ISSN 1125-9078

FITOSOCIOLOGIA

monografica

volume 39 (1) - Suppl. 3 - 2002

Guide to the Excursion of the "Fédération Internationale de Phytosociologie" to the Natural Parks of Conero, Gran Sasso and Monti della Laga, and Circeo

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Printed with the contribution of

Università di Ancona
Facoltà di Agraria

Società Italiana di
Fitosociologia

Fédération Internationale
de Phytosociologie

Journal of the Italian Association for Phytosociology associated with the "Fédération Internationale de Phytosociologie"

Excursion to the National Park of Gran Sasso and Monti della Laga

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The National Park of Gran Sasso and Monti della Laga

The National Park of Gran Sasso and Monti della Laga is situated in central Italy (Fig. 1) and is characterised by the presence of three mountain chains (Fig. 2), two of which are found in the north-east sector: the spine of the Monti Gemelli (the Twin Mountains), made up of the Montagna dei Fiori (that peaks with the Monte Girella, 1814 metres) and the Montagna di Campli (that peaks with the Monte Foltrone: 1718 metres), and the chain of the Monti della Laga (the Laga Mountains) running in a north-south orientation (culminating in the Cima Lepri, 2445 metres). The third chain, that of Gran Sasso d'Italia, that is situated more to the south than the others, comprises a large peak area among which there are important peaks such as: Monte Corvo (2623 metres), Pizzo Intermesoli (2635 metres), Monte Brancastello (2385 metres), Monte Prena (2561 metres) and Monte Camicia (2564 metres), and among which is inserted the peak of Corno Grande that, with its 2912 metres, represents the highest peak of the entire Apennines.

The major part of the territory falls under the administrative juresdiction of the northern sector of the Region of Abruzzo, while the north part of the Monti della Laga belongs to Marche, and the north-west part is in the Region of Lazio.

From the mountain groups of the Monti Gemelli and the Monti della Laga, the waters flow away in the hydrographic basins of the rivers of Tronto, Salinello, Tordino and Castellano, while from the Gran Sasso d'Italia group the waters flow away in the hydrographic basins of the rivers Vomano, Tavo, Fino and Piombo; all of these flow into the Adriatic Sea.

The Park territory is mainly made up of two lithological types of sedimentary origins: calcareous-marly rocks that form the structure of the Gran Sasso chain and that of Monti Gemelli, and sandstone-silt rocks of the Monti della Laga.

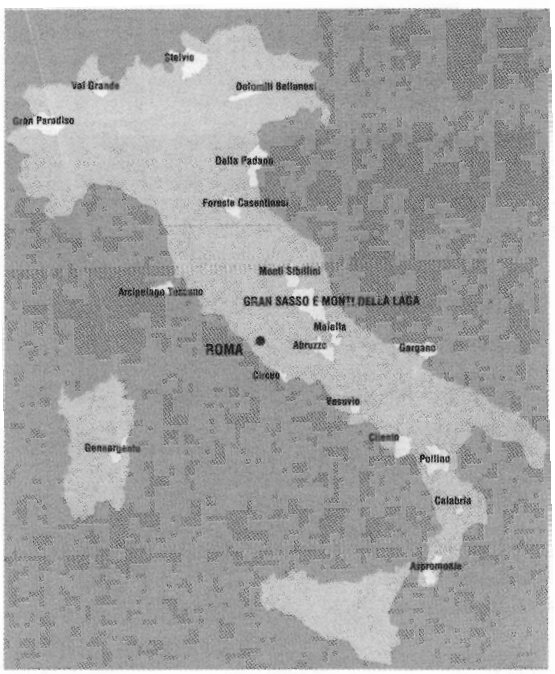
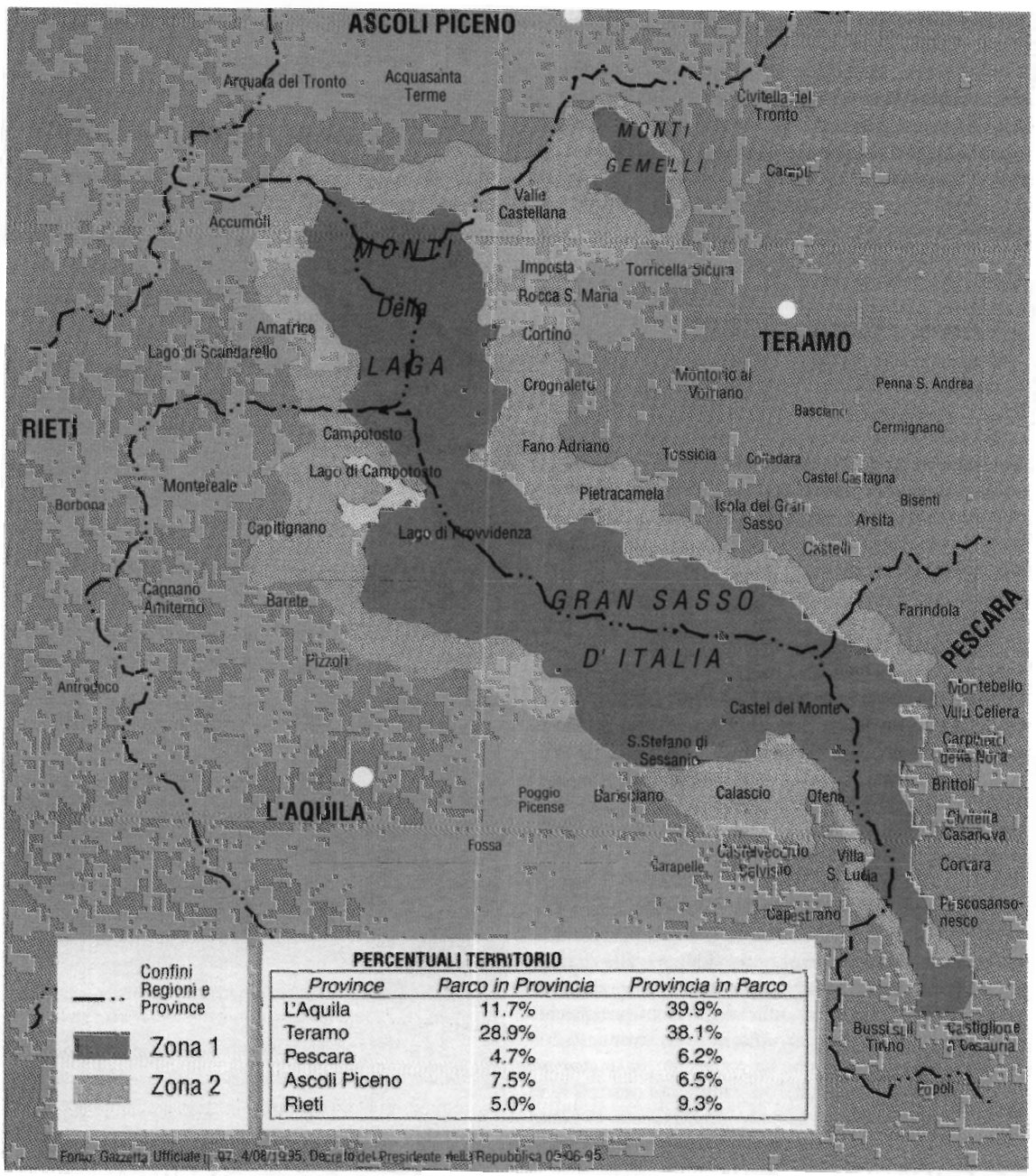


Fig. 1 - Italian National Parks (from Vallarola, 1998)

At a height of 2700 metres, the Ghiacciaio del Calderone (Calderone Glacier) is found, a glacier remaining from the last würmian glacial phase, that has notably reduced in the last few years.

The Plio-Quaternary geological and geomorphological activity was a deciding factor in the determination of the actual morphology, characterised by various glacial episodes, intramountain tectonic basins and impressive fans that have resulted from the breakdown of the carbonaceous rock.

The geographical location undoubtably contributes in a determined way to the increase in the floristic-vegetational diversity of the area, along with other environmental factors such as the lithologic and pedologic diversity, as well as the grouping of the high-altitude peaks which is without comparison in other areas of the Apennines.



PERCENTUALI TERRITORIO

Province	*Parco in Provincia*	*Provincia in Parco*
L'Aquila	11.7%	39.9%
Teramo	28.9%	38.1%
Pescara	4.7%	6.2%
Ascoli Piceno	7.5%	6.5%
Rieti	5.0%	9.3%

Fig. 2 - The National Park of Gran Sasso and Monti della Laga and administrative juresdiction (from Vallarola, 1998)

Bioclimate

The bioclimatic classification of the territory of the Gran Sasso d'Italia has been conducted on the basis of data obtained in 11 thermopluvimetric stations between Vomano, Aterno-Pescara and Tordino basins (Fig. 3). Precipitation analysis demonstrated greater aridity in the western stations than in the eastern ones.

The correlation between average annual temperature and altitude is very significant (r=0.987). The coldest month is January in all stations, except Campo Imperatore, where it is February. The warmest month is generally August. The study of temperatures by decades (monthly average, average of the maximums and of the minimums) for the Campo Imperatore station revealed a certain increase of the average minimum temperatures over the years, while the averages of the maximums remained fairly constant.

Correlating altitude and average temperature, it can be seen that the temperature decreases 0.58°C every 100 m of altitude increase for the southern slope and 0.62°C for the northern one (Baldoni *et al.*, 1999).

The bio-climatic classification was carried out in accordance with the classification proposed by Rivas-Martinez *et al.* (1999) and the results are shown in Tab 1.

By applying the regression equation obtained through the correlation of the compensated thermicity index (Itc) and altitude, it can be seen that the hilly belt rises to 800m on the southern slope and 900m on the northern one. The montane belt develops as far as 1800m on the southern slope and 1750 on the northern, while the subalpine one rises to 2550m on the southern and 2400m on the northen slope; above is the alpine belt, the highest point of which in this territory is on Corno Grande (2912m).

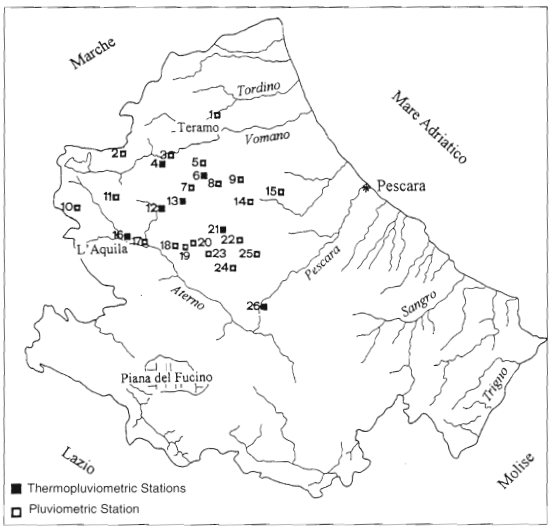


Fig. 3 - Localization of climatic stations (from Baldoni *et al.*, 1999)

Tab. 1 - Bioclimatic classification on the bases of Rivas-Martinez's index

Stations	Altitude	Macrobioclimate	Bioclimate	Bioclimatic belt	Ombrotype
Assergi	1040	Temperate	Oceanic	Sub-Supramediterranean	Low humid
Barisciano	810	Mediterranean	Pluviseasonal-oceanic	Low Supramediterranean	Upper subhumid
Campo Imperatore	2137	Temperate	Oceanic	Upper orotemperate	Low hyperhumid
Campo Imperatore	2140	Temperate	Oceanic	Upper orotemperate	Low hyperhumid
Campotosto	1430	Temperate	Oceanic	Upper supratemperate	Upper humid
Casteldelmonte	1300	Temperate	Oceanic (Submediterranean)	Upper supratemperate	Upper humid
Isola del Gran Sasso	429	Temperate	Oceanic	Upper mesotemperate	Upper humid
L'Aquila	735	Mediterranean	Pluviseasonal-oceanic	Low Supramediterranean	Upper subhumid
Penne	446	Temperate	Oceanic (Submediterranean)	Sub-Mesomediterranean	Low humid
Pietracamela	1015	Temperate	Oceanic (Submediterranean)	Sub-Supramediterranean	Upper humid
Termine	1050	Temperate	Oceanic (Submediterranean)	Low Supratemperate	Upper humid
Teramo	300	Temperate	Oceanic (Submediterranean)	Sub-Mesomediterranean	Low humid

The Flora

In the "Compendio sulla flora del Gran Sasso d'Italia" (Tammaro, 1983), in total are indicated 1517 entities. Later research (Ballelli, 1999) allows to obtain a more complete picture about the real consistency of the floristic heritage of Gran Sasso and demonstrated that these actually include at least 1795 entities (Tab. 2).

Among the new species found, *Carex ornithopoda* Willd. subsp. *ornithopodioides* (Hausm.) Nyman. and *Draba dubia* Suter (Fig. 4) were reported for the first time for the Apennines flora; they show the relic condition of some species here arrived during the Würmian ice age. Central Apennines new species are: *Juniperus communis* L. subsp. *hemisphaerica* (J. & C. Presl) Nyman (Fig. 5) and *Phleum phleoides* (L.) Karsten and for the territory of Abruzzo region, *Hymenolobus pauciflorus* (Koch) Schinz & Thell.

Other species of remarkable phytogeographic interest, besides the endemic entities listed below, are: *Adonis distorta* Ten., *A. vernalis* L., *Malcolmia orsiniana* (Ten.) Ten., *Silene cattariniana* Ferrarini et Cecchi (Fig. 6), *Potentilla nitida*, *Goniolimon italicum* Tammaro, Pignatti et Frizzi, *Tofieldia calyculata* (L.) Wahlenb., *Festuca violacea* Gaudin subsp. *italica* Foggi, Graz. Rossi et Signorini (Fig. 7), *F. alfrediana* Foggi et Signorini (Fig. 8), *F. alpina* Suter subsp. *riverae* Cars, Kerguélen et Plonka (Fig. 9), *Ononis cristata* Miller, etc.

The chorological spectrum (Fig. 10) makes evident the high percentage of entities with a continental gravitation such as the Euro-Asiatic, the montane centre-southern European and the Boreal species that together reach 50%, in relation with the prevalent high of the study territory and the high-montane bioclimatic belt, on the other hand the value of the entities belonging to the Mediterranean area (25,08%) is much lower. The amount of endemic species is good (7,30%), these are almost exclusive of the cacuminal sectors, characterising the natural environmental value of this part of the calcareous central Apennines.

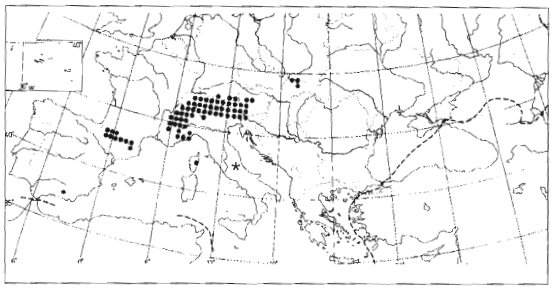


Fig. 4 – Distribution of *Draba dubia* (from Jalas & Suominen, 1996)

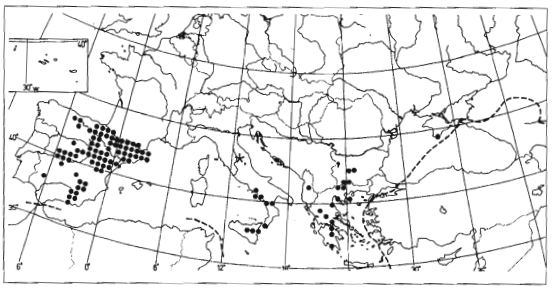


Fig. 5 – Distribution of *Juniperus communis* ssp. *hemisphaerica* (from Jalas & Suominen, 1988)

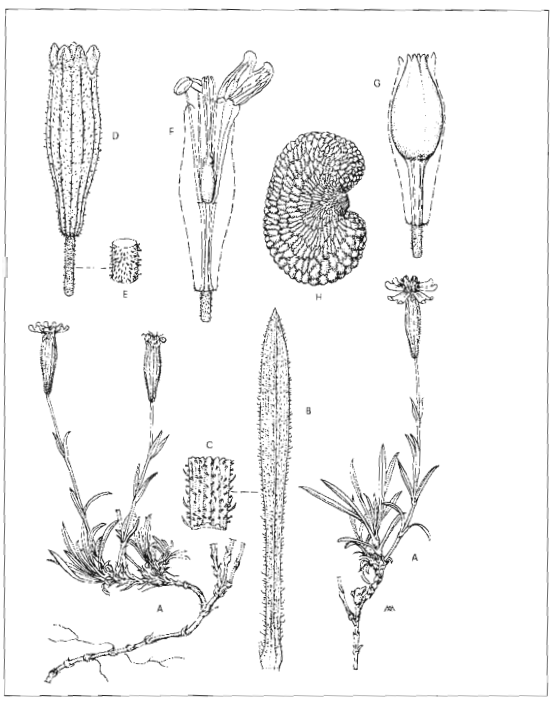


Fig. 6 - *Silene cattariniana* (from Ferrarini and Cecchi, 2001)

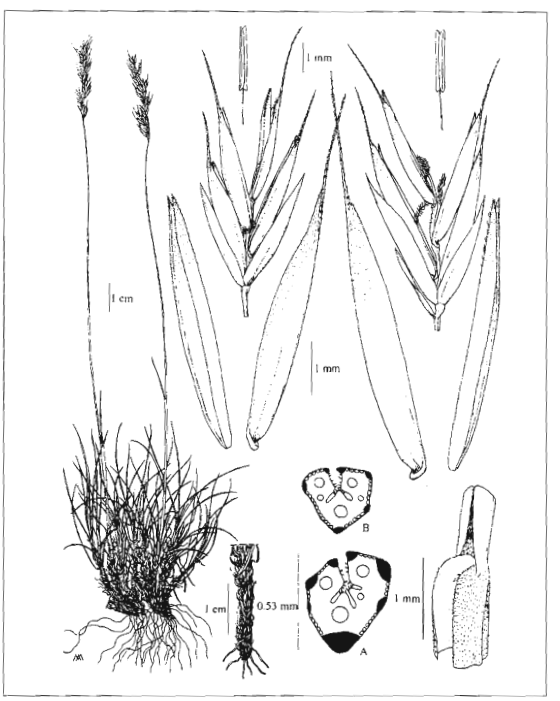


Fig. 7 - *Festuca violacea* subsp. *italica* (from Foggi *et al.*, 1999)

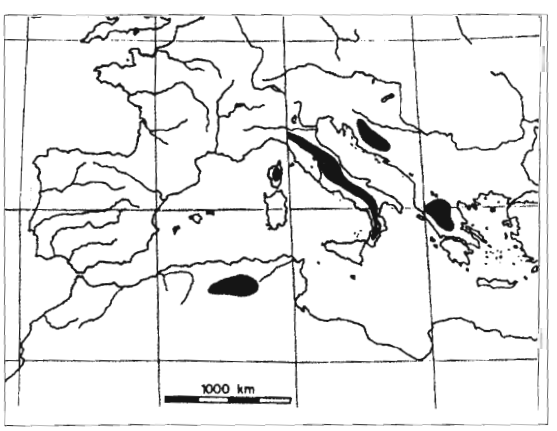


Fig. 8 - Distribution of *Festuca alfrediana* (from Catonica, 2001)

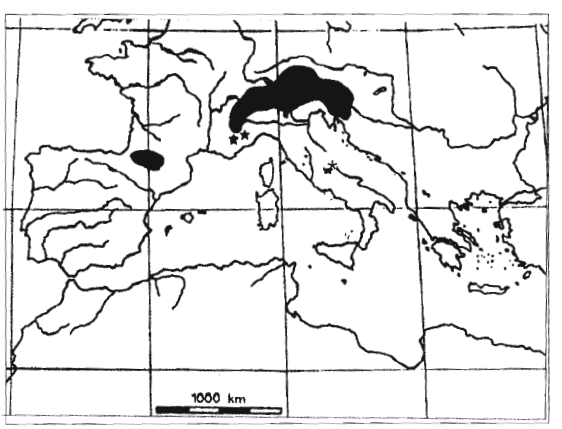


Fig. 9 - Distribution of *Festuca alpina* ssp. *alpina* and (*) *F. alpina* subsp. *riverae* (from Catonica, 2001)

The biological spectrum (Fig. 10) makes evident the definite prevalence of the Hemicryptophites (52,60%), plants that good develop in cold and temperate-cold climates, particularly frequent in the grasslands of montane and high-montane areas of Apennines. The second group is represented by Therophytes reaching 21,10%, entities developing in warm and dry climates, in this territory mainly relegated to altitudes lower then 800 m, in dry grasslands and degraded habitats.

The value of the other biological categories has got little importance.

The families having the highest number of entities are: Compositae 254, Gramineae 146, Leguminosae 127, Cruciferae 95, Caryophyllaceae 90, Labiatae 79, Scrophulariaceae 74, Umbelliferae 73, etc.; while the most represented genera are: Carex 39, Ranunculus 30, Trifolium 28, Hieracium 26, Silene 25, Festuca and Campanula 21, Saxifraga 18, Allium 17, Potentilla 16, Sedum, Bromus and Centaurea 15, etc..

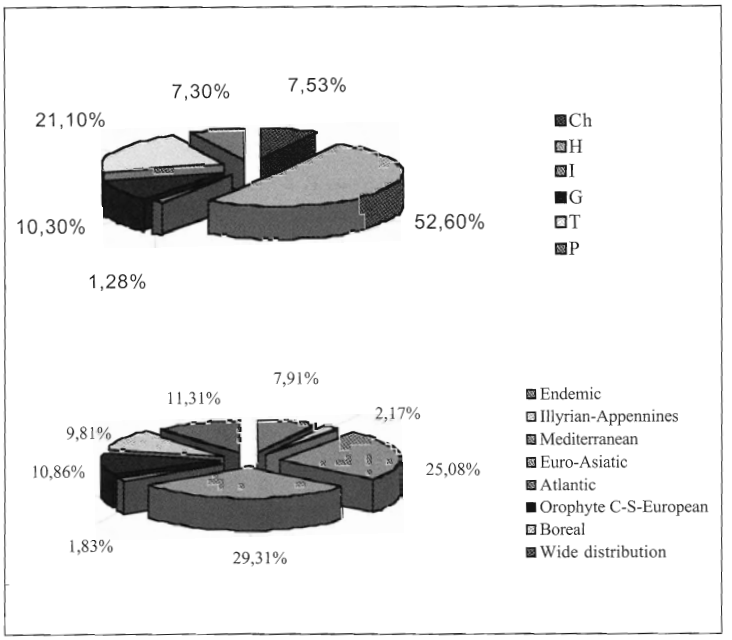


Fig. 10 - Biological and Chorological spectra of the Gran Sasso Flora

Tab. 2 - Taxonomical units present in the Gran Sasso d'Italia territory

	F	G	E
Pteridophyta	13	17	36
Gymnospermae	3	8	15
Angiospermae			
Dicotyledones	85	448	1413
Monocotyledones	15	117	331
	116	590	1795

F= Families, G= Genera, E=Entities

List of the endemic entities present in central Apennines:

Adonis distorta Ten.
Androsace vitaliana (L.) Lapeyr. subsp. *praetutiana* (Sünd.) Kress
(*Vitaliana primuliflora* Bertol. subsp. *praetutiana* (Sünd.) I. K. Ferguson)
Anthemis carpatica Willd. subsp. *petraea* (Ten.) R. Fern.
Anthemis cretica L. subsp. *alpina* (L.) R. Fern.
Aquilegia magellensis Huter, Porta e Rigo
Asperula neglecta Guss.
Astrantia pauciflora Bertol. subsp. *tenorei* (Mariotti) Bechi et Garbari
Campanula tanfanii Podlech
Centaurea ambigua Guss. subsp. *nigra* (Fiori) Pignatti
Cerastium thomasii Ten.
Cymbalaria pallida (Ten.) Wettst.
Galium magellense Ten.
Gentiana columnae Ten. (*Gentianella columnae* (Ten.) Holub.)
Goniolimon italicum Tammaro, Pignatti et Frizzi
Herniaria bornmuelleri Chaudhri
Leucanthemum tridactylites (Fiori) Bazzich.
Ligusticum lucidum Mill. subsp. *cuneifolium* (Guss.) Tammaro
Ononis cristata Mill. subsp. *apennina* Tammaro et Catonica
Pinguicula fiorii Tammaro et Pace
Ranunculus magellensis Ten.
Saxifraga italica D.A. Webb
Saxifraga oppositifolia L. subsp. *speciosa* (Dörfl. et Hayek) Engl. et Irmsch. (*S. speciosa* (Dörfl. et Hayek) Dörfl. et Hayek)
Sempervivum riccii Iberite et Anzal. (*S. italicum* I. Ricci nom. inv.)
Silene cattariniana Ferrarini et Cecchi
Silene notarisii Ces.
Soldanella minima Hoppe subsp. *samnitica* Cristof. et Pignatti
Taraxacum glaciale Hand.-Mazz.

Thlaspi stylosum (Ten.) Mutel
Trisetaria villosa (Bertol.) Banfi et Soldano (*Trisetum bertolonii* Jonsell;
T. villosum (Bertol.) Schult.)
Viola eugeniae Parl. subsp. *eugeniae*
Viola magellensis Porta et Rigo ex Strobl

The vegetation

In the lower hilly belt of the Park, that stretches from the valley bottom up to 500-600 metres, a forestal vegetation is found, characterised by the abundant penetration of the Mediterranean elements of the *Quercion ilicis* alliance, inside the mixed coenosis dominated by downy oak *(Quercus pubescens)* or hop hornbeam *(Ostrya carpinifolia)* and flowering ash *(Fraxinus ornus)* that are representative of the *Lauro nobilis-Quercenion pubescentis* suballiance, of the *Ostryo-Carpinion orientalis* alliance. Inside this belt, in rocky areas, can also be found the extra-zonal hol oak woods of the *Fraxino orni-Quercetum ilicis* association and their related substitute formations. Higher up, but still in the hilly belt, the mixed woods of *Ostrya carpinifolia* of the *Scutellario-Ostryetum* association of the *Laburno-Ostryenion* suballiance of the *Ostryo-Carpinion orientalis* alliance dominate.

The mountane belt, between 1000 and 1800 metres, is characterised by the presence of beech of the *Geranio nodosi-Fagenion sylvaticae* suballiance of the *Fagion sylvaticae* alliance, and in the areas in which this has been destroyed, of the secondary grasslands of the *Festuco-Brometea* class.

The subalpine belt, between 1800 and 2300 metres, is essentially made up of Dwarf Juniper; (*Juniperus communis* ssp. *alpina*) and of Bearberry (*Arctostaphylos uva-ursi*) of the *Daphno oleoidis-Juniperetum alpinae* association of the *Daphno oleoidis-Juniperion alpinae* alliance. In this bioclimatic belt, on the Monti della Laga, there are the heathlands of Bilberry (*Vaccinium mirtyllus*) and *Vaccimium gaultherioides* that provide an easily recognisable belt.

