Fitosociologia vol. 48 (1): 3-21, 2011

Syntaxonomical analysis of the *Kobresio-Myosuroidis-seslerietea caeruleae* and *Carici Rupestris-Kobresietea Bellardii* classes in the central southern Apennines.

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Abstract
The aim of this study is a critical analysis of the syntaxonomic classification of the primary grasslands of the central-southern Apennines with a dominance of *Sesleria juncifolia* ssp. *juncifolia* and of those with a predominance of *Kobresia myosuroides*. The hypothesis considered is the coexistence in the Apennines of the classes *Kobresio myosuroidis-Seslerietea caeruleae* (=*Elyno myosuroidis-Seslerietea caeruleae*) and *Carici rupestris-Kobresietea bellardii*.
277 phytosociological relevés were analysed, which relate to seven different plant associations of the central-southern Appenines; 80 of these relevés were unpublished. A syntaxonomic revision is proposed, according to which the coenoses with a dominance of *Sesleria juncifolia* ssp. *juncifolia*, attributed to the class *Kobresio-Seslerietea*, to the order *Seslerietalia tenuifoliae*, to the suborder *Seslerienalia apenninae* and to the alliance *Seslerion apenninae*, are distinct from those with a prevalence of *Kobresia myosuroides*, ascribed to the class *Carici-Kobresietea*, to the order *Oxytropido-Kobresietalia*, to the alliance *Oxytropido-Elynion* and to the suballiance *Leontopodio-Elynenion*.
The proposal of Bruno & Furnari (1966) is reconsidered, with regard to the Apennine order *Seslerietalia apenninae*, which is included as a suborder (*Seslerienalia apenninae*) in the Balcan-Apennine order *Seslerietalia tenuifoliae*. The syntaxonomic collocation of the alliance *Leontopodio-Elynenion* is re-examined, which is assigned to the class *Carici-Kobresietea*, as a modification of the previous interpretation that assigned it to the class *Kobresio-Seslerietea* (Blasi *et al*., 2003). Seven new subassociations are proposed: *hieracietosum cymosi* and *anthylletosum pulchellae*, referred to the association *Carici humilis-Seslerietum apenninae*; *festucetosum alfredianae*, referred to the association *Seslerietum apenninae*; *polygaletosum alpestris*, referred to the association *Seslerio apenninae-Dryadetum octopetalae*; *anthylletosum weldenianae* and *helianthemetosum grandiflorii*, referred to the association *Helianthemo alpestris-Festucetum italicae*; and *saxifragetosum speciosae*, referred to the association *Galio magellensis-Silenetum acaulis*.

Keywords: central-southern Apennines, *Carici-Kobresietea*, *Kobresio-Seslerietea*, primary grasslands, syntaxonomy.

Riassunto
Il presente studio ha l'obiettivo di analizzare in forma critica l'inquadramento sintassonomico delle praterie primarie dell'Appennino centro-meridionale a dominanza di *Sesleria juncifolia* ssp. *juncifolia* e di quelle con predominanza di *Kobresia myosuroides*. Viene presa in considerazione l'ipotesi della coesistenza in Appennino delle classi *Kobresio myosuroidis-Seslerietea caeruleae* (=*Elyno myosuroidis-Seslerietea caeruleae*) e *Carici rupestris-Kobresietea bellardii*.
Vengono analizzati 277 rilievi fitosociologici, di cui 80 inediti, relativi a 7 diverse associazioni vegetali dell'Appennino centro-meridionale e viene proposta la revisione sintassonomica secondo la quale risultano distinte le cenosi a dominanza di *Sesleria juncifolia* ssp. *juncifolia*, attribuite alla classe *Kobresio-Seslerietea*, all'ordine *Seslerietalia tenuifoliae*, al subordine *Seslerienalia apenninae* e all'alleanza *Seslerion apenninae*, da quelle a prevalenza di *Kobresia myosuroides*, ascritte alla classe *Carici-Kobresietea*, all'ordine *Oxytropido-Kobresietalia*, all'alleanza *Oxytropido-Elynion* e alla suballeanza *Leontopodio-Elynenion*.
Viene recuperata la proposta di Bruno et Furnari (1966), riguardo l'ordine appenninico *Seslerietalia apenninae*, che viene inserito come subordine (*Seslerienalia apenninae*) nell'ordine appenninico-balcanico *Seslerietalia tenuifoliae*. Viene rivista la collocazione sintassonomica della suballeanza *Leontopodio-Elynenion*, che viene assegnata alla classe *Carici-Kobresietea*, modificando la precedente interpretazione (Blasi et al., 2003), che l'attribuiva alla classe *Kobresio-Seslerietea*.
Si propongono sette nuove subassociazioni, *hieracietosum cymosi* e *anthylletosum pulchellae*, riferite all'associazione *Carici humilis-Seslerietum apenninae*, *festucetosum alfredianae*, all'associazione *Seslerietum apenninae*, *polygaletosum alpestris*, all'associazione *Seslerio apenninae-Dryadetum octopetalae*, *anthylletosum weldenianae* e *helianthemetosum grandiflorii*, all'associazione *Helianthemo alpestris-Festucetum italicae*, *saxifragetosum speciosae*, all'associazione *Galio magellensis-Silenetum acaulis*.

Parole chiave: Appennino centro-meridionale, *Carici-Kobresietea*, *Kobresio-Seslerietea*, praterie primarie, sintassonomia.

The study area

The locations of the coenoses attributed to the classes *Kobresio myosuroidis-Seslerietea caeruleae* and *Carici rupestris-Kobresietea bellardii* are included in the central-southern Apennine territory, between the Umbria–Marche sector to the north, and the Lazio–Molise sector to the south (Fig. 1). This is the area with the highest peaks of the mountain chain: Sibillini, Laga, Gran Sasso, Velino-Sirente, Maiella, Terminillo and Simbruini-Ernici.

From the point of view of the altitude, as well as the cryorotemperate and orotemperate belts of these mountains, the data analysed include the upper supratemperate belt of these and of other lower mountain peaks that do not go above the altitude limits of the woods, like Mount Catria, Mount San Vicino, Mount Gemmo and Mount Coscerno (Umbria–Marche Apennines).

From the floristic point of view, the central-southern

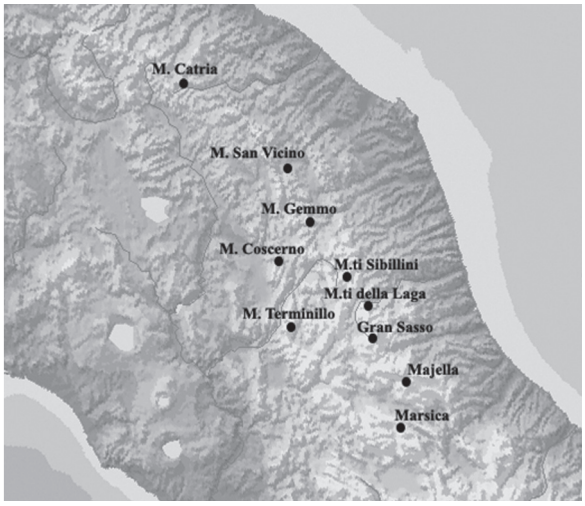

Fig. 1 - Areas from where the data considered in the present study come.

Apennines are an area that has been well characterised (Pignatti, 1982; Passalacqua & Bernardo, 1998; Passalacqua 1998; Lucchese & De Simone, 2000; Catonica & Manzi, 2002) and can be easily separated from the northern Apennines. This area also maintains strict links with the Balcan peaks, together with which they make up the Balcan–Apennine Province, within the Eurosiberian Region (Rivas-Martínez, 2001).

Materials and methods

These data, gathered in the central-southern Apennines and relative to the coenoses included in the classes *Kobresio-Seslerietea* and *Carici-Kobresietea*, have been collected together here as both unpublished and present in the literature.

Overall, 277 relevés have been considered. Of these, 197 are already published and relate to the studies of Furnari (1961; Gran Sasso), Bruno & Furnari (1966; Gran Sasso), Feoli-Chiapella & Feoli (1977; Maiella), Pedrotti (1982; Laga Mountains), Biondi *et al*. (1988; central Apennines), Petriccione *et al*. (1993; Valleys of Amplero and Vallelonga), Biondi & Ballelli (1995; Mount Coscerno and Mount of Civitella), Allegrezza *et al*. (1997; central Italian calcareous rocky sectors), Biondi *et al*. (1999; Campo Imperatore), Biondi *et al*. (2000; Corno Grande), Biondi *et al*. (2002; Gran Sasso and Laga Mountains), Allegrezza (2003; Mount San Vicino), Blasi *et al*. (2003, 2005, central Apennines). The other 80 relevés are unpublished and related to the Sibillini Mountains (Val di Bove and Val di Panico) and to the Maiella Massif.

The 277 relevés have undergone multivariate analysis (Package Syntax 2000, Podani 2001) using the cord distance coefficient for the construction of the dissimilarity matrix and the complete linkage as an algorithm for the construction of clusters. Moreover, principal component analysis (PCA) has also been carried out.

Statistical analysis

The dendrogram obtained from the cluster analysis (Fig. 2) shows a clear division into two main clusters (1 and 2) that can themselves be subdivided into four and three subclusters, respectively (a-d, e-g).

Cluster 1

This cluster includes the relevés that make up the perennial herbaceous communities with a dominance of *Sesleria juncifolia* ssp. *juncifolia*, *Dryas octopetala* ssp. *octopetala* and *Carex kitaibeliana* ssp. *kitaibeliana* of the following bioclimate belts: cryorotemperate, orotemperate and upper supratemperate (sub-clusters a, b, c, d). These are discontinuous formations that are often terraced, and which are located on steep slopes with rocky outcrops and a lack of soil, often under windy conditions along the top, and under particularly intense cryoturbation.

Cluster 2

Cluster 2 groups the primary coenoses of the cryorotemperate belt that have a good level of ground cover, with the exception of the *Silene acaulis* communities; the ground cover of this plant association is considered as within the hummocks that form its edaphic support. These are characterised by the presence and dominance of *Helianthemum oelandicum* ssp. *alpestre*, *Kobresia myosuroides* and *Silene acaulis* ssp. *bryoides* (sub-clusters e, f, g), which grow on evolved soils and are characterised by limited cryoturbation due to the prolonged and abundant snow cover.

From the analysis, it can therefore be seen that these 277 relevés can be attributed to the following seven different associations, in agreement with the data collected in the literature:

a: *Seslerietum apenninae* (68 rel.)
b: *Carici humilis-Seslerietum apenninae* (47 rel.)
c: *Seslerio apenninae-Dryadetum octopetalae* (16 rel.)
d: *Caricetum kitaibelianae-rupestris* (32 rel.)
e: *Helianthemo alpestris-Festucetum italicae* (32 rel.)
f: *Leontopodio nivalis-Elynetum myosuroidis* (50 rel.)
g: *Galio magellensis-Silenetum acaulis* (32 rel.)

