

FORESTS OF BRYCE CANYON NATIONAL PARK: CONSEQUENCES
OF PAST MANAGEMENT POLICIES AND RECOMMENDATIONS FOR THE FUTURE

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HISTORY

More than fifty years have passed since Bryce Canyon National Park was created from the Sevier (now Dixie) National Forest by Act of Congress (____ 4 ____, 1928). The National Park Service had earlier been charged by Congress (____ 3 ____, 1916) with the task of conserving the natural biotic communities within national parks in such a manner that they would be left unimpaired for the recreational use of future generations. Prior to their inclusion in the National Park System, the forest communities of the Paunsaugunt Plateau had been greatly modified by man's exploitative activities, especially logging and grazing by domestic livestock. Other prior disruptions of the biota included predator control, hunting, water diversions, and accidental as well as purposeful introductions of exotic plants and animals. Since 1928 the area has been partially protected from livestock grazing by fencing. Wildfires have been vigorously suppressed, and occasional epidemics of bark beetles and defoliating moths have been combatted with pesticides. Despite these unnatural interventions in the natural dynamics of the park's ecosystems, there appears to have been a tacit assumption that natural biological succession would result in pristine forests comparable to those that prevailed before the arrival of white settlers in the 1870's.

The viewpoint that a disturbed and degraded forest would revert to a high quality pristine forest by simply being left alone while being protected from fires, insects, grazing and logging is unrealistic and ecologically unsound. Evidence is accumulating in the literature (and through field observation of fire scarred older trees at Bryce Canyon National Park) that light fires were part of nature and were a major factor in the development of the pristine forests (6,7,8,9). Many experts of forest sciences are of the opinion that some insect epidemics of the 20th century forests have been facilitated by fire and pest control programs (12 -). Prior to partial fencing to exclude domestic livestock from the park's meadows and forests, almost 60 years of uncontrolled grazing had undoubtedly resulted in a loss of ground cover and an acceleration of soil erosion (9). The light ground fires that frequently swept the understories of forests in early settlement times were probably fueled in large part by a blanket of dry perennial herb cover that has since been destroyed by persistent over-grazing. Soil erosion and increased cover of shrub and tree reproduction may make it difficult to reinstate an herbaceous cover comparable to that which fueled pre-settlement ground fires.

ECOLOGICAL CHANGES

During the 21-year period between the initial phytoecological study of the Bryce Canyon forests (1, 1960) and the present study (2, 1981) Bryce Canyon forest communities have changed dramatically. The density of coniferous trees has increased greatly. A heavy fuel layer of litter, forest debris, and young trees has accumulated

and constitutes a serious fire hazard. The thickening forest has impaired scenic vistas that were unobstructed by the open forests of 21 years ago. The distribution of tree sizes suggests that the forests of 50 years ago were very open as were the pristine forests of the 1970's. During the recent period of increase in the density of coniferous trees, the floristic diversity of the forest has diminished. Fire-suppression has created dense conifer forests which are monotonous in the extreme. The increases in density of coniferous trees have been accompanied by decreases in aspen trees and in all groups of understory plants. Shrubs, grasses, and forbs have all shown decreases in total cover and number of species per unit area (floristic diversity). The decline of aspen trees and of colorfully flowered understory plants has impaired the scenic values of the forest communities to park visitors. The dense conifer forests have also resulted in reduced carrying capacities for big game and many smaller animals. As a consequence, there are fewer wildlife individuals for visitors to observe and photograph. The closure of once open forests has facilitated the spread of the parasitic mistletoe as well as some fungal diseases and insects from infected to healthy trees. In summary, fifty years of management of Bryce Canyon's biotic communities has resulted in the loss or reduced abundance of many of the biotic resources that Bryce Canyon National Park was established to preserve.

CONSEQUENCES OF INACTION

The National Park Service now must decide whether to pursue a course of active management of Bryce Canyon forests. If the unnatural, monotonous, fire-prone forests which have developed as a consequence of a century of ecologically unsound management are to be restored to a more natural condition, active management procedures seem necessary. The consequences of choosing inaction or settling for the status quo include the possibility of all-consuming wildfires, which could be so severe that the soil and biota which are dependent on it would be dramatically altered. Time is running out, since the fire danger intensifies with each passing season. With each passing year the probability of uncontrollable wildfire and the magnitude of potential fire damage increases geometrically. Probable consequences of a forest wildfire are frightening because of the density and nearly continuous extent of forest cover across the park's plateau tops. Should such a fire sweep the park's forests, seed sources may be so scattered and limited that secondary succession would proceed at unusually slow rates. The possibility exists that a very hot fire would destroy the bulk of the organic matter in the soil and set the stage for extremely accelerated erosion of ashes and soil materials. The resulting unforested wasteland could resist full reforestation by natural or artificial means for hundreds of years. Complete loss of the forest would seriously detract from the scenic values of the geologic formations that are so wonderfully complemented by the forest greenery of the Paunsaugunt Plateau.

