

Phytosociological notes on the *Lygeum spartum* grasslands from Crete

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Abstract: Brullo, S., Giusso del Galdo, G. & Guarino, R. *Phytosociological notes on Lygeum Spartum grasslands from Crete. Lazaroa 23: 65-72 (2002).*

Lygeum spartum grasslands from Crete have been studied by using the phytosociological approach. This type of pastures of *Lygeo-Stipetalia tenacissimae* (*Lygeo-Stipetea* class), are included into a new alliance named *Scorzonero creticae-Lygeion sparti*. Three new associations have been recognized: *Limonio hyssopifolii-Lygeetum sparti*, occurring on halomorphic badlands in the Sitia territory (NE Crete); *Erodio crassifolii-Lygeetum sparti*, growing on heavily eroded clayey outcrops eastward of Ierapetra (SE Crete); *Convolvulo oleifolii-Lygeetum sparti*, substituting the previous one on stratified marls mixed to conglomerates close to Makrigialos. Within the last association, two subassociations have been recognized: *limonietosum roridi*, grouping the aspects occurring near the sea, and *fumanetosum laevipedis* relative to the inland aspects. To evaluate the similarity among the relevés, a numerical multivariate analysis has been performed.

Resumen: Brullo, S., Giusso del Galdo, G. & Guarino, R. *Notas fitosociológicas sobre los albardinares de Lygeum spartum de Creta. Lazaroa 23: 65-72 (2002).*

Se han estudiado los albardinares de *Lygeum spartum* L. de Creta aplicando el método fitosociológico. Este tipo de vegetación está incluido en el orden *Lygeo-Stipetalia tenacissimae* (clase *Lygeo-Stipetea*) de la que describimos una nueva alianza en el presente trabajo, *Scorzonero creticae-Lygeion sparti*. Asimismo se describen tres nuevas asociaciones incluidas en dicha alianza: *Limonio hyssopifolii-Lygeetum sparti*, presente sobre substratos arcillosos halomórficos de Sitia (NE Creta), *Erodio crassifolii-Lygeetum sparti*, colonizadora de los afloramientos arcillosos, fuertemente erosionados al este de Ierapetra (SE Creta) y *Convolvulo oleifolii-Lygeetum sparti*, que sustituye a la precedente sobre margas estratificadas mezcladas con conglomerados cerca de Makrigialos. En esta última asociación han sido también reconocidas dos subasociaciones nuevas: *limonietosum roridi*, localizada cerca del mar y *fumanetosum laevipedis* de territorios situados en el interior. Con el objetivo de evidenciar el grado de similitud de los inventarios, se ha efectuado un análisis numérico multivariable.

INTRODUCTION

Within phytosociological investigations on the coastal vegetation of Crete, grasslands dominated by *Lygeum spartum* L., colonizing badlands, are examined.

This vegetation is linked to Pliocene clayey substrata, occurring in the eastern part of the island, normally close to the sea. As emphasized by the ombrothermic diagrams of Sitia and Ierapetra (Figure 1), the climate of this area is very arid. According to the bioclimatic classification of RIVAS-MARTÍNEZ & LOIDI ARREGUI (1999), the south-eastern sector of the island (Ierapetra) is much more xeric than the northeastern one (Sitia); the former must be ascribed

to the inframediterranean lower dry type, and the latter to the thermomediterranean upper dry one.

For their ecology, structure and floristic set, the *Lygeum spartum* grasslands belong to the class *Lygeo-Stipetea* Rivas-Martínez 1978, nom. conserv., which groups herbaceous perennial steppe-communities distributed in the driest territories of the Mediterranean area (BRAUN-BLANQUET & BOLÒS, 1958; RIVAS-MARTÍNEZ, 1978; BRULLO & *al.*, 1990; RIVAS-MARTÍNEZ & *al.*, 1999). In particular, due to the dominance of *Lygeum spartum*, this vegetation can be referred to the *Lygeo-Stipetalia* order, which is well represented in the Iberian Peninsula, Maghreb, S Italy, Sicily, S Sardinia, while in eastern Mediterranean area it is probably circumscribed to Crete.

