

The Blue Ridge Parkway Study: Landscape Management—History, Classification, Simulation, and Evaluation

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The historical practices of vegetation management along the Blue Ridge Parkway in North Carolina and Virginia are reviewed. These management practices include girdling, slash burning, grazing, and natural succession. A landscape classification is documented that includes more than 250 scenes from scenic overlooks along 469 mi of parkway. Classification is needed to select suitable images for simulation of alternative vegetation management practices along the parkway and at scenic overlooks. Techniques for actual photographic simulation of vegetation management alternatives are described and evaluated. Finally, a visual preference survey that was administered to users of the Blue Ridge Parkway to solicit preferences for vegetation management alternatives is statistically analyzed and discussed. Management recommendations are made that synthesize survey results, historical management practices, and physical, vegetative, and soil factors.

In 1984 the School of Landscape Architecture of the State University of New York (SUNY), in cooperation with the University of Tennessee, undertook a research project to study viewer reactions to certain vegetation management techniques used by the National Park Service on the Blue Ridge Parkway, North Carolina. The aims of SUNY were twofold. The first was to generate a series of photographic simulations of the visual effect produced by the control of vegetation immediately surrounding the parkway's scenic overlooks. Ultimately, the simulations were incorporated into a visitor questionnaire (1, 2). The second aim and the purpose of this article involved the investigation and documentation of alternative methods of vegetation management to those currently used by the Park Service.

PURPOSE

In 1936 governance of the Blue Ridge Parkway became part of the National Park Service [see the Land Tenure chronology in Table 1 (3–12)]. The initial idea of a Blue Ridge Parkway was conceived before World War I, but the concept of a scenic road connecting the Shenandoah to the north and the Great Smokey Mountains National Park to the south developed mostly during the Depression years.

One of the prime goals then and today was to provide the users with a living museum of natural and man-made form. The

problem in pursuing this goal lies in the difficulty of maintaining the open quality of the Blue Ridge that the visiting public prefers. Rapid vegetation growth produced from highly conducive environmental conditions can eventually block the visitors' view from the road.

Most vegetation management techniques used by the Park Service in the Blue Ridge are very expensive and time-consuming and, perhaps more important, inconsistent with the living-museum goal. The approach here was to investigate alternative methods that might be more consistent with this goal by presenting the following:

- A clear picture of the most historically significant cultures of the Blue Ridge settlement;
- The kinds of land management techniques utilized by native Americans and settlers; and
- The relationship between these techniques, where applicable, and the kinds of management practice problems faced by the National Park Service today.

BLUE RIDGE CULTURE AND MANAGEMENT PRACTICES

The first known party to have explored the Blue Ridge Mountains was DeSoto in 1560, followed by the Bickell Party in the 1730s (4). In addition to finding Indians inhabiting the area, they found a pristine virgin landscape described as "beautiful valleys covered with woods, pastures and savannahs." The trail system developed by the Indians was extensive, particularly on the slopes and summits where they set up summer camps. Some evidence indicates that these campsites, referred to as "balds," are still identifiable because of the intense use by the Indians and later settlers (13) (see Figure 1).

By 1950 the Blue Ridge was sparsely settled by isolated family farming units (Figure 1). The land, like most of the South at this time, was managed as garden rather than field. Once suitable farm and pasture land was found by analyzing vegetation cover, hillsides were cleared by burning and girdling (11).

Among the early mountaineers, the Scot-Irish rapidly adopted the Indian ways of cultivation (see the Land Tenure chronology, Table 1). They used the simple technique of slash and burn but with no replenishment of the soil (14). Following the Germans, they settled first in the bottom lands where soil and game were best. But as they moved into the smaller coves where the soil was shallower, widespread erosion led the U.S.

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TABLE 1 HISTORICAL BACKGROUND (3)

Period	Location	Land Tenure Practice	Culture	Source
Late 1600s	Virginia and Carolinas	Plantation settlement, extensive agricultural practice, free-range of livestock, crude structures, cash cropping	English with Scot-Irish servants	Stilgoe (11)
Pre-1716	Shenandoah Valley	Timber burned to increase game habitats	Native American	Kercheval (6)
Early 1700s	Appalachia	Tree girdling, rough ploughing between dead stands	Scot-Irish	Kercheval (6)
1718	Pennsylvania, Great Valley, North Carolina Piedmont, and Blue Ridge	Small patch farming; trees girdled, left standing, or burned; corn and tobacco crops	Scot-Irish	Stilgoe (11), Graeff (5), Opie (8), Kercheval (6)
1775	North Carolina	German movement continues from Pennsylvania into western countries and highlands of North Carolina	German	Bittenger (4)
1776	Blue Ridge, North Carolina	Blue Ridge and Alleghenys opened up for settlement by Continental Congress		
1700s	Pennsylvania	Permanent meadows ploughed; pasturing May 1–Nov. 1; vegetable gardening on warm side of house; neatly fenced; efficient farm practices; tilled intensively, rotated crops, manured; farmstead kept orderly and clean; frequently cattle and sheep turned out into newly cut-over land to subdue it for cultivation; prevailing practice was to pasture livestock on worn-out field reverting to succession; fewer farmers laid down land in grass after taking two to four grain crops; upland meadows pastured several years before reverting to crop rotation; apple orchards common; fences symbolize good farming	German	Long (12)
1700s	Pennsylvania	German farm distinguished from Scot-Irish by superior size of barns, plain compact form of houses, height of enclosures, extent of orchards, fertility of fields, luxuriousness of meadows, appearance of plenty and order	German	Long (12)
1700–1800	Blue Ridge	Bottom lands settled first, most fertile soil and game; future settlers moved into hills and coves	Scot-Irish	Kercheval (6), Weller (10)
1700–1800	Appalachia	Houses built on bottom lands near streams; slopes farmed (perpendicular farming)	Scot-Irish	Weller (10)
1700–1800	Appalachia	Unfamiliar with manuring or soil conditioning; hillside patches cleared as lower fields depleted	Scot-Irish	Kollmorgen (7)
1700–1800	Appalachia	Principal crops corn and tobacco	Scot-Irish	Weller (10), Stilgoe (11)
Mid-late 1800	Blue Ridge, North Carolina	Exploitation by lumber and mining companies results in large tracts of cut-out, burned-out, washed-out lands; feldspar and mica; primarily small operations	Scot-Irish	Sheppard (9)
1936–present	Blue Ridge, North Carolina	Governance by National Park Service	National Park Service	Smathers (4)

Department of Agriculture to proclaim that 100,000 farms were unfit for agriculture (15).