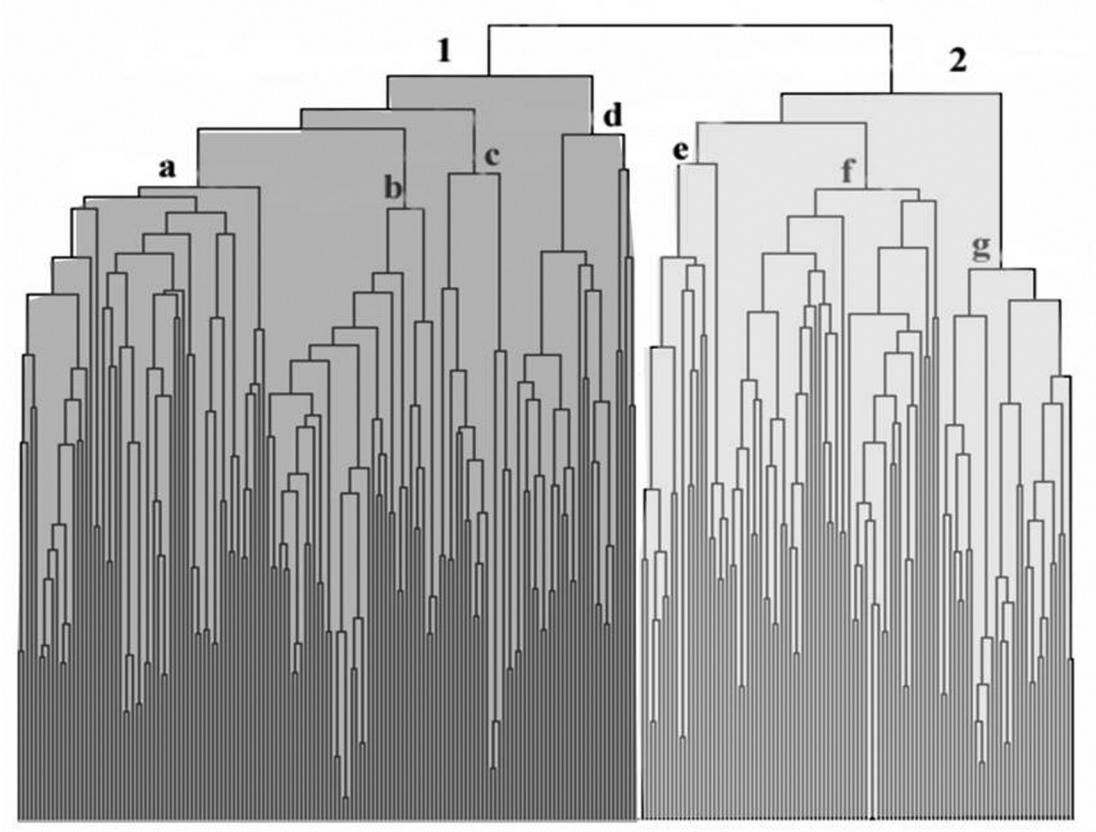

Fig. 2 - Dendrogram for the 277 relevés.

The separation of these seven plant formations into two particularly distinct groupings is also apparent from the PCA of the seven floristic groups (Fig. 3). From this analysis (Fig. 3), it can be hypothesised that the distribution along axis 1 can be interpreted as the altitudinal gradient. Indeed, the vegetation of *Carex humilis* and *Sesleria juncifolia* ssp. *juncifolia* of the upper supratemperate belt is positioned to the extreme right, while the formations of *Silene acaulis* ssp. *bryoides* and *Kobresia myosuroides*, which can grow up to the summit sectors, are close to the second axis.

Along axis 2, the plant associations appear to be distributed from the bottom to the top according to a gradient linked to the slope of the terrain. Indeed, at the bottom, there are the coenoses of the class *Kobresio-Seslerietea*, which grow under conditions of relatively steep slope. The mean slope recorded for the four associations is 26.56°. The communities gathered in the second cluster are instead on lesser slopes, decreasing as they approach the higher part of the axis. The slope for *Leontopodio nivalis-Elynetum myosuroidis* is 17.13°, for *Helianthemo alpestris-Festucetum italicae*, 16.82°, and for *Galio magellensis-Silenetum acaulis*, 11.88°.

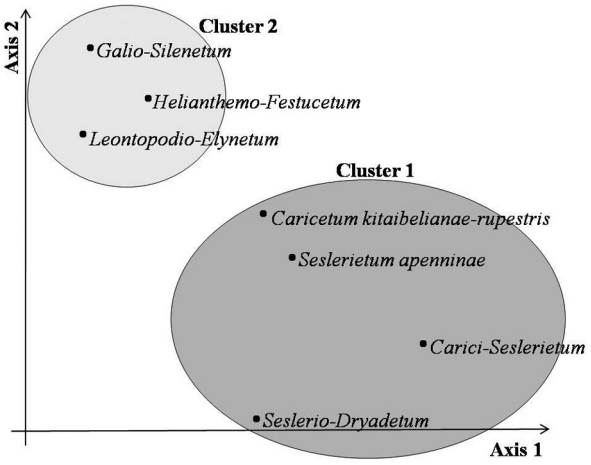

Fig. 3 - Principal component analysis according to the floristic cortège of the seven phytocoenoses.

Syntaxonomic problematics related to the study of the high altitude grasslands

The high-altitude vegetation of the central-southern Apennines has been studied for at least 40 years, and during the various investigations the research groups have delved into the floristic and phytosociological difficulties. The syntaxonomic classification of these grasslands is, however, still under discussion, and

there is no univocal interpretation at present. From the literature, it can be seen that various studies refer some of these coenoses to the class *Carici-Kobresietea* (Ohba 1974; Biondi *et al*. 1999, 2000, 2002), while others put them all into the class *Kobresio-Seslerietea* (Feoli-Chiapella & Feoli 1977; Oriolo 2001; Blasi *et al*. 2003, 2005).

With the aim of resolving these problems, the data collected here have been analysed not only from a numerical point of view, but also from the floristic and syntaxonomic points of view.

On the basis of these comparisons (Tables 2 and 3), it can be seen that among the species used by Ohba (1974) to characterise the class *Carici-Kobresietea*, almost all of those present in the relevés that we have analysed (9 out of 10) were already used for the characterisation at various levels of the class of the Apennine coenoses *Kobresio-Seslerietea* (Braun-Blanquet, 1948).

The coenoses of cluster 2, which represent the climatophilous vegetation of the summit sectors of the highest Apennine peaks, are anyway characterised by the constant presence of species of Arctic–Alpine and circumboreal origins, which reach mean percentage cover levels that are almost double with respect to those of cluster 1 (Fig. 4). These floristic entities, which can be considered as glacial relicts, descended to lower latitudes with the last glaciation, and then ascended again up the highest altitudes, where they found refuge from the later increases in temperature. These represent 80% of the group of species characteristic of the class *Carici-Kobresietea* that are found in the relevés collected and analysed here.

The grasslands corresponding to cluster 1, instead, mainly occupy the orotemperate belt of the Apennine chain, and are distinguished by the presence of a considerable group of orophytes and Mediterranean-montane species, which were for the large part indicated by Bruno & Furnari (1966) as characteristic of the order *Seslerietalia apenninae* and of the alliance *Seslerion apenninae*. These species, which within this cluster reach mean percentage cover values that are considerably greater than in cluster 2 (Fig. 4), found refuge at low altitudes and then differentiated during the period of the Plio-Pleistocene glaciation; only following the post glacial warming they have returned up to higher altitudes.

The hypothesis of the presence of both of the classes in the central-southern Apennines would therefore be confirmed by these considerations. This is founded on not just phytogeographical criteria, but also on the influence of edaphic factors. Indeed, the coenoses of cluster 1 appear to be differentiated from those of cluster 2 because they can survive under the more xeric conditions arising from the more superficial and less evolved soils. The coenoses corresponding to the three branches of cluster 2 grow instead under conditions of deeper soils and with less steep slopes.

In conclusion, we hypothesize a temporary solution of the syntaxonomic problematics. It modifies the previous interpretations of Feoli-Chiapella & Feoli (1977), Oriolo (2001) and Blasi *et al*. (2003, 2005), who identified the class *Kobresio-Seslerietea* as the only syntaxon that is representative of the primary grasslands of the central-southern Apennines. Our proposal is based upon a statistical analysis which confirms ecological differences at a territorial scale and shows a partial floristic autonomy of the *Carici-Kobresietea* class. This is due to the marginal position of the study area with respect to the distribution area of the same class.

Syntaxonomic attribution of the clusters

The coenoses corresponding to the a, b, c and d branches have been assigned to the class *Kobresio-Seslerietea*, to the order *Seslerietalia tenuifoliae*, to the suborder *Seslerienalia apenninae* and to the alliance *Seslerion apenninae*. The suborder allows the proposal of Bruno & Furnari (1966) to be readopted, regarding the order *Seslerietalia apenninae*, and therefore the collocation of this order at the hierarchical level is revised.

The association *Caricetum kitaibelianae-rupestris* Biondi *et al*. 2000, is referred to the alliance *Seslerion apenninae*, in agreement with its original inclusion (Biondi *et al*. 2000). This is not in agreement with the previous interpretation of Blasi *et al*. (2003), who assigned it to the suballiance *Leontopodio-Elynenion*. This is because as judged by this re-analysis, it is floristically more similar to the associations of cluster 1 than of cluster 2.

The coenoses of the class *Carici-Kobresietea*, relative to the e, f and g branches, are instead included in the order *Oxytropido-Kobresietalia*, to the alliance *Oxytropido-Elynion* and to the suballiance *Leontopodio-Elynenion*. This syntaxon allows the coenoses of the Apennine distribution areas within the above alliance to be distinguished. For this suballiance, which was initially referred to the alliance *Seslerion apenninae* and to the class *Kobresio-Seslerietea* (Blasi *et al*., 2003), the floristic composition has been described in detail.

veg. comm.	*ChSa*			*Sa*			*SaDo*			*Ckr*			*HaFi*			*LnEm*			GmSa		
corotype	n°	freq.	cop.	n°	freq.	cop.	n°	freq.	cop.	n°	freq.	cop.	n°	freq.	cop.	n°	freq.	cop.	n°	freq.	cop.
pal	1,28	0,06	0,04	0,25	0,01	0,01	0,06	0,00	0,00	0,22	0,01	0,01	0,34	0,01	0,01	0,08	0,00	0,00	0,09	0,01	0,00
oro	4,77	0,21	0,29	5,79	0,27	0,38	5,38	0,37	0,47	5,63	0,35	0,33	8,00	0,35	0,35	6,66	0,33	0,30	4,22	0,30	0,24
mmo	4,09	0,18	0,19	3,47	0,17	0,18	2,06	0,14	0,11	1,56	0,09	0,08	2,22	0,10	0,14	1,64	0,09	0,09	2,28	0,15	0,10
eur	8,64	0,38	0,36	5,47	0,26	0,20	3,38	0,23	0,12	2,56	0,14	0,09	4,84	0,21	0,20	3,60	0,18	0,16	2,19	0,14	0,10
end	2,77	0,12	0,10	3,93	0,18	0,15	2,06	0,14	0,07	2,75	0,19	0,18	4,72	0,20	0,18	2,72	0,14	0,09	3,75	0,25	0,18
caa	1,04	0,05	0,03	2,41	0,11	0,09	1,56	0,11	0,24	3,22	0,21	0,32	2,69	0,12	0,12	5,24	0,27	0,35	2,16	0,15	0,39
sum	22,57	1,00	1,00	21,32	1,00	1,00	14,50	1,00	1,00	15,94	1,00	1,00	22,81	1,00	1,00	19,94	1,00	1,00	14,69	1,00	1,00

Tab. 1 - Number, frequency and mean cover value for each corotype within the considered coenosis.
Pal, paleotemperate; Oro, orophyte; Mmo, Mediterranean-montane; Eur, European; End, endemic; Caa, circumboreal Arctic–Alpine. *ChSa*, *Carici humilis-Seslerietum apenninae*; *Sa*, *Seslerietum apenninae*; *SaDo*, *Seslerio apenninae-Dryadetum octopetalae*; *Ckr*, *Caricetum kitabelianae-rupestris*; *HaFi*, *Helianthemo alpestris-Festucetum italicae*; *LnEm*, *Leontopodio nivalis-Elynetum myosuroidis*; *GmSa*, *Galio magellensis-Silenetum acaulis*.

Kobresio myosuroidis-Seslerietea caeruleae Br.-Bl. 1948 nom. mut. Rivas-Martinez *et al*. 2000

Sub-order *Seslerienalia apenninae* Bruno & Furnari 1966 *em*. *hoc loco* and alliance *Seslerion apenninae* Furnari in Bruno & Furnari 1966 *em*. *hoc loco* (Table 2).

The grasslands of *Sesleria juncifolia* ssp. *juncifolia* are now included in the order *Seslerietalia tenuifoliae*, even though some of the species identified by Horvat (1930) for the Balcans are found in the Apennines.

On the other hand, it needs to be noted that the studies that have referred this coenosis to the order *Seslerietalia tenuifoliae* (Allegrezza *et al*. 1997; Allegrezza 2003; Biondi *et al*. 1988, 1999, 2000, 2002; Blasi *et al*. 2003, 2005) did this using entities not identified by Horvat (1930) and never added to the list of the characteristic species according to the norms for syntaxonomic nomenclature.