The vegetation that characterises the belt of the alpine bioclimatic, that extends above 2300 metres, is mainly represented by the primary grasslands of the *Carici rupestris-Kobresietea bellardii* and *Festuco-Seslerietea* classes.

Finally, the vegetal formation that characterises the summit area of Corno Grande, near the crest at around 2800 metres in height, is made up of *Cerastium thomasii* and *Arabis alpina* of the *Arabido alpinae-Cerastietum thomasii* association of the *Linario-Festucion dimorphae* alliance.

The fauna

In the Park there are over 300 species of vertebrates: 22 species of fish, 14 of amphibians, 16 of reptiles, 51 of mammals and more than 200 species of birds.

Among the reptiles, the most notable species is the Orsini Viper (*Vipera ursinii*).

With the mammals, the presence of the Roe Deer (*Capreolus capreolus*), the Deer (*Cervus elaphus*), the Chamois (*Rupricapra pyrenaica ornata*) and the Wild Boar (*Sus scrofa*) arises from the reintroduction that has been carried out over the last 20-30 years for hunting.

The sporadic signs of the Bear (*Ursus arctos marsicanus*) are the result of a slow process of recolonisation by a few of the individuals from the population present in the nearby Parco Nazionale d'Abruzzo, while nowadays the Otter (*Lutra lutra*) is still absent from the Park territory. Among the other mammalian species, those that can be mentioned are the Wolf (*Canis lupus*), the Wild Cat (*Felis silvetris*), the Snow vole (*Chiononys nivalis*) and the Apennines Shrew (*Sorex sanniticus*).

Of the birds, the Common Raven (*Corvus corax*), that was definitely present up to a few years after the war, can be seen rarely in some areas of Gran Sasso. The most interesting species that are present now are: the Golden Eagle (*Aquila chrysaetos*), the Peregrine Falcon (*Falco peregrinus*), the Lanner Falcon (*Falco biarmicus*), the Yellow-billed Cough (*Pyrrhocorax graculus*) and Red-billed Cough (*Pyrrhocorax pyrrhocorax*), the White-winged snow finch (*Montifringilla nivalis*), the Rock Partridge (*Alectoris graeca*), the Nightjar (*Caprimulgus europaeus*), the Collared Flycatcher (*Ficedula albicollis*), the Middle Spotted Woodpecker (*Picoides medius*), the Kingfisher (*Alcedo atthi*), and the Red-backed Shrike (*Lanius collurio*).

Moreover, there are numerous other species of invertebrates, among which there are 21 species endemic to the Park territory, of which four are exclusive to the Monti della Laga and 17 to Gran Sasso.

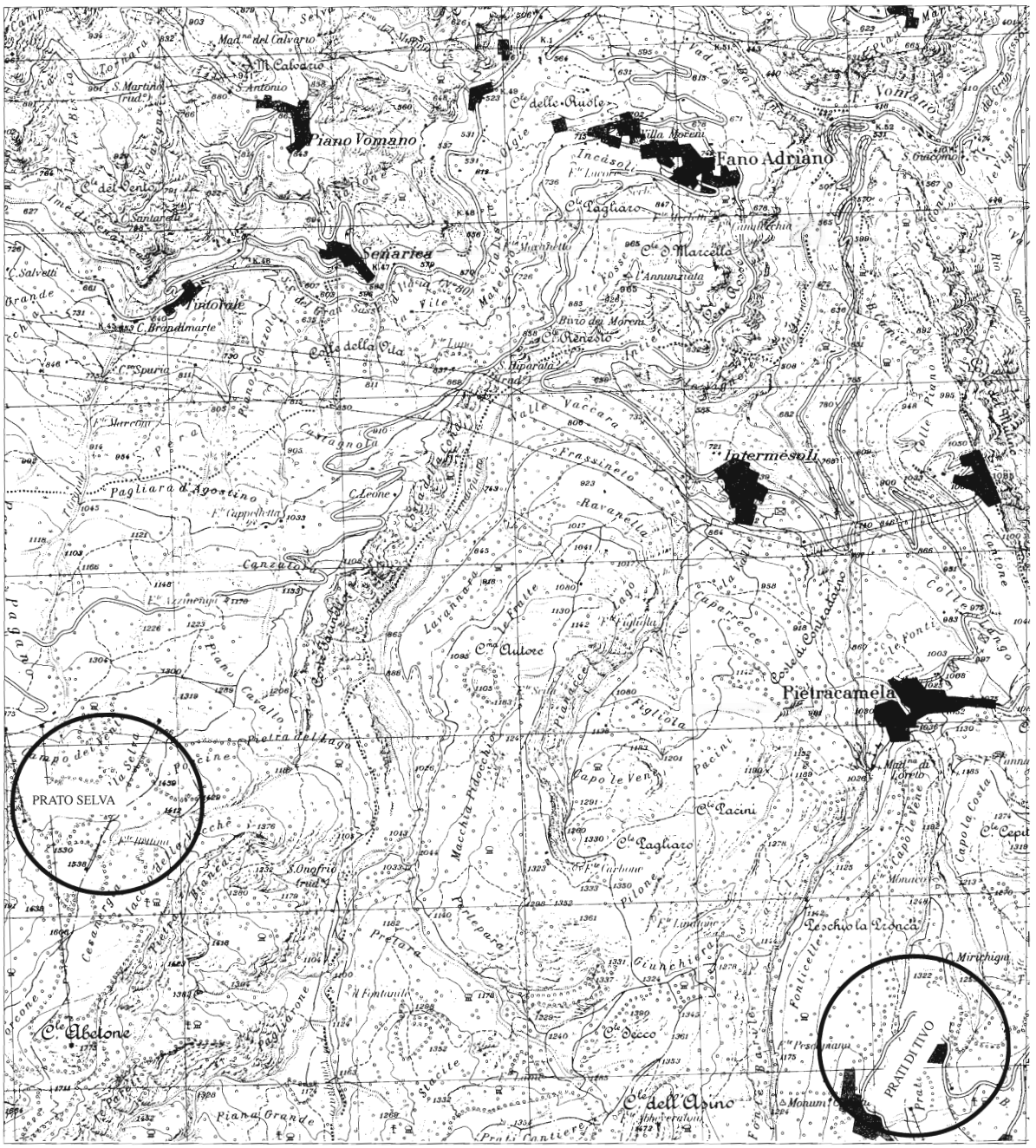


Fig. 11 – Map of the Excursion area from the Vomano River valley to Prati di Tivo and Prato Selva

Excursion to the Northern aspect of Gran Sasso d'Italia (20 September, 2002)

Vomano Valley (Fig. 11)

The valley of Vomano (in a south-west/north-east orientation) separates the "Formazione del Flysh della Laga" (Laga flysh formation) from the "Formazione delle marne a Obulina" (Obulina marl formation), Marne con Cerrogna (Cerrogna marl formation), and Bisciaro formation made up of marl-limestone, limestone-marl, and sandstone-marl.

1st Stop - The Pietracamela woods

The low areas of the valley of the left hydrographic aspect are characterised by the hottest faces of the Laga flysh formation, colonised by mixed xerophilous oak woods of *Quercus pubescens* and *Carpinus orientalis* with Mediterranean sclerophyllous species (Tab. 3: rel. 1) that are growing in the rock debri and giving way to woods of *Quercus ilex* on the compact sands. On the fresh faces of the right hydrographic aspect, on the marl-limestone formation of the sloping aspects, there is a mixed deciduous wood, with a predominance of *Ostrya carpinifolia* and with the abundant presence of *Carpinus orientalis* (Tab. 3: rel. 2) which is part of the *Asparago acutifolii-Ostryetum carpinifoliae* association, taken as type-association of the *Lauro nobilis-Quercenion pubescentis* suballiance, of the *Ostryo-Carpinion orientalis* alliance. Higher up, the vegetation is more mesophilous, determining the transition towards the formation of the *Scutellario columnae-Ostryetum carpinifoliae* association in the new *carpinetosum orientalis* subassociation (rel. type n. 1 of Tab. 4) of the *Laburno-Ostryenion* suballiance of the *Ostryo-Carpinion orientalis* alliance. It is possible to find within this vegetation a mesophilous variant with *Fagus sylvatica* (Tab. 4: rel. 4-5), along the fall lines, and a pioneer rocky aspect with *Sesleria nitida* (Tab. 4: rel. 3), indicating the link with the grasslands dominated by this species.

Carpinus orientalis is particularly abundant on the edges of the forest coenosis, where it dominates pre-forestal phytocoenosis (Tab. 5) with respect to the woods with a predominance of *Ostrya carpinifolia*.

On the border there is the mantle of *Cytisus sessilifolius* of the *Spartio juncei-Cytisetum sessilifolii* association, with a variant with *Chamaecytisus hirsutus* (Tab. 6) and forest edges of *Melampyrum italicum* of the *Ptilostemo strictae-Melampyretum italici* association (Tab. 7, after Biondi *et al.* 2001).

2nd Stop - Prati di Tivo (1460 m)

In the Prati di Tivo area there is an extended monospecific wood of long-trunked beech that can be classified within the calcicole *Cardamino kitaibelii-Fagetum sylvaticae* Ubaldi *et al.* 1987 ex Ubaldi 1995 association (Tab. 8: rel. 1-2) of the central Apennines, which has extensions into the central-northern and central-southern. It is thought that to this association can also be referred the beech woods that in the past were attributed to the *Polysticho aculeati-Fagetum* Feoli & Lagonegro ex Biondi *et al.* 1999 association, which can therefore now be considered as a synonym of the *Cardamino kitaibelii-Fagetum sylvaticae* association.

In this association the characteristic and differential species are *Cardamine kitaibelii*, with the part of the areal entirely included in the distribution zone of the association (Fig. 12), and other species with similar distribution areals such as *Cardamine enneaphyllos* (Fig. 13) and *Cardamine heptaphylla* (Fig. 14). Meanwhile, these three can also be recognised as the differential species of the central-northern Apennines *Geranio nodosi-Fagenion* suballiance, of which *Geranium nodosum* and *Adenostyles australis* are the characteristic species.

The forest edges formations belongs to the *Trifolietum medii-ochroleuci* association, of the *Trifolion medii* alliance described for this area (Tab. 9: rel. 1-3; after Biondi *et al.*, 2001), and of which the characteristic species are: *Trifolium medium, T. ochroleucum* and *Dactylorhiza maculata*.

3rt Stop - Prato Selva (1375 m)

In the Prato Selva area the substratum is supplied by the Flysh della Laga formation (alternating sandstone and turbidite clay). The forestal vegetation is represented by an acidophilous beech wood of the *Solidagini-Fagetum sylvaticae* Ubaldi *et al.* 1987 ex Ubaldi 1995 association (= *Veronico-Fagetum sylvaticae* Longhitano & Ronsisvalle 1974 non Montacchini 1972) *vaccinietosum myrtilli* Ubaldi *et al.* 1987 ex Ubaldi 1995 subassociation (Tab. 8: rel. 3-5) that can be differentiated from the analogous coenosis on limestone of Prati di Tivo by the presence of: *Vaccinium myrtillus, Pyrola minor, Veronica officinalis, Avenella flexuosa, Gnaphalium sylvaticum*, etc. In contact with the beech wood there is a mantle of *Cytisus scoparius* (Tab. 10). The prevalent forest edges are of *Pteridium aquilinum* and of *Trifolium medium* and *T. ochroleucon* of the *Trifolietum medii-ochroleuci* association (Tab. 9: rel. 4-6; after Biondi *et al.*, 2001) in the acidophilous variant differentiated by the presence of: *Digitalis ferruginea, Astragalus glycyphyllos* and *Cytisus scoparius*.

Tab. 3 - ***LAURO NOBILIS-QUERCENION PUBESCENTIS*** (Ubaldi 1988) Ubaldi 1995

arenaceous substratum (A) "Flysh della Laga"
rel. 1 - *Quercus pubescens, Carpinus orientalis* and *Pistacia lentiscus* aggr.

calcareous substratum (C) marly limestone; calcareous marls and arenaceous marls
rel. 2 - *Asparago acutifolii-Ostryetum carpinifoliae* Biondi 1982

Rel. n.	1	2	P
Altitude (m)	650	480	r
Exposure	SW	O	e
Slope (°)	55	45	s.
Coverage %	95	100	
Area (m^2)	200	120	
Charact. species of the *Asparago-Ostryetum carpinifoliae* ass.			
Asparagus acutifolius L.	1.2	1.2	2
Lithospermum purpurocaeruleum L.	+.2	+	2
Diff. species of the *Lauro nobilis-Quercenion pubescentis* suball.			
Juniperus oxycedrus L. ssp. oxycedrus	+.2	+	2
Viburnum tinus L. ssp. tinus	1.2	.	1
Pistacia lentiscus L.	1.1	.	1
Quercus ilex L. ssp. ilex	.	+.2	1
Pistacia x saportae Burnat	.	+.2	1
Lonicera etrusca Santi	.	+.2	1
Charact. and diff. species of the *Ostryo-Carpinion orientalis* all.			
Hippocrepis emerus (L.) Lassen subsp. emeroides (Boiss. et Spruner) Lassen	1.2	1.2	2
Carpinus orientalis Mill.	4.5	3.3	2
Ostrya carpinifolia Scop.	1.2	3.4	2
Acer opalus Mill. subsp. obtusatum (Waldst. et Kit.) Gams	+	1.2	2
Cytisophyllum sessilifolium (L.) O. Lang	.	+.2	1
Charact. species of the *Quercetalia pubescentis* ord. and the *Querco-Fagetea* class			
Fraxinus ornus L. ssp. ornus	3.3	4.5	2
Quercus pubescens Willd.	2.3	2.2	2
Viola alba Besser ssp. dehnhardtii (Ten.) W. Becker	1.2	1.2	2
Tamus communis L.	1.2	1.2	2
Hedera helix L. ssp. helix	1.3	.	1
Hieracium murorum L. (s.l.)	+	.	1
Lonicera xylosteum L.	+	.	1
Sorbus torminalis (L.) Crantz	.	+	1
Brachypodium sylvaticum (Huds.) P. Beauv. ssp. sylvatica	.	+	1
Orchis purpurea Huds.	.	+	1
Ulmus minor Mill. ssp. minor	.	1.2	1
Other species			
Clematis vitalba L.	+.2	+.2	2
Dactylis glomerata L. (s.l.)	+	+.2	2
Brachypodium rupestre (Host) Roem. et Schult.	1.2	+.2	2
Inula conyza DC.	+	+	2
Ptilostemon strictus (Ten.) Greuter	+.2	+	2
Prunus spinosa L.	1.2	+	2
Teucrium chamaedrys L. ssp. chamaedrys	+	+	2
Carex flacca Schreb. (s.l.)	2.2	1.1	2
Arabis turrita L.	+.2	1.1	2
Accidental species	3	8	

Tab. 4 - ***SCUTELLARIO COLUMNAE-OSTRYETUM CARPINIFOLIAE*** Pedrotti, Biondi & Ballelli ex Pedrotti *et al.* 1980
carpinetosum orientalis subass. nova

Rel. n.	1*	2	3	4	5	P
Altitude (m)	530	620	540	490	600	r
Exposure	ONO	ONO	NW	ONO	N	e
Slope (°)	30	30	40	30	30	s.
Coverage %	100	100	100	100	100	
Area (m^2)	150	120	100	200	100	
Charact. and diff. species of the *Scutellario-Ostryetum carpinifoliae* ass. and of the *carpinetosum orientalis* subass.						
Carpinus orientalis Mill.	2.2	2.2	4	3.3	2.3	5
Fraxinus ornus L. ssp. ornus	2.3	1.2	2	2.3	1.2	5
Cornus mas L.	2.2	1.2	2	2.3	+.2	5
Pyracantha coccinea M. Roem.	1.1	+	.	1.1	+	4
Scutellaria columnae All. ssp. columnae	+	+	+	+	.	4
Melampyrum italicum Soó	+	+	2	.	.	3
Diff. species of the *Sesleria nitida* var.						
Sesleria nitida Ten.	.	.	4	.	.	1
Diff. species of the *Fagus sylvatica* var.						
Fagus sylvatica L. ssp. sylvatica	1.2	1.2	+	4.5	4.4	5
Geranium nodosum L.	.	.	.	1.2	1.2	2
Charact. and diff. species of the *Laburno anagyroidis-Ostryenion carpinifoliae* suball.						
Acer opalus Mill. ssp. obtusatum (Waldst. et Kit.) Gams	2.2	3.4	2	1.2	+	5
Carex digitata L.	1.2	+.2	.	1.2	.	3
Hippocrepis emerus (L.) Lassen ssp. emeroides (Boiss. et Spruner) Lassen	1.1	+	2	.	.	3
Lilium bulbiferum L. ssp. croceum (Chaix) Baker	+	.	.	1.2	+	3
Digitalis micrantha Roth	+	+	+	.	.	3
Helleborus foetidus L.	+	+	+	.	.	3
Laburnum anagyroides Medik.	.	.	+	.	.	1
Charact. and diff. species of the *Ostryo-Carpinion orientalis* all.						
Ostrya carpinifolia Scop.	4.5	4.4	3	+.2	1.2	5
Quercus ilex L. ssp. ilex	.	+	+	+	+.2	4
Cytisophyllum sessilifolium (L.) O. Lang	.	.	+	.	.	1
Charact. and diff. species of the *Quercetalia pubescentis* ord. and the *Querco-Fagetea* class						
Viola alba Besser ssp. dehnhardtii (Ten.) W. Becker	1.2	+.2	2	+.2	+.2	5
Campanula trachelium L. ssp. trachelium	1.2	+	2	1.1	1.1	5
Sorbus torminalis (L.) Crantz	1.2	+	1	+	+	5
Euphorbia amygdaloides L. ssp. amygdaloides	1.1	+	1	+	+.2	5
Mercurialis perennis L.	2.3	1.2	+	2.2	1.2	5
Tamus communis L.	1.1	+	.	1.2	1.1	4
Solidago virgaurea L. ssp. virgaurea	1.2	+	.	1.1	+	4
Viola reichenbachiana Jord. ex Boreau	+	+	.	1.1	1.2	4
Hedera helix L. ssp. helix	3.4	2.3	.	3.4	1.2	4
Corylus avellana L.	1.2	1.2	.	2.2	1.2	4
Hepatica nobilis Mill.	1.2	1.2	.	2.3	1.2	4
Melica uniflora Retz.	1.2	1.2	.	1.2	+.2	4
Primula acaulis (L.) L. ssp. acaulis	.	+	+	1.1	+	4
Sorbus aria (L.) Crantz	.	+.2	1	+.2	.	3
Cephalanthera longifolia (Huds.) Fritsch	+	+	+	.	.	3
Hieracium murorum L. (s.l.)	+	+	1	.	.	3
Mycelis muralis (L.) Dumort.	+	+	.	+	.	3
Brachypodium sylvaticum (Huds.) P. Beauv. ssp. sylvaticum	+.2	.	1	.	+.2	3
Acer campestre L.	+	.	+	.	1.1	3
Cephalanthera damasonium (Mill.) Druce	.	+	.	.	+.2	2
Allium ursinum L. (s.l.)	.	+	.	.	+	2
Aquilegia vulgaris L. (s.l.)	+.2	+	.	.	.	2
Neottia nidus-avis (L.) L.C. Rich.	+	+	.	.	.	2
Quercus pubescens Willd.	+	.	+	.	.	2
Lathyrus venetus (Mill.) Wohlf.	.	.	.	+	+	2
Lonicera xylosteum L.	+	.	.	+.2	.	2
Sanicula europaea L.	+	.	.	.	+.2	2
Sorbus domestica L.	+	.	.	.	.	1
Lithospermum purpurocaeruleum L.	.	+	.	.	.	1
Melittis melissophyllum L. ssp. melissophyllum	.	+	.	.	.	1
Ulmus minor Mill. ssp. minor	.	.	.	+.2	.	1
Orchis purpurea Huds.	.	.	.	.	+	1
Prunus avium L.	.	.	.	.	+	1
Quercus cerris L.	.	.	.	.	+.2	1
Epipactis helleborine (L.) Crantz ssp. helleborine	.	.	.	.	+	1
Other species						
Crataegus monogyna Jacq. sp. monogyna	+	+.2	1	+	+.2	5
Lonicera caprifolium L.	+.2	+	.	+	+	4
Stachys officinalis (L.) Trevis. ssp. officinalis	.	+	.	+	+.2	3
Cyclamen repandum Sm. ssp. repandum	.	+	.	+	+	3
Ajuga reptans L.	+.2	.	.	+.2	+.2	3
Prunus spinosa L.	.	+	.	.	+.2	2
Ruscus aculeatus L.	+.2	+	.	.	.	2
Carex flacca Schreb. (s.l.)	+.2	.	+	.	.	2
Chamaecytisus hirsutus L. ssp. polytrichus (M. Bieb.) Ponert	+	.	+	.	.	2
Teucrium flavum L. ssp. flavum	.	+	2	.	.	2
Inula conyza DC.	.	.	+	+	.	2
Juniperus oxycedrus L. ssp. oxycedrus	.	.	+	+	.	2
Accidental species	7	3	2	-	4	

Tab. 5 - ***CARPINUS ORIENTALIS*** community

Rel. n.	1	2	
Altitude (m)	540	645	P
Exposure	O	ONO	r
Slope (°)	30	20	e
Coverage %	100	100	s.
Area (m^2)	100	80	
Carpinus orientalis Mill.	5.5	4.5	2
Corylus avellana L.	+.2	1.2	2
Fraxinus ornus L. ssp. ornus	2.3	1.2	2
Melampyrum italicum Soó	+	+	2
Cornus mas L.	1.2	.	1
Cyclamen repandum Sm. ssp. repandum	.	1.1	1
Diff. species of the *Lauro nobilis-Quercenion pubescentis* suball.			
Quercus ilex L. ssp. ilex	+	.	1
Juniperus oxycedrus L. ssp. oxycedrus	+.2	.	1
Viburnum tinus L. ssp. tinus	+	.	1
Lonicera etrusca Santi	+	.	1
Diff. species of the *Laburno anagyroidis-Ostryenion carpinifoliae* suball.			
Acer opalus Mill. subsp. obtusatm (Waldst. et Kit.) Gams	1.2	.	1
Carex digitata L.	.	1.2	1
Charact. and diff. species of the *Ostryo-Carpinion orientalis* all.			
Ostrya carpinifolia Scop.	1.2	.	1
Hippocrepis emerus (L.) Lassen ssp. emeroides (Boiss. et Spruner) Lassen	+	.	1
Charact. species of the *Quercetalia pubescentis* ord. and *Querco-Fagetea* class			
Campanula trachelium L. ssp. trachelium	+	+	2
Hedera helix L. ssp. helix	+	1.2	2
Viola alba Besser ssp. dehnhardtii (Ten.) W. Becker	+	1.1	2
Tamus communis L.	+	+.2	2
Scutellaria columnae All. ssp. columnae	+	.	1
Quercus pubescens Willd.	+.2	.	1
Solidago virgaurea L. ssp. virgaurea	+	.	1
Cephalanthera damasonium (Mill.) Druce	+	.	1
Lathyrus venetus (Mill.) Wohlf.	.	+.2	1
Cephalanthera longifolia (Huds.) Fritsch	.	1.1	1
Euphorbia amygdaloides L. ssp. amygdaloides	.	+.2	1
Brachypodium sylvaticum (Huds.) P. Beauv. ssp. sylvaticum	.	+.2	1
Lithospermum purpurocaeruleum L.	.	+	1
Acer campestre L.	.	+	1
Other species			
Clematis vitalba L.	+	+	2
Ptilostemon strictus (Ten.) Greuter	+	.	1
Arabis turrita L.	1.2	.	1
Dactylis glomerata L. (s.l.)	1.2	.	1
Teucrium flavum L. ssp. flavum	+	.	1
Silene italica (L.) Pers. ssp. italica	+	.	1
Tanacetum corymbosum (L.) Sch. Bip.	+	.	1
Cornus sanguinea L. ssp. sanguinea	.	1.2	1
Carex flacca Schreb. (s.l.)	.	+.2	1
Fragaria vesca L.	.	+.2	1
Robinia pseudoacacia L.	.	+.2	1
Inula conyza DC.	.	+	1
Stachys officinalis (L.) Trevis. ssp. officinalis	.	+	1
Ajuga reptans L.	.	+	1
Euonymus europaeus L.	.	+	1
Rubus hirtus Waldst. et Kit.	.	+	1
Veronica chamaedrys L. ssp. chamaedrys	.	+	1
Pteridium aquilinum (L.) Kuhn ssp. aquilinum	.	+	1

Tab. 6 - ***SPARTIO JUNCEI-CYTISETUM SESSILIFOLII*** Biondi, Allegrezza & Guitian 1988
Chamaecytisus hirsutus var.

