3. Project Year 1998

The Mineral King Risk Reduction Project was initialized during March 1995 with inventory and monitoring field work and burn operations begun during the summer and fall (2,100 ac/850 ha in the Atwell Segment (segment #3), **Fig. 2.1-1**). No burns were conducted during 1996 due to the extent of resource demands during the summer of 1996 inside and outside the parks (more acres burned in the western USA than any year since 1920). The critical Redwood Segment, below and west of Atwell Mill, was burned during November 1997 (184 ha/455 ac). This completed the basic buffer of burned areas across the East Fork drainage (Atwell and Redwood Segments, and the Deer Creek Burn) which will provide better fire protection for Atwell, Cabin Cove, Silver City, and Mineral King from wildfires burning up out of the chaparral. Burning in the watershed during 1998 amounted to about 150 ha (371 ac) in two segments (**Fig. 3-1**).

Burn operations plans developed by the Fire Management Office during the spring of 1998 called for burning portions of the Tar Gap and Lookout Segments (segments #10 and #2 respectively) during the summer/fall. Ignitions in the Tar Gap Segment were planned to begin as fuels at higher elevations in the unit dried during the summer. The primary goal of the plan was to burn areas above the Tar Gap Trail with the trail being the main holding line. Depending on circumstances burning might continue below the Tar Gap Trail with the Hockett Trail being the secondary and lower holding line. The burn was to extend from the Mosquito Creek/Mineral Creek area in the northeast portions of the segment to Horse Creek to the south. Additional burning in chaparral and oak woodland in the Lookout Segment were planned to take place following significant rainfall. The plan is for rainfall to wet down heavy forest fuels while brush fuels would dry rapidly following precipitation.

