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A PHYTOSOCIOLOGICAL STUDY OF A SMALL DESERT AREA IN ROCK VALLEY, NEVADA

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ABSTRACT.— The aim of this study was to gain more understanding of the compositional structure of vegetation in the US/IBP Desert Biome validation site located in Rock Valley, Nevada. The vegetation data collected from 85 stands, randomly distributed to cover all physiographic variations in the study site, permitted categorization of the vegetation units either by coordinates or by class membership. The vegetational groupings so identified were then used for constructing a more reliable vegetation map for the Rock Valley validation site.

Multivariate statistical methods have been increasingly used in an attempt to reduce the complexity of plant ecological data and provide a clearer understanding of the underlying pattern. This in turn can form the base of a second, more rewarding phase of phytosociology, i.e., the causal nature of this pattern.

Two basic approaches have been used to simplify the complex ecological data:

1. CLASSIFICATION: In this approach the stands or the sampling units are arranged in groups, the members of which have certain common properties.

2. ORDINATION: Such a technique attempts to find the major axes of variation. Each sample unit can then be related to one or more of these axes so as to convey maximum information about its composition and relationships with other sample units. As Goodall (1970) points out, any particular piece of vegetation can be categorized either by coordinates or by class membership, the latter being less precise but more convenient.

The initial inventory of Rock Valley began in 1971. The US/IBP Desert Biome Program, in seeking to understand the functioning of the arid land ecosystem, has established research areas in each of four major arid land types in western North America. One of them was in Rock Valley, Nevada.

The Desert Biome research program design embraced two types of endeavors. One involved the investigation of specific abiotic and population processes and the development of models of these processes and of the function of large systems. The other involved the testing of these models by comparing their prediction with actual measurements of changes in the states of the desert ecosystem. The validation of a system model required, then, an exhaustive initial inventory of the system followed by periodic evaluations of extensive arrays of state variables and the external influences impinging upon them.

During the spring of 1971, the IBP validation site in Rock Valley was delimited. The site is about 0.46 km^2 in extent. In July 1970 the site was being photographed at two scales, 1:2400 and 1:600. These photographs are being kept as a permanent record and could be used to evaluate changes brought about by continued use of the area. Other descriptions of the site are reported by Turner (1973, 1975, 1976) and Turner and McBrayer (1974). The plant taxonomy of the area is given by Beatley (1976).

The objective of this work was twofold: (1) conduct initial inventory of the microvariations in vegetational structure, and (2) present such variations in the form of a vegetation map delimiting the boundaries of the identified vegetational units. Such information is prerequisite for future assessments in vegetational changes.

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This study is closely related to those previously carried out by El-Ghonemy et al. (1980a, 1980b, this volume) in the northern Mojave Desert, in which full account is given on the location, physiography, climate, vegetational groupings, successional trends, and community diversity.

Methods

Selection of stands and sampling technique: Sampling of perennial vegetation was carried out in 190 stands in quadrats of 50 × 2 m size. The coordinates of these quadrats were generated by a computer program designed to insure random dispersion (Wallace and Romney 1972). Density measurements of each species at each site were determined. Shrubs with canopies overlapping the quadrat boundaries were counted inside only when their root crowns were inside the boundary line.

Detailed characterization of soil was develped from four soil profiles excavated at each of the four corners of the validation site. These profiles were dug to the respective hard pan layer underlying the area. The soil profiles were described and characterized according to the USDA 1960 soil classification and seventh approximation system. Soil chemical analysis was according to the U.S. Salinity Laboratory Staff (1954) procedures.

Multivariate analysis of the vegetation data: One classification and one ordination technique were applied. The classification technique is the unweighted pair-group method of the agglomerative clustering technique, using the arithmetic averages to compute the similarity between a cluster and a stand which is a candidate for entry into a cluster (Sneath and Sokal 1973). The Euclidean distance (ED) was used as a measure of similarity among stands.

The ordination technique is that of the principal component analysis of the matrix of interstand correlation coefficients (Sneath and Sokal 1973). Eigenvectors (normalized to eigenvalues) were not rotated. To facilitate data processing, the number of stands (190) was reduced through random selection to 85 stands.

Results and Discussion

Classification of the vegetation data: Figure 1 shows cluster analysis dendrograms with the dotted horizontal lines denoting the levels at which clusters were distinguished

