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The vegetation of supra–forest meadows and rock crevices of Mount Erimanthos (NW Peloponnisos, Greece)

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Abstract

The vegetation of supra - forest meadows and rock crevices of Mount Erimanthos (NW Peloponnisos, Greece). The study is based on 218 vegetation samplings, which have been classified with TWINSPAN and Cluster Analysis and ordained with Detrended Correspondence Analysis (DCA). 6 plant communities are included in class *Daphno-Festucetea* Quézel 1964, 1 (scree formations) in *Drypetea spinosae* Quézel 1964, 1 in *Juncetea trifidae* Hadac in Klika & Hadac 1944 and 7 in *Asplenietea trichomanis* (Br.-Bl. In Mayer & Br.-Bl. 1934) Oberdorfer 1977.

Key words: *Asplenietea trichomanis*, Classification, *Daphno-Festucetea*, Greece, Phytosociology.

Riassunto

La vegetazione delle praterie alto-montane e delle pareti rocciose del Monte Erimanthos (Peloponneso nord-occidentale, Grecia). Lo studio si basa su 218 rilievi della vegetazione che sono stati sottoposti a classificazione di tipo TWINSPAN e Cluster Analysis e a ordinamento tramite metodi di Detrended Correspondence Analysis (DCA). Sei comunità vegetali sono state attribuite alla classe *Daphno-Festucetea* Quézel 1964, una (formazioni dei detriti) alla classe *Drypetea spinosae* Quézel 1964, una alla classe *Juncetea trifidae* Hadac in Klika & Hadac 1944 e sette alla classe *Asplenietea trichomanis* (Br.-Bl. in Mayer & Br.-Bl. 1934) Oberdorfer 1977.

Parole chiave: *Asplenietea trichomanis*, Classificazione, *Daphno-Festucetea*, Grecia, Fitosociologia.

Introduction

Erimanthos mountain complex is situated in NW Peloponnisos between 21^0 44' - 22^0 01' N and 37^0 54' - 38^0 03' E (Fig. 1). The massif is formed by several summits: Neraidovouni (alt. 1923 m), Olenos (Granitis, 2222 m), Barba (2169 m), Profitis Ilias (2124 m), Neropouli (1809 m), Pirgako (2050 m), Lepida (1893 m), Psiles Korifes (1878 m), Kallifoni (1996 m) and Tris Ginaikes (1834 m), with the first seven of them constituting the main mass of the mountain. From a geological point of view, Mt. Erimanthos (Olenos) is a part of the Olenos – Pindos geotectonic zone (Mountrakis, 1985) and the main geological substrates are limestone, radiolarite and flysch (mainly in the western slopes). The orientation of its main mass is NE – SW, while the eastern summits (mainly Kallifoni and Tris Ginaikes) have a E - W orientation. A topographic map of the research area is given in Maroulis & Artelari (2001).

The western part of the mountain complex receives about 1400 mm annual rainfall at an altitude of 1000 m, while the eastern part receives about 1200 mm, in a same altitude. It also appears that the eastern part is slightly colder than the western, because it is more continental.

The considerable cover of supra – forest meadows and rock crevices provides a great variety in the corresponding communities.

Erimanthos, although it is close to the city of Patras has not been explored from the phytosociological point of view, except for some samplings of Barbero & Quézel (1976), carried out in forest stands. Furthermore, phytosociological data from the higher altitudes of southern Greek mountains and especially their chasmophytic communities were too few. Taking into account the large number of steep rocks in S Greece and their altitudinal range (0-2500 m), we can say that chasmophytic communities are almost unexplored.

Chasmophytic plant communities are studied in an altitudinal range from 450 to 2200 m and supra forest meadows from 1300 to 2200 m.

Material and methods

218 vegetation samplings have been carried out during the years 1998 – 2002 with the Braun Blanquet (1964) method. The sampling plots were physiognomically homogenous and their size was according to Mucina (1997): Rocky meadows and screes 75 – 100 m^2, grassy meadows 20 – 25 m^2 and chasmophytic vegetation: 10 – 15 m^2.

All samplings have been introduced in Turboveg Database (Hennekens 1999) and analysed with the statistical package PC – ORD (Mc Cune & Mefford, 1999).

Classification of the samplings has been carried out with TWINSPAN (Hill, 1979) and is based in the creation of pseudospecies. The analysis begins with a

Correspondence Analysis and the samplings are further classified according to the pseudospecies presence. In the present paper the cover class used in the field (r – 5) has been rescaled to the scale 1 - 9, according to van der Maarel (1979), with the following equivalence: r=1, + = 2, 1=3, 2=5, 3=7, 4=8, 5=9.

Complemantery to TWINSPAN analysis, an ordination of both data subsets has been carried out with Detrended Correspondence Analysis (DCA). Correspondence Analysis has been developed independently from a line of researchers, while Hill (1973, 1974) is the first who imported the method in ecology. He also imported the algorithm of "Reciprocal Averaging", which is used by the statistical package PC-ORD. In this algorithm the samplings and the species are classified simultaneously. The scores of samplings in the axes result from the weighted averages of species scores and, inversely, the species scores in the axes result from the weighted averages of sampling scores. Detrended Correspondence Analysis is based on the axes scores of Correspondence Analysis and has been developed to solve some problems of the last method (the "compaction" of axes to its outmost and the "arch effect"). It consists in the segmentation of the first axis in a number of segments, inside which the scores of the second axis are regulated so their mean is zero (Hill 1979a).

Synopsis of the above methods is given in Legendre & Legendre (1998) and in Kent & Coker (1992).

Rare taxa are not included in the presantation of the corresponding phytosociological tables.

Diagnostic species of syntaxa are according to researchers of Greek Mountain vegetation, mainly Quézel (1964, 1967, 1973), Bergmeier (1990, 2002), Georgiadis & Dimopoulos (1993), and Karetsos (2002). Small additions have been made in the case where a taxon shows a considerable affinity for a syntaxon (e.g. *Teucrium chamaedrys* subsp. *chamaedrys* for *Stipo – Morinion* etc.).

The typification of new syntaxa is according to the International Phytosociological Code (Weber et al. 2000). Data of Theocharopoulos *et al*. (2002) have been taken into account. For the phytosociological nomenclature, Rodwell *et al.* (2002) have also been taken into consideration.

Species nomenclature follows respectively Strid & Tan (1997, 2002), Strid (1986) and Strid & Tan (1991), Greuter *et al*. (1984 – 1989), and Tutin *et al.* (1968 – 1980, 1993).

Results

1. Supra – forest meadows

The whole set of 133 samplings has been analysed with TWINSPAN, while the 106 samplings of *Daphno-Festucetalia* and *Drypidetalia spinosae* orders (excluding the samplings of *Trifolietalia parnassi*) have been complementarily analysed with DCA (Fig.1). The axis 1 of DCA is correlated to the altitude, with the more alticole sites (*Festuco politae-Festucetum cyllenicae* association) in the left part and the less alticole sites (*Juniperetum foetidissimae scabiosetosum ochroleucae*) in the right. The second axis also offers good information, with the rockier sites in the superior part (*Valantia aprica-Scrophularia myriophylla* comm.) and the less rocky (*Marrubio cyllenei-Astragaletum rumelici* association) in the inferior part. It is interesting to observe the floristic resemblance of some *Drypatalia spinosae* samplings to the meadows of *Festuca*: *Festuca cyllenica* invades easily in screes and tends to stabilize them.

1.1. Grassy meadows: *Alopecuro gerardii-Crocetum sieberi* Quézel 1964 (*Trifolion parnassi*, Tab. 1).

The grassy meadows of the higher summits can be included in the association *Alopecuro gerardii-Crocetum sieberi* Quézel 1964. The syntaxon is developed from 1700 up to 1950 m, in places with slight or null slope and consequently deep soil.

Compared to the rocky meadows, its floristic composition has large dissimilarities, although it may exist in neighboring places (e.g. the *Marrubio cyllenei-Astragaletum rumelici* scrub).

Plantago atrata subsp. *graeca* and *Plantago holosteum* dominate strongly and characterize the physiognomy of communities, together with *Edraianthus parnassicus, Poa thessala, Alopecurus gerardii, Hieracium hoppeanum* subsp. *pilisquamum, Phleum alpinum, Armeria canescens* etc. The leaves of dominating taxa are, as a rule, patent to the ground, hardly exceeding the soil surface, while their flowering shoots rarely exceed 30 cm. They are thus very well adapted to the pasture. The total herb cover is close to 100%.

The association *Alopecuro gerardii-Crocetum sieberi* is a characteristic community of grassy meadows ('pelouses rases'), with large development in the mountains of Southern Greece (Quézel, 1964).

Among the two diagnostic taxa, only *Alopecurus*

gerardii is presented in a very high constancy (27/27). *Crocus sieberi* subsp. *sublimis* has a weaker presence (9/27), because it flowers and develops its leaves very early the spring, with the melting of snow (field observations), so in late spring or early summer its leaves are often missing.

Trifolietalia parnassii and *Trifolion parnassii* are represented by *Plantago atrata* subsp. *graeca* (27/27), *Plantago holosteum* (24/27), *Phleum alpinum* (23/27), *Edraianthus parnassicus* (21/27), *Hieracium hoppeanum* subsp. *pilisquamum* (16/27), *Luzula spicata* subsp. *pindica* (15/27), *Trifolium parnassi* (15/27), *Campanula radicosa* (10/27), *Ranunculus sartorianus* (8/27), *Dianthus tymphresteus* (7/27), *Taraxacum cylleneum* (3/27) etc. Diagnostic taxa of order and alliance are according to Quézel (1964).

Plantago atrata subsp. *graeca* and *Plantago holosteum* seem to be perfectly adapted in heavy pasture. They develop very low flowering shoots, inaccessible from the herbivores and they form a dense and hard layer (especially *Plantago holosteum*), particularly resistant to animal trampling.

Three subgroups of the association have been distinguished:

Typical subgroup is characterized by a floristic sequence with *Armeria canescens*, *Hieracium hoppeanum* subsp. *pilisquamum*, *Ornithogalum exscapum* and *Trisetum tenuiforme.*

The subgroup with *Carduus tmoleus* and *Cirsium hypopsilum* is characterized by diagnostic species of *Daphno-Festucetalia* meadows, especially spiny herbs. The mentioned subgroup indicates that the continuous heavy pasture can result to the progressive replacement of *Alopecuro gerardii-Crocetum sieberi* meadows from *Marrubio cyllenei -Astragaletum rumelici* formations. This is also supported by the relatively strong presence

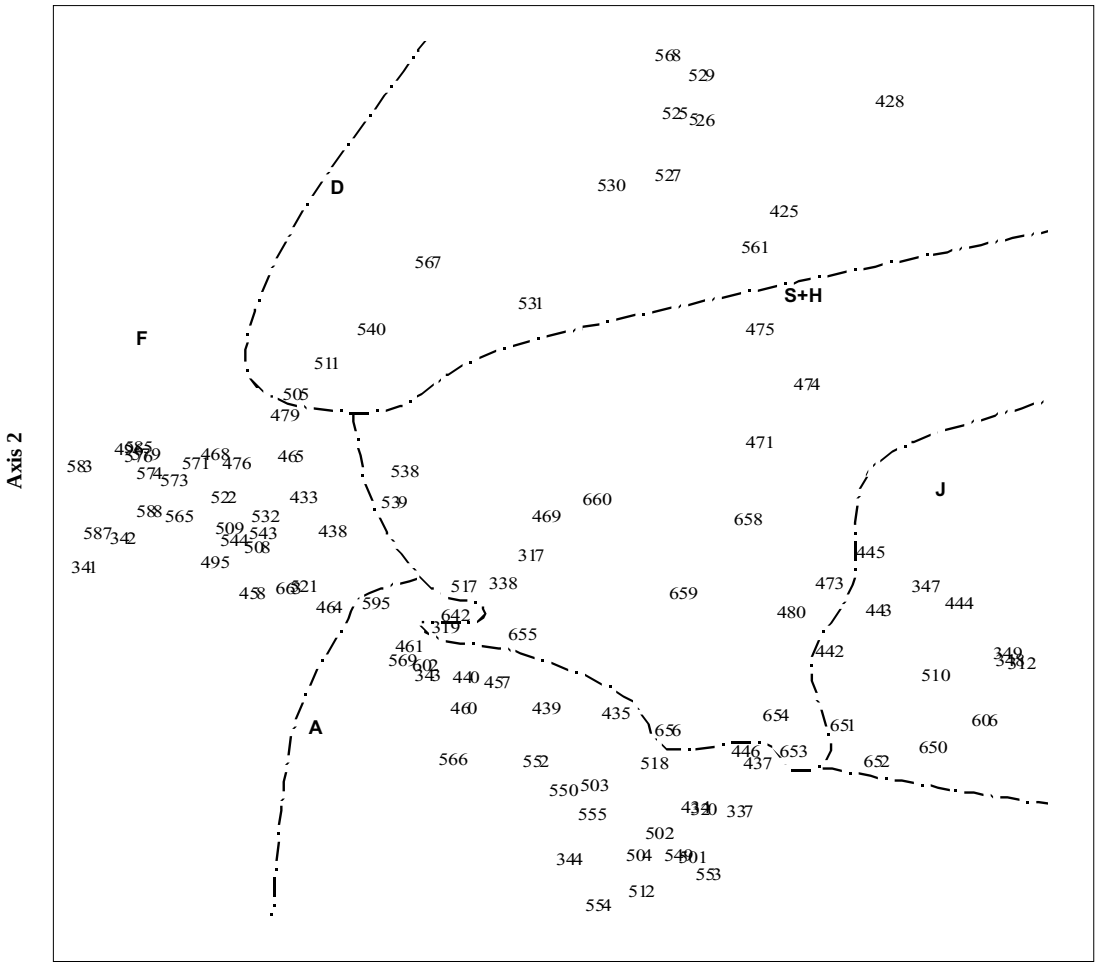

Fig. 1 - DCA plot of 106 *Daphno-Festucetalia* and *Drypidetalia spinosae* samplings. (Inertia: 6.063, eigenvalue ax.1: 0.532, eigenvalue ax.2: 0.465). D: *Valantia aprica-Scrophularia myriophylla* comm., F: *Festuco politae-Festucetum cyllenicae*, S: *Stipa pennata* subsp. *pulcherrima-Sesleria vaginalis* comm., A: *Marrubio cyllenei -Astragaletum creticae*, H: *Hippocrepis comosa -Stipa pennata* subsp. *pulcherrima comm.*, J: *Juniperetum foetidissimae scabiosetosum ochroleucae*

Tab. 1- The associacion *Alopecuro gerardii – Crocetum sieberi* (*Trifolion parnassi*) of grassy meadows.

