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Phytosociological analysis of the grasslands of Montagna dei Fiori (central Italy) and syntaxonomic review of the class *Festuco-Brometea* in the Apennines

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Abstract
This article consists of two main parts. The first part presents a phytosociological study of the secondary grasslands of Montagna dei Fiori (1814 m a.s.l.), within the National Park of Gran Sasso and the Laga Mountains, in Abruzzo, central Italy. The second part provides a syntaxonomic review of the Apennine grassland communities belonging to the class *Festuco-Brometea*.
As far as the first part is concerned, the vegetation analysis was conducted on 38 phytosociological relevés. These were analysed statistically using cluster analysis, fuzzy analysis, and principal component analysis, and are compared with published relevés of similar grassland phytocoenoses. Five plant communities were identified, four of which are newly described: one belongs to the class *Nardetea strictae* (*Campanulo micranthae-Nardetum strictae*) and the last three to the class *Festuco-Brometea* (*Cerastio suffruticosi-Brachypodietum genuensis*, *Astragalo depressi-Koelerietum splendentis* and *Festuco circummediterraneae-Achilletum tomentosae*).
In the second part, regarding the syntaxonomic review of the class *Festuca-Brometea*, the synchorological meaning of the recent classifications of the Italian forest communities is discussed at the alliance and order levels in order to highlight the strong link between forest communities of the Italian peninsula and the Illyrian-Balkan communities. As the secondary grasslands derived by substitution from the forest communities, it seems logical to consider the chorological origin of the two formations as similar since they are dynamically linked, as well as their floristic composition also justify. Thus, it is proposed to include the meso-xerophilous and xerophilous basophilous grasslands of the Apennines in the order *Scorzonero villosae-Chrysopogonetalia grylli*, within which there are defined the new Apennine alliance, *Phleo ambigui-Bromion erecti* This alliance was previously considered as invalid because its nomenclatural type, the association *Asperulo purpureo-Brometum erecti*, had an invalid and illegitimate name. The recent validation of this association, by Di Pietro (2011), has allowed to validly repropose the alliance *Phleo ambigui-Bromion erecti*. Of this new alliance the following three new suballiances have been recognised: *Phleo ambigui-Bromenion erecti*; *Brachypodenion genuensis* and *Sideritidenion italicae*.
The alliance *Phleo ambigui-Bromion erecti*, is distributed along the northern Apennines, except for the western-most parts (Liguria and a part of northern Tuscany), on the whole of the central Apennines and part of the southern Apennines (the boundary is in the Basilicata Region).
In the southern-most part of the calcareous Appennines the secondary grasslands are referred to the endemic alliance *Hippocrepido glaucae-Stipion austroitalicae* in which two new suballiances have recognised: *Hippocrepido glaucae-Stipienion austroitalicae* and *Violo pseudogracilis-Bromopsienion caprinae*. The last one is obtained by reduction of the alliance *Violo pseudogracilis-Bromopsion caprinae*.
Moreover, the validity of the order *Brometalia erecti* Koch 1926 is confirmed and the order *Artemisio albae-Brometalia erecti* Ubaldi ex Dengler & Mucina in Mucina *et al*. 2009, proposed by Mucina *et al*. (2009), is rejected because, on the basis of the nomenclatural priority, it is illegitimate. Therefore the suborder *Artemisio albae-Bromenalia erecti* of the order *Brometalia erecti* is considered to be re-proposed, and the new chorological range, comprising the sub-Mediterranean area of France and the north-western Italy (Liguria and a part of northern Tuscany), is indicated.

Key words: Apennines, *Brometalia erecti*, ecological spectrum, *Festuco-Brometea*, grasslands, phytosociology, *Scorzonero villosae-Chrysopogonetalia grylli*, synchorology, statistical analysis, syntaxonomy.

Introduction

This article is divided into two main parts: the first provides a description of the secondary grassland communities in the most elevated area of the massif of Montagna dei Fiori (1814 m a.s.l.) in the National Park of Gran Sasso and the Laga Mountains (Abruzzo, central Italy), while the second part discusses the specific syntaxonomic classification of the class *Festuco-Brometea* communities, which indicates the need for the proposal of new syntaxonomic classification of the Apennines grasslands of this class.

Although Montagna dei Fiori has been the subject of several studies, it remains practically unexplored in terms of vegetation and plant landscape analyses. The few published studies of Montagna dei Fiori discussing the geobotanical point of view, have usually not been very specific or detailed regarding the vegetation, since the massif has been treated more as territorial 'appendices' of wider and more analysed areas, such as the Laga mountains (Monti della Laga) and the Gran Sasso d'Italia mountain chain.

The Montagna dei Fiori area and all of the mountainous Apennine areas have been affected by anthropic interventions since the distant past. These activities have intensely modified the plant landscape, which has generated a high series of anthropic ecosystems. Within these ecosystems, the pastures

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are certainly the more representative, as during some periods in the past extensive farming was the major economic resource of this mountainous area, as the major part of the central Apennines. Unequivocal evidence of this is seen in the richness of some of the towns of Abruzzo and Marche, like the most important ones in the area: L'Aquila and Ascoli Piceno.

Generally speaking, the study area is largely occupied by wood vegetation (43.19%), which, together with reforestation, characterises more than half of this region. These formations are distributed throughout the whole area, but they are denser in the northern parts. Grasslands (34.20%) are instead concentrated in the highest parts of the mountain, and characterise the land physionomy of the summit areas (Fig. 1). These grassland coenoses are of secondary origin, and they have mainly arisen from past deforestation. They are in the highest areas of the mountainous massif (Mount Girella and Mount Piselli), which are completely representative of Abruzzo, and grow in the upper mesotemperate bioclimatic belt. Along the ridge areas on the western side of the massif, lithological and ecological conditions have prevented soil evolution, and as a result, more complex plant settlements have developed. In these areas, only limited *Sesleria apennina* grasslands grow, which for the reasons mentioned above, can be considered of a sub-primary type (Biondi *et al*., 1988). There are other grasslands that have essentially arisen from the abandonment of agriculture activities in the Marche parts, along the lower altitudes of Mount Piselli, although these are not discussed in this article.

The study area

The study area extends along the part of the Montagna dei Fiori massif that is in Abruzzo (Fig. 2), and covers an area of about 438 hectares. The massif is on the eastern margin of the Laga Mountains group, and with Montagna di Campli, it forms the Monti Gemelli massif, the only one in central Italy that is not far from the sea, at just 30 km. This part of Montagna dei Fiori in Abruzzo is characterised by two important peaks: Mount Girella (1814 m a.s.l.), the highest peak of this mountainous massif, and Mount Piselli (1676 m a.s.l.). From the administrative point of view, this includes part of the Teramo province, with the cities of Civitella del Tronto and Valle Castellana.

The study area is fully included in the National Park of Gran Sasso and the Laga Mountains, in the district known as *Tra i due regni* (Between the two kingdoms). Moreover, this area includes two Natura 2000 sites, the SAC IT7120213 area of "Montagna dei Fiori, and Campli and Gole del Salinello mountains", and the SPA IT7110128 area of "The National Park of Gran Sasso and the Laga Mountains".

Geological aspects

As far as the geological structure is concerned (Fig. 3), Montagna dei Fiori is the outer emerging Mesozoic nucleus of the central Apennines area, and it has an eastern structure with southern development situated on the Monti Sibillini side and the Gran Sasso chain. The emerging stratigraphic succession in this area is formed by the lands of the Umbria-Marche succession facies, even if within the series various detritic levels have been classified that distinguish the Montagna dei Fiori succession from the typical Umbria successions. The emerging lands are estimated as from between the

Fig. 2 - The Montagna dei Fiori study area.

Fig. 1 - The eastern slopes of Montagna dei Fiori.

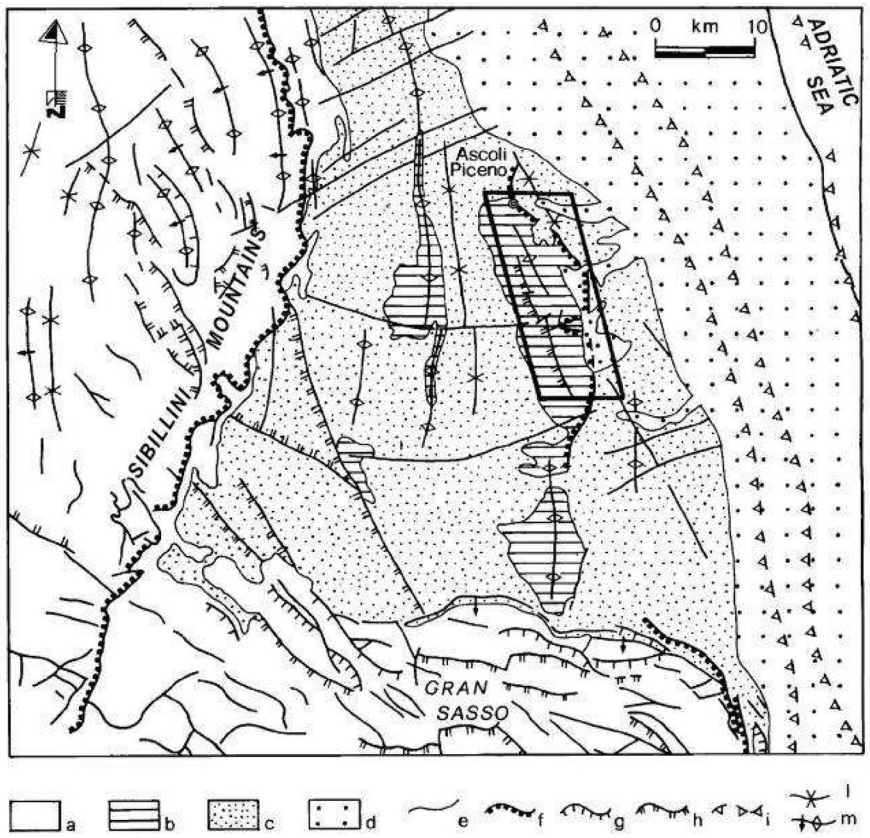

Fig. 3 - Struttural sketch of the Montagna dei Fiori area. (a) Carbonate units of the Sibillini Mountains and of the Gran Sasso chain. (b) Pre-Messinian units of Gorzano Mountain, Acquasanta, and of Montagna dei Fiori. (c) The Laga formation. (d) Plio-Pleistocene undifferentiated sediments of the Adriatic margin. (e) Undetermined faults. (f) Main Post-Tortonian thrusts. (g) Overthrusts and reverse faults. (h) Normal faults. (i) Main buried Post-Tortonian overthrusts. (l) Syncline axes. (m) Anticline axes. The arrows indicate the plunge of the axial plain. (Reprinted from Bigi *et al*., 1991).

lower Lias (upper Trias?) and terminal Miocene; on the eastern side of the structure, there are wide debris coverings and alluvial seeding deposits organised as several terraced layers (Mattei, 1987).

Bioclimatic aspects

The bioclimatic classification of the study area was carried out using the climatic data collected at the thermo-pluvial stations in Santo Stefano and Teramo, the nearest to the study area (Fig. 4). On the basis of the indices of Rivas-Martinez *et al*. (1999; 2001), the study area is included in the Temperate oceanic (submediterranean) macroclimate, low mesotemperate thermotype, low sub-humid ombrotype, and in the Temperate oceanic (steppic) macroclimate, upper mesotemperate thermotype and upper sub-humid ombrotype.

Materials and methods

The study of the grassland phytocoenoses was carried out following the phytosociological methods of the Zurich-Montpelliere sigmatist school, as successively integrated (Rivas-Martìnez, 2005; Géhu, 2006; Biondi, 2011; Blasi *et al*., 2011; Pott, 2011). Thirty-eight phytosociological relevés were carried out in study area during the spring and summer in 2009 and 2010.

These relevés were analysed by multivariate statistics using hierarchical (cluster analysis) and non-hierarchical (fuzzy analysis) classification techniques, and ordination techniques (Principal Components Analysis; PCA).

To perform the statistical analyses, the coverage values were transformed into quantitative data using the Van der Maarel ordinal scale (1979). Cluster analysis was carried out using the SYNTAX 2000 software (Podani, 2001) and by applying the complete link algorithm (Orloci, 1978) to the *similarity ratio* matrix (Westoff & Van der Maarel, 1978) of all of the phytosociological relevés of the study area. Using the MATEDIT programme (Burba *et al*., 1992), the groups identified by cluster analysis were defined as fuzzy sets (Zadeh, 1965) and used as order axes to represent the various groups. Finally, in order to obtain further confirmation of the classification results, the relevés were also analysed by means of Principal Components Analysis (PCA). Using the transformed matrix with the percentage coverage values, the ordination diagram (PCA) was obtained (Podani, 2001).

On the basis of the results obtained, the relevés of the groups identified were compared with published relevés that are similar from the ecologic and

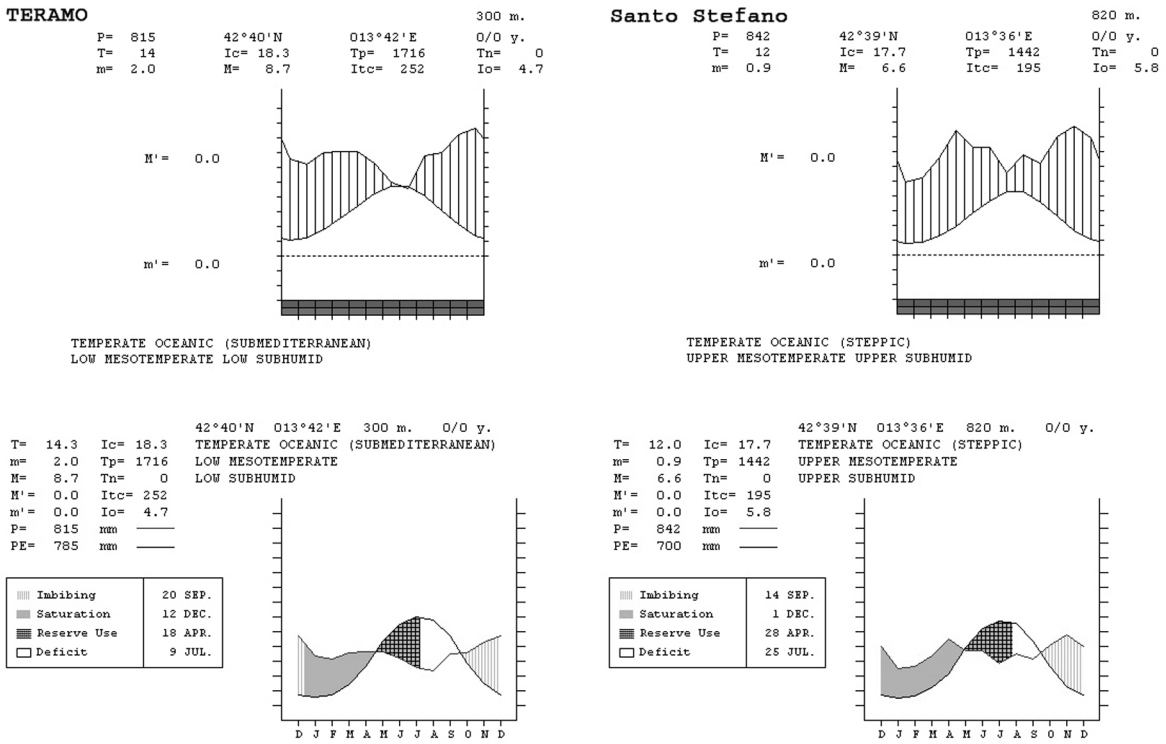

Fig. 4 - Bioclimatic (above) and evaspotraspiration (below) diagrams from the two nearby thermo-pluvial stations.

geomorphological points of view, and additionally studied using cluster analysis applied to the matrices that resulted from the average linkage comparison (UPGMA; Anderberger, 1973) based on the similarity function of *similarity ratio* between relevés.

