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PLANT COMMUNITY RESPONSES TO THE USE OF PRESCRIBED BURNING AS AN ALTERNATIVE TO MOWING IN THE MANAGEMENT OF BIG MEADOWS, SHENANDOAH NATIONAL PARK¹

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Big Meadows exists as one of the few remaining open grassland communities in Shenandoah National Park. Extensive pasture and various stages of old-field succession characterized the vegetation along Skyline Drive when private use was terminated and the park established in 1935. Uninterrupted succession during the forty succeeding years has returned over 99% of the acreage within this long, narrow Virginia park to successional forest. This loss of open plant communities threatens the existence within the park of several plant and animal species due to the reduction of habitat diversity. The major exception to this trend of maturation is the approximately 100 ha tract located across Skyline Drive from the Byrd Visitor Center which is known as Big Meadows. This community which contains predominantly herbaceous vegetation, has been maintained at an early stage of succession by periodic mowing. Shrub growth is presently so extensive that mowing has been an annual fall management practice for over ten years. This has become an increasingly expensive undertaking, and furthermore, it appears to be stabilizing the community at the shrub-briar stage rather than the more desirable grassland-shrub mosaic.

The decision was made in the fall of 1974 to undertake a limited experimental study of the feasibility of the use of prescribed burning as an alternative management practice to mowing. This paper is a report of the preliminary findings concerning the plant community response to a burn which was carried out on April 17, 1975. These data were gathered during the balance of the summer growing season. This paper will be limited to a discussion of the two management questions which were initially posed: 1. Can the less expensive and more rapidly accomplished prescribed burning be used as a substitute for mowing? 2. Would prescribed burning alter the apparent tendency for the meadow to stabilize at the shrub-briar stage and maintain a more heterogeneous mosaic of vegetation?

Sixteen 0.1 ha plots were studied using a 2 x 2 x 2 replicated factorial experimental design. The three main effects were the presence or absence of the prescribed burn treatment, whether the plot had been mowed the previous fall (1974), and the stage of succession in terms of being predominantly grassland with herbaceous species or shrubland with blackberries, *Rubus* spp., and black locust, *Robinia pseudoacacia*, as dominant types. Ms. Baxter used a 0.5 m² frame which was partitioned into decimeter square sections to estimate cover and Mr. Lilly used 0.25 m² above ground clip samples to measure standing crop. These vegetation characteristics were sampled prior to the burn and at several additional times during the growing season. The first complete post-burn samples were taken in May, one month after treatment. Rapid regrowth of vegetation

occurred in all burned plots and no adverse soil nutrient loss or erosion effects were observed.³

The total biomass of living tissue in the grassland component of the meadow community at three times during the growing season is presented in Fig. 1. Each of the bars represents one of the four management combinations. Considerable variability was evident early in the season due to the discontinuous distribution of *Vaccinium*. Burning significantly reduced the living herbage in both mowed and unmowed communities subsequent to the stress but all treatments returned to approximately control levels by the end of the season.

Biomass data from the shrub community are considered similarly in Fig. 2. It was more difficult to separate living and dead tissue in this community when the April pre-burn samples were taken than it was in the grassland community. Therefore, total living and dead biomass are included and the living proportion is estimated based on values obtained after the stalks leafed-out in May. Significant reductions in biomass were obtained from both mowing and burning which persisted until the end of the growing season. No consistent differences were observed between the treatment combinations for August standing crop. Therefore, burning and mowing appear to be equally effective in reducing shrub-briar growth.

Total vegetation cover in both the grassland and shrub communities is presented for each treatment combination Fig. 3. Values in excess of one meter square vegetation per meter square surface area are explained by layering of the vegetation. These August data represent the maximum end-of-season plant cover since fall die-back began to occur during the month of September. Cover follows the same pattern as biomass in the shrub community and is significantly reduced by both mowing and burning. However, in the grassland, a reduction in cover following burning persists until the end of the season in comparison with the control vegetation, while mowing alone may even increase total plant cover in some cases.

