STUDIA GEOBOTANICA
10: 59-70, 1990

THE FLORISTIC COMPOSITION OF THE SILA GRECA PASTURES (CALABRIA, S - ITALY)

Liliana BERNARDO, Michele CODOGNO and Domenico PUNTILLO

Keywords: Sila, pastures, vegetation, Calabria (S-Italy).

Abstract. The classification of 28 phytosociological relevés of pasture vegetation from the Ionian slope of the Sila massif (S-Italy) allowed to recognize four main vegetation types. They are: *Hedysarum coronarium - Cynara cardunculus* community, *Agrostis castellana - Oenanthe pimpinelloides* community, *Vulpia ciliata-Trifolium arvense* community and *Potentilla calabra - Armeria canescens* community. The indirect gradient analysis based on the reciprocal ordering of relevés and species, and on the ecological evaluation of the species, reveals that the floristical variation is related to both climatic and edaphic factors. The four community - type are well characterized by different structural and phytogeographic features.

Introduction

The pasture vegetation of the Sila plateau has been already studied by Sarfatti (1954), Giacomini & Gentile (1961) and Abbate *et al.* (1984). The pastures of the Ionian slope of the Sila (Sila Greca), however, have never been the object of careful investigations, with the exception of two studies on their structural and phytogeographic variations respectively by Codogno *et al.* (1987) and Codogno & Puntillo (1987). Sila Greca is a region where the cattle grazing is one of the most important human activities and a vegetational study of the pastures in this area can be useful in the re-establishment and management of these natural resources.

The aims of this study are:
- to relate the floristical variation of the pasture vegetation to possible environmental gradients;
- to identify floristically defined pasture types.

Survey area

The survey area is located on the northeastern slope of the Sila massif, between the Cino and Nicà Rivers (Fig. 1). This area is limited at the southern side by a

* This study has been supported by C.N.R. funds (resp. Prof. G. Cesca) and M.P.I. (40%) funds (resp. Prof. D. Lausi).

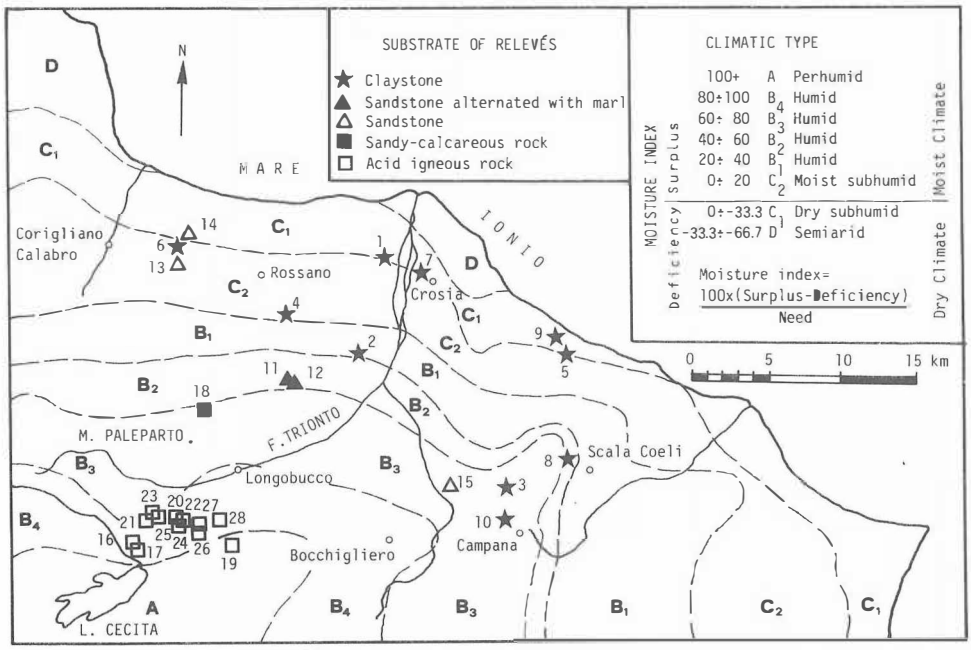


Fig. 1 — Map of the survey area with relevé localities. The climate types are following the Thornthwaite's classification (1948). For each sampling site the substrate type is indicated.

mountain ridge (M. Altare, m. 1653 m; M. Paleparto, 1480 m), that separates the Sila Greca from the Sila Grande, and at the northern side by the Ionian Sea. The altitudinal variation is very sharp (from 1500 m to the sea level in only 20 km) and deep valleys are cut by periodic streams ("fiumare").

The geological substrate is composed by a fairly wide range of rocks (Magri *et al.*, 1963-1965; Ogniben, 1973): igneous rocks (granite), metamorphic rocks (gneiss, schists and phyllites) and sedimentary rocks (sandstones, claystones, limestones, marls, etc.). These different bedrocks have given rise to different soils.