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- *Limonio hyssopifolii*-*Lygeetum sparti*
- *Erodio crassifolii*-*Lygeetum sparti*
- ▲ *Convolvulo oleifolii*-*Lygeetum sparti*

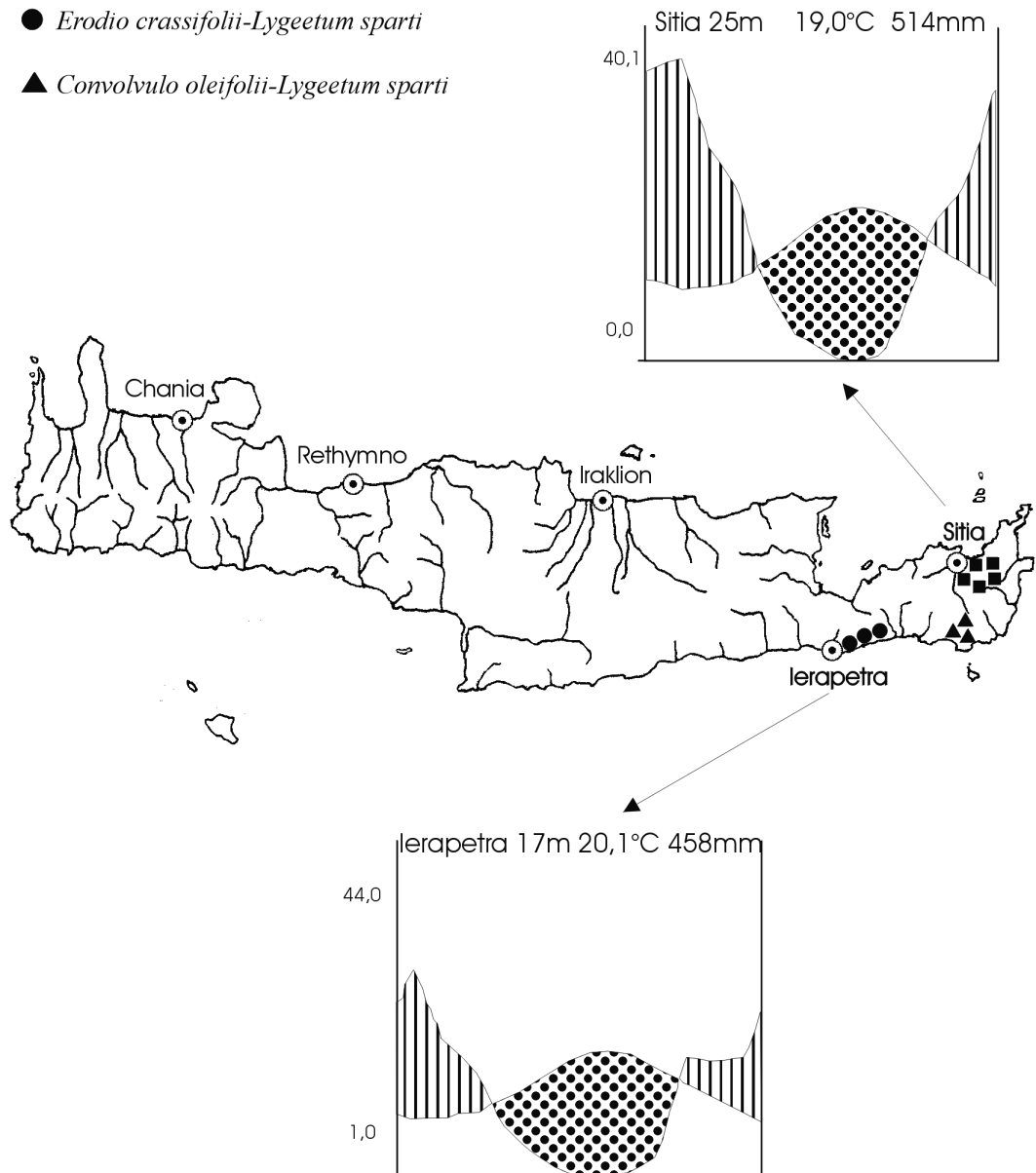


Figure 1.—Ombrothermic diagrams of Sitia and Ierapetra and distribution of the *Scorzonero creticae*-*Lygeion sparti* associations.

On the whole, this order has a southern Mediterranean distribution, since it groups communities ecologically selected by the tolerance to markedly thermo-xeric climatic conditions, even increased by the badness of the soils, which are prevalently clayey and heavily eroded by the weathering.

MATERIALS AND METHODS

For the phytosociological study, 34 relevés have been taken according to the well known Braun-Blanquet's approach (BRAUN-BLANQUET, 1964; WESTHOFF & MAAREL, 1978) and arranged in a table

counting 58 species (Table 1). While taking the relevés, a particular care was placed in respecting the criterion of structural homogeneity, since in the Mediterranean badlands is normally established a mosaic between terophytic communities and hemicrypto-chamaephytic ones. Such formations, even if mixed together, are completely different in structure, ecology and floristic set, because the microphytes, forming annual communities, avoid the summer drought-stress by seeds, while perennial plants are adapted to tolerate it (BRULLO & al., 1990).

