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The microgeosigmetum of the Colli Berici Oligocene barrier-reef (NE-Italy)

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Abstract

Communities inhabiting different microhabitat of limestone cliffs outcropping in the Colli Berici (NE-Italy) were studied with a phytosociological approach. This rock face system is original both from a geological point of view – being a Venetian Oligocene facies occurring only in this area – and as regards floristic emergencies and plant communities. Biogeographic and bioclimatic factors give the Oligocene barrier-reef unique traits determining the existence of peculiar and often endemic coenoses. Hence, some new associations are described: *Junco bufonii-Polypogonum monspeliensis*, *Campanulo carnicae-Athamantetum turbith*, *Parietario judaicae-Stellarietum pallidae*, *Celtido australis-Fraxinetum orni*. With regard to the coenose characterised by the stenoendemic *Saxifraga berica*, it had been necessary to describe the new association *Saxifragetum bericae* in place of the precedently published *Adiantum-Saxifragetum bericae* which has to be rejected as a *nomen dubium*.

Key words: Colli Berici, microgeosigmetum, northeastern Italy, phytosociology, rock face vegetation.

Introduction

Among the habitat existing in the Colli Berici (NE-Italy) the limestone cliff system, outcropping mainly along the south-eastern border of the area, is considered for a long time now of particular naturalistic relevance because of rare species occurrence, its biogeographical setting, thickness and extent of the exposed rock faces (SBI, 1971). Notwithstanding its isolation in the Po Plain context, the Colli Berici (maximum elevation: 444 m a.s.l.) are thought to be the south-eastern continuation of the close Monti Lessini, as they show stratigraphical analogies with the Paleogene formations of the Lessini Shelf, a paleogeographical unit of the Southern Alps (Bassi *et al.*, 2000). They substantially share common floristic-vegetational features (*Carpinion orientalis*, *Tilio-Acerion*) with low-altitude prealpine slopes, but they show also original traits as consequence of the geographical separation. The occurring of the stenoendemic *Saxifraga berica* (Béguinot, 1904) is well suited to combine this double aspect: on the one hand originality in its highest expression on the other the belonging to the Southern Prealps, which are widely recognized as one of the most relevant Alpine chain parts hosting high numbers of endemics – mainly characteristic of calcareous cliff *Potentilletalia caulescentis* order (Pawłowski, 1970) – due to the role of Pleistocene refugia (e.g. Tribsch & Schönswetter, 2003). Many montane species, very common in prealpine range, do not occur or are absolute rarities in the study area, a decrease particularly affecting the rocky habitat, where rupicolous alpic species, except for *Campanula carnica*, are completely lacking. Thus, the absence of *Potentilla caulescens* is part of the impo-

verishment of the Mediterranean-mountain chorotype whose rate is lower in the study area than in localities with a similar climate lying on outer Venetian pre-Alps (Tasinazzo, 2006). Conversely, the postglacial migration of eastern species along the prealpine foothills resulted in the occurring of *Athamanta turbith* (Zenari, 1921) which is known from Friulan Pre-Alps eastwards, the Colli Berici Oligocene barrier-reef representing the southwesternmost, disjunct distribution site.

At the same time, the Colli Berici are also considered one of the northern Italy geographical unit where the Mediterranean influence is more marked (Barbero, 1979), with the widespread distribution on southern slopes of *Quercetalia ilicis* species – such as *Pistacia terebinthus*, *Asparagus acutifolius* and *Ruscus aculeatus* – locally assuming a relict biogeographic significance. Some exposed rock faces harbour *Teucrium flavum* subsp. *flavum* (Tasinazzo, 2013), another disjunct relic species characteristic of the calciphilous, chasmophytic vegetation occurring in the Mediterranean macrobioclimate (*Asplenietalia glandulosi*).

In spite of these peculiarities, the area is in the Padanian Sector of the Apennino-Balkan Province where a mesotemperate bioclimate predominates (Rivas-Martínez & Rivas-Sáenz, 1996-2009).

The interrelationship between Oligocene reef inhabiting species coming from different phytogeographical regions outlines original communities that cannot be found nowhere else or coenoses occurring at northern boundaries of their distribution range. The microtopographic complexity of the Oligocene reef is responsible for the occurrence of a mosaic of neighbouring communities spreading on very small surfaces, i.e. a

microgeosigmetum (Rivas-Martínez *et al.*, 1999) whose microsigmassociations are reliant on exposure, strata inclination, occurrence or absence of mineral microsoils and of small water-flow.

The study aims to give a phytosociological overview of the plant communities thriving on this unique Oligocene reef embracing different phytogeographic provenances. These communities are inclusive of the above-mentioned microgeosigmetum but also of a lithophilous shrubby coenose colonizing the flat, cracked upper part of the limestone outcrop. The study may also provide a knowledge basis for future evaluations of increasing human pressure (in particular climbing) or recent rainfall pattern changes on the conservation status of some of these fragile habitats protected by the Directive 92/43 EEC.

Study area

The Colli Berici rise island-like in the Venetian plain south of Vicenza (Veneto, north-eastern Italy, Fig. 1). They stretch over an area of less than 200 km² culminating with the maximum elevation of 444 m a.s.l. The area is geologically interpreted as a flattened, slightly bent anticline along a NNE-SSW axis which is thought to be in connection northward to the western part of the Monti Lessini (Antonelli *et al.*, 1990). The stratigraphical succession consists of carbonate and more rare igneous rocks ranging from the Late Cretaceous to the Early Miocene (Bosellini, 1967). The Rupelian Calcareniti di Castelgomberto occur in north-eastern and central-north Colli Berici with a thickness ranging from 80 to 200 m. These carbonates consist of massive limestones and irregularly bedded biogenic calcarenites with coralline red algae and coral colonies, the latter dominating on the eastern margin of the Colli Berici (Bassi *et al.*, 2000). Here, particularly in the Lumignano neighbourhood, they originate rock faces giving the landscape a somehow alpine connotation certainly atypical for a hilly territory (Fig. 2). From a geological point of view, these cliffs represent a particular facies of the Venetian Oligocene, detectable only in this area (Mietto, 2003). The most reliable hypothesis interprets them as the result of discontinuous bioconstructed structures, separated from each other by tidal channels, inside a barrier reef-type setting, i.e. the Colli Berici Oligocene barrier-reef (Frost, 1981). The massive Calcareniti di Castelgomberto overlay the marly limestones belonging to the Marne di Priabona formation, whose partial impermeability cause little water springs close to the cliff base where half-caves (locally 'covoli') and flat bedrock outcrops are frequent. Also the cliffs are characterised by numerous small to medium-size half-caves that originate from the synergy between speleogenetic processes and cliff degradation phenomena, although the origin is often

more complex (Mietto & Sauro, 2003). Besides these covoli, in the Oligocene rock faces undisturbed real caves occur (habitat 8310).

By applying the methodology proposed by Rivas-Martínez (2008) to the data of thermopluviometric stations lying at the piedmont of the hills, the Colli Berici are in an area influenced by a temperate-oceanic to temperate-continental (submediterranean) bioclimate, upper mesotemperate thermotype and prevalently upper subhumid ombrotype (Fig. 3). Nevertheless, the microclimate around the Oligocene reef site is likely to be considered affected by accentuated submediterraneity.

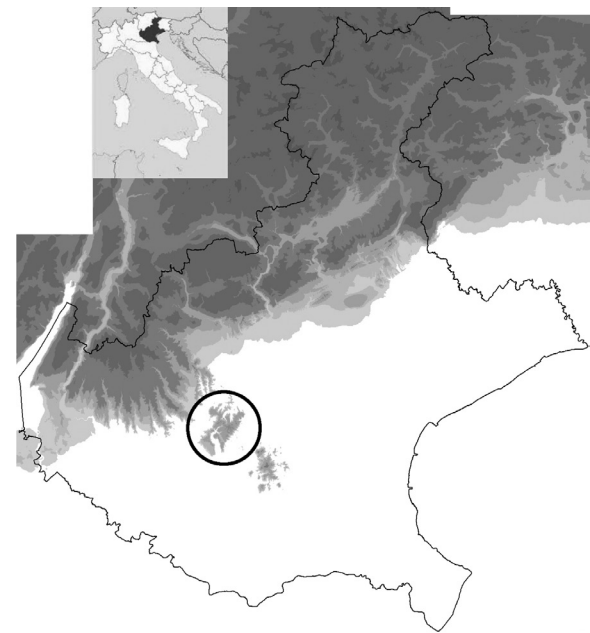


Fig. 1 - The study area (circle) in the northeastern prealpine and Venetian context.



Fig. 2 - Oligocene cliff sector of the Colli Berici with evident half-caves carved in Calcareniti di Castelgomberto formation.

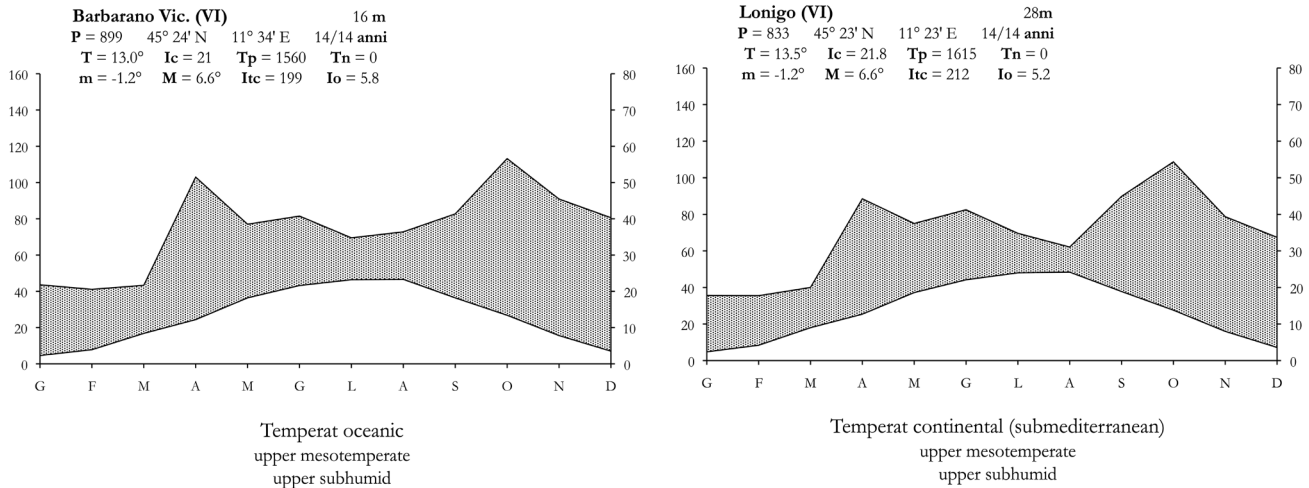


Fig. 3 - Bioclimatic diagrams of Barbarano Vicentino and Lonigo thermo-pluviometric stations.

Materials and Methods

A total of 74 original relevés were used. Only the communities thriving in correspondance of bedrock outcrops were analyzed paying attention to discriminate geomorphological and ecological limits responsible for the occurring of neighboring plant communities inside the microgeosigmetum (Rivas-Martínez *et al.*, 1999). The field survey followed Braun-Blanquet's classical approach (Braun-Blanquet, 1928) using a 8-value alpha-numerical scale including 2a and 2b as proposed by Barkman *et al.* (2004). Data were collected mainly during 2010-2013 years, except for those concerning Tab. 1 which dating back to 2001 have traditional Braun-Blanquet's cover values.

Life forms are taken from Pignatti *et al.* (2005), chorotypes too, but in some cases, e.g. *Bromus condensatus*, *Satureja montana* subsp. *variegata*, data follow Poldini (1989) and Aeschiman *et al.* (2004). The following main groups of chorotypes were used: endemic, mediterranean, eurasiatic, south european-south siberian, atlantic, orophytic south european, boreal, cosmopolitan, eastern and alien. Ellenberg's indicator values were obtained by Pignatti *et al.* (2005). Life form, chorological and ecological spectra were weighted on species coverage values. Archaeophytes refer to Poldini (2009), taking into account only certain assignments. Bryophytes had been considered only in relevés where their presence was relevant as far as biomass and coverage.

The following symbols were used in the tables: M = moss, pl = plantules, B2: herb layer.

Results

Eight communities belonging to seven classes were detected (Fig. 4).

JUNCO BUFONII-POLYPOGONETUM MONSPELIENSIS ass. nova hoc loco (Tab. 1, holotypus: rel. 10)

Differential species: *Juncus bufonius*, *Laphangium luteoalbum*, *Polypogon monspeliensis*, *Veronica anagallis-aquatica*.

Floristic composition: the coenose physiognomy is determined by the dominance of *Polypogon monspeliensis*, more rarely of *Juncus bufonius*, both gaining high constancy (V frequency class); among the few other elements present, *Blackstonia perfoliata/perfoliata* and *Parietaria judaica* (V), *Anagallis arvensis* and *Catapodium rigidum* (IV) occur regularly. *Veronica anagallis-aquatica* is represented by small-size, terrophyte specimens. Interannual variability of the floristic composition and of ephemeral wetland species are common, due to the influence of dry or wet years as have been observed from many parts of the world (Deil, 2005). The ephemeral association develops in late spring-summer season on very small surfaces averaging 1.5 m². The mean species number per relevé is 11.1, excluding some usually occurring cryptogamic entities.

