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ORIGINAL ARTICLE

The vegetation of alpine belt karst-tectonic basins in the central Apennines (Italy)

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Abstract
The vegetation communities of the karst-tectonic basins of the Majella massif alpine belt were studied using the phytosociological methods, and analysed from coenological, synchorological and syntaxonomical viewpoints. During the field-work, 115 relevés were performed using the phytosociological approach of Braun-Blanquet, and these relevés were further subjected to multivariate analyses. Eight clusters of relevés resulted from the numerical classification. The plant communities identified in the study area were ascribed to the following five associations, two sub-associations and one community type: *Leontopodio – Seslerietum juncifoliae* (ass. nova); *Helianthemo – Festucetum italicae* (ass. nova); *Gnaphalio – Plantaginetum atratae*; *Taraxaco – Trifolietum thalii gnaphalietosum magellensis* (subass. nova); *Luzulo italicae – Nardetum*, *Carici – Salicetum retusae*; *Saxifrago – Papaveretum julici*, *Saxifrago – Papaveretum androsacetosum* (subass. nova), *Plantago atrata* and *Leontodon montanus* community. The distribution of these communities within the karst basins was found to be related to variations in topographic and geomorphological parameters, such as altitude, slope, soil availability and stoniness. All the new associations proposed in this paper belong to the suballiance *Leontopodio – Elynenion* and to the alliance *Seslerion apenninae*, both of which are endemic to the central Apennines. In order to compare the plant community types identified within the Majella massif to similar associations found in the rest of the Apennine chain, synoptic tables were constructed. Finally, a comparative phytogeographical analysis of the alpine belt vegetation of the Apennines, Dinarides, southern Balkans and eastern Alps is presented.

Key words: *Alpine belt, phytosociology, snowbed vegetation, synchorology, syntaxonomy*

Introduction

Although the Apennine chain stretches from the north of Italy (Liguria) to the southernmost part of Calabria, it is only in the high mountains of the central Apennines that there is an alpine bioclimatic belt. Nevertheless, altitudes in the central Appenines are relatively low compared to those of mountain chains such as the Alps or the Pyrenees, and this, together with the strong influence of the Mediterranean climate, means that the alpine belt develops only above an average altitude of 2,400 – 2,500 m a.s.l (Baldoni et al., 1999; Blasi et al., 2003). All the plant community types that characterize the central Apennine alpine belt tend to reflect the main geomorphological features of the area, with most plant communities occurring in relation to cliffs, screes, steep slopes, windy ridges, and snowbeds formed within deep gullies. The situation in the Majella massif, however, contrasts markedly with this. Here the typical rounded shape of peaks has led to the development of large plateaux even at altitudes exceeding 2,600 m a.s.l., forming a distinct environment that is unique in the Apennine landscape. As a consequence, the average altitude of the Majella massif is higher even than the average altitude of the Gran Sasso – the highest peak in the Apennine chain (Demangeot, 1965; Jaurand, 1994). By way of comparison, the Majella massif has an overall area of 11 km^2 above 2,500 m, against only 2 km^2 of the Gran Sasso (Giraudi, 1998). In contrast to the other massives of the Apennine chain, which are characterized by glacial valleys, the quaternary glaciation of the Majella massif was characterized by an extended ice cap (about 30 km^2), which covered the higher portion of the area, and in some places

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(e.g., the Femmina Morta valley) was up to 200 m thick (Giraudi, 1998; Catonica & Manzi, 2002). Thus, although the high-altitude plateau of the Majella massif broadly shares the main vegetational features of the high altitude central Apennine vegetation in general, it does exhibit some peculiar floristic and coenological characteristics which suggest that it did, indeed, have a different background to the quaternary development of its vegetation.

Over the years, numerous authors have focussed on the vegetation of the summit areas of the Majella massif, both providing general phytosociological and phytogeographical accounts of central Apennine high-altitude vegetation (Bruno & Furnari, 1966; Lakusic, 1969a, b; Barbero & Bonin, 1969; Bonin 1969, 1978; Furnari, 1970; Avena & Bruno, 1975), and through contributions focusing specifically on the summit vegetation of the Majella (Migliaccio, 1966, 1970; Feoli & Feoli-Chiapella, 1976; Feoli-Chiapella & Feoli, 1977; Petriccione, 1988; Ubaldi et al., 1998). Further phytosociological contributions which included new data on the Majella massif summit vegetation come from Feoli-Chiapella (1983), Pignatti (1994); Petriccione & Persia (1995) and Blasi et al. (2003).

The present contribution proposes a phytosociological scheme for the vegetation of the large karst-tectonic basins occurring in the summit area of the Majella massif, for which a complete and detailed phytosociological study is still lacking. Moreover, a comparative phytogeographical analysis of the alpine belt vegetation of the Apennines, Dynarids, southern Balkans and eastern Alps is presented.

Study area

With the 2,794 m a.s.l. of Mount Amaro, the Majella massif is the second highest Apennine massif after the Gran Sasso (Figure 1). The study area was restricted to those summit areas from about 2,300 m a.s.l to the highest peaks (over 2,700 m). From a lithological point of view, the substrata are mainly composed of massive cretaceous and paleogenic limestone deposits (Parotto & Praturlon, 1975). As regards geomorphology, the Majella massif is characterized by peaks with compact shape and an extremely gentle summit profile (Figure 2). As mentioned before, this has led to the development of an extensive summit area, upon which morphogenesis is due mostly to periglacial processes and wind action. As for bioclimate, the survey area belongs to the very cold axeric subregion, for which potential vegetation types consist of a complex mosaic of dry grasslands, snow-bed vegetation and scree communities (Figure 3). According to Blasi & Michetti (2003) and Rivas-Martínez (1995), this area falls within the Temperate macrobioclimate which typically occurs along the boundary between the alpine and sub-alpine bioclimatic belts; in the Majella massif this boundary runs at 2,550 m a.s.l. (Blasi et al. 2003).

Figure 1. Study area.

Figure 2. The karst basin of Fondo di Femmina Morta (Majella mountain, 2400 m a.s.l.).

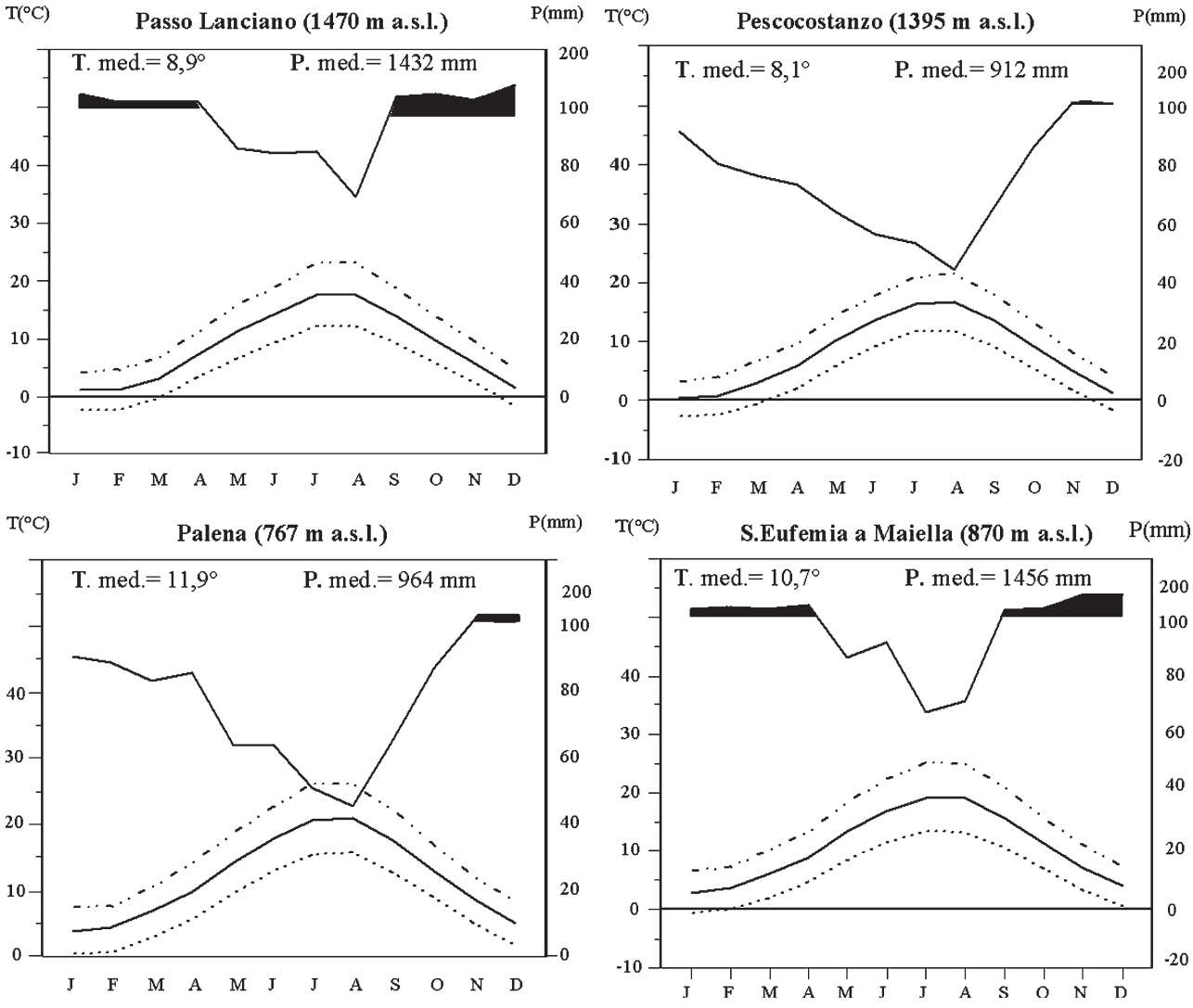

Figure 3. Ombro-thermic diagrams from the thermo-pluviometric stations present in the Majella area.

Data and methods

The field work was carried out in the years 1999–2000 during which 115 relevés were performed using the Braun-Blanquet phytosociological approach (Braun-Blanquet 1964). The Braun-Blanquet values were transformed into numerical values according to Van der Maarel (1979). The row data were further treated with multivariate analysis procedures using the Syntax 5.02 software package (Podani, 1994). For the classification (Figure 4), chord distance and average correlation were used on the quantitative data. For the ordination (Figure 5), a Principal Components Analysis (PCA) with superimposed partition (Podani, 1993) was performed. Life form and chorological spectra (based on presence, frequency and specific cover index) were calculated for each community type. In order to obtain more complete information about the various communities we analyzed for each association: whether or not specific life forms and chorotypes occurred (normal spectrum); the frequency of occurrence; and the degree of abundance through the I.R.S. (species cover index). Plant nomenclature follows Tutin et al. (1968–1993) and Conti (1998). For life forms reference was made to Pignatti (1982), while for the chorotypes reference was made to Pignatti (1982), Conti (1998) and Lucchese (2000). In order to compare the plant community types identified within the Majella massif with similar associations found in the rest of the Apennine chain, various synoptic tables were constructed. Since the various columns of the synoptic table refer to phytosociological tables published over a period of forty years, we have checked and updated the nomenclature of the most critical taxa using various floras and checklists (Pignatti, 1982; Tutin et al., 1968–1993, Greuter et al., 1984; Conti, 1998) and several taxonomic accounts. Phytosociological nomenclature follows the rules of ICPN (Weber et al., 2000).

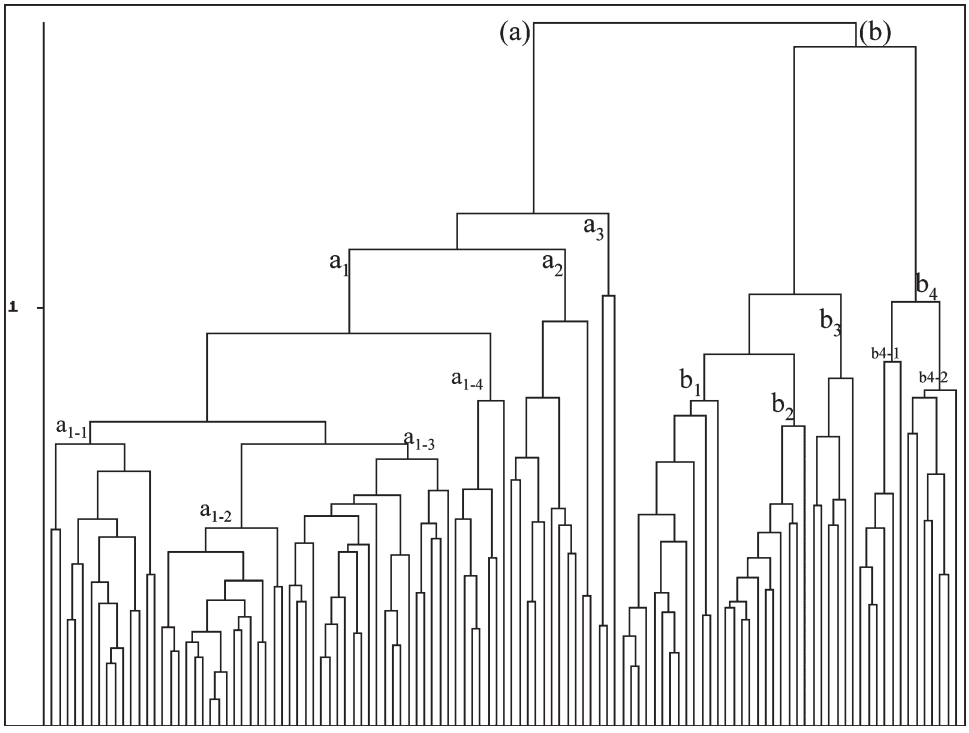

Figure 4. Cluster analysis dendrogram (see text for explanations).

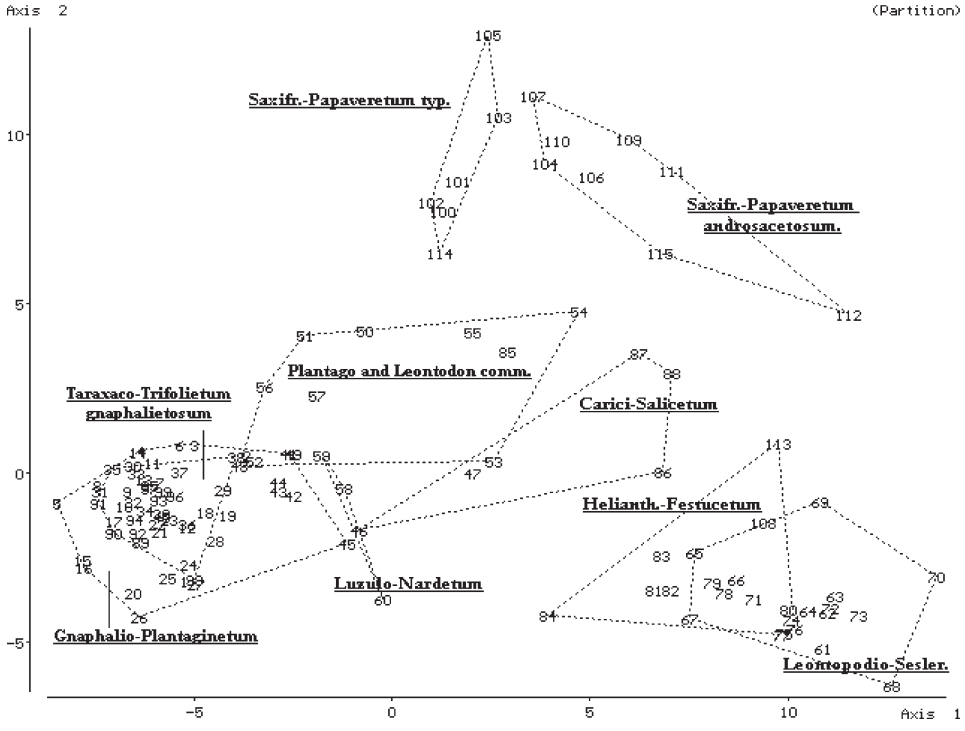

Figure 5. PCA ordination with superimposed partition.

With regard to the comparative table (Figure 11) showing the main community types of the alpine belt of the Apennines, Balkans, and eastern Alps, reference was made to the numerous syntaxonomical reviews regarding these areas (Quézel, 1964, 1967; Lakušič, 1969a, b; Horvat et al., 1974; Ohba, 1974; Grabherr, 1993a, b; Englisch et al., 1993; Feoli-Chiapella & Poldini, 1993; Oberdorfer, 1994; Theurillat et al., 1994; De Foucault, 1994; Dimopoulos & Georgadis, 1995; Dimopoulos et al., 1997; Mucina, 1997; Valachovič et al., 1997; Biondi et al., 1999, 2000; Blasi et al., 2003).

Results

Multivariate analysis

Two main clusters ('a' and 'b' in Figure 4) were isolated in the classification dendrogram. Cluster 'a' corresponds to those vegetation types that have developed on areas with relatively deep soil, such as flat areas, dolinas and water flow lines. These are characterized by species mainly belonging to *Nardetea strictae*, *Salicetea herbaceae*, or to the mesophilous fringe of *Elyno – Seslerietea*. Cluster 'b' is characterized by both dry grasslands and talus slope communities which exhibit a strong floristic component linked, respectively, to *Elyno – Seslerietea* and *Thlaspietea rotundifolii*. Reading the dendrogram from left to right, the following vegetation types can be identified: cluster a_{1-1}; a_{1-2}; a_{1-4}: *Plantago atrata* community type; cluster a_{1-3}: *Trifolium thalii* community type; cluster a_2: *Plantago atrata* and *Leontodon montanus* community type; cluster a_3: *Nardus stricta* community type; cluster b_1: *Sesleria juncifolia* community type; cluster b_2: *Festuca violacea* subsp. *italica* community type; cluster b_3: *Salix retusa* community type; cluster b_4: *Papaver alpinum* and *Saxifraga oppositifolia* community type.

The PCA (with superimposed partition) calculated along three major axes (Figure 5) shows a more or less distinct grouping along the first two axes for almost all the plant community types recognized in the study area. For the snowbed vegetation only, a significant overlapping of the polygons that represent the *Plantago atrata* and the *Trifolium thalii* communities occurs. The distribution of the clusters along the first PCA axis shows a gradient, moving from left to right, from edapho-mesophilous to edapho-xerophilous conditions. The *Plantago* and *Leontodon* community, and the *Salix retusa* community behave as intermediate vegetational types between the vegetation of screes (*Thlaspietea*), snowbeds (*Salicetea herbaceae; Nardetea strictae*) and that of slopes (*Elyno – Seslerietea*). The distribution of the clusters along the second axis is linked to an increasing altitudinal gradient.

Vegetation

Gnaphalio – Plantaginetum atratae Feoli-Chiapella & Feoli 1977 (Cluster $a_{1-1} + a_{1-2} + a_{1-4}$) (Table I)

Synecology: In the intramontane basins of the alpine bioclimatic belt, *Plantago atrata* is the most widely found species. The typical *Plantago atrata* communities grow mainly on decarbonated soils occuring at the bottom of the dolinas, which pockmark the plain of the large high-altitude karst basins, where snow remains for much of the year. In this particular case, *Plantago atrata* tends to form small-sized carpets together with other species that have slightly mesophilous preferences, such as *Ranunculus sartorianus*, *Arabis surculosa*, *Trifolium thalii*, *Gnaphalium hoppeanum* subsp. *magellense*, *Crepis aurea* subsp. *glabrescens*, *Taraxacum apenninum*, *Botrichium lunaria* ecc. Also frequent in the *Plantago atrata* communities are species that have a broader ecological amplitude, such as *Carex kitaibeliana*, *Festuca violacea* subsp. *italica* and *Minuartia verna*. The limestone debris which occurs in the upper layers of the soil may act as a nucleus of aggregation for several species which are more commonly found in xeric conditions (e.g., *Draba aizoides*, *Thlaspi stylosum*, *Helianthemum oelandicum* subsp. *alpestre*, *Trinia dalechampii* ecc.).

Syntaxonomy: The inclusion of our relevés in the *Gnaphalio magellensis – Plantaginetum atratae* (which, in fact, was first described for this same area) seems to be well-founded on both floristic and ecological grounds. Nevertheless, the group of relevés that form the original phytosociological table of this association appears to be rather heterogeneous; consequently, the ecology of the community does not emerge in a clear manner (Feoli-Chiapella & Feoli, 1977). Since the type-relevé of this association has never been specified, it seemed to us appropriate to provide the lectotypification (The lectotypus of *Gnaphalio magellensis – Plantaginetum atratae* is indicated hoc loco in rel. 1 of table 1 in Feoli-Chiapella & Feoli, 1977). This allows the association to be considered a mesophilous *Plantago atrata* community occuring on relatively deep soils and exhibiting continuous cover. From the new relevés presented in the present paper, two contrasting variants of *Gnaphalio – Plantaginetum* were identified (Table I). The variant with *Salix retusa*, on the one hand, occurs on the slopes of the larger and deeper dolinas, where it may play a primary role in the colonization and stabiliziation of substrates (especially in relation to profile microconvexities). The variant with *Taraxacum glaciale*, on the other hand, is typical of the bottom of dolinas and snowbeds, where it is restricted to the microconcavities in which water from rain and melting snow tends to remain for prolonged periods.

Gnaphalio – Plantaginetum seems to be fairly similar to *Ranunculo pollinensis – Plantaginetum*, which was recently described within the alpine belt of the Gran Sasso massif (Biondi et al., 2000), and was considered, by the authors, to be a geo-vicariant community of *Gnaphalio – Plantaginetum*. Comparing the floristic composition and the ecological features of *Ranunculo – Plantaginetum* and *Gnaphalio – Plantaginetum*, however, it is likely that these associations should be regarded in form of geographical variants or, at the most, of sub-associations of the same association type.