Unlike the Scot-Irish, the goal of the Germans was to own the land and manage it more efficiently. They chose land heavily timbered with hardwoods in valleys composed of limestone soils similar to those in their homeland (12). They planted small gardens on the warm side of their homes in which several types of exotic and domestic vegetables were grown. In addition, they usually planted orchards of fruit trees in the first cleared field.

The Germans consolidated some of the abandoned patches left by the Scot-Irish and, following their European traditions, allowed cattle and sheep to graze and subdue the land for

several years before cultivation. After a period of intense tilling, crops were planted and rotated followed by more manuring to increase fertility. Cattle were routinely allowed to free-range (unmanaged grazing) after the fields became permanent.

MANAGEMENT TECHNIQUES UTILIZED

The land management mind set carried into the Blue Ridge by these cultures largely determined how the Blue Ridge looks today. Research indicates four major categories of use and management. They were sometimes used singly but most often in combination with other techniques.

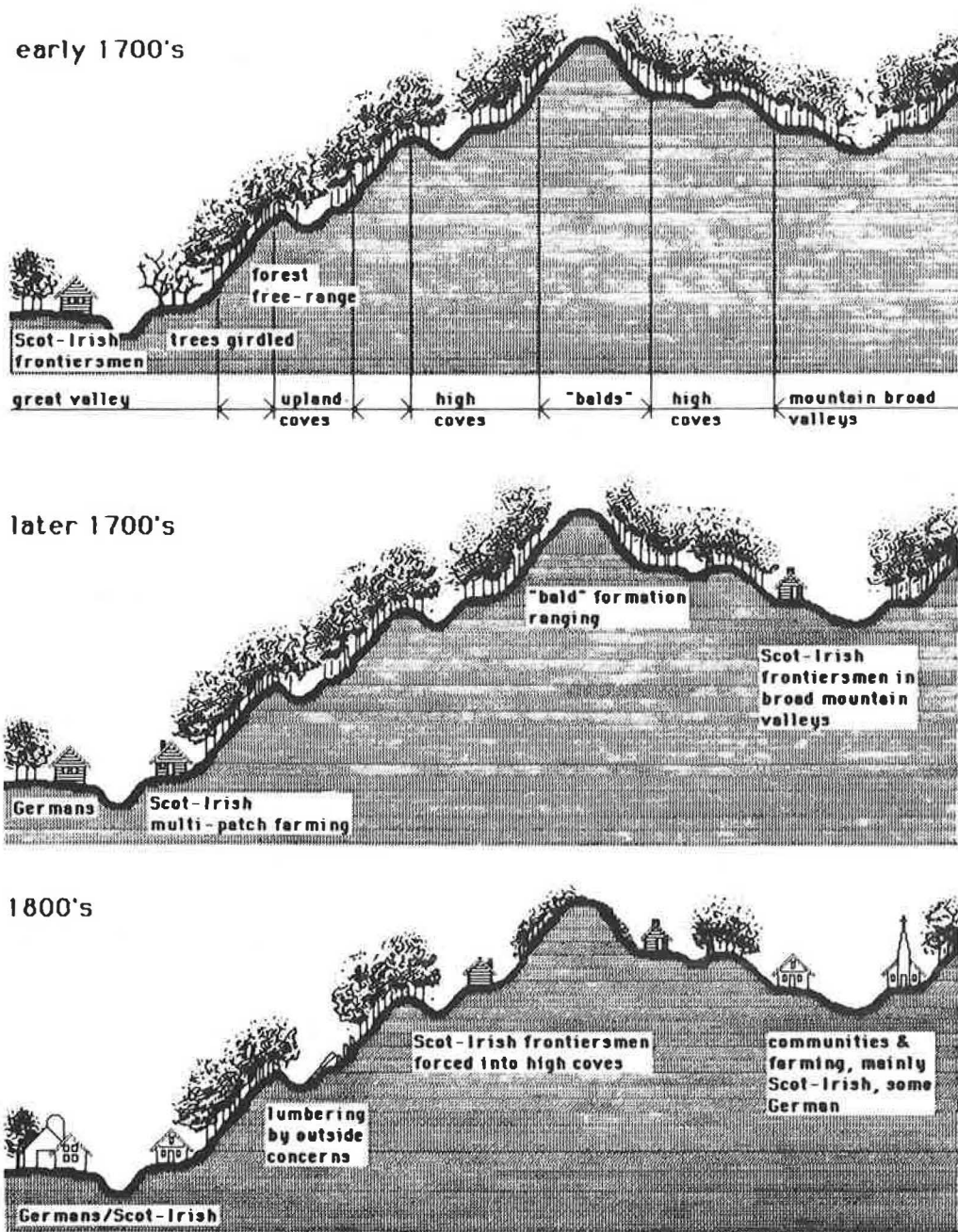


FIGURE 1 Management practices of the different cultures settling in the Blue Ridge Mountains (3).

Girdling

During the mid-1800s to early 1900s, a form of vegetation management called girdling was used, primarily by the Scot-Irish. The technique involves simply removing a band or belt of a tree's bark and cambium layer, thus inhibiting the flow of moisture and nutrients to the upper stems. Eliminating the tree canopy encourages understory growth for forage or cultivation.

Slash Burning

The slash-burning technique, most closely associated with the German culture, had as its goal the superenrichment of the soil.

Tree limbs and slabs were piled evenly across the ground and fired, singeing the soil. Then rye was planted and harvested, after which more limbs were spread and fired, followed by a planting of grains. The process was repeated every 5 or 6 years.

A by-product of this technique was the resumption of successional growth. Large areas called "colicks" were formed after the fields became derelict and are composed even today of a dominant cover of compact heath shrubs.

