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A phytosociological survey of the main plant community types of alpine and sub-alpine belt in the Sibillini Mountains (Central Apennines, Italy)

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Abstract: Costanzo E., Furnari F. & Tomaselli V. *A phytosociological survey on the main plant community types of alpine and sub-alpine belt in the Sibillini Mountains (Central Apennines, Italy). Lazaroa 30: 219-250 (2009).*

The vegetation communities of the alpine and subalpine bioclimatic belts of Sibillini Mountains were investigated following the phytosociological approach. During fieldwork 108 relevés were collected. The vegetation of grasslands and pastures, screes, talus slopes and high altitude rock faces was investigated, identifying several phytosociological types within the following alliances: *Seslerion apenninae* (*Elyno-Seslerietea*) with the two suballiances *Seslerenion apenninae* and *Leontopodio nivalis-Elynenion myosuroidis*, *Ranunculo pollinensis-Nardion strictae* (*Nardetea strictae*), *Phleo ambigui-Bromion erecti* with the suballiance *Brachypodenion genuensis* (*Festuco-Brometea*), *Arction lappae* (*Artemisietea vulgaris)*, *Saxifragion australis* and *Cystopteridion fragilis* (*Asplenietea trichomanis*)*, Linario-Festucion dimorphae* (*Thlaspietea rotundifolii*). Raw data from 63 relevés, regarding the vegetation of grasslands and pastures, was subjected to multivariate analysis. The main structural and ecological characteristics of these communities are shown in this paper. The study showed strong similarities with the high altitude vegetation of the Majella and Gran Sasso massif.

Key words: Alpine plant communities, subalpine plant communities, Sibilini Mountains, Phytosociology, Central Apennines, Italy.

Resumen: Costanzo E., Furnari F. & Tomaselli V. *Estudio fitosociológico de los principales tipos de comunidades vegetales de los pisos bioclimáticos alpino y subalpino de los Montes Sibillini (Apeninos Centrales, Italia). Lazaroa 30: 219-250 (2009).*

Las comunidades vegetales de los pisos bioclimáticos alpino y subalpino de los Montes Sibillini (Apeninos centrales, Italia central) han sido estudiados utilizando el metodo fitosociológico. Durante el trabajo de campo se recolectaron 108 inventarios fitosociológicos. Del análisis de los mismos se han reconocido varias asociaciones y subasociaciones pertenecientes a las siguientes alianzas: *Seslerion apenninae* (*Elyno-Seslerietea*) a través de las suballianzas *Seslerenion apenninae* y *Leontopodio nivalis-Elynenion myosuroidis*, *Ranunculo pollinensis-Nardion strictae* (*Nardetea strictae*), *Phleo ambigui-Bromion erecti* con la suballianza *Brachypodenion genuensis* (*Festuco-Brometea*), *Arction lappae* (*Artemisietea vulgaris*), *Saxifragion australis* y *Cystopteridion fragilis* (*Asplenietea trichomanis*), *Linario-Festucion dimorphae* (*Thlaspietea rotundifolii).* Los datos sobre la vegetación de las praderas y pastizales fueran objeto de análisis multivariante. Se describen las principales características estructurales y ecológicas de las comunidades vegetales estudiadas y se señalan las similitudes con la vegetación de alta montaña de otros macizos de los Apeninos Centrales.

Palabras clave: Vegetación alpina y subalpina, Montes Sibilini, Fitosociología, Apeninos Centrales, Italia.

INTRODUCTION

The Sibillini Mountains are located in the central Apennines, between the Marche and Umbria regions (Figure 1). This area is characterized by great geomorphological heterogeneity, with a correspondingly high biological richness: the flora is one of the richest in the central Apennines and the vegetation is diversified into many plant communities.

The first studies on the high-altitude vegetation of the central Apennines date from towards the middle of the last century (Lüdi, 1943; Montelucci, 1952-1953) and comprise a large number of surveys on the Gran Sasso massif (Furrer & Furnari, 1960; Giacomini & Furnari, 1961; Furnari, 1961; Bruno & Furnari, 1966; Bonin & Vedrenne, 1979). Later, other parts of the central Apennines, including the Sibillini (Furnari, 1970), were investigated (Barbero & Bonin, 1969; Bazzichelli & Furnari, 1970; Furnari, 1970; Migliaccio, 1970; Feoli Chiapella & Feoli, 1977; Avena & Blasi, 1980; Pedrotti, 1981, 1982 a).

In recent years the vegetation surveys on the central Apennines have intensified with several scientific works regarding, particularly Gran Sasso (Biondi &

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al., 1988, 1992, 1995b, 1999a, b, 2000; Tammaro, 1995), Velino (Petriccione, 1994 a; Pirone & *al.*, 1999), Abruzzo, Lazio and Molise National Park (Petriccione, 1986; Conti & Manzi, 1992; Conti, 1995; Di Pietro & *al*., 2004, 2005) and with specific investigations on the high-altitude vegetation of the central Apennines (Pignatti, 1994; Blasi & *al*., 2003, 2005). Several scientific papers have been published on the Sibillini Mountains, (Biondi & Ballelli, 1982; Pedrotti, 1982b, c; Marchesoni, 2005; etc.), but there has still been no comprehensive work on high-altitude vegetation. Thus the objective of this paper is to present the results of a study on the vegetation types of the alpine and subalpine belts of the Sibillini Mountains. The vegetation of grasslands and pastures, screes, talus slopes and rock faces at high altitudes was investigated.

Study area

The Sibillini massif is located in the central Apennines and forms a chain 40 km long, running NNW-SSE (Figure 1). It lies within the Sibillini Mountains National Park, which covers an area of about 70,000 ha. Several peaks exceed 2000 m. The highest peak, M. Vettore, reaches 2476 m.

The geological substrate consists of carbonaceous rocks (limestones and marls; Mesozoic-lower Tertiary). At the highest altitudes there is a predominance of limestones. Glacial morphologies, such as glacial cirques and moraines originating during the Quaternary glaciations are frequent. The most important is the Valle del Lago glacial cirque, located on the northern slope of M. Vettore and at the foot of which lies the Lago di Pilato glacial lake (Giovagnotti, 1976).

Regarding the bioclimate, the entire central Apennines belongs to the Temperate Region (Blasi, 1994; Biondi & Baldoni, 1995; Rivas-Martinez, 1995, 1996). The Sibillini Mountains also fall within the temperate macrobioclimate, with a high oceanic component (Biondi & Baldoni, 1995). The authors have found the following bioclimatic belts: colline, montane, subalpine and alpine.

The study area falls within the subalpine and alpine belts, in an altitudinal range from about 1850 m to the top (2476 m), covering an area of about 8000 ha. The altitude of the Sibillini mountains is limited compared to the highest Apennine massif (Gran Sasso and Majella). We can assume that the boundary between the alpine and the subalpine belts runs at 2300-2400 m, and this means that the alpine bioclimatic belt is limited only to the highest peaks in this massif.

Soils of subalpine and alpine belts are acid brown soils (*typic* and *lithic Hapludolls* or *typic Haplumbrept*) or brown rendzinas (*lithic Rendolls*). At a lower altitude, in the montane belt, we can find subacid brown soils (*typic* and *dystric Eutrochrepts*) and calcareous brown soils (*typic* and *dystric Xerochrepts*) partly decarbonated. On steep slopes, the pedogenetic process remains incomplete and lithosoils (*lithic Xerorthents*) are formed.

MATERIALS AND METHODS

The fieldwork was carried out during the summers of 1998 and 1999. During this period, 108 relevés were

Figure 1.- Sibillini Mountains National Park.

made using the phytosociological method of the Zurich-Montpellier school (Braun-Blanquet, 1964).

For the identification of the collected specimens we have referred to Pignatti (1982), Fiori (1924) and Tutin & *al.* (1964-1980). Plant nomenclature follows Conti & *al.* (2005).

For each phytosociological table the specific life forms and chorotypes were considered. For life forms, reference was made to Pignatti (1982). For chorotypes, reference was also made to Pignatti (1982), and for the Apennine endemic component solely to Conti (1998). The frequencies of life forms and chorotypes were thus calculated for each phytosociological table.

A matrix of 63 relevés was selected for 132 species of grassland and high-altitude pasture vegetation, and the cover-abundance values were transformed according to Van Der Maaler (1979). By applying the Syntax 2000 package (Podani, 2001) the matrix was subjected to multivariate analysis (chord distance and average correlation) for the hierarchical clustering of the relevés. A PCA with superimposed partition was performed for the ordination.

RESULTS

Numerical analysis

The multivariate analysis of the grassland relevés (Tables 1-8), shows two main clusters (Figure 2). Cluster A includes acidophilous and sub-acidophilous grasslands, while cluster B comprises basophilous pastures and dry grasslands on pioneer soils. Cluster A is subdivided into two sub-clusters: a1, including *Festuco-Brometea* grasslands dominated by *Brachypodium genuense* (and referred to *Brachypodietum genuensis*); and a2, including the *Nardetea strictae* acidophilous grasslands. Sub-cluster a2 is divided into a2.1 (thick and acidophilous grasslands growing on deep or relatively deep soils, dominated by *Trifolium thalii* or by *Nardus stricta* and referred respectively to *Taraxaco-Trifolietum thalii* and to *Luzulo-Nardetum*); and a2.2 (acidophilous grasslands growing on thin soils, dominated by *Plantago atrata* and *Ranunculus pollinensis* and referred to *Ranunculo-Plantaginetum* and sub-acidophilous grasslands with *Sesleria juncifolia subsp.*

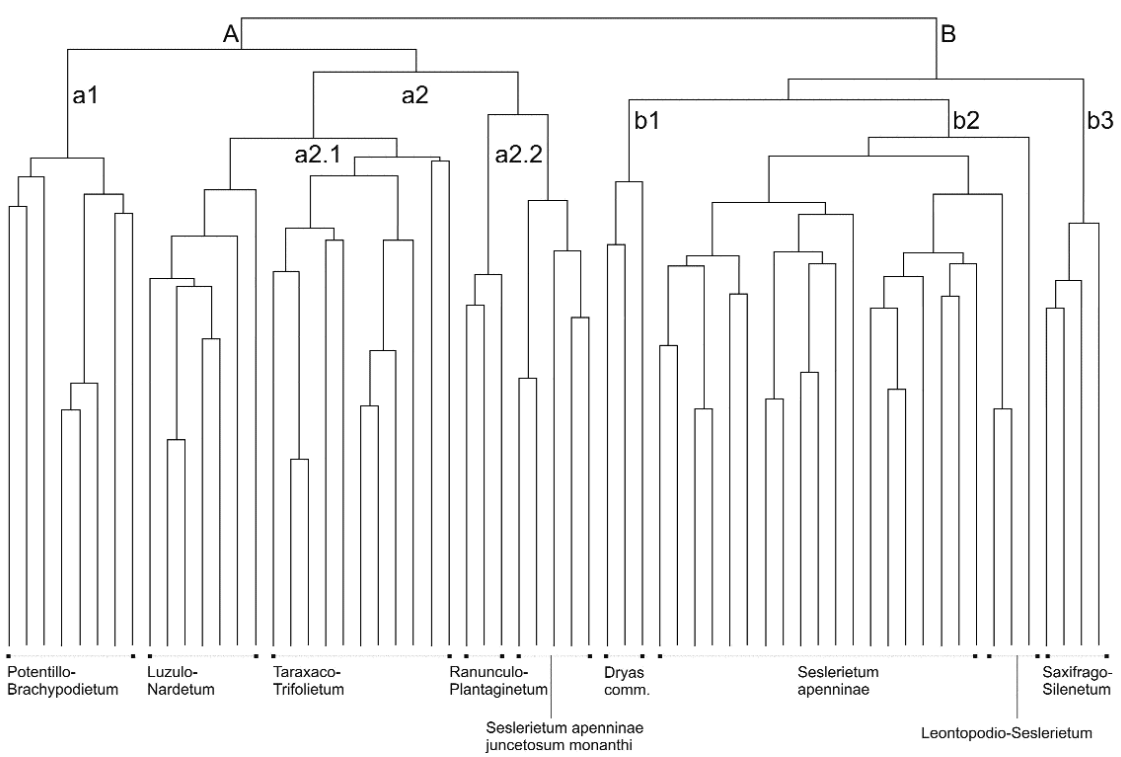

Figure 2.- Dendrogram resulting from the multivariate analysis of the relevés of grasslands and pastures.

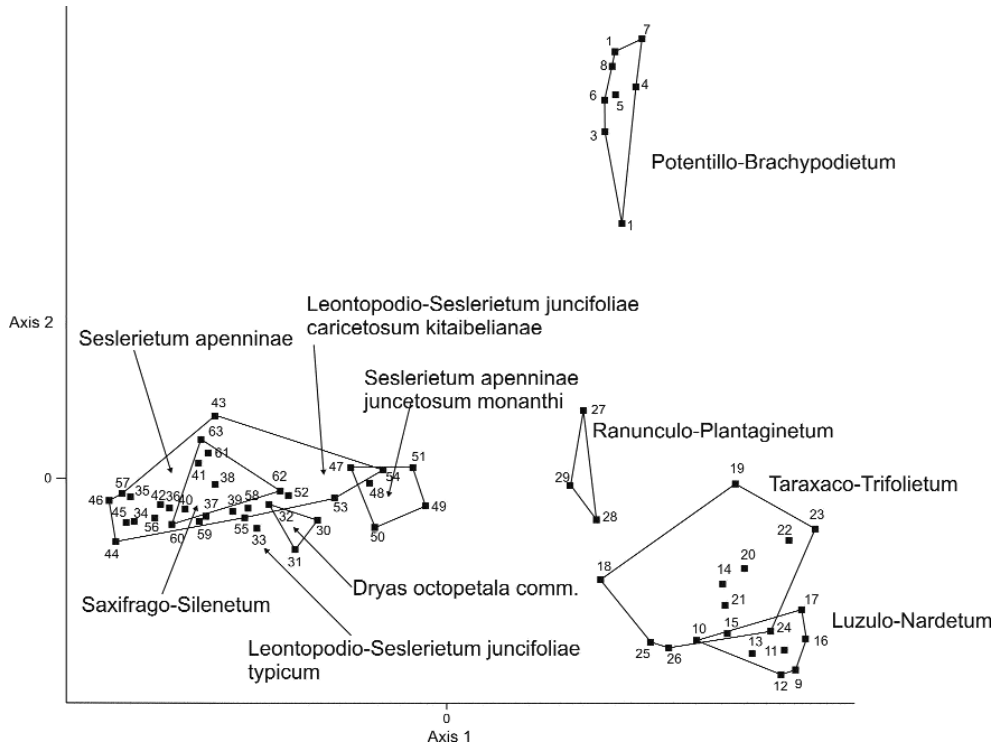

Figure 3.- PCA ordination with superimposed partition (axis 1 and axis 2).

juncifolia, dominated by *Juncus trifidus subsp. monanthos* and classified as subass. *juncetosum monanthi* of *Seslerietum apenninae*). Cluster B comprises three subclusters including communities of *Seslerion apenninae*: b1 includes three relevés of grasslands with *Dryas octopetala* (two of them, with high cover values of *Dryas*, have been phytosociologically classified as *Seslerio-Dryadetum octopetalae*); b2 is characterized by xerophilous and basophilous *Sesleria juncifolia* grasslands (*Seslerietum apenninae* and *Leontopodio-Seslerietum juncifoliae* relevés fall in this sub cluster); and b3 includes dwarf cushion communities with *Silene acaulis* (*Saxifrago-Silenetum cenisiae*).

The PCA analysis (superimposed partition along three axes) shows 8 groups. The distribution of the clusters along axis 1 (Figure 3) appears to follow a soil gradient, from left to right, from basophilous to acidophilous vegetation types: two main groups of clusters are clearly separated: the *Seslerion* communities on the left and the *Nardion* communities on the right. The PCA indicates a general overlapping of the *Seslerion* communities, except for the *juncetosum monanthi* subass. of *Seslerietum apenninae* which splits quite clearly. Along axis 2 the clean separation of *Brachipodium genuense* communities is probably due to the dominance of species of the *Festuco-Brometea* class, so we can assume a xero-thermal gradient along the axis. The distribution along the third axis (Figure 4) does not seem to reveal any particularly defined correlation.