To value the similarity among the available material, a numerical multivariate analysis has been performed by using the package Syntax 5.0 (PODANI, 1995). To reduce the noise due to accidental species, only those having more than 10% of presence in the table (35 in total) have been processed. To produce the classification dendrogram, the algorithm of the Euclidean squared distance and the average linkage as agglomeration criterion have been adopted. Besides, a principal coordinates analysis, based on the same data set, has been performed by adopting the Euclidean distance as resemblance coefficient.

Every numerical performance is based on quantitative data. The floristical nomenclature follows JAHN & SCHÖNFELDER (1995) or TURLAND & al. (1993). The bioclimatic classification follows RIVAS-MARTÍNEZ & LOIDI (1999).

RESULTS AND DISCUSSION

The dendrogram (Figure 2) lets to distinguish three main groups among the processed relevés. This is in accordance with the results of the principal coordinates analysis (Figure 3). It was deemed to formalise such groups as new associations, since no data about the Cretan *Lygeum spartum* vegetation are available in literature. They have been named, respectively, *Limonio hyssopifolii-Lygeetum sparti*, *Erodio crassifolii-Lygeetum sparti* and *Convolvulo oleifolii-Lygeetum sparti*. The rightmost cluster in figure 2 bears two subgroups, representing the coastal and the inland aspects of the *Convolvulo oleifolii-Lygeetum sparti*. The variance collected by the first axis of the principal coordinates analysis diagram can be correlated to the climatic aridity, which reaches lower values along the northern coast of the island, where *Limonio hyssopifolii-Lygeetum sparti*