Table I. *Gnaphalio – Plantaginetum atratae* Feoli-Chiapella & Feoli 1977.

relevée No.	2	3	4	5	6	7	8	13	14	15	16	18	19	20	21	22	25	29	33	24	27	28	32	34	35	36
altitude m a.s.l. (x 10)	242	241	235	235	239	234	235	239	240	235	245	245	258	232	247	247	254	245	233	233	246	248	245	263	263	261
aspect	E	SE	.	S	.	S	S	ENE	.	NE	.	.	NE	N	NE	N	NE	.	.	.	.	.	.	ESE	ESE	ESE
slope	25	40	.	2	.	3	2	15	.	10	.	.	35	25	35	15	45	.	.	.	.	.	.	40	30	50
rockiness (%)	15	15	15	30	20	5	5	10	5	2	10	30	25	2	5	.	2	.	.	.	.	.	.	15	10	.
detritus (%)	2	5	.	.	.	.	.	.	.	.	.	.	5	8	40	20	40	30	2	2	10	30	10	5	20	10
area (m^2)	20	5	20	20	27	24	14	20	25	10	20	100	9	16	2	8	8	10	4	6	25	50	30	6	4	4
cover (%)	80	70	85	70	80	95	95	90	85	98	70	70	60	90	55	65	60	70	98	98	90	70	90	80	70	85
number of species per relevé	15	10	14	13	14	11	10	17	15	11	12	19	18	22	14	10	8	15	9	14	12	12	12	19	21	22
Gnaphalio-Plantaginetum atratae																										
Ranunculus sartorianus Boiss. & Heldr.	2	2	1	1	2	2	3	2	2	3	3	2	1	2	2	1	2	3	1	3	3	2	1	1	1	2
Gnaphalium hoppeanum Koch subsp.magellense (Fiori) Strid	2	1	1	1	2	1	+	1	1	+	+	2	+	1	+	+	+	1	.	+	+	1	+	+	+	+
Arabis surculosa A. Terrac.	+	.	.	.	.	.	.	.	.	+	+	.	+	+	.	+	+	.	.	1	.	.	.	+	.	.
Gnaphalio-Plantaginetum* var. with *Taraxacum glaciale																										
Taraxacum glaciale Hand-Mazz	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	1	2	3	2	2	3	3	+	.	.
Gnaphalio-Plantaginetum* var. with *Salix retusa																										
Salix retusa L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	1	1
Ranunculo-Nardion; Nardetalia strictae; Nardetea strictae																										
Plantago atrata Hoppe subsp.atrata	3	3	3	3	4	4	3	3	3	2	4	3	4	3	2	2	3	4	3	3	3	4	3	2	2	3
Trifolium thalii Vill.	2	2	1	1	2	2	2	2	+	1	1	.	1	+	.	.	.	+	1	1	1	+	+	.	+	.
Crepis aurea (L.) Cass.subsp.glabrescens (Caruel.) Arcang.	1	.	+	.	1	.	.	.	.	.	.	.	1	3	2	2	1	+	1	3	+	.	.	1	2	1
Taraxacum apenninum (Ten.) Ten.	2	2	.	.	+	.	.	.	.	.	.	1	1	.	.	2	1	1	.	+	1	1	2	1	2	1
Trifolium pratense L. subsp.semipurpureum (Strobl) Pign.	2	2	+	1	1	+	+	1	1	.	+	.	2	2	.	.	.	.	.	+	+	.	+	.	.	.
Phleum alpinum subsp.rhaeticum Humphries	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	2	.	.	.	2	.	.	1
Botrychium lunaria (L.) Sw.	+	.	+	+	+	1	1	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Viola eugeniae Parl. subsp. eugeniae	.	.	.	.	.	.	.	+	+	.	.	+	.	1	+	+	.	.	.	.	.	+	.	+	+	.
Hieracium pilosella L.	.	.	.	+	+	.	.	2	1	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Luzula italica Parl.	.	.	+	.	.	.	.	1	2	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Herniaria glabra subsp. nebrodensis Jan ex Nyman	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	+	+	.	.	.	.
Sagina glabra (Willd.) Fenzl	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.
Euphrasia minima Jacq. ex DC.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.	.	.	.
Ingr. ***Leontopodio-Elynenion; Seslerion apenninae; Seslerietalia tenuifoliae;Elyno myosuroidis-Seslerietea coeruleae***																										
Carex kitaibeliana Degen ex Bech	2	1	1	1	3	1	1	2	2	+	.	.	+	2	+	+	.	1	.	.	.	+	+	1	1	1
Minuartia verna (L.) Hiern. subsp. verna	+	.	+	+	+	+	+	+	+	+	1	1	+	+	+	.	.	+	.	+	+	+	.	.	+	+
Festuca violacea Gaudin subsp. italica Foggi, G. Rossi & Signorini	.	.	+	+	+	+	+	1	+	+	.	.	+	+	.	.	.	+	.	.	.	.	.	.	+	+
Armeria canescens (Host) Boiss.subsp. canescens	.	.	.	.	.	.	.	+	.	.	.	3	1	2	1	.	+	+	.	.	+	+	+	1	1	2
Potentilla crantzii (Crantz) Beck ex Fritsch subsp.crantzii	.	.	+	+	1	+	.	1	1	+	.	1	.	+	.	.	.	+	.	.	.	.	.	.	.	+
Draba aizoides L. subsp.aizoides	.	.	.	.	.	.	.	+	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	+	+	+
Trinia dalechampii (Ten.) Janch.	.	.	.	+	.	.	.	+	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	+	.
Anthyllis vulneraria L. subsp. pulchella (Vis.) Bornm.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	+	+
Thymus praecox Opiz subsp. polytrichus (Borbàs) Jalas	+	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Campanula scheuchzeri Vill.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	1	.	.	.	.	.	.	.	.	.	.	+
Helianthemum oelandicum (L.) Dum.subsp alpestre (Jacq.) Ces.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	+
Edrajanthus graminifolius (L.) A. DC subsp. graminifolius	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Pulsatilla alpina (L.) Delarbre subsp.alpina	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Satureja alpina (L.) Scheele subsp. alpina	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Phyteuma orbiculare L.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Sedum atratum L. subsp.atratum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.
Erigeron epiroticus (Vierh.) Halàcsy	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Polygala alpestris Rchb.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gentiana verna L. subsp.verna	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Silene acaulis (L.) Jacq s. l.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Helictotrichon praetutianum (Parl. Ex Arcang.) Roser	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Achillea oxyloba (DC.) Sch.Bip. subsp. barrelieri (Ten.) F. Conti	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Other species																										
Poa alpina L. subsp.alpina	+	+	+	+	+	+	+	1	+	.	+	1	1	+	.	2	.	1	2	2	1	1	1	1	1	1
Cerastium thomasii Ten.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.	.	.	+	.	.	.	.	.	.	.	+
Astragalus depressus L. subsp.depressus	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	+	+
Thlaspi stylosum (Ten.) Mutel	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	+	+	.
Carduus chrysacanthus Ten. subsp. chrysacanthus	+	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.
Saxifraga adscendens L. subsp. adscendens	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	+	.	.
Cerastium arvense subsp.suffruticosum (L.) Hegi	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.
Myosotis ambigens (Bég.) Grau	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.

As far as the higher rank syntaxa are concerned, *Gnaphalio – Plantaginetum* was originally provisionally ascribed to the alliance *Arabidion caeruleae* and to the *Elyno – Seslerietea* class. Petriccione & Persia (1995) proposed the new alliance *Festucion macratherae* which included both *Ranunculo – Nardion* and *Caricion kitaibelianae* but which was placed in the mesophilous fringe of *Elyno – Seslerietea*. De Foucault

(1994) included *Ranunculo–Nardion* in the order *Trifolietalia parnassii*, whose distribution area, he maintained, was restricted to the Apennine chain and the mountains of southern Greece. Biondi et al. (2000), instead, included *Ranunculo pollinensis–Plantaginetum atratae* in *Ranunculo–Nardion* and *Nardetalia*. In our opinion, *Gnaphalio–Plantaginetum* is also to be included in *Ranunculo–Nardion*, since this alliance is endemic to the central and southern Apennines (Bonin, 1972). In fact, many characteristic species of *Ranunculo–Nardion* are to be found in the community, species that often exhibit high cover values (*Ranunculus sartorianus*, *Viola eugeniae*, *Taraxacum apenninum*). The alliance invalidly described as *Caricion kitaibelianae* (Art. 3f) by Migliaccio (1970) should probably also be included in the *Ranunculo–Nardion* range.

As regards the class and the order, the reference to *Nardetalia* and *Nardetea* is provisionaly maintained even if these syntaxa are more often associated (at least on the Alps and in the Western Europe) to the secondary acidophilous grasslands of the hilly and montane bioclimatic belt. In particular, on the Alps, grassland types, which are developed in ecological conditions similar to those of *Gnaphalio–Plantaginetum* of the Majella, are often included in *Juncetea trifidi* (*Caricetea curvulae*) or *Elyno–Seslerietea* (*Caricion ferrugineae*) (Braun-Blanquet, 1926; Horvat et al., 1974; Grabherr, 1993a, b; Sburlino et al., 1999; Buffa & Sburlino, 2001; Buffa et al., 2002). These references, however, are to be excluded for central Apennine since they lack most of the character species that are restricted to the Alps, or only sporadically reach the northern Apennines (Tomaselli & Rossi, 1994).

Taraxaco apennini–Trifolietum thalii Biondi et al. 1992
Taraxaco apennini–Trifolietum thalii gnaphalietosum magellensis subass. nova hoc loco (Holotypus rel. 53) (Cluster a_{1-3}). (Table II)

Synecology: *Trifolium thalii* community types develop exclusively in dolinas of larger dimensions. These have a wider central zone in which calcareous debris is absent, and where *Trifolium thalii* is dominant. *Trifolium thalii* can also be found within the gullies that occur along drainage lines running down the gentle slopes that border the large karst basins. Here snow accumulates for longer periods, and water (due to rainfall and melting snow) is present even during the summer. In addition to *Trifolium thalii*, other species characteristic of snowbed environments, exhibit high frequencies (e.g., *Plantago atrata, Taraxacum glaciale, Taraxacum apenninum, Gnaphalium hoppeanum* subsp. *magellense*). The role played by *Elyno–Seslerietea* is minor, being restricted to *Carex kitaibeliana, Minuartia verna, Armeria canescens* and *Festuca violacea* subsp. *italica*. Also worthy of note is the presence of *Cerastium cerastoides* and *Carex parviflora* which, though abundant in snowbed environments in the Alps, are very rare in the Apennines. In fact, they are known only for the Gran Sasso and Majella.

Syntaxonomy: Central Apennine *Trifolium thalii* community types have been interpreted in two different ways. Either they were considered coenologically autonomous, or they were related, in the form of subassociation or variant, to grasslands dominated by *Festuca violacea* subsp. *italica* (in which other binomies, such as *F. violacea* s.l., *F. violacea* subsp. *macrathera*, *F. macrathera* are to be included), or *Festuca rubra* subsp. *microphylla* (which includes other binomies such as *F. nigrescens* subsp. *microphylla* and, in some cases, *F. nigrescens* s.l.).

The Majella *Trifolium thalii* communities are to be included in the *Taraxaco–Trifolietum thalii,* which was previously described for the Gran Sasso massif (Biondi et al., 1992) (see Synoptic Table I, columns 2 and 8). The Gran Sasso *Taraxaco–Trifolietum*, however, is poorer in several high-altitude snowbed species, which are common in the Majella area, such as *Arabis surculosa*, *Crepis aurea* subsp. *glabrescens*, *Gnaphalium hoppeanum* subsp. *magellense*, *Taraxacum glaciale* and *Viola eugeniae*. This is due to the fact that Gran Sasso *Trifolium thalii* communities were described in the upper montane and lower subalpine belts whereas the Majella ones were described in the alpine belt. For this reason, Majella communities have to be regarded as a new subassociation of *Taraxaco apennini–Trifolietum thalii* named *gnaphalietosum magellensis*, whose differential species are *Gnaphalium hoppeanum* subs. *magellense*, *Taraxacum glaciale* and *Crepis aurea* subsp. *glabrescens*. Floristic similarities to *Taraxaco–Trifolietum* are those shown by *Trifolio–Festucetum microphyllae* (Petriccione & Persia, 1995). However this association is dominated by *Festuca rubra* subsp. *microphylla*, whereas *Trifolium thalii* behaves only as a low-cover species.

Thus, in Italy, *Taraxaco–Trifolietum* can be considered to be a geovicariant association of the northern Apennine *Trifolio thalii–Festucetum puccinellii* and of *Trifolio thalii–Festucetum nigricantis* of the Alps.

Plantago atrata and ***Leontodon montanus*** community (Cluster a_2) (Table III)

Synecology: In addition to their typical aspect related to high-altitude talus slopes (Feoli-Chiapella, 1983), *Leontodon montanus* stands are located either in the area of contact between the floor and the sides of the valleys that border the karst basin, or in the flat, or slightly convex areas

Table II. *Taraxaco apenninae – Trifolietum thalii gnaphalietosum magellensis* subass. nova.

relevée No.	42	44	47	48	49	50	51	52	53*	54	55	57
altitude m a.s.l. (x 10)	262	236	238	235	237	236	245	247	256	239	258	260
aspect	WNW	NW	SSW	SSE	WSW	SSW	.	.	.	.	.	.
slope	25	5	3	5	6	4	.	.	.	.	.	.
rockiness (%)	10	.	.	.	.	.	2	.	.	.	.	.
detritus (%)	10	5	5	8	3	10	10	10	5	5	5	25
area (m2)	10	18	25	40	18	15	6	6	22	15	25	60
cover (%)	80	95	95	90	97	85	80	90	95	95	90	75
number of species per relevé	11	14	17	15	14	16	11	14	13	14	19	25
Taraxaco apennini-Trifolietum thalii									*			
Trifolium thalii Vill.	3	3	4	4	4	4	4	4	5	5	4	4
Taraxacum apenninum (Ten.) Ten.	2	1	+	+	.	+	.	1	+	+	1	2
***Taraxaco apennini-Trifolietum thalii gnaphalietosum magellensis* subass. nova**												
Taraxacum glaciale Hand-Mazz	+	.	2	3	3	3	1	1	1	.	1	1
Gnaphalium hoppeanum Koch subsp. magellense (Fiori) Strid	+	.	+	1	+	1	+	+	+	+	+	.
Crepis aurea (L.) Cass. subsp.glabrescens (Caruel.) Arcang.	2	2	+	1	.	.	.	1	2	1	1	1
Ranunculo-Nardion; Nardetalia strictae; Nardetea strictae												
Plantago atrata Hoppe subsp. atrata	2	1	2	2	2	1	2	1	1	1	2	2
Ranunculus sartorianus Boiss. & Heldr.	1	1	1	1	2	2	1	3	1	+	.	1
Trifolium pratense L. subsp. semipurpureum (Strobl) Pignatti	1	+	+	.	.	+	.	.	.	+	+	+
Arabis surculosa A. Terrac.	.	+	.	.	1	.	.	+	1	+	+	+
Sagina glabra (Willd.) Fenzl	.	1	.	1	1	1	.	.	.	+	+	.
Phleum alpinum subsp. rhaeticum Humphries	.	.	1	1	.	1	.	.	.	.	.	1
Hieracium pilosella L.	.	.	1	+	.	+	+	.	.	.	.	.
Chenopodium bonus-henricus L.	.	1	.	.	1	.	.	.	.	.	+	.
Viola eugeniae Parl. subsp. eugeniae	.	.	1	+	.	.	.	+	.	.	.	.
Cerastium cerastoides (L.) Britton	.	+	.	.	.	.	.	.	.	.	2	.
Botrychium lunaria (L.) Sw.	.	.	.	.	.	.	+	.	.	.	.	+
Euphrasia minima Jacq. ex DC.	.	.	.	.	.	.	.	.	.	.	+	.
Campanula scheuchzeri Vill.	.	.	.	.	.	.	.	.	.	.	.	+
Ingr. ***Leontopodio-Elynenion; Seslerion apenninae; Seslerietalia tenuifoliae;Elyno myosuroidis-Seslerietea coeruleae***												
Minuartia verna (L.) Hiern. subsp. verna	.	+	+	+	+	+	.	+	+	+	.	+
Carex kitaibeliana Degen ex Bech	.	.	1	1	.	+	+	+	+	+	+	1
Armeria canescens (Host) Boiss.subsp. canescens	+	.	.	.	.	.	+	+	1	.	+	1
Festuca violacea Gaudin subsp. italica Foggi, Graz. Rossi & Signorini	.	+	.	.	.	+	.	+	.	.	.	+
Potentilla crantzii (Crantz) Beck ex Fritsch subsp. crantzii	.	.	1	.	.	.	+	.	.	.	.	.
Helictotrichon praetutianum (Parl. Ex Arcang.) Roser	.	.	+	.	.	.	.	.	.	.	.	.
Polygala alpestris Rchb.	.	.	.	.	+	.	.	.	.	.	.	.
Carex parviflora Host	.	.	.	.	.	.	.	.	.	.	+	.
Thymus praecox Opiz subsp. polytrichus (Borbàs) Jalas	.	.	.	.	.	.	.	.	.	.	.	+
Pedicularis elegans Ten. (s.l.)	.	.	.	.	.	.	.	.	.	.	.	+
Silene acaulis (L.) Jacq s. l.	.	.	.	.	.	.	.	.	.	.	.	+
Other species												
Poa alpina L. subsp.alpina	1	1	+	+	2	2	2	+	+	+	1	1
Thlaspi stylosum (Ten.) Mutel	.	.	.	.	+	.	.	.	.	+	+	+
Carduus chrysacanthus Ten. subsp. chrysacanthus	.	+	+	.	1	.	.	.	.	.	.	.
Cerastium arvense subsp. suffruticosum (L.) Hegi	.	.	.	+	1	+	.	.	.	.	.	.
Cerastium thomasii Ten.	+	.	.	.	.	.	.	.	+	.	.	.
Achillea oxyloba (DC.) Sch.Bip. subsp. barrelieri (Ten.) F. Conti	.	.	.	.	.	.	.	.	.	.	+	1
Poa molineri Balbis	.	.	.	.	.	+	.	.	.	.	.	.
Veronica alpina L.	.	.	.	.	.	.	.	.	.	.	+	.
Astragalus depressus L. subsp. depressus	.	.	.	.	.	.	.	.	.	.	.	+
Senecio squalidus L.	.	.	.	.	.	.	.	.	.	.	.	1
Leontodon montanus Lam. subsp. montanus	.	.	.	.	.	.	.	.	.	.	.	+
Galium magellense Ten.	.	.	.	.	.	.	.	.	.	.	.	+

that can be found between two or more adjacent dolinas. These sites tend to be characterized by thin and poorly developed soils in which there is a significant amount of calcareous debris (typically sharp chips of stone ranging between 0.5 and 5 cm in size) in the surface layers, which are clearly of cryoclastic and periglacial origin. From a physiognomical point of view the *Leontodon* community is characterized by an average cover that rarely exceeds 50% and in which *Plantago atrata, Leontodon montanus, Potentilla crantzii* and *Poa alpina* are the major species. While generally similar to the humid and fine textured talus slopes, these environments are not characterized by unstable substrates, and, consequently, are not involved in solifluction or washing-away processes. Therefore, in addition to typical snow-bed species, such as *Plantago atrata, Ranunculus sartorianus, Gnaphalium*

Table III. *Plantago atrata* and *Leontodon montanus* community.

relevée No.	58	59	60	61	62	63	64	65	66
altitude m a.s.l. (x 10)	242	241	242	256	250	244	252	251	257
aspect	.	.	E	SW	NNE	.	NNE	NE	SW
slope	.	.	10	25	15	.	45	45	11
rockiness (%)	5	10	5	5	2	5	10	10	.
detritus (%)	90	80	70	60	80	85	45	50	70
area (m2)	70	50	70	10	100	100	4	13	64
cover (%)	30	35	40	50	35	30	45	40	40
number of species per relevé	20	21	20	28	27	28	12	11	29
***Plantago atrata* and *Leontodon montanus* community**									
Leontodon montanus Lam. subsp.montanus	2	2	1	+	1	1	2	1	3
Plantago atrata Hoppe subsp.atrata	1	3	3	1	.	1	2	1	+
Leontopodio-Elynenion; Seslerion apenninae; Seslerietalia tenuifoliae; Elyno myosuroidis-Seslerietea coeruleae									
Armeria canescens (Host) Boiss.subsp. canescens	+	2	+	2	1	2	+	.	2
Minuartia verna (L.) Hiern. subsp. verna	+	+	+	+	1	1	.	+	1
Sedum atratum L. subsp. atratum	+	+	+	+	+	+	.	.	+
Anthyllis vulneraria L. subsp. pulchella (Vis.) Bornm.	+	+	.	+	1	+	.	.	1
Achillea oxyloba (DC.) Sch.Bip. subsp. barrelieri (Ten.) F. Conti	+	+	.	+	+	+	+	+	+
Potentilla crantzii (Crantz) Beck ex Fritsch subsp. crantzii	+	+	2	1	2	+	.	.	+
Carex kitaibeliana Degen ex Bech	+	+	+	1	.	.	+	+	.
Silene acaulis (L.) Jacq s. l.	+	+	.	+	2	+	.	.	+
Festuca violacea Gaudin subsp. italica Foggi, Graz. Rossi & Signorini	.	.	+	2	2	1	.	+	3
Satureja alpina (L.) Scheele subsp. alpina	+	+	+	.	.	+	.	.	2
Trinia dalechampii (Ten.) Janch.	+	.	.	+	+	+	.	.	1
Pedicularis elegans Ten. (s.l.)	.	.	+	+	+	.	.	.	+
Thymus praecox Opiz subsp. polytrichus (Borbàs) Jalas	.	.	+	1	.	.	+	.	+
Draba aizoides L. subsp.aizoides	.	.	.	1	+	+	.	.	1
Campanula scheuchzeri Vill.	.	.	.	+	+	1	.	.	2
Andosace villosa L. subsp.villosa	.	.	.	+	+	+	.	.	.
Gentiana verna L. subsp.verna	.	.	.	+	+	.	.	.	+
Edrajanthus graminifolius (L.) A. DC subsp. graminifolius	.	.	.	.	+	+	.	.	+
Pulsatilla alpina (L.) Delarbre subsp.alpina	.	.	.	.	+	+	.	.	.
Helictotrichon praetutianum (Parl. Ex Arcang.) Roser	.	.	.	+	.	.	.	.	.
Leontopodium alpinum Cass. subsp. nivale (Ten.) Tutin	.	.	.	.	.	+	.	.	.
Erigeron epiroticus (Vierh.) Halàcsy	.	.	.	.	.	.	.	.	+
Ingr. *Ranunculo-Nardion; Nardetalia strictae; Nardetea strictae*									
Gnaphalium hoppeanum Koch subsp. magellense (Fiori) Strid	+	+	1	+	+	1	+	+	1
Hieracium pilosella L.	+	+	+	+	.	+	.	.	+
Viola eugeniae Parl. subsp. eugeniae	.	+	+	+	+	+	.	.	1
Ranunculus sartorianus Boiss. & Heldr.	+	+	1	.	.	.	.	+	+
Taraxacum apenninum (Ten.) Ten.	+	.	.	.	.	.	2	+	.
Taraxacum glaciale Hand-Mazz	.	+	.	.	.	.	.	.	.
Trifolium thalii Vill.	.	.	+	.	.	.	.	.	.
Trifolium pratense L. subsp. semipurpureum (Strobl) Pignatti	.	.	.	+	.	.	.	.	.
Crepis aurea (L.) Cass. subsp. glabrescens (Caruel.) Arcang.	.	.	.	.	.	.	+	.	.
Linario-Festucion dimorphae; Thlaspietalia rotundifolii; Thlaspietea rotundifolii									
Cerastium thomasii Ten.	2	2	+	+	1	2	.	.	2
Ranunculus brevifolius Ten.	1	+	+	1	+	+	.	.	2
Myosotis ambigens (Bég.) Grau	+	+	.	.	+	.	.	.	1
Galium magellense Ten.	.	1	.	.	+	+	.	.	+
Thlaspi stylosum (Ten.) Mutel	.	.	.	+	.	+	.	.	+
Saxifraga oppositifolia L. subsp. speciosa (Dörfl. & Hayek) Engl. & Irmsch	.	.	.	.	1	+	.	.	.
Carduus chrysacanthus Ten. subsp. chrysacanthus	.	.	.	.	+	.	+	.	.
Ranunculus magellensis Ten.	.	.	.	.	.	.	+	+	.
Other species									
Poa alpina L. subsp. alpina	2	1	2	2	1	1	3	3	1
Astragalus depressus L. subsp.depressus	.	.	+	.	.	.	.	.	.
Poa molineri Balbis	.	.	.	1	.	.	.	.	.
Saxifraga adscendens L. subsp. adscendens	.	.	.	.	+	.	.	.	.
Leontodon crispus Vill. subsp. asper (Waldst. & Kit.) Rohlena	.	.	.	.	.	2	.	.	.

hoppeanum subsp. *magellense* and *Taraxacum apenninum*, species that are more commonly to be found on screes, such as *Leontodon montanus, Ranunculus brevifolius, Achillea oxyloba* subsp. *barrelieri, Ranunculus magellense* and *Galium magellense*, also occur.