Grazing

The settlers raised a variety of domestic animals, including sheep, cattle, and mules. Due to the thinness of the upland soils,

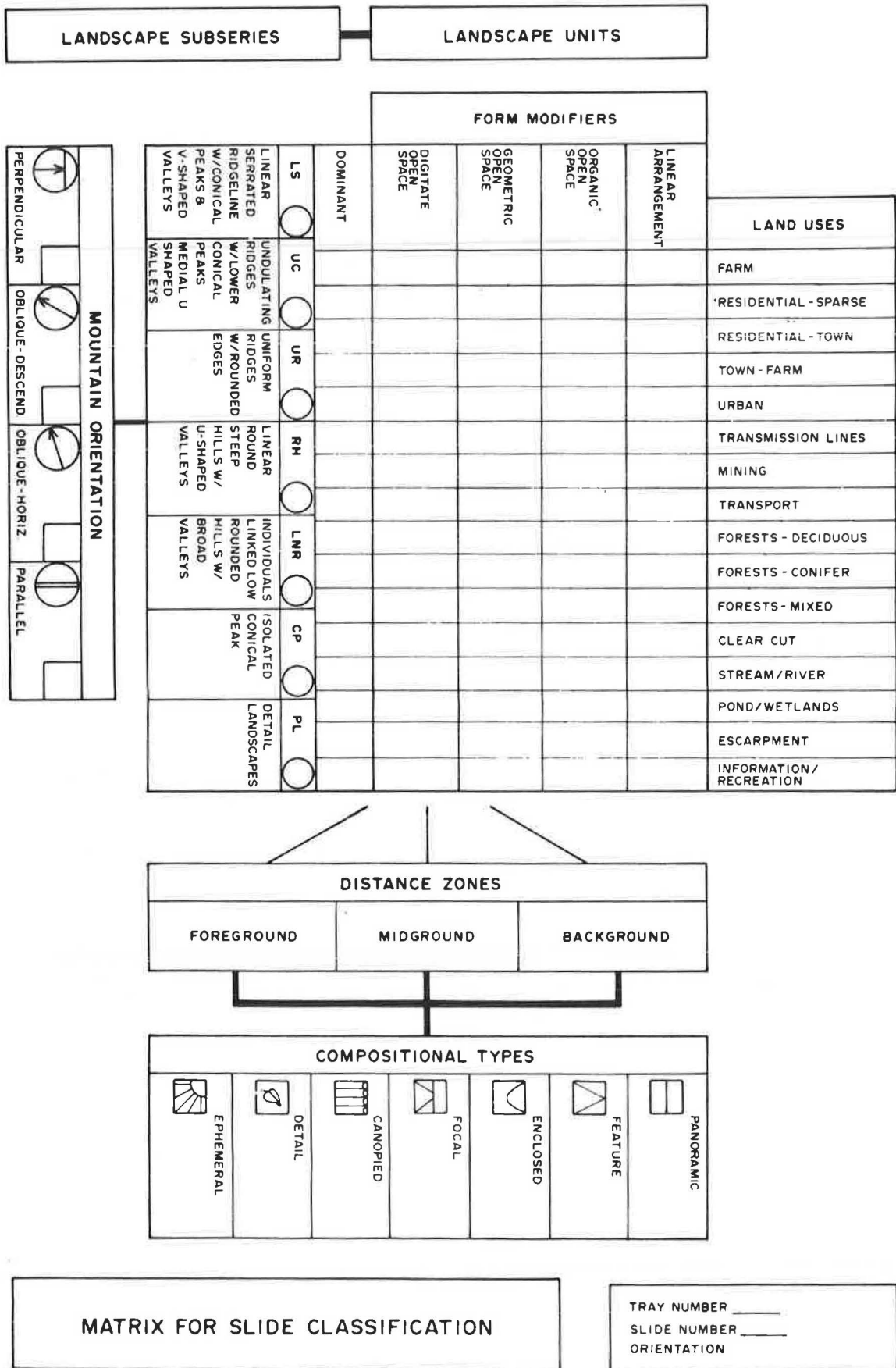


FIGURE 2 Matrix for slide classification.

evidence indicates that many of the so-called grassy balds referred to earlier were maintained and extended by the constant trampling. The succeeding grasses, mostly mountain oat grass (*Danthonia omissa* and *Rumex acetosella*), were too competitive and choked most tree and shrub volunteers (4).

Natural Succession

The natural succession process is exhibited by the ongoing emergence of plant species and is seen most dramatically following catastrophic phenomena like cutting and burning by man or by natural processes like high winds or soil erosion. The result is usually associated with deep erosion to less fertile subsoil in the margins of old fields and includes heath or broom sedge and asters, which can compete with other grasses and usually replace them quickly.

Growing in sparse stands, broom sedge (*Andropogon* spp.), for example, survives as a monoculture until enough ground litter is produced to support other forms of grass and woody vegetation (16). At the time of writing, the authors had not found enough reference material to indicate the length of time before other pioneering plants outcompete broom sedge on abandoned farmland. However, it appears that the plant has potential applications in a vegetation management policy for the parkway. Broom sedge is particularly suitable because it does not pose the same entangling and overgrown characteristics as kudzu or the woody pioneering plants that it outcompetes. It presents to the viewer a fine-textured, uniform mass of vegetation for an apparently extended period of time, and its maintenance needs are minimal.

LANDSCAPE CLASSIFICATION

Along the 469 mi of the Blue Ridge Parkway, more than 250 scenic overlooks have been established. Because of logistical and financial constraints, as well as the tolerance levels of questionnaire respondents (17), simulation of vegetation management techniques at every overlook was beyond the scope of this project. Therefore, it became necessary to select several overlook scenes representative of the range of visual experiences encountered along the entire parkway.

In order to initiate this selection process, a library of Ektachrome slides was obtained from the University of Tennessee. The photographic library of 298 slides contained a view from each of the established parkway overlooks plus a number of duplicate photographs made to compensate for poor lighting conditions or technical problems.

The slide selection process involved four sequential steps:

1. Formulation of a landscape classification system,
2. Classification of each of the slides in the photographic library,
3. Grouping of overlook scenes on the basis of similar landscape components, and
4. Selection of one or two representative slides from each of the established groups of overlook scenes on the basis of degree of photographic quality and suitability for simulation purposes.

The classification system used to denote the representativeness of all the images and assist in selection of images for management prescription and simulation included land use, landform pattern, and landform spatial configuration; distance zones seen; and landscape compositional types (see Figure 2). Further details may be found elsewhere (18).

