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Vegetation and plant landscape of Asinara National Park (Italy)

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Abstract

The vegetation of the Asinara National Park, established in 1997, is dramatically degraded as a consequence of the intensive human use during the last centuries. Fire, overgrazing, intensive and extensive farming activities, carried out during the 112 years of the presence of a penal colony, determined the spread of secondary plant communities. Human induced effects are evident also in the communities of the psammophilous and hygrophilous geo-sigmata.

Overall, 51 plant communities, ascribed to 21 classes, were detected. Six new associations and seven new subassociations were described. In the plant landscape three vegetation series and five geo-sigmata were identified. 18 habitats of community interest were recognized. Issues concerning the management of the plant communities and plant landscape are stressed in the discussion.

Key words: biodiversity conservation, Habitat Directive, plant communities, potential vegetation, vegetation series.

Introduction

Asinara National Park, which includes the island of Asinara (north-western Sardinia), was established in 1997. The same area was recognized as SCI (ITB 010082: Isola dell'Asinara) and as Important Plant Area (SAR14) (Blasi *et al.*, 2010, 2011; Marignani *et al.*, 2014).

Due to its central position in the Mediterranean Sea the island had a very troubled history which deeply imprinted its vegetation and plant landscape. During the centuries it was visited by Phoenicians, Greeks and Romans. In the Middle Ages it was occupied by Camaldolese monks which were devoted to the cultivation of the land but also, in the sheltered bays, by pirates and privateers. Over time, arrived on the island the Liguria fishermen and the Sardinian shepherds. In 1885 the island was expropriated by Italian King Umberto for the creation of an agricultural penal colony and a health quarantine station. During the First World War, the island was used as a concentration camp for thousands of Serb and Austro-Hungarians prisoners. The penal colony was latter transformed into a maximum security prison until the institution of the National Park (Forteleoni & Gazale, 2008).

The Asinara Island (51.92 km²) is included in the Sardinia-Corsica Block Province, Campidano-Sassarese lowland section (Blasi & Frondoni, 2011). The island is elongated in shape with coastal cliffs in the western side, and lower coast, with some small beaches in the eastern side. The geological substratum is mainly represented by schist. Granitic lithologies occur in the central-southern sector and in the extreme north-eastern sector (Carosi *et al.*, 2004) while alluvial

and sandy formation are confined to small areas. The main relief is Punta della Scomunica (408 m a.s.l) and the only perennial stream is Riu di Baddi Longa.

According to the classification by Rivas-Martínez *et al.* (2001), the island is characterized by an Oceanic Pluviseasonal Mediterranean bioclimate, upper thermo-Mediterranean phytoclimatic belt.

The flora of the island consists of 630 entities of which 35 (i.e. 5.5%) are endemic (Bocchieri, 1988; Bocchieri & Filigheddu, 2008).

The vegetation of Asinara is dramatically degraded as a consequence of the intensive human use. Fire, overgrazing, intensive and extensive farming activities carried out during the 112 years of the presence of the penal colony determined the spread of secondary plant communities. Human induced effects are evident also in azonal communities as those of dunes and wetlands (Bocchieri & Filigheddu, 2008).

Therefore urgent measures aimed to ensure the presence and maintenance of the plant communities, especially those recognized as habitats of Community interest (Commission of the European Community, 1992) are needed. The management of plant biodiversity requires knowledge of the flora, vegetation and plant landscape. While a floristic check-list of the island is available (Bocchieri, 1988), only fragmented information concerning vegetation was published (Biondi *et al.*, 2001; Camarda *et al.*, 1998; Valsecchi, 1998).

The aims of this research were: i) to identify and characterize the plant communities; ii) to identify and characterize the vegetation series and geo-sigmata, and iii) to analyse the habitats of community interest (Commission of the European Community, 1992) present in the Asinara National Park.

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Materials and methods

176 vegetation surveys were performed at 23 locations on the island (Fig. 1), according to the Zürich-Montpellier phytosociological method (Braun-Blanquet, 1951). Vegetation series and geo-sigmata were defined basing on the sinphytosociologic method (Biondi, 2011; Rivas Martínez, 1976), according to Bacchetta et al. (2009; 2010).

The biodiversity concern of each plant community was assessed according to the Annex I of the Habitat Directive (Commission of the European Community, 1992), on the basis of the Interpretation Manual of European Union Habitats (Commission of the European Community, 2013) and the specialized literature (Bagella et al., 2007; Biondi et al., 2012; Farris et al., 2007a).

Plant nomenclature follows Conti et al. (2005), except *Cyperus longus* subsp. *badius* which follows Pignatti (1982).

Syntaxonomy is based on the Third Edition of the International Code of Phytosociological Nomenclature (Weber et al., 2000).

The syntaxonomical system is that proposed by Biondi & Blasi (www.prodromo-vegetazione-italia.org).

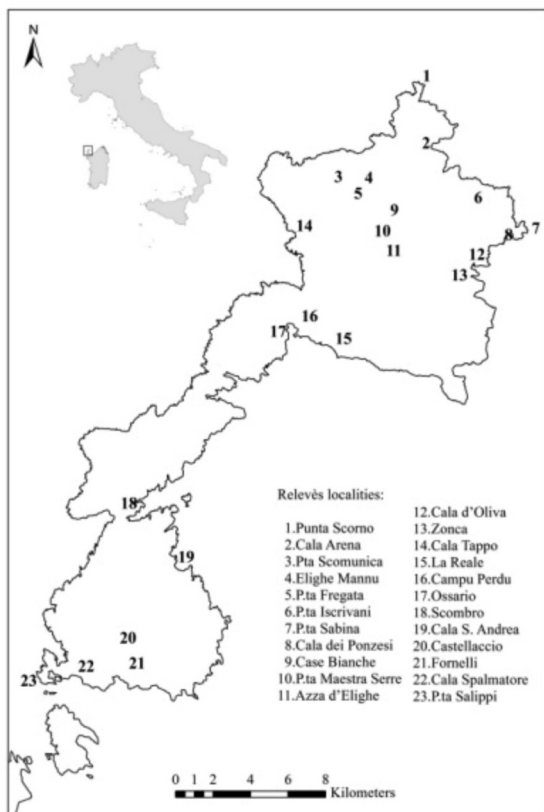


Fig. 1 – Study area with the location of the relevès

Results

Plant communities

FLOATING OR ROOTED SUBMERGED AQUATIC VEGETATION

Floating or submerged communities growing in fresh water or in brackish coastal wetlands.

Fresh-water vegetation

Aquatic fresh water rooted hydrophytes communities ascribed to the class *Potametea pectinati*.

CALLITRICHETUM STAGNALIS Segal 1965 (Tab. 1, rel. 1-5)

Plant communities growing in deeper areas of temporary ponds, in permanent ponds and in slow-flowing streams strongly dominated by *Callitriche stagnalis* (Bagella et al., 2009).

RANUNCULETUM BAUDOTII Br.-Bl. in Br.-Bl., Roussine & Nègre 1952

ranunculetum baudotii subass. nova (typus Tab. 7, rel. 5 in Biondi & Bagella, 2005)

callitrichetosum hamulatae subass. nova (Tab. 1, rel. 6-8; holotypus rel. 6)

Plant communities growing in temporary or permanent ponds slightly salty. The new subassociation *callitrichetosum hamulatae* is based on the presence of *Callitriche hamulata* as differential species.

Marine and salt-water vegetation

Aquatic halophilous communities growing in temporary or permanent littoral salt-water pools and lagoons ascribed to *Ruppiaetea* class.

ENTEROMORPHO INTESTINALIDIS-RUPPIETUM MARITIMAE Westhoff ex Tüxen & Böckelmann 1957 (Tab. 2)

Tab. - 1-5: *Callitrichetum stagnalis* Segal 1965; *Ranunculetum baudotii* Br.-Bl. in Br.-Bl., Roussine & Nègre 1952. 6-8: *callitrichetosum hamulatae* subass. nova

Relevè number	1	2	3	4	5	6*	7	8	presences
Cover (%)	100	100	90	90	100	100	100	100	
Area (m ²)	10	2	2	1	1	10	5	1	
Characteristic and differential species of association									
<i>Callitriche stagnalis</i> Scop.	5	5	5	4	4	.	.	.	5
<i>Ranunculus peltatus</i> Schrank subsp. <i>baudotii</i> (Godr.) C.D.K. Cook	.	.	.	.	.	3	5	2	3
Differential species of the subass. <i>callitrichetosum hamulatae</i> subass. nova									
<i>Callitriche hamulata</i> Kutz.	.	.	.	.	.	5	2	5	3
Other species									
<i>Mentha pulegium</i> L. subsp. <i>pulegium</i>	+	.	.	.	+	+	.	.	3
<i>Juncus acutus</i> L. subsp. <i>acutus</i>	+	.	.	.	+	.	.	.	2
Sporadic species	1	3	0	1	0	4	0	0	

Submerged halophilous phanerogamic communities developing in winter and spring in brackish coastal ponds which can be either perennial or seasonal.

AMPHIBIOUS VEGETATION OF FRESH-WATERS, SPRINGS AND FENS

Tab. 2 - *Enteromorpha intestinalidis-Ruppium maritima* Westhoff ex Tüxen & Böckelmann 1957

Relevè number	1	2	3	4	5	presences
Cover (%)	100	100	100	100	100	
Area (m ²)	5	5	2	2	6	
Characteristic and differential species of association						
<i>Ruppia maritima</i> L.	5	5	5	3	4	5
<i>Enteromorpha intestinalis</i> (Linnaeus) Nees	.	2	.	5	.	2

Pioneer ephemeral vegetation

Ephemeral plant communities growing in temporary ponds and rock pools ascribed to *Isoetes durieui-Juncetea bufonii* class. The patterns of these communities are strongly affected by microecological environmental conditions (Gigante *et al.*, 2013), particularly hydrology (Bagella & Caria, 2012, 2013; Bagella *et al.*, 2010a, 2010b) and soil features (Caria *et al.*, 2013).

LYTHRO HYSSOPIFOLIAE-CRASSULETUM VAILLANTII Bagella, Caria, Farris, Filigheddu 2009 (Tab. 3, rel. 1-2)

Annual small size plant communities flowering until late spring, growing mainly in small granitic rock pools (Bagella *et al.*, 2009).

Tab. 3 – 1-2: *Lythro hyssopifoliae-Crassuletum vaillantii* Bagella, Caria, Farris, Filigheddu 2009; 3: *Anthoxantho aristati-Agrostetum salmanticae* Biondi & Bagella 2005; 4-7: *Junco bufonii-Isolepidetum setaceae* O. Bolòs & Masello in O. Bolòs 1979 *juncetosum bufonii* subass. nova; 8-11: *Junco bufonii-Isolepidetum setaceae* O. Bolòs & Masello in O. Bolòs 1979 *silenetosum laetae* subass. nova; 12-17: *Lythro hyssopifoliae-Silenetum laetae* ass. nova

Relevè number	1	2	3	4	5*	6	7	8*	9	10	11	12	13	14	15	16*	17	presences
Cover (%)	100	90	100	80	80	80	60	90	100	100	100	100	90	90	90	100	100	
Area (m ²)	2	1	50	6	6	6	2	1	0.5	0.5	2	30	3	5	15	8	5-6	
Characteristic and differential species of association and suassociation																		
<i>Tillaea vaillantii</i> Willd.	5	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
<i>Agrostis pourretii</i> Willd.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
<i>Anthoxanthum aristatum</i> Boiss. subsp. <i>aristatum</i>	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
<i>Junco bufonius</i> L.	.	.	.	3	3	4	3	1	+	+	1	1	.	+	1	2	.	8
<i>Isolepis setacea</i> (L.) R. Br.	.	.	.	3	3	+	1	4	4	3	3	.	1	1	.	.	.	4
<i>Silene laeta</i> (Aiton) Godron	+	.	2	.	.	.	.	1	2	1	+	2	+	4	3	4	4	12
<i>Lythrum hyssopifolia</i> L.	.	.	1	.	.	.	.	.	+	.	.	1	1	1	1	1	1	8
Characteristic and differential species of the upper sintaxa																		
<i>Mentha pulegium</i> L. subsp. <i>pulegium</i>	.	.	+	+	+	+	1	+	1	.	.	+	.	7
<i>Junco pygmaeus</i> Rich. & Thuill.	+	+	1	.	.	.	.	.	.	.	.	+	3
<i>Solenopsis laurentia</i> (L.) C. Presl	1	.	+	.	.	2
Other species																		
<i>Anagallis arvensis</i> L. subsp. <i>latifolia</i> (L.) Arcang.	+	+	+	.	+	.	+	1	1	+
<i>Ranunculus sardous</i> Crantz s.l.	.	.	2	.	.	.	.	.	.	.	2	1	+	+	+	+	1	8
<i>Carex divisa</i> Huds.	.	.	1	.	.	.	1	+	.	.	.	1	+	.	1	.	1	7
<i>Hordeum marinum</i> Huds. subsp. <i>marinum</i>	.	.	3	.	.	.	.	.	.	.	.	2	.	+	.	2	+	5
<i>Anthemis arvensis</i> L. subsp. <i>arvensis</i>	+	+	+	1	.	.	.	.	.	4
<i>Apium nodiflorum</i> (L.) Lag. subsp. <i>nodiflorum</i>	1	1	.	2	1	4
<i>Bromus hordeaceus</i> L. subsp. <i>hordeaceus</i>	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1	1	1	4
<i>Lotus ornithopodioides</i> L.	1	2	+	.	.	.	.	.	.	4
<i>Plantago coronopus</i> L. ssp. <i>commutata</i> (Guss.) Pilger	.	4	.	.	+	+	1	.	.	.	.	.	.	.	.	.	.	4
<i>Polygomon subspathaceus</i> Req.	+	+	+	1	.	4
<i>Spergularia salina</i> J. & C. Presl	.	.	.	1	1	1	1	.	.	.	.	.	.	.	.	.	.	4
<i>Trifolium resupinatum</i> L.	+	.	.	+	+	4
<i>Junco subulatus</i> Forsskal	1	.	2	.	1	.	3
<i>Melilotus siculus</i> (Turra) Steud.	+	+	1	.	3
<i>Paspalum distichum</i> L.	.	.	1	.	.	.	.	.	.	+	+	.	.	.	.	.	.	3
<i>Rumex conglomeratus</i> Murray	+	+	.	.	.	3
<i>Aira caryophyllea</i> L. subsp. <i>caryophyllea</i>	.	+	+	1
<i>Baldellia ranunculoides</i> (L.) Parl.	+	r	.	.	.	.	.	.	2
<i>Centaurium erythraea</i> Rafn subsp. <i>erythraea</i>	+	.	.	+	.	2
<i>Cynodon dactylon</i> (L.) Pers.	r	.	.	2	.	.	.	.	.	2
<i>Cyperus longus</i> L. subsp. <i>badius</i> (Desf.) Asch. et Gr.	1	.	.	.	.	.	2
<i>Gaudinia fragilis</i> (L.) Beauv.	2	.	+	.	.	.	2
<i>Lolium perenne</i> L.	.	.	2	.	.	.	.	.	.	.	.	1	.	.	.	.	.	2
<i>Lotus conimbricensis</i> Brot.	+	+	.	.	2
<i>Plantago lanceolata</i> L.	.	.	+	+	2
<i>Ranunculus muricatus</i> L.	+	+	2
<i>Samolus valerandi</i> L.	+	3	.	.	.	2
Sporadic species																		
	0	0	8	0	0	0	2	2	1	0	1	4	0	0	0	1	4	

ANTHOXANTHO ARISTATI-AGROSTIETUM SAL-MANTICAE Biondi & Bagella 2005 (Tab. 3, rel. 3)

Ephemeral small grasses communities growing on soils that are flooded in winter and partially in spring (Bagella et al., 2009). These communities are quite spread in the island, particularly in flat areas behind coastal dunes.

JUNCO BUFONII-ISOLEPIDETUM SETACEAE O. Bolòs & Masello in O. Bolòs 1979

juncetosum bufonii subass. nova (Tab. 3, rel. 4-7; holotypus rel. 5)

silenetosum laetae subass. nova (Tab. 3, rel. 8-11; holotypus rel. 8)

Dwarf plant communities growing in early spring in the rivulets. The subassociation *silenetosum laetae* is typical of the coastal retrodunal sector.

LYTHRO HYSSOPIFOLIAE-SILENETUM LAETAE ass. nova (Tab. 3, rel. 12-17; holotypus rel. 16)

Annual vegetation growing in the hedges of small ponds or rivulets.

Vegetation of lakes, springs, fens and bogs

Spring communities of base-poor water referable to *Montia fontanae-Cardaminetea amarae* class and lacustrine and riverine helophyte communities dominated by perennial graminoids, sedges, forbs and herbs of fresh and brackish waters referable to *Phragmito australis-Magnocaricetea elatae* class.

MONTIETUM FONTANAE Br.-Bl. 1915 (Tab. 4)

Annual spring communities dominated by *Montia fon-*

Tab. 4 - *Montietum fontanae* Br.-Bl. 1915

Relevè number	1	2	presences
Cover (%)	100	100	
Area (m ²)	0.25	0.04	
Characteristic and differential species of association			
<i>Montia fontana</i> L. subsp. <i>amporitana</i> Sennen	5	5	2
Other species			
<i>Ranunculus muricatus</i> L.	+	+	2
<i>Silene laeta</i> (Aiton) Godron	+	1	2
<i>Silene gallica</i> L.	.	+	1
<i>Anagallis arvensis</i> L. subsp. <i>latifolia</i> (L.) Arcang.	.	+	1

tana associated with some species typical of the class *Isoeto durieui-Juncetea bufonii*.