A second year study and more extensive evaluation of the 1975 data will provide additional information concerning the individual species responses to the prescribed burn. Two major trends are already evident. Roughly twenty percent of the cover in the control grassland community is graminoid (*Agrostis tenuis*, *Calamagrostis canadensis*, *Dactylis glomerata*, *Danthonia compressa*, *Panicum implicatum*, *P. latifolium*, *P. linearifolium*, *Carex argyrantha*, *C. brevior*, *C. glaucaudea*, *C. leptalea*, *C. tribuloides*, and *Luzula bulbosa*). Figure 4 shows that both mowing and burning tend to increase graminoid cover in the successional communities and illustrates the large difference in species composition between the two seral stages. The second major trend is illustrated in Fig. 5. In this case, the relative cover of the two major briar species in the shrub community is illustrated. *Robinia* and *Rubus* occur in nearly

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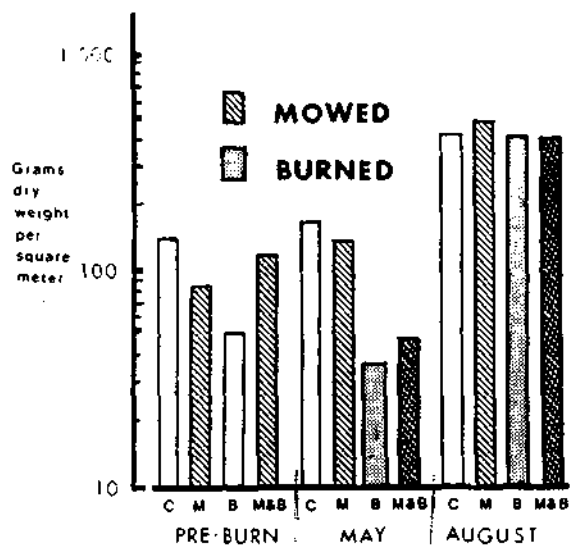


FIGURE 1. Total biomass in the grass dominated community type at Big Meadows, Shenandoah National Park. C = untreated control vegetation; M = mowed in late 1974; B = burned on April 17, 1975.

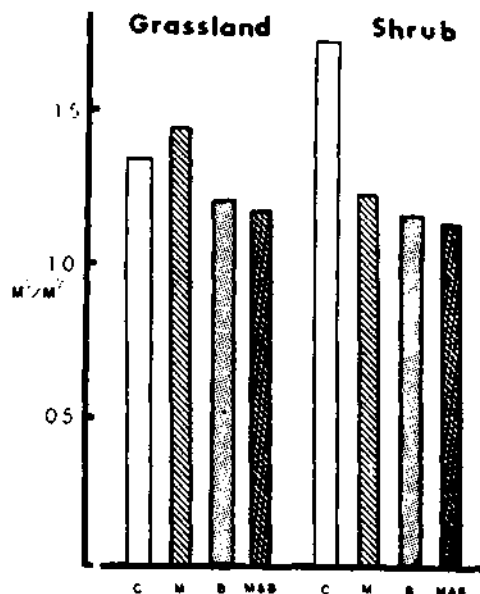


FIGURE 3. Total absolute cover in August in both the grassland and shrub community types at Big Meadows, Shenandoah National Park. C = untreated control vegetation; M = mowed in late 1974; B = burned on April 17, 1975.

