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Phytosociological study of the shrub and pre-forest communities of the effusive substrata of NW Sardinia

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Abstract

The trachybasalt biogeographic sub-district of the NW Sardinian district, included in the coastal and hilly sub-sector of the Sardinian biogeographic sector, is characterised by two large effusive complexes: that of the rhyolites, andesites and dikes of the Oligo-Miocene alkaline volcanic cycle (14-32 Ma) and alkaline basalts, rhyolites, rhyodacites and dikes of the volcanic cycle with alkaline, transitional and sub-alkaline affinity of the Pliocene-Pleistocene (0.14-5.3 Ma). Between 2000 and 2004, 156 surveys were carried out on shrub communities in order to improve knowledge of their phytosociology. Vegetation analysis led to the identification of 11 associations and 13 subassociations, referring to 3 syntaxonomic classes. Of these, 5 new associations are hereby described for the first time: *Clematido vitalbae-Maletum pumilae*, *Crataego monogynae-Aceretum monspessulani*, *Lavatero olbiae-Rubetum ulmifolii*, *Genisto desoleanae-Ericetum arboreae* and *Telino monspessulanae-Cytisetum villosi*.

Key-words: effusive substrata, NW Sardinia, phytosociology, shrub communities, vegetation series.

Riassunto

Studio fitosociologico delle comunità arbustive e preforestali dei substrati effusivi della Sardegna nord-occidentale. Il subdistretto biogeografico trachi-basaltico del distretto sardo nord-occidentale, incluso nel sottosettore costiero e collinare del settore biogeografico sardo, è caratterizzato da due vasti complessi effusivi: quello delle rioliti e andesiti del ciclo calcalcalino Oligo-Miocenico (14-32 milioni di anni) e quello dei Basalti alcalini del ciclo Plio-Pleistocenico (0,14-5,3 milioni di anni). Tra il 2000 e il 2004, sono stati realizzati 156 rilievi fitosociologici sulle comunità arbustive e preforestali di quest'area, per migliorarne le conoscenze fitosociologiche. L'analisi della vegetazione ha permesso d'individuare 11 associazioni e 13 subassociazioni, riferite a 3 classi. Tra queste, 5 nuove associazioni sono qui descritte: *Clematido vitalbae-Maletum pumilae*, *Crataego monogynae-Aceretum monspessulani*, *Lavatero olbiae-Rubetum ulmifolii*, *Genisto desoleanae-Ericetum arboreae* e *Telino monspessulanae-Cytisetum villosi*.

Parole chiave: comunità arbustive, fitosociologia, sardegna nord-occidentale, serie di vegetazione, substrati effusivi.

Introduction

The effusive substrata of NW Sardinia are amongst the least studied areas of the island from the point of view of both flora and vegetation (Farris & Filigheddu, 2006). Detailed flora and vegetation studies of specific zones of the area simply do not exist, there being merely distribution data on forest, bush and chamaephyte species (Camarda & Valsecchi, 1983, 1990). Exhaustive data on the forest communities of the study area are provided by papers published recently on Sardinian forest communities (Bacchetta *et al*., 2003a, 2004a, 2004b). In the past Valsecchi (1994) published a phytosociological study on the dwarf communities dominated by species of the genus *Genista* L., while some data concerning coastal vegetation are provided by Mayer (1995). To our knowledge there has been no scientific contribution concerning shrub vegetation, except for *Myrtus communis* L. communities (Cossu *et al*., 2004). To the contrary, the shrub communities of the limestone, alluvial and metamorphic substrata of the Nurra and Sassarese sub-regions, that are adjacent to the study area, have been extensively studied from a phytosociological point of view (Biondi *et al*., 2001, 2002).

Hence, a study of the shrub vegetation was undertaken with the aim of improving geobotanical knowledge of the area and of establishing a syntaxonomic scheme for the shrub communities, determining the floristic composition, the biogeographic value and alpha-diversity, and understanding their role within secondary succession.

Study area

The study area (Fig. 1) is between 40° 40'N and 40° 01'N and between 8°18'E and 9°00'E from Greenwich. The cartographic references, on 1:100,000 I.G.M. maps, are to be found on sheets 192 (Alghero), 193 (Bonorva) and 205-206 (Capo Mannu-Macomer). The area includes the sub-regions of Logudoro, Mejlogu, Planargia, Marghine, Campeda and Montiferru (Le Lannou, 1941; Terrosu Asole, 1982). From an adminstrative point of view it lies within the provinces of Sassari, Nuoro and Oristano. Some survey work has also been carried out on the mountains of the Goceano (in the province of Sassari) – a metamorphic chain that borders with the Marghine and Logudoro areas.

The area of study borders with La Nurra to the north,

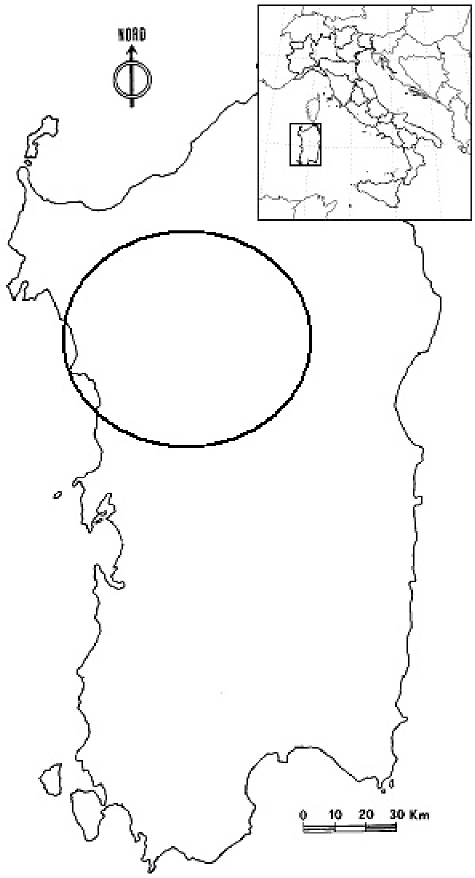

Fig. 1 – Study area

with the Sardinian sea to the west and with the Campidano di Milis to the south, while the eastern border is determined by the sedimentary substrata of the marine succession of the Lower and Middle Miocene, that form the geomorphic landscape of the Sassarese sub-region and spread without interruption from Porto Torres to Bonorva with a NNW-SSE orientation. These sedimentary substrata are found below the effusive cover and often emerge in the study area, especially in Planargia and Mejlogu. Therefore the surface that is actually occupied by the effusive substrata is c. 1800 km^2.

The substrata studied may be ascribed to two vast complexes: the rhyolites and andesites of the Oligo-Miocene calcalkaline cycle (14-32 Ma) and the basalts of alkaline, transitional and sub-alkaline affinity of the Plio-Pleistocene cicle (0.14–5.3 Ma) (Carmignani *et al*., 2001).

Sardinian Oligo-Miocene volcanism is one of the most important tertiary geological events in the western Mediterranean (Carmignani *et al*., 2001). The Marghine chain is part of this, and constitutes one of the most marked relief features in Sardinia – it separates structural zones and delimits the tilted complex to the NW, which constitutes the northern sector of the island. This chain, together with that of the Goceano, continues in the relief of Alà dei Sardi, giving rise to the longest mountain complex of the island (c. 100 km) and acting as a watershed between the hydrographical basins of the Coghinas and Temo rivers to the north and the Tirso river to the south. From Macomer, where it interacts extensively with the basaltic *plateaus* of Campeda, the trachyte relief increases in altitude, as it continues north-eastwards, as far as the highest point: Mt. Palai (1200 m a.s.l.). To the west the chain degrades, having a border composed of a series of cliffs and plateaus (such as that on which the town of Macomer is located), from the 798 m a.s.l. of Mt. Pitzolu to the c. 420 m a.s.l. of the basaltic plateau of Abbasanta, with a difference in altitude of c. 350 m. The whole of the SW side of the chain, as far as Mt. Iammeddari (1118 m a.s.l.), is characterised by very deep gorges and steep slopes.

Tablelands dominate the Oligo-Miocene effusive system, which is the result of differential erosive phenomena (Brandis, 1978), which have given rise to vast plateaus or mountains with a typical truncated-conical shape. Mt. Miale Ispina, 269 m a.s.l., constitutes the northern extremity of this effusive system, while Mt. Mannu, 802 m a.s.l. and Mt. Palai, 1200 m a.s.l. are the western and eastern limits, respectively. The hydrographical basin of the Temo river (Bosa) dominates the hydrography of almost all the system with its surface area of 837 Km^2.

The volcanic relief of Montiferru dominates the Plio-Pleistocene volcanic landscape system: this is composed of rhyolites and phonolites with trachybasalt dykes, alkaline and hawaiite basalts, as well as lava flows of alkaline and transitional basalts that compose the plateaus of Campeda and Abbasanta. The Montiferru volcano is steep and exceeds 1000 m in altitude (Mt. Urtigu, 1050 m a.s.l. is the highest point). On the other hand, the plateaus of Campeda and Abbasanta reach altitudes of 600-700 m a.s.l. and 200-400 m a.s.l., respectively. In the westernmost part of the plateau of Campeda, close to Montiferru, lies Mt. S. Antonio, the only mountain worthy of mention. The hydrography of Montiferru has a characteristic radial symmetry, with the head of the valleys that develop in the higher mountainous area from which numerous rivers and streams, which are often perennial, originate.

The border between the two principal landscape systems, that of the Plio-Pleistocene volcanites to the south and those of the Oligo-Miocene to the north, is constituted by rivers: to the west Rio Mannu di Foghe, further to the NE Rio Temo from Badde Salighes, an affluent from the left side of the Temo river of Bosa.

For the phytoclimatic setting reference was made to temperature and precipitation values from the stations of Campeda, Cuglieri, Olmedo, Santulussurgiu, Villanova Monteleone and Vallicciola, provided by the Servizio Agrometeorologico Regionale (S.A.R.) [Regional Service for Agricultural Meteorology] of the Autonomous Region of Sardinia. The meteorological station of Vallicciola was taken into consideration even though it does not lie within the area of study (it is in Gallura, in the province of Olbia-Tempio, in NE Sardinia), as it is the only meteorological station in Sardinia that is situated above 1000 m a.s.l.: the analysis of the data from this station is essential for the definition of the phytoclimate of the mountainous areas studied.

The average annual temperature varies from 16.7°C in Olmedo to 10.3°C in Vallicciola. The averages of the minimum temperatures for the coldest month, almost always January, vary from 8.3°C in Olmedo to 0.4°C in Vallicciola. The averages of the maximum temperatures for the coldest month vary from 11.3°C in Olmedo to 6.3°C in Vallicciola (Tab. 1). The averages for annual rainfall vary from 574 mm in Olmedo to 1271 mm in Vallicciola. The area of study, one of the rainiest in Sardinia (Pinna, 1985), is under the influence of prevalent subhumid ombrotypes, with rainfall always exceeding 900 mm year^{-1} above 500 m a.s.l. (Tab. 2). The analysis of annual series of temperature and precipitation values obtained from the S.A.R. permitted the elaboration of the principal bioclimatic indexes (Tab. 3), according to the proposal by Rivas-Martínez *et al.* (2002), and the definition of the phytoclimatic classification of the survey stations (Tab. 4 and Fig. 2). Despite the scarcity of phytoclimatic stations above 600 m a.s.l., it has been possible to recognise two different bioclimatic regions in the area, in accordance with Blasi and Michetti (2002): one which is Mediterranean, the other Temperate of the sub-Mediterranean variant. The first, which is clearly prevalent, is present with three phytoclimatic belts: Upper Thermomediterranean (coastal), Lower Mesomediterranean below 500 m a.s.l.

Tab. 1 – Temperature values for the stations in the study area (T = average annual temperature; M = average of the maximum in the coldest month; m = average of the minimum in the coldest month)

Station	Altitude (m a.s.l)	Years	Years of observation	T °C	M °C	m °C
Olmedo	52	1988-1999	12	16.7	11.3	8.3
Cuglieri	484	1965-2000	36	14.5	9.8	4.9
S. Lussurgiu	557	1965-2000	36	13.9	8.4	3.6
Villanova M.teleone	567	1942-1980	38	14.1	8.9	3.8
Campeda	651	1973-1986	14	12.6	9.4	1.9
Vallicciola	1040	1965-1987	23	10.3	6.3	0.4

Tab. 2 – Precipitation values for the stations in area of study (P = mean annual rainfall)

Station	Altitude (m a.s.l)	Years	Years of observation	P (mm)
Olmedo	52	1965-1999	35	574
Cuglieri	484	1965-1997	33	791
S. Lussurgiu	557	1965-1999	35	1174
Villanova M.teleone	567	1931-1980	49	976
Campeda	651	1965-1986	22	850
Vallicciola	1040	1965-1987	23	1271

Tab. 3 – Bioclimatic indicators (Rivas-Martínez *et al*., 2002): Tp = positive annual temperature, Ic = continentality index, It = Index of thermicity, Io = Ombrothermic index

Station	Tp	Ic	It	Io
Olmedo	2005	15.3	363	2.9
Cuglieri	1744	15.3	292	4.5
S. Lussurgiu	1673	17.0	259	7.0
Villanova M.teleone	1692	16.7	268	5.8
Campeda	1518	15.8	239	5.6
Vallicciola	1235	15.9	170	10.3

Tab. 4 – Bioclimatic classification after Rivas-Martínez *et al.* (2002)

Station	Bioclimate	Thermotype	Ombrotype	Continentality
Olmedo	Mediterranean pluviseasonal oceanic	Upper thermomediterranean	Upper dry	Euoceanic
Cuglieri	Mediterranean pluviseasonal oceanic	Lower mesomediterranean	Lower subhumid	Euoceanic
S. Lussurgiu	Mediterranean pluviseasonal oceanic	Upper mesomediterranean	Lower humid	Semicontinental
Villanova M.teleone	Mediterranean pluviseasonal oceanic	Upper mesomediterranean	Upper subhumid	Euoceanic
Campeda	Mediterranean pluviseasonal oceanic	Upper mesomediterranean	Upper subhumid	Euoceanic
Vallicciola	Temperate oceanic submediterranean	Lower supratemperate	Upper humid	Euoceanic

and Upper Mesomediterranean above 500 m a.s.l. The temperate sub-Mediterranean oceanic bioclimatic region is present above 700-750 m a.s.l. in Montiferru, Marghine and Goceano, with the Upper Mesotemperate (up to c. 1100 m a.s.l.) and the Lower Supratemperate (above 1100 m a.s.l.) phytoclimatic belts, generally with a lower humid ombrotype.

According to Arrigoni (1983) the area of study coincides with the trachybasalt biogeographic subdistrict of the NW Sardinian district, included in the coastal and hilly sub-sector of the Sardinian biogeographic sector.

In the Natura 2000 Network (Blasi, 1996) project, realised on the basis of the prescriptions of the “Habitat” Directive 43/92/EEC, the following S.I.C.s have been proposed in the area of study: ITB 000040 Valley of the Temo river (1,947 ha); ITB 000041 internal and coastal areas between Bosa and Capo Marrargiu-Porto Tangone (29,634 ha); ITB 001101 the Plateau of Campeda (4,668 ha); ITB 001102 Marghine-Goceano (14,984 ha); ITB 001104 Middle Valley of the Tirso river and Plateau of Abbasanta (8,999 ha); and ITB 002201 Riu Sos Molinos, Sos Lavros, Monte Urtigu (26 ha).