Rel. n.	1
Altitude (m)	540
Exposure	-
Slope (°)	-
Coverage %	90
Area (m^2)	10
Charact. species of the ass. and of the upper units	
Hippocrepis emerus (L.) Lassen ssp. emeroides (Boiss. et Spruner) Lassen	4.5
Cytisophyllum sessilifolium (L.) O. Lang	2.2
Chamaecytisus hirsutus L. subsp. polytrichus (M. Bieb.) Ponert	1.2
Crataegus monogyna Jacq. ssp. monogyna	+
Other species	
Fraxinus ornus L. ssp. ornus	1.2
Carpinus orientalis Mill.	1.2
Sesleria nitida Ten.	2.3
Melampyrum italicum Soó	1.1
Genista tinctoria L.	1.2
Teucrium flavum L. ssp. flavum	+
Cornus mas L.	+.2
Arabis turrita L.	+
Viburnum tinus L. ssp. tinus	+.2
Lithospermum purpurocaeruleum L.	+
Acer opalus Mill. subsp. obtusatum (Waldst. et Kit.) Gams	+
Quercus pubescens Willd.	+
Sorbus aria (L.) Crantz	+
Lonicera xylosteum L.	+
Sorbus torminalis (L.) Crantz	+

Tab. 7 - ***PTILOSTEMO STRICTAE-MELAMPYRETUM ITALICI*** Biondi, Carni, Vagge, Taffetani & Ballelli 2001

Rel. n.	1	2	3	4	5	P
Altitude (m)	825	755	710	680	690	r
Exposure	W	WSW	E	NW	W	e
Slope (°)	15	15	30	15	2	s.
Coverage %	100	90	90	100	100	
Area (m^2)	10	15	10	10	15	
Charact. and diff. species of the ass.						
Melampyrum italicum Soó	4.4	4.5	4.4	4.4	5.5	5
Viola alba Besser subsp. dehnhardtii (Ten.) W. Becker	+	1.1	1.2	1.1	1.1	5
Ptilostemon strictus (Ten.) Greuter	+	1.1	1.1	.	.	3
Silene italica (L.) Pers. subsp. italica	.	.	1.2	1.1	+	3
Scutellaria columnae All. subsp. columnae	.	.	.	+	+	2
Charact. and diff. species of the *Geranion sanguinei* all.						
Scabiosa columbaria L. subsp. columbaria	+	+	1.1	+	+	5
Genista tinctoria L. subsp. tinctoria	2.2	+	+	+	1.2	5
Helleborus foetidus L.	+	.	+	+	.	3
Inula conyza DC.	.	+	1.1	+	.	3
Peucedanum cervaria (L.) Lapeyr.	+.2	.	+	.	+	3
Chamaecytisus triflorus (Lam.) Skalická subsp. triflorus	+	.	.	+	1.1	3
Charact. and diff. species of the *Origanetalia* ord. and *Trifolio-Geranietea* class						
Helianthemum nummularium (L.) Mill. subsp. obscurum (Celak.) Holub	+	+	+	+	.	4
Satureja vulgaris L. subsp. vulgaris	2.2	.	+	.	+	3
Origanum vulgare L. subsp. vulgare	1.2	+	.	+	.	3
Stachys officinalis (L.) Trevis. subsp. officinalis	.	.	+	+	+	3
Cruciata glabra (L.) Ehrend.	.	.	+	+	+	3
Lathyrus sylvestris L. subsp. sylvestris	2.2	+	.	.	.	2
Trifolium ochroleucon Huds.	+	.	.	.	+	2
Brachypodium sylvaticum (Huds.) P. Beauv. subsp. sylvaticum	.	.	.	+	+	2
Ajuga reptans L.	.	.	.	+	+	2
Hypericum perforatum L. (s.l.)	.	+	.	.	.	1
Trifolium medium L. subsp. medium	1.1	.	.	.	.	1
Other species						
Dactylis glomerata L. subsp. glomerata	+.2	1.2	1.2	1.2	+	5
Bromus erectus Huds. subsp. erectus	+.2	+.2	1.1	1.2	+	5
Lonicera etrusca Santi	1.2	+	.	+	+	4
Brachypodium rupestre (Host) Roem. et Schult.	3.3	3.3	.	.	+.2	3
Linum viscosum L.	+	+.2	+	.	.	3
Teucrium chamaedrys L. subsp. chamaedrys	+	+	.	.	+	3
Tamus communis L.	.	+	+	+	.	3
Hedera helix L. subsp. helix	.	.	+	+.2	+	3
Carex flacca Schreb. (s.l.)	.	.	+	+	+.2	3
Euphorbia amygdaloides L. subsp. amygdaloides	.	.	+	1.1	1.1	3
Silene vulgaris (Moench) Garcke subsp. angustifolia Hayek	+	+	.	.	.	2
Anthemis tinctoria L. subsp. tinctoria	+	+	.	.	.	2
Galium verum L. subsp. verum	+	+	.	.	.	2
Galium mollugo L.	+	.	+	.	.	2
Sedum rupestre L. subsp. rupestre	+	.	+	.	.	2
Hippocrepis emerus (L.) Lassen (s.l.)	+	.	+	.	.	2
Ranunculus bulbosus L. subsp. aleae (Willk.) Rouy et Foucaud	+	.	.	+	.	2
Campanula trachelium L. subsp. trachelium	+	.	.	.	+	2
Veronica chamaedrys L. subsp. chamaedrys	+	.	.	.	+	2
Lotus corniculatus L. (s.str.)	.	+	+	.	.	2
Medicago lupulina L.	.	.	+	+	.	2
Primula acaulis (L.) L. subsp. acaulis	.	.	(+)	.	1.1	2
Euphorbia cyparissias L.	.	.	+	.	+	2
Melica uniflora Retz.	.	.	.	1.2	+	2
Accidental species	8	7	7	3	4	

Tab. 8 - ***FAGION SYLVATICAE*** Luquet 1926

Rel. n.	1	2	3	4	5	P
Altitude (m)	1400	1360	140	1420	1350	r
Exposure	NNO	ONO	NO	N	N	e
Slope (°)	10	10	30	20	20	s.
Coverage %	100	100	100	90	100	
Area (m²)	200	300	300	300	100	
Charact. and diff. species of the *Cardamino kitalibelii-Fagetum sylvaticae* ass.						
Saxifraga rotundifolia L. ssp. rotundifolia	+	1.2	.	.	+	3
Cardamine kitaibelii Bech.	1.1	+	.	.	.	2
Polygonatum multiflorum (L.) All.	+.2	1.2	.	.	.	2
Epilobium montanum L.	+	.	.	+	.	2
Polystichum aculeatum (L.) Roth	+	.	.	.	1	2
Cardamine enneaphyllos (L.) Crantz	.	+	.	.	.	1
Charact. and diff. species of the *Solidagini-Fagetum sylvaticae* ass. *vaccinietosum myrtilli* subass.						
Vaccinium myrtillus L.	.	.	1.3	1.3	1	3
Veronica officinalis L.	.	.	1.2	+.2	1	3
Veronica montana L.	+	.	+	.	2	3
Luzula sieberi Tausch	.	+	+.2	1.2	.	3
Solidago virgaurea L. (s.l.)	.	+	1.2	1.2	.	2
Deschampsia flexuosa (L.) Trin.	.	.	+	+.2	.	2
Galium rotundifolium L.	.	.	1.2	1.2	.	2
Abies alba Mill.	.	.	+	.	.	1
Gnaphalium sylvaticum L.	.	.	+	.	.	1
Luzula forsteri (Sm.) DC. ssp. forsteri	.	.	+.2	.	.	1
Orthilia secunda (L.) House	.	.	.	.	1	1
Pyrola minor L.	.	.	1.2	.	.	1
Charact. and diff. species of the *Geranio nodosi-Fagenion sylvaticae* suball. and the *Fagion sylvaticae* all.						
Euphorbia amygdaloides L. ssp. amygdaloides	+	1.2	+	+	+	5
Geranium nodosum L.	2.2	2.3	.	.	.	2
Galium odoratum (L.) Scop.	2.3	2.3	.	.	.	2
Adenostyles australis (Ten.) Nyman	1.1	+	.	.	.	2
Charact. species of the *Fagetalia sylvaticae* order and *Querco-Fagetea* class						
Dactylorhiza maculata (L.) Soó ssp. fuchsii (Druce) Hyl.	+	+	+	+	+	5
Neottia nidus-avis (L.) L.C. Rich.	+	+	+	+	+	5
Mycelis muralis (L.) Dumort.	+	+	1.1	+	+	5
Poa nemoralis L.	+	+	1.2	1.2	+	5
Viola reichenbachiana Jord. ex Boreau	1.2	+	+.2	+	2	5
Fagus sylvatica L. ssp. sylvatica	5.5	5.5	5.5	5.5	5	5
Festuca heterophylla Lam. ssp. heterophylla	+.2	1.2	1.2	+.2	1	5
Primula acaulis (L.) L. ssp. acaulis	+	+	+	.	+	4
Sanicula europaea L.	2.3	2.3	+.3	+	.	4
Cardamine bulbifera (L.) Crantz	1.1	+	+	1.1	.	4
Aremonia agrimonoides (L.) DC. ssp. agrimonoides	+	+	.	1.1	.	3
Epipactis helleborine (L.) Crantz ssp. helleborine	+	+	.	+	+	3
Lathyrus vernus (L.) Bernh. ssp. vernus	1.1	2.3	.	2	.	3
Hieracium murorum L. (s.l.)	1.2	1.2	2.2	.	.	3
Veronica montana L.			.	.	.	2
Brachypodium sylvaticum (Huds.) P. Beauv. ssp. sylvaticum	+	+	.	.	.	2
Allium ursinum L. (s.l.)	+.2	1.3	.	.	.	2
Prenanthes purpurea L.	.	1.2	+	.	.	2
Lilium martagon L.	+	1.1	.	.	.	2
Daphne mezereum L.	1.1	+	.	.	.	2
Sorbus aucuparia L. ssp. aucuparia	+	.	.	.	.	1
Pulmonaria apennina Cristof. et Puppi	.	+	.	.	.	1
Cephalanthera rubra (L.) L.C. Rich.	.	+	.	.	.	1
Hepatica nobilis Mill.	.	+	.	.	.	1
Melica uniflora Retz.	.	+	.	.	.	1
Ulmus glabra Huds.	.	+	.	.	.	1
Actaea spicata L.	+	.	.	.	.	1
Hieracium racemosum Waldst. et Kit.	.	.	.	+	.	1
Monotropa hypopitys L.	.	.	.	+	.	1
Acer platanoides L.	.	.	.	.	+	1
Acer pseudoplatanus L.	.	.	+	.	.	1
Carex sylvatica Huds.	+	.	.	.	.	1
Daphne laureola L.	.	.	.	.	+	1
Dryopteris filix-mas (L.) Schott	.	.	.	.	+	1
Epipactis microphylla (Ehrh.) Sw.	.	.	.	.	+	1
Oxalis acetosella L.	.	.	.	.	1	1
Platanthera bifolia (L.) Rchb.	.	.	+.2	.	.	1
Polystichum setiferum (Forssk.) T. Moore ex Woynar	+	.	.	.	.	1
Taxus baccata L.	+	.	.	.	.	1
Other species						
Rubus sp.	1.2	1.2	+	1.1	1	5
Ajuga reptans L.	+	+	+	.	1	4
Juniperus communis L. ssp. communis	.	+	+.2	.	+	3
Silene italica (L.) Pers. ssp. italica	.	+	1.2	+	.	3
Agrimonia eupatoria L. ssp. eupatoria	.	+	+	.	.	2
Fragaria vesca L.	+.2	.	+.2	.	.	2
Ranunculus lanuginosus L.	.	.	+	+	.	2
Accidental species	1	1	12	2	2	

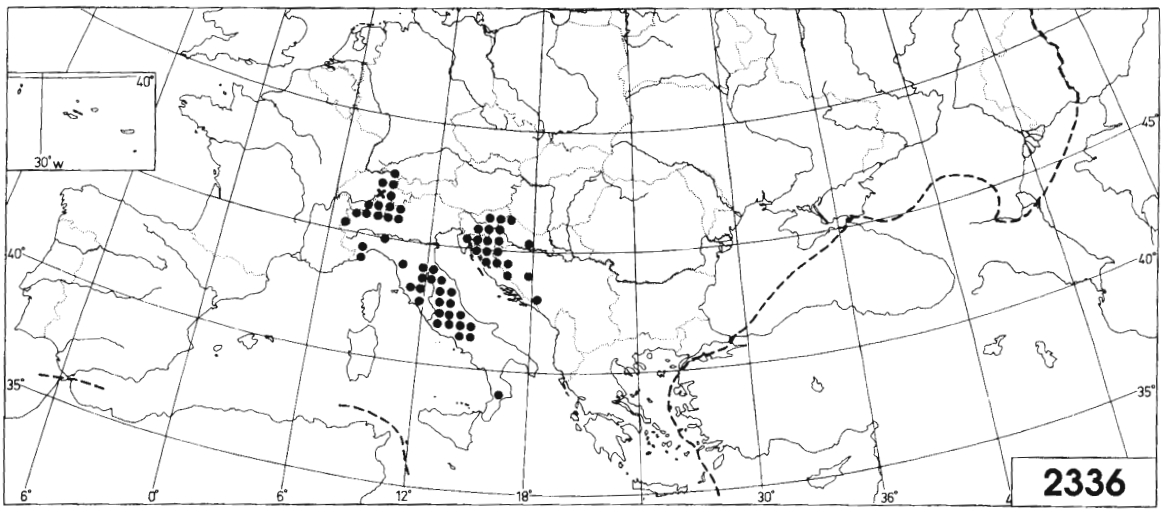


Fig. 12 – Distribution of *Cardamine kitaibelii* (from Jalas &Suominen, 1994)

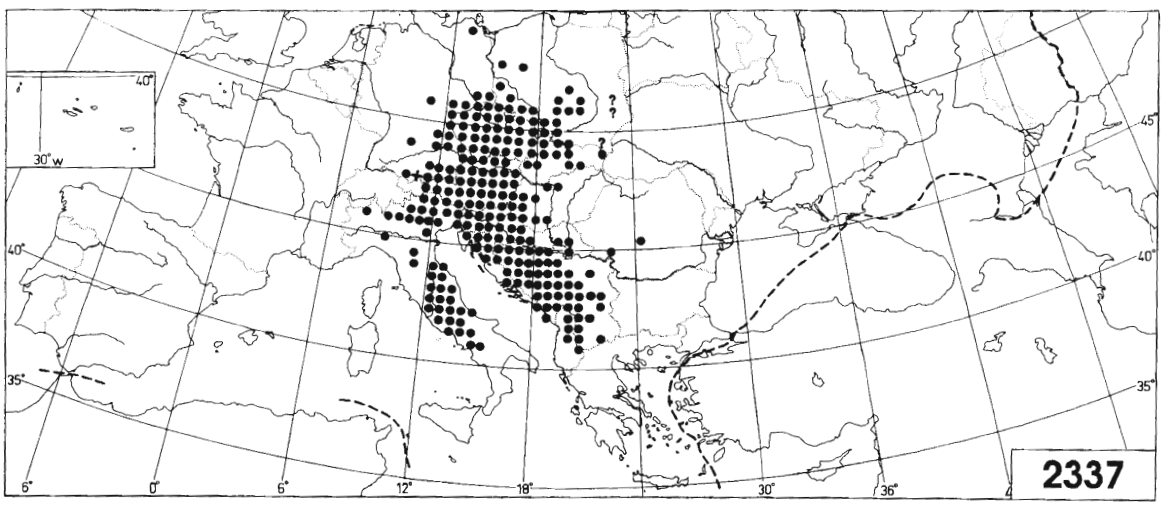


Fig. 13 – Distribution of *Cardamine enneaphyllos* (from Jalas & Suominen, 1994)

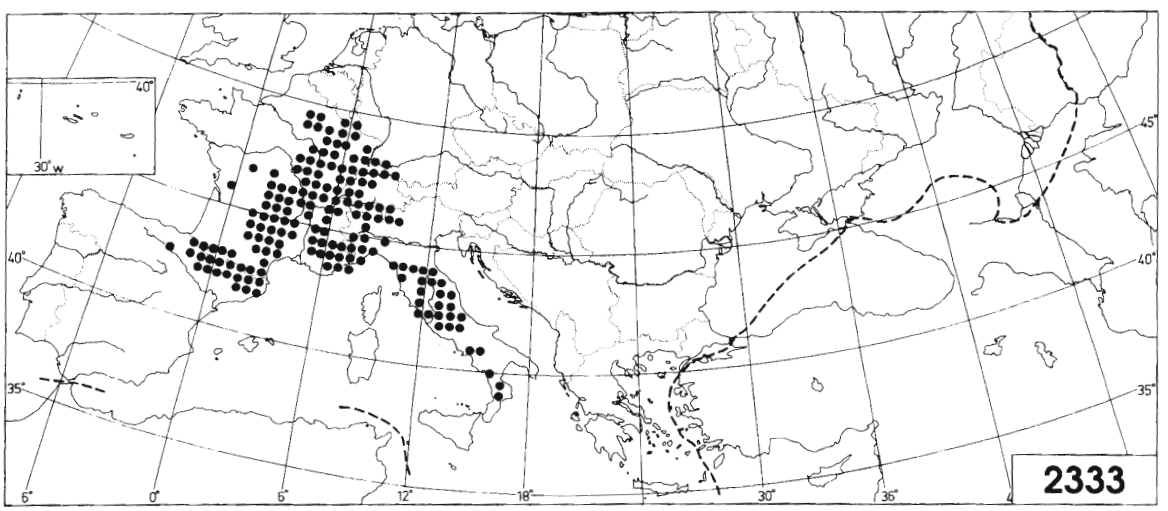


Fig. 14 – Distribution of *Cardamine heptaphylla* (from Jalas & Suominen, 1994)

Tab. 9 - ***TRIFOLIETUM MEDII-OCHROLEUCI*** Biondi, Carni, Vagge, Taffetani & Ballelli 2001

Rel. n.	1	2	3	4	5	6	P
Altitude (m)	1235	1375	1375	1380	1400	1420	r
Exposure	N	WNW	WNW	W	N	N	e
Slope (°)	20	10	40	3	20	2	s.
Coverage %	10	15	25	20	7	15	
Area (m^2)	100	100	100	100	100	100	
Charact. and diff. species of the ass.							
Trifolium medium L. subsp. medium	2.2	3.3	5.5	4.4	4.4	4.5	6
Trifolium ochroleucon Huds.	3.3	3.3	2.3	3.3	1.2	+	6
Dactylorhiza maculata (L.) Soó (s.l.)	1.2	+	1.1	+	.	+	5
Diff. species of theacidophilous var.							
Digitalis ferruginea L.	.	.	.	+	+	1.1	3
Astragalus glycyphyllos L.	.	.	.	+	.	+	2
Cytisus scoparius (L.) Link	.	.	.	+	+	.	2
Charact. and diff. species of the *Trifolion medii* all.							
Hieracium sylvaticum (L.) L.	.	+	1.1	.	+	.	3
Viola reichenbachiana Jordan ex Boreau	.	.	.	.	+	+	2
Peucedanum schottii Besser	+	+	.	.	.	.	2
Knautia drymeia Heuffel (s. l.)	1.2	.	.	.	2.3	.	2
Festuca heterophylla Lam. subsp. heterophylla	.	.	.	.	.	+.2	1
Cruciata glabra (L.) Ehrend.	.	.	.	.	.	+	1
Anthoxanthum odoratum L.	+	.	.	.	.	.	1
Veronica officinalis L.	.	.	.	.	.	+	1
Brachypodium sylvaticum (Huds.) Beauv. subsp. sylvaticum	.	.	.	.	2.2	.	1
Pteridium aquilinum (L.) Kuhn subsp. aquilinum	.	.	.	.	1.1	.	1
Ajuga reptans L.	.	.	.	.	.	+	1
Prunella vulgaris L. subsp. vulgaris	.	.	.	.	.	+	1
Charact. and diff. species of the *Origanetalia* ord. and the *Trifolio-Geranietea* class							
Hypericum perforatum L. (s.l.)	.	.	+	+	+	+	4
Helianthemum nummularium (L.) Mill. subsp. obscurum (Celak.) Holub	+	+	1.1	.	1.1	.	4
Lathyrus pratensis L.	.	+.2	+	+	+	.	4
Genista tinctoria L. subsp. tinctoria	+	.	.	.	1.2	+	3
Galium album Mill.	.	.	.	+	1.1	+	3
Campanula rapunculus L. subsp. rapunculus	.	.	.	+	+	+	3
Bupleurum falcatum L. subsp. falcatum	+	.	.	1.2	+	.	3
Vicia cracca L. subsp. cracca	+	.	1.1	.	+.2	.	3
Poa trivialis L. subsp. trivialis	.	.	+	.	.	+	2
Achillea millefolium L.	.	.	.	+	+	.	2
Digitalis micrantha Roth.	.	+	+	.	.	.	2
Silene italica (L.) Pers. subsp. italica	.	.	.	+.2	1.1	.	2
Euphorbia cyparissias L.	.	+	1.1	.	.	.	2
Origanum vulgare L. subsp. vulgare	+	.	.	.	.	.	1
Chamaecytisus triflorus (Lam.) Skalická subsp. triflorus	+	.	.	.	.	.	1
Satureja vulgaris (L.) Fritsch subsp. vulgaris	.	.	.	.	.	+.2	1
Laserpitium latifolium L.	+	.	.	.	.	.	1
Thesium linophyllon L. subsp. montanum (Ehrh. ex Schrad.) Celak.	+.2	.	.	.	.	.	1
Peucedanum cervaria (L.) Lapeyr.	.	.	.	.	.	+	1
Other species							
Dactylis glomerata L. subsp. glomerata	+	+	+	+	+	+	6
Leontodon hispidus L. subsp. hispidus	1.2	+	1.1	+	+	+	6
Lotus corniculatus L. (s.str.)	+	+	+	1.2	+	.	5
Polygala nicaeensis Risso ex W.D.J. Koch subsp. mediterranea Chodat	+	1.2	1.1	1.2	.	+	5
Brachypodium rupestre (Host) Roem. et Schult.	2.2	2.2	2.3	3.3	.	.	4
Primula acaulis (L.) L. subsp. acaulis	+	+	1.1	.	+	.	4
Plantago media L.	.	+	+.2	+	+	.	4
Gymnadenia conopsea (L.) R. Br. subsp. conopsea	+	1.1	+	+	.	.	4
Medicago lupulina L.	+	+	1.1	.	.	.	3
Bromus erectus Huds. subsp. erectus	+	+.2	.	1.1	.	.	3
Linum catharticum L. subsp. catharticum	+	+	.	.	.	+.2	3
Tussilago farfara L.	1.1	+	+	.	.	.	3
Daucus carota L. subsp. carota	.	+	+	.	.	+	3
Fragaria vesca L.	.	.	+	.	1.1	2.2	3
Euphorbia amygdaloides L. subsp. amygdaloides	.	.	+	.	+	+	3
Galium mollugo L.	+	+	+.2	.	.	.	3
Ranunculus polyanthemos L. subsp. nemorosus (DC.) Schübl. et G. Martens	1.2	+	1.1	.	.	.	3
Ononis spinosa L. subsp. spinosa	+	1.2	.	1.2	.	.	3
Carex flacca Schreb. (s.l.)	+.2	+.2	.	.	.	.	2
Hippocrepis comosa L.	+	+	.	.	.	.	2
Trifolium repens L. subsp. repens	.	+	.	.	.	+	2

Tab. 10 - ***CYTISUS SCOPARIUS*** community

Rel. n.	1	2	3	
Altitude (m)	1350	1280	1440	P
Exposure	W	S	E	r
Slope (°)	20	30	10	e
Coverage %	100	85	90	s.
Area $^{(m2)}$	40	40	30	
Charact. and diff. species of the *Cytisetea striati-scoparii* Rivas-Martinez 1975 class				
Cytisus scoparius (L.) Link ssp. scoparius	4	2.3	3.4	3
Pteridium aquilinum (L.) Kuhn ssp. aquilinum	5	+.2	.	2
Charact. species of the *Rhamno-Prunetea* Rivas Goday & Borja ex Tüxen 1962 class				
Juniperus communis L. ssp. communis	1	5.5	1.2	3
Rosa canina L. (s.l.)	.	2.3	2.3	2
Rubus ulmifolius Schott	.	1.2	2.2	2
Chamaecytisus hirsutus L. ssp. polytrichus (M. Bieb.) Ponert	.	1.2	.	1
Crataegus monogyna Jacq. ssp. monogyna	.	.	1.2	1
Other species				
Fagus sylvatica L. ssp. sylvatica	1.2	+.2	1.2	3
Fragaria vesca L.	1	1.2	2.3	3
Acer pseudoplatanus L.	.	+	1.1	2
Brachypodium sylvaticum (Huds.) P. Beauv. ssp. sylvaticum	.	1.2	+.2	2
Euphorbia cyparissias L.	1	.	+	2
Agrostis capillaris L.	3	.	.	1
Astragalus glycyphyllos L.	.	1.2	.	1
Brachypodium rupestre (Host) Roem. et Schult.	.	+	.	1
Carlina utzka Hacq.	+	.	.	1
Cruciata glabra (L.) Ehrend.	.	+	.	1
Cynosurus cristatus L.	1	.	.	1
Dactylorhiza maculata (L.) Soó ssp. fuchsii (Druce) Hyl.	.	.	+	1
Danthonia decumbens (L.) DC.	1	.	.	1
Daphne laureola L.	.	+	.	1
Galium album Mill. ssp. album	.	.	+	1
Geum urbanum L.	.	.	+	1
Hieracium murorum L. (s.l.)	.	.	+.2	1
Hypericum perforatum L. (s.l.)	.	.	+.2	1
Hypochaeris radicata L.	+	.	.	1
Malus sylvestris Mill.	.	.	+	1
Nardus stricta L.	+	.	.	1
Potentilla micrantha Ramond ex DC.	1	.	.	1
Quercus pubescens Willd.	.	+.2	.	1
Ranunculus lanuginosus L.	.	+	.	1
Salix caprea L.	.	.	+	1
Senecio stabianus Lacaita	.	1.2	.	1
Viola alba Besser ssp. dehnhardtii (Ten.) W. Becker	.	+.2	.	1

Campo Imperatore

The vast high-plain of Campo Imperatore (Fig. 15) are formed from a series of adjacent plains of an eastern inclination that, from a height of 2000 metres, descend, initially steeply down to about 1600 metres, and then levelling, with slight slopes, until the lowest point in height, corresponding to 1430 metres. The Apennines chain in this area is formed of two mountainous allignments that run parallel in a west-north-west/east-south-east orientation, for a complete length of about 40 kilometres (25 miles). The northern allignment comprises the highest peaks of the massif, including Corno Grande (2912 metres), Corno Piccolo (2655 metres) and Monte Camicia (2654 metres).

The morphology of this area is notably harsh: the northern aspect is formed by the side of a upwarp overfold, in the shape of a steep bastion that projects up from the hilly relief below, and that reaches up 1400 metres to the heights of Corno Grande and Monte Camicia. The southern allignment reaches less elevated heights (Pizzo Cefalone, 2533 metres) and, in the eastern areas, slopes towards the valley of the Aterno River with a succession of small ridges and broad tectonic-karst depressions. Between the two allignments there is interposed the characteristic tectonic depression that, in the eastern area, widens to form the high-plains of Campo Imperatore, one of the largest of the Apennines, that characterises the landscape of this area of the massif. In this area the dolomitic limestone and dolostone, marly-limestone calcareous-marl, and deposits of various origins predominate.

During the Quaternary period, the primitive tectonic depression of Campo Imperatore was partially filled with moraine, river-glacier, and pre- and post-glacial lake deposits, with impressive blankets of detritus, and with large alluvial cones. On this substratum, the modelling arising from the karst phenomena have resulted in the formation of typical morphologies, among which the dolina and microdolina areas stand out.

The soils of Campo Imperatore (by R. Calandra)

The plateau of "Campo Imperatore" exhibits a soilscape varying from Entisols and different types of Mollisols to highly evolved examples of Inceptisols.

The pedogenesis is clearly explained firstly on the basis of evolutive geodynamics and particular pedoclimatic conditions, therefore the soil survey needs a preliminary morphological research, as well as a study of substrata and thermal regime and soil moisture definition.

The studied area showed a variable lithological aspect: pure, marly, cherty, bituminous and dolomitic limestones; dolomites, marls and conglomerates. Faults and folds have produced a great discontinuity in the outcrops of such materials so deeply tectonized.

A particularly severe climate has inevitably determined a massive breaking of the rock walls, producing detrital masses that after reworking by glacial, fluvial-lacustrine and gravitational events, have given rise to the present geomorphological aspects.

Erosion and karst phenomena, less evident but so important for the pedogenesis, have also contributed to the significant geomorphological units.

It has been possible to establish that for the deepest soils of plain and lowland with A.W.C. between 100 and 250 mm, the control section is dry from the end of June to the end of July - beginning of August, but never for 45 consecutive days as the American Classification defines for the Xeric moisture regime; in this area there is, therefore, a Udic moisture regime.

Considering the slopes and other more troubled situations, for soils having A.W.C. > 100 mm, the control section is dry for more than 70 days (from August to October),while for less deep soils, with A.W.C. < 100 mm, the control section is dry for more than 110 days, therefore their moisture regime is Xeric.