Many of these species were actually already indicated for the order *Seslerietalia apenninae*, proposed by Bruno & Furnari (1966) as the vicariant syntaxon of the orders *Seslerietalia coeruleae* (Alps) and *Seslerietalia tenuifoliae* (Balcans). As an alternative to maintaining the current classification, we believe that it is more correct to return to the proposal put forward by Bruno & Furnari (1966).

From this analysis, we can subdivide the characteristic species of the order *Seslerietalia apenninae* into three groups. As well as being found in the Apennine relevés, most of these entities are also found in the Balcans and the Alps: *Minuartia verna* ssp. *verna*, *Draba aizoides* ssp. *aizoides*, *Phyteuma orbiculare*, *Oxytropis neglecta*, *Helianthemum oelandicum* ssp. *incanum*, *Pedicularis verticillata*, *Helianthemum nummularium* ssp. *grandiflorum*, *Polygala alpestris*, *Astragalus sempervirens*, *Biscutella laevigata* ssp. *laevigata*, *Oxytropis campestris*, *Thymus praecox* ssp. *polytrichus*, *Koeleria lobata*, *Potentilla crantzii* ssp. *crantzii*, *Cyanus triumphetti*, *Linum capitatum*, *Linum alpinum* and *Aster alpinus* ssp. *alpinus*. This first group takes on a differential role of an ecological type in comparison with the associations of the class *Carici-Kobresietea*; only the last three of these species form part of the group identified by Horvat (1930) in his description of the order *Seslerietalia tenuifoliae*.

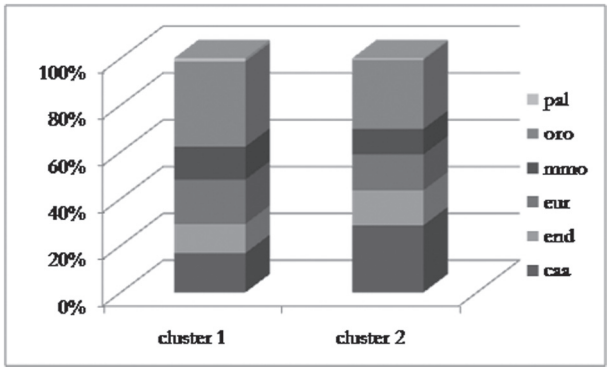

Fig. 4 - Mean percentage cover values for each chorotype within the two clusters. Pal, paleotemperate; Oro, orophyte; Mmo, Mediterranean-montane; Eur, European; End, endemic; Caa, circumboreal Arctic–Alpine.

Two species are present on the Apennine and Balcan sesleria grasslands, but not in those of the Alps: *Dianthus sylvestris* ssp. *longicaulis* and *Anthyllis vulneraria* ssp. *pulchella*.

The rest of the species identified by Bruno & Furnari (1966) to define the order *Seslerietalia apenninae* can instead be considered as geographical differentials of the Apennine heights in comparison with the Balcan mountains: *Trinia dalechampii*, *Anthyllis vulneraria* ssp. *weldeniana*, *Gentiana verna* ssp. *verna*, *Pulsatilla alpina* ssp. *millefoliata*, *Acinos alpinus* ssp. *meridionalis*, *Erigeron epiroticus*, and *Pedicularis*

Tab. 2 - The vegetation of *Kobresio myosuroidis-Seslerietea caeruleae class* in central-southern Apennines

			1	2	3	4	
		Mean altitude (m. a.s.l. x 10)	1496	2121	2182	2361	
		Mean slope (°)	25	29	34	28	
		Mean coverage (%)	86	65	67	78	
		Number of relevés	47	68	16	32	
	Dif. and char. sp. *Kobresio myosuroidis-Seslerietea caeruleae* Br.-Bl. 1948 nom. mut. Rivas-Martinez, Diaz, Fernandez-Gonzalez, Izco, Loidi, Lousa & Penas 2002						
•	Ch rept	(CIRCUM.)ART.ALP.	Dryas octopetala L. ssp. octopetala	6	4	100	13	4
•	H caesp	(CIRCUM.)ART.ALP.	Carex rupestris All.	.	1	13	94	3
•	Ch pulv	(CIRCUM.)ART.ALP.	Silene acaulis (L.) Jacq. ssp. bryoides (Jord.) Nyman	.	38	.	84	2
•	H caesp	ART.ALP.	Kobresia myosuroides (Vill.) Fiori	.	9	.	.	1
•	H caesp	OROF. S-EUROP.	Carex parviflora Host	4	.	.	.	1
	Dif. and char. sp. *Seslerietalia tenuifoliae* Horvat 19*30* and *Seslerienalia apenninae* Bruno & Furnari 1966 em. hoc loco						
•	H ros	SE-EUROP.	Minuartia verna (L.) Hiern ssp. verna	43	46	25	22	4
•	H ros	OROF. CENTRO-EUROP.	Draba aizoides L. ssp. aizoides	28	71	13	41	4
	Ch suffr	EUROP.-CAUC.	Trinia dalechampii (Ten.) Janchen	13	47	25	47	4
	H scap	EURIMEDIT.	Anthyllis vulneraria L. ssp. weldeniana (Rchb.) Cullen	53	43	44	19	4
	H scap	OROF. S-EUROP.	Phyteuma orbiculare L.	6	12	6	3	4
	Ch pulv	OROF. S-EUROP.	Ranunculus breyninus Crantz	23	22	19	6	4
•	H scap	OROF. S-EUROP.	Oxytropis neglecta Ten.	3	3	19	9	4
	H scap	MEDIT.-MONT.	Dianthus sylvestris Wulfen ssp. longicaulis (Ten.) Greuter & Burdet	63	25	17	10	4
	Ch suffr	EUROP.-CAUC.	Helianthemum oelandicum (L.) DC. subsp. incanum (Willk.) G. Lopèz	87	7	50	13	4
•	H ros	EURASIAT.	Gentiana verna L. ssp. verna	17	47	.	31	3
	H scap	EURIMEDIT.	Anthyllis vulneraria L. ssp. pulchella (Vis.) Bornm.	15	34	.	13	3
	H caesp	ENDEM.	Festuca violacea Gaudin ssp. italica Foggi, Graz. Rossi & Signorini	6	44	.	75	3
	H scap	OROF. S-EUROP.	Pulsatilla alpina (L.) Delarbre ssp. millefoliata (Bertol.) D.M. Moser	2	21	13	.	3
	Ch suffr	OROF. S-EUROP.	Acinos alpinus (L.) Moench ssp. meridionalis (Nyman) P.W. Ball	4	3	.	16	3
	H scap	(CIRCUM.)ART.ALP.	Pedicularis verticillata L.	.	3	19	13	3
	Ch suffr	EUROP.-CAUC.	Helianthemum nummularium (L.) Miller subsp. grandiflorum (Scop.)Sch.e Th.	11	10	.	9	3
•	H scap	ENDEM. ILLIR.-APPENN.	Erigeron epiroticus (Vierh.) Halacsy	2	10	.	16	3
•	H scap	OROF.-CIRCUMBOR.	Aster alpinus L. ssp. alpinus	2	38	.	22	3
	H scap	OROF. S-EUROP.	Polygala alpestris Rchb.	.	4	19	13	3
	Ch frut	OROF. S-EUROP.	Astragalus sempervirens Lam.	19	28	6	.	3
	H scap	OROF. S-EUROP.	Biscutella laevigata L. ssp. laevigata	13	7	.	31	3
•	H scap	EUROSIB.	Oxytropis campestris (L.) DC.	.	25	.	6	2
	Ch rept	OROF. S-EUROP.	Thymus praecox Opiz subsp. polytrichus (Borbàs) Jalas	9	28	.	.	2
	H caesp	MEDIT.-MONT.	Koeleria lobata (M. Bieb.) Roem. et Schult.	57	4	.	.	2
•	H scap	ARTICO-ALP.	Potentilla crantzii (Crantz) Beck ex Fritsch ssp. crantzii	.	12	.	6	2
	H caesp	EUROP.-CAUC.	Cyanus triumfettii (All.) Dostàl ex Á. Löve et D. Löve	6	3	.	.	2
	Ch suffr	OROF. SE-EUROP.	Linum capitatum Kit. ex Shult. ssp. serrulatum (Bertol.) Hartvig	.	3	.	.	1
	H scap	OROF. S-EUROP.	Linum alpinum Jacq.	.	3	.	.	1
	H scap	OROF. S-EUROP.	Pedicularis comosa L. ssp. comosa	30	.	.	.	1
	Dif. and char. sp. *Seslerion apenninae* Furnari in Bruno & Furnari 1966 em. hoc loco						
	H caesp	OROF. SE-EUROP.	Sesleria juncifolia Suffren subsp. juncifolia	100	100	94	78	4
	Ch suffr	MEDIT.-MONT.	Anthyllis montana L. ssp. atropurpurea (Vukot.) Pignatti	87	41	56	19	4
	Ch suffr	ENDEM.	Edraianthus graminifolius (L.) DC. ssp. graminifolius	79	84	75	97	4
	H caesp	OROF. SE-EUROP.	Carex kitaibeliana Degen ex Bech ssp. kitaibeliana	32	74	88	84	4
	H scap	NE-MEDIT.-MONT.	Carum flexuosum (Ten.) Nyman	26	3	31	6	4
	H ros	ENDEM.	Pedicularis elegans Ten.	9	79	6	13	4
•	Ch rept	EURASIAT.	Androsace villosa L. ssp. villosa	21	74	69	22	4
	H scap	OROF. S-EUROP.	Gentiana dinarica Beck	23	15	56	.	3
	G rhiz	OROF. S-EUROP.	Ranunculus thora L.	6	1	25	.	3
	Ch pulv	OROF. S-EUROP.	Saxifraga caesia L.	.	1	19	13	3
	H scap	OROF. SE-EUROP.	Thesium parnassi DC.	4	18	19	.	3
	T scap	EUROP.-CAUC.	Euphrasia salisburgensis Funk ex Hoppe	9	40	25	.	3
•	Ch suffr	E-MEDIT.-MONT.	Helianthemum oelandicum (L.) DC. ssp. alpestre (Jacq.) Ces.	.	87	19	69	3
	G rhiz	OROF. SE-EUROP.	Ranunculus brevifolius Ten.	15	13	.	3	3
	H caesp	MEDIT.-MONT.	Paronychia kapela (Hacq.) Kerner ssp. kapela	28	34	.	.	2
	Ch suffr	(CIRCUM.)ART.ALP.	Arctostaphylos uva-ursi (L.) Sprengel	11	3	.	.	2
	H caesp	OROF. S-EUROP.	Carex firma Host	.	.	6	3	2
•	H scap	ENDEM.	Leontopodium nivale (Ten.) Huet ex Hand.-Mazz.	.	22	44	.	2
	T scap	OROF. S-EUROP.	Sedum atratum L. ssp. atratum	.	18	.	50	2
	H scap	OROF. S-EUROP.	Androsace vitaliana (L.) Lapeyr. ssp. praetutiana (Sund.) Kress	.	13	.	25	2

1 *Carici humilis-Seslerietum apenninae* Biondi, Ballelli, Guitan &Allegrezza 1988
2 *Seslerietum apenninae* Bruno & Furnari 1966
3 *Seslerio apenninae-Dryadetum octopetalae* Biondi *et al.* 1999
4 *Caricetum kitaibelianae-rupestris* Biondi *et al.* 2000

• Species also belonging to *Carici rupestris-Kobresietea bellardii* class and its lower hierarchical levels

Tab. 3 - The vegetation of *Carici rupestris-Kobresietea bellardii class* in central southern Apennines

