4. Projects – Year 2000

4.1 - Vegetation

4.11) Mineral King Landscape Assessment (MKLA) in support of the Mineral King Risk Reduction Project (MKRRP)

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INTRODUCTION AND PROJECT OBJECTIVES

As in many western forests, the suppression of wildfires over the last century has altered forests in Mineral King. It is believed that the lack of fire directly has affected regeneration of many tree species, availability of habitat for birds and wildlife, susceptibility of the forest to insect attacks and disease, and diversity of small forest plants. Many park managers and scientists believe we should restore these forests to within a range of historic conditions at the same time catastrophic fire risks are reduced. To examine the effects of restoring forests with the direct application of fire we are monitoring the landscape-scale effects of the Mineral King Risk Reduction Project (MKRRP) to discover how re-introduced fire alters this forest.

In order to address the questions of *when* and *where* prescribed fire can be used to restore some components of historic forest structure, pattern and composition, we need to understand first, what historic forests were like when these forests were experiencing more frequent fire; second, how these forests have changed up to the present with the suppression of fire; and third, what effect re-introduced fire has on altering current forest conditions. To answer these questions we need data from three time periods. Historic data are necessary to establish a baseline from the past to present and to act as targets for restoration through prescribed burning. Current conditions data are used to measure the change from historic conditions and to act as a benchmark for change to the post-fire state. Finally, post-fire data will be used to determine the effect fire has on changing forest structure, composition and pattern, and to compare resultant forests with targets—states or range of conditions derived from past landscapes—established using the historic data.

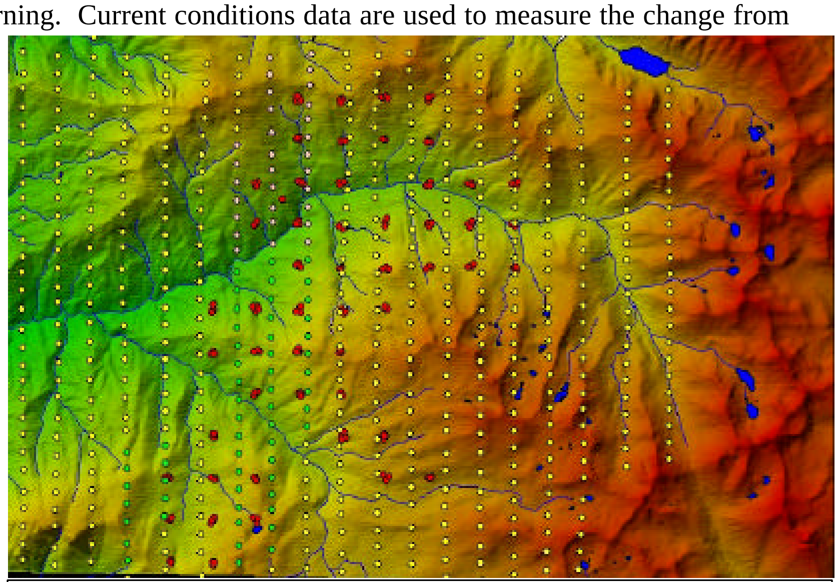


Figure 4.11-1: A digital elevation model (DEM) perspective of Mineral King. Green is low elevation and red is high elevation. Water is marked in blue. Yellow, green and pink dots represent center points of aerial images from 1997. Red dots (in tight clusters) represent MKLA forest inventory plots.

By collecting data over several spatial scales and across these three time periods we hope to assemble many pieces of the puzzle of landscape-level forest landscape change, disturbance and restoration. This large picture view of dynamics in this

Figure 4.11-3: Hemispherical photography processing steps (images: raw, corrected,

watershed will help us better understand:

- How variability in microclimate and topography in the forest affect stand heterogeneity
- How fires interact with stand heterogeneity to modify landscape mosaics of patches, gaps, and gradients
- What changes in structure and pattern have occurred in the system during the period of suppression
- What compositional shifts have resulted during fire's absence
- How a sampling strategy across a landscape could provide useful measures of landscape patterns and change (and perhaps could lay the groundwork for standard protocols for forested landscape monitoring)

And, as a result,

- When and where prescribed fire can be used as a restoration tool

In 1996 and 1997, over two hundred forest plots were established throughout the watershed. We hoped to inventory plots directly before the reintroduction of fire and immediately after. Unfortunately for this particular study, the schedule of burning has not matched the schedule of inventory. Over the last four years only twenty-nine plots out of 205 have burned (14%).