The ecological spectra were obtained by comparisons using bioindication values, as defined by Ellenberg (1974), for each floristic species, weighted on the specific covering grade. These values represent biotic and abiotic factors that determine the ecological conditions of a species, and they include in particular: light radiation (L), temperature (T), continental climes (C), water availability in soil (U), pH (R) and nutrients (N).

Results

The dendrogram in Figure 5 highlights the cluster separation for all of the relevés carried out in the study area, and reveals two main clusters: the first cluster (I) identifies the mesophilous grasslands with a continuous structure that expand on the well-defined ground, and are distributed in two sub-clusters characterised by the dominance of *Nardus stricta* (subcluster A) and *Brachypodium genuense* (subcluster B). The second cluster (II) consists of relevés carried out on the aridophilous and discontinuous grasslands where the ground is largely eroded and is characterised by rocky outcrops. Within the second cluster, there are three subclusters identified that are referred to three grassland types according to the physionomic structure: *Festuca circummediterranea* and *Achillea tormentosa* (subcluster C), *Koeleria splendens* (subcluster D) and *Sesleria apennina* (subcluster E). The formations identified in this second cluster are the ones where the sheep pastures were mainly concentrated.

The dispersion diagram of the relevès (Fig. 6), along the axes defined by subcluster A (cluster 1) and subcluster E (cluster 5), highlights the separation of the groups, in agreement with what was highlighted in the dendrogram and shows a floristic variation gradient that defines, from top to bottom, the passage from xerophilous coenoses, dominated by *Sesleria appennina*, to mesophilous ones dominated by *Nardus stricta*.

Finally, the ordination diagram obtained from the Principal Components Analysis created on two axes (50% cumulative variance) confirms the separation of the two main clusters, especially in relation to axis 1 (Fig. 7), and the presence of an environmental gradient that is linked to soil humidity. Moreover, this describes the passage from sites characterised by edaphic aridity to sites with a greater water availability.

The *Nardus stricta* community

Relevés related to subcluster A of the dendrogram in Figure 5, where *Nardus stricta* is dominant, were

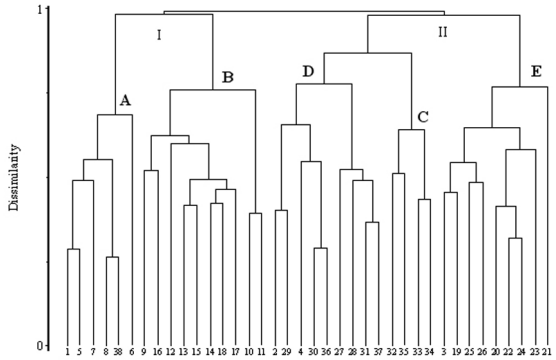

Fig. 5 - Dendrogram from the phytosociological relevés of the study area.

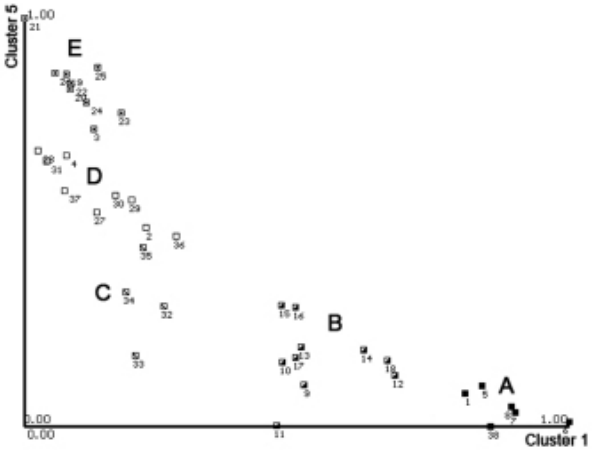

Fig. 6 - Diagram obtained through fuzzy analysis applied to the relevés of the study area. The letters are associated to groups of relevés that represent the same typologies identified by the dendrogram.

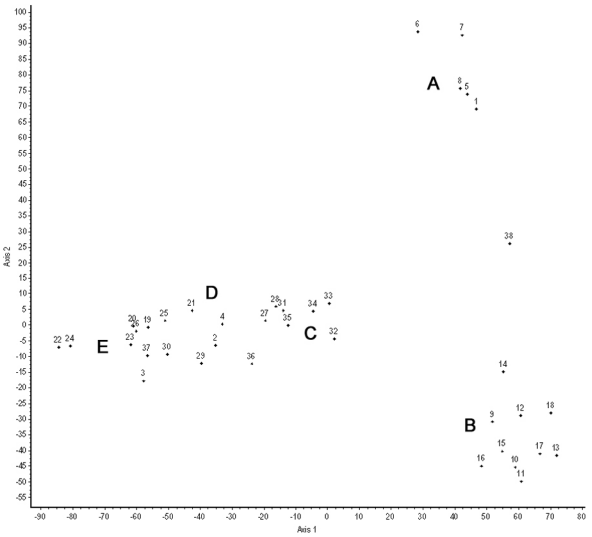

Fig. 7 - Ordination diagram (PCA) of the Montagna dei Fiori grasslands. The letters are associated to the groups of relevés that represent the same typologies identified by the dendrogram.

compared to formations with a similar structure belonging to the following associations: *Poo violaceae-Nardetum strictae* Pedrotti 1981, *Poo violaceae-Nardetum strictae festucetosum circummediterraneae* Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999 and *Nardo strictae-Brachypodietum genuensis* Pignatti 1977 corr. Di Pietro, De Santis & Fortini 2005. These were found and described for the reliefs of the National Park of Gran Sasso and the Laga Mountains, as well as in the National Park of Abruzzo, Lazio and Molise.

The dendrogram obtained by statistical analysis (Fig. 8) differentiates four clusters that correspond to different formations that are compared. In particular, relevés from the Montagna dei Fiori grasslands (Fig. 8, first cluster on the left) are different from the others, because of a group of more or less exclusive species, including: *Campanula micrantha*, *Cynosurus cristatus*, *Trifolium pratense* subsp. *semipurpureum* and *Silene ciliata* subsp. *graefferi*. These are therefore considered as characteristic and differential of the new association *Campanulo micranthae-Nardetum strictae* ass. nova (rel. *typus* n. 1 in Table 1), of which *campanuletosum micranthae* subass. nova corresponds to the *typus*.

The grassland ascribed to this new association are meso-hygrophilous plant communities, in which the *Nardus stricta* dominance is largely linked to decarbonated soils. These grasslands are localised in depressed or sub-flat areas, where accumulation of organic substance and substrate humidity is more considerable in comparison to the other grasslands analysed. In the study area at present, they were detected on the west side of Fosso del Vallone and in the saddle zones, on the southern side of Mount Piselli peak.

The characteristic species of the associations are: *Campanula micrantha*, which is endemic of the central Apennines, *Silene ciliata* Pourr. subsp. *graefferi* (Guss.) Nyman, which is an endemic subspecies of the central Apennines (Fig. 9), and *Trifolium pratense* subsp. *semipurpureum*, which is an endemic subspecies of the central-southern Apennines and Sicily. The differential acidophilous species are: *Naurdus stricta, Luzula multiflora, Agrostis capillaris* and *Cynosurus cristatus*.

In this new association, two other new subassociations were identified: *festucetosum paniculatae* subass. nova (rel. *typus* n. 3 in Table 1), and *festucetosum circummediterraneae* subass. nova (rel. *typus* n. 5 in Table 1). The first of these subassociations is characterised by an abundance of *Festuca paniculata* (L.) Schinz & Thell. subsp. *paniculata*, which defines

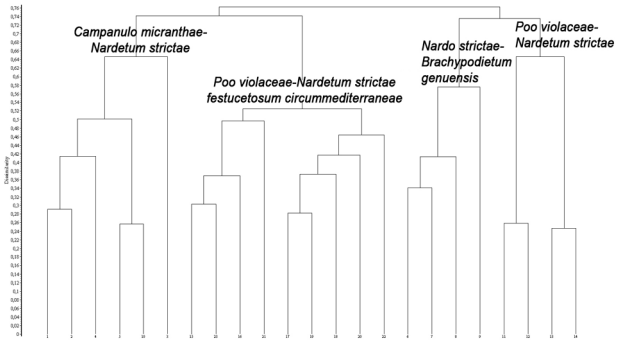

Fig. 8 - Dendrogram for the sub-cluster A phytosociological relevés, and published relevés as comparison.

the physionomy of these phytocoenoses and which indicates a more acidic soil. The second subassociation was identified as *festucetosum circummediterraneae,* and it provides the connections with the formations belonging to the class *Festuco-Brometea* that are distributed mainly in the study area.

THE *BRACHYPODIUM GENUENSE* COMMUNITY

Relevés of subcluster B in the dendrogram shown in Figure 5, where *Brachypodium genuense* is dominant, were compared to relevés attributed to the associations *Potentillo rigoanae-Brachypodietum genuensis* Lucchese, Persia & Pignatti 1995 and *Nardo strictae-Brachypodietum genuensis* Pignatti 1977 corr. Di Pietro, De Santis & Fortini 2005 described for the Abruzzo Apennines. The two associations used for the comparison were selected on the basis of the species that represent their physionomy and of their geographic location. Moreover, both communities can expand on calcareous substrates with subacid or acid pH, as for *Nardo-Brachypodietum genuensis*.

The dendrogram in Figure 10 revealed two main groups of relevés: the plant communities of the *Nardo-Brachypodietum genuensis* and Montagna dei Fiori association (cluster I), and the plant communities of the *Potentillo-Brachypodietum genuensis* association (cluster II). This partition has to be ascribed mainly to both a larger number of species of the class *Nardetea strictae* in the *Nardo-Brachypodietum genuensis* association and in the relevés of Montagna dei Fiori, and to the low number of *taxa* of the class *Kobresyo-Seslerietea*, which is abundant in *Potentillo-Brachypodietum genuensis*.

However, the coenosis of Montagna dei Fiori cannot be attributed to *Nardo-Brachypodietum genuensis*, as *Nardo-Brachypodietum genuensis* represents a more acidophilous formation (pH 5.6), and for this reason it is included in the alliance *Ranunculo pollinensis-Nardion strictae* (*Nardetea strictae*). Moreover, the relevés of the *Brachypodium genuense* grasslands (Table 2) of Montagna dei Fiori are rich in species

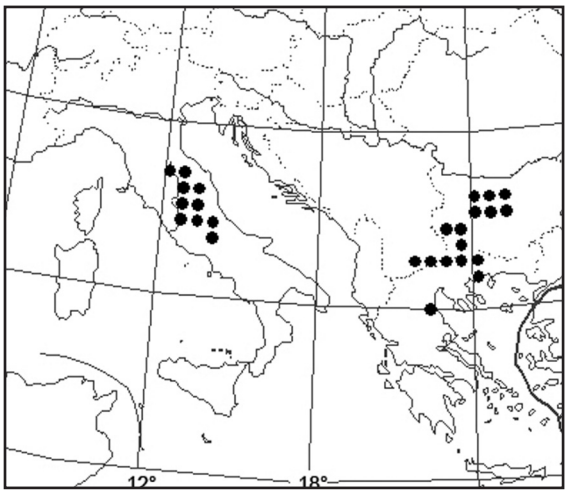

Fig. 9 - Distribution range of *Silene ciliata* subsp. *graefferi* (from Jalas & Suominen, 1986).

belonging to the class *Festuco-Brometea*, and for this reason they are attributed to the new association, *Cerastio suffruticosi-Brachypodietum genuensis* ass. nova (rel. *typus* n. 1 in Table 2). The following three new subassociations were also identified: *brachypodietosum genuense* subass. nova, which is the *typus*, *nardetosum strictae* subass. nova (rel. *typus* n. 6 in Table 2) and *filipenduletosum vulgaris* subass. nova (rel. *typus* n. 9 in Table 2).

The characteristic and differential species of the association are: *Cerastium arvense* subsp. *suffruticosum*, *Armeria majellensis*, *Carlina acaulis* subsp. *caulescens*, *Luzula campestris*, *Poa alpina, Dianthus monspessulanus*, *Alchemilla colorata* and *Silene ciliata* subsp. *graefferi*.

The subassociation *nardetosum strictae* was found in the lower areas of the mountainside, near the relatively flat zones where it is in contact with formations of the alliance *Ranunculo-Nardion*. The differential species are: *Hypericum richeri*, *Festuca paniculata*, *Nardus stricta*, *Avenella flexuosa*, *Trifolium pratense* subsp. *semipurpureum* and *Ranunculus pollinensis*.

Close to the *Fagus sylvatica* forest coenosis, these grasslands become rich in species that differentiate the new subassociation *filipenduletosum vulgari,* which is differentiated by: *Filipendula vulgaris*, *Helianthemum nummularium* subsp. *obscurum*, *Scabiosa maritima, Fragaria vesca* and *Sesleria nitida*. In the study area this subassociation covers most of the side of Fosso del Vallone and all of the eastern side of the mountain.

THE *ACHILLEA TOMENTOSA* AND *FESTUCA CIRUMMEDITERRANEA* COMMUNITY

Relevés relative to subcluster C of the dendrogram in Figure 5 show physionomic and floristic characters that are different from what has been described in the

Tab. 1 - *Campanulo micranthae-Nardetum strictae* ass. nova (rel. *typus* n. 1)
nardetosum strictae subass. nova (association *typus*)
subass. f*estucetosum paniculatae* subass. nova (rel. 2-4; rel. *typus* n. 3)
subass. *festucetosum circummediterraneae* subass. nova (rel. 5-6; rel. *typus* n. 5)