BALDELLIO RANUNCULOIDIS-ELEOCHARITETUM PALUSTRIS Biondi & Bagella 2005 (Tab. 5, rel. 1-3)

Dense communities growing in areas characterized by a high variability in water level and not suitable for tall helophytes which need a more stable hydrology.

JUNCO ACUTI-OENANTHETUM CROCATAE Biondi & Bagella 2005

oenanthesum crocatae Biondi & Bagella 2005 (Tab. 5, rel. 4-9)

Tall forbs communities mainly found in the pebbly beds of oligotrophic streams, characterized by prolonged drought periods.

SCIRPO COMPACTI-JUNCETUM SUBULATI Géhu, Biondi, Géhu-Franck & Costa 1992 (Tab. 5, rel. 10)

Sub-halophilous mono-specific communities growing on soil waterlogged in winter and dry in summer.

Tab. 5 - 1-3: *Baldellio ranunculoidis-Eleocharitetum palustris* Biondi & Bagella 2005; 4-9: *Junco acuti-Oenanthesum crocatae* Biondi & Bagella 2005 *oenanthesum crocatae* Biondi & Bagella 2005; 10: *Scirpo compacti-Juncetum subulati* Géhu et al. 1992; 11: *Apietum nodiflori* Br.-Bl. 1952

Relevè number	1	2	3	4	5	6	7	8	9	10	11	presences
Cover (%)	90	100	80	90	100	100	90	100	100	80	70	
Area (m ²)	6	10	6	10	10	6	8	20	18	15	4	
Characteristic and differential species of association												
<i>Eleocharis palustris</i> (L.) Roem. & Schult. subsp. <i>palustris</i>	4	.	4	.	.	.	.	.	.	.	.	2
<i>Baldellia ranunculoides</i> (L.) Parl.	.	1	1	.	.	.	.	.	.	.	.	2
<i>Mentha pulegium</i> L. subsp. <i>pulegium</i>	1	4	2	.	.	.	.	.	.	.	.	3
<i>Juncus acutus</i> L. subsp. <i>acutus</i>	.	.	.	2	2	2	+	1	4	.	.	6
<i>Oenanthe crocata</i> L.	.	.	.	4	3	4	5	4	.	.	.	5
<i>Juncus subulatus</i> Forsskal	.	.	.	.	.	.	.	.	.	4	.	1
<i>Apium nodiflorum</i> (L.) Lag. subsp. <i>nodiflorum</i>	.	.	.	.	1	.	.	.	.	.	3	2
Characteristic and differential species of the upper syntaxa												
<i>Carex otrubae</i> Podp.	.	.	.	.	+	+	1	+	2	.	.	5
Other species												
<i>Rumex conglomeratus</i> Murray	1	.	.	.	+	.	.	1	+	.	.	4
<i>Vitex agnus-castus</i> L.	.	.	.	.	.	+	+	1	.	.	.	3
<i>Callitriche stagnalis</i> Scop.	1	.	.	.	.	.	.	.	.	.	+	2
<i>Carex divisa</i> Huds.	.	.	.	+	.	.	.	.	.	.	.	2
<i>Dittrichia viscosa</i> (L.) Greuter	.	.	1	.	+	.	.	.	.	.	.	2
<i>Paspalum distichum</i> L.	1	+	.	.	.	.	.	.	.	.	.	2
<i>Rubus ulmifolius</i> Schott	.	.	.	1	1	.	.	.	.	.	.	2
<i>Rumex crispus</i> L.	.	.	.	.	.	+	+	.	.	.	.	2
<i>Galactites elegans</i> (All.) Soldano	.	.	.	.	.	+	.	+	.	.	.	2
Sporadic species												
	1	7	1	0	1	1	1	0	3	0	0	

APIETUM NODIFLORI Br.-Bl. 1952 (Tab. 5, rel. 11)
Hydrophytic dense and often mono-specific communities growing in shallow water often rich in nitrates.

COASTAL AND CONTINENTAL HALOPHILOUS AND SAND DUNE VEGETATION

Vegetation of coastal sand dunes and rocky coast

Pioneer perennial rhizomatous grasses and chamaephyte coastal sand dune communities with Mediterranean and Atlantic littoral distribution, ascribed to *Ammophiletea* class; annual communities usually found in strandlines, beaches and coastal sand dunes, where billows release organic matter, mainly constituted by *Posidonia oceanica* remainders ascribed to *Cakiletea maritima* class (Farris *et al.*, 2007a); and halophilous scrub dwarf communities growing on the cliffs ascribed to the class *Helichryso-Crucianelletea maritima*.

SILENO CORSICAE-AMMOPHILETUM ARUNDINACEAE Bartolo, Brullo, De Marco, Dinelli, Signorello & Spampinato 1992 (Tab. 6, rel. 1-2)

Plant community, endemic to Sardinia-Corsica because the presence of *Silene succulenta* subsp. *corsica*, colonizing the top of white dunes, and positively contributing to their evolution.

SPOROBOLETUM ARENARII (Arènes 1924) Géhu & Biondi 1994

elymetosum farcti Géhu & Biondi 1994 (Tab. 6, rel. 3-4)

Pauci-specific community that usually colonizes the foot of embryonic dunes, sometimes interested by temporary sea ingression. The presence of communities of the subass. *elymetosum farcti* indicates a progressive coastal erosion (Géhu & Biondi, 1994).

ANCHUSO CRISPAE-CENTAUREETUM SPHAEROCEPHALAE ass. nova (Tab. 6, rel. 5-9; holotypus rel. 7)

Halo-nitrophilous communities growing on flat dunes characterized by the presence of large stockpile of organic matter. These communities are narrow endemic because the area of overlapping between the two characteristic species, the Sardinian-Corsican endemic *Anchusa crispa* subsp. *crispa* and the western Mediterranean *Centaurea sphaerocephala*, corresponds just to the Asinara National Park.

SALSOLO KALI-CAKILETUM MARITIMAE Costa & Manz. 1981 corr. Rivas-Martínez *et al.* 1992 (Tab. 7)

Low-cover annual communities, growing along the shore, formed by specialized halo-nitrophilous plants. In disturbed sites they are also present on the dunes in a mosaic patchy distribution with communities of the orders *Ammophiletalia* and *Cutandietalia maritima*

Tab. 6 - 1-2: *Sileno corsicae-Ammophiletum arundinaceae* Bartolo, Brullo, De Marco, Dinelli, Signorello & Spampinato 1992; 3-4: *Sporobolium arenarii* (Arènes 1924) Géhu & Biondi 1994 *elymetosum farcti* Géhu & Biondi 1994; 5-9: *Anchuso crispa-Centaureetum sphaerocephalae* ass. nova

Relevé number	1	2	3	4	5	6	7*	8	9	presences
Cover (%)	80	70	80	70	20	30	25	30	20	
Area (m ²)	20	30	30	20	80	70	75	80	75	
Characteristic and differential species of association										
<i>Ammophila arenaria</i> (L.) Link subsp. australis (Mabille) Lainz	4	3	.	.	.	.	.	.	.	4
<i>Silene succulenta</i> Forssk. subsp. <i>corsica</i> (DC.) Nyman	+	+	.	.	.	.	.	.	.	4
<i>Sporobolus virginicus</i> Kunth	+	+	4	3	1	1	+	1	+	9
<i>Centaurea sphaerocephala</i> L.	.	.	.	.	3	4	3	3	4	5
<i>Anchusa crispa</i> Viv. subsp. <i>crispa</i>	.	.	.	.	2	1	1	2	1	5
Characteristic and differential subass. <i>elymetosum farcti</i>										
<i>Elymus farctus</i> (Viv.) Runemark ex Meldeis subsp. <i>farctus</i>	+	.	.	+	.	.	.	.	.	4
Characteristic and differential species of the upper sintaxa										
<i>Pancratium maritimum</i> L.	1	1	1	1	.	.	.	.	.	4
<i>Eryngium maritimum</i> L.	+	.	+	+	.	.	.	.	.	4
<i>Euphorbia paralias</i> L.	1	1	.	.	.	.	.	.	.	4
<i>Medicago marina</i> L.	1	+	.	.	.	.	.	.	.	4
<i>Otanthus maritimus</i> (L.) Hoffmanns. & Link subsp. <i>maritimus</i>	.	.	+	+	+	.	+	.	+	7
Other species										
<i>Lotus cytisoides</i> L. subsp. <i>conradiae</i>	.	.	.	.	.	.	.	.	.	0
Gamisans	2	+	.	.	2	.	.	.	.	5
<i>Silene coelirosa</i> (L.) Godr.	+	.	1	.	.	.	.	.	.	2
<i>Lagurus ovatus</i> L. subsp. <i>ovatus</i>	.	.	1	r	.	.	.	.	.	2
<i>Glaucium flavum</i> Crantz	.	.	r	+	.	.	.	.	.	2
<i>Sonchus oleraceus</i> L.	.	.	.	.	r	.	.	r	.	2
<i>Matthiola tricuspidata</i> (L.) R. Br.	.	.	.	.	+	.	1	+	.	3
<i>Cakile maritima</i> Scop. subsp. <i>maritima</i>	.	.	.	.	+	r	r	+	.	4
<i>Silene nummica</i> Vals.	.	.	.	.	2	2	1	+	.	4
<i>Lobularia maritima</i> (L.) Desv. subsp. <i>maritima</i>	.	.	.	.	1	+	r	.	.	3
<i>Vulpia fasciculata</i> (Forssk.) Fritsch	.	.	.	.	1	1	1	+	+	5
<i>Lotus cytisoides</i> L. subsp. <i>conradiae</i>	.	.	.	.	.	.	.	.	.	0
Gamisans	.	.	.	.	1	1	+	+	+	5
<i>Medicago littoralis</i> Loisel.	.	.	.	.	+	+	.	r	.	3
Sporadic species										
	3	0	0	0	0	0	0	0	0	

Tab. 7 - *Salsola kali-Cakiletum maritima* Costa & Manz. 1981 corr. Rivas-Martínez *et al.* 1992

Relevé number	1	2	3	presences
Cover (%)	40	50	40	
Area (m ²)	5	8	10	
Characteristic and differential species of association				
<i>Cakile maritima</i> Scop. subsp. <i>maritima</i>	3	3	2	3
<i>Salsola kali</i> L.	1	1	1	3
Characteristic and differential species of the upper sintaxa				
<i>Chamaesyce peplis</i> (L.) Prokh.	+	+	+	3
<i>Polygonum maritimum</i> L.	1	+	.	2
<i>Salsola soda</i> L.	1	+	.	2

(Farris *et al.*, 2007a).

CENTAUREETUM HORRIDAE Molinier & Molinier 1955

camphorosmetosum monspeliaca Biondi, Filigheddu & Farris 2001 (Tab. 8, rel. 1-4)

Spiny cushion-forming secondary garrigues dominated by the narrow endemic *Centaurea horrida* growing in the transition between the cliff face and the cliff plateau. These communities are favoured by human-

Tab. 8 - 1-4: *Centaureetum horridae* Molinier & Molinier 1955 *camphorosmetosum monspeliacae* Biondi, Filigheddu & Farris 2001; 5-9: *Euphorbio pithysae Helichrysetum microphylli* Biondi 1992 *euphorbietosum pithysae* Biondi, Filigheddu & Farris 2001

Relevè number	1	2	3	4	5	6	7	8	9	presences
Cover (%)	80	80	60	70	100	60	60	60	90	
Area (m ²)	30	50	50	100	80	30	40	40	10	
Characteristic and differential species of association an subassociation										
Camphorosma monspeliaca L.	+	2	+	1	.	.	2	1	.	6
Centaurea horrida Badarò	4	4	2	3	.	.	.	.	.	4
Helichrysum italicum (Roth) G. Don subsp. microphyllum (Willd.) Nyman	1	2	2	.	1	2	3	3	3	8
Euphorbia pithyusa L. subsp. pithyusa	.	.	2	1	1	1	2	3	3	7
Other species										
Lotus cytisoides L. subsp. conradiae Gamisans	.	+	1	+	.	.	+	+	1	6
Avena fatua L.	+	+	.	+	.	.	+	+	.	5
Thymelaea hirsuta (L.) Endl.	.	.	.	1	4	+	2	.	1	5
Carlina corymbosa L.	+	.	.	.	.	.	1	1	1	4
Dactylis glomerata L. subsp. hispanica (Roth) Nyman	1	.	.	+	.	.	.	.	+	4
Juniperus phoenicea L. subsp. turbinata (Guss.) Nyman	+	+	.	.	.	1	.	.	.	3
Lolium rigidum Gaudin s.l.	.	.	.	1	.	.	1	+	.	3
Pistacia lentiscus L.	.	.	.	.	+	+	.	.	.	3
Reichardia picroides (L.) Roth	1	+	.	.	.	.	.	.	1	3
Brachypodium retusum (Pers.) P. Beauv.	.	.	.	.	.	+	.	+	.	2
Briza maxima L.	.	.	.	+	.	.	.	+	.	2
Bromus hordeaceus L. subsp. hordeaceus	.	.	.	1	.	.	+	.	.	2
Cistus monspeliensis L.	.	.	.	.	2	.	.	+	.	2
Daucus carota L. s.l.	.	+	.	+	.	.	.	.	.	2
Hypochaeris laevigata (L.) Ces., Pass. & Gibelli	.	.	.	.	.	.	+	+	.	2
Lagurus ovatus L. subsp. ovatus	.	+	.	.	.	.	.	.	+	2
Lobularia maritima (L.) Desv. subsp. maritima	.	.	.	.	.	+	.	.	+	2
Rostraria litorea (All.) Holub	.	.	.	.	.	.	+	+	.	2
Rumex bucephalophorus L. subsp. bucephalophorus	.	.	.	.	.	.	+	+	.	2
Triticum ovatum (L.) Raspail	.	.	.	.	.	.	+	+	.	2
Sporadic species	1	1	2	4	2	5	8	1	6	

induced destruction of shrubby and woody evergreen vegetation of the class *Quercetea ilicis* (Farris et al., 2009), even if overgrazing and trampling caused by feral ungulates can cause major disturbance at population level (Pisanu et al., 2012).

EUPHORBIO PITHYUSAE-HELICHRYSSETUM MICROPHYLLI Biondi 1992

euphorbietosum pithysae Biondi, Filigheddu & Farris 2001 (Tab. 8, rel. 5-9)

Primary and secondary garrigues mainly located near the coast, but sometimes also in the inland territories.

COASTAL AND CONTINENTAL HALOPHILOUS VEGETATION

Coastal chasmophytic communities of cliffs and lithosols splashed by marine salt-spray including: chamaephytic communities growing in cliff crevices facing the sea and experimenting high levels of marine salt-spray ascribed to the class *Crithmo-Staticetea*; perennial halophilous to halo-tolerant communities dominated by hemycryptophytes and geophytes, located on permanently wet soils temporarily flooded by salt-water, ascribed to the class *Juncetea maritimi*; littoral communities on sandy soils under salt-spray, ascribed to the class *Saginetea maritimae* and perennial dwarf succulent communities growing on salt-soils ascribed

to the class *Sarcocornietea fruticosae*.

CRITHMO-LIMONIETUM ACUTIFOLII R. & R. Molinier em. Biondi, Filigheddu & Farris 2001 *limonietosum acutifolii* Biondi, Filigheddu & Farris 2001 (Tab. 9)

Perennial communities, including several endemic species exclusive of north-western Sardinia, growing in crevices of both the granitic and schist cliffs reached by intense and continuous salt-spray (Biondi et al., 2001).

JUNCETUM ACUTI Molinier & Tallon 1969 (Tab. 10)

Pauci-specific communities growing in the hedges of salty ponds, on medium salinity soils, never or rarely flooded.

