

Supplementary Materials

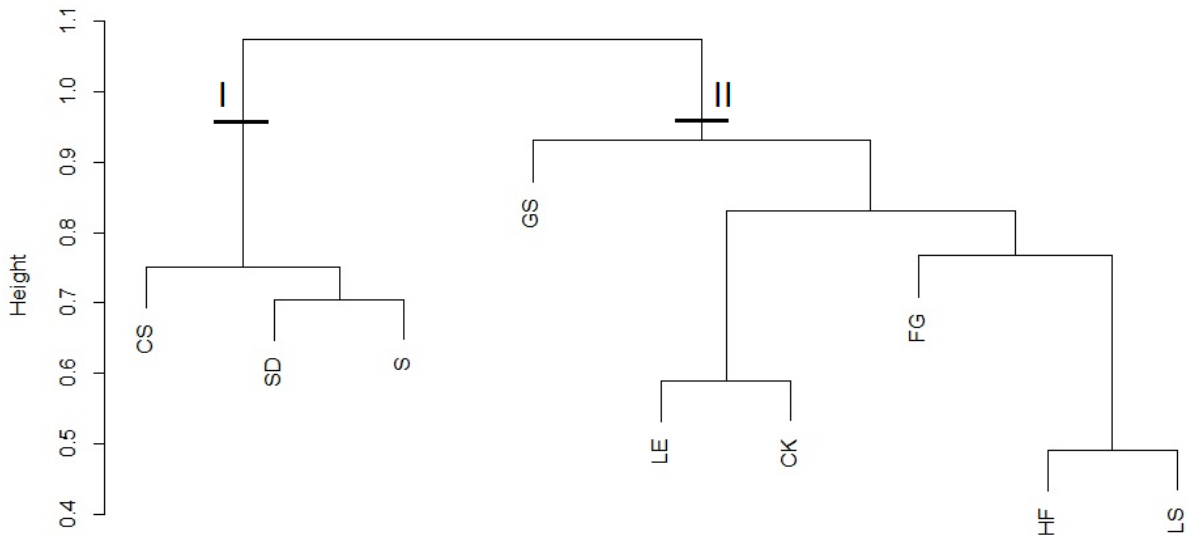


Figure S1. Dendrogram obtained from the classification of the relevés groups of the Central Apennines communities, from the high mountain to alpine belts, belonging to the *Carici rupestris-Kobresietea bellardii* and *Festuco-Seslerietea* classes. Cluster I: *Carici rupestris-Kobresietea bellardii* class; Cluster II: *Festuco-Seslerietea* class. Legend of plant associations: (LE) *Leontopodio nivalis-Elynetum myosuroidis* (typus of the *Leontopodio nivalis-Elynion myosuroidis* alliance); (GS) *Galio majellensis-Silenetum acaulis*; (CK) *Caricetum kitaibelianae-rupestris*; (FG) *Festuco italicae-Geranietum argentei* (ass. nova, study area); (LS) *Leontopodio nivalis-Seslerietum juncifoliae*; (HF) *Helianthemo alpestris-Festucetum italicae*; (SD) *Seslerio apenninae-Dryadetum octopetalae*; (S) *Seslerietum apenninae* (typus of the *Seslerion apenninae* alliance); (CS) *Carici humilis-Seslerietum apenninae* (typus of the *Carici humilis-Seslerion apenninae* alliance).