MANAGEMENT OPTIONS

If the National Park Service is willing to implement plans to actively manage the forests, much can be done to guide changes back toward healthy ecosystems that prevailed prior to the advent of European man. Any workable management plan is likely to require that the forests be divided into management units by rather wide east-west firebreaks. Such broad openings could run in meandering lines from the rim of the plateau to the East Fork of the Sevier River, thus separating the Paunsaugunt forests into several management units. Firebreaks should be designed with uneven edges that simulate openings in the forest.

Firebreaks should be opened using procedures that minimize soil erosion, nutrient losses and fire hazards. Existing coniferous trees could be eliminated in several ways, but use of a suitable herbicide would have many advantages. A quickly labile herbicide applied early in the spring, soon after conifers begin active growth but before aspen trees and understory herbs leaf out, would be cost effective and would eliminate the conifers while preserving the desirable aspen and herbs. Death of the conifers would permit more light to reach the forest floor, reduce transpiration losses, and return nutrient rich foliage and small twigs to the soil surface, where the nutrients could be returned to the other components of the system and cover seeds of desirable understory species that may be sown prior to the leaf fall (Table I). Simultaneously many of the older aspen trees could be felled to stimulate widespread suckering from the root systems. Conifer trees would not be removed during the first season after treatment

in order that all dead needles and small twigs might be left on the site. Early in the second growing season, crews could begin to fell the dead conifers with chain saws. Trees could be limbed on the site. The tree bolls and larger limbs should probably be removed from the firebreaks to reduce fuel accumulations. This work could proceed all summer and until accumulated snowfall forced workers from the area. Tree bolls and larger branches could be lifted from the firebreaks to log storage areas by helicopter to minimize soil disturbances. Tree bolls and branches could be cut into pieces suitable for firewood and stored for later sale to visitors for use in park campgrounds. Park visitors should be educated in various features of the project, such as the desirable aspects of light natural fires, the necessity of removal of excess trees if healthy forest ecosystems are to be maintained, and the probability of large, devastating wildfires if some management action is not taken. Campers could be taught that their campfires are temporarily accomplishing the same result that light ground fires produced prior to the coming of European man.

A few large windfirm dead trees should be left in each firebreak to provide habitat for woodpeckers and other birds and insects that dwell in snags. Perhaps no more than one snag per acre would be needed. The snags should be ponderosa pine, limber pine or Douglas fir. White fir snags should not be left. Trees that have natural cavities should be left as nesting sites for cavity nesting birds, such as mountain bluebirds or kestrels.

Hopefully, aspen stands should rejuvenate and spread under the prescribed treatment. It is certain that firebreak areas will

quickly be occupied by manzanita, ceanothus, bitterbrush, oak, wild rose, serviceberry and other shrubs after the conifer trees are removed. In order to increase the porportion of the understory cover contributed by herbaceous species, locally collected seed of desirable grasses and floriferous forbs should be sown into the firebreaks prior to the needle fall of the dying conifers. The resulting cover of the firebreak should be floristically attractive, ecologically diverse, attractive to animals, and resistant to fire. Such firebreaks should greatly lessen the chances of widespread, dangerous wildfires in the Paunsaugunt forests of the park. Other benefits would include the creation of loci of highly diverse assemblages of plants and animals that are readily accessible for park visitors to photograph and enjoy.

In order to insure the creation of acceptable green-belt firebreaks in the openings between forest units, a collection of seeds of grasses and forbs will be needed (Table I). Volunteer student aids could collect seeds of grasses and colorful forbs during several seasons. Collection sites should be away from visitor-use areas of the park.

The use of natural or controlled fire to modify the isolated blocks of forest created by the greenbelt openings is a management option worthy of consideration. Natural fires ignited by lightening should be allowed to burn without suppression. In case a fire does destroy a stand of trees, the area could become a useful demonstration area to teach the park visitors about natural catastrophes and secondary succession. The option of prescribed burning for management of blocks of forest would be expensive, but probably represents the optimum tool for restoring overstocked forests to more natural conditions. Controlled burning would require a crew to

TABLE I. Native forbs and grasses suitable for seeding in forest openings to enhance green belt development and attractiveness.