SENECIONI LEUCANTHEMIFOLII-NANANTHETUM PERPUSILLAE Biondi, Filigheddu & Farris 2001

plantagnetosum bellardi Biondi, Filigheddu, Farris 2001 (Tab. 11, 1-12)

Annual communities dominated by endemic *Nananthea perpusilla*, endemic to Sardinia-Corsica, on medium granulometry soils with water stagnation at least for a short period. They present hygrophilous features and can therefore be considered as a transition between the communities of the class *Saginetea maritimae*

Tab 9 - *Crithmo-Limonietum acutifolii* R. & R. Molinier em. Biondi, Filigheddu & Farris 2001 *limonietosum acutifolii* Biondi, Filigheddu & Farris 2001

Relevè number	1	2	presences
Cover (%)	70	40	
Area (m ²)	20	10	
<i>limonietosum acutifolii</i>			
<i>Crithmum maritimum</i> L.	+	1	2
<i>Limonium acutifolium</i> (Rchb.) Salmon	3	2	2
sintaxa			
<i>Erodium corsicum</i> Léman	1	+	2
<i>Frankenia hirsuta</i> L.	1	.	1
<i>Galium verrucosum</i> Hudson var. <i>halophilum</i> (Ponzo) Natali et Jeanmonod	.	r	1
Other species			
<i>Lotus cytisoides</i> L. subsp. <i>conradiae</i> Gamisans	+	r	2
<i>Catapodium balearicum</i> (Willk.) H. Scholz	.	r	1
<i>Daucus carota</i> L. s.l.	.	1	1
<i>Euphorbia pithyusa</i> L. subsp. <i>pithyusa</i>	1	.	1
<i>Helichrysum italicum</i> (Roth) G. Don subsp. <i>microphyllum</i> (Willd.) Nyman	1	.	1
<i>Plantago coronopus</i> L. subsp. <i>coronopus</i>	.	r	1
<i>Reichardia picroides</i> (L.) Roth	.	+	1
<i>leucanthemifolius</i>	.	+	1
<i>Silene nummica</i> Vals.	.	r	1
<i>Silene succulenta</i> Forssk. subsp. <i>corsica</i> (DC.) Nyman	.	r	1
<i>Sporobolus virginicus</i> Kunth	.	r	1
<i>Valantia muralis</i> L.	.	r	1

Tab. 10 - *Juncetum acuti* Moliner & Tallon 1969

Relevè number	1	2	3	presences
Cover (%)	80	50	80	
Area (m ²)	6	20	30	
Characteristic and differential species of association				
<i>Juncus acutus</i> L. subsp. <i>acutus</i>	4	3	5	3
Characteristic and differential species of the upper sintaxa				
<i>Carex extensa</i> Gooden.	1	.	.	1
Other species				
<i>Arthrocnemum fruticosum</i> (L.) Moq.	+	+	2	3
<i>Limbarda crithmoides</i> (L.) Dumort. s.l.	2	2	1	3
<i>Agropyron elongatum</i> (Host) Beauv.	1	+	.	2
<i>Atriplex portulacoides</i> L.	+	.	1	2
<i>Isolepis setacea</i> (L.) R. Br.	+	.	.	1
<i>Tamarix africana</i> Poir.	+	.	.	1

and those of the class *Isoeto durieui-Juncetea bufonii*.

PARAPHOLISO STRIGOSAE-HORDEETUM MARINI Géhu & de Foucault 1977

Hainardetosum cylindrica Biondi, Ballelli, Allegrezza & Manzi 1990 (Tab. 11, rel. 13-14)

Annual communities typical of bare surfaces.

SPERGULARIO SALINAE-HORDEETUM MARINI Biondi, Filigheddu & Farris 2001 (Tab. 11, rel. 15-24)

Nitrophilous annual communities growing on clay-sandy soils completely dry in summer, often in mosaic with the perennial succulent communities of the class *Sarcocornietea fruticosae*.

PUCCINELLIO CONVOLUTAE-ARTHROCNEMETUM MACROSTACHYI (Br.-Bl. (1928) 1933) Géhu ex Géhu, Costa, Scoppola, Biondi, Marchiori, Peris,

Géhu-Franck, Caniglia & Veri 1984

juncetosum maritimi Géhu & Biondi 1994 (Tab.12, rel. 1-3)

Perennial hyperaline dwarf communities growing in the higher positions of salty pans and salty ponds on clay soils that are wet in winter and dry in summer (Filigheddu *et al.*, 2000; Biondi *et al.*, 2001; Biondi *et al.*, 2004).

PUCCINELLIO FESTUCIFORMIS-HALIMIONETUM PORTULACOIDIS Géhu, Biondi, Géhu-Franck & Costa 1992 (Tab. 12, rel. 4-6)

Perennial halophilous communities growing in the hedge of coastal saltmarshes on sandy-clay soils rarely flooded. Some species typical of the association are not here present, similarly to already observe for those of Elba island (Foggi *et al.*, 2006).

PUCCINELLIO FESTUCIFORMIS-SARCOCORNIE-TUM FRUTICOSAE (Br.-Bl. 1928) Géhu 1976 (Tab. 12, rel. 7-9)

Perennial halophilous communities growing in medium-slope hyperaline ponds frequently inundated.

LIMONIETUM LAETI-GLOMERATI Biondi, Filigheddu & Farris 2001

limonietosum glomerati Biondi, Filigheddu & Farris 2001 (Tab. 12, rel. 10-12)

Pauci-specific communities dominated by the hemycryptophyte *Limonium glomeratum*, a triploid species endemic to Sardinia (Arrigoni & Diana, 1985), and the narrow endemic *Limonium laetum*, exclusive of Asinara and Stintino Peninsula (Arrigoni & Diana, 1999), growing in salty depressions behind coastal dunes, which are flooded in winter and have soil with a mixed clay-sandy matrix.

SPERGULARIO SALINAE-TRIGLOCHINETUM BARRELIERI ass. nova (Tab. 12, rel. 13-15; holotypus rel. 13)

Perennial halophilous low-cover communities growing on clay waterlogged salty soils in the bottom of clay shallow depressions.

CHASMOCOMOPHYTIC, EPIPHYTIC AND SCREE VEGETATION

Chasmocomphytic, epiphytic and scree vegetation
Epiphytic and comophytic shaded communities growing in crevices, holes and small caves, or in micro-depressions and micro-terraces with small soil development, referred to the class *Anomodonto-Polypodieta cambrica*.

These communities are usually composed by few species but have an important biogeographical significance because of the high percentage of endemic entities,

Tab. 11 - 1-12: *Senecioni leucanthemifolii-Nanantheetum perpusillae* Biondi, Filigheddu, Farris 2001 *plantaginetosum bellardi* Biondi, Filigheddu, Farris 2001; 13-14: *Parapholis strigosae-Hordeetum marini* Géhu & de Foucault 1977 *hainardetosum cylindricae* Biondi, Ballelli, Allegrezza & Manzi 1990; 15-24: *Spergulario salinae-Hordeetum marini* Biondi, Filigheddu & Farris 2001.

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	presences	
Cover (%)	55	55	55	60	70	70	60	60	60	60	50	50	100	100	80	100	100	80	90	90	100	90	100	100		
Area (m ²)	2	2	2	1	1	1	1	1	1	1	1	1	1	2	1	5	10	2	3	2	1	1	1	2		
Characteristic and differential species of association																										
Nananthea perpusilla (Loisel.) DC.	3	3	3	3	1	1	3	2	1	2	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	12
Senecio leucanthemifolius Poir. subsp. leucanthemifolius	1	1	1	+	1	1	.	.	.	.	+	1	+	.	.	.	.	.	.	.	.	.	.	.	.	12
Romulea requienii Parl.	1
Parapholis strigosa (Dumort.) C.E. Hubb.	2	2	.	.	.	.	.	.	.	.	.	.	.	2
Hordeum marinum Huds. subsp. marinum	5	5	4	4	4	1	4	4	3	2	4	5	.	12
Spergularia salina J. & C. Presl	1	.	+	1	1	.	.	.	.	2	2	8
Parapholis incurva (L.) C.E. Hubb.	+	3	3	+	.	1	.	.	.	4
Differential species of the subassociation <i>plantaginetosum bellardi</i>																										
Hypochoeris glabra L.	2	1	+	+	1	1	1	1	1	+	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	12
Anagallis foemina Miller	+	+	2
Bellium bellidioides L.	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Differential species of the subassociation <i>hainardetosum cylindricae</i>																										
Hainardia cylindrica (Willd.) Greuter	+	+	3	.	.	.	+	.	.	.	.	4
Characteristic and differential species of the upper sintaxa																										
Parapholis incurva (L.) Hubb.	.	.	.	3	1	.	.	.	.	.	1	+	1	.	.	.	.	.	.	.	.	.	.	.	.	5
Polypogon subspathaceus Req.	+	2	.	.	1	1	.	.	4
Catapodium balearicum (Willk.) H. Scholz	+	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
Other species																										
Plantago coronopus L. subsp. coronopus	.	+	1	1	.	.	1	1	1	1	1	1	.	.	.	.	.	.	1	2	2	.	+	1	+	15
Silene nummica Vals.	1	+	.	+	1	1	.	1	.	+	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	9
Bromus hordeaceus L. subsp. hordeaceus	+	+	+	+	1	2	+	+	.	8
Juncus bufonius L.	2	1	2	.	1	3	.	.	.	+	+	.	.	7
Melilotus siculus (Turra) Steud.	+	1	1	+	.	2	.	.	.	.	.	.	6
Frankenia laevis L. subsp. laevis	.	.	.	1	+	+	.	.	.	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	6
Cynodon dactylon (L.) Pers.	+	+	3	2	.	.	.	1	.	.	.	.	.	5
Euphorbia pithyusa L. subsp. pithyusa	.	.	.	+	.	.	1	2	1	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	5
Medicago lupulina L.	+	.	.	.	1	1	.	.	.	4
Anagallis arvensis L. subsp. latifolia (L.) Arcang.	+	.	+	+	3
Camphorosma monspeliaca L.	.	.	.	+	+	3
Gaudinia fragilis (L.) Beauv.	+	2	+	.	.	.	3
Helichrysum italicum (Roth) G. Don subsp. microphyllum (Willd.) Nyman	3
Juncus subulatus Forsskal	+	(+)	.	+	3
Lolium perenne L.	+	.	+	+	.	3
Lolium rigidum Gaudin	+	1	.	.	+	.	.	.	.	.	.	3
Poa annua L.	+	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
Rumex bucephalophorus L. subsp. bucephalophorus	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
Atriplex portulacoides L.	+	+	2
Carex otrubae Podp.	+	+	2
Centaurium erythraea Rafn subsp. erythraea	1	1	2
Cyperus longus L. subsp. badius	+	1	.	.	.	.	.	.	.	2
Geranium molle L.	2
Glebionis coronaria (L.) Spach	+	.	2
Juncus capitatus Weigel	1	1	.	.	.	.	2
Limonium acutifolium (Rchb.) Salmon	2	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Polypogon monspeliensis (L.) Desf.	2	2	2
Rumex pulcher L. subsp. pulcher	+	2
Silene coeli-rosa (L.) Godr.	3	2	.	.	2
Suaeda maritima (L.) Dumort.	2	+	2
Torilis nodosa (L.) Gaertn.	1	1	.	.	2
Trifolium angustifolium L. subsp. angustifolium	+	2
Trifolium resupinatum L.	1	1	.	.	.	.	.	.	.	.	2
Valantia muralis L.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Sporadic species	0	1	0	0	0	0	0	0	0	0	1	1	0	2	7	4	0	0	0	2	1	1	1	0	0	

the narrow area of presence, and finally because they represent the biogeographical connections between the Sardinian-Corsican and the Balearic and Catalan-Provençal provinces

UMBILICO RUPESTRIS-ASPLENIETUM OBOVATI Biondi, Bocchieri, Brugiapaglia, Mulas ex Géhu & Biondi 1994 (Tab. 13, rel. 1)
Plant communities growing in sunny granitic crevices not reached by salt-spray.

Tab. 12 - 1-3: *Puccinellio convolutae-Arthrocnemetum macrostachyi* (Br.-Bl. (1928) 1933) Géhu ex Géhu, Costa, Scoppola, Biondi, Marchiori, Peris, Géhu-Franck, Caniglia et Veri 1984 *juncetosum maritimi* Géhu & Biondi 1994; 4-6: *Puccinellio festuciformis-Halimionetum portulacoidis* Géhu, Biondi, Géhu-Franck & Costa 1992; 7-9: *Puccinellio festuciformis-Sarcocornietum fruticosae* (Br.-Bl. 1928) J. M. Géhu 1976; 10-12: *Limonietum laeti-glomerati* Biondi, Filigheddu & Farris 2001; ; 13-15: *Spergulario salinae-Triglochietum barrelieri* ass. nova.

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	presences
Cover (%)	100	100	100	90	100	100	70	90	80	90	80	80	50	50	50	
Area (m ²)	10	10	10	12	20	30	20	20	50	6	10	6	3	3	3	
Characteristic and differential species of association																
<i>Arthrocnemum macrostachyum</i> (Moric.) Moris	5	3	2	.	.	.	.	.	.	.	.	.	.	.	.	3
<i>Limonium glomeratum</i> (Tausch) Erber	.	1	1	.	.	.	.	.	.	3	2	3	.	.	.	5
<i>Limonium laetum</i> Pignatti	.	.	.	.	.	.	.	.	.	3	3	.	.	.	.	2
<i>Atriplex portulacoides</i> L.	+	+	2	3	5	5	1	1	+	2	1	2	.	.	.	12
<i>Arthrocnemum fruticosum</i> (L.) Moq.	.	.	.	1	1	1	3	4	5	.	.	.	.	.	.	5
<i>Triglochin bulbosum</i> L. susp. <i>barrelieri</i> (Loisel.) Rouy	.	.	.	.	.	+	.	.	.	1	1	1	3	3	2	7
<i>Spergularia salina</i> J. & C. Presl	.	.	.	+	.	.	.	.	.	.	.	.	1	1	2	4
Differential species of the subassociation <i>juncetosum maritimi</i>																
<i>Juncus maritimus</i> Lam.	+	+	1	.	.	.	.	.	.	1	1	.	.	.	.	5
Characteristic and differential species of the upper syntaxa																
<i>Limbarda crithmoides</i> (L.) Dumort. s.l.	.	1	1	.	1	.	.	+	.	1	1	+	.	.	.	7
Other species																
<i>Juncus acutus</i> L. subsp. <i>acutus</i>	.	+	1	.	.	.	.	+	.	2	2	2	.	.	.	6
<i>Lagurus ovatus</i> L. subsp. <i>ovatus</i>	.	.	.	.	+	.	.	.	.	+	+	.	.	.	.	4
<i>Parapholis incurva</i> (L.) C.E. Hubb.	.	.	.	.	.	+	.	.	.	1	+	1	.	.	.	4
<i>Pistacia lentiscus</i> L.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	3
<i>Agropyron elongatum</i> (Host) Beauv.	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	2
<i>Limonium narbonense</i> Mill.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	2
<i>Centaureum erythraea</i> Rafn subsp. <i>erythraea</i>	.	.	.	.	.	.	.	.	.	1	+	.	.	.	.	2
<i>Frankenia hirsuta</i> L.	.	.	.	.	.	.	.	.	.	2	2	.	.	.	.	2
<i>Medicago lupulina</i> L.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	2
<i>Plantago coronopus</i> L. subsp. <i>coronopus</i>	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	2
<i>Sporobolus virginicus</i> Kunth	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	2
Sporadic species	0	0	0	0	2	1	1	0	0	0	1	0	0	0	0	

ASPLENIO-CYMBALARIETUM AEQUITRILLOBAE Pignatti E. & S. 1974 (Tab. 13, rel. 2-3)
Plant communities of the shady crevices with some moist soil, characterized by the Tyrrhenian endemic *Cymbalaria aequitriloba* (Arrigoni, 1979).

BELLIO BELLIDIOIDIS-ARENARIETUM BALEARICAE Biondi & Bagella 2005 (Tab. 13, rel. 4-8)
Plant communities growing on shady granitic terraces, within holes or crevices with dark and moist soil characterized by the presence of the Sardinian-Corsican-Balearic endemic *Arenaria balearica* (Diana Corrias, 1981). Other associated Tyrrhenian endemic species are *Bellium bellidioides* and *Cymbalaria aequitriloba*.

SYNANTHROPIC, FRINGE AND MEGAFORBIC VEGETATION

Synanthropic vegetation
Perennial and tall biennial forbs, grasses and thistle pioneer ruderal and nitrophilous sunny communities ascribed to the class *Artemisietea vulgaris* and annual ephemeral weed, ruderal, nitrophilous and semi-nitrophilous communities ascribed to the class *Stellarietea mediae*.

ASPHODELO AFRICANI-BRACHYPODIETUM RAMOSI Biondi & Mossa 1992 corr. Bacchetta, Guarino, Brullo & Giusso del Galdo 2005

Tab. 13 - 1: *Umbilico rupestris-Asplenietum obovati* Biondi, Bocchieri, Brugiapaglia, Mulas ex Géhu & Biondi 1994; 2-3: *Bellio bellidioidis-Arenarietum balearicae* Biondi & Bagella 2005; 4-8: *Asplenio-Cymbalarietum aequitrilobae* E. Pignatti & S. Pignatti 1974

Relevé number	1	2	3	4	5	6	7	8	presences
Cover (%)	100	80	100	100	100	100	100	100	
Area (m ²)	0,1	1	0	0,2	0,1	0,1	0,2	0	
Characteristic and differential species of association									
<i>Umbilicus rupestris</i> (Salisb.) Dandy	1	.	.	2	.	+	.	.	3
<i>Asplenium obovatum</i> Viv. subsp. <i>obovatum</i>	5	+	.	.	.	.	.	.	2
<i>Cymbalaria aequitriloba</i> (Viv.) A. Chev. subsp. <i>aequitribiloba</i>	1	3	2	.	.	2	.	2	5
<i>Arenaria balearica</i> L.	.	.	.	5	5	5	5	3	5
<i>Bellium bellidioides</i> L.	1	2	5	2	1	1	3	.	7
Characteristic species of the upper syntaxa									
<i>Anogramma leptophylla</i> (L.) Link	.	2	.	.	.	.	.	.	1
Sporadic species	0	2	0	1	0	1	1	0	

brachypodietosum ramosi Biondi, Filigheddu & Farris 2001 (Tab. 14, rel. 1)
Hemycryptophytic heliophilous communities growing in the crevices of rocky areas and in the clearing of maquis and garrigues.