Syntaxonomy: As it is impossible to find a suitable syntaxonomical reference at the association level, we remain on the more general level of *Plantago atrata* and *Leontodon montanus* community type. The floristic and coenological features of this community type appear to be intermediate between those of

different phytosociological classes (*Nardetea*, *Elyno–Seslerietea*, *Thlaspietea*). Reference to *Thlaspietea rotundifolii*, however, is to be excluded since this community does not develop on unstable and incoherent substrates. At the same time, reference to *Nardetea* is also to be excluded due to the occurrence of a relatively high number of scree species. From a structural and coenological viewpoint (Figures 7–8 and Synoptic Table II), the *Plantago* and *Leontodon* community exhibits an autonomous position that is closer to those of *Seslerion apenninae* communities, rather than to those of *Nardetea* or *Thlaspietea* communities.

Carici kitaibelianae–Salicetum retusae Biondi et al. 1999 (Cluster b_3) (Table IV)

Synecology: On the slopes of karst basins, at the stable and relatively moist detrital flows, typical *Salix retusa* communities become established, their extent varying between 10 and 50 m^2. These *Salix* communities are typically poor in species diversity. Thus, companion species generally have extremely low cover values, as the dominance of *Salix* is more or less total. The number of species that can share the role of physiognomically important species with the willow is very limited; amongst them, *Helianthemum oelandicum* subsp. *alpestre*, *Anthyllis vulneraria* subsp. *pulchella* and *Silene acaulis*.

Syntaxonomy: The syntaxonomical reference of the central Apennine *Salix retusa* community can only be the *Carici–Salicetum retusae* (cf. Biondi et al. 1999; Blasi et al. 2003). As already stated in Blasi et al. (2003), it is likely that the floristic impoverishment in alpine *Arabidion caeruleae* species that characterize the Maiella *Salix retusa* communities (and, more generally all Apennine *Salix retusa* communities) is due to their very marginal position in the distribution area of both alliance and species.

Luzulo italicae–Nardetum strictae Biondi et al. 1992 (Cluster A_3) (Table V)

Synecology: The peculiar structural and lithomorphological features of the Majella massif, together with the high stoniness of the summit areas and the occurrence of flattish zones only at altitudes exceeding 2,300–2,400 m, lead to environmental conditions that are not favourable to the development of *Nardus stricta* communities (only two *Nardus stricta* stands suitable for sampling were found). This vegetation type is the most acidophilous, since it develops on flattish stations and on leached soils, characterized by the complete absence of a calcareous skeleton or superficial detritus. The physiognomy of *Nardus stricta* communities is of extremely dense and close carpets, which are typically poor floristically and in which *Nardus* is absolutely dominant. The species associated to the Majella *Nardus* communities are *Festuca rubra* subsp. *commutata*, *Luzula bulgarica*, *Plantago atrata* and *Trifolium thalii*, other species, having a broader ecological amplitude, such as *Carex kitaibeliana*, *Poa alpina* and *Minuartia verna* may also be frequent. The occurrence of *Potentilla crantzii* is particularly significant, since this species is a typical indicator of the alpine bioclimatic belt, and is substituted by *Potentilla rigoana* in the *Nardus stricta* communities of the subalpine and upper montane belts.

Syntaxonomy: The *Nardus stricta* communities were observed by Migliaccio (1970), who included them in the *Nardetum aprutinum* (nom. illeg. Art. 34). The sporadic *Nardus* stands observed in the present study are to be included in *Luzulo–Nardetum*. This association was described precisely for the flat subalpine areas of the central Apennine limestone mountains (Biondi et al., 1992), whereas the *Agrostio–Nardetum* is restricted to the montane belt and the *Poo violaceae–Nardetum* to the siliceous mountains (Pedrotti, 1981, 1982; Abbate et al., 1994).

Chorological table	nr. sp.	Frq.%	Cover %
Circumbor/ Artic-alpine	18	17.2	18.9
Amphiadriatic	5	6.7	5.9
Endem. Centr. and South. Apennine	8	10.0	6.9
Endem Ital. Peninsula	7	5.5	4.5
Endem.Central Apenn. s.s.	12	8.1	5.3
Eurasiatic	6	7.5	3.7
Mediterranean-Mount.	6	6.3	5.2
Oroph. Central-Europ. and Euras.	5	3.7	3.4
Oroph. South-eastern Europ.	14	15.5	17.6
Oroph. Southern Europ.	14	10.3	14.7
Oroph. South-West Europ.	5	4.4	10.8
Oroph.Central and South Europ.	2	2.9	0.9
Subendemic	2	2.0	2.2

Life form table	nr. sp.	Frq.%	Cover %
Ch frut	1	0.9	2.3
Ch pulv	3	3.0	3.4
Ch rept	3	3.1	1.5
Ch succ	1	1.1	1.3
Ch suffr	17	14.0	9.8
G rhiz	5	2.0	0.9
H bienn	3	0.8	0.1
H caesp	16	20.0	32.6
H ros	14	20.2	25.9
H scap	36	33.0	21.5
P rept	1	0.1	0.0
T scap	4	1.9	0.7

Figure 6. Life forms and chorological tables for the species occurring in the entire set of relevés. Frequency and cover values are based on the presence and the specific cover index (i.r.s.) of the species in the phytosociological tables.

	Gna-Plant			Tar-Trif gn.			Car-Salic			Plant-Leont			Luz-Nar			Leo-Sesl			Het-Fest			Sax-Pap			Sax-Pap andr		
Chorotypes	n sp.	frq.	cov.	n sp.	frq.	cov.	n sp.	frq.	cov.	n sp.	frq.	cov.	n sp.	frq.	cov.	n sp.	frq.	cov.	n sp.	frq.	cov.	n sp.	frq.	cov.	n sp.	frq.	cov.
Circumb. /Art. alp.	7	17.0	20.2	7	17.0	15.2	9	18.2	19.3	5	14.8	23.4	4.0	25.8	60.2	11	20.0	15.1	8	15.1	11.1	6	17.3	15.9	8	17.1	29.8
Amphiadr.	3	9.1	4.3	2	9.3	2.1	1	2.0	0.3	2	5.1	2.2	2.0	9.7	3.8	3	6.2	26.9	3	6.8	1.6	,	,	,	2	2.7	0.7
Endem. C-S Apenn.	6	8.9	3.6	5	8.7	2.2	4	14.1	11.0	6	12.8	10.5	2.0	12.9	14.5	3	7.7	5.1	5	8.3	15.5	4	14.7	12.4	5	13.9	6.4
Endem. Italian	3	4.3	4.3	2	5.0	3.4	2	5.1	1.8	3	3.6	2.4	1.0	3.2	0.3	3	6.8	2.6	2	5.6	8.0	4	12.0	13.1	5	7.5	3.8
Endem. C-Apenn.	4	7.4	5.3	6	10.3	7.4	4	7.1	1.0	6	11.7	10.4	1.0	3.2	0.3	3	1.2	0.2	3	3.8	1.0	4	26.7	37.8	5	15.5	11.0
Eurasiat.	4	9.4	2.1	4	8.7	1.5	1	4.0	0.6	2	7.1	2.6	4.0	19.4	4.8	4	8.3	12.2	3	7.1	2.7	,	,	,	2	2.7	3.8
Medit. Mont.	2	2.0	0.2	2	1.7	0.2	3	9.1	10.3	2	5.1	2.2	,	,	,	5	11.1	8.0	4	8.3	9.9	2	14.7	15.4	5	11.8	15.0
Oroph. C-Eur./Euras	3	1.7	1.2	2	1.7	0.4	3	7.1	30.6	2	3.1	0.6	1.0	3.2	0.3	4	4.6	0.7	4	5.9	4.4	2	4.0	2.6	3	6.4	8.8
Oroph. SE-Europ.	7	16.7	16.0	6	14.7	9.9	6	18.2	19.6	8	19.4	26.9	2.0	9.7	12.8	8	16.0	17.1	9	17.5	32.4	3	4.0	0.7	7	9.1	10.5
Oroph. SW-Europ.	11	14.4	34.4	9	12.7	14.3	4	6.1	3.2	6	13.8	17.3	1.0	6.5	0.7	5	5.5	0.8	8	9.5	3.2	2	6.7	2.1	4	4.8	1.7
Oroph. S-Europ.	2	6.7	7.8	3	9.0	43.4	1	1.0	0.1	1	0.5	0.1	1.0	6.5	2.1	1	3.4	4.6	2	4.1	4.9	,	,	,	2	1.6	0.6
Oroph. C-S Europ.	2	2.4	0.4	2	1.3	0.2	2	7.1	1.5	2	2.6	1.3	,	,	,	2	4.6	0.7	2	3.8	1.7	,	,	,	1	1.6	0.6
Subendemic	,	,	,	,	,	,	1	1.0	0.7	1	0.5	0.1	,	,	,	2	4.6	6.2	2	4.1	3.7	,	,	,	2	5.3	7.3
Life forms	n sp.	frq.	cov.	n sp.	frq.	cov.	n sp.	frq.	cov.	n sp.	frq.	cov.	n sp.	frq.	cov.	n sp.	frq. cov	cov.	n sp.	frq.	cov.	n sp.	frq.	cov.	n sp.	frq.	cov.
Ch frut	1	0.9	1.1	2	1.3	0.2	1	5.1	30.3	,	,	,	,	,	,	1	0.9	0.1	1	0.6	1.1	1	1.3	1.2	1	1.6	3.3
Ch pulv	1	0.4	0.1	1	0.7	0.1	2	4.0	5.8	2	4.1	2.9	,	,	,	1	2.8	3.8	2	3.3	2.8	2	6.7	9.3	2	8.6	21.0
Ch rept	1	0.9	0.1	1	0.3	0.1	2	3.0	0.4	2	3.6	1.1	,	,	,	3	4.6	0.7	2	6.5	4.9	1	2.7	1.4	3	5.3	6.3
Ch succ	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	1	3.4	4.6	1	3.3	4.4	,	,	,	,	,	,
Ch suffr	6	10.0	1.5	4	9.3	1.4	6	17.2	12.6	5	13.3	12.8	1.0	6.5	0.7	8	16.0	12.0	6	10.7	16.0	9	37.3	38.5	11	25.1	27.1
G rhiz	2	2.4	0.5	1	1.0	0.1	1	2.0	3.2	1	3.6	3.2	,	,	,	2	1.2	0.2	2	1.2	0.4	1	1.3	1.2	2	3.7	4.0
H bienn	1	0.7	0.1	2	0.7	0.2	1	2.0	0.3	1	0.5	0.1	,	,	,	2	1.5	0.2	1	0.6	0.1	,	,	,	,	,	,
H caesp	9	24.6	21.9	9	25.3	54.4	6	17.2	16.7	6	12.2	24.9	7.0	38.7	79.2	9	21.5	49.1	8	18.3	38.1	3	8.0	4.3	6	11.2	9.4
H ros	11	27.0	50.6	11	28.7	30.1	8	23.2	7.7	12	25.0	37.6	3.0	16.1	4.5	7	14.2	7.6	8	14.5	6.8	2	2.7	0.5	8	9.1	6.5
H scap	18	30.7	23.7	16	30.7	13.1	13	24.2	22.8	16	34.2	16.7	7.0	35.5	15.2	17	31.7	19.7	21	39.3	24.7	7	38.7	42.5	16	33.7	21.5
P	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	1	0.3	0.1	1	0.3	0.2	,	,	,	,	,	,
T scap	3	2.2	0.5	3	2.0	0.4	1	2.0	0.3	1	3.6	0.7	1.0	3.2	0.3	1	0.9	1.7	2	1.5	0.4	1	1.3	1.2	2	1.6	0.9

Figure 7. Chorological and biological (life forms) features of the various plant communities identified. For each community type, the number of species (n. sp.), the % frequency (frq.) and the % cover (cov.) were calculated.

Class	Community type H/Ch ratio	norm.	frq.	cover
Nardetea	Luzulo-Nardetum	17	13.8	99
	Taraxaco-Trifolietum	4.7	7.07	57.5
	Gnaphalio-Plantaginetum	4.3	6.09	35.6
Elyno-Seslerietea	Plantago and Leontodon comm.	3.8	3.55	4.7
	Helianthemo-Festucetum	3.1	3	2.3
	Leontopodio-Seslerietum	2.3	2.42	3.5
Thlaspietea	Carici-Salicetum	2.5	2.75	0.96
	Saxifrago-Papaveretum androsacetosum	1.6	1.4	0.84
	Saxifrago-Papaveretum	0.9	0.7	0.6

Figure 8. Hemicryptophyte/Chamaephyte ratio in the plant communities identified.

Leontopodio nivalis–Seslerietum juncifoliae ass. nova hoc loco (Holotypus rel. 74)
(Cluster b_1) (Table VI)

Synecology: *Sesleria juncifolia* grasslands are at their optimum within the crests and ridges bordering the high-altitude large tectonic basins of the Majella, where the substrate is subjected to frequent cryoturbation processes. The high altitude and the continuous action of winds cause several periglacial phenomena. The soils (brown rendzinas), are relatively deep, but rich in calcareous skeletons. These physical features, together with the scarce surface debris, allow the *Sesleria* grassland to be almost continuous, and to reach a surprisingly high degree of cover compared with the common aspect of these grassland types in the Apennines. The physiognomy of the community is mainly due to grassy clustered hemicryptophytes (*Sesleria juncifolia*, *Carex humilis*, *Carex kitaibeliana*) and small size chamaephytes (*Helianthemum oelandicum* subsp. *alpestre*, *Silene acaulis*). It is also worth noting the abundance of *Carex humilis*, which is unusual at such high altitudes (this species finds its coenological optimum in the

Table IV. *Carici kitaibelianae – Salicetum retusae* Biondi et al. 1999.

relevée No.	67	68	69	70	71
altitude m a.s.l. (x 10)	262	256	256	249	252
aspect	.	SW	SW	WSW	ENE
slope	.	40	30	70	15
rockiness (%)	.	5	5	10	.
detritus (%)	10	25	10	80	90
area (m2)	7	30	8	50	100
cover (%)	90	80	80	35	35
number of species per relevé	19	21	18	19	22
Carici kitaibelianae-Salicetum retusae					
Salix retusa L.	4	4	3	2	3
Carex kitaibeliana Degen ex Bech	2	1	1	2	.
Arabidion coeruleae, Arabidetalia coeruleae, Thlaspietea rotundifolii					
Achillea oxyloba (DC.) Sch.Bip. subsp. barrelieri (Ten.) F. Conti	.	+	+	+	+
Saxifraga paniculata Mill. subsp. paniculata	.	+	+	+	.
Gnaphalium hoppeanum Koch subsp. magellense (Fiori) Strid	+	+	.	.	.
Saxifraga oppositifolia L. subsp. speciosa (Dörfl. & Hayek) Engl. & Irmsch	.	.	.	2	1
Iberis saxatilis L. subsp. saxatilis	.	.	.	+	1
Cerastium thomasii Ten.	.	.	.	+	+
Thlaspi stylosum (Ten.) Mutel	.	+	.	.	.
Leontodon montanus Lam. subsp.montanus	.	.	.	+	.
Ingr. ***Seslerion apenninae; Seslerietalia tenuifoliae;Elyno-Seslerietea coeruleae***					
Helianthemum oelandicum (L.) Dum. subsp alpestre (Jacq.) Ces.	1	+	4	1	+
Anthyllis vulneraria L. subsp. pulchella (Vis.) Bornm.	+	1	1	2	3
Armeria canescens (Host) Boiss. subsp. canescens	1	1	1	+	+
Draba aizoides L. subsp. aizoides	+	1	+	+	+
Pedicularis elegans Ten. (s.l.)	+	+	+	+	+
Festuca violacea Gaudin subsp. italica Foggi, Graz. Rossi & Signorini	1	1	1	.	2
Minuartia verna (L.) Hiern. subsp. verna	+	+	.	+	+
Edrajanthus graminifolius (L.) A. DC subsp. graminifolius	.	.	+	+	+
Thymus praecox Opiz subsp. polytrichus (Borbàs) Jalas	+	.	.	.	+
Trinia dalechampii (Ten.) Janch.	.	+	.	.	+
Sedum atratum L. subsp. atratum	.	+	.	.	+
Helictotrichon praetutianum (Parl. Ex Arcang.) Roser	.	.	1	1	.
Silene acaulis (L.) Jacq s. l.	.	.	+	2	.
Persicaria vivipara (L.) Ronse Decraene	.	.	1	.	2
Potentilla crantzii (Crantz) Beck ex Fritsch subsp. crantzii	1	.	.	.	.
Oxytropis campestris (L.) DC. subsp. campestris	.	.	2	.	.
Andosace villosa L. subsp.villosa	.	.	.	.	+
Gentiana verna L. subsp.verna	.	.	.	.	+
Other species					
Poa alpina L. subsp.alpina	1	2	1	+	+
Viola eugeniae Parl. subsp. eugeniae	+	+	+	.	.
Plantago atrata Hoppe subsp. atrata	2	+	.	.	.
Saxifraga adscendens L. subsp. adscendens	+	+	.	.	.
Ranunculus sartorianus Boiss. & Heldr.	2	.	.	.	.
Trifolium thalii Vill.	+	.	.	.	.
Astragalus depressus L. subsp. depressus	+	.	.	.	.
Trifolium pratense L. subsp. semipurpureum (Strobl) Pignatti	.	3	.	.	.
Campanula scheuchzeri Vill.	.	+	.	.	.
Poa molineri Balbis	.	.	+	.	.
Campanula tanfanii Podl.	.	.	.	+	.
Leontopodium alpinum Cass. subsp. nivale (Ten.) Tutin	.	.	.	.	1
Aster alpinus L.	.	.	.	.	+

upper montane belt), and the presence of *Leontopodium alpinum* subsp *nivale*, a rare sub-endemic (amphi-Adriatic) species which can be found, always sporadically, in only a few central Apennine sites (Gran Sasso, Majella, Sibillini and Abruzzo National Park (Pignatti, 1982; Petriccione, 1985; Conti, 1998).

Syntaxonomy: By comparing to it other *Sesleria juncifolia* phytosociological associations described for the central Apennines (Synoptic Table III), the coenological autonomy of the Majella *Sesleria juncifolia* community emerges clearly. The new association, *Leontopodio nivalis – Seslerietum apenninae*, proposed in this paper is representative of those *Sesleria juncifolia* communities restricted to the alpine belt of the Apennines. Characteristic species are: *Leontopodium alpinum* subsp. *nivale*, *Aster alpinus*, *Iberis saxatilis* and *Ranunculus oreophilus*. The distribution area of this association includes all the central Apennine limestone massifs that exhibit an alpine belt (Majella and Gran Sasso).

Table V. *Luzulo italicae–Nardetum strictae caricetosum kitaibelianae* Biondi et al. 1999.

relevée No.	72	73
altitude m a.s.l. (x 10)	236	236
aspect	.	.
slope	.	.
rockiness (%)	.	.
detritus (%)	5	5
area (m2)	80	50
cover (%)	95	95
number of species per relevé	17	14
Luzulo italicae-Nardetum strictae caricetosum		
Luzula italica Parl.	2	2
Potentilla crantzii (Crantz) Beck ex Fritsch subsp. crantzii	2	+
Viola eugeniae Parl. subsp. eugeniae	.	+
caricetosum kitaibelianae		
Erigeron epiroticus (Vierh.) Halàcsy	1	1
Carex kitaibeliana Degen ex Bech	+	.
Gentiana verna L. subsp .verna	+	.
Ranunculo-Nardion; Nardetalia strictae; Nardetea strictae		
Nardus stricta L.	4	4
Hieracium pilosella L.	1	1
Trifolium pratense L. subsp. semipurpureum (Strobl) Pignatti	1	+
Trifolium thalii Vill.	+	1
Ranunculus sartorianus Boiss. & Heldr.	+	1
Plantago atrata Hoppe subsp. atrata	+	+
Festuca laevigata Gaudin subsp. crassifolia (Gaudin) Kerguélen & Plonka	+	.
Herniaria glabra L. subsp. nebrodensis Jan ex Nyman	.	+
Other species		
Festuca violacea Gaudin subsp. italica Foggi, Graz. Rossi & Signorini	2	2
Poa alpina L. subsp.alpina	2	1
Minuartia verna (L.) Hiern. subsp. verna	+	+
Cerastium arvense L. subsp. suffruticosum (L.) Hegi	+	.
Gnaphalium hoppeanum Koch subsp. magellense (Fiori) Strid	+	.