Due to the limited extent of burning in the mixed conifer portion of the watershed, we have turned our short-term attention to a more robust examination of the current (pre-fire) conditions in the area. These analyses are described below.

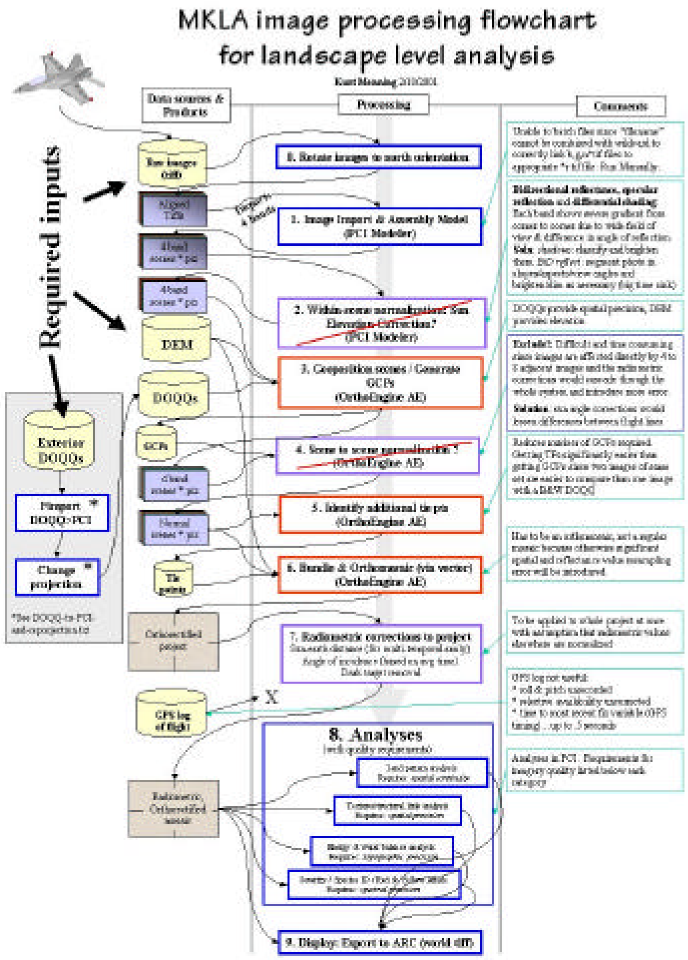
SUMMARY OF METHODS

Data on current conditions have been collected both within forests using an extensive forest inventory approach, and from the air in 1997 and 1999, using aerial photography. Field data for pre- and post-fire conditions are collected from forest plots ten meters in radius. These are located precisely using a precision global positioning system (GPS) unit. Within each plot, relatively broad inventories have been completed: trees were identified by species, measured and mapped; fuel conditions have been recorded; brush and plant cover were described; slope and aspect have been recorded; and light penetrating through the forest canopy was measured. When fire has burned in a plot, we re-inventory the plot completely and also measure the degree of scorching and charring on each tree.

In addition, we have collected hemispherical photographs from three points in 141 of the plots. These photos are transformed into binary images and run through software that determines the amount of biologically useable light reaching the location the photo was taken over the course of the growing season (**figure 4.11-3**). In particular, we are interested in percent open canopy, percent direct transmitted light, percent diffuse transmitted light, and percent total transmitted light.

Collection of the remote imagery data involved a more elaborate process. High resolution, digital photographs were collected during an over-flight in the summer of 1997. The digital photographs, with a resolution of about one meter, are actually four simultaneous pictures in different bands of light—blue, green, red, and near infrared. The instrument digitally records the time, flight conditions and position of each set of photographs. It is hoped that this special imagery will allow us to determine individual tree species and detect subtle changes in forest conditions due to stress or insect attack. Unfortunately, Digital Orthorectified Quadrangle (DOQ) maps were not immediately available and image processing was delayed until this year.