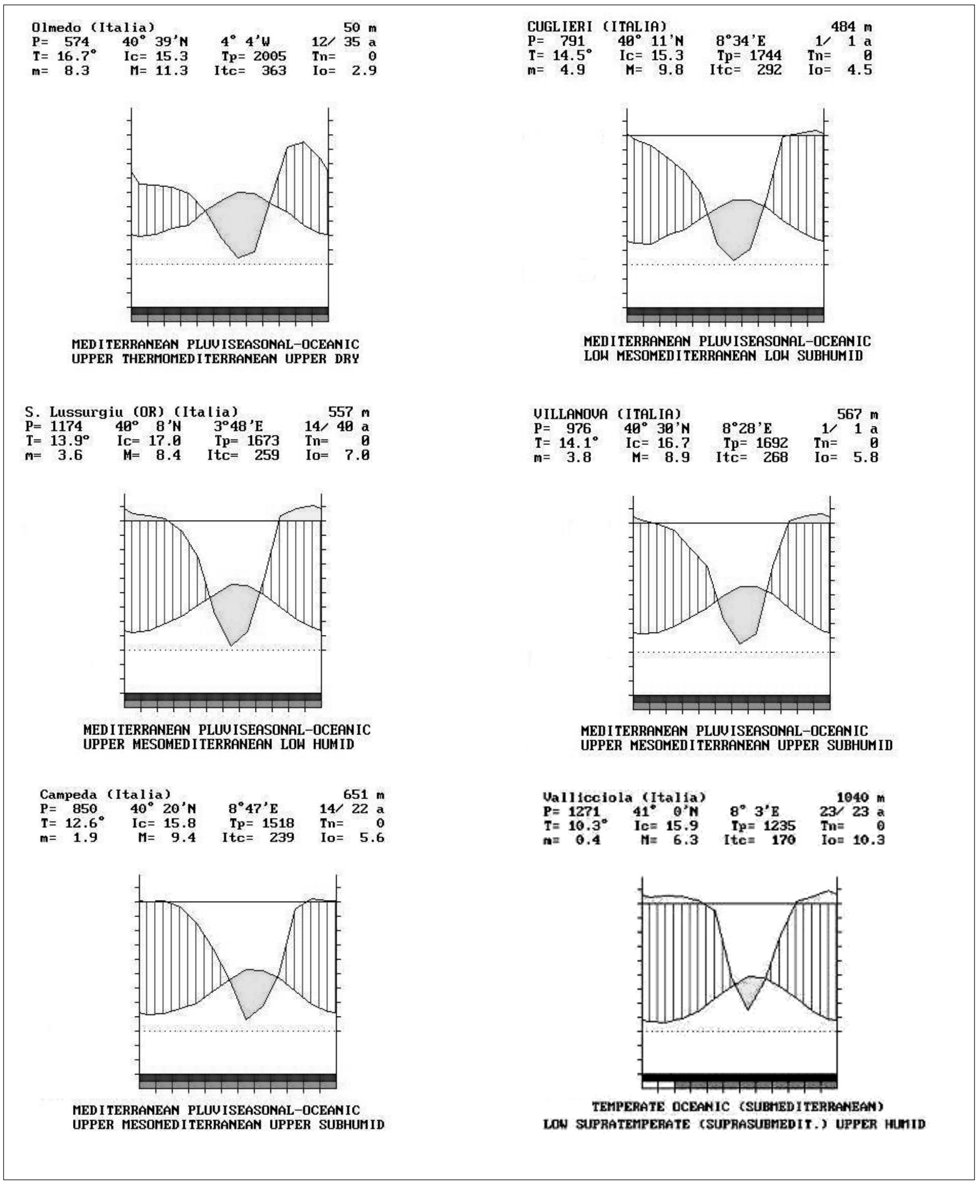

Fig. 2 – Bioclimatic diagrams for the survey stations for the area of study

Materials and Methods

Between 2000 and 2004 156 phytosociological surveys were carried out on the shrub communities of the effusive substrata, following the method of the Sigmatist school of Zürich-Montpellier (Braun-Blanquet, 1951).

The phytosociological data relating to cover underwent multivariate analysis using Matedit (Burba *et al.,* 1992) software: a matrix of 156 columns x 109 rows was elaborated, in which the cover values were converted according to a quantitative scale proposed by Van der Maarel (1979). The surveys were classified with the algorithm of the medium linkage calculated with the similarity ratio option on the specific cover (Westoff & Van der Maarel, 1978).

The discrimination of the single associations follows the ordering obtained by way of statistical analysis, visualised as a dendrogram, while the ordering of the surveys within the associations, transferred to ordered tables, was carried out independently of statistical analysis with the aim of underlining possible subassociations or variants.

The alphanumeric codes in the ordered tables referring to the geo-lithological substrata are after a proposal by Carmignani *et al*. (2001), as a supplement to the Geological Map of Sardinia – scale 1:200,000 (Barca *et al*., 1996), according to Tab. 5.

The taxonomical classification is after Conti *et al*. (2005), except for some cases in which it was deemed preferable to follow Pignatti (1982), Tutin *et al*. (1964-1980, 1993), Arrigoni *et al*. (1976-1991), Greuter *et al*. (1984-1989), Valdés *et al.* (1987), Valsecchi (1993), Rossellò & Sàez (1998), Cesca *et al*. (2001), Bacchetta *et al*. (2003b), Camarda (2003) and Bagella & Urbani (2006).

The biological forms, on the basis of Raunkiaer's classification (1934), were verified directly in the field and expressed following a proposal by Pignatti (1982) for Italian flora. The chorological types are also drawn from Pignatti (1982). The syntaxonomy follows the criteria of the *Third Edition of the International Code for Phytosociological Nomenclature* (Weber *et al*., 2000), translated into Italian by Scoppola (Weber *et al.*, 2002).

For each association the following were calculated: average specific density, biological spectrum and chorological spectrum based on species frequencies. For the calculation of the chorological spectrum the chorological types drawn from Pignatti (1982) were grouped into wider classes (Pignatti, 1994). The biological and chorological spectra, based on frequency, were also calculated, from the surveys grouped by altitude class (0-200 m; 200-400 m; 400-600 m; and 600-800 m).

Each association was related to one or more vegetation series, according to the synphytosociological method (Rivas-Martínez, 1976).

Results

The following is an illustration of the shrub associations that represent the communities dominated by phanerophytes and nanophanerophytes, substituting the potential tree vegetation of the landscape units of effusive Oligo-Miocene and Plio-Pleistocene systems of NW Sardinia, constituting the trachybasalt biogeographic subdistrict of the NW Sardinian district (Arrigoni, 1983).

Four large typologies of shrub vegetation can be identified (Fig. 3). The first (cluster A) includes six spiny deciduous or semi-deciduous shrub communities, dominated mainly by entities of the Rosacee family, such as *Rubus ulmifolius*, *Prunus spinosa*, *Crataegus monogyna*, *Rosa canina*, *Pyrus spinosa* and *Malus pumila*, that establish dynamic relations mostly with the deciduous forest vegetation. These communities are assigned, in the context of the *Pruno-Rubion ulmifolii* Mediterranean alliance of the *Rhamno-Prunetea* class (Poldini *et al*., 2002; Rivas-Martìnez *et al*., 2002), to the *Pruno-Rubenion ulmifolii* suballiance, differentiated by the interaction with sclerophyllous Mediterranean elements, such as *Asparagus acutifolius*, *Smilax aspera*, *Lonicera implexa* and *Myrtus communis* (Blasi *et al*., 2002): the meso-hygrophilous shrub communities recently described for NW Sardinia on sedimentary and alluvial substrata (Filigheddu *et al*., 1999; Biondi *et al*., 2002) also lie within this suballiance.

Cluster B represents two secondary shrub communities on effusive substrata that fall within the *Ericion arboreae* alliance of the *Pistacio-Rhamnetalia* order (Rivas-Martínez, 1975): the formations of high maquis with *Erica arborea* and *Arbutus unedo*, substitution of cork-oak and holm-oak forests, mainly in the meso-Mediterranean bioclimatic belt, fall within the *Erico arboreae-Arbutetum unedoni* association with two subassociations (cluster 7); the shrub communities of lower height, dominated by *Erica arborea* and *Genista desoleana*, in the upper meso-temperate and lower supra-temperate belts (in the sub-Mediterranean variant), in series with the forest association *Saniculo*

Tab. 5 – Legend of the codes identified for the lithological typologies studied (from Barca *et al*., 1996)

5a	Basalts of the Pliocene-Pleistocene alkaline, transitional and subalkaline volcanic cycle (0,14-5,3 Ma)
5b	Trachytes of the Pliocene-Pleistocene alkaline, transitional and subalkaline volcanic cycle (0,14-5,3 Ma)
9	Lower-Middle Miocene marine succession and continental deposit
11	Rhyolitic of the Oligocene-Miocene calcalkaline volcanic cycle (14-32 Ma)
12	Andesites of the Oligocene-Miocene calcalkaline volcanic cycle (14-32 Ma)
52	Metavolcanic rocks of the ordovician magmatic and volcano-sedimentary complex

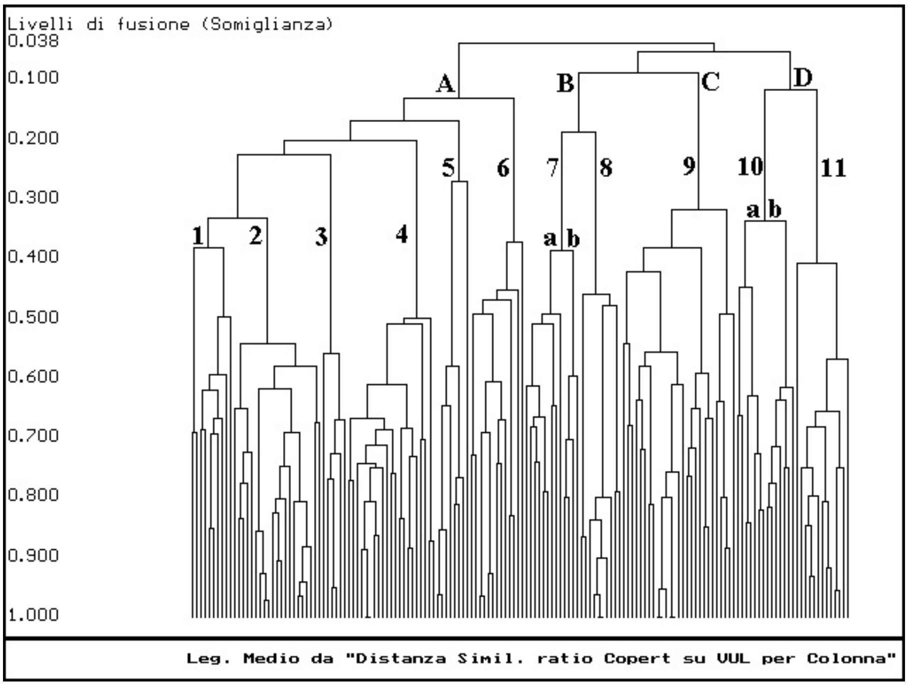

Fig. 3 – Dendrogram of the surveys relating to the shrub communities of effusive substrata (average link calculated by way of *similarity ratio*): A = *Rhamno-Prunetea* class, B = *Ericion arboreae* alliance of the *Quercetea ilicis* class, C = *Cytisetea scopario-striati* class, D = *Oleo-Ceratonion* alliance of the *Quercetea ilicis* class, 1 = ass. *Clematido cirrhosae-Crataegetum monogynae*, 2 = ass. *Crataego monogynae-Pyretum amygdaliformis*, 3 = ass. *Clematido vitalbae-Maletum pumilae*, 4 = ass. *Crataego monogynae-Aceretum monspessulani*, 5 = ass. *Lavatero olbiae-Rubetum ulmifolii*, 6 = ass. *Vicio tenuifoliae-Prunetum spinosae*, 7 = ass. *Erico arboreae-Arbutetum unedoni* (a = subass. *phillyreetosum latifoliae*, b = subass. *ilicetosum aquifolii*), 8 = ass. *Genisto desoleanae-Ericetum arboreae*, 9 = ass. *Telino monspessulanae-Cytisetum villosi*, 10 = ass. *Calicotomo-Myrtetum* (a = subass. *myrtetosum communis*, b = subass. *chamaeropetosum humilis*), 11 = ass. *Pistacio lentisci-Calicotometum villosae* subass. *euphorbietosum dendroidis*

europaeae-Quercetum ilicis, are related to the new association *Genisto desoleanae-Ericetum arboreae* (cluster 8).

Cluster C is composed of acidophile shrub communities, dominated by *Cytisus villosus* and *Teline monspessulana*, sometimes with *Calicotome villosa* and *C. spinosa*, in the upper meso-Mediterranean belt, with great recovery capacity after bush and forest fires: these are related to the *Sarothamnion scoparii* alliance of the *Cytiso villosi-Telinetalia monspessulanae* order, within the *Cytisetea scopario-striati* class (Rivas-Martínez & Belmonte, 1987; Rivas-Martínez *et al*., 2001).

Cluster D groups two communities of sclerophylls, substituting the evergreen forest vegetation, that constitute the most thermophile aspects, mainly of the Oligo-Miocenic trachytes, in the upper thermo-Mediterranean and lower meso-Mediterranean bioclimatic belts: these associations are related to the *Oleo-Ceratonion* alliance of the *Pistacio-Rhamnetalia* order, within the *Quercetea ilicis* class (Biondi *et al*., 2001; Rivas-Martínez, 1975; Rivas-Martínez *et al*., 2002), and are enriched by species that are markedly thermophile such as *Euphorbia dendroides*, *Asparagus albus*, *Chamaerops humilis*. On the whole, 11 associations were found, which are described below.

CLEMATIDO CIRRHOSAE-CRATAEGETUM MONOGYNAE Filigheddu, Farris, Bagella & Biondi 1999, Tab. 6, rel. 1-10.

These communities are dominated by *Crataegus monogyna* and *Rubus ulmifolius*, with *Prunus spinosa* and *Rosa sempervirens*, and develop mainly on colluvial soils at an average altitude of 480 m a.s.l., in the sub-humid meso-Mediterranean phytoclimatic belt. They constitute dense formations, 3 m high on average, with an average specific richness of 2.75 species10 m^{-2}. These are communities with a prevalence of phanerophytes (44.1%) and nanophanerophytes (27.4%), in which the steno-Mediterranean (35.3%) and Euro-Asiatic (32.3%) entities are practically equal. These shrubs are assigned to the *Clematido cirrhosae-Crataegetum monogynae* association, which has been described for the

Tab. 6 - *Clematido cirrhosae-Crataegetum monogynae* Filigheddu, Farris, Bagella & Biondi 1999

			1	2	3	4	5	6	7	8	9	10	Pres.
		Rel. no.	1	2	3	4	5	6	7	8	9	10	
		Coverage (%)	100	100	100	100	100	100	100	100	100	100	
		Area (m^2)	5	10	20	25	50	50	50	50	60	50	
		Exposure	0	0	0	NW	0	0	0	NNE	N	0	
		Slope (%)	0	0	0	5	0	0	0	5	10	0	
		Altitude (m asl)	730	730	200	600	400	340	400	500	550	340	
		Average vegetation height (m)	2	2	4	3	4	ND	4	2.5	2.5	ND	
		Substratum	5	5	9	9	5	11	5	12	12	11	
		No. of species	7	6	9	7	13	13	13	12	14	8	
		Charact. and diff. taxa of the ass.											
PALEOTEMP.	P caesp	*Crataegus monogyna* Jacq.	3.4	3.4	4.4	4.4	4.4	4.5	3.4	4.4	3.4	3.3	10
STENOMEDIT.	NP	*Rosa sempervirens* L.	.	.	2.3	2.3	3.3	2.3	1.3	1.3	2.3	.	7
STENOMEDIT.	P lian	*Clematis cirrhosa* L.	.	.	.	.	.	1.3	.	.	.	1.3	2
EURIMEDIT.	G rad	*Tamus communis* L.	.	.	.	.	+.2	.	+.2	.	.	.	2
		Charact. and diff. taxa of the upper units											
EURIMEDIT.	NP	*Rubus ulmifolius* Schott	2.3	4.4	1.2	1.2	2.3	2.3	1.2	2.2	2.2	2.3	10
EUROP.-CAUC.	P caesp	*Prunus spinosa* L.	.	.	1.2	+.2	2.3	2.2	1.2	1.2	1.2	.	7
EURASIAT.	P caesp	*Euonymus europaeus* L.	.	.	.	.	1.3	1.1	2.3	1.2	.	2.3	5
STENOMEDIT.	P caesp	*Pyrus spinosa* Forssk.	.	.	.	1.2	1.2	1.2	1.2	.	.	.	4
PALEOTEMP.	NP	*Rosa canina* L.	3.3	1.2	.	.	.	.	.	+.2	+.2	.	4
EUROP.-CAUC.	P lian	*Clematis vitalba* L.	.	.	.	.	.	.	.	+.2	1.2	.	2
		Charact. and diff. taxa of the *Quercetea ilicis* class											
STENOMEDIT.	G rhiz	*Asparagus acutifolius* L.	.	.	+	1.1	1.1	.	2.2	1.1	1.1	.	6
STENOMEDIT.	P lian	*Rubia peregrina* L.	.	.	.	.	+.2	+.2	1.2	+.2	1.2	.	5
SUBTROP.	NP	*Smilax aspera* L.	.	.	.	.	1.3	1.3	1.2	.	1.2	1.3	5
STENOMEDIT.	G rhiz	*Arisarum vulgare* Targ.-Tozz.	.	.	.	.	+	.	+	.	.	.	2
STENOMEDIT.	NP	*Euphorbia characias* L.	.	.	.	.	.	+	.	.	.	+.2	2
S-STENOMEDIT.	P caesp	*Pistacia lentiscus* L.	.	.	.	.	.	1.2	.	.	.	.	1
EURIMEDIT.	P caesp	*Rhamnus alaternus* L.	.	.	1.2	.	.	.	.	.	.	.	1
EURIMEDIT.	G rhiz	*Ruscus aculeatus* L.	.	.	.	+.2	.	.	.	.	.	.	1
STENOMEDIT.	P scap	*Quercus ilex* L.	.	.	.	.	.	+	.	.	.	.	1
		Charact. and diff. taxa of the *Querco-Fagetea* class											
EURIMEDIT.	P lian	*Hedera helix* L.	1.2	.	+.2	.	+.2	.	1.2	.	+.2	.	5
PALEOTEMP.	H caesp	*Brachypodium sylvaticum* (Hudson) Beauv.	+	1.2	.	.	.	.	.	.	.	.	2
MEDIT.ATL.(EURI)	H scap	*Oenanthe pimpinelloides* L.	.	.	.	.	.	.	.	1.1	+.2	.	2
EURIMEDIT.	H ros	*Viola alba* Besser ssp. *dehnhardtii* (Ten.) W. Becker	+	1.2	.	.	.	.	.	.	.	.	2
SE-EUROP.	P caesp	*Quercus pubescens* Willd.	.	.	.	.	.	.	.	.	.	+	1
		Other species											
COSMOPOL.	G rhiz	*Pteridium aquilinum* (L.) Kuhn	1.2	2.3	.	.	.	.	.	1.2	+	.	4
STENOMEDIT.	G rhiz	*Arum italicum* Miller	.	.	1.2	.	+.2	.	+.2	.	.	.	3
W-STENOMEDIT.	G bulb	*Allium triquetrum* L.	.	.	+	.	.	+	.	.	.	.	2
PALEOTEMP.	H scap	*Hypericum perforatum* L.	.	.	.	.	.	.	.	+	+	.	2
W-STENOMEDIT.	P caesp	*Cytisus villosus* Pourret	.	.	.	.	.	.	.	.	2.3	.	1
EURIMEDIT.	H caesp	*Carex divulsa* Stockes	.	.	.	.	.	.	.	.	.	r	1

sedimentary and alluvial substrata of the Sassarese (Filigheddu *et al.*, 1999), a zone bordering on the area of study. This association is a dynamic phase moving towards more evolved formations of *Pyrus spinosa* in the neutral-acidophile meso-Mediterranean series of *Ornithogalo pyrenaici-Querco ichnusae* sigmetum (Bacchetta *et al.*, 2004b).