Several *Sesleria juncifolia* associations have been described for the central Apennines. *Carici humilis–Seslerietum*, which was described for the montane belt, cannot be taken as reference because it is almost completely lacking in *Elyno–Seslerietea* species, whereas the *Festuco–Brometea* ones behave as absolutely dominant (Biondi et al., 1988; Petriccione & Persia, 1995)[1]. *Pedicularido–Seslerietum caricetosum ericetori* (= *Elyno–Seslerietum tenuifoliae sensu* Petriccione (1991) exhibit various important diagnostic species, such as *Carex ericetorum*, *Elyna myosuroides* and *Pedicularis verticillata*, which are lacking from the Majella relevés, whereas other species, such as *Leontopodium nivale*, *Carex humilis*, *Poa molineri*, *Helictotrichon praetutianum* and *Draba aizoides*, are absent from the *Pedicularido–Seslerietum*. Recently, a *Sesleria* community type named *Pediculari–Seslerietum apenninae leontopodietosum* was described for the subalpine belt of the eastern part of the Majella massif, but it is likely to be included in the *Seslerietum apenninae* coenological range (Ubaldi et al., 1998). In fact, despite the occurrence of *Leontopodium nivale*, this community type is restricted to the subalpine belt, and consequently still includes species which are more often linked to *Bromus erectus* secondary grasslands, such as *Helianthemum oelandicum* subsp. *incanum*, *Festuca circummediterranea*, *Dianthus sylvestris* subsp. *garganicus*, *Anthyllis vulneraria* subsp. *polyphylla*, *Juniperus alpina* and *Pinus mugo*.

Finally, it is not possible to relate the Majella community to *Seslerietum apenninae*, as the latter is still rich in 'thermophilous' species coming from the montane belt, and lacks the specific components typical of the alpine belt.

As far as the suballiance level is concerned, the occurrence of *Leontopodium nivale* (together with the almost total absence of *Festuco–Brometea* transgressive species) allow this association to be included in *Leontopodio–Elynenion*, where it tends to occupy the lower fringe bordering on the subalpine belt.

Helianthemo alpestris – Festucetum italicae ass. nova hoc loco (Holotypus rel. 90) (Cluster b_2) (Table VII)

Synecology: Vegetation in which *Helianthemum oelandicum* subsp. *alpestre* and *Festuca violacea* subsp. *italica* are dominant tends to form discontinuous carpets of grass that colonize the slightly sloping stretch connecting the lower part of the slope to the bottom of the karst basin, or the sub-level or semi-convex environments between adjacent dolinas. The substrate is typically pebbly with a rather minute clast

Table VI. *Leontopodio nivalis – Seslerietum juncifoliae* ass. nova.

relevée No.	74	75	76	77	78	79	80	81	82	83	84	85	86
altitude m a.s.l. (x 10)	235	234	234	235	237	235	234	241	241	241	251	247	249
aspect	NE	ENE	ENE	NE	ENE	NE	.	SE	W	.	E	NE	NNE
slope	40	40	40	10	10	10	.	15	23	.	15	13	14
rockiness (%)	5	5	15	15	5	10	5	15	20	10	.	5	5
detritus (%)	15	15	10	15	15	15	60	40	50	70	30	50	35
area (m2)	50	50	60	60	40	45	50	150	200	200	120	100	150
cover (%)	80	85	85	85	80	75	60	60	40	35	80	65	70
number of species per relevé	29	28	29	30	21	17	26	29	21	24	22	24	26
Leontopodio nivalis-Seslerietum juncifoliae	*												
Leontopodium alpinum Cass. subsp. nivale (Ten.) Tutin	2	2	+	+	+	2	+	2	+	2	+	+	2
Iberis saxatilis L. subsp. saxatilis	+	+	+	+	+	+	.	+	2	2	2	+	+
Ranunculus oreophilus M. Bieb.	+	+	+	+	+	.	+	+	+	+	.	+	+
Aster alpinus L.	2	2	+	+	+	2	2	2	.	2	.	+	+
Leontopodio-Elynenion													
Helianthemum oelandicum (L.) Dum. subsp alpestre (Jacq.) Ces.	+	+	+	+	+	.	+	2	2	3	.	2	2
Oxytropis campestris (L.) DC. subsp. campestris	+	+	+	+	+	+	+	+	.	2	.	+	2
Silene acaulis (L.) Jacq s. l.	+	+	+	+	.	.	.	+	3	3	.	+	+
Minuartia verna (L.) Hiern. subsp. verna	.	.	.	.	+	+	+	+	+	+	+	+	+
Potentilla crantzii (Crantz) Beck ex Fritsch subsp. crantzii	+	+	+	+	.	.	.	+	.	.	.	.	.
Gentiana verna L. subsp. verna	+	+	+	+	.	.	.	.	.	.	.	.	.
Dryas octopetala L.	.	.	.	.	.	.	.	.	.	.	+	+	.
Elyna myosuroides (Vill.) Fricsch	.	.	.	.	.	.	.	.	.	.	.	+	+
Persicaria vivipara (L.) Ronse Decraene	.	.	.	.	.	.	.	.	.	.	.	.	+
Seslerion apenninae;													
Anthyllis vulneraria L. subsp. pulchella (Vis.) Bornm.	2	2	2	2	+	+	+	+	.	+	+	+	+
Pedicularis elegans Ten. (s.l.)	+	+	+	+	+	+	.	2	2	2	+	+	2
Trinia dalechampii (Ten.) Janch.	+	+	+	+	+	.	+	+	.	+	+	+	+
Festuca violacea Gaudin subsp. italica Foggi, Graz. Rossi & Signorini	+	+	+	+	.	+	2	+	+	+	+	.	.
Helictotrichon praetutianum (Parl. Ex Arcang.) Roser	+	+	+	+	.	+	+	+	+	.	+	.	.
Myosotis ambigens (Bég.) Grau	.	.	+	+	.	.	.	+	.	.	.	.	.
Seslerietalia tenuifoliae;													
Sesleria juncifolia Suffren	3	3	4	4	2	4	3	3	3	3	4	3	3
Edrajanthus graminifolius (L.) A. DC subsp. graminifolius	+	+	+	+	+	+	.	+	+	2	2	+	+
Carex kitaibeliana Degen ex Bech	2	.	.	2	+	+	2	2	3	3	3	+	+
Cerastium arvense L. subsp. suffruticosum (L.) Hegi	+	+	+	+	+	.	+	.	+	+	.	.	.
Andosace villosa L. subsp. villosa	+	+	+	+	.	.	.	.	.	+	+	+	.
Armeria canescens (Host) Boiss.subsp. canescens	+	+	+	+	.	.	+	.	+	.	.	.	.
Anthyllis montana L. subsp. atropurpurea (Vuk.) Pignatti	.	.	.	.	.	.	.	+	.	.	2	.	.
Festuca laevigata (Gaudin) subsp. crassifolia (Gaudin) Kerguélen & Plonka	.	.	.	.	.	.	+	.	.	.	.	.	.
Elyno-Seslerietea													
Sempervivum arachnoideum L. subsp. arachnoideum	+	+	+	+	+	+	.	2	.	+	2	3	2
Draba aizoides L. subsp. aizoides	+	+	+	+	+	+	+	+	.	.	+	+	+
Erigeron epiroticus (Vierh.) Halàcsy	+	+	+	+	.	.	+	+	.	.	.	.	.
Pulsatilla alpina (L.) Delarbre subsp.alpina	+	+	.	.	.	.	+	.	+	.	.	.	.
Euphrasia salisburgensis Funck ex Hoppe	.	.	.	.	.	.	.	2	.	+	.	.	2
Campanula scheuchzeri Vill.	.	.	.	.	.	.	+	.	.	.	.	.	.
Helianthemum nummularium (L.) Mill. subsp. grandiflorum (Scop.) Schinz &	.	.	.	.	.	.	.	.	.	.	+	.	.
Polygala alpestris Rchb.	.	.	.	.	.	.	.	.	.	.	.	.	+
Other species													
Saxifraga paniculata Mill. subsp. paniculata	+	+	+	+	+	.	.	+	2	2	2	+	+
Carex humilis Leyss.	2	2	2	+	3	3	+	3	.	.	.	3	3
Poa molineri Balbis	.	+	+	.	.	+	+	+	.	.	+	+	+
Poa alpina L. subsp. alpina	+	.	.	+	+	.	+	.	.	.	+	+	+
Thymus praecox Opiz subsp. polytrichus (Borbàs) Jalas	.	.	+	+	.	.	+	+	+	+	.	.	.
Saxifraga adscendens L. subsp. adscendens	+	+	+	+	.	.	.	.	.	.	.	.	.
Arenaria grandiflora L. subsp. grandiflora	.	.	.	.	.	.	.	.	+	+	.	+	+
Juncus monanthos Jacq.	.	.	+	+	.	.	.	+	.	.	.	.	.
Salix retusa L.	.	.	.	.	+	+	.	.	.	.	.	.	+
Saxifraga oppositifolia L. subsp. speciosa (Dörfl. & Hayek) Engl. & Irmsch	.	.	.	.	.	.	+	.	+	+	.	.	.
Viola eugeniae Parl. subsp. eugeniae	+	+	.	.	.	.	.	.	.	.	.	.	.
Valeriana saliunca All.	.	.	.	.	.	.	.	.	+	2	.	.	.
Gentiana columnae Ten.	.	.	.	.	+	.	.	.	.	.	.	.	.
Hieracium pilosella L.	.	.	.	.	.	.	+	.	.	.	.	.	.
Plantago atrata Hoppe subsp. atrata	.	.	.	.	.	.	+	.	.	.	.	.	.
Thesium parnassi A. DC.	.	.	.	.	.	.	.	+	.	.	.	.	.
Galium magellense Ten.	.	.	.	.	.	.	.	.	+	.	.	.	.
Pinus mugo Turra	.	.	.	.	.	.	.	.	.	.	+	.	.
Potentilla apennina Ten.	.	.	.	.	.	.	.	.	.	.	+	.	.

Table VII. *Helianthemo alpestris–Festucetum italicae* ass. nova.

relevée No.	87	88	89	90	91	92	93	94	95	96	97	98	99
altitude m a.s.l. (x 10)	235	233	236	234	237	233	237	236	234	238	235	262	253
aspect	NE	ENE	SE	SW	ESE	SE	SSE	ENE	NE	SE	NNE	S	SE
slope	5	5	10	10	15	15	15	15	10	15	25	11.5	.
rockiness (%)	2	5	10	2	5	10	50	5	5	.	5	2	15
detritus (%)	40	15	50	40	60	25	30	25	45	20	20	45	55
area (m2)	40	40	50	40	45	50	60	40	60	40	40	100	130
cover (%)	65	80	45	60	45	55	45	70	70	70	80	50	60
number of species per relevé	26	25	26	30	28	35	31	28	23	22	29	23	21
Helianthemo alpestris-Festucetum italicae				*									
Festuca violacea Gaudin subsp. italica Foggi, Graz. Rossi & Signorini	3	3	3	3	2	2	2	2	3	2	2	1	+
Leontopodium alpinum Cass. subsp. nivale (Ten.) Tutin	1	1	2	1	1	1	1	1	1	1	+	1	1
Helianthemum oelandicum (L.) Dum. subsp alpestre (Jacq.) Ces.	1	3	2	2	1	+	2	.	1	2	4	3	3
Sempervivum arachnoideum L. subsp. arachnoideum	2	+	1	2	1	+	1	.	2	1	.	2	+
Poa molineri Balbis	2	2	1	1	1	+	.	.	1	.	1	.	.
Leontopodio-Elynenion													
Minuartia verna (L.) Hiern. subsp. verna	+	+	.	+	+	+	+	+	+	+	+	.	+
Silene acaulis (L.) Jacq s. l.	.	1	1	+	+	+	1	+	.	+	.	2	2
Oxytropis campestris (L.) DC. subsp. campestris	.	.	+	+	+	+	1	1	2	1	1	+	.
Potentilla crantzii (Crantz) Beck ex Fritsch subsp.crantzii	+	1	1	.	.	+	+	1	2	+	.	.	.
Gentiana verna L. subsp. verna	+	.	.	+	.	+	+	.	.	.	+	+	.
Sedum atratum L. subsp. atratum	.	.	.	+	.	+	+	.	.	.	+	.	.
Persicaria vivipara (L.) Ronse Decraene	.	.	.	.	.	.	.	.	.	.	.	+	.
Oxytropis neglecta Ten.	.	.	.	.	.	.	.	.	.	.	.	+	.
Seslerion apenninae													
Anthyllis vulneraria L. subsp. pulchella (Vis.) Bornm.	2	1	2	2	+	1	2	2	1	2	1	1	2
Helictotrichon praetutianum (Parl. Ex Arcang.) Roser	2	2	2	1	1	+	2	2	+	.	.	2	+
Trinia dalechampii (Ten.) Janch.	+	2	1	1	+	1	1	1	1	+	+	.	.
Leucanthemum tridactylites (Fiori) Bazzich.	+	.	1	+	+	+	+	+	.	+	.	.	.
Pedicularis elegans Ten. (s.l.)	.	.	.	+	1	+	+	+	.	.	.	1	+
Ranunculus oreophilus M. Bieb.	+	.	+	+	.	+	1	1	.	.	.	.	.
Achillea oxyloba (DC.) Sch.Bip. subsp. barrelieri (Ten.) F. Conti	.	.	.	.	.	+	.	.	.	.	.	+	.
Seslerietalia tenuifoliae													
Carex kitaibeliana Degen ex Bech	2	2	1	2	2	3	2	2	1	2	2	3	3
Andosace villosa L. subsp.villosa	2	1	1	+	.	+	1	+	2	+	.	+	1
Draba aizoides L. subsp.aizoides	+	1	1	1	+	1	.	+	1	+	1	+	.
Armeria canescens (Host) Boiss. subsp. canescens	1	1	.	1	.	1	1	+	+	.	1	+	.
Edrajanthus graminifolius (L.) A. DC subsp. graminifolius	.	.	1	+	+	+	.	+	.	.	1	2	2
Sesleria juncifolia Suffren	+	+	+	+	+	+	1	.	.	.	.	.	.
Elyno-Seslerietea													
Thymus praecox Opiz subsp. polytrichus (Borbàs) Jalas	1	1	+	+	+	.	1	1	1	1	1	1	.
Pulsatilla alpina (L.) Delarbre subsp. alpina	1	+	1	+	+	+	+	1	+	1	+	.	.
Erigeron epiroticus (Vierh.) Halàcsy	.	+	.	.	+	+	+	+	+	+	+	.	.
Aster alpinus L.	1	+	.	.	+	.	+	+	.	+	.	.	.
Campanula scheuchzeri Vill.	.	.	+	+	.	.	+	.	.	.	1	.	.
Phyteuma orbiculare L.	.	.	.	.	.	.	+	.	.	.	1	.	.
Polygala alpestris Rchb.	.	.	.	.	.	.	+	.	.	.	+	.	.
Euphrasia salisburgensis Funck ex Hoppe	.	.	.	.	.	.	.	.	.	.	.	.	1
Other species													
Cerastium arvense L. subsp.suffruticosum (L.) Hegi	1	+	+	1	1	2	+	1	+	.	.	.	.
Saxifraga paniculata Mill. subsp.paniculata	1	1	2	+	1	+	1	+	.	.	.	.	1
Gnaphalium hoppeanum Koch subsp. magellense (Fiori) Strid	.	+	+	1	+	+	.	+	.	+	1	.	.
Poa alpina L. subsp. alpina	.	.	.	.	.	+	1	1	.	1	1	2	.
Hieracium pilosella L.	.	+	.	+	.	+	.	.	.	.	+	.	.
Viola eugeniae Parl. subsp. eugeniae	.	.	.	.	+	+	.	.	1	.	+	.	.
Myosotis ambigens (Bég.) Grau	+	.	.	.	.	+	.	.	.	.	+	.	.
Trifolium thalii Vill.	.	.	+	.	.	.	.	1	.	.	1	.	.
Ranunculus brevifolius Ten.	.	.	.	.	+	+	.	.	.	1	.	.	.
Iberis saxatilis L. subsp. saxatilis	.	.	.	.	+	.	.	.	.	.	.	1	1
Trifolium pratense L. subsp. semipurpureum (Strobl) Pignatti	.	.	.	.	.	.	.	.	+	+	1	.	.
Saxifraga adscendens L. subsp. adscendens	+	.	.	.	.	.	.	.	+	.	.	.	.
Plantago atrata Hoppe subsp. atrata	.	.	.	.	.	.	.	.	+	.	1	.	.
Salix retusa L.	.	.	.	.	.	.	.	.	.	.	.	1	2
Thlaspi stylosum (Ten.) Mutel	.	.	.	.	.	.	.	+	.	.	.	.	.
Luzula italica Parl.	.	.	.	.	.	.	.	.	.	.	+	.	.
Leontodon montanus Lam. subsp. montanus	.	.	.	.	.	.	.	.	.	.	.	+	.
Arenaria grandiflora L. subsp. grandiflora	.	.	.	.	.	.	.	.	.	.	.	.	1
Pinus mugo Turra	.	.	.	.	.	.	.	.	.	.	.	.	1
Saxifraga oppositifolia L. subsp. speciosa (Dörfl. & Hayek) Engl. & Irmsch	.	.	.	.	.	.	.	.	.	.	.	.	1
Valeriana saliunca All.	.	.	.	.	.	.	.	.	.	.	.	.	1

size, and abundant fine material that increases debris cohesion. The dominant species is *Festuca violacea* subsp. *italica*, even though *Helianthemum oelandicum* subsp.*alpestre* and *Carex kitaibeliana* can also have high cover values. *Anthyllis vulneraria* subsp. *pulchella*, *Draba aizoides, Minuartia verna, Androsace villosa, Cerastium arvense* subsp. *suffruticosum,* and *Armeria canescens* are also constantly present. Even in strictly Apennine terms, the abundant cover of *Leontopodium alpinum* subsp. *nivale*, *Sempervivum arachnoideum* and *Poa molineri* is peculiar; these populations tend to form closed spots scattered within the community.

Syntaxonomy: The Majella *Festuca violacea* subsp. *italica* communities are included in the new association *Helianthemo alpestris–Festucetum italicae* ass. nova, which belongs to the suballiance *Leontopodio–Elynenion*. The characteristic species are *Helianthemum oelandicum* subsp. *alpestre*, *Sempervivum arachnoideum*, *Poa molineri*, and *Helictotrichon praetutianum*.

The only reference to a *Festuca violacea* vegetation in the phytosociological literature of the Apennines is the one relatives to *Luzulo italicae–Festucetum macratherae*[2], which is a typical closed semi-mesophilous grassland community rich in species of *Nardetalia* (Synoptic Table II).

Helianthemo–Festucetum shows a certain similarity, at least if one compares the original diagnoses, to *Helianthemetum alpestris* described for the Maiella by Migliaccio (1970). However, while the reference bioclimatic belt (upland plain) coincides, none of the species originally considered as characteristic of *Helianthemetum alpestris,*[3] i.e., *Persicaria vivipara, Trifolium noricum, Oxytropis pyrenaica, Luzula multiflora* and *Saxifraga caesia,* is present in our surveys. This specific component, while seeming fairly heterogeneous in ecological terms, indicates that *Helianthemetum alpestris* effectively a community that developed in more evolved soil types than that in which *Helianthemo–Festucetum* is found.

Saxifrago speciosae–Papaveretum julici Feoli-Chiapella & Feoli, 1977

Saxifrago speciosae–Papaveretum julici androsacetosum villosae subass. nova hoc loco (Holotypus rel. 107) (Cluster b_4) (Table VIII; Synoptic Table IV)

Synecology: The mild crest ridges occurring at higher altitudes (> 2,600 m a.s.l.) on the Majella are colonized by a plant community whose species are well adapted to the cold microclimate as well as to a stony environment. The fragmentation *in situ* of the parent rock, and the presence of sub-level morphologies give rise to the accumulation of a considerable amount of clasts of small and medium size whose downward flow is very slow. In this environment, species typical of the high altitude talus slopes occur, including *Saxifraga oppositifolia* subsp. *speciosa*, *Cerastium thomasii, Papaver alpinum* subsp. *ernesti–mayerii, Silene acaulis* subsp. *acaulis*, *Viola magellensis, Alyssum cuneifolium, Saxifraga exarata* subsp. *ampullacea,* and *Androsace vitaliana* subsp. *praetutiana* etc. Especially in the most favourable situations, there can be a conspicuous invasion of the transgressive component by the *Seslerietalia tenuifoliae* (*Edrajanthus graminifolius, Carex kitaibeliana, Anthyllis vulneraria* subsp. *pulchella, Festuca violacea* subsp. *italica, Sesleria juncifolia, Leontopodium alpinum* subsp. *nivale*), and, more generally, by the circumboreal component of *Elyno–Seslerietea* (*Persicaria vivipara, Minuartia verna, Erigeron epiroticus, Oxytropis campestris*).

Syntaxonomy: In syntaxonomic terms this community is assigned to *Saxifrago speciosae–Papaveretum julici* described specifically for these areas by Feoli-Chiapella & Feoli (1977)[4]. In this community, the subassociation *typicum* (corresponding to the variant to *Saxifraga* and *Artemisia* in Feoli-Chiapella & Feoli, 1977) characterizes the summit of the slopes, as does the subassociation *androsacetosum villosae* (subass. nova) present in environments which are more sheltered from the dominant winds or in micro-depressions. The subassociation *typicum* exhibits the classic floristic connotation of the scree-type vegetation (few species per relevé and low cover indices), while the subassociation *androsacetosum villosae* shows a higher number of species per relevé as well as a higher cover of the main species since it develops in a more favourable edaphic situation (see Table VIII). The subassociation *androsacetosum villosae* had already been proposed, although not in a valid manner (Art. 5), by Feoli-Chiapella (1983) who considered it as a transition term towards *Crepidi–Leontodontetum*. To avoid further proliferation of names, we decided to maintain the same epithet of subassociation, but gave it a different diagnosis. In particular, *Silene acaulis*, *Festuca violacea* subsp. *italica* and *Persicaria vivipara* are also added to the group of differential species. They bear witness to the passage to less drastic ecological conditions, and enable this subassociation to be identified as an intermediate form towards *Leontopodio–Elynenion* communities.

