Executive Summary Project Y07-1254 - Effect of site type on competitive interactions among trees in complex-structured mixed species sub-boreal forests

Project history, purpose, methodology and scope

This two year project started in April 2006 and runs till March 2008. This report represents accomplishments during the first fiscal year, ending March 31, 2007.

The purpose of the project is to provide (1) a new remote sensing technology that allows economic creation of large stem-mapped areas across natural resource gradients, (2) insight into how individual-tree competitive interactions among trees species change across resource gradients, and (3) robust growth functions that can be incorporated into individual tree models.

This project will carry out basic research on competitive interactions among trees species, how these interactions affect growth, and how these interactions may vary across resource gradients in structurally complex mixed-species stands. This type of research is the foundation for practicing scientifically sound forest management. One of the major impediments to improving out knowledge of complex stands is the cost of acquiring basic stand data. The use of remote sensing techniques will allow data to be gathered at a much lower cost, and as a result the current gaps in knowledge will be filled more rapidly.

We will sample across a range of stand ages and disturbance histories to obtain a dataset that allows analysis of all the dominant tree species in our study area. To perform the proposed analysis, it is essential to obtain a large sample of trees that exhibits both variability in tree neighbourhoods and site quality. Thus, the ideal research sites (stands) will exhibit variability in both site quality and tree neighbourhoods. The critical issue is to get sufficient variability in site quality and tree neighbourhoods to test for alternate competitive effects across resource gradients.

We will use a new generation, airborne, digital camera to acquire the high spatial resolution digital imagery at each sample stand. Individual image frames covering 400 x 400 m can be acquired with a pixel size less than 20 cm, in four spectral wavelengths (usually wavelengths corresponding to Landsat, such as blue, green, red and the near infrared region of the electromagnetic spectrum). Each ortho-photo will then be digitally analyzed with image processing software, including software specifically designed to extract individual tree crown locations, to derive a map of individual tree locations. We will aim for a sample of approximately 600 trees/species across a broad range of stand conditions and resource availability. To obtain a balanced sample across competitive neighbourhoods and site quality, the sampling will be performed as stratified random sampling. For each sampled tree, we will measure diameter at 1.3 m (DBH) and take an increment core at DBH to determine past radial growth rates. Additionally, the DBH and species of all trees within a specified radius of the sample tree will be recorded.

The research will be conducted within mixed species stands of the Sub-Boreal Spruce (SBS) zone around Smithers, BC. The major trees species of this area are lodgepole pine

(*Pinus contorta* var. *latifolia*), interior spruce (hybrid of *Picea glauca* and *P. engelmannii*), subalpine fir (*Abies lasiocarpa*) and trembling aspen (*Populus tremuloides*). Minor species include paper birch (*Betula papyrifera*) and black cottonwood (*Populus balsamifera* ssp. *trichocarpa*). Results will be applicable to sub-boreal forest of north central BC.

First Year Results

We established 71 experimental sites throughout the SBSmc around Smithers, BC (Figure 1). The sites range from dry poor sites to wet rich sites and are distributed across a wide range of stand structures and age classes. Each site was classified to site series and white plastic markers were distributed in each site.

Three sets of aerial imagery were obtained for each site. First, 10cm resolution images obtained in the summer. Second, 5cm images obtained in the summer. Third, we obtained 5cm imagery in the winter under overcast conditions.

Most aerial photographs are taken under sunny clear conditions and this was the objective for our summer 10 and 5 cm photos (Figure 2). We found that it was very hard to distinguish individual trees on images taken under clear sunny conditions. Some of our summer images were obtained with overcast conditions (Figure 2) and these were much better suited for stem mapping of individual trees.

To test if we could stem-map from the summer photos, we did manual stem-mapping (manually marking the trees on the image) of 41 stem-maps in 11 experimental sites (e.g. Figure 3). We found it to be possible to use the summer pictures for this purpose on dry sites. We still have to try out this technique on moister sites.