DACTYLO HISPANICAE-CAMPHOROMETUM MONSPELIACAE Biondi, Filigheddu & Farris 2001 (Tab. 14, rel. 2-3)
camphorosmetosum monspeliacae Biondi, Filigheddu & Farris 2001

Tab. 14 - 1: *Asphodelo microcarpi-Brachypodietum ramosi* Biondi & Mossa 1992 *brachypodietosum ramosi* Biondi, Filigheddu & Farris 2001; 2-3: *Dactylo hispanicae-Camphorosmetum monspeliacae* Biondi, Filigheddu & Farris 2001 *camphorosmetosum monspeliacae* Biondi, Filigheddu & Farris 2001

Relevè number	1	2	3	presences
Cover (%)	80	90	90	
Area (m ²)	40	15	20	
Characteristic and differential species of association				
Brachypodium retusum (Pers.) P. Beauv.	3	.	.	1
Asphodelus microcarpus Salzm. et Viv.	+	.	.	
Dactylis glomerata L. subsp. hispanica (Roth) Nyman	+	+	1	3
Camphorosma monspeliaca L.	.	4	3	2
Characteristic and differential species of the upper sintaxa				
Lotus cytisoides L. subsp. conradiae Gamisans	1	+	2	3
Carlina corymbosa L.	1	+	+	3
Panacratium illyricum L.	+2	.	3	2
Anemone hortensis L. subsp. hortensis	1	.	.	1
Bellis sylvestris Cirillo	+	.	.	1
Daucus carota L. subsp. carota	.	.	1	1
Plantago lanceolata L.	+	.	.	1
Reichardia picroides (L.) Roth	+	.	.	1
Sixalix atropurpurea (L.) Greuter & Burdet subsp. grandiflora (Scop.) Soldano & F. Conti	+	.	.	1
Other species				
Parapholis incurva (L.) C.E. Hubb.	.	+	+	2
Rostraria litorea (All.) Holub	.	+	+	2
Silene gallica L.	.	+	+	2
Allium triquetrum L.	2	.	.	1
Arisarum vulgare Targ.-Tozz.	+	.	.	1
Avena fatua L.	.	.	+	1
Briza maxima L.	.	.	+	1
Centranthus calcitrapa (L.) DC.	.	.	+	1
Euphorbia characias L.	r	.	.	1
Galactites elegans (All.) Soldano	+	.	.	1
Galium verrucosum Hudson var. halophilum (Ponzo)	.	.	+	1
Natali et Jeanmonod	.	.	+	1
Hypochoeris achyrophorus L.	.	.	1	1
Hypochoeris laevigata (L.) Ces., Pass. & Gibelli	.	+	+	1
Hypochoeris radicata L.	+	.	.	1
Lagurus ovatus L. subsp. ovatus	.	.	1	1
Lolium rigidum Gaudin s.l.	.	2	.	1
Plantago coronopus L. subsp. coronopus	.	+	.	1
Pulicaria odora (L.) Rchb.	+	.	.	1
Rhagadiolus stellatus (L.) Gaertn.	.	+	.	1
Rumex bucephalophorus L. subsp. bucephalophorus	.	+	.	1
Ruta chalepensis L.	r	.	.	1
Senecio leucanthemifolius Poir. subsp. leucanthemifolius	.	.	+	1
Silene nummica Vals.	.	.	+	1
Trifolium scabrum L. subsp. scabrum	.	+	.	1
Valantia muralis L.	+	.	.	1
Vulpia ligustica (All.) Link	.	.	+	1

Halo-nitrophilous open grasslands growing on the schist cliffs, usually frequented by sea-birds and feral goats.

MESEMBRIANTHEMETUM CRYSTALLINO-NODIFLORIO Bolòs 1957 (Tab. 15, rel. 1)

Annual succulent prostrate, nitrophilous communities growing on rocky or loamy barren often salty soils, mostly in the littoral.

ANTHEMIDO ARVENSI-ECHIETUM PLANTAGINEI ass.nova (Tab. 15, rel. 2-7; holotypus rel. 4)

Sub-nitrophilous spring blooming Mediterranean an-

Tab. 15 - 1: *Mesembrianthemum crystallino-nodiflori* O. Bolòs 1957; 2-7: *Anthemido arvensis-Echietum plantaginei* ass. nova

Relevè number	1	2	3	4*	5	6	7	presences
Cover (%)	60	80	70	80	90	80	80	
Area (m ²)	1	20	50	30	20	30	30	
Characteristic and differential species of association								
Mesembrianthemum nodiflorum L.	3	.	.	.	.	.	.	1
Anthemis arvensis L. subsp. arvensis	.	2	2	2	1	+	1	6
Echium plantagineum L.	.	2	3	4	2	3	3	6
Characteristic and differential species of the upper sintaxa								
Galactites elegans (All.) Soldano	.	1	+	+	1	2	2	6
Rostraria litorea (All.) Holub	.	1	1	1	+	3	1	6
Silene gallica L.	.	2	1	1	+	2	1	6
Bromus hordeaceus L. subsp. hordeaceus	.	.	+	1	+	+	+	5
Glebionis segetum (L.) Fourr.	.	.	2	+	3	3	2	5
Trifolium cherleri L.	.	.	1	+	1	1	1	5
Avena fatua L.	.	+	+	+	.	+	.	4
Carthamus lanatus L. subsp. lanatus	.	.	+	+	+	.	1	4
Cynosurus echinatus L.	.	.	+	.	+	+	.	3
Anacyclus clavatus (Desf.) Pers.	1	+	2
Biserrula pelecinus L.	.	.	+	.	.	+	.	2
Glebionis coronaria (L.) Spach	.	.	+	.	.	.	+	2
Hordeum murinum L. subsp. leporinum (Link) Arcang.	.	+	+	2
Medicago polymorpha L.	.	.	+	.	+	.	.	2
Raphanus raphanistrum L. subsp. raphanistrum	.	1	+	.	.	.	.	2
Rhagadiolus stellatus (L.) Gaertn.	.	.	+	.	+	.	.	2
Trifolium angustifolium L. subsp. angustifolium	1	+	.	2
Other species								
Plantago lagopus L.	.	2	2	+	+	1	1	6
Lolium perenne L.	+	.	+	+	1	1	1	5
Plantago coronopus L. subsp. coronopus	.	.	1	+	1	1	+	5
Hordeum marinum Huds. subsp. marinum	.	.	+	+	.	+	+	4
Trifolium scabrum L. subsp. scabrum	.	.	1	+	+	+	.	4
Carlina corymbosa L.	.	+	.	.	.	+	+	3
Cichorium intybus L. s.l.	.	.	.	+	+	.	.	2
Convolvulus arvensis L.	+	+	2
Daucus carota L. subsp. carota	.	.	+	+	.	.	.	2
Hypochoeris achyrophorus L.	.	.	+	.	+	.	.	2
Trifolium campestre Schreb.	+	+	.	2
Trifolium resupinatum L.	.	.	1	+	.	.	.	2
Trifolium stellatum L.	+	+	2
Urospermum dalechampii (L.) F.W. Schmidt	.	.	+	.	.	+	.	2
Sporadic species								
	3	5	1	0	3	1	1	

nual communities growing on flat deep soils trampled and fertilized by livestock and feral ungulates.

GRASSLAND AND MEADOW VEGETATION

Therophytic grasslands

Pioneer spring and early summer ephemeral plant communities dominated by non nitrophilous annual short herbs and grasses referred to the class *Tuberarietea guttatae*.

SENECIONI LEUCANTHEMIFOLII-MATTHIOLETUM TRICUSPIDATAE (Paradis & Piazza 1992)

Géhu & Biondi 1994 (Tab. 16, rel. 1-2)

Halophilous annual communities growing on the whi-

Tab. 16 - 1-2: *Senecioni leucanthemifolii-Matthioletum tricuspidae* (Paradis & Piazza 1992) Géhu & Biondi 1994; 3-6: *Matthiolo tricuspidae-Silenetum coeli-rosae* ass. nova; 7-9: *Hypecoo procumbentis-Silenetum nummicae* Biondi, Filigheddu & Farris 2001

Relevé number	1	2	3	4	5*	6	7	8	9	presences
Cover (%)	80	80	90	80	80	90	90	80	50	
Area (m ²)	10	10	10	6	4	8	8	10	10	
Characteristic and differential species of association										
<i>Senecio leucanthemifolius</i> Poir. subsp. <i>leucanthemifolius</i>	2	2	.	.	.	.	1	.	1	4
<i>Matthiola tricuspida</i> (L.) R. Br.	3	3	1	2	1	1	1	1	.	8
<i>Silene coelirosa</i> (L.) Godr.	.	.	3	3	4	2	.	.	.	4
<i>Silene nummica</i> Vals.	+	1	.	.	.	.	3	2	3	5
<i>Hypecoum procumbens</i> L.	.	.	.	.	.	.	2	2	+	3
Characteristic and differential species of the upper syntax										
<i>Lagurus ovatus</i> L. subsp. <i>ovatus</i>	+	+	1	.	1	1	.	.	.	5
<i>Silene beguinotii</i> Vals.	.	.	.	1	1	.	2	1	+	5
<i>Vulpia fasciculata</i> (Forssk.) Fritsch	2	.	.	.	.	.	+	+	+	4
Other species										
<i>Lotus cytisoides</i> L. subsp. <i>conradiae</i> Gamisans	.	+	.	+	.	.	.	.	.	2
<i>Sporobolus virginicus</i> Kunth	.	.	.	+	+	.	.	.	.	2
<i>Cakile maritima</i> Scop. subsp. <i>maritima</i>	.	.	.	+	.	.	.	+	.	2
<i>Glaucium flavum</i> Crantz	.	.	.	.	.	.	.	+	.	1
<i>Medicago littoralis</i> Loisel.	+	+	.	.	.	.	+	.	.	3
<i>Parapholis incurva</i> (L.) C.E. Hubb.	.	.	2	1	2	.	.	+	.	4
<i>Plantago coronopus</i> L. subsp. <i>coronopus</i>	.	.	+	.	1	+	+	.	.	4
<i>Anacyclus clavatus</i> (Desf.) Pers.	.	.	+	.	1	1	.	.	.	3
<i>Anagallis arvensis</i> L. subsp. <i>latifolia</i> (L.) Arcang.	+	+	.	.	.	.	+	.	.	3
<i>Anthemis arvensis</i> L. subsp. <i>arvensis</i>	.	.	1	1	.	.	1	.	.	3
<i>Glebionis coronaria</i> (L.) Spach	.	.	2	1	+	.	.	.	.	3
<i>Hordeum marinum</i> Huds. subsp. <i>marinum</i>	.	.	.	+	+	1	.	.	.	3
<i>Hordeum murinum</i> L. subsp. <i>leporinum</i> (Link) Arcang.	1	1	.	+	.	.	.	.	.	3
<i>Lolium rigidum</i> Gaudin s.l.	.	.	1	2	1	.	.	.	.	3
<i>Melilotus siculus</i> (Turra) Steud.	.	.	1	+	+	.	.	.	.	3
<i>Crepis sancta</i> (L.) Babç. subsp. <i>sancta</i>	1	1	.	.	.	.	.	.	.	2
<i>Echium plantagineum</i> L.	.	.	.	+	.	1	.	.	.	2
<i>Euphorbia peplus</i> L.	.	.	.	.	.	.	+	.	+	2
<i>Gynandrisis sisyrrinchium</i> (L.) Parl.	.	.	.	+	.	+	.	.	.	2
<i>Hedypnois rhagadioloides</i> (L.) F.W. Schmidt	.	.	.	.	.	.	1	+	.	2
<i>Lobularia maritima</i> (L.) Desv. subsp. <i>maritima</i>	.	.	.	.	.	.	1	1	.	2
<i>Malva parviflora</i> L.	.	.	.	+	+	.	.	.	.	2
<i>Medicago rigidula</i> (L.) All.	.	.	.	.	.	.	1	+	.	2
<i>Polycarpon tetraphyllum</i> (L.) L. subsp. <i>alsinifolium</i> (Biv.)	.	.	.	.	.	.	.	.	.	2
Ball	.	.	.	.	.	.	1	+	.	2
<i>Torilis nodosa</i> (L.) Gaertn.	.	.	.	+	+	.	.	.	.	2
Sporadic species	0	0	3	1	4	4	2	1	1	

te and the grey dunes in mosaic with the perennial vegetation.

MATTHIOLO TRICUSPIDATAE-SILENETUM COELI-ROSAE ass. nova (Tab. 16, rel. 3-6; holotypus rel. 5)

Halo-nitrophilous annual communities growing on the continental slope of small sandy dunes where abundant deposit of *Posidonia oceanica* was stocked.

HYPECOO PROCUMBENTIS-SILENETUM NUMMICAE Biondi, Filigheddu & Farris 2001 (Tab. 16, rel. 7-9)

Reptant therophytes plant communities growing on trampled flat sandy areas.

Meadow and chionophilous grassland vegetation

Mesophile meadows growing on deep and moist soils, widely spread by human activities, referred to the class *Molinio-Arrhenatheretea*.

Paspalum disticum community (Tab. 17, rel. 1-2)

Perennial hygrophilous communities growing in the hedges of ponds and channels on alluvial soils having a superficial groundwater aquifer or stagnant water for long periods.

AGROSTIO STOLONIFERAЕ-CYPERETUM BADIИ Biondi & Bagella 2005

cyperetosum badii Biondi & Bagella 2005 (Tab. 17, rel. 3)

Perennial hygrophilous communities growing in the central area of shallow wet depressions.

HEATHLAND, DWARF SCRUB AND SCRUB VEGETATION

Heathland and dwarf scrub vegetation

Dwarf scrub secondary communities, also named garrigues as a consequence of both harsh environmental conditions (summer drought, salt-spray, wind) and human use (burning, clearing, grazing and browsing)

Tab. 17 - 1-2: *Paspalum distichum* community; 3: *Agrostis stoloniferae-Cyperetum badii* Biondi & Bagella 2005 *cypretosum badii* Biondi & Bagella 2005

Relevé number	1	2	3	presences
Cover (%)	100	100	100	
Area (m ²)	5	5	8	
Characteristic and differential species of association				
<i>Paspalum distichum</i> L.	4	5	.	2
<i>Agrostis stolonifera</i> L.	.	.	3	1
<i>Cyperus longus</i> L. subsp. <i>badius</i> (Desf.) Asch. et Gr.	.	.	3	1
Characteristic and differential species of the upper syntaxa				
<i>Carex divisa</i> Huds.	.	.	2	1
<i>Trifolium fragiferum</i> L. subsp. <i>fragiferum</i>	.	.	+	1
Other species				
<i>Rumex bucephalophorus</i> L. subsp. <i>bucephalophorus</i>	2	2	.	2
<i>Bromus hordeaceus</i> L. subsp. <i>hordeaceus</i>	.	.	+	1
<i>Callitriche stagnalis</i> Scop.	+	.	.	1
<i>Carex otrubae</i> Podp.	.	.	2	1
<i>Cerastium glomeratum</i> Thuill.	.	+	.	1
<i>Cynosurus echinatus</i> L.	.	.	+	1
<i>Dittrichia viscosa</i> (L.) Greuter s.l.	.	+	.	1
<i>Echium vulgare</i> L. s.l.	.	+	.	1
<i>Hordeum marinum</i> Huds. subsp. <i>marinum</i>	.	.	1	1
<i>Linum bienne</i> Miller	.	+	.	1
<i>Lythrum hyssopifolia</i> L.	.	.	1	1
<i>Mentha pulegium</i> L. subsp. <i>pulegium</i>	.	+	.	1
<i>Plantago lanceolata</i> L.	.	+	.	1
<i>Poa annua</i> L.	.	+	.	1
<i>Ranunculus muricatus</i> L.	.	+	.	1
<i>Ranunculus ophioglossifolius</i> Vill.	2	.	.	1
<i>Ranunculus sardous</i> Crantz s.l.	.	.	+	1
<i>Rumex pulcher</i> L. subsp. <i>pulcher</i>	.	.	+	1
<i>Samolus valerandi</i> L.	+	.	.	1
<i>Silene laeta</i> (Aiton) Godron	.	.	1	1
<i>Trifolium resupinatum</i> L.	.	.	+	1

ascribed to the class *Cisto ladaniferi-Lavanduletea stoechadis*.

STACHYDI GLUTINOSAE-GENISTETUM CORSICAE Gamisans & Muracciole 1984

teucrietosum mari Gamisans & Muracciole 1984 (Tab. 18, rel. 1-3)

Cushion-forming dwarf communities growing on rocky acidic substrata and windy inland sites not reached by salt-spray, characterized by the presence of the Sardinian-Corsican endemic *Genista corsica* (Valsecchi, 1978) and the north-eastern Tyrrhenian endemic *Stachys glutinosa* (Camarda, 1980).

EUPHORBIO CHARACIAE-CISTETUM MONSPELIENSIS ass. nova

cistetosum monspeliensis (Tab. 18, rel. 4-8; holotypus rel. 5)

euphorbietosum dendroidis (Tab. 18, rel. 10-12; holotypus rel. 12)

Secondary scrub communities, dominated by *Cistus monspeliensis*, typical of the early post fire recovery. The communities ascribed to the subassociation *euphorbietosum dendroidis* are more thermophilous and develop on the southern slopes.

