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SHRUB CHANGES IN THE SIERRA DE GRAZALEMA AS A CONSEQUENCE OF EXPLOTATION ABANDONMENT

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Abstract

The aim of this study is to describe the secondary shrub communities of Sierra de Grazalema (Cádiz province, S. Spain). Six types of communities are separated, out of which *Pistacia* and *Lavandula* types clearly differ from the other four: *Ulex, Cistus, Phlomis* and Grassland types.

Introduction

The Sierra de Grazalema exhibits a wide variety of environments and a important vascular flora, more than 1300 taxa (APARICIO, 1985). The result is a considerable vegetation heterogeneity. Similarly to most areas in Spain, the vegetation of the Sierra de Grazalema is represented by a secondary type vegetation. From the 60's and due to a progressive abandonment of secular agriculture and husbandry practices, the vegetation has displayed a general undergoing. The aim of this study is to describe a particular case of these secondary shrub communities.

Study Area

The study was carry out at the North of Sierra de Grazalema Natural Park. The climate is Mediterranean, with temperate, humid winters and very warm, dry summer. Mean annual rainfall varies between 2223 and 966 mm, and annual temperatures between 8 and 25,2°C. Jurasic materials, lime and dolomite, and triasic (clays, marly) are the dominante. The survey area is extended over 400 has. of Arroyo Ballesteros and El Pinar valleys with the altitude ranging between 650 and 1150 m.

Methods

Sampling

57 sampling sites were located throught the study area, representing most woody vegetation types over the disturbed area. The cover of woody plant species was measured by the line interception method along a 25 m transect. Bare soil was recorded as an additional variable when no woody species existed, wether or not there was herbaceous cover (BASANTA & GARCÍA NOVO, 1988). Shrub structure was sampled at

each site, measuring the heigh of all individuals along the transect. For each sample, altitude and slope were recordered. One sample of the top soil (0-10 cm) was taken at each site for pH and conductivity.

Analisys

Cluster analysis with SIMCLUST program (WOLFE, 1990) and indirect gradient analysis with CANOCO program (TER BRAAK, 1988) were used to reveal major variations. Gradient analysis was also used to compare sample clusters obtained by SIMCLUST, using Bray-Curtis and Euclidean distance coefficients to obtain the similarity matrix, and the unweigthed and weighted average methods to perform cluster analysis. The indirect gradient analysis was a detrended correspondence analysis (DCA) with the options of detrending by a second-order polynomial (JONGMAN & al., 1987).

Additionally, in order to stablish the groups characteristics obtained in the cluster the plots score in the DCA axis I and II were correlated (Pearson test) with the sample characteristics: altitude, slope, pH, conductivity, bare soil percentage, vegetation cover percentage, mean plant height and maximun plant height.

Dominance-diversity curves (WHITTAKER, 1967, 1970) for the vegetation types were developed by plotting the log relative-cover values against the rank of the species in each schrub type.

Diversity measurements: Species diversity (H': Shannon index), evenness (J') and dominance (D: Simpson index) were calculated on the basis of cover data (MAGURRAN, 1988). Species richness (S) was also computed.

$$H' = -\Sigma\, p_i * \ln p_i \qquad J' = H' / \ln S \qquad D = \Sigma\, p_i^2$$

Results and discussion

The classification analysis separated the samples in six distinct groups (Figure 1). The Table 1 shows the characteristics mean values of each group. The groups are named after the dominant species.

Pistacia type group belongs to the most conservated shrub comunity area. This area has unsuitable conditions for agriculture or husbandry practices due to the high slopes and the presence of lithosoil surface.

The *Ulex, Cistus, Phlomis* and Grassland shrub types are different succesional states, a consequence of the abandonment of traditional activities and the effect of periodic fires. Finaly, Lavandula types are seral communities belonging to higher vegetation zones.

The first axis of the DCA analisys (Figure 2) shows the samples ordinated in a gradient from vegetation zones more structurated and diverse (*Pistacia* and *Lavandula* types) to zones of lower pH, undeveloped vertical structure, lower diversity and higher dominance corresponding to *Ulex, Cistus, Phlomis* and Grassland types. The second axis is positively correlated with altitude and mean vegetation height (Table 2).