		Rel. n.	1*	2	3**	4	5***	6	P
		Altitude (m a.s.l.)	1626	1612	1625	1726	1618	1606	r
		Slope (°)	5	15	5	0	5	35	e
		Aspect	SSW	NNE	E	-	N	ENE	s
		Coverage (%)	100	100	100	100	100	100	
		Area (m^2)	150	120	90	120	70	120	
		Charact. and diff. species of the ass. *Campanulo micranthae-Nardetum strictae*							
H caesp	S-EUROP.-SUDSIB.	Nardus stricta L.	5.5	5.5	5.5	5.5	5.5	4.4	6
H scap	ENDEM.	Campanula micrantha Bertol.	1.2	1.2	1.1	+	+	1.2	6
H caesp	CIRCUMBOR.	Luzula multiflora (Ehrh.) Lej.	1.2	1.2	2.2	2.2	2.2	2.3	6
H caesp	CIRCUMBOR.	Agrostis capillaris L.	1.2	1.2	2.3	2.2	4.4	2.3	6
H caesp	EUROP.-CAUCAS.	Cynosurus cristatus L.	1.1	1.1	2.3	.	2.3	2.3	5
H scap	ENDEM.	Trifolium pratense L. subsp. semipurpureum (Strobl) Pign.	1.2	1.2	1.2	.	1.2	.	4
H caesp	APP.-BALCANICA	Silene ciliata Pourr. subsp. graefferi (Guss.) Nyman	1.2	1.2	1.1	.	.	.	3
		Diff. species of the subass. *festucetosum paniculatae*							
H caesp	W-MEDIT.-MONT.	Festuca paniculata (L.) Sch. et Th.	.	3.3	4.5	3.3	.	.	3
		Diff. species of the subass. *festucetosum circummediterraneae*							
H caesp	EURIMEDIT.	Festuca circummediterranea Patzke	.	.	.	.	2.2	2.3	2
		Charact. and diff. species of the all. *Ranunculo pollinesis-Nardion strictae*							
H bienn	ENDEM.	Cirsium tenoreanum Petrak	+	+	+	1.1	+	.	5
H scap	ENDEM.	Ranunculus pollinensis (Terr.) Chiov.	.	1.2	1.2	.	1.2	1.2	4
H ros	OROF. S-EUROP.	Plantago atrata Hoppe	1.1	.	.	.	.	.	1
H ros	ENDEM.	Taraxacum apenninum (Ten.) Ten.	.	.	2.3	.	.	.	1
		Charact. and diff. species of the ord. *Nardetalia strictae* e della *Nardetea strictae*							
H scap	SUBCOSMOP.	Rumex acetosella L.	3.3	1.2	.	3.3	+	+	5
H caesp	CIRCUMBOR.	Poa alpina L.	.	1.2	1.2	1.2	1.2	.	4
H scap	S-EUROP.-SUDSIB.	Hypericum richeri Vill.	+.2	+.2	1.2	.	.	.	3
H ros	EURASIAT.	Alchemilla colorata Buser	.	.	3.3	.	1.2	2.2	3
H caesp	EURASIAT.	Anthoxanthum odoratum L.	.	.	+.2	.	.	1.2	2
H caesp	SUBCOSMOP.	Avenella flexuosa (L.) Parl.	.	.	.	1.2	.	+	2
G bulb	OROF. SE-EUROP.	Crocus vernus (L.) Hill subsp. vernus	.	.	.	.	+	.	1
		Charact. and diff. species of the cl. *Festuco-Brometea*							
H ros	OROF. SE-EUROP.	Armeria majellensis Boiss.	+	+	1.2	+	1.2	2.2	6
H ros	EUROP.	Carlina acaulis L. subsp. caulescens (Lam.) Schübl. & G. Martens	2.2	1.2	1.2	+.2	2.2	+	6
H scap	ALPINO-APPENNINICA	Cerastium arvense L. subsp. suffruticosum (L.) Ces.	+.2	+.2	1.2	1.2	.	1.1	5
H ros	EUROP.-CAUCAS.	Hieracium pilosella L.	3.4	3.3	2.3	.	2.3	1.2	5
H caesp	OROF. S-EUROP.	Brachypodium genuense (DC.) Roem. & Schult.	2.3	2.3	1.2	.	2.2	4.4	5
H scap	EUROSIB.	Achillea millefolium L.	1.2	1.2	.	.	1.2	1.2	4
Ch rept	EURIMEDIT.	Thymus longicaulis Presl	1.2	1.2	.	2.2	.	.	3
H scap	CENTRO-EUROP.	Euphorbia cyparissias L.	3.3	2.2	3.4	.	.	.	3
H scap	PALEOTEMP.	Lotus corniculatus L.	+.2	+.2	.	.	+	.	3
H scap	EURASIAT.	Campanula glomerata L.	+	.	.	.	+	1.2	3
H scap	OROF. S-EUROP.	Dianthus monspessulanus L.	+	.	+	.	.	1.2	3
H scap	CENTRO-EUROP.	Filipendula vulgaris Moench	.	+.2	.	.	1.1	1.2	3
H caesp	OROF. SE-EUROP.	Koeleria splendens Presl	1.2	1.2	.	.	.	.	2
T scap	CIRCUMBOR.	Rhinanthus minor L.	+.2	.	.	+.2	.	.	2
H caesp	EUROSIB.	Briza media L.	+.2	.	.	.	.	+	2
H scap	EUROSIB.	Trifolium pratense L. subsp. pratense	.	.	.	1.2	.	+	2
H scap	EUROP.-CAUCAS.	Hieracium piloselloides Vill.	.	.	.	.	1.2	1.2	2
H caesp	CIRCUMBOR.	Poa pratensis L.	.	.	.	+.2	.	.	1
Ch suffr	OROF. S-EUROP.	Acinos alpinus (L.) Moench	.	.	.	1.1	.	.	1
H scap	EURIMEDIT.	Galium lucidum All.	+.2	.	.	.	.	.	1
T scap	EURIMEDIT.	Linum catharticum L.	.	.	+	.	.	.	1
H caesp	PALEOTEMP.	Bromus erectus Hudson	.	.	.	.	+.2	.	1
H ros	CENTRO-EUROP.	Primula elatior (L.) Hill	.	.	.	.	.	+.2	1
		Other species							
H scap	OROF. SE-EUROP.	Verbascum longifolium Ten.	+	.	.	+	+	.	3
H scap	EURIMEDIT.	Geranium pyrenaicum Burm. f.	+	+.2	.	.	.	.	2
		Accidental species	2	1	-	1	-	1	

literature for central Italy. They are plant formations dominated by *Achillea tormentosa* and *Festuca cirummediterranea*. These communities are found in areas characterised by erosion activities and by an accumulation of organic substances due to grazing. Therefore, these conenoses were attributed to the new association *Festuco circummediterranee-Achilletum tomentosae* (rel. *typus* n. 2 in Table 3), and to two new subassociations: *achilletosum tomentosae* subass. nova, corresponding to the *typus*, and *sedetosum albi*

Tab. 2 - *Cerastio suffruticosi-Brachypodietum genuensis* ass. nova (rel. *typus* n.1)
brachypodietosum genuense subass. nova (association *typus*)
nardetosum strictae subass. nova (rel. 5-8; rel *typus* n. 6)
filipenduletosum vulgaris subass. nova (rel. 9-10; rel typus n. 9)

		Rel. n.	1*	2	3	4	5	6**	7	8	9***	10	P
		Altitude (m a.s.l.)	1652	1606	1656	1488	1755	1692	1606	1798	1382	1411	r
		Slope (°)	35	35	35	15	40	20	35	3	45	40	e
		Aspect	E	NNE	ENE	WNW	NE	ENE	NE	NNW	NNE	NE	s
		Coverage (%)	100	100	100	100	100	100	100	100	100	100	
		Area (m^2)	90	150	150	130	130	150	200	150	150	150	
		Charact. and diff. species of the ass. *Cerastio suffruticosi-Brachypodietum genuensis*											
H caesp	OROF. EUROP.	Brachypodium genuense (DC.) Roem. & Schult.	5.5	4.4	5.5	5.5	5.5	4.4	5.5	5.5	5.5	5.5	10
H scap	ALPINO-APPENNINICA	Cerastium arvense L. subsp. suffruticosum (L.) Ces.	1.2	+.2	1.1	1.2	1.1	1.2	1.2	.	+.2	+.2	9
H ros	OROF. SE-EUROP.	Armeria majellensis Boiss.	2.2	.	2.2	+.2	1.2	1.2	1.1	+.2	+	+	9
H ros	CENTRO-EUROP.	Carlina acaulis L. subsp. caulescens (Lam.) Schübl. & G. Martens	1.2	1.1	+	3.4	1.1	2.2	2.2	2.2	.	.	8
H caesp	EUROP.-CAUCAS.	Luzula campestris (L.) DC.	2.2	1.2	.	+	1.2	.	+	1.1	+	+.2	8
H caesp	CIRCUMBOR.	Poa alpina L.	1.2	.	1.1	.	2.3	+.2	1.2	.	1.1	.	6
H scap	OROF. S-EUROP.	Dianthus monspessulanus L.	1.2	2.3	1.2	1.2	.	+.2	.	1.2	.	.	6
H ros	EURASIAT.	Alchemilla colorata Buser	.	2.3	.	.	.	+.2	+.2	1.2	.	1.2	5
H caesp	APP.-BALCANICA	Silene ciliata Pourr. subsp. graefferi (Guss.) Nyman	+.2	+.2	.	.	1.2	+.2	+.2	.	.	.	5
		Diff. species of the subass. *nardetosum strictae*											
H caesp	S-EUROP.-SUDSIB.	Nardus stricta L.	.	.	.	.	1.2	1.2	2.3	2.2	.	.	4
H caesp	W-MEDIT.-MONT.	Festuca paniculata (L.) Sch. et Th.	.	.	+	.	.	3.4	.	1.2	1.2	.	4
H scap	S-EUROP.-SUDSIB.	Hypericum richeri Vill.	1.2	.	.	.	2.2	.	+	.	.	+	4
H caesp	SUBCOSMOP.	Avenella flexuosa (L.) Parl.	.	.	.	.	.	+.2	+	1.2	.	.	3
H scap		Trifolium pratense L. subsp. semipurpureum (Strobl) Pign.	.	.	.	.	.	1.2	.	1.2	.	.	2
H scap	ENDEM.	Ranunculus pollinensis (Terr.) Chiov.	.	.	.	.	.	.	1.2	.	.	.	1
			.	.	.	.	.	.	.	.	.	.	
		Diff. species of the subass. *filipenduletosum vulgaris*	.	.	.	.	.	.	.	.	.	.	
H scap	CENTRO-EUROP.	Filipendula vulgaris Moench	1.2	3.3	.	.	.	+.2	+.2	.	3.4	4.4	6
Ch suffr	EUROP.-CAUCAS.	Helianthemum nummularium (L.)Miller subsp.obscurum (Celak.) Holub	.	1.2	1.2	.	.	1.2	.	1.2	1.2	1.2	6
H rept	EUROSIB.	Fragaria vesca L.	.	.	.	.	.	.	.	.	+.2	+.2	2
H caesp	ENDEM.	Sesleria nitida Ten.	.	.	.	.	.	.	.	.	1.2	1.2	2
H bienn	STENOMEDIT.	Scabiosa maritima L.	.	.	.	.	.	.	.	.	3.3	3.4	2
		Charact. and diff. species of the all. *Phleo ambigui-Bromion erecti*, ord. *Scorzonero-Chrysopogonetalia* and cl. *Festuco-Brometea*											
H caesp	EURIMEDIT.	Festuca circummediterranea Patzke	.	+.2	2.3	2.2	2.2	2.2	2.2	+.2	1.1	1.2	9
		Koeleria splendens Presl	3.3	+.2	1.2	+.2	2.2	1.2	+.2	2.2	+.2	.	9
H scap	CENTRO-EUROP.	Euphorbia cyparissias L.	1.2	2.4	3.3	3.3	3.3	3.4	3.3	.	2.3	1.3	9
H ros	EUROP.-CAUCAS.	Hieracium pilosella L.	2.3	3.3	4.4	3.3	2.3	3.3	3.3	3.3	+.2	.	9
H caesp	EUROSIB.	Briza media L.	2.3	2.2	.	.	1.2	1.2	1.2	+.2	+	+.2	8
Ch rept	EURIMEDIT.	Thymus longicaulis Presl	1.2	.	1.2	1.2	1.2	2.3	.	1.2	1.3	.	7
H scap	EUROSIB.	Achillea millefolium L.	1.2	1.2	.	1.2	.	1.2	.	1.1	1.2	2.2	7
H scap	PALEOTEMP.	Lotus corniculatus L.	1.2	2.4	1.2	.	1.2	.	.	+.2	+	.	6
H scap	EURIMEDIT.	Galium lucidum All.	+.2	+.2	.	+.2	.	1.2	.	.	1.2	+.2	6
T scap	EURIMEDIT.	Linum catharticum L.	2.2	+	.	1.2	1.2	.	1.2	.	+	.	6
H scap	EUROSIB.	Leucanthemum vulgare Lam.	2.2	+.2	.	+.2	1.2	+.2	.	.	.	+	6
H scap	EUROSIB.	Trifolium pratense L. subsp. pratense	1.2	2.2	1.2	1.2	1.2	.	.	.	1.2	.	6
H scap	EURASIAT.	Campanula glomerata L.	.	1.2	.	.	.	1.2	1.2	.	.	+	4
H scap	(CIRCUM.)ART.ALP.	Potentilla crantzii (Crantz) Beck	.	+.2	.	1.2	2.3	2.3	.	.	.	.	4
H scap	MEDIT.-MONT.	Arabis collina Ten.	+	.	+.2	.	1.2	.	.	.	.	.	3
G bulb	PALEOTEMP.	Allium sphaerocephalon L.	.	1.2	.	.	1.1	.	.	.	.	1.1	3
H caesp	PALEOTEMP.	Bromus erectus Hudson	1.2	+.2	.	.	.	.	.	.	.	.	2
H scap	EURIMEDIT.	Asperula cynanchica L.	+.2	.	.	.	.	.	.	1.2	.	.	2
Ch suffr	OROF. S-EUROP.	Acinos alpinus (L.) Moench	.	.	1.2	.	1.2	.	.	.	.	.	2
H scap	EURASIAT.	Bupleurum falcatum L.	1.2	.	.	.	.	+	.	.	.	.	2
H scap	SE-EUROP.-PONTICA	Eryngium amethystinum L.	.	.	+.2	2.2	.	.	.	.	.	.	2
H scap	EUROP.	Potentilla tabernaemontani Asch.	.	.	2.3	.	.	.	.	.	2.3	.	2
Ch suffr	OROF. SE-EUROP.	Asperula purpurea (L.) Ehrend.	.	.	1.2	.	+.2	.	.	.	.	.	2
H caesp	OROF. S-EUROP.	Veronica orsiniana Ten.	1.2	+	+	.	1.2	.	.	.	.	.	4
H scap	ENDEM.	Knautia calycina (Presl) Guss.	.	1.2	.	.	.	.	.	.	1.2	+.2	3
H ros	EUROP.-CAUCAS.	Bellis perennis L.	.	+	.	.	+.2	.	.	.	.	.	2
H bienn	ENDEM.	Gentianella columnae (Ten.) Holub	.	.	.	+.2	.	2.2	.	.	.	.	2
H scap	EUROP.-CAUCAS.	Hieracium piloselloides Vill.	.	.	.	1.2	.	.	+.2	.	.	.	2
G bulb	EURIMEDIT.	Muscari atlanticum Boiss. et Reuter	.	.	1.2	.	.	+	.	.	.	.	2
H ros	OROF. SE-EUROP.	Armeria canescens (Host) Boiss.	.	+.2	.	.	.	.	.	.	.	.	1
H scap	MEDIT.-MONT.	Dianthus sylvestris Wulfen subsp. longicaulis (Ten.) Greuter & Burdet	+.2	.	.	.	.	.	.	.	.	.	1
H ros	EURASIAT.	Gentiana verna L.	.	.	.	.	.	.	.	+	.	.	1
H ros	EURASIAT.	Plantago lanceolata L.	.	.	.	.	.	.	.	.	+.2	.	1
H bienn	PALEOTEMP.	Campanula rapunculus L.	.	.	.	.	.	.	.	.	.	+	1
H scap	S-EUROP.-SUDSIB.	Achillea tomentosa L.	.	.	.	.	.	.	.	.	+.2	.	1
H ros	EURIMEDIT.	Astragalus monspessulanus L.	.	.	.	.	+	.	.	.	.	.	1
H scap	ENDEM.	Centaurea ambigua Guss.	.	.	.	.	.	.	.	.	+.2	.	1
		Charact. and diff. species of the all. *Ranunculo-Nardion*, ord. *Nardetalia* and cl. *Nardetea strictae*											
H ros	OROF. S-EUROP.	Plantago atrata Hoppe	1.2	2.3	.	.	+.2	.	+	.	2.2	2.2	6
H caesp	CIRCUMBOR.	Agrostis capillaris L.	+.2	.	2.2	.	1.2	2.2	1.2	1.2	.	.	6

H bienn	ENDEM.	Cirsium tenoreanum Petrak	.	+	+	1.1	1.1	1.1	.	.	.	.	5
H scap	EUROP.-CAUCAS.	Trifolium alpestre L.	.	.	.	.	+.2	1.2	1.2	.	+.2	3.3	5
H scap	ENDEM.	Campanula micrantha Bertol.	1.2	2.4	.	.	.	+.2	+	.	.	.	4
H scap	SUBCOSMOP.	Rumex acetosella L.	+	.	.	+	.	.	1.2	.	.	.	3
H ros	Endem.	Taraxacum apenninum (Ten.) Ten.	.	.	.	2.2	.	.	.	.	.	.	1
H caesp	CIRCUMBOR.	Luzula multiflora (Ehrh.) Lej.	.	.	.	.	.	1.2	.	.	.	.	1
		Other species											
H ros	EURASIAT.	Plantago media L.	.	+.2	3.3	.	1.2	2.2	+	+	.	1.1	7
H caesp	EUROP.-CAUCAS.	Cynosurus cristatus L.	+.2	.	1.2	+.2	.	2.2	2.2	.	+.2	.	6
H caesp	ENDEM.	Sesleria apennina Ujhelyi	+.2	.	.	.	+.2	.	+.2	.	.	.	3
H scap	OROF. SE-EUROP.	Verbascum longifolium Ten.	.	+	+	.	+	.	.	.	.	.	3
H scap	CIRCUMBOR.	Rumex acetosa L.	.	+.2	+.2	.	+.2	.	.	.	.	.	3
Ch succ	W- E C-EUROP.	Sedum rupestre L.	.	.	1.2	.	+.2	.	.	.	+.2	.	3
H caesp	PALEOTEMP.	Dactylis glomerata L.	.	.	.	1.2	.	.	.	.	.	+.2	2
T scap	EURIMEDIT.	Cynosurus echinatus L.	.	.	1.2	.	.	.	+.2	.	.	.	2
G bulb	OROF. S-EUROP.	Fritillaria tenella Bieb.	.	1.1	.	.	+	.	.	.	.	.	2
T scap	CIRCUMBOR.	Rhinanthus minor L.	1.2	.	.	.	+.2	.	.	.	.	.	2
		Accidental species	3	2	-	4	1	-	-	-	1	-	

subass. nova (rel. *typus* n. 4 in Table 3).