Life forms and chorotypes: in the biological spectrum (Fig. 7) terrophytes are largely dominant (75.8%), followed by hemicryptophytes (19.3%) while geophytes are negligible (2.5%); mediterranean (41.2%) and cosmopolitan (37.7%) groups are equally distributed and prevail on the Eurasiatic components (17%; Fig. 6).

Syntaxonomy: even though original floristic, structural and ecological features are clear arguments in favour of the syntaxonomic autonomy of the coenose, its attribution to higher syntaxonomic ranks appears problematic. Above-mentioned highly frequent species come each one from a different class. In particular, *Polypogon monspeliensis*, which is the most abundant one, is considered characteristic of *Frankenion pulverulenta* alliance (Brullo & Giusso Del Galdo, 2003)

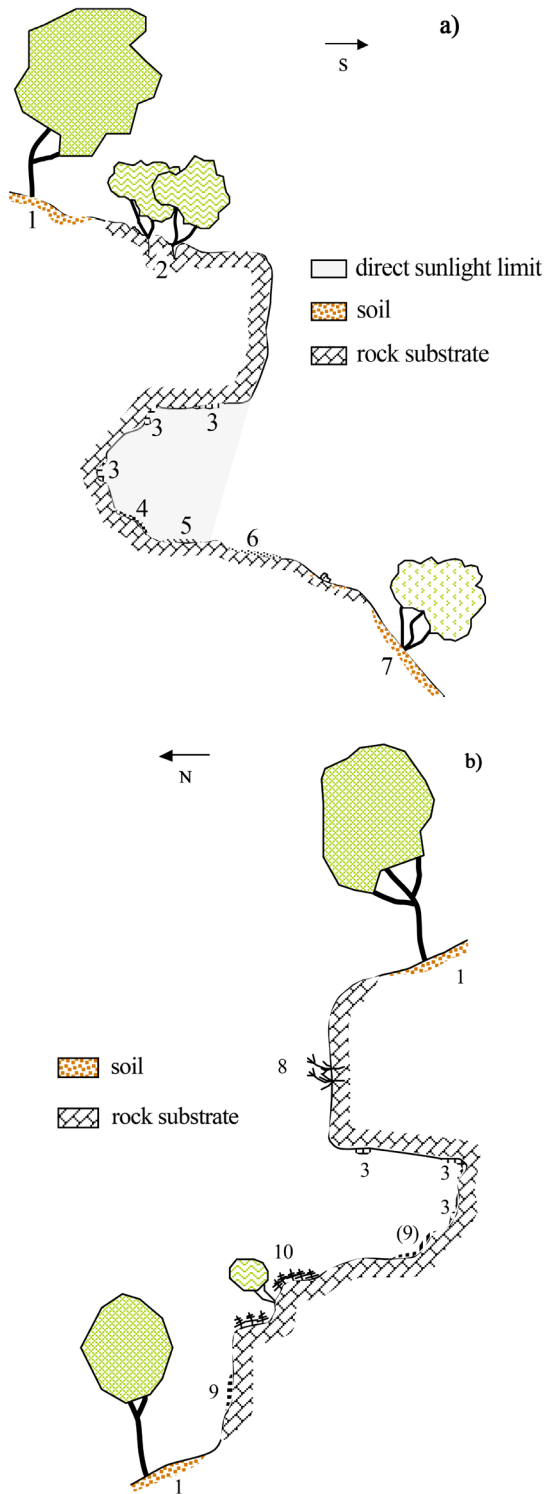


Fig. 4 - Vegetation transect in south-exposed (a) and north-exposed (b) Colli Berici Oligocene barrier-reef. 1: *Buglossoido-Ostryetum*; 2: *Celtido-Fraxinetum*; 3: *Eucladio-Adiantetum*; 4: *Parietaria judaica* community; 5: *Parietario-Stellarietum*; 6: *Junco-Polypogonetum*; 7: *Pruno-Paliuretum*; 8: *Campanulo-Athamantetum*; (9): *Saxifragetum bericae* (suboptimal); 9: *Saxifragetum bericae* (optimal); 10: *Polypodium cambricum* community. Modified from Tasinazzo (2014).

consisting of annual halophilous communities, typically coastal, of temporarily flooded depressions (Biondi *et al.*, 2014) within *Saginetea maritima*. It occurs abundant and frequent also in other subhalophilous communities linked to clayey badlands developing in the inland areas of central Mediterranean territories (*Gaudinio-Podospermion cani*; Biondi *et al.*, 2014). In these areas it also thrives frequently in temporary limestone rock pools (Minissale & Sciandrello, 2014). Nevertheless, inside alpine range *P. monspeliensis* is quite rare, its sociological preferences change but data are lacking, thereby the species is referred with doubt to *Chenopodium rubri* (Aeschmann *et al.*, 2004), alliance comprising annual nitrophilous, halophile-like vegetations (Theurillat *et al.*, 1995) of nitrogen-rich, sandy, periodically flooded substrates. As no other species of the alliance or higher syntaxonomic ranks occur in the stands and considering the different ecological context in which communities of the class generally occur, the attribution of *Junco-Polypogonetum* to *Bidentetea tripartitae* appears at least questionable. The same consideration applies to *Stellarietea mediae* because only *Anagallis arvensis* is present with high frequency and relatively high coverage values. Eutrophic conditions are also highlighted by the frequent occurring of *Parietaria judaica* (*Parietarietea*) deriving from the catenal contacts with the *Parietaria judaica* community. Actually, many of entities occurring in our relevés are considered as character species of ephemeral wetland vegetation (*Isoëto-Nanojuncetea*): *Juncus bufonius*, *Laphangium luteoalbum*, *Centaureum pulchellum*, *Lythrum hyssopifolia* and *Samolus valerandi*; as regards *Blackstonia perfoliata/perfoliata*, some authors evaluates it as characteristic of the class (Brullo & Minissale, 1998; Deil, 2005), whereas other do not so (Pietsch, 1973; Oberdorfer, 1992; Traxler, 1993; Tauber & Petersen, 2000; Aeschmann *et al.*, 2004). *Isoëto-Nanojuncetea* communities occupy a broad range of various natural or man-made habitats and *Nanocyperion* alliance, distributed in Temperate bioclimate, includes prevailing therophytic coenoses with a late summer-autumn blooming on periodically flooded, mesotrophic to eutrophic microsites. It must be observed that *Chenopodium rubri* and *Nanocyperion* communities share some common ecological features comprising substrata undergoing an alternation of moistening and drying up and eutrophic conditions, the latter being not a rule for *Nanocyperion*. In our opinion the attribution of *Junco-Polipogonetum* to *Isoëto-Nanojuncetea* is floristically reasonable but it appears debatable because of its unusual location and absence of real flooding - substituted by incostant dripping water. Original geomorphological features combined with the lack of perialpine tabular material useful for comparisons do not facilitate the syntaxonomical framing. It follows that its ascription to higher ranks requires

Tab. 1 - *Junco bufonii*-*Polypogonetum monspeliensis* ass. nova

N° of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Presence	Frequency %
Area (m ²)	1.5	0.5	1.5	1	2.5	0.5	2	2	3	1.5	1	2	2	2	0.5	1.5	1	1		
Half-cave exposure	S	S	S	E	SE	S	E	S	S	E	SE	E	S	E	S	E	SE	S		
N° of species	11	7	16	11	14	11	7	16	12	12	12	8	10	10	12	7	14	9		
Diff. species of association																				
Polypogon monspeliensis (L.) Desf.	.	.	1	.	1	2	1	1	2	2	3	1	2	3	3	1	+	+	15	83
Juncus bufonius L. (Cl)	3	3	2	1	+	.	.	+	+	+	2	1	+	+	+	1	.	+	15	83
Laphangium luteoalbum (L.) Tzvelev (Cl)	.	+	.	+	1	.	+	1	1	+	.	+	+	.	.	1	+	.	11	61
Veronica anagallis-aquatica L.	+	.	+	+	.	.	.	+	.	.	.	1	1	+	+	.	.	+	9	50
Char. species of <i>Isoëto-Nanojuncetea</i> (Cl)																				
Blackstonia perfoliata (L.) Huds. ssp. perfoliata	+	.	+	+	1	+	+	1	1	+	+	+	+	+	1	.	+	.	15	83
Centaurium pulchellum (Sw.) Druce	.	.	+	+	1	+	.	+	+	1	+	.	.	.	+	.	+	+	11	61
Lythrum hyssopifolia L.	.	.	.	.	.	.	.	.	.	1	3	.	.	+	+	.	1	1	6	33
Samolus valerandi L.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	1	6
Char. species of <i>Stellarietea mediae</i>																				
Anagallis arvensis L.	+	.	+	1	+	1	2	1	+	1	1	1	+	+	.	.	1	.	14	78
Bromus madritensis L.	.	.	.	.	.	1	.	.	+	.	+	.	+	.	1	.	1	+	7	39
Sonchus oleraceus agg.	.	+	.	.	.	.	+	+	+	.	.	.	+	.	.	.	.	.	5	28
Geranium rotundifolium L.	+	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	3	17
Geranium columbinum L.	.	.	.	.	.	+	.	.	.	.	+	.	.	+	.	.	.	.	3	17
Erigeron annuus (L.) Desf.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	+	.	2	11
Papaver rhoeas L.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	2	11
Muscari comosum (L.) Mill.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1	.	2	11
Chaenorhinum minus (L.) Lange ssp. minus	.	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	11
Other species																				
Parietaria judaica L.	.	+	1	1	+	1	+	+	1	1	+	+	.	+	+	+	.	+	15	83
Catapodium rigidum (L.) Hubbard	+	.	.	.	+	1	+	+	1	+	+	.	+	+	.	+	+	.	12	67
Verbena officinalis L.	.	.	.	.	+	.	.	.	.	.	1	.	.	+	+	.	+	1	6	33
Asparagus acutifolius L.	r	.	+	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	4	22
Saxifraga tridactylites L.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	3	17
Minuartia hybrida (Vill.) Shischk. ssp. hybrida	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	11
Medicago lupulina L.	+	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	11
Arenaria serpyllifolia L.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	2	11
Eupatorium cannabinum L.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	2	11
Rosa canina agg. (B2)	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	2	11
Galium lucidum All.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	2	11
Centaurium erythraea Rafn	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	2	11

further informations - not least also investigations on sparse cryptogamic layer occurring in the coenose - for a reliable synsystematic arrangement.

Synecology: with initial surprise we read of the historical presence within the study area of *Lythrum hyssopifolia* in a "mixed wood on the eastern slope of the Monte della Croce of Lumignano" (Cobau, 1940), where *Ostrya carpinifolia*, *Quercus pubescens* and *Fraxinus ornus* form an ecologically inappropriate habitat to the species (*Buglossoido-Ostryetum*). After the discovery of some individual community at the limestone outcrops of Mt. alla Croce the reasons for the historical reporting were clarified being imputable to run-off and propagules dissemination. The association harbours on the floor of the half-caves (= Balmen) or on the opposite rocky plateau at the base of the Oligocene cliff (Fig. 8). Occurrence of hygrophilous

communities belonging to *Agrostio-Scirpoidion* (sub *Holoschoenion-Molinion*; Deil, 1995) or *Scheuchzerio-Caricetea nigrae* (Neto *et al.*, 2007) at the base of rocky cavities under conditions of constant water supply had already been reported in previous studies. The substrate of *Junco-Polypogonetum* consists of thin lenticular accumulations (few mm and up to 1 cm) of fine silt-sandy clasts, periodically moistened by dripping water from micro-sources arising from the wall or roof of the rocky niche in a warm and sunny microclimate (Fig. 5). In rare sites the dripping collects in very small (about 0.3-0.5 m²) standing pools persistent for most of the year, ensuring relatively more stable conditions. Changes in the circulation of underground karst water or dry years are responsible for temporary or permanent variations of the vegetational framework. Therefore, the occurring of the association

appears particularly unstable and inconsistent over the years, because of its close dependence on yearly rainfall and of the uncertainty of microsources. The replacement of *Junco-Polypogonetum* by fragments of *Sedo-Scleranthetea*-communities takes place when moisture conditions change and xeric species take over the hygrophilous ones, as it was observed in Mediterranean macrobioclimate cenoses of *Isoëtetalia* which are substituted by *Tuberaria guttata*-communities in the dry season (Deil, 2005).

In warm periods, under high evapotranspiration rates the Ca⁺⁺ salts are drawn upward by capillarity and accumulate at the surface of thin substratum when water evaporates, making it alkaline. This phenomenon can explain the spread of *P. monspeliensis* indicating salinity or alkalinity conditions. The run-off of domestic pigeons' droppings staying in the upper part of the half-cave and the frequent visit of these rocky niches for recreational purposes result in nitrogen supply and high incidence of some nitrophilous species, like *Anagallis arvensis* and *Bromus madritensis*. In last years the increasing anthropic pressure is leading to habitat ruderalization and degradation of potential vegetation, aspect not represented in the proposed relevés that were performed, except one, in 2001 when human disturb was sporadic.

