Comparative study of Abert Squirrel Herbivory Patterns in Burn and Non-burn Ponderosa Pine Zones

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Abstract. A prescribed low intensity burn site and a control site were investigated to distinguish differential herbivory patterns exhibited by Abert Squirrels. The number of "bones" or remnant feeding twigs per tree were recorded and shown to be significantly higher (p= 0.009) within the burn site. This variation in feeding behavior may be attributed to increased growth in phloem tissue or decreased levels of secondary metabolic compounds following a fire.

Introduction. The tassel-eared Abert Squirrel (Fig.1) is commonly found within the ponderosa forests of the Colorado Front Range. These squirrels exhibit highly specific herbivory patterns on the cone and phloem tissues of the Ponderosa Pine. Specific trees are targeted by Aberts, while other neighboring trees are left completely untouched. Several projects are currently studying whether this specificity is related to differences in secondary compounds, physical structures, and resin pressures among trees (Linhart et al, 1993).

A controlled low intensity surface burn was conducted on Flagstaff Mountain by Boulder Mountain Parks in October 1993. This site was a test zone for the importance of burns within protected areas and their effects on the proliferation of flora and fauna within these zones. The burn resulted in the removal of understory growth and the creation of snags for wildlife habitation (Kimmins et al, 1996).

Although there have been no specific studies done on the effects of fire on the Abert feeding patterns, periodic fires have been shown to be important in maintaining the habitats of Key Deer by benefiting their food sources (Carlson et al, 1993). Our study would indicate whether small controlled burns have a positive or negative effect on Abert feeding. We expect to see an increase in food consumption in the burn site due to increases in ponderosa pine growth and changes in chemical composition.

Methods. We conducted our study at burn and control sites on the top of Flagstaff Mountain near the Ute Trail. The burn site was located to the south of the Ute Trail near the Artist Point parking lot. The control site was adjacent to the burn on the north side of the Ute Trail. We randomly chose trees by spinning a group member to a point on the horizon. The closest tree along this imaginary line was measured to insure the diameter was within 10 to 20 inches at breast height. To determine Abert feeding rates at these trees we looked for "bones". "Bones" are portions of the crown branches from which the phloem has been thoroughly gnawed and eaten by the Aberts. At each tree we recorded the number of bones beneath the canopy.

Results. We used Analysis of Variance (ANOVA) to determine a P-value of 0.009 showing a significant difference in feeding by Aberts in the burn versus the non-burn site. The average number of bones per tree was much higher in the burn site (20.35 bones/tree) than in the non-burn site (3.2 bones/tree). The error bars within this graph indicate a distinct variance among trees within individual sites (Fig. 2).

Average Bones Per Tree in Burn and Non-Burn Sites

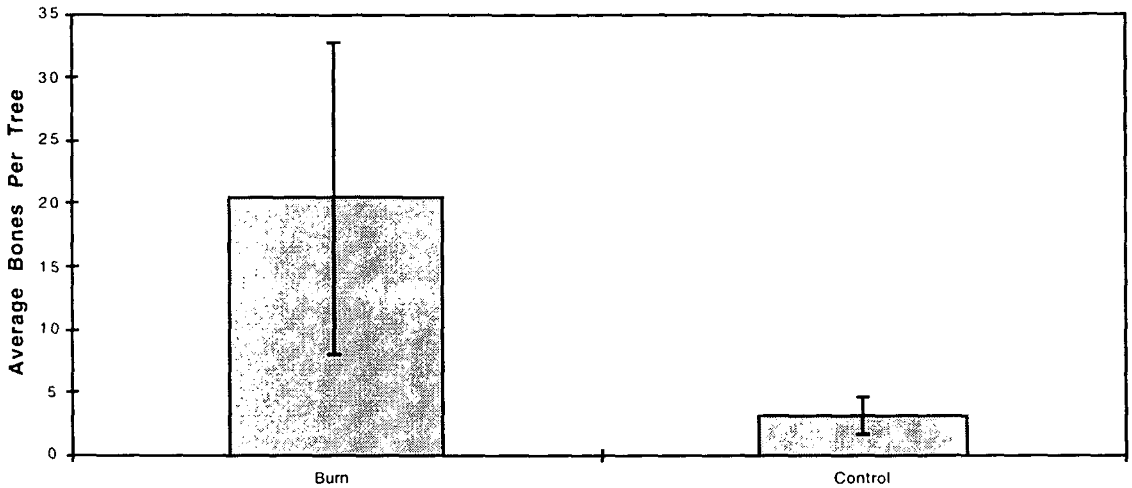

Figure 2. The average number of bones counted per tree at the burn and control sites based on raw data collected at Flagstaff Mountain.