A: Subgroup with *Carduus tmoleus* and *Cirsium hypopsilum*
B: Typical subgroup (with *Armeria canescens* and *Trisetum tenuiforme*)
C: Subgroup with *Crepis aurea* subsp. *lucida*

	A	B	C	
Number of sampling	4455644	666556555555555	55666	P
	7749066	566450449211111	99001	R
	7886532	712614577034569	89015	E
				S
Altitude(x10m)	1111111	111111111111111	11111	E
	9989888	888888889877788	99998	N
	0557522	568508555535705	50005	C
				E
				S
Alopecuro gerardii - Crocetum sieberi Quézel 1964				
Alopecurus gerardiii	5787775	323385575333223	33377	27
Crocus sieberi sublimis	--7--5-	32--5---3--3---	-2-3-	9
Subgroup with Carduus tmoleus				
Cardus tmoleus	35233-3	3-------2--2---	---22	11
Cirsium hypopsilum	3-2-2-3	---------------	-----	4
Typical subgroup(with Hieracium hoppeanum subsp. pilisquamum & Armeria canescens)				
Hieracium hoppeanum pilisquamum	-----77	532353575-5355-	-3---	16
Armeria canescens	-------	535-55-2-555353	-----	12
Ornithogalum exscapum	---5-3-	-3255-3--522--3	3----	11
Trisetum tenuiforme	-----22	-2----23-735537	-----	11
Subgroup with Crepis aurea subsp. lucida & Ranunculus sartorianus				
Crepis aurea lucida	---3---	--------53----3	77878	9
Ranunculus sartorianus	-------	5-2------2-----	25353	8
Sagina procumbens	-----33	---------3-----	2-223	7
Thlaspi ochroleucon	-------	---------------	---33	2
Trifolion parnassi, Trifolietalia parnassi (of class Juncetea trifidae)				
Plantago atrata graeca	7555733	887555535888778	75353	27
Plantago holosteum	--23375	577858878352873	777-3	24
Phleum alpinum	-723573	3233523335-3225	22--3	23
Poa thessala	7733353	323535333553-33	3----	22
Edraianthus parnassicus	-75733-	-2355-335332223	-32-5	21
Trifolium parnassi	----335	-2--3--333---22	53385	15
Luzula spicata pindica	--3----	3233-32525--332	32---	15
Campanula radicosa	-2-23--	-------3-5--22-	22--2	10
Dianthus tymphresteus	-----33	---2--23-----2-	2----	7
Taraxacum cylleneum	----7--	------2-------2	-----	3
Accompanying species				
Asperula aristata thessala	2--23-3	-3323-2-2353333	----3	17
Festuca polita	222--37	2222------2-2--	-----	11
Daphne oleoides	23-----	----2--2-2-2222	-----	9
Thymus longicaulis chaubardii	5------	---2--3----533-	-----	6
Anthemis tinctoria parnassica	-------	---------222255	-----	6
Silene multicaulis	2------	------2-2-3----	2----	5
Eryngium amethystinum	-------	----3-----3332-	-----	5
Dactylis glomerata	33-----	------------222	-----	5
Hieracium cymosum heldreichianum	-------	----------23322	-----	5
Campanula spatulata spatulata	-------	333-----------5	-----	4
Allium frigidum	32---2-	------2--------	-----	4
Verbascum epixanthinum	2------	----32-----2---	-----	4
Thlaspi graecum	-------	232------------	-----	3
Aethionema saxatilis oreophilum	-------	-----------223-	-----	3
Arabis subflava	-------	22--3----------	-----	3
Dianthus androsaceus	-------	-32--3---------	-----	3
Erysimum cephalonicum	-------	31---3---------	-----	3
Minuartia attica attica	3------	------3--2-----	-----	3
Poa timoleontis	-------	--5---------53-	-----	3
Festuca cyllenica	22-----	--------------3	-----	3

Taxa with 2 presences
Taraxacum gionense, (657/2,662/5), Alyssum montanum subsp. repens (661/2, 604/2), Taraxacum gracilens (551/2, 519/2), Myosotis sylvatica subsp. cyanea (657/2, 515/2), Leontodon cichoriaceus (662/3, 514/2), Arenaria leptoclados (477/3, 478/3), Leontodon crispus subsp. asper (513/3, 515/3), Astragalus depresus (462/3, 661/2).
Taxa with 1 presence
Sedum laconicum (661/1), Anthoxanthum odoratum (661/2), Trifolium repens (662/5), Galium taygeteum (514/3), Thymus sp. (516/5), Astragalus creticus rumelicus (514/2), Muscari comosum (513/2), Euphorbia herniarifolia (520/2), Ranunculus ficarioides (551/3), Hippocrepis commosa (477/3), Ptilostemon afer (477/2), Marrubium cylleneum (477/2), Sedum acre (478/2), Morina persica (478/2), Allium guttatum subsp. sardoum (478/2), Scleranthus perennis subsp. marginatus (463/3), Taraxacum delphicum (596/2), Bellis perennis (605/3), Lotus corniculatus (661/2), Scilla bifolia (657/2), Geocaryum parnassicum (662/2), Tragopogon crocifolius subsp. samaritanii (657/2), Stachys germanica subsp. heldreichii (657/2), Scorzonera mollis (662/1), Lepidium hirtum subsp. nebrodense (657/2).

of *Trifolietalia parnassii* diagnostics in the samplings of *Marrubio cyllenei-Astragaletum rumelici* association, which is also developed in mild slopes and relatively deep soil.

A third subgroup, with *Crepis aurea* subsp. *lucida*, *Thlaspi ocroleucum*, *Sagina procumbens* and *Ranunculus sartorianus*, is developed in the most wet sites (e.g. in sites where the snow melts particularly late in summer, near springs and streams, in eastern and northern expositions with a long - lasting daily shadowing etc.). *Trifolium parnassi* has there relatively large covers, while in the rest samplings has a very weak presence.

Quézel (1964), the author of the mentioned syntaxon, also described the associations *Astragalus tymphresteus-Trifolium ottonis* and *Plantago lanceolata* var. *capitata-Trifolium alpestre* from Giona. Both have considerable floristic resemblances with the described vegetation group of Erimanthos. Smaller resemblance has the association *Nardus stricta-Luzula spicata* Quézel 1964, described from the mountains Giona, Killini, Taygetos, and some regions of Pindos.

The same researcher (1967) described the association *Alopecurus gerardii-Crocus veluhensis* Quézel 1967 from the mountains Karava, Peristeri and Tymfi, sited earlier (1964) by him as a subassociation of *Alopecuro gerardii -Crocetum sieberi* association, in Giona.

He also (1967) described the association *Poa violacea -Silene roemeri* Quézel 1967 from Pindos and the association *Poa violacea-Minuartia recurva* Quézel 1967 from Mount Smolikas, with a floristic composition clearly distinct to that of *Alopecuro gerardii-Crocetum sieberi* association and with apparently more northern floristic influences. Both associations are included in *Poion violaceae* Horvat 1937,

Georgiadis & Dimopoulos (1993) confirm the existence of *Alopecuro gerardii-Crocetum sieberi* in Mount Killini of N Peloponnese, with also a strong presence of *Plantago atrata* subsp. *graeca* and *Plantago holosteum*.

Finally, Karetsos (2002) described the *Trifolium hybridum* community, from Mount Iti, with a floristic composition clearly differentiated to that of *Alopecuro gerardii-Crocetum sieberi*.

1.2. Rocky meadows

1.2.1. *Juniperetum foetidissimae scabiosetosum ochroleucae* subass. nova hoc loco (*Stipo-Morinion*, Tab. 2, column J, holotypus rel. 347)

The subassociation *Juniperetum foetidissimae scabiosetosum ochroleucae* has been sampled in four summits of the mountainous complex: Melissovouni, Barba, Kallifoni and Tris Ginaikes. It is developed on limestone, between 1350 – 1750 m and it is associated to sites with a high cover in bare rock. It is succeeding the fir (*Abies cephalonica*) forests, starting its development above the fir – forest timberline.

It has the physiognomy of a sparse shrub, or a sparse forest with aged trees. *Scabiosa ochroleuca* (9/13) is grown exclusively in the sites of the present syntaxon, while *Juniperus foetidissima* is the dominating species. An exception is observed in Kallifoni, where the stands of *Juniperus foetidissima* are usually degraded and the stands are dominated by low individuals of *Juniperus oxycedrus* subsp. *oxycedrus*. There, the presence of radiolarite leads to a particular aspect with *Dianthus pinifolius* subsp. *lilacinus* (Tab. 2, sampl. 650, 651 & 652).

The new syntaxon is included in *Stipo-Morinion* alliance, with characteristic taxa *Melica ciliata* (4/13), *Festuca jeanpertii* (11/13), *Malcolmia graeca* subsp. *bicolor* (5/13), *Teucrium chamaedrys* subsp. *chamaedrys* (8/13), *Pterocephalus perennis* (8/13), *Scutellaria rupestris* subsp. *parnassica* (5/13), *Ajuga orientalis* (3/13), *Stipa pennata* subsp. *pulcherrima* (4/13) and *Achillea fraasii* (1/13).

The alliance *Astragalo-Seslerion* is represented very weakly, while *Eryngio – Bromion* is represented quite strongly: *Astragalus creticus* subsp. *rumelicus* (5/13), *Marrubium cylleneum* (6/13), *Dasypyrum hordaceum* (4/13), *Erysimum pectinatum* (3/13), *Cirsium hypopsilum* (3/13), *Eryngium amethystinum* (11/13), *Galium thymifolium* (5/13), *Galium taygeteum* (10/13), *Campanula spatulata* subsp. *spatulata* (10/13) etc.

The formations of *Juniperus foetidissima*, at least up to 1600 m, have their origin in older fir forests. That's why forest species of the order *Quercetalia pubescentis* are quite strongly represented: *Myosotis sylvatica* subsp. *cyanea* (7/13), *Thymus longicaulis* subsp. *chaubardii* (11/13), *Lamium garganicum* subsp. *striatum* (7/13), *Silene italica* subsp. *peloponnesiaca* (8/13), *Doronicum orientale* (6/13) etc. However it is clear that taxa of *Daphno-Festucetalia* have a stronger presence.

Juniperetum foetidissimae of *Stipo-Morinion* has been described by Georgiadis & Dimopoulos (1993) in Mount Killini, an also N Peloponnesian mountain. Although *Scabiosa ochroleuca* is absent in the original description of the association, the ecological and floristic similarities of both communities do not permit us to determine a new association. *Juniperetum foetidissimae typicum* grows in very similar altitudes (1350 - 1750 m), also in stony places.

Tab. 2 - Communities of *Daphno – Festucetalia* and *Drypetalia spinosae* (106 samplings)

D: *Valantia aprica - Scrophularia myriophylla* comm.. (Silenion caesiae).
F: *Festuco politae – Festucetum cyllenicae* (*Eryngio – Bromion*), ass. nova hoc loco, holotypus rel. 509.
A & Ac: *Marrubio cyllenei – Astragaletum rumelici* (*Eryngio – Bromion*), ass. nova hoc loco, holotypus rel. 460.
A: Typical subgroup.
Ac: Subgroup with *Cachrys ferrulacea.*
S: *Stipa pennata* subsp. *pulcherrima – Sesleria vaginalis* comm. 78-80. Subgroup with *Asphodeline lutea* and *Vincetoxicum hirundinaria* subsp. *nivale* (*Stipo-Morinion*).
H: *Hippocrepis comosa - Stipa pennata* subsp. *pulcherrima* comm. (*Stipo-Morinion*).
J: *Juniperetum foetidissimae scabiosetosum ochroleucae* (*Stipo-Morinion*), subass. nova hoc loco, holotypus rel. 347.