Synchorology: the association occurs throughout the Colli Berici in the half-caves hollowed in the Oligocene reef; geomorphologically comparable and climatically similar habitats personally visited in eastern Pre-Alps Subsection and in Northwestern Illyrian Province (sensu Blasi *et al.*, 2014) gave negative results, except for the under rock dominating Mezzocorona (TN) in Val Lagarina (locality Castello of S. Gottardo). Here, the known presence of *Polypogon monspeliensis* (Prosser, 2001) was locally accompanied (13.08.2001) by the occurring of *Veronica anagallis-aquatica*, *Centaureum pulchellum*, *Blackstonia perfoliata/perfoliata* and *Parietaria judaica* in an ecological – hilly belt, presence of dripping water, southern exposure - and vegetational framework (*Carpinion orientalis*) that

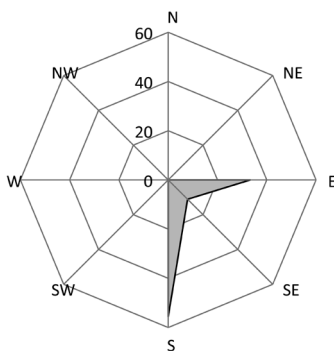


Fig. 5 - Half-cave exposure with *Junco bufonii-Polypogon monspeliensis*.

can be referred to *Junco-Polypogonetum*. The association is therefore to be considered as subendemic.

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EUCLADIO-ADIANTETUM CAPILLI-VENERIS Br.-Bl. ex Horvatic 1934 (Tab. 2)

Differential species: Adiantum capillus-veneris, Eucladium verticillatum (M).

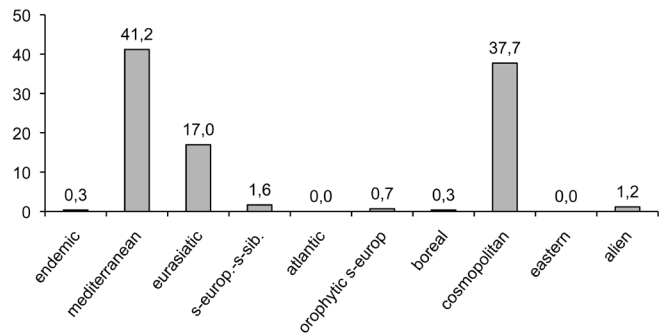


Fig. 6 - Weighted chorological spectrum of *Junco bufonii-Polypogon monspeliensis*.

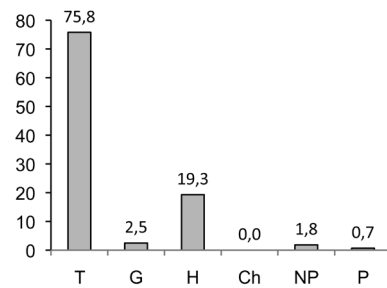


Fig. 7 - Weighted life-form spectrum of *Junco bufonii-Polypogon monspeliensis*.



Fig. 8 - Growth site of *Junco-Polypogonetum* on rocky floor of Oligocene half-caves in the Colli Berici.

Floristic composition: it is an extremely poor-specific, typically two-stratified vegetation type: *Adiantum capillus-veneris* takes root within a lower carpet of lime incrusting *Eucladium verticillatum* moss. Other indetermined bryophytes and other vascular species are only sporadic. *Eucladium verticillatum* is a basi-philous, sciaphilous, moderately termophilous moss adapted to moist-wet rocks (Dierßen, 2001). Stands occupy very small surfaces averaging 2 m².

Syntaxonomy: the stands from the study area are classified into *Eucladio-Adiantetum* association that is considered the widespread basal community of *Adiantetea* class (Deil, 1998). *Ficus carica* was recognized as association differential species by Zechmeister & Mucina (1994) who however attribute the alliance *Adiantion* not to the unrecognized *Adiantetea* but to the *Montio-Cardaminetea* class in disagreement with the prevailing current opinion of most authors. As part of moss and liverwort flora investigations carried out in Italian Alps and Pre-Alps, Giacomini (1951) reports three phytosociological relevés from the cave entrance on the M.t Tondo in the Colli Berici, which he attributes to *Eucladio-Adiantetum*. They are lacking in vascular plants but the occurring of *Adiantum capillus-veneris* is reported in the text; this material was recognized as belonging to the most widespread and typical subass. *eucladietosum* by Dakskobler *et al.* (2014).

Synecology: the community develops on the roof and walls of shaded half-caves in correspondence of carbonate-rich dripping water; the half-cave offers constant microclimate parameters, i.e. no direct rain, air humidity guaranteed supply (Deil, 1995), nevertheless the coenose tolerates quite well also prolonged summer dryness but half-light conditions are required. Warm temperatures promote the deposit of limestone concretions among *Eucladium* leaves giving rise to initial travertine formations. The concretionary process remains

at an early stage because of the inconstancy of water supply which *Eucladium* is able to confront pretty well. The most flourishing individual communities are found in sites best provided in atmospheric moisture because of either constant dripping water from the roof or the occurring of micro springheads from the wall, or due to better exposures or tree vegetation growing in front of half-cave.

Synchorology: the community is widespread in the Mediterranean basin but also extends to atlantic coasts up to Ireland (Deil, 1998).

Natura 2000 Habitat: none.

CAMPANULO CARNICAE-ATHAMANTETUM TURBITH ass. nova *hoc loco* (Tab. 3, *holotypus*: rel.7)

Differential species: *Athamanta turbith* subsp. *turbith*, *Teucrium flavum* subsp. *flavum*.

Floristic composition: the coenose is sparsely distributed on oligocene little-size cliffs and its physiognomy arises from the dominance of *Athamanta turbith* and *Campanula carnica*. Besides the two species, also *Galium lucidum*, *Parietaria judaica* and *Satureja montana/variata* are at V frequency class. Woody species are almost exclusively in the form of plantulae. Mean species number per stand is 12.9.

Life forms and chorotypes: the coenose is almost entirely made up of hemicryptophytes (66.5%) as a result of high coverage values of *Athamanta turbith*, *Campanula carnica/carnica*, *Parietaria judaica* and *Galium lucidum* (Fig. 10). With regard to biogeographic distribution, eastern (28.8%) and mediterranean (23.4%) group species predominate on endemic ones (12.2%; Fig. 9). The prevalent geoelements include some of the most peculiar species which contribute to characterise the biogeographical identity of the study area and of the coenose too (*Athamanta turbith/turbith*, *Teucrium flavum/flavum*). The meeting of eastern and mediterranean

Tab. 2 - *Eucladio-Adiantetum capilli-veneris* Br.-Bl. ex Horvatić 1934

N° of relevé	1	2	3	4	5	6	Presence	Frequency %
Area (m ²)	3	1	1	2	2	3		
N° of species	4	2	4	3	6	3		
<hr/>								
Diff. species of association								
<i>Adiantum capillus-veneris</i> L. (All, Or, Cl)	3	4	5	5	2a	4	6	100
<i>Eucladium verticillatum</i> (With.) Bruch & Schimp. (All, Or, Cl)	4	2b	1	2a	2a	4	6	100
Char. species of <i>Adiantion</i> (All), <i>Adiantetalia</i> (Or) and <i>Adiantetea</i> (Cl)								
<i>Pellia endiviifolia</i> (Dicks.) Dumort.	.	.	.	.	.	1	1	17
Char. species of <i>Asplenietea trichomanis</i>								
<i>Campanula carnica</i> Mert. & W.D.J. Koch ssp. <i>carnica</i>	.	.	+	.	+	.	2	33
<i>Asplenium ruta-muraria</i> L.	.	.	.	.	+	.	1	17
Other species								
<i>Parietaria judaica</i> L.	+	.	+	.	+	.	3	50
<i>Conocephalum conicum</i> (L.) Underw.	2b	.	.	.	.	.	1	17
<i>Hedera helix</i> L.	.	.	.	+	.	.	1	17
<i>Ficus carica</i> L. (pl)	.	.	.	.	+	.	1	17

Tab. 3 - *Campanulo carnicae-Athamantetum turbith* ass. nova

N° of relevé	1	2	3	4	5	6	7	8	9	10	Presence	Frequency %
Area (m ²)	6	8	15	15	20	10	20	10	8	4		
Cliff exposure	W	E	NE	E	E	E	SE	NE	SW	SW		
N° of species	12	10	15	13	18	17	14	13	9	8		
Diff. species of association												
<i>Athamanta turbith</i> (L.) Brot. ssp. <i>turbith</i>	3	2b	2b	2b	2b	2b	2a	1	.	1	9	90
<i>Teucrium flavum</i> L. ssp. <i>flavum</i> (Cl)	.	.	.	.	.	.	.	1	r	.	2	20
Char. species of <i>Physoplexido-Saxifragion</i> (All) and <i>Potentilletalia caulescentis</i>												
<i>Campanula carnica</i> Mert. & W.D.J. Koch ssp. <i>carnica</i> (All)	1	1	2a	+	1	+	1	2a	+	2b	10	100
<i>Asplenium ruta-muraria</i> L.	+	.	.	+	+	+	+	r	.	+	7	70
<i>Polypodium cambricum</i> L.	.	.	.	.	+	.	.	.	.	.	1	10
Char. species of <i>Asplenietea trichomanis</i> (Cl)												
<i>Asplenium trichomanes</i> L. ssp. <i>quadrivalens</i> D.E. Mey.	.	.	+	.	.	+	.	r	.	.	3	30
<i>Muscari botryoides</i> (L.) Mill. ssp. <i>longifolium</i> (Rigo) Garbari	.	.	.	.	.	.	.	.	1	.	1	10
Char. species of <i>Festuco-Brometea</i>												
<i>Satureja montana</i> L. ssp. <i>variegata</i> (Host) P.W. Ball	1	2a	2a	2a	1	+	+	+	.	.	8	80
<i>Bromus condensatus</i> Hack. ssp. <i>microtrichus</i> (Borbás) Poldini & Oriolo	+	.	+	1	2a	1	+	1	.	.	7	70
<i>Melica ciliata</i> L. ssp. <i>ciliata</i>	.	.	.	+	1	+	+	+	.	.	5	50
<i>Sanguisorba minor</i> Scop.	.	.	+	+	+	.	.	.	.	.	3	30
<i>Teucrium montanum</i> L.	.	.	+	.	+	.	.	.	.	.	3	30
<i>Erysimum rhaeticum</i> (Hornem.) DC.	.	.	.	+	+	.	.	.	.	.	2	20
<i>Euphorbia cyparissias</i> L.	.	r	.	.	.	+	.	.	.	.	2	20
<i>Stachys recta</i> L. ssp. <i>recta</i>	.	+	.	.	+	.	.	.	.	.	2	20
Char. species of <i>Trifolio-Geranietea</i>												
<i>Galium lucidum</i> All.	+	+	1	+	+	1	+	+	.	1	9	90
<i>Anthericum ramosum</i> L.	.	+	+	+	.	+	.	.	.	.	4	40
<i>Arabis turrita</i> L.	.	.	.	.	+	+	.	.	+	+	4	40
Char. species of <i>Rhamno-Prunetea</i> or <i>Quercu-Fagetea</i>												
<i>Fraxinus ornus</i> L. (pl+B2)	+	1	+	1	1	+	+	.	.	.	7	70
<i>Emerus majus</i> Mill. ssp. <i>majus</i> (pl+B2)	+	+	+	.	.	.	.	.	r	1	5	50
<i>Amelanchier ovalis</i> Medik. (pl+B2)	1	.	+	.	.	+	+	.	.	.	4	40
<i>Hedera helix</i> L.	.	.	.	.	.	.	.	+	+	.	2	20
<i>Melittis melissophyllum</i> L.	.	.	.	.	+	+	.	.	.	.	2	20
<i>Ostrya carpinifolia</i> Scop. (pl+B2)	.	.	.	.	.	+	+	.	.	.	2	20
Other species												
<i>Parietaria judaica</i> L.	1	1	.	1	1	2a	1	2a	1	+	9	90

nean floristic species gives the association thriving in this isolated hilly complex absolutely original features that have no parallel elsewhere. An endemism level is assured by the east-alpine *Campanula carnica/carnica* and the alpine *Erysimum rhaeticum* which are here at the extreme southeastern distribution borders of their wide distribution area.