			5	6	7	
		Mean altitude (m. a.s.l. x 10)	2630	2420	2532	
		Mean slope (°)	28	16	15	
		Mean coverage (%)	57	87	90	
		Number of relevés	32	50	32	
	Dif. and char. sp. *Carici rupestris-Kobresietea bellardii* Ohba 1974 nom. mut. prop. Rivas-Martinez, Diaz, Fernandez-Gonzalez, Izco, Loidi, Lousa & Penas 2002					
•	H ros	SE-EUROP.	Minuartia verna (L.) Hiern ssp. verna	72	62	47	3
•	Ch pulv	(CIRCUM.)ART.ALP.	Silene acaulis (L.) Jacq. ssp. bryoides (Jord.) Nyman	75	84	100	3
•	H scap	EUROSIB.	Oxytropis campestris (L.) DC.	44	28	13	3
•	H scap	ARTICO-ALP.	Potentilla crantzii (Crantz) Beck ex Fritsch ssp. crantzii	66	80	31	3
•	H caesp	ART.ALP.	Kobresia myosuroides (Vill.) Fiori	6	96	13	3
•	H scap	OROF.-CIRCUMBOR.	Aster alpinus L. ssp. alpinus	19	14	12	3
•	Ch rept	(CIRCUM.)ART.ALP.	Dryas octopetala L. ssp. octopetala	.	12	.	1
•	H caesp	(CIRCUM.)ART.ALP.	Carex rupestris All.	.	12	.	1
	H scap	(CIRCUM.)ART.ALP.	Erigeron uniflorus L.	.	6	.	1
•	T scap	ARTICO-ALP.	Gentiana nivalis L.	.	12	.	1
	Dif. and char. sp. *Oxytropido-Kobresietalia* Oberdorfer ex Albrecht 1968						
•	H ros	EURASIAT.	Gentiana verna L. ssp. verna	31	36	19	3
•	H ros	OROF. CENTRO-EUROP.	Draba aizoides L. ssp. aizoides	81	60	50	3
•	Ch rept	EURASIAT.	Androsace villosa L. ssp. villosa	53	22	44	3
•	T scap	OROF. S-EUROP.	Sedum atratum L. ssp. atratum	14	16	6	3
	H ros	OROF. S-EUROP.	Gentiana brachyphylla Vill. ssp. favratii (Rittener) Tutin	19	.	9	2
	Dif. and char. sp. *Oxytropido-Elynion myosuroidis* Br.-Bl. 1949						
•	H scap	NE-MEDIT.-MONT.	Erigeron epiroticus (Vierh.) Halacsy	50	42	47	3
•	H caesp	OROF. S-EUROP.	Carex parviflora Host	9	20	.	2
	Dif. and char. sp. *Leontopodio nivalis-Elynenion myosuroidis* Blasi, Di Pietro, Fortini & Catonica 2003						
	G rhiz	ARTICO-ALP.	Bistorta vivipara (L.) Delarbre	22	90	31	3
	H scap	OROF. SE-EUROP.	Gnaphalium hoppeanum Koch ssp. magellense (Fiori) Strid	53	14	16	3
•	H scap	ENDEM.	Leontopodium nivale (Ten.) Huet ex Hand.-Mazz.	81	24	19	3
•	Ch suffr	E-MEDIT.-MONT.	Helianthemum oelandicum (L.) DC. ssp. alpestre (Jacq.) Ces.	78	82	19	3
	T scap	OROF. SE-EUROP.	Gentiana utriculosa L.	.	6	9	2
•	H scap	OROF. S-EUROP.	Oxytropis neglecta Ten.	.	28	19	2
	H scap	EUROSIB.	Carex ericetorum Pollich	.	22	.	1
	Ch rept	CIRCUMBOR.	Antennaria dioica (L.) Gaertner	.	22	.	1

5 *Helianthemo alpestris-Festucetum italicae* Blasi, Di Pietro & Pelino 2005
6 *Leontopodio nivalis-Elynetum myosuroidis* Feoli-Chiappella & Feoli 1977
7 *Galio magellensis-Silenetum acaulis* Blasi, Di Pietro, Fortini & Catonica 2003

• Species also belonging to *Kobresio myosuroidis-Seslerietea caeruleae* class and its lower hierarchical levels

comosa ssp. *comosa*.

In conclusion, given that many entities are represented in the Apennines as well as the Balcans, even if they were not identified by Horvat (1930) for the order *Seslerietalia tenuifoliae*, and that only the small group of species given above can differentiate the two regions from a phytogeographical point of view, we believe that it is the right time to readopt the proposal relating to the order *Seslerietalia apenninae* at a lower hierarchical level with respect to the Apennine–Baltic order *Seslerietalia tenuifoliae*, redefining the syntaxon as the suborder *Seslerienalia apenninae*.

Moreover, we suggest the amendment of the group of characteristic species of the same suborder with the addition of *Ranunculus breyninus* and *Festuca violacea* ssp. *italica*. The former species is not exclusive to the Apennine relevés, but is constantly present in the associations of the first cluster and has already been identified (Biondi *et al*. 2000, 2002, Allegrezza *et al*. 2003) as characteristic of the superior level for the association of the classes *Kobresio-Seslerietea*. *Festuca violacea* ssp. *italica*, is endemic, and therefore it's a geographical differential compared to the Balcan sesleria grasslands.

For the alliance *Seslerion apenninae*, we propose to integrate this group of characteristic species with *Carum flexuosum*, a north-eastern Mediterranean montane species that has already been indicated as characterising the syntaxon in the study of the grasslands of Campo Imperatore (Biondi *et al*., 1999).

CARICI HUMILIS-SESLERIETUM APENNINAE BIONDI *ET AL*. 1988

dryadetosum octopetalae Biondi *et al*. 1999

genistetosum michelii Allegrezza *et al*. 1997 *em. hoc loco*

hieracietosum cymosi subass. nova (type rel.: n. 38 of Table 4)

anthylletosum pulchellae subass. nova (type rel.: n. 45 of Table 4)

Synchorology

This association was described for the first time in a study of the grasslands of *Sesleria juncifolia* ssp. *juncifolia* located below the potential limits of the woods, in the central Apennines (Biondi *et al*., 1988). Then it was seen in the Valleys of Amplero and Vallelonga (Petriccione *et al*., 1993), on Mount Coscerno and Mount of Civitella (Biondi & Ballelli, 1995) and on Mount Gemmo (Allegrezza *et al*., 1997). The association *Carici humilis-Seslerietum apenninae* was found more recently also in Campo Imperatore (Biondi *et al*., 1999), on the ridges of Mount San Vicino (Allegrezza, 2003) and in Val di Bove (Sibillini Mountains, our unpublished relevés).

Syndynamics

These pastures have strong xeric characteristics and they form chain contact with the high-altitude perennial edaphoxerophilous herbaceous communities and the secondary grassland formations of *Festuco-Brometea* of the supratemperate belt.

The association is referred to the grasslands with a dominance of *Sesleria juncifolia* ssp. *juncifolia* that are located below the potential limits of the woods, and although included in the class *Kobresio-Seslerietea* it has a large contingent of species of the class *Festuco-Brometea*. Therefore, from the chorological point of view, this is an association in which the European species reach the greatest percentage cover (over 35%; Table 1).

Synecology

The association is found in the central-southern Apennines, from Mount Catria to Marsica. These coenoses can be considered as permanent stages, sometimes with characteristics of primary formations when they are found in summital positions, where because of cryoturbation, the growth of woody vegetation is impeded. The association *Carici humilis-Seslerietum apenninae* can be seen also on the detritus layers and the alluvial cones, where the particular drainage conditions and the absence of soil block the evolution of the substratum and therefore the development of more mature vegetation.

Physiognomy

The physiognomy is characterised by the abundant presence of dense tufts of *Sesleria juncifolia* ssp. *juncifolia* associated with chamaephytes like *Anthyllis montana* ssp. *atropurpurea*, *Globularia meridionalis, Helianthemum oelandicum* ssp. *incanum* and *Teucrium montanum*, and hemicryptophytes such as *Carex humilis, Koeleria lobata, Dianthus sylvestris* ssp. *longicaulis* and *Bromus erectus*.

Syntaxonomy

Following the comparative analysis of the relevés under examination, it is possible to confirm the validity of the association *Carici humilis-Seslerietum apenninae* and of the subassociation *dryadetosum octopetalae* (Biondi *et al*., 1999), while it has been necessary to amend the subassociation *genistetosum michelii* (Allegrezza *et al*., 1997). Moreover, two new plant communities are proposed: *hieracietosum cymosi* and *anthylletosum pulchellae* (Table 4).

At the higher altitudes that are reached by this coenosis (1,790-1,850 m), the subassociation *dryadetosum octopetalae* (Biondi *et al*., 1999) has been described, which provides chain contact with the chamaephytic grasslands of the association *Seslerio apenninae-Dryadetum octopetalae*.

In rocky calcareous locations that are less exposed to the rigours of winter, the subassociation *genistetosum michelii* (Allegrezza *et al*., 1997, 2003) has been seen, which represents the more distinctly chamaephytic and rocky aspect of the association. In the present study, this formation is amended with the addition to the group of species already described of *Potentilla cinerea*, which under ecological conditions of rocky outcrops behaves as a chamaephyte.

In the basin of Mount Bove (in the Sibillini Mountains), at heights near to the potential limits of the woods (1,620-1,815 m), on slopes mainly exposed to the north and with variable slopes from 20° to 30°, the new subassociation *hieracietosum cymosi* is described, which is mainly made up of scapose hemicryptophytes *Campanula tanfanii* and *Hieracium cymosum*, and of the suffruticose chamaephytic species *Trinia dalechampii, Helianthemum nummularium* ssp. *grandiflorum* and *Erysimum cheiri*; to these there can be added *Saxifraga paniculata, Thymus praecox* ssp. *polytricus, Erophyla verna* ssp. *verna* and *Solenanthus*

apenninus.

The grasslands of *Sesleria juncifolia* ssp. *juncifolia* seen on Mount Coscerno and Mount of Civitella (Biondi & Ballelli, 1995) were originally attributed to the type subassociation; from the comparison proposed in Table 4, a large differential group can be distinguished: *Knautia arvensis, Anthyllis vulneraria* ssp. *pulchella, Festuca robustifolia, Eryngium amethystinum, Onobrychis alba* ssp. *alba* and *Sedum acre* allow the characterisation and description of the new subassociation *anthylletosum pulchellae*.

Seslerietum apenninae Bruno & Furnari 1966
juncetosum monanthi Biondi *et al*. 1999
festucetosum alfredianae subass. nova (type rel.: n. 49 of Table 5)

Syndynamics

The association *Seslerietum apenninae* makes up the main edaphoxerophilous vegetation of the orotemperate bioclimate belt, and locally also the same of the cryorotemperate belt. It is often in contact with the vegetation of the association *Leontopodio nivalis-Elynetum myosuroidis* and with that of the screes.

Synecology

This formation grows on the peaks on superficial soils with limited slope and with rocky outcrops, and also on detritus and often on terraced slopes. On the basis of the ecological evaluation carried out at Campo Imperatore (Biondi *et al*., 1999), the soil on which the association *Seslerietum apenninae* grows has a pH that is slightly basic (centroid 7.66), a high skeleton content (centroid 44%) and a relatively good ability for cationic exchange.

During the winter period, due to the actions of the wind, the soil can remain without snow cover for long periods, with the consequence that the vegetation is left exposed to the severity of the climatic agents. The harshness of the winter provides strong selection pressure against the floristic entities with greater nutritional and ecological needs, and at the same time, it supports the development of those species that are adapted to this habitat. An example is seen in the way *Sesleria juncifolia* ssp. *juncifolia* grows under certain conditions: in situations that are particularly windy and where there is no snow cover, the leaves of this grass tend to grow at the side opposite from which the dominant wind comes, while the branches at the other side tend to dry up. It is maybe a consequence of this that the hummocks formed by this vegetation are elongated in the form of strips, which on some slopes cause the typical terraced aspect.

Physiognomy

The physiognomy is due to the presence of *Sesleria juncifolia* ssp. *juncifolia* accompanied by chamaephytes such as *Helianthemum oelandicum* ssp. *alpestre* and *Anthyllis montana* ssp. *atropurpurea* and by high-altitude microthermal species like *Androsace villosa* ssp. *villosa, Draba aizoides* ssp. *aizoides, Pedicularis elegans* and *Silene acaulis* ssp. *bryoides*. The mean cover of the plant of the relevés analysed is 65%.

Synchorology and syntaxonomy

The association is included in the alliance *Seslerion apenninae*, of the suborder *Seslerienalia apenninae*, of the order *Seslerietalia tenuifoliae* and of the class *Kobresio-Seslerietea*.