	D	F	A	Ac	S	H	J	
	00000000000000	00000000000000000000000000000000	0000000000000	0000000000000000000	0000000000	000000000	0000001111111	
Increasing number	00000000011111	11111222222222233333333333444	4444445555555	555666666666677777	7777788888	888889999	9999990000000	
	12345678901234	56789012345678901234567890123	4567890123456	789012345678901234	5678901234	567890123	4567890123456	
Number of sampling	44555555555555	55555545445445544553563555544	5554645444463	545444555535555533	3544345543	666666644	6444433335666	
	22601633262224	87788792773332495464864770066	6696065546344	1453334500300051542	3177173361	555565587	0444444411555	
	58151701586790	36985462962381458352731138958	9654212700923	860457932174352440	8754719899	568903403	6234578920012	
Altimeter(x10m)	01111111111111	22222121111111111212212111122	1121111111111	111111111111111111	1111111111	111111111	1111111111111	
	91266788878888	00021919988449988050290897801	7608987657569	858444876566666666	8877669967	888987776	5433366665666	
	50055050005805	80525587008003750008005505085	5508000208005	505350800503073755	0550550005	005700557	8087804558035	
Valantia aprica - Scrophularia myriophylla comm.								
Valantia aprica	53332-332222--	----------2--	----------	-2-2----------	----------	---------	----2--------	15
Scrophularia myriophylla	3-2-23332322--	----------	----------	----------	----------	---------	----------	10
Urtica dioica	553223---3----	----2---2--3----------	--------2--2-	----------	--2-------	---------	----------	13
Drypetalia spinosae								
Ptilostemon afer	--3--22--2222-	-----22----3222--22----32-23-	--23-2-22----	-2-23--------2---3	--2--22---	--3-----2	--2----------	35
Senecio thapsoides	---23232-22232	--3-332-3--------22---323---2	----------2-	----------	--22------	---------	----------	24
Festuca spectabilis affinis	-----55-775575	--------322----------	2----------3	----------	3-55-3--2-	---25--3-	----------	21
Drypis spinosa	53233322525323	----------	----------	----------	----------	---------	----------	14
Silene caesia	57------2-357-	----------	----------	----------	----------	---------	----------	6
Festuco politae – Festucetum cyllenicae								
Festuca cyllenica	---55533-----5	998888888888878877887777777777	5-573---3----	----3----------	772-5-75-5	533552---	----------	54
Festuca polita	----------	3335335--3533--553777383535-2	---3-5--23---	--------35--------	------3-2-	---------	-----3-------	33
Allium frigidum	----------2-2	-232222-------3322233-3222--2	-------2----3	-22---2----222----	-2----22--	----2----	----------	32
Campanula albanica albanica	----------	5333333----------3--332322	----------	----------	----------	---------	----------	14
Silene multicaulis multicaulis	----------	2-22---325-------2---2---22-3	-----2-------	----------	-------2--	----2----	----------	14
Sideritis clandestina peloponnesiaca	----------	----2--2----------2-2222	--2--------3-	----------3	--2-------	---------	----------	11
Geocaryum peloponnesiacum	----------	-3----------2----2--2----3--	----------	----------	----------	---------	----------	5
Taraxacum delphicum	----------	2-222----------2--------	----------	----------	----------	---------	3----------	5
Silene vulgaris prostrata f.pubigera	----------	----------22-2	----------	----------	----------	---------	----------	3
Dianhus integer minutiflorus	----------	-3-3----------	----------	----------	----------	---------	----------	2
Differentiating								
Minuartia attica attica	--2---------2	23-3-233--2-33-3323333-333523	22------3----	-2----------	32--322--3	2-2--2---	-----2----333	41
Carum graecum graecum	-------23-----	-2222-2----5--2---2-22-3--3--	-----2--2----	----------	------2---	---------	----------	17
Marrubio cyllenei – Astragaletum rumelici								
Astragalus creticus rumelicus	---3-2--------	-----3-2--2--7777725-2533--2-	8888899888889	758-7-575335533555	35--532357	---22----	-5333----2---	62
Marrubium cylleneum	------22------	----------2---2--3----------	---25-223375-	22-237252552253353	3-2-535575	222232332	-332-2-32----	53
Dasypyrum hordaceum	----------	----------2----------	35----3--33-3	77787888888753353-	52--------	---------	53------33---	30
Erysimum pectinatum	----------2-3	----------2-----2----------	------2----23	--333-22--22---2--	-------3--	---2-----	---3--2---2--	20
Lolium perrene	2----------	----------	-----23--23-2	--3----3-3----2---	----------	---------	3-2---------	12
Digitalis ferruginea	----------	----------5----------	----------2-3	---3332----------	----------	---------	---2--------2	9

Marrubio cyllenei — Astragaletum rumelici, subgroup with Cachrys ferrulacea

```
Cachrys ferrulacea                ----------2--- ----------2------2--3---22--  ------------ ---2----2278889997 ----3----3 --------2 2------------ 21
Ribes uva-crispa                  33------------ ----------2----------------  -----2-----3- -----2-2223-2-2--- --2-22---- -------- 2----2---2--- 18
Scandix macroryncha               2------------- ------------------2---------  ------------ 3-----33---33232-- --------2- 33---33-- ------------ 15
Ornithogalum oligophyllum         -------------- 2------2------2--32-2--------  -----------2- --------3---3-325- -------3-- --------- ------------- 13
Crataegus orientalis              -------------- ---------------------------  ------------ 2-------2252-2---3 ---------- 1-------- ---------12- 10
Anchusa hybrida                   -------------- ---------------------------  --------2---- -3-----2-22---2--3 ---------- 2----2--- -------------  9

Communities with Stipa pennata subsp. pulcherrima (Stipo — Morinion)

Stipa pennata pulcherrima         -------------- --------322--------3-------3-  -------2----- 77--35-------2---- 7555353-23 357878888 ------3---225 33

Stipa pennata pulcherrima — Sesleria vaginalis comm. Subgroup with Asphodeline lutea and Vincetoxicum hirundinaria subsp. nivale

Asphodeline lutea                 -------------- ---------------------------  ------------ ------------------ --223----- -------3- -2-----------  5
Vincetoxicum hirundinaria nivale  -------------- ---------------------------  ------------ ------------------ --352----- --------- -------------  3

Hippocrepis comosa - Stipa pennata subsp. pulcherrima comm.

Erysimum cephalonicum             ------22------ -------2--2-2------3---------  --------2-2-- ----2------------3 ----32---3 2322233-- -----------32 22
Hippocrepis comosa                -------------- ---------------------------  ------------ ------------------2 ----3----- 332-22-2- ------------3  9
Minuartia confusa                 -------------- --------2--------2----------  ------------ ------------------ -------2-- 2---22-2- -----2-------  8
Helictotrichon aetolicum          -------------- ---------------------3------  ------------ ------------------ ---------- --2-3-2-- -------------  4
Narcissus poeticus                -------------- ---------------------------  ------------ ------------------ ---------- --22----- -------------  2
Secale montanum                   -------------- ---------------------------  ------------ ------------------ ---------- --3-3---- -------------  2

Juniperetum foetidissimae scabiosetosum ochroleucae

Juniperus foetidissima            -------------- ---------------------------  ------------ ----------2------- ---------- --------- 8578877877233 14
Scabiosa ochroleuca               -------------- ---------------------------  ------------ ------------------ ---------- --------- 32---333-3233  9

Differentiating

Juniperus oxycedrus               -------------- ---------------------------  ------------ ------------------ ---------- 2-------- -22237755-877 12
Brachypodium rupestre             -------------- ---------------------------  ------------ ------------------ ---------- --------- --333----7---  4

Subgroup with Dianthus pinifolius subsp. lilacinus

Dianthus pinifolius lilacinus     -------------- ---------------------------  ------------ ------------------ ---------- -----2--- ----------222  4
Agrostis stolonifera              -------------- ---------------------------  ------------ ------------------ ---------- --------- ----------222  3
Hypericum rumeliacum apollinis    -------------- ---------------------------  ------------ ------------------ ---------- --------- -----------22  2

Stipo - Morinion

Melica ciliata                    353-3-2-3--3-- --------32-------------------  2-----352333- -32-----22-3------ 3275-5--5- --222--35 -3--233------ 36
Festuca jeanpertii                --------2---2- --------23-------------------  3----5-----3- -----------33----- -535-7--3- --533-335 535553--35333 32
Malcolmia graeca bicolor          ---------22--- ---------------------------  --2-2-----2-- 33--35----3-3----- -32-335233 -333-2323 -3322---3---- 31
Teucrium chamaedrys chamaedrys    -------------- ---------------------------  2------------ ------------------ --32--2-2- --33----2 -232223---23- 16
Pterocephalus perrenis perrenis   -------------- ---------------------------  ------------ ----23----------- -2-2----2- 32----2-- -323-333--53- 16
Scutelaria rupestris parnassica   --------3----- --------3-------------------  ------------ -------------3---- --32---3-- --------- -3335-2------ 11
Ajuga orientalis                  -------------- --------2-------------------  ------------ ------------------ ----2----- --23-22-- ------22-----  8
Scorzonera mollis mollis          -------------- ---------------------------  ------------ ------------------ ---------- 2----22-- ----------323  6
Achillea fraasii                  -------------- ---------------------------  ------------ ------------------ -3--2----3 ------2-2 -----3-------  6
Morina persica                    -------------- --------5-------------------  ------------ ------------------ --2--5--2- -------2- -------------  5

Eryngio - Bromion

Carduus tmoleus                   --2332--23-222 33322223-23--23355-32-33333-2  2-5355-23323- -2---3-2223-222-3- --22333323 ---23---2 -2----------- 65
Cirsium hypopsilum                ---22----2---2 --2--2-3222-23--3-2--2-2-----  22-3533223233 --23333-52-2-23-23 3-2-222223 22222--3- 2------2---1- 57
Eryngium amethystinum             -----------2- ----------------2-3--2---3---  35--333533535 2355555557-333333- 35-2--322- 35--23333 25532-33-2333 56
Galium thymifolium                ---3333-3-2332 33333--5333535---35-2-2-233-2  2-2--------3- 2--335----322----- ----33232- -33-3222- -----233--33- 55
Galium taygeteum                  -------------- -2333--2-3523-2-3-3-2----33-2  -3-2-3525-3-- 3357555535-3-233-3 ---2--3--- 3----352- 322222---2333 54
Campanula spatulata spatulata     --2-----3-3-2- -2---2-332333333-3-3-33------  ------333-333 22-33-322-32----3- ------33-- 2-3-3---- -3233--333353 50
Bromus cappadocicus lacmonicus    -------------- -----32------5--2-3--5-23322-  772-33---5--- ------2------2---- ------3--- 55--355-- ----------332 28

Astragalo - Seslerion

Sesleria vaginalis                -------------7 2533235-55725----35235-553577  23--3---2---- 2--37--------3---- -533557883 73-33--33 -2557-------- 51
Tragopogon crocifolius samaritanii 2-----------2- -2---2--2--------2---2--2-2--  -----------3- 2-2-2-2-233-2----- --2-2----3 --2----2- -----2-2----- 25
Astragalus angustifolius          -------------- ---------------------------  ---3--------- ------------------ -2--3----- 22------- --------5-3--  7
```