CRATAEGO MONOGYNAE-PYRETUM AMYGDALIFORMIS Biondi, Farris & Filigheddu 2002, Tab. 7, rel. 11-31.
ROSETOSUM SEMPERVIRENTIS subass. nova typica hoc loco (typus rel. no. 7, Tab. 4 in Biondi *et al.*, 2002); *ROSETOSUM CANINAE* subass. nova hoc loco (typus rel. no. 22, Tab. 7).

This meso-hygrophilous community with *Pyrus spinosa*, *Rubus ulmifolius*, *Crataegus monogyna* and *Prunus spinosa*, is 3.8 m high on average, and constitutes a pre-forest type of vegetation. It develops mainly on Oligo-Miocene rhyolites (85.7%), at an average altitude of 491.4 (250-1100 m a.s.l.), with a prevailing northern aspect (40%). Average specific richness is 4.78 species10 m^{-2} and this is a community dominated by phanerophytes (50.9%) and nanophanerophytes (30.3%), with geophytes (13.7%) and hemicryptophytes (4.0%). The steno-Mediterranean and Euro-Asiatic species represent 48.6% and 29.1%, respectively, followed by those that are Euri-Mediterranean (16.0%), of wide distribution (5.7%), and endemic (0.6%). These spiny deciduous shrub communities are assigned to the *Crataego monogynae-Pyretum amygdaliformis* association that has been described for the alluvial plain of the Nurra (Biondi *et al.*, 2002). Two subassociations have been highlighted

Tab. 7 - *Crataego monogynae-Pyretum amygdaliformis* Biondi, Farris & Filigheddu 2002
rosetosum sempervirentis subass. nova (typus rel. no. 7, Tab. 4 in Biondi *et al* ., 2002)
rosetosum caninae subass. nova (typus rel. no. 22)

		Rel. no.	11	12	13	14	15	25	30	31	16	17	18	19	20	21	22*	23	24	26	27	28	29	Pres.
		Coverage (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	80	100	100	100	
		Area (m²)	5	20	20	15	15	18	40	20	4	30	20	12	10	25	30	12	30	10	10	10	10	
		Exposure	0	ND	ND	ND	N	ND	ESE	0	NE	E	E	E	S	NNE	SW	NE	SE	ND	N	N	ND	
		Slope (%)	0	ND	ND	ND	20	ND	0	0	25	5	5	10	5	10	5	5	<5	ND	ND	ND	ND	
		Altitude (m asl)	450	250	250	380	380	340	300	300	450	500	600	600	700	280	500	600	1100	620	550	550	620	
		Average vegetation height (m)	4	ND	ND	ND	ND	ND	4.5	3	5	3.5	3.5	3.5	3.5	3	3	3.5	5	4	4	4	ND	
		Substratum	11	11	11	11	11	11	11	11	11	11	11	11	5b	11	5b	11	52	11	11	11	11	
		No. of species	8	9	12	11	8	9	9	12	7	5	6	7	10	6	7	11	8	7	7	8	8	
		Charact. and diff. taxa of the ass.																						
STENOMEDIT.	P caesp	*Pyrus spinosa* Forssk.	3.4	4.5	4.5	3.4	3.4	4.5	3.4	3.4	4.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	4.5	21
PALEOTEMP.	P caesp	*Crataegus monogyna* Jacq.	1.2	2.3	1.2	2.3	1.2	1.2	.	+	.	.	.	+.2	3.3	2.3	1.2	1.2	2.3	1.2	1.2	2.3	1.2	17
		Diff. taxa of the *rosetosum sempervirentis* subass.																						
STENOMEDIT.	NP	*Rosa sempervirens* L.	3.3	2.3	2.3	1.3	2.3	1.3	+.2	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	8
STENOMEDIT.	P lian	*Lonicera implexa* Aiton	.	1.2	+.2	+.2	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	4
SUBTROP.	NP	*Smilax aspera* L.	.	1.2	1.3	1.3	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	4
STENOMEDIT.	P lian	*Clematis cirrhosa* L.	.	+.2	1.3	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
STENOMEDIT.	P lian	*Rubia peregrina* L.	.	.	.	.	+	+.2	.	1.3	.	.	.	.	.	.	.	.	.	.	.	.	.	3
STENOMEDIT.	P caesp	*Myrtus communis* L.	.	.	.	.	.	.	1.2	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	2
		Diff. taxa of the *rosetosum caninae* subass.																						
PALEOTEMP.	NP	*Rosa canina* L.	.	.	.	.	.	.	.	.	3.4	2.3	2.3	2.3	1.2	2.2	2.3	2.3	1.2	+.2	+.2	+.2	1.2	13
W-STENOMEDIT.	P caesp	*Cytisus villosus* Pourret	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	+.2	1.2	.	r	.	.	+.2	5
		Charact. and diff. taxa of the upper units																						
EURIMEDIT.	NP	*Rubus ulmifolius* Schott	2.2	3.3	3.3	2.3	2.3	2.3	3.3	3.3	2.2	3.4	3.3	2.3	2.3	2.3	2.3	3.3	2.3	2.3	2.3	2.3	2.3	21
EUROP.-CAUC.	P caesp	*Prunus spinosa* L.	2.3	2.2	1.2	.	.	.	2.3	.	1.2	2.3	2.3	2.3	1.3	1.3	1.2	.	.	+	+	+.2	+.2	15
EURASIAT.	P caesp	*Euonymus europaeus* L.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
EURIMEDIT.	G rad	*Tamus communis* L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	1
CW ASIAT.	P scap	*Malus pumila* Miller	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	1
		Charact. and diff. taxa of the *Quercetea ilicis* class																						
STENOMEDIT.	G rhiz	*Asparagus acutifolius* L.	.	1.2	+.2	1.2	1.1	+.2	.	+	.	1.2	+.2	+	1.2	+.2	.	.	.	.	.	+.2	.	12
W-MEDIT.(EURI)	P scap	*Quercus suber* L.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	r	.	.	+.2	3
STENOMEDIT.	P caesp	*Daphne gnidium* L.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+.2	.	.	.	.	.	2
STENOMEDIT.	NP	*Euphorbia characias* L.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
STENOMEDIT.	P caesp	*Calicotome spinosa* (L.) Link	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	1
S-STENOMEDIT.	P caesp	*Pistacia lentiscus* L.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
STENOMEDIT.	P scap	*Quercus ilex* L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	1
		Other species																						
COSMOPOL.	G rhiz	*Pteridium aquilinum* (L.) Kuhn	.	.	.	.	.	.	1.2	.	+	.	.	.	1.1	.	1.1	1.1	1.1	.	.	.	.	6
W-STENOMEDIT.	G bulb	*Allium triquetrum* L.	.	.	+.2	+.2	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	+.2	+	5
STENOMEDIT.	NP	*Cistus monspeliensis* L.	+	.	.	.	.	+.2	.	+.2	.	.	.	.	.	.	.	+.2	.	.	.	.	.	4
		Occasional species	1	0	1	1	1	2	2	2	1	0	1	0	0	0	0	1	2	0	2	1	0	

in this work. One of these is with myrtle (subass. *rosetosum sempervirentis*), that is more thermophile, of the upper thermo-Mediterranean and sub-humid lower meso-Mediterranean (sometimes upper dry) phytoclimatic belts, at an average altitude of 331.2 m a.s.l. (250-450 m a.s.l.), that corresponds to the type that has been described for the alluvial plain of the Nurra (Biondi *et al*., 2002). The subassociation *rosetosum caninae*, that is more mesophile, from the upper meso-Mediterranean to the upper meso-temperate belts, at an average altitude of 590 m a.s.l. (280-1100 m a.s.l.), is widespread on the volcanic plateaus of the internal areas. This association participates in the series of *Violo dehnhardtii-Querco suberis* sigmetum and of *Ornithogalo pyrenaici-Querco ichnusae* sigmetum (Bacchetta *et al.*, 2004a, 2004b).

These types of mantles or shrub groves, found in NW Sardinia, are often managed with fire. As a result of human intervention, in the cork-oak series there are isolated plants, such as *Quercus suber* and *Pyrus spinosa* trees: the result is a pastureland with cork-oak and wild pear trees (*dehesa*), which is very common in the landscape units of the volcanic plateaus.

CLEMATIDO VITALBAE-MALETUM PUMILAE ass. nova hoc loco (typus rel. no. 35, Tab. 8).

This association is exclusive to the area of Mt. S. Antonio (Macomer – Nu), where *Malus pumila* reaches notable densities.

The *Clematido vitalbae-Maletum pumilae* association constitutes the pre-forest community related to deciduous oak forests of the *Ornithogalo pyrenaici-Quercetum ichnusae ilicetosum aquifolii* subassociation (Bacchetta *et al.*, 2004b), usually at the margins of and clearings in woods. The presence of *Malus pumila* (*Malus pumila* Mill. = *Malus domestica* Borkh.: Heywood & Zohary, 1995) is characteristic – this species is of central-western origin and was introduced to Europe for cultivation, probably naturalised, in a period no later than the Medieval. In the area of St. Leonardo – Mt. S. Antonio (Santulussurgiu – Macomer) Cistercian monks managed a large wooded area, later named “Bosco della Commenda di San Leonardo” (Beccu, 2000). Alongside the dominating species are *Rubus ulmifolius*, *Crataegus monogyna*, *Prunus spinosa*, *Clematis vitalba*, *Rosa canina*, and *Pteridium aquilinum*. It is found on level zones of Plio-Pleistocene basalts, at average altitudes of 700 m a.s.l., in the semicontinental, upper sub-humid, upper meso-Mediterranean (up to upper meso-temperate) phytoclimatic belt. It is a deciduous pre-wood, 3.5 m high on average, with an average specific richness of 1.91 species10 m^{-2}. The phanerophytes compose 59.6%, the nanophanerophytes, 25.5% and the geophytes, 14.9%. The Euro-Asiatic species count for 66%, followed by those that are Euri-Mediterranean (19.1%), and of widespread distribution(12.8%),

Tab. 8 - *Clematido vitalbae-Maletum pumilae* ass. nova (typus rel. no. 35)

		Rel. no.	32	33	34	35*	36	37	Pres.
		Coverage (%)	100	100	100	100	100	100	
		Area (m^2)	50	50	50	40	30	25	
		Exposure	0	0	0	0	0	N	
		Slope (%)	0	0	0	0	0	0	
		Altitude (m asl)	650	650	650	750	750	750	
		Average vegetation height (m)	1.8	2.5	3.5	5	4	4	
		Substratum	5b	5b	5b	5b	5b	5b	
		No. of species	8	8	9	7	7	8	
		Charact. and diff. taxa of the ass.							
CW ASIAT.	P scap	*Malus pumila* Miller	3.4	3.4	3.3	4.4	4.4	3.4	6
EUROP.-CAUC.	P lian	*Clematis vitalba* L.	+.2	3.5	3.5	3.5	3.5	1.3	6
		Charact. and diff. taxa of the upper units							
PALEOTEMP.	NP	*Rosa canina* L.	1.2	3.3	1.2	2.3	1.2	1.2	6
EURIMEDIT.	NP	*Rubus ulmifolius* Schott	3.3	2.2	2.3	1.2	2.2	1.3	6
PALEOTEMP.	P caesp	*Crataegus monogyna* Jacq.	2.3	1.2	2.3	2.3	+	2.3	6
EUROP.-CAUC.	P caesp	*Prunus spinosa* L.	1.2	2.3	1.2	1.2	+	+.2	6
EURASIAT.	P caesp	*Euonymus europaeus* L.	.	2.3	.	.	.	.	1
		Other species							
COSMOPOL.	G rhiz	*Pteridium aquilinum* (L.) Kuhn	1.1	1.1	+	+	1.2	1.1	6
EURIMEDIT.	P lian	*Hedera helix* L.	.	.	+.2	.	.	1.2	2
STENOMEDIT.	P caesp	*Teline monspessulana* (L.) Koch	2.2	.	.	.	.	.	1
EURIMEDIT.	G rhiz	*Ruscus aculeatus* L.	.	.	+.2	.	.	.	1

while the steno-Mediterranean species constitute a very low percentage (2.1%).

CRATAEGO MONOGYNAE-ACERETUM MONSPESSULANI ass. nova hoc loco (typus rel. no. 49 Tab. 9).
GLECHOMETOSUM SARDOAE subass. nova typica hoc loco (typus rel. no. 49 Tab. 9);
PYRETOSUM SPINOSAE subass. nova hoc loco (typus rel. no. 40, Tab. 9);
SORBETOSUM TORMINALIS subass. nova hoc loco (typus rel. no. 41, Tab. 9).

The communities that can be referred to this association are deciduous pre-woods dominated by *Acer monspessulanum*, *Crataegus monogyna*, *Rubus ulmifolius* and *Rosa canina*. It is mainly found on Oligo-Miocene rhyolites, at an average altitude of 951.7 m a.s.l., (750-1050 m a.s.l.), in the upper meso-temperate and lower supratemperate (in the Sub-Mediterranean variant) humid phytoclimatic belts. In this community, that is 5 m high on average, with an average specific richness of 4.24 species 10 m^{-2}, the phanerophytes constitute 63.9%, the nanophanerophytes 24.5%, followed by the geophytes (7.1%) and the hemicryptophytes (4.5%).

The Euro-Asiatic species constitute 48.4%, those that are Euri-Mediterranean, 35.5%, followed by those that are steno-Mediterranean (8.4%), widespread (5.2%) and endemic species (2.6%).

As well as the typical sub-association (*glechometosum sardoae*), two other sub-associations were found: one which is edafo-xerophilous with wild pear (subass. *pyretosum spinosae*), at an average altitude of 960.2 m a.s.l., (750-1050 m a.s.l.); the other which is edafo-mesophilous with *Sorbus torminalis* (subass. *sorbetosum torminalis*), at an average altitude of 950 m a.s.l., (900-1050 m a.s.l.). This association is part of the *Glechomo sardoae-Querco congestae* sigmetum series (Bacchetta *et al*., 2004b).

This is widespread in Marghine, Planargia and Goceano, with a prevalence of temperate, Euri-Mediterranean and Euro-Asiatic deciduous phanerophytes, active in colonising clearings, abandoned pasturelands and also areas that have been hit by bushfires. Together with the preceding association with the grownwild apple tree, this is a shrub community of notable height, and can be defined as pre-wood, that is in serial contact with forest formations of deciduous oaks on trachytes and constitutes a peculiar formation, as it is of a central European type, in a context that is markedly Mediterranean.

LAVATERO OLBIAE-RUBETUM ULMIFOLII ass. nova hoc loco (typus rel. no. 65, Tab. 10).

This community is dominated by *Rubus ulmifolius*, *Lavatera olbia* and *Dorycnium rectum* and is found at an average altitude of 235 m a.s.l. (50-500 m a.s.l.), mainly on Oligo-Miocene and Plio-Pleistocene rhyolites, in the lower meso-Mediterranean (from upper thermo-Mediterranean to upper meso-Mediterranean) lower subhumid belts and with mainly western aspect (75%). These are thorny evergreen shrub groves, that are 1.9 m high and with a specific richness of 2.27 species10 m^{-2}, mainly with phanerophytes (40%), followed by emicriptophytes (26.7%), nanophanerophytes (17.8%), terophytes (8.9%), geophytes (4.4%) and camaephytes (2.2%). The most representative contingent is that of the steno-Mediterranean species (51.1%), followed by those that are Euri-Mediterranean (26.7%), Euro-Asiatic (6.7%), Mediterranean-Atlantic (6.7%), widespread (4.4%) and endemic (4.4%). These shrub communities are widespread in NW Sardinia and grow rapidly, displaying notable recovery capacities, and are often managed with fire. This association is found in the edafo-mesophilous and riparian series: *Allio triquetri-Ulmo minoris arisaretosum vulgaris* (Filigheddu *et al*., 1999) sigmetum and *Oenantho crocatae-Alno glutinosae* sigmetum (Arrigoni *et al*., 1996). On effusive substrata this association occupies a similar position to that of the *Vinco sardoae-Rubetum ulmifolii* association on alluvial substrata, described for the Nurra and Sassarese areas by Biondi *et al*. (2002).

VICIO TENUIFOLIAE-PRUNETUM SPINOSAE Filigheddu, Farris, Bagella & Biondi 1999 (Tab. 11).