The first description of *Sesleria juncifolia* ssp. *juncifolia* grasslands in the Apennines can be attributed to Lüdi (1943), who used the term *Carex laevis-Sesleria tenuifolia* Trockenrasen, although, based on Article 3c of the Code for Phytosociological Nomenclature, this term cannot be considered valid. The double name of *Seslerietum tenuifoliae* was used to describe the formations with a dominance of *Sesleria juncifolia* ssp. *juncifolia* found on Mount Terminillo and Gran Sasso by Montelucci (1952) and Furnari (1961), respectively. Both of these descriptions cannot be considered valid because they are synonymous with the previous association *Seslerietum tenuifoliae* indicated by Horvat in 1930 and used to describe a vegetation seen on the Croatian mountains, which is anyway syntaxonomically different to that identified in the Apennines (Mucina, 2003).

In their report of the excursion of the International Phytosociological Society, Bruno & Furnari (1966) described two relevés (pages 5 and 17) as "*Seslerietum* of *Sesleria apennina* Ujheyi and *Carex kitaibeliana* Degen". Biondi *et al*. (1999) indicated that this second name here is a correction of the first one previously used. As a consequence, they considered "*Seslerietum apenninae* Furnari 1961 corr. Furnari 1966" as the correct name for the coenosis in question, indicating the type relevé in Furnari (1961), the relevé that in the original study took the name of "*Seslerietum tenuifoliae*" instead.

Mucina (2003) did not accept the standardisation of the name *Seslerietum apenninae* based on the relevé in Furnari (1961). Instead, he identified relevé 4 of page 17 of Bruno & Furnari (1966) as the holotype of the association, indicating that this was the correct reference to this syntaxonomic unit, in that it is clear that the term *Seslerietum* is for *Seslerietum apenninae*, being that *Sesleria apennina* is the only *Sesleria* present in the relevé.

Migliaccio (1970) and then Bonin (1978) described a formation of *Sesleria* that they indicated as *Seslerietum apenninae*. The proposal of these last authors cannot be considered valid, in that also in this case, this was a synonym of an already used name.

For the cryorotemperate belt of the Maiella Massif, the new association *Leontopodio nivalis-Seslerietum apenninae* has been described, with the characteristic and differential species of the association indicated as *Leontopodium nivale, Aster alpinus* ssp. *alpinus, Iberis saxatilis* and *Ranunculus breyninus* (Blasi *et al*. 2005). According these authors, this phytocoenosis grows on brown rendzina and relatively deep soils, but with a high skeleton content, and from the point of view of the physiognomy, it has a percentage cover of soil greater than the other formations of *Sesleria juncifolia* ssp. *juncifolia* found in the central-southern Apennines. From an analysis of Table 5, it can be seen that this formation as described Blasi *et al*. (2005) does not show any autonomy, either florisic or structural, if it is compared with the relevés of the other primary grasslands ascribed to the association *Seslerietum apenninae*. In particular, the group of species proposed as characteristic and differential of this last coenosis, as *Helianthemum oelandicum* ssp. *alpestre*, *Pedicularis elegans* and *Androsace villosa* ssp. *villosa*, are well represented in the relevés of the new association. Also, the entities said to be diagnostic for the association *Leontopodio nivalis-Seslerietum apenninae* are actually constantly present and well represented also in the relevés of the previous association *Seslerietum apenninae*.

From the analyses of the relevés, the presence of two subassociations is revealed.

For Campo Imperatore the subassociation *juncetosum monanthi* has been described (Biondi *et al*., 1999). This syntaxon is characterised by Arctic–Alpine species and shows dynamic connections with the climatophilous vegetation of the Alpine belt of the association *Leontopodio nivalis-Elynetum myosuroidis*.

For the Sibillini Mountains and the Maiella, the new subassociation *festucetosum alfredianae* is here proposed, in which the participation of rupicolous species of the class *Asplenietea trichomanis* (*Saxifraga paniculata*) and of scree entities of the class *Thlaspietea* (*Iberis saxatilis*, *Thlaspi stylosum*, *Silene multicaulis* ssp. *multicaulis, Galium magellense*, *Leontodon montanus* ssp. *melanotrichus* and *Saxifraga oppositifolia* ssp. *speciosa*) indicate the change towards more xeric conditions that are typical of less evolved soils. To this can then be added *Arenaria bertolonii*, *Cerastium thomasii* and *Sempervivum arachnoideum*. The coenosis has a cover that is generally discontinuous and grows on a terraced morphology, with slopes greater than 20°, with mainly a southern exposure, and at altitudes between 1,880 m and 2,510 m.

Seslerio apenninae-Dryadetum octopetalae Biondi *et al*. 1999
caricetosum firmae Biondi *et al*. 1999
polygaletosum alpestris subass. nova (type rel.: n. 14 of Table 6)
Synchorology

The association was first described during geobotanical analyses carried out by Biondi *et al*. (1999) in Campo Imperatore, and later it was found again for the summit sectors of the Maiella Massif (Di Fabrizio *et al*. 2006; unpublished relevés).
Synecology

The association *Seslerio apenninae-Dryadetum octopetalae* consists of primary grasslands of the cryorotemperate, orotemperate and supratemperate bioclimate belts. It is found under particularly selective conditions that are characterised by strong winds, and soils that are subjected to intense cryoturbation.

Dryas octopetala ssp. *octopetala* is a creeping chamaephyte, and it is a species with a great colonisation ability both on moving detritus and on lithosoils. It forms closed islands of vegetation that gathers small patches of soil, thus allowing the growth of floristic entities that would otherwise not be able to occupy these habitats.
Physiognomy

The physiognomy of this coenosis is characterised by *Dryas octopetala* ssp. *octopetala* and other chamaephytes, like *Edraianthus graminifolius* ssp. *graminifolius*, *Androsace villosa* ssp. *villosa*, *Anthyllis montana* ssp. *atroporpurea*, and caespitose hemicryptophytes such as *Sesleria juncifolia* ssp. *juncifolia*, *Carex kitaibeliana* ssp. *kitaibeliana* and *Carex mucronata*, and it is characterised by its floristic paucity (mean of 14.5 species/relevé; Table 1).
Syntaxonomy

From the relevés of Campo Imperatore, the subassociation *caricetosum firmae* was differentiated for the cryoorotemperate belt (Biondi *et al*., 1999). This syntaxon is of particularly phytogeographical interest, as Campo Imperatore is the only Apennine location for *Carex firma*.

Some relevés were carried out in the locality of the Valle Taranta, in the Maiella Massif (Di Fabrizio *et al*. 2006; unpublished relevés), at altitudes between

Tab. 6 - *Seslerio apenninae-Dryadetum octopetalae* Biondi *et al.* 1999

		Number of relevé	1	2	3	4	5	6	7	8	9	10	11*	12	13+	14!+	15	16	
		Altitude (m. a.s.l. x 10)	188	188	190	183	199	176	191	192	179	211	226	200	223	225	232	232	
		Aspect	sse	s	w	sw	s	wsw	nw	s	sw	s	e	sw	w	ne	ne	e	
		Slope (°)	40	45	25	40	30	5	5	30	5	5	5	40	30	35	30	25	
		Coverage (%)	100	95	75	80	70	40	60	70	70	70	80	80	90	95	100	100	
		Relevé area (m²)	6	6	25	12	20	10	15	15	20	15	20	30	10	20	20	15	
Dif. and char. sp. *Seslerio apenninae-Dryadetum octopetalae* Biondi *et al.* 1999																			
Ch rept	(CIRCUM.)ART.ALP.	Dryas octopetala L. ssp. octopetala	4	4	1	2	3	2	2	2	2	2	4	2	3	4	4	4	16
H caesp	OROF. SE-EUROP.	Carex mucronata All.	.	.	.	.	2	2	2	2	2	3	1	3	.	.	.	.	8
H scap	ENDEM.	Leontopodium nivale (Ten.) Huet ex Hand.-Mazz.	.	.	.	.	.	.	.	.	.	1	1	+	+	1	+	+	7
G rhiz	OROF. S-EUROP.	Ranunculus thora L.	1	.	+	.	.	+	.	+	.	.	.	.	.	.	.	.	4
Dif. sp. *caricetosum firmae* Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999																			
H caesp	(CIRCUM.)ART.ALP.	Carex rupestris All.	.	.	.	.	.	.	.	.	.	.	+	.	1	.	.	.	2
H caesp	Orof. S-Europ.	Carex firma Host	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	1
G rhiz	Artico-Alp	Bistorta vivipara (L.) Delarbre	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1
Dif. sp. *polygaletosum alpestris* subass. nova																			
Ch suffr	EUROP.-CAUC.	Trinia dalechampii (Ten.) Janchen	.	.	.	+	.	.	.	.	.	.	.	.	.	+	+	+	4
H scap	OROF. S-EUROP.	Polygala alpestris Rchb.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	4	4	3
H scap	(CIRCUM.)ART.ALP.	Pedicularis verticillata L.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	+	3
H scap	OROF. S-EUROP.	Oxytropis neglecta Ten.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	+	3
Dif. and char. sp. *Seslerion apenninae* Furnari in Bruno & Furnari 1966 em. hoc loco																			
H caesp	OROF. SE-EUROP.	Sesleria juncifolia Suffren ssp. juncifolia	1	+	3	3	2	1	3	1	3	2	2	3	.	+	+	+	15
H caesp	OROF. SE-EUROP.	Carex kitaibeliana Degen ex Bech ssp. kitaibeliana	+	1	1	2	.	1	+	3	.	+	1	+	1	2	1	+	14
Ch suffr	ENDEM.	Edraianthus graminifolius (L.) DC. ssp. graminifolius	.	+	1	1	+	+	+	.	1	+	+	.	.	+	+	+	12
Ch rept	EURASIAT.	Androsace villosa L. ssp. villosa	+	+	+	+	.	+	+	1	+	+	+	1	.	.	.	.	11
Ch suffr	MEDIT.-MONT.	Anthyllis montana L. ssp. atropurpurea (Vukot.) Pignatti	1	+	.	1	+	1	1	1	2	.	1	.	.	.	.	.	9
H scap	OROF. S-EUROP.	Gentiana dinarica Beck	1	+	+	.	.	+	+	+	1	.	1	+	.	.	.	.	9
H scap	NE-MEDIT.-MONT.	Carum flexuosum (Ten.) Nyman	.	1	.	.	+	.	.	+	.	.	+	+	.	.	.	.	5
T scap	EUROP.-CAUC.	Euphrasia salisburgensis Funk ex Hoppe	.	.	.	.	+	.	.	+	.	1	.	+	.	.	.	.	4
Ch pulv	OROF. S-EUROP.	Saxifraga caesia L.	.	.	.	.	.	.	+	.	.	.	.	1	+	.	.	.	3
H scap	OROF. SE-EUROP.	Thesium parnassi DC.	.	.	+	.	.	+	.	.	+	.	.	.	.	.	.	.	3
Ch suffr	E.-MEDIT.-MONT.	Helianthemum oelandicum (L.) DC. ssp. alpestre (Jacq.) Ces.	1	2	.	.	.	.	.	.	.	.	+	.	.	.	.	.	3
H ros	ENDEM.	Pedicularis elegans Ten.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	1
Dif. and char. sp. *Seslerietalia tenuifoliae* Horvat 1930, *Seslerienalia apenninae* Bruno & Furnari 1966 em. hoc loco, *Kobresio myosuroidis-Seslerietea caeruleae* Br.-Bl. 1948 nom. mut. Rivas-Martinez, Diaz, Fernandez-Gonzalez, Izco, Loidi, Lousa & Penas 2002																			
Ch suffr	EUROP.-CAUC.	Helianthemum oelandicum (L.) DC. ssp. incanum (Willk.) G. Lopèz	.	.	+	+	.	+	1	1	2	1	.	2	.	.	.	.	8
H scap	EURIMEDIT.	Anthyllis vulneraria L. ssp. weldeniana (Rchb.) Cullen	.	.	+	.	.	.	.	+	+	.	.	+	+	1	+	.	7
H ros	SE-EUROP.	Minuartia verna (L.) Hiern ssp. verna	.	.	.	+	.	.	+	.	+	.	.	+	.	.	.	.	4
Ch pulv	(CIRCUM.)ART.ALP.	Ranunculus breyninus Crantz	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	3
H scap	MEDIT.-MONT.	Dianthus sylvestris Wulfen ssp. longicaulis (Ten.) Greuter & Burdet	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	3
H ros	OROF. C-EUROP.	Draba aizoides L. ssp. aizoides	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	2
H scap	OROF. S-EUROP.	Pulsatilla alpina (L.) Delarbre ssp. millefoliata (Bertol.) D.M. Moser	.	+	.	.	.	.	.	.	.	.	1	.	.	.	.	.	2
H scap	OROF. S-EUROP.	Phyteuma orbiculare L.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	1
Ch frut	N-MEDIT.-MONT.	Astragalus sempervirens Lam.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1
Other species																			
Ch suffr	OROF. S-EUROP.	Lomelosia graminifolia (L.) Greuter et Burdet ssp. graminofolia	2	3	+	+	1	1	+	.	.	+	.	.	.	.	.	.	8
Ch rept	NE-MEDIT.-MONT.	Globularia meridionalis (Podp.) O. Schwarz	.	.	+	1	+	+	+	+	1	.	.	1	.	.	.	.	8
H caesp	ENDEM.	Avenula praetutiana (Parl. ex Arcang.) Pignatti	.	+	.	+	+	+	.	1	.	.	.	1	.	.	.	.	6
H ros	EUROP.-CAUC.	Leontodon hispidus L.	.	1	+	+	1	.	.	.	.	.	.	.	.	.	.	.	4
H caesp	EURASIAT.	Carex humilis Leyss.	.	.	.	.	+	.	1	+	.	.	.	+	.	.	.	.	4
H scap	E-EUROP.	Myosotis alpestris F. W. Schmidt	+	.	.	.	.	.	.	+	+	.	.	+	.	.	.	.	4
Ch suffr	OROF. S-EUROP.	Teucrium montanum L.	.	.	.	.	+	.	.	+	+	.	.	.	.	.	.	.	3
H caesp	SUBENDEM.	Carex macrolepis DC.	1	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	3
H caesp	OROF.EUROP.	Brachypodium genuense (DC.) Roem et Schult.	.	.	+	+	.	.	.	.	.	.	.	+	.	.	.	.	3
T scap	EURIMEDIT.	Linum catharticum L.	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	3
Ch suffr	NE-STENOMEDIT.	Potentilla apennina Ten. ssp. apennina	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	2
H caesp	S-MEDIT.-MONT.	Festuca alfrediana Foggi & Signorini	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1
H ros	OROF. S-EUROP.	Bellidiastrum michelii Cass.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	1