Vegetation

Xerophilous and basophilous perennial grasslands of alpine and subalpine belts

Xerophilous and basophilous perennial grasslands of alpine and subalpine belts belong to the Eurosiberian class *Elyno myosuroidis-Seslerietea coeruleae*, to the *Seslerietalia tenuifoliae* order (Balkans and Apennines) and to the *Seslerion apenninae* alliance (alpine, subalpine and, sometimes, montane belts of the Apennines). The two suballiances *Leontopodio nivalis-Elynenion myosuroidis* (alpine belt) are present in the

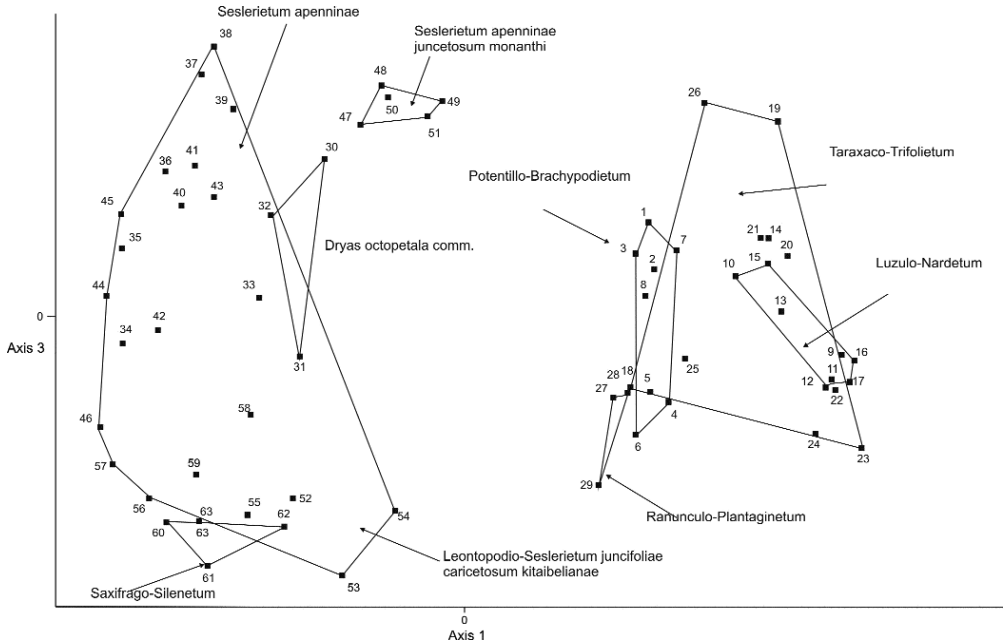

Figure 4.- PCA ordination with superimposed partition (axis 1 and axis 3).

study area, including the associations *Leontopodio nivalis-Seslerietum juncifoliae* with the new subassociation *caricetosum kitaibelianae* and *Saxifrago speciosae-Silenetum cenisiae*, and *Seslerenion apenninae* (subalpine belt), including the two associations *Seslerio apenninae-Dryadetum octopetalae* and *Seslerietum apenninae*.

Leontopodio nivalis-Seslerietum juncifoliae Blasi, Di Pietro & Pelino 2005 (Table 1, rel. 1-4) ***caricetosum kitaibelianae* subass.** *nova hoc loco* (Table 1, rels. 2-4, *holotypus* hoc loco rel. 2)

The xerophytic summit grasslands are characterized by a group of characteristic species of *Leontopodio nivalis-Elynenion myosuroidis*, such as *Silene acaulis*, *Minuartia verna subsp. verna, Potentilla cranztii* subsp. *crantzii, Leontopodium nivale*, *Oxytropis campestris* subsp. *campestris, Sedum atratum* subsp. *atratum, Helianthemum oelandicum* ssp.*alpestre* (Table 1). The physiognomy is given by *Carex kitaibeliana* and *Sesleria juncifolia subsp. juncifolia.* This vegetation grows along crests of the summit areas, in an altitudinal range between approximately 2380 m to the top. It covers surfaces characterized by soils with a high debris component and large outcropping rocks, exposed to cold winds blowing mainly from the northeast. Cover values are on average between 40% and 70%, exposure and slope are also variable. These plant communities show ecological and floristic relations with *Leontopodio nivalis-Seslerietum juncifoliae*, an association described for the alpine belt of the Majella massif and typically located on crests and ridges at high altitudes (Blasi & *al*., 2005). In Table 1, only rel. 1 (Mt. Vettore, near the top) can be attributed to the typical form of the association, and in the PCA analysis it splits separately from the other relevés of *Sesleria juncifolia* communities (Figure 3). Relevés 2-4, made at lower altitudes around the top of Vettore (Table 19), show a general poorness of characteristic species and low cover values of *Sesleria juncifolia subsp. juncifolia. Carex kitaibeliana*, with high cover values, characterizes the physiognomy of these grasslands. This vegetation is here characterized as a new subassociation, *caricetosum kitaibelianae* subass. nova (Table 1, rels. 2-4, *holotypus* rel. 2). *Leontopodio nivalis-Seslerietum juncifoliae caricetosum kitaibelianae* has ecological relations with *Caricetum kitaibelianae-rupestris* Biondi, Allegrezza, Ballelli & Taffetani 2000 (Biondi & *al*., 2000), occurring on the summit areas of Corno Grande (Gran Sasso, Central Apennines).

Table 1

Leontopodio nivalis-Seslerietum juncifoliae Blasi, Di Pietro et Pelino 2005
subass. *caricetosum kitaibelianae subass. nova hoc loco*
(Leontopodio-Elynenion, Seslerion apenninae, *Seslerietalia tenuifoliae, Elyno myosuroidis-Seslerietea caeruleae)*

Altitude (m)	2470	2420	2422	2375
Slope (°)	-	-	-	20
Aspect	-	-	-	W
Area (m^2)	100	100	100	100
Cover (%)	40	75	70	40
N.	1	2	3	4
Characteristics of association				
Leontopodium nivale	1	1	+	1
Aster alpinus subsp. *alpinus*	1	.	.	.
Diff. Subass. *caricetosum kitaibelianae*				
Carex kitaibeliana subsp. *kitaibeliana*	.	3	3	2
Characteristics of *Elynenion*				
Potentilla cranztii subsp. *crantzii*	+	1	1	+
Minuartia verna subsp. *verna*	1	+	.	1
Helianthemum oelandicum subsp.alpestre	+	.	.	+
Silene acaulis subsp. *cenisia*	1	.	.	.
Sedum atratum subsp. *atratum*	+	.	.	.
Dryas octopetala	.	.	.	1
Characteristics of *Seslerion*				
Pedicularis elegans	1	1	1	+
Trinia dalechampii	+	.	.	.
Carum flexuosum	.	.	.	+
Characteristics of *Seslerietalia*				
Sesleria juncifolia subsp. *juncifolia*	*2*	*1*	+	*2*
Armeria canescens	+	*1*	+	.
Gentiana dinarica	*1*	+	.	.
Edraianthus graminifolius subsp. *graminifolius*	.	*1*	+	.
Globularia meridionalis	.	.	+	.
Acinos alpinus subsp. *alpinus*	.	+	.	.
Characteristics of *Seslerietea*				
Thymus praecox subsp. *polytrichus*	+	+	1	.
Androsace villosa subsp. *villosa*	+	1	1	.
Draba aizoides subsp. *aizoides*	+	+	+	
Gentiana verna subsp. *verna*	1	.	.	+
Anthyllis vulneraria subsp. *vulnerarioides*	.	+	.	+
Sempervivum arachnoideum	.	+	1	.
Pulsatilla alpina subsp. *millefoliata*	.	+	.	.
Ranunculus breyninus	+	.	.	.
Pedicularis tuberosa	.	.	.	+
Coronilla vaginalis	.	.	.	+
Other species				
Saxifraga paniculata	+	+	+	.
Plantago atrata subsp. *atrata*	.	2	2	+
Senecio doronicum	.	+	1	+
Cerastium arvense subsp. *suffruticosum*	.	1	+	.
Hieracium pilosella	.	1	+	.
Alyssum montanum subsp. *montanum*	.	1	1	.
Asperula cynanchica	.	+	+	.

Other species: *Poa alpina* subsp. *alpina* 2, *Erigeron epiroticus* 1, *Senecio squalidus* + in 1; *Saxifraga oppositifolia* subsp. *speciosa*, *Sedum acre, Hieracium lactucella* ssp *lactucella* and *Ranunculus brevifolius* + in 2; *Saxifraga exarata* subsp. *ampullacea* + in 3; *Adonis distorta, Campanula glomerata, Hieracium villosum, Valeriana montana* subsp. *montana*, *Juniperus communis* var. *saxatilis*, *Salix retusa, Galium lucidum* and *Trifolium pratense* subsp. *semipurpureum* + and *Biscutella laevigata* 1 in 4.
Localities: 1: Vettore, Furnari 1970; 2-3: 27/7/99 Cima del Lago; 4: Vettore, Furnari 1970.

Saxifrago speciosae-Silenetum cenisiae Petriccione 1993 (Table 2, rel. 1-4)

Dwarf-cushion vegetation characterized by *Silene acaulis subsp. cenisia*, covering only scattered and often limited areas is found on rendzina soils with abundant outcropping rocks in the higher parts of the massif. It is located on ridges at altitudinal ranges varying from 2300 m to the top, and forming a mosaic with the grasslands of *Leontopodio nivalis-Seslerietum apenninae caricetosum kitaibelianae*. This vegetation can be referred to *Saxifrago speciosae-Silenetum cenisiae*, an association described for the Velino massif and present in the alpine belt of the main massifs of the central Apennines (PETRICCIONE, 1993; PETRICCIONE & PERSIA, 1995). Characteristic species of the association, shown in Table 2, are: *Silene acaulis subsp. cenisia, Saxifraga oppositifolia subsp. speciosa, Potentilla cranztii subsp. crantzii, Ranunculus brevifolius*. This vegetation is the typical "alpine tundra" of the alpine belt: it grows on primitive soils rich in debris and coarse clast deriving from the fragmentation *in situ* of the underlying rock, and has very low cover values (25-30%). *Saxifrago speciosae-Silenetum cenisiae* shows strong ecological similarities with *Galio magellensis-Silenetum acaulis* Blasi, Di Pietro, Fortini et Catonica 2003, described for the alpine belt of Gran Sasso and Majella. The two associations can be considered as a territorial vicariant.

Table 2

Saxifrago speciosae-Silenetum cenisiae Petriccione 1993

(*Leontopodio-Elynenion, Seslerion apenninae, Seslerietalia tenuifoliae, Elyno myosuroidis-Seslerietea caeruleae*)

Altitude (m)	2300	2350	2350	2400
Slope (°)	40	45	50	50
Aspect	E-SE	SE	NE	NE
Area (m^2)	10	5	10	30
Cover (%)	30	30	25	20
N.	1	2	3	4
Association differentials				
Silene acaulis subsp. *cenisia*	2	1	1	.
Saxifraga oppositifolia subsp. *speciosa*	+	1	+	.
Potentilla cranztii subsp. *crantzii*	.	+	.	.
Ranunculus brevifolius	.	.	.	+
Characteristic of *Elynenion*				
Leontopodium nivale	1	1	+	+
Minuartia verna subsp. *verna*	.	+	+	+
Helianthemum oelandicum subsp. *alpestre*	1	.	.	.
Sedum atratum subsp. *atratum*	+	.	.	.
Characteristic of *Seslerion*				
Artemisia umbelliformis subsp. *eriantha*	+	+	1	1
Phyteuma orbiculare	+	.	+	.
Characteristic of *Seslerietalia*				
Carex kitaibeliana subsp. *kitaibeliana*	1	+	1	+
Edraianthus graminifolius subsp. *graminifolius*	1	+	+	1
Globularia meridionalis	+	+	+	1
Sesleria juncifolia subsp. *juncifolia*	+	.	.	+
Characteristic of *Seslerietea*				
Sempervivum arachnoideum	+	+	+	1
Thymus praecox subsp. *polytrichus*	+	+	.	+
Gentiana verna subsp. *verna*	+	+	+	.
Anthyllis montana subsp. *atropurpurea*	1	1	+	.
Draba aizoides subsp. *aizoides*	.	+	.	+
Aster alpinus subsp. *alpinus*	.	+	.	.
Other species				
Saxifraga paniculata subsp. *stabiana*	+	+	1	1
Saxifraga exarata subsp. *ampullacea*	+	.	1	1
Dianthus sylvestris subsp. *sylvestris*	.	1	.	+
Hieracium pilosella	.	+	.	+

Other species: Valeriana saliunca 1 in 3;Asperula cynanchica + in 4.

Localities: 1: ridge below Cima del Lago, 27/7/99; 2-4: ridge below Cima del Lago, 27/7/99.

Seslerio apenninae-Dryadetum octopetalae Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999 (Table 3, rels. 1-2)

The communities dominated by *Dryas octopetala* occur exclusively on the steep and stony slopes of the Lago di Pilato valley (Table 19), on soils rich in calcareous debris and exposed to heavy north winds, at altitudes between 1850 and 1900 m a.s.l. This vegetation has been described for the central Apennines (Gran Sasso) as a discontinuous and xerophytic carpet on stabilized debris (Furrer & Furnari, 1960), and was subsequently characterised as *Seslerio apenninae-Dryadetum octopetalae* (Biondi & *al*., 1999a). Characteristic and differential species recognized by the authors of the association are: *Dryas octopetala, Sesleria juncifolia, Carex mucronata, Ranunculus thora* and *Leontopodium nivale.* The characteristic species found in the communities observed in the Lago di Pilato valley are *Dryas octopetala* and *Leontopodium nivale* (Table 3). PCA analysis segregates a group of three relèves of plant communities with *Dryas octopetala* (Figure 3, rels. 30-32), but only rel. 30 and 31 have here been referred to the *Seslerio-Dryadetum sensu* Biondi & *al* 1999 (Table 3, rels. 1-2). Relevé 32, made at higher altitudes and in different ecological conditions shows low cover value of *Dryas*, and has been referred to *Leontopodio nivalis-Seslerietum juncifoliae caricetosum kitaibelianae* (Table 1, rel. 4)

Seslerio apenninae-Dryadetum octopetalae is in contact, near the summit areas, with *Leontopodio nivalis-Seslerietum juncifoliae caricetum kitaibelianae* grasslands.

Table 3
Seslerio apenninae-Dryadetum octopetalae
Biondi & al. 1999
(*Seslerenion apenninae, Seslerion apenninae, Seslerietalia tenuifoliae, Elyno myosuroidis-Seslerietea caeruleae*)

Altitude (m)	1850	1900
Slope (°)	35	15
Aspect	N	E
Area (m^2)	50	50
Cover (%)	100	80
Char. Ass.		
N.	1	2
Association characteristics		
Dryas octopetala	5	3
Leontopodium nivale	.	1
Characteristic of *Seslerenion* and *Seslerion*		
Anthyllis montana subsp. *atropurpurea*	+	+
Linum capitatum subsp. *serrulatum*	+	1
Pedicularis elegans	+	.
Festuca violacea subsp. *italica*	+	.
Characteristic of *Seslerietalia*		
Carex kitaibeliana subsp. *kitaibeliana*	2	3
Sesleria juncifolia subsp. *juncifolia*	1	+
Edraianthus graminifolius subsp. *graminifolius*	+	+
Gentiana dinarica	+	.
Characteristic of *Seslerietea*		
Gentiana verna subsp. *verna*	+	+
Juncus trifidus subsp. *monanthos*	+	+
Anthyllis vulneraria subsp. *vulnerarioides*	.	+
Campanula scheuthzerii	+	.
Pulsatilla alpina subsp. *millefoliata*	1	.
Other species		
Ranunculus apenninus	+	1
Euphrasia salisburgensis	+	+
Salix retusa	+	.
Trifolium pratense subsp. *pratense*	+	.
Galium lucidum	+	.
Gentiana lutea subsp. *lutea*	+	.
Minuartia verna subsp. *verna*	+	.
Helianthemum oelandicum subsp. *alpestre*	.	1
Plantago atrata subsp. *atrata*	.	1

Other species: *Asperula cynanchica, Trifolium thalii, Alchemilla alpina, Arenaria bertolonii, Bistorta vivipara* and *Rhamnnus pumila* + in 1; *Arenaria grandiflora* subsp. *grandiflora* and *Potentilla apennina* subsp. *apennina* 1, *Saxifraga paniculata* and *Silene acaulis* + in 2.
Localities: 1: Valle del Lago, 6/8/99; 2: Lago di Pilato, 6/8/99.