The climate is Mediterranean, with humid winters and dry summers. As far as the degree of humidity is concerned, the climate presents a broad range of variation related to the altitude (Ciancio, 1971): from the semiarid climate of the coast to the perhumid climate of the highest localities (see Fig. 1).

The vegetation is strongly influenced by both the moisture degree (elevation; Codogno & Puntillo, 1988) and the texture of the substrate.

Data and methods

This study is based on a set of 28 phytosociological relevés (Tab. 1), taken with the Braun-Blanquet (1964) method in stations at different elevation (between 0-1500 m) and on different substrates, in order to reflect the broadest possibile

Tab. 1 — Structured table of species and relevés. Relevé group numbers are as in the dendrogram of Fig. 2. The species which have not been retained in this table are in the Appendix.

Relevé Group No.	1									2			3					4											
Relevé No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Hedysarum coronarium	2	+	2	2	+	1	3	+	+	3																		
Cichorium intybus	+	r	2	+	r	r		r	+	1		1																
Cynara cardunculus	1	r		1	+	3	2		+																			
Inula viscosa	r		+	+	1	+	r	r																				
Euphorbia exigua	2	r	+		r	+	1		+																			
Blackstonia perfoliata	r	r	+	r	r	r		r		+																		
Bellardia trixago		+	+	+	+	+		+	r	+																		
Anagallis arvensis	+		r	+	r	r	1		r					+														
Linum strictum	r	+		+	+	r	r																					
Scorzonera trachysperma	+	1		1	r		+	+		+																		
Ononis alopecuroides			2	1	+	1	1																					
Sonchus oleraceus	+	r		r			r		r																			
Plantago serraria		+	1	1	1				+																			
Bellevalia romana	r	r				1	1																					
Picris echioides	2					+	r	1																				
Pallenis spinosa		r		1	+			r																				
Hypochoeris achyrophorus	+	r				r			+																			
Foeniculum vulgare		r			r	+	+																					
Catananche lutea	+	+					+																					
Carduus corymbosus	+	+					+																					
Nigella damascena	r	r		r																								
Centaurium maritimum	+			+					r																			
Brachypodium distachyum		+		r	2																							
Avena fatua	+	+				r																						
Gladiolus italicus	r	r				+																						
Polygala monspeliaca		r	+			r																						
Euphorbia helioscopia						+	r		r																			
Sonchus arvensis						r		+	+				+															
Crepis vesicaria					+	1		+																				
Ophrys bertolonii					+		r	+																				
Carex flacca		r		+	+			2		+																		
Tragopogon dubius	+	r		+						1																		
Trifolium lappaceum	+		+	1								+																
Aegilops geniculata	+	1	1	+	r	r					+	+																
Scabiosa maritima				r	+	r	+				+	+																
Catapodium rigidum	+	r						r			+	+																
Centaurium erythraea	+	r	1	1						+	r	+			r													
Dactylis hispanica		3			1	1		2		+	+	1																
Trifolium pallidum	+		1	1						1	+	+																
Dipsacus fullonum								2			r	r																
Potentilla reptans								r			r	r																
Oenanthe pimpinelloides								+		+	+	+																
Centaurea jacea											1	1																
Echium italicum											1	+																
Prunella vulgaris				+							+	+																
Quercus ilex (saplings)											r	r																
Origanum vulgare											r	r																
Agrostis castellana										1	+	+							+		+							
Gastridium ventricosum		+		+						+	+	1	2															
Tolpis virgata											r	r			+													
Lotus angustissimus											r	+			+		+											
Gaudinia fragilis										+	+	+		+	+													
Medicago orbicularis							+				+	+		r	+													
Trifolium angustifolium					r					+	1	+	+	r	r													
Hypericum perforatum										+			+		+	+	1											
Vulpia ciliata											+		3	1	+	+	+											
Trifolium arvense													1	r	1	2	2		+									
Chondrilla juncea													+		+	+	+											
Silene gallica													+	1	r		+											
Vicia cracca														r	+	+	+	r										


Anthemis arvensis
Briza maxima
Echium plantagineum
Trifolium strictum
Jasione echinata
Crepis corymbosa
Legousia speculum-veneris
Linaria arvensis
Trifolium nigrescens
Vicia bithynica
Oglifa gallica
Silene conica
Poa annua
Micropus erectus
Verbascum thapsus
Torilis arvensis
Convolvulus elegantissimus
Lathyrus sphaericus
Hypochoeris radicata
Carduus nutans
Tolpis umbellata
Sinapis pubescens
Herniaria glabra
Cerastium semidecandrum
Silene vulgaris
Centaurea deusta
Achillea nobilis s.l.
Anthyllis vulneraria ssp.maura
Trifolium ochroleucum
Plantago serpentina
Petrorhagia saxifraga
Anthoxanthum odoratum
Anthemis montana
Phleum ambiguum
Poa bulbosa
Festuca circummediterranea
Armeria canescens
Helianthemum nummularium
Hieracium hoppeanum
Potentilla calabra
Sedum tenuifolium
Bunium bulbocastanum
Thymus pulegioides
Hypericum barbatum
Leontodon cichoraceus
Rumex acetosella
Viola aethnensis ssp.messanensis
Orchis sambucina
Cuscuta epithymum
Silene alba
Cirsium vallis-demonii
Plantago lanceolata
Hypochoeris laevigata
Lolium perenne
Lotus corniculatus
Aira cupaniana
Sherardia arvensis
Mentha pulegium
Cynosurus echinatus
Trifolium campestre
Daucus carota
Leopoldia comosa
Bellis perennis
Dactylis glomerata
Geranium dissectum
Bromus sterilis
Parentucellia viscosa
Convolvulus arvensis
Galium verum
Raphanus raphanistrum
Carlina vulgaris