2,250 m and 2,320 m, on slopes with a steepness of around 30° and generally with a northern exposure. These relevés are again distinguished by their floristic paucity, the low number of species of the upper syntaxonomic units, the large cover, and the constant presence of *Polygala alpestris*. From these relevés, it was possible to describe the new subassociation *polygaletosum alpestris*. The differential species are: *Trinia dalechampii*, *Polygala alpestris, Pedicularis verticillata* and *Oxytropis neglecta*, all of which are of the class *Kobresio-Seslerietea*.

Caricetum kitaibelianae-rupestris Biondi *et al*. 2000
artemisietosum erianthae Biondi *et al*. 2000
Synchorology

The association *Caricetum kitaibelianae-rupestris* (Table 7) was described for the first time for Corno Grande (Biondi *et al*., 2000), and later found in other locations (Mount Aquila) in the Gran Sasso Group (Biondi *et al*., 2002; Blasi *et al*., 2003). This grassland with *Carex kitaibeliana* ssp. *kitaibeliana* and *Carex rupestris* can be considered the Apennine vicariant of the association *Caricetum rupestris* described for the cryorotemperate belt of the Dolomites (Pignatti & Pignatti, 1985).

Syndynamics

This is considered to be in chain contact with the climatophilous vegetation of the cryorotemperate belt: the elyna grassland of the association *Leontopodio nivalis-Elynetum myosuroidis*.

Synecology

This is a discontinuous edaphoxerophilous grassland that grows on primitive soils that are sometimes terraced. On the basis of the data of the relevés, it can be noted that this has a mean cover of the soil of almost 80%, and that this plant coenosis rarely descends below 2,350 m.

Physiognomy

The physiognomy of the association *Caricetum kitaibelianae-rupestris* arises from a substantial group of caespitose hemicryptophytes, such as *Carex rupestris, Carex kitaibeliana* ssp. *kitaibeliana, Sesleria juncifolia* ssp. *juncifolia,* and *Festuca violacea* ssp. *italica*.

Syntaxonomy

Of particular chorological interest, there are *Carex rupestris* and *Silene acaulis* ssp. *bryoides*, which are both Arctic–Alpine circumboreal species (they characterise the association and increase the mean cover value of this chorotype to more than 32%; Table 1). This is because they group in a floristic cortège that is dominated by southern European orophytes that are typically Apennine, like *Sesleria juncifolia* ssp. *juncifolia*, *Carex kitaibeliana* and *Sedum atratum*, and other species, like the endemic *Edraianthus graminifolius* ssp. *graminifolius* and *Festuca violacea* ssp. *Italica*, and the Mediterranean-montane *Helianthemum oelandicum* ssp. *alpestre*. These last are all characteristic of the suborder *Seslerienalia apenninae* or of the alliance *Seslerion apenninae*, allowing this coenosis to be differentiated from *Caricetum rupestris* of the Alps and to include it within the class *Kobresio-Seslerietea*.

For Corno Grande and Mount Aquila, in small valley-like situations of the rocky crests with high slope (more than 35°) with a mainly northern exposure and under conditions of continual disturbance because of the wind, the subassociation *artemisietosum erianthae* has been described (Biondi *et al*., 2000). *Artemisia umbelliformis* ssp. *eriantha* is a suffruticose chamaephyte that grows on the highest calcareous heights of the Apennines (Sibillini Mountains, Gran Sasso and Maiella Massifs) and of the maritime Alps. Individuals frequently grow in the cracks and breaks in the rocks, where there is accumulation of soil and where they are sheltered from the winds.

For Gran Sasso, there are also two variants that have been identified: one with *Salix retusa* (Blasi *et al*., 2003) and the other with *Dryas octopetala* ssp. *octopetala* (Biondi *et al*., 2000).

Carici rupestris-Kobresietea bellardii Ohba 1974 nom. mut. prop. Rivas-Martinez *et al*. 2002

Suballiance *Leontopodio nivalis-Elynenion myosuroidis* Blasi *et al*. 2003 (Table 3)

The associations *Helianthemo alpestris-Festucetum italicae*, *Leontopodio nivalis-Elynetum myosuroidis* and *Galio magellensis-Silenetum acaulis* are included in the suballiance *Leontopodio nivalis-Elynenion myosuroidis* according to the interpretation of Blasi *et al*. (2003). However, the syntaxonomic collocation of the last of these syntaxa needs to be revised, with modifications proposed for the previous interpretation (Blasi *et al*., 2003) that attributed it to the alliance *Seslerion apenninae*, to the order *Seslerietalia tenuifoliae* and to the class *Kobresio-Seslerietea*; we propose its assignment to the class *Carici-Kobresietea*, in agreement with Biondi *et al*. (1999) and as described previously.

The suballiance *Leontopodio nivalis-Elynenion myosuroidis* would represent the Apennine-focussed syntaxon of the central-southern European alliance *Oxytropido-Elynion* (Braun-Blanquet, 1948). This last, and the order *Oxytropido-Kobresietalia*, both

considered by Braun-Blanquet (1948) and Albrecht (1969) to be the lower hierarchical levels of the class *Kobresio-Seslerietea*, are now gathered in the class *Carici-Kobresietea* on the basis of what was stated more recently by Ohba (1974) and Biondi *et al*. (1999). On the basis of this syntaxonomic interpretation, only the entities representative of the three associations of interest, and not those indicated in the literature as diagnostic of the upper hierarchical levels, can be considered characteristic species of this suballiance: *Bistorta vivipara*, *Gnaphalium hoppeanum* ssp. *magellense*, *Leontopodium nivale*, *Helianthemum oelandicum* ssp. *alpestre*, *Gentiana utriculosa*, *Oxytropis neglecta*, *Carex ericetorum*, and *Antennaria dioica*.

Helianthemo alpestris-Festucetum italicae Blasi *et al*. 2005

anthylletosum weldenianae subass. nova (type rel: 19 of Table 8)

helianthemetosum grandiflorum subass. nova (type rel: 30 of Table 8)

Synchorology

The association *Helianthemo alpestris-Festucetum italicae* was observed in various locations of the cryorotemperate belt of the Maiella Massif (Blasi *et al*., 2005), and later found in other locations of the same massif (Di Fabrizio *et al*. 2006; unpublished relevés).

Syndynamics

In the systems of depressions and cattle holes, and particularly common at the head of the valleys cut out by glaciation, this coenosis can provide chain contact between the vegetation at the base of the valley and that of the summit subplain sectors, covering the less steep slopes of the depressions.

Synecology

This is found as discontinuous grasslands both on the relatively steep slopes with rocky outcrops and in subplain situations with deeper soils

Physiognomy

Helianthemum oelandicum ssp. *alpestre* and *Festuca violacea* ssp. *italica* have the greatest effects on the physiognomy of this phytocoenosis. There is also an important presence of microthermal hemicryptophytes like *Carex kitaibeliana* ssp. *kitaibeliana, Draba aizoides* ssp. *aizoides* and *Leontopodium nivale*, and chamaephytes such as *Thymus praecox* ssp. *polytricus*, *Edraianthus graminifolius* ssp. *graminifolius* and *Silene acaulis* ssp. *bryoides*.

Syntaxonomy

On the basis of the analyses carried out in the present study, the association *Helianthemo alpestris-Festucetum italicae* can be included in the suballiance *Leontopodio-Elynenion* and in the alliance *Oxytropido-Elynion* ascribed to the order *Oxytropido-Kobresietalia* and to the class *Kobresio-Seslerietea*.

In the steep locations (35°-40°) that are characterised by terraced soils with greatly fractured rocky outcrops and small and medium sized rock detritus, the new subassociation *heliathemetosum grandiflorii* can be identified. In the relevés, there is an evident absence of species of this suballiance, while there are a number of entities that have infiltrated from the lower altitudes: *Hippocrepis comosa* ssp. *comosa*, *Senecio scopolii*, *Hieracium naegelianum* and *Medicago lupulina*. This infiltration from below is evidence of microclimate conditions that are relatively milder with respect to those expected for the altitude, probably because of their ESE exposure and their position protected from the wind. The differential species of the subassociation are: *Helianthemum nummularium* ssp. *grandiflorum* (*Festuco-Brometea*), *Doronicum columnae* (*Mulgedio-Aconitetea*), *Trifolium noricum* ssp. *praetutianum* (*Salicetea herbaceae*), *Rumex nebroides*, *Senecio scopolii*, *Hieracium naegelianum* and *Cerastium thomasii* (*Thlaspietea*).

In locations characterised by less steep slopes (10°-25°), on soils that are relatively more evolved and terraced, there is the new subassociation *anthylletosum weldenianae*. This herbaceous community can represent the chain contact between the edaphoxerophilous formations and those climatophilous that is often seen in the system of depressions and cattle holes at the bottom of the glacial valleys. The differential species of the subassociation are: *Anthyllis vulneraria* ssp. *weldeniana* (*Festuco-Brometea*), *Armeria majellensis* ssp. *majellensis* (*Festuco-Brometea*), *Acinos alpinus* ssp. *meridionalis* (*Kobresio-Seslerietea*) and *Gentiana brachyphylla* ssp. *favratii* (*Carici-Kobresietea*).

Leontopodio nivalis-Elynetum myosuroidis Feoli-Chiapella & Feoli 1977

trinietosum dalechampii Biondi *et al*., 1999 em. hoc loco

Synchorology

The association *Leontopodio nivalis-Elynetum myosuroidis* (Table 9) was first found on the summit sectors of the Maiella Massif by Feoli-Chiapella & Feoli (1977), and later at Campo Imperatore (Biondi *et al*., 1999), where the subassociation *trinietosum dalechampii* was also described. Blasi *et al*. (2003) extended observations of this coenosis to other locations of Gran Sasso, Maiella and Laga Massifs.

As well as the relevés already published, unpublished relevés from the Maiella are included here (Table 9, rel. n° 16-22).