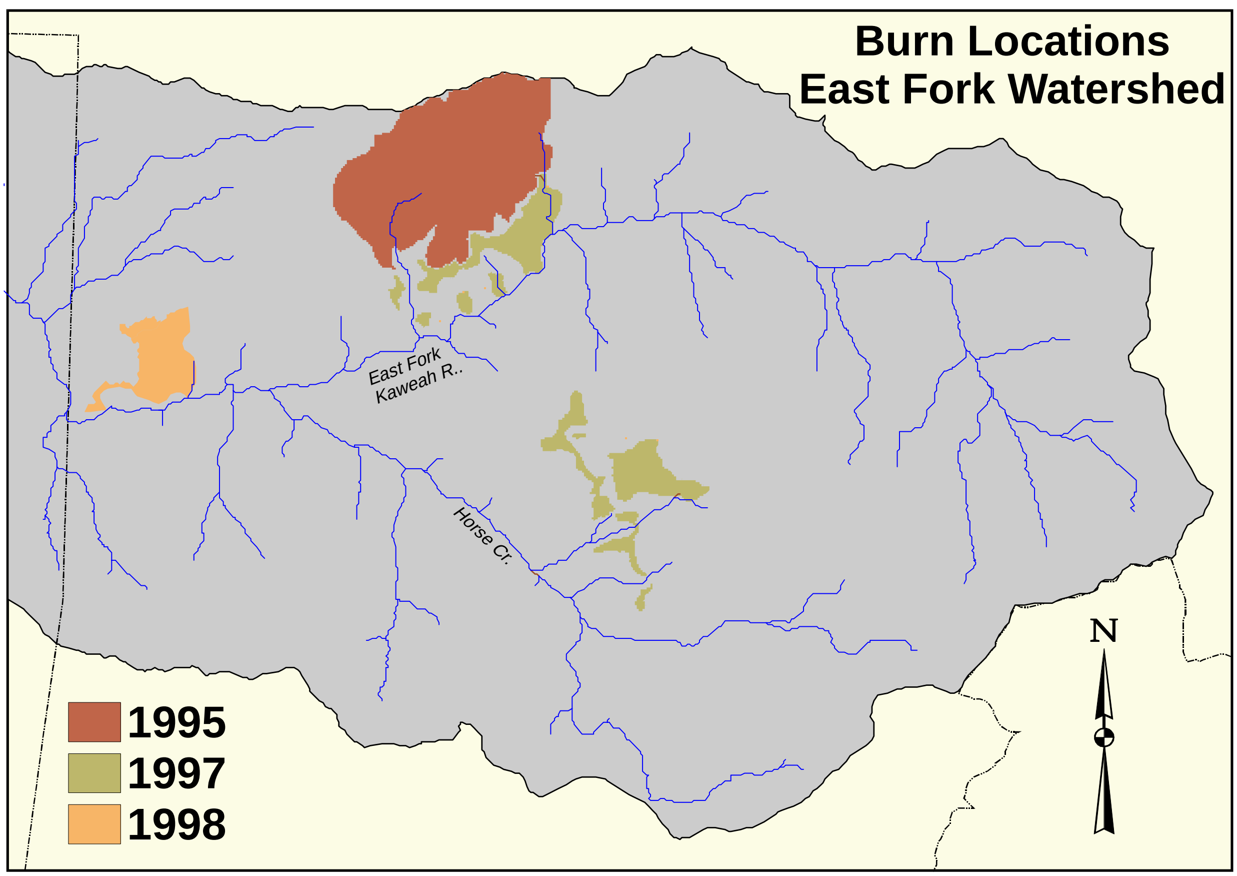

Figure 3-1. Locations of areas burned in the East Fork watershed from 1995 through 1998.

Figure 3-2. Prescribed burn in chaparral vegetation at Lookout Point entrance station. Area below structures was backfired prior to main unit ignition.

Portions of the Lookout Segment were burned during late October 1998. Ignitions were carried out at Lookout Point below and to the east of the entrance station structures (**Fig. 3-2**) and along the Mineral King Road toward Trauger's Creek. Both hand crews and a helitorch (**Fig. 3-3**) conducted ignitions. Unexpected weather and fire behavior eventually carried the burn from the road to the crest to Conifer Ridge where it burned out of the burn segment. Fire activity outside the burn unit was suppressed and a line constructed on Conifer Ridge to prevent future slop-overs. Vegetation burned in this portion of the unit was primarily chaparral and oak woodland communities.

Figure 3-3. Helitorch ignition of main Lookout Point segment below entrance station.

Monitoring, inventory, and research progressed, covering a large portion of the watershed (**Fig. 3-4**). Projects included studies begun during 1995 and several new investigations. The former include: (1) fire effects plots; (2) sequoia fire scars; (3) natural resource inventory; (4) fuels; (5) wildlife-small mammal populations; (6) fire history; (7) watershed-chemistry and hydrology; (8) watershed-aquatic macroinvertabrates; (9) resampling of red-fir plots established by Donald Pitcher. The latter include: (1) fire and red fir regeneration; (2) landscape analysis of changes in forest structure over time; (3) population and niche requirements of bark-foraging birds; and (4) establishing permanent fuel plots. A significant amount of information has been collected from throughout the East Fork during summer over the past four seasons.

3.1 - Vegetation Sampling

3.11) Mineral King Landscape Assessment[1] in support of the Mineral King Risk Reduction Project

Principle Investigators:

Kurt Menning, Dr. Tracy Benning, and Dr. John Battles, University of California, Berkeley, in conjunction with Dr. Nathan L. Stephenson, Biological Resources Division of United States Geologic Survey, Sequoia and Kings Canyon Field Station.

1998 field crew: Kurt Menning, Adrian Das, Brian Knaus, Jeannette Owen, Jonny Beals-Nesmith, and Ryan Slack.

PROJECT OBJECTIVES and BACKGROUND

As coordinators of the Mineral King Landscape Assessment (MKLA) we are about to begin our fourth year of investigating forest conditions of the mixed conifer forest in the Mineral King watershed. As in many western forests, the suppression of wildfires has altered forests over the last century in Mineral King. The lack of fire has directly 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. As a result, many park managers and scientists believe we should restore forests to within some range of historic conditions at the same time we reduce risk. To test the effects of restoring forests with fire we are monitoring the 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 what historic forests were like when these forests were experiencing more frequent fire, how these forests have changed up to the present with the suppression of fire, and what effect re-introduced fire has on altering current forest conditions. To answer these questions we need data from three time periods: past, present (pre fire), and post-fire. Historic data are necessary to establish a baseline from the past to present and to act as targets for restoration through the re-implementation of fire. Current 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 are 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.

