VEGETATION SAMPLING AND CLASSIFICATION

Introduction

This report presents the results of the vegetation classification portion of the USGS-NPS Vegetation Mapping Program at Devils Tower National Monument. The major goal of this portion of the project was to classify and describe all plant communities found within the study area. In addition, vegetation data were used by the photointerpreter to determine relationships between signatures on aerial photos and vegetation types on the ground, and in some cases, to correlate habitat characteristics and vegetation types for predictive modeling.

Sampling strategy and field methods are described for vegetation sampling. The vegetation classification, field key to the vegetation types, and descriptions of each type are also included. As a supplement to this report, the raw plot data are included as original field forms and in electronic form in the PLOTS database (a Microsoft Access database).

Methods

The methods used for the sampling and analysis of vegetation data and the development of the classification generally followed the standards outlined in the Field Methods for Vegetation Mapping document produced for this project. This process began with the development of a preliminary list of vegetation types from the National Vegetation Classification System (NVCS) that were thought to have a high likelihood of being in the mapping area. The list was prepared by literature review, including previous vegetation classifications of the Monument, and contacting knowledgeable experts. Due to the small size of the mapping area, it was initially thought that sampling would occur across the entire mapping area. However, it was not possible to obtain permission to go on private lands beyond the Monument's boundaries, so all sampling was done within Devils Tower NM. There were no areas that were not accessible within the Monument.

Twenty-eight plots were collected in late July and August of 1996. The field team attempted to place plots in each of the vegetation types on the preliminary list that they could find. In addition, vegetation types that were encountered in the field which appeared distinct from any on the preliminary list were sampled. Plots were subjectively placed, generally in vegetation that was representative of an area of relatively homogeneous vegetation which covered more than 1/2 ha (the minimum mapping unit). Thus, ecotones and small patches were avoided. However, in cases where several vegetation types regularly occurred in mosaics of small stands, it was necessary to use multiple plots and sample smaller patches.

Number of plots and plot size varied by community. The number of plots depended on the areal extent of the community on Devils Tower NM, i.e. more widespread communities had more plots than rarer ones. Forest and woodland communities were generally sampled with 20 x 20 meter plots

while herbaceous communities were generally sampled with 10 x 10 meter plots. In some instances rectangular plots of the same area were used (i.e. 10 x 40 m or 5 x 20 m) in linear or narrow polygons.

In late May and June of 1997, after a preliminary vegetation map had been prepared by the photointerpreter, a map validation step was performed in which further data were collected to obtain more information on the vegetation types and to better correlate the vegetation with the signatures on the aerial photographs. With the exception of two communities, every polygon within the Monument boundaries that had not been sampled the previous year was visited. This resulted in the collection of thirty-eight observation points. At each point, the dominant species in each vegetation stratum were recorded with an estimated cover class. These extra points gave a better understanding of the variation within vegetation types and allowed sampling of three types that had not been found the previous field season.

The final vegetation classification and descriptions were produced using plots, observation points, and the experience of the field team. Field personnel organized the plots and observation points into groups based on vegetation structure and composition. The number of plots ranged from 0-6 per type and the average number of observation points ranged from 0-6 per type. The two sparsely vegetated communities were not sampled with either plots or observation points because they were easily distinguished from surrounding vegetation types and adequate descriptions existed. Quantitative analyses were also completed to compare to the subjective classification. Average cover of each species and vegetation stratum were computed. Only the plots were used for quantitative analysis because of the more detailed information collected for them. They were analyzed using an ordination technique, Detrended Correspondence Analysis (DCA), and a clustering algorithm, Unweighted Pair-Group Method Using Arithmetic Means (UPGMA). Because there were few plots per type and the locations of the plots were chosen to emphasize the variation within a vegetation type, there was substantial variation within each type. These factors lessened the utility of the numerical analyses. Thus, the results of the numerical analyses were not used to derive the classification, but were compared to the subjective classification and any discrepancies in plot placement were examined.

Results

The classification of the vegetation at Devils Tower NM resulted in 16 types being defined, including two forest types, five woodland types, seven herbaceous types, and two sparsely vegetated types. Two of the herbaceous types and the two sparsely vegetated types do not have rangewide descriptions because they were newly described from Devils Tower NM. One of the herbaceous types is heavily dominated by exotics and the other is the result of continuing and extensive disturbance by prairie dogs. The names of these two herbaceous vegetation types end with "Community" to signify that they do not fully fit within the NVCS.