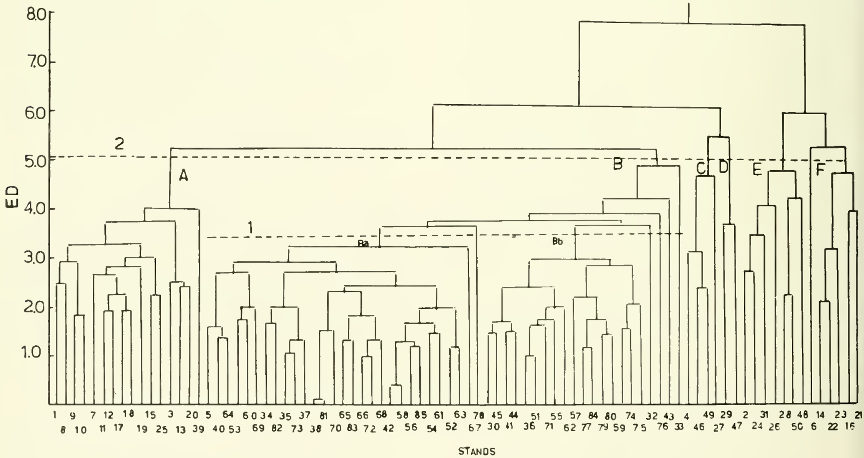

Fig. 1. Dendrogram resulting from the application of the agglomerative clustering analysis. The pecked lines denote the levels at which the dendrogram yields meaningful vegetational groupings.

TABLE 1. Estimated densities (number of individuals/ha) of the perennial species in seven vegetational groupings on the Rock Valley validation site, with relative density as percentage given in parentheses.

Species	Vegetational groupings° A	Ba	Bb	C	D	E	F
Ambrosia dumosa°°	2635 (29.5)	1098 (18.6)	2635 (36.5)	4026 (36.0)	2050 (15.9)	4758 (32.6)	3806 (24.6)
Grayia spinosa	2342 (26.2)	132 (2.2)	176 (2.4)	630 (5.6)	2196 (17.0)	3118 (21.3)	4978 (32.2)
Lycium pallidum	878 (10.0)	220 (3.7)	410 (5.7)	659 (5.8)	1244 (9.6)	878 (6.0)	1025 (6.6)
Krameria parvifolia	878 (10.0)	1479 (25.0)	1318 (18.2)	878 (7.8)	1771 (13.7)	1098 (7.5)	1756 (11.3)
Larrea tridentata	732 (8.2)	1186 (20.0)	849 (11.7)	732 (6.5)	805 (6.0)	732 (5.0)	1610 (10.4)
Ephedra nevadensis	439 (4.9)	659 (11.0)	805 (11.1)	1464 (13.1)	658 (5.0)	1171 (8.0)	644 (4.2)
Ceratoides lanata	439 (4.9)	15 (0.2)	88 (1.2)	1830 (16.3)	3806 (30.4)	1171 (8.0)	790 (5.0)
Lycium andersonii	293	952	732	322	366	483	205
Machaeranthera tortifolia	0.0	29 (0.5)	37 (0.5)	37 (0.3)	0.0	293 (2.0)	76 (1.2)
Acamptopappus shockleyi	18 (0.2)	0.0	29 (0.4)	0.0	0.0	132 (1.0)	29 (0.9)
Oryzopsis hymenoides	49 (0.6)	102 (1.7)	148 (2.0)	146 (1.4)	0.0	293 (2.0)	132 (0.9)
Psorothamnus fremontii	0.0	0.0	0.0	73 (0.7)	0.0	22 (0.1)	0.0
Coleogyne ramosissima	0.0	0.0	6 (0.1)	415 (4.2)	0.0	0.0	0.0
Salazaria mexicana	73 (0.8)	0.0	0.0	0.0	0.0	0.0	0.0
Mirabilis pudica	0.0	0.0	3 (0.1)	0.0	0.0	0.0	0.0
Opuntia exhinocarpa	0.0	0.0	0.0	0.0	0.0	22 (0.1)	0.0
Encelia virginensis	0.0	17 (0.2)	0.0	0.0	0.0	0.0	0.0

°A = *A. dumosa-G. spinosa.*
Ba = *K. parvifolia-L. tridentata.*
Bb = *A. dumosa-K. parvifolia.*
C = *A. dumosa-C. lanada.*
D = *C. lanata-G. spinosa.*
E = *A. dumosa-G. spinosa-E. nevadensis.*
F = *G. spinosa-A. dumosa.*
°°Nomenclature according to Beatley 1976.

and identified. At threshold line 2, six clusters (A–F) were identified and named after two or more of the species with the highest density values. Stand number 6, dominated by *Grayia spinosa* (Hook.) Moq. (density = 41 percent), being dissimilar to all other stands, remained as a separate unit. At a slightly higher level of dissimilarity this stand, however, fused with a neighboring grouping codominated by *G. spinosa* and *Ambrosia dumosa* (A. Gray) Payne.

The following is a description of the vegetational groupings:

GROUPING A (A. dumosa-G. spinosa): This grouping is represented by 12 stands (Fig. 1) covering most of the northern part of the study area (Fig. 2). The two most abundant species are *A. dumosa* and *G. spinosa.* The area occupied by this grouping represents about 21 percent (10 ha) of the whole area.

The soil supporting this grouping is characterized by deeper horizons and a relatively more favorable moisture regime. Detailed physical and chemical attributes of the soil profile sampled within one of the representative stands of this grouping (Table 2) indicate predominance of coarse materials, relatively high percentage of water-soluble cations and anions, and low exchangeable sodium percentages.