Seslerietum apenninae Furnari in Bruno & Furnari 1966 (Table 4, rel. 1-24) **subass.*** juncetosum monanthi*** Biondi & al. 1999 (Table 4, rel. 20-24)

Seslerietum apenninae grows near regular slopes with variable inclination values varying from 0° to 45° (Table 4), on undeveloped soils rich in calcareous debris, in windy stands characterized by high evapo-transpiration (Furrer & Furnari, 1960; Furnari, 1961; Migliaccio, 1970; Petriccione, 1994b). With their typical steppe morphology and their large extension, these grasslands characterize the landscape of the subalpine belt.

Seslerietum apenninae is found in the central and southern calcareous Apennines, from the Sibillini to Pollino (Biondi & *al*., 1988; Petriccione & Persia, 1995). Characteristic species are *Pedicularis elegans*, *Helianthemum oelandicum subsp. alpestre* and *Androsace villosa. Silene cattariniana* Ferrarini et Cecchi (= *Silene graminea* Vis.; Ferrarini & Cecchi, 2001), endemic and rare species of the central Apennines (Table 4, rels. 10-12) occurring on the Vettoretto mountain.

Relevés 13-18 were made along ridges of the summit areas of the massif, on soils with a high debris component and outcropping rocks. In these environmental conditions *Sesleria juncifolia* cover values appear lower

compared to the typical form of the association and, in this case, the physiognomy is characterized by *Carex kitaibeliana.*

Biondi & *al*. (1999a) described, for the Gran Sasso massif, the *juncetosum monanthi* subassociation, characterized by *Juncus trifidus subsp. monanthos* and *Bistorta vivipara* and occurring close to the grasslands of the *Leontopodio nivalis-Elynetum myosuroidis* Feoli-Chiapella & Feoli 1977. In our opinion this subassociation, growing on deep soils and with the presence of a significant number of species of *Nardetea strictae* (Table 4, rels. 20-24), characterizes the *Sesleria juncifolia* communities that come into contact with the mesophilous grasslands of the *Nardetea strictae* class. This group of five relevés, on the basis of PCA analysis, split clearly from the group of *Sesleria juncifolia* grasslands (Figures 3 and 4).

Mesophilous and acidophilous perennial grasslands of alpine and subalpine belts

Mesophilous and acidophilous perennial grasslands growing on deep, leached, acid or sub-acid soils of alpine and subalpine belts belong to the *Nardetea strictae* class, the *Nardetalia strictae* order and to the *Ranunculo pollinensis-Nardion strictae* alliance, endemic to the southern-central Apennines.

Three associations were found in the study area: *Ranunculo pollinensis-Plantaginetum atratae*, *Luzulo italicae-Nardetum strictae*, *Taraxaco apennini-Trifolietum thalii*.

Ranunculo pollinensis-Plantaginetum atratae Biondi, Ballelli, Allegrezza & Taffetani 2000 (Table 5, rels. 1-4)

The plant communities dominated by *Plantago atrata* subsp. *atrata* grow in slight hollows or in the bottom of dolinas, sited on the highest part of the massif, where snow remains for most of the year, on decarbonated and not very developed soils. This vegetation forms dense carpets covering small and scattered surfaces, often in contact with *Leontopodio nivalis-Seslerietum juncifoliae caricetosum kitaibelianae* grasslands. The physiognomy of this vegetation is given by *Plantago atrata* and by a contingent of acidophilous small hemicryptophytes characteristic of *Ranunculo-Nardion* and *Nardetea strictae.* Biondi & *al*. (2000) have distinguished this association from the others of *Ranunculo-Nardion* due to the presence of *Ranunculus pollinensis*, *Viola eugeniae* subsp. *eugeniae*, *Rumex nebroides* and *Crepis aurea* subsp. *glabrescens*, reported in Table 5 as differential species.

Floristic, ecological and structural features allow this vegetation to be framed within *Ranunculo pollinensis-Plantaginetum atratae*, described for the alpine belt of the Gran Sasso massif. Biondi & *al*. (2000) recognize this association as a geo-vicariant of *Gnaphalio magellensis-Plantaginetum atratae* Feoli-Chiapella & Feoli 1977, described for the Majella massif.

Luzulo italicae-Nardetum strictae Biondi, Ballelli, Allegrezza, Frattaroli & Taffetani 1992 (Table 6, rels. 1-8)

Nardus stricta vegetation forms dense grasslands on flattish (or slightly sloping) areas and on leached soils. *Festuca microphylla*, *Plantago atrata*, *Luzula spicata* subsp. *italica* and *Poa alpina* subsp. *alpina* also have high cover values and are physiognomic species of these acidophilous pastures. This vegetation is referred to the *Luzulo italicae-Nardetum strictae*, association described for the Gran Sasso massif and characterised by *Luzula spicata* subsp. *italica*, *Potentilla cranztii* subsp. *crantzii*, *Viola eugeniae* subsp. *eugeniae*, *Euphrasia salisburgensis* (Biondi & *al*., 1999a). Those authors described the subass. *caricetosum kitaibelianae* as a xerophilous variant, often in contact with *Seslerietum apenninae* grasslands and characterized by the presence of a group of characteristic species of the *Elyno-Seslerietea* class. This subassociation was not found in the study area. *Luzulo italicae-Nardetum strictae* is distributed in the subalpine belt of the calcareous central Apennines, and it is often in contact with *Taraxaco apennini-Trifolietum thalii* (Biondi & *al*., 1992, 1999a; Blasi & *al*., 2005).

Taraxaco apennini-Trifolietum thalii Biondi, Ballelli, Allegrezza, Frattaroli & Taffetani 1992. (Table 7, rels. 1-10)

Taraxaco apennini-Trifolietum thalii includes acidophilous, mesophilous and thick grasslands, where physiognomy is given by the dominance of *Trifolium thalii*, *Festuca microphylla* and *Plantago atrata* with the presence of a large group of acidophilous species of *Nardetea strictae* and *Ranunculo-Nardion*. This vegetation grows in large dolinas or wide hollows on deep, wet and acid soils where the snow remains for a considerable time (Furrer & Furnari, 1960; Giacomini & Furnari, 1961; Bazzichelli & Furnari, 1970; Pet-

Table 4

Seslerietum apenninae Furnari in Bruno et Furnari 1966

(*Seslerenion apenninae, Seslerion apenninae, Seslerietalia tenuifoliae, Elyno myosuroidis-Seslerietea caeruleae*)

Altitude (m)	2100	2130	2260	2260	1930	2238	2092	2130	2100	2022	2050	2040	2130	2150	2200	2200	2230	2100	2150	2160	2160	2097	2270	1900
Slope (°)	45	10	35	40	-	10	25	45	20	25	-	-	40	45	50	50	-	-	45	35	40	40	25	40
Aspect	NO	S	O	NO	-	S	E	SSE	S	NO	-	-	SO	SO	O	O	-	-	NO	SO	O	N	NO	O-NO
Area (m^2)	100	50	30	30	50	16	16	30	16	100	80	100	100	80	50	30	80	50	100	50	50	50	100	50
Cover (%)	80	50	60	60	50	35	40	60	20	50	50	60	60	50	40	40	50	70	90	100	100	100	100	100
N.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Association Characteristics																								
Helianthemum oelandicum subsp.*alpestre*	2	1	1	+	1	2	2	1	2	1	+	1	1	1	2	2	.	+	1	+	.	1	+	1
Pedicularis elegans	1	1	+	+	+	+	+	1	1	+	+	1	+	+	+	+	+	+	1	+	1	.	+	.
Androsace villosa subsp. *villosa*	1	1	+	1	1	1	+	+	1	+	1	1	+	1	+	+	1	1	+	+	.	.	.	.
Differential of *juncetosum monanthi*																								
Juncus trifidus subsp. monanthos	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	3	4	4	4
Bistorta vivipara	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	4	3	3	.
Characteristics suballiance.																								
Anthyllis montana subsp. *atropurpurea*	.	+	+	1	+	+	1	+	+	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.
Helianthemum nummularium subsp. grandiflorum	.	+	1	2	.	.	.	2	.	.	.	.	+	.	.	.	2	.	.	+	.	+	+	1
Paronychia kapela subsp. *kapela*	.	+	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Coronilla vaginalis	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Linum alpinum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
Characteristics of *Seslerion*																								
Leontopodium nivale	+	2	.	.	.	1	.	.	.	.	+	+	+	1	.	.	+	2	1	+	+	+	+	+
Festuca violacea subsp. italica	.	+	.	.	1	1	1	.	+	.	.	.	+	+	.	.	.	.	.	3	2	+	2	2
Trinia dalechampii	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+			
Silene cattariniana	.	.	.	.	.	.	.	.	.	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.
Achillea barellieri subsp. barellieri	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Avenula praetutiana	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carum flexuosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Characteristics of *Seslerietalia*																								
Carex kitaibeliana subsp. kitaibeliana	3	3	1	1	2	2	2	3	2	1	2	1	3	3	2	1	2	3	2	2	1	1	3	2
Sesleria juncifolia subsp. *juncifolia*	2	3	3	4	3	2	2	2	3	3	2	3	.	+	+	+	1	.	3	2	2	2	2	2
Edraianthus graminifolius subsp. *graminifolius*	1	1	1	2	+	1	1	1	+	+	1	1	+	1	+	1	.	1	1	.	.	+	+	1
Armeria canescens	+	.	.	.	.	.	.	+	+	.	.	.	1	+	+	1	+	.	+	+	+	2	+	+
Gentiana dinarica	.	2	.	.	.	.	.	.	1	.	.	.	.	1	+	1	.	1	.	.	.	.	.	.
Globularia meridionalis	.	.	.	.	.	.	.	.	.	.	1	1	.	.	+	1	+	1	.	.	.	.	.	.
Characteristics of *Seslerietea*																								
Thymus praecox subsp. polytrichus	1	1	.	.	1	2	+	+	1	1	+	1	1	1	+	+	+	+	1	+	.	+	.	1
Silene acaulis	1	+	.	.	.	+	.	+	+	.	+	+	.	+	1	1	.	+	.	.	.	+	1	.
Pulsatilla alpina subsp. *millefoliata*	+	.	.	.	+	.	.	+	+	+	.	.	.	+	+	+	.	+	.	+	.	+	+	+
Anthyllis vulneraria subsp. *vulnerarioides*	.	.	2	3	+	1	+	.	+	.	.	.	.	.	.	.	.	+	+	1	1	.	2	2
Gentiana verna subsp. *verna*	.	.	1	1	1	.	.	.	.	.	+	+	.	.	.	.	.	.	.	1	1	+	+	.
Ranunculus breyninus	1	.	.	.	.	+	+	+	.	.	.	.	+	1	+	+	.	.	+	1	+	.	.	.
Aster alpinus subsp. *alpinus*	1	+	+	1	.	.	+	.	.	.	.	.	.	+	+	+	.	.	.	1	.			
Phyteuma orbiculare	.	.	+	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.
Campanula scheuthzerii	.	.	.	.	.	.	.	.	.	.	.	.	+	1	+	.	.	.	.	.	.	1	1	1
Sempervivum arachnoideum	.	+	+	.	.	.	.	.	.	.	+	.	+	+	+	.	1	+	.	.	.	.	.	.
Draba aizoides subsp. *aizoides*	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Leontodon montanus subsp. *breviscapus*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	.	.	.
Pedicularis tuberosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+

Characteristics *Nardetea strictae*																								
Plantago atrata subsp. *atrata*	.	.	.	.	.	.	.	.	.	.	.	.	1	2	.	.	1	+	.	2	2	.	+	1
Viola eugeniae subsp. eugeniae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	+	1	.
Botrychium lunaria	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	+	.
Ranunculus apenninus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	3
Coeloglossum viride	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.
Hieracium pilosella	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Luzula spicata subsp. *italica*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.
Other species																								
Minuartia verna subsp. *verna*	1	.	+	.	+	1	+	.	+	1	+	1	1	1	+	+	+	+	+	+	+	+	+	+
Dianthus sylvestris subsp. *sylvestris*	+	+	+	1	.	.	2	+	1	+	+	+	+	1	.	+	1	.	1	1	2	.	.	+
Poa alpina subsp. *alpina*	.	+	+	.	1	2	1	1	.	+	+	+	1	1	+	.	1	+	.	1	+	.	+	+
Asperula cynanchica	.	+	.	.	1	+	+	.	.	1	.	1	.	.	+	1	.	+	+	+	.	+	.	+
Saxifraga paniculata	1	1	.	.	.	.	+	1	+	+	.	.	.	1	1	1	1	+	+	.	.	+	.	.
Trifolium pratense subsp. *semipurpureum*	.	+	.	.	.	.	.	.	+	+	.	.	1	+	.	.	.	.	.	1	.	1	+	2
Euphrasia salisburgensis	.	+	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	+	+	.	+	1	1
Cerastium arvense subsp. *suffruticosum*	.	.	.	.	1	.	+	.	+	.	.	.	+	.	.	.	.	.	.	.	.	+	1	+
Potentilla apennina subsp. *apennina*	1	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	+	1	+	.	.	.	.
Galium lucidum	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	.	.
Biscutella laevigata subsp. *laevigata*	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	1	1	+	.	+
Alyssum montanum subsp. *montanum*	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	+	.	+	.	.	+	.	.
Saxifraga oppositifolia subsp. *speciosa*	2	.	.	.	.	.	.	+	.	.	.	.	.	+	+	.	.	.	+	.	.	.	.	.
Oxytropis campestris subsp. *campestris*	1	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	2	+	2	.	.	.	.	.
Alchemilla nitida	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	1	.	.	+	.	.
Hieracium lactucella ssp *lactucella*	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.
Cyanus triumfettii	.	.	.	.	1	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.
Erigeron epiroticus	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Achillea millefolium subsp. *millefolium*	.	.	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Allium sphaerocephalon subsp. *sphaerocephalon*	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.
Arenaria grandiflora subsp. *grandiflora*	.	1	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Brachypodium genuenese	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Doronicum columnae	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Festuca circummediterranea	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Galium magellense	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.
Potentilla cranztii subsp. *crantzii*	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Potentilla tabernaemontani	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.
Rhamnus pumilus	.	.	.	.	1	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sedum magellense subsp. *magellense*	.	.	2	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sedum acre	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.

Other species: *Globularia meridionalis* + in 2; *Adonis distorta* and *Valeriana saliunca* + in 3; *Sedum acre* + in 4; *Astragalus sempervirens* + in 5; *Trifolium montanum* subsp. *rupestre* and *Senecio squalidus* +, *Koeleria lobata* 1 in 6; *Ranunculus brevifolius* + in 7; *Bromus erectus* and *Leontodon crispus* subsp. *crispus* + in 8; *Linum capitatum* subsp. *serrulatum* + in 9; *Leucanthemum heterophyllum, Astragalus vesicarius* subsp. *vesicarius, Cynoglossum magellense, Hippocrepis comosa* and *Astragalus depressus* subsp. *depressus* + in 12; *Acinos alpinus* subsp. alpinus + in 13; Sedum atratum subsp. atratum + in 17; *Senecio doronicum* + in 18 and 20; *Asplenium viridae, Arctostaphylos uva-ursi, Nigritella widderi, Pedicularis comosa* subsp. *comosa, Hieracium villosum, Crepis aurea* subsp. *glabrescens*, *Luzula campestris* and *Festuca dimorpha* +, *Galium lucidum* and *Scabiosa columbaria* subsp. *columbaria* 1 in 22; *Ranunculus pollinensis* 1, *Gnaphalium hoppeanum* subsp. *magellense* + in 23; *Euphrasia salisburgensis* + in 24.