The communities that can be related to this association are constituted by thorny deciduous shrub groves with *Prunus spinosa*, *Rubus ulmifolius* and *Vicia tenuifolia*, that are 2.3 m high on average, mainly found on Oligo-Miocene rhyolite substrata at an average altitude of 353.8 m a.s.l. (150-700 m a.s.l.), in the lower sub-humid lower meso-Mediterranean (upper thermo-Mediterranean – upper meso-Mediterranean) phytoclimatic belt; aspect is generally towards north (66.7%). The average specific richness is 2.34 species10 m^{-2}. These are communities with a prevalence of phanerophytes (29.2%), followed by nanophanerophytes (24.7%), hemicryptophytes (23.6%), geophytes (20.2%) and therophytes (2.2%). The Euro-Asiatic species constitute 33.7%, those that are steno-Mediterranean 30.3%, the Euri-Mediterranean 28.1%, followed by the Mediterranean-Atlantic (3.4%)

Tab. 9 - *Crataego monogynae-Aceretum monspessulani* ass. nova (typus rel. no. 49)
glechometosum sardoae subass. nova (typus rel. no. 49)
pyretosum spinosae subass. nova (typus rel. no. 40)
sorbetosum torminalis subass. nova (typus rel. no. 41)

			38	39	40*	43	44	45	46	50	42	49*	51	54	58	55	56	57	47	48	41*	52	53	P
		Rel. no.	38	39	40*	43	44	45	46	50	42	49*	51	54	58	55	56	57	47	48	41*	52	53	P
		Coverage (%)	100	100	90	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	r
		Area (m²)	15	20	30	30	30	20	20	15	20	20	30	30	20	20	30	20	25	30	25	20	30	e
		Exposure	ENE	0	SE	ND	0	0	ND	ENE	0	0	0	0	0	ND	ND	ND	0	0	S	0	0	s.
		Slope (%)	5	0	<5	ND	0	0	ND	5	0	0	0	0	0	ND	ND	ND	0	0	0	0	0	
		Altitude (m asl)	750	1035	1050	1030	1050	1020	1000	750	900	1000	900	1000	900	900	1030	900	900	1020	900	1050	900	
		Average vegetation height (m)	4.5	ND	4.5	ND	ND	ND	ND	4.5	6	6	5	5	4	ND	ND	5	5	4	6	ND	5	
		Substratum	11	11	52	11	11	11	11	11	11	11	11	11	11	11	11	11	11	5b	11	11	11	
		No. of species	9	8	11	5	5	5	8	9	6	8	7	7	5	9	7	7	6	8	9	9	7	
		Charact. and diff. taxa of the ass. and the subass. *glechometosum sardoae*																						
EURIMEDIT.	P caesp	*Acer monspessulanum* L.	3.4	3.4	3.4	3.4	3.4	3.4	4.4	4.4	3.4	4.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	5.5	3.4	3.4	21
PALEOTEMP.	P caesp	*Crataegus monogyna* Jacq.	2.3	3.3	2.3	2.3	1.2	1.2	1.2	2.3	2.3	+.2	1.2	1.2	1.2	+	+.2	.	1.2	1.2	1.2	1.2	2.3	20
ENDEM.	H rept	*Glechoma sardoa* Bég.	.	.	.	.	.	.	1.2	.	+.2	+.2	.	+.2	.	.	.	.	.	.	.	.	.	4
		Diff. taxa of the *pyretosum spinosae* subass.																						
STENOMEDIT.	P caesp	*Pyrus spinosa* Forssk.	+.2	1.1	1.2	+.2	1.2	1.2	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	8
		Diff. taxa of the *sorbetosum torminalis* subass.																						
PALEOTEMP.	P caesp	*Sorbus torminalis* (L.) Crantz	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	2.3	1.2	1.2	+	+	+	1.1	8
EURASIAT.	P scap	*Pyrus communis* L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	+	+	+	4
		Charact. and diff. taxa of the upper units																						
EURIMEDIT.	NP	*Rubus ulmifolius* Schott	2.2	1.2	1.3	1.2	1.2	2.3	1.2	1.3	1.2	2.3	.	.	2.3	1.2	1.2	2.3	2.2	3.4	2.2	1.2	1.2	19
PALEOTEMP.	NP	*Rosa canina* L.	1.2	1.2	+.2	+.2	1.2	+.2	+.2	1.2	.	1.2	2.3	1.2	+.2	+.2	+.2	+.2	.	+.2	+.2	2.3	2.3	19
EUROP.-CAUC.	P caesp	*Prunus spinosa* L.	1.3	1.1	+.2	.	.	.	.	+.2	.	.	+	.	.	.	1.2	.	+	.	.	+.2	+	9
EUROP.-CAUC.	P lian	*Clematis vitalba* L.	1.2	.	.	.	.	.	.	2.3	+.2	+.2	1.2	.	3.5	.	.	3.5	.	+.2	.	.	.	8
EUROP.-CAUC.	P caesp	*Sambucus nigra* L.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+.2	.	2
		Charact. and diff. taxa of the *Querco-Fagetea* class																						
EURIMEDIT.	P lian	*Hedera helix* L.	+.2	+	+	.	.	.	.	1.2	.	.	1.3	.	.	+.2	+.2	+.2	.	1.2	+.2	.	.	10
EURIMEDIT.	P caesp	*Ilex aquifolium* L.	.	.	+	.	.	.	.	.	.	+.2	.	.	.	1.2	.	.	.	.	.	.	.	3
S-EUROP.-SUDSIB.	P scap	*Fraxinus ornus* L.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	2
EUROSIB.	H scap	*Viola reichenbachiana* Jordan *ex* Boreau	.	+.2	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	2
EURASIAT.	G bulb	*Ranunculus ficaria* L.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
		Other species																						
COSMOPOL.	G rhiz	*Pteridium aquilinum* (L.) Kuhn	1.1	.	1.1	.	.	.	1.1	+	.	1.1	.	+.2	.	1.1	.	.	.	1.1	.	.	.	8
STENOMEDIT.	P lian	*Rubia peregrina* L.	.	.	.	.	.	.	.	.	.	.	.	1.3	.	.	.	+	.	.	+.2	.	.	3
EURIMEDIT.	G rhiz	*Sambucus ebulus* L.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	+.2	.	2
W-EURIMEDIT.	H scap	*Digitalis purpurea* L.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
STENOMEDIT.	P scap	*Quercus ilex* L.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1

Tab. 10 - *Lavatero olbiae-Rubetum ulmifolii* ass. nova (typus rel. no. 65)

			59	60	61	62	63	64	65*	66	Pres.
		Rel. no.	59	60	61	62	63	64	65*	66	P
		Coverage (%)	100	100	100	100	100	100	100	100	r
		Area (m²)	30	30	30	15	8	20	40	25	e
		Exposure	W	W	0	W	SW	W	0	NW	s.
		Slope (%)	5	5	0	5	5	5	0	30	
		Altitude (m asl)	150	150	50	500	150	430	300	150	
		Average vegetation height (m)	2	2	1.8	2	1.8	2	2	1.8	
		Substratum	11	11	11	5a	5b	5a	11	11	
		No. of species	6	6	6	5	3	5	5	9	
		Charact. and diff. taxa of the ass.									
EURIMEDIT.	NP	*Rubus ulmifolius* Schott	2.3	3.4	3.4	4.4	4.4	3.4	4.5	4.4	8
STENOMEDIT.	P caesp	*Lavatera olbia* L.	2.3	2.3	2.3	1.2	2.3	2.3	2.3	+.2	8
STENOMEDIT.	H scap	*Dorycnium rectum* (L.) Ser.	4.4	3.4	3.3	2.3	.	.	1.2	.	5
		Charact. and diff. taxa of the upper units									
EUROP.-CAUC.	P lian	*Clematis vitalba* L.	.	.	.	2.3	.	1.2	.	.	2
STENOMEDIT.	P caesp	*Pyrus spinosa* Forssk.	.	+	.	.	+	.	.	.	2
EUROP.-CAUC.	P caesp	*Prunus spinosa* L.	.	.	.	.	.	.	1.2	.	1
		Other species									
SUBATL.	H scap	*Oenanthe crocata* L.	.	.	1.3	.	.	1.2	1.1	.	3
EURIMEDIT.	T scap	*Vicia villosa* Roth	+.2	+.2	.	.	.	.	.	3.3	3
		Occasional species	2	1	2	1	0	1	0	6	

Tab. 11 - *Vicio tenuifoliae-Prunetum spinosae* Filigheddu, Farris, Bagella & Biondi 1999

		Rel. no.	67	68	69	70	71	72	73	74	75	76	77	78	79	P
		Coverage (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	r
		Area (m²)	100	30	30	30	10	30	30	30	15	10	15	20	30	e
		Exposure	N	N	NW	NW	ND	ND	ND	ND	ND	0	ND	0	ND	s.
		Slope (%)	ND	10	0	0	ND	ND	ND	ND	ND	0	ND	0	ND	
		Altitude (m asl)	150	200	450	450	340	330	330	340	340	300	340	700	330	
		Average vegetation height (m)	2.5	2.5	3	3	1.5	ND	2.5	ND	ND	3	1.5	2	2	
		Substratum	9	9	11	11	11	11	11	11	11	11	11	5b	11	
		No. of species	11	7	5	6	8	6	7	4	6	7	7	9	6	
		Charact. and diff. taxa of the ass.														
EUROP.-CAUC.	P caesp	*Prunus spinosa* L.	4.4	4.4	5.5	5.5	4.5	4.4	5.5	4.5	4.4	4.4	4.4	4.4	3.4	13
EURASIAT.	H scap	*Vicia tenuifolia* Roth	1.1	1.1	.	.	2.3	2.3	1.1	1.2	2.3	.	1.2	.	+.2	9
		Charact. and diff. taxa of the upper units														
EURIMEDIT.	NP	*Rubus ulmifolius* Schott	2.2	1.2	1.2	2.3	2.2	2.2	+.2	+.2	+.2	2.3	2.3	2.2	+.2	13
EURIMEDIT.	G rad	*Tamus communis* L.	.	.	.	.	+.2	1.2	.	.	.	1.3	1.3	.	.	4
EUROP.-CAUC.	P lian	*Clematis vitalba* L.	.	2.2	.	.	.	.	.	.	.	.	.	.	.	1
PALEOTEMP.	P caesp	*Crataegus monogyna* Jacq.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	1
PONTICO	P scap	*Prunus avium* L.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	1
ND	P scap	*Prunus domestica* L.	.	.	.	+	.	.	.	.	.	.	.	.	.	1
STENOMEDIT.	P caesp	*Pyrus spinosa* Forssk.	+	.	.	.	.	.	.	.	.	.	.	.	.	1
PALEOTEMP.	NP	*Rosa canina* L.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	1
		Charact. and diff. taxa of the *Quercetea ilicis* class														
STENOMEDIT.	NP	*Rosa sempervirens* L.	2.3	1.2	.	.	.	.	.	.	2.3	3.3	3.3	.	.	5
STENOMEDIT.	G rhiz	*Asparagus acutifolius* L.	1.1	.	.	.	+.2	.	1.2	+	.	.	.	.	.	4
SUBTROP.	NP	*Smilax aspera* L.	.	.	.	.	.	.	.	.	+	1.3	1.3	.	.	3
STENOMEDIT.	P lian	*Rubia peregrina* L.	.	.	.	.	.	+.2	.	.	.	.	.	+	1.1	3
STENOMEDIT.	P caesp	*Myrtus communis* L.	.	.	.	.	.	.	.	.	.	2.2	.	.	.	1
		Other species														
W-STENOMEDIT.	G bulb	*Allium triquetrum* L.	3.3	2.2	.	.	.	+	1.2	.	.	.	.	+.2	.	5
STENOMEDIT.	G rhiz	*Arum italicum* Miller	1.2	1.2	.	.	.	.	.	.	.	.	.	1.3	.	3
EURIMEDIT.	H caesp	*Carex divulsa* Stockes	.	.	.	.	+.2	.	+	.	+	.	.	.	.	3
		Occasional species	3	0	3	3	2	0	1	0	0	1	1	1	2	

and widespread distribution species (3.4%).

These hedges, or shrub groves, located in NW Sardinia, are often managed with fire. The series is often blocked, while in some sites it is found to be in serial contact with elm *(Allio triquetri-Ulmo minoris arisaretosum vulgaris* sigmetum, Filigheddu *et al.*, 1999) and white poplar woods.

ERICO ARBOREAE-ARBUTETUM UNEDONIS Allier & Lacoste 1980 ex Foggi in Foggi & Grigioni 1999 (Tab. 12);

PHILLYREETOSUM LATIFOLIAE (Allier & Lacoste 1980) Foggi & Grigioni 1999;

ILICETOSUM AQUIFOLII subass. nova hoc loco (typus rel. no. 89, Tab. 12).

Tab. 12 - *Erico arboreae-Arbutetum unedonis* Molinier 1937
phillyreetosum latifoliae (Allier & Lacoste 1980) Foggi & Grigioni 1999
ilicetosum aquifolii subass. nova (typus rel. no. 89)

		Rel. no.	80	81	82	83	84	85	86	87	88	89*	90	91	92	Pres.
		Coverage (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	
		Area (m^2)	60	100	50	50	30	50	20	50	100	50	50	50	50	
		Exposure	NE	0	ESE	0	NW	NNW	0	NNW	0	NW	NW	SE	NW	
		Slope (%)	5	0	5	0	30	5	0	15	0	15	15	20	15	
		Altitude (m asl)	300	250	350	250	200	300	400	400	680	700	800	750	750	
		Average vegetation height (m)	3	2	2.5	2.5	3	2.5	3	2.5	2.5	3	3	2.5	3	
		Substratum	11	11	11	11	11	11	11	5a	11	5a	5a	5a	5a	
		No. of species	13	18	14	12	9	16	10	13	10	13	13	12	14	
		Charact. and diff. taxa of the ass.														
STENOMEDIT.	P caesp	*Arbutus unedo* L.	4.5	3.4	4.5	3.4	3.4	3.4	3.4	3.4	3.4	4.4	4.4	3.4	3.4	13
STENOMEDIT.	P caesp	*Erica arborea* L.	3.4	3.3	2.3	3.3	3.3	4.5	2.3	2.3	2.3	2.3	1.2	3.3	2.3	13
		Diff. taxa of the *phillyreetosum latifoliae* subass.														
STENOMEDIT.	P caesp	*Calicotome spinosa* (L.) Link	2.2	2.2	1.2	2.3	1.2	1.2	1.2	.	1.2	.	.	.	.	8
STENOMEDIT.	P lian	*Lonicera implexa* Aiton	1.1	.	.	+.2	1.3	+.2	1.2	+.2	+.2	.	.	.	.	7
STENOMEDIT.	P caesp	*Myrtus communis* L.	3.3	1.2	2.3	1.2	2.3	2.3	.	.	.	.	.	.	.	6
S-STENOMEDIT.	P caesp	*Pistacia lentiscus* L.	1.2	.	+.2	+.2	1.2	+.2	+	.	.	.	.	.	.	6
EURIMEDIT.	H scap	*Pulicaria odora* (L.) Rchb.	1.2	1.2	1.2	1.2	.	+.2	.	1.2	.	.	.	.	.	6
STENOMEDIT.	P caesp	*Phillyrea latifolia* L.	.	.	+.2	.	.	.	1.1	2.3	.	.	.	.	.	3
W-STENOMEDIT.	P caesp	*Phillyrea angustifolia* L.	.	+	.	.	.	.	.	.	1.1	.	.	.	.	2
STENOMEDIT.	P caesp	*Calicotome villosa* (Poiret) Link	.	.	.	.	.	.	.	+	.	.	.	.	.	1
		Diff. taxa of the *ilicetosum aquifolii* subass.														
EURIMEDIT.	P caesp	*Ilex aquifolium* L.	.	.	.	.	.	.	.	.	.	1.2	2.3	1.2	2.2	4
EUROP.-CAUC.	P lian	*Clematis vitalba* L.	.	.	.	.	.	.	.	.	.	1.3	+.2	2.3	1.2	4
PALEOTEMP.	P caesp	*Crataegus monogyna* Jacq.	.	.	.	.	.	.	.	.	.	1.2	+.2	+	1.2	4
COSMOPOL.	G rhiz	*Pteridium aquilinum* (L.) Kuhn	.	.	.	.	.	.	.	.	.	1.1	1.1	1.2	+	4
EURIMEDIT.	P lian	*Hedera helix* L.	.	.	.	.	.	.	.	.	.	+.2	+	.	1.2	3
		Charact. and diff. taxa of the *Quercetea ilicis* class														
STENOMEDIT.	P lian	*Rubia peregrina* L.	1.1	.	+.2	.	+.2	.	+.2	.	.	.	.	.	.	4
SUBTROP.	NP	*Smilax aspera* L.	.	+	.	.	1.3	+.2	.	+	.	.	.	.	.	4
STENOMEDIT.	P caesp	*Daphne gnidium* L.	.	+	.	.	.	+	.	.	+.2	.	.	.	.	3
STENOMEDIT.	G rhiz	*Arisarum vulgare* Targ.-Tozz.	2.2	.	.	.	.	.	.	.	.	.	.	.	.	1
STENOMEDIT.	G rhiz	*Asparagus acutifolius* L.	.	.	.	.	.	+	.	.	.	.	.	.	.	1
		Charact. and diff. taxa of the *Pistacio lentisci-Rhamnetalia alaterni* order														
STENOMEDIT.	NP	*Euphorbia characias* L.	.	.	.	.	.	.	.	+	.	.	.	.	.	1
		Charact. and diff. taxa of the *Quercion ilicis* all., *Quercetalia ilicis* order														
STENOMEDIT.	P scap	*Quercus ilex* L.	.	.	1.2	.	+	.	.	1.1	.	1.1	1.1	+.2	+.2	7
W-MEDIT.(EURI)	P scap	*Quercus suber* L.	2.2	1.1	.	+	.	1.1	1.1	.	1.1	.	.	.	.	6
STENOMEDIT.	NP	*Rosa sempervirens* L.	.	.	.	.	.	.	+.2	.	.	+.2	1.2	+.2	1.2	5
NW-STENOMEDIT.	G bulb	*Cyclamen repandum* S. *et* S.	.	.	.	.	.	.	.	+.2	.	1.2	1.2	.	+.2	4
W-STENOMEDIT.	H scap	*Galium scabrum* L.	.	.	.	.	.	.	.	.	.	+	+.2	.	.	2
EURIMEDIT.	G rhiz	*Ruscus aculeatus* L.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	1
		Other species														
W-STENOMEDIT.	P caesp	*Cytisus villosus* Pourret	.	1.2	.	.	.	.	+.2	+	.	1.2	1.2	2.3	+.2	7
EURIMEDIT.	NP	*Rubus ulmifolius* Schott	.	.	1.2	.	.	+.2	.	.	.	1.2	1.2	1.2	+.2	6
STENOMEDIT.	NP	*Cistus monspeliensis* L.	1.2	1.2	1.2	1.2	.	+.2	.	.	.	.	.	.	.	5
STENOMEDIT.	P caesp	*Pyrus spinosa* Forssk.	.	+	+	1.2	.	+	.	.	.	.	.	.	+	5
EURIMEDIT.	G rad	*Tamus communis* L.	.	.	+	+.2	.	+.2	.	+	.	.	.	.	.	4
STENOMEDIT.	Ch rept	*Selaginella denticulata* (L.) Link	.	.	.	1.2	.	.	.	.	.	.	.	.	.	1
		Occasional species	2	6	1	0	0	1	0	0	3	0	0	2	1	