The winter imagery was obtained in March and we have only had a chance to do minor initial assessment of the picture quality. This initial assessment illustrates that the winter photos are far superior to the summer photos (Figure 2). Consequently, it is our plan to use the winter photos for automated stem-mapping with the pattern recognition software E Cognition.

During the first field season, approximately 3,200 trees were measured and mapped on sub-mesic ecosystems within 41 stem-maps at 11 sites. A total of 385 target growth trees were identified and full measurement information collected, including 10-year radial increment measurements (at DBH) taken from cores.

Contacts for further information on the project

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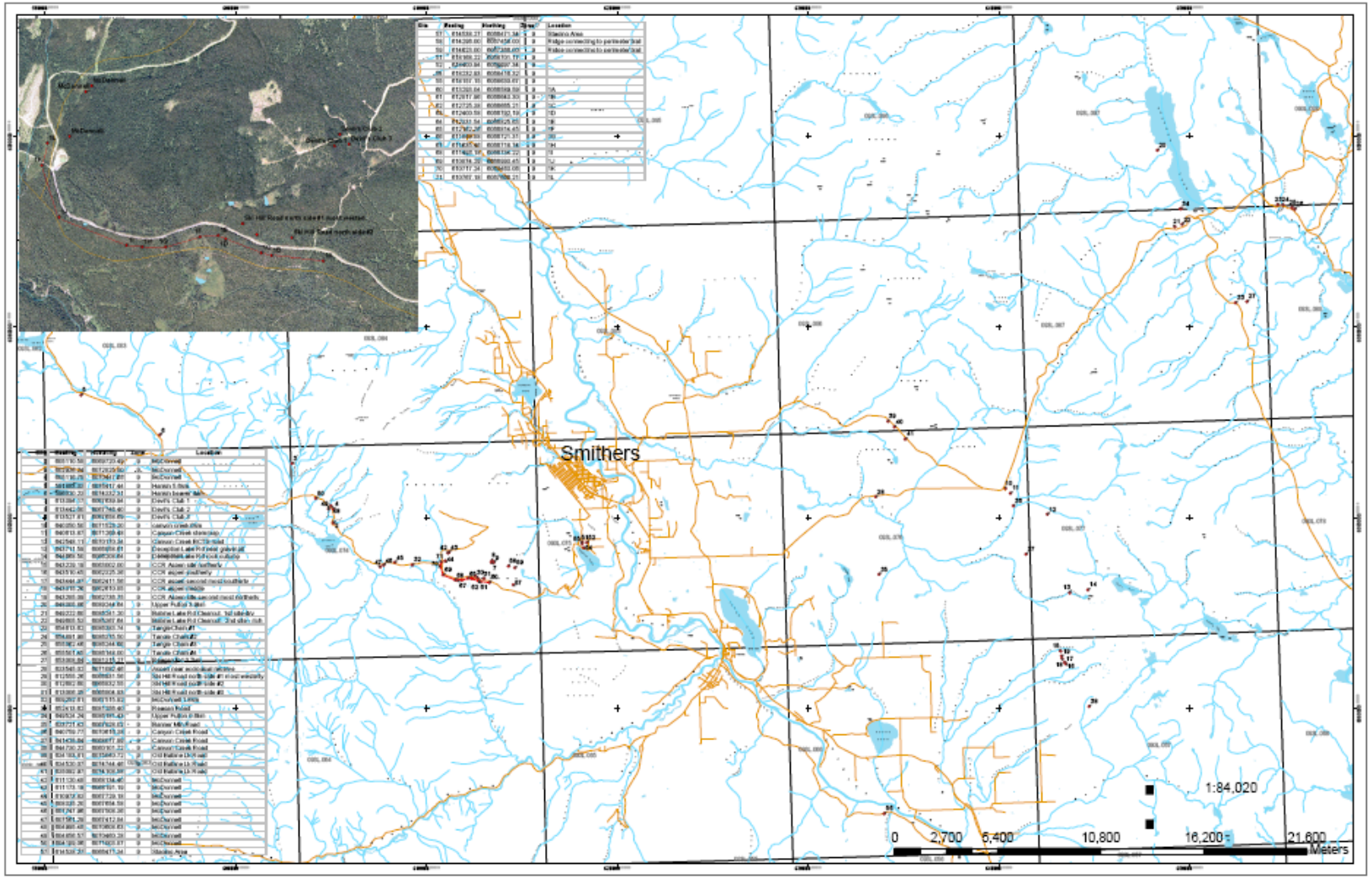

Figure 1. Distribution f the 72 sampling sites throughout the SBSmc around Smithers, BC.