Localities: 1: M. Porche, 30/07/99; 2: M. Argentella, summit plateau with outcropping rocks, 2/8/99; 3-4: Pizzo Berro, 25/7/98; 5: Forca Viola, ridge, 10/7/98; 6: Rifugio Zillioli, M. Vettore, 3/7/98; 7: Pizzo Tre Vescovi, 6/7/98; 8: M. Bove Sud, 6/7/99; 9: M. Sibilla, 31/7/99; 10-12: M. Vettoretto, 27/7/99; 13-18: M. Porche, summit plateau with outcropping rocks, 30/7/99; 19: saddle between Palazzo Borghese and Sasso di Palazzo Borghese, 28/7/99; 20-21: M. Argentella, 2/8/99; 22: M. Sibilla, 31/07/99; 23: M. Vettore, 04/08/99; 24: Valle del Lago, 6/8/99.

RICCIONE & PERSIA, 1995; BIONDI & *al*., 1999a). Cover values are very high, comprising between 90 and 100%. Slope inclination values are low and the flattish morphologies of the sites certainly favour the development of deep soils. Characteristic species are *Trifolium thalii*, *Taraxacum apenninum* and *Bellis perennis*. This vegetation is distributed on the calcareous massifs of the central-southern Apennines, from the Sibillini to Pollino, mainly in the subalpine belt. It is a primary pasture of high environmental value. At present, due to the high grazing load, particularly during the summer, the distribution area of these grasslands is reduced and fragmented.

Mesophilous and neutrophilous perennial grasslands of subalpine and montane belts

The neutrophilous, mesophilous or slightly xerophilous perennial grasslands of subalpine and montane belts belong to the *Festuco-Brometea* class, the *Brometalia-erecti* order, the *Phleo ambigui-Bromion erecti* alliance (endemic to the calcareous Apennines) and the *Brachypodenion genuensis* suballiance (subalpine and montane belts of the central-northern Apennines). The only association recognized in the Sibillini mountains is the *Potentillo rigoanae-Brachypodietum genuensis*.

Table 5

Ranunculo pollinensis-Plantaginetum atratae Biondi et al. 2000 (*Nardion strictae, Nardetalia strictae, Nardetea strictae*)

Altitude (m)	2100	1930	1980	2200
Slope (°)	25	5	15	20
Aspect	S	SO	O	SE
Area (m^q)	20	100	50	50
Cover (%)	95	95	90	90
N.	1	2	3	4
Association and *Nardion* differential				
Ranunculus pollinensis	2	1	+	1
Viola eugeniae subsp. *eugeniae*	+	+	1	+
Rumex nebroides	1	+	.	.
Crepis aurea subsp. *glabrescens*	.	.	1	1
Characteristics of *Nardetalia* and *Nardetea*				
Plantago atrata subsp. *atrata*	3	4	3	2
Ranunculus apenninus	1	2	2	1
Poa alpina subsp. *alpina*	1	1	.	2
Hieracium pilosella	1	.	2	1
Luzula campestris	.	1	1	1
Alchemilla colorata	+	+	.	.
Botrychium lunaria	.	1	+	.
Other species				
Trifolium pratense subsp. *semipurpureum*	2	2	1	2
Asperula cynanchica subsp. *cynanchica*	+	1	+	+
Edraianthus graminifolius subsp. *graminifolius*	+	+	1	+
Armeria canescens	+	+	1	1
Cerastium arvense subsp. *suffruticosum*	+	+	+	+
Potentilla cranztii subsp. *crantzii*	2	+	1	1
Thymus praecox subsp. *polytrichus*	1	2	1	+
Carex kitaibeliana	1	2	2	1
Phyteuma orbiculare	1	1	+	.
Festuca violacea subsp. *italica*	2	3	.	2
Centaurea cana	+	.	1	+
Helianthemum nummularium subsp. *grandiflorum*	1	.	1	.
Helianthemum oelandicum subsp.*alpestre*	+	.	1	.
Avenula praetutiana	.	+	+	.
Trinia dalechampii	.	+	.	+

Other species: *Anthemis cretica* subsp. *columnae, Pedicularis elegans, Dianthus sylvestris* subsp. *sylvestris*, *Galium lucidum, Brachypodium genuenese* and *Cynoglossum magellense* +, *Carlina acaulis* subsp. *caulescens* 2 in 1; *Carduus chrysacanthus* subsp. *chrysacanthus*, *Polygala alpestris, Pulsatilla alpina* subsp. *millefoliata, Campanula scheuthzerii* and *Erigeron epiroticus* +, *Gentiana verna* subsp. *verna* 1 in 2; *Koeleria lobata* and *Trifolium montanum* subsp. *rupestre* +, *Lotus corniculatus* subsp. *corniculatus* and *Ranunculus brevifolius* 1 in 3; *Dianthus monspessulanus* and *Robertia taraxacoides* + in 4.
Localities: 1: M. Sibilla, 31/7/99; 2-3: Pizzo Tre Vescovi, 10/7/98; 4: M. Porche, 30/07/99.

Table 6

Luzulo italicae-Nardetum strictae Biondi, Ballelli, Allegrezza, Frattaroli et Taffetani 1992
(*Ranunculo pollinensis-Nardion strictae, Nardetalia strictae, Nardetea strictae*)

Altitude (m)	2070	2125	2110	2040	2030	2100	2300	2200
Slope (°)	10	30	20	30	20	20	20	35
Aspect	E-SE	NO	NO	S	SE	SE	NE	N-NW
Area (m^2)	100	50	50	100	100	100	100	50
Cover (%)	100	100	100	100	100	100	60	100
N.	1	2	3	4	5	6	7	8
Association differentials								
Luzula spicata subsp. *italica*	2	1	1	2	+	1	2	2
Potentilla cranztii subsp. *crantzii*	.	.	.	1	+	+	1	+
Euphrasia salisburgensis	+	.	.	+	+	.	.	.
Viola eugeniae subsp. *eugeniae*	+	.	.	.	.	1	1	.
Characteristics of *Nardion*								
Ranunculus apenninus	.	1	1	2	1	2	1	+
Rumex nebroides	+	.	.	.	.	.	.	.
Characteristics of *Nardetalia*								
Festuca microphylla	2	2	1	2	2	2	2	2
Agrostis capillaris subsp. *capillaris*	.	+	.	2	3	1	.	.
Hieracium lactucella ssp *lactucella*	.	.	.	.	+	.	1	.
Botrychium lunaria	.	+	.	.	.	.	.	.
Characteristics of *Nardetea*								
Nardus stricta	3	2	3	3	2	4	2	3
Trifolium thalii	1	+	1	+	1	1	.	1
Plantago atrata subsp. *atrata*	.	3	2	2	4	4	2	.
Hieracium pilosella	.	.	.	1	2	1	.	.
Gentiana lutea subsp. *lutea*	1	1	+	.	.	.	.	.
Crepis aurea subsp. *glabrescens*	.	.	.	2	1	+	.	.
Rumex acetosa subsp. *acetosa*	.	.	.	+	1	+	.	.
Phleum rhaeticum	2	+	.	.	.	.	.	.
Festuca rubra subsp. *commutata*	.	.	.	1	+	.	.	.
Anthoxanthum odoratum subsp. *odoratum*	.	.	.	+	.	+	.	.
Bellis perennis	.	.	.	.	.	+	.	.
Other species								
Phyteuma orbiculare	+	+	+	1	+	+	+	1
Armeria canescens	+	2	1	+	1	+	+	.
Avenula praetutiana	2	2	1	+	+	+	.	1
Poa alpina subsp. *alpina*	1	2	2	1	1	.	3	2
Carex kitaibeliana	.	1	1	+	.	1	1	1
Gentiana verna subsp. *verna*	.	+	+	+	.	+	+	+
Trifolium pratense subsp. *semipurpureum*	1	3	2	1	+	.	.	2
Anthyllis vulneraria subsp. *vulnerarioides*	1	1	1	.	.	.	+	+
Cerastium arvense subsp. *suffruticosum*	+	.	.	.	+	1	1	.
Thymus praecox subsp. *polytrichus*	.	.	.	2	1	1	1	.
Campanula scheuthzerii	.	.	.	+	+	+	1	.
Achillea millefolium subsp. *millefolium*	+	1	1	.	.	.	.	.
Galium magellense	+	+	+	.	.	.	.	.
Brachypodium genuenese	+	.	.	1	+	.	.	.
Bromus erectus	2	.	.	+	+	.	.	.
Alchemilla alpina	+	2	1	.	.	.	.	+
Minuartia verna subsp. *verna*	.	+	1	.	.	.	+	.
Erigeron epiroticus	.	.	.	+	+	.	1	.
Pedicularis comosa subsp. *comosa*	+	+	.	.	.	.	.	.
Sesleria juncifolia subsp. *juncifolia*	+	.	.	.	.	.	.	1
Leontodon crispus subsp. *crispus*	.	1	.	+	.	.	.	.
Arabis collina subsp. *collina*	.	1	+	.	.	.	.	.
Acinos alpinus subsp. *alpinus*	.	1	+	.	.	.	.	.
Asperula cynanchica	.	+	+	.	.	.	.	.
Helianthemum nummularium subsp. *grandiflorum*	.	1	+	.	.	.	.	.
Rhinanthus minor	.	+	+	.	.	.	.	.
Crocus vernus subsp. *vernus*	.	.	.	1	+	.	.	.
Lotus corniculatus subsp. *corniculatus*	.	.	.	+	.	+	.	.
Polygala alpestris	.	.	.	+	1	.	.	.
Juncus trifidus subsp. *monanthos*	.	.	.	.	.	.	.	2

Other species: Campanula foliosa, Centaurea ambigua subsp. nigra, Dianthus monspessulanus and Trifolium montanum subsp. rupestre + in 1; Carlina acaulis subsp. caulescens + in 4; Trinia dalechampii, Gentiana nivalis, Pedicularis elegans, Thesium parnassi and Draba aizoides subsp. aizoides +, Silene acaulis and Gnaphalium hoppeanum subsp. magellense 1 in 7; Campanula glomerata and Potentilla tabernaemontani 1 in 8.
Localities: 1: M. Sibilla, 27/07/98; 2-3: M. Petrara, 25/7/98; 4-6: M. Argentella, 2/8/99; 7: Vettore, Furnari 1970; 8: M. Priora, near the top, 25/7/98.

Potentillo rigoanae-Brachypodietum genuensis Lucchese, Persia & Pignatti 1995. (Table 8, rels. 1-8)

Brachypodium genuense grasslands found in the subalpine belt of the Sibillini mountains (Table 8) grow on calcareous slopes with moderate gradient, in fairly xeric stands, often with a southern exposure, and cover an altitudinal range between 1800 and 2100 m *Brachypodium genuense* shows high cover values, giving these grasslands a smooth and dense appearance. Biondi & *al.* (2002) described *Brachypodium genuense* grasslands for the subalpine belt of Gran Sasso such as *Stacydo alopecuroidis-Brachypodietum genuensis* Biondi & *al.* 2002, belonging to *Brachypodenion genuensis* suballiance and characterized by *Stachys alopecuros* subsp. *divulsa*, *Galium corrudifolium, Centaurea ambigua* subsp. *nigra, Cyanus triumfetti* and *Erysimum majellense*). The relevés made in the subalpine belt of the Sibillini appear to have ecological similarities with this association, but due to the absence of the characteristic species (except for the presence of *Stachys alopecuros* subsp. *divulsa* in relevés 7 and 8 and of *Centaurea ambigua subsp. nigra* in relevé 6), it was considered advisable to frame this vegetation into *Potentillo rigoanae-Brachypodietum genuensis. Potentillo rigoanae-Brachypodietum genuensis* includes the *Brachypodium genuense* grasslands of the central-southern calcareous Apennines, from the Sibillini to southern Calabria, occurring in the montane and subalpine belts. Characteristic species are *Potentilla rigoana*, *Trifolium montanum* subsp. *rupestre* and *Verbascum longifolium* (Lucchese & *al*., 1995). This vegetation grows on relatively deep and subacid soils (Furrer & Furnari, 1960; Lucchese & *al*., 1995; Lucchese, 1987; Di Pietro & *al*., 2005). It forms pastures growing on stable screes or slopes with calcareous outcrops, conforming a typical mosaic with other plant communities such as *Seslerietum apenninae*, in the subalpine belt.

Nitrophilous vegetation

The nitrophilous vegetation occurring in the subalpine belt is often correlated with overgrazing. The communities found in the study area belong to the *Artemisietea vulgaris* class and to the *Artemisietalia vulgaris* order (perennial nitrophilous herbaceous vegetation growing on deep and well-nitrified soils). *Arction lappae* is the only alliance present in the study area. This vegetation is related to the pastoral activities largely practised within the subalpine belt. It occurs especially in folds, or close to watering sources, or in other places where livestock remain for considerable periods of time.

Carduetum chrysacanthi Pedrotti 1981 (Table 9, rels. 1-3)

Carduetum chrysacanthi, described for the subalpine belt of the Laga massif (central Apennines, Pedrotti, 1981, 1982a) and found also in Campo Imperatore (Gran Sasso, Biondi & *al*., 1999a), grows especially in places with a high density of livestock and, therefore with accumulated organic remains. Characteristic of the association is *Carduus chrysacanthus.* Other nitrophilous species are *Urtica dioica*, *Scrophularia scopolii*, *Rumex nebroides*, *Achillea millefolium*. The association's area of distribution includes the montane and subalpine belt of the southern-central Apennines (Biondi & *al*., 1999a), generally over 2000 m.

Chenopodio boni-henrici-Carduetum affinis Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999 (Table 9, rels. 4-5)

This association develops on wet and deep soils, in places where livestock remains for considerable periods of time, such as in folds. The flattish morphology of these stands favours the accumulation of organic substances in the soil. Described by Biondi & *al*. (1999a) for the subalpine belt of Gran Sasso, it is characterized by *Carduus affinis* and *Chenopodium bonus-henricus. Chenopodio boni-henrici-Carduetum affinis* occurs in the subalpine belt, below 2000 m, at lower altitudes than *Carduetum chrysacanthi*.

Cliff vegetation

Cliff vegetation is ascribed to the *Asplenietea trichomanis* holoarctic class, to the *Potentilletalia caulescentis* order (communities on carbonaceous rocks in the Eurosiberian and Mediterranean areas), and to the two following alliances: *Saxifragion australis* (endemic to the central-southern Apennines), with the two associations *Potentilletum apenninae* and *Saxifrago australis-Trisetetum bertolonii*; *Cystopteridion fragilis* (Eurosiberian alliance distributed, in Italy, in the Alps and central-northern Apennines, in shaded niches on north-facing rock walls), with the association *Asplenio-Cystopteridetum fragilis*.