Synecology

From the ecological point of view, this elyna grassland is generally found for locations at altitudes greater than 2,300 m and on soils that are relatively deep.

Physiognomy

This vegetation is the climatophilous formation of the cryorotemperate belt of the central-southern Apennines and it is a closed grassland with a dominance of *Kobresia myosuroides* (=*Elyna myosuroides*), a caespitose hemicryptophyte with an Arctic–Alpine circumboreal distribution.

This formation is made up of numerous species with an eastern distribution, such as: *Oxytropis campestris, Alchemilla colorata, Carex ericetorum, Trinia dalechampii, Trifolium thalii, Androsace villosa* ssp. *villosa* and *Gentiana verna* ssp. *verna*, with a significant presence of Arctic-Alpine entities, like: *Kobresia myosuroides*, *Pedicularis verticillata, Ranunculus breyninus*, *Bistorta vivipara, Potentilla crantzii* ssp. *crantzii, Silene acaulis* ssp. *bryoides,* and *Gentiana nivalis*.

Syntaxonomy

The four species suggested by Feoli-Chiapella & Feoli (1977) to describe this coenosis have been confirmed. It is, however, necessary to propose an amendment to the group of differential species identified by Biondi *et al*. (1999) for the subassociation *trinietosum dalechampii*.

This syntaxon has been recorded for Gran Sasso, Laga, and Maiella Massifs in situations of slopes of mainly northern exposure on evolved soils from 2,020 m to 2,470 m in altitude and with a particularly dense cover, mainly due to the presence of scapose and rosette hemicryptophytes.

Of the group of differential species originally proposed, *Alchemilla colorata*, *Trinia dalechampii* and *Antennaria dioica* have been confirmed, while *Armeria majellensis* ssp. *majellensis* has little significance: it is more diffuse in the type subassociation and particularly sporadic in *trinietosum dalechampii*. Some other species instead appear to be better for the differentiation of this subassociation: *Trifolium thalii*, *Plantago alpina* and *Plantago atrata* (*Nardetea*), *Carex ericetorum*, *Pedicularis verticillata, Ranunculus breyninus, Luzula spicata* ssp. *italica* and *Gentiana verna* ssp. *verna* (*Kobresio-Seslerietea*), *Festuca rubra* (*Molinio-Arrhenatheretea*) and *Viola eugeniae* ssp. *eugeniae*.

Galio magellensis-Silenetum acaulis Blasi *et al*. 2003

trifolietosum thalii Blasi *et al*. 2003

alyssetosum cuneifolii Blasi *et al*. 2003

saxifragetosum speciosae subass. nova (type rel: n° 25 of Table 10)

Synchorology

This association was described by Blasi *et al*. (2003) for Maiella (Mount Focalone, Mount Amaro, Terzo Portone, Cima Pomilio and Mount Sant'Angelo), Gran Sasso (Corno Grande and Mount Aquila) and Laga (Mount Gorzano), but this formation is also found on other Apennine Massifs, such as Sibillini and Velino Mountains.

Synecology

The association *Galio magellensis-Silenetum acaulis* grows in particularly selective ecological situations: where there is scarse snow cover, the periglacial phenomena are intense, and the soils are primitive, mainly protorendzina, with superficial relatively large clasts derived from fragmentation through the cryoclastic actions of the rocks there. From the data relative to the location, it can be seen that in the situation investigated, the association is found at altitudes greater than 2,300 m, both on slopes (with a mainly southern exposure) and in subplain situations.

Physiognomy

This vegetation typology, characteristic of the Alpine belt, is tightly linked with an important pioneer species, *Silene acaulis* ssp. *bryoides*, a hummock-forming chamaephyte with a great capacity for adaptating to very different environments (cliffs, screes, ridges, summit plains). Once its hummocks have developed, they provide substrate for the growth of species that cannot survive directly on the bare soils affected by intense cryoturbation.

Syntaxonomy

Although it is indicated as a syntaxon of the class *Kobresio-Seslerietea* (Biondi *et al*., 2006), in agreement with Blasi *et al*. (2003), it is believed best to relocate the cenoesis in the class *Carici-Kobresietea*, due to a closer resemblance to the association *Leontopodio-Elynetum*, because of the strong presence of Arctic–Alpine, circumboreal, and endemic species.

From the analysis of the chorology, a strong presence of endemic species and Nordic species can be noted (Table 1).

In Blasi *et al*. (2003), together with the type subassociation *Galio magellensis-Silenetum acaulis* subass. *silenetosum acaulis*, two other subassociations have been described, *trifolietosum thalii* and *alyssetosum cuneifolii*, for the Laga (on arenaceous substrata) and for the Maiella (on calcareous substrata,

in subplain areas), respectively.

In the present study, the validity of the association and of the subassociations already described is confirmed, and moreover, there is a new subassociation proposed (Table 10). Here, the new subassociation *saxifragetosum speciosae* is proposed for the relevés carried out in the localities of Mount Focalone, Mount Amaro, Terzo Portone, Cima Pomilio and Mount Sant'Angelo (Di Fabrizio *et al*. 2006; Maiella Massif, unpublished relevés) in situations of relatively steep slopes (from 10° to 35°) and at altitudes between 2,525 m and 2,670 m. The differential species are: *Edraianthus graminifolius* ssp. *graminifolius, Carex kitaibeliana* ssp. *kitaibeliana, Anthyllis vulneraria* ssp. *weldeniana*, *Pedicularis elegans* (*Kobresio-Seslerietea*), *Armeria majellensis* ssp. *majellensis* (*Festuco-Brometea*) and *Leontodon montanus* ssp. *melanotrichus* (*Thlaspietea*). *Saxifraga oppositifolia* ssp. *speciosa* is instead transgressive from the suballiance *Leontopodio-Elynenion*.

Syntaxonomic scheme

KOBRESIO MYOSUROIDIS-SESLERIETEA CAERULEAE BR.-BL. 1948 NOM. MUT. RIVAS-MARTINEZ, DIAZ, FERNANDEZ-GONZALEZ, IZCO, LOIDI, LOUSA & PENAS 2002

Seslerietalia tenuifoliae Horvat 1930

◊*Seslerienalia apenninae* Bruno & Furnari 1966 em. hoc loco

○*Seslerion apenninae* Furnari in Bruno & Furnari 1966 em. hoc loco

●*Carici humilis-Seslerietum apenninae* Biondi, Ballelli, Guitian & Allegrezza 1988

dryadetosum octopetalae Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999

genistetosum michelii Allegrezza, Biondi, Formica & Ballelli 1997 em. hoc loco

hieracietosum cymosi subass. nova

anthylletosum pulchellae subass. nova

●*Seslerietum apenninae* Bruno & Furnari 1966

juncetosum monanthi Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999

festucetosum alfredianae subass. nova

●*Seslerio apenninae-Dryadetum octopetalae* Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999

caricetosum firmae Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999

polygaletosum alpestre subass. nova

●*Caricetum kitaibelianae-rupestris* Biondi, Allegrezza, Ballelli & Taffetani, 2000

artemisietosum erianthae Biondi Allegrezza, Ballelli & Taffetani, 2000

Dryas octopetala ssp. *octopetala* variant

Salix retusa variant

CARICI RUPESTRIS-KOBRESIETEA BELLARDII OHBA 1974 NOM. MUT. PROP. RIVAS-MARTINEZ, DIAZ, FERNANDEZ-GONZALEZ, IZCO, LOIDI, LOUSA & PENAS 2002

Oxytropido-Kobresietalia Oberdorfer ex Albrecht 1968

○*Oxytropido-Elynion myosuroidis* Br.-Bl. 1949

◦*Lentopodio nivalis-Elynenion myosuroidis* Blasi, Di Pietro, Fortini & Catonica 2003

●*Helianthemo alpestris-Festucetum italicae* Blasi, Di Pietro & Pelino, 2005

anthylletosum weldenianae subass. nova

helianthemetosum grandiflorum subass. nova

●*Leontopodio nivalis-Elynetum myosuroidis* Feoli Chiapella & Feoli 1977

trinietosum dalechampii Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999 em. hoc loco

●*Galio magellensis-Silenetum acaulis* Blasi, Di Pietro, Fortini & Catonica 2003

trifolietosum thalii Blasi, Di Pietro, Fortini & Catonica 2003

alyssetosum cuneifolii Blasi, Di Pietro, Fortini & Catonica 2003

saxifragetosum speciosae subass. nova

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Appendix 1: type relevés

Tab. 4: *Carici humilis-Seslerietum apenninae* Biondi, Ballelli, Guitian *et* Allegrezza 1988 type rel.: n. 6 (n. 6 in tab. 1 in Biondi *et al*. 1988); *dryadetosum octopetalae* Biondi *et al*. 1999 type rel.: n. 20, (n.8 in tab. 7 in Biondi *et al*. 1999); *genistetosum michelii* Allegrezza *et al*. 1997 em. hoc loco type rel.: n. 26, (n. 4 in tab. 6 in Allegrezza *et al*. 1997); *hieracietosum cymosi* subass. nova type rel.: n. 38; *anthylletosum pulchellae* subass. nova type rel.: n. 45.

Tab. 5: *Seslerietum apenninae* Bruno & Furnari 1966 type rel.: n. 2 (n. 4 at page 17 in Bruno & Furnari 1966); *juncetosum monanthi* Biondi *et al*. 1999 type rel.: n. 22 (n. 8 in tab. 6 in Biondi *et al*. 1999); *festucetosum alfredianae* subass. nova type rel.: n. 49.

Tab. 6: *Seslerio apenninae-Dryadetum octopetalae* Biondi *et al*. 1999 type rel.: n. 11 (n. 11 in tab. 5 in Biondi *et al*. 1999); *caricetosum firmae* type rel.: n.13 (n. 13 in tab. 5 in Biondi *et al*. 1999); *polygaletosum alpestris* subass. nova type rel.: n. 14.

Tab. 7: *Caricetum kitaibelianae-rupestris* Biondi *et al*. 2000 type rel.: n. 3 (n. 3 in tab. 2 in Biondi *et al*. 2000); *artemisietosum erianthae* Biondi *et al*. 2000 type rel.: n. 28 (n. 10 in tab. 2 in Biondi *et al*. 2000).

Tab. 8: *Helianthemo alpestris-Festucetum italicae* Blasi, Di Pietro *et* Pelino, 2005 type rel.: n. 4 (n. 90 in tab. 7 in Blasi *et al*. 2005); *anthylletosum weldenianae* subass. nova type rel.: n. 19; *helianthemetosum grandiflorum* subass. nova type rel.: n. 30.

Tab . 9: *Leontopodio nivalis-Elynetum myosuroidis* Feoli Chiapella & Feoli 1977 type rel.: n. 14 (ril. n. 19 in tab. 2 in Feoli-Chiappella & Feoli 1977); *trinietosum dalechampii* Biondi *et al*., 1999 em. hoc loco type rel.: n. 23 (n. 3 in tab. 1 in Biondi *et al*. 2000).

Tab. 10: *Galio magellensis-Silenetum acaulis* Blasi *et al*. 2003 type rel.: n. 6 (n. 6 in tab. 5 in Blasi *et al*. 2003); *trifolietosum thalii* Blasi *et al*. 2003 type rel.: n. 9 (n. 9 in tab. 5 in Blasi *et al*. 2003); *alyssetosum cuneifolii* Blasi *et al*. 2003 type rel.: n. 17, (n. 17 in tab. 5 in Blasi *et al*. 2003); *saxifragetosum speciosae* subass. nova type rel.: n. 25.