Syntaxonomy: *Athamanta turbith* has in the rocky cliff of Colli Berici a disjunct distribution area, the outermost southwestern growth site (Zenari, 1921) with respect to the main Illyric distribution area which only laps against northeastern Italy. In the neighbour Carnic Alps the species grows on rock faces from hilly to mountain areas, for example in *Spiraeo-Potentilletum caulescentis* (Poldini, 1973), but it shows also a glareicolous behaviour colonizing screes and rocky debris in the lower thermophilous Karst (Poldini, 1978; Poldini, 1989; Surina & Martinčič, 2012). It is considered character species of *Phyteumato-Potentilletum caulescentis*, a chasmophytic coenose from Slovenian montane Karst, and differential species of south-western hilly

slopes of north-Adriatic Karst calcareous screes, i.e. *Festuco-Drypidetum athamantetosum turbith* (Poldini, 1978). Despite altitudinal affinities with litoraneous Karst, in the study area the species is an obliged casmophyte, possibly also due to the local absence of scree habitat. The relict occurrence of the recently discovered stenomediterranean *Teucrium flavum/flavum* (Tasinazzo, 2013) enriches the mediterranean chorotype by means of a disjunct population which is far distant from the closest sites located in the calcareous outcrops of Apennines and Karst from Trieste. *Teucrium flavum* is invariably considered characteristic of *Asplenietalia glandulosi*, i.e. chasmophytic, thermophilous vegetation occurring in the Mediterranean macrobioclimate (Meier & Braun-Blanquet, 1934; Poldini, 1989; Brullo *et al.*, 2001; Aeschmann *et al.*, 2004). Noteworthy is that, with the exclusion of *Campanula carnica/carnica*, widespread alpine orophytes characterizing near prealpine casmophytic vegetation – e.g. *Potentilla caulescens*, *Physoplexis comosa*, *Hieracium porrifolium*, *Primula auricula*, *Moehringia bavarica*

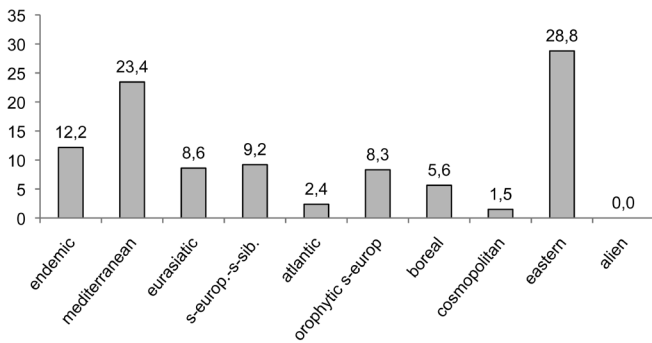


Fig. 9 - Weighted chorological spectrum of *Campanulo carnicae-Athamantetum turbith*.

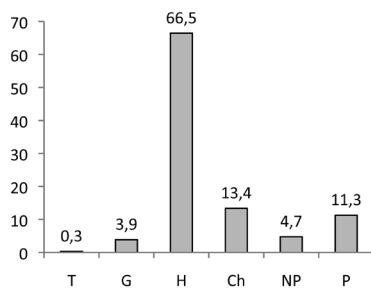


Fig. 10 - Weighted life-form spectrum of *Campanulo carnicae-Athamantetum turbith*.

ecc. – lack. Consequently, the *Asplenieta* class appears poorly represented in characteristics components, except for the two eponymous species *C. carnica* and *A. turbith* and for *Asplenium ruta-muraria*, the only fern able to bear the xeric growth conditions exacerbated by the lack of atmospheric moisture.

Synecology: vertical cliffs of solid, little degradable limestone are interrupted by small rock crevices and alveoli often associated with fossil coral structures still recognizable, where the sparse coenosis thrives, most frequently on small rock faces. The vegetation develops at sites with a diffuse radiation, with a preference for those not exposed to direct sunlight, so avoiding southern exposures (Fig. 11). Small rocky surfaces and the contiguity with fragments of dry meadows favour the occurring of many *Festuco-Brometea* species the most frequent being *Bromus condensatus* and *Satureja montana/variiegata*, the latter already listed by Trinajstić (1980) as differential of *Centaureo-Campanutetalia*, i.e. the casmophytic vegetation of Adriatic basin in the context of the Mediterranean macrobioclimate. Instead, the frequent *Parietaria judaica* emphasizes the proximity to nutrient-rich rocky habitats.

Synchorology: the habitat originality, due both to the geographical isolation of the area and to its submediterranean climate, results in an endemic rocky vegetation.

Natura 2000 Habitat: 8210

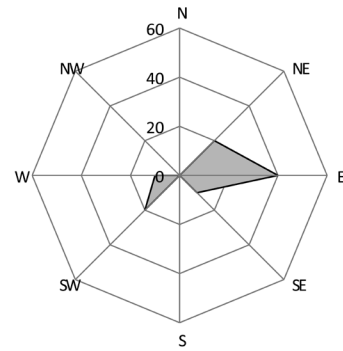


Fig. 11 - Cliff exposure with *Campanulo carnicae-Athamantetum turbith*.

SAXIFRAGETUM BERICAE ass. nova *hoc loco* (Tab. 4, *holotypus*: rel. 6)

Character species: *Saxifraga berica*.

Floristic composition: the physiognomy of this sparse rock coenose is due to the stenoendemic *Saxifraga berica* which initially described by Béguinot as a variety (1904) and then as a geographical race (1905) of *S. petraea* was successively elevated to the species rank by Webb (1963). Only *Asplenium trichomanes/quadrivalens* constantly associates with it, as other species occur in most cases in low frequency classes; nemoral elements coming from surrounding coppice contribute to the coenose which remains paucispecific even by computing mosses: on average 7.1 species per stand; also the moss layer is poor in species and coverage, with only *Rhyncostegiella tenella* and *Rhyncostegium confertum* occurring quite regularly (III frequency class).

Life forms and chorotypes: due to the weight of the *Saxifraga berica* coverage and to the paucity of vascular species, the endemism rate is absolutely the highest among local associations (Fig. 13); for the same reason chamaephytes are the most represented (Fig. 14).

Syntaxonomy: Lausi (1967) described the endemic *Adianto-Saxifragetum bericae*, with *Saxifraga berica* as character species, through five relevés carried out in local half-caves, but including – as himself states – ‘the whole vegetation of rocky niche’. The Lausi’s synthetic approach does not highlight the micro-site ecological differences occurring inside the cavity, responsible of as many different communities or associations belonging to various phytosociological classes (Fig. 4). Most of his relevés were of 30-100 m² – whereas *Saxifraga berica* usually develops over 3-4 (10) m² – so it was unavoidable for the author to sample in the same stand different vegetational types which are really only in catenal contact. In fact, by his own admission, the author found difficult to ascribe the association to higher syntaxonomical levels. Since Lausi’s association has not so far been typified, it is possible to identify *hoc loco* the *lectotypus*: rel. 1 in Table 1 in Lausi (1967). As the others, it consists of an *Adian-*

Tab. 4 - *Saxifragetum bericae* ass. nova

N° of relevé	1	2	3	4	5	6	7	8	9	10	Presence	Frequency %
Area (m ²)	2.5	2.5	4	3	3	10	2	10	2	3		
Cliff exposure	N	N	NE	NW	N	E	E	N	NE	N		
N° of species	7	8	2	13	14	8	4	5	6	4		
char. species of association												
<i>Saxifraga berica</i> (Bég.) D.A. Webb	2a	2b	3	3	3	2b	3	3	3	2b	10	100
char. species of <i>Physoplexido-Saxifragion</i>												
<i>Campanula carnica</i> Mert. & W.D.J. Koch ssp. <i>carnica</i>	.	.	.	+	+	.	.	2a	.	+	4	40
char. species of <i>Asplenieta trichomanis</i>												
<i>Asplenium trichomanes</i> L. ssp. <i>quadrivalens</i> D.E. Mey.	1	+	+	2a	1	+	+	1	+	1	10	100
char. species of <i>Quercio-Fagetea</i>												
<i>Lamium flavidum</i> F. Herm.	.	.	.	+	2a	.	.	+	.	.	3	30
<i>Phyllitis scolopendrium</i> (L.) Newman	.	.	.	+	+	.	.	.	.	.	2	20
<i>Hepatica nobilis</i> Schreb.	.	.	.	+	+	.	.	.	.	.	2	20
<i>Lactuca muralis</i> (L.) Gaertn.	.	.	.	.	+	.	.	.	.	.	1	10
<i>Mercurialis perennis</i> L.	.	.	.	+	.	.	.	.	.	.	1	10
<i>Viola reichenbachiana</i> Jord. ex Boreau	.	.	.	.	1	.	.	.	.	.	1	10
Other species												
<i>Hedera helix</i> L.	+	+	.	1	+	.	.	+	.	.	5	50
<i>Parietaria judaica</i> L.	+	.	.	.	.	+	.	.	+	+	4	40
<i>Geranium robertianum</i> L.	+	.	.	+	.	+	.	.	.	.	3	30
<i>Ficus carica</i> L. (pl)	.	.	.	.	.	r	.	.	.	.	1	10
<i>Lilium bulbiferum</i> L. ssp. <i>bulbiferum</i>	.	.	.	.	+	.	.	.	.	.	1	10
<i>Parietaria officinalis</i> L.	.	.	.	+	.	.	.	.	.	.	1	10
<i>Sambucus nigra</i> L. (pl)	.	.	.	+	.	.	.	.	.	.	1	10
Mosses and liverworts												
<i>Rhynchostegiella tenella</i> (Dicks.) Limpr.	.	+	.	.	+	+	+	.	+	.	5	50
<i>Eucladium verticillatum</i> (With.) Bruch & Schimp.	1	+	.	.	.	+	.	.	+	.	4	40
<i>Rhynchostegium confertum</i> (Dicks.) Schimp.	.	+	.	+	2a	+	.	.	.	.	4	40
<i>Noceocephalum conicum</i> (L.) Underw.	+	.	.	.	.	.	.	.	.	.	1	10
<i>Homalothecium sericeum</i> (Hedw.) Schimp.	.	.	.	.	+	.	.	.	.	.	1	10
<i>Cirriphyllum crassinervium</i> (Taylor) Loeske & M.Fleisch.	.	.	.	.	.	.	+	.	.	.	1	10
<i>Scorpiurum circinatum</i> (Bruch) M.Fleisch. & Loeske	.	+	.	.	.	.	.	.	.	.	1	10
<i>Neckera complanata</i> (Hedw.) Huebener	.	.	.	.	+	.	.	.	.	.	1	10

tum capillus-veneris-predominating cover mixed with subordinate *Saxifraga berica*, while the two species are characterised by absolutely not overlapping niches and are mutually exclusive (see Tab. 2 and Tab. 4): the former strictly thrives in correspondence of dripping water where originates the *Eucladio-Adiantetum*, the latter systematically avoids it. Also significant is the cover of *Parietaria judaica* that preferentially occurs at the bottom of the cleft wall. The Lausi's relevés were chosen from large areas including little community complexes and according to art. 37 of ICPN (Weber *et al.*, 2000) the name of an association may be rejected as a *nomen dubium* when its type relevé is considered to be so complex that an assignment to one of the currently distinguished associations does not seem possible. Therefore, *Adianto-Saxifragetum bericae* has to be considered *nomen dubium* and the original relevés included in Tab. 4 have to be ascribed to a new association (Theurillat, *in litt.*). It is proposed the name

Saxifragetum bericae with *Saxifraga berica* as character species. *S. berica* belongs to the Ser. *Arachnoideae* (Engler & Irmischer) Gornall which gathers four endemics to the Eastern Alps (Webb & Gornall, 1989). One of these is *S. petraea* L. which was hypothesized to be a descendant of *S. berica* (Banfi *et al.*, 1985) and it is considered characteristic of *Physoplexido-Saxifragion* (Mucina & Theurillat, 2015). Hence, despite the chasmophytic taxa paucity due to the already mentioned absence in the study area, *S. berica* and *Campanula carnica* allow the connection with the alliance of the calciphilous plant communities thriving in the south-eastern Alps.

Synecology: *Saxifraga berica* shows a fairly broad niche; it is only averse to dripping or sunny sites as well as to excessively solid substrates, revealing mesophilous and emisciophilous features. The species preferentially colonizes alveolar surfaces induced by differential carbonate dissolution. Thus, the associa-

tion thrives on little shady ledges or on erratics under a sufficiently damp microclimate which is guaranteed by gorge areas, northern exposure and by the screen of tree canopy (Fig. 15). Fresh temperatures, relatively high air humidity and no direct solar radiation are also assured inside shaded half-caves where *Saxifragetum bericae* occurs too, on the roof or the wall, only coming into contact with *Eucladio-Adiantetum* which gets the upper hand on moistened rock micro-fissures. The unavoidable contacts between the two communities are represented only by the sporadic growth of *Eucladium verticillatum* small tufts. Moreover, light (L) and moisture (U) bioindicator values (Fig. 12) as well as exposure graphs highlight ecological vicariance between *Saxifragetum bericae* and the other chasmophytic coenose occurring in the study area, i.e. *Campanulo-Athamantetum*.

Synchorology: like the character species, the association is stenoendemic only occurring in the Colli Berici district, where its main distribution area coincides with the rocks outcropping in the Lumignano area, although it is to be found in a fragmented fashion in other northern hilly parts.

Natura 2000 Habitat: 8210

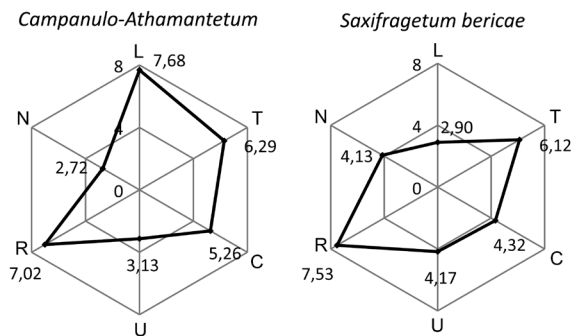


Fig. 12 - Ecograms of *Campanulo-Athamantetum* and *Saxifragetum bericae*.