Saxifrago–Papaveretum reveals moderate floristic similarities to the *Arabido–Cerastietum thomasii* of the Gran Sasso (Biondi et al., 2000; Blasi et al., 2003) and to *Saxifrago–Silenetum*, described for Monte Velino as well as for the Maiella, more or less at the same altitude (Petriccione, 1993; Petriccione & Persia, 1995). The synoptic table (Synoptic Table IV), however, supports the coenological and syntaxonomical autonomy of the *Saxifrago–Papaveretum*. In a larger

Table VIII. *Saxifrago speciosae – Papaveretum julici* Feoli-Chiapella & Feoli 1977.

relevée No.	100	101	102	103	104	105	106	107*	108	109	110	111	112	113
altitude m a.s.l. (x 10)	272	273	268	278	272	260	258	278	278	261	251	269	264	264
aspect	SW	N	N	W	.	N	S	NE	E	NW	.	.	.	W
slope	12	19	10	8	.	24	17	16	8	10.5	.	.	.	9
rockiness (%)	.	.	.	.	.	.	2	50	2	.	10	3	.	.
detritus (%)	97	97	90	80	90	100	80	80	90	75	60	80	85	80
area (m2)	200	200	150	200	200	150	200	200	200	250	200	200	250	150
cover (%)	10	10	35	20	30	10	30	30	18	35	50	18	35	35
number of species per relevé	10	14	11	20	14	6	15	30	16	29	31	20	21	25
Saxifrago-Papaveretum julici								*						
Papaver alpinum L. subsp. ernesti-mayeri (Markgr.) Wraber	1	1	+	+	2	1	+	+	1	+	.	+	+	+
Saxifraga oppositifolia L. subsp. speciosa (Dörfl. & Hayek) Engl. & Irmsch	.	+	.	2	2	+	2	2	1	2	2	+	1	2
Androsace vitaliana (L.) Lapeyr subsp. praetutiana (Sund) Kress	+	+	.	1	+	.	1	1	1	1	.	1	1	+
Alyssum cuneifolium Ten. subsp. cuneifolium	1	1	1	+	2	1	+	1	1	.	.	1	.	.
Saxifraga exarata Vill. subsp. ampullacea (Ten.) D. A. Webb	.	+	.	1	+	.	.	1	1	+	.	+	+	+
***Saxifrago-Papaveretum julici androsacetosum villosae* subass. nova hoc loco**														
Silene acaulis (L.) Jacq s. l.	.	+	.	.	.	.	2	2	2	3	3	1	1	2
Androsace villosa L. subsp. villosa	.	.	.	+	1	.	+	+	+	2	1	2	2	1
Festuca violacea Gaudin subsp. italica Foggi, Graz. Rossi & Signorini	.	.	.	.	.	.	+	+	1	+	1	+	+	+
Persicaria vivipara (L.) Ronse Decraene	.	.	.	1	.	.	.	2	.	1	2	.	1	+
Linario-Festucion dimorphae														
Cerastium thomasii Ten.	1	+	2	1	2	+	2	1	1	.	1	1	+	+
Galium magellense Ten.	+	+	1	2	2	.	1	1	.	+	1	1	+	1
Myosotis ambigens (Bég.) Grau	1	1	1	1	2	1	+	1	1	+	.	.	.	+
Viola magellensis Porta & Rigo ex Strobl	1	+	1	2	2	.	.	1	2	+	.	.	1	1
Valeriana saliunca All.	.	.	.	.	.	.	.	+	2	2	1	+	2	1
Artemisia eriantha Ten.	.	.	.	+	.	.	.	+	.	.	.	.	.	.
Arenaria bertolonii Fiori	.	.	.	2	.	.	.	.	.	.	.	.	.	.
Ranunculus seguieri Vill. subsp. seguieri	.	.	.	.	.	.	.	.	.	.	.	1	.	.
Thlaspietalia rotindifolii; Thlaspietea rotundifolii														
Arenaria grandiflora L. subsp. grandiflora	+	1	+	.	2	+	2	1	1	2	2	2	1	1
Linaria alpina (L.) Miller	+	+	.	+	+	.	+	+	1	+	.	+	.	.
Leontodon montanus Lam. subsp. montanus	.	.	.	.	+	.	2	+	.	+	1	.	.	+
Salix retusa L.	.	.	.	1	.	.	.	2	.	1	2	.	.	.
Iberis saxatilis L. subsp.saxatilis	.	.	.	.	.	.	.	.	.	1	1	2	2	.
Arabis alpina L. subsp. caucasica (Willd. Ex Schlecht.) Briq.	.	1	+	.	.	.	.	.	.	.	.	.	.	.
Crepis pygmaea L. subsp. pygmaea	.	.	.	.	.	.	+	.	+	.	.	.	.	.
Saxifraga paniculata Mill. subsp.paniculata	.	.	.	.	.	.	.	.	.	.	2	.	.	+
Ingr. *Seslerion apenninae; Seslerietalia tenuifoliae; Elyno-Seslerietea*														
Achillea oxyloba (DC.) Sch.Bip. subsp. barrelieri (Ten.) F. Conti	.	.	+	.	.	.	+	1	.	1	1	+	.	+
Carex kitaibeliana Degen ex Bech	.	.	.	+	.	.	.	1	.	1	3	.	1	+
Edrajanthus graminifolius (L.) A. DC subsp. graminifolius	.	.	.	+	.	.	.	.	.	1	2	+	1	.
Anthyllis vulneraria L. subsp. pulchella (Vis.) Bornm.	.	.	.	.	.	.	.	1	.	+	2	.	+	+
Armeria canescens (Host) Boiss. subsp. canescens	.	.	+	.	.	.	.	.	.	+	1	.	.	+
Minuartia verna (L.) Hiern. subsp. verna	.	.	.	.	.	.	.	1	.	2	1	.	2	.
Sedum atratum L. subsp. atratum	.	.	.	1	.	.	.	1	.	.	.	.	.	+
Erigeron epiroticus (Vierh.) Halàcsy	.	.	.	.	.	.	.	+	.	+	.	1	.	.
Draba aizoides L. subsp.aizoides	.	.	.	.	.	.	.	1	.	+	+	.	.	.
Leontopodium alpinum Cass. subsp. nivale (Ten.) Tutin	.	.	.	.	.	.	.	.	.	+	1	.	2	.
Oxytropis campestris (L.) DC. subsp. campestris	.	.	.	.	.	.	.	1	.	.	1	.	.	.
Potentilla crantzii (Crantz) Beck ex Fritsch subsp. crantzii	.	.	.	.	.	.	.	+	.	1	.	.	.	.
Sesleria juncifolia Suffren	.	.	.	.	.	.	.	.	.	.	.	.	+	+
Cerastium tomentosum L.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex capillaris L. subsp. capillaris	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Helianthemum oelandicum (L.) Dum. subsp alpestre (Jacq.) Ces.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Pedicularis elegans Ten. (s.l.)	.	.	.	.	.	.	.	.	.	.	2	.	.	.
Helictotrichon praetutianum (Parl. Ex Arcang.) Roser	.	.	.	.	.	.	.	.	.	.	1	.	.	.
Pulsatilla alpina (L.) Delarbre subsp.alpina	.	.	.	.	.	.	.	.	.	.	1	.	.	.
Campanula scheuchzeri Vill.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Dryas octopetala L.	.	.	.	.	.	.	.	.	.	.	1	.	.	.
Thymus praecox Opiz subsp. polytrichus (Borbàs) Jalas	.	.	.	.	.	.	.	.	.	.	1	.	.	.
Helianthemum nummularium (L.) Mill. subsp. grandiflorum (Scop.) Schinz & Thell.	.	.	.	.	.	.	.	.	.	.	2	.	.	.
Euphrasia salisburgensis Funck ex Hoppe	.	.	.	.	.	.	.	.	.	.	1	.	.	.
Gentiana verna L. subsp.verna	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Other species														
Poa alpina L. subsp. alpina	.	+	1	1	1	.	.	2	.	+	.	+	.	+
Campanula tanfanii Podl.	.	.	.	.	.	.	.	.	.	+	.	.	+	+
Poa molineri Balbis	.	.	.	.	.	.	.	.	2	.	.	.	.	.
Leontodon hispidus L. subsp. hispidus	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Taraxacum apenninum (Ten.) Ten.	.	.	.	.	.	.	.	.	.	.	.	+	.	.

Synoptic Table I. *Plantago atrata* and *Trifolium thalii* communities in central Apennine

Synoptic Table 1	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
number of relevés per column	38	19	15	3	8	15	10	11
Gnaphalio-Plantaginetum								
Ranunculus sartorianus Boiss. & Heldr.	100	89	80	100	100	V	70	72
Gnaphalium hoppeanum Koch subsp.magellense (Fiori) Strid	97	89	100	33	38	.	20	.
Arabis surculosa A. Terrac.	26	58	13	66	13	.	.	.
Saxifraga italica D A. Webb	.	5	27	.	.	.	.	.
Ranunculus magellensis Ten.	.	.	40	.	.	.	.	.
Soldanella minima Hoppe subsp. samnitica	.	.	13	.	.	.	.	.
Ranunculo-Nardion; Nardetalia strictae; Nardetea strictae								
Plantago atrata Hoppe subsp.atrata	100	100	93	100	100	V	100	100
Poa alpina L. subsp.alpina	92	100	100	100	88	.	90	100
Crepis aurea (L.) Cass.subsp.glabrescens (Caruel.) Arcang.	58	84	13	33	100	IV	.	.
Botrychium lunaria (L.) Sw.	32	16	.	66	63	II	40	.
Viola eugeniae Parl. subsp. eugeniae	29	37	73	100	88	.	30	.
Luzula italica Parl.	16	.	53	.	75	IV	70	9
Campanula scheuchzeri Vill.	11	5	7	.	13	.	20	.
Phleum alpinum L. subsp. rhaeticum Humphries	11	37	.	.	25	II	.	.
Euphrasia minima Jacq. ex DC.	5	16	13	.	.	.	.	9
Taraxacum glaciale Hand-Mazz	32	58	.	.	13	.	.	.
Trifolium thalii Vill.	79	100	33	100	13	V	100	100
Taraxacum apenninum (Ten.) Ten.	53	74	33	.	75	III	50	100
Sagina glabra (Willd.) Fenzl	8	37	20	.	.	V	70	36
Trifolium pratense L. subsp.semipurpureum (Strobl) Pignatti	53	58	.	.	.	.	30	.
Herniaria glabra subsp. nebrodensis Jan ex Nyman	16	11	7	.	.	.	20	.
Saxifraga adscendens L. subsp. adscendens	11	5	40	.	.	.	10	.
Bellis perennis L.	.	.	7	100	88	V	.	63
Gentianella columnae (Ten.) Holub	.	.	7	.	13	.	40	.
Taraxacum officinale Weber (s.l.)	.	.	.	66	13	.	.	.
Hypericum richeri Vill.	.	.	.	.	50	II	.	.
Rumex nebroides Campd.	.	.	.	.	75	.	40	.
Nardus stricta L.	.	.	.	.	63	.	40	27
Festuca nigrescens Lam. Subsp. microphylla (St. Yves) Markgr.-Dann..	.	.	.	.	.	.	100	27
Rumex acetosa L. subsp. acetosa	.	.	.	100	.	.	.	.
Poa violacea Bellardi	.	.	.	.	13	.	.	.
Juncus monanthos Jacq.	.	.	.	.	25	.	.	.
Festuca rubra L. s.l.	.	.	.	.	38	.	.	.
Alopecuros gerardi Vill.	.	.	.	.	25	.	.	.
Anthoxanthum alpinum Loeve & Loeve	.	.	.	.	50	.	.	.
Soldanella alpina L.	.	.	.	.	38	.	.	.
Astrantia pauciflora Bertol. subsp. tenorei (Mariotti) Bechi et Garbari	.	.	.	.	13	.	.	.
Potentilla rigoana Wolf	.	.	.	.	.	.	65	.
Hieracium pilosella L.	.	.	.	.	.	.	20	.
Dianthus deltoides L. subsp. deltoides	.	.	.	.	.	.	10	.
Alchemilla colorata Buser	.	.	.	.	.	.	.	45
Elyno myosuroidis-Seslerietea coeruleae								
Minuartia verna (L.) Hiern. subsp. verna	79	79	53	66	.	IV	50	.
Carex kitaibeliana Degen ex Bech	76	74	60	.	63	.	30	.
Festuca violacea Gaudin	.	.	.	.	.	.	.	.
subsp. italica Foggi, Graz. Rossi & Signorini	50	32	.	100	13	V	10	.
Armeria canescens (Host) Boiss.subsp. canescens	50	58	80	100	75	.	50	.
Potentilla crantzii (Crantz) Beck ex Fritsch subsp.crantzii	39	21	27	.	13	II	.	.
Draba aizoides L. subsp.aizoides	21	16	67	.	.	I	.	.
Cerastium arvense L. subsp.suffruticosum (L.) Hegi	8	21	.	.	13	V	.	36
Trinia dalechampii (Ten.) Janch.	16	.	13	33	.	.	.	.
Anthyllis vulneraria L. subsp. pulchella (Vis.) Bornm.	16	16	40	.	.	II	.	.
Thymus praecox Opiz subsp. polytrichus (Borbás) Jalas	13	11	.	.	.	.	40	.
Helianthemum oelandicum (L.) Dum.subsp alpestre (Jacq.) Ces.	13	.	27	.	.	.	.	.
Phyteuma orbiculare L.	11	.	13	.	13	II	40	.
Sedum atratum L. subsp.atratum	11	5	27	.	.	.	.	.
Erigeron epiroticus (Vierh.) Halácsy	5	.	20	.	.	.	10	.
Edrajanthus graminifolius (L.) A. DC subsp. graminifolius	5	.	.	.	.	.	.	.
Pulsatilla alpina (L.) Delarbre subsp.alpina	5	.	13	.	25	.	20	.
Satureja alpina (L.) Scheele subsp. alpina	5	11	40	66	.	II	10	.
Gentiana verna L. subsp.verna	5	11	27	33	38	II	30	.
Pedicularis elegans Ten. (s.l.)	5	11	20	.	.	.	.	.
Silene acaulis (L.) Jacq s. l.	5	16	27	.	.	I	.	.
Polygala alpestris Rchb.	3	5	.	.	13	III	10	.
Carex parviflora Host	3	11	47	.	.	.	.	.
Helictotrichon praetutianum (Parl. Ex Arcang.) Roser	3	5	.	33	.	.	20	.
Persicaria vivipara (L.) Ronse Decraene	3	.	20	.	.	.	.	.
Astragalus depressus L. subsp.depressus	16	11	.	.	.	.	.	.
Sempervivum arachnoideum L. subsp. arachnoideum	.	5	7	.	.	.	.	.
Andosace villosa L. subsp.villosa	.	.	7	33	.	.	.	.
Sesleria tenuifolia Schrad subsp.tenuifolia	.	.	7	.	13	.	.	.
Gentiana nivalis L.	.	.	7	.	.	II	.	.
Cerastium tomentosum L.	.	.	.	100	.	.	20	.
Elyna myosuroides (Vill.) Fritsch	.	.	33	.	.	.	.	.
Aster alpinus L.	.	.	7	.	.	.	.	.
Oxytropis campestris (L.) DC. subsp.campestris	.	.	7	.	.	.	.	.

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Leontopodium alpinum Cass. subsp. nivale (Ten.) Tutin	.	.	20	.	.	.	.	.
Oxytropis neglecta Ten.	.	.	13	.	.	.	.	.
Linum alpinum L. subsp. julicum (Hayek) Gams	.	.	.	.	13	.	.	.
Pedicularis verticillata L.	.	.	.	.	13	.	.	.
Anthemis cretica L. subsp. columnae (Ten.) Frantzen	.	.	.	.	13	.	.	.
Anemone narcissiflora L. subsp. narcissiflora	.	.	.	.	13	.	.	.
Other species								
Salix retusa L.	13	.	33	.	.	.	.	.
Hieracium micranthum Huet du Pav.	29	26	40	.	.	IV	70	.
Thlaspi stylosum (Ten.) Mutel	18	42	20	.	.	.	.	.
Cerastium thomasii Ten.	16	16	7	.	.	.	.	.
Carduus chrysacanthus Ten. subsp. chrysacanthus	8	16	.	33	13	.	.	.
Myosotis ambigens (Bég.) Grau	5	.	60	.	.	.	.	.
Cerastium cerastoides (L.) Britton	3	11	7	.	.	.	.	.
Achillea oxyloba (DC.) Sch.Bip. subsp. barrelieri (Ten.) F. Conti	3	21	33	.	.	.	.	.
Leontodon montanus Lam. subsp.montanus	3	5	40	.	.	.	.	.
Euphrasia salisburgensis Funck ex Hoppe	.	.	13	.	.	IV	50	.
Carlina acaulis L. subsp. caulescens (Lam.) Schbler & Martens	.	.	7	66	.	.	20	.
Chenopodium bonus-henricus L.	.	21	.	33	.	.	.	.
Veronica alpina L.	.	11	.	.	.	.	.	.
Senecio squalidus L.	.	5	13	33	.	.	.	.
Galium magellense Ten.	.	5	33	.	.	.	.	.
Sibbaldia procumbens L.	.	.	13	.	25	.	.	.
Cerastium arvense L. subsp. strictum (Koch) Schinz & Keller	.	.	7	.	.	.	40	.
Verbascum longifolium Ten.	.	.	.	66	.	.	20	.
Asperula cynanchica L.	.	.	.	33	.	.	10	.
Poa molineri Balbis	.	5	.	.	.	.	.	.
Ranunculus brevifolius Ten.	.	.	13	.	.	.	.	.
Thymus alpigenus (Kerner) Ronn.	.	.	40	.	.	.	.	.
Arabis alpina L. subsp. caucasica (Willd. Ex Schlecht) Briq.	.	.	13	.	.	.	.	.
Arenaria grandiflora L. subsp. grandiflora	.	.	13	.	.	.	.	.
Festuca alfrediana Foggi & Signorini	.	.	33	.	.	.	.	.
Gentiana brachyphylla Vill. subsp. favratii (Rittener) Tutin	.	.	60	.	.	.	.	.
Hypochaeris cretensis (L.) Bory & Chaub.	.	.	13	.	.	.	.	.
Saxifraga oppositifolia L. (s.l.)	.	.	27	.	.	.	.	.
Saxifraga paniculata Mill. subsp.paniculata	.	.	20	.	.	.	.	.
Trifolium noricum Wulfen subsp. praetutianum (Savi) Arcang.	.	.	27	.	.	.	.	.
Linaria alpina (L.) Mill.	.	.	7	.	.	.	.	.
Juniperus communis L. subsp. nana (Willd.) Syme	.	.	7	.	.	.	.	.
Coronilla vaginalis Lam.	.	.	7	.	.	.	.	.
Asperula neglecta Guss.	.	.	7	.	.	.	.	.
Galium pumilum Murray	.	.	.	100	.	.	.	.
Medicago lupulina L.	.	.	.	33	.	.	.	.
Leontodon hispidus L. subsp. hispidus	.	.	.	33	.	.	.	.
Thymus serpyllum L.	.	.	.	33	.	.	.	.
Thesium parnassi A. DC.	.	.	.	33	.	.	.	.
Sedum acre L.	.	.	.	33	.	.	.	.
Scrophularia scopolii Hoppe in Pers.	.	.	.	33	.	.	.	.
Leontodon crispus Vill. subsp. asper	.	.	.	33	.	.	.	.
Doronicum columnae Ten.	.	.	.	33	.	.	.	.
Crocus albiflorus Kit.	.	.	.	.	25	.	.	.
Hieracium lactucella Wallr.	.	.	.	.	13	.	.	18
Anthyllis vulneraria L. subsp. vulnerarioides (All.) Arcang.	.	.	.	.	25	.	.	.
Carastium arvense L. subsp. strictum (L.) Gaudin	.	.	.	.	38	.	.	.
Cynoglossum magellense Ten.	.	.	.	.	25	.	.	.
Pedicularis comosa L.	.	.	.	.	38	.	.	.
Silene multicaulis Guss	.	.	.	.	13	.	.	.
Silene roemeri Friv. subsp. staminea (Bertol.) Nyman	.	.	.	.	13	.	.	.
Agrostis rupestris All.	.	.	.	.	.	II	.	.
Carduus defloratus L. subsp. tridentinus (Evers) Lad.	.	.	.	.	.	II	.	.
Helianthemum nummularium								.
subsp. grandiflorum (Scop.) Schinz & Thell.	.	.	.	.	.	II	.	.
Ranunculus oreophilus M. Bieb.	.	.	.	.	.	.	10	.
Alchemilla glaucescens Wallr.	.	.	.	.	.	.	10	.
Anthyllis vulneraria L. subsp. nana	.	.	.	.	.	.	20	.
Brachypodium genuense (DC.) Roem. & Schult.	.	.	.	.	.	.	10	.
Cirsium tenoreanum Petr.	.	.	.	.	.	.	10	.
Cynoglossum magellense Ten.	.	.	.	.	.	.	10	.
Euphorbia cyparissias L.	.	.	.	.	.	.	50	.
Festuca circummediterranea Patzke	.	.	.	.	.	.	10	.
Galium anisophyllon Vill.	.	.	.	.	.	.	30	.
Gentiana lutea L. subsp. lutea	.	.	.	.	.	.	10	.
Gymnadenia conopsea (L.) R. Br. subsp. conopsea	.	.	.	.	.	.	10	.
Rhinantus wettsteinii (Sterneck) Soo	.	.	.	.	.	.	20	.
Stachys alopecuros (L.) Benth. (s.l.)	.	.	.	.	.	.	10	.
Barbarea bracteosa Guss.	.	.	.	.	.	.	.	54
Veronica serpyllifolia L. subsp. humifusa (Dickson) Syme	.	.	.	.	.	.	.	36
Trifolium repens L. subsp. prostratum (Biasiol.) Nyman	.	.	.	.	.	.	.	100

1: *Gnaphalio – Plantaginetum atratae typicum* Feoli-Chiapella e Feoli 1977 (present paper); 2: *Taraxaco apenninae – Trifolietum thalii gnaphalietosum magellensis* subass. nova (present paper); 3: *Gnaphalio – Plantaginetum* Feoli-Chiapella e Feoli 1977 (From Feoli-Chiapella & Feoli, 1977); 4: Vegetation with *Trifolium thalii* and *Plantago atrata* (From Bazzichelli e Furnari, 1979); 5: *Ranunculo pollinensis – Plantaginetum atratae* (From Biondi et al., 2000); 6: *Festuco – Trifolietum thalii apenninicum* (From Migliaccio, 1970); 7: *Trifolio thalii – Festucetum microphyllae* Petriccione & Persia 1995 (From Petricione & Persia, 1995). 8: *Taraxaco apennini – Trifolietum thalii* Biondi et al. 1992 (From Biondi et al., 1992).