Table 7

Taraxaco apennini-Trifolietum thalii Biondi, Ballelli, Allegrezza, Frattaroli & Taffetani 1992
(*Ranunculo pollinensis-Nardion strictae, Nardetalia strictae, Nardetea strictae*)

Altitude (m)	2100	1940	2150	2150	2257	1950	2030	2050	1900	2040
Slope (°)	25	.	.	15	5	10	5	25	35	30
Aspect	W	.	.	NW	N	NW	W-SW	SW	N-NE	W
Area (m^2)	50	4	100	100	6	16	100	100	50	50
Cover (%)	100	95	100	100	95	100	90	100	100	90
N.	1	2	3	4	5	6	7	8	9	10
Association characteristics										
Trifolium thalii	4	5	3	4	2	1	3	4	2	2
Taraxacum apenninum	+	+	.	.	1	2	+	+	2	+
Bellis perennis	.	.	.	.	.	.	1	+	1	+
Festuca rubra subsp. *commutata*	.	1	.	.	.	.	.	1	.	.
Characteristic of *Nardion*										
Ranunculus apenninus	.	.	2	1	+	2	+	2	3	+
Luzula spicata subsp. *italica*	+	1	1	+	+	+	.	.	.	.
Viola eugeniae subsp. *eugeniae*	.	.	+	.	.	1	+	.	.	.
Rumex nebroides				.	.	.	.	2	.	.
Characteristic of *Nardetalia*										
Festuca microphylla	4	1	4	4	1	3	+	4	3	2
Crepis aurea subsp. *glabrescens*	3	.	.	.	+	3	2	+	2	.
Agrostis capillaris subsp. *capillaris*	.	.	.	+	.	.	.	.	.	.
Botrychium lunaria	.	.	1	2	.	.	.	.	.	.
Sagina glabra	+	.	+	.	.	.	.	.	.	.
Hieracium lactucella ssp *lactucella*	.	.	.	1	.	2	.	.	.	.
Characteristic of *Nardetea*										
Plantago atrata subsp. *atrata*	2	.	3	3	2	.	+	3	4	3
Phleum rhaeticum	+	.	.	.	2	+	1	+	.	.
Nardus stricta	.	.	+	+	+	.	+	.	+	.
Rumex acetosa subsp. *acetosa*	+	.	.	.	.	1	.	+	.	.
Gentiana lutea subsp. *lutea*	.			.	1	+	.	.	.	.
Hieracium pilosella	.	.	1	.	.	.	.	.	.	.
Other species										
Trifolium pratense subsp. *semipurpureum*	1	+	3	3	3	2	+	1	3	+
Poa alpina subsp. *alpina*	+	2	1	1	3	1	+	3	1	2
Cerastium arvense subsp. *suffruticosum*	+	+	1	1	.	+	+	1	1	+
Carex kitaibeliana	.	+	+	1	1	1	.	+	1	2
Armeria canescens	+	.	+	+	.	+	+	+	+	.
Phyteuma orbiculare	+	.	2	1	1	2	.	+	.	.
Gentiana verna subsp. *verna*	+	.	1	1	+	1	.	.	.	1
Potentilla cranztii subsp. *crantzii*	+	+	1	2	1	.	.	.	.	.
Thymus praecox subsp. *polytrichus*	+	.	2	1	.	+	.	.	.	2
Campanula scheuthzerii	+	.	+	1	.	.	.	.	1	.
Anthyllis vulneraria subsp. vulnerarioides	.	.	.	.	+	+	.	.	.	2
Ranunculus breyninus	2	.	.	.	1	.	.	.	.	.
Hippocrepis comosa	+	.	.	.	.	.	.	.	.	+
Euphrasia salisburgensis	+	.	1	.	.	.	.	.	.	.
Androsace villosa subsp. *villosa*	.	.	+	+	.	.	.	.	.	.
Leontodon hispidus subsp. *hispidus*	.	.	.	.	1	.	1	.	.	.
Helianthemum oelandicum subsp.*alpestre*	.	.	.	.	.	+	.	.	.	2
Erigeron uniflorus	.	.	.	.	.	+	.	.	.	+
Carduus chrysacanthus subsp. *chrysacanthus*	.	.	.	.	.	1	.	.	.	+
Achillaea millefolium subsp. *millefolium*	.	.	.	.	.	+	.	.	.	+
Cynoglossum magellense	.	.	.	.	.	.	+	.	.	+
Minuartia verna subsp. *verna*	.	.	.	.	.	.	+	.	+	.
Brachypodium genuenese	.	.	.	.	.	.	.	+	+	.

Other species: *Robertia taraxacoides, Lamium garganicum* subsp. *garganicum, Arabis collina* subsp. *collina*, *Gymnadenia conopsea* subsp. *conopsea* and *Achillea barellieri* +, *Rhamnus alpina* subsp. *alpina* 1 in 2; *Trinia dalechampii* and *Gnaphalium hoppeanum* subsp. *magellense* + in 3; *Arenaria grandiflora* subsp. *grandiflora* and *Dianthus cartusianorum* +, *Galium magellense* and *Pedicularis comosa* subsp. *comosa* 1 in 4; *Coeloglossum viridae*, *Galium lucidum* and *Linum alpinum* 1 in 6; *Carlina acaulis* subsp. *caulescens*, *Rumex scutatus* subsp. *scutatus*, *Sesleria juncifolia* subsp. *juncifolia* and *Anthoxanthum odoratum* subsp. *odoratum* + in 7; *Carduus defloratus* subsp. *carlinifolius* + in 8; *Festuca dimorpha* and *Astragalus sempervirens* + in 9; *Doronicum columnae, Myosotis alpestris* subsp. *alpestris, Potentilla apennina* subsp. *apennina* and *Pulsatilla alpina* subsp. *millefoliata* +; *Acinos alpinus* subsp. *alpinus* 1 in 10.

Localities: 1: M. Sibilla, 31/7/99; 2: Lago Pilato, 1/7/98; 3-4: M. Argentella, ridge, 2/8/99; 5: Pizzo Berro, 25/7/98; 6: saddle between M. Acuto e Pizzo Tre Vescovi, 6/7/98; 7: M. Rotondo, 31/7/98; 8: M. Vettore, 4/8/99; 9: Fabrica Viola, 6/8/99; 10: Pizzo Tre Vescovi near the top, 6/7/98.

Table 8

Potentillo rigoanae-Brachypodietum genuensis Lucchese, Persia & Pignatti 1995
(*Brachipodenion genuensis, Phleo ambigui-Bromion erecti, Artemisio albae-Bromenalia erecti, Brometalia erecti, Festuco-Brometea*)

Altitude (m)	1980	2000	2030	2100	1900	2050	1950	2040
Slope (°)	45	45	40	25	25	10	30	30
Aspect	SO	S	SSO	S	SE	SE	N	SO
Area (m^2)	100	100	100	100	50	100	50	50
Cover (%)	90	80	90	100	100	100	100	100
N.	1	2	3	4	5	6	7	8
Association and *Brachypodenion* Characteristics								
Brachypodium genuense	4	3	4	5	5	3	5	4
Armeria canescens	1	+	+	.	+	2	.	.
Potentilla rigoana	.	.	.	1	+	+	.	+
Achillea tenorii	.	.	.	.	.	1	.	.
Trifolium montanum subsp. rupestre	.	.	.	+	.	.	.	.
Verbascum longifolium	.	.	.	.	+	.	.	.
Characteristics of *Bromion*								
Silene otites subsp. otites	+	1	.	.	+	.	.	.
Carex macrolepis	.	.	.	.	1	.	.	.
Centaurea ambigua subsp. *nigra*	.	.	.	.	.	+	.	.
Characteristic of *Bromenalia*								
Dianthus sylvestris subsp. *sylvestris*	.	1	1	.	.	.	.	.
Alyssum montanum subsp. *montanum*	.	.	.	.	.	+	.	.
Characteristic of *Brometalia* and *Brometea*								
Trifolium pratense subsp. *semipurpureum*	1	1	1	1	+	3	1	1
Bromus erectus	+	1	1	+	.	+	+	1
Galium lucidum	1	+	+	1	+	.	+	.
Achillea millefolium subsp. *millefolium*	+	.	.	+	+	.	.	+
Lotus corniculatus subsp. *corniculatus*	.	.	.	+	+	.	1	.
Asperula cynanchica	.	.	.	.	.	+	.	+
Carlina acaulis subsp. *caulescens*	.	.	.	+	.	.	.	1
Dianthus monspessulanus	.	.	.	.	1	1	.	.
Festuca circummediterranea	.	.	.	.	.	1	.	1
Carex caryophyllea	.	.	.	.	.	+	.	.
Rhinantus wettstenii	.	.	.	.	.	.	+	.
Dianthus carthusianorum	.	.	.	.	.	.	.	+
Campanula glomerata	.	.	.	.	+	.	.	.
Trasgressives of *Nardetea*								
Plantago atrata subsp. *atrata*	1	1	1	.	.	1	.	1
Hieracium pilosella	2	1	3	1	+	.	.	.
Gentiana lutea subsp. *lutea*	.	.	.	+	.	+	+	3
Rumex acetosa subsp. *acetosa*	.	.	.	+	1	.	+	.
Viola eugeniae subsp. *eugeniae*	.	.	.	.	.	+	+	+
Luzula spicata subsp. *italica*	.	.	.	+	.	+	.	.
Ranunculus apenninus	.	.	.	.	.	+	+	.
Trasgr. Elyno-Seslerietea								
Thymus praecox subsp. *polytrichus*	1	1	1	.	+	2	+	.
Carex kitaibeliana subsp. *kitaibeliana*	+	+	+	.	.	1	.	+
Avenula praetutiana	+	1	.	+	.	2	1	.
Acinos alpinus subsp. *alpinus*	+	1	.	+	.	.	1	.
Campanula scheuthzerii	+	.	+	+	+	.	.	.
Anthyllis vulneraria subsp. *vulnerarioides*	.	.	.	.	.	+	+	+
Festuca violacea subsp. *italica*	.	.	.	1	.	1	+	.
Phyteuma orbiculare	.	.	.	1	.	.	1	.
Other species								
Poa alpina subsp. *alpina*	1	+	1	.	+	1	.	.
Cerastium arvense subsp. *suffruticosum*	1	1	1	+	.	+	.	.
Senecio doronicum	+	1	1	+	.	.	+	.
Carduus chrysacanthus subsp. *chrysacanthus*	+	+	+	.	.	.	+	.
Cynoglossum magellense	+	.	.	.	.	+	+	2
Festuca dimorpha	+	1	+	2	.	.	.	.

N.	1	2	3	4	5	6	7	8
Potentilla apennina subsp. *apennina*	+	+	1	.	.	.	.	.
Ranunculus breyninus	1	.	+	+	.	.	.	.
Rumex scutatus subsp. *scutatus*	+	+	+	.	.	.	.	.
Helianthemum nummularium subsp. grandiflorum	1	1	.	.	.	.	.	.
Anthemis cretica subsp. *columnae*	.	+	+	.	.	.	.	.
Luzula multiflora subsp. *multiflora*	.	.	.	1	2	.	.	.
Doronicum columnae	.	.	.	.	.	.	+	1
Erigeron epiroticus	.	.	.	.	.	+	+	.
Trifolium noricum subsp. *praetutianum*	.	.	.	.	+	1	.	.
Stachys alopecuros subsp. *divulsa*	.	.	.	.	.	.	1	2
Arabis collina subsp. *collina*	.	.	.	+	.	.	.	.
Pedicularis comosa subsp. *comosa*	.	.	.	.	+	.	.	.
Festuca laevigata	.	.	.	.	+	.	.	.

Other species: *Melilotus albus* + in 1; *Myosotis alpestris* subsp. *alpestris* and *Coronilla vaginalis* + in 3; *Agrostis stolonifera* subsp. *stolonifera* 2; *Botrichium lunaria, Carduus defloratus* subsp. *carlinifolius*, *Phleum rhaeticum* and *Gnaphalium hoppeanum* subsp. *magellense* + in 4; *Crocus vernus* subsp. *vernus*, *Dianthus deltoides* subsp. *deltoides* and *Dianthus deltoides* subsp. *deltoides* + in 5; Minuartia verna subsp. *Verna, Cirsium acaule* subsp. *acaule* and *Sesleria juncifolia* subsp. *juncifolia* + Achillea tenorii 1, *Potentilla tabernaemontani* 2 in 6; *Galium magellense*, *Leucanthemum heterophyllum* and *Linum alpinum* +; *Linum capitatum* subsp. *serrulatum* 1; *Luzula sylvatica* subsp. *sylvatica* 1; *Rhinantus wettstenii* + in 7; *Cerastium tomentosum* 1, *Dianthus carthusianorum* + in 8.
Localities: 1-3: M. Porche, 30/7/99; 4: M. Argentella, 2/8/99; 5: M. Vettore, 4/8/99; 6: M. Rotondo, 31/7/98; 7: saddle between M. Acuto e Pizzo Tre Vescovi, 6/7/98; 8: M. Rotondo, 31/7/98.

Table 9
Carduetum chrysacanthi Pedrotti 1981 (rel. 1-3)
Chenopodio boni-henrici-Carduetum affinis Biondi & al. 1999 (rel. 4-5)
(Arction lappae, Artemisietalia vulgaris, Artemisietea vulgaris)

Altitude (m)	2080	2100	2050	1980	1950
Slope (°)	-	10	5	-	15
Aspect	-	SO	ESE	NO	ONO
Area (m^2)	10	20	20	50	50
Cover (%)	90	90	100	90	95
N.	1	2	3	4	5
Association characteristics					
Carduus chrysacanthus subsp. *chrysacanthus*	2	2	1	.	.
Carduus affinis subsp. *affinis*	.	.	.	2	4
Chenopodium bonus-henricus	.	.	.	1	1
Characteristics of higher units					
Urtica dioica subsp. *dioica*	+	3	4	1	2
Rumex nebroides	2	1	+	2	1
Rumex alpestris	.	.	.	3	1
Other species					
Poa alpina subsp. *alpina*	1	1	1	+	1
Scrophularia scopolii	2	+	1	3	.
Achillea millefolium subsp. *millefolium*	2	1	1	.	1
Cerastium arvense subsp. *suffruticosum*	+	1	+	.	.
Trifolium pratense subsp. *semipurpureum*	+	1	2	.	.
Cynoglossum magellense	+	1	.	.	+
Barbarea bracteosa	+	.	.	+	+
Crepis aurea subsp. *glabrescens*	.	1	.	+	1
Doronicum columnae	2	+	.	.	.
Phleum rhaeticum	+	.	+	.	.
Myosotis alpestris	+	.	.	+	.
Festuca circummediterranea	.	1	+	.	.
Taraxacum apenninum	.	1	.	+	.
Ranunculus apenninus	.	.	.	1	+

Other species: *Acinos alpinus* subsp. *alpinus* and *Erysimum pseudorhaeticum* +, *Verbascum longifolium* 1 in 1; *Dactylis glomerata* 1 in 3.
Localities: 1-2: 06/07/98 Pizzo Tre Vescovi; 3: 03/07/98 Monte Vettore; 4: 6/8/99 Lago di Pilato; 5: 03/07/98 Monte Vettore.

There are many endemic elements present in these habitats: *Saxifraga callosa* subsp. *callosa* (= *Saxifraga lingulata* Bellardi subsp. *australis* (Moric.) Pign.), *Potentilla apennina, Trisetaria villosa* (= *Trisetum bertolonii* Jonsell), *Achillea barrelieri* subsp. *barellieri, Festuca alfrediana*, *Saxifraga paniculata,* etc.

Saxifrago australis-Trisetetum bertolonii Biondi & Ballelli 1982 (Table 10, rels. 1-3)

Association widely spread on calcareous rocks of the central Apennines (Biondi & Ballelli, 1982; Biondi & *al*., 1990, 1992, 1997, 1999a, 2000; Tammaro, 1995; Giancola & Stanisci, 2006), with a very wide altitudinal range, from about 300 m to 2000 m. Characteristic species are *Saxifraga callosa* subsp. *callosa* and *Trisetaria villosa.* Other chasmophilous species of *Potentilletalia*, frequently occurring in these chasmophilous communities, are *Potentilla apennina*, *Saxifraga paniculata* subsp. *stabiana* and *Festuca alfrediana* (Table 10)

Potentilletum apenninae Feoli et Feoli Chiapella 1976 (Table 10, rels. 4-10)

Potentilletum apenninae is largely spread throughout the calcareous central Apennines (Feoli & Feoli Chiapella, 1976; Avena & Blasi, 1980; Petriccione, 1994a; Tammaro, 1995; Biondi & *al*, 1997; Giancola & Stanisci, 2006), but with a narrower and higher altitudinal range than the previous association. In the Sibillini massif it occurs from 1900 to 2200 m. and is widely distributed on cliffs and rock faces. Characteristic species are *Potentilla apennina* and *Saxifraga paniculata* subsp. *stabiana.*

Asplenio-Cystopteridetum fragilis Oberd. (1936) 1945. (Table 10, rels. 11-12)

Asplenio-Cystopteridetum fragilis occurs on shaded and north-exposed rock walls, characterized by a cold and moist microclimate. Characteristic of the association is *Cystopteris fragilis.* This chasmophytic sciophilous vegetation has been reported by Tomaselli (1994) for the northern Apennines. It also occurs in central Italy in Molise (Giancola & Stanisci, 2006), and is here reported also for the Sibillini massif.

Scree vegetation

The scree vegetation is ascribed to the *Thlaspietea rotundifolii* holoarctic class, to the *Thlaspietalia rotundifolii* order (high-altitude vegetation on base-rich screes in Eurosiberian and Mediterranean areas) and to the *Linario-Festucion dimorphae* alliance (scree vegetation of the central and southern calcareous Apennines). The following associations have been found in the study area: *Isatido allionii-Thlaspietum stylosi*, *Isatido-Heracleetum orsinii*, *Galio magellensis-Festucetum dimorphae*, *Drypido-Festucetum dimorphae*.