There are European and south-eastern European species in the new association, and this mixture is well represented by the characteristic and differential species: *Achillea tomentosa*, *Potentilla crantzii*, *Koeleria splendens* and *Festuca circummediterranea*. In the areas with rocky soils, where there is massive penetration of characteristic species of the class *Sedo-Scleranthetea*, the subassociation *sedetosum albi* is present. These formations are found in small areas on Mount Piselli, and along the western ridge of Fosso del Vallone.

The *Koeleria splendens* community

Relevés related to subcluster D in the dendogram of Figure 5 indicated open grassland that colonises highly eroded soils with rocky outcrops. These grasslands compete in their extension with the mesophilous coenoses of *Cerastio-Brachypodietum genuensis*, and they are the ones that are mainly subject to pasture pressure.

On the basis of the comparison between these grasslands and the formations belonging to the association *Koelerio splendentis-Brometum erecti*, Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999 (Fig. 11), the first ones show similarities in physionomy and structure to the pasture grasslands of Campo Imperatore. On the other hand, they reveal a lack of several species that are typical of higher bioclimatic belts and of continental areas, which are well represented in the Gran Sasso grasslands, and a high penetration of species of the class *Festuco-Brometea*. This ecological and microclimatic condition is also shown by fewer species belonging to the class *Kobresyo-Seslerietea,* which gives the Campo Imperatore grasslands the typical aspect of a coenoses growing in the montane and upper montane belts.

The diversification in the floristic structure is highlighted by the ecological spectrum, as assessed using the Ellenberg indices, with the two clusters compared in Figure 11. The spectrum (Fig. 12) shows that the flora of the Montagna dei Fiori is typical of warmer and less continental conditions than the flora indicated by the species of the Campo Imperatore grasslands. Thus, it was considered appropriated to assign the grassland identified in the study area to the new association A*stragalo depressi-Koelerietum splendentis* (ril. *typus* n. 2 in Table 4).

The following species are assigned as characteristic and differential of the association: *Koeleria splendens*, *Globularia meridionalis*, *Astragalus depressus*, *Minuartia verna*, *Potentilla crantzii, Helianthemum oelandicum* subsp. *italicum, Centaurea ambigua* and *Seseli viarum*, which marks the rocky aspect.

The *Sesleria apennina* community

Reléves relating to subcluster F shown in Figure 5 identified open *Sesleria apennina* grasslands. For classification of these communities, a comparison was made between formations detected in the study area and those belonging to the association *Carici humilis-Seslerietum apenninae* Biondi, Guitian, Allegrezza & Ballelli 1988 of the central Apennines (Lancioni *et al*., 2011).

The dendrogram obtained from the statistical

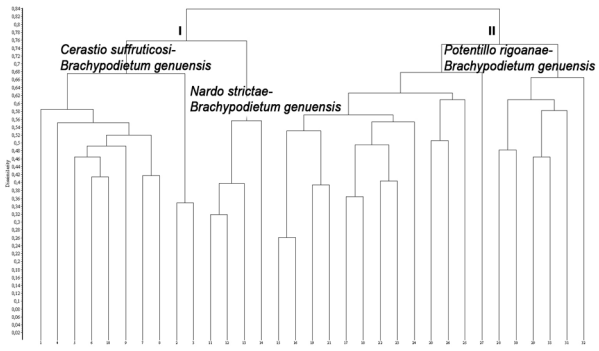

Fig. 10 - Dendrogram for the cluster analysis carried out on relevés used to compare coenoses of group D of the study area.

Tab. 3 - *Festuco circummediterraneae-Achilleetum tomentosae* ass. nova (rel. *typus* n. 2)
achilleetosum tomentosae subass. nova (association *typus*)
sedetosum albi subass. nova (rel. 3-4; rel. *typus* n. 4)

		Rel. n.	1	2*	3	4**	P
		Altitude (m a.s.l.)	1616	1619	1617	1608	r
		Slope (°)	2	15	40	40	e
		Aspect	E	NE	E	NNW	s
		Coverage (%)	95	100	95	90	
		Area (m^2)	4	90	150	85	
		Charact. and diff. species of the ass. *Festuco circummediterraneae-Achilleetum tomentosae*					
H scap	S-EUROP.-SUDSIB.	Achillea tomentosa L.	4.4	4.4	3.3	2.2	4
H scap	(CIRCUM.)ART.ALP.	Potentilla crantzii (Crantz) Beck	2.3	3.3	2.3	1.2	4
H caesp	MEDIT.-MONT.	Koeleria splendens Presl	2.3	2.2	3.3	4.4	4
H caesp	EURIMEDIT.	Festuca circummediterranea Patzke	1.2	2.3	2.2	2.3	4
		Diff. species of the subass. *sedetosum albi*					
Ch succ	CENTRO-EUROP.	Sedum sexangulare L.	1.2	.	+.2	+.2	3
Ch succ	EURIMEDIT.	Sedum album L.	.	.	1.2	2.3	2
Ch succ	W- E C-EUROP.	Sedum rupestre L.	.	.	2.2	1.2	2
H scap	EURIMEDIT.	Asperula cynanchica L.	.	.	1.2	+.2	2
H caesp	EURASIAT.	Carex humilis Leyser	.	.	1.2	1.2	2
H scap	NE-MEDIT.-MONT.	Carum heldreichii Boiss.	.	.	+.2	2.2	2
H scap	ENDEM.	Seseli viarum Calest.	.	.	1.2	1.1	2
H caesp	OROF. S-EUROP.	Silene ciliata Pourr. subsp. graefferi (Guss.) Nyman	.	.	2.3	+.2	2
		Charact. and diff. species of the all. *Phleo ambigui-Bromion erecti*, ord. *Scorzonero-Chrysopogonetalia* and cl. *Festuco-Brometea*					
H scap	CENTRO-EUROP.	Euphorbia cyparissias L.	2.2	3.3	1.2	3.3	4
Ch rept	EURIMEDIT.	Thymus longicaulis Presl	+	2.3	1.2	2.2	4
Ch suffr	OROF. S-EUROP.	Acinos alpinus (L.) Moench	2.3	1.2	+	.	3
H ros	OROF. SE-EUROP.	Armeria majellensis Boiss.	+	1.2	.	+	3
H ros	CENTRO-EUROP.	Carlina acaulis L. subsp. caulescens (Lam.) Schübl. & G.	.	1.2	2.2	1.2	3
H scap	OROF. S-EUROP.	Cerastium arvense L. subsp. suffruticosum (L.) Nym.	+	.	1.2	1.1	3
H scap	SE-EUROP.-PONTICA	Eryngium amethystinum L.	+	1.2	+	.	3
H ros	EUROP.-CAUCAS.	Hieracium pilosella L.	2.2	.	1.2	1.2	3
H ros	EURASIAT.	Plantago major L.	.	.	2.2	+.2	2
H caesp	CIRCUMBOR.	Poa alpina L.	.	2.3	.	1.2	2
G bulb	N-STENOMEDIT.	Allium saxatile Bieb.	+	.	.	.	1
G bulb	PALEOTEMP.	Allium sphaerocephalon L.	.	.	1.1	.	1
H scap	EURIMEDIT.	Anthyllis vulneraria L. subsp. maura (Beck) Linbd.	.	.	1.2	.	1
H ros	OROF. SE-EUROP.	Armeria canescens (Host) Boiss.	.	.	1.2	.	1
Ch suffr	OROF. SE-EUROP.	Asperula purpurea (L.) Ehrend.	.	.	.	+.2	1
H ros	S-EUROP.-SUDSIB.	Astragalus depressus L.	.	.	.	+	1
H ros	EURIMEDIT.	Astragalus monspessulanus L.	+	.	.	.	1
H caesp	ENDEM.	Avenula praetutiana (Parl.) Pign.	.	.	2.2	.	1
H caesp	OROF. EUROP.	Brachypodium genuense (DC.) Roem. & Schult.	.	.	2.3	.	1
H scap	CENTRO-EUROP.	Filipendula vulgaris Moench	.	.	+.2	.	1
H bienn	ENDEM.	Gentianella columnae (Ten.) Holub	.	.	+.2	.	1
Ch suffr	OROF. SW-EUROP.	Helianthemum oelandicum (L.) DC. subsp. italicum (L.)Font-Quer et R	.	.	.	3.3	1
H scap	EUROP.-CAUCAS.	Hieracium piloselloides Vill.	.	.	+	.	1
H ros	EUROP.-CAUCAS.	Leontodon hispidus L.	.	.	1.1	.	1
T scap	EURIMEDIT.	Linum catharticum L.	.	.	1.2	.	1
H caesp	EUROP.-CAUCAS.	Luzula campestris (L.) DC.	.	.	+	.	1
Ch suffr	EURASIAT.	Minuartia verna (L.) Hiern	.	.	.	1.1	1
G bulb	EURIMEDIT.	Muscari atlanticum Boiss. et Reuter	.	.	1.2	.	1
H scap	SE-EUROP.	Ranunculus illyricus L.	.	.	.	+	1
T scap	CIRCUMBOR.	Rhinanthus minor L.	.	.	1.2	.	1
H scap	EURIMEDIT.	Stachys germanica L.	.	.	.	+.2	1
H scap	EUROP.-CAUCAS.	Trifolium alpestre L.	.	1.2	.	.	1
H caesp	S-EUROP.-SUDSIB.	Trifolium ochroleucum HUdson	.	.	2.2	.	1
H caesp	OROF. SW-EUROP.	Trifolium thalii Vill.	.	1.2	.	.	1
H caesp	OROF. S-EUROP.	Veronica orsiniana Ten.	.	.	+	.	1
		Other species					
T scap	EURIMEDIT.	Cynosurus echinatus L.	2.3	3.4	.	.	2
H caesp	PALEOTEMP.	Poa bulbosa L.	3.4	.	1.2	.	2
		Accidental species	1	5	8	2	

analysis of the comparison matrix (Fig. 13) separates the group of Montagna dei Fiori relevès from those of the Apennine formations, which suggests a different vegetation typology. Anyway , these plant communities were attributed to the association *Carici humilis-Seslerietum apenninae* Biondi, Guitian, Allegrezza & Ballelli 1988, for which the following two subassociations were described: *caricetosum humilis* subass. nova (subassociation *typus*; rel. *typus* n. 6 in Table 1 in Biondi *et al*., 1988) and *astragaletosum sempervirentis* subass. nova (rel. *typus* n. 9 in Table 5). Relevès carried out for Montagna dei Fiori are indeed

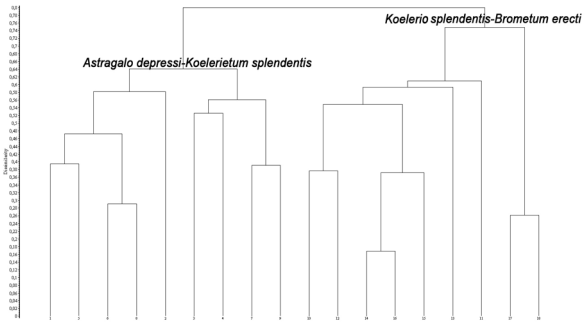

Fig. 11 - Dendrogram related to Cluster analysis carried out on relevés used to compare coenoses of the study area regarding group D.

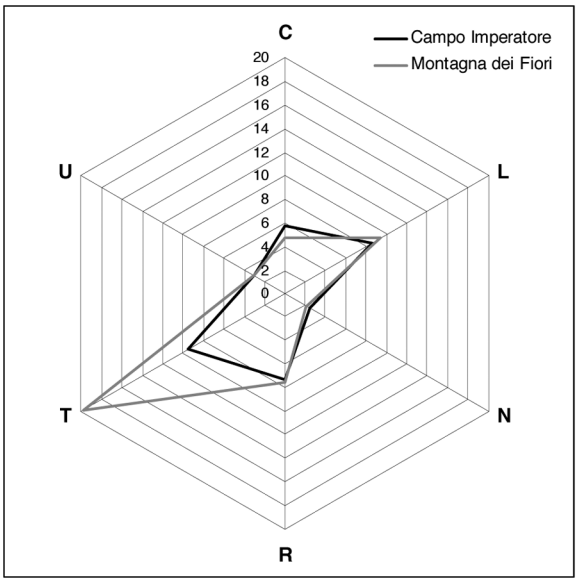

Fig. 12 - Ecological spectrum of the association *Astragalo depressi-Koelerietum splendentis* for Montagna dei Fiori (grey) and *Koelerio splendentis-Brometum erecti* for Campo Imperatore (black).

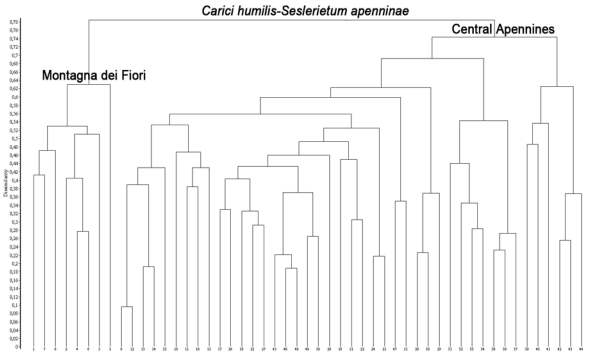

Fig. 13 - Dendrogram from the cluster analysis carried out on relevès used to compare coenoses of the study area for group E.

similar to those of the indicated association, both from the physionomic point of view, as *Sesleria apennina* is largely dominant, and from the ecological and environmental contexts in which they were found. It is important to note that the relevès used to make the comparisons were, for the most part, described for the Apennine relief under conditions characterised by a temperate macrobioclimate and strong continentality. Even if Montagna dei Fiori is a high mountain (1814 m a.s.l.), its flora lacks continental and subcontinental species, since its proximity to the sea completely cancels out these conditions.

The diversification in the floristic structure is largely highlighted by the ecological spectrum (Fig. 14) in which the two different groups of the dendrogram are compared (Fig. 13). As for the grasslands of the association *Astragalo-depressi-Koelerietum splendentis*, Figure 14 shows flora linked mostly to warm situations in terms of Montagna dei Fiori, in comparison to flora that characterises *Carici hulmilis-Seslerietum apenninae* formations of other Apennine reliefs. Moreover, in the study area, a greater number of Mediterranean (steno-, euri-, and mediterranean-orophytic) species were found, and there was a decrease in the number of euroasiatic and orophytic species (i.e. south-eastern European orophytes).