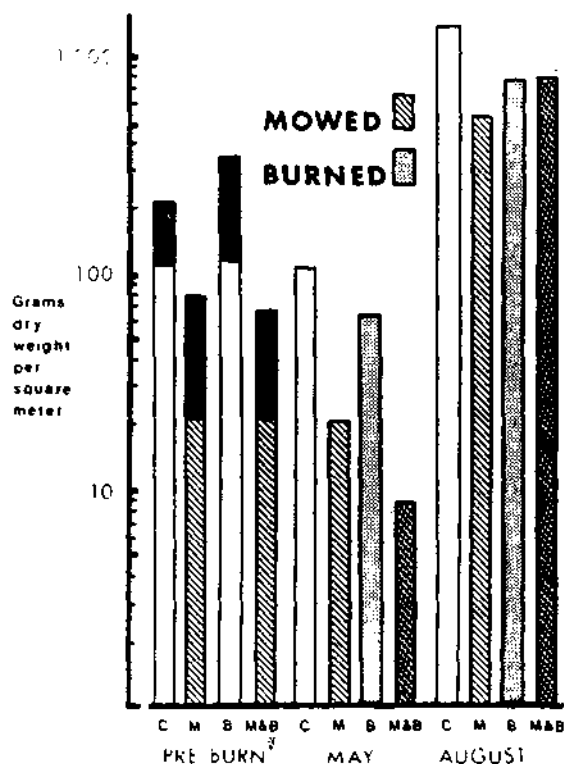


FIGURE 2. Total biomass in the shrub-briar dominated community type at Big Meadows, Shenandoah National Park. C = untreated control vegetation; M = mowed in late 1974; B = burned on April 17, 1975. *The April pre-burn sample includes both living and dead above ground tissues. The amount of dead tissue is estimated by the black portion of the bars.

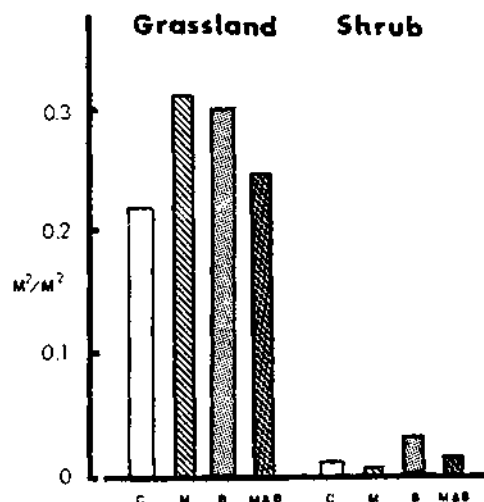


FIGURE 4. Absolute cover in August of the graminoid species in the grassland and shrub-briar community type at Big Meadows, Shenandoah National Park. C = untreated control vegetation; M = mowed in late 1974; B = burned on April 17, 1975.

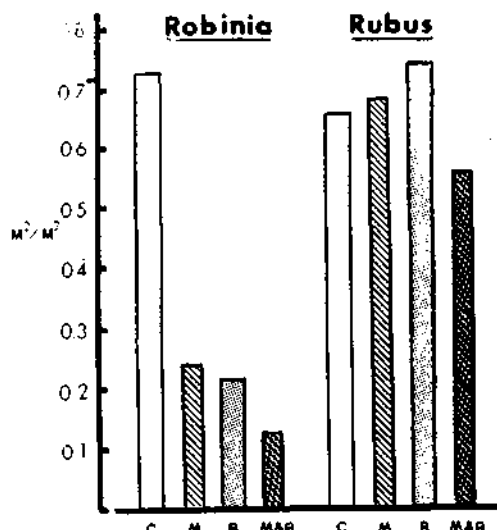


FIGURE 5. Absolute cover in August in the shrub-briar community type of the two major dominant species. C = untreated control vegetation; M = mowed in late 1974; B = burned on April 17, 1975.

