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NATIONAL MONUMENT
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Vegetation Baseline Study of Mount Rushmore
National Monument

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INTRODUCTION

Mount Rushmore National Monument is a 486 ha tract of land located in the central core area of the Black Hills.

Objectives of this study were:

1. Collect plants throughout the monument area to update and complete the list of plants that occur there.
2. Describe any remnant virgin, or near virgin, forests that might occur there, to provide a baseline vegetation study.
3. Interpret the successional trends that are apparent.

This small area within the "crystalline core" contains one of the few old stands of Pinus ponderosa in the Black Hills. Because of its essentially pristine condition, this stand is a valuable reference site against which to evaluate changes elsewhere in the Hills resulting from intense forest management on the same habitat type.

STUDY REGION

Elevations at Mount Rushmore National Monument are between 1280 m at Lafferty Gulch to 1745 m at Mt. Rushmore. The 486 ha area is part of the central crystalline area of the Hills, and consists of Pre-Cambrian igneous and sedimentary rocks. Soils are generally thin and coarse-textured particularly along upper slopes. Along streams, the soils are deeper and much finer-textured. The prominent geologic feature is the granitic

Mt. Rushmore on which the faces were sculpted. Elsewhere granitic ridges of less prominence are distinctive land marks. Old Baldy Mountain at 1708 m is in the northwestern corner of the monument. Doane Mountain is located just south of Mount Rushmore. Just north of Mount Rushmore are several ridges and peaks that are sparsely vegetated or bare. Lafferty Gulch is a mesic stream environment which enters the monument from the north (Figures 1 and 2). Highway 87 crosses the monument in a generally east-west direction. Access roads are very limited, as shown in Figure 1.

In the absence of climatic data from the Monument or from Keystone, nearby, that from Custer, SD, may serve to characterize the climate. Only precipitation data are available from Custer, and the following are the monthly means:

J = 10.4 mm	J = 50.4 mm
F = 9.7	A = 64.0
M = 25.4	S = 26.7
A = 47.8	O = 26.7
M = 78.5	N = 9.9
J = 78.5	D = 9.1

Annual = 437.0

Of the total annual precipitation, 79% falls during the 6 warm months of the year. While these data refer to Custer, SD, the pattern for most precipitation falling during the warm six months will hold for Mt. Rushmore National Monument. Though temperature data are not available for the Monument or the area close by, data from more distant weather stations in the Hills indicate mean temperatures are generally higher in the winter and lower in the summer than on the surrounding plains. Annual temperature extremes are also less in the Hills than on the plains.