Synoptic Table II. *Festuca violacea* subsp *italica* communities in the central Apennines

Synoptic Table 2	**1**	**2**	**3**	**4**
number of relevés per column	13	9	18	20
Helianthemo alpestris-Festucetum italicae				
Festuca violacea Gaudin subsp. italica Foggi, Graz. Rossi & Signorini	100	67	94	V
Leontopodium alpinum Cass. subsp. nivale (Ten.) Tutin	100	11	.	.
Helianthemum oelandicum (L.) Dum.subsp alpestre (Jacq.) Ces.	92	.	6	.
Sempervivum arachnoideum L. subsp. arachnoideum	85	.	.	.
Poa molineri Balbis	62	11	.	.
***Plantago atrata* and *Leontodon montanus* comm.**				
Plantago atrata Hoppe subsp.atrata	15	89	94	V
Leontodon montanus Lam. subsp.montanus	8	100	.	.
Leontopodio-Elynenion				
Minuartia verna (L.) Hiern. subsp. verna	85	89	61	V
Potentilla crantzii (Crantz) Beck ex Fritsch subsp.crantzii	62	78	.	V
Sedum atratum L. subsp.atratum	31	78	.	.
Silene acaulis (L.) Jacq s. l.	77	67	39	.
Gentiana verna L. subsp.verna	46	33	61	II
Carex ericetorum Pollich	.	.	17	.
Oxytropis campestris (L.) DC. subsp.campestris	77	.	6	.
Persicaria vivipara (L.) Ronse Decraene	8	.	11	.
Oxytropis neglecta Ten.	8	.	.	.
Elyna myosuroides (Vill.) Fricsch	.	.	17	.
Erigeron uniflorus L.	.	.	.	III
Gentiana nivalis L.	.	.	.	II
Seslerion apenninae				
Armeria canescens (Host) Boiss.subsp. canescens	69	89	83	.
Anthyllis vulneraria L. subsp. pulchella (Vis.) Bornm.	100	67	.	V
Trinia dalechampii (Ten.) Janch.	85	56	61	.
Helictotrichon praetutianum (Parl. Ex Arcang.) Roser	85	11	44	.
Achillea oxyloba (DC.) Sch.Bip. subsp. barrelieri (Ten.) F. Conti	15	89	.	.
Cerastium arvense L. subsp.suffruticosum (L.) Hegi	69	.	.	IV
Pedicularis elegans Ten. (s.l.)	.	44	6	.
Leucanthemum tridactylites (Fiori) Bazzich.	62	.	.	.
Leontodon crispus Vill. subsp. asper (Waldst. & Kit.) Rohlena	.	11	.	.
Cerastium tomentosum L.	.	.	47	.
Festuca laevigata Gaudin subsp. crassifolia (Gaudin) Kerguélen & Plonka	.	.	6	.
Seslerietalia apenninae				
Carex kitaibeliana Degen ex Bech	100	67	78	.
Edrajanthus graminifolius (L.) A. DC subsp. graminifolius	62	33	11	.
Polygala alpestris Rchb.	15	.	72	V
Andosace villosa L. subsp.villosa	85	33	.	.
Sesleria juncifolia Suffren	54	.	6	.
Ranunculus oreophilus M. Bieb.	46	.	.	.
Asperula cynanchica L.	.	.	6	.
Anthyllis vulneraria L. subsp. nana	.	.	33	.
Carduus carlinefolius Lam.	.	.	33	.
Stachys alopecuros (L.) Benth. (s.l.)	.	.	6	.
Helianthemum nummularium (L.) Mill. subsp. grandiflorum (Scop.) Schinz & Thell.	.	.	.	IV
Elyno- Seslerietea				
Campanula scheuchzeri Vill.	31	44	61	.
Thymus praecox Opiz subsp. polytrichus (Borbàs) Jalas	85	44	83	.
Pulsatilla alpina (L.) Delarbre subsp.alpina	85	22	22	.
Erigeron epiroticus (Vierh.) Halàcsy	62	11	72	.
Draba aizoides L. subsp.aizoides	85	44	.	V
Phyteuma orbiculare L.	15	.	11	IV
Euphrasia salisburgensis Funck ex Hoppe	8	.	22	III
Satureja alpina (L.) Scheele subsp. alpina	.	56	11	I
Saxifraga paniculata Mill. subsp.paniculata	69	.	6	.
Juncus monanthos Jacq.	.	.	6	I
Aster alpinus L.	46	.	.	.
Astragalus depressus L. subsp.depressus	.	11	.	.
Galium anisophyllon Vill.	.	.	28	.

	1	**2**	**3**	**4**
Nardetea strictae s.l.				
Gnaphalium hoppeanum Koch subsp.magellense (Fiori) Strid	62	100	44	.
Poa alpina L. subsp.alpina	46	100	100	.
Viola eugeniae Parl. subsp. eugeniae	31	67	72	.
Trifolium pratense L. subsp.semipurpureum (Strobl) Pignatti	23	11	61	.
Trifolium thalii Vill.	23	11	.	II
Luzula italica Parl.	8	.	89	IV
Ranunculus sartorianus Boiss. & Heldr.	.	56	83	IV
Hieracium pilosella L.	.	67	17	.
Botrychium lunaria (L.) Sw.	.	.	61	III
Taraxacum apenninum (Ten.) Ten.	.	33	.	.
Crepis aurea (L.) Cass.subsp.glabrescens (Caruel.) Arcang.	.	11	.	I
Taraxacum glaciale Hand-Mazz	.	11	.	.
Gentiana columnae Ten.	.	.	17	.
Luzula multiflora (Ehrh) Lej. subsp. multiflora	.	.	28	.
Nardus stricta L.	.	.	22	.
Potentilla rigoana Wolf	.	.	89	.
Rumex nebroides Campd.	.	.	22	.
Alchemilla colorata Buser	.	.	.	I
Hypericum richeri Vill. Subsp. richeri	.	.	.	IV
Phleum alpinum L. subsp. rhaeticum Humphries	.	.	.	I
Sagina saginoides (L.) Karsten subsp. saginoides	.	.	.	I
Thlaspietea rotundifolii s.l.				
Myosotis ambigens (Bég.) Grau	23	44	61	.
Thlaspi stylosum (Ten.) Mutel	8	33	.	.
Galium magellense Ten.	.	44	6	.
Ranunculus brevifolius Ten.	23	78	.	.
Iberis saxatilis L. subsp.saxatilis	23	.	.	.
Arenaria grandiflora L. subsp. grandiflora	8	.	.	.
Valeriana saliunca All.	8	.	.	.
Cerastium thomasii Ten.	.	78	.	.
Saxifraga oppositifolia L. subsp. speciosa (Dörfl. & Hayek) Engl. & Irmsch	.	22	.	.
Ranunculus magellensis Ten.	.	22	.	.
Carduus chrysacanthus Ten. subsp. chrysacanthus	.	22	.	.
Other species				
Saxifraga adscendens L. subsp. adscendens	15	11	28	.
Hieracium micranthum Huet du Pav.	31	.	83	.
Salix retusa L.	15	.	.	.
Pinus mugo Turra	8	.	.	.
Saxifraga oppositifolia L. (s.l.)	8	.	.	.
Alyssum diffusum Ten.	.	.	6	.
Brachypodium genuense (DC.) Roem. & Schult.	.	.	6	.
Cerastium arvense ssp. strictum (Kock) Schinz & Keller	.	.	83	.
Gentiana lutea L. subsp. lutea	.	.	6	.
Juniperus communis L. subsp. nana (Willd.) Syme	.	.	6	.
Scabiosa holosericea Bertol.	.	.	6	.
Dianthus sylvestris Wulfen (s.l.)	.	.	6	.
Alchemilla glaucescens Wallr.	.	.	87	.
Silene ciliata Pourr. Subsp. graefferi (Guss.) Nyman	.	.	44	.
Aster bellidiastrum (L.) Scop.	.	.	6	.
Festuca circumeditteranea Patzke	.	.	11	.
Koeleria splendens C. Presl.	.	.	11	.
Rhinantus wettsteinii (Sterneck) Soo	.	.	11	.
Thesium parnassi A. DC.	.	.	6	.
Carduus defloratus L. subsp. tridentinus (Evers) Lad.	.	.	.	III
Hieracium serpyllifolium Freis.	.	.	.	IV
Saxifraga trydactylites L.	.	.	.	III
Trifolium montanum L. subsp. montanum	.	.	.	III

1: *Helianthemo alpestris – Festucetum italicae* (present paper); 2: *Plantago atrata* and *Leontodon montanus* (present paper); 3: *Luzulo – Festucetum macratherae* Bonin 1978 (From Bonin, 1978); 4: *Caricetum kitaibelianae* Migliaccio 1970 (From Migliaccio, 1970).

geographical key, the *Saxifrago–Papaveretum* may be regarded as geo-vicariant of the *Papaveretum rhaetici* of the eastern Alps.

Structural and chorological analysis

The life-form spectrum shows that in the environment of the vegetation investigated it is basically the hemicryptophytic and the chamaeophytic components (68% and 24%, respectively, of the entire flora) that take on a discriminating role in the structure of the communities, whereas the role of geophytes, therophytes and phanerophytes is negligible (the latter being limited to the sporadic presence of *Pinus mugo)*. Apart from having a clear floristic – ecological and physiognomic – structural significance, the hemicryptophyte/chamaeophyte ratio (Figure 8) seems to be discriminating also in syntaxonomic

Synoptic Table III. *Sesleria juncifolia* communities in the central Apennines

Synoptic Table 3	1	2	3	4	5	6
number of relevés per column	13	10	10	20	10	3
Leontopodio nivalis-Seslerietum juncifoliae						
Iberis saxatilis L. subsp.saxatilis	92	.	10	.	.	.
Aster alpinus L.	100	.	.	55	.	3
Leontopodium alpinum Cass. subsp. nivale (Ten.) Tutin	100	.	.	.	.	3
Ranunculus oreophilus M. Bieb.	85	.	.	65	.	.
Leontopodio-Elynenion						
Minuartia verna (L.) Hiern. subsp. verna	69	I V	20	85	90	1
Silene acaulis (L.) Jacq s. l.	69	I	.	65	20	.
Gentiana verna L. subsp.verna	31	I	.	55	10	3
Helianthemum oelandicum subsp. alpestre (Jacq.) Ces.	85	V	.	95	40	.
Oxytropis campestris (L.) DC. subsp.campestris	85	I I	.	55	.	3
Persicaria vivipara (L.) Ronse Decraene	8	.	.	50	20	.
Dryas octopetala L.	15	.	.	.	50	.
Sedum atratum L. subsp.atratum	.	.	.	30	.	.
Elyna myosuroides (Vill.) Fricsch	15	.	.	45	.	.
Carex ericetorum Pollich	.	.	.	65	.	.
Potentilla crantzii (Crantz) Beck ex Fritsch subsp.crantzii	38	.	.	.	.	.
Pediculars verticillata L.	.	.	.	30	.	.
Seslerion apenninae						
Trinia dalechampii (Ten.) Janch.	85	I I I	60	75	50	1
Pedicularis elegans Ten. (s.l.)	92	.	40	75	30	3
Festuca violacea subsp. italica Foggi, Rossi & Signorini	77	.	30	25	50	.
Anthyllis montana L. subsp atropurpurea (Vuk.) Pignatti	15	.	80	20	50	.
Helictotrichon praetutianum (Parl. Ex Arcang.) Roser	69	.	20	.	50	.
Asperula cynanchica L.	.	.	40	15	60	.
Linum capitatum Schult. subsp. serrulatum (Bertol.) Hartvig.	.	.	10	10	10	.
Myosotis ambigens (Bég.) Grau	23	.	20	45	.	.
Cerastium tomentosum L.	.	.	60	.	50	.
Astrantia pauciflora subsp.tenorei (Mariotti) Bechi et Garbari	.	.	.	30	20	.
Leucanthemum tridactylites (Fiori) Bazzich.	.	.	.	.	30	.
Linum alpinum Jacq. subsp. julicum (Hayek) Hegi	.	.	.	5	.	.
Anthemis cretica subsp. alpina (L.) R. Fern.	.	.	10	35	.	.
Scabiosa silenifolia Waldst. & Kit.	.	.	6	.	40	.
Trifolium noricum Wulfen subsp. praetutianum (Savi) Arcang.	.	.	.	8	.	.
Alyssum diffusum Ten.	.	.	30	.	.	.
Anthyllis vulneraria L. subsp. pulchella (Vis.) Bornm.	92	I V	80	75	.	.
Achillea oxyloba subsp. barrelieri (Ten.) F. Conti	.	.	.	5	.	.
Androsace vitaliana (L.) Lapeyr subsp. praetutiana (Sund) Kress	.	I I I	.	5	.	.
Cerastium arvense subsp.suffruticosum (L.) Hegi	62	.	30	.	.	.
Cynoglossum magellense Ten.	.	.	.	5	.	.
Linum austriacum L. tommasinii (Rchb.) Greuter & Burdet	.	.	.	.	10	.
Seslerietalia tenuifoliae						
Sesleria juncifolia Suffren	100	V	100	95	100	3
Edrajanthus graminifolius (L.) A. DC subsp. graminifolius	92	V	60	80	90	1
Andosace villosa L. subsp.villosa	54	I V	10	40	40	.
Carex kitaibeliana Degen ex Bech	85	.	20	95	80	.
Armeria canescens (Host) Boiss.subsp. canescens	46	.	.	80	.	1
Gentiana dinarica Beck	.	I I	.	5	70	.
Seseli tommasinii Rchb f.	.	.	30	.	.	.
Paronychia kapela (Hacq.) A. Kern. subsp. kapela	.	I I	50	.	40	.
Pedicularis comosa L.	.	.	10	15	30	.
Carduus carlinefolius Lam.	.	I I	10	.	.	.
Carum heldreichii Boiss.	.	I	10	.	20	.
Helianthemum numm. (L.) Mill. subsp. grandiflorum (Scop.) Sch. & Th.	8	I I I	.	.	.	.
Festuca laevigata subsp. crassifolia (Gaudin) Kerg.& Plonka	8	.	.	.	10	.
Poa molineri Balbis	62	.	.	.	.	2
Elyno-Seslerietea						
Pulsatilla alpina (L.) Delarbre subsp.alpina	31	I I I	20	30	50	.
Euphrasia salisburgensis Funck ex Hoppe	23	I I	60	30	60	.
Poa alpina L. subsp.alpina	54	.	40	80	50	.
Juncus monanthos Jacq.	23	.	.	30	30	.
Thymus praecox Opiz subsp. polytrichus (Borbàs) Jalas	46	.	40	90	.	.
Saxifraga paniculata Mill. subsp.paniculata	85	.	10	55	.	.
Erigeron epiroticus (Vierh.) Halàcsy	46	.	.	35	30	.
Campanula scheuchzeri Vill.	8	.	.	15	10	.
Polygala alpestris Rchb.	8	.	.	10	.	1
Phyteuma orbiculare L.	.	.	.	45	40	.
Galium anisophyllon Vill.	.	.	.	45	10	.
Satureja alpina (L.) Scheele subsp. alpina	.	II	.	5	.	.
Gentiana lutea L. subsp. lutea	.	.	.	5	.	1
Sempervivum arachnoideum L. subsp. arachnoideum	85	.	.	.	10	.
Draba aizoides L. subsp.aizoides	85	I V	.	.	80	1
Astragalus depressus L. subsp.depressus	.	.	10	.	.	.
Gentiana ciliata L. subsp. ciliata	.	.	.	.	10	.
Anemone narcissiflora L. subsp. narcissiflora	.	.	.	15	.	.
Ranunculo-Nardion; Nardetalia; Nardetea						
Viola eugeniae Parl. subsp. eugeniae	15	.	10	20	30	.
Aster bellidiastrum (L.) Scop.	.	.	10	.	30	.
Plantago atrata Hoppe subsp.atrata	8	.	.	15	.	.
Potentilla rigoana Wolf	.	.	10	30	.	.
Botrychium lunaria (L.) Sw.	.	.	.	25	.	.
Coeloglossum viride (L.) Hartm.	.	.	.	25	10	.
Gnaphalium hoppeanum Koch subsp.magellense (Fiori) Strid	.	.	.	5	10	.
Luzula italica Parl.	.	.	.	20	.	.
Rumex nebroides Campd.	.	.	.	15	.	.
Valeriana montana L.	.	.	.	.	20	.
Luzula multiflora (Ehrh) Lej. subsp. multiflora	.	.	.	5	.	.
Veronica aphylla L.	.	.	.	.	20	.

	1	2	3	4	5	6
Thlaspietea rotundifolii						
Saxifraga oppositifolia L. (s.l.)	23	.	.	15	.	.
Arenaria grandiflora L. subsp. grandiflora	31	.	.	5	.	.
Galium magellense Ten.	8	.	.	.	10	.
Hieracium pilosella L.	.	.	40	5	10	.
Saxifraga caesia L.	.	.	.	10	60	.
Arenaria bertolonii Fiori	.	.	.	.	30	.
Erysimum majellense Polatschek	.	.	.	5	10	.
Ranunculus brevifolius Ten.	.	.	10	.	.	.
Trifolium pratense L. subsp.semipurpureum (Strobl) Pign.	.	.	.	20	.	1
Valeriana saliunca All.	15	.	.	.	.	.
Artemisia eriantha Ten.	.	.	.	5	.	.
Festuca dimorpha Guss.	.	.	.	.	10	.
Ranunculus thora L.	.	.	.	.	20	.
Festuco-Brometea & Cisto-Micromerietea						
Dianthus sylvestris Wulfen (s.l.)	.	I I I	90	55	60	3
Globularia meridionalis (Podp.) O. Schwarz.	.	V	70	5	40	2
Biscutella levigata L. subsp. levigata	.	.	60	5	40	.
Gymnadenia conopsea (L.) R. Br. subsp. conopsea	.	.	10	.	10	.
Helianthemum oelandicum (L.) Dum. subsp. incanum (Willk.) G. Lòpez	.	.	100	.	40	3
Koeleria lobata (M. Bieb.) Roem. & Schult.	.	.	40	.	50	1
Helianthemum numm. (L.) Mill. subsp. obscurum (Celak.) Holub	.	.	.	10	10	.
Teucrium montanum L.	.	.	50	.	30	.
Carlina acaulis L. subsp. caulescens (Lam.) Schbler & Martens	.	.	10	.	40	.
Festuca circummediterranea Patzke	.	.	.	50	.	3
Brachypodium genuense (DC.) Roem. & Schult.	.	.	30	.	20	.
Scabiosa holosericea Bertol.	.	.	20	25	.	.
Astragalus sempervirens Lam. subsp. gussonei Pignatti	.	.	20	10	.	.
Centaurea triunfetti All. subsp. cana (Sm.) Dostal	.	.	20	10	.	.
Carex macrolepis DC.	.	.	30	.	10	.
Rhinantus wettsteinii (Sterneck) Soo	.	.	30	.	.	.
Asperula aristata L.	.	.	20	.	.	.
Bromus erectus Huds subsp. erectus	.	.	50	.	40	.
Hippocrepis comosa L.	.	.	.	.	20	.
Sesleria nitida Ten.	.	.	10	.	.	.
Thymus longicaulis C. Presl. subsp. longicaulis	.	.	50	.	.	.
Astragalus vesicarius L. subsp. vesicarius	.	.	.	.	20	.
Carex caryophyllea Latourr.	.	.	.	.	10	.
Leontodon hispidus L. subsp. hispidus	.	.	.	.	20	.
Linum catharticum L. (s.l.)	.	.	.	.	40	.
Petrorhagia saxifraga (L.) Link subsp. saxifraga	.	.	.	.	10	.
Thymus striatus Vahl	.	.	.	.	10	.
other species						
Carex humilis Leyss.	77	.	100	.	.	.
Thesium parnassi A. DC.	8	.	10	.	60	.
Juniperus communis L. subsp. nana (Willd.) Syme	.	.	30	20	40	2
Gentiana columnae Ten.	8	.	.	20	.	.
Potentilla apennina Ten.	8	.	.	.	20	.
Hieracium amplexicaule L.	.	.	.	25	.	.
Cerastium arvense L. subsp. strictum (Koch) Schinz & Keller	.	.	.	50	.	.
Senecio doronicum (L.) L. subsp. doronicum	.	.	10	10	.	.
Hieracium micranthum Huet du Pav.	8	.	.	25	.	.
Salix retusa L.	23	.	.	15	.	.
Sedum acre L.	.	.	20	5	.	.
Sedum rupestre L. subsp. rupestre	.	.	30	.	10	.
Alchemilla nitida Buser	.	.	.	.	20	.
Euphorbia cyparissias L.	.	.	10	.	10	.
Galium lucidum All.	.	.	70	.	10	.
Saxifraga adscendens L. subsp. adscendens	31	.	.	.	.	.
Onobrychis alba (Waldst. & Kit.) Desv.subsp. alba	.	.	40	.	.	.
Daphne oleoides Schreb.	.	.	30	.	.	.
Muscari neglectum Guss. ex Ten. (s.l.)	.	.	10	.	10	.
Pinus mugo Turra	8	.	.	.	.	1
Valeriana tuberosa L.	.	.	10	.	.	.
Silene saxifraga L.	.	.	.	.	30	.
Allium oleraceum L. (s.l.)	.	.	.	.	10	.
Arabis rosea DC.	.	.	.	.	10	.
Arcostaphylos uva-ursi (L.) Spreng.	.	.	.	.	10	.
Coronilla vaginalis Lam.	.	.	.	.	30	.
Epipactis helleborine (L.) Crantz subsp. helleborine	.	.	.	.	10	.
Luzula sylvatica (Huds.) Gaudin subsp. sylvatica	.	.	.	.	20	.
Primula auricula L. subsp. balbisii (Lehm.) Nyman	.	.	.	.	40	.
Saxifraga porophylla Bertol. subsp. porophylla	.	.	.	.	10	.
Seseli montanum L.	.	.	.	.	20	.
Soldanella alpina L.	.	.	.	.	10	.
Thlaspi praecox Wulfen	.	.	.	.	10	.
Festuca gr. varia s.l.	.	.	.	.	.	1
Medicago prostrata Jacq. subsp. prostrata	.	.	.	.	.	1
Anthyllis vulneraria L. subsp. polyphylla (DC.) Nyman	.	.	.	.	.	3
Euphrasia italica Wettst.	.	.	.	.	.	1
Ranunculus apenninus Chiov.	.	.	.	.	.	1
Astragalus australis (L.) Lam.	.	.	.	.	.	1

1: *Leontopodio nivalis – Seslerietum juncifoliae* (present paper); 2: *Seslerietum apenninae* Furnari *in* Bruno & Furnari 1966; 3: *Pedicularis elegantis – Seslerietum caricetosum humilis* Petriccione 1995; 4: *Pedicularis elegantis – Seslerietum caricetosum ericetori* Petriccione 1995; 5: *Scabioso silenifoliae – Seslerietum apenninae* Bazzichelli et Furnari 1979; 6: *Pediculari – Seslerietum leontopodietosum nivalis* Ubaldi et al. 1998.