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

How variability in microclimate and topography in the forest affect stand heterogeneity?

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[1] The Mineral King Landscape Assessment represents a broad collaborative effort involving Sequoia and Kings Canyon National Park; U. S. Geological Survey, Biological Resources Division; and the University of California, Berkeley's Laboratories of Forest Community Ecology (Dr. John Battles) and Landscape Ecology (Dr. Tracy Benning). Kurt Menning, a Ph.D. candidate at the University of California, Berkeley, is the lead analyst in the project.

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 we started the project and established 52 forest plots (**Fig. 3.11-3**). None of the plots burned between the summers of 1996 and 1997, and so in the summer of 1997 we continued focusing on the current conditions in the watershed. We expanded our sampling throughout the watershed by increasing our number of forest plots to over 200. With the fires that burned in Mineral King in autumn of 1997 we targeted summer 1998 as our opportunity to revisit plots that had been burned.

We entered the 1998 field season with preliminary fire extent maps that indicated that 25 to 40 of the MKLA plots should have burned. In the course of the summer, our crew re-inventoried 68 MKLA plots and found that only nine plots had burned. Seven of these burned plots were west of Atwell Creek and two were along the Tar Gap Trail. Of the plots that did burn, five are mixed-conifer plots, two are mixed-conifer/oak woodland, and two are red fir. With such a small sample of burned plots we have been unable to draw meaningful conclusions about the effects of fire. Unfortunately, there were no fires in the autumn of 1998 and spring of 1999 near the plots and so we will have no new fire data in the summer of 1999. As a result, we have turned our short-term attention to a more robust examination of the current (pre-fire) conditions in the watershed. These analyses are described below.

METHODS

Data collected in support of this project come from three time periods—historic, pre-fire (current conditions), and post-fire and three spatial scales—within plots, between plots and across the landscape. Current conditions and post-fire data are collected both within forests by use of an extensive forest inventory approach, and from the air, using aerial photographs. Historic data have not yet been examined closely.

Field data for pre- and post-fire conditions are collected from forest plots ten meters in radius **(Fig. 3.11-1**). These are located precisely using a precision global positioning system (GPS) unit. Within each plot, trees are identified by species, measured and mapped; fuel conditions are recorded; brush and plant

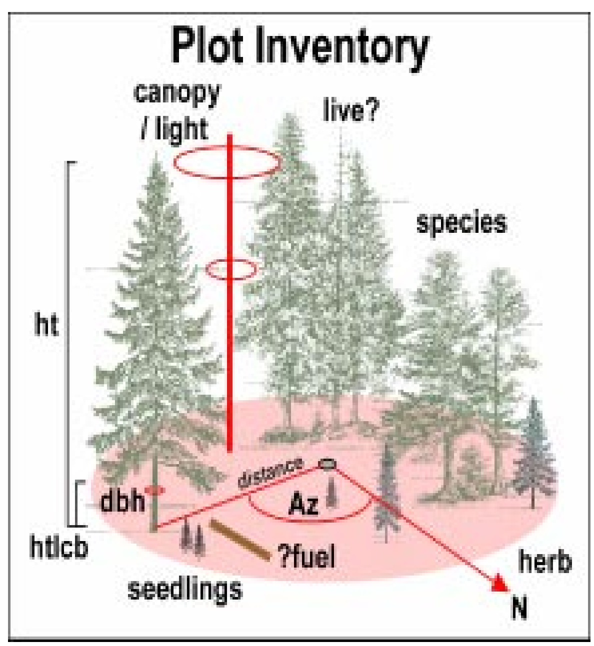

Figure 3.11-1.