With regard to the "thermal" regime, thirty-year data from 34 thermometric stations of Abruzzo have been examined, defining a mean gradient of 0,57°C/100 m, therefore the lower altimetric limit of the "Cryic" soil temperature regime is at about 1750 m. For the "Frigid" regime, the altitude limits range from 1585m to 1750 m, while below 1585 m the soil temperature regime becomes "Mesic".

Severe morphological and climatic conditions have significantly influenced the soilscape, showing young soils largely diffused, quite developed and deep soils limited to flat or concave areas often subject to water stagnation and colluvium. In the first case it was observed that, except limited areas where Lithic Cryumbrepts occur, in most surfaces above 1800 m of altitude Lithic Cryorthents are prevailing.

These are soils that anywhere are highly rocky and stony and are associated with cryonival forms and extensive surfaces without soils that are prevailing gradually with the altitude (walls with rock outcrops and movable coarse aggregates). Soils that are on more stable surfaces having an elevation of about 2000 m, are alternating like a "mosaic" with dark, thin soils rich in skeleton, attributed to Cryic-lithic Rendolls and Entic

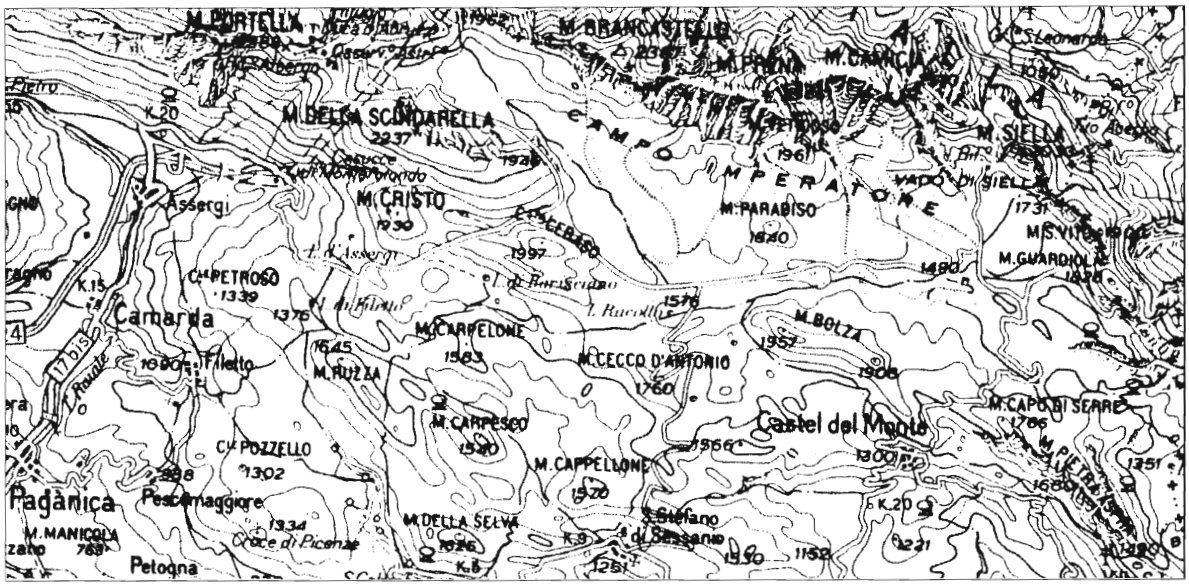


Fig. 15 - Map of Campo Imperatore

Cryumbrepts.

At gradually lower altitudes Lithic Xerorthents and Entic, Lithic and Typic Rendolls are found together with partially or totally decarbonated deeper soils as Eutrochreptic Rendolls or Typic, dystric and lithic Xerochrepts .

Obviously, the first types will prevail in the steepest areas or however more subject to erosion phenomena, while the others are located at the lower relief top, on moderate slopes or at their base where the most developed profiles occur. In the plain areas these soils are often lacking in skeleton and gradually deeper and desaturated; they are defined, therefore, as Entic, Lithic and Typic Haplumbrepts. Similar soils (Cumulic Haplumbrepts) are found in the doline concavities or in the lowest depressions of high altitude valleys (Typic Cryumbrepts).

By these features, soil situations hardly mappable for their limited extension, except when included in bigger associations, have been described. Among such soils a particular mention is given to soils like "Rendzinas", where the carbonates are present either in the "fine earth" or in the "coarse fraction". The less developed soils are defined as Entic Haploxerolls being thinner, less rich in humus, with more skeleton and carbonates.

These soils remain "young" by continuous removal of pedogenized material, at the doline border, or by periodic contribution of fresh mineral material at fan level, where they are associated with the Typic Xerorthents. The Eutrochreptic, Lithic or Cryic-Lithic Rendolls are soils occurring, on the contrary, on the bigger doline and valley walls at the fan base and partially settled detritus. Finally, Entic Rendolls are found on lacustrine sediments of depressions and near sinkholes. They are characteristic for their very high carbonate content and a moderate humus content.

Ecology of grassland at Campo Imperatore (by Gratani L, Rossi A., Crescente M.F. & Frattaroli A.R.)

Plant biomass was measured by total harvesting in June (presampling in 1990 and sampling in 1991), corresponding to the period of peak standing crop. Spatial distribution from 1440 to 2000 m elevation was studied. Plant biomass and structure resulted from the interactions of many variables acting on vegetation at different levels. Geomorphology and soil depth were of great importance. By the elevation, microhabitats differences between northern and southern slopes were of obvious importance for plants growth. In the northern slopes, more exposed to the wind, vegetative activity and flowering were reduced. Green shoot biomass ranged from 44.0 to 3314.3 g m^{-2} and *Graminaceae* were the most important component of plant biomass. The root-shoot ratio, always upon 1, may result from a higher proportion of the photosynthate to belowground organs. The highest plant biomass values of the association of the "mountain plane" were attributable to the standing dead component. Expressed on a percentage basis its contribution to total biomass amounted to 28%. The highest plant biomass values of "subalpine plane" were

due to the woody structure of *Juniperus communis* ssp. *alpina* and *Arctostaphylos uva-ursi*.

Mosses and Lichens were directly related to side exposure and soil evolution. The reduction of plant height decreased LAI. Plant aboveground biomass, height and LAI were significantly correlated and the relationship between vegetation structure and microtopography provided a synthetic image of the mosaic phenomena occurring within these grassland systems. The regression analysis of LAI versus biomass and of LAI versus height based on date pooled through the sampling in 1991, were highly positive (R= 0.84; R= 0.86). They emphasise the interaction among the variables.

The biomass evaluation enabled us to draw the "Map of Plant Biomass at Campo Imperatore (Gran Sasso d'Italia)". It showed the distribution of quantitative data on the territory. 11 biomass classes were defined and they allowed us to delimit: 1) high biomass (from 1541 to 3360 g m^{-2}) corresponding to deeper soil and favourable exposition; 2) mean biomass (from 491 to 910 g m^{-2}); 3) low biomass (from <70 to 420 g m^{-2}) corresponding to very inclined slopes or Nord exposition sites. Different associations can be included in the same biomass class, by the importance of topography, soil depth and soil evolution. This map allowed as to follow changes in biomass between years and to define livestock carrying capacity for each plant formation which are requisite date for any range management project (Gratani *et al.*, 1999).

The vegetation of Campo Imperatore

The vegetation of Campo Imperatore is essentially part of two bioclimatic belts: montane and subalpine.

The montane bioclimatic belt of Campo Imperatore extends from between about 1440 metres to 1900 metres (Fig. 16). The climax vegetation is represented by the beech woods of the *Cardamino kitaibelii-Fagetum sylvaticae* association of which there remain sporadic examples in this area. Touching the beech woods, there are traces of shrub formations of *Rhamnus alpinus* subsp. *fallax* of the *Rubo idaei-Rhamnetum fallacis* association and extensive substitute grasslands of the *Koelerio splendentis-Brometum erecti* association. The alluvial cones are colonised by a scree vegetation of *Festuca dimorpha* of the *Galio-Festucetum dimorphae* association *tolpidetosum staticifoliae* subass. that in the more stable places, at the base of the cones, in connected with the formations of *Plantago holosteum* and *Helianthemum oleandicum* ssp. *canum* of the *Plantago holostei-Helianthemetum cani* association that represents the typical vegetation of the stream beds that cross the high-plain. The more stable, although patchy, primitive grasslands have been colonised by the grasses of the *Polygalo majoris-Seslerietum nitidae* association and by heterotypic aspects of the *Carici humilis-Seslerietum apenninae* association that are being infiltrated by the shrubbery of *Juniperus communis* ssp. *alpina*.

The vegetation present on the river-glacier and lake deposits that characterise the high-plain of Campo Imperatore consists of a grassland of *Festuca circummediterranea* of the *Poo alpinae-Festucetum circummediterraneae* association.

In the plain area, on the partly hydromorphic soil of the grey Rendzina type there is a grassland of the *Cirsio acaulis-Seslerietum nitidae* association.

Still in the plain area, there are dolina fields that represent the present karst transformation of the glacial moraine. The vegetation that has colonised the dolina has been described (Biondi *et al.*, 1999) as micro-geosygmeta in which are seen three vegetational typologies that belong to three different classes (Fig. 17). In the summit area, on the edge of the doline, there is the *Carici humilis-Seslerietum apenninae* association that is in contact with that of the inside slopes of the *Koelerio splendentis-Brometum erecti* association. Finally, at the bottom of the doline, on the deep acid soil, there is the *Poo violaceae-Nardetum strictae* association.

The principal component analysis of the interpolated data relative to the pedologic variables (pH, % skeleton, AWC and CSC, cationic exchange capacity) of the associations of the montane bioclimatic belt is shown in Fig. 18. The first two components explain 92% of the total variance. The revealed gradient re-proposes the same sequence of associations individuated on a floristic basis (Fig. 19). Starting with the types on the more evolved soil, with the maximal values of AWC and CSC, and following the decrease in AWC and CSC and the consequent increase in pH and skeleton, one arrives at the types characterised by the primitive soils.

The agreement between the floristic structure of the vegetation and the whole pedologic variables of the montane bioclimatic belt has hence been proven, and therefore also that between the sygmeta (acidophilous and basophile) and the ecology of the association.

The response curves for the associations of the montane bioclimatic belt are given in Fig. 20. The sequence follows the order given by the preceding assessment (Fig. 18 and 19) and corresponds to that of the two sygmeta, acidophilous or basophile, of the belt. The

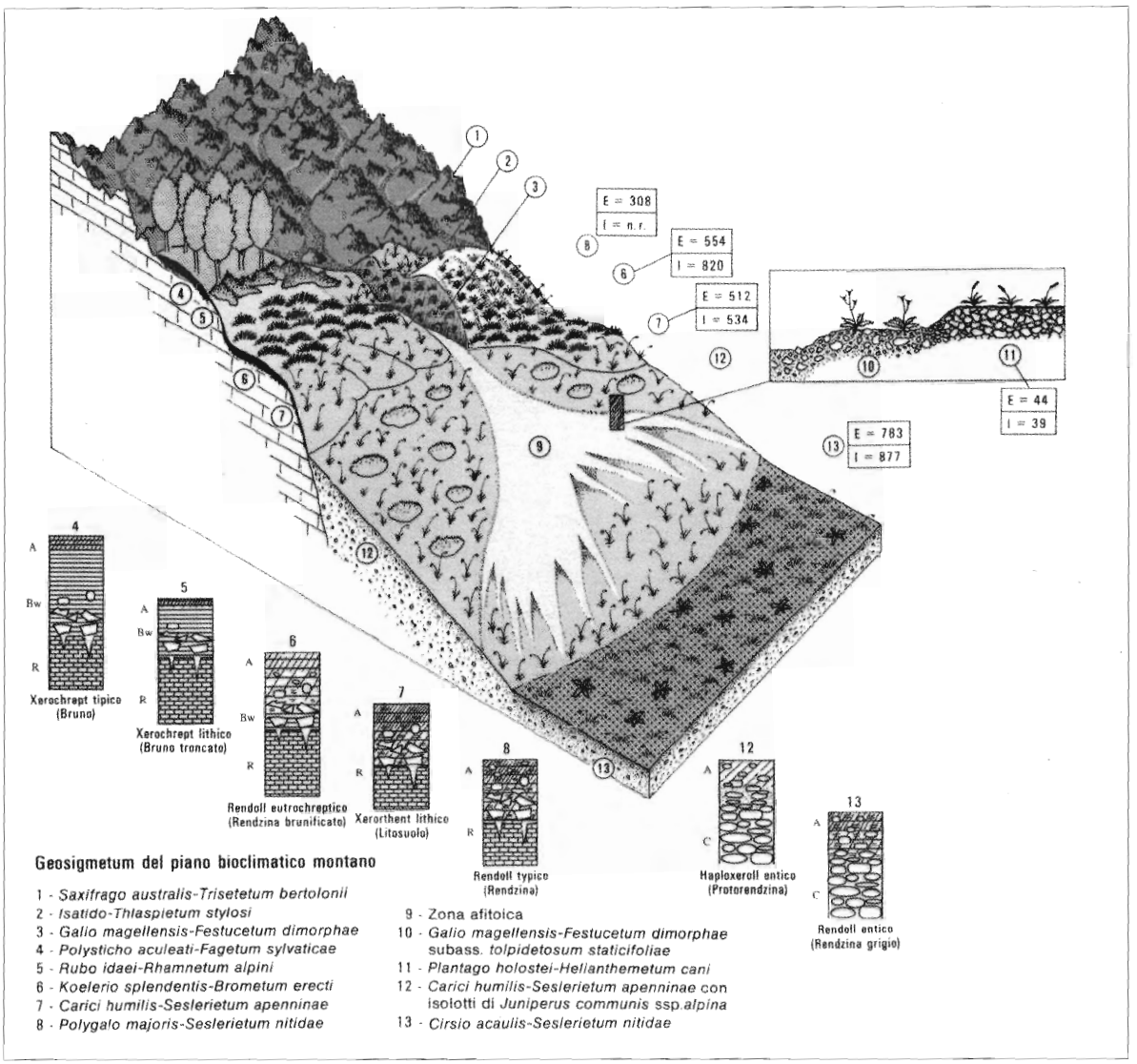


Fig. 16 – Geosygmetum of the montane bioclimatic belt (from Biondi *et al.*, 1995)

model of the coenocline explains the behaviour of the associations with respect to all the variables examined in an almost perfect manner. There is total agreement between the change in ecological factors and both the response in phytomass and the vegetation of the montane bioclimatic belt. Tab. 11 shows the ecological amplitude and the centroid of the associations, arranged along the sequence (Zuccarello *et al.*, 1999).

The plant landscape of the Campo Imperatore area near the Botanic Gardens, from where the excursion for Corno Grande starts, corresponds to the geosygmetum of the subalpine belt (Fig. 21).

On the deep and decarbonated soils there is a dense grassland of *Luzula italica*, *Festuca nigrescens* ssp. *microphylla* and *Nardus stricta* of the association *Luzulo italicae-Nardetum strictae* (Tab. 12: rel. 1-3) of the central-southern Apennines alliance *Ranuncolo pollinensis-Nardion strictae*. The links with the association *Seslerietum apenninae* are indicated by the subassociation *caricetosum kitaibelianae* (Tab. 12: rel. 4-7) differentiated by *Carex kitaibeliana*, *Gentiana verna* ssp. *verna*, *Phyteuma orbiculare*, *Draba aizoides*, *Erigeron epiroticus* and *Festuca violacea* ssp. *italica*. In contact with the formation of *Nardus stricta*, in the concave geomorphologies, in which soil has accumulated and in which the snow remains for longer, there are dense carpets of *Trifolium thalii* and *Taraxacum apenninum* of the association *Taraxaco*

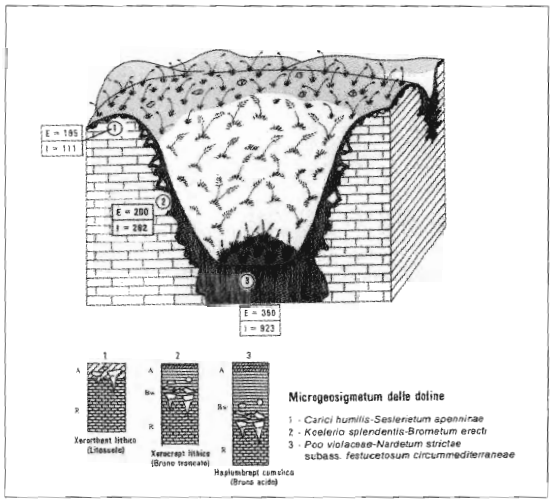


Fig. 17 – Microgeosygmetum of the dolina (from Biondi *et al*, 1995)

apennini-Trifolietum thalii (Tab. 13).

The principal-component analysis of the interpolated data relative to the pedologic variables of the surveys of the associations of the subalpine bioclimatic belt is shown in Fig. 22. The first two components explain 96% of the total variance. Also in this case the revealed gradient re-proposes the same sequence of associations individuated on a floristic basis (Fig. 23). The trajectory of the releves at its extremities again shows the vegetation types with the more evolved soils at one extreme, and those with primitive soils at the other. In this case, however, the water and exchange capacities are not strougly correlated as was the case in the montane belt. Indeed, the CSC reaches maximum values in the *Luzulo italicae-Nardetum strictae* association *caricetosum* subass., occupying a intermediate position in the sequence, and then decreases towards the extremities characterised on one side by maximum values of AWC and minimum pH, and on the other by alkali pH and abundant skeleton.

The agreement between the floristic structure of the vegetation and all the pedologic variables has been proven with the subalpine bioclimatic belt, and, therefore, that between the subalpine geosygmetum (including the *Seslerio apenninae-Dryadetum octopetalae* association and excluding the chamaephytic *Daphno oleoidis-Juniperetum alpinae* association) and the ecology of the association. The response curves for the associations of the subalpine bioclimatic belt are given in Fig. 24. The sequence of associations follows the order shown in Fig. 22 and Fig. 23 and corresponds to that of the geosygmetum of the belt (Fig. 21). The model of the coenocline explains the

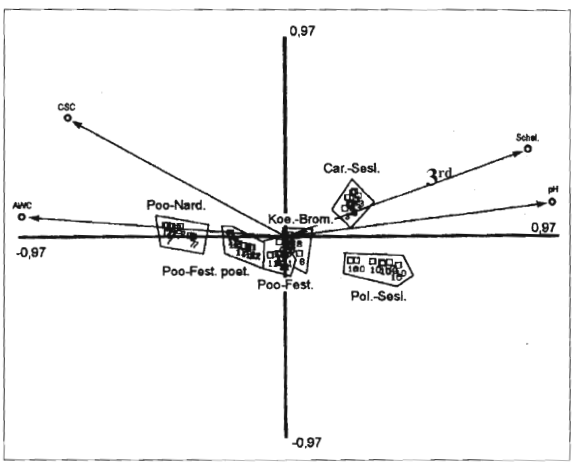


Fig. 18 – Principal component analysis of the ecological space of the montane sub-system (from Zuccarello *et al.*, 1999)

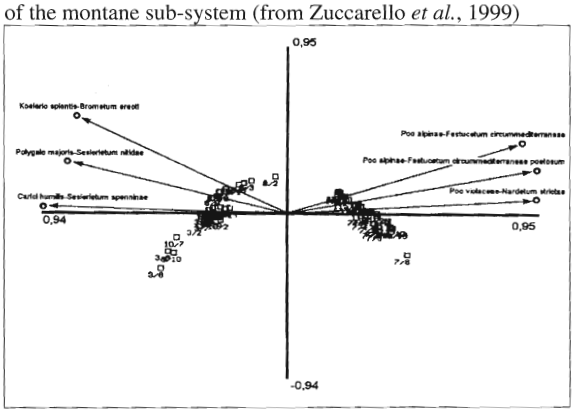


Fig. 19 – Principal component analysis of the associations' space of the montane sub-system (from Zuccarello *et al.*, 1999)

Tab. 11 – Ecological amplitude of the associations along the geosygmeta sequence (acidophilous and basophilous) of the montane bioclimatic belt (from Zuccarello *et al.*, 1999)

Tipi fitosociologici	pH		Schel		AWC		CSC		Bio	
	min	Max	min	Max	min	Max	min	Max	min	Max
Poo violaceae - Nardetum strictae	4,47	6,17	0,0	13,5	95,4	203,1	20,5	63,8	389	1279
Poo alpinae - Festucetum circummediterraneae poetosum	5,16	6,95	0,0	28,0	53,7	155,1	18,6	48,3	348	1096
Poo alpinae - Festucetum circummediterraneae	5,79	7,05	0,0	28,0	37,4	126,5	4,4	47,9	340	875
Koelerio splendentis - Brometum erecti	6,46	7,67	0,2	29,1	52,7	126,6	8,0	48,0	345	874
Polygalo majoris - Seslerietum nitidae	7,12	8,40	17,2	56,2	13,4	101,0	1,0	31,1	67	851
Carici humilis - Seslerietum apenninae	7,22	8,40	31,2	69,8	13,3	113,8	18,5	48,0	145	876

Tipi fitosociologici	pH		Schel		AWC		CSC		Bio	
	Cen	%	Cen	%	Cen	%	Cen	%	Cen	%
Poo violaceae - Nardetum strictae	5,24	42,57	0,0	15,3	147,9	44,9	43,2	44,7	842	51,2
Poo alpinae - Festucetum circummediterraneae poetosum	6,03	44,92	10,2	31,8	99,7	42,2	33,3	30,7	688	43,0
Poo alpinae - Festucetum circummediterraneae	6,46	31,55	11,5	31,9	84,1	37,2	27,4	44,9	611	30,8
Koelerio splendentis - Brometum erecti	7,07	30,32	14,6	32,8	90,0	30,8	29,8	41,3	611	30,4
Polygalo majoris - Seslerietum nitidae	7,84	32,02	36,6	44,4	55,6	36,5	9,0	31,0	449	45,1
Carici humilis - Seslerietum apenninae	8,19	29,44	49,4	43,8	58,9	41,9	33,3	30,4	544	42,1

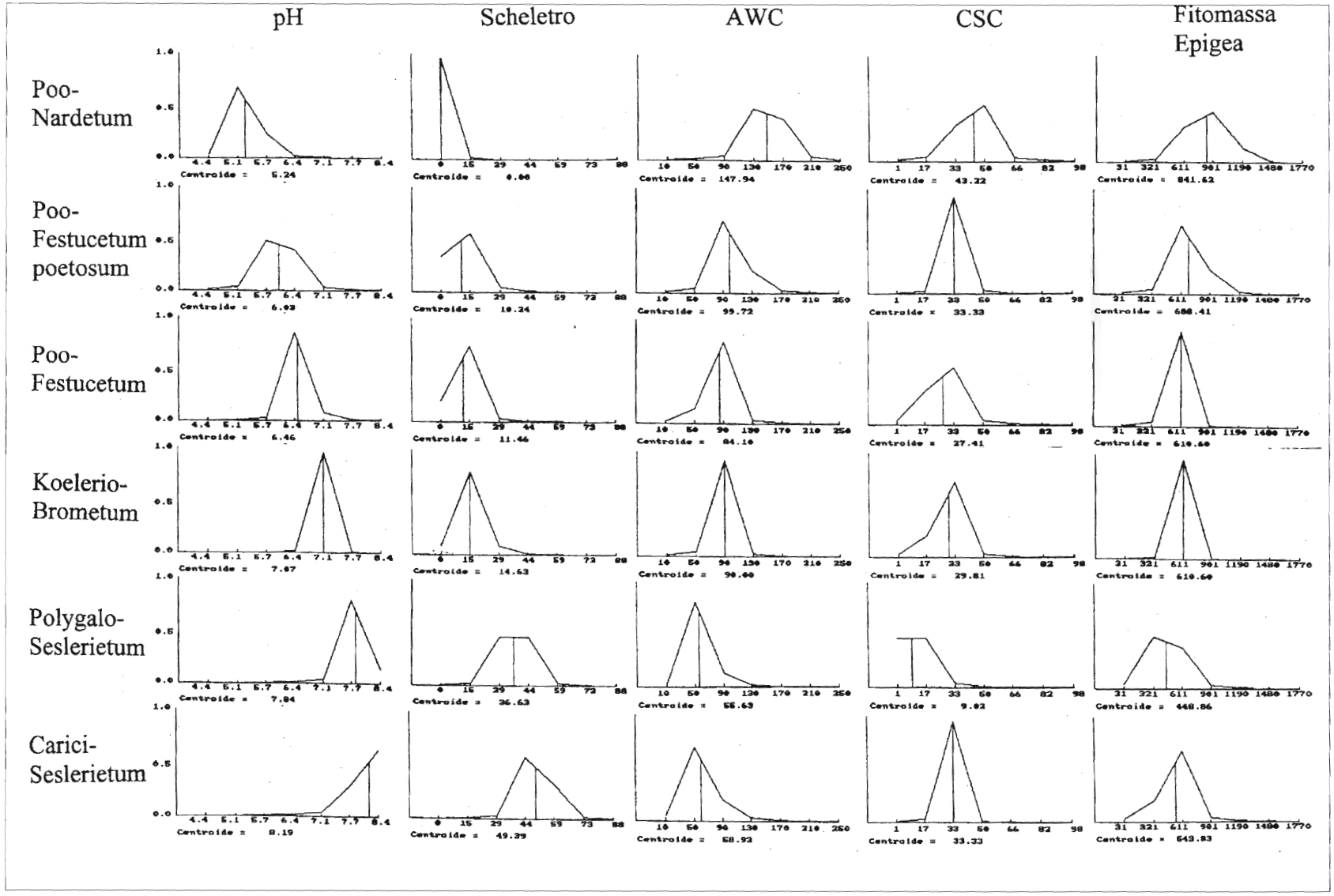


Fig. 20 – The response curves for the associations of the montane sub-system (from Zuccarello *et al.*, 1999)

Tab. 12 - ***LUZULO ITALICAE-NARDETUM STRICTAE*** Biondi, Ballelli, Allegrezza, Frattaroli & Taffetani 1992
caricetosum kitaibelianae Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999