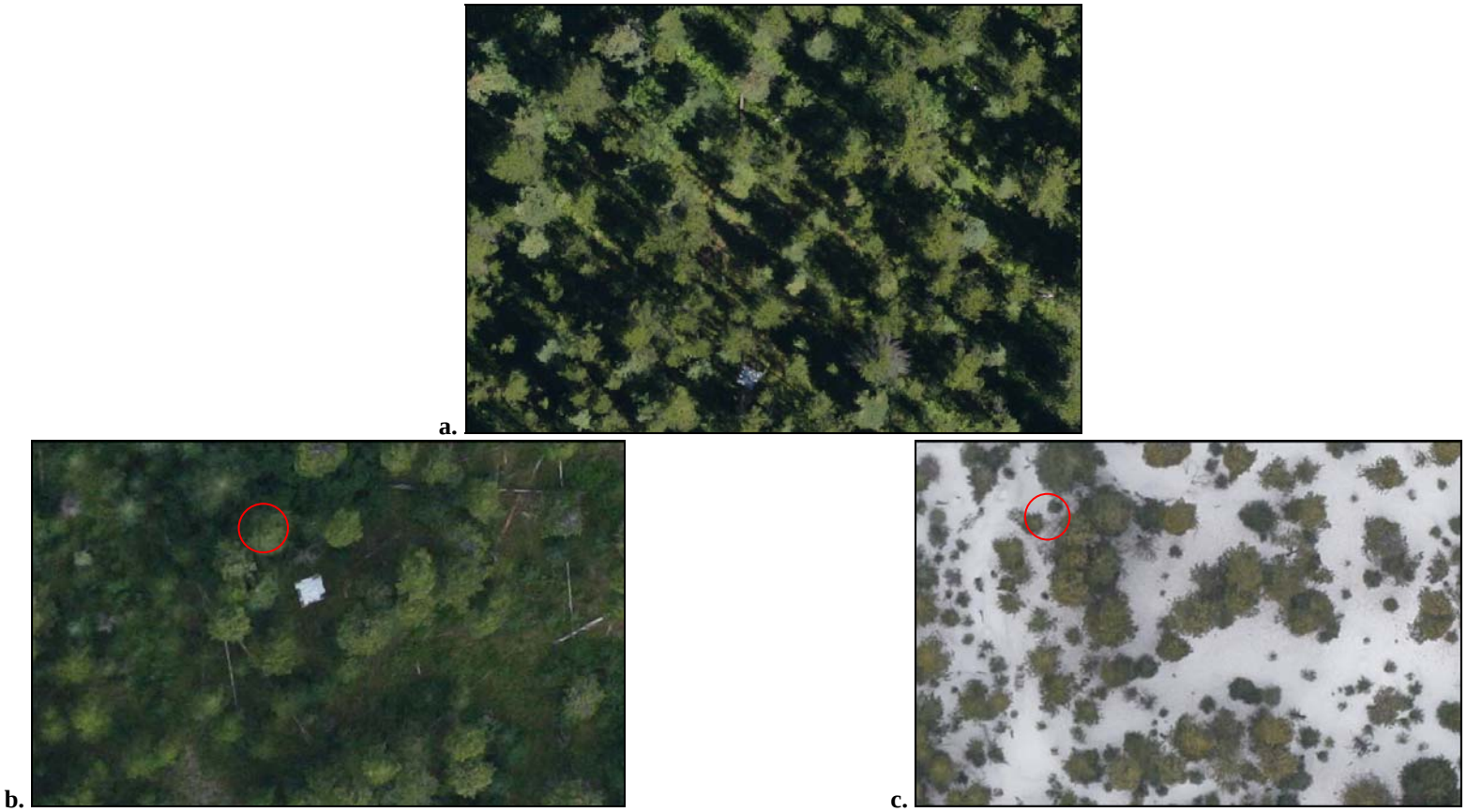

Figure 2. Sample of 5cm resolution aerial photographs from Site 10 in summer high-contrast light conditions (a), Site 46 in summer low-contrast light conditions (b) and Site 