Isatido allionii-Thlaspietum stylosi Migliaccio 1970 corr. Feoli Chiapella 1983. (Table 11, rels. 1-2)

Pioneer vegetation on steep and unstable slopes with high granulometry and mobility, occurring in the alpine and subalpine belts. *Isatido allionii-Thlaspietum stylosi* grows in conditions of greater slope and altitude compared to the other associations in the alliance, from which it differs due to the absence of large size species such as *Festuca dimorpha* or *Heracleum sphondilium subsp. orsini* (Blasi & *al*., 2003). Characteristic species of the association are *Isatis apennina* (= *Isatis allionii* Ball.), *Thlaspi stylosum* and *Crepis pygmaea*. A large group of *Linario-Festucion dimorphae* diagnostic species, such as *Papaver alpinum* subsp. *hernesti-majeri*, *Ranunculus brevifolius*, *Arenaria bertolonii*, *Robertia taraxacoides*, etc., characterize these communities (Table 11). The cover values are generally very low.

Described by Migliaccio for the Majella massif (corr. by Feoli-Chiapella (1983) in *Isatido allionii-Thlaspietum stylosi*), it has been reported for other sites in the Abruzzo region (Terminillo and Velino massifs, Bonin, 1978; Campo Imperatore, Biondi & *al*., 1999a; Corno Grande, Biondi & *al*., 2000). In the study area it has been found only in the Lago di Pilato valley.

Isatido-Heracleetum orsinii Feoli-Chiapella 1983 (Table 11, rels. 3-5)

Isatido-Heracleetum orsinii occurs in the subalpine belt of the central calcareous Apennines, on steep slopes with an inclination often exceeding 45°, clast size between 5 and 10 cm and high mobility. Characteristic species are *Heracleum sphondilium* subsp. *orsini* and *Isatis apennina.*

Table 10

Saxifrago australis-Trisetetum bertolonii Biondi et Ballelli 1982 (rel. 1-3)
Potentilletum apenninae Feoli et Feoli Chiapella 1976 (rel. 4-10)
Asplenio-Cystopteridetum fragilis Oberd. (1936) 1945 (rel. 11-12)
(*Potentilletalia caulescentis, Asplenietea trichomanis*)

Altitude (m)	1950	1900	2000	1900	1980	2050	2160	2150	2145	2140	1900	1900
Slope (°)	90	.	90	90	90	80	80	80	80	85	90	90
Aspect	E	.	NE	NNO	O	SO	NO	NO	SSE	N	NE	NO
Area (m^2)	6	4	10	9	10	10	5	10	5	5	8	8
Cover (%)	20	5	20	30	10	30	5	15	20	30	5	50
Relev. Nr.	1	2	3	4	5	6	7	8	9	10	11	12
Association characteristics												
Trisetaria villosa	+	+	+	.	.	.	.	.	.	.		.
Saxifraga callosa subsp. *callosa*	+	1	.	.	+	1	1	+	.	+	2	.
Potentilla apennina subsp. *apennina*	.	+	+	1	+	+	+	+	1	+	1	+
Saxifraga paniculata subsp. *stabiana*	+	+	+	1	1	2	+	1	2	+	2	+
Cystopteris fragilis	.	.	.	.	.	.	.	.	.	.	+	2
Characteristics of *Cystopteridion*												
Asplenium viride	.	.	.	.	.	.	.	.	.	.	.	+
Characteristics of *Saxifragion australis* and *Potentilletalia*												
Dryopteris villarii subsp. *villarii*	.	.	.	+	.	.	.	+	+	+	.	1
Potentilla caulescens subsp. *caulescens*	.	.	1	.	.	+	.	.	.	.	.	.
Festuca alfrediana	.	+	+	.	.	.	+	.	+	.	.	.
Valeriana saliunca	.	.	.	.	.	.	1	.	.	+	.	.
Saxifraga exarata subsp. *ampullacea*	.	.	.	.	.	.	.	+	.	.	.	.
Characteristics of *Asplenietea trichomanis*												
Rhamnus pumila	1	.	.	+	+	.	.	.	.	.	.	.
Sedum dasyphyllum subsp. *dasyphyllum*	.	+	.	.	.	.	+	.	.	.	.	.
Asplenium ruta-muraria subsp. *ruta-muraria*	.	.	.	.	.	.	.	.	.	+	.	.
Other species												
Helianthemum oelandicum subsp. *alpestre*	+	.	+	+	+	1	+	+	1	+	+	
Campanula scheuthzerii	.	+	+	+	+	.	.	.	.	.	1	+
Poa alpina subsp. *alpina*	.	+	+	.	+	.	.	.	.	.	+	+
Edraianthus graminifolius subsp. *graminifolius*	+	.	+	1	1	.	+	+	.	+	.	.
Robertia taraxacoides	.	+	+	.	.	.	.	.	.	.	+	+
Sempervivum arachnoideum	+	+	.	.	1	.	.	.	.	.	.	.
Alchemilla alpina	.	.	.	1	+	1	.	+	+	.	1	1
Draba aizoides subsp. *aizoides*	.	.	.	.	+	+	.	+	.	1	.	.
Trifolium thalii	.	.	.	.	.	.	1	1	1	2	.	.
Saxifraga oppositifolia subsp. *speciosa*	.	.	.	.	.	.	1	1	.	1	.	.
Pulsatilla alpina subsp. *millefoliata*	.	.	.	+	.	.	+	+	.	.	+	+
Silene acaulis	.	.	.	.	+	.	.	1	.	+	.	.
Anthemis cretica subsp. *columnae*	.	.	.	.	.	.	+	+	.	1	.	+
Carum flexuosum	1	.	.	+	.	.	.	.	.	.	.	.
Alchemilla flabellata	1	.	.	2	.	.	.	.	.	.	.	.
Anthyllis montana subsp. *atropurpurea*	+	.	.	+	.	.	.	.	.	.	.	.
Teucrium montanum	+	.	.	+	.	.	.	.	.	.	.	.
Arenaria grandiflora subsp. *grandiflora*	.	1	.	.	.	.	.	.	.	.	1	.
Thymus praecox subsp. *polytrichus*	.	+	.	.	+	.	.	.	.	.	.	.
Asperula cynanchica	.	+	.	.	.	.	.	.	.	.	+	.
Adenostyles glabra subsp. *glabra*	.	+	.	.	+	.	.	.	.	.	.	.
Galium lucidum	.	+	.	.	+	.	.	.	.	.	.	.
Paronychia kapela subsp. *kapela*	.	.	.	+	+	.	.	.	.	.	.	.
Globularia meridionalis	.	.	.	.	+	+	.	.	.	.	.	.
Carex kitaibeliana	.	.	.	.	.	1	.	.	+	.	.	.
Gentiana dinarica	.	.	.	.	.	+	.	.	.	+	.	.
Minuartia verna subsp. *verna*	.	.	.	.	+	.	.	.	.	+	.	.

Other species: *Globularia meridionalis, Paronychia kapela* subsp. *kapela, Alyssum montanum* subsp. *montanum*, *Aster alpinus* subsp. *alpinus* and *Silene otites* subsp. *otites*, *Acinos alpinus* subsp. *alpinus* and *Erysimum pseudorhaeticum* +, *Verbascum longifolium* 1 in 1; *Trifolium thalii* + in 2; *Alchemilla alpina, Phyteuma orbiculare, Dryas octopetala, Heracleum sphondylium* subsp. *orsini, Juncus trifidus* subsp. *monanthos* and *Juniperus communis* var. *saxatilis* +, *Dactylis glomerata* 1in 3; *Cerastium tomentosum* +; *Crepis aurea* subsp. *glabrescens* 1 in 4; *Androsace villosa* subsp. *villosa* + in 5; *Ranunculus apenninus* + in 10; *Biscutella laevigata* 1, Dianthus *sylvestris* subsp. *sylvestris*, *Myosotis alpestris* subsp. *alpestris* and *Sedum atratum* subsp. *atratum* + in 11; *Arabis alpina* subsp. *caucasica, Cerastium arvense* subsp. *suffruticosum* and *Senecio doronicum* + in 12.

Localities: 1: M. Bove Nord, 6/7/99; 2: F.ca Viola, 6/8/99; 3: Lago di Pilato, 6/8/99; 4: M. Bove Nord, 6/7/99; 5-6: Palazzo Borghese, 28/7/99; 7-10: M. Sibilla, rocky ridge, 31/7/99; 11: F.ca Viola, 6/8/99; 12: Valle del Lago, 6/8/99.

The authors described several subassociations and variants. The subass. *festucetosum dimorphae* was found in the study area, considered by the authors as the typical form of the association. In the Sibillini mountains it occurs in an altitudinal range between about 1850 m and 2200 m. On the north-facing slopes of the Lago di Pilato valley, *Isatido-Heracleetum orsinii* is replaced by *Isatido-Thlaspietum stylosi. Isatido-Heracleetum orsinii*, as well as in the study area, is present in Gran Sasso and Majella (FEOLI-CHIAPELLA, 1983) and on M. Marsicano in the Abruzzo National Park (PETRICCIONE, 1986). Recently, DI PIETRO & *al.* (2004), investigating the scree vegetation of the Abruzzo National Park, described a *Heracleum sphondium* subsp. *orsini* ecological variant of *Galio-Festucetum dimorphae*, similar to the *Isatido-Heracleetum orsinii* association, for ecological and floristic features, but distinguished due to the absence of *Isatis apennina.*

Galio magellensis-Festucetum dimorphae Feoli-Chiapella 1983 subass. ***ranunculetosum brevifolii*** Feoli-Chiapella 1983 (Table 12, rels. 1-5) subas. ***armerietosum*** Feoli-Chiapella 1983 (Table 12, rels. 6-7)

Galio magellensis-Festucetum dimorphae is distributed in the montane and subalpine belts of the central Apennines and occurs on talus slopes with an

Table 11

Isatido-Thlaspietum stylosi Migliaccio 1970 corr. Feoli Chiapella 1983 (rels. 1-2)
Isatido-Heracleetum orsinii Feoli Chiapella 1983 subass. *Festucetosum dimorphae* Feoli Chiapella 1983 (rels. 3-5)
(*Linario-Festucion dimorphae, Thlaspietalia rotundifolii, Thlaspietea rotundifolii*)

Altitude (m)	1975	2050	1870	2150	2100
Slope (°)	45	40	35	50	45
Aspect	NE	NNE	N	E	E
Area (m^2)	100	100	50	30	30
Cover (%)	30	20	25	15	10
N.	1	2	3	4	5
Association characteristics					
Thlaspi stylosum	+	1	.	.	.
Crepis pygmaea subsp. *pygmaea*	1	2	2	1	.
Isatis apennina	1	+	1	1	+
Heracleum sphondylium subsp. *orsini*	.	.	+	+	.
Differential of *festucetosum dimorphae*					
Festuca dimorpha	.	.	2	1	+
Characteristics of *Festucion*					
Robertia taraxacoides	+	+	+	.	.
Papaver alpinum subsp. *hernesti-majeri*	2	1	.	.	.
Ranunculus brevifolius	+	1	.	.	.
Arenaria bertolonii	1	+	.	.	.
Galium magellense	+	+	.	.	.
Festuca dimorpha	+	.	.	.	.
Characteristics of *Thlaspietalia* and *Thlaspietea*					
Senecio squalidus	.	1	1	1	1
Scrophularia hoppii	+	1	.	+	.
Linaria alpina	1	+	.	.	.
Sedum magellense subsp. *magellense*	.	.	+	.	+
Valeriana montana	.	.	+	.	.
Rumex scutatus subsp. *scutatus*	.	.	1	.	.
Other species					
Rumex acetosa subsp. acetosa	.	.	+	1	1
Alchemilla alpina	+	1	.	.	.
Anthemis cretica subsp. columnae	+	+	.	.	.
Crepis aurea subsp. glabrescens	+	1	.	.	.
Campanula scheuthzerii	.	.	.	+	+

Other species: *Silene vulgaris* 3, *Edraianthus graminifolius* subsp. *graminifolius* and *Euphrasia salisburgensis* + in 1; *Poa alpina* + in 2; *Gentiana lutea* subsp. *lutea*, *Leonthodon crispus* subsp. *crispus* and *Senecio doronicum* + in 4; *Cerastium arvense* subsp. *suffruticosum* + in 5.
Localities:1-2: Lago di Pilato, 6/8/99; 3: Forca Viola, 10/7/98; 4-5: M. Vettore, 27/7/99.

Table 12

Galio magellensis-Festucetum dimorphae Feoli Chiapella 1983
(*Linario-Festucion dimorphae, Thlaspietalia rotundifolii, Thlaspietea rotundifolii*)

Altitude (m)	2050	1800	1860	1900	2350	1800	1850
Slope (°)	30	35	30	25	20	35	35
Aspect	SE	SO	NE	N	NE	NO	N
Area (m^2)	100	100	100	100	100	100	100
Cover (%)	60	30	30	40	40	40	30
N.	1	2	3	4	5	6	7
Association characteristics							
Galium magellense	1	+	+	1	1	+	+
Differential of *ranunculetosum brevifolii*							
Ranunculus brevifolius	1	1	1	1	1	.	.
Thlaspi stylosum	.	.	.	1	+	.	.
Differential of *armerietosum*							
Acinos alpinus subsp. *alpinus*	.	+	.	.	.	1	+
Armeria canescens	.	.	+	.	.	+	+
Characteristics of *Festucion*							
Festuca dimorpha	4	2	2	3	3	3	2
Carduus chrysacanthus subsp. *chrysacanthus*	+	+	+	+	.	1	.
Cerastium tomentosum	+	1	.	+	.	1	1
Carum flexuosum	.	1	1	1	1	.	1
Robertia taraxacoides	.	1	1	.	.	.	.
Scrophularia hoppii	.	+	.	1	.	.	.
Isatis apennina	+	.	.	.	.	.	.
Achillea barellieri subsp. *barellieri*		.	.	.	2	.	.
Characteristics of *Thaspietalia* and *Thlaspietea*							
Leontodon montanus subsp. *breviscapum*	1	.	.	+	.	+	.
Valeriana saliunca	+	1	+	.	.	.	.
Anthemis cretica subsp. *columnae*	+	.	.	1	.	.	+
Arabis alpina subsp. *caucasica*	.	+	.	.	.	+	.
Senecio squalidus subsp. *squalidus*	+	.	.	.	+	.	.
Linaria alpina	.	.	.	.	+	.	.
Other species							
Campanula scheuthzerii	1	+	1	+	.	+	.
Helianthemum oelandicum subsp. *alpestre*	+	+	.	+	.	+	.
Brachypodium genuense	+	1	.	.	.	.	+
Euphorbia cyparissias	1	+	.	+	.	.	.
Senecio doronicum	.	+	.	.	.	+	1
Dianthus sylvestris subsp. *sylvestris*	.	+	.	.	.	+	+
Alyssum montanum subsp. *montanum*	+	+	.	.	.	.	.
Pulsatilla alpina subsp. *millefoliata*	+	.	.	.	1	.	.
Stachys recta subsp. *recta*	.	+	.	1	.	.	.
Hieracium cymosum	.	+	.	.	.	+	.
Carlina acaulis subsp. *caulescens*	.	+	.	.	.	.	+
Astragalus sempervirens	.	.	.	.	.	1	+
Biscutella laevigata	.	.	.	.	.	+	+
Trifolium pratense subsp. *semipurpureum*	.	.	.	.	+	.	1
Phyteuma orbiculare	.	.	.	.	+	+	.

Other species: *Hieracium pilosella* 1; *Ranunculus breyninus, Rumex nebroides, Dianthus monspessulanus, Melilotus albus* and *Silene multicaulis* subsp. *multicaulis* + in 1; *Dryas octopetala* 2 in 3; *Carduus chrysacanthus* subsp. *chrysacanthus* +; *Anemone apennina* 1 in 5; *Phleum rhaeticum* and *Alchemilla alpina* + in 6.