GROUPING B (*A. dumosa-Krameria parvifolia* Benth.): Most of the stands (50) belong to the grouping. Inspection of Figure 1 shows that this grouping is not a natural one, and at a slightly higher similarity level (threshold line 1) there would be grounds for the identification of two subgroupings, Ba and Bb (Table 1).

SUBGROUPING BA [*K. parvifolia-Larrea tridentata* (Sesse & Moc. ex DC.) Cov.]: The area occupied by this subgrouping covers about 19 ha representing about 40 percent of the study area (Fig. 2). Properties of soil profiles collected from two representative stands within this community indicate high lime content, low values for water-soluble cations, and a moderate exchangeable sodium percentage (Tables 3 and 4).

TABLE 2. Physical and chemical attributes of soil profile at the northwest corner of the study area.

Area	Elevation feet	Slope %	Aspect	Physiography	Erosion
Rock Valley	3340	2	NE	Bajada	Moderate

Horizon	Depth cm	Color dry	Color wet	Phase	Consistence dry
A1	000–009	10YR5/4	10YR4/3	Smooth	Soft
A2	009–021	10YR7/3	10YR5/4	Smooth	Sltly hard
C1	021–032	10YR7/3	10YR5/4	Gravelly	Soft
C2	032–050	10YR7/3	10YR6/4	Cobb & Gravl	Sltly hard

Horizon	Percent moisture retention 0 Sat.	1/3 Bar	1 Bar	15 Bar	pH Paste	pH Sat. Ext.	Ec 25 (mmhos /cm)
A1	27.1	8.2	7.1	6.4	8.3	8.8	1.93
A2	22.0	13.5	11.9	8.1	8.7	8.9	0.70
C1	27.3	14.1	11.3	8.3	8.7	9.0	0.49
C2	29.1	15.4	13.0	7.8	8.7	8.9	0.65

Horizon	Organic carbon %	Exchangeable cations (MEQ/100 gm) Na	K	Ca + Mg	Exch. Na %	Cation Exch. Cap. (MEQ/100gm)
A1	1.18	1.56	3.40	7.90	1.2	12.9
A2	0.42	1.41	4.27	10.57	8.7	16.3
C1	0.36	1.22	4.27	9.51	8.1	15.0
C2	0.28	2.05	4.77	7.68	14.1	14.5

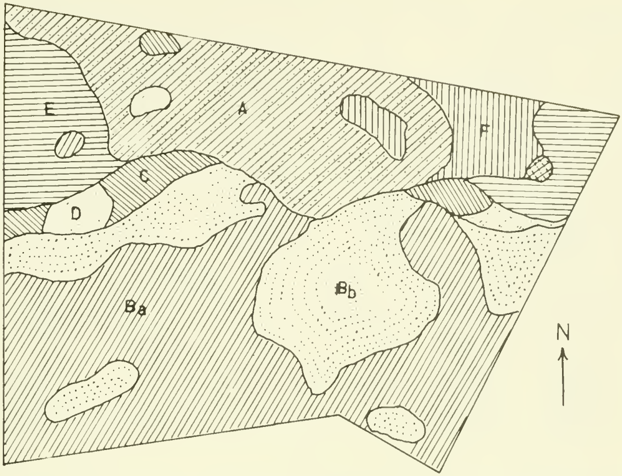

Fig. 2. Vegetation map of the Rock Valley validation site. The vegetation is divided according to the classification derived from the agglomerative clustering analysis. The groupings are: Grouping A (*A. dumosa-G. spinosa*); Grouping B (*A. dumosa-Krameria parvifolia* Benth.); Subgrouping Ba (*K. parvifolia-Larrea tridentata*); Subgrouping Bb (*A. dumosa-K. parvifolia*); Grouping C (*A. dumosa-Ceratoides lanata* Pursh J. T. Howell); Grouping D (*C. lanata-G. spinosa-A. dumosa*); Grouping E (*A. dumosa-G. spinosa-Ephedra nevadensis* S. Wats.); Grouping F (*G. spinosa-A. dumosa*).

Table 2 continued.

% Surface stoniness	Soil origin	Relief	Drainage	Permeability
20–40%	Alluvium	Smooth	Well	Moderate

		Particle size distribution (mm) %			
Consistence moist	Consistence wet	Coarse sand 2–0.25	Fine sand 0.25–0.05	Silt 0.05–0.002	Clay <0.002
Friable	Nonsticky	40.3	51.2	4.7	3.8
Friable	Sltl sticky	45.4	33.9	13.4	7.3
Very friable	Nonsticky	43.4	40.3	10.2	6.1
Friable	Nonsticky	55.4	34.7	7.5	2.4