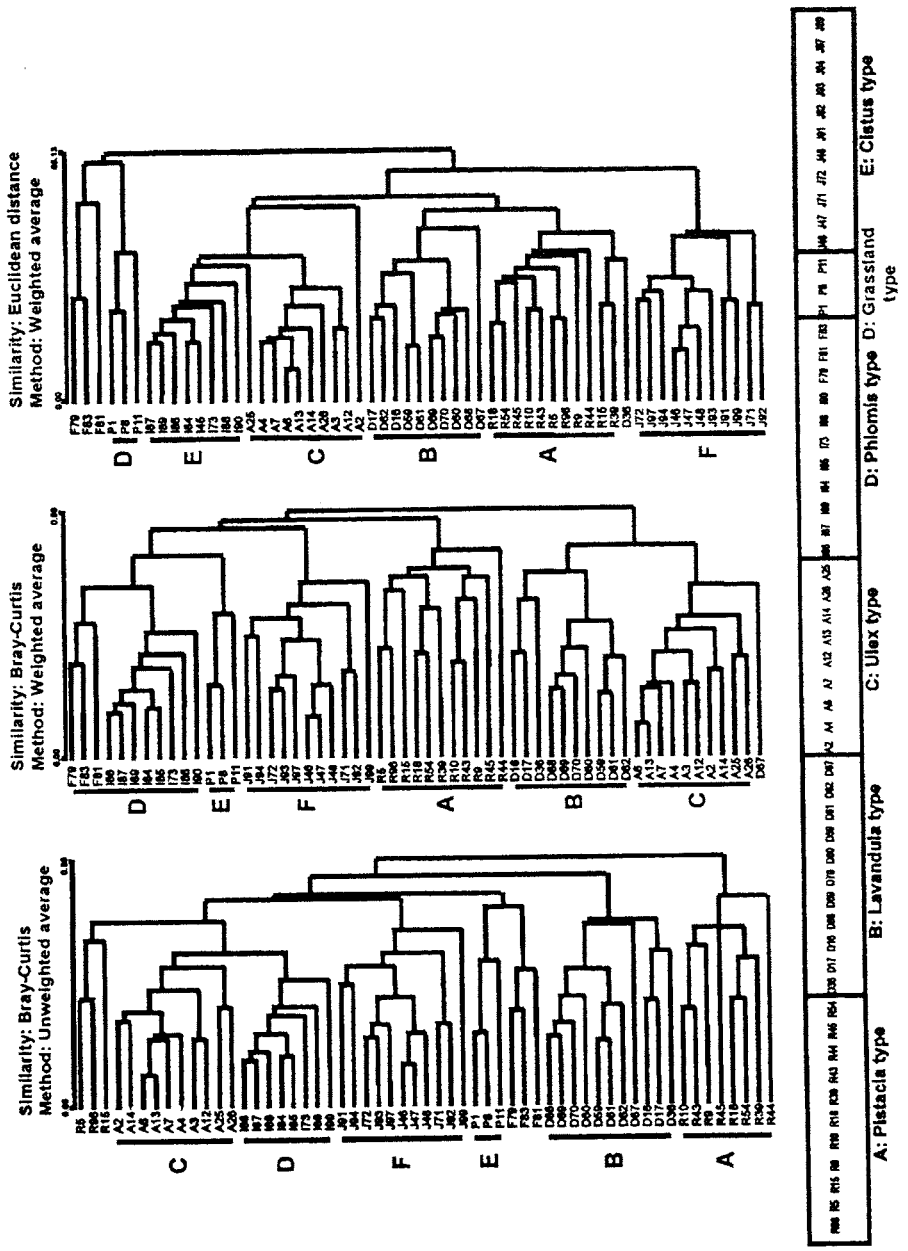

Fig. 1 Cluster analysis of the samples.