Tab. 18 - 1-3: *Stachydi glutinosae-Genistetum corsicae* Gamisans & Muracciole 1984 *teucrietosum mari* Gamisans & Muracciole 1984; 4-8: *Euphorbio characiae-Cistetum monspeliensis* ass. nova *cistetosum monspeliensis* subass. nova; 10-12 *Euphorbio characiae-Cistetum monspeliensis* ass. nova *euphorbietosum dendroidis* subass. nova

Relevé number	1	2	3	4	5*	6	7	8	10	11	12*	presences	
Cover (%)	90	60	70	80	80	80	80	80	80	95	80		
Area (m ²)	50	8	50	100	100	100	100	50	50	50	80		
Characteristic and differential species of association and subassociation													
<i>Stachys glutinosa</i> L.	1	1	3	.	.	.	.	.	.	.	.	3
<i>Genista corsica</i> (Loisel.) DC.	4	3	3	.	.	.	.	.	.	.	.	3
<i>Cistus monspeliensis</i> L.	2	1	.	4	4	4	4	3	3	4	4	10	
<i>Euphorbia characias</i> L.	1	+	1	2	2	2	2	2	+	1	+	11	
<i>Daphne gnidium</i> L.	.	.	.	r	r	+	+	+	.	.	.	5	
<i>Rubus ulmifolius</i> Schott	.	.	.	+	.	+	+	.	.	.	.	3
Differential species of the subassociation <i>teucrietosum mari</i>													
<i>Teucrium marum</i> L.	+	+	+	.	.	.	.	.	.	.	.	3
Differential species of the subassociation <i>euphorbietosum dendroidis</i>													
<i>Euphorbia dendroides</i> L.	1	2	3	3
Other species													
<i>Pistacia lentiscus</i> L.	+	.	.	1	+	1	+	1	1	1	3	9	
<i>Helichrysum italicum</i> (Roth) G. Don subsp. <i>microphyllum</i> (Willd.) Nyman	2	2	+	1	1	1	+	1	.	.	.	8	
<i>Asphodelus microcarpus</i> Salzm. et Viv.	.	.	.	1	1	1	1	1	1	1	.	7	
<i>Brachypodium retusum</i> (Pers.) P. Beauv.	.	.	2	.	+	.	+	.	.	.	.	3
<i>Calicotome villosa</i> (Poirlet) Link	.	.	.	.	.	.	1	.	.	+	1	3
<i>Ferula communis</i> L.	.	.	.	1	1	+	+	1	2	1	.	7	
<i>Pteridium aquilinum</i> (L.) Kuhn subsp. <i>aquilinum</i>	.	.	.	.	.	+	1	.	.	.	.	2
Sporadic species	0	0	3	0	0	0	2	1	0	0	0	17	

FOREST, WOODLAND, SEMIDESERT AND DESERT POTENTIAL NATURAL VEGETATION

Marshy, chionophilous or pioneer riparian shrublands and woodlands

Riverine and lacustrine dwarf woodlands, scrubs and tall grasses communities ascribed to the class *Nerio oleandri-Tamaricetea africanae* and riverine communities growing on wet fluvisols ascribed to the class *Salici purpureae-Populetea nigrae*.

PIPTATHERO MILIACEI-TAMARICETUM AFRICANAE Angius & Bacchetta 2009 (Tab. 19; rel. 1-2)

Sub-halophilous groves having a wide range of tolerance to water and soil salinity (Angius & Bacchetta, 2009).

OENANTHO CROCATAE-VITICETUM AGNI-CASTI ass. nova (Tab. 19, rel. 3-7; holotypus rel. 6)

Dense riparian groves, dominated by tall Mediterranean herbs and the scrub *Vitex agnus-castus*, growing in slowly flowing fresh water.

ALLIO TRIQUETRI-ULMETUM MINORIS Filigheddu, Farris, Bagella & Biondi 1999 (Tab. 20)

Edapho-hygrophilous communities (Filigheddu et al., 1999) which are represented just by a small forest stand in Cala Reale.

Tab. 19 - 1-2: *Piptathero miliacei-Tamaricetum africanae* Angius & Bacchetta 2009; 3-7: *Oenanthe crocatae-Vitice-tum agni-casti* ass. nova

Relevè number	1	2	3	4	5	6*	7	presences
Cover (%)	100	90	100	100	90	80	90	
Area (m ²)	25	20	20	20	20	20	20	
Characteristic and differential species of association								
Tamarix africana Poir.	4	3						2
Vitex agnus-castus L.			5	4	5	5	5	5
Oenanthe crocata L.	2		4	3	2	2	1	6
Other species								
Allium triquetrum L.	1	1				3	1	4
Carex otrubae Podp.	1	1				r	+	4
Rumex conglomeratus Murray	3	2				+	+	4
Apium nodiflorum (L.) Lag. subsp. nodiflorum	+	+					+	3
Galactites elegans (All.) Soldano			+	+	+			3
Juncus acutus L. subsp. acutus	+	1				+		3
Paspalum distichum L.	3	3				+		3
Ranunculus ophioglossifolius Vill.	+					r	r	3
Rubus ulmifolius Schott				+		+	1	3
Rumex crispus L.			+	+	1			3
Samolus valerandi L.	3	2				r		3
Euphorbia segetalis L.	+					+		2
Galium debile Desv.	2						r	2
Phragmites australis (Cav.) Trin.		+						2
Sporadic species	10	8	2	3	3	8	8	

Tab. 20 - *Allio triquetri-Ulmetum minoris* Filigheddu, Farris, Bagella & Biondi 1999 *arisaretosum vulgare* Filigheddu, Farris, Bagella & Biondi 1999

Relevè number	1
Cover (%)	90
Area (m ²)	50
association and subassociation	
Ulmus minor Mill. subsp. minor	4
Allium triquetrum L.	1
Arisarum vulgare Targ.-Tozz.	1
Other species	
Populus canescens (Aiton) Sm.	1
Rubus ulmifolius Schott	1
Oenanthe crocata L.	+
Pistacia lentiscus L.	+
Rumex conglomeratus Murray	+

Eurosiberian and mediterranean climactic zonal and potential natural vegetation

Evergreen and semi-deciduous woodlands, scrublands and maquis typical of Mediterranean Region ascribed to the class *Quercetea ilicis*.

PRASIO MAJORIS-QUERCETUM ILICIS Bacchetta, Bagella, Biondi, Farris, Filigheddu & Mossa 2004 *quercetosum ilicis* Bacchetta, Bagella, Biondi, Farris, Filigheddu & Mossa 2004 (Tab. 21, rel. 1-4)

Tab. 21 - 1-4: *Prasio majoris-Quercetum ilicis* Bacchetta, Bagella, Biondi, Farris, Filigheddu & Mossa 2004 *quercetosum ilicis* Bacchetta, Bagella, Biondi, Farris, Filigheddu & Mossa 2004; 5-13: *Pistacio lentisci-Calicotometum villosae* Biondi, Filigheddu & Farris 2001 *euphorbietosum dendroidis* Farris, Secchi & Filigheddu 2007; 14-15: *Asparago albi-Oleetum sylvestris* Bacchetta, Bagella, Biondi, Farris, Filigheddu & Mossa 2003; 16-21: *Euphorbio characiae-Juniperetum turbinatae* Biondi, Filigheddu & Farris 2001

Relevè number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	presences	
Cover (%)	90	90	90	90	100	100	100	100	100	100	90	100	100	40	90	90	90	90	90	50	100		
Area (m ²)	200	100	200	100	20	50	20	20	30	30	50	50	60	12	10	10	50	20	100	100	200		
Characteristic and differential species of association and of subassociation																							
Quercus ilex L. subsp. ilex	5	4	4	4		+				+												6	
Arisarum vulgare Targ.-Tozz.	1		1	1										1	1			+	1	1	1	9	
Prasium majus L.		+		+							+					1			+	+	1	5	
Pistacia lentiscus L.	+	1			1	1	2	1	1	3	2	3	2	1	2	3		2	2	1	1	18	
Calicotome villosa (Poiret) Link					4	3	3	3	3	3	2	1				+						9	
Euphorbia dendroides L.					+	+		1	2	2	3	2	3	1	+				2			8	
Olea europaea L.	r												+	2	4	3						5	
Juniperus phoenicea L. subsp. turbinata (Guss.) Nyman											1						3	4	5	4	5	5	7
Euphorbia characias L.		1		+	+	2	+	1	1	+							2	1	2	1	1	+	14
Characteristic and differential species of the upper syntaxa																							
Rubia peregrina L. subsp. peregrina							+		+	+				1							r	5	
Clematis cirrhosa L.			+									+		3	2							4	
Pulicaria odora (L.) Rechb.	+			+	+			+														4	
Anagyris foetida L.				+															+			2	
Cyclamen repandum Sm. subsp. repandum	2		2																			2	
Lonicera implexa Aiton subsp. implexa									1	1												2	
Asparagus acutifolius L.													+									1	
Daphne gnidium L.						+																1	
Phillyrea latifolia L.												+										1	
Ruscus aculeatus L.	+																					1	
Other species																							
Allium triquetrum L.																							
Rubus ulmifolius Schott			+	+	2	1	1	+	+	1				1	1							10	
Cistus monspeliensis L.					1	1	1	1	1	+		1										7	
Asphodelus microcarpus Salzm. et Viv.						1			1	+			+						+			5	
Asplenium onopteris L.	+		+	+																		3	
Brachypodium retusum (Pers.) P. Beauv.							+			+	+	1		+								5	
Carex distachya Desf.	1	+	1	1																		4	
Lythrum tribracteatum Spreng.	1		1	+		+																4	
Pteridium aquilinum (L.) Kuhn subsp. aquilinum					1		1	1														3	
Tamus communis L.	r	+	+	+										1								5	
Ferula communis L.											1		1					+			r	4	
Sporadic species	0	0	1	0	1	0	0	0	0	0	0	0	0	18	1	0	0	0	0	0	0	1	

Thermo- to meso-Mediterranean holm oak acidophilous forests (Bacchetta *et al.*, 2009) which occupy the uppermost part of Asinara. They survive just in one stand, Elighe Mannu, and present a low species diversity and stratification as a consequence of the severe pressure from livestock and feral herbivores.

PISTACIO LENTISCI-CALICOTOMETUM VILLOSAE Biondi, Farris & Filigheddu 2001
euphorbietosum dendroidis Farris, Secchi & Filigheddu 2007 (Tab. 21, rel. 5-13)
 Thermophilous shrub communities growing in burnt and overgrazed areas (Farris *et al.*, 2007a).

ASPARAGO ALBI-OLEETUM SYLVESTRIS Bacchetta, Bagella, Biondi, Farris, Filigheddu & Mossa 2003 (Tab. 21, rel. 14-15)
 Climatophilous and edapho-xerophilous woods, sparsely growing far from the coast until 200 m a.s.l. (Bacchetta *et al.*, 2003).

EUPHORBIO CHARACIAE-JUNIPERETUM TURBINATAE Biondi, Filigheddu & Farris 2001 (Tab. 21, rel. 16-21)
 Thermo-Mediterranean xerophilous communities, typical of Paleozoic schist (Gianguzzi *et al.*, 2012), growing from inland to coastline.

Sintaxonomic scheme

POTAMETEA PECTINATI Klika in Klika & Novák 1941

POTAMETALIA PECTINATI Koch 1926

Ranunculion aquatilis Passarge 1964

Callitrichetum stagnalis Segal 1965

Ranunculetum baudotii Br.-Bl. in Br.-Bl., Roussine & Nègre 1952

callitrichetosum hamulatae subass. nova

RUPPIETEA MARITIMAE Tüxen ex Den Hartog & Segal 1964

RUPPIETALIA MARITIMAE Tüxen ex Den Hartog & Segal 1964

Ruppion maritimae Br.-Bl. ex Br.-Bl., Roussine & Nègre 1952

Enteromorpha intestinalidis-Ruppium maritimae Westhoff ex Tüxen & Böckelmann 1957

ISOËTO DURIEUI-JUNCETEA BUFONII Br.-Bl. & Tüxen ex Westhoff, Dijk & Paschier 1946

ISOËTETALIA DURIEUI Br.-Bl. 1936

Isoëtion durieui Br.-Bl. 1936

Lytho hyssopifoliae-Crassuletum vaillantii Bagella, Caria, Farris, Filigheddu 2009

Agrostion salmanticae Rivas Goday 1958 nom. mut.

Anthoxantho aristati-Agrostietum salmanticae Biondi & Bagella 2005

NANOCYPERETALIA FLAVESCENTIS Klika 1935

Nanocyperion flavescens Koch ex Libbert 1932

Junco bufonii-Isolepidetum setaceae O. Bolòs & Masello in O. Bolòs 1979

juncetosum bufonii subass. nova

silenetosum laetae subass. nova

Lytho hyssopifoliae-Silenetum laetae ass. nova

MONTIO FONTANAE-CARDAMINETEA AMARAE Br.-Bl. & Tüxen ex Klika & Hadač 1944

MONTIO FONTANAE-CARDAMINETALIA AMARAE Pawłowski in Pawłowski, Sokołowski & Wallisch 1928

Cardamino amarae-Montion fontanae Br.-Bl. 1926

Montietum fontanae Br.-Bl. 1915

PHRAGMITO AUSTRALIS-MAGNOCARICETEA ELATAE Klika in Klika & Novák 1941

SCIRPETALIA COMPACTI Hejný in Holub, Hejný, Moravec & Neuhäusl 1967 corr. Rivas-Martínez, Costa, Castroviejo & E. Valdés 1980

Scirpion compacti Dahl & Hadač 1941 corr. Rivas-Martínez, Costa, Castroviejo & E. Valdés 1980

Scirpo compacti-Juncetum subulati Géhu, Biondi, Géhu-Franck & Costa 1992

NASTURTIO OFFICINALIS-GLYCERIETALIA FLUITANS Pignatti 1953

Glycerio fluitantis-Sparganion neglecti Br.-Bl. & Sissingh in Boer 1942

Glycerienion fluitantis (Géhu & Géhu-Franck 1987) J.A. Molina 1996

Baldellio ranunculoidis-Eleocharitetum palustris Biondi & Bagella 2005

Phalaridenion arundinaceae Kopeck 1961

Junco acuti-Oenanthetum crocatae Biondi & Bagella 2005

oenanthetosum crocatae Biondi & Bagella 2005

Apion nodiflori Segal in Westhoff & Den Held 1969

Apietum nodiflori Br.-Bl. 1952

AMMOPHILETEA Br.-Bl. & Tüxen ex Westhoff, Dijk & Passchier 1946

AMMOPHILETALIA Br.-Bl. 1933

Ammophilion australis Br.-Bl. 1921 Rivas-Martínez, Costa & Izco in Rivas-Martínez, Lousã, T.E. Díaz, Fernández-González & J.C. Costa 1990

Ammophilenion australis

Sileno corsicae-Ammophiletum arundinaceae Bartolo, Brullo, De Marco, Dinelli, Signorello & Spampinato 1992

Agropyro-Minuartion peploidis Tx. in Br.-Bl. & Tx. 1952

Sporoboletum arenarii (Arènes 1924) Géhu & Biondi 1994

elymetosum farcti Géhu & Biondi 1994

Anchuso crispae-Centaureetum sphaerocephalae ass. nova

CAKILETEA MARITIMAE Tüxen & Preising. ex Br.-Bl. & Tüxen 1952

EUPHORBIETALIA PEPLIS Tüxen 1950

Euphorbion peplis Tüxen 1950

Salsolo kali-Cakiletum maritimae Costa & Manz. 1981 corr. Rivas-Martínez et al. 1992

HELICHRYSO-CRUCIANELLETEA MARITIMAE (Sissingh 1974) Géhu, Rivas-Martínez & Tüxen in Géhu 1975 em. Biondi & Géhu in Géhu & Biondi 1994

HELICHRYSETALIA ITALICI Biondi & Géhu in Géhu & Biondi 1994

Euphorbion pithyusae Biondi & Géhu 1994

Centaureetum horridae Molinier & Molinier 1955

camphorosmetosum monspeliacae Biondi, Filigheddu & Farris 2001

Euphorbio pithyusae-Helichrysetum microphylli Biondi 1992

euphorbietosum pithyusae Biondi, Filigheddu & Farris 2001

CRITHMO-STATICETEA Br.-Bl. in Br.-Bl., Roussine & Nègre 1952 em. Biondi 2007

CRITHMO MARITIMI-STATICETALIA Molinier 1934

Erodio corsici-Limonion articulati (Gamisans & Muracciole) Géhu & Biondi 1994

Crithmo-Limonietum acutifolii Molinier & Molinier 1955 em. Biondi, Filigheddu & Farris 2001

limonietosum acutifolii Biondi, Filigheddu & Farris 2001

JUNCETEA MARITIMI Br.-Bl. in Br.-Bl., Roussine & Nègre 1952

JUNCETALIA MARITIMI Br.-Bl. ex Horvatic 1934

Plantaginion crassifoliae Br.-Bl. in Br.-Bl., Roussine & Nègre 1952

Juncetum acuti Moliner & Tallon 1969

SAGINETEA MARITIMAE Westhoff, Leeuwen & Adriani 1962

SAGINETALIA MARITIMAE Westhoff, Leeuwen & Adriani 1962

Saginion maritimae Westhoff, Leeuwen & Adriani 1962

Senecioni leucanthemifolii-Nanantheetum perpusillae Biondi, Filigheddu & Farris 2001

plantaginetosum bellardi Biondi, Filigheddu, Farris 2001

FRANKENIETALIA PULVERULENTAE Rivas-Martínez ex Castroviejo & Porta 1976

Frankenion pulverulentae Rivas-Martínez. ex Castroviejo & Porta 1976

Parapholiso strigosae-Hordeetum marini Géhu & de Foucault 1977

hainardetosum cylindrica Biondi, Ballelli, Allegranza & Manzi 1990

Spergulario salinae-Hordeetum marini Biondi, Filigheddu & Farris 2001

SARCOCORNIETEA FRUTICOSAE Br.-Bl. & Tüxen ex A. Bolòs & O. Bolòs in A. Bolòs 1950 ex Rivas-Martínez, T.E. Díaz, Fernández-Gonzales, Izco, Loidi, Lousã & Penas 2002