ecological variation. The location of the relevés is reported in Fig. 1.

Data analysis occured in the following steps:

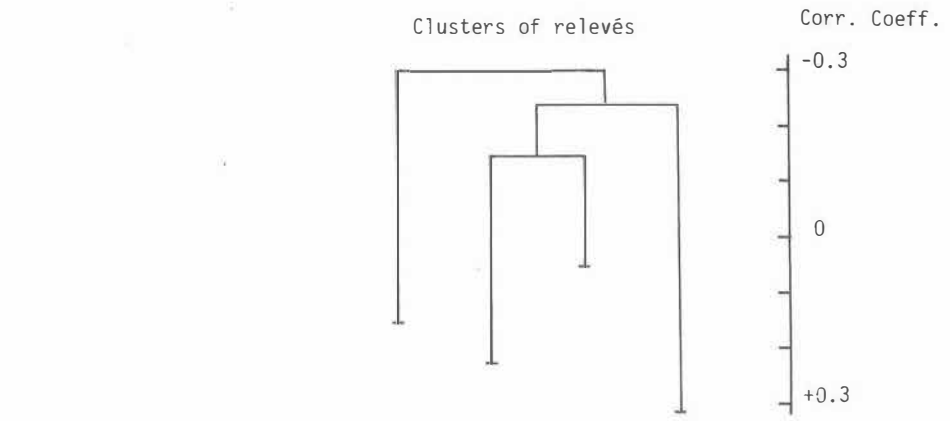
- numerical classification of the relevés, to obtain community - types. The clustering was Complete Linkage based on Correlation Coefficient as similarity measure, using binary data (Anderberg, 1973).
- reciprocal ordering (Orlóci, 1978) of both the relevés and the species, to analyze the floristical variation in the data set, and to detect possible ecological gradients underlying this variation. The reciprocal ordering used cover data, modified according van der Maarel (1979).

In the relevés, 348 species are represented. The high number of species required a size reduction of the data set for the handling with automated methods. For the numerical classification only the species having occurencies in more than one relevé have been retained (218 species). The reciprocal ordering is based only on the species of the characteristic specific combinations of the community - types obtained by classification (143 species) following the approach of Raabe (1950) and Feoli (1975). The latter species have been reported in Tab. 1. The other species are in the Appendix.

Results and discussion

The numerical classification of the relevés produced four main groups (Fig. 2). In Tab. 1 the relevés are ordered according to the dendrogram of Fig. 2. In this table most species are linked only to one (or at most two) relevé group and a clear floristic trend is evident. The ecological significance of this trend results from the indirect gradient analysis based on the reciprocal ordering of relevés and species shown in Fig. 3. In this figure, the compositional gradient (dashed line through the centroids of the relevé groups) can be interpreted as revealing ecological gradients, on the basis of the climatic and edaphic features of the relevé sites (Fig. 2) and of the ecological significance of the species plotted in Fig. 3. From relevé group 1 to group 4 both air moisture (from dry - subhumid to perhumid climate type) and soil texture (from fine - grained soil derived from clay rocks to coarse - grained soil derived from acid igneous rocks) increase. It is noterhworthy that in Fig. 3 the second canonical variate separates the relevés taken ont abandoned cultivations (groups 2 and 3; acid igneous rocks) increase. It is noteworthy that in Fig. 3 the second canonical variate separates the relevés on abandoned cultivations (groups 2 and 3; negative scores) from the others (positive scores).