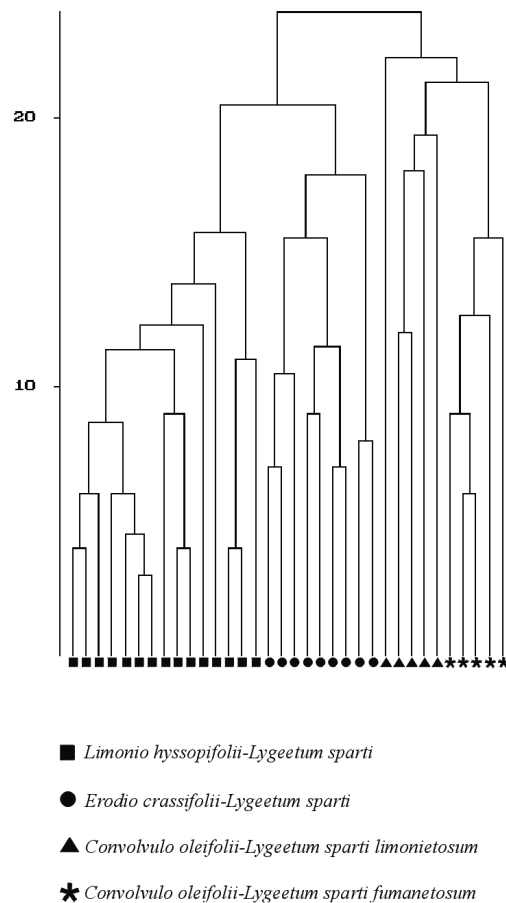


Figure 2.—Classification dendrogram produced by using the average linkage criterion on a dissimilarity matrix obtained from the classification of the Euclidean squared distance algorithm.

is localized. The second axis seems to be probably correlated to the soil salinity; even if no pedological analysis has been performed, this hypothesis is supported by the floristic set of the surveyed associations. In particular, *Erodio crassifolii-Lygeetum sparti*, for the occurrence of *Erodium crassifolium*, *Limonium virgatum*, *Plantago albicans*, is the most halophilous community, while *Convolvulo oleifolii-Lygeetum sparti* can be considered the least halophilous one, as attested by the presence of some phrygana species such *Colvolvulus oleifolius*, *Sarcopoterium spinosum*, *Corydanthus capitatus* and *Hyparrhenia hirta* too.

Regarding to the alliance, the Cretan communities are differentiated by the occurrence of some eastern species, such as *Scorzonera cretica*, *Carlina*

Table 1

Limonium hyssopifolii-*Lygeetum sparti* (1-15).

Erodio crassifolii-*Lygeetum sparti* (16-24).

Convolvulo oleifolii-*Lygeetum sparti limonietosum roridi* (25-29).

Convolvulo oleifolii-*Lygeetum sparti fumanetosum laevipedis* (30-34).

(*Scorzonero creticae*-*Lygeetum sparti*, *Lygeo-Stipetalia*, *Lygeo-Stipetea*)

Relevé number	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	29	30	31	32	33	34				
Group	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	B	B	B	B	B	B	B	B	B	B	C	C	C	C	C	D	D	D	D	D			
Altitude (m a.s.l.)	8	10	10	10	20	25	25	20	22	20	25	10	8	10	10	15	15	10	12	15	15	12	20	5	5	10	6	8	100	100	80	70	70					
Surface (m ²)	50	50	50	20	20	25	10	15	20	10	10	100	100	100	100	100	100	100	100	100	100	30	20	100	50	100	50	100	100	50	50	50	50					
Cover (%)	90	90	95	80	100	100	100	100	100	100	80	90	100	100	90	80	80	90	90	90	80	90	70	80	90	80	80	70	90	100	90	80	80	70				
Slope (°)	20	20	20	15	20	20	15	20	30	30	20	30	15	20	20	15	20	20	15	20	25	20	20	10	25	15	25	15	25	30	35	35	40	40				
Exposure	E	N	N	N	S	S	SW	S	SW	SW	S	S	NE	NE	S	S	S	S	S	S	S	S	S	S	SE	SE	SE	E	E	E	E	SE	SE	SE				
Association characteristic species																																						
<i>Limonium hyssopifolium</i>																																						
<i>Erodium crassifolium</i>																																						
<i>Allium hirtovaginatam</i>																																						
<i>Convolvulus oleifolius</i>																																						
Subassociation differential species																																						
<i>Limonium roridum</i>																																						
<i>Fumana laevipes</i>																																						
<i>Scorzonero creticae</i> - <i>Lygeetum sparti</i> characteristic species:																																						
<i>Scorzonera cretica</i>																																						
<i>Phagnalon graecum</i>																																						
<i>Carlina graeca</i>																																						
<i>Lygeo-Stipetalia</i> & <i>Lygeo-Stipetea</i> characteristic species:																																						
<i>Lygeum spartum</i>																																						
<i>Dactylis hispanica</i>																																						
<i>Reichardia picroides</i>																																						
<i>Pallenis spinosa</i>																																						
<i>Urginea maritima</i>																																						
<i>Asphodelis ramosus</i>																																						
<i>Hyparrhenia hirta</i>																																						
<i>Bituminaria bituminosa</i>																																						
<i>Asphodeline lutea</i>																																						
<i>Convolvulus althaeoides</i>																																						
Companion species:																																						
<i>Helichrysum barrelieri</i>																																						
<i>Coridolymus capitatus</i>																																						
<i>Lotus cytisoides</i>																																						