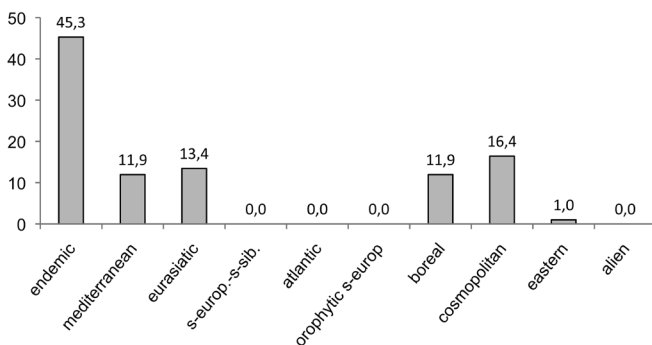


Fig. 13 - Weighted chorological spectrum of *Saxifragetum bericae* (mosses and liverworts excluded).

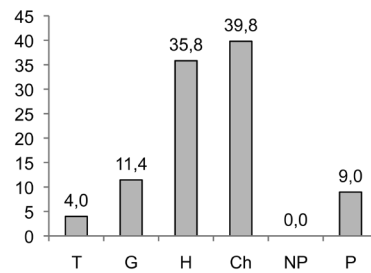


Fig. 14 - Weighted life-form spectrum of *Saxifragetum bericae* (mosses and liverworts excluded).

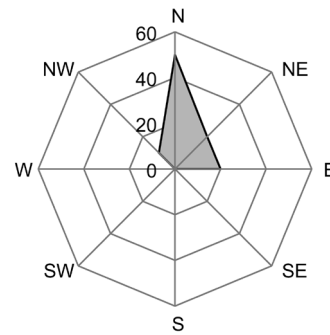


Fig. 15 - Cliff exposure with *Saxifragetum bericae*.

PARIETARIA JUDAICA community (Tab. 5)

Floristic composition: with only 4.0 species per relevé, it is a very paucispecific community due to the frequently occurring of only *Parietaria judaica*.

Syntaxonomy: *Parietarietea* class gathers wall as well as rock vegetation under marked anthropogenic pressure. Within the only *Tortulo-Cymbalarietalia* order, two alliances are recognized: *Parietarium judaicae* and *Cymbalario-Asplenion* mainly dependent on Mediterranean and Temperate bioclimate, respectively (Brullo & Guarino, 1998 and 2002).

Non-sample of the moss layer, which is usually absent or negligible, combined with the absence of vascular species considered characteristic or differential of the two alliances, not allow for the attribution to any of them, although the framing in *Cymbalario-Asplenion* is more likely on biogeographic basis. However, the submediterranean influence pervading the study area do not exclude the belonging of relevés to *Parietarium* that can also occur in edaphoxeric conditions under a temperate bioclimate (Brullo & Guarino, l.c.). Hence, relevés are generally referred to the order.

Synecology: *P. judaica* gives rise to an almost monospecific phytocenon at the base of the half-caves, in marked-naturalness not dripping sites occurring in rain shadow; nitrification processes probably arise as a result of dryness acting on thin mineral soil made up of sandy clasts and partially decomposed vegetal parts; the absence of *Sisymbrietalia* characteristic spe-

Tab. 5 - *Parietaria judaica* community

N° of relevé	1	2	3	4	5	Presence	Frequency %
Area (m ²)	6	2	6	4	3		
Half-cave exposure	E	SE	N	E	SW		
N° of species	6	1	6	5	2		
<i>Parietaria judaica</i> L.	5	4	4	4	4	5	100
Other species							
<i>Eupatorium cannabinum</i> L.	2a	.	.	3	.	2	40
<i>Carex flacca</i> Schreb.	2b	.	.	2a	.	2	40
<i>Campanula carnica</i> Mert. & W.D.J. Koch ssp. <i>carnica</i>	.	.	.	+	+	2	40
<i>Asparagus acutifolius</i> L.	+	.	.	.	.	1	20
<i>Brachypodium sylvaticum</i> (Huds.) P.Beauv.	.	.	.	+	.	1	20
<i>Cornus sanguinea</i> L. (pl)	2b	.	.	.	.	1	20
<i>Hedera helix</i> L.	.	.	1	.	.	1	20
<i>Hepatica nobilis</i> Schreb.	.	.	+	.	.	1	20
<i>Lactuca muralis</i> (L.) Gaertn.	.	.	+	.	.	1	20
<i>Parietaria officinalis</i> L.	.	.	2b	.	.	1	20
<i>Pistacia terebinthus</i> L. (pl)	1	.	.	.	.	1	20
<i>Sambucus nigra</i> L. (pl)	.	.	+	.	.	1	20

cies differentiates these relevés from those thriving in lower part of man-made walls under strong eutrophication (Poldini & Vidali, 1995). *Campanula carnica* highlights the topographic contact with casmophitic vegetation, infrequent *Pistacia terebinthus* and *Asparagus acutifolius* plantulae stress the influence of a submediterranean microclimate. It is in catenal contact with *Eucladio-Adiantetum* and *Parietario-Stellarietum pallidae* or *Junco-Polypogonetum*.

Natura 2000 Habitat: none.

POLYPODIUM CAMBRICUM community (Tab. 6)

Floristic composition: the community develops on reduced-size areas, on average about 5 m²; the structure and physiognomy are determined by the growth of *Polypodium cambricum* creeping rootstalks which results in the large dominance of the mediterranean fern; *Asparagus acutifolius* and *Ruscus aculeatus*, the most frequent companions, contribute to a mean number of 11.1 species/relevé including sporadic nanophanerophytes (*Emerus majus/majus*), the commonest and the most covering bryophytes and rare mainly stunted shrubs.

Life forms and chorotypes: the predominance of *Polypodium cambricum* has repercussions on the high incidence of hemicryptophytes (60%), whereas the low rate of therophytes is only attributable to the occurrence of sporadic synanthropic species due to light human alterations (trampling, climbing) influencing the easier access stands of the association marginally (Fig. 17). On the whole, the absence of alien species stresses the integrity of the growth sites (Fig. 16). The clear preponderance of the mediterranean chorotype is always imputable to *Polypodium cambricum* coverage but also depend on the high frequency of *Asparagus acutifolius* and *Ruscus aculeatus*.

Syntaxonomy: como-chasmophytic, calciphilous com-

munities developing in eastern prealpine territories under a temperate bioclimate are gathered into *Ctenidio-Polypodium vulgare* (*Asplenietea*), in which *Polypodium vulgare* proves to be the dominating pteridophyte (Brullo *et al.*, 2001). However, also associations differing for the prevailing of *P. interjectum* are referred to this alliance, such as the *Neckero-crispae-Polypodium interjecti* described from the Karst region (Poldini, 2009). In comparison with the latter, the mediterranean *Polypodium cambricum* identifies environmental conditions marked by higher thermophily, as the absolute predominance of mediterranean chorotype and the remarkable occurrence of *Quercetea ilicis*-character species in the stands show. The community to which it gives rise in southern Prealps could deserve a syntaxonomic autonomy, constituting an ecological vicariance of *Neckero-Polypodium*. Nevertheless, as in our relevés bryophytes were only partially identified and considering the important role played in this type of communities by the moss layer, insights are necessary before of a formal typification.

Synecology: the community inhabits little rocky ledges interposed between vertical cliffs, subvertical rocky slopes or erratics in prevalently northern and eastern exposures avoiding direct sunlight (Fig. 18); it prefers semi-shaded sites taking advantage of the presence of a sparse woody canopy which is sometimes necessary to compensate for sub-optimal exposures. It is in catenal contact with *Campanulo-Athamantetum* and *Saxifragetum bericae*.

Synchorology: the distribution area of *Polypodium cambricum* laps against the central and north-eastern prealpine foothills marginally, entering the Alps only along few valley bottoms of the Insubric district (Bona *et al.*, 2005). The occurrence of the community in north-eastern Italy had not been yet recorded. According to our unpublished relevés, it is surely present

Tab. 6 - *Polypodium cambricum* community

N° of relevé	1	2	3	4	5	6	7	8	Presence	Frequency %
Area (m ²)	1	3	1.5	3	6	15	1	8		
Cliff exposure	NE	NE	E	E	E	NE	NE	E		
Elevation (m)	410	220	220	100	230	225	160	80		
N° of species	7	10	8	12	14	13	5	20		
<hr/>										
<i>Polypodium cambricum</i> L.	4	5	3	4	4	5	5	4	8	100
Char. species of <i>Asplenietea trichomanis</i>										
<i>Asplenium trichomanes</i> L. ssp. <i>quadrivalens</i> D.E. Mey.	.	.	+	1	1	.	.	.	3	38
<i>Muscari botryoides</i> (L.) Mill. ssp. <i>longifolium</i> (Rigo) Garbari	.	2a	.	.	+	.	.	1	3	38
<i>Ceterach officinarum</i> Willd. ssp. <i>officinarum</i>	.	.	.	.	r	.	.	+	2	25
<i>Hylotelephium maximum</i> (L.) Holub	.	+	.	.	.	.	.	+	2	25
<i>Campanula carnica</i> Mert. & W.D.J. Koch ssp. <i>carnica</i>	.	.	.	.	.	+	.	.	1	13
Char. species of <i>Quercetea ilicis</i>										
<i>Asparagus acutifolius</i> L.	.	1	.	+	+	+	+	+	6	75
<i>Ruscus aculeatus</i> L.	+	+	.	.	2a	+	+	+	6	75
<i>Pistacia terebinthus</i> L. (B2)	.	.	.	.	.	.	.	2a	1	13
Other species										
<i>Arabis turrata</i> L.	.	.	.	1	1	+	.	+	4	50
<i>Parietaria judaica</i> L.	.	.	.	1	+	1	.	+	4	50
<i>Emerus majus</i> Mill. ssp. <i>majus</i> (B2)	.	.	1	1	2a	.	.	.	3	38
<i>Hedera helix</i> L.	.	.	.	+	.	.	3	+	3	38
<i>Geranium purpureum</i> Vill.	.	+	.	.	+	.	.	1	3	38
<i>Veronica hederifolia</i> L.	+	.	.	.	.	.	.	+	2	25
<i>Lactuca muralis</i> (L.) Gaertn.	.	.	.	+	.	+	.	.	2	25
<i>Cardamine hirsuta</i> L.	.	.	.	.	+	.	.	+	2	25
<i>Loncomelos</i> spp.	.	.	.	.	.	+	.	+	2	25
<i>Sedum montanum</i> E.P. Perr. & Song. ssp. <i>orientale</i> 't Hart	.	r	.	.	.	+	.	.	2	25
Mosses and liverworts										
<i>Porella platyphylla</i> (L.) Pfeiff.	1	+	3	+	.	.	.	.	4	50
<i>Scorpiurum circinatum</i> (Bruch) M.Fleisch. & Loeske	.	.	+	4	2b	.	.	.	3	38
<i>Homalothecium sericeum</i> (Hedw.) Schimp.	2b	.	1	+	.	.	.	.	3	38

also on Euganean Hills and in Benacense district (e.g. M.t Moscal); on Berici Hills it occurs in more than a few spots of the cliffs facing the Lumignano area, while in other parts it proves to be more rare and localized.
Natura 2000 Habitat: 8210

PARIETARIO JUDAICAE-STELLARIETUM PALLIDAE ass. nova *hoc loco* (Tab. 7, *holotypus*: rel. 1)
Differential species: *Stellaria pallida*, *Parietaria judaica*.

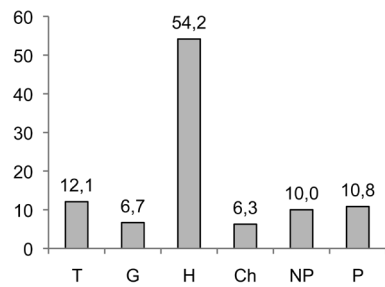


Fig. 17 - Weighted life-form spectrum of *Polypodium cambricum* community (mosses and liverworts excluded).

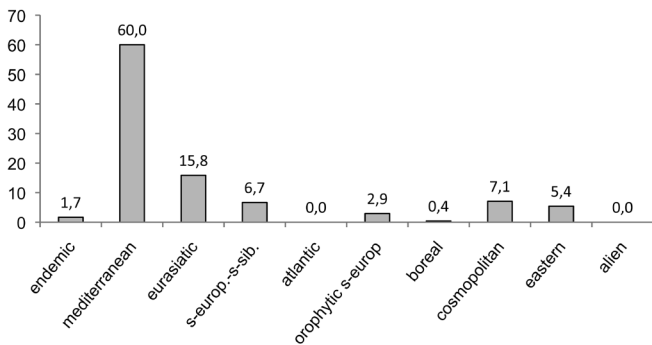


Fig. 16 - Weighted chorological spectrum of *Polypodium cambricum* community (mosses and liverworts excluded).

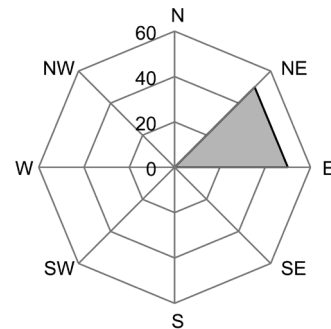


Fig. 18 - Cliff exposure with *Polypodium cambricum* community.

Floristic composition: it is a spring discontinuous community largely dominated by annual short forbs – above all *Stellaria pallida* and *Cardamine hirsuta* – whose physiognomy is determined even by the perennial *Parietaria judaica*. The average species number per relevé is 8.6 excluding the contribution mostly negligible of cryptogames.