Selection of Views for Vegetation Management Simulations

Determining what views (slides) were suitable for simulation purposes was based largely on foreground vegetation. In order to simulate the results of possible management techniques for vegetation, it was important to choose views that contained as much foreground plant material as possible. Views that show vegetation from the ground to the crowns of the plants produce a more accurate simulation than the views that show just the tops of plants. For example, if one option for management of vegetation was controlled burning of shrubs and the original view contained just the crowns of the plant material, the simulation of burning would not portray the total effect of the burning. The effect on surrounding grass and plants and the appearance of the ground could not be simulated.

Foreground Vegetation Suitability

The first phase in determining foreground vegetation suitability for simulation was an area measurement of all slides. The foreground vegetation in each slide was measured as a percentage of the entire scene. The slides were projected onto a grid. The number of grid sectors with foreground vegetation on them was then counted. If less than one-third of the sectors were filled with foreground vegetation, the view was eliminated from further consideration for simulation. The one-third rule was used for several reasons. First, if less than one-third of the slide showed foreground vegetation, the view could be overpowered by the emergent background scenery during a simulation of vegetation removal. The view might then be judged on the quality of the background and not on the management technique that was simulated. Second, the one-third rule proved to be an effective means of eliminating some of the 298 slides so that a manageable number remained. The slides that contained more than one-third foreground vegetation were then classified according to the foreground vegetation suitability index (Figure 3).

The foreground vegetation suitability index accomplished several things. It was a means to identify the amount of primary and secondary vegetation that could be seen from base to crown alone. A grid system was used to determine the dominant vegetation. Then the vegetation was classified in order of dominance for easy reference and comparison of vegetation among slides; without this classification, grass was usually viewed as the dominant foreground vegetative feature, shrubs or shrub grown as secondary foreground vegetation, and mature deciduous trees as the third most dominant (Figure 3).

As stated before, views that showed the vegetation from base to crown were determined to be most applicable for simulation. The final phase for foreground vegetation suitability was the grouping of views in two final categories: those that showed

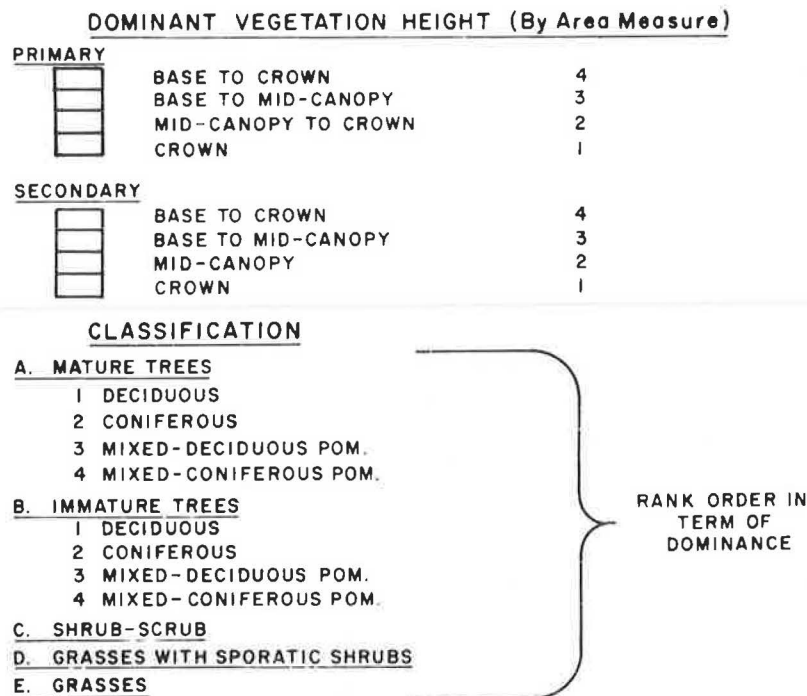


FIGURE 3 Foreground vegetation suitability index.

both the primary and secondary foreground vegetation from base to crown (most suitable for simulation) and those that showed either the primary or the secondary foreground vegetation from base to crown and either the primary or the secondary foreground vegetation, or both, from base to mid-canopy. This category was marginal for simulation. In the final analysis, 10 views were determined suitable for simulation according to foreground vegetation, and 21 views were marginal.

The next step was to determine what images would be required to produce the simulations. In this project, two factors were of prime concern: (a) the visual impact of roadside vegetation on the visitor to the parkway and (b) the impact of management techniques utilized by the Park Service along the parkway.

Data Treatment

Once the most suitable views had been selected, the next step was to apply appropriate management techniques to each scene. To accomplish this task, advice from Park Service managers was needed. Each of the 10 representative views was printed, inserted into an acetate envelope, and sent, together with an acetate marker, to the Blue Ridge Parkway Management Supervisor in Asheville, North Carolina. Comments and graphic delineation from the Park Service managers were drawn directly on the acetate overlay, and the views were returned. The managers identified three major management techniques common to the 10 representative views: (a) mowing either by bush hog on accessible sites or by hand cutting, (b) selective cutting of brush or trees to allow for significant views, and (c) controlled burning in places inaccessible to machines.

Three types of information were needed for the simulation: U.S. Geological Survey (USGS) quadrangle maps for back-

ground topological data, photographs taken behind the vegetation to be removed or modified, and photographs taken in front of the scene for contextual information. Photographs behind vegetation were crucial because the three management techniques supplied by the Park Service involved eliminating vegetation in one form or another, which would reveal new vegetation, topography, or man-made forms.

Another concern to be addressed was seasonal variation. Some management techniques might have a significant impact on views in summer, but the impact on views in winter might be quite different. Possible procedures were to consider proposed changes with different seasonal impacts or to choose the season with the highest visitation frequency, such as summer with vegetation in full leaf. In this case, the latter procedure was used. It is important that simulations be made for the same season in which subjects will be responding to a photograph questionnaire.

Specific Visual Simulation Techniques

Prototypical Scene Development

As stated before, the purpose of the project was to solicit visitor responses to certain Park Service vegetation management techniques. After the representative scenes were chosen and comments were received from the National Park Service, each scene was analyzed to determine the appropriate montage technique. This was accomplished by overlaying the original 8- by 10-in. print with acetate and with the USGS quads to determine hidden topographic features. Ideas were tested using markers.

It was decided that two pages with eight views per page would be prepared. Each page would contain the before-and-after views of four scenes, and each photograph would be 2 by

3 in. to allow for a rating scale beneath the images. Consequently, each montage was created at the 8- by 10-in. size and then photographically reduced.