Iberis sempervirens	----------	------2----------	----------	----------	---22-----	---------	----------	3
Veronica sartoriana	----------	23-2-------------	----------	----------	----------	---------	----------	3
Daphno - Festucetalia								
Daphne oleoides	----2-------3	22332335323--3-32523323335533	223222-223232	2---2---2--222-23-	5533533333	22-32-2-3	----2333-3332	72
Cerastium candidissimum	2-2--3-------	-2-3-332-----2----3333-33--53	33533---2772-	22-2553-2-525-----	3--332-323	55-23-3-3	-2---323 222	56
Verbascum epixanthinum	---2---------	22222--3322-222-23--2----3222	--22---22-33-	22-332---2-2-2-2--	--22322-2-	---22-2-2	--2------2---	47
Phleum montanum	2----------	----------2------2------	-3-32--33-3--	53-575-222-3--2-33	3---23--3-	32---3333	3532233333-22	43
Senecio squalidus	-------3----2	--222--332---32-32-3--3--322-	--22--353-277	-3---23--23-----3-	5-2-3-2--3	--333---3	--2--2--2----	43
Acinos alpinus meridionalis	----------2--	---2---2223--3-3---32----3--3	3--------223-	3--32-3-2--------3	3---3-33-3	--323--2-	--------2---	32
Asperula aristata thessala	----------	233332-5--3-23------22-3235-3	-----3333-333	--------5--3------	3-----23--	35----2--	----------	32
Asyneuma limonifolium	------22----23	-22-2-2-3-----3--3--3--2---2-	--2-2---2-2--	--3--2------2-----	----------	-33---2--	-2--2333--3-3	31
Stachys germanica heldreichii	----------	---------2----------	------23223--	52-332--32----2---	2------32-	22---332-	2-2-2--2--22-	28
Quercetea pubscentis								
Myosotis sylvatica cyanea	2-----2-2--2--	3-2232-3-33333232-----3-222--	2-32--223-33-	22-3332----2-----3	322-3-2333	--333--22	--222----2233	58
Thymus longicaulis chaubardii	----------	---2------------------------	-------3--2--	33-235-5-----2----	---2-2--2-	3----3--3	-3333333-3223	27
Lamium garganicum striatum	5----------	----------	--2---------3	--2--22-----3-----	----------	------2--	32-2222--3---	14
Silene italica peloponnesiaca	----------	----------	----------	----------	----------	---------	3--23-33-322-	9
Doronicum orientale	----------	----------2----------	--------2----	--------2---------	----------	---------	----2---33225	9
Prunus cocomilia	-2----------	----------	----------	---------22-------	3---------	--1------	-----2-2-----	7
Arrhenatherum elatius	----------	----------7----------	----------	---2----------	----------	-----2---	----------333	6
Lathyrus digitatus	----------	----------	----------	----------	----------	-----1---	--332-------2	5
Juncetea trifidae, Trifolietalia parnassi								
Poa thessala	----32--------	-2-3-3-3-23--5-3---3-5-333-32	-------353333	5325---333-33232--	-7------3-	-2---3-3-	-2-------3-3-	43
Armeria canescens	----------	----------33--	-------3---2-	-2------2--3------	----------	2----2---	-----3-3-3222	15
Phleum alpinum	---32---------	2--2---2--2--2-3----------	-------5-----	----------2-2-3	----3-----	---------	2----------2	15
Plantago atrata graeca	----------	----------2----------	-------3---2-	2--3----33-2-----2	----------	2--------	3----------	11
Hieracium hoppeanum pilisquamum	----------	-------2----------	-----2-5--2--	----------	---------3	----------	-----3---	---------223	9
Alopecurus gerardiii	----------	2--2----------2	----3--------	----------3	----------	2----2---	----------2	8
Trifolium parnassi	----------	2--------2-------2----------	------22-----	---3----------3	----------	---------	----------	7
Accompanying species								
Dactylis glomerata	3--352--3-----	335332-3335555-333---3--35--3	5533333333333	3-33--3-333--3323-	5------3--	----3-23-	3--------3---	56
Cerastium brachypetalum roeseri	2----------	--23----3--53--32-233-3------	2-22-2--35533	-3375----23232-3--	-33--33-33	-------33	-3333-3------	44
Lactuca viminea	2-5--2--2-333-	----------2----------2-	223322---23--	-32-23-22----2-2--	--2233-32-	-2333--3-	-32--2-2-----	40
Crepis sancta	255-------33--	------2-------3----------	2-33----323--	-3-53533--5------3	33-233-333	------223	-333-5333----	39
Poa bulbosa	--2-----2-----	----------2-2--3---------3---	------3-3--3-	-3-3----333-3-2---	3----2----	-----3---	-23333333-233	30
Geranium subcaulescens	---2----------	-2--------5--323-32--5---53-2	--3----23-233	2-----2----22-----	------23-3	22-22----	----------	29
Trifolium physodes	----------	----------	------5---2--	-3-3---3223---3--5	----------	23---2---	2-233-3335233	24
Rosa agrestis	2----------	----------2--2----------	--------22-33	-2------3233--2---	----322---	-----23--	2222-2-2-2---	24
Arenaria leptoclados	-2----------	----3----222----2---3--------	--------2----	532-2-------22--3-	32---3232-	------2-2	--2----------	24
Trisetum tenuiforme	----------	3---------5535--5--------2---	------775-3--	3333-----3-32-3---	----------	---------	3---------323	23
Sanguisorba minor muricata	----------2--	---------2--------3----------	------3------	2-----3-33-------3	----3-----	2-22-2---	22---3----233	20
Centaurea affinis laconiae	------2-------	----------2----------	------5------	----2--2----------	--2-------	35---2--3	3222-2-2-52-2	19
Anemone blanda	---2-----2----	-3--------333----------33--	----------	------3----------	------33--	--3332---	--------33---	17
Hieracium cymosum heldreichianum	----------	-----2-------2-------2--222--	------2----2-	--------33-2--2---	----------	---3-----	2---------23-	16
Polygala nicaensis mediterannea	----------	-------2--2-23-------2---23--	------2------	3-------2---------	----2-----	3--3-----	----------333	16
Aethionema saxatilis oreophilum	----------2--	----------3-------2---2-	----------	2-------22-2------	----2-2---	--3-2----	----2-2--2---	15
Sedum album	----------	------2----22----------2--	----------	----------3-------	2-23--2---	-------2-	-2223---3----	15
Allium guttatum sardoum	----------2-	----------3-3----2---22--2-	---2----2-2--	--3--------33-----	---2----2-	---------	----------	15
Sedum acre	----------	---------2--2-----2----------	-------22----	---2-3----2-------	--22------	-------2-	--22----3----	14
Poa trivialis sylvicola	----------	-2-3------57-----2----------	--------3----	---53-----3------5	----3-----	---------	---23-55-----	14
Astragalus depressus	----------	----------2------	----------	---2----------2--3	----3-----	----3-2--	2-2---2--222-	13
Alyssum montanum repens	----------	----------2----32---3--	---3---------	-----2----------	-------2--	23---22--	----------3	12
Thlaspi perfoliatum	--2----------	---------2-------2---3------	-----2-------	----------3--2--	------2---	-2---2---	--------3---	11
Bellis perennis	----------	----------233----------	----------	------3--3--3---33	---------3	---------	5--------3---	11
Micromeria juliana	----------	----------	----------	----------	--32------	--------3	-3223333--2--	11
Gerananium macrostylum	----------	----------	----------	-------2-3--------	----------	35---53--	--------2-333	10
Rosa pulverulenta	----------	----------2-------3-------	2------2-----	----------	--2-------	-3---2---	-----3-----33	10
Bromus tectorum	57----------	----------	---2---------	-3---3----------	-----2----	---------	-33-23-------	10
Bromus squarrosus	----------	----------	----------	-2---3----------	-----3--3-	---------	-33325-------	9
Thlaspi graecum	----------	----------33----------	---2----2----	----------	----------	-----2---	----2-----222	9
Carduus macrocephalus	22----------	----------	33-2-------3-	-2--2----------	------2---	------2--	----------	9
Anthemis arvensis arvensis	3----------	----------	----------	-3---3----------35	----------	2-----5--	------233----	9
Centaurea pichleri	----------	----------	------2------	-------2---------3	----------	-3---22--	----------233	9

Prunus prostrata	--------3----- ----------	----------	----------3-	2----------	2-2-223-----	---2-----	----------	9
Lepidium hirtum nebrodense	-------2------ ----------	----------	--------2-3--	3------2---2--2---	----------	-2---22--	----------	9
Crocus sieberi	---------- -------3----------	----------	----------	----------	----------	33-2-2---	--------3-2-2	8
Euphorbia herniarifolia	---------- -----2--2--------2-----2---2	----------	----------	----------	--2-------	--2-2----	----------	8
Arum maculatum	---------- ----------	----------	-----2---2---	-------2----------	----22--22	----2----	----------	8
Erophila verna	-------2----- ----------22---2----------	----------	--------2-----	---3----------	----------	---------	---2---3-----	8
Leontodon cichoriaceus	---------- ----------2-------	----------	------2------	--------32--------	----------	-2-------	2--------2-3	8
Legousia speculum-veneris	---------- ----------	----------	----------2--	-3---3----------	--2-------	------2-2	-32----------	8
Allium flavum tauricum	---------- --------2----------	----------	-----2-------	----------	-----2--2-	-------2-	-22-2--------	8
Rumex pulcher	---------- ----------2-3---------2--53--	----------	----------	---------2-2------	----------	---------	----------	7
Muscari neglectum	---------- ---------------2----------	----------	----------	----------	-3--3---23	---------	-----22------	7
Viola kitaibeliana	---------- ----------	----------	----------	----2----------	----2-3--2	---------	32-2---------	7
Crepis neglecta	-----------2- ----------	----------	----------	3-3-----2---3-2---	------3---	---------	----------	7
Koeleria lobata	-------2------ ----------	----------	-----2-------	----------	-3--------	--------3	-33-2--------	7
Leontodon graecus	---------- ----------	----------	----------	----------	----------	-----2---	------333-223	7
Centaurea raphanina mixta	---------- ----------	----------	----------	----------	----3-----	---------	--2-2---3-222	7
Ranunculus ficarioides	---------- ----------3-----2-----	----------	2-3----------	2-----3----------	----------	---------	----------	6
Ranunculus sartorianus	---------- 23--------2-2----2--------2--	----------	----------	----------	----------	---------	----------	6
Cynosurus echinatus	---------- ----------	----------	----------	--2--32-------3---	----------	------2--	----2-------	6
Papaver dubium	---------- --------2----------	----------	--------2-2--	-2----------	----------	-----2---	-2----------	6
Geranium pyrenaicum	---------- ------------2----------	----------	----------	----22----------3	----3-----	---------	----------2-	6
Petrorhagia illyrica illyrica	---------- ----------	----------	----------2--	-2-23----------	----------	---------	-2--3-------	6
Silene radicosa	---------- ----------	----------	----------	----------	-3-2------	---------	-23-3-------3	6
Achilea holosericea	------2------- ----------	----------	----------	-----2---2--------	----------	---------	-----333-----	6
Scorzonera cana	---------- ----------	----------	----------	----------	----------	-2---22--	-----2----22-	6
Arabis subflava	---------- -------2--2--2----------	----------	--2---------	----------	----------	---3-----	----------	5
Sedum laconicum	---------- -2----------2--	----------	----------	---2--------2-----	----------	---------	----------2-	5
Valeriana tuberosa	---------- ------------23----------	----------	----------	--------2---------	-2-------2	---------	----------	5
Geranium lucidum	33---------- ----------3----------	----------	----------	----------3-------	----------	---------	---2---------	5
Lotus corniculatus	---------- ---------3----------2--	----------	------2-2----	-------2----------	----------	---------	----------	5
Umbilicus erectus	---------- ----------3----------	----------	----------	---------22-------	----------	---------	------32-----	5
Alysum siculum	---------- ----------2----------	----------	----------	----------------3	----------	-3-------	-----3------2	5
Anthemis tinctoria parnassica	---------- ----------	----------	----------2--	----------	----3-----	---------	2--------3---	4
Muscari comosum	---------- ----------	----------	----------2--	---2---2----------	----------	-2-------	----------	4
Bupleurum falcatum cernuum	---------- ----------3----------	----------	-------2-2---	----------	----------	---------	3----------	4
Viola chelmea	---------- -----3----------32----	----------	----------	------2----------	----------	---------	----------	4
Crucianella angustifolia	---------- ----------	----------	----------	-2----------	----------	-----3---	--2-2--------	4
Dianthus viscidus	---------- ----------	----------	----------	---------3----------	----------	---------	2---------23-	4
Sorbus umbellata	---------- ----------	----------	----------	--------2---------	----------	--2------	-----2----2--	4
Anthemis cretica cretica	---------- ----------1-------	----------	----------	----------	----------	---------	----------333	4
Stipa holosericea	---------- ----------	----------	----------	----------	----------	---------	-32--32------	4

Taxa with 3 presences:
Leontodon crispus subsp. asper (319/3, 655/2, 656/2), Cruciata laevipes (552/2, 553/2, 653/3), Plantago holosteum, (656/2, 652/2, 653/2), Ballota acetabulosa (428/5, 561/2, 442/2), Bromus sterilis (561/5, 568/2, 312/2), Aubrieta deltoidea (511/2, 503/2, 659/2), Logfia arvensis (546/2, 553/2, 512/2), Veronica glauca subsp. chaubardii (438/3, 546/5, 437/3), Veronica chamaedrys subsp. chamaedryoides (433/2, 434/2, 435/3), Taraxacum sp. (553/3, 656/3, 606/3), Ornithogalum montanum (434/3, 443/2, 445/2), Crupina crupinastrum (442/2, 443/2, 650/2), Origanum vulgare (348/3, 349/3, 510/2), Petrorhagia prolifera (347/3, 348/2, 312/3), Acer monspessulanum (425/2, 337/2, 347/3).
Taxa with 2 presences:
Minuartia stellata (588/2, 587/2), Scutelaria alpina (576/2, 579/2), Scilla bifolia (341/2, 659/3), Ornithogalum exscapum (552/2, 320/3), Medicago lupulina (317/3, 538/2), Helicotrichon agropyroides (561/3, 565/2), Brachypodium sylvaticum (425/3, 433/2), Dianthus biflorus(574/2, 439/3), Ornithogalum collinum (544/3, 518/2), Asperugo procumbens (530/2, 587/2), Bromus intermedius (566/5, 503/3), Aremonia agrimonoides (549/2, 502/2), Helleborus cyclophyllus (460/3, 320/5), Ranunculus psilostachys (504/2, 654/2), Stellaria media (320/3, 312/3), Holosteum umbellatum (653/2, 654/2), Sternbergia lutea (653/2, 654/2), Juniperus communis subsp. nana (656/2, 652/2), Plantago argentea (654/2, 652/2), Sorbus aria (655/2, 651/1), Malabaila involucrata (650/2, 651/2), Scrophularia canina subsp. bicolor (442/2, 443/2), Clinopodium vulgare (349/3, 651/2), Vicia tenuifolia (347/3, 349/3), Potentilla micrantha (337/3, 606/3).
Taxa with 1 presence:
Plantago lanceolata (653/2), Bromus hordaceus (651/2), Rumex tuberosus (651/2), Knautia integrifolia (650/2) Lapsana communis (349/2), Pimpinella tragium subsp. polyclada (349/2), Briza maxima (349/3), Trifolium aurantiacum (348/2), Arabis glabra (348/3), Selinum silaifolium (347/2), Thesium parnassi (653/2), Potentilla pedata (502/2), Cuscuta epithymum subsp. kotchyi (457/2), Lamium amplexicaule (435/2), Draba muralis (434/3), Rhagadiolus stellatus (337/3), Centaurea cyanus (320/3), Minuartia juniperina (656/2), Salvia argentea (654/2), Ornithogalum nutans (650/2), Colchicum graecum (650/2), Polypodium vulgare (474/2), Satureja parnassica subsp. parnassica (474/2), Teucrium montanum subsp. montanum (660/2), Galium divaricatum (660/2), Campanula radicosa (457/3), Dianthus tymphresteus (439/2), Taraxacum gracilens (587/2), Taraxacum cylleneum (495/3), Anthoxanthum odoratum (656/3), Sedum laconicum (651/2), Lotus corniculatus (358/3), Hieracium leithneri (583/2), Allium achaicum (576/2), Crepis incana (571/2), Corydalis solida subsp. incisa (509/3), Myosotis alpestris (509/2), Scabiosa taygetea (509/3), Hieracium pannosum (438/2), Lathyrus laxiflorus (438/2), Coronilla emerus subsp. emeroides (433/3), Buglossoides arvensis subsp. gasparinni (660/2), Asplenium trichomanis subsp. inexpectans (475/2), Allium phthioticum (317/3), Hordeum bulbosum (561/3), Nepeta argolica subsp. argolica (527/2), Arabis verna (428/2), Dianthus androsaceus (656/2), Trifolium repens (312/2), Sagina procumbens (469/2), Cardamine hirsute (425/2), Crepis foetida (425/3), Cyclamen hederifolium (606/2), Convolvulus arvensis (555/3), Senecio macedonicus (553/3), Capsella bursa-pastoris (512/2), Medicago sp. (312/3), Trifolium stellatum (312/3), Valeriana italica (312/2), Echinops sphaerocephalus subsp. alidus (347/3), Vicia hybrida (312/3).