The evergreen shrub groves with *Arbutus unedo*, *Erica arborea*, *Calicotome spinosa*, *Lonicera implexa*, *Quercus ilex* and *Cytisus villosus* are found on Oligo-Miocene (61.5%) and Plio-Pleistocene (38.5%) rhyolites at an average altitude of 471.5 m a.s.l. (200-800 m a.s.l.) and with a prevailing NW aspect (46.1%). The average height of the vegetation is 2.7 m, with an average specific richness of 2.35 species10 m^{-2}. It is a community with a prevalence of phanerophytes (65.3%), followed by nanophanerophytes (16.8%), geophytes (10.8%), emicriptophytes (6.6%) and chamaephytes (0.6%). Synchorological analysis displays a clear prevalence of steno-Mediterranean species (74.2% of which 15.6% are W-Mediterranean), with respect to the Euri-Mediterranean (14.4%), Euro-Asiatic (6.6%) and widespread distribution species (4.8%).

Two subassociations have been identified: the *ilicetosum aquifolii*, which is mesophile of the upper subhumid meso-Mediterranean belt (sometimes upper meso-temperate), at an average altitude of 750 m a.s.l. (700-800 m a.s.l.); the typical subassociation *phillyreetosum latifoliae* is found in the lower subhumid (upper dry) lower meso-Mediterranean belt at an average altitude of 347.8 m a.s.l. (200-680 m a.s.l.).

This association is part of the evergreen series *Galio scabri-Querco ilicis*, *Prasio majoris-Querco ilicis* and *Violo dehnhardtii-Querco suberis* sigmeta (Bacchetta *et al*., 2004a). These are evolved forms of maquis that develop after bushfires, widespread in the western Mediterranean, with notable capacities of evolving into forests, often liable to further bushfires, tillage for agricultural purposes and reforestation.

This association is the dominant aspect of the vegetation landscape of the meso-Mediterranean landscape unit on rhyolite slopes and plateaus, where it is, however, limited to the meso-Mediterranean phytoclimatic belt with rare penetration into the upper thermo-Mediterranean for edaphic compensation. The *ilicetosum aquifolii* subassociation constitutes a peculiar floristic combination, given by the interaction between Mediterranean and mesophile temperate elements.

As described in detail by Foggi *et al.* (2006), Molinier (1937) described this maquis with *Arbutus unedo* and *Erica arborea*, denominated *Erico-Arbutetum* by Allier & Lacoste (1980) but not typified. The typification of the name *Erico-Arbutetum* Allier & Lacoste with a survey of the subassociation *phillyreetosum latifoliae*, that hence becomes the typical subassociation, was carried out by Foggi & Grigioni (1999).

The subassociation *ilicetosum aquifolii*, mesophile of the upper meso-Mediterranean belt in contact with the temperate bioclimate, is hereby established.

GENISTO DESOLEANAE-ERICETUM ARBOREAE ass. nova hoc loco (typus rel. no. 96 Tab. 13).

The evergreen shrub community composed of *Erica arborea*, *Genista desoleana*, *Crataegus monogyna*, *Rubus ulmifolius* and *Rosa serafini* is found on the Plio-Pleistocene rhyolite substrata of Montiferru and Goceano, at an average altitude of 875 m a.s.l. (800-950 m a.s.l.), in the lower humid, upper meso-temperate

Tab. 13 - *Genisto desoleanae-Ericetum arboreae* ass. nova (typus rel. no. 96)

		Rel. no.	93	94	95	96*	97	98	99	100	101	102	Pres.
		Coverage (%)	100	100	100	100	100	100	100	100	90	90	
		Area (m^2)	30	30	50	50	50	50	50	50	30	30	
		Exposure	NW	NW	NE	NE	SSW	SSW	NE	NE	W	W	
		Slope (%)	5	5	<5	<5	<5	<5	<5	<5	5	5	
		Altitude (m asl)	800	800	950	950	800	800	950	950	850	900	
		Average vegetation height (m)	1.2	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	
		Substratum	5a	5a	5a	5a	5a	5a	5a	5a	5a	5a	
		No. of species	7	9	10	9	9	11	11	10	8	9	
		Charact. and diff. taxa of the ass.											
STENOMEDIT.	P caesp	*Erica arborea* L.	3.3	2.3	3.4	3.4	3.4	3.4	3.4	4.4	2.3	3.4	10
NW-STENOMEDIT.	NP	*Genista desoleana* Vals.	2.3	2.3	3.3	2.3	1.2	1.2	1.2	1.2	3.4	2.3	10
MEDIT.-MONT.	NP	*Rosa serafini* Viv.	.	+	.	.	+	.	+	.	1.2	1.1	5
		Charact. and diff. taxa of the upper units											
STENOMEDIT.	P caesp	*Daphne gnidium* L.	+	+	+	+	+	+.2	+	+	.	.	8
STENOMEDIT.	P scap	*Quercus ilex* L.	.	.	+.2	+.2	+	+	+.2	1.1	.	.	6
STENOMEDIT.	P caesp	*Arbutus unedo* L.	.	.	.	.	.	+.2	.	.	.	+.2	2
		Other species											
STENOMEDIT.	P caesp	*Teline monspessulana* (L.) Koch	2.2	1.2	1.2	2.2	2.3	2.3	2.3	2.2	+.2	+	10
EURIMEDIT.	NP	*Rubus ulmifolius* Schott	1.2	1.2	+.2	+	+.2	+.2	+.2	1.2	1.2	+.2	10
PALEOTEMP.	P caesp	*Crataegus monogyna* Jacq.	3.4	3.4	+	+	+.2	+	+	+.2	.	.	8
STENOMEDIT.	NP	*Cistus salvifolius* L.	3.3	1.2	+.2	+.2	.	.	1.2	+.2	1.2	1.2	8
		Occasional species	0	2	1	0	1	2	2	1	2	2	

(sub-Mediterranean variant) phytoclimatic belt, with prevailingly western aspect (60%). This plant community, that is 1.2 m high on average, with a specific richness of 2.21 species10 m^{-2}, has a prevalence of phanerophytes (52.7%), followed by nanophanerophytes (36.6%), geophytes (6.4%), hemicryptophytes (2.1%) and chamaephytes (2.1%). The steno-Mediterranean species constitute the highest percentage (65.6%, of which 14% are W-Mediterranean) compared to those that are Euri-Mediterranean (12.9%), Euro-Asiatic (10.7%), of widespread diffusion (6.4%) and endemic (4.3%). This association is part of the *Saniculo europaeae-Querco ilicis* sigmetum series of Montiferru and Goceano (Bacchetta *et al.*, 2004a), where it constitutes post-bushfire maquis with notable capacities to evolve, and is often liable to further bushfires or tillage for mechanised reforestation (Sardinian Regional forest holding of Sos Pabariles, Santulussurgiu – OR).

This association dominates the vegetation landscape of the summit zones of Montiferru, that were hit by devastating bushfires in the summers of 1983 and 1994. It substitutes the potential holm-oak forest vegetation but its capacity to evolve and re-colonise eroded ground that has been hit by fire is not always understood by the land managers: rather than using species that participate in this association, debatable mechanised reforestation with the use of allochthonous species (*Pinus* sp. pl., *Acer* sp. pl., *Genista aetnensis*) is often preferred, especially in forest areas. The dominance of these broadleaf tree species (*Erica arborea* and *Genista desoleana*) in this type of shrub grove is the result of several ecological factors. In particular *G. desoleana* is part of a group (Valsecchi, 1993) in which apomixis (Diana & Villa, 1991) also exists as a reproductive strategy – a possible reply to selective environments (Nogler, 1984). In this case, we are dealing with windy sites, which are cold in winter with frequent appearance of ice, even in the soil.

TELINO MONSPESSULANAE-CYTISETUM VILLOSI ass. nova hoc loco (typus rel. no. 127 Tab. 14).
CYTISETOSUM VILLOSI subass. nova typica hoc loco (typus rel. no. 127 Tab. 14);
CALICOTOMETOSUM SPINOSAE subass. nova hoc loco (typus rel. no. 119, Tab. 14);
CALICOTOMETOSUM VILLOSAE subass. nova hoc loco (typus rel. no. 114, Tab. 14);

The evergreen shrub grove with *Cytisus villosus*, *Rubus ulmifolius*, *Teline monspessulana* and *Pyrus spinosa*, is found on Oligo-Miocene rhyolites (55.5%) and Plio-Pleistocene basalts (37.0%), at an average altitude of 529.3 m a.s.l. (300-800 m a.s.l.), in the upper subhumid upper meso-Mediterranean belt, with prevailingly eastern aspect (68.4%).

Despite the low number of characteristic species of the upper syntaxonomic units, the prevalence in frequency and cover of *Cytisus villosus* and *Teline monspessulana* within this community, allowed us to assign it to the *Cytisetea scopario-striati* class.

This vegetation community, 2 m high on average, with an average specific richness of 1.97 species10 m^{-2}, has a prevalence of phanerophytes (55.1%) and nanophanerophytes (25.5%), followed by geophytes (14.5%), hemicryptophytes (4.8%) and camaephytes (0.4%). From synchorological analysis a clear prevalence of steno-Mediterranean species (66.8% of which 17.4% are W-Mediterranean) can be seen, in comparison to those that are Euri-Mediterranean (12.5%), Euro-Asiatic (11.3%), of widespread distribution (7.3%), Mediterranean-Atlantic (0.8%), endemic (0.8%) and Mediterranean-mountainous (0.4%).

The two subassociations with *Calicotome* sp. are the most thermophile aspects of the association: the first, *calicotometosum villosae* subassociation, is found on Plio-Pleistocene basalts at an average altitude of 582.2 m a.s.l. (300-800 m a.s.l.); the second, *calicotometosum spinosae* subassociation, is found on Oligo-Miocene rhyolites, at an average altitude of 560 m a.s.l. (550-600 m a.s.l.). The typical subass. *Cytisetosum villosi* is therefore described.

This association is part of the series *Galio scabri-Querco ilicis*, *Violo dehnhardtii-Querco suberis* and *Ornithogalo pyrenaici-Querco ichnusae* sigmeta of NW Sardinia (Bacchetta *et al.*, 2004a, 2004b), where it constitutes post-bushfire maquis with notable capacities of evolving into forest. It substitutes the potential holm-oak, cork-oak and deciduous oak vegetation on effusive substrata of the upper meso-Mediterranean phytoclimatic belt, with possible penetration into the lower meso-Mediterranean and upper meso-temperate. In comparison to the association *Erico arboreae-Arbutetum unedonis*, with which it often establishes dynamic contact, it constitutes a less evolved stage. It also often establishes serial contact with other mantle and pre-forest communities included in the cork-oak and deciduous oak series, where it is the true pioneer association for recovery, being able to colonise vast areas very quickly.

CALICOTOMO-MYRTETUM Guinochet in Guinochet & Drouineau 1944 em. O. Bolòs 1962 (Tab. 15).

Tab. 14 - *Telino monspessulanae -Cytisetum villosi* ass. nova (typus rel. no. 127)
cytisetosum villosi subass. nova (typus ril. n. 127)
calicotometosum spinosae subass. nova (typus rel. no. 119)
calicotometosum villosae subass. nova (typus rel. no. 114)