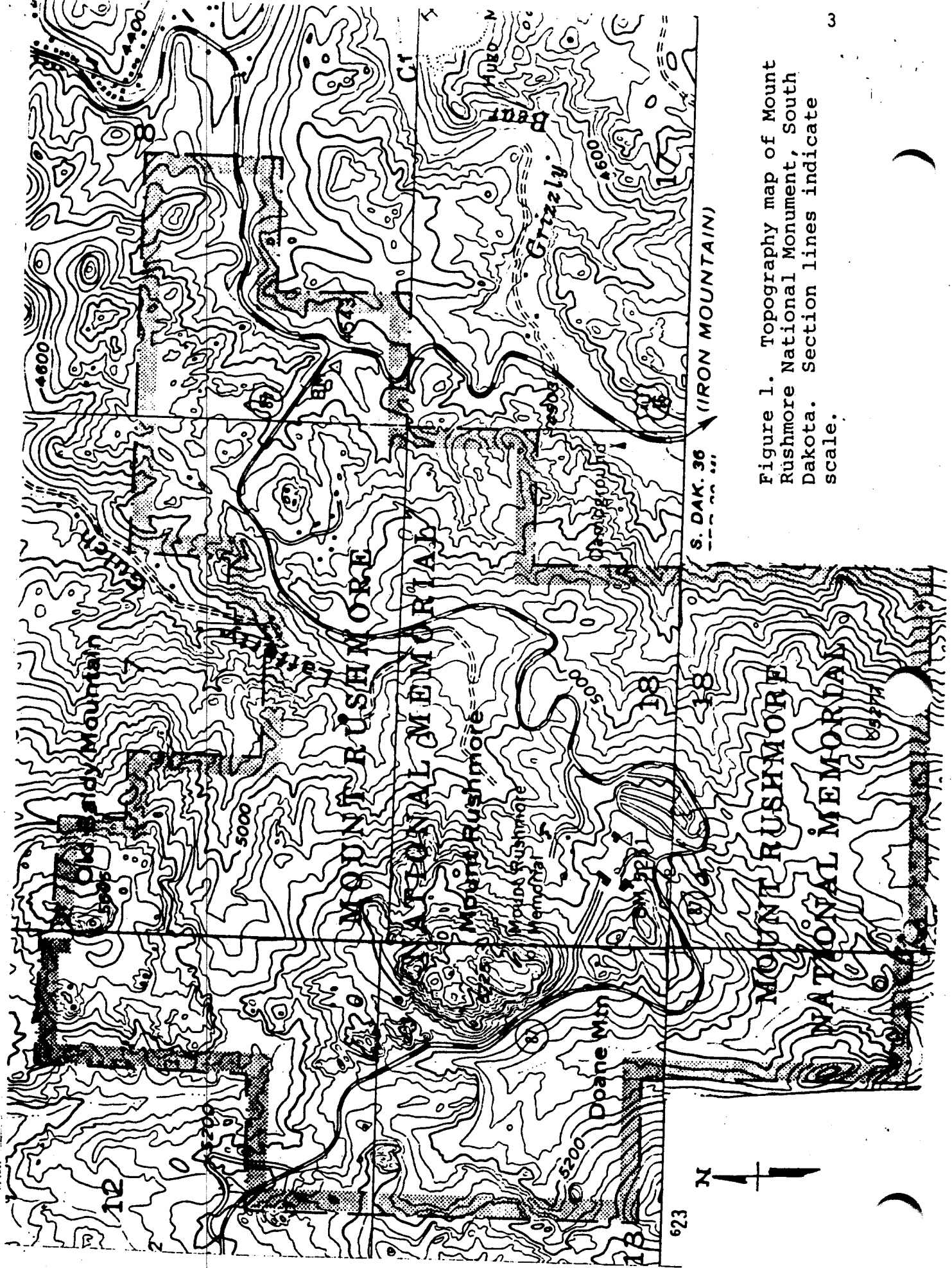


Figure 1. Topography map of Mount Rushmore National Monument, South Dakota. Section lines indicate scale.