	Sat. extract soluble				Cations and anions			
Percent lime (<2.0 mm)	Na (MEQ/liter)	K (MEQ/liter)	Ca (MEQ/liter)	Mg (MEQ/liter)	Cl (MEQ/liter)	NO3 (MEQ/liter)	SO4 (MEQ/liter)	Sat. Ext. Boron ppm
4.0	7.05	3.75	28.18	18.76	9.80	0.00	1.03	0.00
6.5	1.75	1.50	8.05	2.63	1.30	0.00	0.21	0.00
6.4	1.20	0.92	4.02	4.03	0.60	0.00	0.15	0.00
20.0	2.70	1.00	2.68	1.23	1.10	0.60	0.14	0.00

	DTPA-extractable micronutrients						
P (NaHCO3) ppm	Fe ppm	Zn ppm	Cu ppm	Mn ppm	Organic N %	Structure	
3.80	1.2	0.49	0.19	4.35	.081	Wk.Fine	Sub.Ang.B1
1.08	1.0	0.49	0.10	2.35	.048	Mod.Med.	Sub.Ang.B1
0.80	1.5	0.57	0.13	8.10	0.27	Wk.Fine	Sub.Ang.B1
0.52	0.8	0.55	0.18	3.20	.048	Mod.Med.	Sub.Ang.B1

TABLE 3. Physical and chemical attributes of soil profile at the northeast corner of the study area.

Area	Elevation feet	Slope %	Aspect	Physiography	Erosion
Rock Valley	3360	1	NE	Bajada	Slight

Horizon	Depth cm	Color dry	Color wet	Phase	Consistence dry
A1	000–009	10YR4/3	10YR3/3	Smooth	Soft
A2	009–019	10YR7/3	10YR4/4	Smooth	Sltly hard
B	019–037	10YR6/4	7.5YR4/4	Gravelly	Soft
C1	037–047	10YR7/3	10YR6/4	Gravelly	Sltly hard

Horizon	Percent moisture retention 0 Sat.	1/3 Bar	1 Bar	15 Bar	pH Paste	pH Sat. Ext.	Ec 25 (mmhos /cm)
A1	33.0	9.4	8.0	4.4	8.1	8.2	2.27
A2	27.6	14.2	12.8	7.9	8.6	8.9	0.69
B	28.8	13.0	11.3	8.1	8.7	9.0	0.53
C1	29.3	15.2	12.7	7.3	8.7	8.8	0.53

Horizon	Organic carbon %	Exchangeable cations (MEQ/100 gm) Na	K	Ca + Mg	Exch. Na %	Cation Exch. Cap. (MEQ/100gm)
A1	1.95	1.36	1.54	10.35	10.3	13.3
A2	0.25	1.43	2.93	12.64	8.4	17.0
B	0.21	1.22	2.93	12.85	7.2	17.0
C1	0.18	1.71	1.57	9.22	13.7	12.5

TABLE 4. Physical and chemical attributes of soil profile at the southwest corner of the study area.

Area	Elevation feet	Slope %	Aspect	Physiography	Erosion
Rock Valley	3360	1	NE	Bajada	Slight

Horizon	Depth cm	Color dry	Color wet	Phase	Consistence dry
A1	000–005	10YR5/3	10YR4/3	Gravelly	Soft
A2	005–018	10YR7/3	10YR5/3	Smooth	Sltly hard
A3	018–038	10YR6/3	10YR5/4	Gravelly	Soft
C1	038–063	10YR7/3	10YR5/4	Gravelly	Loose

Horizon	Percent moisture retention 0 Sat.	1/3 Bar	1 Bar	15 Bar	pH Paste	pH Sat. Ext.	Ec 25 (mmhos /cm)
A1	33.0	9.6	8.3	6.1	7.9	8.5	1.21
A2	17.5	12.9	11.0	7.0	8.6	8.8	0.45
A3	28.8	14.2	10.4	7.0	8.7	8.8	0.45
C1	34.5	13.2	10.9	6.4	8.6	8.9	0.62

Horizon	Organic carbon %	Exchangeable cations (MEQ/100 gm) Na	K	Ca + Mg	Exch. Na %	Cation Exch. Cap. (MEQ/100gm)
A1	1.07	1.05	1.81	6.14	11.7	9.0
A2	0.24	1.24	0.99	9.02	11.0	11.3
A3	0.34	1.35	1.36	8.54	12.0	11.3
C1	0.27	1.28	0.65	7.57	13.5	9.5

Table 3 continued.

% Surface stoniness 20–40%	Soil origin Alluvium	Relief Smooth	Drainage Well	Permeability Rapid

Consistence moist	Consistence wet	Particle size distribution (mm) %: Coarse sand 2–0.25	Fine sand 0.25–0.05	Silt 0.05–0.002	Clay <0.002
Friable	Nonsticky	46.0	45.8	3.6	4.6
Friable	Sltl sticky	33.3	39.5	17.7	9.5
Friable	Nonsticky	43.6	42.5	8.3	5.6
Friable	Nonsticky	51.0	36.9	8.3	3.8

