3.14) Prescribed Fire and Heavy Fuel Effects on Mature Giant Sequoia Trees

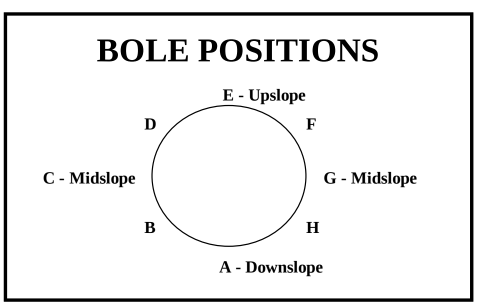
- Georgia Dempsey and MaryBeth Keifer, Science and Natural Resources Management, SEKI

In 1995, a pilot project was initiated in the Atwell Grove area of Sequoia National Park. This fire scar study was undertaken as one facet of the Mineral Kink Risk Reduction Project (MKRRP). The focus of this pilot project was to assess the impacts of fire on giant sequoias, (*Sequoiadendron giganteum*). Preliminary results obtained from data collected over the course of two summers (1995-1996) are presented below. Variables such as charring, the formation and positioning of new scars, fuel consumption, scorch height, and tree mortality were examined on a total of 60 study trees.

The impetus to conduct such a study has its basis in history. In 1986, no prescribed burns occurred in the sequoia-mixed conifer forests of the park due to a controversy focused around the charring of a sequoia tree within the Broken Arrow burn unit, located in Giant Forest. This incident spurred a review of the park's burn program by a group of independent scientists. Though the burn program was deemed to be sound, the review panel suggested initiating more research projects to better determine the effects of fire on park resources (Christensen et al, 1987). Information gathered during this study should help managers to decide new policies regarding burning operations in this forest type.

Despite the one-year hiatus on burning, dendrochronolgy records have shown that fires were a natural and frequent element of these forests prior to the 1860's. By examining fire scars that had formed in five different giant sequoia groves, along 160 km of transects, Swetnam et al.(1992) discovered that the longest fire return interval found between fires, was a period of 30 years. Often the return interval was less than 15 years, with the mean ranging between three and eight years depending upon site characteristics. These frequent fires were generally of a low to moderate severity (Kilgore 1981) but occasional flare-ups did occur where jackpots of fuel were encountered (Stephenson et al. 1991) thus creating vegetation mosaics.

Using this background knowledge, 60 giant sequoia trees were chosen for this study, based upon the criteria which follow. Initially, 30 trees were scarred; 15 of these had relatively high fuel loads and 15 had relatively low fuel loads. Conversely, 30 trees were unscarred with fuel loads that ranged similarly. Slope measurements ranged between 20 and 70% and aspect was between SE and SW. Rejection criteria included: slopes out of the range stated, aspects out of the range stated, the presence of heavy ladder fuels within a 25 ft. radius of each tree, trees with >75% of the basal circumference scarred by fire, twin trees, trees located within ten ft. of other sequoias, trees with extreme abnormalities such as an excessive lean or a highly irregular bole shape. Trees that passed this series of criteria were tagged at 8 fixed positions so that variables could be measured on each tree relative to the bole's position with the slope, as shown in the diagram below.



One year, post-fire measurements indicate that one hundred sixty-three new scars formed on a total of thirty-four of the study trees. Close examination of these scars indicates that the average maximum width of the scars was 11.0 cm, during the yr-01 check, as compared to 12.2 cm the following year. The yr-01 data also reveals that, on the average, new scars started forming 105.9 cm above the ground and ranged to an average maximum height of 135.9 cm. Consequently, the actual, average height of the scars was approximately 30 cm.

Though the averages are meaningful in a broad sense, the ranges of these values are also telling since a wide variety of scar sizes and positions were used to obtain these typical results. For example, maximum width values ranged from .25 cm up to 131 cm across, when measured along a level plane. Likewise some scars started forming at the base of the tree while others sprang up 790 cm up the bole. Maximum height values displayed a similarly large range with one scar peaking at .75 cm above the ground while another ascended up the bole to a total height of 860 cm.

Bark charring was measured on 58 of the 60 study trees. Sampling indicates that the average distance covered by blackened bark, or char, was 367.3 cm. Maximum char height was also mapped and recorded on 57 of these trees by utilizing the 8 marked positions shown in the diagram above. Position "E," the most upslope position, received the greatest number of maximum char records with a total of 23. The average charred distance at this bole position was 1100.6 cm. This same position also accounts for the greatest number of newly formed scars (**Fig. 4.14-2**).