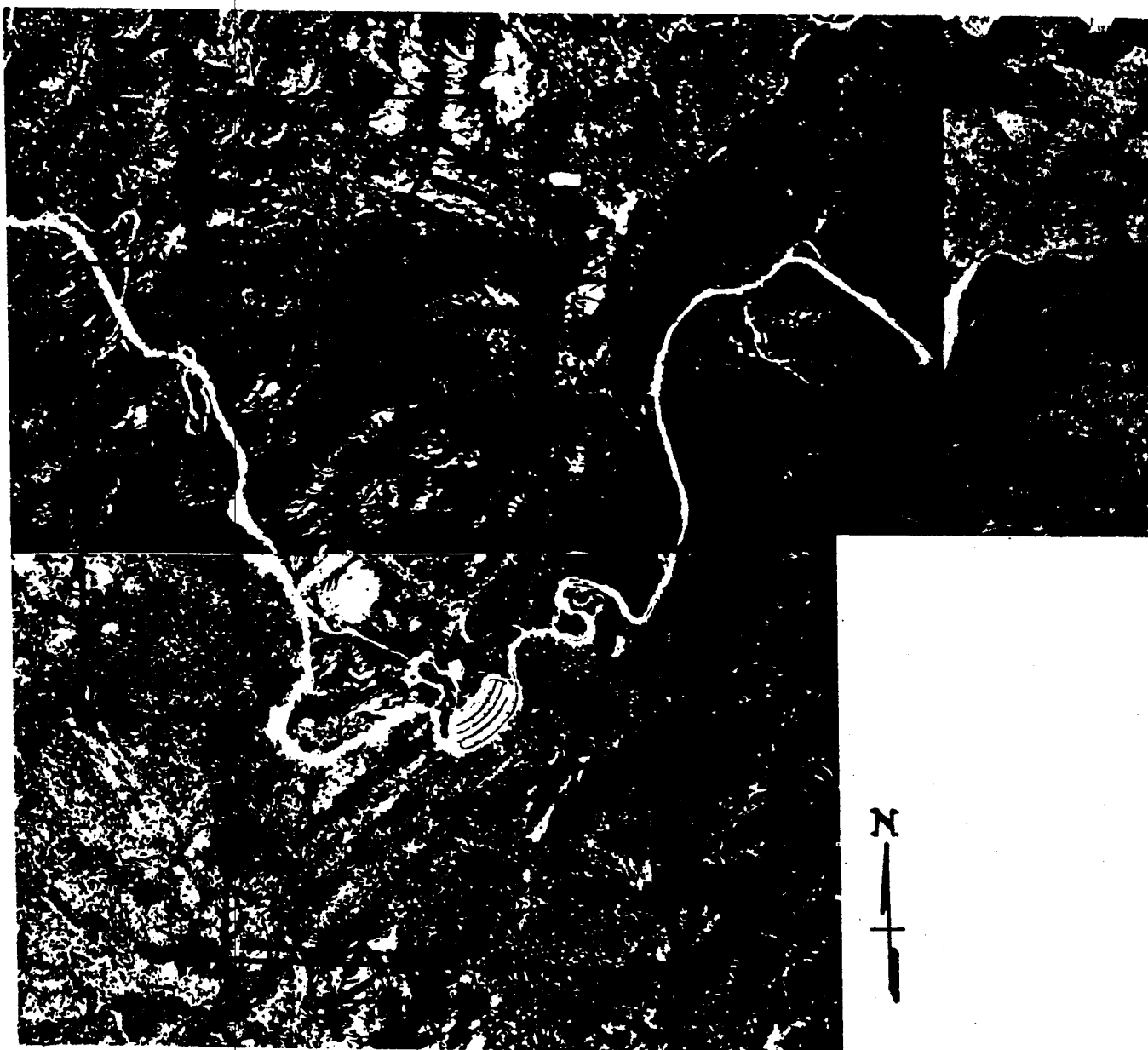


Figure 2. Aerial photo of Mount Rushmore and vicinity. The National Monument is outlined as closely as possible. Compare to Figure 1. Scale at bottom of photo is 0.5 km.

SAMPLING METHODS

The field work for this study was done during one growing season. It was done in conjunction with a broader study of the forest habitat types of the Black Hills National Forest.

The methods used followed closely those used to sample forest vegetation of the Routt, White River and Black Hills National Forests (Hoffman 1986, Hoffman and Alexander 1980, 1983). In brief, the methods are these.

- 1) We walked throughout the 486 ha area listing all plant species and noting the range of possible habitat types present. A sizeable portion of the monument area is taken up with parking lots, visitors' center, gift shop, walkways, and living quarters. Service and maintenance facilities occupy a limited amount of space.
- 2) We sampled quantitatively two stands of Pinus ponderosa-dominated vegetation as follows:
 - a) At each stand we determined the most homogeneous part and staked out a plot 15 x 25 m (375 m²). We subdivided this into three 5 x 25 m subplots. Trees larger than seedlings were tallied in all three subplots and recorded in diameter size classes (Appendix A). Within two 1 x 25 m transects placed along the inner sides of the central subplot, we counted and recorded all tree seedlings.

- b) We estimated coverage of undergrowth species within 50 - 2 x 5 dm microplots placed at 1 m intervals along the inner sides of the central subplot. We followed the method of Daubenmire (1959) to record coverages and calculated frequencies of all species present in the plots. These data are recorded in Appendix B.
- c) We collected 25 soil samples from the upper decimeter of mineral soil at each stand. These samples were composited and air-dried in the field, then taken to the laboratory for analyses. In the laboratory the soils were passed through a 2 mm screen, and the samples were tested for pH (glass electrode on the saturated soil paste, exchangeable Ca and Mg (EDTA titration method), K and P (bicarbonate extraction method), pH lime requirement (Ohio SMP method), cation exchange capacity and base saturation (by addition), organic matter (dichromate method), and particle size distribution (modified Bouyoucos method). Soils data are recorded in Appendix C.
- d) We cored the largest two trees in each stand to estimate time since last destructive fire.
- e) We used Van Bruggen (1985) and Dorn (1977) for plant nomenclature. Our complete species list, arranged by Plant Families, is given in Appendix D.