Synoptic Table IV. Alpine belt scree communities in the central Apennines

Synoptic Table 4	**1**	**2**	**3**	**4**	**5**
number of relevés per column	6	8	8	9	16
Saxifrago-Papaveretum julici					
Papaver alpinum L. subsp. ernesti-mayeri (Markgr.) Wraber	100	88	.	33	31
Saxifraga oppositifolia L. (s.l.)	67	100	87	44	31
Arenaria grandiflora L. subsp. grandiflora	83	100	.	.	.
Androsace vitaliana subsp. praetutiana (Sund) Kress	67	88	50	.	12
Saxifraga exarata Vill. subsp. ampullacea (Ten.) D. A. Webb	50	75	.	33	.
Valeriana saliunca All.	.	88	50	.	.
Saxifrago-Papaveretum julici androsacetosum villosae					
Andosace villosa L. subsp.villosa	33	100	.	.	.
Achillea oxyloba subsp. barrelieri (Ten.) F. Conti	17	75	75	33	75
Leontodon montanus Lam. subsp.montanus	17	63	75	.	81
Silene acaulis (L.) Jacq s. l.	17	100	87	11	19
Festuca violacea subsp. italica Foggi, Rossi & Signorini	.	100	.	.	.
Persicaria vivipara (L.) Ronse Decraene	17	63	.	.	.
Linario-Festucion dimorphae					
Cerastium thomasii Ten.	100	88	.	100	75
Galium magellense Ten.	83	88	.	44	37
Viola magellensis Porta & Rigo ex Strobl	83	63	.	11	37
Alyssum cuneifolium Ten. subsp. cuneifolium	100	50	.	.	37
Artemisia eriantha Ten.	17	13	.	.	.
Iberis saxatilis L. subsp. saxatilis	.	50	.	.	.
Arenaria bertolonii Fiori	17	.	.	.	6
Ranunculus seguieri Vill. subsp. seguieri	.	13	.	.	.
Ranunculus brevifolius Ten.	.	.	87	.	6
Adonis distorta Ten.	.	.	.	.	25
Cymbalaria pallida (Ten.) Wettst.	.	.	.	.	6
Thlaspi stylosum (Ten.) Mutel.	.	.	.	.	37
Festuca dimorpha Guss.	.	.	.	.	6
Isatis allionii P. W. Ball.	.	.	.	.	44
Doronicum columnae Ten.	.	.	.	.	18
Hipochaeris cretensis (L.) Bory & Chaub.	.	.	.	.	12
Carduus chrysacanthus Ten. subsp. chrysacanthus	.	.	.	.	6
Erysimum majellense Polatschek	.	.	.	.	6
Leucanthemum ceratophylloides (All.) Nyman					
subsp. tenuifolium (Guss.) Bazzich. & Marchi	.	.	.	.	6
Scrophularia juratensis Schleich.	.	.	.	.	6
Saxifraga glabella Bertol.	.	.	.	.	6
Sedum magellense Ten.	.	.	.	.	6
Thlaspietalia rotindifolii; Thlaspietea rotundifolii					
Arabis alpina L. subsp. caucasica (Willd. Ex Schlecht.) Briq.	33	.	.	100	50
Linaria alpina (L.) Miller	67	63	.	.	62
Salix retusa L.	17	38	.	.	13
Crepis pygmaea L. subsp. pygmaea	.	25	.	.	62
Saxifraga paniculata Mill. subsp.paniculata	.	25	.	.	.
Draba aspera Bertol.	.	.	.	55	25
Hutchinsia alpina (L.) R. Br.	.	.	.	77	.
Saxifraga caesia L.	.	.	.	11	.
Campanula cochlearifolia Lam.	.	.	.	11	.
Saxifraga sedoides L. subsp. sedoides	.	.	.	.	6

	1	**2**	**3**	**4**	**5**
Elyno-Seslerietea s.l.					
Armeria canescens (Host) Boiss.subsp. canescens	17	38	.	22	13
Carex kitaibeliana Degen ex Bech	17	63	62	.	.
Myosotis ambigens (Bég.) Grau	100	63	.	.	75
Edrajanthus graminifolius (L.) A. DC subsp. graminifolius	17	50	.	.	.
Potentilla crantzii (Crantz) Beck ex Fritsch subsp.crantzii	.	25	75	.	12
Thymus praecox Opiz subsp. polytrichus (Borbás) Jalas	.	13	62	.	.
Euphrasia salisburgensis Funck ex Hoppe	.	13	25	.	.
Pulsatilla alpina (L.) Delarbre subsp.alpina	.	13	62	.	.
Sedum atratum L. subsp.atratum	17	25	.	.	13
Erigeron epiroticus (Vierh.) Halàcsy	.	38	.	.	19
Helictotrichon praetutianum (Parl. Ex Arcang.) Roser	.	13	.	.	6
Cerastium tomentosum L.	17	.	.	.	6
Carex capillaris L. subsp. capillaris	17	.	.	.	.
Anthyllis vulneraria L. subsp. pulchella (Vis.) Bornm.	.	63	.	.	.
Minuartia verna (L.) Hiern. subsp. verna	.	50	.	.	.
Leontopodium alpinum Cass. subsp. nivale (Ten.) Tutin	.	38	.	.	.
Draba aizoides L. subsp.aizoides	.	38	.	.	.
Sesleria juncifolia Suffren	.	25	.	.	.
Oxytropis campestris (L.) DC. subsp.campestris	.	25	.	.	.
Pedicularis elegans Ten. (s.l.)	.	13	.	.	.
Campanula scheuchzeri Vill.	.	13	.	.	.
Dryas octopetala L.	.	13	.	.	.
Helianthemum oelandicum (L.) Dum.subsp alpestre (Jacq.) Ces.	.	13	.	.	.
Gentiana verna L. subsp.verna	.	13	.	.	.
Helianthemum numm. (L.) Mill. subsp. grandiflorum (Scop.) Sch.& Thel	.	13	.	.	.
Poa molineri Balbis	.	13	.	.	.
Oxytropis neglecta Ten.	.	.	12	.	.
Elyna myosuroides (Vill.) Fritsch	.	.	.	.	6
Thymus alpigenus (Kerner) Ronn	.	.	.	.	6
Trinia dalechampii (Ten.) Janch.	.	.	.	.	6
Phyteuma orbiculare L.	.	.	.	.	6
Carum heldreichii Boiss.	.	.	.	.	6
Other species					
Poa alpina L. subsp.alpina	67	50	.	100	87
Campanula tanfanii Podl.	.	38	.	.	.
Leontodon hispidus L. subsp. hispidus	.	13	.	.	.
Taraxacum apenninum (Ten.) Ten.	.	13	.	.	13
Festuca alfrediana Foggi & Signorini	.	.	87	33	6
Veronica aphylla L.	.	.	50	.	.
Asperula cynanchica L.	.	.	12	.	.
Cerastium arvense subsp. strictum (Koch) Schinz & Keller	.	.	.	.	19
Satureja alpina (L.) Scheele	.	.	.	.	13
Alchemilla alpina L.	.	.	.	.	6
Alyssum montanum L. subsp. montanum	.	.	.	.	6
Saxifraga adscendens L. subsp. parnassica (Boiss. & Heldr.) Hayek	.	.	.	.	6
Senecio squalidus L.	.	.	.	.	50

1: *Saxifrago – Papaveretum julici* (present paper); *Saxifrago – Papaveretum julici androsacetosum villosae* (present paper); *Saxifrago speciosae – Silenetum cenisiae* Petriccione 1993; 4: *Arabido alpinae – Cerastietum thomasii* Biondi et al. 2000; 5: *Crepido – Leontodontetum montanii* Feoli Chiapella e Feoli 1977.

terms as it separates, in a fairly clear manner, the communities of *Thlaspietea rotundifolii* from those of *Elyno – Seslerietea* and those of *Nardetea*. Following an increasing edaphic availability gradient, the H/Ch ratio increases, not only at the level of the higher syntaxonomical hierarchy but also within the same association. It is interesting to note the behaviour of *Carici – Salicetum retusae*, whose trend is more similar to that of the *Elyno – Seslerietea* communities than that of *Thlaspietea* to which it effectively belongs. This fact confirms, at the structural level, the transitory position occupied by *Salix retusa* communities in the upper levels of the Apennines. The strong chamaephytic presence in *Saxifrago – Papaveretum* confirms the structural differences between the screes of the alpine belt and those of the sub-alpine belt when the hemicryptophytes are absolutely dominant (Feoli-Chiapella, 1983, Blasi et al., 2003).

The general chorological table (Figure 6) shows a floristic division that reflects the three main

biogeographical components characterizing the central Apennine high-altitude vegetation, such as the Circumboreal of northern provenance, the south-eastern European Orophyte, inclusive of the Pyrenean–Alpine–Carpathian belt and of the eastern circum-Mediterranean mountain system, and the Endemic. In the last-named, which altogether, including what are termed the subendemic the central-Apennine s.s. species are preponderant, confirming the fact that the central Apennines, with its lofty peaks, is a clearly autonomous biogeographical unit in the general Apennine system. Still well represented is the chorotype composed of those species which are endemic of the central and southern Apennines, whereas fewer endemic and subendemic species are shared with the northern Apennines s.l. or with the rest of the Italian peninsula. This fact is essentially in accord with that of the relative influence, on the vegetation investigated, of the European orophilous component, which is mostly of southern and eastern provenance. Central European and Eurasian orophytes are scarcely represented, being limited to *Euphrasia minima, Pinus mugo, Androsace villosa, Gentiana verna* and *Salix retusa*. There is a significant contribution of amphi-Adriatic species such as *Sesleria juncifolia, Arabis surculosa, Potentilla apennina, Erigeron epiroticus* and *Gnaphalium hoppeanum* subsp. *magellense*, which paints to the close link exsisting with the Balkan district.

The partial chorological spectra relating to the single communities confirm the percentages reported in the general chorological spectrum. However, even at the chorological level, the greater or lesser availability of soil (or an increase in physical parameters such as stoniness and rockiness) determines a parallel percentage increase of the endemic component, and a corresponding decrease in the circumboreal one.

Syndynamics and landscape analysis

As in all geographical areas subjected to extreme conditions (climatic, geomorphological or edaphic), also in the Maiella alpine belt changes in the vegetation linked to syndynamic processes are practically non-existent, especially if a short-term time scale is adopted (decades). Relevant changes at the geomorphological or climatic level, followed by equally evident transformations of the vegetation probably require a long time. In geo-symphytosociological terms, the landscape of the study area may therefore be considered as being composed of microgeosigmeta in turn formed by microsigmeta whose syndynamic variability is reduced to single communities of a permanent type (Figure 9). According to classical methodologies (Géhu & Rivas-Martínez, 1981; Theurillat, 1992) within the framework of a considerable, homogeneous geomorphological unit such as the high-elevation karsic tectonic depressions, the presence of two microgeosigmeta which may be regarded as vicariant depending on the altitude, can be recognized. Based on the criteria for the hierarchical classification of the landscape (Blasi et al., 2000) the pattern of the Maiella alpine landscape appears to have a deductive typological scheme as shown in Figure 10.

Given the lack of geomorphological maps at a scale pertinent to the vegetation community types

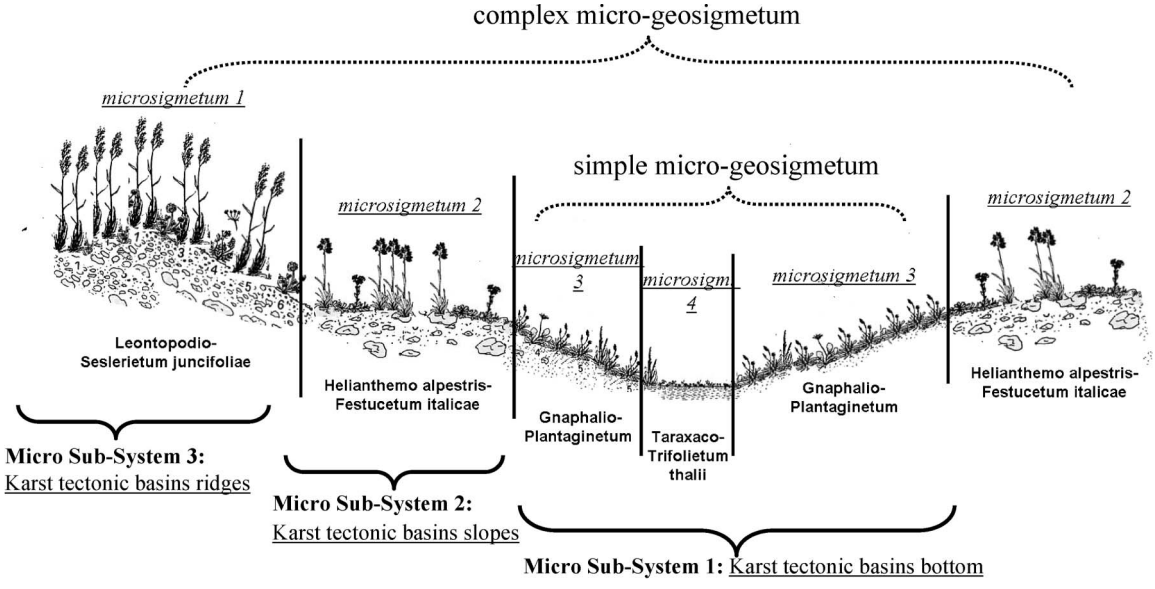

Figure 9. Schematic cross-section of the vegetation of the Majella lower alpine belt karst-tectonic basins (Fondo di Femmina Morta 2380 m, lower alpine belt). This complex micro-geosigmetum includes a simple microgeosigmetum restricted to the karst-tectonic sub-systems of the basin bottom.

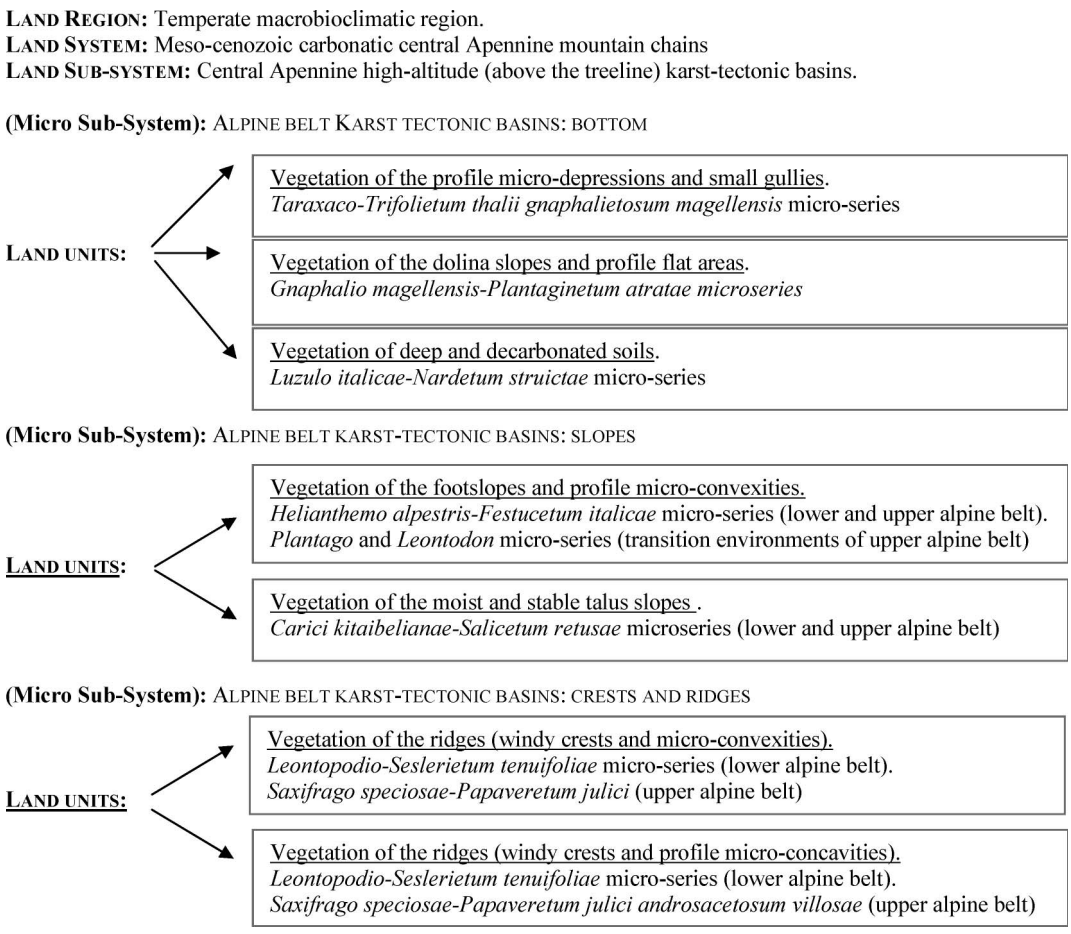

Figure 10. Deductive typological scheme for the Maiella alpine landscape.

examined here, this hierarchical scheme is to be considered as only typological, and does not provide quantitative data about the reciprocal surface covered by the various plant communities identified.

Considering all that has been published to date on the Maiella alpine vegetation, it is possible to envisage a complex geosigmetum scheme relating to the upland plain, taken as a whole, as follows:

Vegetation of the windy ridges and steeper slopes

- *Leontopodio nivalis – Elynetum myosuroidis*
- *Saxifrago speciosae – Papaveretum julici typicum*
- *Leontopodio nivalis – Seslerietum juncifoliae*

Vegetation of the unstable talus slopes

- *Crepido pygmaeae – Leontodontetum montanae*

Vegetation of the stable scree and relatively steep slopes

- *Galio – Silenetum acaulis alyssetosum cuneifolii*
- *Carici kitaibelianae – Salicetum retusae*
- *Carici kitaibelianae – Salicetum retusae elynetosum*
- *Saxifrago speciosae – Papaveretum julici androsacetosum villosae*

Vegetation of the mild slopes with abundance of debris

- *Plantago atrata* and *Leontodon montanus* comm.
- *Helianthemo alpestris – Festucetum italicae*

Vegetation of snowbeds and dolinas

- *Gnaphalio magellensis – Plantaginetum atratae*
- *Taraxaco apennini – Trifolietum thalii gnaphalietosum*
- *Luzulo italicae – Nardetum strictae*

Biogeographical considerations and conclusions

This paper, apart from providing new phytosociological data on the high-altitude vegetation of the Maiella, contributes towards the definition of a phytosociological and syntaxonomic scheme for the alpine belt of the Central Apennines. In particular, it better defines the coenological and syntaxonomic

variability of a number of important communities described in the past, such as *Gnaphalio – Plantaginetum* and *Saxifrago – Papaveretum*. New associations having peculiar floristic – coenological characteristics are described, namely *Helianthemo – Festucetum* and *Leontopodio – Seslerietum*, which represent the permanent grassland communities of the climatophilous and edapho-xerophilous microseries of the Alpine belt karst-tectonic basins. In particular, the description of a *Sesleria juncifolia* community pertaining to the alpine bioclimatic belt, supports the argument that the ecological space of *Seslerion apenninae* is not limited to the subalpine belt, but extends up to the highest levels of the main peaks with the endemic *Leontopodio – Elynenion* suballiance.

Lastly, the autonomous identity of the central Apennine high-altitude vegetation is underlined, which, while retaining clear floristic and coenological links with the Alps and with the Boreal region due to glaciations, nevertheless shows a unique biogeographical pattern resulting from the combination of the southern European orophilous floristic component with the central Apennine endemic element. All this confirms the fact that in the alpine bioclimatic belt of central Apennines there is a real ecological space only for one single class, *Elyno-Seslerietea*, which is representative of the most of Southern-European highland systems, whereas the order *Seslerietalia tenuifoliae* testifies the biogeographical vicinity of the Balkan system (Oriolo, 2001; Blasi et al., 2003). This scheme, which emphasizes the biogeographical relationships between the Apennines and the Balkans appears to be coherent with recent biogeographic syntheses (Rivas-Martínez, 1996) and with data published about the dwarf-shrub vegetation of the subalpine belt (Stanisci, 1997), and the beech woodlands of the montane belt (Bergmeier & Dimopoulos, 2001; Biondi et al., 2002; Di Pietro, 2002; Di Pietro et al., 2004).

This syntaxonomic interpretation coincides with the one indicated for the Balkans (Horvat et al., 1974) where the vegetation of the alpine belt was also included in the order *Seslerietalia tenuifoliae*, and where, in the *Edrajantho – Seslerion* alliance of the high mountains of Macedonia (*Onobrychido – Seslerietalia*) two suballiances were recognized, namely *Seslerenion tenerrimae* for the sub-alpine belt, and *Elynenion myosuroidis* for the alpine one.

As shown in Figure 11, the communities of the alpine belt described to date for the Apennines, exhibit a biogeographical relationship with the Balkan mountain system both in floristic and coenological (and consequently syntaxonomic) terms. In fact, apart from a number of associations rich in circumboreal or arctic – alpine species, and therefore closely related to communities present also in the Alps (e.g., those community types with a dominance of *Salix retusa, S. herbacea* or *Carex rupestris*), there are other communities (in particular those with a dominance of *Sesleria juncifolia, Edrajanthus graminifolius, Potentilla apennina*) which in syntaxonomic terms express a typical amphi-Adriatic vicariance both of the associations and of the alliances. Again it is clear (see Figure 11), that in the Balkan mountain system, the greatest vegetational affinities with the Apennine alpine belt are evidenced above all in the southern sector of the Dinaric Alps where in addition to the evident Apennine – Balkan affinities, the circumboreal and arctic – alpine component is still well represented. On the contrary, the mountain systems of northern Greece, and even more so those of the Peloponnese, all of which were less affected by glaciations, take on a definitely oro-Mediterranean vegetational character which is, in turn, related to a bioclimatic pattern characterized by lower mean annual rainfall and by longer periods of summer drought even at relatively high levels. In this bioclimatic and biogeographical context, the high-altitude vegetation exhibits not only an abundance of taxa that are foreign to the Apennine flora, but also a structural physiognomic pattern with a strong upswing of the belt of dwarf bushes and chamaeophytes. In syntaxonomic terms, all this translates into a higher hierarchical level of vicariance compared with the central-eastern sector of the Balkans, which is often manifest at the order level (*Drypidetalia spinosae*) or even at the class level (*Daphno – Festucetea*).