These herbaceous formations are characterised by a major contingent of species belonging to the class *Festuca-Brometea* and by a reduction in the typical species of the class *Kobresyo-Seslerietea*.

In the study area, these formations were mainly found on the southern and south-western slopes of the mountain as well as on the steeper and eroded areas along the higher ridges of the mountain.

The characteristic and differential species of the association are: *Carex humilis*, *Anthyllis montana* subsp. *atropurpurea*, *Seseli viarum, Helianthemum oelandicum* subsp. *italicum, Globularia meridionalis, Asperula purpurea, Dianthus sylvestris* subsp. *longicaulis* and *Saxifraga lingulata* subsp. *australis*, which can also colonise substrates with rocky outcrops, even if related to the order *Potentilletalia caulescentis*.

The subassociation *astragaletosum sempervirentis* regards aspects linked to situations of major altitude, characterised by the presence of differential species such as: *Astragalus sempervirens*, *Silene graminea*, *Brassica gravinae*, *Erysimum pseudorhaeticum*, *Teucrium chamaedrys, Sempervivum tectorum* and *Linaria purpurea*.

Syntaxonomic review of the secondary grasslands of the Apennines

Xerophilous and meso-xerophilous calciphilous secondary grasslands that are mainly in the

Tab. 4 - *Astragalo depressi-Koelerietum splendentis* ass. nova (rel. *typus* n. 2)

		Rel. n.	1	2*	3	4	5	6	7	8	9	P
		Altitude (m a.s.l.)	1638	1617	1683	1675	1319	1392	1414	1368	1624	r
		Slope (°)	15	5	45	5	40	45	30	40	5	e
		Aspect	ENE	S	SW	SW	W	W	SE	SW	SE	s
		Coverage (%)	75	90	75	95	55	100	70	65	60	
		Area (m^2)	60	10	20	100	60	20	50	60	40	
		Charact. and diff. species of the ass. *Astragalo depressi-Koelerietum splendentis*										
Ch rept	NE-MEDIT.-MONT.	Globularia meridionalis (Podp.) O. Schwarz	4.5	4.5	5.5	4.4	3.4	2.3	5.5	2.3	4.4	9
H caesp	OROF. SE-EUROP.	Koeleria splendens Presl	2.2	4.4	4.4	3.3	2.3	2.3	3.3	1.2	2.2	9
H ros	S-EUROP.-SUDSIB.	Astragalus depressus L.	.	1.2	1.2	1.2	2.2	+	1.2	1.1	.	7
Ch pulv		Minuartia verna (L.) Hiern	1.2	+.2	+.2	.	1.2	+	+.2	.	.	6
H scap	(CIRCUM.)ART.ALP.	Potentilla crantzii (Crantz) Beck	3.4	2.3	.	.	2.3	2.3	4.4	2.2	.	6
Ch suffr	EUROP.-CAUCAS.	Helianthemum oelandicum (L.) DC. subsp. italicum (L.)Font-Quer et R	.	2.2	1.2	+.2	.	1.2	2.2	3.4	.	6
H scap	ENDEM.	Seseli viarum Calest.	1.2	2.2	.	1.1	.	.	+.2	.	1.2	5
H scap	ENDEM.	Centaurea ambigua Guss.	.	1.2	.	.	+.2	2.2	1.2	+.2	.	5
		Charact. and diff. species of the all. *Phleo ambigui-Bromion erecti*, ord. *Scorzonero-Chrysopogonetalia* and cl. *Festuco-Brometea*										
H scap	ALPINO-APPENNINICA	Cerastium arvense L. subsp. suffruticosum (L.) Ces.	1.2	+.2	.	+.2	1.2	1.2	1.2	+.2	1.2	8
H scap	EURIMEDIT.	Galium lucidum All.	1.2	+	1.2	1.2	1.2	.	.	+.2	+	7
H scap	SE-EUROP.-PONTICA	Eryngium amethystinum L.	.	1.2	+	+.2	1.1	1.2	1.2	+.2	.	7
H caesp	CIRCUMBOR.	Poa alpina L.	4.4	3.3	1.2	2.2	.	2.2	1.2	.	1.2	7
H caesp	EURIMEDIT.	Festuca circummediterranea Patzke	2.2	2.3	2.2	2.2	+	.	+.2	.	.	6
Ch rept	EURIMEDIT.	Thymus longicaulis Presl	.	1.3	2.3	2.3	1.2	.	.	.	3.4	5
H caesp	PALEOTEMP.	Bromus erectus Hudson	.	.	+	.	2.3	1.2	.	2.2	+.2	5
H scap	S-EUROP.-SUDSIB.	Achillea tomentosa L.	1.2	.	.	+.2	+.2	.	+.2	.	1.2	5
T scap	EURASIAT.	Euphrasia pectinata Ten.	1.2	.	1.2	.	.	1.2	+.2	.	+.2	5
Ch suffr	OROF. SE-EUROP.	Asperula purpurea (L.) Ehrend.	+.2	.	.	.	1.3	1.2	1.2	1.2	.	5
H scap	CENTRO-EUROP.	Euphorbia cyparissias L.	1.2	1.1	1.2	2.3	.	.	.	+.2	.	5
H ros	EUROP.-CAUCAS.	Hieracium pilosella L.	3.4	3.3	.	1.2	2.2	.	1.2	.	.	5
H ros	EUROP.	Carlina acaulis L. subsp. caulescens (Lam.) Schübl. & G. Martens	1.1	+.2	1.1	2.3	.	.	.	.	.	4
G bulb	EURIMEDIT.	Muscari atlanticum Boiss. et Reuter	+.2	+	.	.	+.2	.	.	.	+	4
H caesp	OROF. S-EUROP.	Brachypodium genuense (DC.) Roem. & Schult.	.	1.3	+.2	2.3	.	.	.	.	.	3
H caesp	S- E C-EUROP.	Hippocrepis comosa L.	.	.	.	.	1.2	.	+.2	+.2	.	3
H scap	EURIMEDIT.	Asperula cynanchica L.	1.2	.	.	+.2	.	1.2	.	.	.	3
H scap	N-Europ.	Anthyllis vulneraria L. subsp. vulnerarioides (All.) Arcang.	.	+.2	.	.	.	.	.	+.2	.	2
H ros	OROF. SE-EUROP.	Armeria majellensis Boiss.	+.2	.	.	1.1	.	.	.	.	.	2
Ch suffr	OROF. S-EUROP.	Acinos alpinus (L.) Moench	1.2	.	.	.	.	.	.	1.2	.	2
H bienn	ENDEM.	Gentianella columnae (Ten.) Holub	+	1.1	.	.	.	.	.	.	.	2
T scap	PALEOTEMP.	Medicago lupulina L.	+.2	.	.	.	1.2	.	.	.	.	2
Ch suffr	EURIMEDIT.	Teucrium chamaedrys L.	.	.	.	.	+.2	.	.	+.2	.	2
H scap	ENDEM.	Erysimum majellense Polatschek	.	.	.	.	+.2	.	.	+.2	.	2
Ch suffr	W-EUROP. (ATL.)	Helianthemum apenninum (L.) Miller	.	.	.	.	1.2	.	+	.	.	2
H caesp	SUBENDEM.	Carex macrolepis DC.	+.2	.	.	.	.	.	.	.	.	1
G bulb	PALEOTEMP.	Allium sphaerocephalon L.	.	+	.	.	.	.	.	.	.	1
G bulb	N-STENOMEDIT.	Allium saxatile Bieb.	.	+.2	.	.	.	.	.	.	.	1
Ch suffr	EUROP.-CAUCAS.	Helianthemum nummularium (L.)Miller subsp.obscurum (Celak.) Holub	.	.	.	.	+.2	.	.	.	.	1
H scap	EUROSIB.	Achillea millefolium L.	.	.	.	.	+.2	.	.	.	.	1
H scap	S-EUROP.-SUDSIB.	Globularia punctata Lapeyr.	.	.	.	.	.	1.2	.	.	.	1
H caesp	SUBATLANT.	Brachypodium rupestre (Host) R. et S.	.	.	.	.	.	.	1.1	.	.	1
T scap	EURIMEDIT.	Linum catharticum L.	.	.	.	.	.	.	+.2	.	.	1
H caesp	ENDEM.	Sesleria nitida Ten.	.	.	.	.	.	.	+.2	.	.	1
G rhiz	ENDEM.	Phleum ambiguum Ten.	.	.	.	.	.	.	.	1.2	.	1
H scap	EURASIAT.	Knautia arvensis (L.) Coulter	.	.	.	.	.	.	.	1.2	.	1
H scap	SE-EUROP.	Centaurea rupestris L.	.	.	.	.	.	.	.	+	.	1
H scap	S-EUROP.-SUDSIB.	Polygala major Jacq.	.	.	.	.	.	.	.	+.2	.	1
		Charact. and diff. species of the all. *Seslerion apenninae*, ord. *Seslerietalia tenuifoliae* and cl. *Kobresyo-Seslerietea*										
Ch pulv		Saxifraga lingulata Bellardi subsp. australis (Moric.) Pign.	.	+	.	.	1.3	+	.	.	.	3
H scap	SE-EUROP.	Trinia dalechampii (Ten.) Janchen	1.1	.	.	1.1	1.1	.	.	.	.	3
Ch rept	SE-EUROP.	Thymus striatus Vahl	.	.	.	.	1.2	1.2	.	2.3	.	3
H caesp	EURASIAT.	Carex humilis Leyser	+.2	.	.	.	.	.	.	.	+.2	2
Ch succ	OROF. S-EUROP.	Sempervivum tectorum L.	.	+.2	+	.	.	.	.	.	.	2
Ch suffr	EUROP.-CAUCAS.	Helianthemum oelandicum (L.) DC. subsp. incanum (Willk.) G. López	.	.	.	.	1.3	.	.	3.4	.	2
H caesp	ENDEM.	Sesleria apennina Ujhelyi	.	.	.	.	.	.	.	.	1.2	1
Ch suffr		Anthyllis montana L. subsp. atropurpurea (Vukot.) Pign.	1.2	.	.	.	.	.	.	.	.	1
H scap	NE-MEDIT.-MONT.	Carum flexuosum (Ten.) Nyman	+	.	.	.	.	.	.	.	.	1
H scap	MEDIT.-MONT.	Dianthus sylvestris Wulfen subsp. longicaulis (Ten.) Greuter & Burdet	.	1.2	.	.	.	.	.	.	.	1
H ros		Saxifraga paniculata Miller subsp. stabiana (Ten.) Pign.	.	.	1.2	.	.	.	.	.	.	1
H ros	S-EUROP.-SUDSIB.	Leontodon crispus Vill.	.	.	+	.	.	.	.	.	.	1
H ros	OROF. CENTRO-EUROP.	Draba aizoides L.	1.3	.	.	.	.	.	.	.	.	1
		Other species										
Ch succ	EURIMEDIT.	Sedum album L.	+.2	2.3	+.2	+.2	1.2	1.2	+.2	1.3	2.3	9
Ch succ	CENTRO-EUROP.	Sedum sexangulare L.	+.2	1.2	.	.	.	.	.	.	1.2	3
Ch succ	EURIMEDIT.	Sedum dasyphyllum L.	.	+.2	1.1	.	1.2	.	.	.	.	3
T scap	EURIMEDIT.	Cynosurus echinatus L.	+.2	.	.	.	.	.	+.2	1.2	.	3
H caesp		Silene ciliata Pourr. subsp. graefferi (Guss.) Nyman	1.2	.	+	.	.	.	.	.	.	2
H scap	EUROP.	Potentilla tabernaemontani Asch.	.	.	+.2	1.2	.	.	.	.	.	2
H ros	EURASIAT.	Plantago media L.	.	.	+	.	.	.	+.2	.	.	2
T scap	PALEOTEMP.	Thlaspi perfoliatum L.	.	.	.	.	+.2	.	.	+.2	.	2
Ch suffr	NE-MEDIT.-MONT.	Minuartia graminifolia (Ardoino) Jav.	.	.	.	.	.	3.4	+	.	.	2
		Accidental species	6	0	1	0	5	1	0	9	2	

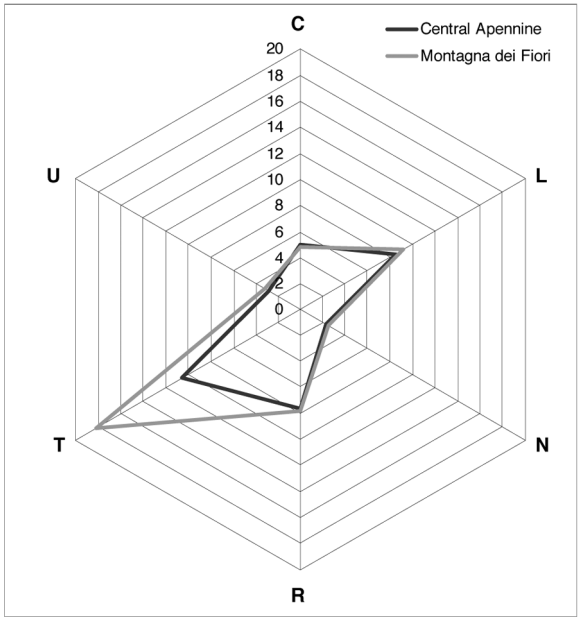

Fig. 14 - Ecological spectrum relative to the *Sesleria apennina* formations on Montagna dei Fiori (grey) and the coenoses of *Carici humilis-Seslerietum apenninae* of the central Apennines (black).

mesotemperate and supra-temperate bioclimatic belts of the Apennines are traditionally included in the order *Brometalia erecti* Koch 1926 (=*Brometalia erecti* Br.-Bl. 1936), within the class *Festuco-Brometea* (Royer, 1991, Biondi & Blasi, 1982; Biondi *et al*., 1995; Biondi *et al*., 2005).

Recently, a new syntaxonomic interpretation was proposed, and these grasslands were related to the order *Artemisio albae-Brometalia erecti* Ubaldi ex Dengler & Mucina 2009 (= *Brometalia erecti* Koch 1926 *nomen ambiguum*). The proposed new *syntaxon* contains as a single order the xerophilous alliances of the class *Festuca-Brometea*. Therefore, the new syntaxonomic vision cancels the subdivision implemented by Royer (1991), and later by Biondi *et al*. (1995), where the meso-xerophilous and xerophilous alliances were divided into two different suborders: *Leucanthemo-Bromenalia* (=*Mesobromenalia*), and *Artemisio-Bromenalia* (=*Xerobromentalia*).

This syntaxonomic scheme (Mucina *et al*., 2009) was recently confirmed in another study that provided a dry grassland review of the central-southern Apennines (Di Pietro, 2011), and it was further modified by the addition of other changes to the lower hierarchical ranks.

Syn-phytogeographical considerations

The new syntaxonomic proposal that is presented here primarily relates to the biogeographical aspects that have led to the rewriting of a good part of the Italian vegetation classifications in the last few years. In detail, as far as the forest communities of the Italian peninsula are concerned, on the basis of a detailed analysis, the high-rank *syntaxa* that were previously attributed to central European syn-chorotypes were related to eastern ones, mainly with a Balkan distribution. As examples, we can quote the mesophilous woods that belong to the order *Fagetalia sylvaticae* Pawlowski in Pawlowski, Sokolowski & Wallisch 1928, which were classified in the eastern European and Balkan alliance *Aremonio-Fagion sylvaticae* (Horvat 1938) Torok, Podani & Borhidi 1989. The following suballiance has been recognised within this: *Cardamino kitaibelii-Fagenion sylvaticae* Biondi, Casavecchia, Pinzi, Allegrezza & Baldoni 2002, which is endemic to the Apennines and which is distributed on most of the Padanian sub-Province and on the upper sectors of the Apennine sub-Province, until the calcareous relief of the Abruzzo Apennines (Biondi *et al*., 2002).