<i>Achillea millefolium</i>	Western yarrow
<i>Agropyron smithii</i>	Western wheatgrass
<i>Arenaria fendleri</i>	Sandwort
<i>Astragalus miser</i>	Weedy milkretch
<i>Aster chilensis</i>	Aster
<i>Balsamorhiza sagittata</i>	Arrowleaf balsamroot
<i>Carex rossii</i>	Ross sedge
<i>Cirsium pulchellum</i>	Purple thistle
<i>C. arizonicum</i>	Arizona thistle
<i>Clematis pseudoalpina</i>	Western virgin's bower
<i>Cordylanthus kingii</i>	Birdbeak
<i>Erigeron divergens</i>	Spreading daisy
<i>Eriogonum racemosum</i>	Wild buckwheat
<i>Euphorbia lurida</i>	Spurge
<i>Geranium fremontii</i>	Pink wild geranium
<i>G. richardsonii</i>	White wild geranium
<i>Hymenoxys acaulis</i>	Stemless hymenoxys
<i>H. richardsonii</i>	Colorado rubberweed
<i>Ipomopsis aggregata</i>	Scarlet gilia
<i>Koeleria nitida</i>	Junegrass
<i>Leucocrinum montanum</i>	Star lily
<i>Linum kingii</i>	Yellow flax
<i>Linum lewisii</i>	Blue flax
<i>Lotus utahensis</i>	Utah trefoil
<i>Oenothera brachycarpa</i>	Giant evening primrose
<i>O. lavandulaefolia</i>	Lavenderleaf evening primrose
<i>Oryzopsis hymenoides</i>	Indian ricegrass
<i>Pedicularis centranthera</i>	Lousewort
<i>Penstemon caespitosa</i>	Mat penstemon
<i>P. leiophyllus</i>	Royal blue penstemon
<i>Poa fendleriana</i>	Mutton grass
<i>Sevecio multilobatus</i>	Groundsel
<i>Sitanion hystrix</i>	Squirreltail
<i>Stipa comata</i>	Needle-and-thread grass
<i>S. lettermanii</i>	Letterman needlegrass
<i>Swertia radiata</i>	Green gentian

work on the project for about eight months every year (the winter season with very heavy snow excepted). Prescribed burning carefully and skillfully used could remove debris and litter and kill unwanted tree seedlings and saplings, while leaving the overstory intact. Light burning would probably create greater diversity in the forest community. Gradually forests could be restored to conditions similar to those prevailing in prehistoric times. In the late stages of manipulation, only fire prescription experts would be needed to burn the light accumulation of debris and fallen conifer needles so that a clean, open forest could be maintained.

The management options recommended for the forests of Bryce Canyon National Park are in conformity with the policies of the National Park Service. In the Administrative Policies for natural areas of the National Park System (10) active management of the natural environment is a requirement, inasmuch as passive protection is not sufficient. Native environmental complexes are to be restored, protected and maintained at levels determined through historical and ecological research of plant-animal relationships. Further support for the management recommendations is provided by the management policies of the National Park Service (11) which states: "Manipulation of terrain and vegetative cover may be carried out to encourage, simulate, or restore natural conditions on lands altered by human activity through: . . . restoration to a natural appearance of areas disturbed by fire control activities . . . (and) restoration of landscapes, altered by human activities prior to park establishment, to a natural appearing state."

In a National Park Service Occasional Paper (5) recommendations similar to those of this paper are made concerning the forests of Yosemite National Park. In Yosemite Valley ". . . large accumulation of woody debris and the continuous vertical canopy created by trees of many heights produce an excessive wildfire hazard. These fuel conditions could cause extensive conflagrations during dry windy weather. Understory fuels should be reduced by removing dead limbs from large trees, eliminating small overtopped trees, and prescribed burning of the accumulated debris during safe weather conditions. Burning was a natural process in the pristine Yosemite Valley. The ultimate objective should be restoration of open forest conditions by reducing large bodies of fuel in nearly all the forests . . . Vistas cut through forests should be wide and irregular to give the appearance of natural openings."

The outcome of appropriate management operations would be an attractive and healthy mosaic of forest communities in varied stages of succession. Animal diversity and flowering plant cover would be high in such forests. Generally, soil moisture conditions would increase as conifers were replaced by aspen and associated broadleafed understory herbs. Water run-off from such treated areas may increase by as much as 10 cm (4 inches) per unit area. The increased water yield from upland areas of the forest should result in an expansion of and greater production in the more mesic communities that border the intermittent stream channels of the park.

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