THE VEGETATION

Over most of the monument area Pinus ponderosa dominates forests in various stages of succession. The major habitat type of the area is Pinus ponderosa/Arctostaphylos uva-ursi (Hoffman 1986). In fact the most mature stands of this habitat type in the Black Hills occur in Starling Canyon on Monument property. It is below Highway 87 just south and southwest of Mt. Rushmore. We sampled quantitatively two of these stands to record the vegetation and other site characteristics. A profile diagram of site 1 is shown in Figure 3. The documentation of these 2 stands will become more important with time as the Black Hills National Forest is more intensively managed, and little to no vegetation remains that retains characteristics of a pristine state.

The vegetation of Starling Canyon represents primarily the Pinus ponderosa/Arctostaphylos uva-ursi habitat type. It is prominent along the lower to higher slopes of the canyon. The dominant Pinus ponderosa is 200+ years old in this canyon and the tree cores indicate the trees are sound, without insect or fungal damage. The undergrowth is dominated by Arctostaphylos uva-ursi with coverage of 76 - 85%. Spiraea betulifolia and Symphoricarpos albus are also common shrubs in this vegetation. Oryzopsis asperifolia is an important grass; forb composition is somewhat variable but Glycyrrhiza lepidota, Lathyrus ochroleucus, Potentilla fissa, and Smilacina stellata are important in one or the other of the two stands sampled.

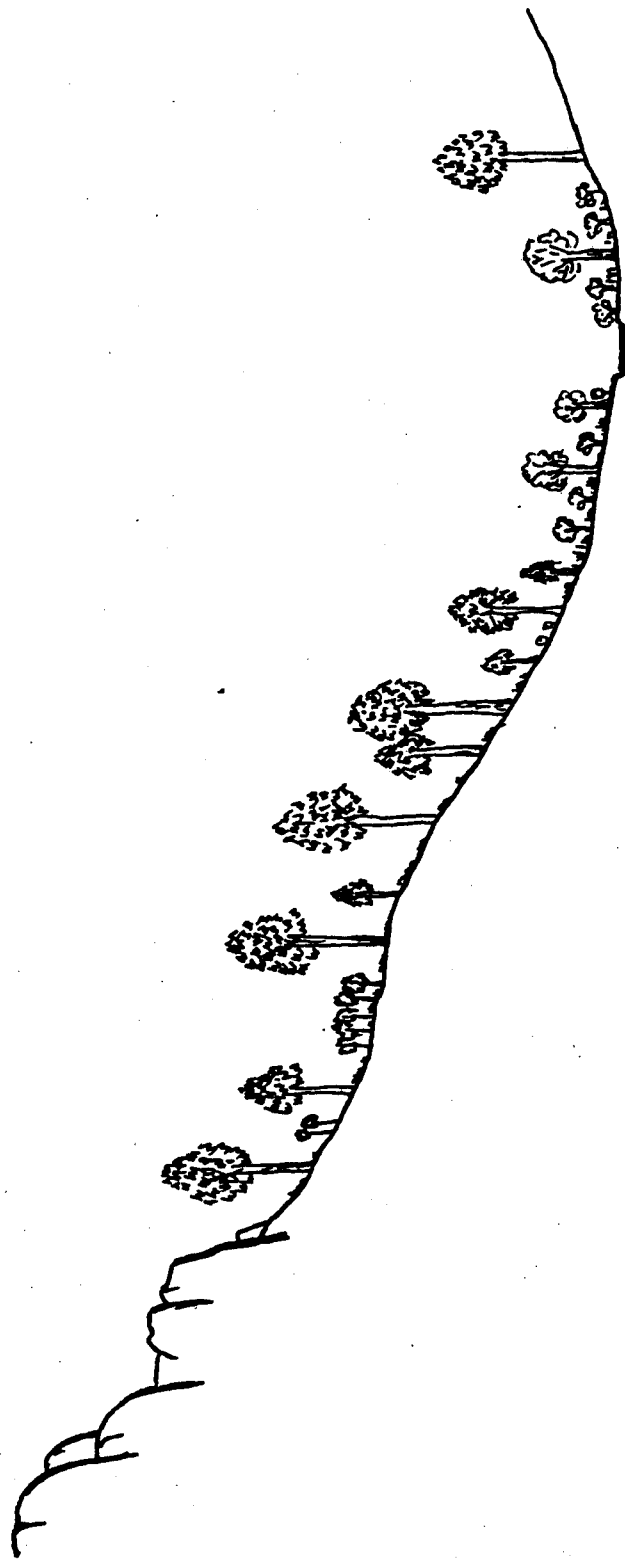


Figure 3. Profile diagram of a location in Starling Canyon. Pinus ponderosa exceeds 200 years in this location. The largest trees are rather evenly spaced. Along the stream Quercus macrocarpa and Corylus cornuta occur. The habitat type above the stream influence and below the rock is Pinus ponderosa/ Arctostaphylos uva-ursi.