		Rel. no.	103	104	105	106	107	117	125	126	127*	116	112	113	108	118	119*	120	121	122	123	124	128	129	109	110	111	114*	115	Pres.
		Coverage (%)	100	100	100	100	100	100	100	100	90	100	100	100	100	90	90	100	100	100	90	100	90	100	100	100	100	100	100	
		Area (m²)	80	80	50	100	30	80	20	30	30	50	50	50	50	25	30	50	60	50	50	80	30	30	25	30	30	30	30	
		Exposure	NE	SW	NE	SE	SE	ND	0	E	E	ND	ND	ND	ND	SW	SW	ND	ND	ENE	W	ND	NNE	SE	SE	SE	W	SSE	SSE	
		Slope (%)	10	5	10	5	10	ND	0	5	30	ND	ND	ND	ND	20	10	ND	ND	5	25	ND	15	10	25	25	<5	5	5	
		Altitude (m asl)	550	550	700	800	650	300	500	490	700	650	300	320	630	450	400	660	550	550	420	320	500	500	600	550	550	550	550	
		Average vegetation height (m)	2	2	3	2	2.5	ND	2.5	2	1	ND	ND	ND	ND	2	1.8	ND	1.8	1.5	1.5	ND	2	2	2.5	2.5	1.5	2.2	2.2	
		Substratum	5b	5b	5b	5b	5a	11	11	12	5b	11	11	11	11	11	11	11	11	11	11	11	11	11	5b	5b	5b	5b	5b	
		No. of species	19	16	8	6	8	10	12	7	7	9	7	7	9	7	12	8	11	7	8	11	7	9	9	10	6	8	9	
		Charact. and diff. taxa of the ass. and the *cytisetosum villosi* subass.																												
W-STENOMEDIT.	P caesp	*Cytisus villosus* Pourret	5.5	4.5	4.4	5.5	5.5	3.3	1.2	1.2	2.3	4.4	4.4	4.4	4.5	3.4	4.5	4.5	3.3	1.2	2.3	2.3	2.3	1.2	4.4	4.4	4.5	4.5	4.5	27
STENOMEDIT.	P caesp	*Teline monspessulana* (L.) Koch	.	.	.	.	+.2	.	4.5	4.4	3.4	2.3	1.2	2.3	+.2	1.2	+	+.2	.	+	.	.	3.4	2.3	1.2	1.2	1.2	2.3	2.3	19
COSMOPOL.	G rhiz	*Pteridium aquilinum* (L.) Kuhn	.	.	.	1.2	.	.	1.1	1.2	2.2	.	.	.	.	.	1.1	.	.	1.2	1.1	.	1.1	2.2	.	.	.	1.1	1.1	11
		Diff. taxa of the *calicotometosum spinosae* subass.																												
STENOMEDIT.	P caesp	*Calicotome spinosa* (L.) Link	.	.	.	.	.	.	.	.	.	1.2	+.2	+.2	1.2	2.3	2.3	1.2	2.3	3.4	3.4	3.3	1.2	3.3	.	.	.	.	.	13
		Diff. taxa of the *calicotometosum villosae* subass.																												
STENOMEDIT.	P caesp	*Calicotome villosa* (Poiret) Link	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.3	1.2	+	1.2	1.2	5
		Charact. and diff. taxa of the *Quercetea ilicis* class																												
STENOMEDIT.	NP	*Rosa sempervirens* L.	.	1.2	.	.	.	.	2.3	+.2	.	.	.	.	.	+	.	.	.	.	+.2	.	+.2	3.5	+	+	.	.	.	9
STENOMEDIT.	P caesp	*Erica arborea* L.	.	.	+.2	.	.	.	.	.	.	.	.	+.2	.	.	.	1.2	.	.	+.2	+	.	.	1.2	1.1	.	+	+.2	9
STENOMEDIT.	G rhiz	*Asparagus acutifolius* L.	1.1	1.1	.	.	.	1.2	.	.	+	1.2	+.2	.	.	.	+	.	1.1	.	.	.	.	.	.	.	.	.	.	8
W-MEDIT.(EURI)	P scap	*Quercus suber* L.	+	1.2	.	.	.	r	+	.	.	.	+	.	.	.	.	+.2	.	.	.	+	.	.	.	.	.	.	.	7
STENOMEDIT.	P caesp	*Arbutus unedo* L.	.	1.2	1.2	.	1.2	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	1.1	+	.	.	+.2	7
SUBTROP.	NP	*Smilax aspera* L.	1.3	1.2	.	.	+.2	+	1.2	.	.	.	.	.	.	.	+.2	.	+	.	.	.	.	.	.	.	.	.	.	7
STENOMEDIT.	NP	*Euphorbia characias* L.	1.2	.	.	.	+.2	.	.	.	.	.	+	.	1.2	.	.	.	.	.	.	+.2	.	.	.	+.2	+.2	.	.	7
EURIMEDIT.	H scap	*Pulicaria odora* (L.) Rchb.	+.2	+	.	.	.	r	.	.	.	+	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	5
NW-STENOMEDIT.	G bulb	*Cyclamen repandum* S. *et* S.	1.3	1.2	2.2	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	4
STENOMEDIT.	P scap	*Quercus ilex* L.	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
STENOMEDIT.	P caesp	*Daphne gnidium* L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	+	+.2	.	3
STENOMEDIT.	H caesp	*Carex distachya* Desf.	+.2	.	.	.	.	.	.	.	.	.	.	.	r	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	3
STENOMEDIT.	P lian	*Lonicera implexa* Aiton	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	2
S-STENOMEDIT.	P caesp	*Pistacia lentiscus* L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	+.2	.	.	.	.	.	.	.	.	2
EURIMEDIT.	G rhiz	*Ruscus aculeatus* L.	.	.	.	.	.	+.2	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
STENOMEDIT.	P lian	*Clematis cirrhosa* L.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
		Charact. and diff. taxa of the *Querco-Fagetea* class																												
SE-EUROP.	P caesp	*Quercus pubescens* Willd.	+	+	.	.	.	.	.	+	.	r	.	+.2	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	8
MEDIT.ATL.(EURI)	H scap	*Oenanthe pimpinelloides* L.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	2
ENDEM.	G rhiz	*Paeonia morisii* Cesca, Bernardo et Passalacqua	.	.	.	.	.	.	.	.	.	+.2	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
EURASIAT.	P scap	*Pyrus communis* L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	1
		Charact. and diff. taxa of the *Rhamno-Prunetea* class																												
EURIMEDIT.	NP	*Rubus ulmifolius* Schott	2.2	1.2	2.2	1.2	1.2	.	2.2	2.3	1.2	.	.	.	2.3	+.2	+.2	.	.	+.2	+.2	.	1.2	1.2	1.2	2.3	+.2	+.2	+.2	20
STENOMEDIT.	P caesp	*Pyrus spinosa* Forssk.	+	+	.	+.2	.	.	.	.	+	.	.	+	.	+.2	.	.	1.1	+.2	1.2	+	.	+.2	+	+	.	+	+	15
PALEOTEMP.	P caesp	*Crataegus monogyna* Jacq.	+	.	+	+.2	.	+.2	+.2	.	.	+	.	.	.	.	.	.	.	+.2	.	.	+.2	.	.	+	.	.	+	10
PALEOTEMP.	NP	*Rosa canina* L.	2.3	.	.	2.3	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	+.2	.	.	.	.	.	4
EURIMEDIT.	G rad	*Tamus communis* L.	+.2	+.2	.	.	.	.	1.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
EUROP.-CAUC.	P lian	*Clematis vitalba* L.	.	.	1.3	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
EUROP.-CAUC.	P caesp	*Prunus spinosa* L.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
		Charact. and diff. taxa of the *Cisto-Lavanduletea* class																												
STENOMEDIT.	NP	*Cistus monspeliensis* L.	.	.	.	.	.	+.2	1.2	1.2	.	.	.	.	+.2	1.2	1.2	r	1.2	.	.	1.3	.	1.2	.	.	.	.	.	10
STENOMEDIT.	NP	*Cistus salvifolius* L.	.	+.2	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	+.2	.	.	1.2	.	.	.	.	4
STENOMEDIT.	NP	*Lavandula stoechas* L.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
		Occasional species	2	1	1	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	

Tab. 15 - *Calicotomo-Myrtetum* Guinochet *in* Guinochet & Drouineau 1944 *em* . O. Bolòs 1962
myrtetosum communis O. Bolòs 1962
chamaeropetosum humilis O. Bolòs 1962

		Rel. no.	132	133	134	135	136	137	138	139	140	141	142	143	130	131	P
		Coverage (%)	100	100	100	100	100	100	90	100	90	100	100	100	100	100	r
		Area (m²)	50	50	30	30	50	40	60	50	60	50	40	30	100	40	e
		Exposure	NNW	0	0	0	0	NE	NW	NW	NW	NW	NW	W	SE	ND	s.
		Slope (%)	5	0	0	0	0	10	30	15	30	30	30	0	5	ND	
		Altitude (m asl)	300	200	480	480	480	150	150	150	150	200	200	200	50	50	
		Average vegetation height (m)	1.5	1.5	1.2	1.2	2.5	1.5	1.8	1.5	1.8	2	2	2.5	2	2.5	
		Substratum	11	11	11	11	11	11	11	11	11	11	11	11	11	11	
		No. of species	10	7	9	7	10	10	10	11	13	12	12	11	22	14	
		Charact. and diff. taxa of the ass. and the *myrtetosum communis* subass.															
STENOMEDIT.	P caesp	*Calicotome spinosa* (L.) Link	2.3	1.2	2.3	1.2	1.2	4.4	3.3	4.5	3.4	4.4	4.5	2.3	2.2	1.2	14
STENOMEDIT.	P caesp	*Myrtus communis* L.	3.4	4.5	3.4	4.4	4.5	1.2	.	.	.	1.2	1.2	2.3	3.3	3.4	11
S-STENOMEDIT.	P caesp	*Pistacia lentiscus* L.	1.2	1.2	.	.	.	3.4	3.4	3.4	2.3	1.2	1.2	3.4	4.4	2.3	11
W-STENOMEDIT.	P caesp	*Phillyrea angustifolia* L.	.	.	.	.	.	.	.	.	.	.	.	+	+	1.2	3
STENOMEDIT.	P caesp	*Daphne gnidium* L.	.	.	.	.	.	+	.	+	.	.	.	.	+	.	3
		Diff. taxa of the *chamaeropetosum humilis* subass.															
W-STENOMEDIT.	NP	*Chamaerops humilis* L.	.	.	.	.	.	1.2	1.2	2.2	2.2	2.2	2.2	1.2	+.2	+	9
STENOMEDIT.	P lian	*Clematis cirrhosa* L.	.	.	.	.	.	.	.	.	.	.	.	+.2	1.3	+.2	3
		Diff. taxa of the *Quercetea ilicis* class															
STENOMEDIT.	G rhiz	*Asparagus acutifolius* L.	.	.	.	.	+.2	1.1	1.2	+	1.2	.	.	.	1.1	1.1	7
STENOMEDIT.	P lian	*Rubia peregrina* L.	.	.	.	.	.	.	+.2	+.2	+.2	1.1	.	+.2	1.3	1.3	7
EURIMEDIT.	H scap	*Pulicaria odora* (L.) Rchb.	1.2	.	+.2	1.2	.	.	+.2	.	+.2	.	.	.	.	.	5
STENOMEDIT.	G rhiz	*Arisarum vulgare* Targ.-Tozz.	.	.	.	.	.	.	1.1	.	1.2	1.1	.	.	.	+.2	4
STENOMEDIT.	P lian	*Lonicera implexa* Aiton	.	.	.	.	+.2	+.2	.	.	.	.	.	.	1.2	+.2	4
STENOMEDIT.	P caesp	*Olea europaea* L. var. *sylvestris* Hoffmgg. et Link	.	+	.	.	.	.	.	+	.	.	.	.	+.2	.	3
SUBTROP.	NP	*Smilax aspera* L.	.	.	.	.	.	.	.	+.2	.	.	.	1.3	+.2	.	3
EURIMEDIT.	P caesp	*Rhamnus alaternus* L.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	1
		Charact. and diff. taxa of the *Pistacio lentisci-Rhamnetalia alaterni* order															
STENOMEDIT.	NP	*Euphorbia characias* L.	.	.	.	.	.	.	.	.	.	.	1.2	+	.	.	2
W-STENOMEDIT.	Ch frut	*Asparagus albus* L.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	1
		Charact. and diff. taxa of the *Quercion ilicis* all., *Ericion arboreae* all., *Quercetalia ilicis* order															
W-MEDIT.(EURI)	P scap	*Quercus suber* L.	+	.	+	+	+	.	.	.	.	+	+	.	+	.	7
STENOMEDIT.	P caesp	*Erica arborea* L.	+	+.2	+	.	.	.	.	.	.	1.2	+.2	.	1.1	.	6
STENOMEDIT.	P caesp	*Arbutus unedo* L.	+	.	1.1	.	+	.	.	.	.	+.2	+	.	.	.	5
STENOMEDIT.	NP	*Rosa sempervirens* L.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	+.2	2
STENOMEDIT.	H caesp	*Carex distachya* Desf.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	1
EURIMEDIT.	G rhiz	*Ruscus aculeatus* L.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	1
STENOMEDIT.	P caesp	*Phillyrea latifolia* L.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	1
STENOMEDIT.	P scap	*Quercus ilex* L.	.	.	.	.	.	.	.	.	1.1	.	.	.	.	.	1
		Other species															
STENOMEDIT.	NP	*Cistus monspeliensis* L.	1.2	2.2	1.2	+.2	+.2	+.2	1.2	.	1.2	+	+.2	.	+	+.2	12
STENOMEDIT.	P caesp	*Pyrus spinosa* Forssk.	+	+	1.1	1.1	.	+	+	1.2	1.1	+	+	.	1.2	1.2	12
EURIMEDIT.	NP	*Rubus ulmifolius* Schott	.	.	.	.	+.2	.	+	+	+.2	+.2	.	.	.	+.2	6
EURIMEDIT.	G rad	*Tamus communis* L.	.	.	1.2	1.2	1.3	.	.	.	.	.	.	+.2	+.2	.	5
STENOMEDIT.	Ch rept	*Selaginella denticulata* (L.) Link	.	.	.	.	.	.	.	.	.	.	.	.	+	.	1

MYRTETOSUM COMMUNIS O. Bolòs 1962;
CHAMAEROPETOSUM HUMILIS O. Bolòs 1962.

The evergreen shrub grove composed of *Calicotome spinosa*, *Cistus monspeliensis*, *Pyrus spinosa*, *Myrtus communis*, *Pistacia lentiscus* and *Chamaerops humilis,* is found on the Oligo-Miocene rhyolite substrata of the Logudoro area, at an average altitude of 231.4 m a.s.l. (50-480 m a.s.l.), with mainly western aspect (53.8%) and with an average specific richness of 2.32 species10 m^{-2}. This vegetation community, that is 1.8 m high on average, has a prevalance of phanerophytes (58.2%), followed by nanophanerophytes (23.4%), geophytes (11.4%), hemicryptophytes (5.7%) and camaephytes (1.3%). The best represented contingent is that of the steno-Mediterranean species (86.7% of which 13.9% are W-Mediterranean), in comparison to those that are Euri-Mediterranean (11.4%) and of widespread distribution (1.9%). Two subassociations have been identified: subass. *myrtetosum communis*, that is found in the lower subhumid lower meso-Mediterranean phytoclimatic belt, at an average altitude of 388 m a.s.l. (200-480 m a.s.l.); the subass. *chamaeropetosum humilis* is found in the lower subhumid (upper dry) upper thermo-Mediterranean phytoclimatic belt, at an average altitude of 144.4 m a.s.l. (50-200 m a.s.l.). The subass. *myrtetosum communis* participates in the series of the *Violo dehnhardtii-Querco suberis myrtetosum communis* sigmetum (Bacchetta *et al*., 2004a); subass. *chamaeropetosum humilis* is part of the series *Asparago acutifolii-Oleo sylvestris* sigmetum (Bacchetta *et al*., 2003a). In both cases these shrub groves constitute communities that substitute thermophile forest communities composed of cork-oak and wild olive, that have undergone extensive grazing and frequent bushfires.

This association is the vegetation community with the highest cover value of *Myrtus communis*, hence the management of this shrub vegetation and the series in which it participates may have important economic consequences in the territory connected to the production of myrtle berries used for the production of the typical liqueur, *mirto*.

The association with *Myrtus communis* and *Calicotome spinosa* was first reported for Mediterranean France by Guinochet & Drouineau (1944) and later typified by O. de Bolòs (1962). Successively, the association was erroneously reported for the Nurra (Valsecchi, 1976), however, as underlined by Biondi *et al*. (2001), those shrub communities are characterised by the presence of *Calicotome villosa* and should be assigned to the following association. Here we underline the presence of a thermo-xerophile community composed of *Myrtus communis* and *Calicotome spinosa*, with *Chamaerops humilis* and *Clematis cirrhosa* absent from Tab. 2 in Guinochet & Drouineau (1944), which permit the identification of the subass. *chamaeropetosum humilis,* already reported for areas surrounding Barcelona (Bolòs, 1962). The typical subass. *myrtetosum communis,* which was also described by Bolòs (1962) in Catalonia is also reported.

PISTACIO LENTISCI-CALICOTOMETUM VILLOSAE Biondi, Filigheddu & Farris 2001 (Tab. 16).
EUPHORBIETOSUM DENDROIDIS subass. nova hoc loco (typus rel. no. 153, Tab. 16);

This evergreen shrub composed of *Calicotome villosa* and *Pistacia lentiscus*, with *Euphorbia dendroides*, *Cistus monspeliensis*, *Pyrus spinosa*, *Lavandula stoechas* and *Olea europaea* var. *sylvestris*, is found on the Oligo-Miocene rhyolites of Logudoro, at an average altitude of 188.5 m a.s.l. (50-400 m a.s.l.), in the lower subhumid (upper dry) upper thermo-Mediterranean (lower meso-Mediterranean) phytoclimatic belt with a western aspect. This community, that is 1.6 m high on average, with an average specific richness of 1.29 species10 m^{-2}, is composed mostly of phanerophytes (54%), followed by nanophanerophytes (33.9%), chamaephytes (8.9%), geophytes (2.4%) and hemicryptophytes (0.8%). Steno-Mediterranean species constitute 91.1% (of which 14.5% are W-Mediterranean), followed by Mediterrean mountainous (4%), Euri-Mediterranean (2.4%), widespread distribution (1.6%) and endemic (0.8%) species.

This association is part of the series *Asparago albi-Oleo sylvestris* sigmetum (Bacchetta *et al*., 2003a) and *Chamaeropo-Junipero turbinatae* sigmetum (Biondi *et al*., 2001) of NW Sardinia; it is locally found in Logudoro and Montiferru coastal zones.

This vegetation community is that most frequently hit by bushfires in the summer: bearing in mind that this maquis grows on unstable substrata that are particularly friable, its management and that of the series in which it participates may have important applications in the control of the stability of the *cuestas* slopes, especially on the coast between Alghero and Bosa. It has been described for the peninsula of Stintino (Biondi *et al.*, 2001) where it participates in the holm-oak series, it has since been found in the Archipelago of La Maddalena, an area in which the subass. *phillyreetosum angustifoliae* has been described (Biondi & Bagella, 2005). We hereby establish the new subass. *euphorbietosum dendroidis* that differs from the subass.