Rel. n.	1	2	3	4	5	6	7	
Altitude (m)	2100	2040	2060	2080	2060	2060	2000	P
Exposure	NO	NO	S	-	ONO	S	N	r
Slope (°)	5	4	20	-	10	10	20	e
Coverage %	100	100	100	100	100	100	95	s.
Area (m^2)	30	10	40	20	30	40	30	
Charact. and diff. species of the ass.								
Luzula italica Parl.	2.2	2.2	2.2	1.2	1.2	2.2	2.2	7
Crocus albiflorus Kit.	1.1	1.2	1.1	+	1.1	.	1.1	6
Potentilla crantzii (Crantz) G. Beck ex Fritsch	.	.	+.2	1.2	1.2	1.2	1.2	5
Viola eugeniae Parl. ssp. eugeniae	.	.	+	+.2	1.1	1.2	.	4
Euphrasia salisburgensis Funk	.	.	+	.	.	.	.	1
Diff. species of the *caricetosum kitaibelianae* subass.								
Carex kitaibeliana Degen ex Bech.	.	.	.	+.2	1.2	2.3	+.2	4
Gentiana verna L. ssp. verna	.	+	.	+	.	+	.	3
Draba aizoides L.	.	.	.	+	+	+	.	3
Erigeron epiroticus (Vierh.) Halacsy	.	.	.	1.1	+	+	.	3
Festuca violacea Gaudin ssp. italica Foggi, Graz. Rossi & Signorini	.	.	.	1.2	1.1	.	1.1	3
Phyteuma orbiculare L.	.	.	.	+	+	.	.	2
Charact. and diff. species of the *Ranunculo pollinensis-Nardion strictae* all.								
Trifolium thalii Vill.	1.2	+.2	+.2	+.2	+.2	.	+.2	6
Ranunculus pollinensis (Terr.) Chiov.	1.2	.	.	1.1	+.2	+	+	5
Plantago atrata Hoppe ssp. atrata	.	1.1	3.3	1.2	1.2	.	1.2	5
Taraxacum apenninum (Ten.) Ten.	+	.	.	+.2	+	.	.	3
Ranunculus apenninus Chiov.	.	+	1.1	.	.	.	.	2
Poa variegata Lam.	.	.	.	+.2	.	.	.	1
Charact. species of the *Nardetalia strictae* ord. and the *Nardetea strictae* class								
Festuca nigrescens Lam. ssp. microphylla (St.-Yves) Mgf.-Dbg.	4.5	2.2	1.2	3.3	2.2	2.3	2.3	7
Poa alpina L. ssp. alpina	2.3	3.3	1.1	2.2	2.2	3.3	2.2	7
Nardus stricta L.	2.3	4.4	4.4	+.2	.	+.2	.	5
Botrychium lunaria (L.) Swartz	.	.	.	+	1.1	1.1	+	4
Phleum alpinum L. ssp. rhaeticum Humphries	+	1.1	.	.	.	.	.	2
Campanula scheuchzeri Vill.	.	.	+	.	.	.	.	1
Other species								
Trifolium repens L. ssp. prostratum (Biasol.) Nyman	+.2	+.2	+.2	1.2	1.2	1.2	1.1	7
Galium anisophyllon Vill. ssp. anisophyllon	+	.	.	+	+.2	1.1	+.2	5
Hieracium x micranthum Huet du Pav.	1.2	.	.	1.2	+.2	2.2	.	4
Herniaria glabra L. ssp. glabra	+.2	.	.	+	+	.	+	4
Stachys tymphaea Hausskn.	1.1	.	.	+	1.1	.	1.1	4
Cerastium arvense L. ssp. suffruticosum (L.) Nyman	.	+	1.1	.	.	+	1.2	4
Helictotrichon versicolor (Vill.) Pilger ssp. praetutianum (Arcang.) Renzoni	.	.	.	+.2	2.2	+	2.2	4
Armeria majellensis Boiss.	.	.	.	+	+	1.1	1.1	4
Alchemilla colorata Buser	.	.	.	+.2	+.2	1.2	+.2	4
Trifolium pratense L. ssp. semipurpureum (Strobl) Pignatti	.	.	.	+.2	+.2	2.2	+	4
Myosotis alpestris F.W. Schmidt	.	.	.	+.2	+	+	.	3
Anthyllis vulneraria L. ssp. vulnerarioides (All.) Arcang.	+.2	.	.	1.2	+.2	.	.	3
Accidental species	2	-	2	6	3	5	10	

behaviour of the associations for pH, skeleton and AWC in an almost perfect manner, as in the preceding case. Although it correlates well enough with the general structure of the geosygmetum, the epigeal phytomass reveals a maximum peak in the *Luzulo-Nardetum*, the second association of the sequence. The cationic exchange capacity, however, shows an oscillating behaviour along the geosygmetum. Therefore, there is total agreement between the changes in the ecological factors pH, skeleton and AWC and the geosygmetum of the subalpine bioclimatic belt, partial agreement for the response in phytomass, and disagreement for the CSC. Tab. 14 shows the ecological amplitude and the centroid of the associations ordered along the sequence of the geosygmetum.

The Sperman's correlation coefficient shows a

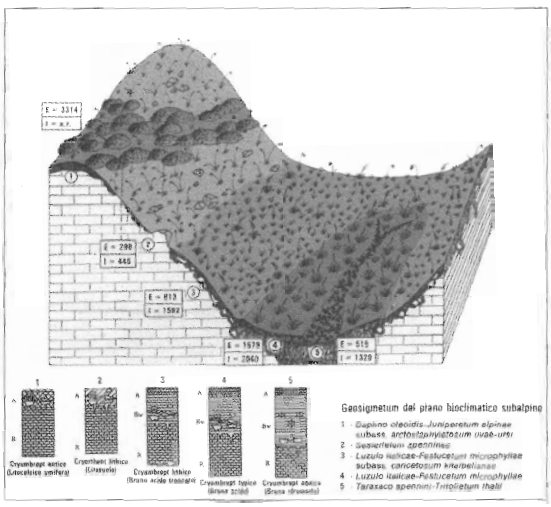


Fig. 21 – Geosygmetum of the subalpine bioclimatic belt (from Biondi *et al.*, 1995)

significant correlation between the sequence of the releves along the geoseries (the anticommutative difference between the *Taraxaco apennini-Trifolietum thalii* and *Seslerio apenninae-Dryadetum octopetalae* fuzzy set) and the considered ecological variables (Tab. 15), as in the montane belt. The sequence of the releves along the gradient of floristic variation is not correlated with the potential annual radiation only (Zuccarello *et al.*, 1999).

Tab. 15 – Correlation of the relevés' sequence along the geoseries of the sub alpine bioclimatic belt (anticommutative difference between the *Taraxaco apennini-Trifolietum thalii* and *Seslerio apenninae-Dryadetum octopetalae* fuzzy sets) and the pedological variables (from Zuccarello *et al.*, 1999)

	pH	Schel	AWC	CSC	Bio	En.	Pen.
Sequence	-	-	+	+	+	0	-

\+ Correlation positive
\- Correlation negative
0 Correlation absence

Tab. 13 - ***TARAXACO APENNINI-TRIFOLIETUM THALII*** Biondi, Ballelli, Allegrezza, Frattaroli & Taffetani 1992

Rel. n.	1	2	3	4	5	P
Altitude (m)	2050	2050	2080	2090	1640	r
Exposure	NO	-	E	-	-	e
Slope (°)	15	-	3	-	-	s.
Coverage %	100	100	100	100	100	
Area (m^2)	5	5	4	4	10	
Charact. species of the ass.						
Trifolium thalii Vill.	+.2	1.2	1.2	1.2	+.2	5
Taraxacum apenninum (Ten.) Ten.	3.4	+	2.2	1.2	1.2	5
Bellis perennis L.	1.2	.	1.2	1.2	1.2	4
Barbarea bracteosa Guss.	.	+	+	+	+.2	4
Sagina glabra (Willd.) Fenzl ssp. glabra	.	+.2	.	1.2	.	2
Veronica serpyllifolia L. ssp. humifusa (Dickson) Syme	.	1.1	.	.	.	1
Charact. species of the *Ranunculo pollinensis-Nardion strictae* all.						
Plantago atrata Hoppe ssp. atrata	2.2	2.2	2.2	2.3	2.2	5
Ranunculus pollinensis (Terr.) Chiov.	1.1	1.1	.	.	.	2
Luzula italica Parl.	+.2	.	.	.	.	1
Charact. specie of the *Nardetalia strictae* ord. and the *Nardetea strictae* class						
Poa alpina L. ssp. alpina	1.1	2.3	1.2	1.1	2.2	5
Festuca nigrescens Lam. ssp. microphylla (St.-Yves) Markgr.-Dann.	1.2	1.2	.	.	+.2	3
Nardus stricta L.	+.2	+.2	.	.	.	2
Other species						
Trifolium repens L.ssp. prostratum (Biasol.) Nyman	1.2	3.4	3.4	3.3	2.2	5
Cerastium arvense L. ssp. suffruticosum (L.) Nyman	+	.	.	+	+	2
Alchemilla colorata Buser	+	.	.	.	+.2	2
Accidental species	9	2	1	-	2	

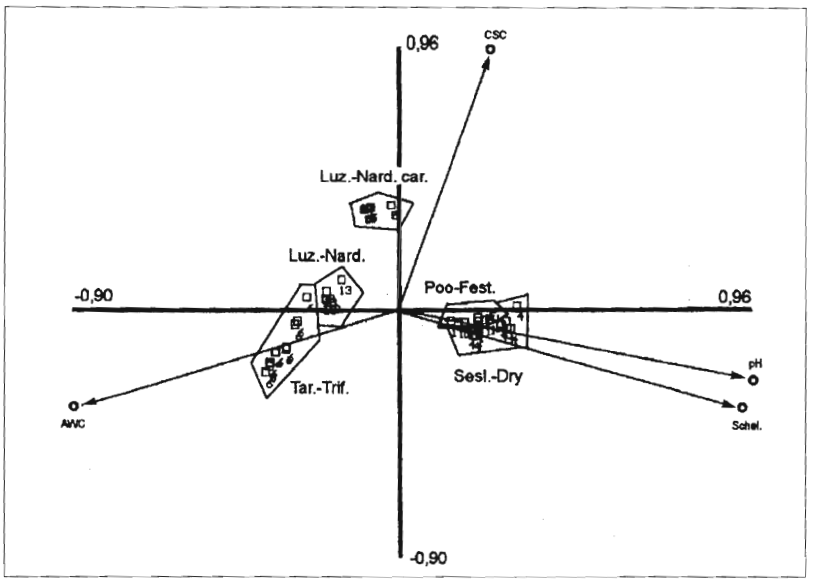


Fig. 22 - Principal component analysis of the ecological space of the sub-alpine sub-system (from Zuccarello *et al.*, 1999)

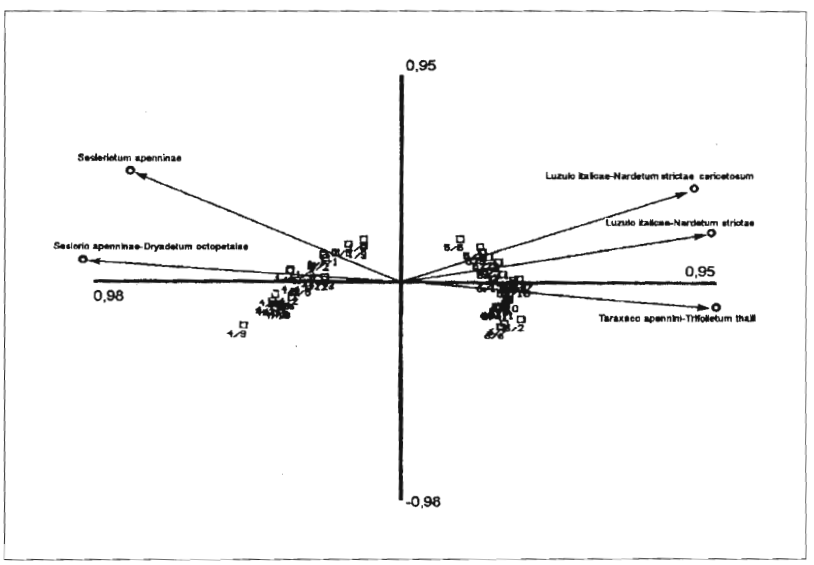


Fig. 23 – Principal component analysis of the associations' floristic space of the sub alpine sub-system (from Zuccarello *et al.*, 1999)

Tab. 14 - Ecological amplitude of the associations along the subalpine geosygmetum (from Zuccarello *et al.*, 1999)

Tipi fitosociologici	pH		Schel		AWC		CSC		Bio	
	min	Max	min	Max	min	Max	min	Max	min	Max
Taraxaco apennini - Trifolietum thalii	4,46	5,91	0,0	19,1	52,2	126,3	3,5	47,0	351	1117
Luzulo italicae - Nardetum strictae	4,53	6,32	0,0	13,4	14,0	122,2	18,7	48,3	942	1721
Luzulo italicae - Nardetum strictae caricetosum	5,12	6,34	0,0	14,1	13,3	98,1	34,7	65,4	461	1164
Seslerietum apenninae	7,07	8,35	30,6	57,5	13,7	86,9	18,8	47,9	59	584
Seslerio apenninae - Dryadetum octopetalae	7,17	8,40	35,1	71,9	13,7	90,0	18,7	48,1	61	822

Tipi fitosociologici	pH		Schel		AWC		CSC		Bio	
	Cen	%	Cen	%	Cen	%	Cen	%	Cen	%
Taraxaco apennini - Trifolietum thalii	5,16	36,22	2,0	21,7	87,9	30,9	25,4	44,8	708	44,1
Luzulo italicae - Nardetum strictae	5,47	44,72	0,0	15,2	62,2	45,1	33,3	30,5	1321	44,8
Luzulo italicae - Nardetum strictae caricetosum	5,73	30,58	1,0	16,0	55,2	35,3	51,0	31,6	843	40,4
Seslerietum apenninae	7,66	32,09	44,0	30,5	50,0	30,5	33,3	30,0	321	30,2
Seslerio apenninae - Dryadetum octopetalae	8,10	30,82	55,3	41,8	54,2	31,8	33,3	30,3	411	43,8

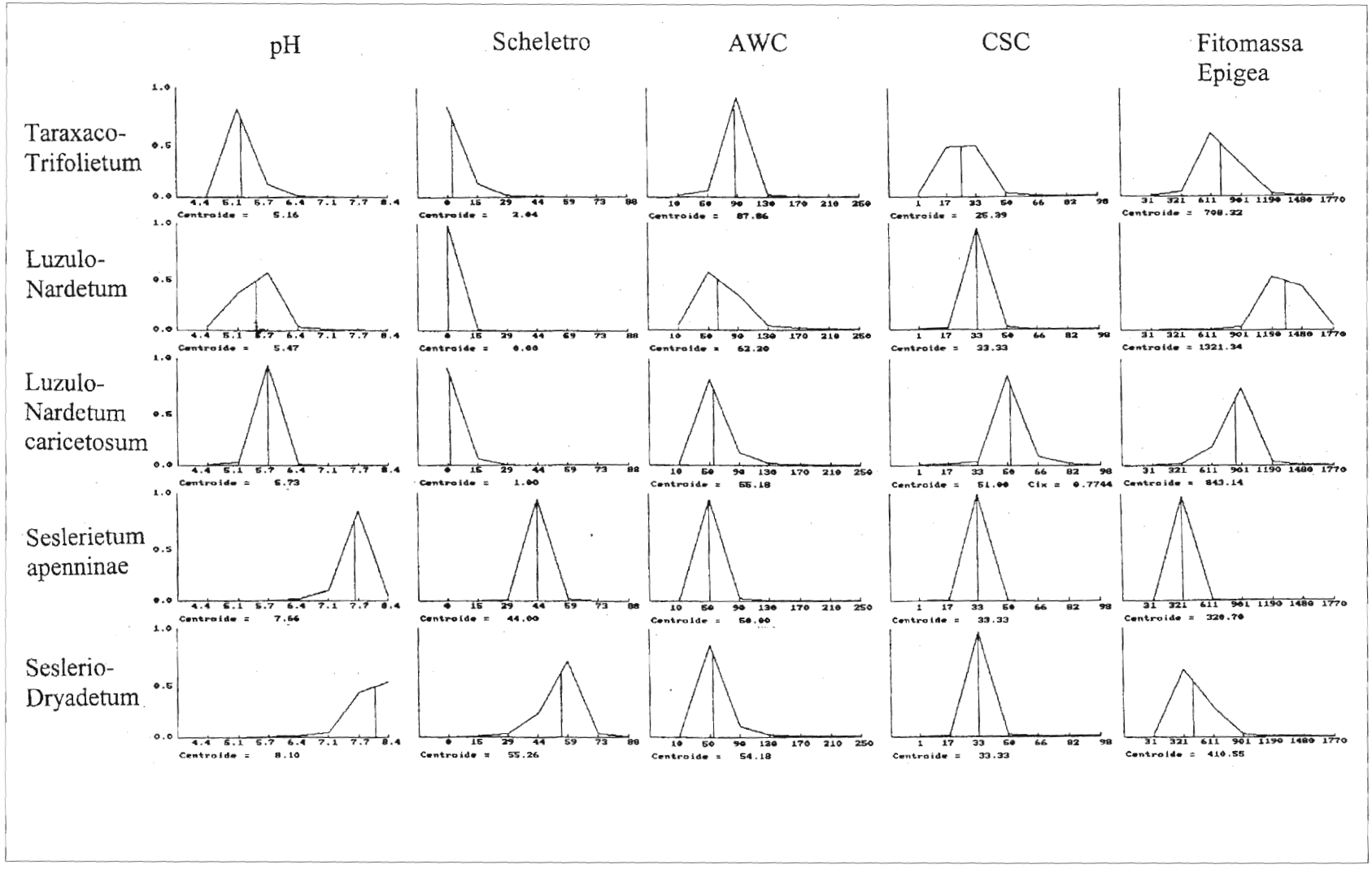


Fig. 24 - The response curves for the associations of the subalpine sub-system (from Zuccarello *et al.*, 1999)

Excursion from Campo Imperatore to Corno Grande (21 September, 2002)

Fig. 25 – Map of the excursion area from Campo Imperatore to Corno Grande

1st Stop - The path to Monte Aquila (2496 m)

At the start of the path (2200 metres) there is the vegetation of the *Seslerietum apenninae* association of the *Seslerion apenninae* alliance that makes up the edapho-xerophilous vegetation of the subalpine belt (Tab. 16; Fig. 25). This phytocoenosis in the alpine belt (at around 2300-2400 metres) is taken over by the formations of *Carex rupestris* and *C. kitaibeliana* of the *Caricetum kitaibelianae-rupestris* association.

Along the path, mobile screes are crossed, where the vegetation is mainly differentiated on the basis of the

height, and the size of the stones. With medium and small sized stones there is the vegetation of *Festuca dimorpha* and *Galium majellense,* with *Heracleum pyrenaicum* subsp. *orsinii*, of the *Galio-Festucetum dimorphae* association (Tab. 17) that represents the type association of the Apennines *Linario-Festucion dimorphae* alliance which on the larger stones is taken over by the vegetation of *Crepis pygmaea* and *Isatis allionii* of the *Isatido-Thlaspietum stylosi* association (Tab. 18: rel. 1-4) that also grows in the alpine belt.

Under the vertical rocky outcrops there are alluvial cones, some more, some less stable, that have been colonised by the primitive vegetation, differentiated by three endemic species which are *Brachypodium genuense*, *Stachys alopecurus* ssp. *divulsa* and *Centaurea ambigua* subsp. *nigra*, that together characterise the new *Stachydo divulsae-Brachypodietum genuensis* association of the Apennines *Phleo ambigui-Bromion erecti* alliance, *Brachypodenion genuenis* suballiance (Tab. 19 type rel. n. 3). In the new association two new subassociations have been individuated: *laserpitietosum siculi* (Tab. 19: type rel. n. 4) for the mainly stable aspect and *luzuletosum sieberi* (Tab. 19: type rel. n. 8) found on the teramano side, that indicates deep soils that are undergoing a process of decalcification.

In the rock fissures there is the rocky vegetation of *Silene monachorum* with *Trisetum bertolonii, Campanula tanfanii* and *Saxifraga lingulata* ssp. *australis* of the *Saxifrago-Trisetetum bertolonii* association (Tab. 20) of the central-southern Apennines *Saxifragion australis* alliance, while on northern faces, the vegetation is dominated by *Asplenium fissum* with *A. viride*. Still on the northern faces under conditions of prolonged snow-covering of the soil there are strips of the shrub-like vegetation of *Salix retusa* of the *Carici kitaibelianae-Salicetum retusae* association (Tab. 21).

2nd Stop - Sella di Monte Aquila (about 2400 m)

The vegetal communities found in this area and up to the peak of Corno Grande collectively define an extremely rich plant landscape that is linked to both the geomorphological and macro- and micro-climate variations.

In Fig. 26 a schematic representation of the habitat in which the associations under study are found is given. The higher areas, made of Triassic limestone that has been strongly modelled by the climatic and prior glacial activities, present environments particularly inhospitable

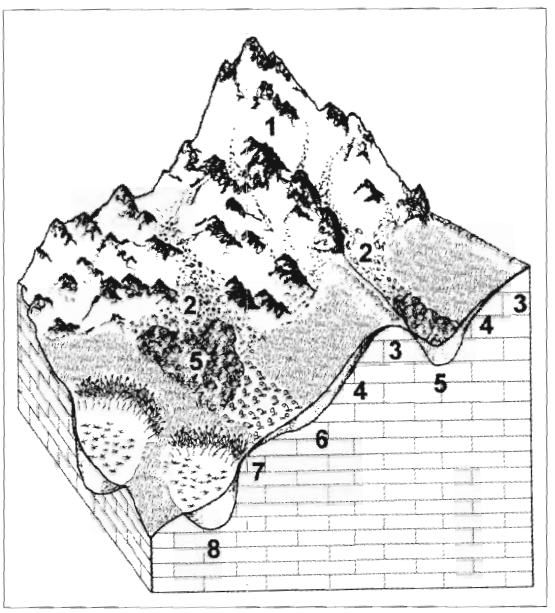


Fig. 26 – Geosygmetum of the alpine bioclimatic belt (from Biondi *et al.*, 2000)

for the plants that have succeeded in colonising them through pioneer forms of vegetation which have taken over the rocks or have made use of the small soil deposits. It is in this environment that the most spectacular vegetation of the mountain is found, represented by the endemic *Arabido alpinae-Cerastietum thomasii* association. In the area below, where detritic material has accumulated or there is variably evolved soil, there is a network of communities that is better structured and richer in species. The *Leontopodio nivalis-Elynetum myosuroidis* association can be considered as the climax vegetation of the deep and evolved soils of this territory. The pioneering formations, particularly diffuse on the crest and on the ridges tormented by the cryoperturbations, belong to the *Caricetum kitaibelianae-rupestris* association. The habitats of these depression areas that make up the so-called "vallette nivali" (snow basins) are thus very particular, as they are where the vegetation is conditioned by the persistence of the snow during part of the summer period. It is in these small depressions that the microcoenosis with the dwarf willows (*Salix herbacea* and *S. retusa*) of the *Armerio majellensis-Salicetum herbaceae* and *Carici kitaibelianae-Salicetum retusae* associations are found, and where there are dense populations of perennial grass species of the *Ranunculo pollinensis-Plantaginetum atratae* association that can be differentiated into the *soldanelletosum alpinae* and *alopecuretosum gerardii* subassociations according to the positions that they occupy inside the valletta nivale.

Tab. 16 - ***SESLERIETUM APENNINAE*** Furnari 1961 corr. Furnari 1966

Rel. n.	1
Altitude (m)	2200
Exposure	SSE
Slope (°)	25
Coverage %	90
Area (m^2)	50
Charact. and diff. species of the ass.	
Sesleria apennina Ujhelyi	4.5
Androsace villosa L. ssp. villosa	+
Helianthemum oelandicum (L.) DC. ssp. alpestre (Jacq.) Breistr.	+.2
Charact. species of the upper units	
Carex kitaibeliana Degen ssp. kitaibeliana	2.2
Festuca violacea Gaudin ssp. italica Foggi, Graz. Rossi & Signorini	2.3
Edraianthus graminifolius (L.) DC. ssp. graminifolius	+.2
Draba aizoides L. ssp. aizoides	+.2
Sedum atratum L. ssp. atratum	+
Aster alpinus L.	+
Anthyllis montana L. ssp. atropurpurea (Vukot) Pignatti	+
Phyteuma orbiculare L.	+
Ranunculus breyninus Crantz	1.1
Centaurea triumfetti All. ssp. triumfetti	1.1
Avenula praetutiana (Parl. ex Arcang.) Pignatti	1.2
Astragalus sempervirens Lam. ssp. gussonei Pignatti	+.2
Oxytropis campestris (L.) DC. (s.l.)	+
Paronychia kapela (Hacq.) A. Kern. ssp. kapela	+.2
Gentiana dinarica Beck	(+)
Other species	
Poa alpina L. ssp. alpina	2.2
Minuartia verna (L.) Hiern. ssp. verna	1.2
Anthyllis vulneraria L. ssp. vulnerarioides (All.) Arcang.	1.1
Dianthus sylvestris Wulfen ssp. sylvestris	1.2
Botrychium lunaria (L.) Swartz	+
Anthemis montana L.	+.2
Asperula cynanchica L.	+.2
Carex caryophyllea La Tourr.	1.2
Cynoglossum magellense Ten.	+
Erysimum pseudorhaeticum Polatschek	+
Galium corrudifolium Vill.	1.2
Globularia meridionalis (Popd.) O. Schwartz	+.2
Helianthemum oelandicum (L.) DC. ssp. canum (L.) Bonnier	+.2
Hieracium pilosella L.	+
Hippocrepis comosa L.	+.2
Myosotis alpestris F. W. Schmidt	+.2
Pedicularis tuberosa L.	+
Hypochoeris robertia Fiori	+
Saxifraga adscendens L. ssp. adscendens	+
Silene roemeri Friv.	+
Thymus cfr. kerneri Borbàs	1.2
Trifolium pratense L. ssp. semipurpureum (Strobl.) Pignatti	1.1
Viola eugeniae Parl. ssp. eugeniae	+
Saxifraga paniculata Mill.	+.2

Tab. 17 - ***GALIO MAGELLENSIS-FESTUCETUM DIMORPHAE*** Feoli Chiapella 1983

Rel. n.	1	2	3	P
Altitude (m)	2190	2280	2200	r
Exposure	NNE	NNE	NNE	e
Slope (°)	35	30	35	s.
Coverage %	30	70	60	
Area (m^2)	10	30	8	
Charact. species of the ass.				
Galium magellense Ten.	+.2	1.2	+.2	3
Festuca dimorpha Guss.	3.4	3.4	2.2	3
Charact. species of the *Linario-Festucion dimorphae* all.				
Doronicum columnae Ten.	+	+.2	+	3
Hypochaeris robertia Fiori	1.1	.	1.2	2
Ranunculus brevifolius Ten. ssp. brevifolius	1.2	+	.	2
Thlaspi stylosum (Ten.) Mutel	1.1	.	+	2
Heracleum pyrenaicum Lam. ssp. orsinii (Guss.) Pedrotti & Pignatti	.	2.3	+	2
Cerastium tomentosum L. ssp. album (Ten.) Tammaro	+	.	.	1
Achillea oxyloba (DC.) Sch. Bip. ssp. barrelieri (Ten.) F. Conti	+	.	.	1
Charact. species of the *Thlaspietalia rotundifolii* ord. and the *Thlaspietea rotundifolii* class				
Valeriana montana L.	.	+	2.2	2
Rumex scutatus L.	.	.	2.2	1
Other species				
Hieracium bifidum Kit.	1.1	+	+.2	3
Cynoglossum magellense Ten.	+	1.2	+	3
Pulsatilla alpina (L.) Delarbre ssp. alpina	+	+	.	2
Accidental species	9	10	7	