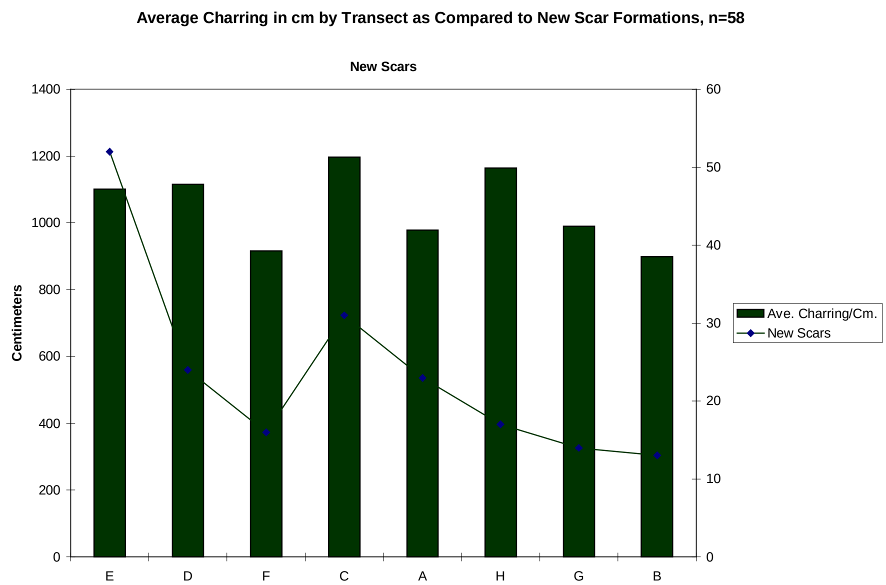
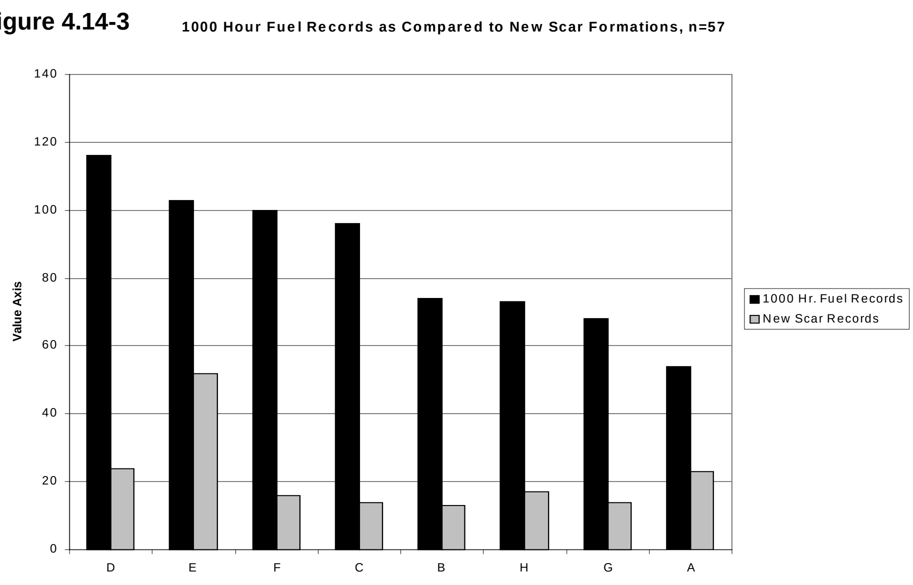


Figure 4.14-2

The appropriate location and orientation of 1000 hour logs was drawn in reference to the bole of each of the study trees, both pre and post-fire. This was intended to show large accumulations of fuel within a ten ft. radius of each sequoia. Likewise, the length and diameter of each log was also recorded on the map. To date, these maps have been analyzed by transect out to the two ft. and five ft. intervals. **Fig. 4.14-3** displays the findings for the 5-ft. interval. Note that positions E, C and D, which had the highest number of new scar records respectively, also ranked within the top four positions for having 1000-hour logs within 5 ft. of the bole.

Figure 4.14-3



The reduction of 1000 hr. time-lag fuels as well as litter and duff has been analyzed by bole position. The average percentage of reduction for this fuel category, is as follows: A=43%, B=97%, C=46%, D=50%, E=51%, F=75%, G=60% and H=57%. To date, tons per acre (tpa) have been estimated by using only the 1000 hour intercepts. This method reveals that position A had 11.95

tpa and ranked 4th for new scar formations; B had 31.96 tpa and ranked 8th; C had 207.37 tpa and ranked 2nd; D had 207.98 and ranked 3rd; E had 110.27 and ranked 1st; F had 79.15 and ranked 6th; G had 71.08 and ranked 7th; while H had 34.99 and ranked 5th. More comprehensive analyses are planned for the future and will examine fuel loadings by transect and by individual tree. Fine forest fuels such as litter and duff were reduced more uniformly, with all positions showing at least 95.9% of the material removed by the application of fire.

To date, only a very preliminary analysis has been run on this project's database. Further examination of the data and additional statistical tests should better illuminate the multi-faceted relationship that exists between scar formation and fuel consumption. Despite the infancy of this analysis, the pilot project did reveal that despite heavy fuel loads no mortality occurred within the trees sampled. Numerous scars did form as a result of the burn, however, they were typically small in size despite the buildup of fuels. Future work will entail monitoring these trees to watch for changes in scar size and shape over time as well as conducting a more detailed analysis.