As shown in Appendix B total undergrowth species in the two stands were 19 and 25 respectively though the total coverage exceeded 100% in each stand. Shrubs provided the greatest coverage in this vegetation.

The soils of the *Pinus/Arctostaphylos* stands sampled showed some interesting similarities as well as differences. Stands higher on the slopes have quite thin soils while those on lower positions have thicker and heavier soils.

Over much of the higher elevations the vegetation is also dominated by *Pinus ponderosa*, but the stands are younger, and in places tree stumps indicate past logging. The stumps are hard and have decayed very little. Most are encrusted with lichens. Over most of the area north of Mt. Rushmore the pine forests alternate with rock outcroppings. We walked the entire length of what we termed "East-West Gulch" north of Mt. Rushmore and it is entirely *Pinus/Arctostaphylos* habitat type. The soils are shallow, and the trees are shallowly rooted. The higher sides of the gulch are bare rock surfaces with some crevices in which plants grow.

In places, northwest of Mt. Rushmore, for example, there are rather extensive stands of dense pines. These are small, less than 1 dm dbh, and extremely dense. They no doubt became established after disturbance such as fire or logging or both, and they have not self-thinned their populations. The undergrowth is very sparse if at all present in these stands.

Quercus macrocarpa occurs along the drainageway in Starling Canyon. The vegetation is similar to that along other drainages in the Hills. The oak in these mesic habitats is as large as

anywhere in the Hills and we counted xylem rings from one of the trees. Also in these mesic streamside habitats a few Pinus ponderosa occur; some are 8+ dm dbh. As nearly as we could determine, using a 16 inch increment borer, these trees are nearly the same age as those higher on the slopes, 200+ years, but are larger as a result of additional soil moisture. Corylus cornuta is commonly associated with Quercus in these habitats.

Picea glauca is found only in areas of the Monument where soil moisture and/or cool air drainage satisfy its requirements. The largest, 4 - 5 dm dbh, are in Lafferty Gulch near the northeastern boundary of the Monument. It occurs with Betula papyrifera, Betula occidentalis, Populus tremuloides and other mesophytic species common to these habitats. We found very few seedlings of Picea in these habitats. A few Picea glauca also occur along the drainageway of Starling Canyon.

The vegetation of Mt. Rushmore National Monument is a small part of the total in the Black Hills. It may be viewed as a localized entity within the Hills, or it may be viewed as part of the total. A description of the forest habitat types of the entire Black Hills National Forest is forthcoming (Hoffman and Alexander 1986). As indicated above, the climax forest in Starling Canyon, representative of the Pinus ponderosa/Arctostaphylos uva-ursi habitat type, is a benchmark and should be preserved at all costs. It is the most mature forest of this habitat type in the Black Hills.

The flora was identified and listed for the Monument. We collected some but not all the species. This list is given as Appendix E of this report.

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- Dorn, R. D. and J. L. Dorn. 1977. Flora of the Black Hills. Private Publication by the authors, 377 p.
- Hoffman, G. R. and R. R. Alexander. 1986. The forest habitat types of the Black Hills National Forest. USDA For. Service Res. Paper RM-000 (IN PRESS).
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APPENDIX A

Tree population analyses of Mt. Rushmore National Park. Numbers of trees listed per 375 m², with basal area for the stands as m²/ha. Abbreviations of tree species are as follows:

Pn p-- *Pinus ponderosa*

Qu m-- *Quercus macrocarpa*

Stand	Basal Area	Species	Diameter (at breast height) classes in dm						
			0-1	1-2	2-3	3-4	4-5	5-6	6-7
			<.5	>.5					
<i>Pinus ponderosa</i> / <i>Arctostaphylos uva-ursi</i> habitat type									
1	44.1	Pn p	831	9		2	5	4	1
		Qu m	15						
2	25.2	Pn p	78	2	2	2	5	2	

APPENDIX B

Pinus ponderosa/*Arctostaphylos uva-ursi* habitat type table with stand data. In the plant data, the number to the left of the slash is percent coverage where the value exceeds 0.5%, with a + to the left of slash indicating coverage of 0.5% or less. Number to the right of slash is percent frequency. Stand numbers, locations, and topographic position are also given.