Table S1. Synoptic table with frequency values in percent of the plant communities occurring in the alpine and subalpine belts of the central Apennines. Column 1 - *Festuco italicae-Geranietum argentei* ass. nova from Table 1: rels. 1-4 in this paper (study area, Central Apennines); column 2 - *Galio magellensis-Silenetum acaulis* Blasi et al. 2003 from Table 5: rels. 1-8 in Blasi et al. (2003), Gran Sasso mountains (Central Apennines); column 3 - *Helianthemo alpestris-Festucetum italicae* Blasi et al. 2005 from Table VII: rels. 1-13 in Blasi et al. (2005), Majella mountains (Central Apennines); column 4 - *Leontopodio nivalis-Seslerietum juncifoliae* Blasi et al. 2005 from Table VI: rels. 1-13 in Blasi et al. (2005), Majella mountains (Central Apennines); column 5 - *Seslerio apenninae-Dryadetum octopetalae* Biondi et al. 1999 from Tab. 5: rels. 1-13 in Biondi et al. (1999), Gran Sasso mountains (Central Apennines); column 6 - *Leontopodio nivalis-Elynetum myosuroidis* Feoli Chiapella et Feoli 1977 (column 6) from Table 1: rels. 1-8 in Biondi et al. (2000), Gran Sasso mountains (Central Apennines); column 7 - *Caricetum kitaibelianae-rupestris* Biondi et al. 2000 from Table 2: rels. 1-12 in Biondi et al. (2000), Gran Sasso (Central Apennines).

No. of column	1	2	3	4	5	6	7
No. relevés	4	8	13	13	13	8	12

***Festuco italicae-Geranietum argentei* ass. nova**

Festuca violacea Ser. ex Gaudin subsp. *italica* Foggi, Gr. Rossi et Signorini

Achillea barrelieri (Ten.) Sch. Bip. subsp. *barrelieri*

Gentianella columnae (Ten.) Holub

Geranium argenteum L.

Potentilla brauneana Hoppe

100	25	100	77		75	83
75	87	15		15		33
100			8			
100						
75						

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

Galium magellense Ten.

Androsace vitaliana (L.) Lapeyr. subsp. *praetutiana* (Buser ex Sünd) Kress

Saxifraga aizoides L.

Festuca alfrediana Foggi et Signorini subsp. *ferrariniana* Foggi, Parolo et Gr. Rossi

Gentiana utriculosa L.

Cerastium thomasii Ten.

25	87		8			33
	100				12	33
	50				12	33
	75					
	37					
	100					

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

Helianthemum oelandicum (L.) Dum.Cours. subsp. *alpestre* (Jacq.) Ces.

Sempervivum arachnoideum L.

Poa molineri Balb.

Trifolium thalii Vill.

Leucanthemum trydactylites (A. Kern. et Huter ex Porta et Rigo) Huter, Porta et Rigo

Trifolium pratense L. subsp. *semipurpureum* (Strobl) Pignatti

	92	85	23	87	83
	85	85		12	33
100	61	61			
	23			12	
	61				
	23				

***Leontopodio nivalis-Seslerietum juncifoliae* Blasi et al. 2005**

Sesleria juncifolia Suffren subsp. *juncifolia*

Aster alpinus L. subsp. *alpinus*

Ranunculus breyninus Crantz

Iberis saxatilis L. subsp. *saxatilis*

Carex humilis Leyss.

50	54	100	100	50	92
25	31	85		50	42
100	23	85			17
	23	92	15		
		77	31		

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

Dryas octopetala L. subsp. *octopetala*

Carex mucronata All.

Gentiana dinarica Beck

Lomelosia graminifolia (L.) Greuter et Burdet subsp. *graminifolia*

Ranunculus thora L.

15	100		33
	61		
	69		
	61		
	31		

***Leontopodio nivalis-Elynetum myosuroidis* Feoli Chiapella et Feoli 1977**

Carex myosuroides Vill.

5	15	100	17
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Antennaria dioica (L.) Gaetn.	50	8
Armeria gracilis Ten. subsp. majellensis (Boiss.) Arrigoni	50	42
Alchemilla colorata Buser	75	

***Caricetum kitaibelianae-rupestris* Biondi *et al.* 2000**

Carex rupestris All.	8	50	92
Potentilla apennina Ten. subsp. apennina	8	15	42
Artemisia eriantha Ten.			42
Gentiana orbicularis Schur			33