Tab. 16 - *Pistacio lentisci-Calicotometum villosae* Biondi, Filigheddu & Farris 2001
euphorbietosum dendroidis subass. nova (typus rel. no. 153)

		Rel. no.	144	145	146	147	148	149	150	151	152	153*	154	155	156	Pres.
		Coverage (%)	100	100	100	100	100	100	100	90	90	90	90	90	100	
		Area (m^2)	100	100	100	50	50	100	100	20	20	80	60	80	100	
		Exposure	W	W	W	NW	W	W	W	NW	NW	W	W	W	W	
		Slope (%)	5	20	20	20	15	20	20	15	15	20	20	20	20	
		Altitude (m asl)	50	100	100	400	500	150	100	300	200	150	100	150	150	
		Average vegetation height (m)	1	1.5	2	1.5	1.5	1.5	2	1.5	1.5	2	2	1.5	2	
		Substratum	11	11	11	11	11	11	11	5a	5a	11	11	11	11	
		No. of species	16	13	10	6	7	13	9	6	6	10	8	8	12	
		Charact. and diff. taxa of the ass.														
STENOMEDIT.	P caesp	*Calicotome villosa* (Poiret) Link	3.3	4.4	4.5	4.4	3.4	4.5	4.4	4.5	4.4	3.4	4.4	3.4	3.4	13
S-STENOMEDIT.	P caesp	*Pistacia lentiscus* L.	1.2	2.3	3.3	2.3	3.3	3.3	2.2	2.3	2.3	1.2	2.3	1.2	3.4	13
		Diff. taxa of the *euphorbietosum dendroidis* subass.														
STENOMEDIT.	NP	*Euphorbia dendroides* L.	.	2.2	1.1	1.2	1.1	1.2	1.1	.	.	2.3	2.3	3.3	+.2	10
W-STENOMEDIT.	Ch frut	*Asparagus albus* L.	1.1	+.2	1.1	.	.	+	+	.	.	+	+.2	+.2	1.1	9
S-MEDIT.MONT	NP	*Artemisia arborescens* L.	.	.	.	.	.	1.2	+	.	.	+	.	1.2	2.2	5
W-STENOMEDIT.	NP	*Chamaerops humilis* L.	1.1	.	.	.	.	.	.	.	.	1.2	1.2	+.2	.	4
		Diff. taxa of the *Quercetea ilicis* class														
STENOMEDIT.	P caesp	*Olea europaea* L. var. *sylvestris* Hoffmgg. et Link	+.2	+	+.2	.	.	+	1.2	.	1.1	.	+.2	.	.	7
STENOMEDIT.	P lian	*Lonicera implexa* Aiton	1.3	+.2	.	.	.	+.2	.	.	.	.	.	.	1.2	4
STENOMEDIT.	P lian	*Clematis cirrhosa* L.	.	.	.	.	+.2	+.2	.	.	.	.	.	.	+	3
EURIMEDIT.	P caesp	*Rhamnus alaternus* L.	+.2	.	+.2	.	.	+	.	.	.	.	.	.	.	3
STENOMEDIT.	G rhiz	*Asparagus acutifolius* L.	.	1.1	.	.	.	.	.	.	.	.	.	.	+.2	2
STENOMEDIT.	P caesp	*Daphne gnidium* L.	+	.	.	.	.	.	.	.	.	.	.	.	.	1
		Charact. and diff. taxa of the *Pistacio lentisci-Rhamnetalia alaterni* order														
W-STENOMEDIT.	P scap	*Juniperus phoenicea* L. subsp. *turbinata (* Guss.) Nyman	.	.	.	.	.	.	.	.	.	+.2	+	1.2	.	3
STENOMEDIT.	Ch frut	*Prasium majus* L.	.	1.2	.	.	.	.	+	.	.	.	.	.	.	2
W-STENOMEDIT.	P caesp	*Phillyrea angustifolia* L.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	1
STENOMEDIT.	P caesp	*Myrtus communis* L.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	1
		Charact. and diff. taxa of the *Quercion ilicis* all., *Ericion arboreae* all., *Quercetalia ilicis* order														
STENOMEDIT.	P caesp	*Erica arborea* L.	+	+	.	.	.	+	.	1.2	1.2	.	.	.	.	5
STENOMEDIT.	NP	*Rosa sempervirens* L.	.	+.2	+	.	.	.	.	.	.	.	.	.	+.2	3
STENOMEDIT.	P caesp	*Arbutus unedo* L.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	1
STENOMEDIT.	P scap	*Quercus ilex* L.	.	.	.	.	.	.	.	+	.	.	.	.	.	1
		Other species														
STENOMEDIT.	NP	*Cistus monspeliensis* L.	1.2	+.2	+	1.2	1.2	1.2	+.2	+.2	+.2	.	.	.	+.2	10
STENOMEDIT.	P caesp	*Pyrus spinosa* Forssk.	.	1.2	1.2	1.2	2.3	+	+.2	+	+	.	.	.	1.2	9
STENOMEDIT.	NP	*Lavandula stoechas* L.	1.1	+	+	+	+.2	+	.	.	.	+	.	+	+	9
		Occasional species	2	0	0	0	0	0	0	0	0	2	1	0	0	

phillyreetosum angustifoliae and from the typical subass. *rosmarinetosum officinalis*, established by Biondi & Bagella (2005), as a result of the presence of a contingent of thermophile species the distribution range of which is centred in the western Mediterranean.

Discussion and conclusions

Eleven associations and thirteen sub-associations were identified in the area of study. These fall into three classes. Five new associations are described in this work (*Clematido vitalbae-Maletum pumilae*, *Crataego monogynae-Aceretum monspessulani*, *Lavatero olbiae-Rubetum ulmifolii*, *Genisto desoleanae-Ericetum arboreae* and *Telino monspessulanae-Cytisetum villosi*). Vegetation communities referring to the *Cytisetea scopario-striati* class are reported for the first time in Sardinia.

In relation to the average specific richness of the 11 associations (Fig. 4), it may be observed that this is greater in the communities of the *Rhamno-Prunetea* class and lower in those of the *Pistacio lentisci-Rhamnetalia alaterni* order of the *Quercetea ilicis* class and in that of the *Cytisetea scopario-striati* class: this may relate to the lower penetration of sunlight in the evergreen shrub groves in comparison to that of the deciduous and semi-deciduous of the *Rhamno-Prunetea* class.

The prevalence in the area of study of the associations of the *Rhamno-Prunetea* class and of the *Ericion arboreae* alliance of the *Quercetea ilicis* class, as well as the presence of shrub communities referring to the *Cytisetea* class, may be explained above all on a bio-climatic basis: in the area the (lower and upper) meso-Mediterranean and meso-supratemperate (sub-Mediterranean) phytoclimatic belts, with subhumid-humid ombrotypes are prevalent. These favour the presence of mesophile entities, that tend to constitute communities with an original floristic composition if compared to Sardinian flora.

On the other hand, in areas bordering on that of the

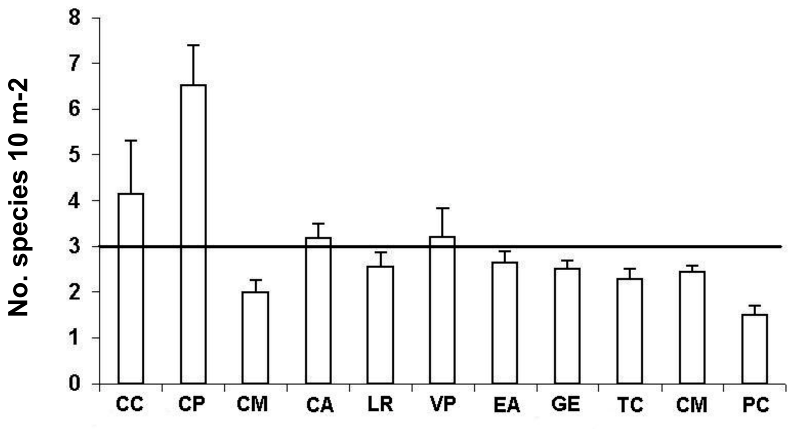

Fig. 4 – Specific richness (no. of species 10 m^{-2}) of the 11 associations studied: CC = *Clematido cirrhosae-Crataegetum monogynae*, CP = *Crataego monogynae-Pyretum amygdaliformis*, CM = *Clematido vitalbae-Maletum pumilae*, CA = *Crataego monogynae-Aceretum monspessulani*, LR = *Lavatero olbiae-Rubetum ulmifolii*, VP = *Vicio tenuifoliae-Prunetum spinosae*, EA = *Erico arboreae-Arbutetum unedoni*, GE = *Genisto desoleanae-Ericetum arboreae*, TC = *Telino monspessulanae-Cytisetum villosi*, CM = *Calicotomo-Myrtetum*, PC = *Pistacio lentisci-Calicotometum villosae* subass. *euphorbietosum dendroidis*

study, such as the Nurra and Sassarese, in which the phytoclimatic belts present are mostly those of the upper thermo-Mediterranean and lower meso-Mediterranean with dry ombrotypes (upper and lower), associations of the *Oleo-Ceratonion* alliance prevail (Biondi *et al.*, 2001 and 2002). The nature of the substrata may also favour the presence of mesophile entities: in fact, volcanic substrata, that are generally impermeable, may give rise to edaphic compensation, especially in the plateaus.

A fairly homogenous distribution of the different biological forms emerges from the biological spectra of the eleven shrub communities studied (Fig. 5) and the biological spectra in the four different altitude ranges (Fig. 6); there is, however, a prevalence of woody species. Camaephytes and therophytes are absent, while the hemicryptophytes, which are ever present, prevail in the two associations of *Lavatero olbiae-Rubetum ulmifolii* and *Vicio tenuifoliae-Prunetum spinosae*. It may be noted that the camaephytes, even with low values, are always present in the associations of the *Quercetea ilicis* and *Cytisetea scopario-striati* classes. This trend is confirmed by the examination of the shrub communities in the different altitude ranges: above 600 m both the therophytes and camaephytes disappear completely (Fig. 6).

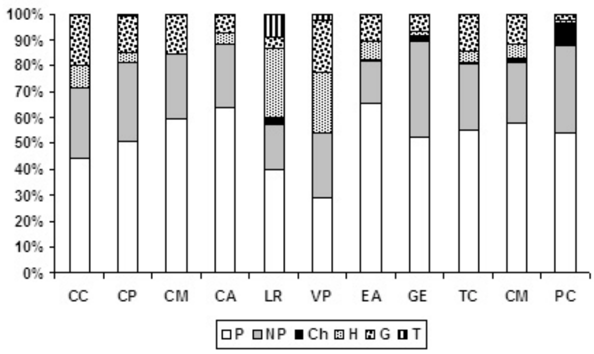

Fig. 5 – Biological spectra of the 11 associations studied: CC = *Clematido cirrhosae-Crataegetum monogynae*, CP = *Crataego monogynae-Pyretum amygdaliformis*, CM = *Clematido vitalbae-Maletum pumilae*, CA = *Crataego monogynae-Aceretum monspessulani*, LR = *Lavatero olbiae-Rubetum ulmifolii*, VP = *Vicio tenuifoliae-Prunetum spinosae*, EA = *Erico arboreae-Arbutetum unedoni*, GE = *Genisto desoleanae-Ericetum arboreae*, TC = *Telino monspessulanae-Cytisetum villosi*, CM = *Calicotomo-Myrtetum*, PC = *Pistacio lentisci-Calicotometum villosae* subass. *euphorbietosum dendroidis*

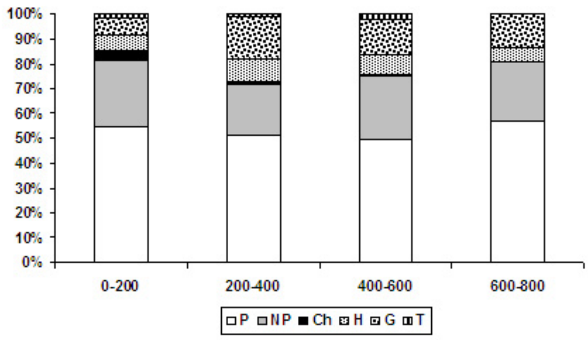

Fig. 6 – Biological spectra, based on frequencies, of the shrub communities on volcanic substrata in four different altitude ranges

However, the chorological spectra (Fig. 7) highlight a different floristic composition between the communities of the *Rhamno-Prunetea* class on one hand, and those of the *Quercetea ilicis* and *Cytisetea scopario-striati* classes on the other. In the associations of the *Quercetea ilicis* and *Cytisetea scopario-striati* classes, the steno-Mediterranean species are of great importance, as they always reach 70% of the total frequencies. In the associations of the *Rhamno-Prunetea* class there is a significant decrease in the steno-Mediterranean species, with a corresponding increase in the Euro-Asiatic and Euri-Mediterranean elements, that become clearly dominant in the associations of *Clematido vitalbae-Maletum pumilae* and *Crataego monogynae-Aceretum monspessulani*: these two associations therefore constitute two shrub communities of notable bio-geographic interest in the Sardinian context. In fact, they are pre-woods in series with deciduous oak forests, that are exclusive to the temperate climatic "islands" of Marghine and Goceano. The importance of bio-climatic factors in the conditioning of the floristic composition of the shrub communities studied is confirmed by the chorological spectra of the shrub communities on volcanic substrata in the four different altitude ranges (Fig. 8), from which one may easily note the increase of the Euro-Asiatic and Euri-Mediterranean components as altitude increases and a corresponding decrease in the steno-Mediterranean component. Above 600 m a.s.l. the Euro-Asiatic and steno-Mediterranean components are equal.

The identification of the main vegetation series present in the territory (Bacchetta *et al.*, 2003a, 2004a, 2004b; Filigheddu *et al.*, 1999) allowed us to attribute each shrub community to one or more vegetation series (Tab. 17). This is very important in terms of management application, as it allows prediction of the evolution of secondary succession processes and speculation regarding what forest community will develop subsequent to the recovery carried out by a given shrub community. In fact it must always be borne in mind that shrub groves are substitution communities, that in the long run, if not disturbed (e.g. by bushfires, grazing, etc.), are inevitably replaced by potential forest vegetation. This is even more important in light of the fact that in Appendix I of the Directive 92/43/EEC "Habitat" (European Commission, 1992 and 2003), *Calicotomo-Myrtetum chamaeropetosum humilis* and *Pistacio lentisci-Calicotometum villosae euphorbietosum dendroidis*, constitute the Community habitat "Thermo-Mediterranean and pre-desert scrub" (code 5330). The shrub communities composed of *Myrtus communis*, *Pistacia lentiscus*, *Calicotome spinosa* and *Chamaerops humilis* develop on level ground as a substitution for woods of cork oak and wild olive; while those composed of *Pistacia lentiscus*, *Calicotome villosa* and *Euphorbia dendroides* are a regressive phase of the forest formations with *Juniperus phoenicea* subsp. *turbinata*, *Quercus ilex* or *Olea europaea* var. *sylvestris*, after bushfires and destruction of the forest community.

Phytosociological studies of the shrub communities are necessary in order to acquire information regarding their spatial distribution and composition in relation to climatic and edaphic factors and to dynamism in the context of the series they belong to. These data may be used both for management purposes and the use of shrub species in natural forestry, and for the conservation of a

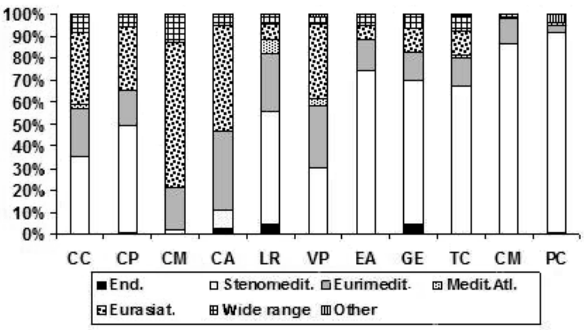

Fig. 7 – Chorological spectra of the 11 associations studied: CC = *Clematido cirrhosae-Crataegetum monogynae*, CP = *Crataego monogynae-Pyretum amygdaliformis*, CM = *Clematido vitalbae-Maletum pumilae*, CA = *Crataego monogynae-Aceretum monspessulani*, LR = *Lavatero olbiae-Rubetum ulmifolii*, VP = *Vicio tenuifoliae-Prunetum spinosae*, EA = *Erico arboreae-Arbutetum unedoni*, GE = *Genisto desoleanae-Ericetum arboreae*, TC = *Telino monspessulanae-Cytisetum villosi*, CM = *Calicotomo-Myrtetum*, PC = *Pistacio lentisci-Calicotometum villosae* subass. *euphorbietosum dendroidis*.

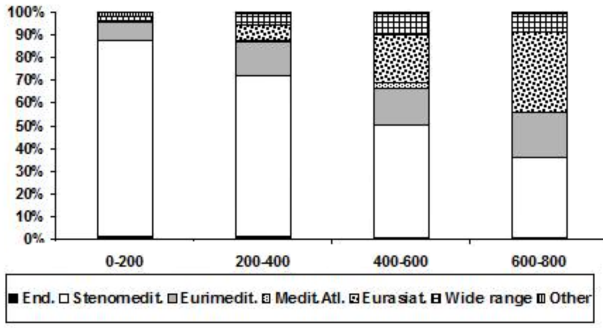

Fig. 8 – Chorological spectra, based on frequencies, of the shrub communities on volcanic substrata in four different altitude ranges

habitat that is of importance at the European level. In fact, in many areas it is of fundamental importance today to bring about a return to acceptable levels of naturalness, providing for the reconstitution of the vegetation cover of woods without the use of allochthonous species, but rather with the use of shrub species that facilitate the spread and growth of forest species. At the same time, management activity, especially in the areas included in the Natura 2000 Network, should not tend towards general recovery of forest communities, but must aim to preserve semi-natural habitats, such as those of shrubs, by way of the maintenance of moderate levels of disturbance (grazing, controlled burning of small surfaces), on the basis of the ecological needs of the species characterising the vegetation communities.