Syntaxonomical scheme:

ELYNO – SESLERIETEA Br.-Bl. 1948
- *SESLERIETALIA TENUIFOLIAE* Horvat 1930
- *SESLERION APENNINAE* Furnari *in* Bruno & Furnari 1966
- *LEONTOPODIO NIVALIS – ELYNENION MYOSUROIDIS* Blasi & Di Pietro in Blasi, Di Pietro, Fortini & Catonica 2003
- *Leontopodio nivalis – Seslerietum juncifoliae* Blasi, Di Pietro & Pelino ass. nova
- *Helianthemo alpestris – Festucetum italicae* Blasi, Di Pietro & Pelino ass. nova
- *Plantago atrata* and *Leontodon montanus* community

THLASPIETEA ROTUNDIFOLII Br.-Bl. 1948
- *THLASPIETALIA ROTUNDIFOLII* Br.-Bl. in Br.-Bl. & Jenny 1926
- *LINARIO – FESTUCION DIMORPHAE* Avena & Bruno 1975
- *THLASPIENION STYLOSI* Avena & Bruno 1975
- *Saxifrago speciosae – Papaveretum julici* Feoli-Chiapella & Feoli 1977

Majella	Gran Sasso	Laga Mountains	Dinarides (Velebit and Durmitor)	Southern Balkans (Macedonia)	mainland Greece (Olimpos and Pindhos)	Alps
Seslerion apenninae	**Seslerion apenninae**	**Seslerion apenninae**	**Seslerion juncifoliae**	**Edrajantho-Seslerion juncifoliae**	**Astragalo-Seslerion**	**Elynion myosuroidis**
Leontopodio-Elynetum	Leontopodio-Elynetum	Leontopodio-Elynetum	Elyno-Edrajantetum serpyllifoliae Elyno-Edrajanthetum alpini	Diantho jacupicensis-Elynetum Edrajantho-Elynetum		Elynetum myosuroidis
Galio-Silenetum alyssetosum	Galio-Silenetum typicum	Galio-Silenetum trifolietosum	Edrajantho Dryadetum octopetalae			
	Caricetum kitaibelianae-rupestris		Carici kitaibelianae-Helianthemetum balcanici	Trifolio norici-Caricetum rupestris		Caricetum rupestris
Leontopodio-Seslerietum apenninae			Carici kitaibelianae-Helianthemetum alpestris	Helianthemo scardici-Seslerietum juncifoliae	Thymo boisserii-Seslerietum cerulantis	Caricetum firmae
	Seslerio apenninae-Dryadetum octopetalae		**Oxytropidion urumovii**			Dryadetum octopetalae
Helianthemo alpestris-Festucetum italicae			Carici-Crepidetum dinarici	Edrajantho-Helianthemetum balcanici		
Helianthemetum alpestris			Festuco-Alchemilletum serbicae	Edrajantho-Helianthemetum alpestris		
Ranunculo-Nardion	**Ranunculo-Nardion**	**Ranunculo-Nardion**	**Caricion ferrugineae**	**Potentillo-Nardion**	**Trifolion parnassi**	**Caricion ferrugineae**
Taraxaco-Trifolietum gnaphalietosum	Luzulo italicae-Nardetum	Poo violaceae-Nardetum	Soldanello-Plantaginetum durmitorei	Trifolio-Nardetum strictae	Thesio parnassi-Nardetum	Trifolio thalii-Festucetum nigricantis (CW-Alps)
Luzulo italicae-Nardetum	Ranunculo-Plantaginetum		Hyperico-Caricetum ferrugineae		Alopecuro-Gnaphalietum hoppeanii	**Knautio-Trifolietum nivalis (SE-Alps)**
Gnaphalio-Plantaginetum						**Nardion strictae**
Arabidion caeruleae	**Arabidion caeruleae**	**Arabidion caeruleae**	**Salicion retusae**	**Salicion retusae**		**Arabidion caeruleae**
Carici-Salicetum retusae elynetosum	Carici-Salicetum retusae	Carici-Salicetum retusae trifolietosum	Salicetum retuseae-kitaibelianae Soldanello-salicetum retusae	Salicetum retusae-reticulatae macedonicum		Salicetum retusae-reticulatae
Festucion dimorphae			**Bunion alpini Saxifragion prenjae**	**Thlaspion rotundifolii**	**Silenion coesiae**	**Thlaspion rotundifolii**
Saxifrago-Papaveretum julici	Arabido-Cerastietum thomasii	Achilleo-Saxifragetum aizoidis	Saxifrago-Papaveretum kerneri Sagino-Gnaphalietum pilchleri		Alyssum handelii-Achillea ambrosiaca ass.	Papaveretum rheatici Papaveri kerneri-Thlaspietum kerneri
Crepidi-Leontodonetum montani	Isatido-Thlaspietum stylosi		Euphorbio-Valerianetum bertisceae	Linario-Valerianetum bertisceae		Leontodonetum montani
Salicetea herbaceae						
	Armerio-Salicetum herbaceae gnaphalietosum	Armerio-Salicetum herbaceae trifolietosum	Salicetum herbaceae dinaricum	Salicetum herbaceae macedonicum		Salicetum herbaceae Nardo-Gnaphalietum supinae
Saxifragion australis	**Saxifragion australis**		**Amphoricarpion autariati**		**Galion degenii Saxifragion scardicae**	**Androsaco-Drabion**
Potentillo-Festucetum alfredianae	Potentillo-Festucetum alfredianae		Edrajantho-Potentilletum clusianae		Achyllea clavenae-Minuartia stellata ass.	Potentilletum nitidae

Figure 11. Vegetational comparison between the main alpine belt plant communities occurring in the Apennines (Majella, Gran Sasso, Laga mountains), Dinarid Alps, southern Balkans and eastern Alps.

Saxifrago speciosae – Papaveretum julici androsacetosum villosae Feoli-Chiapella *ex* Blasi, Di Pietro & Pelino subass. nova

ARABIDETALIA CAERULEAE Rubel *ex* Br.-Bl. 1948

ARABIDION CAERULEAE Br.-Bl. in Br.-Bl. & Jenny 1926

Carici kitaibelianae – Salicetum retusae Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999

NARDETEA STRICTAE Rivas Goday in Rivas Goday & Rivas Martínez 1963

NARDETALIA STRICTAE Oberdorfer *ex* Preising 1949

RANUNCULO – NARDION Bonin 1972

Gnaphalio magellensis – Plantaginetum atratae Feoli-Chiapella & Feoli 1977

Taraxaco apennini – Trifolietum thalii Biondi, Ballelli, Allegrezza, Frattaroli & Taffetani 1992

Taraxaco apennini – Trifolietum thalii gnaphalieto sum magellensis Blasi, Di Pietro & Pelino subass. nova

Luzulo italicae – Nardetum strictae caricetosum kitaibelianae Biondi, Ballelli, Allegrezza, Frattaroli & Taffetani 1992

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Notes

[1] *Carici – Seslerietum was included, in the form of a thermophilous subassociation in the range of Pedicularido elegantis – Seslerietum*, considered as the only syntaxonomical reference in the central Apennines regarding *Sesleria* community grasslands. According to ICPN (Weber et al., 2000), the name *Pedicularido – Seslerietum* is to be considered both an invalid and illegitimate name (Art. 5, 6, 23, 25).

[2] In the group of species forming part of the *Festuca violacea* s.l. group, the discrimination of *Festuca violacea* subsp. italica Foggi, Graz. Rossi & Signorini was made only recently (Foggi et al., 1998). Previously this entity was normally attributed to *Festuca violacea* Gaudin, and subsequently to *Festuca macrathera* (Hackel) Mgf.-Dbg. Today there is a tendency to consider *F. violacea* subsp.*macrathera* as belonging exclusively

to the Balkans and *F. violacea* subsp. *italica* as endemic to the southern central Apennines.

[3] A strict observance of the ICPN leads to consider *Helianthemetum alpestris* Migliaccio 1970 as invalid name (Art. 7) since the list of accompanying species is not given at all in the synoptic table. Doubts about the validity of this name, were already raised in Blasi et al., 2003.

[4] Strictly from the standpoint of nomenclature, in proposing the name *Saxifrago–Papaveretum* there is no indication as to which species of the *Saxifraga* genus the taxon originating the name of the association should be referred. In fact, table 3 in Feoli-Chiapella & Feoli (1977) presents various species of the genus *Saxifraga,* including *Saxifraga exarata* subsp. *ampullacea* (sub *Saxifraga moschata*), among the characteristic species of the association (cl. frq. III), *Saxifraga oppositoifolia* subsp. *speciosa* (cl. frq. V), *Saxifraga sedoides* (cl. frq. I) among the characteristic species of higher order, and *Saxifraga stabiana* in the list of sporadic species. In a later work (Feoli-Chiapella, 1983), one of the authors lectotypifies the association and inserts among the characteristic species of the association also *Saxifraga oppositifolia* subsp. *speciosa* (which is the only species in the table that is present in all the relevés and which is included as the first characteristic species). In our view, the full name of the association should be *Saxifrago speciosae–Papaveretum julici.*

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Appendix 1: Complete list of the syntaxa quoted in the text

Achilleo clavanae–Minuartietum stellatae Quezel 1967; *Achilleo mucronulatae–Saxifragetum aizoidis* Di Pietro, Conti & Vannicelli-Casoni 2001; *Alopecuro gerardii–Gnaphalietum hoppeani* Quézel 1964; *Alyssum handelii–Achilleetum ambrosiacae* Quézel 1967; *Amphoricarpion autariati* Lakušić 1968; *Androsaco–Drabion* T. Wraber 1970; *Arabidetalia caeruleae* Rubel *ex* Br.-Bl. 1948; *Arabidion caeruleae* Br.-Bl. *in* Br.-Bl. & Jenny 1926; *Arabido alpinae–Cerastietum thomasii* Biondi, Allegrezza, Ballelli & Taffetani 2000; *Armerio majellensis–Salicetum herbaceae* Biondi, Allegrezza, Ballelli & Taffetani 2000; *Armerio majellensis–Salicetum herbaceae gnaphalietosum magellensis* Blasi,

Di Pietro, Fortini & Catonica 2003; *Armerio majellensis – Salicetum herbaceae trifolietosum thalii* Blasi, Di Pietro, Fortini & Catonica 2003; *Asplenietea trichomanis* (Br.-Bl. *in* Meier & Br.-Bl. 1943) Oberd. 1977; *Astragalo – Seslerion* Quézel 1964; Gams 1936; *Caricetea curvulae* Br.-Bl. 1948; *Caricetum kitaibelianae* Migliaccio 1970; *Caricetum kitaibelianae – rupestris* Biondi, Allegrezza, Ballelli & Taffetani 2000; *Carici – Crepidetum dinarici* Lakušič 1964; *Carici humilis – Seslerietum apenninae* Biondi, Ballelli, Guitian & Allegrezza 1988; *Carici kitaibelianae – Helianthemetum alpestris* Horvat 1930; *Carici kitaibelianae – Helianthemetum balcanici* Horvat 1930; *Carici kitaibelianae – Salicetum retusae* Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999; *Carici kitaibelianae – Salicetum retusae elynetosum* Blasi, Di Pietro, Fortini & Catonica 2003; *Carici kitaibelianae – Salicetum retusae trifolietosum thalii* Blasi, Di Pietro, Fortini & Catonica 2003; *Caricion kitaibelianae* Migliaccio 1970; *Carici rupestris – Kobresietea bellardii* Ohba 1974; *Caricion ferrugineae* G. Br.-Bl. & J Br.-Bl. 1931; *Caricion firmae* Gams 1936; *Daphno – Festucetea* Quézel 1964; *Dryadetum octopetalae* Rübel 1911; *Drypetea spinosae* Quézel 1967; *Edrajantho – Dryadetum octopetalae* Lakušić (1968) 1970; *Edrajantho graminifolii – Helianthemetum alpestris* Horvat 1935; *Edrajantho graminifolii – Helianthemetum balcanici* Horvat 1935; *Edrajantho – Seslerion* Horvat 1949; *Elynenion myosuroidis sensu* Horvat, Glavac, Ellemberg 1974); *Elynetum apenninicum* Lakušić 1968; *Elynetum myosuroides* Rübel 1911; *Elyno – Seslerietea* Br.-Bl. 1948; *Elyno myosuroidis – Seslerietum tenuifoliae* Petriccione 1991; *Euphorbio – Valerianetum bertisceae* Lakušić 1966; *Festuco – Alchemilletum serbicae* Lakušič 1964; *Festuco – Brometea* Br.-Bl. & Tüxen *ex* Br.-Bl. 1949; *Galio magellensis – Silenetum acaulis* Blasi, Di Pietro, Fortini & Catonica 2003; *Galion degenii* Quézel 1967; *Gnaphalio magellensis – Plantaginetum atratae* Feoli-Chiapella & Feoli 1977; *Helianthemo alpestris – Festucetum italicae* Blasi, Di Pietro & Pelino ass .nova; *Hyperico – Caricetum ferrugineae* Horvat 1956; *Juncetea trifidi* Hadač 1946; *Knautio – Trifolietum nivalis* E. Pignatti & S. Pignatti 1988; *Leontodontetum montani* Feoli Chiapella & Feoli 1977; *Leontopodio nivalis – Elynenion myosuroidis* Blasi & Di Pietro *in* Blasi, Di Pietro, Fortini & Catonica 2003; *Leontopodio nivalis – Seslerietum juncifoliae* Blasi, Di Pietro & Pelino ass. nova; *Linario – Valerianetum bertisceae* Horvat 1936; *Luzulo italicae – Festucetum macratherae* Bonin *ex* Petriccione & Persia 1995; *Luzulo italicae – Nardetum strictae* Biondi, Ballelli, Allegrezza, Frattaroli & Taffetani 1992; *Moheringio ciliatae – Linarietum alpinae* Horvat *in* Horvat, Glavac & Ellemberg 1974; *Onobrichi – Seslerietalia* Horvat 1949; *Nardetea strictae* Rivas Goday *in* Rivas Goday & Rivas Martínez 1963; *Nardetalia strictae* Oberdorfer *ex* Preising 1949; *Nardo strictae – Gnaphalietum supini* (Bartsch & Bartsch 1940) K. Müller 1948; *Oxytropidion urumovii* Lakušič 1964; *Papaveri kerneri – Thlaspietum kerneri* T. Wraber 1970; *Papaveretum rhaetici* Wikus 1959; *Papaveri julici – Thlaspietum rotundifolii* T. Wraber 1970; *Pedicularido elegantis – Seslerietum apenninae* Petriccione & Persia 1995; *Pedicularido elegantis – Seslerietum apenninae caricetosum humilis* (Biondi, Ballelli, Guitian & Allegrezza 1988) Petriccione & Persia 1995; *Pedicularido elegantis – Seslerietum apenninae caricetosum ericetori* (Petriccione 1991) Petriccione & Persia 1995; *Pedicularido elegantis – Seslerietum apenninae leontopodietosum nivalis* Ubaldi, Filz, De Santo, Di Cecco 1998; *Phleo ambigui – Bromion erecti* Biondi & Blasi *ex* Biondi, Ballelli, Allegrezza & Zuccarello 1995; *Poo violaceae – Nardetum* Pedrotti 1981; *Potentilletalia caulescentis* Br.-Bl. *in* Br.-Bl. & Jenny 1926; *Potentilletum apenninae* Feoli & Feoli-Chiapella 1976; *Potentilletum nitidae* Wikus 1959; *Potentillion caulescentis* Br.-Bl. & Jenny 1926; *Potentillo apenninae – Festucetum alfredianae* Blasi, Di Pietro, Fortini & Catonica 2003; *Potentillo apenninae – Saxifragetum paniculatae* Jovanović-Dunjić 1952; *Potentillo crantzii – Leontodonetum montani* Blasi, Di Pietro & Pelino ass. nova hoc loco; *Potentillo fernatae – Nardion strictae* Simon 1958; *Ranunculo pollinensis – Nardion strictae* Bonin 1972; *Ranunculo pollinensis – Plantaginetum atratae* Biondi, Allegrezza, Ballelli & Taffetani 2000; *Sagino – Gnaphalietum pichlerii* Lakušić 1966; *Saxifragion prenjae* Lakušić 1966; *Saxifrago – Papaveretum kernerii* Lakušić 1966; *Saxifrago speciosae – Papaveretum julici* Feoli-Chiapella & Feoli 1977; *Saxifrago speciosae – Papaveretum julici androsacetosum villosae* Feoli-Chiapella & Feoli *ex* Blasi, Di Pietro & Pelino subass. nova hoc loco; *Salicetea herbaceae* Br.-Bl. 1948; *Salicetum herbaceae dinaricum* Lakusic 1969; *Salicetum herbaceae macedonicum* Lakusic 1969; *Salicetum herbaceae* Rübel 1911; *Salicetum retusae – reticulatae* Br.-Bl. *in* Br.-Bl. & Jenny 1926; *Salicetum retusae – reticulatae macedonicum* Horvat 1936; *Salicion herbaceae* Br.-Bl. *in* Br.-Bl. & Jenny 1926; *Salicion retusae* Horvat 1949; *Saxifragion australis* Biondi & Ballelli *ex* Brullo 1983; *Saxifrago marginatae – Potentilletum apenninae* Horvat 1936; *Saxifrago speciosae – Papaveretum julici* Feoli-Chiapella & Feoli 1977; *Saxifrago speciosae – Papaveretum julici* androsacetosum villosae Blasi, Di Pietro & Pelino subass. nova; *Saxifrago speciosae – Silenetum cenisiae* Petriccione 1993; *Scabioso silenifoliae – Seslerietum apenninae* Bazzichelli & Furnari 1979; *Seslerenion apenninae* Blasi & Di Pietro *in* Blasi, Di Pietro, Fortini & Catonica 2003; *Seslerietalia tenuifoliae* Horvat 1930; *Seslerienion tenerrimae sensu* Horvat, Glavac, Ellemberg 1974; *Seslerio apenninae – Dryadetum octopetalae* Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian, Zuccarello 1999; *Seslerion apenninae* Furnari *in* Bruno & Furnari 1966; *Seslerion juncifoliae* Horvat 1930;

Silenion coesiae Quézel 1964; *Soldanello – Salicetum retusae* Horvat 1933; *Taraxaco apennini – Trifolietum thalii* Biondi et al. 1992; *Taraxaco apennini – Trifolietum thalii gnaphalietosum magellensis* Blasi, Di Pietro & Pelino subass. nova; *Thesio parnassi – Nardetum strictae* Quézel 1964; *Thlaspietalia rotundifolii* Br.-Bl. *in* Br.-Bl. & Jenny 1926; *Thlaspietea rotundifolii* Br.-Bl. 1948; *Thlaspion rotundifolii* Jenny-Lips 1930; *Thymo boisserii – Seslerietum ceruleae* Quézel 1967; *Trifolietalia parnassi* Quézel 1964; *Trifolion parnassi* Quézel 1964; *Trifolio – Nardetum strictae* Blečić & Tatić 1964; *Trifolio thalii – Festucetum microphyllae* Petriccione & Persia 1995; *Trifolio thalii – Festucetum puccinellii* Rossi 1994; *Trifolio thalii – Festucetum nigricantis* Br.-Bl. *in* Br.-Bl. & Jenny 1926 *corr.* Grabherr, Greimler & Mucina *in* Grabherr & Mucina 1993.

Appendix 2: Place and date of the relevés

Table I: Rel. 2, 3: Femmina Morta – Tavola Rotonda 20/7/2000; Rel. 4, 5, 7, 8, 15: Fondo di Femmina Morta 5/7/2002; Rel. 6, 13, 14: Femmina Morta 20/7/2000; Rel. 16, 18: Valle di Femmina Morta 14/7/2000; Rel. 19 M.Amaro(WSW) 28/7/2000; Rel. 20: Fondo di Femmina Morta 30/6/2000; Rel. 21, 22: Valle di Femmina Morta 5/7/2000; Rel. 25 Altare dello Stincone – Grotta Canosa 5/7/2000; Rel. 27, 28, 29, 32: Valle di Femmina Morta 28/7/2000; Rel. 24, 33: Fondo di Femmina Morta 8/8/1999; Rel. 34, 35: near M.Amaro 6/7/2000; Rel.36: near M.Amaro 28/7/2000. **Table II**: Rel. 42: N. M.Amaro 6/7/2000; Rel. 44: Fondo di Femmina Morta 14/7/2000; Rel. 47, 48: Femmina Morta 8/8/2000; Rel. 49: Fondo di Femmina Morta 10/8/2002; Rel. 50: Fondo di Femmina Morta 11/8/2002; Rel. 51: Valle di Femmina Morta 28/7/2000; Rel. 52: Valle di Femmina Morta 5/7/2000; Rel. 53:Sella Grotta Canosa 9/8/2000; Rel. 54: Femmina Morta 20/7/2000; Rel. 55, 57: M.Amaro – Pesco Falcone 28/7/2000. **Table III**: Rel. 58, 59, 60, 63: Femmina Morta 10/8/2000; Rel.61, 62: Sella Grotta Canosa 9/8/2000; Rel. 64: WSW M.Amaro 28/7/2000; Rel. 65: Valle di Femmina Morta 28/7/2000; Rel. 66: Grotta Canosa 25/7/2002. **Table IV**: Rel. 67: M.Amaro – Pesco Falcone 28/7/2000; Rel. 68, 69, 71: Sella Grotta Canosa 9/8/2000; Rel. 70: Valle di Femmina Morta 9/8/2000. **Table V**: Rel. 72, 73: Tavola Rotonda 17/8/2000. **Table VI**: Rel. 74, 75, 76, 77, 78, 79: Femmina Morta – Tavola Rotonda 2/8/2000; Rel.80: Femmina Morta – Tavola Rotonda 17/8/2000; Rel.81, 85, 86: Femmina Morta 8/8/2002; Rel. 82, 83: Femmina Morta 30/7/2002; Rel. 84: Valle Cannella (Rif. Manzini) 1/8/2002. **Table VII**: Rel. 87, 88, 89, 90, 91, 93, 94, 95, 96: Femmina Morta – Tavola Rotonda; Rel. 92, 97: Fondo di Femmina Morta 8/8/1999; Rel. 98: Monte Rotondo 21/7/2001; Rel. 99: Valle Cannella (Rif. Manzini) 2/8/2002. **Table VIII**: Rel. 100, 101: M. Acquaviva 20/7/2002; Rel. 102: M. Falcone 20/7/2002; Rel. 103: M. Amaro 25/7/2002; Rel. 104: W.Acquaviva (Mammoccio) 2/8/2002; Rel. 105: M. S. Angelo 21/7/2002; Rel. 106: M. S. Angelo 21/7/2002; Rel. 107, 108 M. Amaro 25/7/2002; Rel. 109, 112: M. Macellaro 29/7/2002; Rel.110: Valle Cannella(Rif. Manzini) 1/8/2002; Rel. 111: M.Amaro – Grotta Canosa 25/7/2002; Rel. 113: Cima Pomilio 21/7/2002.