Localities: 1: M. Vettore, 27/7/99; 2: M. Argentella, 2/8/99; 3-4: Forca Viola, 10/7/98; 5: Vettore, Furnari 1970; 6: M. Bove Sud, 6/7/99; 7: Forca Viola, 10/7/98.

average inclination of around 30°, moderate mobility and medium clast size. The physiognomy is given by *Festuca dimorpha*, which forms a discontinuous carpet on the scree surface. The characteristic species is *Galium magellense.* Feoli-Chiapella (1983) characterized some subassociations, closely linked to the degree of stabilization of the substrate. The study area contained: *Ranunculetosum brevifolii* (Table 12, rels. 1-5), considered by the author as the typical aspect of the association, growing on slopes with an average inclination of 25°-30°, moderate mobility and clast size exceeding 10 cm; *armerietosum* (Table 12, rels. 6-7), growing on more stable substrates, often in contact with the communities of *Elyno-Seslerietea. Galio magellensis-Festucetum dimorphae* is the most widely distributed scree vegetation in the study area, in an altitudinal range between 1800 and 2350 m. It can be considered the most widespread and frequent scree-vegetation type in the central Apennines. It is also, together with the subass. *armerietosum*, the vegetation of stable screes.

Drypido-Festucetum dimorphae Bonin 1978 em. Feoli-Chiapella 1983 (Table 13, rels. 1-15)

Drypido-Festucetum dimorphae occupies unstable screes characterized by low granulometry, (clast size lower than 4 cm), high mobility and an inclination of over 40°. It has a wide altitudinal range, from about 650 to 2000 m (Feoli-Chiapella, 1983), although it spreads mainly throughout the montane belt. Physiognomic species are *Drypis spinosa, Festuca dimorpha* and *Cerastium tomentosum. Drypis spinosa* is the characteristic of the association. On the basis of the floristic composition *Drypido-Festucetum dimorphae*, it shows some ecological variants (Feoli-Chiapella, 1983). The typical form is present in the study area, characterized by the higher cover values of *Drypis spinosa* (Table 13, rels. 1-5), and the *Brachypodium genuense* variant (Table 13, rels. 6-15). This latter is considered the most stable stadium on relatively consolidated slopes, often in contact with the communities of *Potentillo rigoanae-Brachypodietum genuensis* (Feoli-Chiapella, 1983).

The list of plant communities found in the study area is given in the syntaxonomical scheme (Table 14). Place and date of relevés and the list of sporadic species are given in Table 19 and Table 20 respectively.

Chorological and life-form analyses

The chorological analysis shows that the dominant elements in almost all the associations are the orophilous-southern European (with high frequencies, varying from 22% to 51%) and endemic (including the three groups of the Apennines, central Apennines and central-southern Apennines). The Euro-Asiatic and the northern (including circumboreal and Arctic-Alpine) elements also have considerable values (Table 14). The northern, the endemic and the orophilous-southern European elements typically characterize the high altitude environments (Blasi & *al*., 2003, 2005). The substantial presence of the Euro-Asiatic element is marked in grasslands and pastures (Table 2-8). The amphi-Adriatic element is well represented in all the vegetation types. In a recent work comparing the high-mountain flora in the central Apennines (Lucchese & De Simone, 2000), the authors assume a central core of the geographic and floristic district in the central Apennines formed by Gran Sasso, Majella and Velino, linked towards the north with the Sibillini and Laga. The Sibillini mountains show a high frequency of endemic, orophilous and amphi-Adriatic elements similar to Gran Sasso, Majella and Velino. Nevertheless, the Sibillini has a lower floristic richness compared to the other main massifs in the central Apennines.

On the basis of the life-form analysis, hemicryptophytes (H) are dominant in all the associations reported in this work (from 50% to 85%). Chamaephytes (Ch) are also well represented and have their highest values in the chasmophilous vegetation of *Saxifragion australis* alliance and their lowest values in the thick grasslands of the *Nardetea* class (Table 15). Other life-forms are very scarce or completely absent, except for geophytes (G), which have a significant role in some types of scree vegetation.

DISCUSSION

The studies carried out on the high-altitude vegetation of the Sibillini served to highlight the great richness of environments, habitats and micro-habitats, the corresponding vegetation types as well as the strong relationships with other calcareous massifs in the central Apennines. Numerous similarities can be observed with the high-altitude (alpine belt) environments of the Majella massif: the presence of the *Leontopodio nivalis-Seslerietum juncifoliae* association, including the

Sesleria juncifolia grasslands of the alpine belt characterized by a high presence of *Leontopodium nivale*, is a characteristic of these two massifs. The abundance of *Leontopodium nivale* in *Sesleria juncifolia* grasslands is a peculiarity that the Sibillini shares with Majella. *Saxifrago-Silenetum cenisiae* appears to be shared by the Sibillini and Velino. This alpine tundra association is replaced, in Gran Sasso, Majella and Laga, by *Galio magellensis-Silenetum acaulis* (Blasi & *al.* 2003). There are also strong similarities with the high altitude vegetation of the Gran Sasso massif, shown by the large number of vegetation types shared exclusively by these two massifs. In particular, the associations *Seslerio-Dryadetum octopetalae, Ranunculo pollinensis-Plantaginetum atratae* and *Chenopodio bonihenrici-Carduetum affinis* have so far been found only in these two areas. Nevertheless, the lower altitude of the Sibillini, compared to Majella and Gran Sasso, the high level of anthropic disturbance (especially grazing) and the fragmentation of plant communities probably does not permit the complete expression of the alpine belt and of several corresponding plant communities (Biondi & *al*., 2000; Blasi & *al*., 2003; Blasi & *al*., 2005).

Some further syntaxonomical and geobotanical considerations should be provided. With regard to alpine vegetation, Blasi & *al*. (2005), following the scheme of Oriolo (2001), have reconsidered the alpine grasslands of Apennines (before inclusion in the *Carici rupestris-Kobresietea bellardii* Ohba 1974 class) and have returned them to the *Elyno-Seslerietea* class, in the *Seslerion apenninae* order, characterizing two suballiances: *Seslerenion apenninae*, including primary and secondary grasslands of the subalpine and montane belts, and *Leontopodio nivalis-Elynenion myosuroidis*, including only the primary grasslands of the alpine belt. They demonstrated the existence and autonomy of an Apennine alpine bioclimatic belt, well expressed in the three study areas, the Gran Sasso, Majella and Laga mountains (central Apennines, Abruzzo region). With regard to the Sibillini mountains, the phytosociological research presented in this paper indicates the presence of an alpine belt and the corresponding primary plant community types, such as the *Leontopodio nivalis-Seslerietum juncifoliae* (in its typical form and with the subass. *caricetosum kitaibelianae*) and the *Saxifrago speciosae-Silenetum cenisiae*, included in the *Leontopodio nivalis-Elynenion myosuroidis*. The two associations *Seslerietum apenninae* and *Seslerio apenninae-Dryadetum octopetalae* have been referred to the *Seslerenion apenninae* suballiance. The synoptic table (Table 16) compares some *Sesleria juncifolia* associations described for the central Apennines, including the Sibillini. The table shows a general likeness between the *Sesleria juncifolia* vegetation of the Sibillini, Gran Sasso and Majella and, in particular, the close similarity between columns 2-5 (*Seslerietum apenninae* of Gran Sasso, *Seslerietum apenninae* of the Sibillini, *Leontopodio nivalis-Seslerietum juncifoliae* of Majella and *Leontopodio nivalis-Seslerietum juncifoliae caricetosum* of the Sibillini). The synoptic table shows a high floristic similarity between the columns (particularly the characteristic species of *Seslerietum apenninae* are largely shared).

With regards to acidophilous grasslands, *Luzulo-Nardetum* and *Taraxaco-Trifolietum* have a wide distribution area in the calcareous central Apennines, while *Ranunculo-Plantaginetum*, reported only for the Gran Sasso and Sibillini, is a geographical vicariant of *Gnaphalio magellensis-Plantaginetum atratae* Feoli Chiapella & Feoli 1977 of the Majella massif. A synoptic table of these three associations is provided in Table 17.

Scree vegetation, on the basis of physical parameters such as granulometry and inclination (Avena & Bruno, 1975; Avena & Blasi, 1980), covers different microgeo-morphological ambits. In the study area, four sections have been identified (according to the scheme of Di Pietro & *al*. 2004) and their corresponding vegetation types: 1) area of high mobility of clasts or core of the scree. In the central Apennines this ambit is characterized by *Cymabalarietum pallidae* Bazzichelli & Furnari 1979 (Bazzichelli & Furnari, 1970; Feoli-Chiapella, 1983) while in the study area *Isatido-Heracleetum orsini festucetosum dimorphae* and *Isatido-Thlaspietum stylosi* have their optimum. 2) Middle area, corresponding to the lower and wider part of the scree, were *Galio-Festucetum dimorphae ranunculetosum brevifolii* is found. 3) Edge or wing of the talus slope, on relatively consolidated slopes, where the occurring association is *Galio-Festucetum dimorphae armerietosum.* 4) In the part of the talus slope characterized by low granulometry and high mobility, there is an occurrence of *Drypido-Festucetum dimorphae*.

The results of the analysis of chorological types (Table 14) confirm the close relationships of the floristic component characterizing the high-altitude vegetation of the Sibillini with the corresponding vegetation of the other main massifs of the central Apennines.

The northern, the endemic and the orophilous-south-

Table 13

Drypido-Festucetum dimorphae Bonin 1978 em. Feoli Chiapella 1983

(*Linario-Festucion dimorphae, Thlaspietalia rotundifolii, Thlaspietea rotundifolii*)

Altitude (m)	2075	1860	1950	1900	1685	2120	2100	2100	2100	1890	1890	2000	2050	1930	1960
Slope (°)	25	30	40	45	35	35	30	30	30	40	45	35	40	25	30
Aspect	O	N	N	NE	S	SE	SE	SE	S	NO	NO	S-SO	NO	S	SE
Area (m^2)	50	16	50	50	100	80	100	100	100	100	100	60	100	50	50
Cover (%)	60	30	20	30	40	60	60	70	60	50	70	75	50	30	30
Relevé Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Association characteristics															
Drypis spinosa subsp. spinosa	1	2	1	2	1	1	1	+	+	1	1	+	+	1	1
Diff. var. Brachypodium genuense															
Brachypodium genuense	.	.	.	.	.	1	2	+	1	1	1	+	+	1	1
Characteristics of *Festucion*															
Festuca dimorpha	4	1	1	1	3	3	2	4	3	3	4	3	3	2	2
Cerastium tomentosum	.	+	1	1	1	.	.	2	1	1	1	.	.	1	1
Carduus chrysacanthus subsp. chrysacanthus	.	.	.	.	.	1	1	1	+	1	+	.	1	+	1
Ranunculus brevifolius	.	.	.	.	.	.	.	.	.	1	1	.	1	1	1
Robertia taraxacoides	.	1	1	2	1	.	.	.	.	.	.	.	.	.	.
Carum flexuosum	.	.	.	.	1	.	.	.	.	.	.	.	1	+	+
Doronicum columnae	1	.	.	.	.	.	.	.	.	+	.	.	1	.	.
Arenaria bertolonii	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
Characteristics of *Thlaspietalia* and *Thlaspietea*															
Rumex scutatus subsp. *scutatus*	1	1	1	+	1	.	.	+	+	.	.	+	.	.	.
Senecio squalidus subsp. *squalidus*	.	.	.	.	1	1	.	.	.	+	.	.	+	.	.
Arenaria grandiflora subsp. *grandiflora*	.	.	.	.	.	.	.	.	.	+	.	+	.	.	+
Acinos alpinus subsp. *alpinus*	1	.	.	.	.	.	.	1	.	.	.	.	.	.	.
Linaria purpurea	1	.	.	.	.	.	.	.	.	.	.	1	.	.	.
Anthemis cretica subsp. *columnae*	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.
Valeriana montana	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.
Leucanthemum heterophyllum	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Other species															
Thymus praecox subsp. *polytrichus*	1	.	.	.	1	+	+	1	1	1	1	.	.	1	+
Galium lucidum	1	.	.	.	.	+	1	1	+	+	1	+	.	.	+
Campanula scheuthzerii	.	.	.	.	.	2	1	2	1	1	+	.	.	+	1
Hieracium pilosella	.	.	.	.	.	1	1	1	+	.	+	1	.	.	+
Cerastium arvense subsp. *suffruticosum*	+	.	.	.	.	+	+	+	+	.	.	+	.	.	.
Poa alpina subsp. *alpina*	+	.	.	.	.	+	+	1	1	.	.	.	+	.	.
Euphorbia cyparissias	.	.	.	1	.	.	.	.	+	1	+	.	.	+	1
Bromus erectus	.	.	.	.	.	+	+	+	+	.	.	.	.	+	+
Hieracium cymosum	.	.	.	.	.	+	1	+	1	.	+	2	.	.	.
Sesleria juncifolia subsp. *juncifolia*	.	.	+	.	.	+	1	+	.	.	.	.	+	.	.
Campanula glomerata	.	.	+	.	.	1	1	1	1	.	.	.	.	.	.
Senecio doronicum	1	.	.	.	.	+	+	.	+	.	+	.	.	.	.
Ranunculus apenninus	+	.	.	.	.	.	.	+	+	.	.	1	.	.	.

Relevé Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Biscutella laevigata	.	.	.	.	.	.	.	1	+	.	+	.	.	+	.
Gentiana lutea subsp. *lutea*	.	.	.	.	.	+	.	+	.	.	+	+	.	.	.
Silene otites subsp. *otites*	.	.	.	.	.	.	+	+	.	1	+	.	.	.	.
Trinia dalechampii	+	.	.	.	.	.	.	.	.	+	+	.	.	.	.
Carex kitaibeliana	.	.	.	.	.	.	.	.	.	+	+	.	+	.	.
Carlina acaulis subsp. *caulescens*	.	.	.	.	.	.	.	.	.	.	.	+	.	1	1
Trifolium pratense subsp. *semipurpureum*	.	.	.	.	.	.	.	1	.	+	+	.	.	.	.
Paronychia kapela subsp. *kapela*	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.
Armeria canescens	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Leontodon hispidus subsp. *hispidus*	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Stachys recta	.	.	.	.	1	.	.	.	.	.	.	.	.	.	+
Sesleria nitida	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1
Asperula cynanchica	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.
Astragalus sempervirens	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+
Carex macrolepis	.	.	.	.	.	+	1	.	.	.	.	.	.	.	.
Gentiana dinarica	.	.	.	.	.	.	.	.	.	+	2	.	.	.	.
Linum alpinum	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.
Lotus corniculatus subsp. *corniculatus*	.	.	.	.	.	.	.	.	1	.	.	1	.	.	.
Minuartia verna subsp. *verna*	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.
Phyteuma orbiculare	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.
Cyanus triumfettii	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.

Other species: *Alyssum montanum* subsp. *montanum* and *Dianthus monspessulanus* + in 6; *Hieracium lactucella* ssp *lactucella* 1, *Trifolium montanum* subsp. *rupestre* + in 8 ; *Aster alpinus* subsp. *alpinus* and *Coronilla* vaginalis + in 9; rel. 12: *Linum capitatum* subsp. s*errulatum*, *Medicago lupulina, Polygala alpestris, Verbascum longifolium* and *Dianthus sylvestris* subsp. *sylvestris* +, *Festuca circummediterranea* and *Globularia meridionalis* 1 in 12; *Pulsatilla alpina* subsp. *millefoliata* + and *Ranunculus breyninus* 1 in 13; *Bupleurum baldense* + in 14; *Koeleria lobata* + in 15.
Localities: 1: Pizzo Tre Vescovi, 6/7/98; 2: Forca Viola, 10/7/98; 3-4: Fonte Jumenta M. Bove, 3/7/99; 5: M. Sibilla, 31/7/99; 6-9: M. Vettore, 27/7/99; 10-11: M. Argentella, 28/7/99; 12: M. Bove Nord, 6/7/99; 13: M. Porche, 30/7/99; rel. 14-15: M. Argentella, 2/8/99.