Montage Techniques

In the development of the simulations themselves, several ideas and media were tried. The first and most commonly used montage technique was "cut and paste." Depending on the amount of change required, two approaches can be utilized. First, in relatively small areas—for example, a bank of large shrubs that has to be eliminated and replaced with smaller shrubs or grass while providing appropriate background material—a technique called "windowing" can be performed (Figure 4).

When relatively large areas of the image, such as a tree mass, mountains, or sky, have to be altered, a technique called "layering," which is similar to the "windowing" technique, can be used (Figure 5). Again, the material to be changed is trimmed away, the backing is stripped from the edge to be retained, and new material is cemented in place. Experimentation proved to be equally successful in both front and back applications.

The next most common technique used is called "coloring." In this instance, a variety of materials was used, ranging from color dyes to air brush techniques. In this project, coloring was confined to touch-ups. Color dyes, matched to Cibachrome print material, appeared to work best for touch-ups in most instances (19, 20).

The last type of montage involves the techniques of "dodging" and "burning-in" commonly utilized in a darkroom (21). These procedures have been documented in a number of professional darkroom manuals. Basically, in slide printing, "dodging" means masking an area so that after development, the area appears black or dark, whereas "burning-in" produces the opposite effect. Experimentation with this approach was not as satisfactory as that with the cut-and-paste technique. The various techniques are summarized in Table 2.

VISUAL SURVEY APPROACH TO EVALUATE VEGETATION MANAGEMENT ALTERNATIVES

Introduction

These simulations were used by the University of Tennessee team in the preparation of a questionnaire to assess vegetation

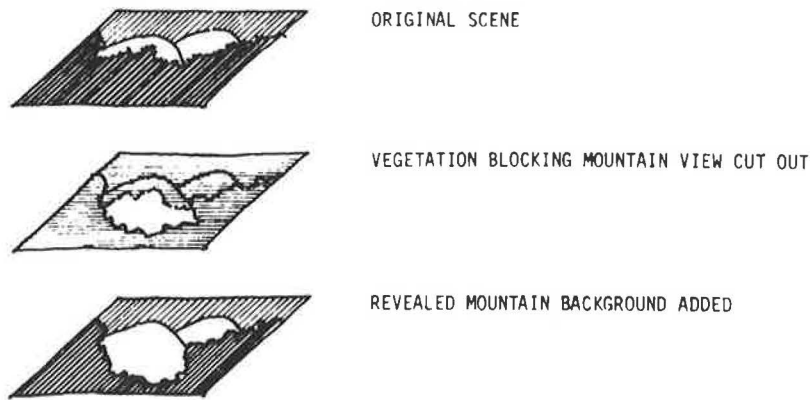


FIGURE 4 Windowing.

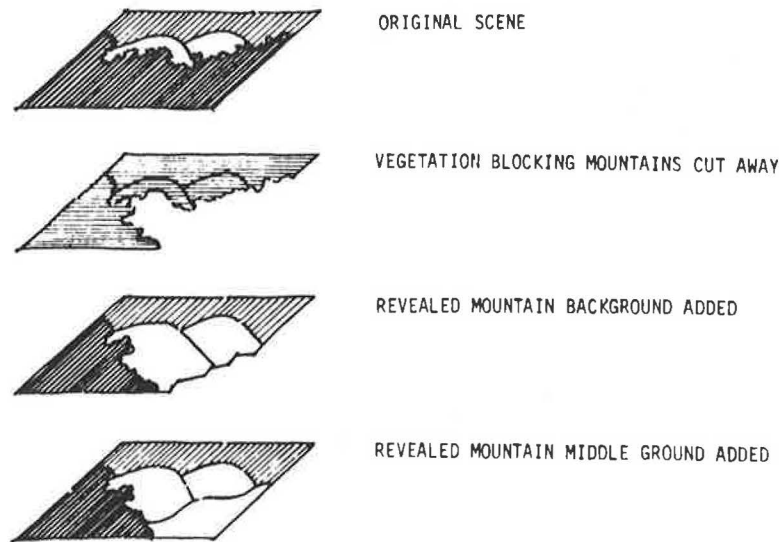


FIGURE 5 Layering.

TABLE 2 SUMMARY MATRIX OF MONTAGE TECHNIQUES

Technique	Simulation Condition	Materials Needed	Skills Needed
Windowing	Small areas, minor modifications	New materials to substitute and blend with removed areas	Cut and paste; no special skills
Layering	Major modifications	Same as above	Same as above
Feathering	To blend vegetation	New material	Same as above
Coloring	Touch-up to hide cut edges	Color dyes, felt markers	Artistic skills
Dodging and burning-in	Blending homogeneous zones—sky, etc.	Darkroom equipment	Trial and error

management alternatives for the Blue Ridge Parkway. Each questionnaire was divided into five response sections: visual preference evaluations of pairs of photographic simulations; ratings of vegetation management alternatives; reported participation in outdoor activities; rating of leisure attitude statements; and respondent characteristics. In addition, half the questionnaires included a leaflet that indicated that ecological and economic benefits could be derived from reduced roadside mowing. Approximately 500 questionnaires were distributed between Tuesday, August 9, and Sunday, August 21, 1983. Questionnaire booklets were handed out and retrieved at pullouts along the full length of the parkway.

In this section the visual preferences and attitudes toward vegetation management alternatives are investigated. Also considered is the potential of an information leaflet to influence these responses. The primary methods used in this investigation are the analysis of variance (ANOVA) and *t*-test. The following description of the three relevant portions of the questionnaire will establish the context needed to interpret the results of the analyses.

Information Leaflet

The information leaflet at the beginning of the visual preference section in half of the questionnaires consisted of three photographs, arranged diagonally on the page from left to right. Two of these photographs were also used to represent two sites in the questionnaire (Sites 3 and 8). The third photograph was only used on this page. In the upper right-hand corner was the following "ecological" message:

There are idle spots on every farm—and every highway is bordered by an idle strip as long as it is. Keep cow, plow, and mower out of these idle spots, and the full native flora, plus dozens of interesting stowaways could be part of the normal environment of every citizen (Alda Leopold, pioneer ecologist, from *A Sand County Almanac*).

In the lower left corner was the following "economic" message: "Just a 50% reduction in mowing on the Blue Ridge Parkway will save taxpayers \$71,000 per year."