Leontopodio-Elynion, Oxytropido-Elynalia, Carici rupestris-Kobresietea bellardii

Silene acaulis (L.) Jacq. subsp. bryoides (Jord.) Nyman	100	100	77	69	8	87	92
Erigeron epiroticus (Vierh.) Halácsy	75	25	61	46		62	42
Carex kitaibeliana Degen <i>ex</i> Bech.	100		100	85	85	100	92
Sabulina verna (L.) Rchb. subsp. verna	100		92	69	31	50	42
Sedum atratum L.	100	25	31			37	58
Leontopodium nivale (Ten.) É. Huet <i>et</i> A. Huet <i>ex</i> Hand.-Mazz.	50		100	100	31	12	
Potentilla crantzii (Crantz) Beck <i>ex</i> Fritsch subsp. crantzii	100		61	38		75	17
Bistorta vivipara (L.) Delarbre			8	8	8	100	33
Omalotheca diminuta (Braun-Blanq.) Bartolucci <i>et</i> Galasso	50	5	61				
Pedicularis verticillata L. subsp. verticillata		5				25	33
Oxytropis campestris (L.) DC.			77	85			
Trifolium noricum Wulfen subsp. praetutianum (Guss. <i>ex</i> Savi) Arcang.						12	8
Carex ericetorum Pollich						62	33
Oxytropis neglecta J. Gay <i>ex</i> Ten.			8				
Gentiana nivalis L.						25	
Saxifraga exarata Vill. subsp. ampullacea (Ten.) D.A. Webb							17

Festuco-Seslerietea

Draba aizoides L. subsp. aizoides	75	62	85	85	15	100	75
Edraianthus graminifolius (L.) DC. <i>ex</i> Meisn. subsp. graminifolius	75	25	61	92	77	75	100
Androsace villosa L. subsp. villosa	50		85	54	85	25	33
Pulsatilla alpina (L.) Delarbre subsp. millefoliata (Bertol.) D.M. Moser	50		85	31	15	12	33
Trinia dalechampii (Ten.) Janch.	25		83	85	8	62	50
Gentiana verna L. subsp. verna	50		46	31		87	33
Pedicularis elegans Ten.	25			92	8	37	17
Euphrasia salisburgensis Funck <i>ex</i> Hoppe	75		8	23		12	
Phyteuma orbiculare L.			15		8	25	8
Polygala alpestris Rchb. subsp. alpestris			8	8			
Galium anisophyllum Vill.						37	8
Saxifraga caesia L.					23		17
Coeloglossum viride (L.) Hartm.						12	17
Thesium parnassi A. DC.				8	23		
Alchemilla nitida Buser	50						
Paronychia kapela (Hacq.) A. Kern. subsp. kapela	25						
Carduus defloratus L. subsp. carlinifolius (Lam.) Ces.	25						
Bellidiastrum michelii Cass.	75						
Helianthemum nummularium (L.) Mill. subsp. grandiflorum (Scop.) Schinz <i>et</i> Thell.				8			
Biscutella laevigata L. subsp. laevigata							8
Carex firma Host					8		