Tab. 18 - ***ISATIDO ALLIONII-THLASPIETUM STYLOSI*** Migliaccio 1970 corr. Feoli Chiapella 1983
papaveretosum degenii Biondi, Allegrezza, Ballelli & Taffetani 2000
leontodonetosum melanotrichi Biondi, Allegrezza, Ballelli & Taffetani 2000

Rel. n.	1	2	3	4	5	6	7	8	
Altitude (m)	2200	2280	2280	2260	2320	2350	2160	2160	P
Exposure	E	E	ENE	ENE	ONO	O	N	N	R
Slope (°)	45	45	35	40	30	30	40	50	E
Coverage %	30	40	30	40	60	60	40	60	S
Area (m^2)	6	3	20	50	70	30	10	30	
Charact. species of the ass.									
Crepis pygmaea L. ssp. pygmaea	3.3	1.2	+	1.3	2.2	.	3.3	1.2	7
Isatis allionii Ball.	.	+	2.2	3.3	3.3	3.4	1.2	2.3	7
Diff. species of the *papaveretosum degenii* subass.									
Papaver degenii (Urum. & Jav.) Kuzm.	.	.	.	.	3.3	3.3	.	.	2
Diff. species of the *leontodonetosum melanotrichi* subass.									
Leontodon montanus Lam. ssp. melanotricus (Vierh.) Widder	.	.	.	.	.	.	2.2	1.2	2
Achillea oxyloba (DC.) Sch. Bip. ssp. barrelieri (Ten.) F. Conti	.	.	.	.	.	.	1.1	+.2	2
Papaver alpinum L. ssp. ernesti-mayeri (Markgr.) Wraber	.	.	.	.	.	.	1.2	2.3	2
Ranunculus brevifolius Ten. ssp. brevifolius	.	.	.	.	.	.	1.1	1.2	2
Charact. species of the upper units									
Heracleum sphondylium L. ssp. orsinii (Guss.) H. Neumayer.	.	+	1.2	+	1.1	+	.	.	5
Senecio squalidus L.	.	+	.	+.2	1.2	1.2	.	.	4
Galium magellense Ten.	.	+.2	.	.	.	.	2.2	2.2	3
Festuca dimorpha Guss.	.	.	1.2	+	.	.	.	+	3
Hypochaeris robertia Fiori	+	.	.	.	+	.	.	.	2
Scrophularia juratensis Schleicher	1.1	.	+	.	.	.	.	.	2
Doronicum columnae Ten.	.	+	+	.	.	.	.	.	2
Rumex scutatus L.	.	.	+	1.2	.	.	.	.	2
Valeriana montana L.	.	2.2	.	.	.	.	.	.	1
Linaria alpina (L.) Mill.	.	.	.	.	.	+.2	.	.	1
Other species									
Myosotis alpestris F. W. Schmidt.	+	.	.	.	.	.	1.2	.	2
Poa alpina L. ssp. alpina	.	+.2	.	.	.	1.2	.	.	2
Cerastium arvense L. ssp. strictum (L.) Gaudin	.	+.2	.	.	.	.	+.2	.	2
Accidental species	7	-	-	-	1	-	1	1	

Tab. 19 - ***STACHYDO DIVULSAE-BRACHYPODIETUM GENUENSIS*** ass. nova
stachyetosum divulsae subass. nova
laserpitietosum siculi subass. nova
luzuletosum sieberi subass. nova

Rel. n.	1	2	3+	4*	5	6	7	8°	
Altitude (m)	2210	2230	2270	2250	2090	2100	2070	1830	P
Exposure	SE	SE	SSE	SE	ESE	ESE	E	NW	r
Slope (°)	45	40	45	20	50	30	30	40	e
Coverage %	90	85	85	90	95	100	100	80	s.
Area (m^2)	70	30	40	20	50	40	80	40	
Charact. and diff. species of the ass.									
Brachypodium genuense (DC.) Roem. & Schult.	4.5	2.3	3.3	2.3	2.3	4.5	4.5	3.3	8
Stachys alopecuros (L.) Benth. ssp. divulsa (Ten.) Pignatti	2.3	1.1	1.2	1.2	2.2	2.3	2.2	2.3	8
Galium corrudifolium Vill.	1.2	2.2	+	1.2	1.2	+.2	+	1.2	8
Centaurea ambigua Guss. ssp. nigra (Fiori) Pignatti	2.2	1.2	2.2	3.3	.	.	.	.	4
Centaurea triumfetti All. (s.l.)	.	1.2	1.2	.	1.2	.	+	.	4
Erysimum majellense Polatschek	1.2	1.2	1.1	.	.	.	.	.	3
Diff. species of the *laserpitietosum siculi* subass.									
Laserpitium siler L. var. siculum (Spreng.) Fiori	.	.	.	4.4	.	.	.	.	1
Cerastium tomentosum L. (s.l.)	.	.	.	2.2	.	.	.	.	1
Diff. species of the *luzuletosum sieberi* subass.									
Leucanthemum vulgare Lam. (s.l.)	.	.	.	.	1.2	2.2	1.2	1.2	4
Carex macrolepis DC.	.	.	.	.	2.3	2.3	+.2	+.2	4
Cruciata glabra (L.) Ehrh.	.	.	.	.	1.2	1.2	1.2	+	4
Hypericum richeri Vill. ssp. richeri	.	.	.	.	+	1.1	.	1.2	3
Luzula sieberi Tausch	.	.	.	.	.	+.2	+.2	1.1	3
Anthoxanthum odoratum L.	.	.	.	.	.	.	1.2	1.2	2
Charact. and diff. species of the *Brachypodenion geniensis* suball. and the *Phleo ambigui-Bromion erecti* all.									
Armeria majellensis Boiss. ssp. majellensis	2.2	1.2	1.1	+	+	+	+	+.2	8
Helictotrichon versicolor (Vill.) Pilger ssp. praetutianum (Arcang.) Renzoni	1.2	1.2	1.2	+	2.2	+	.	1.2	7
Festuca circummediterranea Patzke	2.2	2.2	2.3	2.3	3.3	.	.	2.3	6
Helianthemum nummularium (L.) Mill. ssp. grandiflorum (Scop.) Schinz & Thell.	.	+	1.2	+	2.2	1.2	2.3	.	6
Koeleria lobata (M. Bieb.) Roem. & Schult.	+	1.2	.	1.2	2.2	.	.	1.1	5
Rhinanthus wettsteinii (Sterneck) Soó	+	1.2	+	.	1.1	.	1.2	.	5
Erysimum pseudorhaeticum Polatschek	.	.	.	+	+	.	.	.	2
Trifolium pratense L. ssp. semipurpureum (Strobl) Pignatti	.	.	.	.	.	2.2	2.3	.	2
Globularia meridionalis (Podp.) O. Schwarz	.	.	+.2	.	.	.	.	.	1
Polygala major L.	.	.	.	.	1.2	.	.	.	1
Arabis collina Ten.	.	.	.	.	.	.	.	+	1
Silene ciliata Burr. ssp. graefferi (Guss.) Nyman	.	.	.	.	.	.	+	.	1
Trifolium montanum L. ssp. rupestre (Ten.) Nyman	.	.	.	.	.	.	+	.	1
Stachys recta L. (s.l.)	.	.	.	.	.	+	.	.	1
Charact. species of the *Brometalia erecti* ord. and the *Festuco-Brometea* class									
Bromus erectus Huds.	+.2	1.2	1.2	.	3.4	1.2	3.3	2.2	7
Cerastium arvense L. ssp. suffruticosum (L.) Nyman	1.2	1.2	2.2	.	1.1	+	+	+.2	7
Hippocrepis comosa L.	+.2	+.2	1.2	+	+	+.2	.	.	6
Euphorbia cyparissias L.	+	+	.	.	.	2.3	1.2	2.2	5
Thymus longicaulis C. Presl ssp. longicaulis	.	.	.	+	+.2	.	.	1.2	3
Carlina acaulis L. ssp. simplex (Waldst. & Kit.) Nyman	.	+	.	.	.	1.1	.	.	2
Asperula cynanchica L.	.	.	.	.	+	.	.	+	2
Achillea collina Becker ex Rchb.	.	.	.	.	1.2	.	.	1.2	2
Gymnadenia conopsea (L.) R. Br.	.	.	.	.	+	.	.	+	2
Scabiosa columbaria L. (s.l.)	.	.	.	.	.	+.2	+.2	.	2
Helianthemum nummularium (L.) Mill. ssp. obscurum (Celak.) Holub	.	.	.	.	1.2	.	.	.	1
Hieracium pilosella L. (s.l.)	.	.	.	.	+	.	.	.	1
Campanula glomerata L. (s.l.)	.	.	.	.	.	.	.	1.2	1
Dianthus monspessulanus L.	.	.	.	.	.	.	2.2	.	1
Polygala nicaeensis Risso ex W.D.J. Koch ssp. mediterranea Chodat	.	.	.	.	.	.	.	+	1
Knautia purpurea Borbas	.	.	.	.	+.2	.	.	.	1
Other species									
Lotus corniculatus L. (s.l.)	+.2	+	+	+	1.1	1.2	.	+	7
Phyteuma orbiculare L.	+	+	.	+	1.1	+	+	1.1	7
Acinos alpinus (L.) Moench	1.2	1.2	1.2	+	+.2	.	.	1.2	6
Gentiana lutea L. ssp. lutea	+	+	.	.	+.2	+	+.2	+	6
Poa alpina L.	2.2	1.2	1.2	.	.	+	.	+.2	5
Bunium bulbocastanum L.	.	+	+	+	.	+	.	+	5
Linaria purpurea (L.) Mill.	1.1	1.1	.	.	+	+.2	.	+	5
Senecio doronicum L. ssp. gerardii (Gren. & Godr.) Nyman	+	1.2	.	.	1.1	.	+	1.2	5
Carduus carliniifolius Lam.	+	.	.	.	2.2	+.2	1.1	1.2	5
Doronicum columnae Ten.	+.2	+.2	.	.	.	.	+	2.2	4
Ranunculus breyninus Crantz	+	1.1	+	.	1.2	.	.	.	4
Trifolium pratense L. ssp. nivale (W.D.J. Koch) Arcang.	1.2	+	1.1	.	.	.	+	.	4
Festuca dimorpha Guss.	.	+	.	+	.	1.2	.	.	3
Dianthus sylvestris Wulfen ssp. sylvestris	+	+.2	+	.	.	.	.	.	3
Silene multicaulis Guss. ssp. multicaulis	+	.	+.2	+	.	.	.	.	3
Biscutella laevigata L. ssp. laevigata	.	.	.	.	+	+	+	.	3
Accidental species	11	9	8	1	12	14	14	12	

Tab. 20 - ***SAXIFRAGO AUSTRALIS-TRISETETUM BERTOLONII*** Biondi & Ballelli 1982

Rel. n.	1
Altitude (m)	2230
Exposure	N
Coverage %	70
Area (m2)	6
Charact. species of the ass. and *Saxifragion australis* all.	
Saxifraga lingulata Bellardi ssp. australis (Moric.) Pignatti	1.2
Campanula tanfanii Podlech	+.2
Trisetum bertolonii Johnsell	1.2
Charact. species of the*Potentilletalia caulescentis* ord. and the *Asplenietea* class	
Silene pusilla Waldst. & Kit. ssp. pusilla	2.3
Rhamnus pumilus Turra	+.2
Sedum dasyphyllum L.	+
Primula auricula L. ssp. balbisii (Lehm.) Nyman	+.2
Cystopteris fragilis (L.) Berhn.	1.1
Kernera saxatilis (L.) Rchb.	(+)
Other species	
Edraianthus graminifolius (L.) DC. ssp. graminifolius	+
Lomelosia graminifolia (L.) Greuter & Burdet	(+)
Hypochaeris robertia Fiori	+.2

Tab. 21 - ***CARICI KITAIBELIANAE-SALICETUM RETUSAE*** Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999

Rel. n.	1	2	3	4	5	P
Altitude (m)	2600	2550	2520	2250	2280	r
Exposure	NNO	NNO	NNO	NE	N	e
Slope (°)	30	25	25	40	50	s.
Coverage %	80	80	80	95	100	
Area (m^2)	8	10	8	10	15	
Charact. species of the ass. and the upper units						
Salix retusa L.	3.4	3.3	4.5	4.5	4.5	5
Carex kitaibeliana Degen ssp. kitaibeliana	2.2	1.2	+	+.2	1.2	5
Trifolium noricum Wulfen ssp. praetutianum (Guss.) Pignatti	.	.	.	+	+.2	2
Other species						
Gentiana dinarica Beck	+	+	+	1.1	1.1	5
Myosotis alpestris F. W. Schmidt	+	+	+	.	+	4
Poa alpina L. ssp. alpina	+	+.2	1.2	.	1.2	4
Viola eugeniae Parl. ssp. eugeniae	1.1	+	+	+	.	4
Draba aizoides L. ssp. aizoides	+.2	.	+	+	+	4
Achillea oxyloba (DC.) Sch. Bip. ssp. barrelieri (Ten.) F. Conti	+	+.2	1.2	.	.	3
Silene acaulis (L.) Jacq. (s.l.)	2.3	.	1.3	.	1.2	3
Ranunculus pollinensis (Terr.) Chiov.	.	.	.	1.2	1.1	2
Luzula campestris (L.) DC. ssp. campestris	.	.	.	+	+	2
Plantago atrata Hoppe ssp. atrata	.	.	.	1.1	1.2	2
Anemone narcissiflora L. ssp. narcissiflora	.	.	.	1.1	1.1	2
Accidental species	-	1	2	10	6	

Tab. 22 - ***CARICETUM KITAIBELIANAE-RUPESTRIS*** Biondi, Allegrezza, Ballelli & Taffetani 2000
artemisietosum erianthae Biondi, Allegrezza, Ballelli & Taffetani 2000

Rel. n.	1	2	3	4	5	6	7	8	9	
Altitude (m)	2380	2460	2400	2400	2300	2600	2300	2390	2460	P
Exposure	O	NO	O	SO	O	NO	N	S	NE	R
Slope (°)	20	20	30	25	20	40	80	35	60	E
Coverage %	85	95	85	100	80	90	80	70	70	S
Area (m²)	50	30	20	20	15	50	20	20	20	
Charact. and diff. species of the ass.										
Sesleria apennina Ujhelyi	+.2	1.3	1.2	3.3	3.3	2.2	1.1	3.3	+	9
Silene acaulis (L.) Jacq. (s.l.)	1.2	2.3	2.3	+.2	1.2	.	3.3	+.2	2.2	8
Carex kitaibeliana Degen ssp. kitaibeliana	2.2	2.2	2.2	2.3	1.2	1.2	+	2.2	.	8
Carex rupestris All.	4.5	3.4	2.2	3.3	2.2	2.3	+.2	1.2	.	8
Festuca violacea Gaudin ssp. italica Foggi, Graz. Rossi & Signorini	2.2	+.2	2.3	+.2	.	+.2	+	+.2	1.2	8
Diff. species of the *artemisietosum erianthae* subass.										
Artemisia petrosa (Baumg.) ex DC. ssp. eriantha (Ten.) Giac. & Pignatti	.	.	+	.	.	.	2.2	1.2	3.4	4
Saxifraga paniculata Mill. ssp. paniculata	.	.	+.2	.	.	.	1.2	.	1.2	3
Saxifraga exarata Vill. ssp. ampullacea (Ten.) D.A. Webb	.	.	.	.	.	.	.	+.2	2.3	2
Charact. species of the *Seslerion apenninae* all., the *Seslerietalia tenuifoliae* ord. and the *Elyno-Seslerietea* class										
Edraianthus graminifolius (L.) DC. ssp. graminifolius	1.1	1.2	+.2	+	1.1	1.1	+	1.2	1.2	9
Helianthemum oelandicum (L.) DC. ssp. alpestre (Jacq.) Breistr.	2.2	2.3	2.3	1.2	1.1	+.2	.	2.2	1.2	8
Draba aizoides L. ssp. aizoides	1.1	1.2	1.2	+	+	1.2	+.2	+	.	8
Sedum atratum L. ssp. atratum	.	+	+	.	.	.	+	+	+	5
Trinia dalechampii (Ten.) Janchen	1.1	.	2.2	+	.	.	.	+	.	4
Aster alpinus L.	+.2	.	.	1.1	+	.	.	+	.	4
Potentilla apennina Ten.	.	.	.	.	+.2	.	+.2	.	1.2	3
Gentiana verna L. ssp. verna	+	.	.	+	+	.	.	.	.	3
Androsace villosa L. ssp. villosa	.	.	.	.	+	.	+.2	+	.	3
Pedicularis verticillata L.	.	.	.	+	.	.	+	.	.	2
Pulsatilla alpina (L.) Delarbre ssp. alpina	.	.	.	.	+	.	.	+	.	2
Polygonum viviparum L.	.	.	.	1.1	.	+	.	.	.	2
Pedicularis elegans Ten.	.	.	1.1	+	.	.	.	.	.	2
Anthyllis montana L. ssp. atropurpurea (Vukot) Pignatti	.	.	.	.	+	.	.	.	.	1
Saxifraga caesia L.	.	.	.	.	.	1.2	.	.	.	1
Coeloglossum viride (L.) Hartm.	.	.	.	+	.	.	.	.	.	1
Phyteuma orbiculare L.	.	.	.	+	.	.	.	.	.	1
Carum heldreichii Boiss.	.	.	.	.	.	.	+	.	.	1
Other species										
Poa alpina L. ssp. alpina	1.2	.	1.2	+	.	.	1.2	+.2	2.2	6
Armeria majellensis Boiss.	+	.	+.2	+	+	+	.	.	.	5
Minuartia verna (L.) Hiern. ssp. verna	1.1	.	1.2	.	+	.	+	+.2	.	5
Erigeron epiroticus L. (Vierth.) Halacsy	1.1	.	+.2	+	.	.	.	+	+.2	5
Anthyllis vulneraria L. ssp. vulnerarioides (All.) Arcang.	.	.	+.2	+	+	.	+	.	.	4
Thymus cfr. kerneri Borbàs	.	1.2	.	.	+.2	.	.	+.2	1.2	4
Androsace vitaliana (L.) Lapeyr. ssp. praetutiana (Sund) Kress	1.2	.	+.2	.	.	.	.	1.2	+.2	4
Dianthus sylvestris Wulfen ssp. sylvestris	.	1.2	.	.	+.2	.	.	1.2	.	3
Cerastium arvense L. ssp. strictum (L.) Gaudin	+.2	.	.	.	.	.	.	+.2	1.2	3
Sempervivum arachnoideum L. ssp. tomentosum (C.B. Lehm. & Schinittsp.) Schinz & Thell.	1.2	.	.	+	1.2	.	.	.	.	3
Galium magellense Ten.	.	.	+.2	.	.	.	.	+.2	+.2	3
Achillea oxyloba (DC.) Sch. Bip. ssp. barrelieri (Ten.) F. Conti	+	.	+.2	.	.	1.1	.	.	.	3
Saxifraga aizoides L.	+.2	.	.	.	1.2	.	.	1.2	.	3
Gentiana majellensis (Vaccari ex Ronniger) Tammaro	.	.	1.2	+.2	.	.	.	+	.	3
Accidental species	2	3	4	10	3	3	4	2	4	

The path that follows along sella di Monte Aquila, along the ridge, crosses the xerophytic grassland of *Carex rupestris* and *C. kitaibelianae* of the *Caricetum kitaibelianae-rupestris* association of the *Seslerion apenninae* alliance (Tab. 22). This association represents the Apennines vicariant of the *Caricetum rupestris* association that has been described for the alpine and snow belts of the Italian Dolomites (Pignatti & Pignatti, 1985). In the territory of Gran Sasso, *Carex rupestris*, a circumboreal arctic-alpine species, is instead part of a typically Apennines floristic context exemplified by *Sesleria apennina, Edraianthus graminifolius, Festuca violacea* ssp. *italica* and *Carex kitaibeliana*, which become differential species with respect to the formations of *Carex rupestris* of the Alps.

In contact with the formations of *Carex rupestris*, the vegetation of *Elyna myosuroides* of the *Leontopodio nivalis-Elynetum myosuroidis* association is found, that represents the climatic vegetation of the alpine belt, here present in the *trinietosum dalechampii* subassociation and in the variant with *Antennaria dioica* (Tab. 23). It grows in the lightly cryoperturbed substratum, almost a real podzol soil (profile: altitude 2440 metres, west-facing, 40° inclination). This represents a rare example of podzolization on limestone. Moreover, on the Alps the formations of *Elyna* are normally found on the ridge crests, while the formations of *Carex curvula* covers the sides; in this case, however, the formations of *Elyna*

have a position and soil typical of the *Carex curvula*'ones.

At the bottom of the microdoline, which characterise the area, where the snow remains for long periods of the year, and on decarbonated soil, the edapho-hygrophilous herbaceous vegetation of *Ranunculus pollinensis* and *Plantago atrata* of the *Ranuncolo pollinensis-Plantaginetum atratae* association of the central-southern Apennines *Ranuncolo-Nardion strictae* alliance is found (Tab. 24). In the alpine belt, this phytocoenosis replaces the vegetation of *Trifolium thalii* of the *Taraxaco-Trifolietum thalii* association typical of the subalpine belt, and represents the Apennines substitute of the *Crepido-Plantaginetum montanae* association described for the analogous formations present in the vallette nivali of the Dolomites (Wikus, 1960). In this association, there have been individuated the variant with *Taraxacum glaciale* (Tab. 24: rel. 2), a very rare species throughout the Gran Sasso territory, and the *alopecuretosum gerardii* subassociation, differentiated by *Alopecurus gerardii* and *Anthoxanthum alpinum*, that are found on the steeper areas of the microdoline on less evolved and decarbonated soil (Tab. 24: rel. 3-4).

In this area the willow formations of *Salix herbacea* are found, that on the Gran Sasso d'Italia reach their southern limit of the Italian peninsula and of the entire distribution of this species (Fig. 27). These formations are found in a fragmented form in the alpine bioclimatic belt of Corno Grande at the bottom of the vallette nivali, under prolonged snow cover, on decarbonated soils. The shrub-like formations of *Salix herbacea* have been included in the *Armerio majellensis-Salicetum herbaceae* association (Tab. 25) (Biondi *et al.*, 2000) that represents the Apennines replacement of the *Salicetum herbaceae* association (Rubel 1912) Br.-Bl. 1913 of the Alps, with respect to which the differential species are: *Armeria majellensis, Carex kitaibeliana* and *Ghaphalium hoppeanum* here in the subspecies *magellense*. The contact with the willow formations of *Salix retusa* is represented by the *salicetosum retusae* subassociation (Tab. 25: rel. 1-2).

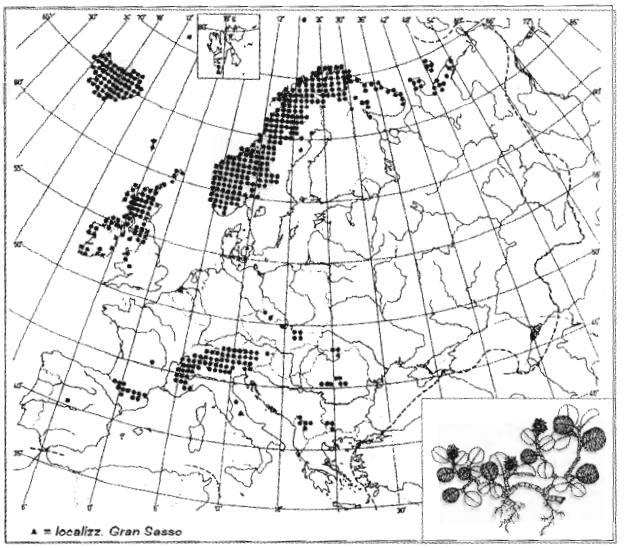


Fig. 27 – Distribution of *Salix herbacea* (from Biondi *et al.*, 2000)

3rd Stop - The ascent to Corno Grande (2912 m)

The peak of Corno Grande, made up of a sort of limestone pyramid, is part of the highest area of Gran Sasso d'Italia, defined by Demangeot (1965) as the "massiccio del Corno Grande" (massif of Corno Grande). It has among the steepest cliffs of the entire chain, that have been formed by the karst and glaciation phenomena. The lithology comes from the meso-Cenozoic carbonatic series which gave rise to the Triassic dolostones and the solid limestone that together make up a good part of the south-eastern area of Corno Grande.

Along the path that ascends rapidly across the mobile scree flows, with medium and large rocks, the screes vegetation is found, dominated by *Papaver degenii* of the *Isatido-Thlaspietum stylosi* association *papaveretosum degenii* subass. (Tab. 18: rel. 5-6). *Papaver degenii* is an endemic Balcan-Apennines species, widely diffuse in the vegetation of the Balcan peninsula where it forms part of the *Veronico-Papaverion degenii* alliance Mucina *et al.*, 1990. Continuing towards the summit along the fractures of the rock bed, there is the rock vegetation dominated by the endemic *Cerastium thomasii* (Fig. 28) with *Arabis alpina* ssp. *alpina* and *Draba aspera* of the *Arabido alpinae-Cerastietum thomasii* association of the *Linario-Festucion dimorphae* alliance (Tab. 26) that makes up the summit vegetation. *Draba aspera* (Fig. 29) an orophyte of southern Europe grows on the highest of limestone cliffs (above 2000 metres) and is therefore rare in the Italian territory. This species is known in few places in the Apuan Alps and in the Apennines.

On the mobile scree slides, with medium and large rocks, the *Arabido alpinae-Cerastietum thomasii* association is present in the *papaveretosum degenii* subassociation (Tab. 26: rel. 7-9).