Visual Preference Evaluations

The general instructions in the questionnaire were as follows:

Vegetation management along the Blue Ridge Parkway can be conducted at various levels of intensity. For example, the roadside grass can be mowed weekly, monthly, bimonthly, etc. We would like your opinion of some possible levels of grass mowing and tree-clearing that might be practiced on the Parkway.

By rating the vegetation management examples in our photo, we can determine what Parkway visitors prefer.

There is a collection of photographs presented as three (3) pairs per page. Each picture has a short description under it. Please pay particular attention to the described feature as you rate each photograph. First, look through them quickly to get a general feeling for the photographs. Then, go back and carefully read the description. Rate EACH photo (compared to its pair) for HOW MUCH YOU LIKE IT. Simply circle the number of your choice below each photograph.

- 1 = not at all
- 2 = a little
- 3 = somewhat
- 4 = quite a bit
- 5 = very much

The questionnaire presented 18 photograph pairs, each representing an alternative intensity of management. In most cases, both photographs appeared to be of the same site. However, two pairs of photographs were obviously of different sites; in several other pairs, the montage process caused slightly noticeable differences between pairs that might have been interpreted as site differences.

These photograph pairs represented two general types of management activity: 8 simulated roadside mowing and 10 vista maintenance. The mowing comparisons ranged from a single mower's width from the roadside to complete mowing to the treeline (Sites 2, 6, and 7). Other mowing-width comparisons were also presented (Sites 1, 3, and 9). One pair addressed the frequency of mowing (Site 8) and the eighth pair mowing around a road sign (Site 4). Among these photo pairs, two were the same but with different captions (Sites 3 and 8) and two other pairs had one photograph in common (2a and 7b) and used the same captions.

Three management alternatives were represented among the 10 vista management comparisons. Two sites (5 and 15) represented the effects of controlled burning as a vista management tool. Intensive cutting of woody vegetation was represented at four sites (10, 12, 13, and 16), whereas four more represented moderate or selective cutting (11, 14, 17, and 18). Of particular interest among these photographs were the reuse of one photograph (10a and 17a) to create a three-sequence comparison (10a, 10b and 17a, 17b) and the removal of a single foreground tree to reduce vista enframing (Sites 14 and 18). The management treatment was generally tree removal at these sites; however, at one, it was specifically removal of hardwoods to emphasize conifers (Site 18). At two other sites (13 and 17), the treatment resulted in a mown foreground crest rather than residual wood vegetation.

Vegetation Management Alternatives

Respondents were also asked to state their support or nonsupport for the various levels at which the grass and shrubs along the Blue Ridge Parkway could be maintained. Responses were recorded on a seven-point bipolar scale: (1) strongly support, (2) support, (3) probably support, (4) don't know, (5) probably don't know, (6) don't support, (7) definitely don't support. Twelve management alternatives were described in all: four of these alternatives concerned the frequency of mowing, four described the width of the mown area, one posed safety as the sole criterion for mowing, and three addressed intensity of cutting or trimming of woody vegetation to maintain vistas at roadside pulloffs.

MANAGEMENT FINDINGS

Vegetation Management Alternatives

The overall statistical analysis for each alternative management statement showed, in general, that less intensive management practices received greater support (see Table 3). An average or typical evaluation supported mowing every 3 or 4 weeks when the grass becomes about 8 in. tall. Mowing should extend to some natural break close (within a couple of mower's widths) to the road's edge. Moderate tree thinning was preferred, but the pulloff vistas should be maintained in any case. Overall, respondents were more supportive of vista maintenance than of mowing activities.

The mean ratings for both those respondents who did and those who did not receive the leaflet about the ecological and economic benefits of reduced mowing are also compared in Table 3. In general, those provided with this information tended

to be more supportive of reduced mowing and less supportive of intensive mowing. This is the direction of influence that one would expect; however, the differences are statistically significant only for the most intensive mowing practices and the restriction of mowing to reasons of safety. The mowing leaflet did not appear to influence ratings of vista maintenance alternatives in any significant way.

The relationship between the intensity of management and the influence of the leaflet was further investigated by using two-way ANOVA models. The management alternatives are grouped for these analyses according to mowing frequency (Statements 1 through 4), mowing width (Statements 5 through 8), and vista maintenance (Statements 10 through 12). The results in Table 4 indicate that the variation in ratings attributable to management intensity is significant in all three models.

TABLE 4 EFFECT OF MANAGEMENT INTENSITY AND INFORMATION ON RATINGS OF VEGETATION MANAGEMENT ALTERNATIVES

Management Action	Effect	df	F-value
Mowing frequency	Intensity	3	130.0 ^a
	Information	1	9.7 ^b
	Interaction	3	3.4 ^c
Mowing width	Intensity	3	38.9 ^a
	Information	1	6.0 ^c
	Interaction	3	4.4 ^b
Cutting woody vegetation	Intensity	2	3.5 ^c
	Information	1	0.9n.s.
	Interaction	2	0.6n.s.

NOTE: n.s. = $p \geq .05$
^a $p < .001$.
^b $p < .01$.
^c $p < .05$.

TABLE 3 MEAN RATINGS OF VEGETATION MANAGEMENT ALTERNATIVES AND EFFECT OF INFORMATION LEAFLET

Vegetation Management Alternative	Information Leaflet		t
	With (N = 241)	Without (N = 222)	
The roadside grass should be mowed	6.15	5.64	3.47 ^a
1. Weekly, like a lawn			
2. Every 2 weeks, when 3 to 6 in. tall	4.50	3.88	3.21 ^a
3. Once per month, when at least 10 in. tall	3.79	3.86	-0.41n.s.
4. Once in fall after wildflowers are through blooming	3.65	3.57	0.42n.s.
5. Only one mower's width (7 ft) from the edge of the road surface	3.22	3.41	-1.04n.s.
6. Two mower's widths (14 ft) from the road's edge	4.43	4.23	1.20n.s.
7. From the road's edge to the ditch or swale	3.92	3.73	1.14n.s.
8. From the road's edge to the treeline	4.90	4.18	3.67 ^a
9. As little as possible, only when necessary to maintain driver safety and help prevent grass fires	3.76	4.21	-2.11 ^b
Shrubs and trees at pull-off vistas should be cut or trimmed			
10. Annually to maintain a completely clear view	3.70	3.46	1.19n.s.
11. Every 5 to 7 years, before the shrubs in foreground block much of distant view	3.32	3.21	0.63n.s.
12. Just often enough so that no more than 1/3 of view is blocked	3.53	3.57	-0.22n.s.