Scabiosetosum ochroleucae has floristic resemblances with the association *Onobrychis ebenoides* var. *minor-Juniperus foetidissima*, described by Quézel (1973) in Vardoussia, also in *Stipo-Morinion* alliance. There, *Scabiosa crenata*, very related to *Scabiosa ochroleuca*, is reported as diagnostic of the association. Despite the floristic and ecological similarities, the diagnostic taxa of *Onobrychis ebenoides* var. *minor-Juniperus foetidissima* association are missing from our samplings.

The development of *Juniperetum foetidissimae* in two closely related mountains of Northern Peloponnese, up to the relatively "low" altitude of 1350 m, is related to the degradation of fir forest, after an anthropogenic impact. The rarefaction and the lowering of the upper fir forest treeline and the consequent soil degradation encourage the installation of *Juniperus foetidissima*. The competitive advantage of *Juniperus foetidissima* on limestone with shallow soil and large cover in bare rock is also increased by the smaller vulnerability of its young individuals in comparison with the young individuals of *Abies cephalonica*, to the effect of pasturage.

1.2.2. Communities with *Stipa pennata* subsp. *pulcherrima* (*Stipo-Morinion*, Tab. 2, columns S and H)

The columns S and H of Tab. 2 are composed from 19 samplings, which become from rocky places of summits Kallifoni, Barba and Profitis Ilias. They are characterized by the strong presence of *Stipa pennata* subsp. *pulcherrima*.

The differences of both groups are relatively small: Group S is characterized by the absence of the sequence with *Hippocrepis comosa*, *Minuartia confusa* etc. and it is developed mainly in the summits Barba and Profitis Ilias. *Sesleria vaginalis* has a strong presence. Group H is diagnosed by the floristic sequence with *Hippocrepis comosa*, *Erysimum cephalonicum* and *Minuartia confusa*, and is developed mainly in summit Kallifoni. The presence of *Sesleria vaginalis* and *Festuca cyllenica* is weaker, while *Stipa pennata* subsp. *pulcherrima* finds here its ecological optimum.

Stipa pennata subsp. *pulcherrima* is well known as a diagnostic taxon of *Stipo-Morinion* alliance and participates in many communities of Greek mountains.

According to Quézel (1964), it grows with a high constancy, in the associations *Scabiosa taygetea-Onosma leptanthum* Quézel 1964 (Taygetos) and *Galium lucidum-Ribes uva-crispa* Quézel 1964 (Killini).

It is also present in samplings of Georgiadis & Dimopoulos (1993) from Killini, as characteristic of *Stipo-Morinion*, in the associations *Juniperetum foetidissimae* Georgiadis & Dimopoulos 1993 and *Aceri monspessulanum-Prunetum mahaleb* Georgiadis & Dimopoulos 1993, with exceptional constancy and covers 1 - 2 (scale + to 5).

The behavior of *Sesleria vaginalis*, considered as a characteristic of *Astragalo-Seslerion*, is remarkable. It presents two ecological optima, the first in the association *Festuco politae-Festucetum cyllenicae* and the second in the communities of *Stipa pennata* subsp. *pulcherrima*, in smaller altitude. *Sesleria vaginalis* appears to prefer the relatively higher altitudes and also the rockiest places.

1.2.2.1. *Stipa pennata* subsp. *pulcherrima-Sesleria vaginalis* comm. (Tab. 2, column S)

The community is described by 10 samplings, carried out in the summits Barba and Profitis Ilias, in strongly rocky places, from 1600 to 1850 m, e.g. in the same altitudinal level with the association *Marrubio cyllenei-Astragaletum rumelici*. Consequently, the succession of two groups is based not on the altitude but on soil – substrate factors.

The present group is characterized by the absence of the sequence with *Hippocrepis comosa* and by the very strong presence of *Sesleria vaginalis* and *Festuca cyllenica* as well. It cannot also be included in the association rank because the two characteristic taxa are not fidele.

Sesleria vaginalis is a taxon that characterizes *Astragalo-Seslerion* alliance and presents its main ecological optimum in the association *Festuco politae-Festucetum cyllenicae.*

It was not possible to find more differentiating taxa, except perhaps from *Festuca spectabilis* subsp. *affinis*, which is characteristic of *Silenion caesiae* alliance (scree vegetation), and appears here in a secondary ecological optimum. That is due to the very rocky character of samplings sites.

The described community is included in the *Stipo–Morinion* alliance, due to the following diagnostic taxa: *Stipa pennata* subsp. *pulcherrima* (9/10), *Melica ciliata* (6/10), *Festuca jeanpertii* (5/10), *Malcolmia graeca* subsp. *bicolor* (8/10), *Teucrium chamaedrys* subsp. *chamaedrys* (4/10), *Pterocephalus perennis* subsp. *perennis* (3/10), *Scutellaria rupestris* subsp. *parnassica* (3/10), *Achillea fraasii* (3/10), *Morina persica* (3/10), *Asphodeline lutea* (3/10) and *Ajuga orientalis* (1/10).

Eryngio-Bromion is represented quite strongly by the taxa: *Astragalus creticus* subsp. *rumelicus* (8/10),

Marrubium cylleneum (8/10), *Carduus tmoleus* (8/10), *Cirsium hypopsilum* (8/10), *Eryngium amethystinum* (6/10), *Galium thymifolium* (5/10), *Dasypyrum hordaceum* (2/10) etc.

Astragalo-Seslerion is represented weakly, mainly from *Sesleria vaginalis* (9/10) and *Tragopogon crocifolius* subsp. *samaritanii* (3/10).

Samplings 317, 474 and 475 have been carried out in Profitis Ilias, in eastern slopes, and represent very powerfully rocky biotopes, where the vegetation is developed in small slots and holes of limestone parental rock. They are characterized by the presence of *Asphodeline lutea* and *Vincetoxicum hirundinaria* subsp. *nivale*, which is a nitrophilous species, probably related with the presence and nesting of birds (field observations).

1.2.2.2. *Hippocrepis comosa-Stipa pennata* subsp. *pulcherrima* comm. (Tab. 2, column H)

Stipa pennata subsp. *pulcherrima-Hippocrepis comosa* community has a distinct floristic sequence, with the homonymous taxa (9/9 and 6/9 respectively), together with *Erysimum cephalonicum* (7/9), *Minuartia confusa* (4/9), *Helictotrichon aetolicum* (3/9), *Narcissus poeticus* (2/9) and *Secale montanum* (2/9). It is mainly developed in Kallifoni, where is the dominating type of rocky meadows, and in certain places of summit Barba. The presence of *Sesleria vaginalis* and *Festuca cyllenica* is weak, while *Stipa pennata* subsp. *pulcherrima* has large covers.

The described community is developed in habitats similar to those of *Stipa pennata* subsp. *pulcherrima-Sesleria vaginalis* comm., in a little higher altitude and in slightly smaller covers of bare rock.

It is also included in *Stipo-Morinion* alliance, in the base of the following diagnostic taxa: *Stipa pennata* subsp. *pulcherrima* (9/9), *Melica ciliata* (5/10), *Festuca jeanpertii* (6/9), *Malcolmia graeca* subsp. *bicolor* (7/9), *Teucrium chamaedrys* subsp. *chamaedrys* (3/9), *Pterocephalus perennis* subsp. *perennis* (3/9), *Achillea fraasii* (2/9), *Ajuga orientalis* (3/9), *Scorzonera mollis* subsp. *mollis* (3/9), *Asphodeline lutea* (1/9) and *Morina persica* (1/9).

Eryngio-Bromion is represented by *Astragalus creticus* subsp. *rumelicus* (2/9), *Marrubium cylleneum* (9/9), *Carduus tmoleus* (3/9), *Cirsium hypopsilum* (6/9), *Eryngium amethystinum* (7/9), *Galium thymifolium* (6/9), *Bromus cappadocicus* subsp. *lacmonicus* (5/9), *Campanula spatulata* subsp. *spatulata* (3/9) etc. and *Astragalo-Seslerion* by *Sesleria vaginalis* (6/9) and *Tragopogon crocifolius* subsp. *samaritanii* (2/9).

1.2.3. *Marrubio cyllenei-Astragaletum rumelici* ass. nova hoc loco (*Eryngio-Bromion*, Tab. 2, columns A and Ac, holotypus rel. 460)

The association *Marrubio cyllenei-Astragaletum rumelici* ass. nova is very widespread in Erimanthos and it was recorded in many samplings, carried out in the main mass of the mountain complex: Olenos, Neraidovouni and Barba. The complete absence of *Astragalus creticus* subsp. *rumelicus* from the eastern summits is remarkable.

It is developed from 1430 up to 2000 m., with its optimal development from 1600 to 1850 m. From 1800 m to higher altitudes it is gradually succeeded by *Festuco politae-Festucetum cyllenicae* association.

It is generally developed on places with a small cover in bare rock, with relatively deep soil, while sometimes it is also located in radiolarite, or in places that have received material from the erosion of radiolarite rocks. In this case, the ground has characteristic red color. The cover of parental rock is, as a rule, small and the slopes gentle, while *Festuco politae-Festucetum cyllenicae* association and the communities of *Stipa pennata* subsp. *pulcherrima* are connected with steeper slopes.

The association *Marrubio cyllenei-Astragaletum rumelici* is dominated by *Astragalus creticus* subsp. *rumelicus*, *Eryngium amethystinum* and *Dasypyrum hordaceum*. The shrub layer is constituted by *Astragalus creticus* subsp. *rumelicus*, *Marrubium cylleneum*, *Daphne oleoides*, *Cerastium candidissimum* etc. The layer of high herbs is constituted by *Dasypyrum hordaceum*, *Trisetum flavescens*, *Melica ciliata*, *Bromus cappadocicus* subsp. *lacmonicus*, together with a number of thorny perennials, as *Cirsium hypopsilum*, *Eryngium amethystinum*, *Carduus tmoleus*, *Ptilostemon afer* etc.

The diagnostic taxa are *Astragalus creticus* subsp. *rumelicus* (29/31), *Marrubium cylleneum* (25/31), *Dasypyrum hordaceum* (23/31) and *Erysimum pectinatum* (11/31), which have in the mentioned group their ecological optimum. *Lolium perenne* (9/31) and *Digitalis ferruginea* (6/31) are differentiating the syntaxon in Tab. 2.

The described syntaxon is clearly included in *Eryngio – Bromion* alliance, in the base of the following diagnostic taxa: *Carduus tmoleus* (20/31), *Cirsium hypopsilum* (24/31), *Eryngium amethystinum* (27/31), *Galium thymifolium* (10/31), *Galium taygeteum* (22/31), *Campanula spatulata* subsp. *spatulata* (16/31) and

Bromus cappadocicus subsp. *lacmonicus* (8/31).

Stipo-Morinion and *Astragalo-Seslerion* are represented very weakly, with the exception of *Melica ciliata* (12/31), *Malcolmia graeca* subsp. *bicolor* (8/31), *Stipa pennata* subsp. *pulcherrima* (6/31) and *Tragopogon crocifolius* subsp. *samaritanii* (9/31).

It is remarkable that *Dasypyrum hordaceum* is growing in Greece only in Erimanthos and Taygetos and it is developed in the research area exclusively in the communities of the described syntaxon, with particularly high covers.

Classification and ordination of samplings have showed the existence of two subgroups in the association *Marrubio cyllenei-Astragaletum rumelici*:

The typical subgroup (Tab. 2, group A) is characterized by the relatively weak presence of *Dasypyrum hordaceum* (6/13) and the absence of the floristic sequence with *Cachrys ferrulacea, Ribes uva-crispa, Scandix macroryncha, Ornithogalum oligophyllum* and *Crataegus orientalis*. The subgroup with *Cachrys ferrulacea* is characterized by the above mentioned floristic sequence and the strong presence of *Dasypyrum hordaceum* (Tab. 2, column Ac). It is developed in lower altitude than the typical subgroup.

The samplings 67 - 74 have been carried out in places that suffer very strong pasturage (near shielings) and *Cachrys ferrulacea* has there very large covers. In the summer, since middle July, the formations of *Cachrys ferrulacea* remain with a very small total cover, because this annual subshrub gets drained and carried away by the wind.