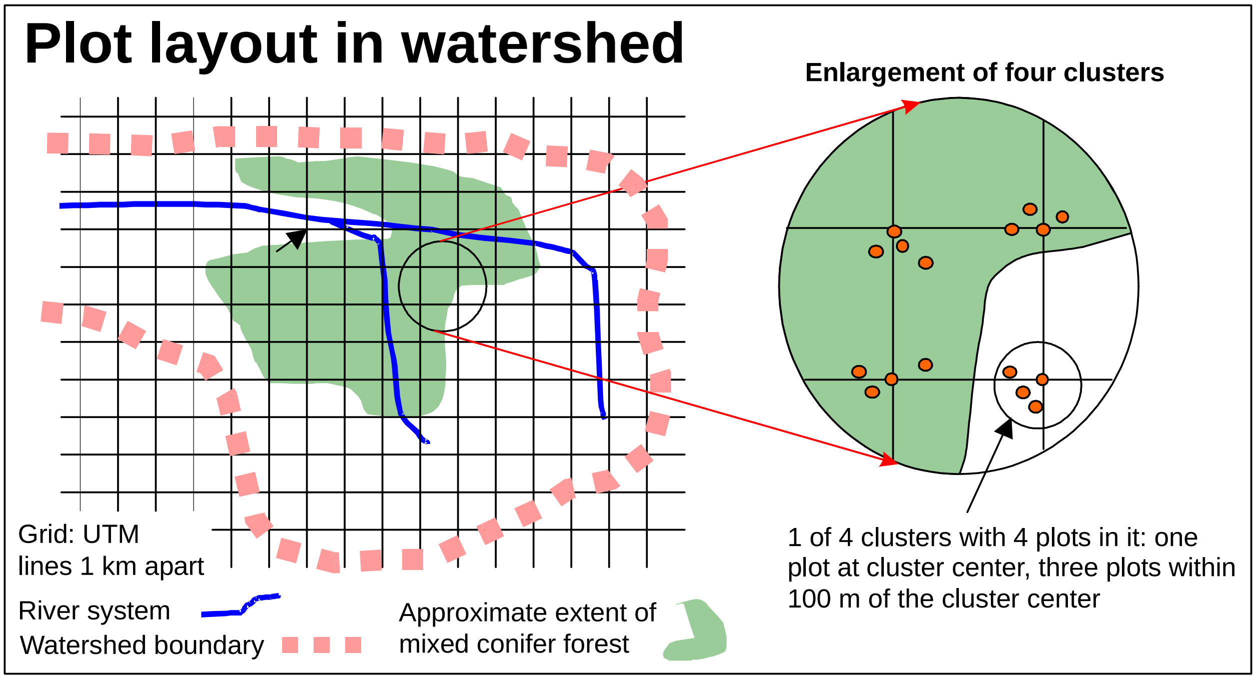

Figure 3.11-2.

cover are described; slope and aspect are recorded; and light penetrating through the forest canopy is measured.

Collection and processing of the remote imagery data is a more elaborate process. High resolution, digital photographs were collected during an overflight 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.

WORK COMPLETED IN 1998

The 200+ plots in the Mineral King Landscape Assessment span the range of the mixed conifer forest type. Over 2500 trees taller than breast height (1.37 m, or 4.5 feet) have been described and mapped covering a total area greater than six and a half hectares (16 acres). In addition, data from 1800 soil depths, litter and duff measurements, and seedling counts have been tallied. Of the 68 plots re-inventoried in 1999 only nine plots had burned. Due to the small nature of the plots, a large number of plots is necessary to draw statistically-valid results. Hence, we have shifted the short-term focus of our analysis from the effects of fire to a more robust investigation of current conditions.

Some fire scientists have contended, for example, that current forests are too evenly structured to experience highly variable mortality from fire. To test this contention prior to the reintroduction of fire, we examined the current structure and composition of the mixed conifer forest in Mineral King using 128 10m radial plots in clusters of four (32 clusters)[2] (**Fig. 3.11-2**) A modified Gini coefficient was used to measure changes in the frequency distributions of diameter, basal area and tree height as a function of macroaspect,

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[2] These plots were chosen from the overall total of 200 because they represent complete clusters of mixed conifer plots whereas some plots have only red fir.