Syntaxonomic scheme

RHAMNO-PRUNETEA Rivas Goday & Borja ex Tüxen 1962
Prunetalia spinosae Tüxen 1952
Pruno-Rubion ulmifolii O. Bolòs 1954
Pruno-Rubenion ulmifolii *Arnaiz 1983*
Clematido vitalbae-Maletum pumilae ass. nova
Clematido cirrhosae-Crataegetum monogynae Filigheddu, Farris, Bagella & Biondi 1999
Crataego monogynae-Aceretum monspessulani ass. nova
glechometosum sardoae subass. nova
pyretosum spinosae subass. nova
sorbetosum torminalis subass. nova
Lavatero olbiae-Rubetum ulmifolii ass. nova
Vicio tenuifoliae-Prunetum spinosae Filigheddu, Farris, Bagella & Biondi 1999
Crataego monogynae-Pyretum amygdaliformis Biondi, Farris & Filigheddu 2002
rosetosum sempervirentis subass. nova
rosetosum caninae subass. nova

CYTISETEA SCOPARIO-STRIATI Rivas-Martínez 1975
Cytiso villosi-Telinetalia monspessulanae Rivas-Martìnez, Fernandéz-Gonzalez, Loidi, Lousã & Penas 2001
Telinion monspessulano-linifoliae Rivas-Martìnez, Fernandez Gonzàlez, Loidi, Lousa & Penas 2001
Telino monspessulanae-Cytisetum villosi ass. nova
cytisetosum villosi subass. nova
calicotometosum villosae subass. nova
calicotometosum spinosae subass. nova

QUERCETEA ILICIS Br.-Bl. ex A. & O. Bolòs 1950
Pistacio lentisci-Rhamnetalia alaterni Rivas-Martínez 1975
Oleo-Ceratonion siliquae Br.-Bl. *ex* Guinochet & Drouineau 1944 *em*. Rivas-Martínez 1975
Calicotomo-Myrtetum Guinochet *in* Guinochet & Drouineau 1944 *em*. O. Bolòs 1962
myrtetosum communis O. Bolòs 1962
chamaeropetosum humilis O. Bolòs 1962
Pistacio lentisci-Calicotometum villosae Biondi, Filigheddu & Farris 2001
euphorbietosum dendroidis subass. nova
Ericion arboreae (Rivas-Martínez ex Rivas-Martínez, Costa & Izco 1986) Rivas-Martínez 1987
Ericenion arboreae Rivas-Martínez, Costa & Izco 1986
Erico arboreae-Arbutetum unedonis Allier & Lacoste 1980 ex Foggi in Foggi & Grigioni 1999
phillyreetosum latifoliae (Allier & Lacoste 1980) Foggi & Grigioni 1999;
ilicetosum aquifolii subass. nova
Genisto desoleanae-Ericetum arboreae ass. nova

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Localities and dates of surveys

Tab. 6 – *Clematido cirrhosae-Crataegetum monogynae*
Ril. 1, 2: 2.01.2001 Mt. St. Antonio (Macomer, NU); ril. 3: 3.01.2001 Puttu Codinu (Villanova M.teleone, SS); ril. 4, 8, 9: 27.09.2001 below Mt. Traessu (Giave-Cossoine, SS); ril. 5, 7: 11.04.2001 beyond Tanca Regia, plateau of Abbasanta (OR); ril. 6, 10: 09.04.2003 road from Ittireddu to Sa Fraigada (Bono, SS).

Tab. 7 – *Crataego monogynae-Pyretum amygdaliformis*
Ril. 11: 3.01.2001 Mt.Fulcadu (Villanova M.teleone, SS); ril. 12, 13: 12.03.2003 Scaladeroccu, Mores (SS); ril. 14: 29.05.2003 along the course of the river Rio Buttule, Bono (SS); rl. 15: 13.05.2003 along the course of the river Rio Buttule, Bono (SS); ril. 16: 3.01.2001 Rajada spring (Villanova M.teleone, SS); RIL. 17, 18, 19: 20.05.2002 towards Interrios (Villanova M.teleone, SS); ril. 20: 10.04.2002 Sa Coa de Su Attu (Borore, NU); ril. 21: 20.05.2002 below Montresta (OR); ril. 22: 22.05.2002 before St. Leonardo (Macomer, NU); ril. 23: 17.05.2002 Sa Falada de Sos Turcos (Villanova M.teleone, SS); ril. 24: 24.05.2002 below Mt.Masiennera (Anela, SS); ril. 25: 09.04.2003 crossroads Ittireddu-Mores-Bono (SS); ril. 26: 13.05.2003 below Mt. Punta Pellegrina (Bono, SS); ril. 27: 13.05.2003 Minudo, junction for Nughedu S. Niccolò (SS); ril. 28: 29.05.2003 Minudo, junction for Nughedu S. Niccolò (SS); ril. 29: 29.05.2003 near Mt. Punta Pellegrina, Bono (SS); ril. 30: 7.05.2002 plateau of Su Bullone (Alghero, SS); ril. 31: 20.05.2002 plateau of Su Bullone (Alghero, SS).

Tab. 8 – *Clematido vitalbae-Maletum pumilae*
Ril. 32, 33, 34, 35, 36: 16.10.2001 below Mt. St. Antonio (Macomer, NU); ril. 37: 10.04.2002 Mt.St. Antonio (Macomer, NU).

Tab. 9 – *Crataego monogynae-Aceretum monspessulani*
Ril. 38, 50: 20.05.2002 Sa Pittada (Bosa, OR); ril. 39: 23.05.2003 Mandra Pudatta (Bolotana, NU); ril. 40: 24.05.2002 Mt. Masiennera (Anela, SS); ril. 41, 47, 53: 21.06.2002 Colonia Montana (Bolotana, NU); ril. 42, 51: 29.05.2003 (Bolotana, NU); ril. 43, 46, 49, 56: 23.05.2003 Rio Ortakis (Bolotana, NU); ril. 44, 52: 23.05.2003 Nuraghe Ortakis (Bolotana, NU); ril. 45, 48: 23.05.2003 Badde Salighes (Bolotana, NU); ril. 54: 29.05.03 Rio Ortakis (Bolotana, NU); ril. 55: 23.05.2003 (Bolotana, NU); ril. 57, 58: 21.06.2002 (Bolotana, NU).

Tab. 10 – *Lavatero olbiae-Rubetum ulmifolii*
Ril. 59, 60: 14.05.2002 Rio Medadu (Olmedo, SS); ril. 61: 5.06.2002 S'Abba Druche (Bosa, OR); ril. 62, 64: 7.06.2002 Rio Bia Iosso (Santulussurgiu, OR); ril. 63: 19.05.2001 St. Cristina (Paulilatino, OR); ril. 65: 27.05.2002 Rio Sa Entale (Montresta, OR); ril. 66: 7.05.2002 La Scaletta (Alghero, SS).

Tab. 11 – *Vicio tenuifoliae-Prunetum spinosae*
Ril. 67, 68: 15.01.2001 Carchinnadas bridge (Mara, SS); ril. 69, 70: 27.05.2002 plateau of Pittu 'e Corru (Villanova M.teleone, SS); ril. 71, 77: 09.04.2003 Ittireddu, Mores, Bono (SS); ril. 72, 74, 75: 29.05.2003 road from Ittireddu to Mores (SS); ril. 73, 79: 28.04.2003 road from Ittireddu to Foresta Burgos (SS); ril. 76: 1.05.2001 Palattu di Silva Manna (Bosa, OR); ril. 78: 4.04.2001 Sa Coa de su Attu (Borore, NU).

Tab. 12 – *Erico arboreae-Arbutetum unedonis*
Ril. 80: 5.05.2002 Su Bullone (Villanova M.teleone, SS); ril. 81: 23.03.2001 Su Bullone (Villanova M.teleone, SS); ril. 82, 85: 7.05.2002 plateau of Su Bullone (Alghero, SS); ril. 83: 17.05.2002 plateau above Su Bullone (Villanova M.teleone, SS); ril. 84: 7.05.2002 La Scaletta (Alghero, SS); ril. 86: 20.05.2002 plateau of Mt. Fulcadu towards the Temo river (Villanova M.teleone, SS); ril. 87: 7.06.2002 valley of the river Rio Bia Iosso (Cuglieri, OR); ril. 88: 27.09.2001 the summit of Mt. Traessu (Giave-Cossoine, SS); ril. 89, 90, 91, 92: 7.06.2002 uphill from Funtana 'e S'Ozzu to La Madonnina (Cuglieri, OR).

Tab. 13 – *Genisto desoleanae-Ericetum arboreae*
Ril. 93, 94: 16.10.2001 Bau 'e Mela (Santulussurgiu, OR); ril. 95, 96, 99, 100: 6.06.2002 Forest of Pabarile (Santulussurgiu, OR); ril. 97, 98: 7.06.2002 Forest of Pabarile (Santulussurgiu, OR); ril. 101, 102: 7.06.2002 windswept plateaus between Mt. Pertusu and Elighes Uttiosos spring, Forest of Pabarile (Santulussurgiu, OR).

Tab. 14 – *Telino monspessulanae-Cytisetum villosi*
Ril. 103, 104, 105: 27.04.2001 valley of the river Rio Bau 'e Mela (Santulussurgiu, OR); 106 – 27.04.2001 junction St. Leonardo (Santulussurgiu, OR); ril. 107, 114, 115: 7.06.2002 valley of the river Sos Molinos (Santulussurgiu, OR); ril. 108, 116: 13.05.2003 below Mt. Punta Pellegrina (Bono, SS); ril. 109, 110: 16.10.2001 Bau 'e Mela (Santulussurgiu, OR); ril. 111: 6.06.2002 mountain of Seneghe (OR); ril. 112, 113, 117: 26.03.2003 junction Ittireddu-Mores-Bono (SS); ril. 118, 128: 17.05.2002 below Rajada spring (Villanova M.teleone, SS); ril. 119: 17.05.2002 Caitta bridge (Villanova M.teleone, SS); ril. 120: 29.05.2003 Mt. Punta Pellegrina (Bono, SS); ril. 121: 09.04.2003 road from Ittireddu to Bono (SS); ril. 122: 20.05.2002 below Sa Pittada (Bosa, OR); ril. 123: 27.05.2002 below Nuraghe Appiu (Villanova M.teleone, SS); ril. 124: 09.04.2003 road from Ittireddu to Sa Fraigada (Bono, SS); ril. 125: 29.04.2001 Pittu 'e Corru (Villanova M.teleone, SS); ril. 126: 18.06.2001 St. Maria Forest (Bosa, OR); ril. 127: 10.04.2002 Sa Preda Lada spring (Santulussurgiu, OR); ril. 129: 18.06.2001 Suelzu Entosu, valley of Interrios (Villanova M.teleone, SS).

Tab. 15 – *Calicotomo-Myrtetum*

Ril. 130: 27.09.2001 Santu Pedru (Alghero, SS); ril. 131: 15.03.2002 Valverde (Alghero, SS); ril. 132: 7.05.2002 plateau of Su Bullone (Alghero, SS); ril. 133: 14.05.2002 plateau of Mt. Rosso (Olmedo, SS); ril. 134, 135, 136: 20.05.2002 plateau of Mt. Fulcadu (Villanova M.teleone, SS); ril. 137: 6.05.2002 Santu Pedru (Alghero, SS); ril. 138, 140, 141, 142: 7.05.2002 La Scaletta (Alghero, SS); ril. 139: 6.05.2002 Aqueduct of Nurra, Mt. Baranta (Olmedo, SS); ril. 143: 7.05.2002 Scala Piccada (Alghero, SS).

Tab. 16 – *Pistacio lentisci-Calicotometum villosae*

Ril. 144 – 28.03.2002 Brionis (Alghero, SS); ril. 145, 146, 149, 150, 153, 154, 155, 156: 28.03.2002 littoral area between Poglina and benchmark 24 Km (Villanova M.teleone, SS); ril. 147, 148: 28.03.2002 slopes after Capo Marargiu (Bosa, OR); ril. 151, 152: 7.06.2002 valley of the river Rio Bia Iosso (Cuglieri, OR).

Sporadic species

Tab. 7 – *Crataego monogynae-Pyretum amygdaliformis*

Ril. 11: *Hedera helix* L. 2.2; ril. 13: *Phalaris coerulescens* Desf. +.2; ril. 14: *Cistus salvifolius* L. r; ril. 15: *Quercus pubescens* Willd. +; ril. 25: *Piptatherum miliaceum* (L.) Coss. subsp. *miliaceum* +.2, *Vicia villosa* Roth 1.3; ril. 30: *Vicia villosa* Roth +.2, *Euphorbia cupanii* Guss. 1.2; ril. 31: *Piptatherum miliaceum* (L.) Coss. subsp. *miliaceum* +, *Dittrichia viscosa* (L.) Greuter s.l. +.2; ril. 16: *Quercus pubescens* Willd. +; ril. 18: *Quercus pubescens* Willd. +; ril. 20: *Cistus salvifolius* L. +.2; ril. 23: *Teline monspessulana* (L.) Koch +.2; ril. 24: *Hedera helix* L. 1.3, *Viola alba* Besser ssp. *dehnhardtii* (Ten.) W. Becker +; ril. 27: *Teline monspessulana* (L.) Koch +, *Phalaris coerulescens* Desf. r; ril. 28: *Teline monspessulana* (L.) Koch +.2.

Tab. 10 – *Lavatero olbiae-Rubetum ulmifolii*

Ril. 59: *Euphorbia cupanii* Guss. 1.2, *Tamarix africana* Poiret +; ril. 60: *Euphorbia cupanii* Guss. 1.1; ril. 61: *Dittrichia viscosa* (L.) Greuter s.l. +, *Salix atrocinerea* Brot. +.2; ril. 62: *Pteridium aquilinum* (L.) Kuhn 1.1; ril. 64: *Pteridium aquilinum* (L.) Kuhn +; ril. 66: *Calicotome spinosa* (L.) Link +, *Euphorbia biumbellata* Poiret 1.2, *Foeniculum vulgare* Miller ssp. *piperitum* (Ucria) Coutinho 1.3, *Lathyrus clymenum* L. 2.3, *Quercus suber* L. +, *Rubia peregrina* L. +.2.

Tab. 11 – *Vicio tenuifoliae-Prunetum spinosae*

Ril. 67: *Ranunculus neapolitanus* Ten. 1.2, *Ranunculus ficaria* L. +, *Narcissus tazetta* L. +.2; ril. 69: *Dorycnium rectum* (L.) Ser. +, *Oenanthe crocata* L. +.2, *Vicia villosa* Roth 1.1; ril. 70: *Dorycnium rectum* (L.) Ser. +, *Oenanthe crocata* L. +, *Vicia villosa* Roth 1.2; ril. 71: *Rumex pulcher* L. +, *Oenanthe pimpinelloides* L. +; ril. 73: *Ulmus minor* Miller 1.1; ril. 76: *Cytisus villosus* Pourret 1.2; ril. 77: *Cytisus villosus* Pourret 1.2; ril. 78: *Vicia cracca* L. 2.2; ril. 79: *Rumex pulcher* L. 2.2, *Ulmus minor* Miller 1.2.

Tab. 12 – *Erico arboreae-Arbutetum unedonis*

Ril. 80: *Cistus salvifolius* L. 1.2, *Cistus creticus* L. ssp. *eriocephalus* (Viv.) Greuter *et* Burdet +; ril. 81: *Brachypodium retusum* (Pers.) P. Beauv. 2.2, *Cistus salvifolius* L. +.2, *Lavandula stoechas* L. +, *Orchis longicornu* Poiret +, *Romulea ligustica* Parl. +, *Asphodelus ramosus* L. subsp. *ramosus* +; ril. 82: *Brachypodium retusum* (Pers.) P. Beauv. +.2; ril. 85: *Cistus creticus* L. ssp. *eriocephalus* (Viv.) Greuter *et* Burdet +.2; ril. 88: *Brachypodium retusum* (Pers.) P. Beauv. 2.2, *Cistus salvifolius* L. 1.2, *Lavandula stoechas* L. 1.2; ril. 91: *Quercus pubescens* Willd. +, *Prunus avium* L. +; ril. 92: *Quercus pubescens* Willd. +.

Tab. 13 – *Genisto desoleanae-Ericetum arboreae*

Ril. 94: *Pyrus spinosa* Forssk. +, *Rosa canina* L. +.2; ril. 95: *Vicia cracca* L. +; ril. 97: *Cytisus villosus* Pourret +.2; ril. 98: *Pyrus spinosa* Forssk. +, *Rosa canina* L. +.2; ril. 99: *Cytisus villosus* Pourret +.2, *Vicia cracca* L. +; ril. 100: *Cytisus villosus* Pourret +; ril. 101: *Cistus creticus* L. ssp. *corsicus* (Loisel.) Greuter *et* Burdet 1.2, *Thymus catharinae* Camarda 1.2; ril. 102: *Cistus creticus* L. ssp. *corsicus* (Loisel.) Greuter *et* Burdet 1.2, *Thymus catharinae* Camarda +.2.

Tab. 14 – *Telino monspessulanae-Cytisetum villosi*

Ril. 103: *Allium triquetrum* L. 2.2, *Teucrium scorodonia* L. 2.2; ril. 104: *Allium triquetrum* L. 1.2; ril. 105: *Allium triquetrum* L. 1.2; ril. 117: *Allium triquetrum* L. +; ril. 127: *Vicia cracca* L. +.2; ril. 113: *Allium triquetrum* L. +; ril. 124: *Artemisia arborescens* L. 1.2, *Ruta chalepensis* L. +.

Tab. 15 – *Calicotomo-Myrtetum*

Ril. 132: *Cistus creticus* L. ssp. *eriocephalus* (Viv.) Greuter *et* Burdet +.2; ril. 137: *Lavandula stoechas* L. +; ril. 140: *Eryngium tricuspidatum* L. 1.1; ril. 142: *Cistus creticus* L. ssp. *eriocephalus* (Viv.) Greuter *et* Burdet +.2; ril. 130: *Allium subhirsutum* L. +, *Brachypodium retusum* (Pers.) P. Beauv. 1.2, *Piptatherum miliaceum* (L.) Coss. subsp. *miliaceum* +.2.

Tab. 16 – *Pistacio lentisci-Calicotometum villosae*

Ril. 144: *Asphodelus ramosus* L. subsp. *ramosus* 1.1, *Brachypodium retusum* (Pers.) P. Beauv. 1.1; ril. 153: *Opuntia ficus-indica* (L.) Miller +, *Genista corsica* (Loisel.) DC. +; ril. 154: *Opuntia ficus-indica* (L.) Miller +.2.