Various shrubby taxa of *Astragalus* and *Marrubium* dominate in the rocky meadows of Greek mountain and many associations with their domination have been described.

Quézel (1964) described the association *Astragalus cylleneus-Cirsium cylleneum* (=*Cirsium hypopsilum*), from Mount Killini. Quézel and Katrabassa (1974) documented its existence in the neighboring Mount Chelmos, while Dimopoulos (1993) suggested the association *Astracantho thracicae-Marrubietum cyllenei*, as a new combinatio of *Astragalus cylleneus-Cirsium cylleneum* association. However, *Astragalus cylleneus* is a local endemic of Chelmos and Killini, while diagnostic taxa as *Centaurea triumfetti* and *Sideritis clandestina* do not exist in the samplings made in Erimanthos. Furthermore, the present data suggest that *Cirsium hypopsilum* (=*C. cylleneum*) seems better as an alliance than an association diagnostic (Tab. 2).

Quézel (1964) also described the association *Astragalus creticus* subsp. *rumelicus-Marrubium velutinum* from mountains Parnassos and Giona. The last syntaxon is also characterized by the domination of *Astragalus creticus* subsp. *rumelicus*, together with *Marrubium velutinum*, a taxon closely related to *Marrubium cylleneum*. Concerning the association diagnostics, *Centaurea affinis* although present in Erimanthos is growing in different habitats (e.g. rock crevices – Tab. 3), and *Astragalus apollineus* is absent. Nevertheless, it is obvious that the mentioned association is ecologically similar to *Marrubio cyllenei-Astragaletum rumelici*.

Quézel (1967) also described the association *Marrubio thessali-Astragaletum angustifolii* from Mount Olympos, which has been also found by Bergmeier (1990) in Mount Kato Olympos.

The association *Marrubio cyllenei-Astragaletum rumelici* is vicariant (ecologically analogous) to the *Astragalus creticus* subsp. *rumelicus-Marrubium velutinum* association. It is developed in similar habitats and presents physiognomic and floristic resemblances. It is also closely related to the association *Astragalus cylleneus-Cirsium cylleneum* Quézel and Katrabassa 1974, of Mounts Killini and Chelmos. However, its unique combination of diagnostic taxa, the particular presence of the African taxon *Dasypyrum hordaceum* and the absence of Quézel's diagnostic taxa, lead us to characterize it as a new association.

1.2.4. *Festuco politae-Festucetum cyllenicae* ass. nova hoc loco (*Eryngio-Bromion*, Tab. 2, column F, holotypus rel. 509)

The association *Festuco politae-Festucetum cyllenicae* dominates from 1750 to 2200 m (with a mean of 1924 m) in the summits Olenos, Barba, Neraidovouni and Profitis Ilias, as long as the slope increases. It is developed on limestone bents, with strong or intermediate slope, where the parental rock has usually not large cover (the cover of bare rock oscillates from 5 to 40%), in soils of rendzina type, little evolved.

It is dominated by *Festuca cyllenica* dense tussocks, in a cover of 60 - 100% and a height of 50 - 120 cm, together with *Festuca polita* and *Sesleria vaginalis*. *Daphne oleoides, Cerastium candidissimum, Galium thymifolium* and *Sideritis clandestina* are the dominating shrubs, while there exists a sublayer of very short herbs, with *Campanula albanica* subsp. *albanica, Silene multicaulis* subsp. *multicaulis, Minuartia attica* subsp. *attica, Allium frigidum, Carum graecum* subsp. *graecum, Poa thessala* etc.

Festuca cyllenica (29/29), *Festuca polita* (24/29),

Allium frigidum (18/29), *Campanula albanica* subsp *albanica* (14/29), *Silene multicaulis* subsp. *multicaulis* (11/29), *Sideritis clandestina* subsp. *peloponnesiaca* (7/29), *Geocaryum peloponnesiacum* (5/29) and *Silene vulgaris* subsp. *prostrata* f. *pubigera* (3/29) are the diagnostic taxa of the association.

Festuco politae-Festucetum cyllenicae is classified in *Eryngio – Bromion* alliance, due to the diagnostic taxa *Carduus tmoleus* (23/29), *Galium thymifolium* (20/29), *Galium taygeteum* (16/29), *Astragalus creticus* subsp. *rumelicus* (15/29), *Campanula spatulata* subsp. *spatulata* (15/29), *Cirsium hypopsilum* (12/29), *Bromus cappadocicus* subsp. *lacmonicus* (11/29), *Marrubium cylleneum* (3/29), *Eryngium amethystinum* (4/29) etc.

Astragalo-Seslerion is represented mainly by *Sesleria vaginalis* (23/29), which obviously finds there its ecological optimum, as well as by *Tragopogon crocifolius* subsp. *samaritanii* (7/29) and *Veronica sartoriana* (3/29).

Communities dominated by taxa of *Festuca varia* group, have been also described by some other researchers:

Quézel & Katrabassa (1974) have described the subassociation *Astragalus cylleneus-Marrubium cylleneum festucetosum variae* (*Eryngio-Bromion* alliance), with 9 samplings (page 17, Tab. 3) in the neighbouring Mount Chelmos, in altitudes close to 1900 m, where together with *Festuca varia* (*F. cyllenica* or *F. graeca*) are also growing *Juniperus communis* subsp. *hemisphaerica*, *Minuartia attica* subsp. *attica, Silene multicaulis* subsp. *multicaulis*, *Asyneuma limonifolium*, *Veronica sartoriana* etc. The presence of *Astragalus cylleneus* and *Marrubium cylleneum* is quite weak (4/9 and 0/9 respectively). *Astragalo-Seslerion* diagnostics have also weaker presence, with the exception of *Sesleria vaginalis*.

The same subassociation is also recorded by Georgiadis & Dimopoulos (1993) in Mount Killini, in altitude higher than 1750 metres, with an important presence of *Astragalus angustifolius*.

As resulted from classification and ordination analyses, the association *Festuco politae-Festucetum cyllenicae* in Erimanthos is, floristically, exceptionally homogeneous (Fig. 1) and has important floristic differences from the association *Marrubio cyllenei-Astragaletum creticae*, which is developed in clearly gentler slopes and lower altitudes. Nevertheless, the samplings 521, 544, 495, 458, 543 (28-32) have quite large covers of *Astragalus creticus* subsp. *rumelicus* and they can be considered transient to the association *Marrubio cyllenei-Astragaletum rumelici.*

The described syntaxon has floristic resemblances with the association *Festuco cyllenicae-Asperuletum boissieri* Georgiadis & Dimopoulos 1993, described from Mount Killini and included clearly in *Astragalo–Seslerion* alliance.

Furthermore, Quézel (1967) described the association *Festuca varia-Marrubium velutinum* subsp. *haussknechtii* (*Eryngio-Bromion*) from central Pindos, with four subassociations, with large enough floristic differences from *Festuco politae-Festucetum cyllenicae.*

The recent typification of *Seslerio achtarovii – Festucetum variae* (*Astragalo-Seslerion*) in Mount Pangeon, by Karagiannakidou et al. (2001), with the domination of *Festuca varia*, is also interesting.

2. Scree vegetation: *Valantia aprica-Scrophularia myriophylla* comm. (*Silenion caesiae*, Tab. 2, column D)

Many screes exist in Erimanthos, even at low altitude, as it happens in the steep western slopes of Neraidovouni and Melissovouni (in an altitude of 900 m).

Scree communities are composed by a small number of characteristic taxa, particularly adapted in the extreme environmental conditions that they face (difficulty of mechanic support, frequent landslips, small availability of water etc.).

In the sites of lower altitude, up to 1650 m (e.g. samplings 425-428), the aspect of the communities is given by *Drypis spinosa*, together with *Urtica dioica*, while in higher altitudes *Festuca spectabilis* subsp. *affinis* dominates in relatively large covers.

The scree vegetation of Erimanthos is differentiated mainly by *Valantia aprica* (11/14), *Scrophularia myriophylla* (10/14) and *Urtica dioica* (7/14) and is included in class *Thlaspietea rotundifolii*, order *Drypidetalia spinosae* and alliance *Silenion caesiae,* as it happens in the majority of Balkan Mountains. Diagnostic taxa of higher syntaxonomic ranks are *Drypis spinosa* (14/14), *Festuca spectabilis* subsp. *affinis* (8/14), *Silene caesia* (6/14), *Senecio thapsoides* (10/14) and *Ptilostemon afer* (7/14).

Valantia aprica and *Scrophularia myriophylla* are also characteristic of *Silenion caesiae* and they have been used for the description of other scree communities:

Quézel (1964) described a communitiy with *Scrphularia myriophylla* and *Drypis spinosa* from Mount Killini, without *Valantia aprica.*

Valantia aprica is a diagnostic taxon of the association *Minuartio juniperinae-Valantietum apricae* Quézel 1964, described from the mountains Taygetos and

Killini.

Georgiadis & Dimopoulos (1993) identified the association *Scrophulario myriophyllae-Thamnosciadietum juncei* also in Mount Killini, where *Valantia aprica* has a strong presence.

Valantia aprica-Scrophularia myriophylla comm. is developed from 900 to 1900 m, on typical, non-stabilized or slightly stabilized screes, with stones of intermediate size and slopes between 40 - 65°. Samplings 511, 540, 531, 537 and 567 have been made in relatively more stabilised sites, where *Festuca cyllenica* and *Astragalus creticus* subsp. *rumelicus*, particularly the first, have relatively large covers. This is documenting that screes tend to be stabilised and progressively evolute to a kind of stony meadow, after the invasion of *Festuca cyllenica* and *Astragalus creticus* subsp. *rumelicus* in them.

3. Chasmophytic communities

The set of 85 samplings has been analysed with TWINSPAN, and complementarily ordained with DCA (Fig.2). The axis 1 of DCA offers the most of information and is strongly correlated to the altitude, with the more alticole community (*Hieracio leithneri – Saxifragetum paniculatae* association) in the left part and the less alticole (*Inulo parnassicae-Ptilostemetum chamepeuce* association) in the right. The second axis does not offer considerable information.

3.1. Communities of *Campanulion versicoloris* alliance (order *Onosmetalia frutescentis*)

The order *Onosmetalia frutescentis* and the alliance *Campanulion versicoloris* were fixed by Quézel (1964) and they are including the chasmophytic communities of Southern Greece, in altitudes up to 1500 m.

A few researchers described more communities of *Campanulion versicoloris*: Dimopoulos (1993), Georgiadis and Dimopoulos (1993), Karetsos (2002), Theocharopoulos *et al.* (2001) etc., while Dimopoulos *et al.* (1997) have also made a synoptic study of the mentioned communities in Greece.

Communities of the following chapters are included in *Onosmetalia frutescentis* and *Campanulion versicoloris*, due to the strong presence of diagnostics *Campanula versicolor, Silene congesta, Onosma frutescens, Asperula lutea, Carum multiflorum,*

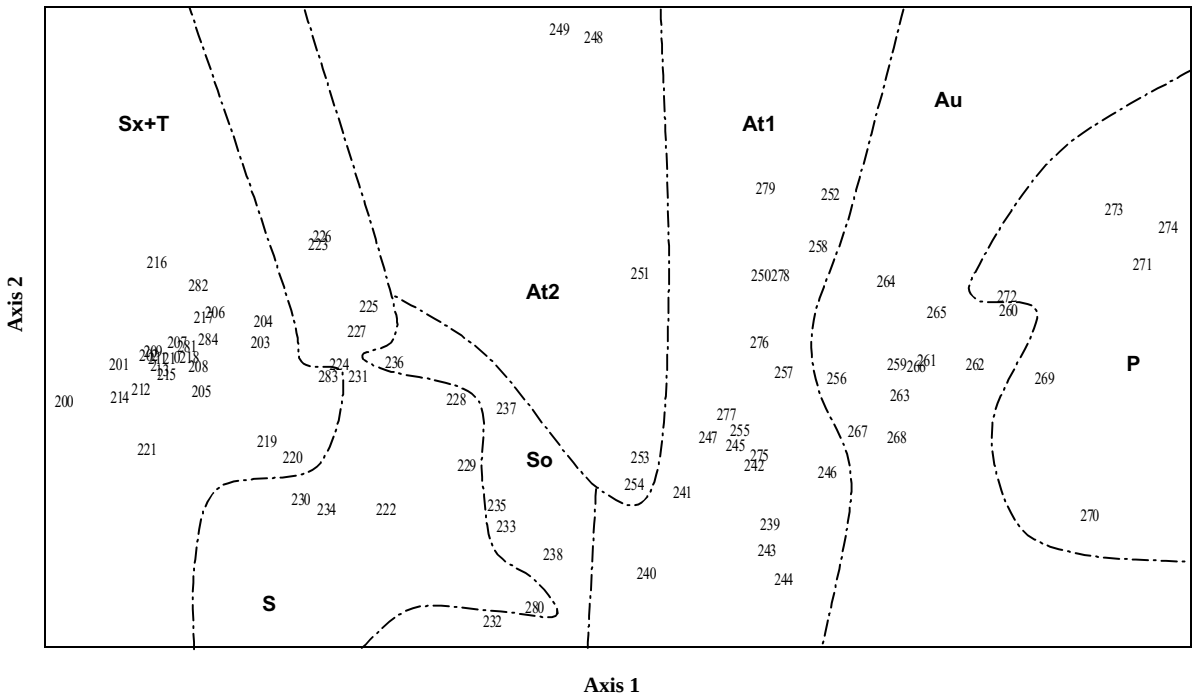

Fig. 2 - DCA plot of 85 *Asplenietea trichomanis* samplings. (Inertia: 5.836, eigenvalue ax.1: 0.758, eigenvalue ax.2: 0.232). T: *Minuartia stellata-Teucrium montanum* comm., Sx: *Hieracio leithneri -Saxifragetum paniculatae*, S: *Aurinio moreanae-Seseletum aroanici*, So: *Asplenium trichomanes* subsp. *inexpectans-Sorbus aria* comm., At1: *Saxifrago chrysosplenifoliae-Athamantetum macedonicae* typical subgroup, At2: *Saxifrago chrysosplenifoliae-Athamantetum macedonicae* subgroup with *Dianthus pinifolius* subsp. *lilacinus*, Au: *Aubrieta deltoidea-Peucedanum achaicum* comm., P: *Inulo parnassicae-Ptilostemetum chamepeuce*

Cephalaria ambrosioides etc.