SARCOCORNIETALIA FRUTICOSAE Br.-Bl. 1933 ex Rivas-Martínez, T.E. Díaz, Fernández-Gonzales, Izco, Loidi, Lousã & Penas 2002

Arthrocnemion macrostachyi Rivas-Martínez 1980 ex Rivas-Martínez, T.E. Díaz, Fernandez-Gonzales, Izco, Loidi, Lousã & Penas 2002

Puccinellio convolutae-Arthrocnemetum macrostachyi (Br.-Bl. (1928) 1933) Géhu ex Géhu, Costa, Scoppola, Biondi, Marchiori, Peris, Géhu-Franck, Caniglia & Veri 1984

juncetosum maritimi Géhu & Biondi 1994

Inulion crithmoidis Brullo & Furnari 1988

Puccinellio festuciformis-Halimionetum portulacoidis Géhu, Biondi, Géhu-Franck & Costa 1992

Puccinellio festuciformis-Sarcocornietum fruticosae (Br.-Bl. 1928) 1952 Géhu 1976

LIMONIETALIA Br.-Bl. & O. Bolòs 1958

Triglochino barrelieri-Limonion glomerati Biondi, Diana, Farris & Filigheddu 2001

Limonietum laeti-glomerati Biondi, Filigheddu & Farris 2001

limonietosum glomerati Biondi, Filigheddu & Farris 2001

Spergulario salinae-Triglochinetum barrelieri ass. nova

ANOMODONTO-POLYPODIETEA CAMBRICI Rivas-Martínez 1975

ANOMODONTO-POLYPODIETALIA CAMBRICI O. Bolòs & Vives in O. Bolòs 1957

Polypodium serrati Br.-Bl. in Br.-Bl., Roussine & Nègre 1952

Umbilico rupestris-Asplenietum obovati Biondi, Bocchieri, Brugiapaglia, Mulas ex Géhu & Biondi 1994

Arenarion balearicae O. Bolòs & Molinier 1969

Bellio bellidiodis-Arenarietum balearicae Biondi & Bagella 2005

Asplenio-Cymbalarietum aequitrilobae E. Pignatti & S. Pignatti 1974

ARTEMISIETEA VULGARIS Lohmeyer, Preising & Tüxen ex von Rochow 1951

BRACHYPODIO RAMOSI-DACTYLETALIA HISPANICAE Biondi, Filigheddu & Farris 2001

Thero-Brachypodium ramosi Br.-Bl. 1925

Asphodelo africana-Brachypodietum ramosi Biondi & Mossa 1992 corr. Bacchetta, Guarino, Brullo & Giusso del Galdo 2005

brachypodietosum ramosi Biondi, Filigheddu & Farris 2001

Reichardio maritimae-Dactylion hispanicae Biondi, Filigheddu & Farris 2001

Dactylo hispanicae-Camphorosmetum monspeliacae Biondi, Filigheddu & Farris 2001

camphorosmetosum monspeliacae Biondi, Filigheddu & Farris 2001

STELLARIETEA MEDIAE Tüxen, Lohmeyer & Preising ex von Rochow 1951

CHENOPODIO-STELLARIENEA Rivas Goday 1956

CHENOPODIETALIA MURALIS Br.-Bl. in Br.-Bl., Gajewski, Wraber & Walas 1936

Mesembryanthemion crystallini Rivas-Martínez, Wildpret, Del Arco, O. Rodríguez, Pérez de Paz, García Gallo, Acebes, T. E. Díaz & Fernández-González 1993

Mesembrianthemetum crystallino-nodiflori O. Bolòs 1957

THERO-BROMETALIA (Rivas Goday & Rivas-Martínez ex Esteve 1973) O. Bolòs 1975

Echio plantaginei-Galactition tomentosae O. Bolòs & Molinier 1969

Anthemido arvensis-Echietum plantaginei ass. nova

TUBERARIETEA GUTTATAE (Br.-Bl. in Br.-Bl., Roussine & Nègre 1952) Rivas Goday & Rivas-Martínez 1963 ex Rivas-Martínez, Díaz, Fernández-González, Izco, Loidi, Lousã & Penas 2002

CUTANDIETALIA MARITIMAE Rivas-Martínez, Díez Garretas & Asensi 2002

Alkanno-Maresion nanae Rivas Goday ex Rivas Goday & Rivas-Martínez 1963 corr. Díez-Garretta, Asensi & Gavilá 2001

Senecioni leucanthemifolii-Matthioletum tricuspidatae (Paradis & Piazza 1992) Géhu & Biondi 1994

Matthiolo tricuspidatae-Silenetum coeli-rosae ass. nova

Hypecoo procumbentis-Silenetum nummicae Biondi, Filigheddu & Farris 2001

MOLINIO-ARRHENATHERETEA Tüxen 1937

HOLOSCHOENETALIA VULGARIS Br.-Bl. ex Tchou 1948

Paspalo distichi-Agrostion semiverticillatae Br.-Bl. in Br.-Bl., Roussine & Nègre 1952

Paspalum disticum community

Agrostio stoloniferae-Cyperetum badii Biondi & Bagella 2005

cyperetosum badii Biondi & Bagella 2005

CISTO LADANIFERI-LAVANDULETEA STOECHADIS Br.-Bl. in Br.-Bl., Molinier & Wagner 1940

LAVANDULETALIA STOECHADIS Br.-Bl. in Br.-Bl., Molinier & Wagner 1940

Teucrium mari Gamisans & Muracciole 1984

Stachydi glutinosae-Genistetum corsicae Gamisans & Muracciole 1984

teucrietosum mari Gamisans & Muracciole 1984

Euphorbio characiae-Cistetum monspeliensis ass. nova

cistetosum monspeliensis subass. nova

euphorbietosum dendroidis subass. nova

NERIO OLEANDRI-TAMARICETEA AFRICANAE Br.-Bl. & O. Bolòs 1958

TAMARICETALIA AFRICANAE Br.-Bl. & O. Bolòs 1958 em. Izco, Fernández-González & A. Molina 1984

Tamaricion africanae Br.-Bl. & Bolòs 1958

Piptathero miliacei-Tamaricetum africanae Angius & Bacchetta 2009

Rubo ulmifolii-Nerion oleandri O. Bolòs 1985

Oenanthro crocatae-Viticetum agni-casti ass. nova

SALICI PURPUREAE-POPULETEA NIGRAE Rivas-Martínez & Cantó ex Rivas-Martínez, Bascónes, T.E. Díaz, Fernández-González & Loidi 2001

POPULETALIA ALBAE Br.-Bl. ex Tchou 1948

Populion albae Br.-Bl. ex Tchou 1948

Fraxino angustifoliae-Ulmenion minoris Rivas-Martínez 1975

Allio triquetri-Ulmetum minoris Filigheddu, Farris, Bagella & Biondi 1999

arisaretosum vulgaris Filigheddu, Farris, Bagella & Biondi 1999

QUERCETEA ILICIS Br.-Bl. in Br.-Bl., Roussine & Nègre 1952

QUERCETALIA ILICIS Br.-Bl. ex Molinier 1934

Fraxino orni-Quercion ilicis Biondi, Casavecchia & Gigante ex Biondi, Casavecchia & Gigante in Biondi, Allegranza, Casavecchia, Galdenzi, Gigante & Pesaresi 2013

Clematido cirrhosae-Quercenion ilicis Bacchetta, Bagella, Biondi, Farris, Filigheddu & Mossa 2004

Prasio majoris-Quercetum ilicis Bacchetta, Bagella, Biondi, Farris, Filigheddu & Mossa 2004

quercetosum ilicis Bacchetta, Bagella, Biondi, Farris, Filigheddu & Mossa 2004

PISTACIO LENTISCI-RHAMNETALIA ALATERNI Rivas Martínez 1975

Ericion arboreae Rivas-Martínez (1975) 1987

Pistacio lentisci-Calicotometum villosae Biondi, Filigheddu & Farris 2001

euphorbietosum dendroidis Farris, Secchi & Filigheddu 2007

Oleo sylvestris-Ceratonion siliquae Br.-Bl. ex Guinochet & Drouineau 1944

Asparago albi-Oleetum sylvestris Bacchetta, Bagella, Biondi, Farris, Filigheddu & Mossa 2003

Juniperion turbinatae Rivas-Martínez 1975 corr. 1987

Euphorbio characiae-Juniperetum turbinatae Biondi, Filigheddu & Farris 2001

Plant landscape

Three vegetation series and five geo-sigmeta were identified.

Vegetation series

1) Sardinian coastal, neutro-acidic on Palaeozoic schist, dry thermo-Mediterranean, edapho-xerophilous series of the Phoenician juniper *Euphorbio characiae-Juniperio turbinatae* sigmetum;

2) Sardinian, neutro-acidic, thermo-Mediterranean, climatic and edapho-xerophilous series of the wild olive *Asparago albi-Oleo sylvestris* sigmetum;

3) Sardinian, neutro-acidic, thermo- meso-Mediterranean, climatic series of the holm-oak *Prasio majoris-Quercio ilicis* sigmetum.

SARDINIAN COASTAL, NEUTRO-ACIDIC ON PALAEOZOIC SCHIST, DRY THERMO-MEDITERRANEAN, EDAPHO-XEROPHILOUS SERIES OF THE PHOENICIAN JUNIPER

Euphorbio characiae-Juniperio turbinatae sigmetum
On Palaeozoic schist of the southern part of Asinara and the central granitic portion, the natural potential vegetation is represented by the Phoenician juniper

groves ascribed to the association *Euphorbio characiae-Juniperetum turbinatae*, that is widespread also in the coastline as the non-prevalent edapho-xerophilous vegetation

The more widespread communities of this series are the shrub communities, referred to the association *Pistacio lentisci-Calicotometum villosae* subass. *euphorbietosum dendroidis*, dominated by *Pistacia lentiscus* and *Euphorbia dendroides*. These species are refused by feral goats and mouflon that are proliferating in the island. The dwarf vegetation participating to this series, also very common on the island, is included in the association *Euphorbio pithyusae-Helichrysetum microphylli* on deep soil, whereas the rocky coastal areas are colonized by the cushion-forming spiny community of the association *Centaureetum horridae*. The secondary perennial grassland is represented by the association *Dactylo hispanicae-Camphorosmetum monspeliacae*. Finally, pioneer annual communities are represented by the associations *Catapodio-Evacetum rotundatae* and *Senecioni leucanthemifolii-Nanantheetum perpusillae*.

SARDINIAN, NEUTRO-ACIDIC, THERMO-MEDITERRANEAN, CLIMACIC AND EDAPHO-XEROPHILOUS SERIES OF THE WILD OLIVE

Asparago albi-Olea sylvestris sigmetum

The potential vegetation characterized by *Olea europaea* occupies mainly the inland areas at elevation not exceeding 200 m a.s.l. It is constituted by climacic and edapho-xerophilous small woods, particularly in the southern (Castellaccio) and northern (Cala d'Oli-va) parts of the island. The association *Asparago albi-Oleetum sylvestris* represents the more xerophilous aspects of Sardinian wild olive groves (Bacchetta et al., 2003). Secondary shrub communities are dominated by *Calicotome villosa* and *Euphorbia dendroides*, whereas the dwarf vegetation is here characterized by *Cistus monspeliensis* and referred to the new association *Euphorbio characiae-Cistetum monspeliensis* subass. *euphorbietosum dendroidis*. In xerophilous position the dwarf communities are represented by the association *Stachydi glutinosae-Genistetum corsicae*. The perennial grasslands were ascribed to the association *Dactylo hispanicae-Camphorosmetum monspeliacae*.

SARDINIA, NEUTRO-ACIDIC, THERMO- MESO-MEDITERRANEAN, CLIMACIC SERIES OF THE HOLM-AOK

Prasio majoris-Quercus ilicis sigmetum

Climacic series of the northern part of the island at an elevation over 150-200 m a.s.l., on schist. The potential vegetation is a holm-oak wood referred to the asso-

ciation *Prasio majoris-Quercetum ilicis* (Bacchetta et al., 2004). As a consequence of human induced pressure, the wider spread communities of the series are represented by the evergreen shrub vegetation of the association *Pistacio lentisci-Calicotometum villosae*. The dwarf communities well adapted to fire were dominated by *Cistus monspeliensis* and *Euphorbia characias* (*Euphorbio characiae-Cistetum monspeliensis* subass. *cistosum monspeliensis*), able to colonize the perennial grassland with *Brachypodium ramosum* (association *Asphodelo africanae-Brachypodietum retusi*).

Geo-sigmata

- 1) Coastal halo-rupicolous geo-sigmatum;
- 2) Coastal psammophilous geo-sigmatum;
- 3) Coastal halophilous geo-sigmatum of salty and brackish wetlands;
- 4) Coastal and inland hygrophilous geo-sigmatum of fresh water wetlands;
- 5) Inland rupicolous geo-sigmatum of chasmo-como-phytic communities.

COASTAL HALO-RUPICOLOUS GEO-SIGMETUM

This geo-sigmatum establishes topographic contacts mainly with the Phoenician juniper series and the coastal psammophilous geo-sigmatum and sometimes with the coastal halophilous geo-sigmatum of salty and brackish wetlands and the coastal and inland hygrophilous geo-sigmatum of fresh water wetlands. Behind the aphytic zone reached by waves, the first plant communities are the perennial halophilous ascribed to the association *Crithmo-Limonietum acutifolii*. The annual communities were referred to the association *Senecioni leucanthemifolii-Nanantheetum perpusillae*. At the top of the cliffs, the geo-sigmatum is completed by the dwarf vegetation of the primary garrigues referred to the association *Centaureetum horridae* subassociation *camphorosmetosum monspeliacae* in windy and rocky sites, mainly in the western coast, and the association *Euphorbio pithyusae-Helichrysetum microphylli* on more developed soils. These two dwarf communities can have a dynamic role when they expand in the cliff plateau, as a consequence of burning and clearing of the woody communities induced by human activities: in this case these garrigues represent the contact with the Phoenician juniper series (Farris et al., 2009).

COASTAL PSAMMOPHILOUS GEO-SIGMETUM

The shore is usually colonized by the association *Salsoleo kali-Cakiletum maritimae*. Embryonic and white dunes are colonized by perennial communities, dominated by tall size grasses able to resprout if buried by the sand. The foot of embrional dunes is colonized by the association *Sporoboletum arenarii* while white du-

nes are occupied by the association *Sileno corsicae-Ammophiletum arundinaceae*.

Clearings among perennial communities are colonized by annual associations of the order *Cutandietalia maritimae*, represented by several associations: *Senecioni leucanthemifolii-Matthioletum tricuspidaeae* growing on coarse sands that are exposed to marine salt-spray, on grazed dunes; *Hypocoo procumbentis-Silenetum nummicae* characterized by reptant therophytes and typical of trampled dunes; *Matthiolo tricuspidaeae-Silenetum coeli-rosae* found in the southern part of the island, on dunes separating the sea from brackish ponds, therefore on wet sands with high amount of organic sediment originated mainly by *Posidonia oceanica*; finally only at Spalmatore, the association *Anchuso crispae-Centaureetum sphaerocephalae* was found, on the top of flat dunes, enriched in nitrogen and trampled by feral ungulates.

Topographic contacts are established with the Phoenician juniper series, the coastal halo-rupicolous geo-sigmatum and sometimes with the coastal halophilous geo-sigmatum of salty and brackish wetlands and the coastal and inland hygrophilous geo-sigmatum of fresh water wetlands.

COASTAL HALOPHILOUS GEO-SIGMETUM OF SALTY AND BRACKISH WETLANDS

This geo-sigmatum includes the specialized, species-poor plant communities of silt and clay soils that are flooded for a part of the year by brackish to salt-water. Topographic contacts are established with the Phoenician juniper series and coastal psammophilous geo-sigmatum.

Bentic vegetation with *Ruppia maritima* and *Enteromorpha intestinalis*, referred to the association *Enteromorpha intestinalidis-Ruppiaetum maritimae*, lives in shallow hyperhaline water of retrodunal depressions.

Perennial terrestrial communities, spatially distributed following a salinity gradient, are usually dominated by succulent chamaephytes of the family *Chenopodiaceae*. The hedge of brackish ponds, never or rarely flooded, with silt-clay soils with high salinity are colonized by the association *Puccinellio convolutae-Arthrocnemetum macrostachyi*. The same levels in saltmarshes, but with sandy-clay soils, are occupied by the association *Puccinellio festuciformis-Halimionetum portulacoidis*. Lower levels and depressions flooded for at least winter season, with hyperhaline clay soil, are the site for the association *Puccinellio festuciformis-Sarcocornietum fruticosae*. Depressions behind the dunes and near wetlands, flooded in winter and with a mixed sandy-clay soil, are usually habitat for the association *Limonietum laeti-glomerati*. Finally, in flat clay waterlogged soils, low cover communities of the new association *Spergulario salinae-Triglochinetum barrelieri* were found.

On sandy soils wet throughout the year and sometimes flooded, the hemycryptophytic and geophytic vegetation of the *Juncetea maritimi* class is present, particularly frequent at the margins of temporary ponds, saltmarshes and depressions, here represented by the association *Juncetum acuti*. Finally some brackish depressions are colonized by sub-halophilous groves with *Tamarix africana*.