On the basis of the structured table of the relevés (Tab. 1) and of the indirect



		1	2	3	4
SUBSTRATE TYPES	Claystone	9	1	-	-
	Sandstone+marl	-	2	-	-
	Sandstone	-	-	3	-
	Sandy-calcareous rock	-	-	-	1
	Acid igneous rock	-	-	2	10
CLIMATIC TYPES	A	-	-	-	1
	B_4	-	-	2	9
	B_3	1	1	1	1
	B_2	1	2	-	-
	B_1	1	-	-	-
	C_2	2	-	1	-
	C_1	4	-	1	-

Fig. 2 — Classification of the relevés. The values in this figure are absolute frequencies of relevés occurring in sites with a given climate and substrate type in the four relevé groups.

gradient analysis, the four relevé groups could be considered as ecologically well characterized noda of the compositional gradient. These noda have been interpreted as distinct community - types:

Hedysarum coronarium - Cynara cardunculus community (Tab. 1, relevé group 1)

Differential species: *Hedysarum coronarium, Cynara cardunculus, Ononis alopecuroides, Scorzonera trachysperma, Plantago serraria, Brachypodium dista-*

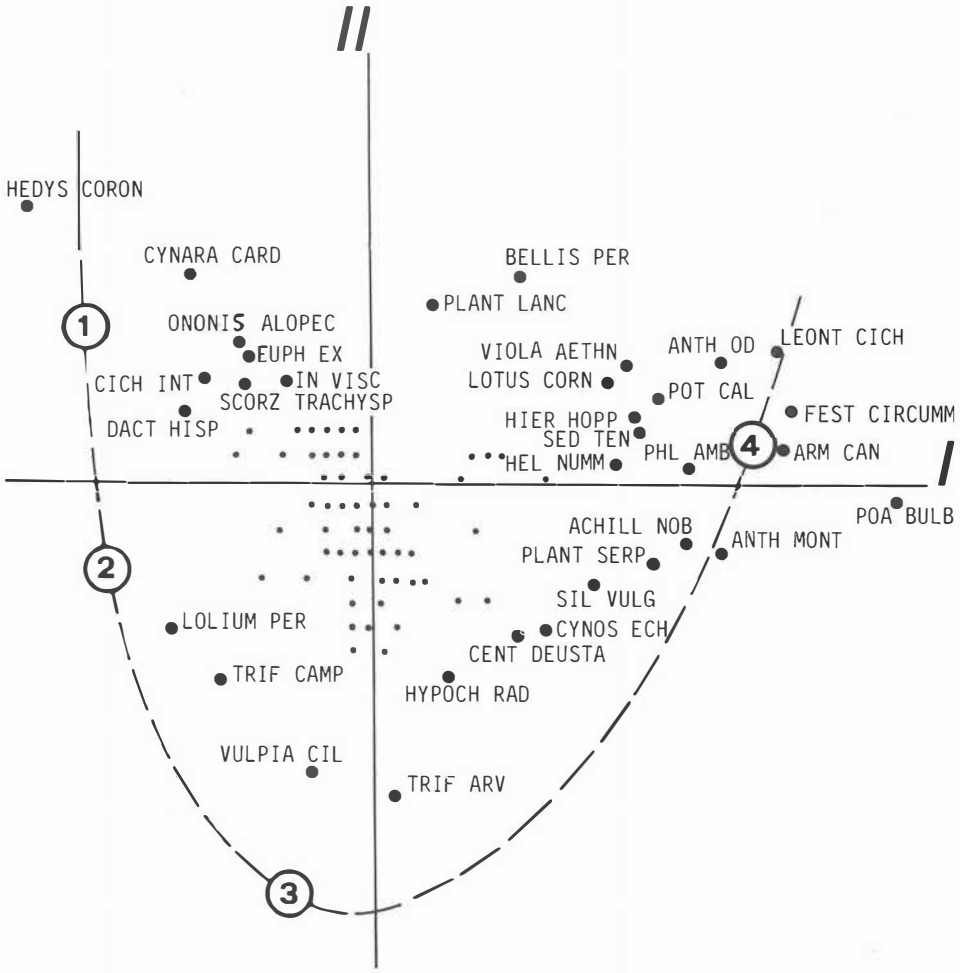


Fig. 3 — Reciprocal ordering of relevés and species. The circled numbers indicate the position of the relevé group centroids as in Fig. 2. Only the names of species characterized by high scores on the first two axis are reported. Further explanations are in the text.

chium, Bellardia trixago, Bellevalia romana, Catananche lutea, Carduus corymbosus, Picris echioides.

This is a forb formation of sites with clay soil at 200-300 m altitude. Remarkable is the high incidence of perennial species (e.g. *Hedysarum coronarium, Cynara cardunculus, Scorzonera trachysperma, Carduus corymbosus, Plantago serraria*). Several species occurring within this community are strictly linked to clay soils (e.g. *Hedysarum coronarium, Ononis alopecuroides, Carduus corymbosus, Catananche lutea*) throughout their ranges.

Relevé 5, with a steppe aspect (high cover values of *Lygeum spartum* and *Cym-*

bopogon hirtus), is similar to the *Lygeum spartum* - prairies described for the clay soils of S - Calabria (Gentile & Di Benedetto, 1961; Schneider & Sutter, 1982) and Basilicata (Zanotti Censoni *et al.*, 1980). Fragments of these prairies are present also in the study area on badlands. The above mentioned authors have placed these formations in the order *Lygeo - Stipetalia,* firstly described for the Ebro valley in NE-Spain (Braun - Blanquet & de Bolos, 1957). The arid climate of this valley explains the massive presence of this semidesert vegetation characterized by some N-African species *(Lygeum spartum, Artemisia herba - alba, Stipa* sp. pl.) (Walter, 1973). On the contrary, in Calabria, with a moister climate (mean annual precipitation nearly always exceeding 500 mm — Caloiero, 1975), the *Lygeum spartum* - prairies are probably an edaphic formation limited to the clay soils of badlands which are among the driest habitats during the vegetative season.