In southern Italy, the endemic alliance *Geranio versicoloris-Fagion sylvaticae* Gentile 1970 has been recognised. It is found in the southern and Sicilian Apennines, but it shows infiltration into the warmer and more arid areas of the central Apennine supra-temperate bioclimatic belt. Its suballiance, *Doronico orientalis-Fagenion sylvaticae* (Ubaldi, Zanotti, Puppi, Speranza & Corbetta ex Ubaldi 1995) stat. nov. Di Pietro, Izco & Blasi 2004, is distributed in the lower supra-temperate bioclimatic belt of the central-southern Apennines from Abruzzo to Sicily, with infiltrations into the Umbria-Marche Apennines.

Even woods previously attributed to the alliance *Carpinion betuli* have been included in the Illyrian-Balkan alliance *Erythronio dentis-canis-Carpinion betuli* (Horvat 1958) Marincek in Wallnöfer, Mucina & Grass 1993. In Italy, the following suballiances have been recognised: *Asparago tenuifolii-Carpinenion betuli* Marincek & Poldini 1994, which is in the extra-Alpine and northern Apennine areas (Biondi *et al*., 2002) and *Pulmonario apenninae-Carpinenion betuli* Biondi, Casavecchia, Pinzi, Allegrezza & Baldoni 2002, which is endemic to the central-northern and central Apennines. Recently, the alliance *Physospermo verticillati-Quercion cerris* Biondi, Casavecchia & Biscotti 2008, was described, which is the vicariant alliance of *Erythronio dentis-canis-Carpinion betuli* in the southern part of the Italian peninsula.

A similar synchorological interpretation is seen in the recent syntaxonomic classification of the ravine woods belonging to the alliance *Tilio platyphylli-Acerion pseudoplatani* Klika 1955 (Kosir *et al*.,2008; Biondi *et al*., 2008; Brullo *et al*. 2001), although these do not produce exploitable secondary grassland communities.

The Apennine woods that belong to the order

Tab. 5 - *Carici humilis-Seslerietum apenninae* Biondi, Ballelli, Guitian & Allegrezza 1988
astragaletosum sempervirentis subass. nova (rel. 8-9; rel *typus* n. 9)

		Rel. n.	1	2	3	4	5	6	7	8	9*	P
		Altitude (m a.s.l.)	1698	1708	1535	1625	1793	1737	1718	1741	1643	r
		Slope (°)	45	30	75	80	35	40	35	45	80	e
		Aspect	E	ESE	SW	NNW	E	ESE	E	SSE	W	s
		Coverage (%)	60	85	80	70	95	95	98	95	80	
		Area (m^2)	60	90	70	60	150	80	120	100	60	
		Charact. and diff. species of the ass. *Carici humilis-Seslerietum apenninae*										
Ch rept	NE-MEDIT.-MONT.	Globularia meridionalis (Podp.) O. Schwarz	5.5	3.4	2.3	2.3	2.3	4.4	4.4	3.4	2.3	9
H caesp	ENDEM.	Sesleria apennina Ujhelyi	2.2	4.5	5.5	5.5	5.5	5.5	5.5	5.5	4.5	9
Ch suffr	EUROP.-CAUCAS.	Helianthemum oelandicum (L.) DC. subsp. italicum (L.)Font-Quer et R	3.4	3.3	3.3	2.2	2.2	3.4	.	2.3	3.3	8
H scap	ENDEM.	Seseli viarum Calest.	1.2	1.2	.	.	1.2	1.2	1.2	1.2	.	6
Ch suffr		Anthyllis montana L. subsp. atropurpurea (Vukot.) Pign.	2.3	.	+.2	1.2	1.2	2.3	.	.	.	5
Ch suffr	OROF. SE-EUROP.	Asperula purpurea (L.) Ehrend.	.	1.2	.	+.2	+.2	.	.	2.3	2.3	5
H caesp	EURASIAT.	Carex humilis Leyser	.	+.2	.	+.2	.	1.2	.	+.2	.	4
H scap	MEDIT.-MONT.	Dianthus sylvestris Wulfen subsp. longicaulis (Ten.) Greuter & Burdet	.	.	1.2	3.4	.	.	.	+.2	1.2	4
Ch pulv		Saxifraga lingulata Bellardi subsp. australis (Moric.) Pign.	.	.	+	1.2	.	.	.	.	2.2	3
		Diff. species of the subass. *astragaletosum sempervirentis*										
H scap	OROF. S-EUROP.	Silene graminea Vis.	+.2	.	.	.	+	.	+.2	1.2	.	4
Ch succ	OROF. S-EUROP.	Sempervivum tectorum L.	.	.	.	+	+.2	.	.	+.2	1.1	4
Ch suffr	EURIMEDIT.	Teucrium chamaedrys L.	1.2	.	.	.	.	.	.	2.3	+.2	3
Ch frut	N-MEDIT.-MONT.	Astragalus sempervirens Lam.	.	.	.	.	+.2	.	.	1.2	2.2	3
H scap	ENDEM.	Erysimum pseudorhaeticum Polatschek	.	.	.	.	.	.	.	+.2	+	2
H scap	ENDEM.	Brassica gravinae Ten.	.	.	.	1.2	.	.	.	.	+	2
H scap	ENDEM.	Linaria purpurea (L.) Miller	.	.	.	.	.	.	.	.	1.2	1
		Charact. and diff. species of the all. *Seslerion apenninae*, ord. *Seslerietalia tenuifoliae* and cl. *Kobresyo-Seslerietea*										
H scap	(CIRCUM.)ART.ALP.	Potentilla crantzii (Crantz) Beck	3.4	.	.	2.3	2.3	2.3	3.3	.	.	5
Ch pulv		Minuartia verna (L.) Hiern subsp. verna	.	.	+	+.2	1.2	1.2	3.4	.	.	5
Ch suffr	ENDEM.	Edraianthus graminifolius (L.) DC.	+.2	.	.	.	.	.	.	+.2	.	2
H scap	NE-MEDIT.-MONT.	Carum flexuosum (Ten.) Nyman	+.2	.	.	.	1.2	.	.	.	.	2
H scap	SE-EUROP.	Trinia dalechampii (Ten.) Janchen	.	1.1	.	+.2	.	.	.	.	.	2
H ros		Saxifraga paniculata Miller subsp. stabiana (Ten.) Pign.	.	.	.	+.2	.	.	.	.	.	1
H ros	S-EUROP.-SUDSIB.	Leontodon crispus Vill.	.	.	.	.	.	.	.	1.2	.	1
Ch suffr	CENTRO-EUROP.	Alyssum montanum L.	.	.	.	.	.	.	.	1.2	.	1
Ch rept	SE-EUROP.	Thymus striatus Vahl	.	.	.	.	.	.	.	.	1.2	1
		Charact. and diff. species of the cl. *Festuco-Brometea*										
H caesp	OROF. SE-EUROP.	Koeleria splendens Presl	3.3	2.2	1.2	3.3	2.3	2.2	2.2	3.3	.	8
H caesp	CIRCUMBOR.	Poa alpina L.	2.3	2.2	1.2	2.3	3.3	3.3	2.3	.	.	7
Ch rept	EURIMEDIT.	Thymus longicaulis Presl	1.3	.	2.2	.	1.2	1.2	1.2	1.2	.	6
H caesp	PALEOTEMP.	Bromus erectus Hudson	1.2	2.2	.	.	3.4	.	1.2	1.2	1.2	6
H caesp	EURIMEDIT.	Festuca circummediterranea Patzke	.	.	1.2	.	1.2	1.2	1.2	1.2	.	5
T scap	EURASIAT.	Euphrasia pectinata Ten.	.	+.2	+.2	.	.	+.2	+	.	+.2	5
H scap	N-Europ.	Anthyllis vulneraria L. subsp. vulnerarioides (All.) Arcang.	.	.	.	.	2.3	3.4	3.3	2.2	1.2	5
H ros	EUROP.	Carlina acaulis L. subsp. caulescens (Lam.) Schübl. & G. Martens	+	1.1	1.2	.	.	.	.	1.2	.	4
H scap	EURIMEDIT.	Galium lucidum All.	+.2	.	.	1.2	1.1	.	.	.	1.2	4
H scap	CENTRO-EUROP.	Euphorbia cyparissias L.	1.2	.	.	.	.	2.3	1.2	1.2	.	4
H caesp	OROF. S-EUROP.	Brachypodium genuense (DC.) Roem. & Schult.	2.3	+.2	1.2	.	.	.	.	1.2	.	4
H caesp	S- E C-EUROP.	Hippocrepis comosa L.	.	.	.	+.2	.	1.2	1.2	+.2	.	4
H scap	SE-EUROP.-PONTICA	Eryngium amethystinum L.	+	.	1.1	.	.	.	.	1.1	.	3
H scap	ALPINO-APPENNINICA	Cerastium arvense L. subsp. suffruticosum (L.) Ces.	.	.	.	.	+.2	.	1.2	1.2	.	3
H scap	ENDEM.	Centaurea ambigua Guss.	.	.	.	.	1.2	.	.	+.2	1.1	3
G bulb	EURIMEDIT.	Muscari atlanticum Boiss. et Reuter	.	.	.	.	1.2	.	+	+	.	3
H scap	EURIMEDIT.	Asperula cynanchica L.	.	+.2	.	.	1.2	.	.	1.2	.	3
H ros	OROF. SE-EUROP.	Armeria majellensis Boiss.	.	.	.	1.2	+	.	+	.	.	3
Ch suffr	OROF. S-EUROP.	Acinos alpinus (L.) Moench	1.2	.	.	1.2	1.2	.	.	.	.	3
G bulb	S-EUROP.-SUDSIB.	Allium lusitanicum Lam.	.	1.1	.	.	+.2	.	.	1.2	.	3
H ros	S-EUROP.-SUDSIB.	Astragalus depressus L.	+	2.2	.	.	.	.	.	.	.	2
H caesp	SUBENDEM.	Carex macrolepis DC.	1.2	.	.	.	.	.	.	.	3.3	2
G bulb	PALEOTEMP.	Allium sphaerocephalon L.	.	.	.	.	2.2	.	.	+	.	2
G bulb	N-STENOMEDIT.	Allium saxatile Bieb.	.	.	.	+.2	.	.	.	.	1.2	2
H scap	ENDEM.	Laserpitium siler L. subsp. siculum (Spreng.) Santangelo, F. Conti e Gubellini	.	.	.	+.2	.	.	.	.	1.1	2
H ros	EUROP.-CAUCAS.	Hieracium pilosella L.	.	.	.	.	.	.	.	2.3	.	1
H bienn	ENDEM.	Gentianella columnae (Ten.) Holub	.	.	.	.	.	.	1.2	.	.	1
G rhiz	ENDEM.	Phleum ambiguum Ten.	+.2	.	.	.	.	.	.	.	.	1
Ch suffr	EUROP.-CAUCAS.	Helianthemum nummularium (L.)Miller subsp.obscurum (Celak.) Holub	.	.	.	.	.	.	.	1.2	.	1
H scap	MEDIT.-MONT.	Arabis collina Ten.	.	+	.	.	.	.	.	.	.	1
H caesp	EURASIAT.	Anthoxanthum odoratum L.	.	.	.	1.2	.	.	.	.	.	1
Ch suffr	S-EUROP.-SUDSIB.	Coronilla vaginalis Lam.	.	.	.	.	.	.	+	.	.	1
H scap	EURASIAT.	Campanula glomerata L.	.	.	.	.	.	.	.	+	.	1
H caesp	W-EURIMEDIT.	Agrostis castellana Boiss. et Reuter	.	.	.	.	.	.	.	+.2	.	1
H scap	EUROSIB.	Leucanthemum vulgare Lam. var. vulgare	.	.	.	.	.	.	.	2.2	.	1
H scap	N-MEDIT.-MONT.	Stachys recta L.	.	.	.	.	.	.	.	.	1.1	1

		Charact. and diff. species of the cl. *Sedo-Scleranthetea*									
Ch succ	EURIMEDIT.	Sedum album L.	1.3	+.2	+.2	1.2	1.2	.	.	+.2	1.2	7
Ch succ	W- E C-EUROP.	Sedum rupestre L.	.	.	.	+.2	+.2	+.2	1.2	1.2	+.2	6
Ch succ	CENTRO-EUROP.	Sedum sexangulare L.	.	.	.	.	.	.	+.2	.	+.2	2
Ch succ	OROF. SW-EUROP.	Sempervivum arachnoideum L.	.	.	.	.	2.4	.	.	.	.	1
		Other species										
H scap	E-EUROP.	Myosotis alpestris F. W. Schmidt	.	.	.	1.2	.	.	1.2	.	.	2
T caesp	COSMOPOL.	Poa annua L.	.	.	.	.	.	+.2	.	+.2	.	2
		Accidental species	2	-	-	-	1	-	1	2	3	

Quercetalia pubescentis Klika 1933 were included in the Apennine-Balkan alliance *Carpinion orientalis* Horvat 1958 (Blasi *et al*., 2004; Blasi *et al*., 2006), which includes the following suballiances: *Laburno anagyroidis-Ostryenion carpinifoliae* (Ubaldi 1981) Poldini 1990, distributed along the northern and central Apennines; *Campanulo-Ostryenion* Ubaldi 1995, which is in the Liguria-Piemonte Apennines and Apuane Alps; *Lauro nobilis-Quercenion pubescentis* Ubaldi (1988) 1995, which includes the thermophilous hornbeam, oak and turkey oak woods of the coastal and sub-coastal areas of central-southern Italy; and *Festuco exaltatae-Ostryenion carpinifoliae* Blasi, Filibeck & Rosati 2006, which includes *Ostrya carpinifolia* woods of the mesotemperate and supratemperate belts of Tyrrhenian southern Italy.

The alliance *Teucrio siculi-Quercion cerridis* Ubaldi 1988 is distributed throughout the whole central-southern Italian peninsula, on vulcanic acid and sub-acid substrata, flysch, compact sandstone and pelitic-arenaceous formations. The alliance *Pino calabricae-Quercion congestae* Brullo, Scelsi, Siracusa & Spampinato 1999 includes the *Quercus virgiliana* and *Quercus dalechampii* woods that grow in the hilly belt, and the *Quercus congesta* woods of the southern part of Calabria and Sicily. Finally *Erythronio-Quercion petraeae* Ubaldi 1988 is the alliance that shows, more than the others, an affinity with the central and southeastern European subacidophilous and mesophilous mixed woods dominated by *Quercus petraea* (Blasi *et al*., 2004; Biondi *et al*., 2010).

The same interpretation was applied to the holm oak woods included in the order *Quercetalia ilicis*, and a syntaxonomic review led to the definition of the alliance *Fraxino orni-Quercion ilicis* Biondi, Casavecchia & Gigante 2003, with relevant suballiances (Biondi *et al*., 2003; Biondi *et al*., 2010).

Therefore, in agreement with the claim of Chiapella Feoli and Poldini (1993) regarding grassland communities of easern Alpine areas, it is logical to assume that as far as the regression dynamics models are concerned, the eastern forest phytocoenosis should produce replacement secondary communities that have an eastern distribution area.

Including the Apennine secondary grasslands in a more central-western order, as Royer (1991) defined the *Brometalia erecti* distribution area, is incompatible under biogeographical terms (Fig. 15; Rivas-Martínez *et al*., 2004). This hypothesis is supported in the same Mucina *et al*., (2009) study where basophilous grasslands of France, southern England, Belgium, southwestern Germany, and northwestern Switzerland were included in the order *Artemisio albae-Brometalia erecti* Ubaldi ex Dengler & Mucina in Mucina *et al*., 2009 (=*Brometalia erecti* Koch 1926 nom. amb. prop. p.p.). This geographical range definition excludes the Apennine grasslands, which owing to their biogeographical location and floristic history, show greater affinity to the Illyrian and Balkan ones.