NOTE: On a seven-point bipolar scale: (1) strongly support, . . . , (4) don't know, . . . , (7) definitely don't support.
n.s. = $p \geq .05$.
^a $p \leq .001$.
^b $p \leq .05$.

These differences were further investigated through multiple-comparison mean separation tests. Tukey's honestly significant differences (HSD) procedure with a significance level of .05 was used. These results indicated that there was no significantly different support for monthly or fall mowings. However, both practices were preferred to biweekly mowings, which were preferred to weekly mowings. A similar situation existed for alternative mowing widths. A single mower's width was preferred above mowing to the swale; both were preferable to double-width mowing or mowing to the treeline. No difference was evident between these latter, more intensive alternatives. In the case of vista maintenance, waiting 5 to 7 years, before much of the distant view is blocked, was preferred. The other two alternatives, annual maintenance and maintaining at least 66 percent openness, were equally preferred. It is important to remember that, overall, there was greater support for vista management than for intensive mowing.

The information leaflet also had a significant effect on the ratings associated with grass management. However, it did not cause any difference in vista management preferences between the two groups. The influence of the leaflet was not even among all the statements. Rather, it had a significantly greater effect on opinions about more intensive mowing activities, as previously indicated by the *t*-tests in Table 3. In addition, those who did not receive the leaflet supported mowing to the treeline over double-width mowing, whereas those who received the information leaflet preferred double-width mowing.

Visual Preference Evaluations

The ratings of how much respondents liked the simulated effects of management alternatives are summarized in Table 5.

The sites have been grouped according to the general management practice they represent, as previously described. The mean values (\bar{x}) represent the difference between the ratings for the less managed or control condition and the more managed or treatment condition. Therefore, a negative value represents visual improvement and a value of zero indicates no change in visual quality. A *t*-test was used to identify those cases in which the mean change was significantly different from zero. The mean differences and *t*-tests are reported for both those who received the information leaflet and those who did not. A paired-comparison *t*-test was used to identify significant differences between the mean change in ratings for these two groups.

ANOVA models reported in Table 6 were used to investigate the effects of these factors. Among the effects incorporated into these models was "activity" or the significance of the change in rating from the control condition (Photograph A) to a treatment condition (Photograph B). The "information" effect refers to the difference between those who did and those who did not receive the information leaflet. In a sense, each of the simulated sites was a repetition or repeated measure of a particular management activity. Collectively, they represented the visual variation of using these practices in the landscape. This variation was represented by a "site" effect. For the analysis of vista clearing, a second model grouped the sites into clearing activities of major and moderate intensity. All possible two-way interactions were also included in these models.

The pattern of visual preference for mowing alternatives was very similar between the two groups. Overall, respondents preferred the control or less mown condition. The major exception was a preference for mowing vegetation around a low road sign (Site 8). The treatment in Site 7 also received a very

TABLE 5 MEAN CHANGE IN VISUAL PREFERENCE RATINGS FOR SIMULATED MANAGEMENT SITUATIONS

Condition	Site	With Leaflet		Without Leaflet		Paired <i>t</i>
		\bar{x}	<i>t</i>	\bar{x}	<i>t</i>	
Mowing width	1	1.57	10.4 ^a	1.72	11.7 ^a	-0.7n.s.
	2	1.32	9.0 ^a	0.95	5.9 ^a	1.7n.s.
	3	0.21	1.2n.s.	-0.29	-1.7n.s.	2.1 ^c
	6	1.03	6.4 ^a	0.47	2.7 ^b	2.4 ^c
	7	-1.50	-10.1 ^a	-1.19	-7.3 ^a	-1.4n.s.
	9	1.00	5.8 ^a	0.64	3.4 ^a	1.4n.s.
	8	0.13	0.8n.s.	-0.45	-3.0 ^a	2.6 ^b
Sign mowing	4	-1.71	-10.7 ^a	-2.36	-18.1 ^a	3.1 ^b
Major clearing	10	-1.89	-14.5 ^a	-2.13	-17.7 ^a	1.4n.s.
	12	-0.30	-1.8n.s.	-0.16	-1.0n.s.	-0.6n.s.
	13	-0.06	-0.4n.s.	-0.23	-1.3n.s.	0.7n.s.
	16	-2.57	-23.4 ^b	-2.55	-24.7 ^a	-0.1n.s.
Moderate clearing	11	-0.32	2.1 ^c	-0.31	-1.9n.s.	-0.1n.s.
	14	1.53	11.2 ^a	1.36	9.8 ^a	0.9n.s.
	17	1.35	9.6 ^a	1.18	7.9 ^a	0.8n.s.
	18	0.35	2.5 ^c	0.25	1.7n.s.	0.5n.s.
Controlled burning	5	1.35	9.1 ^a	1.19	7.7 ^a	0.8n.s.
	15	-0.19	-1.1n.s.	-0.17	-1.0n.s.	-0.1n.s.

NOTE: The mean difference is a less managed or control condition rating minus a more managed or treatment condition. Negative values indicate visual improvement. n.s. = $p \geq .05$.

^a $p < .001$.

^b $p < .01$.

^c $p < .05$.

TABLE 6 EFFECT OF MANAGEMENT ACTIVITY, INFORMATION, AND SITE ON RATINGS OF VISUAL PREFERENCE

Management Action	Effect	df	F-value
Mowing width	Activity	1	595.4 ^a
	Information	1	6.2 ^b
	Site	5	10.1 ^a
	Information × activity	1	23.5 ^a
	Information × site	5	0.4n.s.
	Activity × site	5	40.5 ^a
Controlled burning	Activity	1	69.6 ^a
	Information	1	0.2n.s.
	Site	1	2.4n.s.
	Information × activity	1	0.5n.s.
	Information × site	1	0.1n.s.
	Activity × site	1	140.8 ^a
Vista clearing	Activity	1	92.8 ^a
	Information	1	0.1n.s.
	Site	7	13.2 ^c
	Information × activity	1	1.2n.s.
	Information × site	7	0.2n.s.
	Activity × site	7	295.5 ^a

NOTE: Among the effects incorporated into these analysis-of-variance models, "Activity" refers to control (Photograph A) and treatment (Photograph B) conditions. "Information" refers to those who did or did not receive the information leaflet. "Site" refers to those sites simulating the activity; in a sense these are simulation repetitions or repeated measures of the management activity. "Intensity" regroups the vista-clearing sites into major and moderate clearings. The two-way interactions are indicated by "x." n.s. = $p \geq 0.5$.