Pinus ponderosa/*Arctostaphylos uva-ursi* habitat type

Stand Number	1	2
Location:		
Quarter Section	SE	SE
Section	12	13
Township	2S	2S
Range	5E	5E
Topographic Position:		
Slope	10%	20%
Aspect	30°	56°
Elevation, m	1573	1548
Coverage/Frequency		
SHRUBS		
<i>Amelanchier humulis</i>	-	+ / 2.0
<i>Arctostaphylos uva-ursi</i>	76. / 100.	85. / 100.
<i>Prunus virginiana</i>	-	+ / 2.0
<i>Ribes missouriense</i>	-	+ / 2.0
<i>Rosa acicularis</i>	1.0 / 10.	+ / 2.0
<i>Rosa woodsii</i>	+ / 2.0	-
<i>Rubus idaeus</i>	-	1.4 / 8.0
<i>Spiraea betulifolia</i>	3.4 / 26.	3.3 / 42.

Pinus ponderosa/*Arctostaphylos uva-ursi* habitat type (cont.)

Stand Number	1	2
	Coverage/Frequency	
<i>Symphoricarpos albus</i>	3.0/32.	4.9/32.
FORBS		
<i>Achillea millefolium</i>	+/4.0	+/2.0
<i>Agoseris glauca</i>	-	+/2.0
<i>Anemone patens</i>	+/2.0	-
<i>Apocynum androsaemifolium</i>	+/2.0	+/2.0
<i>Artemisia ludoviciana</i>	0.6/4.0	-
<i>Aster ciliolatus</i>	1.7/8.0	-
<i>Campanula rotundifolia</i>	+/2.0	+/2.0
<i>Cirsium ochrocentrum</i>	-	+/2.0
<i>Fragaria virginiana</i>	+/2.0	0.7/8.0
<i>Glycyrrhiza lepidota</i>	6.4/36.	-
<i>Heuchera richardsonii</i>	-	+/2.0
<i>Hieracium albiflorum</i>	-	+/2.0
<i>Lathyrus ochroleucus</i>	12./68.	+/2.0
<i>Monarda fistulosa</i>	-	+/2.0
<i>Potentilla frissa</i>	-	1.6/16.
<i>Pterospora andromedea</i>	-	+/2.0
<i>Smilacina stellata</i>	1.3/20.	+/2.0

Pinus ponderosa/*Arctostaphylos uva-ursi* habitat type (cont.)

Stand Number	1	2
	Coverage/Frequency	
<i>Solidago speciosa</i>	+/2.0	-
<i>Thermopsis rhombifolia</i>	-	3.4/20.
<i>Vicia americana</i>	1.2/10.	-
Graminoids		
<i>Agropyron caninum</i>	-	+/2.0
<i>Bromus inermis</i>	+/4.0	-
<i>Danthonia spicata</i>	-	1.1/4.0
<i>Oryzopsis asperifolia</i>	8.8/40.	14./48.
Species in microplots	19	25
Coverage of shrubs	84	95
Coverage of forbs	24	8
Coverage of graminoids	9	15
Total coverage	115	116

APPENDIX D

Plant list for Mt. Rushmore National Park. Species are arranged according to family.

Family Equisetaceae

forbs

Equisetum sp.

Family Polypodiaceae

forbs

Pteridium aquilinum

Woodsia oregana

Woodsia scopulina

Family Pinaceae

trees

Pinus ponderosa

Picea glauca

Family Cupressaceae

shrubs

Juniperus communis

Family Cyperaceae

APPENDIX C

Results of soil analyses of the upper 1 dm of mineral soil from each stand sampled.