Vegetation Type	Altitude (m)	Slope	pH	Conductivity (uS)	% Bare soil	% Vegetat. cover	S	H'	D	J'	Scrub (cm)	Maximum of scrub height
Ulex Type (n=10)												
Mean	731,30	25,60	7,35	396,50	11,68	129,20	11,50	1,68	0,30	0,69	61,25	189,09
Std. dev.	44,74	5,82	0,14	63,79	9,76	22,56	3,27	0,39	0,15	0,11	12,86	85,61
Minimum	650,00	15,00	7,14	246,00	0,00	85,60	6,00	0,71	0,16	0,40	33,93	0,00
Maximum	785,00	35,00	7,57	475,00	26,80	164,40	18,00	2,10	0,69	0,82	77,80	300,00
Lavandula Type (n=11)												
Mean	983,27	36,36	7,29	237,54	20,84	120,73	13,73	2,07	0,17	0,80	51,85	235,45
Std. dev.	135,70	5,39	0,56	106,01	13,50	35,18	3,64	0,29	0,05	0,05	15,41	85,37
Minimum	786,00	Slope	6,42	110,70	2,00	71,20	9,00	1,60	0,11	0,73	30,75	80,00
Maximum	1146,00		7,86	408,00	40,00	194,00	20,00	2,49	0,25	0,88	83,50	350,00
Phlomis Type (n=11)												
Mean	963,27	23,18	6,05	214,55	33,31	90,22	7,45	1,51	0,28	0,76	58,72	172,73
Std. dev.	46,25	15,37	0,28	78,16	24,24	35,95	2,11	0,36	0,10	0,10	21,97	119,76
Minimum	850,00	0,00	5,58	127,40	8,00	38,00	4,00	0,75	0,16	0,54	30,00	40,00
Maximum	1008,00	40,00	6,38	362,00	75,60	155,60	12,00	2,14	0,52	0,91	101,16	350,00
Cistus Type (n=12)												
Mean	826,33	33,75	6,46	271,33	20,53	98,70	7,75	1,46	0,32	0,74	74,40	239,17
Std. dev.	95,11	6,44	0,68	68,22	10,14	22,29	3,25	0,42	0,13	0,10	13,52	79,37
Minimum	651,00	20,00	5,39	167,60	2,80	73,20	3,00	0,66	0,16	0,60	58,44	100,00
Maximum	950,00	45,00	7,62	370,00	34,00	150,00	14,00	2,10	0,62	0,86	101,72	350,00
Grassland Type (n=3)												
Mean	723,00	14,00	7,02	375,00	41,47	64,53	7,67	1,51	0,29	0,79	53,38	213,33
Std. dev.	52,37	9,64	0,54	72,69	27,30	38,63	3,51	0,40	0,10	0,15	19,49	40,41
Minimum	677,00	7,00	6,49	295,00	22,80	26,80	4,00	1,12	0,17	0,63	31,48	170,00
Maximum	780,00	25,00	7,57	437,00	72,80	104,00	11,00	1,91	0,36	0,92	68,83	250,00
Pistacia Type (n=10)												
Mean	722,30	30,10	7,45	370,92	9,48	165,32	15,00	2,22	0,15	0,83	122,60	394,44
Std. dev.	57,38	9,67	0,15	124,74	8,98	38,42	2,83	0,14	0,03	0,06	32,09	137,94
Minimum	650,00	15,00	7,24	99,20	0,00	112,00	10,00	2,04	0,11	0,72	64,29	250,00
Maximum	810,00	40,00	7,72	525,00	25,20	242,80	19,00	2,43	0,20	0,90	170,87	700,00

Table 1. Characteristic mean values of the six recogniced groups.

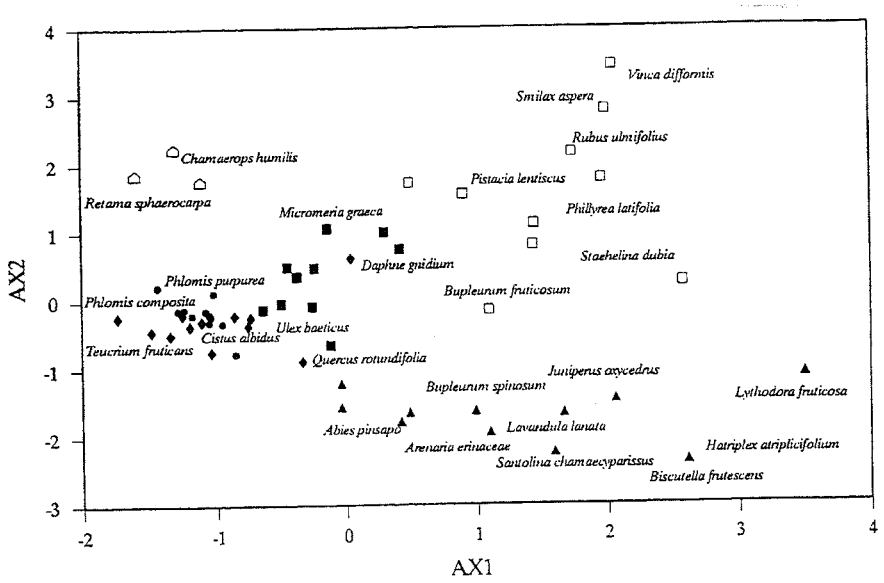

Fig. 2. DCA analysis.