Life forms and chorotypes: therophytes far and away achieve the highest percentage cover (73%), hemicryptophytes (17%) being represented by the only *Parietaria judaica* (Fig. 20); the eponymous *Stellaria pallida* is largely responsible for the high rate of eurasiatic s.l. chorotype (43%), while the numerous little-covering mediterranean s.l. elements (33%; *Bromus sterilis*, *Asparagus acutifolius* ecc.) once again underline that a mild microclimate affect the growth site (Fig. 19).

Syntaxonomy: the alliance *Sisymbrium officinalis* gathers therophyte ruderal communities growing in temperate Europe in disturbed areas such as demolition or construction sites, road verges, railway yards ecc.,

which provide suitable habitat for introduced and alien species. Nevertheless, it comprises also some archaephytic vegetation types, as *Parietario-Stellarietum pallidae* can be considered according to its high archaephyte rate (58.1%; rel. 1-5 in Tab. 7) that drops to 20.8% if we take into account the only disturbed form (rel. 6-8 in Tab. 7). It can be hypothesized that the occurring of this association in the study area dates back to the historical time when some of these half-caves were used by man as shelters for sheep or other animals. *Stellaria pallida* and *Bromus sterilis* assure the framing in *Sisymbrium* and *Sisymbrietalia*, respectively, whereas the belonging to *Stellarietea* is founded on a great number of low-frequency species, except for the common *Cardamine hirsuta* (V frequency class). Since in literature lacks tabular material dealing with similar ecological-feature vegetation types, for these stands it is proposed the name *Parietario-Stellarietum pallidae*.

Synecology: *Stellaria pallida* is considered a possi-

Tab. 7 - *Parietario judaicae-Stellarietum pallidae* ass. nova (rel. 1-5)

N° of relevé	1	2	3	4	5			6	7	8	
Area (m ²)	2	4	4	4	4			4	5	8	
Half-cave exposure	E	SE	E	SE	SE	Presence	Frequency %	SE	NW	E	Presence
Elevation (m)	220	350	360	260	120			90	300	180	
N° of species	7	10	6	6	14			11	7	8	
Diff. species of association											
<i>Stellaria pallida</i> (Dumort.) Crép. (All)	2b	3	3	3	5	5	100	.	.	.	0
<i>Parietaria judaica</i> L.	2a	1	+	+	+	5	100	+	2b	.	2
Char. species of <i>Sisymbrium</i>											
<i>Geranium purpureum</i> Vill.	.	.	+	.	.	1	20	.	.	+	1
Char. species of <i>Sisymbrietalia</i>											
<i>Bromus sterilis</i> L.	+	+	.	.	+	3	60	.	.	+	1
<i>Carduus pycnocephalus</i> L.	r	.	.	.	.	1	20	.	.	.	0
Char. species of <i>Stellarietea mediae</i>											
<i>Cardamine hirsuta</i> L.	2a	+	1	+	1	5	100	1	1	2b	3
<i>Stellaria media</i> (L.) Vill.	.	1	r	+	.	3	60	4	2b	3	3
<i>Fumaria officinalis</i> L.	+	.	.	.	r	2	40	1	.	.	1
<i>Geranium rotundifolium</i> L.	.	.	.	.	+	1	20	+	.	.	1
<i>Allium vineale</i> L.	.	+	.	.	.	1	20	.	.	.	0
<i>Anagallis arvensis</i> L.	.	.	.	.	+	1	20	.	.	.	0
<i>Euphorbia helioscopia</i> L.	.	.	.	.	.	0	0	r	.	.	1
<i>Papaver dubium</i> L.	.	.	.	.	1	1	20	.	.	.	0
<i>Papaver rhoeas</i> L.	.	.	.	.	+	1	20	.	.	.	0
<i>Ranunculus parviflorus</i> L.	.	.	.	.	.	0	0	.	.	2b	1
<i>Sonchus oleraceus</i> L.	.	r	.	.	.	1	20	.	.	.	0
<i>Veronica hederifolia</i> L.	.	.	.	.	.	0	0	+	.	.	1
Other species											
<i>Arabis turrata</i> L.	+	.	.	.	r	2	40	r	.	.	1
<i>Galium aparine</i> L.	.	+	.	.	.	1	20	r	.	+	2
<i>Asparagus acutifolius</i> L.	.	+	.	r	.	2	40	.	.	.	0
<i>Tamus communis</i> L.	.	.	.	.	.	0	0	+	.	r	2
<i>Taraxacum laevigatum</i> (Willd.) DC.	.	r	.	.	.	1	20	.	r	.	1
<i>Ulmus minor</i> Mill. (pl)	.	.	+	1	.	2	40	.	.	.	0

ble ancestor of *Stellaria media* (Negodi, 1935; Sinha & Whitehead, 1965) respect to which it appears more sensitive to frequent habitat disturbance (Verkleij *et al.*, 1980). This feature turns out to be evident by observing the slightly different ecology of the two species at the cliff base. Stands were recorded on the floor of little to medium-size half-caves which are situated in shaded sites devoid of direct radiation (Fig. 21). Thin clay deposits alternating with bedrock outcrops and with collapsed clasts deriving from exfoliation phenomena involving the roof of the rocky hollow constitute the growth substrate of the community. The tree masking, the dripping from the vault and the exposure contribute to maintain adequate moistness conditions during the thriving time in spring. Human alterations, mainly trampling, works particularly outside the half-cave where *Stellaria media* develops on little mature soils with other synanthropic species in a not well defined ruderal phytocenon. From here the forb can spread until the entrance of the cave and participate weakly to the *Stellaria pallida*-dominating coenose (rel. 1-5 in Tab. 7) unless the anthropic disturbance or also animal visits (domestic pigeons, roe deers) increase heavily. In this case *S. pallida* decreases until it disappears being replaced by the more competitive *S. media* with the consequent worsening of the fragile community (rel. 6-8 in Tab. 7). The constant frequency of *Parietaria judaica* stresses the close catenal contacts with the *Parietaria judaica* phytocoenon.

Synchorology: the community distribution locally coincides with sheltered outcropping lying at the base of the Oligocenic cliff; no other information about similar vegetations is at disposal, in spite of the very broad range of paleotemperate *Stellaria pallida*.

Natura 2000 Habitat: none.

CELTIDO AUSTRALIS-FRAXINETUM ORNI ass. nova *hoc loco* (Tab. 8, *holotypus*: rel. 4)

Differential species: *Celtis australis*, *Dictamnus albus*, *Cercis siliquastrum*, *Galatella lynosiris*, *Muscari botryoides* subsp. *longifolium*.

Floristic composition: it is a sparse, bushy, 2-3 m high vegetation composed by prevalent shrub species but also by termophilous tree specimens which usually occur in a small and stunted habitus; the physiognomy is determined by *Fraxinus ornus*, *Prunus mahaleb* and *Pistacia terebinthus* in the upper layer and by *Emerus majus/maius*, *Asparagus acutifolius* and *Ligustrum vulgare* in the lower level, all occurring in V frequency class. Also differential species *Celtis australis* and *Amelanchier ovalis* constantly participate to composition. Many termophilous fringe (*Arabis turrita*, *Dictamnus albus*, *Galatella lynosiris*, *Galium lucidum*, *Inula spiraeifolia* ecc.) and dry grassland (*Bromus condensatus*, *Melica ciliata* ecc.) species underline the brightness of the sites occupied by the communi-

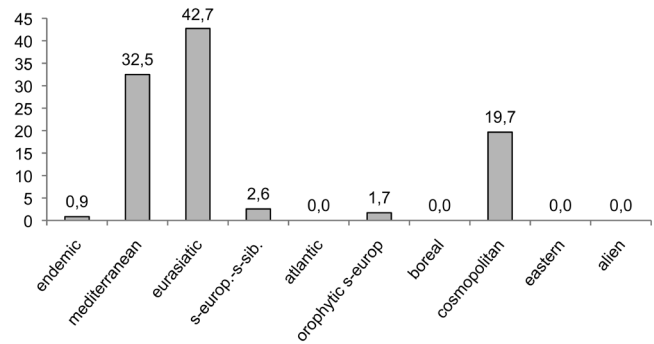


Fig. 19 - Weighted chorological spectrum of *Parietario judaicae-Stellarietum pallidae* (bryophytes excluded; only rel. 1-5 in Tab. 7)

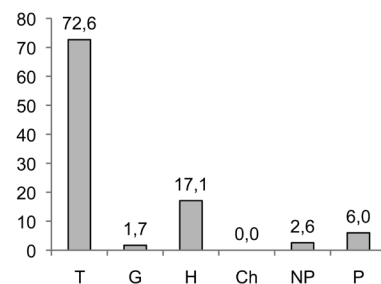


Fig. 20 - Weighted life-form spectrum of *Parietario judaicae-Stellarietum pallidae* (bryophytes excluded; only rel. 1-5 in Tab. 7).

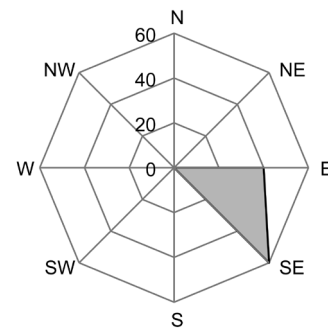


Fig. 21 - Half-cave exposure with *Parietario judaicae-Stellarietum pallidae* (only rel. 1-5 in Tab. 7).

ty; the rocky substrate favours the occurrence of some *Asplenietae* elements and frequent *Parietaria judaica*; *Ruscus aculeatus* (V frequency class) develops under more thick mantle canopy. The average species number per relevé is 32.2.

Life forms and chorotypes: the plant community is well structured because of the balanced involvement of all life forms, which is a likely consequence of its maturity (Fig. 23); phanerophytes largely prevail, but hemicryptophytes and nanophanerophytes attain also high rates and chamaephytes (*Ruscus aculeatus*, *Dictamnus albus*) emphasize the particular macrothermic features of the sites. As regard the chorological spec-