Stand	pH	Mechanical Analysis			Exchangeable Cations			pH Lime Requirement (kg/ha)	P ppm	C.E.C. ¹ (meq/100 g)	B.S. ² (%)	O.M. ³ (%)
		% Sand	% Silt	% Clay (Texture)	(meq/100g)							
					Ca	Mg	K					
<i>Pinus ponderosa/Arctostaphylos uva-ursi</i> habitat type												
1	5.4	48.4	39.6	12.0	4.8	1.6	0.24	-	19.9	6.64	100.0	2.00
		(loam)										
2	5.2	73.4	22.2	4.4	2.9	1.7	0.28	1344	24.2	6.08	80.26	4.66
		(sandy loam)										

¹Cation Exchange Capacity

²Base Saturation

³Organic Matter Content

APPENDIX E

Family Equisetaceae
forbs✓✓ *Equisetum* sp.**Family Polypodiaceae**
forbs✓✓ *Pteridium aquilinum*
✓✓ *Woodsia oregana*
✓✓ *Woodsia scopulina***Family Pinaceae**
trees✓✓ *Pinus ponderosa*
✓✓ *Picea glauca***Family Cupressaceae**
shrubs✓✓ *Juniperus communis***Family Cyperaceae**
graminoids✓✓ *Carex foenea*
✓✓ *Carex peckii***Family Poaceae**
graminoids✓ *Elymus* ~~*Agropyron*~~ *caninum*
✓ *Pascopyrum* ~~*Agropyron*~~ *smithii*✓✓ *Agrostis hyemalis*✓✓ *Agrostis scabra*✓✓ *Agrostis stolonifera*✓✓ *Andropogon gerardi*✓✓ *Andropogon scoparius*✓✓ *Bromus inermis*✓✓ *Danthonia spicata*✓✓ *Elymus canadensis*✓✓ *Elymus virginicus*✓✓ *Festuca idahoensis*✓✓ *Festuca ovina**Schizachyrium scoparium* 3% *scoparium*

- macrantha*
- ✓✓ *Koeleria pyramidata*
 - ✓✓ *Muhlenbergia cuspidata*
 - ✓✓ *Muhlenbergia racemosa*
 - ✓✓ *Oryzopsis asperifolia*
 - ✓ ~~*Piptatherum*~~ *Oryzopsis micrantha*
 - ✓ ~~*Dichanthelium*~~ *Panicum leibergii*
 - ✓✓ *Phleum pratense*
 - ✓✓ *Poa compressa*
 - ✓✓ *Poa palustris*
 - ✓✓ *Schizachne purpurascens*
 - ✓✓ *Sporobolus heterolepis*

Family Liliaceae

forbs

- ✓✓ *Maianthemum canadense*
- ✓✓ *Polygonatum biflorum*
- ✓✓ ~~*Smilacina*~~ *stellata*
Maianthemum

Family Salicaceae

trees

- ✓✓ *Populus acuminata*
- ✓✓ *Populus deltoides*
- ✓✓ *Populus tremuloides*

shrubs

- ✓✓ *Salix planifolia*

Family Betulaceae

trees

- ✓✓ *Betula papyrifera*

shrubs

- ✓✓ *Betula occidentalis*
- ✓✓ *Corylus cornuta*

Family Fagaceae

trees

- ✓✓ *Quercus macrocarpa*

Family Urticaceae

forbs

✓✓ *Urtica dioica***Family Nyctaginaceae**

forbs

✓✓ *Mirabilis hirsuta***Family Ranunculaceae**

forbs

✓✓ *Actaea rubra*✓ *Pulsatilla* ✓ *Anemone patens* ssp. *perfoliata*✓✓ *Ranunculus pensylvanicus*✓✓ *Thalictrum dasycarpum*✓✓ *Thalictrum dioicum*✓✓ *Thalictrum venulosum***Family Saxifragaceae**

shrubs

✓✓ *Ribes cereum*✓✓ *Ribes missouriense*✓✓ *Ribes odoratum* *aureum* var. *villosum*

forbs

✓ *Heuchera richardsonii***Family Rosaceae**

shrubs

✓✓ *Amelanchier alnifolia*✓✓ *Amelanchier humilis*✓✓ *Physocarpus monogynus*✓✓ *Prunus virginiana*✓✓ *Rosa acicularis*✓✓ *Rosa woodsii*✓✓ *Rubus idaeus*✓✓ *Rubus pubescens*✓✓ *Spiraea betulifolia*

forbs

- ✓ *Fragaria virginiana*
- ✓ *Potentilla fissa*
- ✓ *Potentilla hippiana*

Family Fabaceae**forbs**

- ✓ *Astragalus adsurgens*
- ✓ *Glycyrrhiza lepidota*
- ✓ *Lathyrus ochroleucus* won't let me add
- ✓ *Pedionelum Psoralea cuspidata*
- ✓ *Pedionelum Psoralea esculenta*
- ✓ *Thermopsis rhombifolia*
- ✓ *Trifolium repens*
- ✓ *Vicia americana*