In mosaic with the perennial vegetation, annual pioneer communities, dominated by *Hordeum marinum* subsp. *marinum*, *Parapholis strigosa* and *Spergularia salina*, referred to the associations *Spergulario salinae-Hordeetum marini* and *Parapholiso strigosae-Hordeetum marini* were found.

COASTAL AND INLAND HYGROPHILOUS GEO-SIGMETUM OF FRESH WATER WETLANDS

In this geo-sigmatum the plant communities of fresh-water bodies are included, ranging from temporary ponds and wetlands, to artificial lakes, springs and streams. Topographic contacts are established with the Phoenician juniper series and the wild olive series.

Rooting macrophytes of freshwater ponds dominated by *Callitriche stagnalis*, *Callitriche hamulata*, and *Ranunculus peltatus* subsp. *baudotii* were included in the class *Potametea pectinati*. These communities are often in contact with tamarisk groves and the perennial grasslands dominated by *Paspalum distichum*.

Small size communities of rock pools were referred to the association *Lythro hyssopifoliae-Crassuletum vaillantii* salt-tolerant and hygrophilous communities of the central part of rivulets were referred to the association *Junco bufonii-Isolepidetum setaceae*, those of the hedge of rivulets or small ponds to the new association *Lythro hyssopifoliae-Silenetum laetae*. *Agrostis pourretii* communities established on areas that are very shortly flooded by freshwater during spring. Annual spring communities were referred to *Montietum fontanae*.

Riparian vegetation of slowly flowing water is represented by *Vitex agnus-castus* groves, growing also behind dunes. Helophytic vegetation is the sub-halophilous community ascribed to the association *Scirpo compacti-Juncetum subulati*. *Eleocharis palustris* subsp. *palustris* communities colonize areas with high inter-annual variation in water depth, in shallow water often rich in nitrates the association *Apietum nodiflori* is found, and the *Junco acuti-Oenanthetum crocatae* is a forb community mainly found in the pebbly beds of oligotrophic streams, characterized by prolonged drought periods.

Finally, the scarcity of perennial freshwater streams is reflected by the rarity of woody communities of the order *Populetalia albae*: *Ulmus minor* woods were found only at La Reale. This is the only community dominated by deciduous trees present in the island. At

the fringe of freshwater woods, in channels and depressions with deep soil, perennial grasslands of the *Molinio-Arrhenatheretea* class grow, referred to the association *Agrostio stoloniferae-Cyperetum badii* and *Paspalum disticum* community.

INLAND RUPICOLOUS GEO-SIGMETUM OF CHASMO-COMOPHYTIC COMMUNITIES

The communities included in this scattered geo-sigmatum represent the maximum development of vascular plant life in strongly selective environments as rocky ones. Topographic contacts are established with the holm-oak series in the northern part of the island, and the wild olive series in the southern part. Rarely some contact is established with the Phoenician juniper series.

In the island chasmo-comophytic communities are present in crevices and micro-terraces of inland cliffs and rocky areas, particularly in the P.ta della Scomunica-P.ta Maestra Serre-Piano Mannu northern ridge, and the P.ta Maestra Fornelli southern massif in the south. Three main communities were detected: *Bellium bellidioides* communities at the edge of crevices (*Bellio bellidiodis-Arenarietum balearicae*); comophytic communities on thin soil in humid and shady crevices exposed to north-eastern quadrant with *Arenaria balearica* and *Cymbalaria aequitriloba* subsp. *aequitriloba* (*Asplenio-Cymbalarietum aequitriloba*); sciaphilous Pteridophytic community with *Ano-*

gramma leptophylla and *Asplenium obovatum* subsp. *obovatum* (*Umbilico rupestris-Asplenietum obovati*).

Habitats of community interest

29 plant associations were recognized as habitats of community interest. As a whole 18 habitats were recognized, of which four are priority (Tab. 22).

Discussion

This is the first comprehensive study of the vegetation and plant landscape of the Asinara island. Overall, 51 plant communities, ascribed to 21 syntaxonomic classes, were detected. Six new associations and seven new subassociations were described. The plant landscape was interpreted as being constituted by eight units, including three sigmeta and five geo-sigmeta. 18 habitats of community interest were recognized. The three sigmeta have a wide spatial distribution and some secondary communities strongly characterized the plant landscape. The geo-sigmeta, though occupying much smaller areas, give a relevant contribution to the plant biodiversity of the island because they host a high number of endemic and rare plant communities and plant species.

At least 47 vascular plant species found in the described plant communities must be taken into account as a target of conservation actions, as protected by national and international conventions or as endemic

Tab. 22 - Correspondence between plant associations and habitats of community interest

Plant association	NATURE 2000 Habitat
<i>Enteromorpha intestinalidis-Ruppia maritima</i> <i>Ranunculetum baudotii</i>	1150* - Coastal lagoons
<i>Salsola kali-Cakiletum maritima</i>	1210 - Annual vegetation of drift lines
<i>Crithmo-Limonietum acutifolii</i>	1240 - Vegetated sea cliffs of the Mediterranean coasts with endemic <i>Limonium</i> spp
<i>Juncetum acuti</i>	1410 - Mediterranean salt meadows (<i>Juncetalia maritimi</i>)
<i>Puccinellio convolutae-Arthrocnemum macrostachyi</i> <i>Puccinellio festuciformis-Halimionetum portulacoidis</i> <i>Puccinellio festuciformis-Sarcocornietum fruticosae</i>	1420 - Mediterranean and thermo-Atlantic halophilous scrubs (<i>Sarcocornetea fruticosi</i>)
<i>Limonietum laeti-glomerati</i> <i>Spergulario salinae-Triglochetum barrelieri</i>	1510* - Mediterranean salt steppes (<i>Limonietalia</i>)
<i>Sporobolietum arenarii</i> <i>Anchuso crispae-Centaureetum sphaerocephalae</i>	2110 - Embryonic shifting dunes
<i>Sileno corsicae-Ammophiletum arundinaceae</i>	2120 - Shifting dunes along the shoreline with <i>Ammophila arenaria</i> (white dunes)
<i>Senecioni leucanthemifolii-Matthioletum tricuspidatae</i> <i>Matthiolo tricuspidatae-Silenetum coeli-rosae</i> <i>Hypecoo procumbentis-Silenetum nummicae</i>	2230 - <i>Malcolmietalia</i> dune grasslands
<i>Junco bufonii-Isolepidetum setaceae</i> <i>Lythro hyssopifoliae-Silenetum laetae</i>	3130 - Oligotrophic to mesotrophic standing waters with vegetation of the <i>Littorelletea uniflorae</i> and/or <i>Isoeto-Nanojuncetea</i>
<i>Lythro hyssopifoliae-Crassuletum vaillantii</i> <i>Anthoxanto aristati-Agrostietum salmanticae</i>	3170* - Mediterranean temporary ponds
<i>Euphorbio characiae-Juniperetum turbinatae</i>	5210 - Arborecent matorral with <i>Juniperus</i> spp
<i>Centaureetum horridae</i> <i>Euphorbio pithyusae-Helichrysetum microphylli</i>	5320 - Low formations of <i>Euphorbia</i> close to cliffs
<i>Asparago albi-Oleetum sylvestris</i>	5330 - Thermo-Mediterranean and pre-desert scrub
<i>Asphodelo microcarpi-Brachypodietum ramosi</i>	6220* - Pseudo-steppe with grasses and annuals of the <i>Thero-Brachypodietea</i>
<i>Allio triquetri-Ulmetum minoris</i>	92A0 - <i>Salix alba</i> and <i>Populus alba</i> galleries
<i>Piptathero miliacei-Tamaricetum africanae</i> <i>Oenanthe crocatae-Viticetum agni-casti</i>	92D0 - Southern riparian galleries and thickets (<i>Nerio-Tamaricetea</i> and <i>Securinegion tinctoriae</i>)
<i>Prasio majoris-Quercetum ilicis</i>	9340 - <i>Quercus ilex</i> and <i>Quercus rotundifolia</i> forests

or of phytogeographical interest (Rossi *et al.*, 2013). Sardinian endemic plants living on coastal dunes are those with the highest conservation priority (Bacchetta *et al.*, 2012). It has been recently showed how trampling (Fenu *et al.*, 2013) and damage of large herbivores (Pisanu *et al.*, 2012) can affect the population performance of rare plants, that can also face negative fragmentation effects (Budroni *et al.*, 2011).

It is already known that insularity plays a major role in shaping plant features under both the life traits (Talavera *et al.*, 2012) and the genetic traits (Magri *et al.*, 2007). The effect of insularity can be observed also on species and/or population depauperation. In the Asinara island, species elsewhere common, such as those typical of the Mediterranean maquis (*Arbutus unedo*, *Erica arborea*, *Myrtus communis* subsp. *communis*, *Chamaerops humilis*, *Rhamnus alaternus* subsp. *alaternus*, *Quercus suber*, *Lavandula stoechas* subsp. *stoechas*) are rare or localized: therefore in the management of vegetation the specificities of this island system must be taken into account. However, the floristic depauperation can give raise to new species combination in plant communities: this is the case of the new dwarf association *Euphorbio characiae-Cistetum monspeliensis* that is vicariant on Asinara island of the Sardinian widespread *Lavandulo stoechadis-Cistetum monspeliensis* (Biondi *et al.*, 2001; Biondi & Bagella, 2005; Bagella *et al.*, 2013c). Another interesting example is that of the new association *Anchuso crispae-Centaureetum sphaerocephalae*. Indeed, even if few individuals of *Centaurea sphaerocephala* were found at the mouth of the river Fiume Santo near Porto Torres (E. Farris, unpublished), where a dense population of *Anchusa crispa* subsp. *crispa* is also present (Pisanu *et al.*, 2013), at this site the presence of the new association *Anchuso crispae-Centaureetum sphaerocephalae* cannot be sustained. This new association is therefore a very narrow endemic one, exclusive of the Asinara National Park at only one location, and worth of protection because of the presence of a Community habitat and the priority species *Anchusa crispa* (Commission of the European Community, 1992).

Human activities played a fundamental role in shaping plant populations and communities of the island. Grazing, browsing, and trampling through livestock and feral ungulates introduction, repeated fire, particularly during the penal colony management (from 1885 to 1997, this is more than 100 years!), and the massive nitrification of soil, had likely negative effects at both the population and the community levels. At population level, negative effects caused by ungulates have been demonstrated on the priority species *Centaurea horrida* (Pisanu *et al.*, 2012), an endangered spiny chamaephyte exclusive of Sardinia (Pisanu *et al.*, 2009) that has a population structure dominated by adults and a life strategy based more on persistence than on

recruitment (Farris *et al.*, 2012).

At community level the major evidence coming out from this investigation, is the lacking or extreme rarity of potential natural vegetation communities (*sensu* Farris *et al.*, 2010a) in the island. Pressure caused by ungulates as goats, mouflon and wildboar are known to have significant negative effects on the recruitment and persistence of woody plants (Farris & Filigheddu, 2008) and in the island dramatic effects were observed on the population structure of all the woody species, with the exception of *Euphorbia dendroides* and partially of *Pistacia lentiscus*. The effects of overgrazing and overbrowsing, have as a consequence not only the lacking of well structured, old growth forest communities, but also the impossibility to identify the potential natural vegetation in some landscape units. This problem is not only merely theoretical, but it has practical consequences for biodiversity conservation and protected areas management (Bagella *et al.*, 2013a; Rosati *et al.*, 2008; Farris & Filigheddu, 2011). The more emblematic case in this study regards the attribution at association level of Phoenician juniper communities: the destruction of mature stands, the floristic impoverishment caused by repeated fires and prolonged overgrazing, do not allow to precisely determine if the juniper potential vegetation should be referred to only one or two associations. Indeed on the granite areas of Asinara, in analogy with the north-eastern Sardinian areas (coastal Gallura, La Maddalena archipelago) it could be hypothesized the potentiality for the development of the association *Oleo-Juniperetum turbinatae*. Simultaneously, urgent measures of management (ungulates eradication, fencing, transplanting) are needed to enhance the juniper dispersal and recruitment, and the potential vegetation recovery, at least in some areas.

Another case is represented by a cork-oak (*Quercus suber* L.) edaphophilous community located in a small area along the Riu di Baddi Longa valley and connected to the holm-oak series. Because the impoverished floristic composition it was not possible the attribution to a specific association and to the habitat of community interest 9330 - *Quercus suber* forests. Urgent conservation actions are needed to recover this community.

Also annual and perennial herbs and grasses are poorly represented in the island. In Mediterranean and sub-Mediterranean environments, even if grazing affects positively plant biodiversity in secondary grassland communities (Farris *et al.*, 2010b; Bagella *et al.*, 2013b; Bagella & Caria, 2011), overgrazing has detrimental effects on the vegetation composition (Kaya *et al.*, 2011), the carbon budget (Unteregelsbacher *et al.*, 2012), the animal community (Negro *et al.*, 2011) favoring the desertification process (Liu *et al.*, 2013). Apart the truly coastal herb communities referred to

the *Cutandietalia maritimae* order, in Asinara inland territory the pioneer non-nitrophilous annual communities of *Tuberarietea guttatae* class were not found. The priority habitat 6220 was then represented just by the communities of the order *Brachypodio ramosi-Dactyletalia hispanicae* (Farris et al., 2007b; Farris et al., 2013b).

Finally, relevant problems affect perennial dune vegetation and the related habitats of community interest. The association *Sileno corsicae-Elytrigetum junceae*, typical of embryonic dunes and ascribed to the habitat 2110, was not detected in this survey, probably as a consequence of grazing and trampling which can have significant negative effects on dune perennial vegetation (Farris et al., 2013a). It is also noteworthy the total absence from the island of dwarf communities belonging to the alliance *Crucianellion maritimae* referable to the priority habitat 2210. Recently it was demonstrated that *Crucianella maritima* suffers significantly from trampling injuries, whereas other plants like *Sporobolus virginicus* seem to benefit of trampling effects (Farris et al., 2013a). Also dunal juniper formations referable to the priority habitat 2250 were not detected, with the exception of an old growth juniper grove with *Juniperus phoenicea* subsp. *turbinata* at Cala Arena, that was floristically impoverished and therefore not ascribable to this habitat.

Conclusions

Our study confirms the effectiveness of the phytosociological approach for the identification of critical issues concerning plant biodiversity. The knowledge of the floristic and ecological features of plant communities and of the dynamic and spatial relationships between each other represent a strong benchmark and should facilitate the choice of short and long-term vegetation and plant landscape management options.

Acknowledgements

The authors are grateful to the Ente Parco Nazionale dell'Asinara for the help and support during the field work.

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Appendix 1: sporadic species

Tab. 1 - Rel. 1: *Lemna gibba* L. (+). Rel. 2: *Paspalum distichum* L. (1), *Ranunculus ophioglossifolius* Vill. (1), *Rumex conglomeratus* Murray (1). Rel. 4: *Apium nodiflorum* (L.) Lag. subsp. *nodiflorum* (3). Rel. 6: *Cyperus longus* L. subsp. *badius* (+), *Eleocharis palustris* (L.) Roem. & Schult. subsp. *palustris* (+), *Isolepis setacea* (L.) R. Br. (+), *Avena fatua* L. (+).

Tab. 3 - Rel. 3: *Lotus corniculatus* L. subsp. *corniculatus* (1), *Trifolium squarrosum* L. (1), *Anacyclus clavatus* (Desf.) Pers. (+), *Anagallis foemina* Miller (+), *Briza minor* L. (+), *Coleostephus myconis* (L.) Cass. ex Rchb. f. (+), *Linum bienne* Miller (+), *Trifolium nigrescens* Viv. subsp. *nigrescens* (+). Rel. 7: *Sagina maritima* G. Don (2), *Matricaria chamomilla* L. (2). Rel. 8: *Plantago lagopus* L. (+), *Romulea columnae* Sebast. & Mauri (+). Rel. 9: *Trifolium pratense* L. s.l. (+). Rel. 11: *Rumex conglomeratus* Murray (r). Rel. 12: *Carex otrubae* Podp. (2), *Lotus angustissimus* L. (+), *Oenanthe crocata* L. (+), *Trifolium lappaceum* L. (+). Rel. 16: *Triglochin bulbosum* L. susp. *barrelieri* (Loisel.) Rouy (+). Rel. 17: *Agrostis stolonifera* L. (+), *Glebionis coronaria* (L.) Spach (+), *Eleocharis palustris* (L.) Roem.

& Schult. subsp. *palustris* (+), *Trifolium fragiferum* L. subsp. *fragiferum* (+).

Tab. 5 - Rel. 1: *Callitriche hamulata* Kutz. (+). Rel. 2: *Isolepis setacea* (L.) R. Br. (1), *Lotus ornithopodioides* L. (+), *Ranunculus sardous* Crantz s.l. (1), *Silene laeta* (Aiton) Godron (+), *Trifolium pratense* L. s.l. (+), *Anagallis arvensis* L. subsp. *latifolia* (L.) Arcang. (+), *Anthemis arvensis* L. subsp. *arvensis* (+). Rel. 3: *Ranunculus peltatus* Schrank subsp. *baudotii* (Godr.) C.D.K. Cook (1). Rel. 5: *Allium triquetrum* L. (+). Rel. 6: *Cerintho major* L. s.l. (+). Rel. 7: *Echium plantagineum* L. (+). Rel. 9: *Silene laeta* (Aiton) Godron (+), *Atriplex portulacoides* L. (+), *Samolus valerandi* L. (2), *Agropyron elongatum* (Host) Beauv. (1).