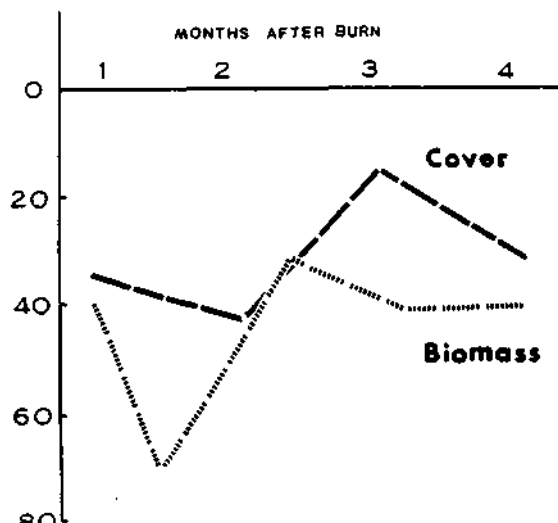


FIGURE 6. Total percent reduction in unmowed shrub-briar community type at Big Meadows, Shenandoah National Park. (Burned vegetation expressed as % of control.)

equal amounts in the unmowed and unburned control plots. A combination of both mowing and burning reduces the *Rubus* cover. However, the end of the season cover following either treatment alone is essentially the same, or possibly greater, than that of the controls. *Robinia* is affected very differently. Both mowing and burning are very effective in reducing black locust cover in contrast to their relative ineffectiveness in controlling the blackberries.

The overall effect of fire in reducing total plant cover and biomass in an unmowed shrub community is shown in Fig. 6. These curves represent the reduction of each as a percentage of the comparable value in the control plots. Maximum reduction of biomass occurred two months after the burn and both cover and biomass remained at 20 to 40% below control levels at the end of the

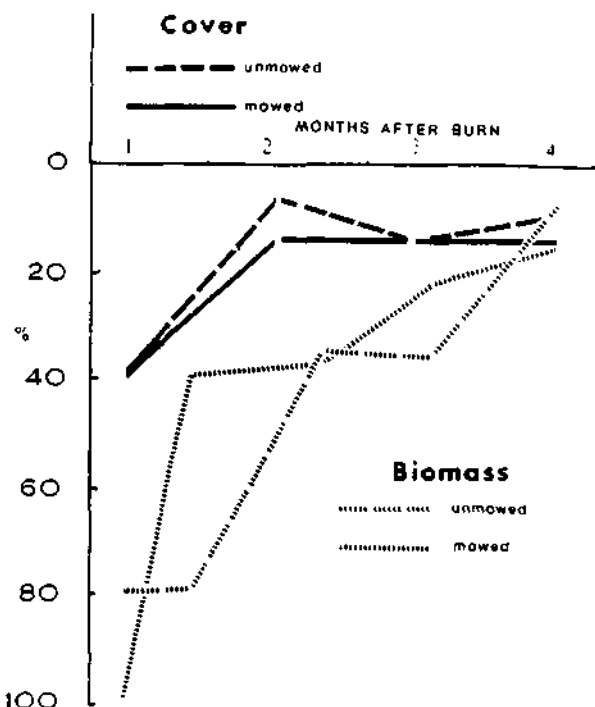


FIGURE 7. Total percent reduction in the grassland type community at Big Meadows, Shenandoah National Park. (Burned vegetation expressed as % of control.)

season. A picture of much more rapid reduction in biomass is obtained in the grassland (Fig. 7). Both cover and biomass increased significantly during the balance of the growing season and this is taken as an indication of the reparability of the system.

The management questions can therefore be partially answered. Prescribed burning is very nearly the same as mowing in its effectiveness as a control method for *Rubus* and *Robinia*. Preliminary indications are that there are also relatively few major differences in the impact of the two treatments on other species. The data from the current year (1976) spring burn will be useful in further documenting the individual species responses. Evaluation of the second question is more difficult. The similarity of the responses to burning and mowing indicates that a "fire stabilized" community will also be dominated by shrubs. In this case the species composition may be dominated by *Rubus* spp. Spot treatments within patches of the shrub-briar community such as repeated burns during the growing season, or more severe eradication techniques, may be necessary if a shrub-grassland mosaic is to be maintained.

Burning therefore appears to be a satisfactory and less expensive alternative to annual mowing. However, burning alone is unlikely to be a completely adequate long range management technique.

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