Nardetea strictae* and *Juncetea trifidi

Plantago atrata Hoppe subsp. atrata	100		15	8		37	
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Luzula italica Parl.	25		8			75	8
Campanula scheuchzeri Vill. subsp. scheuchzeri			31	8			17
Pilosella lactucella (Wallr.) P.D. Sell <i>et</i> C. West subsp. nana (Scheele) M. Laínz	25					37	
Botrychium lunaria (L.) Sw.	25					25	
Anthoxanthum nipponicum Honda						25	8
Taraxacum apenninum (Ten.) DC.	75						
Crepis aurea (L.) Cass. subsp. glabrescens (Caruel) Arcang.	75						
<i>Asplenietea trichomanis</i>							
Saxifraga paniculata Mill.	75	5	69	85	8	12	33
Saxifraga oppositifolia L. subsp. oppositifolia		5	8	23	8		8
Campanula tanfanii Podlech	50				8		
Asplenium viride Huds.	50						
Cystopteris fragilis (L.) Bernh.	75						
Primula auricula L.							33
<i>Thlaspietea rotundifolii</i>							
Saxifraga adscendens L. subsp. adscendens	100		8	31	8	12	8
Ranunculus brevifolius Ten.	25	25	23				
Carum heldreichii Boiss.					38	12	8
Valeriana saliunca All.			8	15			
Robertia taraxacoides (Loisel.) DC.	25	25					
Noccaea stylosa (Ten.) Rchb.		37	8				
Scorzoneroideis montana (Lam.) Holub			8		8		
Leucopoa dimorpha (Guss.) H. Scholz <i>et</i> Foggi	25						
Doronicum columnae Ten.	75						
Arabis alpina L. subsp. caucasica (Willd.) Briq.	25						
other species							
Anthyllis montana L. subsp. jacquinii (Rchb. f.) Rohlena	25			15	69	12	33
Thymus praecox Opiz subsp. polytrichus (A. Kern <i>ex</i> Borbás) Jalas	75	50	92	46	8		33
Myosotis graui Selvi	25	62	23	23		62	17
Poa alpina L. subsp. alpina		87	46	54	8	87	58
Salix retusa L.			15	23	8	12	17
Cerastium arvense L. subsp. suffruticosum (L.) Ces.	50		69	61			8
Viola eugeniae Parl. subsp. eugeniae			31	15		37	8
Helictochloa praetutiana (Parl. <i>ex</i> Arcang.) Bartolucci, F. Conti, Peruzzi <i>et</i> Banfi subsp. praetutiana	75		83	69	46		
Anthyllis vulneraria L. subsp. nana (Ten.) Tammaro	50				8	50	58
Cynanchica pyrenaica (L.) P. Caputo <i>et</i> Del Guacchio subsp. neglecta (L.) P. Caputo <i>et</i> Del Guacchio	25				8	12	
Globularia meridionalis (Podp.) O. Schwarz	75				61		8
Oreojuncus monanthos (Jacq.) Záv. Drábek. <i>et</i> Kirschner	50			23		37	
Armeria canescens (Host) Ebel		37	69	46			
Pilosella officinarum Vaill.			31	8	8		
Dianthus sylvestris Wulfen subsp. sylvestris					8	12	33
Helianthemum oelandicum (L.) Dum. Cours. subsp. incanum (Willk.) G. López	25				61		
Koeleria australis A. Kern	75				8		
Anthyllis vulneraria L. subsp. pulchella (Vis.) Bornm.			100	92			
Arenaria grandiflora L. subsp. grandiflora			8	31			
Pinus mugo Turra subsp. mugo			8	8			
Cerastium arvense L. subsp. strictum (W.D.J. Koch) Gremli					8		33
Juniperus communis L.					15	12	
Armeria gracilis Ten. subsp. gracilis	100						

<i>Carlina acaulis</i> L. subsp. <i>caulescens</i> (Lam.) Schübl. <i>et</i> G. Martens	25		
<i>Ziziphora granatensis</i> (Boiss. <i>et</i> Reut.) Melnikov subsp. <i>alpina</i> (L.) Bräuchler <i>et</i> Gutermann	25		
<i>Anthemis cretica</i> L. subsp. <i>columnae</i> (Ten.) Franzén			37
<i>Festuca laevigata</i> Gaudin		8	
<i>Veronica aphylla</i> L. subsp. <i>aphylla</i>			33
<i>Astrantia pauciflora</i> Bertol. subsp. <i>tenorei</i> (Mariotti) Bechi <i>et</i> Garbari			25
<i>Arctostaphylos uva-ursi</i> (L.) Spreng.			15
<i>Linum capitatum</i> Kit. <i>ex</i> Schult. subsp. <i>serrulatum</i> (Bertol.) Hartvig			15
<i>Carex macrolepis</i> DC.			23
<i>Leontodon hispidus</i> L.			31
<i>Brachypodium genuense</i> (DC.) Roem. <i>et</i> Schult.			23
<i>Anthyllis vulneraria</i> L. subsp. <i>weldeniana</i> (Rchb.) Cullen			23
<i>Teucrium montanum</i> L.			23
<i>Linum catharticum</i> L. subsp. <i>catharticum</i>			23
<i>Coronilla minima</i> L.			15
<i>Bromopsis erecta</i> (Huds.) Fourr.			15
<i>Hieracium bifidum</i> Kit. <i>ex</i> Hornem.			8
<i>Lotus corniculatus</i> L.			8