Percent lime (<2.0 mm)	Sat. extract soluble Na (MEQ/liter)	K	Ca	Mg	Cations and anions Cl (MEQ/liter)	NO3	SO4	Sat. Ext. Boron ppm
3.1	2.85	4.19	25.49	9.71	5.10	0.00	0.89	0.00
5.5	0.95	1.13	8.05	2.38	1.40	0.00	0.30	0.00
3.2	0.90	0.73	4.22	4.91	1.00	0.00	0.18	0.00
3.6	1.20	0.25	4.02	1.20	2.30	0.00	0.09	0.00

P (NaHCO3) ppm	DTPA-extractable micronutrients Fe ppm	Zn ppm	Cu ppm	Mn ppm	Organic N %	Structure	
4.36	2.0	0.90	0.20	14.00	.193	Wk.Fine	Sub.Ang.B1
1.20	0.8	0.55	0.20	3.05	.030	Wk.Med.	Sub.Ang.B1
0.52	1.0	0.25	0.17	4.35	.023	Wk.Fine	Sub.Ang.B1
0.24	0.6	0.28	0.19	2.10	.036	Mod.Fine	Sub.Ang.B1

Table 4 continued.

% Surface stoniness 60–80%	Soil origin Limestone	Relief Smooth	Drainage Well	Permeability Rapid

Consistence moist	Consistence wet	Particle size distribution (mm) %: Coarse sand 2–0.25	Fine sand 0.25–0.05	Silt 0.05–0.002	Clay <0.002
Friable	Nonsticky	11.6	77.9	5.8	4.7
Friable	Sltl sticky	10.0	65.6	16.5	7.9
Friable	Nonsticky	21.0	64.1	8.6	6.2
Loose	Nonsticky	24.4	62.7	6.6	6.3

Percent lime (<2.0 mm)	Sat. extract soluble Na (MEQ/liter)	K	Ca	Mg	Cations and anions Cl (MEQ/liter)	NO3	SO4	Sat. Ext. Boron ppm
5.0	1.00	4.10	20.13	13.77	1.60	0.00	0.40	0.00
13.5	0.70	0.29	4.69	1.83	0.60	0.00	0.10	0.00
21.7	0.90	0.65	3.35	1.87	1.50	0.00	0.15	0.00
19.0	3.00	0.13	4.02	1.26	1.40	0.00	0.16	0.00

P (NaHCO3) ppm	DTPA-extractable micronutrients Fe ppm	Zn ppm	Cu ppm	Mn ppm	Organic N %	Structure	
3.04	2.0	1.20	0.24	14.50	.120	Wk.Fine	Platy
0.52	0.7	0.70	0.32	2.75	.030	Str.Med.	Platy
0.52	0.7	0.80	0.20	5.60	.032	Wk.Fine	Sub.Ang.B1
0.06	1.2	0.70	0.15	5.90	.030	No Str.	Single.Gr

SUBGROUPING Bb (*A. dumosa-K. parvifolia*): This subgrouping links together 17 stands in five patches scattered in a mosaic fashion. The total area occupied by this subgrouping represents about 21 percent of the area. Inspection of Figure 2 indicates that parts of the vegetational zones constituting this subgrouping occupy transitional positions between the southern and northern halves of the study area.

GROUPING C [*A. dumosa-Ceratoides lanata* (Pursh) J. T. Howell]: This grouping comprises four stands occupying intermediate positions between most of the identified groupings. The most significant difference in floristic composition between grouping C and the neighboring groupings is the very low density of *Coleogyne ramosissima* Torr. in these later groupings, though its density in grouping C exceeds 400 plants per ha. The area occupied by grouping C represents about 2 percent of the study area.

GROUPING D (*C. lanata-G. spinosa-A. dumosa*): This is also a transitional grouping comprising two stands and occupying a tiny area covering about 1 percent of the study site. The distinction between this grouping and the neighboring ones is principally based on the relatively high abundance of *C. lanata* (Table 1).

GROUPING E (*A. dumosa-G. spinosa-Ephedra nevadensis* S. Wats.): This grouping comprises seven stands, mostly linked together at relatively low similarity levels. The area representing this grouping covers about 12 percent of the study area in two patches (Fig. 2).

The properties of soil collected from one of the representative stands of this grouping (Table 5) are characterized by relatively high phosphorus and low lime content.

GROUPING F (*G. spinosa-A. dumosa*): This grouping comprises two patches covering about 3 percent of the north-eastern part of

TABLE 5. Physical and chemical attributes of soil profile at the southeast corner of the study area.