^a $p < .001$.

^b $p < .01$.

^c $p < .05$.

positive rating. However, this may have been because the two photographs were of distinctly different sites.

There were significant differences between the mean changes for these two groups at half the sites, which is similar to the influence among the mowing management statements. This result is supported by a significant effect in the ANOVA model for mowing width, as well as the *t*-tests for mowing frequency (Site 8) and mowing around road signs (Site 4). In all these analyses, the information leaflet was associated with preference for reduced mowing activity. This effect was accentuated among those who received the leaflet, accounting for the significant interactive term.

The most significant effect in the ANOVA model for mowing width concerned the change at each site from a more intensive management practice. As has already been described, respondents generally supported less intensive mowing. The actual variation among the sites was also very highly significant, possibly indicating the relative difference in treatment intensity between photographs at a particular site, as well as the visual sensitivity of different sites to management practices. The significant interaction between activity and site is attributable to the essential lack of difference between the photographs at Site 3.

The overall preference for the visual effects of vista management practices was clearer, though different, than it was for mowing practices. Cutting activity that removes large amounts of woody vegetation from an overgrown vista to establish an open view was preferred. However, respondents did not appear

to support cutting when the vista was only slightly blocked or when a significant residual was left that still blocked the view. This result was more accentuated but appeared to support responses to the management statements in which cutting was preferred every 5 to 7 years (seemingly a long time) over annual clearing or clearing before one-third of the view was blocked. Controlled burning also received poor ratings, particularly for the case in which there was little change in the vista's extent. Finally, there were no significant differences between the two groups, indicating that the information leaflet had no effect. This may have been because the leaflet focused on mowing and the effect failed to carry over to tree clearing. Alternatively, it may have been because respondents already had a clear position on vista management that was based on a cultural reticence to cut down trees but a strong visual preference for vistas.

These results are supported by the ANOVA results. The actual change in evaluation from before to after the activity is highly significant. There is also a very highly significant effect, which becomes strengthened, when the results are divided into major and moderate intensity groups. There is also a very highly significant interaction effect between the activity and site or intensity factors. Essentially, this represents the strong preference for major clearing and the perceived undesirability of only modest clearing. The controlled burning analysis exhibits a similar pattern for activity and the interactive term.

SUMMARY AND MANAGEMENT RECOMMENDATIONS

Biophysical and Historical Management Recommendations

Any vegetation management technique utilized should be preceded by a thorough analysis of the goals and objectives to be accomplished. Because the primary object of this research has been the human cultural aspect of viewing from the Blue Ridge Parkway, a number of physical parameters should be considered. Basically, viewing from the Blue Ridge Parkway involves two major components: the position of the viewer and the scene to be viewed. The viewer position generally means either viewing at a scenic overlook while standing or sitting or viewing along the road while in a moving car. The speed of the car and the road configuration are also important because an impressive view is more likely to be seen while on a straight road at a low speed than on a curve (except by a passenger). The amount of vegetation to be removed should be determined not only by what is viewed but by whether the viewer is moving or standing still.

The major management constraint on the scene to be viewed is not only vegetation but also the underlying topography. Most of the Blue Ridge Parkway is located on relatively steep slopes or on a ridge top, which means that major long views contain foreground sloping away from the viewer. The management techniques utilized, controlled burning and cutting or mowing, are effective especially in preventing severe erosion on steep slopes and in soils that are largely thin, well-drained, and sterile. However, because of a climate highly conducive to plant growth, sites of prime viewing require constant care.

Plant material to be considered should in general be self-maintaining and physically and microclimatically appropriate to the area and the surrounding vegetal context of the view and the slope on which it is placed.

Environmentally, perennial vegetation to be introduced should have the following characteristics. First, because most soils on steep slopes and ridge lines are thin and depleted of nutrients, plants should be shallow rooted, fibrous, and able to absorb and hold nutrients for extended periods of time. Second, because the climate is humid and temperate and rainfall is abundant, plants should be able to withstand the potential erosive effects of heavy rainfall, snow, and sedimentation.

Physically, plants should be complementary in terms of form, size, and texture to the surrounding site context, but even more important, the height of the plant should be self-maintaining and predictable because placement on a given slope with respect to the viewer position is crucial in maintaining the desired view. Grasses such as broom sedge could be used in near foreground areas, but if the slope falls away sharply, shrubs should be used. Again, consideration should be given to the two major components—the viewer position and the scene to be viewed.

Perceptually Based Management Recommendations

Perceptually based results support roadside mowing every 3 or 4 weeks when the grass becomes about 8 in. tall. Mowing should extend to some natural break close (within a couple of mower's widths) to the road's edge. Annual maintenance and maintaining 66 percent openness of vistas are equally preferred, so it would make sense to wait 5 to 7 years before trimming or cutting shrubs that would block distant views. Cutting that removes large amounts of woody vegetation from an overgrown vista is supported but not when the vista is only partially blocked or when significant residual woody material is left that partially blocks the view. In other words, cutting should not be done unless there is potential for creating substantially increased visual access or open views. Controlled burning also should not be performed unless there is substantial improvement in vista quality and extent.

Synthesis

The foregoing summarized perceptual results regarding roadside mowing and vista maintenance speak for themselves. In addition, this analysis shows greater support for vista maintenance than roadside mowing. The major synthesis would be the combination at suitable locations of periodic mowing of roadsides and brush clearing of vistas with introduction of plant species that either maintain low height and uniform texture or are historically representative of past vegetative management practices. Plant species of the latter type would be especially appropriate near interpretive areas and facilities.

The determination of the total mix of vegetation management over the length of the parkway is more difficult. Because the investigators dealt primarily with static images and simulations, it is proposed that questions involving spatial sequences of visual experience need sequential or dynamic simulation. A

future agenda item for research would be video simulation of moving sequences of vegetation management changes along the Blue Ridge Parkway using different simulation media [scale models, computer-assisted graphics, or electronic photomontage (computer and video)] to illustrate different management alternatives in real-time sequence.

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