Tab. 23 - ***LEONTOPODIO NIVALIS-ELYNETUM MYOSUROIDIS*** Feoli Chiapella & Feoli 1977
trinietosum dalechampii Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999

Rel. n.	1	2	3	4	
Altitude (m)	2350	2395	2440	2470	P
Exposure	ONO	O	O	E	R
Slope (°)	20	15	40	35	E
Coverage %	90	90	100	100	S
Area (m^2)	20	30	20	20	
Charact. and diff. species of the ass.					
Carex kitaibeliana Degen ex Bech.	1.2	2.2	1.2	1.2	4
Edraianthus graminifolius (L.) DC. ssp. graminifolius	1.2	.	+	.	2
Diff. species of the *trinietosum dalechampii* subass. and the *Alchemilla colorata* var.					
Alchemilla colorata Buser	1.2	+.2	+	1.2	4
Antennaria dioica (L.) Gaetner	2.3	1.2	1.2	1.2	4
Trinia dalechampii (Ten.) Janchen	.	+.2	1.1	1.1	3
Armeria majellensis Boiss.	.	+	+	+	3
Charact. species of the *Oxytropido-Elynion* all., the *Oxytropido-Elynetalia* ord. and the *Carici rupestris-Kobresietea bellardii* class					
Elyna myosuroides (Vill.) Fritsch	3.4	3.3	4.4	4.4	4
Draba aizoides L. ssp. aizoides	1.1	+.2	+	+.2	4
Potentilla cranztii (Crantz) G. Beck ex Fritsch	+.2	1.2	+.2	1.2	4
Carex rupestris All.	2.3	+.2	2.2	1.2	4
Silene acaulis (L.) Jacq. (s.l.)	+.2	+.2	+.2	.	3
Minuartia verna (L.) Hiern. ssp. verna	+	+	.	+.2	3
Erigeron epiroticus (Vierh.) Halácsy	.	+	1.1	.	2
Other species					
Polygonum viviparum L.	1.2	1.1	+	+	4
Helianthemum oelandicum (L.) DC. ssp. alpestre (Jacq.) Breistr.	1.2	2.2	+.2	+.2	4
Luzula italica Parl.	+	1.1	1.1	1.1	4
Sesleria apennina Ujhelyi	+.2	.	+.2	1.2	3
Aster alpinus L.	1.1	.	1.1	1.2	3
Anthemis cretica L. ssp. columnae (Ten.) Frantzén	+.2	+	.	1.2	3
Hieracium lactucella Wallr. Ssp. nanum (Scheele) P.D. Sell	.	1.1	+	+.2	3
Poa alpina L. ssp. alpina	.	1.1	2.3	2.2	3
Gentiana verna L. ssp. verna	.	+	+	+	3
Festuca violacea Gaudin ssp. italica Foggi, Graz. Rossi & Signorini	1.2	+.2	.	.	2
Carex ericetorum Pollich	.	.	1.2	+	2
Plantago atrata Hoppe ssp. atrata	.	+	.	+	2
Galium anisophyllon Vill. ssp. anisophyllon	.	.	+	+.2	2
Androsace villosa L.	+	.	+	.	2
Pedicularis verticillata L.	+	+	.	.	2
Anthoxanthum alpinum Loeve & Loeve	.	.	1.2	2.2	2
Cerastium arvense L. ssp. strictum (L.) Gaudin	.	.	+.2	+.2	2
Accidental species	6	1	6	6	

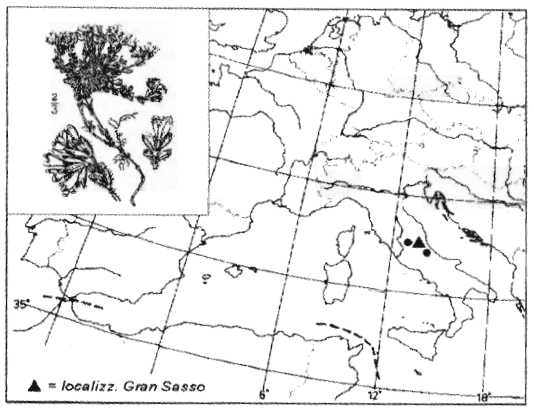


Fig. 28 – Distribution of *Cerastium thomasii* (from Biondi *et al.*, 2000)

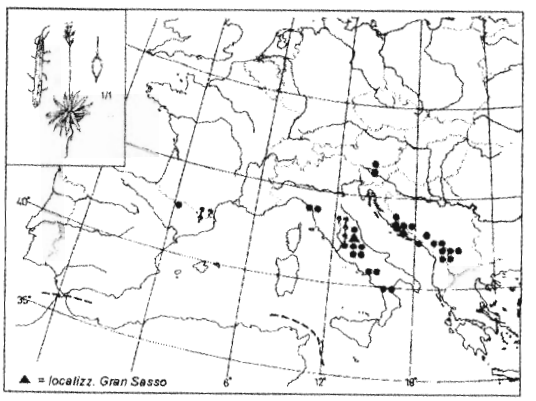


Fig. 29 – Distribution of *Draba aspera* (from Biondi *et al.*, 2000)

Tab. 24 - ***RANUNCULO POLLINENSIS-PLANTAGINETUM ATRATAE*** Biondi, Allegrezza, Ballelli & Taffetani 2000
alopecuretosum gerardii Biondi, Allegrezza, Ballelli & Taffetani 2000

Rel. n.	1	2	3	4	
Altitude (m)	2370	2280	2280	2300	P
Exposure	O	-	NO	O	R
Slope (°)	30	-	30	30	E
Coverage %	100	95	100	95	S
Area (m²)	8	20	4	40	
Charact. and diff. species of the ass.					
Crepis aurea (L.) Cass. ssp. glabrescens (Caurel) Arcang.	2.2	+	2.2	1.2	4
Ranunculus pollinensis (Terr.) Chiov.	2.2	2.2	1.2	1.1	4
Rumex nebroides Campd.	1.1	1.1	+	1.1	4
Viola eugeniae Parl. ssp. eugeniae	+	.	1.1	+	3
Gnaphalium hoppeanum Koch ssp. magellense (Fiori & Paol.) Strid.	.	.	.	+	1
Diff. species of the *Taraxacum glaciale* var.					
Taraxacum glaciale Hand.-Mazz.	.	4.5	.	.	1
Taraxacum officinale Weber	.	1.2	.	.	1
Diff. species of the *alopecuretosum gerardii* subass.					
Anthoxanthum alpinum Love & Love	1.2		1.2	1.1	3
Alopecurus gerardi Vill.			3.3	4.4	2
Charact. species of the *Ranunculo-Nardion* all., the *Nardetalia strictae* ord. and the *Nardetea strictae* class					
Plantago atrata Hoppe ssp. atrata	3.3	1.2	1.2	1.1	4
Poa alpina L. ssp. alpina	1.2	2.3	.	+	3
Taraxacum apenninum (Ten.) Ten.	2.2	.	+.2	+	3
Luzula italica Parl.	1.2	.	+	1.2	3
Nardus stricta L.	.	+	.	+.2	2
Botrychium lunaria (L.) Swartz	1.1	.	1.1	.	2
Phleum alpinum L. ssp. rhaeticum Humphries	.	1.2	.	+	2
Hypericum richeri Vill. ssp. richeri	.	+.2	.	+.2	2
Poa variegata Lam.	+.2	.	.	.	1
Hieracium lactucella Wallr. ssp. nanum (Scheele) P.D. Sell	.	.	.	1.1	1
Other species					
Bellis perennis L.	+	+	1.2	.	3
Armeria majellensis Boiss.	.	+	+	+	3
Sibbaldia procumbens L.	.	+	.	+.2	2
Accidental species	1	2	3	8	

Tab. 25 - ***ARMERIO MAJELLENSIS-SALICETUM HERBACEAE*** Biondi, Allegrezza, Ballelli & Taffetani 2000
salicetosum retusae Biondi, Allegrezza, Ballelli & Taffetani 2000

Rel. n.	1	2	3	4	5	6	
Altitude (m)	2365	2365	2365	2590	2600	2400	P
Exposure	NE	O	-	NNO	S	N	R
Slope (°)	45	30	-	5	5	20	E
Coverage %	90	95	95	60	90	95	S
Area (m2)	4	10	2	5	6	2	
Charact. and diff. species of the ass., the *Arabion caerulae* all., the *Arabidetalia caerulae* ord. and the *Salicetea herbaceae* class							
Salix herbacea L.	2.3	4.4	4.4	3.3	5.5	5.5	6
Armeria majellensis Boiss.	+	+	+	1.2	+	.	5
Carex kitaibeliana Degen ex Bech.	.	+.2	+.2		+.2	.	4
Gnaphalium hoppeanum Koch ssp. magellense (Fiori & Paol.) Strid.	.	.	1.2	1.1	2.2	+	4
Diff. species of the *salicetosum retusae* subass.							
Polygonum viviparum L.	1.2	2.2	.	.	.	1.1	3
Salix retusa L.	2.3	2.3	.	.	.	.	2
Other species							
Poa alpina L. ssp. alpina	1.1	1.2	1.1	+	1.2	1.1	6
Plantago atrata Hoppe ssp. atrata	+.2	1.2	+.2	+	.	+	5
Crepis aurea (L.) Cass. ssp. glabrescens (Caurel) Arcang.	2.2	1.2	.	.	+.2	.	3
Silene acaulis (L.) Jacq. (s.l.)	1.2	+.2	.	1.2	.	.	3
Gentiana verna L. ssp. verna	1.1	1.1	+	.	.	.	3
Ranunculus pollinensis (Terr.) Chiov.	1.1	+.2	.	.	.	.	2
Festuca violacea Gaudin ssp. italica Foggi, Graz. Rossi & Signorini	+.2	.	.	.	.	+	2
Cerastium thomasii Ten.	.	.	.	1.2	1.2	.	2
Carex parviflora Host.	.	.	1.1	.	+	.	2
Accidental species	2	3	2	4	5	6	

Tab. 26 - ***ARABIDO ALPINAE-CERASTIETUM THOMASII*** Biondi, Allegrezza, Ballelli & Taffetani 2000
papaveretosum degenii Biondi, Allegrezza, Ballelli & Taffetani 2000

Rel. n.	1	2	3	4	5	6	7	8	9	
Altitude (m)	2870	2770	2860	2860	2908	2760	2650	2670	2870	P
Exposure	S	N	NE	N	N	O	NNO	NNO	ONO	R
Slope (°)	90	40	45	90	30	80	25	30	45	E
Coverage %	60	30	60	50	60	40	50	45	50	S
Area (m^2)	10	30	10	15	6	30	30	30	30	
Charact. species of the ass.										
Cerastium thomasii Ten.	2.3	2.3	2.3	2.2	2.3	3.3	2.3	1.2	2.3	9
Arabis alpina L. ssp. alpina	1.2	2.2	1.2	1.2	1.2	2.2	2.3	2.2	2.2	9
Draba aspera Bertol.	1.1	.	.	+	1.2	1.2	.	.	+	5
Diff. species of the *papaveretosum degenii* subass.										
Papaver degenii (Urum. & Jav.) Kuzm.	.	.	.	.	.	.	2.2	2.3	+.2	3
Charact. species of the *Festucion dimorphae* all., the *Thlaspietalia rotundifolii* ord. and the *Thlaspietea rotundifolii* class										
Pritzelago alpina (L.) Kuntze ssp. alpina	+	1.1	.	+	.	1.2	1.2	1.2	1.2	7
Saxifraga oppositifolia L. ssp. speciosa (Dorfler & Hayek) Engl. & Irmsch.	+.2	.	.	1.2	1.2	.	.	.	+.2	4
Galium magellense Ten.	1.2	.	2.2	.	.	1.2	2.2	.	.	4
Achillea oxyloba (DC.) Sch. Bip. ssp. barrelieri (Ten.) F. Conti	1.2	.	.	+	.	1.1	.	.	.	3
Viola magellensis Porta & Rigo	1.2	.	.	.	.	.	.	.	.	1
Senecio squalidus L.	+.2	.	.	.	.	.	.	.	.	1
Other species										
Poa alpina L. ssp. alpina	1.2	+	1.2	1.2	+.2	1.1	1.2	1.2	+	9
Festuca alfrediana Foggi & Signorini	.	.	.	2.2	1.2	.	.	.	+	3
Saxifraga exarata Vill. ssp. ampullacea (Ten.) D.A. Webb	+.2	.	.	.	2.2	1.2	.	.	.	3
Armeria majellensis Boiss.	+	.	.	.	.	.	.	.	+	2
Accidental species	2	-	-	-	-	-	1	-	-	

SYNTAXONOMICAL LIST

The list includes all the syntaxonomical units of the vegetation surveyed on the Gran Sasso d'Italia during the researches carried out in the Campo Imperatore (Biondi *et al.*, 1992, 1995, 1999), Vomano Valley and Corno Grande (Biondi *et al.*, 2000; Biondi *et al.*, unpublished data) study.

PINO-JUNIPERETEA Rivas-Martinez 1965
+ *Pino-Juniperetalia* Rivas-Martinez 1965
**Daphno oleoidis-Juniperion alpinae* Stanisci 1997
Daphno oleoidis-Juniperetum alpinae Blasi, Gigli, Abbate & Stanisci 1989 em. Blasi, Gigli & Stanisci 1990
arctostaphyletosum uvae-ursi Blasi, Gigli & Stanisci 1990
juniperetosum hemisphaericae Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999

QUERCO-FAGETEA Br.-Bl. & Vlieger in Vlieger 1937
+*Quercetalia pubescentis* Klika 1933
**Ostryo-Carpinion orientalis* Horvat (1954) 1959
***Lauro nobilis-Quercenion pubescentis* (Ubaldi 1988) Ubaldi 1995
Asparago acutifolii-Ostryetum carpinifoliae Biondi 1982
***Laburno anagyroidis-Ostryenion carpinifoliae* (Ubaldi 1981) Poldini 1990
Scutellario columnae-Ostryetum carpinifoliae Pedrotti, Biondi & Ballelli ex Pedrotti et alii 1980
+ *Fagetalia sylvaticae* Pawlowski in Pawlowski, Sokolowski & Wallish 1928
Fagion sylvaticae Luquet 1926
Geranio nodosi-Fagenion sylvaticae (Gentile 1974) Ubaldi & Speranza 1985
Cardamino kitaibelii-Fagetum sylvaticae Ubaldi *et alii* ex Ubaldi 1995
taxetosum baccatae Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999
Solidagini-Fagetum sylvaticae Ubaldi et alii ex Ubaldi 1995
vaccinietosum myrtilli Ubaldi et alii ex Ubaldi 1995

RHAMNO-PRUNETEA Rivas Goday & Borja ex Tüxen 1962
+ *Prunetalia spinosae* Tuxen 1952
* *Berberidion vulgaris* Br.-Bl. 1950
Rubo idaei-Rhamnetum fallacis Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999
**Cytision sessilifolii* Biondi in Biondi, Allegrezza & Guitian 1988
Spartio juncei-Cytisetum sessilifolii Biondi, Allegrezza & Guitian 1988

CARICI RUPESTRIS-KOBRESIETEA BELLARDII Ohba 1974
+ *Elynetalia myosuroidis* Oberdorfer 1957
* *Oxytropido-Elynion myosuroidis* Br.-Bl. (1948) 1949
Leontopodio nivalis-Elynetum myosuroidis Feoli-Chiapella & Feoli 1977
trinietosum dalechampii Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999

FESTUCO-SESLERIETEA Barbéro & Bonin 1969
+ *Seslerietalia tenuifoliae* Horvat. 1930
* *Seslerion apenninae* Furnari 1966
Seslerio apenninae-Dryadetum octopetalae Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999
caricetosum firmae Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999
Seslerietum apenninae Furnari 1961 corr. Furnari 1966
juncetosum monanthi Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999

Carici humilis-Seslerietum apenninae Biondi, Ballelli, Guitian & Allegrezza 1988
dryadetosum octopetalae Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999
Caricetum kitaibelianae-rupestris Biondi, Allegrezza, Ballelli & Taffetani 2000
artemisietosum erianthae Biondi, Allegrezza, Ballelli & Taffetani 2000

NARDETEA STRICTAE Rivas-Goday ex Rivas-Goday & Rivas-Martinez 1963
+ *Nardetalia strictae* Oberdorfer ex Preising 1949
* *Ranunculo pollinensis-Nardion strictae* Bonin 1972
Ranunculo pollinensis-Plantaginetum atratae Biondi, Allegrezza, Ballelli & Taffetani 2000
soldanelletosum alpinae Biondi, Allegrezza, Ballelli & Taffetani 2000
alopecuretosum gerardii Biondi, Allegrezza, Ballelli & Taffetani 2000
Luzulo italicae-Nardetum strictae Biondi, Ballelli, Allegrezza, Frattaroli & Taffetani 1992
caricetosum kitaibelianae Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999
Taraxaco apennini-Trifolietum thalii Biondi, Ballelli, Allegrezza, Frattaroli & Taffetani 1992
Poo violaceae-Nardetum strictae Pedrotti 1981
festucetosum circummediterraneae Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999

SALICETEA HERBACEAE Br.-Bl. 1948
+ *Salicetalia herbaceae* Br.-Bl. in Br.-Bl. & Jenny 1926
* *Arabidion caerulae* Br.-Bl. in Br.-Bl. & Jenny 1926
Carici kitaibelianae-Salicetum retusae Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999
Armerio majellensis-Salicetum herbaceae Biondi, Allegrezza, Ballelli & Taffetani 2000
salicetosum retusae Biondi, Allegrezza, Ballelli & Taffetani 2000

FESTUCO-BROMETEA ERECTI Br.-Bl. & Tuxen ex Br.-Bl. 1949
+ *Brometalia erecti* Br.-Bl. 1936
++ *Artemisio albae-Bromenalia erecti* Biondi, Ballelli, Allegrezza & Zuccarello 1995
* *Phleo ambigui-Bromion erecti* Biondi & Blasi ex Biondi, Ballelli, Allegrezza & Zuccarello 1995
** *Brachypodenion genuensis* Biondi, Ballelli, Allegrezza & Zuccarello 1995
Koelerio splendentis-Brometum erecti Biondi, Ballelli, Allegrezza, Frattaroli & Taffetani 1992
festucetosum robustifoliae Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999
Polygalo majoris-Seslerietum nitidae Biondi, Ballelli, Allegrezza & Zuccarello 1995
Cirsio acaulis-Seslerietum nitidae Biondi, Ballelli, Allegrezza, Frattaroli & Taffetani 1992
Poo alpinae-Festucetum circummediterraneae Biondi, Ballelli, Allegrezza, Frattaroli & Taffetani 1992
poetosum violaceae Biondi, Ballelli, Allegrezza, Frattaroli & Taffetani 1992
Plantago holostei-Helianthemetum cani Biondi, Ballelli, Allegrezza, Frattaroli & Taffetani 1992 nomen inversum proposit. Biondi & Ballelli 1995
Stachydo divulsae-Brachypodietum genuensis ass. nova hoc loco
stachyetosum divulsae subass. nova hoc loco
laserpitietosum siculii subass. nova hoc loco
luzuletosum sieberi subass. nova hoc loco

MOLINIO CAERULEAE-ARRHENATHERETEA ELATIORIS Tuxen 1937
+ *Arrhenatheretalia* Tuxen 1931
* *Cynosurion cristati* Tuxen 1947
+ *Plantaginetalia majoris* Tüxen & Preising in Tüxen 1950
* *Potentillion anserinae* Tüxen 1947
Junco compressi-Trifolietum repentis Eggler 1933
+ *Trifolio-Hordeetalia secalini* Horvatic 1963
* *Ranunculion velutini* Pedrotti 1976
Aggruppamento a *Deschampsia caespitosa*

TRIFOLIO-GERANIETEA Muller 1962
+*Origanetalia vulgaris* Muller 1962
**Geranion sanguinei* Tüxen in Müller 1962
Ptilostemo strictae-Melampyretum italici Biondi, Carni, Vagge, Taffetani & Ballelli 2001
**Trifolion medii* Muller 1962
Trifolietum medii-ochroleuci Biondi, Carni, Vagge, Taffetani & Ballelli 2001

ARTEMISIETEA VULGARIS Lohmeyer, Preising & Tuxen ex von Rochow 1951
+ *Artemisietalia vulgaris* Lohmeyer in Tuxen 1947
* *Arction lappae* Tuxen 1937
Carduetum chrysacanthi Pedrotti 1981
Chenopodio boni-henrici-Carduetum affinis Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999
+ Onopordetalia acanthii Br.-Bl. & Tuxen ex Klika & Hadac 1944
* Onopordion acanthii Br.-Bl., Gajewski, Wraber & Walas 1936
Verbascetum longifolii-mallophori Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999

EPILOBIETEA ANGUSTIFOLII Tuxen et Preising ex von Rochow 1951
+ *Atropetalia belladonnae* Vlieger 1937
* *Carici piluliferae-Epilobion angustifolii* Tuxen ex von Rochow 1951
Digitali-Epilobietum angustifolii (Chouard 1925) Schwick 1944 em. Tuxen 1950

STELLARIETEA MEDIAE Tuxen, Lohmeyer & Preisingex von Rochow 1951
+ *Sisymbrietalia officinalis* J. Tuxen in Lohmeyer & al. 1962 em. Rivas-Martinez, Bascones, T.E. Diaz, Fernandez-Gonzalez & Loidi 1991
* *Sisymbrion officinalis* Tuxen, Lohmeyer & Preising in Tuxen 1950
Chenopodietum vulvariae Gutt. & Pys. 1976

POLYGONO ARENASTRI-POETEA ANNUAE Rivas-Martinez 1975
+ *Polygono arenastri-Poetalia annuae* Tuxen in Géhu, Richard & Tuxen 1972 corr. Rivas-Martinez, Bascones, T.E. Diaz, Fernandez-Gonzalez & Loidi 1991
* *Saginion procumbentis* Tuxen & Ohba in Géhu, Richard & Tuxen 1972
Aggruppamento a *Herniaria glabra*

ASPLENIETEA TRICHOMANIS (Br.-Bl. in Meier & Br.-Bl. 1934) Oberdorfer 1977
+ *Potentilletalia caulescentis* Br.-Bl. in Br.-Bl. & Jenny 1926
* *Saxifragion australis* Biondi & Ballelli ex Brullo 1983
Saxifrago australis-Trisetetum bertolonii Biondi & Ballelli 1982
* Cystopteridion fragilis Richard 1972
Arenario bertolonii-Caricetum brachystachyos Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999

THLASPIETEA ROTUNDIFOLII Br.-Bl. 1948
+ *Thlaspietalia rotundifolii* Br.-Bl. in Br.-Bl. & Jenny 1926
* *Linario-Festucion dimorphae* Avena & Bruno ex Feoli Chiapella 1983
Arabido alpinae-Cerastietum thomasii Biondi, Allegrezza, Ballelli & Taffetani 2000
papaveretosum degenii Biondi, Allegrezza, Ballelli & Taffetani 2000
Isatido-Thlaspietum stylosi Migliaccio 1970 corr. Feoli Chiapella 1983
papaveretosum degenii Biondi, Allegrezza, Ballelli & Taffetani 2000
leontodonetosum melanotrichi Biondi, Allegrezza, Ballelli & Taffetani 2000
Astero bellidiastri-Saxifragetum aizoidis Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999

Galio magellensis-Festucetum dimorphae Feoli Chiapella 1983
tolpidetosum staticifoliae Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999
silenetosum marginatae Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999
+ *Polystichetalia lonchitis* Rivas-Martinez, T.E. Diaz, F. Prieto, Loidi & Penas 1984
* *Petasition paradoxi* Berger 1922
Arenario bertolonii-Cystopteridetum alpinae Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999

SCHEUCHZERIO PALUSTRIS-CARICETEA FUSCAE Tuxen 1937
+ *Caricetalia davallianae* Br.-Bl. 1949
* *Caricion davallianae* Klika 1934
Pinguiculo vulgaris-Caricetum praetutianae Biondi, Ballelli, Allegrezza, Taffetani, Frattaroli, Guitian & Zuccarello 1999

PHRAGMITO AUSTRALIS-MAGNOCARICETEA Klika in Klika & Novak 1941
+ *Phragmitetalia* W. Koch 1926
* *Phragmition communis* W. Koch 1926
Aggruppamento a *Eleocharis palustris* e *Rorippa sylvestris*

POTAMETEA PECTINATI Klika in Klika & Novak 1941
+ *Potametalia* W. Koch 1926
* *Ranunculion aquatilis* Passarge 1964
Ranunculetum aquatilis (Sauer 1947) Gehu 1961
Aggruppamento a *Myriophyllum spicatum* e *Potamogeton natans*
+ *Utricularietalia* Den Hartog & Segal 1964
* *Ceratophyllion demersi* Den Hartog & Segal ex Passarge 1996
Aggruppamento a *Ceratophyllum demersum*

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Addenda

Tab. 3
Accidental species:
rel. 1 - *Pyracantha coccinea* M. Roem. +.2, *Chamaecytisus hirsutus* L. ssp. *polytrichus* (M. Bieb.) Ponert +, *Bromus e*rectus Huds. ssp. *erectus* +.2; rel. 2 - *Crataegus monogyna* Jacq. ssp. *monogyna* +, *Stachys officinalis* (L.) Trevis. ssp. *officinalis* +, *Hypericum montanum* L. +, *Lathyrus sylvestris* L. ssp. *sylvestris* +, *Spartium junceum* L. +, *Cruciata glabra* (L.) Ehrend. 1.1, *Cornus sanguinea L.* ssp. *sanguinea* 1.2, *Melampyrum italicum* Soó 1.1.
Locality and date of the relevés:
rel. 1: main road Fano Adriano-Campotosto 21.07.1995; rel. 2: on the way to Prati di Tivo 08.07.2002.

Tab. 4
Accidental species:
rel. 1 - *Clematis vitalba* L. +.2, *Brachypodium rupestre* (Host) R. et S. 1.2, *Teucrium chamaedrys* L. +.2, *Cruciata glabra* (L.) Ehrend. +, *Juniperus communis* L. +, *Peucedanum verticillare* (L.) Koch +, *Salvia glutinosa* L. +; rel. 2: *Aegopodium podagraria* L. +, *Stachys sylvatica* L. +, *Vitis vinifera* L. +; rel. 3: *Ptilostemon strictus* (Ten.) Greuter 1, *Arabis turrita* L. 1, rel. 5: *Laurus nobilis* L. +, *Euonymus europaeus* L. +, *Fragaria vesca* L. +, *Rubus hirtus* W. et K. +.
Locality and date of the relevés:
rel. 1: on the way toPrati di Tivo 08.07.2002; rel. 2: on the way toPrati di Tivo 24.06.2002; rel. 3: on the way toPrati di Tivo 23.09.1996; rel. 4: on the way toPrati di Tivo 08.07.2002; rel. 5: on the way toPrati di Tivo 24.06.2002.

Tab. 5
Locality and date of the relevés:
rel. 1: on the way toPrati di Tivo 08.07.2002; rel. 2: on the way toPrati di Tivo 24.06.2002.

Tab. 6
Locality and date of the relevés:
rel. 1: on the way toPrati di Tivo 08.07.2002.

Tab. 7
Accidental species:
rel. 1: *Cruciata laevipes* Opiz +, *Lathyrus pratensis* L. +, *Daucus carota* L. subsp. *carota* +, *Leucanthemum vulgare* Lam. (s. l.) +, *Dianthus monspessulanus* L. +, *Arabis hirsuta* (L.) Scop. +, *Pastinaca sativa* L. subsp. *urens* (Req.) Celak +, *Cytisophyllum sessilifolius* (L.) O. Lang +; rel. 2: *Arabis turrita* L. +.2, *Lithospermum purpurocaeruleum* L. +, *Reichardia picroides* (L.) Roth +, *Carpinus orientalis* Mill. (pl.) +, *Dianthus sylvestris* Wulfen subsp. *garganicus* (Grande) Pignatti +, *Fraxinus ornus* L. subsp. *ornu*s (pl.) +, *Pteridium aquilinum* (L.) Kuhn subsp. *aquilinum* +; rel. 3: *Centaurea nigrescens* Willd. (s. l.)+, *Poa compressa* L. +, *Asperula purpurea* (L.) Ehrend. subsp. *purpurea* +, *Lapsana communis* L. subsp. *communis* +, *Erysimum pseudorhaeticum* Polatschek +, *Anthyllis vulneraria* L. subsp. *maura* (Beck) Maire +, *Clematis vitalba* L. +; rel. 4: *Picris hieracioides* L. subsp. *hieracioides* +, *Carex digitata* L. +, *Gymnadenia conopsea* (L.) R. Br. subsp. *conopsea* +; rel. 5: *Luzula forsteri* (Sm.) DC. subsp. *forsteri* +, *Hepatica nobilis* Mill. +, *Inula salicina* L. +, *Silene catholica* (L.) W.T. Aiton +.
Locality and date of the relevés:
rel. 1: on the way to Pietracamela 13.07.1999; rel. 2, 3, 4, 5: beneath Intermesoli 14.07.1999.