Tab. 8 - *Celtido australis-Fraxinetum orni* ass. nova

N° of relevé	1	2	3	4	5	6	7	8	9	Presence	Frequency %
Area (m ²)	25	40	30	40	30	20	50	20	4		
Height (m)	2.5	2	3.5	2	2	2	2.5	2	2		
N° of species	41	30	35	33	37	30	24	30	37		
Diff. species of association											
<i>Celtis australis</i> L. (All)	+	+	1	+	2b	3	+	+	+	9	100
<i>Dictamnus albus</i> L. (C11)	2a	+	1	2a	+	1	.	r	.	7	78
<i>Cercis siliquastrum</i> L.	2b	2b	1	1	1	.	2b	.	.	6	67
<i>Galatella lynosiris</i> (L.) Rchb.f. (C11)	1	+	+	.	+	+	+	.	.	6	67
<i>Muscari botryoides</i> (L.) Mill. ssp. <i>longifolium</i> (Rigo) Garbari	1	.	+	1	.	.	.	.	.	3	33
Char. species of <i>Carpinion orientalis</i> (All)											
<i>Ostrya carpinifolia</i> Scop.	.	+	.	+	.	.	+	+	2a	5	56
<i>Mercurialis ovata</i> Sternb. & Hoppe	.	.	+	.	.	.	.	.	.	1	11
Char. species of <i>Quercetalia pubescentis</i> or <i>Querceto-Fageteta</i> (C1)											
<i>Fraxinus ornus</i> L.	3	3	3	3	2a	2b	3	2b	2a	9	100
<i>Arabis turrita</i> L.	+	+	+	+	1	1	+	+	.	8	89
<i>Quercus pubescens</i> Willd.	.	.	2a	1	1	.	1	2b	2a	6	67
<i>Hedera helix</i> L. (C1)	.	.	+	.	+	1	.	+	1	5	56
<i>Melittis melissophyllum</i> L.	+	+	+	+	.	+	.	.	.	5	56
<i>Cornus mas</i> L.	.	.	.	+	.	1	.	.	+	3	33
<i>Sorbus torminalis</i> (L.) Crantz (B2)	.	.	+	.	.	.	.	.	.	1	11
<i>Hepatica nobilis</i> Schreb. (C1)	.	.	+	.	.	.	.	.	.	1	11
<i>Mercurialis perennis</i> L. (C1)	.	.	.	.	.	.	.	.	+	1	11
Char. species of <i>Quercetia ilicis</i>											
<i>Asparagus acutifolius</i> L.	2a	2a	1	2a	1	1	1	1	1	9	100
<i>Pistacia terebinthus</i> L.	2b	2a	1	2a	2a	2b	.	+	2b	8	89
<i>Ruscus aculeatus</i> L.	2b	3	2a	1	+	+	1	2a	.	8	89
Char. species <i>Rhamno-Prunetea</i>											
<i>Prunus mahaleb</i> L.	2b	+	1	2b	2a	2b	2a	2a	2a	9	100
<i>Emerus majus</i> Mill. ssp. <i>majus</i>	2b	2b	2a	3	2b	3	2a	2a	2a	9	100
<i>Ligustrum vulgare</i> L.	1	+	+	2a	1	1	.	+	+	8	89
<i>Amelanchier ovalis</i> Medik.	.	1	+	1	.	+	2a	2a	1	7	78
<i>Rubus ulmifolius</i> Schott	+	.	+	+	+	.	.	+	1	6	67
<i>Crataegus monogyna</i> Jacq.	+	+	+	.	.	.	.	+	+	5	56
<i>Euonymus europaeus</i> L.	1	+	+	+	.	+	.	.	.	5	56
<i>Cotinus coggygria</i> Scop.	.	.	.	+	.	.	3	3	.	3	33
<i>Rhamnus cathartica</i> L.	.	2b	.	.	+	3	.	.	.	3	33
<i>Tamus communis</i> L.	2a	.	.	.	+	.	.	.	+	3	33
<i>Rosa canina</i> agg.	.	.	.	+	.	.	.	+	+	3	33
<i>Prunus spinosa</i> L.	.	.	+	.	.	.	.	r	.	2	22
<i>Juniperus communis</i> L.	.	.	.	+	.	.	.	+	.	2	22
Char. species of <i>Trifolio-Geranietea</i> (C11)											
<i>Galium lucidum</i> All.	1	.	.	+	+	+	1	+	+	7	78
<i>Inula spiraeifolia</i> L.	+	1	.	.	1	+	.	.	+	5	56
<i>Anthericum ramosum</i> L.	.	.	+	+	+	.	.	.	.	3	33
<i>Peucedanum oreoselinum</i> (L.) Moench	.	.	.	.	.	.	.	+	+	2	22
<i>Viola hirta</i> L.	+	.	.	.	.	.	.	.	+	2	22
Char. species of <i>Festuco-Brometea</i>											
<i>Bromus condensatus</i> Hack. ssp. <i>microtrichus</i> (Borbás) Poldini & Oriolo	+	+	.	.	+	+	+	1	1	7	78
<i>Melica ciliata</i> L. ssp. <i>ciliata</i>	+	+	+	+	1	.	+	+	.	7	78
<i>Satureja montana</i> L. ssp. <i>variegata</i> (Host) P.W. Ball	.	+	+	+	+	+	+	.	.	5	56
<i>Teucrium chamaedrys</i> L.	+	+	+	.	+	.	+	.	.	5	56
<i>Artemisia alba</i> Turra	+	+	.	.	.	.	.	+	+	4	44
<i>Carex halleriana</i> Asso	+	+	+	.	.	.	.	.	+	4	44
<i>Kengia serotina</i> (L.) Packer	+	+	+	.	.	.	.	.	.	3	33
<i>Stachys recta</i> L. ssp. <i>recta</i>	.	+	.	.	.	.	+	.	+	3	33
<i>Allium sphaerocephalon</i> L.	.	+	.	.	+	.	.	.	.	2	22
<i>Erysimum rhaeticum</i> (Hornem.) DC.	+	.	.	.	.	.	.	.	+	2	22
<i>Festuca stricta</i> Host ssp. <i>sulcata</i> (Hack.) Patzke	.	.	.	.	+	+	.	.	.	2	22
<i>Scabiosa triandra</i> L.	.	.	.	.	.	+	.	+	.	2	22
<i>Teucrium montanum</i> L.	.	.	.	.	.	.	+	.	+	2	22
<i>Thlaspi praecox</i> Wulfen	.	.	.	.	.	+	.	+	.	2	22
Other species											
<i>Dactylis glomerata</i> L.	+	.	+	+	+	.	+	.	.	5	56
<i>Homalothecium sericeum</i> (Hedw.) Schimp. (M)	.	1	1	2b	1	1	.	.	.	5	56
<i>Parietaria judaica</i> L.	.	.	+	.	+	+	+	.	+	5	56
<i>Sedum montanum</i> E.P. Perr. & Song. ssp. <i>orientale</i> t Hart	.	.	.	+	+	+	.	.	.	3	33
<i>Ficus carica</i> L. (B2)	.	.	+	.	.	.	.	.	.	2	22
<i>Geranium purpureum</i> Vill.	1	.	.	.	+	.	.	.	.	2	22
<i>Prospero autumnale</i> (L.) Speta	+	.	.	1	.	.	.	.	.	2	22

trum (Fig. 22), the southern trait of the association is clear in the light of the rate achieved by mediterranean and south-european species (65%). Mediterranean ones are in particular the most represented by virtue of the occurrence and cover values of *Quercetea ilicis* character species (*Pistacia terebinthus*, *Asparagus acutifolius* and *Ruscus aculeatus*), here with a relic biogeographic significance. Despite a relevant eurasiatic chorotype contribution (20%), this coenose is to consider the extreme expression of marginal Mediterranean influence in the study area.

Syntaxonomy: despite the shrub-like growth and large numbers of woody species characteristic of *Rhamno-Prunetea* - according to Poldini *et al.* (2002) - the coenosis is referred to *Querceto-Fagetea* on the basis of weighted biological spectrum, as its structure is mainly determined by phanerophytes, especially by *Fraxinus ornus*. According to the current italian prodrome (<http://www.prodromo-vegetazione-italia.org/>), the bioclimate acting on the area together with the occurrence and structural relevance of mediterranean *Quercetea ilicis*-species, rather than the reported diagnostic taxa which are lacking in the Colli Berici except for *Pulmonaria australis*, assure the belonging of the community to *Ostryo-Carpinenion orientalis*, *Helleboro-Ostryenion* showing more mesophilous traits. From an ecological point of view, *Amelanchier ovalis* and *Prunus mahaleb* underline primitive xeric conditions clear defined in the proposed *Seslerio coeruleae-Ostr-*

yonion suballiance (Ubaldi, 2003). The sparse low-tree canopy allows the participation of numerous *Trifolio-Geranietea* and *Festuco-Brometea* species. Fringe community-species encompass *Dictamnus albus*, *Galium lucidum* and *Cyanus triumfettii*, all characteristic of recently validated *Dictamno-Ferulagion galbaniferae* comprising xerophytic associations of base-rich soils with a mainly Balkan distribution and a penetration along the southern-eastern margins of the Alps (Mucina *et al.*, 2009). The eurimediterranean *Celtis australis* is considered differential also of extrazonal *Celtido-Quercetum ilicis* spread in rocky sites of the prealpine range around insubric lakes and Vallagarina (Pedrotti, 1992; Biondi *et al.*, 2003). In natural vegetation, it sporadically occurs in *Buglossoido-Ostryetum pistacietosum terebinthi* and in *Pruno-Paliuretum* revegetation nuclei but in most cases as young specimens not in able to free itself from surrounding vegetation; only in *Celtido-Fraxinetum* it shows its ecological optimum by reaching adult stage. The doubtful subspecies *Muscari botryoides/longifolium*, ingressive from *Asplenietea trichomanis*, contributes to characterise rocky and macrothermic features of the habitat where this lithophilous association thrives.

The community establishes catenal contacts and shows affinities with *Buglossoido-Ostryetum pistacietosum terebinthi*, i.e. the local edaphoxerophilous head series, but clear floristic and ecological differences argue for its syntaxonomic autonomy.

Synecology: *Celtido-Fraxinetum* is a lithophilous woody permanent community which is locked in its evolution by pedogenetic causes. The coenose thrives at the upper level edge of calcareous cliff where woody and herbaceous components take root into rock cracks and thin, mainly clastic substrate, respectively. The habitat has a high biological integrity degree, as the insignificant rate of exotic species demonstrates (0.2%); despite uncertainty about its autochthonous state, *Cercis siliquastrum* fit well with this rocky landscape occurring more frequently in this community than in *Buglossoido-Ostryetum pistacietosum terebinthi*. With respect to the principal prealpine distribution area *Amelanchier ovalis* behaves here as a relic species avoiding other local communities. The diffused luminosity due to sunny exposure, rocky habitat and low shrub coverage results in the occurrence of numerous helio-termo-xerophilous species coming from seral stages of *Buglossoido-Ostryo carpinifoliae pistacietosum terebinthi* sigmetum. *Celtido-Fraxinetum* appears bound to calcareous level outcrops occurring under the submediterranean variant of the mesotemperate thermotype.

Synchorology: currently observed principally in the Colli Berici district, where its distribution overlaps the upper edge of Oligocene cliff. Although there are not available relevés, partial data suggest its possible oc-

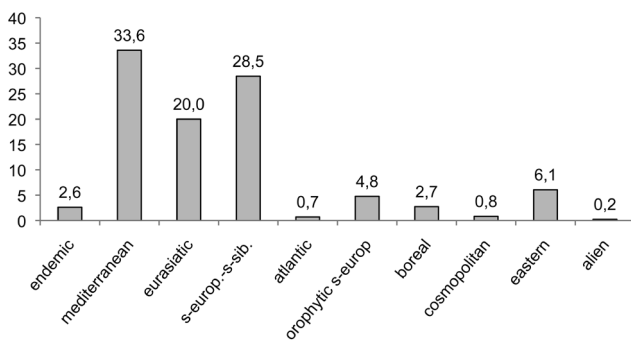


Fig. 22 - Weighted chorological spectrum of *Celtido australis-Fraxinetum orni*.

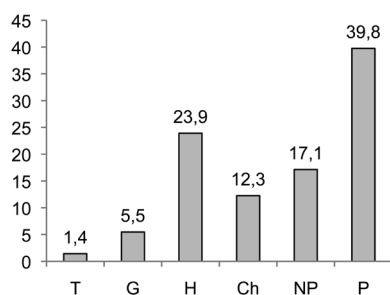


Fig. 23 - Weighted life-form spectrum of *Celtido australis-Fraxinetum orni*.

curring also in marginal prealpine localities, such as outer foothills of M.t Grappa (Lasen, 1994; pers. obs.).

Natura 2000 Habitat: none.

Syntaxonomic scheme

ADIANTEA CAPILLI-VENERIS Br.-Bl. in Br.-Bl., Roussine & Nègre 1952

ADIANTEA CAPILLI-VENERIS Br.-Bl. ex Horvatić 1934

Adiantum capilli-veneris Br.-Bl. ex Horvatic 1934

Eucladio-Adiantetum capilli-veneris Br.-Bl. ex Horvatic 1934

eucladietosum Br.-Bl. 1931 ex Horvatic 1934

ASPENIETEA TRICHOMANIS (Br.-Bl. in Meier & Br.-Bl. 1934) Oberdorfer 1977

POTENTILLETALIA CAULESCENTIS Br.-Bl. in Br.-Bl. & Jenny 1926

Physoplexido comosae-Saxifragion petraeae Mucina & Theurillat 2015

Campanulo carnicae-Athamantetum turbith ass. nova

Saxifragetum bericae ass. nova

Polypodium cambricum community

PARIETARIETEA JUDAICAE Oberdorfer 1977

TORTULO-CYMBALARIETALIA Segal 1969

Parietaria judaica community

STELLARIETEA MEDIAE Tüxen, Lohmeyer & Preising ex Von Rochow 1951

SISYMBRIETALIA OFFICINALIS J. Tüxen ex W. Matuszkiewicz 1962

Sisymbrium officinalis Tüxen, Lohmeyer & Preising ex Von Rochow 1951

Parietario judaicae-Stellarietum pallidae ass. nova

QUERCO ROBORIS-FAGETEA SYLVATICAE Br.-Bl. & Vlieger in Vlieger 1937

QUERCETALIA PUBESCENTIS Br.-Bl. ex Vlieger 1937

Carpinion orientalis Horvat 1958

Celtido australis-Fraxinetum orni ass. nova

Incertae sedis

Junco bufonii-Polypogonetum monspeliensis ass. nova

Other syntaxa cited in the text

Adiantum-Saxifragetum bericae Lausi 1967; *Asplenietalia glandulosi* Br.-Bl. & Meier in Meier & Br.-Bl. 1934; *Bidentetea tripartitae* Tüxen, Lohmeyer & Preising ex Von Rochow 1951; *Buglossoido purpureocaeruleae-Ostryetum carpinifoliae* Gerdol, Lausi, Piccoli & Poldini 1982; *Buglossoido purpureocaeruleae-Ostryetum carpinifoliae pistacietosum terebinthi* Poldini 1988; *Centaureo kartschianae-Campanuletalia pyramidalis* Trinajstić ex Di Pietro & Wagensommer 2008; *Chenopodion rubri* (Tüxen 1960) Hilbig & Jage 1972; *Ctenidio-Polypodion vulgaris* Brullo, Scelsi & Spampinato 2001; *Cymbalario muralis-Asplenion rutae-murariae* Segal 1969 em. Mucina 1993; *Dictamno albi-Ferulagion galbaniferae* (Van Gils, Keysers & Launsdach 1975) de Foucault, Rameau & Royer ex Čarni & Dengler in Mucina, Dengler, Bergmeier, Čarni, Dimopoulos, Jahn & Matevski 2009; *Festuco valesiaca-Brometea erecti* Br.-Bl. & Tüxen ex Br.-Bl. 1949; *Festuco carniolicae-Drypidetum jaquinianae athamantetosum turbith* Poldini 1978; *Frankenion pulverulentae* Rivas-Martínez ex Castroviejo & Porta 1976; *Gaudinio-Podospermion cani* Brullo & Siracusa 2000; *Agrostio stoloniferae-Scirpoidion holoschoeni* de Foucault 2012; *Isoëtetalia durieui* Br.-Bl. 1936; *Isoëto-Nanojuncetea* Br.-Bl. & Tüxen ex Westhoff, Dijk & Passchier 1946; *Neckero crispae-Polypodietum interjecti* Poldini & Tacchi 2009; *Ostryo-Carpinion orientalis* Poldini 1982; *Parietario judaicae* Segal 1969; *Phyteumato-Potentilletum caulescentis* Poldini 1978; *Pruno mahaleb-Paliuretum spina-christi* Poldini & Vidali 2002; *Quercetea ilicis* Br.-Bl. in Br.-Bl., Roussine & Nègre 1952; *Quercu roboris-Fagetea sylvatica* Br.-Bl. & Vlieger in Vlieger 1937; *Rhamno catharticae-Prunetea spinosae* Rivas Goday & Borja ex Tüxen 1962; *Saginetea maritima* Westhoff, Leeuwen & Adriani 1962; *Sedo albi-Scleranthetea biennis* Br.-Bl. 1955; *Seslerio coeruleae-Ostryenion* Ubaldi 2003; *Spiraeo-Potentilletum caulescentis* Poldini 1969; *Scheuchzerio palustris-Caricetea nigrae* nom. mut. propos. ex Steiner 1992; *Tilio platyphylli-Acerion pseudoplatani* Klika 1955; *Trifolio medii-Geranietea sanguinei* Müller 1962.