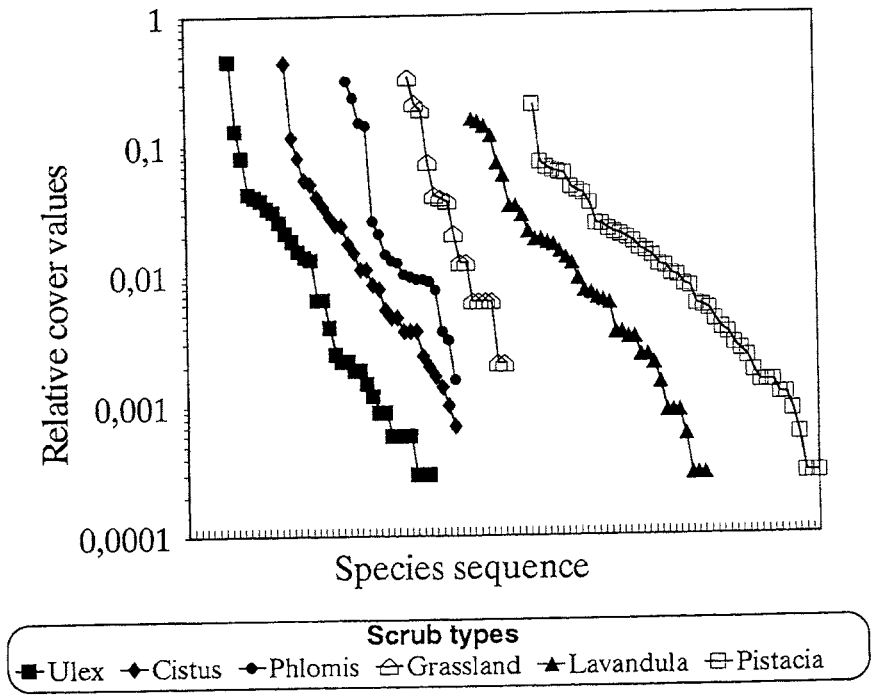

Fig. 3. Dominance-diversity curves.