Tab. 8
Accidental species:
rel. 1: *Aegopodium podagraria* L. 2.2, rel.2 *Rosa pimpinellifolia* L. +; rel. 3: *Polypodium vulgare* L., +.2, *Prunella vulgaris* L., +.2, *Cytisus scoparius* (L.) Link, +.2, *Bellis perennis* L. +, *Campanula rapunculus* L. +, *Cruciata glabra* (L.) Ehrend. +, *Hypericum montanum* L. +, *Jasione montana* L. +, *Tanacetum parthenium* (L.) Sch.-Bip. +, *Trifolium medium* L. +, *Stellaria nemorum* L. 1.2, *Veronica chamaedrys* L. 1.2, rel.4: *Digitalis micrantha* Roth +, *Pteridium aquilinum* (L.) Kuhn + rel.5: *Epilobium* cfr. *lanceolatum* Seb. et Mauri +.
Locality and date of the relevés:
rel. 1, 2: Prati di Tivo 08.07.2002; rel. 3: Prato Selva

24.06.2002; rel. 4: Prato Selva 21.07.1995; rel. 5: Prato Selva 23.09.1996.

Tab. 9
Accidental species:
rel. 1: *Peucedanum verticillare* (L.) Koch 4.4, Festuca pratensis Huds. subsp. apennina (De Not.) Hegi +, *Trifolium montanum* L. subsp. *rupestre* (Ten.) Nyman +, *Centaurea nigrescens* Willd. (s. l.) +, *Dianthus monspessulanus* L. +, *Silene* sp. +, *Leucanthemum vulgare* Lam. (s. l.) +, *Heracleum sphondylium* L. (s. l.) +, *Listera ovata* (L.) R. Br. +, *Linum viscosum* L. +, *Onobrychis viciifolia* Scop. +, *Rhinanthus alectorolophus* (Scop.) Pollich +, *Plantago lanceolata* L. +; rel. 2: *Campanula trachelium* L. subsp. *trachelium* +.2, *Epipactis helleborine* (L.) Crantz subsp. *helleborine* +, *Cephalanthera damasonium* (Mill.) Druce +, *Oenanthe pimpinelloides* L. +, *Leucanthemum vulgare* Lam. (s. l.) 2.2, *Carlina acanthifolia* All. subsp. *acanthifolia* +; rel. 3: *Polygonatum multiflorum* (L.) All. +, *Crepis biennis* L. +, *Listera ovata* (L.) R. Br. +, *Linum viscosum* L. +, *Sesleria nitida* Ten. +, *Gentiana cruciata* L. +, *Platanthera bifolia* (L.) Rchb. +, *Cynosurus cristatus* L. +; rel. 4: *Bunium bulbocastanum* L. +, Galium verum L. subsp. verum +, *Stellaria holostea* L. +, *Briza media* L. +, *Festuca arundinacea* Schreb. subsp. *arundinacea* +, *Galium aparine* L. +, *Astragalus sempervirens* Lam. subsp. *gussonei* Pignatti +, *Onobrychis viciifolia* Scop. 2.2, *Rhinanthus alectorolophus* (Scop.) Pollich 2.2, *Plantago lanceolata* L. +, *Carlina acanthifolia* All. subsp. *acanthifolia* +.2, *Sesleria nitida* Ten. +, *Gentiana cruciata* L. +; rel. 5: *Melica uniflora* Retz. +.2, *Hypericum montanum* L. +, *Populus tremula* L. +, *Sedum rupestre* L. subsp. *rupestre* +, *Mycelis muralis* (L.) Dumort. +, *Aegopodium podagraria* L. +, *Cnidium silaifolium* (Jacq.) Simonk. subsp. *silaifolium* +, *Aremonia agrimonoides* (L.) DC. subsp. *agrimonioides* +; rel. 6: *Bellis perennis* L. 2.2, *Ranunculus* sp. +, *Anemone nemorosa* L. +, *Myosotis sylvatica* Hoffm. subsp. *sylvatica* +, *Veronica urticifolia* Jacq. +, *Valeriana officinalis* L. +, *Euphorbia dulcis* L. subsp. *purpurata* (Thuill.) Rothm. +, *Pulmonaria apennina* Cristof. et Puppi +, *Cynosurus cristatus* L. +, *Alchemilla glaucescens* Wallr. +.
Locality and date of the relevés:
rel. 1: Pietracamela 13.07.1999; rel. 2, 3: Prati di Tivo 13.07.1999; rel. 4: before Amatrice 14.07.1999 rel. 5, 6: Campotosto Lake 14.07.1999;.

Tab. 10
Locality and date of the relevés: rel. 1: Prato Selva 23.09.1996; rel. 2: on the way to Prato Selva 21.07.1995; rel. 3: Prato Selva 21.07.1995.

Tab. 12
Accidental species:
rel. 1 - *Thlaspi caerulescens* J. Presl. & C. Presl. ssp. *brachypetalum* (Jordan) Jalas +, *Carduus chrysacanthus* Ten. +, *Anthoxanthum odoratum* L. +.2, *Hieracium pilosella* L. +; rel. 4 - *Festuca circummediterranea* Patzke +.2, *Anthemis cretica* L. ssp. *columnae* (Ten.) Frenzén +, *Thlaspi caerulescens* J. Presl. & C. Presl. ssp. *brachypetalum* (Jordan) Jalas +, *Thymus* cfr. *alpigenus* (Kerner) Ronn. 1.2, *Achillea collina* Becker +.2, *Koeleria splendens* C. Presl +; rel. 5 - *Anthemis cretica* L. ssp. *columnae* (Ten.) Frenzén +, *Thymus* cfr. *alpigenus* (Kerner) Ronn. 1.3, *Asperula cynanchica* L. +.2; rel. 6 - *Minuartia verna* (L.) Hiern. ssp. *verna* 1.1, *Gentiana nivalis* L. +, *Trinia dalechampii* (Ten.) Janchen +, *Koeleria splendens* C. Presl +, *Agrostis tenuis* Sibth. +; rel. 7 - *Silene graefferi* Guss. +, *Euphorbia cyparissias* L. 1.1, *Festuca circummediterranea* Patzke 1.2, *Rumex nebroides* Campd. +, *Cynoglossum magellense* Ten. 1.1, *Brachypodium genuense* (DC.) Roemer & Schultes +.2, *Medicago lupulina* L. +, *Acinos alpinus* (L.) Moench 1.2, *Crepis aurea* (L.) Crass. ssp. *glabrescens* (Carnel) Arcangeli 1.2, *Verbascum longifolium* Ten. +;
Locality and date of the relevés:
rel. 1, 2 - Near Campo Imperatore hotel (15/07/1989); rel. 3, 5 - Near Campo Imperatore hotel (09/08/1991); rel. 4 - Near Campo Imperatore hotel (15/07/1989); rel. 6, 7 - Near Campo Imperatore hotel (19/07/1991).

Tab. 13
Accidental species:
rel. 1 - *Galium anisophyllum* Vill. +.2, *Hieracium* x *micranthum* Huet du Pav. +, *Anthyllis vulneraria* L. ssp. *vulnerarioides* (All.) Arcang. +, *Phyteuma orbiculare* L. +.2, *Carex kitaibeliana* Degen ex Bech. +, *Cynoglossum magellense* Ten. +, *Gnaphalium hoppeanum* Koch ssp. *magellense* (Fiori & Paol.) Strid +.2, *Carex caryophyllea* Latourr. +, *Seseli montanum* L. +; rel. 2 - *Plantago media* L. +, *Sesleria nitida* +.2; rel. 3 - *Chenopodium bonus-henricus* L. +; rel. 5 - *Carduus nutans* L.ssp. *nutans* +, *Gnaphalium sylvaticum* L. +.2.
Locality and date of the relevés:
rel. 1 - Near Campo Imperatore hotel (09/08/1991); rel. 2, 3, 4, 5 - Small valley near Campo Imperatore hotel (16/07/1989).

Tab. 16
Locality and date of the relevés:
rel. 1 - Path from the Oservatory to Monte Aquila, behind the Botanic Garden (07.07.1988).

Tab. 17
Accidental species:
rel. 1 - *Edraianthus graminifolius* (L.) DC. ssp. *graminifolius*

+.2, *Helianthemum oleandicum* (L.) DC. ssp. *canum* (L.) Bonnier +, *Androsace villosa* L. var. *australis* Fiori +.2, *Globularia meridionalis* (Podp.) O. Scwartz. +.2, *Draba azoides* L. +, *Astragalus depressus* L. +.2, *Pedicularis elegans* Ten. +, *Carduus chrysacanthus* Ten. +, *Viola eugeniae* Parl. ssp. *eugeniae* +; rel. 2 - *Sesleria apennina* Ujhelyi +, *Rumex nebroides* Campd. +, *Anthemis cretica* L. ssp. *columnae* (Ten.) Franzén +.2, *Ranunculus oreophilus* Bieb. 1.1, *Carum heldreichii* Boiss. 1.2, *Phyteuma orbiculare* L. +, *Pedicularis verticillata* L. 1.1, *Saxifraga paniculata* Mill. ssp. *stabiana* (Ten.) Pignatti +, *Campanula tanfanii* Podlech +, *Carduus chrysacanthus* Ten. +; rel. 3 - *Thymus* cfr. *kerneri* Borbás +, *Galium lucidum* All. +, *Rumex nebroides* Campd. +, *Ranunculus oreophilus* Bieb. +, *Carum heldreichii* Boiss. +.2, *Phyteuma orbiculare* L. 1.1, *Pedicularis verticillata* L. +.
Locality and date of the relevés:
rel. 1 - Along the path to Corno Grande (06/07/1988);
rel. 2 - Under Sella di Monte Aquila (06/07/1988);
rel. 3 - Along the path to Corno Grande (06/07/1988).

Tab. 18
Accidental species:
rel. 1 - *Veronica aphylla* L. +.2, *Ranunculus pollinensis* (Terr.) Chiov. +.2, *Festuca circummediterranea* Patzke +, *Draba aizoides* L. +, *Aster bellidiastrum* (L.) Scop. +, *Anemone narcissiflora* L. ssp. *narcissiflora*; *Rumex nebroides* Campd. +; rel. 5 - *Sedum atratum* L. ssp. *atratum* 1.1; rel. 7 - *Edraianthus graminifolius* (L.) DC. ssp. *graminifolius* +.2; rel. 8 - *Pulsatilla alpina* (L.) Delarbre ssp. *alpina* +.
Locality and date of the relevés:
rel. 1, 2, 3 - Along the path to Corno Grande (07/07/1988); rel. 4 - Path to Sella di Monte Aquila (14/07/1994); rel. 5, 6 - Corno Grande (18/08/1994); rel. 7,8 - Along the path to Corno Grande (07/07/1988).

Tab. 19
Accidental species:
rel. 1 - *Anthemis cretica* L. ssp. *columnae* (Ten.) Franzén +, *Hypochoeris cretensis* (L.) Bory & Chaub. +, *Saxifraga paniculata* Mill. ssp. *paniculata* +, *Sedum rupestre* L. ssp. *rupestre* +.2, *Galium anisophyllon* Vill. ssp. *anisophyllon* +, *Arabis hirsuta* (L.) Scop. +, *Hieracium tomentosum* (L.) L. (s.l.) +, *Medicago lupulina* L. var. *cupaniana* (Guss.) Boiss. +, *Rumex angiocarpus* Murb. +, *Sedum acre* L. +, *Silene roemeri* Friv. ssp. *staminea* (Bertol.) Nyman +; rel. 2- *Anthemis cretica* L. ssp. *columnae* (Ten.) Franzén +, *Carex kitaibeliana* Degen ssp. *kitaibeliana* +, *Rumex arifolius* All. +, *Saxifraga paniculata* Mill. ssp. *paniculata* +.2, *Sedum rupestre* L. ssp. *rupestre* +.2, *Cynoglossum magellense* Ten. +, *Potentilla* cfr. *rigoana* Th. Wolf +, *Anthyllis montana* L. ssp. *atropurpurea* (Vukot.) Pignatti +, *Minuartia verna* (L.) Hiern. ssp. *collina* (Neilr.) Domin +; rel. 3 - *Carex kitaibeliana* Degen ssp. *kitaibeliana* 1.1, *Hypochoeris cretensis* (L.) Bory & Chaub. +, *Rumex arifolius* All. +, *Senecio squalidus* L. +, *Viola eugeniae* Parl. ssp. *eugeniae* +, *Myosotis alpestris* F. W. Schmidt ssp. *alpestris* +, *Astragalus sempervirens* Lam. +, *Pulsatilla alpina* (L.) Delarbre ssp. *alpina* +; rel. 4 - *Senecio squalidus* L. +; rel. 5 - *Luzula campestris* (L.) DC. ssp. *campestris* +.2, *Linum capitatum* Kit. ex Schult. ssp. *serrulatum* (Bertol.) Hartwig. 2.2, *Astrantia major* L. ssp. *elatior* (Friv.) K. Maly +, *Hieracium cymosum* L. 1.1, *Veratrum nigrum* L. +, *Primula veris* L. ssp. *suaveolens* (Bertol.) Gutermann & Ehrh. +, *Pedicularis comosa* L. ssp. *comosa* +, *Silene italica* (L.) Pers. ssp. *italica* +, *Sesleria tenuifolia* Schrad. ssp. *tenuifolia* 1.2, *Potentilla crantzii* (Crantz) Beck ex Fritsch ssp. *crantzii* +.2, *Seseli libanotis* (L.) W.D.J. Koch +.2, *Linum viscosum* L. 1.2; rel. 6 - *Plantago argentea* Chaix 1.2, *Hieracium piloselloides* Vill. +, *Rhinathus alecorolophus* (Scop.) Pollich ssp. *alectorolophus* 1.2, *Cynoglossum magellense* Ten. +, *Galium anisophyllon* Vill. ssp. *anisophyllon* +, *Leontodon hispidus* L. 1.2, *Ranunculus* cfr. *polyanthemophyllus* W.D.J. Koch & Hess. +, *Primula veris* L. ssp. *suaveolens* (Bertol.) Gutermann & Ehrh. 1.2, *Stachys tymphaea* Hausskn. +.2, *Rumex nebroides* Camp. +.2, *Thesium parnassi* A. DC. +.2, *Chaerophyllum hirsutum* L. ssp. *majellense* (Ten.) Pignatti +, *Linum alpinum* Jacq. ssp. *julicum* (Hayek) Hegi +, *Thalictrum aquilegifolium* L. ssp. *aquilegifolium* +; rel. 7 - *Arabis sagittata* (Bertol.) DC. +, *Luzula campestris* (L.) DC. ssp. *campestris* 1.1, Rhinathus *alecorolophus* (Scop.) Pollich ssp. *alectorolophus* +, *Achillea tenorii* Grande 1.2, *Linum capitatum* Kit. ex Schult. ssp. *serrulatum* (Bertol.) Hartwig. 1.2, *Linum catharticum* L. ssp. *catharticum* +, *Astrantia major* L. ssp. *elatior* (Friv.) K. Maly 1.1, *Leontodon hispidus* L. +, *Ranunculus* cfr. *polyanthemophyllus* W.D.J. Koch & Hess. +, *Veratrum nigrum* L. +, *Plantago atrata* Hoppe ssp. *atrata* +, *Potentilla* cfr. *rigoana* Th. Wolf 1.2, *Gentiana dinarica* Beck +.2, *Juniperus communis* L. ssp. *nana* (Willd.) Syme +.2; rel. 8 - *Linum catharticum* L. ssp. *catharticum* +, *Hieracium cymosum* L. +, *Plantago atrata* Hoppe ssp. *atrata* +, *Stachys tymphaea* Hausskn. 1.2, *Aquilegia vulgaris* L. (s.l.) +, *Bellis perennis* L. +, *Campanula micrantha* Bertol. +, *Campanula cochlearifolia* Vill. +, *Carduus chrysacanthus* Ten. ssp. *chrysacanthus* 1.2, *Daphne mezereum* L. +, *Festuca rubra* L. (s.l.) 1.2, *Myosotis arvensis* (L.) Hill ssp. *arvensis* +.
Locality and date of the relevés:
rel. 1, 2, 3 - Path from the Oservatory to Monte Aquila (19/07/1995); rel. 4 - Path from the Oservatory to Monte Aquila (08/07/2002); rel. 5, 6, 7, 8 - Prati di Tivo, along the path to Rifugio Franchetti (20/07/1995).

Tab. 20
Locality and date of the relevés:
rel. 1 - Monte Aquila (07/07/1988).

Tab. 21
Accidental species:
rel. 1 - *Cerastium tomentosum* L. ssp. *album* (Presl.) Tammaro 1.2; rel. 2 - *Doronicum columnae* Ten. +, *Gymnadenia conopsea* (L.) R. Br. +, *Saxifraga paniculata* Mill. ssp. *stabiana* (Ten.) Pignatti +, *Gentiana lutea* L. ssp. *lutea* +, *Sesleria apennina* Ujhelyi +.2; rel. 3 - *Cerastium tomentosum* L. ssp. *album* (Presl.) Tammaro 1.2, *Gymnadenia conopsea* (L.) R. Br. +, *Saxifraga paniculata* Mill. ssp. *stabiana* (Ten.) Pignatti +.2, *Polygala alpestris* Rchb. +, *Rumex acetosa* L. +, *Armeria majellensis* Boiss. +.2; rel. 4 - *Pedicularis verticillata* L. +, *Carum heldreichii* Boiss. 1.1, *Anthyllis vulneraria* L. ssp. *vulnerarioides* (All.) Arcang. +, *Pulsatilla alpina* (L.) Delarbre ssp. *alpina* +, *Doronicum columnae* Ten. +, *Gymnadenia conopsea* (L.) R. Br. +, *Saxifraga paniculata* Mill. ssp. *stabiana* (Ten.) Pignatti +, *Gentiana lutea* L. ssp. *lutea* +; rel. 5 - *Gymnadenia conopsea* (L.) R. Br. +, *Saxifraga paniculata* Mill. ssp. *stabiana* (Ten.) Pignatti +.2, *Polygala alpestris* Rchb. +, *Rumex acetosa* L. +.
Locality and date of the relevés:
rel. 1, 2, 3 - Corno Grande (07/07/1988); rel. 4, 5 - Monte Aquila (07/07/1988).

Tab. 22
Accidental species:
rel. 1 - *Myosotis alpestris* F.W. Schmidt. +, *Pedicularis foliosa* L. 1.1; rel. 2 - *Campanula scheuchzeri* Vill. +.2, *Cerastium thomasii* Ten. +, *Senecio doronicum* L. ssp. *doronicum* +;rel. 3 - *Potentilla crantzii* (Crantz) G. Beck ex Fritsch 1.2, *Myosotis alpestris* F.W. Schmidt. +, *Carex ericetorum* Pollich 1.2, *Ranunculus pollinensis* (Terr.) Chiov. +.2; rel. 4 - *Potentilla crantzii* (Crantz) G. Beck ex Fritsch +.2, *Anthemis cretica* L. ssp. *columnae* (Ten.) Frantzen +, *Carex ericetorum* Pollich 1.2, *Elyna bellardii* (All.) Koch 1.2, *Anthemis cretica* L. ssp. *columnae* (Ten.) Frantzen +, *Luzula italica* Parl. +, *Galium anysophillon* Vill. +, *Anthoxanthum alpinum* Loeve & Loeve +, *Antennaria dioica* (L.) Gaertner 1.2, *Viola eugeniae* Parl. ssp. *eugeniae* +, *Saxifraga adscendens* L. ssp. *adscendens* +; rel. 5 - *Saxifraga porophylla* Bertol. +, *Cerastium arvense* L. ssp. *suffruticosum* (L.) Nyman +, *Globularia meridionalis* (Popd.) O. Schwartz +.2;
rel. 6 - *Campanula scheuchzeri* Vill. 1.1, *Salix retusa* L. 2.2, *Dryas octopetala* L. 2.3; rel. 7 - *Saxifraga oppositifolia* L. ssp. *speciosa* (Dörfler & Hayek) Engl. & Irsmsc. 1.2, *Veronica aphylla* L., *Trifolium noricum* Wulfen ssp. *praetutianum* (Guss.) Pignatti 1.2, *Primula auricula* L. ssp. *auricula* 2.2; rel. 8 - *Anthemis cretica* L. ssp. *columnae* (Ten.) Frantzen +, *Pedicularis foliana* 1.1; rel. 9 - *Salix retusa* L. +.2, *Saxifraga oppositifolia* L. ssp. *speciosa* (Darfler & Hayek) Engler & Irsmscher +, *Dryas octopetala* L. 2.3, *Veronica aphylla* L. +.
Locality and date of the relevés:
rel. 1 - M. Aquila (14/07/1994); rel. 2 - Corno Grande (18/08/1995); rel. 3, 4 - Path from the Oservatory to Monte Aquila (19/07/1995); rel. 5 - Sella di Monte Aquila (14/07/1994); rel. 6 - Corno Grande (18/08/1995); rel. 7 - Path from the Oservatory to Monte Aquila (19/07/1995); rel. 8 - M. Aquila (14/07/1994); rel. 9 - Path from the Oservatory to Monte Aquila (19/07/1995).

Tab. 23
Accidental species:
rel. 1 - *Androsace villosa* L. +, *Anthyllis montana* L. ssp. *atropurpurea* (Vukot) Pignatti 1.2, *Saxifraga aizoides* L. +, *Pulsatilla alpina* (L.) Delarbre ssp. *alpina* +, *Androsace vitaliana* Lapeyr. ssp. *praetutiana* (Buser) I.K. Ferguson +.2, *Dianthus sylvestris* Wulfen ssp. *sylvestris* +.2, *Sempervivum arachnoideum* L. 1.2, *Astrantia pauciflora* Bertol. ssp. *tenorei* (Mariotti) Bechi et Garbari 1.1; rel. 2 - *Pedicularis verticillata* L. +, *Ranunculus pollinensis* (Terr.) Chiov. 1.1; rel. 3 - *Androsace villosa* L. +, *Pedicularis verticillata* L. +, *Luzula campestris* (L.) DC. +.2, *Botrychium lunaria* (L.) Swartz +, *Cerastium arvense* L. ssp. *strictum* (L.) Gaudin +.2, *Anthoxanthum alpinum* Loeve & Loeve 1.2, *Saxifraga paniculata* Miller +.2, *Myosotis alpestris* F.W. Schmidt +, *Pedicularis elegans* Ten.; rel. 4 - *Phyteuma orbiculare* L. +, *Luzula campestris* (L.) DC. +.2, *Botrychium lunaria* (L.) Swartz 1.1, *Anthoxanthum alpinum* Loeve & Loeve 2.2, *Cerastium arvense* L. ssp. *strictum* (L.) Gaudin +.2, *Pedicularis tuberosa* L. +, *Coeloglossum viride* (L.) Hartm. +, *Juniperus communis* L. ssp. *alpina* (Suter) Celak. +, *Anthyllis vulneraria* L. ssp. *vulnerarioides* (All.) Arcang. +.2, *Viola eugeniae* Parl. ssp. *eugeniae* +.
Locality and date of the relevés:
rel. 1 - Sella di Monte Aquila (14/07/1994); rel. 2 - M. Aquila (14/07/1994); rel. 3, 4 - Path from the Oservatory to Monte Aquila (19/07/1995).

Tab. 24
Accidental species:
rel. 1 - *Gentiana verna* L. +; rel. 2 - *Cerastium arvense* L. ssp. *strictum* (L.) Gaudin 1.1, *Pedicularis comosa* L. +; rel. 3 - *Pedicularis verticillata* L. +, *Carex kitaibeliana* Degen ex Bech. +, *Gentiana verna* L. ssp. *verna* +; rel. 4 - *Sesleria apennina* Ujhelyi +.2, *Campanula scheuchzeri* Vill. 1.1, *Anthemis cretica* L. ssp. *columnae* (Ten.) Frantzen +, *Silene multicaulis* Guss. 1.1, *Phyteuma orbiculare* L. +, *Gentianella columnae* (Ten.) Holub +, *Silene roemeri* Friv. ssp. *staminea* (Bertol.) Nyman +, *Festuca rubra* L. s. l. 1.2.

Locality and date of the relevés:
rel. 1 - Sella di Monte Aquila (19/07/1995); rel. 2 - Along the path to Corno Grande (18/08/1994); rel. 3 - Monte Aquila (14/07/1994); rel. 4 - Sella di Monte Aquila (18/08/1994).

Tab. 25
Accidental species:
rel. 1 - *Myosotis alpestris* F.W. Schmidt. +, *Erygeron epiroticus* (Vierh.) Halacsy +; rel. 2 - *Viola eugeniae* Parl. ssp. *eugeniae* 1.1, *Anthoxanthum alpinum* Loeve & Loeve +, *Anthyllis montana* L. ssp. *atropurpurea* (Vukot) Pignatti +; rel. 3 - *Taraxacum apenninum* (Ten.) Ten. +, *Trifolium thalii* Vill. 1.2; rel. 4 - *Campanula scheuchzeri* Vill. 1.1, *Anthemis cretica* L. ssp. *columnae* (Ten.) Frantzen +, *Thlaspi stylosum* (Ten.) Mutel +, *Acinos alpinus* (L.) Moench +.2; rel. 5 - *Achillea barrelieri* (Ten.) Schultz Bip. +.2, *Astragalus depressus* L. 2.3, *Minuartia verna* (L.) Hiern ssp. *verna* 1.2, *Carex rupestris* All. 1.2, *Sedum atratum* L. ssp. *atratum* +; rel. 6 - *Luzula italica* Parl. 1.1, *Draba aizoides* L. +, *Taraxacum officinalis* Weber +, *Saxifraga adscendens* L. ssp. *adscendens* +, *Ranunculus montanus* Willd.+, *Hieracium auricula* Lam. et DC. +, *Anthemis mucronulata* Bertol. +.
Locality and date of the relevés:
rel. 1, 2, 3 - Monte Aquila (14/07/1994); rel. 4, 5 - Corno Grande (18/08/1994); rel. 6 - Corno Grande from Furrer & Furnari, 1960.

Tab. 26
Accidental species:
rel. 1 - *Silene acaulis* (L.) Jacq. s.l. +.2, *Campanula cochlearifolia* Lam. +.2; rel. 7 - *Saxifraga caesia* L. +.
Locality and date of the relevés:
rel. 1-9 - Corno Grande (18/08/1994).