Area	Elevation feet	Slope %	Aspect	Physiography	Erosion
Rock Valley	3360	3	NE	Bajada	Slight

Horizon	Depth cm	Color dry	Color wet	Phase	Consistence dry
A11	000–006	10YR5/3	10YR4/2	Gravelly	Loose
A12	006–012	10YR6/3	10YR4/3	Smooth	Soft
C1	012–023	10YR7/3	10YR4/3	Smooth	Soft
C2	023–034	10YR7/3	10YR4/4	Smooth	Soft
C3C	034–057	10YR6/3	10YR4/4	Cobb & Gravl	Soft

	Percent moisture retention						
Horizon	0 Sat.	1/3 Bar	1 Bar	15 Bar	pH Paste	pH Sat. Ext.	EC25 (mmhos /cm)
A11	31.5	8.9	7.7	5.8	8.3	8.9	1.37
A12	28.8	8.1	6.9	5.2	8.7	8.9	0.61
C1	27.6	10.5	9.3	5.6	8.8	9.0	0.44
C2	27.5	12.2	9.3	5.4	8.8	9.0	0.42
C3C	27.4	12.6	9.2	5.7	8.7	8.8	0.42

		Exchangeable cations (MEQ/100 gm)				
Horizon	Organic carbon %	Na	K	Ca + Mg	Exch. Na %	Cation Exch. Cap. (MEQ/100gm)
A11	0.87	0.83	1.34	7.33	8.7	9.5
A12	0.49	0.74	1.36	7.99	7.4	10.0
C1	0.38	0.97	1.56	8.72	8.6	11.3
C2	0.32	1.07	1.48	6.95	11.3	9.5
C3C	0.30	1.29	1.67	7.04	12.9	10.0

the study area (Fig. 2). The big patch occupies an intermediate position between groupings A, D, and F, and the small patch represents a small island within grouping A.

The most important species of this grouping are *G. spinosa* (4978 plants/ha) and *A. dumosa* (3806 plant/ha). Subordinate species are those of *K. parvifolia* and *L. tridentata*.

It is obvious that the application of the agglomerative clustering technique in vegetation analysis has resulted in identifying distinct vegetational groupings. Although interconnected, they are quite recognizable in the field and could be used in drawing a reliable vegetation map for the study site (Fig. 2).

ORDINATION OF THE VEGETATION DATA: The ordination of stands along the second and third principal component axes is illustrated in Figure 3. The groupings and subgroupings derived from the clustering analysis exhibit a clear pattern on the ordination plane. On this plane three major vegetational zones are immediately obvious, a central zone and two lateral ones. The central zone includes subgrouping Bb and Grouping C; the right-hand side zone includes subgrouping Ba and the left-hand side zone includes groupings A, D, E, and F. The separation between these three vegetational zones is effectuated along the second principal axis. On the other hand the distinction between groupings A, C, E, and F is expressed by the third principal axis (Fig. 3).

It is worth noting that groupings A, C, D, E, and F, which exhibit fusion between their stands at remarkably low similarity levels (Fig. 1), occupy the left-hand side of the ordination plane (Fig. 3) and cover in mosaic fashion the northern half of the study area (Fig. 2). On the other hand, subgroupings Ba and Bb, whose stands fuse together at rela-

Table 5 continued.

% Surface stoniness	Soil origin	Relief	Drainage	Permeability
40–60%	Limestone	Smooth	Well	Moderate

Consistence moist	Consistence wet	Particle size distribution (mm) %: Coarse sand 2–0.25	Fine sand 0.25–0.05	Silt 0.05–0.002	Clay <0.002
Friable	Nonsticky	9.6	82.8	3.9	3.7
Friable	Nonsticky	8.6	84.5	4.3	2.7
Friable	Nonsticky	8.0	80.2	7.2	4.6
Friable	Nonsticky	10.0	78.8	7.2	4.1
Friable	Nonsticky	26.8	63.8	5.6	3.8

Percent lime (<2.0 mm)	Sat. extract soluble Na (MEQ/liter)	K	Ca	Mg	Cations and anions Cl (MEQ/liter)	NO3	SO4	Sat. Ext. Boron ppm
11.4	0.60	1.25	13.42	3.53	1.20	0.00	0.35	0.00
5.5	0.25	0.70	8.05	1.08	0.70	0.00	0.16	0.00
15.0	0.30	0.60	3.87	1.34	0.50	0.00	0.14	0.00
16.0	0.40	0.73	4.02	1.19	1.50	0.00	0.14	0.00
36.5	0.45	1.00	2.68	1.23	1.10	0.00	0.14	0.00

P (NaHCO3) ppm	DTPA-extractable micronutrients Fe ppm	Zn ppm	Cu ppm	Mn ppm	Organic N %	Structure	
2.36	1.7	2.75	0.20	12.00	.091	Wk.Fine	Platy
1.64	1.2	1.45	0.15	4.00	.047	Wk.Fine	Sub.Ang.B1
0.40	0.6	1.10	0.20	3.85	.041	Wk.Fine	Sub.Ang.B1
0.00	0.6	0.85	0.18	4.30	.034	Wk.Fine	Sub.Ang.B1
0.00	0.7	1.70	0.18	4.10	.032	Wk.Fine	Sub.Ang.B1

tively high similarity levels, occupy the right-hand side of the ordination plane and cover extensive patches in the southern half of the study area.