Appendix 2: accidental species

Tab. 4: Rel. 22, *Astrantia pauciflora* Bertol.: 1. Rel. 23, *Salix retusa* L.: +. Rel. 24, *Asperula purpurea* (L.) Ehrend.: 1; *Stachys recta* L.: +; *Linum corymbulosum* Rchb.: 1. Rel. 26, *Salix retusa* L.: 1, *Asperula purpurea* (L.) Ehrend.: 1; *Stachys recta* L.: +; *Linum corymbulosum* Rchb.: +, *Saxifraga aizoides* L.: +. Rel. 35, *Galium magellense* Ten.: +; *Robertia taraxacoides* (Loisel.) DC.: 1, *Thlaspi stylosum* (Ten.) Mutel: 1; *Campanula scheuchzeri* Vill.: 1, *Sedum sexangulare* L.: +, *Taraxacum apenninum* Ten.: +. Rel. 36, *Galium magellense* Ten.: 1, *Robertia taraxacoides* (Loisel.) DC.: 1, *Juncus trifidus* L. ssp. *monanthos* (Jacq.) Asch. & Graebn.: 2, *Potentilla hirta* L.: +, *Potentilla caulescens* L.: 2. Rel. 39, *Thesium parnassi* DC., +; *Allium lusitanicum* Lam.: +; *Linaria purpurea* (L.) Miller: +. Rel. 40, *Thlaspi stylosum* (Ten.) Mutel: +, *Campanula scheuchzeri* Vill.: +, *Thesium parnassi* DC.: +. Rel. 44, *Armeria canescens* (Host) Ebel: +. Rel. 45, *Sesleria nitida* Ten.: 1.

Tab. 5: Rel. 1, *Thymus serpyllum* L. s.s.: 1. Rel. 2, *Erysimum cheiri* (L.) Crantz: +; *Thymus serpyllum* L. s.s.: 1; *Cynoglossum magellense* Ten.: +. Rel. 17, *Gentiana brachyphylla* Vill. ssp. *favratii* (Rittener) Tutin: 1. Rel. 19, *Astrantia pauciflora* Bertol.:+. Rel. 22, *Astrantia pauciflora* Bertol.: 1, *Anemonastrum narcissiflorum* (L.) Holub. subsp. *narcissiflorum*: +. Rel. 28, *Trifolium noricum* Wulfen ssp. *praetutianum* (Savi) Arcang.: +. Rel. 29, *Trifolium noricum* Wulfen ssp. *praetutianum* (Savi) Arcang.: +. Rel. 30, *Trifolium thalii* Vill.: +, *Erysimum cheiri* (L.) Crantz: +. Rel. 31, *Trifolium thalii* Vill.: +. Rel. 34, *Erophila verna* (L.) DC. ssp. *verna*: +. Rel. 39, *Erophila verna* (L.) DC. ssp. *verna*: +. Rel. 47, *Valeriana montana* L.: +. Rel. 51, *Sesleria nitida* Ten.: +. Rel. 52: *Sesleria nitida* Ten.: +, *Festuca laevigata* ssp. *crassifolia* (Gaudin) Kerguèlen et Plonka: +.

Tab. 7: Rel. 8, *Coeloglossum viride* (L.) Hartm.: +. Rel. 11, *Festuca alfrediana* Foggi & Signorini: 1. Rel. 12, *Thlaspi stylosum* (Ten.) Mutel: +. Rel. 13, *Gentianella columnae* (Ten.) Holub: +. Rel. 14, *Trifolium montanum* L. ssp. *rupestre* (Ten.) Nyman: 1. Rel. 16, *Phyteuma orbiculare* L.: +. Rel. 18, *Myosotis alpestris* F. W. Schmidt: +; *Valeriana montana* L.: +. Rel. 19, *Armeria canescens* (Host) Ebel: 1.

Tab 8: Rel 11, *Luzula spicata* (L.) DC. ssp. *italica* (Parl.) Arcang.: +. Rel. 13, *Arenaria grandiflora* L. ssp. *grandiflora*: 1, *Saxifraga oppositifolia* L. ssp. *speciosa* (Dörfl. & Hayek) Engl. & Irmsch: 1. Rel. 14, *Juncus trifidus* L. ssp. *monanthos* (Jacq.) Asch. & Graebn.: +. Rel. 18, *Juncus trifidus* L. ssp. *monanthos* (Jacq.) Asch. & Graebn.: +. Rel. 20, *Festuca alfrediana* Foggi & Signorini: 1. Rel. 24, *Saxifraga*

oppositifolia L. ssp. *speciosa* (Dörfl. & Hayek) Engl. & Irmsch: +. Rel. 25, *Arenaria grandiflora* L. ssp. *grandiflora*: +. Rel. 27, *Luzula spicata* (L.) DC. ssp. *italica* (Parl.) Arcang.: 1. Rel. 28, *Galium magellense* Ten.: +, *Leontodon montanus* Lam. ssp. *melanotrichus* (Vierh.) Widder ex Pittoni: +, *Medicago lupulina* L.: +, *Herniaria bornmuelleri* Chaudhri: +, *Taraxacum apenninum* (group): +. Rel. 29, *Hippocrepis comosa* L. ssp. *comosa*: +. Rel. 30, *Galium magellens*e *Ten.: +, Hippocrepis comosa L. ssp. comosa: 1, Leontodon montanus Lam. ssp.* melanotrichus (Vierh.) Widder ex Pittoni: +. Rel. 31, *Astragalus depressus* L. ssp. *depressus*: +. Rel. 32, *Medicago lupulina* L.: 1, *Cuscuta epithymum* (L.) L.: +, *Sedum acre* L.: +.

Tab. 9: Rel. 27, *Pedicularis tuberosa* L.: +. Rel. 28, *Pedicularis tuberosa* L.: +. Rel. 29, *Soldanella alpina* L. ssp. *alpina*: +. Rel. 33, *Galium magellense* Ten.: 1. Rel. 34, *Coeloglossum viride* (L.) Hartm.: +. Rel. 36, *Thymus serpyllum* L. s.s.: +. Rel. 48, *Galium magellense* Ten.: +. Rel. 49, *Astrantia pauciflora* Bertol.: +, *Taraxacum glaciale* E. & A. Huet ex Hand.-Mazz.: 1. Rel. 50, *Astrantia pauciflora* Bertol.: 1, *Coeloglossum viride* (L.) Hartm.: +, *Soldanella alpina* L. ssp. *alpina*: 2, *Taraxacum glaciale* E. & A. Huet ex Hand.-Mazz.: +.

Tab. 10: Rel. 1, *Robertia taraxacoides* (Loisel.) DC.: +. Rel. 7: *Robertia taraxacoides* (Loisel.) DC.: +. Rel. 23, *Botrychium lunaria* (L.) Swartz: +, *Astragalus depressus* L. ssp. *depressus*: +. Rel. 28, *Botrychium lunaria* (L.) Swartz: +, *Artemisia umbelliformis* Lam. subsp. *eriantha* (Ten.) Vallès-Xirau et Oliva Brañas: +. Rel. 29, *Campanula scheuchzeri* Vill.: +.

Appendix 3: localities and dates of relevés

Tab. 4: n. 1-2-3-4-5-6-7-8-9 Central Apennines (n. 1-2-3-4-5-6-7-8-9 from tab. 1 in Biondi *et al*. 1988), n. 10-11-12-13-14-15 Campo Imperatore (Gran Sasso) (n. 1-2-3-4-5-6 from tab. 7 in Biondi *et al*. 1999), n. 16-17-18 Valleys of Amplero and Vallelonga (Marsica) (n. 1-2-3 from tab. 1 in Petriccione *et al*. 1993), n. 19-20-21-22 Campo Imperatore (Gran Sasso) (n. 7-8-9-10 from tab. 7 in Biondi *et al*. 1999), n. 23-24-25-26 Mount Gemmo (Umbria-Marche Apennines), (n. 1-2-3-4 from tab. 6 Allegrezza *et al*. 1993), n. 27-28-29-30-31-32-33-34 Mount S. Vicino (Marche Apennines) (n. 1-2-3-4-5-6-7-8 from tab. 45 Allegrezza 2003), n. 35-36-37-38-39-40 Val di Bove (Sibillini Mountains) (unpublished relevés 07/2004), n. 41-42-43-44-45-46-47 Mount Coscerno and Mount of Civitella (Umbria Apennines) (n. 86-84-83-85-87-88-89 in tab. 1 Biondi & Ballelli 1995).

Tab. 5: n. 1-2 Gran Sasso (n.1 (pag. 5) e n. 4 (pag. 17) Bruno & Furnari 1966), n. 3-4-5-6-7-8-9-10-11-12-13-14 Gran Sasso (n. 1-2-3-4-5-6-7-8-9-10-11-12 from tab. 4 Bruno 1961), n. 15-16-17-18-19-20-21-22-23 Campo Imperatore (Gran Sasso) (n. 1-2-3-4-5-6-7-8-9 from tab. 6 Biondi *et al*. 1999), n. 24-25-26-27-28-29-33-34 Val di Bove (Sibillini Mountains) (unpublished relevés 06/2004), n. 30-31-32-35 Val di Panico (Sibillini Mountains) (unpublished relevés 08/2005), n. 36-37-38-39 Val di Bove (Sibillini Mountains) (unpublished relevés 07/2003), n. 40-41-42-43-44-45-46-47-48-49-50-51-52-53-54-55 Majella (unpublished relevés 07/2006), n. 56-57-58-59-60-61-62-63-64-65-66-67-68 Majella (n. 74-75-76-77-78-79-80-81-82-83-84-85-86 from tab. 6 in Blasi *et al*. 2005).

Tab. 6: n. 1-2-3-4-5-6-7-8-9-10-11-12-13 Campo Imperatore (Gran Sasso) (n. 1-2-3-4-5-6-7-8-9-10-11-12-13 from tab. 5 in Biondi *et al*. 1999), n. 14-15-15 Majella (unpublished relevés 07/2006).

Tab. 7: n. 1-2-3-4-5 Gran Sasso (n. 1-2-3-4-5 from tab. 2 in Biondi *et al*. 2000), n. 6-7-8-9-10 Mount Aquila (n. 1-2-4-5-6 from tab. 22 in Biondi *et al*. 2002), n. 11-12-13-14 Mount Aquila (n. 1-2-3-4 from tab. 4 in Blasi *et al*. 2003), n. 15-16-17 Gran Sasso (n. 6-7-8 from tab. 2 in Biondi *et al*. 2000), n. 18-19-20-21-22-23 Corno Grande (n. 6-7-8-9-10-11 from tab. 4 in Blasi *et al*. 2003), n. 24-25-26 Mount Aquila (n. 7-8-9 from tab. 22 in Biondi *et al*. 2002), n. 27-28-29-30 Gran Sasso (n. 9-10-11-12 from tab. 2 in Biondi *et al*. 2000), n. 31 Mount Aquila (n. 5 from tab. 4 in Blasi *et al*. 2003), n. 32 Mount Aquila (n. 3 from tab. 22 in Biondi *et al*. 2002).

Tab. 8: n. 1-2-3-4-5-6-7-8-9-10-11-12-13 Majella (n. 87-88-89-90-91-92-93-94-95-96-97-98-99 from tab. 7 in Blasi *et al*. 2005), n. 14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32 Majella (unpublished relevés 08/2002).

Tab. 9: n. 1-2-3-4-5-6-7-8-9-10-11-12-13-14 Majella (n. 11-23-12-21-24-22-26-28-27-29-30-18-20-19 from tab. 2 in Feoli-Chiappella & Feoli 1977), n. 15 Laga Mountains (n.1 from tab. 1 in Blasi *et al*. 2003), n. 16-17-18-19-20-21-22 Majella (unpublished relevés 08/2001), n. 23 Gran Sasso (n. 3 from tab. 1 in Biondi *et al*. 2000), n. 24-25-26-27-28-29-30-31-32 Laga Mountains (n. 2-3-4-5-6-7-8-10-12 from tab. 1 in Blasi *et al*. 2003), n. 33-34-35 Gran Sasso (n. 13-14-15 from tab. 1 in Blasi *et al*. 2003), n. 36-37-38 Laga Mountains (n. 1-3-2 in tab. 5 in Pedrotti 1982), n. 39-40-41-42-43-44 Gran Sasso (n. 1-4-5-6-7-8 from tab. 1 in Biondi *et al*. 2000), n. 45-46 Laga Mountains (n. 11-9 from tab. 1 in Blasi *et al*. 2003), n. 47 Gran Sasso (n. 2 from tab. 1 in Biondi *et al*. 2000), n. 48-49-50 Majella and Gran Sasso (n. 16-17-18 tab. 1 in Blasi *et al*. 2003).

Tab. 10: n. 1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19 Majella, Gran Sasso, Laga Mountains (1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19 from tab. 5 in Blasi *et al*. 2003), n. 20-22-23-24-25-26-27-28-29-30-31-32 Majella (unpublished relevés 08/2002).