Figure 4.11-4: Remote image processing flowchart

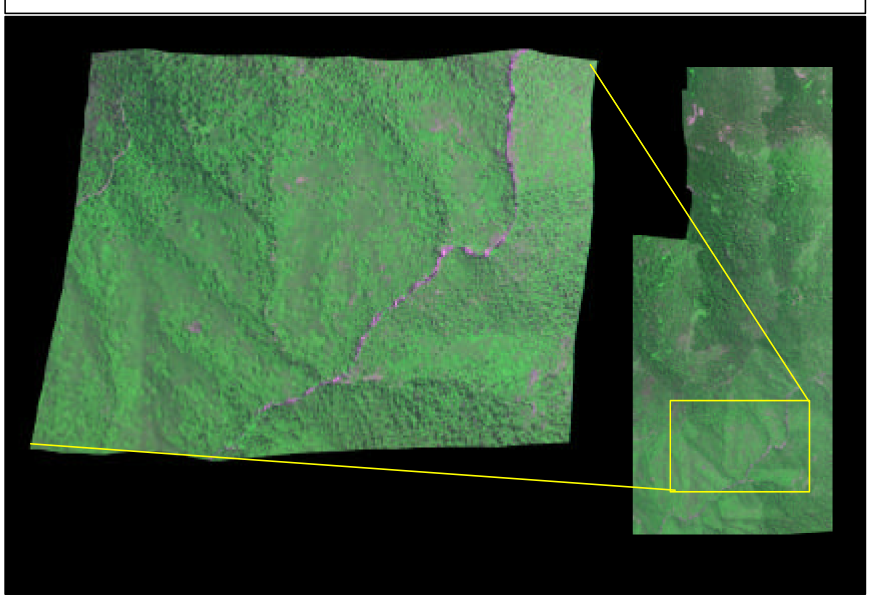


WORK ACCOMPLISHED IN 2000

Fieldwork

In the summer of 2000, we returned to the field for about three weeks to collect several kinds of data. First, we took hemispherical photographs in about a dozen plots in which we had problems with the camera in 1999. Second, our field crew re-inventoried twenty-four plots that we had reason to believe had burned. Twenty of them had been at least partially burned. Third, we collected additional samples from large (>80cm dbh) sugar pines (*Pinus lambertiana*) to further our assessment of the factors leading to the increased sugar pine mortality in the watershed.

Figure 4.11-5: An Orthorectified image being integrated into a mosaicked landscape for continuous pattern analysis.



Remote image processing

With the arrival of USGS digital ortho quart quadrangle (DOQQ) files we were able to move through image processing and mosaicking, a rather complicated procedure

Figure 4.11-6: Landscape structural diversity illustrated

High landscape structural diversity (above)

Low landscape structural diversity (above)

(**figure 4.11-4**). The result was a series of radiometrically- and geometrically-corrected images that are ready for assembly and analysis (**figure 4.11-5**). This image processing and assembly required a full-time assistant and full-time graduate student to work for approximately six months. The area completely encompassing the 205 field plots is now assembled and ready for analysis.

Additional analyses were continued on fire behavior and these are described below.

FINDINGS AND DISCUSSION

<u>Remote sensing processing and analysis</u>

A sub-selection of two hundred images from more than 700 have been turned into a continuous landscape mosaic of the watershed from 1997. This mosaic will be used in continuous landscape-level pattern analysis of forest structure. Currently, this is scheduled to be a chapter in Menning's dissertation and a subsequent paper.

In fall of 2000, we ran a test to determine if the spectral characteristics of the image could be used to help determine landscape structural diversity. By landscape structural diversity, we mean the variability of forest cover across the watershed (**figure 4.11-6**). To do this, we