The *Hedysarum coronarium - Cyanara cardunculus* community and the *Lygeo-Stipetalia* vegetation have strong S - Mediterranean affinities (Codogno & Puntillo, 1987), but they are stucturally different: in the first community - type perennial species are abundant (35% hemicryptophytes and 14% geophytes — Codogno *et al.*, 1987), whereas the *Lygeo - Stipetalia* vegetation is mainly formed by therophytes (more than 70% in Braun - Blanquet & de Bolos, 1957). The high incidence of perennial species in this community is probably linked to climatic (moisture) and other (cattle - grazing) factors.

Agrostis castellana - Oenanthe pimpinelloides community (Tab. 1, relevé group 2)

Differential species: *Agrostis castellana, Oenanthe pimpinelloides, Echium italicum, Gastridium ventricosum.*

This is a forb formation on abandoned cultivation at ca. 700 m altitude. The sites are characterized by deep and clay soil. The perennial species still have a high incidence (e.g. *Agrostis castellana, Oenanthe pimpinelloides, Echium italicum, Cynosurus cristatus, Dactylis hispanica). Lolium perenne* has always high cover values. Several species grow usually on humid substrates (e.g. *Agrostis castellana, Oenanthe pimpinelloides, Lotus angustissimus, Potentilla reptans, Gaudinia fragilis*). On the basis of its floristic composition, this community - type is transitional between the previous and the next community - types.

Vulpia ciliata - Trifolium arvense community (Tab. 1, relevé group 3)

Differential species: *Vulpia ciliata, Trifolium arvense, Chondrilla juncea, Silene gallica, Anthemis arvensis, Echium plantagineum, Briza maxima, Trifolium strictum, Jasione echinata, Hypericum perforatum, Vicia cracca.*

This is a weed formation on abandoned cultivation at an average altitude of 720 m. Ephemeral species are common (e.g. *Vulpia ciliata, Trifolium arvense, Silene gallica, Anthemis arvensis, Echium plantagineum, Briza maxima, Trifolium strictum).* Several species are strictly linked to sandy soils (e.g. *Echium plantagineum, Jasione echinata, Silene conica).* Most species are therophytes with broad ecological

amplitude: only a few species are characteristic of ephemeral formations on acid soil *(Tuberarietalia guttati;* e.g. *Silene gallica, Briza maxima).*

Contrary to the first community-type, this formation has a N-Mediterranean phytogeographical affinity (Codogno & Puntillo, 1987). Moreover, remarkable is the "european-continental" character of this community due to the presence of some S-European/S-Siberian species which in the study area occur mainly in this vegetation type (e.g. *Chondrilla juncea, Carlina vulgaris, Micropus erectus, Agrostemma githago).*

Potentilla calabra - Armeria canescens community (Tab. 1, relevé group 4)

Differential species: *Potentilla calabra, Armeria canescens, Festuca circummediterranea, Helianthemum nummularium, Hieracium hoppeanum, Sedum tenuifolium, Bunium bulbocastanum, Thymus pulegioides, Hypericum barbatum, Leontodon cichoraceus, Plantago serpentina, Petrorhagia saxifraga, Anthoxanthum odoratum, Phleum ambiguum.*

This is a montane grassland formation of sites characterized by sandy soils at an average altitude of 1460 m. Perennial species are most common (ca. 90%, see Codogno *et al.,* 1987; e.g. all the differential species). Chamaephytes have a high incidence (e.g. *Helianthemum nummularium, Thymus pulegioides, Sedum tenuifolium).* Several species occurring in this community are characteristic of prairies on acid sandy soil (*Sedo - Scleranthetea;* e.g. *Plantago serpentina, Petrorhagia saxifraga, Sedum tenuifolium*). *Potentilla calabra* belongs to the *Potentilla argentea*-group wich is characteristic of the class *Sedo - Scleranthetea.* This vegetation type characterizes the pastures of the Sila plateau (Abbate *et al.*, 1984), Aspromonte (Schneider & Sutter, 1982) and similar communities occur also in Sicily on Nebrodi (Brullo & Grillo, 1978) and Madonie (Brullo, 1983). The phytosociology of these formations needs to be supported by more field data from all the W- and central-Mediterranean basin.