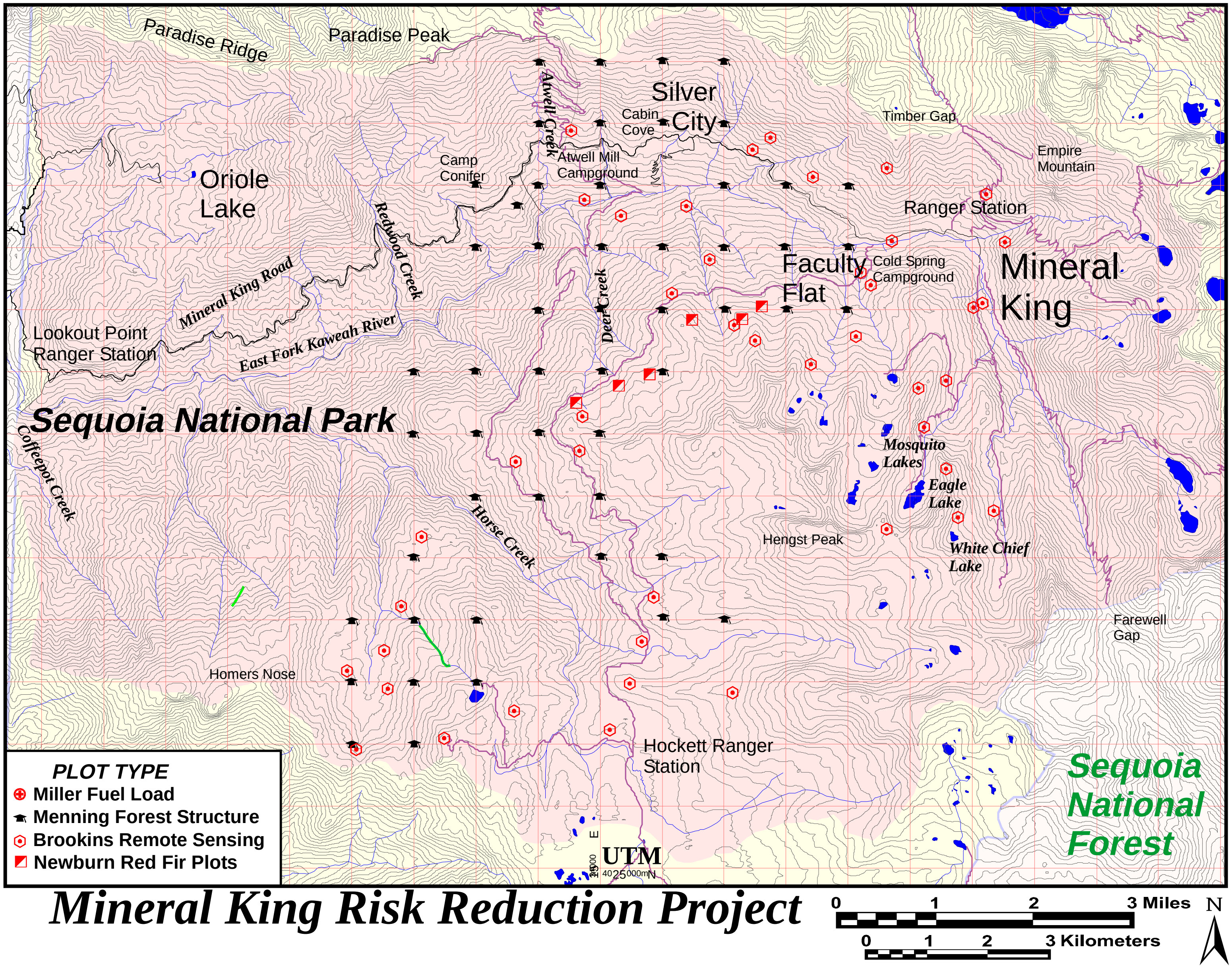

Figure 3.11-3. Plot locations for graduate students working on vegetation studies within the East Fork.