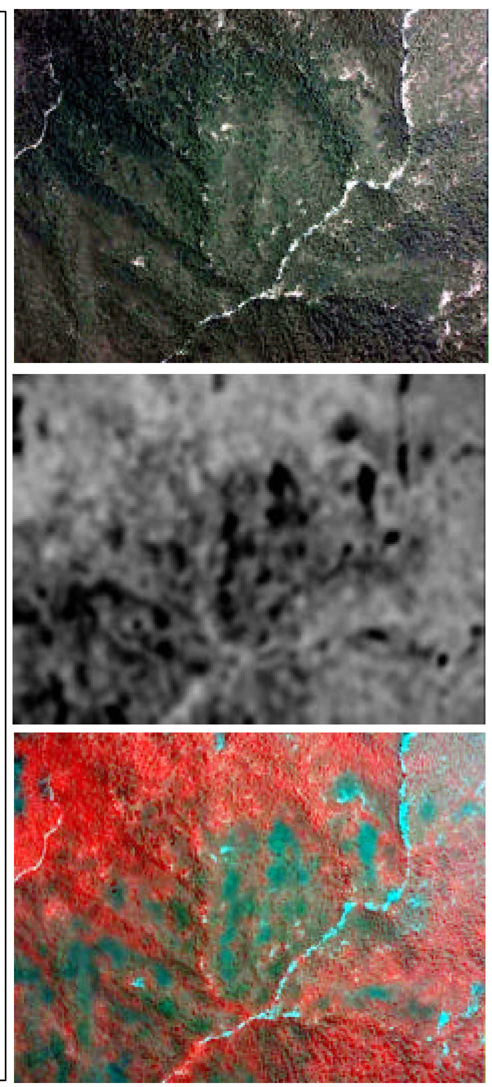


Figure 4.11-7: An example of the application of Spectral Chaos Indicator of Diversity (SCID): a) top—normal image, b) white indicating high diversity, c) projection of b over a.

developed

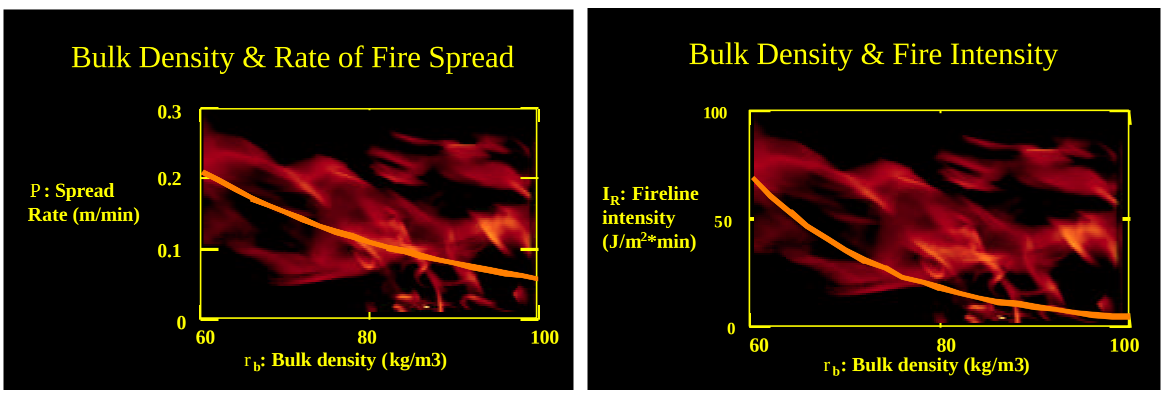
a new method, called the Spectral Chaos Indicator of Diversity (SCID). Because this is still in development, and forms the core of one chapter of Menning's dissertation, the details are not reported here. In short, however, the method allows us to create a continuous metric for the landscape representing structural diversity.

Starting with a multispectral image (**figure 4.11-7a**), we create a coverage that represents structural diversity below (**figure 4.11-7b).** In this second image, the degree of structural variability is represented by the intensity of the color. This can be reprojected over the original image and given a color such as red (**figure 4.11-7c**). In this case, what looks to be a vaporous red cloud floating over the landscape is actually a measure of the degree of variability in forest structure directly below. This method also forms the core of one chapter of Menning's dissertation and will be submitted as a paper next year.

Fire behavior analysis

In 2000, we continued our assessment of bulk forest litter density and its effects on fire behavior. These data were first presented last year in this forum and so are just briefly mentioned here (**figure 4.11-8).** They form half of one chapter in Menning's dissertation and will be presented as a paper in this coming year.

Figure 4.11-8: Diagrams of fire rate of spread and intensity as functions of litter bulk density



THE YEAR AHEAD

Currently, we have no plans to return to the field in the summer of 2001. The primary emphasis of our work at this point is simply to complete Menning's dissertation and provide copies of the final analyses to the National Park Service and USGS. A number of individual papers will be written and submitted over the course of the next few months.

We hope to return to the field in the summer of 2002 to collect additional post-fire data, if available.