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- Appendix I: relevè localities, dates and quadrants**
- Tab. 1 *Junco bufonii*-*Polypogonietum monspeliensis*
Rel. 1: M.t della Cengia (Barbarano), 29/06/2001, 0535/3; Rel. 2, Rel. 3, Rel. 6: Fontecchio (Castegnaro), 03/07/2001, 0535/3; Rel. 4: Valle Pressia (Zovencedo), 07/07/2001, 0534/4; Rel. 5, Rel. 10, Rel. 17: Fontecchio (Castegnaro), 02/07/2001, 0535/3; Rel. 7, Rel. 12, Rel. 16: C. Menarini, 04/07/2001, 0535/1; Rel. 8, Rel. 9, Rel. 13: Brojon (Lumignano), 06/07/2001, 0535/2; Rel. 11: Fontecchio (Castegnaro), 25/06/2014, 0535/3; Rel. 14: S. Cassiano hermitage, 04/07/2001, 0535/2; Rel. 15, Rel. 18: Lumignano, 06/07/2001, 0535/2.
- Tab. 2 *Eucladio-Adiantetum capilli-veneris*
Rel. 1: path to Grotta della Guerra, 24/06/2011, 0535/1; Rel. 2: Grotta della Guerra, 24/06/2011, 0535/1; Rel. 3: Brojon (Lumignano), 05/08/2011, 10535/2; Rel. 4: Copacan spring (Lumignano), 05/08/2011, 0535/2; Rel. 5: M.t alla Croce (Lumignano), 10/10/2011, 0535/2; Rel. 6: S of S. Cassiano hermitage, 21/03/13, 0535/2.
- Tab. 3 *Campanulo carnicae*-*Athamantetum turbith*
Rel. 1: Brojon (Lumignano), 05/08/2011, 0535/2; Rel. 2, Rel. 3, Rel. 4: C. Menarini, 08/08/2011, 0535/1; Rel. 5: Grotta del Tesoro, 08/08/2011, 0535/1; Rel. 6: c/o C. Volpato, 09/08/2011, 0535/1; Rel. 7: C. Menarini, 17/08/2011, 0535/1; Rel. 8: C. Cestonaro, 18/08/2011, 0535/1; Rel. 9: Dente di Lumignano, 28/03/2013, 0535/1; Rel. 10: Sasso di Lumignano, 20/04/2014, 0535/1.
- Tab. 4 *Saxifragetum bericae*
Rel. 1: M.t Castelpiero (Val dei Molini), 01/04/2011, 10535/3; Rel. 2: Val Cumana (Lumignano), 04/04/2011, 10535/2; Rel. 3: C. Tecla (Costozza), 04/04/2011, 10535/2; Rel. 4: loc. Sasso (Lumignano), 24/06/2011, 10535/1; Rel. 5: c/o Grotta della Guerra (Lumignano), 24/06/2011, 0535/1; Rel. 6: path at E of loc. Monumento (Longare), 05/08/2011, 10535/2; Rel. 7: path at E of loc. Monumento (Longare), 05/08/2011, 10535/2; Rel. 8: path at N of M. Sasso (Lumignano), 05/08/2011, 0535/1; Rel. 9: just NE of C. Menarini (Lumignano), 08/08/2011, 0535/1; Rel. 10: on the top of M.t alla Croce (Lumignano), 09/08/2011, 10535/2.
- Tab. 5 *Parietaria judaica* community
Rel. 1: 250 m NNW of C. Menarini, 19/08/2010, 0535/1; Rel. 2: Brojon (Lumignano), 05/08/2011, 0535/2; Rel. 3: path at N of M. Sasso (Lumignano), 05/08/2011, 0535/1; Rel. 4: 150 m NNW of C. Menarini, 08/08/11, 0535/1; Rel. 5: 400 m ENE of C. Cestonaro, 17/08/11, 0535/1.
- Tab. 6 *Polypodium cambricum* community
Rel. 1: 250 m N of M.t Tondo summit (Barbarano Vic.), 17/04/2011, 10535/3; Rel. 2: ledge overhanging the S. Cassiano hermitage, 04/04/2013, 0535/2; Rel. 3: 100 m ENE of C. Menarini, 12/10/2011, 0535/1; Rel. 4: 100 m E of S. Cassiano hermitage, 05/08/2011, 0535/2; Rel. 5: ledge W of S. Cassiano hermitage, 04/04/2013, 0535/2; Rel. 6: 150 m NNW of C. Menarini, 08/08/11, 0535/1; Rel. 7: E of loc. Monumento (Longare), 05/08/11, 0535/2; Rel. 8: ledge 200 m SSE of S. Cassiano hermitage, 21/03/2013, 0535/2.
- Tab. 7 *Parietario judaicae*-*Stellarietum pallidae*
Rel. 1: ledge overhanging the S. Cassiano hermitage, 04/04/13, 0535/2; Rel. 2: cliff between M.t Stria and M.t Bella Pai, 11/04/2013, 0535/3; Rel. 3: cliff 150 m S of C. Leonardi (Mossano), 25/04/2013, 0535/3; Rel. 4: cliff overhanging C. Fontecchio (Castegnaro), 12/05/2013, 0535/3; Rel. 5: ledge just below Brojon (Lumignano), 08/04/2013, 0535/2; Rel. 6: ledge 250 m ESE of M.t alla Croce summit, 29/3/2013, 0535/2; Rel. 7: cliff overhanging C. Battocchi (Brendola), 24/04/2013, 0534/2; Rel. 8: between M.t alla Croce and S. Cassiano hermitage, 04/04/2013, 0535/2.
- Tab. 8 *Celtido australis*-*Fraxinetum orni*
Rel. 1: Brojon (Lumignano), 05/08/2011, 10535/2; Rel. 2: C. Menarini, 08/08/2001-12/10/2011, 0535/1; Rel. 3: M.t alla Croce (Lumignano), 09/08/2011-10/10/2011, 10535/2; Rel. 4: M.t alla Croce (Lumignano), 10/10/2011, 10535/2; Rel. 5, Rel. 6: C. Menarini, 08/08/2011-12/10/2011, 0535/1; Rel. 7: c/o C. Volpato, 09/08/2011, 0535/1; Rel. 8: M.t della Cengia (Barbara-

no), 10/08/2011, 0535/3; Rel. 9: M.t Tondo (Villaga), 14/05/2010, 0535/1.

Appendix II: sporadic species

Tab. 1 *Junco bufonii*-*Polyopogonatum monspeliensis*

Rel. 1: *Trifolium scabrum* L., *Poa annua* L., *Carex divulsa* Stokes; Rel. 2: *Erysimum rhaeticum* (Hornem.) DC.; Rel. 3: *Medicago minima* (L.) L., *Misopates orontium* (L.) Raf. 1, *Papaver dubium* L., *Sanguisorba minor* Scop., *Verbascum blattaria* L.; Rel. 4: *Hedera helix* L.; Rel. 5: *Melica ciliata* L. ssp. *ciliata*; Rel. 6: *Cerastium glomeratum* Thuill.; Rel. 8: *Trifolium campestre* Schreb., *Hypericum perforatum* L., *Malva sylvestris* L.; Rel. 10: *Galium aparine* L.; Rel. 15: *Ajuga chamaepitys* (L.) Schreb., *Allium sphaerocephalon* L. 1, *Fraxinus ornus* L. (pl), *Potentilla recta* L.; Rel. 17: *Euphorbia falcata* L.

Tab. 3 *Campanulo carnicae*-*Athamantetum turbith*

Rel. 1: *Dictamnus albus* L., *Scabiosa triandra* L.; Rel. 3: *Asperula purpurea* (L.) Ehrend., *Globularia bisnagaria* L., *Potentilla pusilla* Host; Rel. 4: *Celtis australis* L. (B2); Rel. 5: *Asparagus acutifolius* L., *Sedum montanum* E.P. Perr. & Song. ssp. *orientale* 't Hart; Rel. 7: *Allium sphaerocephalon* L., *Cotinus coggygria* Scop. (B2), *Ficus carica* L. (B2); Rel. 8: *Calamagrostis varia* (Schrad.) Host, *Clematis recta* L.; Rel. 9: *Geranium purpureum* Vill. r, *Saponaria ocymoides* L. 1; Rel. 10: *Philadelphus coronarius* L. (pl)

Tab. 4 *Saxifragetum bericae*

Rel. 2: *Fissidens* spp.; Rel. 4: *Calypogeia* spp.; Rel. 9: *Bryum* spp.

Tab. 6 *Polypodium cambricum* community

Rel. 1: *Euonymus europaeus* L. (B2), *Ranunculus bulbosus* L.; Rel. 2: *Bromus sterilis* L. r, *Plagiomnium* spp.; Rel. 3: *Galium lucidum* All. 1, *Geranium robertianum* L.; Rel. 4: *Phyllitis scolopendrium* (L.) Newman r; Rel. 5: *Erysimum rhaeticum* (Hornem.) DC., *Silene nutans*

L. ssp. *insubrica* (Gaudin) Soldano 2a, *Tamus communis* L.; Rel. 6: *Arabis sagittata* (Bertol.) DC., *Carex halteriana* Asso, *Thlaspi praecox* Wulfen; Rel. 7: *Lonicera caprifolium* L.; Rel. 8: *Fumaria officinalis* L., *Galium aparine* L. 1, *Geranium rotundifolium* L. 1, *Paliurus spina-christi* Mill.(B2) 2b, *Stellaria media* (L.) Vill. 1, *Sternbergia lutea* (L.) Ker Gawl. ex Spreng.

Tab. 7 *Parietario judaicae*-*Stellarietum pallidae*

Rel. 5: *Catapodium rigidum* (L.) Hubbard 1, *Celtis australis* L. (B2), *Erysimum rhaeticum* (Hornem.) DC. r, *Polyopogon monspeliensis* (L.) Desf.; Rel. 6: *Piptatherum miliaceum* (L.) Coss.; Rel. 7: *Geranium robertianum* L., *Geum urbanum* L., *Lamium flavidum* F. Herm. r; Rel. 8: *Cerastium brachypetalum* Desp. ex Pers. ssp. *brachypetalum* 1.

Tab. 8 *Celtido australis*-*Fraxinetum orni*

Rel. 1: *Bromus sterilis* L., *Cornus sanguinea* L. 2a, *Glaucium italicum* Mill., *Lactuca serriola* L., *Laurus nobilis* L. (cult; B2), *Orlaya grandiflora* (L.) Hoffm., *Ranunculus bulbosus* L., *Saponaria ocymoides* L., *Stellaria media* (L.) Vill., *Viburnum lantana* L. 1; Rel. 2: *Asplenium ruta-muraria* L., Rel. 3: *Clematis vitalba* L., *Cruciata laevipes* Opiz, *Vincetoxicum hirundinaria* Medik.; Rel. 4: *Bothriochloa ischaemum* (L.) Keng, *Setaria viridis* (L.) P.Beauv. r; Rel. 5: *Asperula purpurea* (L.) Ehrend., *Asplenium trichomanes* L. ssp. *quadri-valens* D.E. Mey., *Euphorbia cyparissias* L., *Loncomelos* spp., *Polypodium cambricum* L., *Sedum album* L.; Rel. 6: *Clinopodium vulgare* L., *Hypericum perforatum* L., *Narcissus poeticus* L.; Rel. 7: *Geranium sanguineum* L., *Teucrium flavum* L. ssp. *flavum*; Rel. 8: *Ononis pusilla* L., *Rosa agrestis* Savi; Rel. 9: *Allium lusitanicum* Lam., *Arabis sagittata* (Bertol.) DC., *Campanula spicata* L., *Carex humilis* Leyss., *Cyanus triumfetti* (All.) Dostál ex Á. & D. Löve, *Dianthus sylvestris* Wulfen, *Mercurialis perennis* L., *Ruta graveolens* L., *Silene otites* (L.) Wibel, *Thymus glabrescens* Willd. ssp. *decipiens* (Heinr. Braun) Domin.