In *Campanulion versicoloris* alliance two floristic 'trends' were distinguished: the less alticole is characterized by *Inula verbascifolia* subsp. *parnassica*, *Aurinia saxatilis* subsp. *orientalis*, *Centranthus ruber*, *Carum multiflorum* and *Ephedra phoeminea*, while the more alticole is characterized by *Athamanta macedonica*, together with *Arabis alpina* subsp. *caucasica*, *Saxifraga chrysosplenifolia* etc.

Most samplings have been made in the western slopes of the mountain, which are particularly steep and ascent exceptionally abruptly from 700 up to 1500 m or more.

3.1.1. The association *Inulo parnassicae-Ptilostemetum chamaepeuce* Theocharopoulos *et al.* 2001 (*Campanulion versicoloris*, Tab. 3, column P)

The association *Inulo parnassicae-Ptilostemetum chamaepeuce* is very widespread in S Greece and it was described by Theocharopoulos *et al*. (2001) in the northern part of Corinthian gulf (region from Nafpactos to Itea).

In Erimanthos it is developed on limestones rocks of western slopes (near settlements Alepohori and Greveno), up to 650 m. It is clearly related to the sites of higher temperature and was always found in sunny, west expositions. It was also recorded in the western slopes of the neighboring small mountain Santameri (west of Erimanthos), where 3 more samplings have been made.

Inula verbascifolia subsp. *parnassica*, *Ptilostemon chamaepeuce*, *Campanula versicolor*, *Onosma frutescens*, *Aurinia saxatilis* subsp. *orientalis* and *Pistacia terebinthus* dominate, and the presence of *Ptilostemon chamepeuce*, gives a quite shrubby appearance in the denser formations.

Inula verbascifolia subsp. *parnassica* (=*Inula parnassica*, 5/6), *Ptilostemon chamaepeuce* (6/6) and *Salvia pomifera* subsp. *calycina* (4/6), are diagnostic taxa, while in Santameri an interesting subgroup with *Centaurea niederi*, a S Greek endemic taxon of Red Data Book (Phitos *et al*., 1995) and European Commission directive 92/43 (Dafis et al. 1996) is developed. The peloponnesian endemic *Galium violaceum* is also differentiating.

Inula verbascifolia, as the related taxa of genus *Inula* (*I. candida*, *I. heterolepis* etc.) is a strictly chasmophytic taxon of the southern continental Greece and Ionian islands. *Inula verbascifolia* subsp. *parnassica* is located generally in W Greece and Ionian islands, while *Inula verbascifolia* subsp. *methanaea* in E Greece. It is strongly connected to the communities of *Campanulion versicoloris* and it is recorded (as *I. candida*) with an important constancy in all phytosociological tables of Quézel (1964). In the same tables, the presence of *Ptilostemon chamaepeuce* is weaker, as it appears that it is a more thermophilous taxon, with limited presence in continental places and sites with altitude higher than 500 m.

The samplings cited in the original description of syntaxon (Theocharopoulos *et al*., 2001) have a floristic composition very similar to the described group (Tab. 3). The same researchers described also the subassociation *salvietosum trilobae*. The related *Salvia pomifera* subsp. *calycina* participates also in the floristic composition of syntaxon in Erimanthos and Santameri.

Horvat *et al*. (1974) described a number of chasmophytic communities from Aegean islands (Crete, Karpathos, Rhodes, Samos, Ikaria and Sporades) included in the order *Cirsietalia chamaepeucis* Horvat in Horvat, Glavac & Ellenberg 1974 (*Cirsium chamaepeuce* = *Ptilostemon chamaepeuce*). Many of them are characterized by the domination of *Ptilostemon chamaepeuce*, together with *Inula heterolepis* and they can be considered ecologically analogous to *Inulo parnassicae-Ptilostemetum chamaepeuce*, despite their large number of Aegean taxa.

Karetsos (2002) described the community *Inula candida* subsp. *limonella* from Mount Iti, in altitudes from 200 up to 500 m, without the presence of *Ptilostemon chamaepeuce* (probably because Iti is a strongly continental mountain), while *Inula candida* participates also in the floristic composition of Northern Greek communities, as the association *Ramonda nathalia-Campanula formanekiana* Quézel 1967 of Mount Vermio.

It is obvious that *Inula verbascifolia* subsp. *parnassica* is a taxon dominating in the lower altitudinal levels of *Campanulion versicoloris*. In the research area it is developed up to 1000 m, with local appearances up to 1450 m. Nevertheles it has its ecological optimum up to 600 – 700 m, in the formations of *Inulo parnassicae-Ptilostemetum chamaepeuce*.

3.1.2. *Aubrieta deltoidea-Peucedanum achaicum* comm. (*Campanulion versicoloris*, Tab. 3, column Au.)

The community *Aubrieta deltoidea-Peucedanum achaicum* is developed in the western and southern slopes of the mountain, between 700 and 1100 m, in limestone rocks, occasionally rich in radiolarite material.

It is a community located in the transition zone,

between the less alticole community of *Campanulion versicoloris* (*Inulo parnassicae-Ptilostemetum chamaepeuce*) and the more alticole one (*Saxifrago chrysosplenifoliae-Athamantetum macedonicae*).

Silene congesta (which has there its optimal growth), *Aubrieta deltoidea*, *Campanula versicolor*, *Aurinia saxatilis* subsp. *orientalis* and locally *Inula verbascifolia* subsp. *parnassica* are the dominating taxa. *Aubrieta deltoidea* has a locally large cover, in places where limestone layers have a horizontal arrangement. There exists a relatively large quantity of soil and many adhesion points.

It is differentiated by *Aubrieta deltoidea* (9/11), *Peucedanum achaicum* (6/11), *Ephedra foeminea* (8/11) and *Teucrium flavum* subsp. *hellenicum* (7/11), which find there an ecological optimum. It is also differentiated by the absence of diagnostic taxa of the related *Campanulion versicoloris* communities.

The described community is clearly included in order *Onosmetalia frutescentis* and alliance *Campanulion versicoloris*, due to the strong presence of the diagnostic taxa *Onosma frutescens* (11/11), *Silene congesta* (10/11), *Campanula versicolor* (11/11), *Inula verbascifolia* subsp. *parnassica* (10/11), *Aurinia saxatilis* subsp. *orientalis* (8/11), *Carum multiflorum* (7/11) etc.

It is interesting that *Peucedanum achaicum* is an endemic taxon of Northern Peloponnese with very restricted distribution (only in mountains Erimanthos, Chelmos and Panachaiko).

Aubrieta deltoidea is a taxon quite widespread in Erimanthos. It grows from 600 up to 1800 m, in vertical rocks and in a lesser extent in rocky meadows. It finds its ecological optimum between 700 and 1100 m, in limestone and radiolaritic rocks.

Georgiadis & Dimopoulos (1993) reported the association *Asperulo arcadiensis-Hypericetum vesiculosi* Quézel 1964 from Mount Killini and put it in a new status, where *Aubrieta deltoidea* is exceptionally abundant and dominates together with *Asperula arcadiensis*, *Silene congesta*, *Campanula versicolor*, *Inula verbascifolia* subsp. *parnassica* etc. The mentioned syntaxon has quite large floristic resemblances with the one described here, even if it is developed in higher altitudes (1320 – 1750 m). However, these similarities are mainly due to order and alliance diagnostics, while the complete absence of *Asperulo arcadiensis-Hypericetum vesiculosi* diagnostic taxa and the very local distribution of *Peucedanum achaicum* does not permit to include the recorded group in this last association.

3.1.3. *Saxifrago chrysosplenifoliae – Athamantetum macedonicae* ass. nova hoc loco, (*Campanulion versicoloris*, Tab. 3, columns At1 & At2, holotypus sampl. 247)

Saxifrago chrysosplenifoliae-Athamantetum macedonicae is a distinct phytosociological unit, developed in western and northern slopes, from 700 up to 1450 m, on limestone rocks.

It can be diagnosed by *Athamanta macedonica* (23/24), *Saxifraga chrysosplenifolia* (14/24) and *Umbilicus chloranthus* (7/24) and it is included in the alliance *Campanulion versicoloris*, due to the alliance diagnostic taxa: *Athamanta macedonica*, *Cephalaria ambrosioides* (8/24), *Campanula versicolor* (23/24), *Silene congesta* (14/24), *Onosma frutescens* (12/24) etc.

Although the more thermophilous taxa of *Campanulion versicoloris* (*Centranthus ruber, Aurinia saxatilis* subsp. *orientalis*, *Inula verbascifolia* subsp. *parnassica* etc.) are not present, the presence of *Potentilletalia speciosae* taxa is very weak, with the exception of *Achillea holosericea* (11/24).

The absence of the typical diagnostic taxa of *Campanulion versicoloris* allows the localisation of a particular 'trend' inside the mentioned alliance, with the domination of *Athamanta macedonica*, *Arabis alpina* subsp. *caucasica*, *Saxifraga chrysosplenifolia* and *Umbilicus chloranthus*. Nevertheless, for the determination of an alticole suballiance of *Campanulion versicoloris* more data are needed.

The described syntaxon is presented in two subgroups: the typical subgroup (with *Arabis alpina* subsp. *caucasica*) and the subgroup with *Dianthus pinifolius* subsp. *lilacinus*.

The typical (*Arabis alpina* subsp. *caucasica*) subgroup

The typical subgroup colonizes only limestone rocks and is characterized by *Arabis alpina* subsp. *caucasica* (16/19), *Valeriana italica* (= *V. dioscoridis*, 10/19), *Opopanax hispidus* (4/19) and *Tilia cordata* (3/19).

It is dominated by *Athamanta macedonica*, *Campanula versicolor*, *Arabis alpina* subsp. *caucasica*, *Festuca jeanpertii*, *Silene congesta* etc.

It is the most alticole community of *Campanulion versicoloris*, developed even in the northern slopes of Kallifoni, up to 1450 m.

The neighborhood of forest results to the presence of many trees and shrubs, locally with a large cover: *Tilia cordata*, *Ostrya carpinifolia*, *Fraxinus ornus* etc. It is

possible for the mentioned subgroup to develope even in rocks found inside the forest, even with a clearly weaker presence of chasmophytes.

The subgroup with *Dianthus pinifolius* subsp. *lilacinus*

In western slopes of summit Neropouli and in northern slopes of summit Melissovouni, a distinct subgroup of association *Saxifrago chrysosplenifoliae-Athamantetum macedonicae* is met, differentiated and dominated by *Silene radicosa* (5/5) and *Dianthus pinifolius* subsp. *lilacinus* (4/5). It colonizes limestone rocks, rich in radiolaritic material, with a horizontal stratification of layers and a relatively large quantity of soil between the rock layers. It is developed from 1200 up to 1400 m.

Silene radicosa is a Balkan taxon, the presence of which is surprising enough in steep rocks of *Campanulion versicoloris*. It colonizes, more usually, communities with *Juniperus foetidissima,* (mountains Erimanthoss and Killini), communities with *Crataegus pycnoloba* (Chelmos) and limestone rocks of *Silenion auriculatae* (Erimanthos).

Dianthus pinifolius subsp. *lilacinus* is also a Balkan endemic, with weak presence in Peloponnese.

Saxifrago chrysosplenifoliae-Athamantetum macedonicae is characterized by the presence of many northern origin taxa:

Athamanta macedonica is a taxon of W Balkan and Italy, with strong presence in chasmophytic communities of western Sterea Hellas and Ipiros. Similar spread (Balkans and Italy) has also *Valeriana italica*, while *Saxifraga chrysosplenifolia, Dianthus pinifolius* subsp. *lilacinus, Silene radicosa* and *Cephalaria ambrosioides* are limited in Balkan peninsula. *Arabis alpina* subsp. *caucasica* has also a northern origin.

Some diagnostic taxa of *Saxifrago chrysosplenifoliae-Athamantetum macedonicae* (Tab. 3) are also present in phytosociological tables of previous researchers (Quézel, 1964; Georgiadis & Dimopoulos, 1993 etc.), nevertheless the described syntaxon has a unique floristic composition and clear ecological preferences.

Chasmophytic plant communities dominated by *Athamanta macedonica* are not uncommon in the mountains of W Greece (field observations). Nevertheless, very few related communities have already been described.

The Peloponnesian association *Hyperico vesiculosi - Asperuletum arcadiensis* Quézel 1964, found also by Dimopoulos (1993) in Mount Killini, is a related community of *Campanulion versicoloris,* with some floristic resemblances, developed also in the higher altitudinal levels of the alliance.

