

PLANT COMMUNITY DISTRIBUTION AND DYNAMICS
IN BRYCE CANYON NATIONAL PARK

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Objectives

The overall objectives of the research are:

1. Develop a comprehensive classification for all stages of successional development for all vegetation types within the Park;
2. Map the potential vegetation and current vegetation types throughout the Park;
3. Development a simple succession model for predicting vegetation dynamics for each vegetation type in the Park; and
4. Map distributions of rare or endangered plant species within the Park.

The combination of these objectives will provide Park managers with a predictive tool for Park management, and will provide vegetation ecologists with a comprehensive knowledge of the landscape vegetation dynamics of a range of vegetation types.

Methods

The comprehensive vegetation classification is based on the concept of habitat types (Daubenmire and Daubenmire 1968), with a classification of seral communities within each habitat type based on successional susceptibility and dominance, following Steele (1984). Forest habitat types were classified according to Youngblood and Mauk (1985). Non-forest habitat types had not yet been defined for southern Utah, so non-forest habitats within Bryce Canyon National Park were classified into types based on community composition and dominant species abundance. Both forest and non-forest habitat types were tested for homogeneity and uniqueness by calculating the ratio of within-type similarity to between-type similarity for all types.

For forest types, successional community types were defined within habitat types by determining the set of possible tree species which

occurs in the types were defined within habitat types by determining the set of possible tree species which occurs in the type, ranking the species in order of shade tolerance, and classifying each stand according to a binomial of (1) the least shade tolerant species present in the stand, and (2) the dominant species in the stand. For non-forest types, a similar system based on competitive hierarchy was envisioned, but lack of suitable samples of many seral non-forest communities prevented determining a full classification.

Potential vegetation (habitat types) and current vegetation (classified by the binomial classification) were mapped for the entire Park by a combination of field mapping, interpretation of aerial photography and extrapolation by statistical estimation techniques. Soil types, as mapped by the SCS, were also transferred to mylar overlays for analysis of soil/vegetation relations throughout the Park.

The succession model for simulation of vegetation dynamics was based on the vital attributes concepts of Noble and Slatyer (1980). We modified the method to produce a stochastic simulation model which predicts tree species abundance and seral community type for each forest community given initial conditions and an estimated fire regime. Non-forest communities have a simpler schematic model of vegetation dynamics based on our knowledge of the autecology of the dominant species.

The rare plant species of primary interest within the Park is Pediomelum pariense (Welsh and Atwood) Welsh [previously Psoralea pariensis (Welsh and Atwood)]. Based on the known distribution of this species, we delineated possible habitat for the species based on environmental characteristics, and established transects through the potential distribution zone. Eight detailed vegetation sample plots were established in the area, with 5 of the 8 containing P. pariense. The percent cover, frequency, and density of vascular plant species was estimated in quadrants, and soil samples were collected for analysis in the laboratory.

Results

The potential vegetation of Bryce Canyon was classified into a total of 15 habitat types. Four non-woodland types were defined: Eriogonum corymbosum/Elymus salinus, Artemisia tridentata/Atriplex canescens, Artemisia nova/Stipa comata, and Juncus balticus/Carex rossii. ERCO/ELSA and ARTR/ATCA occur at low elevations on heavy soils in the northeast corner of the Park, ARNO/STCO occurs widely in the northern end of the Park or on xeric sites within the forested zone of the Park farther south, and JUBA/CARO occurs on seeps and seasonally saturated soils within the ARNO/STCO zone. The north end of the Park is dominated by a Pinus edulis/Juniperus osteosperma woodland on all aspects above the valley bottoms. This type is somewhat variable, but does not lend itself to subdivision based on consistent shrub or herbaceous species distributions. The forested zone of the Park consists primarily of

three series, Pinus ponderosa, Pseudotsuga menziesii, and Abies concolor, in order of increasing moisture requirements. Local areas within this zone may support the Pinus flexilis/Pinus longaeva series or the Picea pungens series on specialized edaphic sites.

Without presenting the details of the seral community classification, we can state in general that most of the vegetation within Bryce Canyon should be considered mid-seral or late-seral. In most cases, the eventual climax dominant species is present in significant amounts, but is often not the dominant species. The largest individuals in many stands range in age from 350 to over 400 years, with an indication in many cases that these sites have been subject to recurrent fire on moderate intervals, and that the dominant individuals have survived numerous fires.

All areas of the Park have been mapped to habitat type. All non-forest areas, and the Pinus ponderosa series, as well as most of the Pseudotsuga menziesii series have been mapped to seral community type. Mapping of seral communities within the Abies concolor series is currently under way.

The succession model has been developed and tested on a number of different habitat types. On an individual stand basis, vegetation composition comes into a unique equilibrium with each simulated fire return interval for most habitat types. When spatial distribution of multiple stands is added to the simulation, however, variability is much higher. Synthetic landscapes of 400 individual stands are too small to contain significant disturbance and do not come into equilibrium within 500 year simulations. The landscape simulation predicts a significant interaction of environmental heterogeneity with disturbance regime for areas similar to Bryce Canyon.

Analysis of the distribution of Pediomelum pariense suggests that the species is more widely distributed than previously known. The habitat requirements appear to be tied primarily to substrate, with the best sites occurring on gentle to moderate slopes along the scarp of the Paunsaugunt Plateau.

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