Table 14
Chorotypes of the associations reported in the tables 1-13
(calculated from frequency and expressed in percent, %)

	leontopodio-seslerietum	saxifrago-silenetum	seslerio-dryadetum	seslerietum apenninae	ranunculo-plantaginetum	luzulo-nardetum	taraxaco-trifolietum	potentillo-brachypodietum	carduetum chrysacanthi	chenopodio-carduetum affinis	saxifrago-trisetetum	potentilletum apenninae	asplenio-cystopteridetum	iastido-thlaspietum	isatido-heracleetum	galio-festucetum	drypido-festucetum
Endemic Appenine	2	2	2	1	2	2	1	1	.	7	.	3	.	.	.	.	1
Endemic Centre Appenine	6	7	4	7	2	3	.	3	.	.	3	5	.	5	.	2	.
Endemic Centre-South Appenine	8	12	13	13	21	9	13	17	15	14	9	10	4	16	11	14	10
Endemic Italy	.	.	.	.	.	.	1	.	.	.	3	.	4	5	6	2	1
Subendemic	.	1	.	2	.	.	1	3	.	.	3	5	4	16	17	8	3
Anphiadriatic	4	2	2	2	.	2	1	3	.	.	3	3	.	.	.	2	4
Mediterranean-Montane	2	4	4	8	11	5	9	4	10	14	14	10	13	.	.	12	10
Orophyte S-European	44	40	41	30	28	29	35	32	40	22	30	36	51	43	49	35	36
Euro-Mediterranean	3	3	4	3	5	5	1	5	5	.	9	5	8	.	.	.	6
Euro-Asiatic	17	15	11	20	20	20	21	2	10	14	9	10	.	.	11	15	24
Arctic Alpine	11	10	17	8	2	9	3	1	.	.	11	8	4	5	.	5	.
Circumboreal	3	2	.	4	2	11	11	4	10	22	6	5	8	5	6	.	3
Subcosmopolitan	.	2	2	2	5	3	2	4	10	7	.	.	.	5	.	5	1
Cosmopolitan	.	.	.	.	2	2	1	3	.	.	.	.	4	.	.	.	1

Table 15
Life form of the associations reported in tables 1-13
(calculated from frequency and expressed in percent, %;
H, hemicryptophyte; Ch, chamaephyte; G, geophyte; T, terophyte; NP, nanophanerophyte; P, phanerophyte).

	leontopodio-seslerietum	saxifrago-silenetum	seslerio-dryadetum	seslerietum apenninae	ranunculo-plantaginetum	luzulo-nardetum	taraxaco-trifolietum	potentillo-brachypodietum	carduetum chrysacanthi	chenopodio-carduetum affinis	saxifrago-trisetetum	potentilletum apenninae	asplenio-cystopteridetum	iastido-thlaspietum	isatido-heracleetum	galio-festucetum	
H	68	65	65	65	84	82	79	80	85	93	51	53	75	63	83	83	7
Ch	30	30	23	27	11	8	13	13	10	7	40	41	17	16	6	6	1
G	2	3	8	4	5	5	6	4	5	.	3	3	4	16	11	11	[illegible]
T	.	2	3	2	.	5	1	3	.	.	.	.	4	5	.	.	[illegible]
NP	.	.	1	2	.	.	.	.	.	.	6	3	.	.	.	.	[illegible]
P	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	[illegible]

Table 16
Synthetic table of *Sesleria juncifolia* grasslands in Central Apennines

	1	2	3	4	5	6	7
Association Characteristics							
Helianthemum oelandicum subsp.*alpestre*	V	V	V	V	2	II	2
Androsace villosa subsp. *villosa*	IV	V	V	III	2	V	.
Pedicularis elegans	.	IV	V	V	3	I	2
Leontopodium nivale	.	II	III	V	3	II	2
Aster alpinus	.	I	II	V	1	.	.
Ranunculus oreophilus	.	IV	.	V	.	.	.
Iberis saxatilis subsp. *saxatilis*	.	.	.	V	.	.	.
Dryas octopetala	.	.	.	I	1	V	3
Carex mucronata	.	.	.	.	.	IV	.
Ranunculus thora	.	I	.	.	.	II	.
Char. All. Leontopodio-Elynenion							
Minuartia verna subsp. *verna*	IV	V	V	IV	3	.	2
Silene acaulis	I	III	III	IV	1	.	1
Oxytropis campestris subsp. *campestris*	II	.	II	V	.	.	.
Potentilla cranztii subsp. *crantzii*	.	.	I	II	3	.	1
Sedum atratum subsp. *atratum*	.	II	I	.	1	.	.
Kobresia myosuroides	.	II	.	I	.	.	.
Gentiana nivalis	.	.	I	.	.	.	.
Gnaphalium hoppeanum subsp. *magellense*	.	.	I	.	.	.	.
Carex rupestris	.	.	.	.	.	I	.
Carex firma	.	.	.	.	.	I	.
Char. All. Seslerion apenninae							
Trinia dalechampii	III	II	I	V	1	I	.
Carum flexuosum	I	II	I	.	1	II	1
Avenula praetutiana	.	III	I	IV	.	III	.
Linum capitatum subsp. *serrulatum*	.	II	I	.	.	.	1
Festuca violacea subsp. *italica*	.	.	III	IV	.	.	1
Androsace vitaliana subsp. *praetutiana*	III	.	.	.	.	.	.
Achillea barellieri subsp. *barellieri*	.	.	I	.	.	.	.
Myosotis ambigens	.	.	.	II	.	.	.
Alyssum diffusum	.	.	.	.	.	.	II
Char. Ord. Seslerietalia tenuifoliae							
Sesleria juncifolia subsp. *juncifolia*	V	V	V	V	3	V	3
Edraianthus graminifolius subsp. graminifolius	V	IV	V	V	2	IV	2
Gentiana dinarica	II	IV	I	.	2	IV	1
Carex kitaibeliana	.	IV	V	V	3	V	3
Anthyllis montana subsp. *atropurpurea*	.	III	II	I	.	IV	2
Paronychia kapela subsp. *kapela*	II	II	I	.	.	.	.
Helianthemum nummularium subsp. *grandiflorum*	III	.	II	I	.	.	.
Armeria canescens	.	.	III	III	3	.	.
Thesium parnassi	.	II	.	.	.	II	.
Carduus carlinifolius	II	.	.	.	.	.	.
Pedicularis comosa subsp. *comosa*	.	.	I	.	.	.	.
Festuca laevigata subsp. *crassifolia*	.	.	.	I	.	.	.
Poa molineri	.	.	.	IV	.	.	.
Char. Cl. Elyno-Seslerietea							
Pulsatilla alpina subsp. *millefoliata*	III	III	III	II	1	I	1
Draba aizoides subsp. *aizoides*	IV	III	I	V	.	I	.
Gentiana verna subsp. *verna*	I	II	II	II	1	.	3
Thymus praecox subsp. *polytrichus*	.	V	IV	III	2	.	.
Anthyllis vulneraria subsp. *vulnerarioides*	.	V	III	.	2	.	2
Campanula scheuthzerii	.	.	I	I	.	.	1
Phyteuma orbiculare	.	III	II	.	.	I	.
Sempervivum arachnoideum	.	.	I	V	2	.	.
Anthyllis vulneraria subsp. pulchella	IV	.	.	V	.	.	.
Acinos alpinus subsp. alpinus	II	.	I	.	1	.	.
Saxifraga caesia	.	I	.	.	.	II	.
Bellidiastrum michelii	.	III	.	.	.	I	.
Erigeron epiroticus	.	.	I	III	.	.	.
Linum alpinum	.	II	I	.	.	.	.
Pedicularis tuberosa	.	.	I	.	.	.	1

Coronilla vaginalis	.	.	I	.	.	.	1
Anemone narcissiflora	.	I	.	.	.	.	.
Pedicularis verticillata	.	I	.	.	.	.	.
Polygala alpestris	.	.	.	I	.	.	.
Nardetea strictae							
Juncus trifidus subsp. *monanthos*	.	II	II	II	.	II	.
Plantago atrata subsp. *atrata*	.	.	II	I	3	.	2
Viola eugeniae subsp. *eugeniae*	.	III	I	I	.	.	.
Bistorta vivipara	.	II	I	.	.	I	.
Ranunculus apenninus	.	.	I	.	.	.	2
Botrychium lunaria	.	.	I	.	.	.	.
Hieracium pilosella	.	.	I	.	2	.	.
Luzula spicata subsp. italica	.	.	I	.	.	.	.
Gentiana lutea subsp. lutea	.	.	.	.	.	.	2
Bistorta vivipara	.	.	.	I	.	.	.
Thlaspietea rotundifolii							
Arenaria grandiflora subsp. *grandiflora*	.	.	I	II	.	.	.
Galium magellense	.	.	I	II	.	.	.
Valeriana saliunca	.	.	I	I	.	.	.
Doronicum columnae	.	.	I	.	.	.	.
Carex humilis	.	.	.	.	.	III	.
Lomelosia graminifolia	.	.	.	.	.	IV	.

Procedente of relevés: 1: *Seslerietum apenninae* Furnari in Bruno & Furnari 1966 - Gran Sasso; 2: *Seslerietum apenninae* Biondi et al. 1999 - Gran Sasso; 3: *Seslerietum apenninae* Tab. 4 – Sibillini; 4: *Leontopodio nivalis-Seslerietum juncifoliae* Blasi et al. 2005 – Majella; 5: *Leontopodio nivalis-Seslerietum juncifoliae caricetosum kitaibelianae* Tab. 1 – Sibillini; 6: *Seslerio apenninae-Dryadetum octopetalae* Biondi et al. 1999 - Gran Sasso; 7: *Seslerio apenninae-Dryadetum octopetalae* Tab. 3 - Sibillini.

Table 17
Synthetic table of acidophilous grasslands studied

	1	2	3
Differential and Characteristics of associations			
Ranunculus pollinensis	4	.	.
Rumex nebroides	2	I	I
Crepis aurea subsp. *glabrescens*	2	II	III
Luzula spicata subsp. *Italica*	.	V	III
Potentilla cranztii subsp. *crantzii*	.	IV	.
Euphrasia salisburgensis	.	II	I
Viola eugeniae subsp. *eugeniae*	4	II	II
Trifolium thalii	.	V	V
Taraxacum apenninum	.	.	IV
Bellis perennis	.	I	II
Characteretistics of Ranunculo pollinensis-Nardion strictae			
Plantago atrata subsp. *atrata*	4	IV	IV
Ranunculus apenninus	4	V	IV
Agrostis capillaris subsp. *capillaris*	.	III	I
Alchemilla transiens	.	II	.
Characteretistics of Nardetalia strictae and Cl. Nardetea Strictae			
Poa alpina subsp. *alpina*	3	V	V
Trifolium pratense subsp. *semipurpureum*	4	IV	V
Hieracium lactucella subsp. *lactucella*	4	II	I
Hieracium pilosella	3	II	I
Botrychium lunaria	2	I	I
Festuca microphylla	.	V	V
Nardus stricta	.	V	III
Phleum rhaeticum	.	II	III
Gentiana lutea subsp. *lutea*	.	II	I
Rumex acetosa subsp. *acetosa*	.	II	II
Sagina glabra	.	.	I
Juncus trifidus subsp. *monanthos*	.	I	.
Luzula campestris	3	.	.

Procedente of relevés: 1: *Ranunculo pollinensis-Plantaginetum atratae* Tab. 5; 2: *Luzulo italicae-Nardetum strictae* Tab. 6; 3: *Taraxaco apennini-Trifolietum thalii* Tab. 7.

ern European elements are dominant and typically characterize these high-altitude environments. (Lucchese & De Simone, 2000; Blasi & *al*., 2003, 2005). The large presence of the Euro-Asiatic element is due to the lower altitude of the Sibillini massif (compared to the other main massifs of the central Apennines), which means: a lower development of the alpine belt, a stronger influence of human activities, especially grazing, and a marked presence of the floristic elements of the lower bioclimatic belts. Some considerations can be made concerning the endemic element. The central-southern Apennine and the central Apennine elements are dominant, and this reflects the biogeographical autonomy of the central Apennines with regard to the entire Apennine system, and its importance as a centre of differentiation and conservation of both endemic taxa and arctic-alpine relics (Blasi & *al*., 2003). The high presence of the amphi-Adriatic element, similar to the main massifs of the central Apennines (Lucchese & De Simone, 2000) testifies to the close relationships between the Apennine and Balkan floristic districts.

As regards the disturbance factors linked to human activities that affect these habitats, grazing is certainly the most important. At the same time, this is also an ecological factor that influences many vegetation types and their ecological equilibrium and, certainly contributes to determining the wide diversity of grassland and pasture plant communities. Both the control and the maintenance of grazing are therefore equally important for the preservation of these habitats. Another risk factor is tourist activity, such as mountaineering, hiking and plant collecting (e.g. collecting *Leontopodium nivale*, or other rare and threatened alpine belt species, is still a common habit among some visitors during the summer). Fortunately, the National Park Management Plan has recently provided guidelines for the management of this natural heritage, including the regulation of tourist activities and the maintenance of some traditional human activities such as grazing or mowing, with their coordination and rational management, in an attempt to preserve particular or threatened habitats and species.

SYNTAXONOMICAL SCHEME

ELYNO-SESLERIETEA Br.-Bl. 1948
Seslerietalia tenuifoliae Horvat. 1930
Seslerion apenninae Furnari in Bruno and Furnari 1966
Leontopodio nivalis-Elynenion myosuroidis Blasi, Di Pietro, Fortini and Catonica 2003
Leontopodio nivalis-Seslerietum juncifoliae Blasi , Di Pietro and Pelino 2005
caricetosum kitaibelianae subass. nova hoc loco
Saxifrago speciosae-Silenetum cenisiae Petriccione 1993
Seslerenion apenninae Blasi, Di Pietro, Fortini and Catonica 2003
Seslerio apenninae-Dryadetum octopetalae Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian and Zuccarello 1999
Seslerietum apenninae Furnari in Bruno and Furnari 1966
juncetosum monanthi Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian and Zuccarello 1999

NARDETEA STRICTAE Rivas Goday in Rivas Goday and Rivas Martinez 1963
Nardetalia strictae Oberdorfer ex Preising 1949
Ranunculo pollinensis-Nardion strictae Bonin 1972
Ranunculo pollinensis-Plantaginetum atratae Biondi, Ballelli, Allegrezza and Taffetani 2000
Luzulo italicae-Nardetum strictae Biondi, Ballelli, Allegrezza, Frattaroli and Taffetani 1992
Taraxaco apennini-Trifolietum thalii Biondi, Ballelli, Allegrezza, Frattaroli and Taffetani 1992

FESTUCO-BROMETEA Br.-Bl. and Tüxen ex Br.-Bl. 1949
Brometalia erecti Br.-Bl. 1936
Artemisio albae-Bromenalia erecti Biondi, Ballelli, Allegrezza and Zuccarello 1995
Phleo ambigui-Bromion erecti Biondi et Blasi ex Biondi, Ballelli, Allegrezza and Zuccarello 1995
Brachypodenion genuensis Biondi, Ballelli, Allegrezza and Zuccarello 1995
Potentillo rigoanae-Brachypodietum genuensis Lucchese, Persia and Pignatti 1995

ARTEMISIETEA VULGARIS Lohmeyer, Preising and Tüxen ex von Rochow 1951
Artemisietalia vulgaris Lohmeyer in Tüxen 1947

Arction lappae Tüxen 1937
Carduetum chrysacanthi Pedrotti 1981
Chenopodio boni-henrici-Carduetum affinis Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian and Zuccarello 1999

ASPLENIETEA TRICHOMANIS (Br.-Bl. in Meier and Br.-Bl. 1934) Oberdorfer 1977
Potentilletalia caulescentis Br.-Bl. in Br.-Bl. and Jenny 1926
Saxifragion australis Biondi and Ballelli ex Brullo 1983
Saxifrago australis-Trisetetum bertolonii Biondi and Ballelli 1982
Potentilletum apenninae Feoli and Feoli Chiapella 1976
Cystopteridion fragilis J. C. Richard 1972
Asplenio-Cystopteridetum fragilis Oberd (1936) 1945

THLASPIETEA ROTUNDIFOLII Br.-Bl. 1948
Thlaspietalia rotundifolii Br.-Bl. in Br.-Bl. and Jenny 1926
Linario-Festucion dimorphae Avena and Bruno 1975
Isatido-Thlaspietum stylosi Migliaccio 1970 corr. Feoli Chiapella 1983
Isatido-Heracleetum orsinii Feoli Chiapella 1983
festucetosum dimorphae Feoli Chiapella 1983
Galio magellensis-Festucetum dimorphae Feoli Chiapella 1983
ranunculetosum brevifolii Feoli Chiapella 1983
armerietosum Feoli Chiapella 1983
Drypido-Festucetum dimorphae Bonin 1978 em. Feoli-Chiapella 1983
var. *Brachypodium genuense*

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