut oak predominating) to the wetter and lower elevation low site (with red maple dominating the LAI makeup) (Figure 2). These manually derived values will also be tested against LAI-2000 based estimates. If the correlation is good between manual and LAI-2000 estimates, the LAI-2000 technique will be recommended for future determinations of LAI in deciduous canopies at Black Rock Forest.

These species-specific LAI proportions will be tested against spectrally determined LAI proportions. Spectral species-specific leaf area will be determined by analyzing the helicopter and cherry picker canopy CCD images using the remote sensing software package ENVI (IDL Inc.). These values will be used to determine species specific estimates of 'sun' vs. 'shade' leaf area, which will be a very valuable metric for use in canopy productivity models. In addition, leaf spectral differences will be used in distinguishing species at the canopy level.

Table 1. Litter-trap derived leaf area index (LAI) values for Q. prinus (chestnut oak, 'CO'). Q. rubra (red oak, RO) and A. rubrum (red maple, RM), from the late growing season of 2000.

CO 1.82		CO 0.17	
RM 0.05		RM 2.32	
RO 1.55		RO 2.10	
other 0.77	4.18 = HI site LAI	other 1.30	5.89 = LO site LAI
5.03 = BRF watershed LAI			

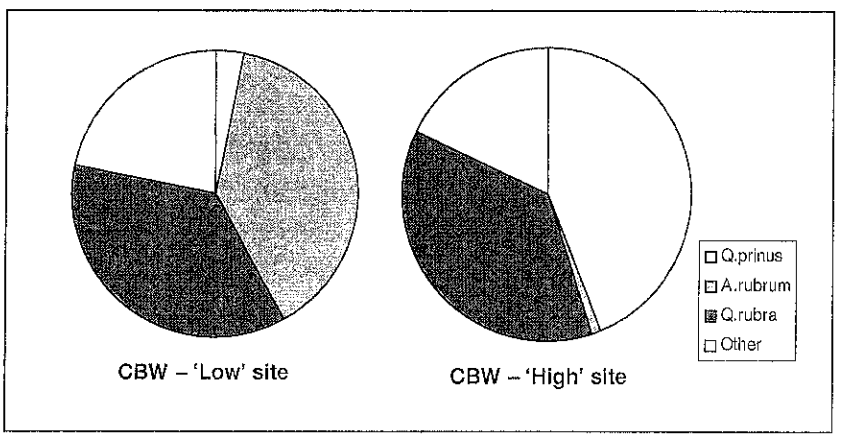

Figure 2. Species-specific proportions of LAI for both the CBW 'low' and 'high' sites for the 2000 growing season.