Tab. 6 - Rel. 1: *Lagurus ovatus* L. subsp. *ovatus* (+), *Matthiola tricuspidata* (L.) R. Br. (+), *Medicago rigidula* (L.) All. (+).

Tab. 8 - Rel. 1: *Euphorbia pithyusa* L. subsp. *cupanii* (Guss. ex Bertol.) Radcl.-Sm. (+). Rel. 2: *Atriplex portulacoides* L. (+). Rel. 3: *Andryala integrifolia* L. (1), *Silene nummica* Vals. (+). Rel. 4: *Asphodelus microcarpus* Salzm. et Viv. (+), *Cynosurus echinatus* L. (+), *Hypochoeris achyrophorus* L. (+), *Senecio leucanthemifolius* Poir. subsp. *leucanthemifolius* (+). Rel. 5: *Artemisia arborescens* L. (r), *Calicotome villosa* (Poir.) Link (+). Rel. 6: *Arisarum vulgare* Targ.-Tozz. (+), *Prasium majus* L. (r), *Teucrium marum* L. (3), *Ruta chalepensis* L. (1), *Rubia peregrina* L. subsp. *peregrina* (+). Rel. 7: *Silene gallica* L. (+), *Cynodon dactylon* (L.) Pers. (+), *Filago gallica* L. (+), *Frankenia laevis* L. subsp. *laevis* (+), *Lotus edulis* L. (+), *Parapholis incurva* (L.) C.E. Hubb. (+), *Rhagadiolus stellatus* (L.) Gaertn. (+), *Trifolium scabrum* L. subsp. *scabrum* (+). Rel. 8: *Daucus carota* L. subsp. *carota* (+). Rel. 9: *Dittrichia viscosa* (L.) Greuter s.l. (1), *Eryngium maritimum* L. (+), *Euphorbia paralias* L. (1), *Glaucium flavum* Crantz (+), *Hordeum murinum* L. subsp. *leporinum* (Link) Arcang. (+), *Vulpia fasciculata* (Forssk.) Fritsch (+).

Tab. 11 - Rel. 1: *Catapodium balearicum* (Willk.) H. Scholz (+). Rel. 2: *Catapodium balearicum* (Willk.) H. Scholz (1), *Polycarpon tetraphyllum* (L.) L. subsp. *alsinifolium* (Biv.) Ball (+). Rel. 3: *Catapodium balearicum* (Willk.) H. Scholz (+). Rel. 11: *Reichardia picroides* (L.) Roth pl. (+). Rel. 12: *Sporobolus virginicus* Kunth (1). Rel. 13: *Bromus hordeaceus* L. subsp. *hordeaceus* (+), *Hainardia cylindrica* (Willd.) Greuter (+). Rel. 14: *Atriplex prostrata* Boucher ex DC. (+), *Bromus hordeaceus* L. subsp. *hordeaceus* (+), *Hainardia cylindrica* (Willd.) Greuter (+), *Polypogon subspatheus* Req. (+). Rel. 15: *Allium triquetrum* L. (1), *Bromus hordeaceus* L. subsp. *hordeaceus* (+), *Hainardia cylindrica* (Willd.) Greuter (3), *Isolepis cernua* (Vahl) Roem. & Schult. (+), *Mentha pulegium* L. subsp. *pulegium* (+), *Ranunculus sardous* Crantz s.l. (1). Rel. 16: *Agrostis stolonifera* L. (+), *Apium nodiflorum*

(L.) Lag. subsp. nodiflorum (+), *Bromus hordeaceus* L. subsp. hordeaceus (+), *Carex divisa* Huds. (3), *Oenanthe globulosa* L. (1). Rel. 17: *Polypogon subspathaceus* Req. (+). Rel. 18: *Hainardia cylindrica* (Willd.) Greuter (+), *Polypogon subspathaceus* Req. (2). Rel. 20: *Lythrum hyssopifolia* L. (+), *Plantago lagopus* L. (+). Rel. 21: *Bromus hordeaceus* L. subsp. hordeaceus (1), *Polypogon subspathaceus* Req. (1). Rel. 22: *Bromus hordeaceus* L. subsp. hordeaceus (2), *Polypogon subspathaceus* Req. (1). Rel. 23: *Bromus hordeaceus* L. subsp. hordeaceus (+). Rel. 24: *Bromus hordeaceus* L. subsp. hordeaceus (+).

Tab. 12 - Rel. 5: *Agropyron repens* (L.) Beauv. (+), *Polypogon subspathaceus* Req. (+). Rel. 6: *Gynandris sisyrinchium* (L.) Parl. (1). Rel. 7: *Juncus subulatus* Forsskal (1). Rel. 11: *Dittrichia viscosa* (L.) Greuter s.l. (+).

Tab. 13 - Rel. 2: *Arisarum vulgare* Targ.-Tozz. (+), *Briza maxima* L. (1). Rel. 4, 6: *Parietaria judaica* L. (+). Rel. 7: *Scrophularia trifoliata* L. (+).

Tab. 15 - Rel. 1: *Parapholis incurva* (L.) C.E. Hubb. (+), *Plantago coronopus* L. subsp. coronopus (1), *Spergularia salina* J. & C. Presl (+). Rel. 2: *Calendula arvensis* L. (1), *Lobularia maritima* (L.) Desv. subsp. maritima (1), *Medicago minima* (L.) L. (+), *Vulpia myuros* (L.) C.C. Gmel. (2), *Anagallis arvensis* L. subsp. latifolia (L.) Arcang. (+). Rel. 3: *Hirschfeldia incana* (L.) Lagr.-Foss. subsp. incana (+). Rel. 5: *Rumex pulcher* L. subsp. pulcher (+), *Scorpiurus muricatus* L. (+), *Sherardia arvensis* L. (+). Rel. 6: *Ornithopus compressus* L. (+). Rel. 7: *Atriplex prostrata* Boucher ex DC. (+).

Tab. 16 - Rel. 3: *Cynosurus echinatus* L. (+), *Hypochoeris achyrophorus* L. (+), *Rostraria litorea* (All.) Holub (+). Rel. 4: *Bartsia trixago* L. (+). Rel. 5: *Eryngium maritimum* L. (+), *Plantago lagopus* L. (r), *Trifolium angustifolium* L. subsp. angustifolium (+), *Trifolium scabrum* L. subsp. scabrum (+). Rel. 6: *Bromus diandrus* Roth subsp. diandrus (+), *Daucus carota* L. subsp. carota (+), *Galactites elegans* (All.) Soldano (+), *Sixalix atropurpurea* (L.) Greuter & Burdet subsp. grandiflora (Scop.) Soldano & F. Conti (+). Rel. 7: *Catapodium rigidum* (L.) C.E. Hubb. ex Dony subsp. rigidum (+), *Rumex bucephalophorus* L. subsp. bucephalophorus (+). Rel. 9: *Fumaria capreolata* L. subsp. capreolata (+).

Tab. 18 - Rel. 3: *Prasium majus* L. (+), *Juniperus phoenicea* L. subsp. turbinata (Guss.) Nyman (+), *Galium verrucosum* Huds. subsp. halophilum (Ponzo) Lambinon (+). Rel. 7: *Brachypodium sylvaticum* (Huds.) P. Beauv. subsp. sylvaticum (+), *Pulicaria odora* (L.) Rchb. (1). Rel. 8: *Lythrum tribracteatum* Spreng. (+). Rel. 12: *Avena fatua* L. (+), *Carlina corymbosa* L. (+), *Lolium rigidum* Gaudin s.l. (+), *Briza maxima* L. (+), *Lagurus ovatus* L. subsp. ovatus (+), *Lobularia maritima* (L.) Desv. subsp. maritima (+), *Andryala integrifolia* L. (+), *Cynosurus echinatus* L. (+), *Hypochoeris*

achyrophorus L. (+), *Dittrichia viscosa* (L.) Greuter s.l. (+), *Ruta chalepensis* L. (1), *Silene gallica* L. (+), *Trachynia distachya* (L.) Link (+), *Carthamus lanatus* L. subsp. lanatus (+), *Galactites elegans* (All.) Soldano (1), *Olea europaea* L. (+), *Polypogon monspeliensis* (L.) Desf. (+).

Tab. 19 - Rel. 1: *Mentha pulegium* L. subsp. pulegium (+), *Glyceria notata* Chevall. (+). Rel. 2: *Lotus ornithopodioides* L. (+). Rel. 4: *Olea europaea* L. (+), *Ferula communis* L. (+). Rel. 6: *Ranunculus muricatus* L. (r). Rel. 7: *Pistacia lentiscus* L. (+), *Brachypodium sylvaticum* (Huds.) P. Beauv. subsp. sylvaticum (r).

Tab. 21 - Rel. 3: *Brachypodium sylvaticum* (Huds.) P. Beauv. subsp. sylvaticum (+). Rel. 5: *Dittrichia viscosa* (L.) Greuter s.l. (+). Rel. 13: *Andryala integrifolia* L. (+), *Trachynia distachya* (L.) Link (+), *Carlina corymbosa* L. (+), *Catapodium rigidum* (L.) C.E. Hubb. ex Dony subsp. rigidum (+), *Geranium molle* L. (+), *Hirschfeldia incana* (L.) Lagr.-Foss. subsp. incana (+), *Hordeum murinum* L. subsp. leporinum (Link) Arcang. (+), *Hypochoeris achyrophorus* L. (+), *Lagurus ovatus* L. subsp. ovatus (+), *Lobularia maritima* (L.) Desv. subsp. maritima (+), *Lolium rigidum* Gaudin (+), *Mercurialis annua* L. (+), *Piptatherum miliaceum* (L.) Coss s.l. (+), *Polypodium cambricum* L. (+), *Polypogon monspeliensis* (L.) Desf. (+), *Reichardia picroides* (L.) Roth (+), *Sideritis romana* L. subsp. romana (+), *Teucrium marum* L. (+), *Torilis nodosa* (L.) Gaertn. (+), *Typha angustifolia* L. (+). Rel. 20: *Polypodium cambricum* L. (1). Rel. 27: *Teucrium marum* L. (+).

Appendix 2: relevés dates and localities

Tab. 1 - Rel. 1: 03/28/2010, Castellaccio. Rel. 2: 04/03/2010, Cala Arena. Rel. 3, 4, 5: 05/22/2010, Cala d'Oliva. Rel. 6: 03/28/2010, Campu Perdu. Rel. 7: 04/03/2010, Ossario. Rel. 8: 04/03/2010, Cala di Scombro.

Tab. 2 - Rel. 1, 2, 3, 4: 05/15/2010, Cala Spalmatore. Rel. 5: 05/28/2010, Cala S. Andrea.

Tab. 3 - Rel. 1, 2: 03/28/2010, Castellaccio. Rel. 3: 06/01/2009, Cala S. Andrea. Rel. 4, 5, 6: 04/02/2010, Cala Reale. Rel. 7: 04/02/2010, Campu Perdu. Rel. 8: 04/03/2010, Ossario. Rel. 9, 10: 04/03/2010, Cala S. Andrea. Rel. 11: 04/03/2010, Cala S. Andrea. Rel. 12, 13, 14, 15, 16, 17: 05/15/2010, Spalmadori.

Tab. 4 - Rel. 1: 03/28/2010, Cala S. Andrea. Rel. 2: 03/28/2010, Castellaccio.

Tab. 5 - Rel. 1: 03/28/2010, Cala d'Oliva. Rel. 2, 3: 04/03/2010, Cala S. Andrea. Rel. 4, 5: 05/15/2010, Spalmadori. Rel. 6, 7, 8: 05/22/2010, Cala d'Oliva. Rel. 9: 05/15/2010, Spalmadori. Rel. 10: 04/02/2010, Fornelli. Rel. 11: 05/22/2010, Cala d'Oliva.

Tab. 6 - Rel. 1, 2: 08/10/2010, Cala Arena, duna. Rel. 3, 4: 07/15/2010, Cala S. Andrea.

Tab. 7 - Rel. 1, 2, 3: 07/15/2010, Cala S. Andrea.

Tab. 8 - Rel. 1, 2, 3, 4: 05/02/1999, Asinara (rel. 27, 28, 29, 30 tab. 38: Biondi et al., 2001). Rel. 5: 04/02/2010, Fornelli. Rel. 6: 04/03/2010, Cala Arena. Rel. 7, 8: 05/21/2010, Punta Sabina. Rel. 9: 07/15/2010, Cala S. Andrea.

Tab. 9 - Rel. 1: 04/02/2010, P.ta Scorno. Rel. 2: 04/03/2010, Cala Arena.

Tab. 10 - Rel. 1: 05/15/2010, Cala Spalmadori. Rel. 2: 05/15/2010, Punta Salippi. Rel. 3: 04/02/2010, Spalmadori.

Tab. 11 - Rel. 1, 2, 3: 04/02/2010, Punta Scorno. Rel. 4, 5, 6: 01/23/2010, Punta Scorno. Rel. 7, 8, 9: 01/23/2010, Semaforo. Rel. 10, 11, 12: 01/23/2010, Cala S. Andrea. Rel. 13: 05/15/2010, Cala S. Andrea. Rel. 14, 15, 16: 05/15/2010, Spalmadori. Rel. 17: 05/15/2010, Punta Salippi. Rel. 18: 05/15/2010, Cala S. Andrea. Rel. 19, 20: 05/15/2010, Piana di Fornelli. Rel. 21, 22: 05/15/2010, Cala Spalmadori. Rel. 23, 24: 09/07/2010, Cala S. Andrea.

Tab. 12 - Rel. 1, 2, 3: 09/07/2010, Cala S. Andrea. Rel. 4, 5: 09/07/2010, Cala S. Andrea. Rel. 6: 05/15/2010, Spalmadori. Rel. 7: 05/15/2010, Punta Salippi. Rel. 8: 05/15/2010, Cala Spalmatore. Rel. 9: 05/15/2010, Punta Salippi. Rel. 10, 11: 04/02/2010, Cala Reale. Rel. 12: 09/07/2010, Cala S. Andrea. Rel. 13, 14, 15: 04/02/2010, Campu Perdu.

Tab. 13 - Rel. 1, 3, 4, 5: 03/28/2010, Castellaccio. Rel. 2: 04/02/2010, Punta Scorno. Rel. 6: 05/03/2010, Punta Scomunica. Rel. 7, 8, 9, 10: 05/21/2010, Punta Scomunica. Rel. 11: 05/22/2010, Castellaccio.

Tab. 14 - Rel. 1: 04/03/2010, Cala Arena. Rel. 2, 3: 05/21/2010, Punta Sabina.

Tab. 15 - Rel. 1: 04/03/2010, Cala Arena. Rel. 2:

04/02/2010, Fornelli. Rel. 3,4,5,6,7: 05/15/2010, Fornelli.

Tab. 16 - Rel. 1: 04/24/2001, Cala S. Andrea (rel. 21 tab. 31: Biondi et al., 2001). Rel. 2: 07/15/2010, Cala S. Andrea. Rel. 3, 4, 5, 6: 05/15/2010, Cala Spalmatore. Rel. 7, 8, 9: 07/15/2010, Cala S. Andrea. Rel. 10, 11, 12, 13, 14: 05/15/2010, Cala Spalmatore.

Tab. 17 - Rel. 1: 03/28/2010, Cala d'Oliva. Rel. 2: 04/03/2010, Cala Arena. Rel. 3: 05/15/2010, Cala Spalmatore.

Tab. 18 - Rel. 1: 04/24/2001, P.ta Scomunica (rel. 9 tab. 38: Biondi et al., 2001). Rel. 2: 04/02/2010, P.ta Maestra Serre. Rel. 3: 03/28/2010, Castellaccio. Rel. 4: 04/02/2010, Elighe Mannu. Rel. 5, 6, 7: 04/02/2010, P.ta Fregata. Rel. 8: 04/02/2010, P.ta Maestra Serre. Rel. 9: 04/02/2010, Azza d'Elighe. Rel. 10: 04/02/2010, Zonca. Rel. 11: 04/02/2010, Cala Tappo. Rel. 12: 05/22/2010, Cala dei Ponzesi.

Tab. 19 - Rel. 1, 2, 3, 4: 05/22/2010, Cala d'Oliva. Rel. 5, 6, 7: 05/28/2010, Cala S. Andrea.

Tab. 20 - Rel. 1: 04/02/2010, Cala Reale.

Tab. 21 - Rel. 1, 2: 04/02/2010, Elighe Mannu. Rel. 3, 4: 04/02/2010, Rio di Baddi Longa, Elighe Mannu. Rel. 5: 04/24/2001, Asinara (rel. 17 tab. 55: Biondi et al., 2001). Rel. 6, 7: 03/28/2010, Castellaccio. Rel. 8, 9: 04/02/2010, Cala Arena. Rel. 10: 04/03/2010, Cala Arena. Rel. 11: 03/28/2010, Castellaccio. Rel. 12, 13, 14, 15, 16: 04/02/2010, Elighe Mannu. Rel. 17: 04/02/2010, Case Bianche. Rel. 18: 04/02/2010, Zonca. Rel. 19: 05/22/2010, Cala dei Ponzesi. Rel. 20: 04/02/2010, P.ta Iscrivani. Rel. 21: 04/02/2010, Cala Arena.