This vegetation type is characterized by the presence of several Mediterranean and S-European orophytes. Moreover, it is remarkable the coexistence of W-European (e.g. *Bunium bulbocastanum)* and SE-European species (e.g. *Hypericum barbatum, Potentilla calabra)* (Codogno & Puntillo, 1987). This reflects the situation of the thorny - cushion associations of the Sila, where *Astragalus calabrus* (with eastern origin) and *Genista anglica* (with W-European origin) coexist in the same altitudinal (montane) belt. Probably, the different historical - genetical factors that have influenced the thorny - cushion associations (Nimis, 1981) had an influence also on the *Potentilla calabra-Armeria canescens* community.

Appendix

Species which have not been retained in Tab. 1:
In 5 relevés: *Ranunculus neapolitanus* (2, 10, 20, 22, 24).
In 4 relevés: *Ranunculus bulbosus* (13, 22, 24, 28).

In 3 relevés: *Trifolium physodes* (3, 9, 10), *Prunella laciniata* (3, 10, 14); *Serapias vomeracea* (5, 8, 10); *Trifolium stellatum* (6, 9, 13); *Galactites tomentosa* (6, 9, 14); *Ranunculus ficaria* (6, 27, 28); *Ranunculus millefoliatus* (7, 26, 27); *Juncus bufonius* (8, 9, 14); *Cytisus scoparius* (8, 23, 25); *Ranunculus flabellatus* (8, 27, 28); *Galium murale* (17, 22, 23); *Malva moschata* (18, 19, 27); *Trifolium repens* (18, 23, 28); *Veronica acinifolia* (20, 22, 24); *Scleranthus polycarpos* (20, 24, 27); *Astragalus glycyphyllos* (22, 23, 27); *Luzula campestris* (26, 27, 28).

In 2 relevés: *Torilis nodosa* (1, 2); *Trifolium congestum* (1, 2); *Tetragonolobus purpureus* (1, 6); *Lythrum junceum* (1, 6); *Ammi majus* (1, 9); *Beta vulgaris* subsp. *maritima* (1, 9); *Medicago rigidula* (1, 12); *Carthamus lanatus* (1, 14); *Calamintha nepeta* (1, 15); *Ammoides pusilla* (1, 15); *Scabiosa columbaria* (1, 15); *Cardopatum corymbosum* (2, 5); *Lotus ornithopodioides* (2, 7); *Kundmannia sicula* (2, 14); *Allium ampeloprasum* (2, 14); *Lophochloa cristata* (2, 14); *Bromus madritensis* (2, 16); *Melilotus sulcata* (3, 4); *Carlina lanata* (3, 6); *Ononis spinosa* (3, 10): *Medicago lupulina* (3, 13); *Asphodelus microcarpus* (4, 5); *Ophrys lutea* (5, 7); *Pistacia lentiscus* pl. (5, 7): *Allium roseum* (5, 7); *Orchis italica* (5, 8); *Cirsium arvense* (5, 9); *Daucus carota* subsp. *maritimus* (5, 9); *Tragopogon porrifolius* (5, 15); *Salvia pratensis* (6, 10); *Urospermum picroides* (7, 9); *Carduncellus coeruleus* (8, 10); *Orchis laxiflora* (8, 10); *Ornithopus compressus* (8, 10); *Calendula arvensis* (9, 14); *Centaurea napifolia* (9, 15); *Cynoglossum creticum* (9, 20); *Bromus scoparius* (10, 14); *Briza minor* (10, 14); *Rumex pulcher* (10, 15); *Linum bienne* (10, 21); *Poa trivialis* (10, 23); *Pinus laricio* pl. (11, 27); *Hypochoeris glabra* (12, 13); *Lolium rigidum* (14, 19); *Rumex acetosa* (14, 20); *Carlina utzka* (17, 26); *Vicia villosa* (20, 22); *Silene paradoxa* (22, 23); *Acinos alpinus* (22, 24); *Rubus idaeus* (22, 24); *Carlina acaulis* (23, 28); *Scilla bifolia* (26, 27); *Doronicum orientale* (27, 28).

In 1 relevé: *Lavatera cretica* (1); *Phalaris brachystachys* (1); *Sideritis romana* (1); *Filago pyramidata* (1); *Phalaris paradoxa* (1); *Melampyrum arvense* (1); *Bromus gussonei* (1); *Ornithogalum pyramidale* (1); *Ononis natrix* (1); *Althaea cannabina* (1); *Ornithogalum pyrenaicum* (2); *Phalaris coerulescens* (2); *Phleum pratense* (3); *Plantago bellardi* (3); *Medicago murex* (3); *Parentucellia latifolia* (3); *Phalaris truncata* (4); *Malope malacoides* (4); *Lygeum spartum* (5); *Cymbopogon hirtus* (5); *Ophrys bombyliflora* (5); *Iris sisyrinchium* (5); *Urginea maritima* (5); *Hedysarum glomeratum* (5); *Evax pygmaea* (5); *Bellis annua* (5); *Anemone hortensis* (6); *Atractylis cancellata* (6); *Plantago media* (6); *Hymenocarpus circinnatus* (6); *Scorzonera humilis* (6); *Allium subhirsutum* (6); *Crupina crupinastrum* (6); *Asphodeline lutea* (7); *Borago officinalis* (7); *Asparagus acutifolius* (7); *Asphodelus albus* (7); *Theligonum cynocrambe* (7); *Anthyllis tetraphylla* (7); *Filago germanica* (7); *Prunus spinosa* pl. (7); *Pastinaca sativa* (8); *Ophrys tenthredinifera* (8); *Arundo pliniana* (8); *Serapias neglecta* (8); *Salvia verbenaca* (8); *Mentha longifolia* (8); *Agrimonia eupatoria* (8); *Eryngium campestre* (8); *Urospermum dalechampii* (8); *Phlomis ferruginea* (8); *Rumex crispus* (9); *Glycyrrhiza glabra* (9); *Medicago sativa* (9); *Verbascum sinuatum* (9); *Vicia lutea* (9); *Melilotus indica* (10); *Anacamptis pyramidalis* (10); *Orchis coriophora* var. *fragrans* (10); *Cynodon dactylon* (11); *Linum tryginum* (12); *Echium vulgare* (12); *Cistus monspeliensis* (13); *Andryala integrifolia*