In Figure 4 (A–F) an indication of the abundance of some common species is plotted on the stand ordination to illustrate some aspects of their phytosociological behavior. For each species, the range of density values was divided into quartiles (I-IC) in order of increasing density. Stands in which a given species concur with density values in the fourth quartile are surrounded by pecked line. For some species these stands occur in one grouping (e.g., *C. lanata* and *G. spinosa*), but for others they are distributed among two or more groupings (e.g., *L. tridentata*, *L. andersonii*, and *K. parvifolia*). It is equally clear that none of these species can be considered as leading dominant (species with the highest density value) for the whole sectors of the study area. Instead, each species exerts local dominance or is distinctly more important in certain grouping of stands.

In a previous study (Turner and McBrayer 1974), The Rock Valley validation site was subjectively divided into six vegetational zones. These zones, although differing in the relative abundance of the various species, were all characterized by having *A. dumosa* as a leading dominant species. Five of these vegetation zones occupy the northern half of

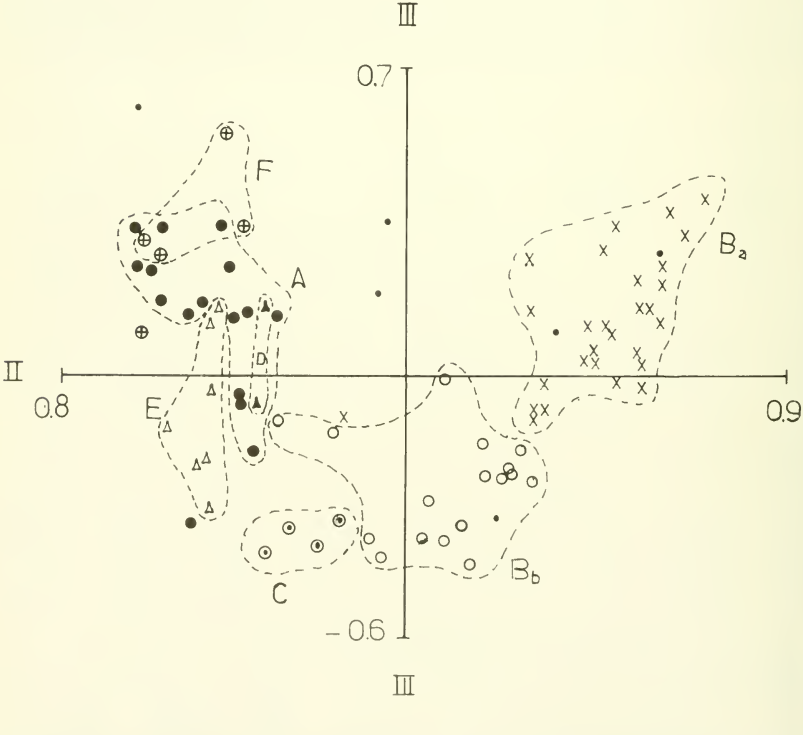

Fig. 3. Ordination plane of stands of the Rock Valley validation site in the plane of the second and third principal component axes. Pecked lines encircle stands belonging to each of the groupings and subgroupings derived from the agglomerative clustering analysis (Fig. 1).