Table S2. Chorological spectrum of the species in Table 1. Legend: (n) percentage of species; (f) percentage frequency; (c) species cover percentage

Chorological type	n %	f %	c %
Endemic Italian and subendemic	25.0	25.2	71.3
Boreal	15.0	16.8	11.4
South European orophytes	38.3	38.5	13.6
European Orophytes	5.0	6.3	1.2
Mediterranean	11.7	9.8	1.8
Eurasian	1.7	0.7	0.1
Cosmopolitan	3.3	2.7	0.5

Table S3. Weight of species shown in the PCA of Figure 5 with respect to the three main components identified (axes PC1, PC2 and PC3) and the relative % of variance explained by each one. The full name of the abbreviated species are reported in Table 4

	Species weight PC1 (%)	Variance explain by species PC1 (%)	Species weight PC2 (%)	Variance explain by species PC2 (%)	Species weight PC3 (%)	Variance explain by species PC3 (%)
Sal.retu	10.08	1.84	0.11	0.01	4.86	0.49
Bis.viv	9.80	1.79	0.05	0.01	0.01	0.00
Tri.pal	7.13	1.30	0.08	0.01	3.21	0.32
Par.pal	7.00	1.28	0.09	0.01	3.13	0.32
Car.rup	4.65	0.85	30.02	3.38	2.19	0.22
Hel.oel.inc	2.89	0.53	0.09	0.01	3.30	0.33
Sax.pan	2.76	0.50	0.36	0.04	0.61	0.06
Thy.pra	2.52	0.46	0.68	0.08	0.46	0.05
Ger.arg	2.46	0.45	0.64	0.07	0.43	0.04
Gal.ani	2.45	0.45	0.02	0.00	0.07	0.01
Gen.ani	2.43	0.44	0.11	0.01	0.53	0.05
Ast.alp	2.41	0.44	3.65	0.41	1.11	0.11
Fes.lae	2.12	0.39	4.30	0.48	1.05	0.11
Ant.nip	2.00	0.37	0.12	0.01	0.77	0.08
Eup.sal	1.68	0.31	0.07	0.01	1.26	0.13
Sol.alp	1.67	0.30	0.21	0.02	1.98	0.20
Ses.jun	1.64	0.30	2.95	0.33	0.19	0.02
Alc.tra	1.32	0.24	8.12	0.91	1.71	0.17
Ach.cla	1.28	0.23	0.01	0.00	0.01	0.00
Ped.ver	1.25	0.23	0.02	0.00	0.12	0.01
Cer.arv	1.22	0.22	2.22	0.25	0.06	0.01
Bra.gen	1.20	0.22	2.48	0.28	0.45	0.05
Pot.cra	1.16	0.21	0.09	0.01	0.87	0.09
Poa.alp	1.15	0.21	2.62	0.29	2.98	0.30
Fes.nit	1.11	0.20	0.01	0.00	0.60	0.06
Agr.rup	1.09	0.20	0.01	0.00	0.82	0.08
Ach.alp	0.92	0.17	1.90	0.21	0.35	0.04
Alc.cin	0.88	0.16	1.80	0.20	0.44	0.04
Fes.ric	0.83	0.15	2.96	0.33	0.93	0.09
Bel.mic	0.77	0.14	2.03	0.23	0.48	0.05
Fes.vio	0.33	0.06	0.25	0.03	1.39	0.14
Alc.flu	0.17	0.03	5.22	0.59	5.47	0.55
Sab.ver	0.11	0.02	0.03	0.00	1.94	0.20
Sil.aca	0.08	0.01	0.18	0.02	2.66	0.27
Dry.oct	0.06	0.01	0.19	0.02	2.00	0.20
Ses.cae	0.03	0.01	0.34	0.04	4.05	0.41
Car.myo	0.02	0.00	0.57	0.06	4.74	0.48
Ses.sph	0.02	0.00	0.25	0.03	1.96	0.20
Cha.alp	0.02	0.00	0.28	0.03	2.36	0.24
Sax.cru	0.01	0.00	0.20	0.02	2.64	0.27
Dia.ste	0.01	0.00	0.17	0.02	1.50	0.15