Some parts of the mapping area that have been classified as natural vegetation have been disturbed in the past. This is especially true in the floodplain of the Belle Fourche River where Euphorbia esula (leafy spurge) dominates the herbaceous stratum in some areas. Species lists and structure of these areas are different from less disturbed examples of the same community. The descriptions of the

vegetation of each community were written based on information from the plots, observation points, and experience of the field team. The two sparsely vegetated communities (Redbeds Sparse Vegetation and Phonolite Porphyry Sparse Vegetation) did not have samples collected because good descriptions already existed from previous vegetation classifications of Devils Tower NM.

The vegetation types described in this report do not necessarily correspond to units on the final vegetation map, for several reasons. In some cases, two or more plant communities distinguishable on the ground could not be distinguished in aerial photographs, nor predicted based on habitat characteristics. In this type of situation, the photointerpreter lumped multiple plant communities into a single map unit, labeled as a complex. In other cases, multiple communities occur as mosaics of small distinct stands which vary over too fine a scale to be mapped individually. These are mapped as mosaics.

In classifying vegetation, we attempt to recognize distinctive assemblages of plant species that occur repeatedly in appropriate habitat conditions. These plant communities become the basic mapping units in preparing vegetation maps. In some cases, the concept of a discrete assemblage of plants characteristic of a given habitat works very well. For example, in the Black Hills it is easy to correctly predict associated species and habitat characteristics for stands of paper birch and beaked hazel. In other cases, it can be very difficult to subdivide vegetation into consistent, repeating assemblages of species. Much of the ponderosa pine vegetation in the Black Hills presents this problem to some degree. Understory composition often is too variable or varies over too fine a scale to easily define discrete communities, especially from remotely sensed data. Boundaries are not easily recognized. Types grade into other types. The extensive disturbance history of ponderosa pine stands in the Black Hills makes this picture even more difficult to interpret.

In the Black Hills, many investigators have reported difficulties in classifying ponderosa pine vegetation. In our study, we encountered the same problems. Pine stands at environmental extremes (most xeric, most mesic) tended to be fairly consistent in species composition. Pinus ponderosa / Schizachyrium scoparium Wooded Herbaceous Vegetation (dry slopes, often south-facing) and Pinus ponderosa / Physocarpus monogynus Forest (northerly slopes) are two good examples. In contrast, stands found on intermediate sites were often problematic due to variable understory composition.

The classification of Devils Tower NM follows. A field key and descriptions for each of the types are included in later sections of the report.

Classification

"*" indicates a new Formation in the National Vegetation Classification System.

I. FOREST
I.A. Evergreen forest
I.A.8. Temperate or subpolar needle-leaved evergreen forest
I.A.8.N Natural/semi-natural
I.A.8.N.b. Rounded-crowned temperate subpolar needle-leaved evergreen forest
PINUS PONDEROSA FOREST ALLIANCE
Pinus ponderosa / Mahonia repens Forest

I.B. Deciduous forest
I.B.2. Cold-deciduous forest
I.B.2.N Natural/semi-natural
I.B.2.N.a. Lowland or submontane cold-deciduous forest
***FRAXINUS PENNSYLVANICA* - (ULMUS AMERICANA) FOREST ALLIANCE**
Fraxinus pennsylvanica - Ulmus americana / Symphoricarpos occidentalis Forest

II WOODLAND
II.A Evergreen woodland
II.A.4 Temperate or subpolar needle-leaved evergreen woodland
II.A.4.N Natural/semi-natural
II.A.4.N.a. Rounded-crowned temperate or subpolar needle-leaved evergreen woodland

PINUS PONDEROSA WOODLAND ALLIANCE
Pinus ponderosa / Carex inops ssp. *Heliophila* Woodland
Pinus ponderosa / Juniperus communis Woodland
Pinus ponderosa / Pseudoroegneria spicata Woodland
Pinus ponderosa / Quercus macrocarpa Woodland

II.B Deciduous woodland
II.B.2 Cold-deciduous woodland
II.B.2.N Natural/semi-natural
II.B.2.N.b. Temporarily flooded cold-deciduous woodland
POPULUS DELTOIDES TEMPORARILY FLOODED WOODLAND ALLIANCE
Populus deltoides - (Salix amygdaloides) / *Salix exigua* Woodland