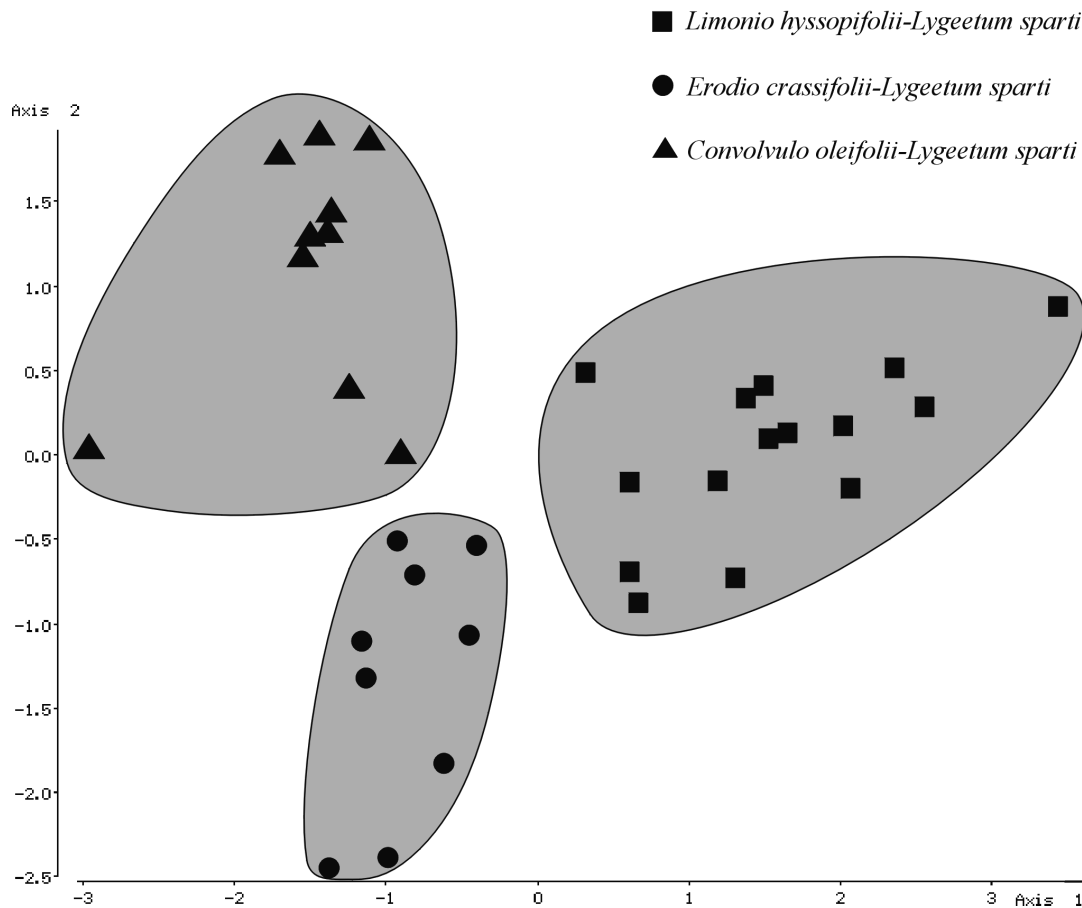


Figure 3.—Principal Coordinates Analysis according to the first/second axis.