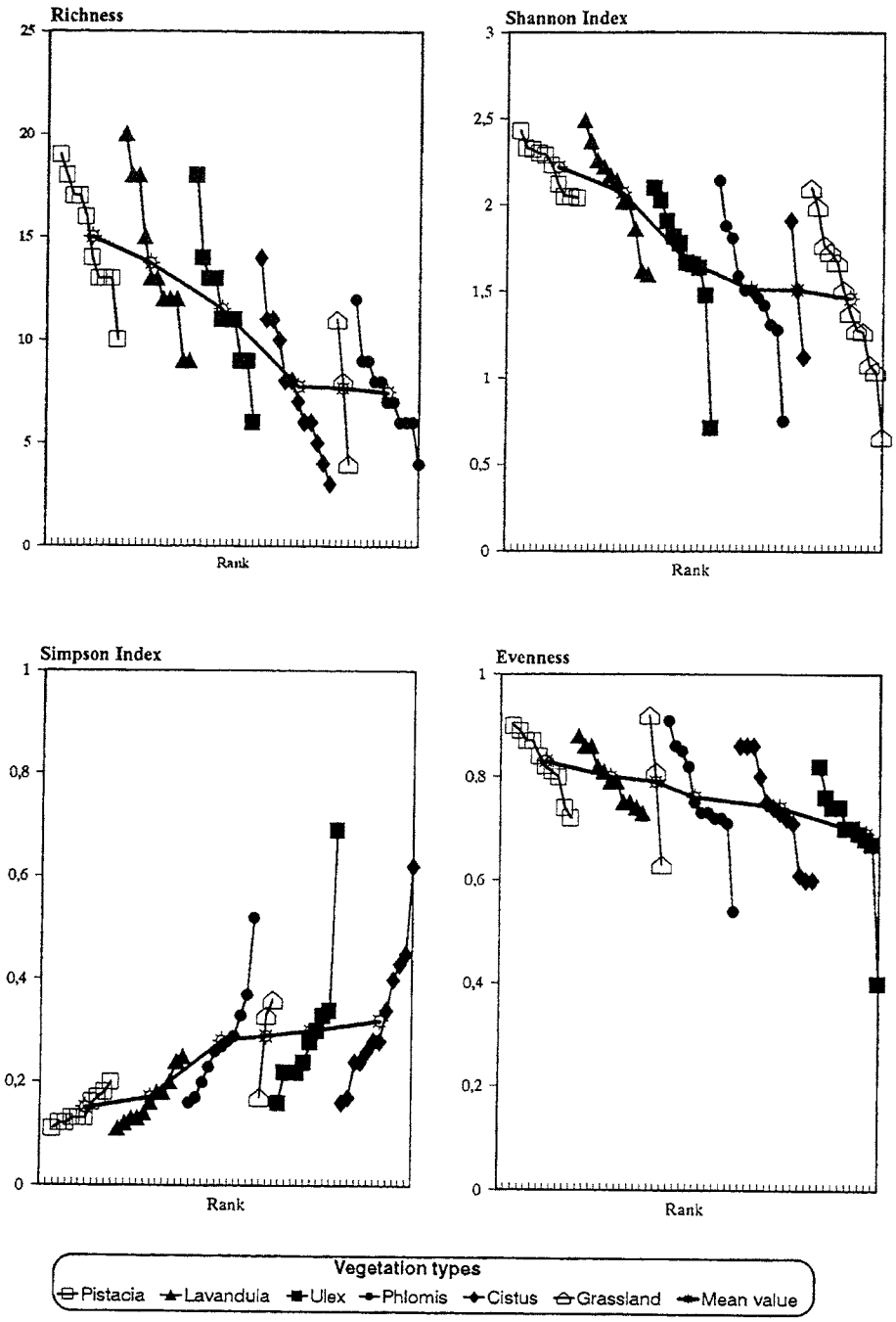

Fig. 4. Species abundance and composition.

	AX1	AX2
Altitude	–0,17	–0,6506 ***
Slope	0.0328	–0,2827
pH	0,665 ***	0,1268
Conductivity	0,417	–0,5283 ***
% Bare soil	–0,3629 **	–0,1523
% Vegetation cover	0,5865 ***	0,3203
S	0,7426 ***	0,0602
H'	0,7073 ***	0,0835
D	–0,5914 ***	0,697
J'	0,34	0,0764
Scrub height	0,3382	0,5864 ***
Maximum scrub height	0,4427 **	0,2878

Table 2. Pearson correlations. ** P<0,001; *** P<=0,000.

Dominance-diversity curves (Figure 3) shows both components of species diversity, richness (on the ordinate) and equitability (slope of the curve). *Pistacia* and *Lavandula* types are clearly different of others due to a lower dominance and higher richness. In each curve are indicated the species which constitute the 50% of the coverture.

The analysis of species abundance and composition through the indices of diversity, dominance and evenness (Figure 4) reveals two groups of communities. The *Pistacia* and *Lavandula* types, which comprise most of the species and show the highest diversity and evenness values, together with low values of dominance. The other groups with *Ulex, Phlomis, Cistus* and Grassland types show lower values of diversity and higher values of dominance, while the evennes values are low, like the first group. The variations of the indices' values are higher in the second group.

References

APARICIO, A. (1985). *Estudio florístico de la Serranía de Grazalema.* Doctoral Thesis. Universidad de Sevilla.

BASANTA, A. & F. GARCÍA NOVO (1988). Estructura y diversidad de los matorrales seriales mediterráneos. *Studia Oecológica* 5:119-136.

JONGMAN, R. H. G.; C. J. F. TER BRAAK & O. F. R. VAN TORENGEN (1987). *Data analysis in community and landscape ecology.* Pudoc Wageningen.

MAGURRAN, A. E. (1988). *Ecological diversity and its measurement.* Croom Helm, London.

TER BRAAK, C. J. F. (1988). *CANOCO (v.1.02).* Agricultural Methematics Group, Wageningen.

WHITTAKER, R. H. (1967). Gradient analysis of vegetation. *Biol. Rev* **42**: 207-264.

—— (1970). *Comunities and ecosystems.* MacMillan, New York.

WOLFE (1990). *SIMCLUST.*

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