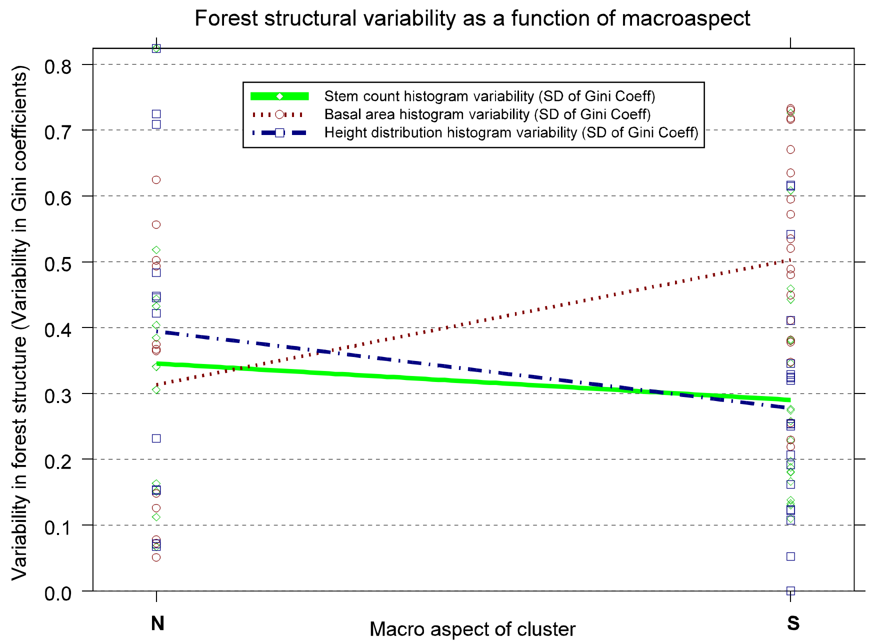

Figure 3.11-4

elevation, and local variation in topography at the scale of 10's to 1000's of meters (**Fig. 3.11-4** and **3.11-5**). Statistically significant differences exist between distributions of height, diameter and basal area as functions of macroaspect, with distributions on southern aspects skewed toward more, smaller trees. Total numbers of trees per plot are not significantly different from clusters on opposite macroaspects. On southern aspects the total basal area per plot is lower and varies less per cluster than on northern aspects. The distribution of basal area by size class, however, is more variable on the southern aspect. Structural variability in the distribution of height, diameter and basal area of the forest between the two macroaspects indicates post-fire structure may also vary between the two macroaspects. High structural diversity on the southern aspect indicates post-fire structural diversity may be higher than comparable locations on the northern aspect, which have a more evenly distributed forest structure. Post-fire analysis will help us determine if this is true.

Having examined the variability in forest structure we decided to examine the variability in ground and surface fuels as well. Do they vary in the same way in relation to topography? The same plots as described above were inventoried for litter (Oi) depth, duff (Oe) depth, and woody surface fuel mass. All three fuels measures are examined as functions of elevation, aspect, and variability in local surface topography. The fuel measures were found to vary with elevation on different aspects of the watershed but not to change predictably with local topography. As a result, we conclude that variability in fuel loads is not as predictable as variability in forest structure. Based on this, we believe that it is important to have detailed ground-based information on both the distribution of fuels and forest structure, in addition to fuels continuity, in order to predict fire behavior and to examine changes to forest structure due to fire.

An additional source of information we are currently processing is the remote imagery. Over seven hundred digital aerial photographs were successfully taken in 1997. Processing and analyzing the images is not yet complete. A heavy workload with the field data and a lack of supporting terrain information from USGS has delayed the process.