graeca and *Phagnalon graecum*. These species are proposed as characteristics of a new alliance, named *Scorzonero creticae-Lygeion sparti* (holotype: *Erodio crassifolii-Lygeetum sparti* *ass. nova, hoc loco*), which can be considered an eastern vicariant of other syntaxa, viz. *Agropyro pectinati-Lygeion sparti* Br.-Bl. & O. Bolòs 1958 *corr.* Rivas-Martínez, Fernández-González & Loidi 1999 from the Iberian Peninsula, *Polygonion tenoreani* Brullo, De Marco & Signorello 1990 from S Italy and *Moricandio-Lygeion sparti* Brullo, De Marco & Signorello 1990 from Sicily and southern Calabria. (Figure 4).

As already mentioned, in addition to the floristic differences, the Cretan associations appear to be quite differentiated also from the ecological and physiognomic-structural point of view.

Limonio hyssopifolii-Lygeetum sparti* Brullo, Giusso & Guarino *ass. nova.

Holotypus: table 1, rel.4, *hoc loco*.

Perennial pioneer community of halomorphic badlands occurring on marly-clayey vertisols close to the sea. It is characterized by the presence of *Limonium hyssopifolium*, a southern Aegean halophyte, playing, in this context, a relevant physiognomic role. This vegetation, having a mean height of 40 cm, shows a monostратified open structure, and reaches its phenological optimum in April, as concern the hemicryptophytes, while July is the flowering period of *Limonium hyssopifolium*, the dominant species. The association is circumscribed to the Sitia territory (northeastern Crete), which is characterized by a thermomediterranean upper dry bioclimate (Figure 1).

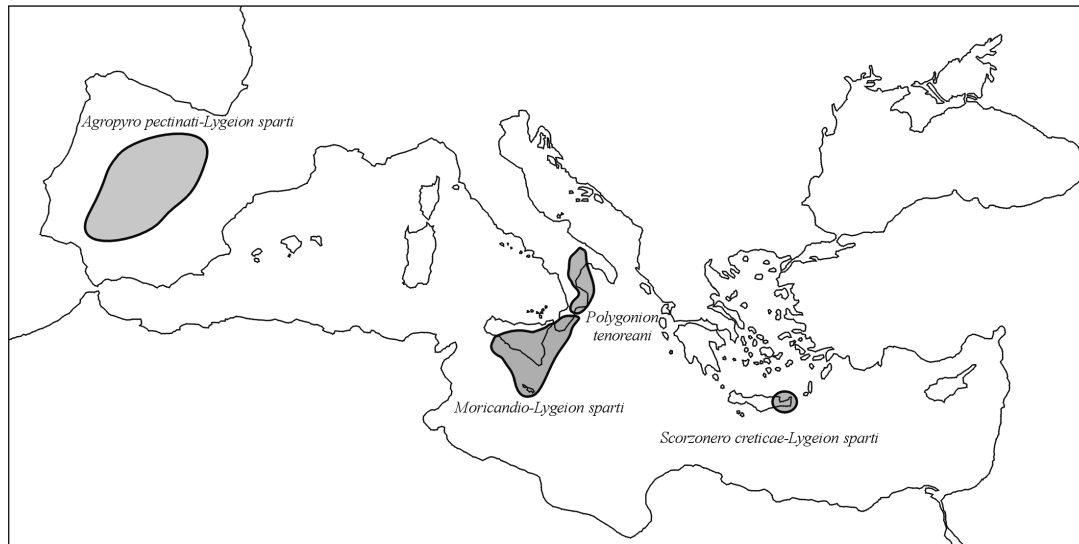


Figure 4.—Geographical distribution of the known alliances regarding *Lygeum spartum* grasslands and belonging to *Lygeo-Stipetalia tenacissimae*.