Discussion. Our statistical results support that fire impacts influence Abert feeding patterns. The large standard error is due to the presence of target and non-target trees; our random selection of subject trees did not measure this distinction between targeted trees therefore we would occasionally record non-target trees. This creates variations in the data, since one tree may have many bones, while a neighboring tree may have none. Although the error shows an inconsistency within sites the intersite bone counts illustrate a clear difference between site palatability.

We attribute this differentiation between sites to the nutrient, chemical, and physical impacts of low intensity fires within ponderosa stands. Due to reduced competition and deposited organic matter nutrient releases occur following fires which promote the increased growth of more mature surviving individuals. Available nutrients, such as nitrogen and phosphorous, were shown to increase in the top 15 centimeters of soil after a fire while deeper layers remain unaffected (Kitchen et al, 1972). Average growth rate was found to distinctly increase following fire in ponderosa within Arizona (Weaver et al, 1955). Peet (1981) suggests that fire reduces competition with grasses and Douglas fir seedlings, which directly results in increased Ponderosa growth. Phloem production is positively correlated to seasonal diameter growth. Because Aberts target phloem tissues when cone crops are unavailable a connection between fire effects and Abert feeding can be established.

Producing secondary metabolic compounds is an energetically expensive investment for stressed trees. Therefore, studies have been focused in determining whether chemical compositions vary in fire zones. Monoterpenes have been found to decrease after fires and it has been found that Aberts feed on trees that contain lower amounts of monoterpenes (White et al, 1993) However, as trees reestablish their metabolic equilibrium these monoterpenes have been found to gradually increase. This shift in chemical content supports our results while the incremental increase might explain why older bones were predominantly found within the burn zone.

This observation of older bones has led us to reevaluate our experimental procedures. It is possible that the variance in proportions of old and new bones between the two sites can be attributed to the differences in forest floor cover. The control site had a much deeper bed of pine needles which concealed possible older bones. This discrepancy has potentially influenced our results. Therefore, in the future we would sift through the needle coverage to thoroughly collect all possible bones. To truly address this question, further studies must comprehensively evaluate both pre-fire and post-fire chemical compositions, nutrient balances, and target tree dispersal's in order to effectively evaluate fire impact on Abert feeding.

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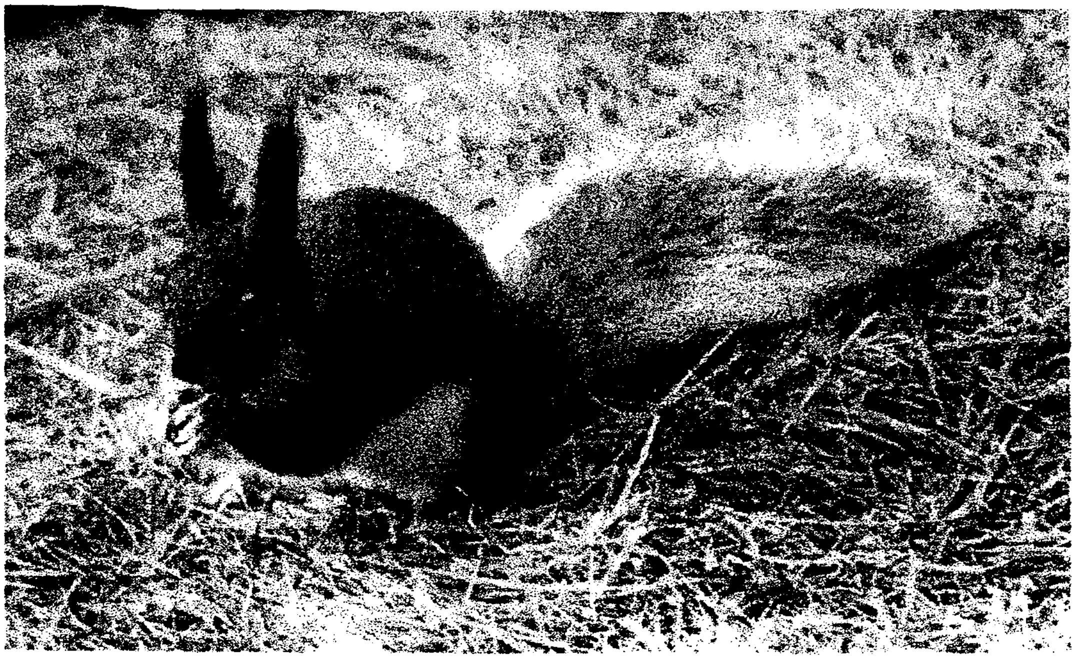

Fig. 1 Abert Squirrel

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