(13); *Rumex bucephalophorus* (13); *Bunias erucago* (13); *Erodium cicutarium* (13); *Tuberaria guttata* (13); *Allium tenuiflorum* (13); *Capsella bursa-pastoris* (14); *Papaver hybridum* (14); *Medicago arabica* (14); *Plantago psyllium* (14); *Cyperus rotundus* (14); *Secale cereale* (14); *Phleum subulatum* (14); *Polycarpon tetraphyllum* (14); *Stachys arvensis* (14); *Sisymbrium officinale* (14); *Trisetaria panicea* (14); *Juncus capitatus* (14); *Polygonum aviculare* (14); *Valerianella microcarpa* (14); *Trifolium tomentosum* (14); *Hordeum leporinum* (14); *Dasypyrum villosum* (14); *Aegilops triuncialis* (14); *Cerastium glomeratum* (14); *Lathyrus cicera* (14); *Bromus tectorum* (14); *Myosotis arvensis* (14); *Juncus ambiguus* (14); *Trifolium glomeratum* (14); *Knautia integrifolia* (15); *Odontites serotina* (15); *Cynosurus elegans* (15); *Lathyrus hirsutus* (15); *Pimpinella peregrina* (15); *Kickxia spuria* (15); *Crepis zacintha* (15); *Helichrysum italicum* (15); *Carex divulsa* (15); *Dianthus carthusianorum* (16); *Petrorhagia prolifera* (16); *Secale strictum* (16); *Crepis neglecta* (17); *Papaver dubium* (17); *Alyssum montanum* (17); *Epilobium tetragonum* (17); *Onopordum illyricum* (17); *Agrostemma githago* (17); *Dianthus vulturius* (18); *Clinopodium vulgare* (18); *Cerastium brachypetalum* (19); *Poa pratensis* (20); *Alopecurus geniculatus* (20); *Smyrnium perfoliatum* (20); *Crepis biennis* (20); *Achillea millefolium* (20); *Ornithogalum umbellatum* (21); *Geranium pusillum* (22); *Prunus cocomilia* pl. (23); *Crocus albiflorus* (26); *Silene behen* (27); *Trifolium pratense* (28); *Cerastium luridum* (28); *Bromus erectus* (28); *Sedum reflexum* (28); *Cruciata laevipes* (28); *Lychnis flos-cuculi* (28).

Nomenclature follows Pignatti (1982).

Riassunto

Sono stati eseguiti 28 rilievi fitosociologici nei pascoli del versante ionico della Sila (Italia meridionale). La classificazione numerica dei rilievi basata sulla composizione floristica ha messo in evidenza l'esistenza di quattro tipi principali di vegetazione: cenosi a *Hedysarum coronarium-Cynara cardunculus*, cenosi ad *Agrostis castellana-Oenanthe pimpinelloides*, cenosi a *Vulpia ciliata-Trifolium arvense* e cenosi a *Potentilla calabra-Armeria canescens*. L'analisi indiretta di gradiente basata sull'ordinamento reciproco dei rilievi e delle specie e sulla valutazione ecologica delle specie ha evidenziato che la variazione floristica è legata a differenze sia climatiche che edafiche all'interno dell'area di studio. Inoltre i quattro tipi di fitocenosi sono risultati essere ben caratterizzati da strutture ed affinità fitogeografiche diverse.

Acknowledgements. We are grateful to Prof. Pier Luigi Nimis (Trieste) for their comments on the manuscript.

References

Abbate G., G. Cesca, M. Codogno, F. Corbetta and D. Puntillo, 1984. *Sindinamica di fitocenosi prative della Sila Grande (Calabria)*. Biogeographia, n.s., 10: 161-178.

Anderberg M.R., 1973. *Cluster analysis for applications*. Academic Press, New York and London.