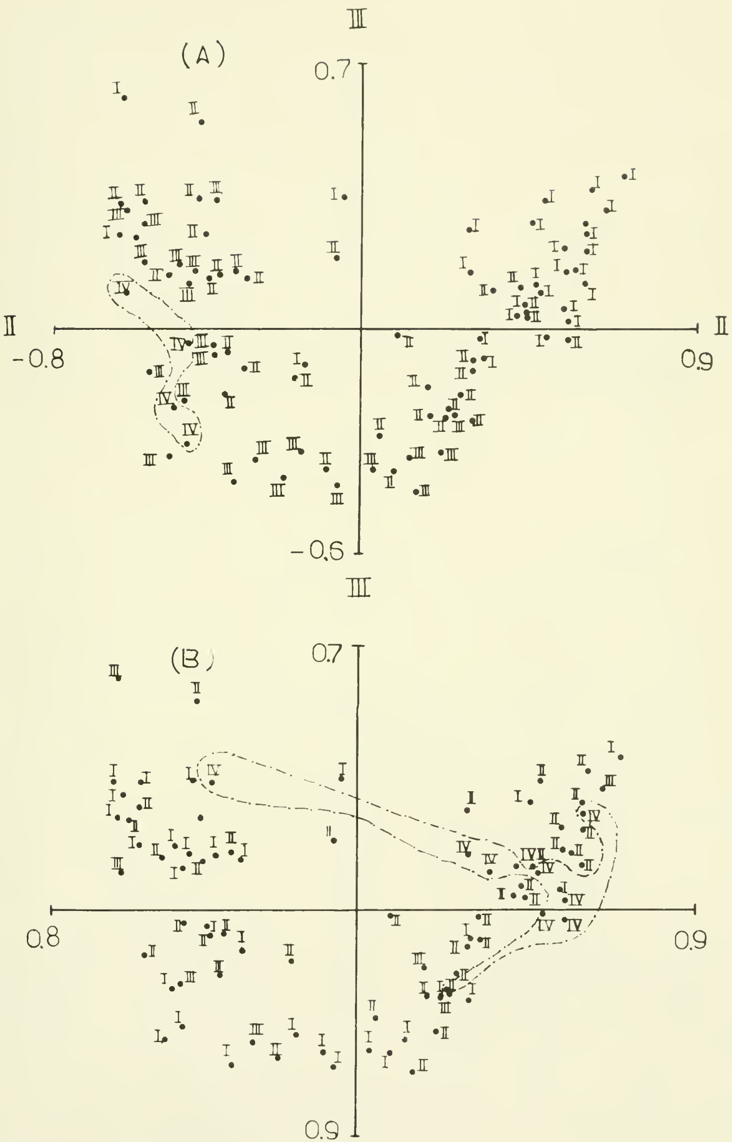

Fig. 4 (A–F). Stand ordination showing density quartiles (I–IV) on an increasing scale of density for selected spe-es. Pecked lines surround stands in which the species is represented with a density value in the fourth quartile. (A) *mbrosia dumosa*, (B) *Lycium andersonii*, (C) *Larrea tridentata*, (D) *Grayia spinosa*, (E) *Ceratoides lanata*, (F) *Kra-eria parvifolia*.

Fig. 4 continued.

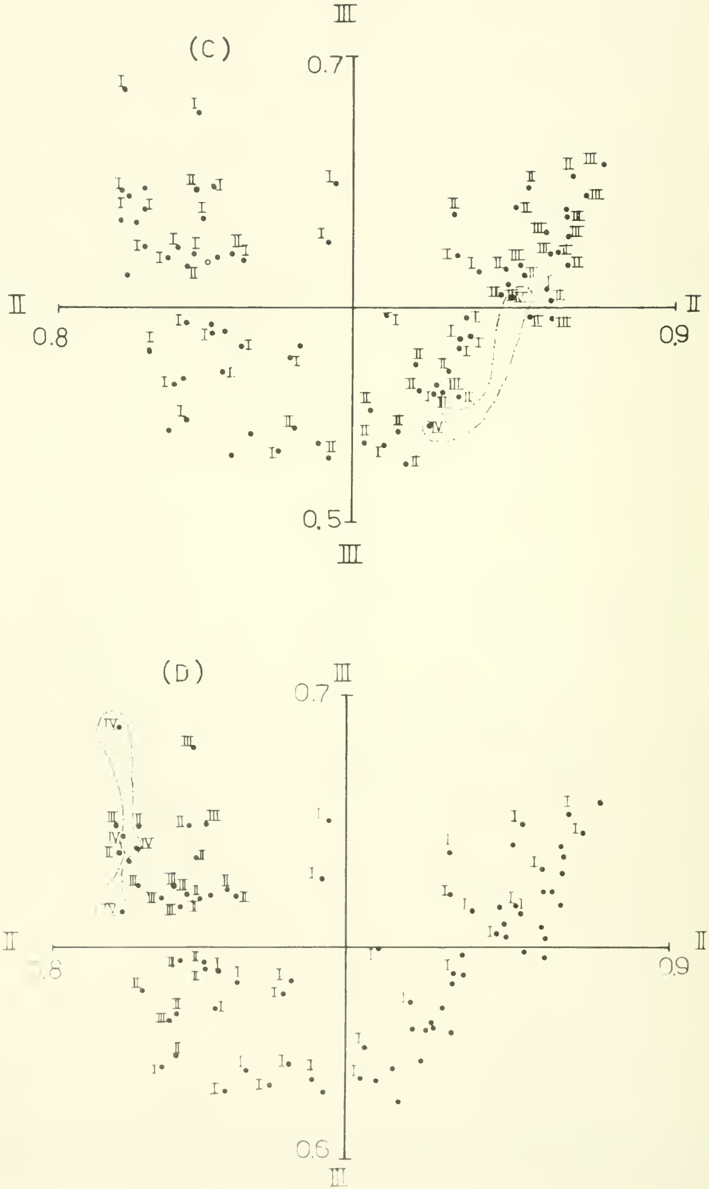

Fig. 4 continued.

the validation site; the southern half is occupied by zone six. In the present study the application of the agglomerative clustering approach in vegetation analysis, substantiated by the principal component analysis, resulted in the identification of seven vegetational groupings segregated among 20 vegetation zones (Fig. 2). In these zones the leading dominant species is not necessarily *A. dumosa*. Other species such as *K. parvifolia* and *G. spinosa* are also leading dominants in fairly extensive patches of the vegetational cover.

We arrived at the following conclusions:

1. Classification and ordination techniques have proved to be compatible, at least in a general way, and have resulted in better analysis for the vegetation date collected from the Rock Valley validation site.

2. Each species has its own distributional pattern; certain species may have similar patterns, but no two are identical.

3. Improved vegetation mapping for the study area was possible, based on vegetational groupings identified through the application of the agglomerative clustering analysis.

Acknowledgments

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