New classification of Apennine grasslands of the class *Festuco-Brometea*

The syntaxonomic scheme of the Apennine secondary grassland communities needs to be reviewed to take into account mainly the synchorological aspects. This scheme has already been applied for the Friuli Venezia Giulia grasslands (Chiapella Feoli & Poldini, 1993; Poldini, 1989; Poldini, 1995) and recently for the *Stipa austroitalica* communities growing on the Adriatic slopes of sub-Apennine areas (Apulia, Basilicata, Molise) (Fanelli *et al*., 2001; Forte *et al*., 2005; Biondi & Guerra, 2008; Terzi *et al*., 2010). In these studies, the grasslands were attributed to the order *Scorzonero-Chrysopogonetalia* rather than to the order *Brometalia erecti*, and this attribution was based on succesional dynamics of the forest vegetation, and of course, on the chorology of the species that make up these grasslands and have an eastern range. At present, owing to the geological history and geographical location of the Italian peninsula, eastern European species strongly characterise the Italian flora. The distribution of these floristic elements can be summarised as three different decreasing gradients: westwards, from Friuli Venezia Giulia to Valle d'Aosta; north-westwards from the central Apennines through Marche, Tuscany, Emilia-Romagna and Liguria; and southwards starting from Basilicata, going towards Calabria and Sicily, and northwards to Campania, Molise and Puglia (Pezzetta, 2010). As a result, the Apennine grassland flora composition is well characterised by amphi-Adriatic species with an eastern and southeastern range centroid. The chorological spectrum which was

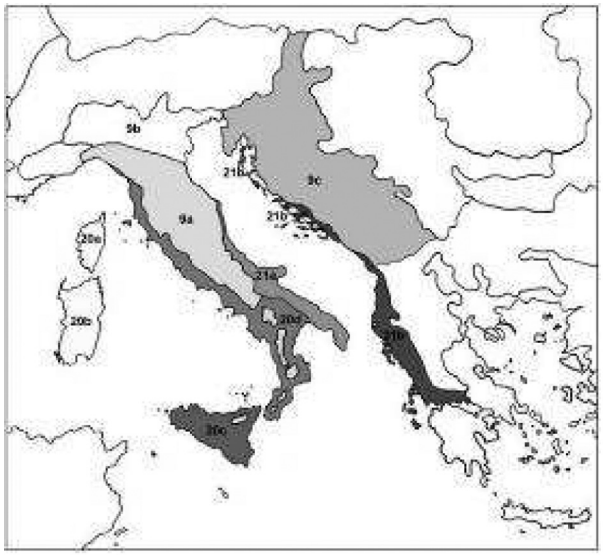

Fig. 15 - Biogeographical map of Italy and the other Adriatic-Ionic areas (redrawn from Rivas-Martínez *et al*., 2004). For the Eurosiberian Region for Italy, there is the Caucasic Alpine sub-Region, within which there are the Alpine and Apennine-Balkan Provinces. The Apennine-Balkan Province (9) comprises: an Apennine sub-Province (9a); a Padanian sub-Province (9b); and an Illyrian sub-Province (9c). For the Mediterranean region there are both west-Mediterranean and east-Mediterranean sub-regions on the Italian peninsula.

evaluated according to weighted frequency and was carried out from the synoptic tables of the *Brometalia erecti* Apennine grasslands (Tables 2 and 3 in Biondi *et al*., 1995), demonstrates this eastern stream. The chorological spectrum in Figure 16 highlights the dominance of the eastern (38.68%: south-eastern-European-Pontic-Eurasiatic, Apennine-Balkan, orophytic south-eastern European) and eastern Mediterranean (18.44%) components, whereas the Atlantic and Western ones are less abundant (7.73%).

Therefore, in the light of these considerations, the abandoning of the traditional attribution of the perennial grassland secondary communities of the Apennines to the order *Brometalia erecti* is considered as necessary to refer them to the Illyrian-Balkan order *Scorzonero villosae-Chrysopogonetalia grylli* Horvatić et Horvat in Horvatić 1963.

Recently a formal review of this order was carried out (Terzi, 2011) in which the following alliances were recognised: *Saturejion subspicatae* (Horvat 1974) Horvatić 1975, *Scorzonerion villosae* Horvatić 1963 and *Hypochoeridion maculatae* Horvatic ex Terzi 2011 in north-eastern Italy; and the endemic alliances *Hippocrepido glaucae-Stipion austroitalicae* Forte & Terzi in Forte, Perrino & Terzi 2005 and *Violo pseudogracilis-Bromopsion caprinae* Terzi 2011 in the southern Italian peninsula.

In a recent review carried out by Di Pietro (2011), the calciphilous grasslands of the hilly, montane and upper montane belts of the Apennines were included in the alliance *Cytiso spinescentis-Bromion erecti* Bonin 1978. This replaced the alliance *Phleo ambigui-Bromion erecti*, which had an invalid published name (Art. 5, 17) because its nomenclature type, the association *Asperulo purpureo-Brometum erecti* Biondi & Ballelli ex Biondi *et al*. 1995, was considered as *nomen invalidum* (art. 5) and *nomen illegitimum* (art. 29c). In the same study, Di Pietro (2011) makes this association valid and designates it as the *holotypus* of the suballiance *Phleo ambigui-Bromenion erecti* Biondi, Allegrezza & Zuccarello ex Di Pietro 2011.

In agreement with Terzi (2011), the alliance *Cytiso-Bromion erecti* Bonin 1978 is considered as invalid (art. 1), as already indicated in Biondi *et al*. (1995). For this reason, the alliance *Phleo ambigui-Bromion erecti* Biondi & Blasi ex Biondi & Galdenzi all. nova *hoc loco* (*holotypus*: *Asperulo purpureo-Brometum erecti* Biondi & Ballelli ex Di Pietro 2011) is re-proposed here, even of the order *Scorzonero-Chrysopogonetalia* Horvatić et Horvat in Horvatić 1963, as the reasons that led to this nomenclature invalidation were without foundation, whereas the analysis performed is certainly appropriate in statistical terms. This alliance is also accepted by the Italian phytosociological community and is still used (Blasi *et al*., 2012).

The characteristic species of the new alliance *Phleo ambigui-Bromion erecti* are derived from the Biondi *et al*. (1995) definition of the alliance: *Allium tenuiflorum* Ten., *Arabis collina* Ten., *Avenula praetutiana* (Parl.) Pign., *Carex macrolepis* DC., *Centaurea ambigua* Guss., *Centaurea triumfetti* All., *Chamaecytisus spinescens* (Presl) Rothm., *Erysimum pseudorhaeticum* Polatschek, *Festuca circummediterranea* Patzke, *Galium lucidum* All., *Globularia meridionalis* (Podp.) O. Schwarz, *Helianthemum canum* (L.) Baumg., *Koeleria splendens* Presl, *Muscari atlanticum* Boiss. et Reuter, *Onosma echioides* L., *Phleum ambiguum* Ten., *Polygala major* Jacq., *Sesleria nitida* Ten., *Silene otites* (L.) Wibel, *Thymus striatus* Vahl, *Trifolium montanum* L., and *Trinia dalechampii* (Ten.) Janchen. This alliance, *Phleo ambigui-Bromion erecti*, has a chorological range that comprises the northern Apennines, except for the western-most parts (Liguria and a part of northern Tuscany), the whole of the central Apennines, and part of the southern Apennines (the boundary is in the Basilicata Region) (Fig. 17). Of this alliance, the three suballiances and their lists of differential species are re-proposed, as already indicated by Biondi *et al*. (1995; 2005). This suballiances are: *Phleo-Bromenion erecti* Biondi & Blasi ex Biondi & Galdenzi all. nova *hoc loco* as *holotypus* of the alliance, *Brachypodenion genuensis* Biondi, Ballelli, Allegrezza & Zuccarello ex Biondi & Galdenzi suball. nova *hoc loco* (upper mesotemperate

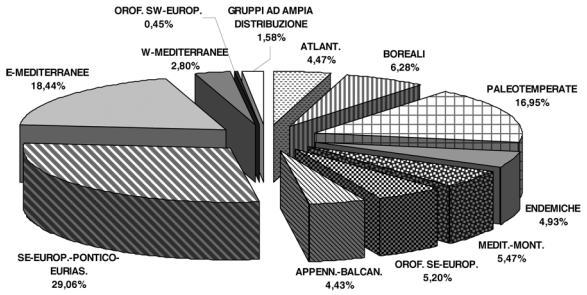

Fig. 16 - Chorological spectrum of the *Brometalia erecti* Apennine grasslands (carried out from relevés reported in Biondi *et al*., 1995).

and lower supratemperate bioclimatic belts of the central Apennines) and *Sideritidenion italicae* Biondi, Ballelli, Allegrezza & Zuccarello 1995 corr. Biondi, Allegrezza, Zuccarello ex Biondi & Galdenzi suball. nova *hoc loco* (central-southern Apennine grasslands with well defined supramediterranean features).

The calcicolous secondary grasslands of the southern-most part of Italy were included in the endemic alliances *Hippocrepido glaucae-Stipion austroitalicae* Forte & Terzi in Forte, Perrino & Terzi 2005, which was described for the eastern areas (Gargano, Molise, eastern Basilicata), and *Violo pseudogracilis-Bromopsion caprinae* Terzi 2011, which included the four associations that were described for the Lucanian Apennines by Biondi *et al*. (1995) and were primarily attributed to the *Cytiso-Bromion caprini* Bonin in Barbero & Bonin 1969 *nom. inval*.. The presence of two alliances in this area is to be considered redundant, so the second alliance was reduced to suballiance rank, as *Violo pseudogracilis-Bromopsienion caprinae* (Terzi 2011) Biondi & Galdenzi stat. nov. *hoc loco*, within the alliance *Hippocrepido glaucae-Stipion austroitalicae*, and it is considered as the central-western vicariant of the suballiance *Hippocrepido glaucae-Stipienion austroitalicae* Biondi & Galdenzi suball. nov. *hoc loco*.

As a result of the inclusion of the Apennine grasslands, the distribution range of the order *Scorzonero-Chrysopogonetalia* is widened further westwards and assumes the role, in biogeographical terms, of amphi-Adriatic order. Indeed, the phytocoenoses of this order are characterised by grasslands that are rich in Mediterranean species and are distinguishable from sub-Atlantic and sub-Mediterranean ones included in the central western order *Brometalia erecti*, and from central-eastern European steppes vegetation of the continental order *Festucetalia valesiacae* (Royer, 1991).

As claimed by some authors (Dengler, 2003; Mucina *et al*., 2009), the order *Brometalia erecti* was proposed as *nomen ambiguum* prop. p.p. [typo excl.], and, it is therefore to be rejected. Recently, Mucina *et al*. (2009)

Fig. 17 - Distribution range of the alliances belonging to the orders *Scorzonero-Chrysopogonetalia* and *Artemisio albae-Brometalia erecti* in Italy.

proposed the new order *Artemisio albae-Brometalia erecti* Ubaldi ex Dengler & Mucina in Mucina *et al*. 2009 as the reference *syntaxon* of the xerophilous basophilous grasslands of central-western Europe, as the replacement of *Brometalia erecti* Koch 1926. This proposal is not justified, because the order *Brometalia erecti* Koch 1926 (=*Brometalia erecti* 1936 Br.-Bl. *nomen ambiguum* porp. p.p. [typo excl.; Art. 31]) was validly published (Art. 2b) and its original definition is sufficient as it contains the valid publication of the name of the subordinated alliance *Bromion erecti* Koch 1926 (*holotypus*: *Mesobrometum erecti* Koch 1926), as provided by Article 8 of the International Code of Phytosociological Nomenclature, 3rd edition (Weber *et al*., 2000). The same order is quoted as an example of sufficient original definition in this document.

As a consequence, the new order of *Artemisio albae-Brometalia erecti* is to be considered as illegitimate because of the nomenclature priority (Art. 22, 23). Therefore, the suborder *Artemisio albae-Bromenalia erecti* of the order *Brometalia erecti* is considered to be re-proposed, although it reduces the geographical range to the sub-Mediterranean area of France to north-western Italy (Liguria and a part of northern Tuscany, Barberis *et al*., 1988; Lombardi *et al*., 2000; Castelli *et al*., 2001). This range approximately corresponds to the western-most part of the *Artemisia alba* Turra range (Fig. 18), while the other part of the range represents the distribution range of the Illyrian order *Scorzonero-Chrysopogonetalia*.

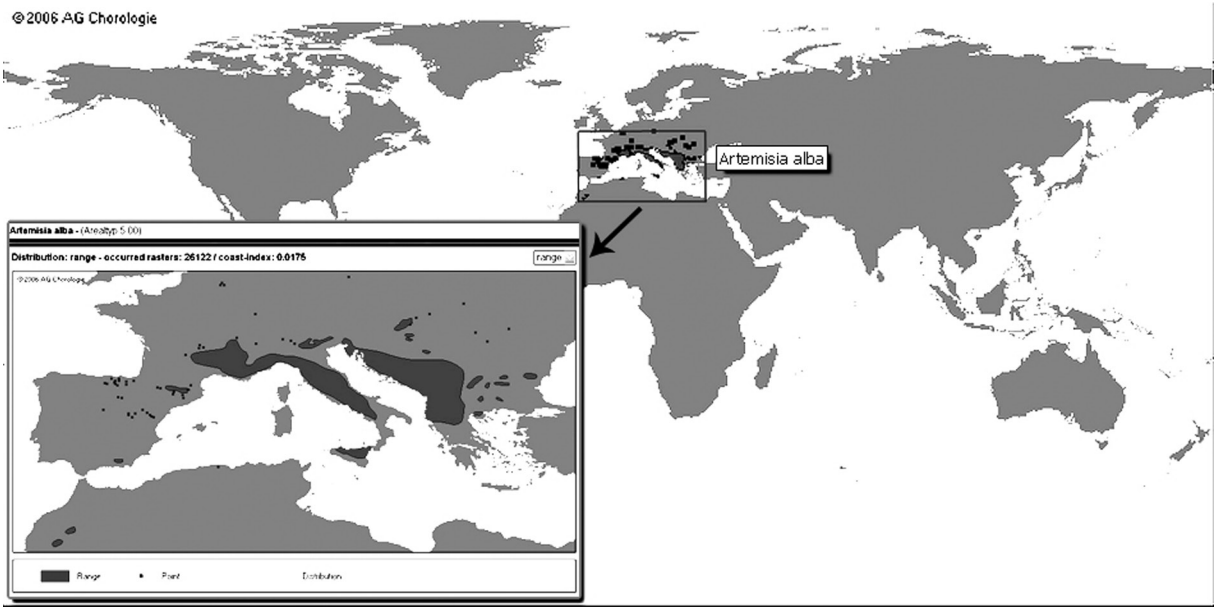

Fig. 18 - Distribution range of *Artemisia alba* Turra (from the website of Climatic Modelling of the Distribution Ranges of Plant Species: http://www2.biologie.uni-halle.de/bot/ag_chorologie/areale/index.php?sprache=E).