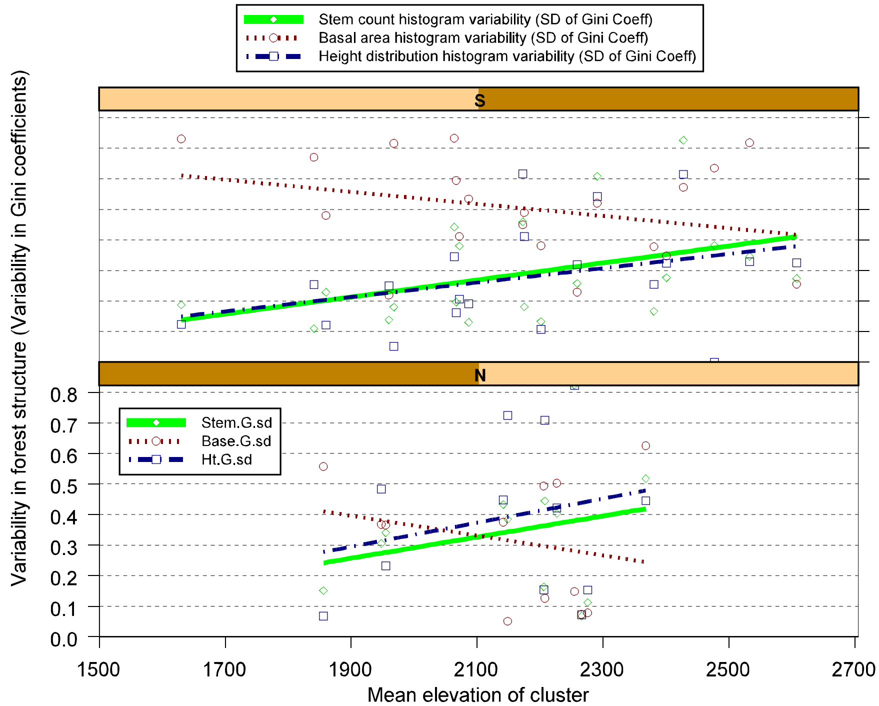

Figure 3.11-5.

FUTURE WORK: SUMMER 1999 and BEYOND

In summer 1999, the MKLA project will expand. We expect to conduct ten weeks of intensive fieldwork. During the six weeks, four field crew members will take hemispherical photographs of forest crown structure in the MKLA plots. Additionally, we will collect more detailed information on soil depth and texture as it affects the retention of water. These factors are important in understanding variability in the way forests grow in the absence of fire and, as a result, the way in which they generate fuels and respond to fire. During a long period of fire suppression, as much of Mineral King has experienced, site-potential differences may have resulted in uneven forest growth. This, in turn, may have resulted in highly variable fuel loads and could lead to a patchy fire pattern. By collecting these additional data we hope to be able to examine these relationships.

We are also beginning related work looking at the effects of fire suppression on the mortality of large sugar pines. Many fire scientists believe that re-introducing fire with prescribed burning can lead to increased mortality of large pines. During fieldwork in Mineral King, however, we have observed another trend that complicates the argument that burning around old pines can kill them. In Mineral King, large sugar pines (***Pinus lambertiana***) appear to be dying with greater frequency than other large trees even *without* fire. It is probable that in the course of fire suppression individual large sugar pines are being out-competed by the many small white fir (***Abies concolor***) and other species that are normally killed in light or moderate fires. The death of large trees due to competition by many small trees during fire suppression has been the source of some conjecture but little direct research. High mortality may also result from manifestation of blister rust or climate change; however, mature trees are not as susceptible to blister rust and the wetter weather this century should favor mature sugar pines in the mixed conifer forest. Hence, we believe the increased mortality of large sugar pines to be due to elevated biotic competition that has resulted from fire suppression.

To address this question, we are going to selectively core and geo-reference large living and dead sugar pines. We would like to determine date of death (through cross dating) and recent rates of growth. If there is a substantial decrease in growth rate over this warmer, wetter century, we may intuit that it is due to increased competition. If this is observed and can be correlated with air photos showing an increased density of small trees in these locations we may be able to show a relationship between the absence of fire and compositional and structural change: the loss of the large pine component of this forest.