Braun-Blanquet J., 1964. *Pflanzensoziologie. Grundzüge der Vegetationskunde.* 3. ed., Springer, Wien, New York.

Braun-Blanquet J. and O. de Bolos, 1957. *Les groupements vegetaux du Bassin moyen de l'Ebre et leur dynamisme.* An. Est. Exper. Aula Dei, Zaragoza.

Brullo S., 1983. *Contributo alla conoscenza della vegetazione delle Madonie (Sicilia settentrionale).* Boll. Acc. Gioenia Sci. Nat., 16: 351-420 + 26 tables.

Brullo S. and M. Grillo, 1978. *Ricerche fitosociologiche sui pascoli dei Monti Nebrodi (Sicilia settentrionale).* Not. Fitosoc., 13: 23-61 + 8 tables.

Caloiero D., 1975. *Le precipitazioni in Calabria nel cinquantennio 1921-70 e carta delle isoiete alla scala 1:500.000.* C.N.R. - I.R.P.I., Cosenza.

Ciancio O., 1971. *Sul clima e sulla distribuzione altimetrica della vegetazione forestale in Calabria.* Ann. Ist. Sper. Selv., 2: 321-372.

Codogno M., L. Bernardo, S. Fascetti and D. Puntillo, 1987. *Correlation between ecological factors and structural features of pasture vegetation in the Sila Greca (Calabria, S-Italy).* Giorn. Bot. Ital., 121 (3-4): 193-196.

Codogno M. and D. Puntillo, 1987. *Contributions to the quantitative phytogeography of Calabria (S-Italy). 1. The pasture vegetation of the Sila Greca.* Ann. Bot. (Roma), 45 (2): 55-63.

Codogno M. and D. Puntillo, 1988. *Über die Veränderungen der Höhenstufenfolge in kleineren Bereichen des Mittelmeerraums (insbesondere innerhalb Kalabriens, S-Italien).* Sauteria, 4: 141-148.

Feoli E., 1975. *Sull'uso della combinazione specifica caratteristica nei confronti tra i tipi di vegetazione.* Giorn. Bot. Ital., 109 (1-2): 87-96.

Gentile S. and G. Di Benedetto, 1961. *Su alcune prateria a* Lygeum spartum *L. e su alcuni aspetti di vegetazione di terreni argillosi della Sicilia orientale e Calabria meridionale.* Delpinoa, n.s., 3: 67-151.

Giacomini V. and S. Gentile, 1961. *Observations synthetiques sur la vegetation antropogene montagnarde de la Calabre (Italie meridionale).* Delpinoa, n.s., 3: 55-66.

Magri G., G. Sidoti and A. Spada, 1963-65. *Rilevamento geologico sul versante settentrionale della Sila (Calabria).* Mem. Note Ist. Geol. Appl., Napoli, 9 (2): 5-59.

Maarel E. van der, 1979. *Transformation of cover-abundance values in phytosociology and its effect on community similarity.* Vegetatio, 39 (2): 97-144.

Nimis P.L., 1981. *The thorny-cushions vegetation in Mediterranean Italy. Phytogeographical problems.* An. Jard. Bot. Madrid, 37 (2): 339-351.

Ogniben L., 1973. *Schema geologico della Calabria in base ai dati odierni.* Geologica Romana, 12: 243-585.

Orlóci L., 1978. *Multivariate analysis in vegetation science.* 2. ed., Junk, The Hague.

Pignatti A., 1982. *Flora d'Italia.* Edagricole, Bologna.

Raabe R.W., 1950. *Über der "Charakteristische Artenkombination" in der Pflanzensoziologie.* Schrift. Naturwiss. Vereins Steiermark, Graz, 91: 105-141.

Sarfatti G., 1954. *Ricerche sui pascoli della Sila (Calabria).* Webbia, 10 (1): 319-440.

Schneider R. and R. Sutter, 1982. *Beitrag zur Flora und Vegetation Südkalabriens.* Phytocoenologia, 10 (3): 323-373.

Thornthwaite C.W., 1948. *An approach toward a rational classification of climate.* Geogr. Rev., 38: 55-94.

Walter H., 1973. *Ökologische Betrachtungen der Vegetationsverhältnisse im Ebrobecken (NO-Spanien).* Acta Bot. Acad. Sc. Hungaricae, 19: 193-402.

Zanotti Censoni A.L., F. Corbetta and L. Aita, 1980. *Carta della vegetazione della Tavoletta "Trivigno" (Basilicata).* Coll. del P.F. "Promozione della Qualità dell'Ambiente", AQ/1/84, C.N.R., Roma.

Author's adresses:

Dr. Liliana Bernardo
Orto Botanico
Università della Calabria
I-87030 Roges di Rende (CS)

Dr. Michele Codogno
Dipartimento di Biologia
Università di Trieste
via A. Valerio 32
I-34127 Trieste

Domenico Puntillo
Orto Botanico
Università della Calabria
I-87030 Roges di Rende (CS).