Family Geraniaceae**forbs**

- ✓ *Geranium richardsonii*

Family Anacardiaceae**shrubs**

- ✓ *Toxicodendron rydbergii*

Family Vitaceae**shrubs**

- ✓ *Parthenocissus vitacea*

Family Violaceae**forbs**

- ✓ *Viola adunca*
- ✓ *Viola canadensis*

Family Elaeagnaceae**shrubs**

- ✓ *Shepherdia canadensis*

Family Onagraceae

forbs

- ✓ ✓ *Epilobium angustifolium*
- ✓ ✓ *Epilobium ciliatum*
- ✓ ✓ *Oenothera strigosa villosa* ssp. *strigosa*

Family Araliaceae

forbs

- ✓ ✓ *Aralia nudicaulis*

Family Apiaceae

forbs

- ✓ ✓ *Cicuta maculata*
 - ✓ ✓ *Heracleum sphondylium*
 - ✓ ✓ *Osmorhiza longistylis*
 - ✓ ✓ *Sanicula marilandica*
-

Family Cornaceae

shrubs

- ✓ ✓ *Cornus stolonifera* *Sericea* ssp. *Sericea*

Family Ericaceae

shrubs

- ✓ ✓ *Arctostaphylos uva-ursi*

forbs

- ✓ ✓ *Pterospora andromedea*

Family Primulaceae

forbs

- ✓ ✓ *Lysimachia ciliata*

Family Apocynaceae

forbs

- ✓ ✓ *Apocynum androsaemifolium*

Family Convolvulaceae

forbs

- ✓ ✓ *Convolvulus arvensis*

Family Boraginaceae

forbs

- ✓✓ *Cynoglossum officinale*
- ✓✓ *Hackelia deflexa*
- ✓✓ *Hackelia floribunda*

Family Lamiaceae

forbs

- ✓✓ *Agastache foeniculum*
- ✓✓ *Mentha arvensis* invalid name in list BONAP 5-11 valid
- ✓✓ *Monarda fistulosa* brodiaeana

Family Scrophulariaceae

forbs

- ✓✓ *Castilleja sulphurea*
- ✓✓ *Penstemon angustifolius*
- ✓✓ *Penstemon gracilis*
- ✓✓ *Penstemon grandiflorus*
- ✓✓ *Verbascum thapsus*

Family Plantaginaceae

forbs

- ✓✓ *Plantago major*

Family Rubiaceae

forbs

- ✓✓ *Galium aparine*
- ✓✓ *Galium boreale* circaeza var. circaeza
- ✓✓ *Galium triflorum*

Family Caprifoliaceae

shrubs

- ✓✓ *Lonicera dioica*
- ✓✓ *Sambucus racemosa*
- ✓✓ *Symphoricarpos albus*
- ✓✓ *Symphoricarpos occidentalis*

Family Campanulaceae

forbs

- ✓ *Campanula rotundifolia*
- ✓ *Triodanis perfoliata*

Family Asteraceae

forbs

- ✓ *Achillea millefolium*
- ✓ *Agoseris glauca*
- ✓ *Antennaria parvifolia*
- ✓ *Antennaria plantaginifolia* won't let me add
- ✓ *Arctium minus*
- ✓ *Artemisia ludoviciana*
- ✓ *Aster ciliolatus*
- ✓ *Aster laevis*
- ✓ *Cirsium ochrocentrum*
- ✓ *Erigeron subtrinervis*
- ✓ *Hieracium albiflorum*
- ✓ *Rudbeckia hirta*
- ✓ *Senecio rapifolius*
- ✓ *Solidago missouriensis*
- ✓ *Solidago speciosa*
- ✓ *Taraxacum officinale*