Syntaxonomic scheme of the communities of Montagna dei Fiori

CL.: ***KOBRESIO MYOSUROIDIS-SESLERIETEA CAERULEA*** Br.-Bl. 1948 nom. mut. Rivas-Martínez, Diaz, Fernandez-Gonzalez, Izco, Loidi, Lousa & Penas 2002
ORD.: ***Seslerietalia tenuifoliae*** Horvat 1939
SUBORD.: *Seslerienalia apenninae* Bruno & Fornari 1966 em. Lancioni, Facchi & Taffetani 2011
ALL.: *Seslerion apenninae* Furnari in Bruno & Furnari 1966 em. Lancioni, Facchi & Taffetani 2011
Carici humilis-Seslerietum apenninae Biondi, Guitan, Allegrezza & Zuccarello 1988
caricetosum humilis subass. nova *hoc loco*
astragaletosum sempervirentis subass. nova *hoc loco*

CL.: ***NARDETEA STRICTAE*** Oberd. 1949
ORD.: ***Nardetalia strictae*** Oberd. 1949 em. Preising 1949
ALL.: *Ranunculo pollinensis-Nardion strictae* Bonin 1972
Campanulo micranthae-Nardetum strictae ass. nova *hoc loco*
nardetosum strictae subass. nova *hoc loco*
festucetosum paniculatae subass. nova *hoc loco*
festucetosum circummediterraneae subass. nova *hoc loco*

CL.: ***FESTUCO-BROMETEA*** Br.-Bl. & Tx. ex Br.-Bl. 1949
ORD.: ***Scorzonero-Chrysopogonetalia*** Horvatić et Horvat in Horvatić 1963
ALL.: *Phleo ambigui-Bromion erecti* Biondi & Blasi ex Biondi, Ballelli, Allegrezza & Zuccarello ex Biondi & Galdenzi all. nova
SUBALL.: *Brachypodenion genuensis* Biondi, Ballelli, Allegrezza & Zuccarello 1995 ex Biondi & Galdenzi suball. nova *hoc loco*
Astragalo depressi-Koelerietum splendentis ass. nova *hoc loco*
Cerastio suffruticosi-Brachypodietum genuense ass. nova *hoc loco*
brachypodietosum genuense subass. nova *hoc loco*
filipenduletosum vulgaris subass. nova *hoc loco*
nardetosum strictae subass. nova *hoc loco*
Festuco circummediterraneae-Achilleetum tomentosae ass. nova *hoc loco*
achilleetosum tomentosae subass. nova *hoc loco*
sedetosum albi subass. nova *hoc loco*

Syntaxonomic scheme of the Apennine grasslands, to the level of alliance and suballiance

Cl.: ***FESTUCO-BROMETEA*** Br.-Bl. & Tx. ex Br.-Bl. 1949
[*Festuco-Brometea* Br.-Bl. & Tüxen 1943 (Art. 8)]

Ord.: ***Scorzonero villosae-Chrysopogonetalia grylli*** Horvatić & Horvat in Horvatić 1963
[*Scorzonero villosae-Chrysopogonetalia grylli* Horvatić et Horvat in Horvatić 1957 A2b, 8; *Scorzonero villosae-Chrysopogonetalia grylli* Horvatić et Horvat in Horvatić 1958 A2b, 8]; *Scorzoneretalia villosae* Horvatić 1973 [A3m]; *Scorzoneretalia villosae* Horvatić 1975 A3m]
Order typus: *Scorzonerion villosae* Horvatić 1963

All.: *Phleo ambigui-Bromion erecti* Biondi & Blasi ex Biondi, Ballelli, Allegrezza & Zuccarello ex Biondi & Galdenzi all. nova *hoc loco*
[*Cytiso-Bromion erecti* Bonin 1978 p.p. nom. Inval. Art. 1; *Cytiso-Bromion caprini* Barbero & Bonin 1969 p.p. nom. inval. Art. 3; *Crepido lacerae-Phleion ambigui* Biondi & Blasi 1982 nom. inval. Art. 3, 5; *Phleo ambigui-Bromion erecti* Biondi, Ballelli, Allegrezza & Zuccarello 1995: nom. inval. Art. 2, 5; *Seslerio nitidae-Caricion macrolepidis* Ubaldi 1997 Synt. synon; *Botriochloo ischaemoni-Bromion erecti* Ubaldi 1997 Synt. synon. p.p.; *Siderition italicae* Ubaldi 2011 Synt. synon.; *Knautio calycinae-Bromion caprini* Ubaldi 2011 Synt. synon.]
Alliance *typus*: *Asperulo purpureae-Brometum erecti* Biondi & Ballelli ex Di Pietro 2011

Suball.: *Phleo ambigui-Bromenion erecti* Biondi, Allegrezza & Zuccarello 1995 ex Biondi & Galdenzi suball. nova *hoc loco*
[*Phleo ambigui-Bromenion erecti* Biondi, Allegrezza & Zuccarello 1995 (nom. inval. Art. 3, 5); *Phleo ambigui-Bromenion erecti* Biondi, Allegrezza & Zuccarello 1995 ex Di Pietro 2011: Synt. Synon. p.p.]

Suball.: *Brachypodenion genuensis* Biondi, Ballelli, Allegrezza & Zuccarello 1995 ex Biondi & Galdenzi suball. nova *hoc loco*
Suballiance *typus*: *Koelerio splendentis-Brometum erecti* Biondi, Ballelli, Allegrezza, Frattaroli & Taffetani 1992

Suball.: *Sideritidenion italicae* Biondi, Ballelli, Allegrezza & Zuccarello 1995 corr. Biondi, Allegrezza, Zuccarello 2005 ex Biondi & Galdenzi suball. nova *hoc loco*
[*Sideridenion syriacae* Biondi, Ballelli, Allegrezza & Zuccarello 1995, *Seslerio-Xerobromion apenninum* Bruno & Covarelli 1968 nom. illeg. Art. 34]
Suballiance *typus*: *Saturejo montanae-Brometum erecti* Avena & Blasi ex Biondi, Ballelli, Allegrezza & Zuccarello 1995

All.: *Hippocrepido glaucae-Stipion austroitalicae* Forte & Terzi in Forte, Perrino & Terzi 2005
Alliance *typus*: *Acino suaveolentis-Stipetum austroitalicae* Forte & Terzi in Forte, Perrino & Terzi 2005

Suball.: *Hippocrepido glaucae-Stipienion austroitalicae* Biondi & Galdenzi suball. nov. *hoc loco*

Suball.: *Violo pseudogracilis-Bromopsienion caprinae* (Terzi 2011) stat. nov. Biondi & Galdenzi *hoc loco*
[*Violo pseudogracilis-Bromopsion caprinae* Terzi 2011]
Suballiance *typus*: *Asphodelo albi-Filipenduletum vulgaris* Corbetta, Ubaldi et Puppi ex Biondi, Balleli, Allegrezza et Zuccarello 1995 nom. invers. propos. Terzi 2011

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Addenda

Table 1 - *Campanulo micranthae-Nardetum strictae* ass. nova
nardetosum strictae subass. nova
festucetosum paniculatae subass. nova
festucetosum circummediterraneae subass. nova
Accidental species:
Rel. 1: Clinopodium vulgare L. +.2, Bupleurum falcatum L. +.2; rel. 2: Trifolium repens L. +; rel. 4: Veronica chamaedrys L. 3.4; Rel. 6: Trifolium alpestre L. +.
Localities and dates of relevés:
[Localities reference system: GAUSS-BOAGA (ROMA 1940) Est Zone]
Rel. 1: Lago di Sbraccia-Valle Castellana (TE) [X: 2404713m, Y: 4735731m], 08/08/2010; rel. 2: Il Vallone-Valle Castellana (TE) [X: 2404454m, Y: 4735937m], 08/08/2010; rel. 3:, Il Vallone-Valle Castellana (TE) [X: 2404403m, Y: 4735948m], 12/08/2010; rel. 4:, Monte Piselli- Civitella del Tronto (TE) [X: 2404885m, Y: 4736720m], 11/08/2010; rel. 5: Il Vallone-Valle Castellana (TE) [X: 2404388m, Y: 4735997m], 12/08/2010; rel. 6: Il Vallone-Valle Castellana (TE) [X: 2404312m, Y: 4735997m], 12/08/2010.

Table 2 - *Cerastio suffruticosi-Brachypodietum genuense* ass. nova
brachypodietosum genuense subass. nova
nardetosum strictae subass. nova
filipenduletosum vulgaris subass. nova
Accidental species
Rel. 1: Carduus affinis Guss. 1.1, Cruciata glabra (L.) Ehrend.+.2, Myosotis alpestris F. W. Schmidt 1.2; rel. 2: Knautia arvensis (L.) Coulter 1.2, Trifolium repens L. 1.1; rel. 4: Stachys germanica L. +, Colchicum lusitanum Brot. 2.2, Onobrychis viciifolia Scop. +.2, Taraxacum officinale Weber (aggregato) 1.2; rel. 5: Clinopodium vulgare L. +.2; rel. 9: Juniperus communis L. +.
Localities and dates of relevés:
[Localities reference system: GAUSS-BOAGA (ROMA 1940) Est Zone]

Rel. 1: Monte Girella - Civitella Del Tronto (TE) [X: 2405869m, Y: 4735680m], 24/08/2010; rel. 2: Monte Piselli-Civitella del Tronto (TE) [X: 2405300m, Y: 4736660m], 22/07/2010; rel. 3: Monte Piselli- Civitella del Tronto (TE) [X: 2404732m, Y: 4737314m], 24/08/2010; rel. 4: Il Vallone-Valle Castellana (TE) [X: 2404337m, Y: 4736447m], 26/08/2010; rel. 5: Monte Girella- Civitella del Tronto (TE) [X: 2404832m, Y: 4737019m], 24/08/2010; rel. 6. Monte Girella-Civitella del Tronto (TE) [X: 2405284m, Y: 4736307m], 24/08/2010; rel. 7: Il Vallone-Valle Castellana (TE) [X: 2404139m, Y: 4736217m], 26/08/2010; rel. 8: Monte Girella-Valle Castellana (TE) [X: 2405315m, Y: 4735562m], 11/08/2010; rel. 9: Il Vallone-Valle Castellana (TE) [X: 2403757m, Y: 4737033m], 08/08/2010; Rel. 10: Il vallone-Valle Castellana (TE) [X: 2403813m, Y: 4736951m], 08/08/2010.

Table 3 - *Festuco circummediterraneae-Achilleetum tomentosae* ass. nova
achilleetosum tomentosae subass. nova
sedetosum albi subass. nova
Accidental species
Rel. 1: Verbascum longifolium Ten.+; rel. 2: Aethionema saxatile (L.) R. Br., Globularia meridionalis (Podp.) O. Schwarz 1.2, Myosotis alpestris F. W. Schmidt +.2, Plantago fuscescens Jordan +, Plantago media L. +.2; rel. 3: Saxifraga bulbifera L. +, Carduus nutans L. +, Centranthus calcitrapa (L.) DC. 1.2, Fritillaria tenella Bieb. 1.2, Draba aizoides L. 1.2, Euphrasia pectinata Ten +.2, Galium lucidum All. 2.2, Rumex acetosa L. 1.2; rel. 4: Carduus affinis Guss. +.2, Cirsium tenoreanum Petrak +.2.
Localities and dates of relevés:
[Localities reference system: GAUSS-BOAGA (ROMA 1940) Est Zone]
Rel. 1: Il Vallone-Valle Castellana (TE) [X: 2404212m, Y: 4735976m], 12/08/2010; rel. 2: Il Vallone-Valle Castellana (TE) [X: 2404199m, Y: 4736081m], 26/08/2010; rel. 3: Monte Piselli- Civitella del Tronto (TE) [X: 2404448m, Y: 4737693m], 27/07/2010; rel. 4: Monte Piselli- Civitella del Tronto (TE) [X: 2404275m, Y: 4737648m] 11/08/2010.

Table 4 - *Astragalo depressi-Koelerietum splendentis* ass. nova
Accidental species
Rel. 1: Myosotis alpestris F. W. Schmidt +, Cytisus sessilifolius L. 1.1, Lonicera xylosteum L. 1.1, Cirsium tenoreanum Petrak +, Lotus ornithopodioides L. +, Cerastium tomentosum L. +; rel. 3: Sempervivum arachnoideum L. +.2; rel. 5: Poa molineri Balbis 1.2, Plantago lanceolata L. +.2, Leontodon leysseri (Wallr.) Beck +, Helichrysum italicum (Roth) Don ssp. italicum +.2, Ceterach officinarum DC. +.2; rel. 6: Silene graminea Vis. 1.2; rel. 8: Centranthus calcitrapa (L.) DC. +, Viola eugeniae Parl. +, Poa bulbosa L. +.2, Lolium perenne L. +, Linum alpinum Jacq. +.2, Geranium pyrenaicum Burm. f. +; Asphodelus albus Miller +.2, Anchusa barrelieri (All.) Vitman +.2, Aethionema saxatile (L.) R. Br. +.2; rel. 9: Sedum rupestre L. 1.2, Juniperus nana Willd. 1.2.
Localities and dates of relevés:
[Localities reference system: GAUSS-BOAGA (ROMA 1940) Est Zone]
Rel. 1: Monte Piselli-Civitella del Tronto (TE) [X: 2404719m, Y: 4737294m], 24/08/2010; rel. 2: Il Vallone-Valle Castellana (TE) [X: 2404592m, Y: 4735706m], 08/08/2010; rel. 3: Monte Piselli-Valle Castellana (TE) [X: 2404444m, Y: 4737082m], 11/08/2010; rel. 4: Monte Piselli-Civitella del Tronto (TE) [X: 2404520m, Y: 4737087m], 11/08/2010; rel. 5: Monte Piselli-Valle Castellana (TE) [X: 2403561m, Y: 4737517m], 10/06/2010; rel 6: Il Vallone-Valle Castellana (TE) [X: 2403567m, Y: 4737505m], 12/08/2010; rel. 7: Loc. Tre Caciare-Valle Castellana (TE) [X: 2403501m, Y: 4738116m], 15/09/2010; rel. 8: Monte Piselli-Valle Castellana (TE) [X: 2403659m, Y: 4737334m], 10/06/2010; rel. 9: Il Vallone-Valle Castellana (TE) [X: 2404202m, Y: 4736074m], 26/08/2010.

Table 5 - *Carici humilis-Seslerietum apenninae* Biondi, Guitan, Allegrezza, Ballelli 1988
astragaletosum sempervirentis subass. nova
Accidental species
Rel. 1: Sedum dasyphyllum L. +.2, Allium ericetorum Thore +.2; rel. 5: Rhinanthus minor L. +; rel. 7: Trifolium pratense L. ssp. semipurpureum (Strobl) Pign. 1.2; rel. 8: Bupleurum falcatum L. +.2, Carduus affinis Guss. +; rel. 9: Campanula micrantha Bertol. +.2, Centranthus calcitrapa (L.) DC. +, Festuca paniculata (L.) Sch. et Th. +.
Localities and dates of relevés:
[Localities reference system: GAUSS-BOAGA (ROMA 1940) Est Zone]
Rel 1: Monte Girella, 24/08/2010; rel. 2: Monte Piselli-Civitella del Tronto (TE) [X: 2404654m, Y: 4736771m], 11/08/2010; rel. 3: Il Vallone-Valle Castellana (TE) [X: 2404434m, Y: 4736393m], 26/08/2010; rel. 4: Il Vallone-Valle Castellana (TE) [X: 2404209m, Y: 4736073m], 26/08/2010; rel. 5: Monte Girella-Civitella del Tronto (TE) [X: 2405522m, Y: 4735628m], 11/08/2010; rel. 6: Monte Girella- CIVITELLA DEL TRONTO (TE) [X: 2405709m, Y: 4735620m], 24/08/2010; rel. 7: Monte Girella-Civitella del Tronto (TE) [X: 2405741m, Y: 4735630m], 24/08/2010; rel. 8: Monte Girella-Civitella del Tronto (TE) [X: 2405647m, Y: 4735585m], 24/08/2010; rel. 9: Il Vallone-Valle Castellana (TE) [X: 2404238m, Y: 4735957m], 12/08/2010.