Erodio crassifolii-Lygeetum sparti Brullo, Giusso & Guarino *ass. nova*

Holotypus: table 1, rel.19, *hoc loco*.

This association occurs along the south-eastern coast of Crete, near Ierapetra, and shows marked halo-xerophilous exigences. It is characterized by *Erodium crassifolium* and *Allium hirtovaginatatum*, steppic species with a southern Mediterranean distribution. The vegetation has a mean height of 35 cm, presents a monostratified open structure and reaches the phenological optimum between April and May. It colonizes heavily eroded clayey outcrops not far from the sea and suffers the inframediterranean lower dry bioclimate of this area (Figure 1).

Convolvulo oleifolii-Lygeetum sparti Brullo, Giusso & Guarino *ass. nova*

Holotypus: table 1, rel.29, *hoc loco*.

This association substitutes the previous one on stratified marls mixed to conglomerates, whose outcrops are localized nearby Makrigialos (SE Crete), an area characterized by a bioclimate quite similar to that one of Ierapetra (Figure 1). The mean height of the vegetation is 50 cm, and structurally it is differentiated by the dominance of various chamaephytes, as *Convolvulus oleifolius*, a southern Aegean element, which is to be considered the chief

species of the association. This community has its phenological optimum in April, when the most species are flowering. From the floristic and ecological point of view, it is possible to distinguish two new subassociations; they are:

- a) ***limonietosum roridi*** (*holotypus*: table 1, rel. 29, *hoc loco*), which is the typical aspect of the association. It occurs not far from the sea, and is differentiated by *Limonium roridum*, species very common in the Aegean area (BRULLO & GUARINO, 2000), which highlights the highest halophily of this community.
- b) ***fumanetosum laevipedis*** (*holotypus*: table 1, rel. 32, *hoc loco*), linked to inland sites, where it grows at altitudes of 70-100 m on slopes facing the sea. It is differentiated by *Fumana laevipes*, a typical element of phrygana.

CONCLUSIONS

At the present state of knowledge, *Lygeum spartum* grasslands are linked to thermo and inframediterranean thermotypes with dry or subhumid ombrotypes and, for this reason, they are concentrated in southern Mediterranean territories. In the Temperate region, badlands and vertisols are normally colonized by mesophilous grasslands dominated by

Elyttrigia sp. pl., such as *E. atherica*, *E. repens* and *E. intermedia*, belonging to *Agropyretalia repentis* Oberd., Müller & Görs in Oberd & al. 1967 (FERRARI & GERDOL, 1987; POTT, 1995).

Within *Lygeum spartum* grasslands, the Cretan communities have an outstanding biogeographical value, due to their remarkable isolation as well as to be the easternmost outposts of *Lygeum spartum* in the Mediterranean basin. It is likely that *Lygeum spartum* grasslands, whose highest diversity is concentrated in north-western Africa and southern Spain, expanded their range to Sardinia, southern Italy, Sicily and Crete during the Messinian period, so becoming isolated after the definitive sea transgression.

The conservation of these small shreds of the biogeographical history of the Mediterranean basin, nowadays heavily threatened by the building trade, is therefore extremely important.

SYNTAXONOMICAL SCHEME

LYGEO-STIPETEA Rivas-Martínez 1978 nom. conserv.
Lygeo-Stipetalia tenacissimae Br.-Bl. & O. Bolòs 1958
Scorzonero creticae-Lygeion sparti all. nova
Limonio hyssopifolii-Lygeetum sparti ass. nova
Erodio crassifolii-Lygeetum sparti ass. nova
Convolvulo oleifolii-Lygeetum sparti ass. nova
limonietosum roridi subass. nova
fumanetosum laevipedis subass. nova

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