46 in winter low-contrast light conditions (c) (red circle indicates identical tree).

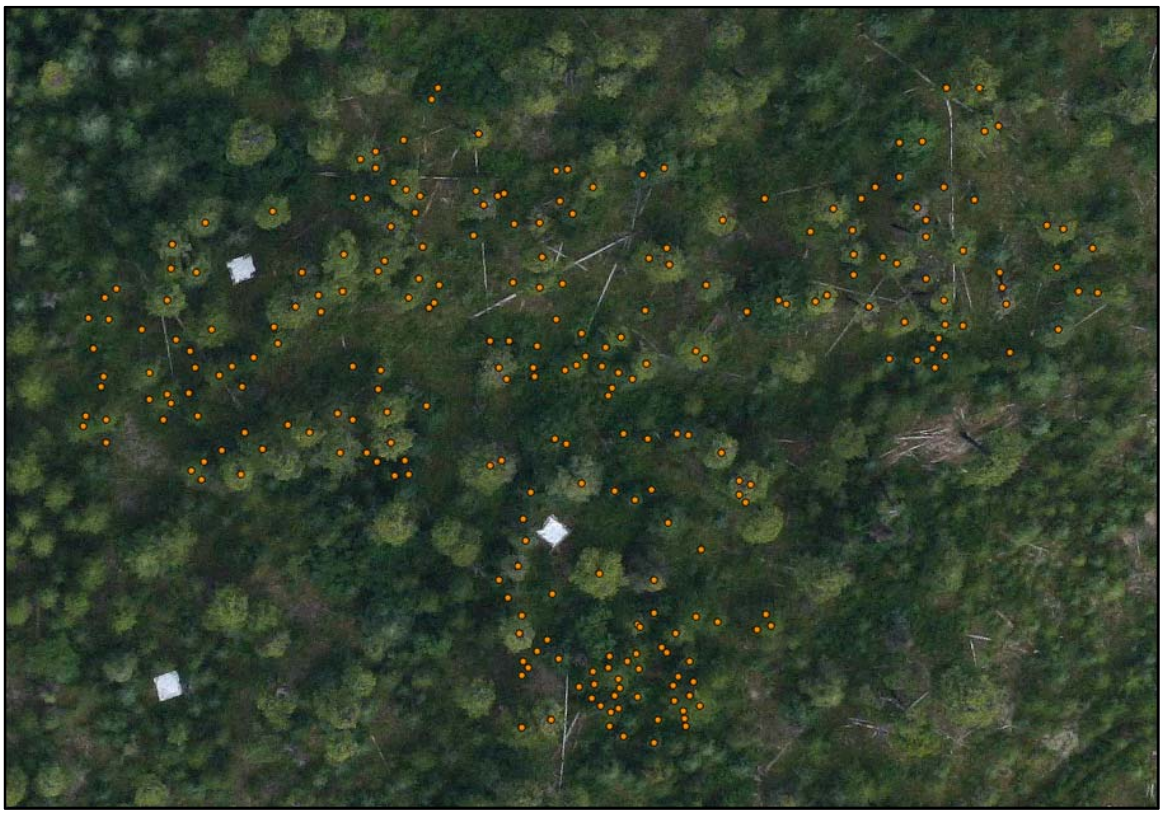

Figure 3 Sample of Site 46 stem-mapped tree locations plotted from field maps to a GIS.