V. HERBACEOUS VEGETATION
V.A. Perennial graminoid. vegetation
V.A.5. Temperate or subpolar grassland
V.A.5.N Natural/semi-natural
V.A.5.N.c. Medium-tall sod temperate or subpolar grassland
PASCOPYRUM SMITHII HERBACEOUS ALLIANCE
Pascopyrum smithii - Bouteluoa gracilis - Carex filifolia Herbaceous Vegetation

ALLIANCE UNDEFINED
Poa pratensis Disturbed Community

SCHIZACHYRIUM SCOPARIUM - BOUTELOUA CURTIPENDULA HERBACEOUS ALLIANCE
Schizachyrium scoparium - *Bouteloua* (curtipendula, gracilis) - *Carex filifolia* herbaceous Vegetation

V.A.5.N.j. Temporarily flooded temperate or subpolar grassland

SPARTINA PECTINATA TEMPORARILY FLOODED HERBACEOUS ALLIANCE
Spartina pectinata - *Scirpus pungens* Herbaceous Vegetation

V.A.6 Temperate or subpolar grassland with a sparse tree layer
V.A.6.N Natural/semi-natural
V.A.6.N.f. Medium-tall temperate or subpolar grassland with a sparse needle-leaved evergreen or mixed tree layer

PINUS PONDEROSA WOODED MEDIUM-TALL HERBACEOUS ALLIANCE
Pinus ponderosa / Schizachyrium scoparium Wooded Herbaceous Alliance

V.A.7. Temperate or subpolar grassland with a sparse shrub layer
V.A.7.N Natural/semi-natural
V.A.7.N.e. Medium-tall temperate or subpolar grassland with a sparse needle-leaved or microphyllous evergreen shrub layer

ARTEMISIA CANA SHRUB HERBACEOUS ALLIANCE
Artemisia cana ssp. *cana* / *Pascopyrum smithii* Shrub Herbaceous Vegetation

V.A.7.N.g. Medium-tall temperate or subpolar grassland with a sparse cold-deciduous shrub layer

RHUS TRILOBATA SHRUB HERBACEOUS ALLIANCE
Rhus trilobata / Pseudoroegneria spicata Shrub Herbaceous Vegetation

VII SPARSE VEGETATION
VII.A Consolidated rock sparse vegetation
VII.A.1 Sparsely vegetated cliffs
VII.A.1.N Natural/semi-natural
VII.A.1.N.a. Cliffs with a sparse vascular vegetation

ROCK OUTCROP / BUTTE SPARSE VEGETATION
Phonolite Porphyry Sparse Vegetation
Redbeds Sparse Vegetation

Conclusion

The vegetation of Devils Tower NM was classified using the techniques established for the NPS/BRD Vegetation Mapping Program. Most of the vegetation types fit within existing associations in the NVCS. Due to extensive disturbance and regional variation, some of the vegetation at Devils Tower NM did not closely match the more general, national description of the community into which it was placed. In addition, four did not fit within the current NVCS and retained park-specific names and descriptions. It is expected that these will be fully placed within a national hierarchy and given rangewide descriptions as the NVCS is further developed.

Several recommendations for future mapping projects have flowed from the experience gained mapping Devils Tower NM. It is recommended that future mapping projects begin fieldwork with a reconnaissance step involving observation point data collection from a large number of points. This type of sampling goes relatively fast and would allow the project investigators to identify plant communities within the study area and to get some feel for variation within each type. After a preliminary classification is in hand, representative stands could be selected for more detailed vegetation plots. Data collected for observation points would also supplement vegetation plot data in preparing community descriptions. This approach is most suited to small parks where regaining access to an area is not especially time-consuming or difficult. In larger parks or those with remote areas, it would still be beneficial to collect observation points from the same area and at the same time as plots are being collected.

Communication between the field ecologists and the photointerpreters/mappers is vital for a successful project. One step that can help this is to begin field work with aerial photos with preliminary vegetation polygons delineated. This helps the ecologists direct their sampling and the process of polygon delineation often generates questions relating to vegetation classification which the field team can investigate during vegetation sampling instead of after the field season.

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