In the base of unpublished data and field observations of both writers, it is estimated that ecologically analogous communities must be developed in rock crevices of similar altitude in regions of western Sterea Hellas and Ipiros.

3.2. Communities of alliance *Silenion auriculatae* (order *Potentilletalia speciosae*)

The first important research on the phytosociology of chasmophytic communities in altitudes higher than 1500 m has also been made by Quézel (1964). He fixed the order *Potentilletalia speciosae* from the mountains of southern Balkan and the alliance *Silenion auriculatae* from the mountains of southern and central continental Greece. In the same paper he described a number of associations, developed in the mountains of S Greece. The only note he made about Erimanthos is the estimate that the association *Minuartia stellata-Valeriana olenaea,* firstly described in Killini, should also be developed there.

The same researcher described the communities of *Potentilletalia speciosae,* developed in Vardoussia (1973), as well as in Pindos, Olympos and Vermio (1967), where he described a second alliance, *Galion degenii.*

Quézel and Katrabassa (1974) described chasmophytic communities from the neighboring Chelmos, included also in *Silenion auriculatae.*

The communities of *Potentilletalia speciosae* that have been described in Greece, present quite large resemblances in their floristic composition with the communities described here. Taxa as *Minuartia stellata, Potentilla speciosa, Saxifraga sempervivum, Hieracium pannosum, Satureja parnassica* etc. are common in both cases. Nevertheless, in the order *Potentilletalia speciosae,* despite the small number of dominating taxa, it seems possible that a large number of communities can be described, because of the high percentage of local endemic taxa and the genetic isolation of the high summits between them. This leads to a statistically important differentiation in the floristic composition of rock crevices, even of two neighboring mountains.

3.2.1. *Sorbus aria-Asplenium trichomanes* subsp. *inexpectans* comm. (*Silenion auriculatae,* Tab. 3, column So)

Tab. 3 - Chasmophytic communities of *Asplenietea trichomanis* (85 samplings).

	T	Sx	S	So	At	At	Au	p	
Number of sampling	22222	22222222222222222222	222222222222	222222	2222222222222222222	22222	22222222222	222222	P
	00000	00000111111111112128888	822222233322	333333	4444434455777745755	44555	56666656666	677777	r
	01234	576890123456781903412	023456701489	235678	3401295657567870982	89134	64012395678	901234	e
									s
Increasing number	00000	00001111111111222222	222333333333	344444	4444455555555556666	66666	67777777777	888888	e
	12345	67890123456789012345 6	789012345678	901234	5678901234567890123	45678	90123456789	012345	n
									c
Altimeter (m x 10)	22221	12222222222221111111	111111111111	111111	1111100111111111111	11111	11000100000	000000	e
	11009	900100001111199689989	889999687644	556654	3344379100012211222	22244	41999089997	666555	
	00758	800305870075305703780	000000500255	580350	0003500000000050550	50500	50000005555	000577	
Teucrium montanum — Satureja parnassica subsp. parnassica comm.									
Satureja parnassica parnassica	-2-22	1---------------3----	----2-------	------	-------------------	-----	-----------	------	6
Teucrium montanum	3333-	----------	----------3-	------	-------------------	-----	-----------	------	5
Rhamnus saxatilis prunifolia	-2-22	----------	-----2------	------	-------------------	-----	-----------	------	4
Iberis sempervirens	--22-	----------	-----2----2-	------	-------------------	-----	-----------	------	4
Hieracio leithneri — Saxifragetum paniculatae									
Saxifraga paniculata	-----	-23233332232-3-2-3255	--------223-	-232-2	--3----------------	-----	-----------	------	22
Hieracium leithneri	----2	3-3--333322-52-2--32-	--3-22----2-	------	-------------------	-----	-----------	------	16
Saxifraga sempervivum	-----	2 223-3222333 32--23-	------2-----	---3--	-------------------	-----	-----------	------	14
Galium incanum	---2-	22--3322333---2------	----------	------	-------------------	-----	-----------	------	11
Euphorbia herniarifolia	--2--	2---22-----22-2------	--2------2--	-----2	-------------------	-----	-----------	------	10
Cotoneaster integerrimus	--2--	-----2---3-2---22-21-	-------2----	--2---	-------------------	-----	-----------	------	10
Scutellaria alpina	-----	---2-2322232---------	----------	------	-------------------	-----	-----------	------	8
Arabis bryoides	-----	223----------------2-	-2----------	------	-------------------	-----	-----------	------	4
Cymbalaria microcalyx minor	-----	-------2-2--3--------	----------	------	---2---------------	-----	-----------	------	4
Aurinio moreanae - Seseletum aroanici									
Koeleria lobata	333-2	2----------2-------	-3335333--2-	22---2	-------------------	---33	-2---------	------	20
Aurinia moreana	---3-	3--2----------------	---32233--22	-----2	-------------------	---22	-----------	------	13
Teucrium chamaedrys chamaedrys	--322	-------------2------	-2233----23-	-2----	-------------------	-----	-----------	------	11
Seseli aroanicum	-----	----------	3-233--3-322	2-----	-------------------	-----	-----------	------	8
Draba lacaitae	-----	----------	23-22--2--2-	------	-------------------	-----	-----------	------	5
Asplenium trichomanes subsp. inexpectans — Sorbus aria comm.									
Sorbus aria	-----	-----2-22-----2--22-	------223222	222222	--2----------------	---2-	2----------	------	19
Asplenium trichomanes inexpectans	-----	----------	----------	-2322-	----------2------	2----	2----------	------	7
Ribes uva-crispa	-----	----------2----	---------2--	--3-32	--2----------------	-----	-----------	------	6
Juniperus foetidissima	-----	----------1	--------2--	2--2--	--2----------------	---22	-----------	------	6
Saxifraga tridactylites	-----	----------	--------2---	--22--	-------2--2--------	-----	-----------	------	5
Silenion auriculatae, Potentilletalia speciosae									
Achillea holosericea	2-333	2---------22-3-2-3222	335553335232	3-2323	-------2---2-333-23	-2332	-----------	------	36
Hieracium pannosum	--2-2	-33222223---22-2-3332	-23-353-3232	233322	--23----------22---	3-323	-----------	------	36
Carum graecum graecum	25-33	333333233333353232233	255555--3232	-2-333	--3----------------	-----	-----------	------	35
Potentilla speciosa	75722	52255555555525533-333	--223-3535-2	3--2--	-------------------	-----	-----------	------	32
Minuartia stellata	55555	5553-2223-3533---3255	-35533325-2-	------	-------------------	-----	-----------	------	26
Viola chelmaea	--322	3-32322332-2332------	-23222------	------	--2--------------3-	-----	-2---------	------	24
Scrophularia laciniata	-----	--22--23-22-3-233-2--	---------3--	---222	---2---------------	-----	-----------	------	14
Rosa heckeliana	---2-	-------2-3-22-3-3-2--	---22-3-----	-22-2-	-------------------	-----	-----------	------	13
Crepis incana	3333-	---22---2--235-------	----------3-	---3--	-------------------	-----	-----------	------	12
Silene parnassica	----3	-322--2-----2----23--	--3235-23---	-2----	-------------------	-----	-----------	------	12
Rhamnus sibthorpianus	-----	3----------2---1---	-------22-23	222---	--33---------------	-----	-----------	------	11
Saxifrago chrysosplenifolii - Athamantetum macedioncae									
Athamanta macedonica	-----	----------	2---------2-	--3-53	-555555252522255233	32555	----3233323	------	34
Saxifraga chrysosplenifolia	-----	----------	----------	---2--	533332-5--33322----	32---	-------3--3	------	17
Umbilicus chloranthus	-----	----------	----------	--2---	---32-----222--2--	2----	-----------	----2-	9
Differentiating in the table									
Fraxinus ornus	-----	----------	2-----2---23	----2-	25323-3-----2-3312-	2-333	-----3-----	------	20
Leontodon graecus	-----	----------	----------	----2-	------3-2--32335335	--322	---3--2--3-	------	17
Ostrya carpinifolia	-----	----------	----------2-	5---23	--2-2-3-2--12-2----	----2	2----------	------	13
Typical subgroup									
Arabis alpina caucasica	-----	----------	-------2--2-	----22	532532222-233252-2-	-----	----------3	------	21
Valeriana italica	-----	----------	----------	------	-3---223--22323-2--	-----	-------222-	------	13
Opopanax hispidus	-----	----------	----------	------	----3-3-------22---	-----	-----------	------	4
Tilia cordata	-----	----------	----------	------	---23---2----------	-----	-----------	------	3
Subgroup with Dianthus pinifolius subsp. lilacinus									
Dianthus pinifolius lilacinus	-----	----------	----------2-	---2--	--------------23323	7732-	-----------	------	11
Silene radicosa	----2	----------	---32-----33	------	-------------------	53722	-----------	------	10
Aubrieta deltoidea — Peucedanum achaicum comm.									
Aubrieta deltoidea	-----	----------2-----	2-------32--	2-3-3-	33-----5322------3-	-322-	352333-535-	------	25
Teucrium flavum hellenicum	-----	----------	---------2--	-----2	-----332------2-2--	-----	-2-33232-3-	----23	16
Peucedanum achaicum	-----	----------	----------	------	--2-----2--2-1--1--	-----	-2-2332--3-	------	11
Ephedra foeminea	-----	----------	----------	------	-------------------	---2-	---23223222	35----	11
Inulo parnassicae - Ptilostemetum chamaepeuce									
Inula verbascifolia parnassica	-----	----------	----------	------	---------------2-2-	-----	555553-----	3-5577	13
Ptilostemon chamaepeuce	-----	----------	----------	------	-------------------	-----	------2-3--	553355	8
Salvia pomifera calycina	-----	----------	----------	------	-------------------	-----	-----------	222--5	4
Centaurea niederi	-----	----------	----------	------	-------------------	-----	-----------	-33---	2
Galium violaceum	-----	----------	----------	------	-------------------	-----	-----------	----22	2
Campanulion versicoloris, Onosmetalia frutesceints									

Campanula versicolor	-----	---------------23----	3-----33-332	353333	33555522233532355222	223-3	52223323225	53-23-	51
Silene congesta	-----	----------	----------	-----3	---2-3-3-5-23355253	---53	-5355555535	-3355-	29
Asperula lutea	-----	----------2----	-5355--23-33	-----5	-------532-3-3533-3	--555	--35333-33-	------	29
Onosma frutescens	-----	----------	----------	------	-------232-2-232223	-33--	23233335233	33223-	28
Centaurea raphanina mixta	-----	----------	1----------	------	-------3-----2-2-5-	2-222	-32-2-3-33-	------	14
Aurinia saxatilis orientalis	-----	----------	----------	------	----------	-----	--252-23335	353233	14
Carum multiflorum	-----	----------3---	2----------	----2-	----3-22---------2-	-----	--32232-25-	332---	15
Cephalaria ambrosioides	-----	----------	----------	------	--23-------2-2-223-	-3---	22--22-----	------	12
Centranthus ruber	-----	----------	----------	------	----------	-----	--222------	32223-	8
Asplenietea trichomanis									
Asplenium ceterah	-----	----------	-----2----2-	--222-	----2-333223-3--33-	-----	-32233-3222	23---2	27
Sedum album	----2	222222--3-2-2---2--2-	-32--2--3-22	323322	33332-3232333-3--33	3-32-	22-33----23	------	23
Polypodium vulgare	-----	--2--3222---3-------	----------2-	--322-	2---2----------	32---	----------	------	14
Accompanying species									
Galium thymifolium	----3	3332232-22322-3-3--33	33--3333332-	233333	3--2--3-------3----	-2-32	----------	------	36
Minuartia attica	--33-	2--323----332323--2-2	3323--3332--	-2-32-	------3233----3--2-	-233-	-3----3--3-	------	34
Festuca jeanpertii	-----	----------3-------	2-------33-2	332335	5553355-35335353-3-	333-2	23----3----	------	33
Poa thessala	--333	3-33333-233533-33-235	--3-233-322-	---35-	---2----------	3533-	----------	------	31
Poa bulbosa	-----	----------	2-23-23-323-	-23-3-	3-----35233--25---3	--333	------23253	-2-5-3	30
Micromeria juliana	-----	----------	----------3-	------	------222333-2-3333	32332	33-32223-22	---3-3	28
Hippocrepis emerus emeroides	--22-	----------	----------2-	-----2	--2-52523-2---3-2-5	--223	---223222-2	2-2--2	27
Festuca cyllenica	33--3	3335-5233-535-3533333	-2-5-3-2-52-	--3-53	----------	-----	----------	------	26
Quercus coccifera	-----	----------	----------	-----2	55----37-222----2-3	---22	---3555233-	32----	21
Anthemis cretica	----2	2----3--2222-2-------	--2335-2--3-	2--22-	----------2-------	2----	----------	------	19
Centaurea affinis laconiae	-----	----------	--53532---33	------	--------2----1222--	-5322	-----2----	------	17
Phlomis fruticosa	-----	----------	----------	------	-------3-2-2-2----5	-----	-233--322--	5-3-33	15
Hedera helix	-----	----------	----------	------	552-2-333-23-------	--2--	--332----3-	-3----	15
Daphne oleoides	2-333	3--3----22---2-2---2-	3---2-------	-232--	----------	---2-	----------	------	15
Dactylis glomerata	--33-	-------2----2--------	--222-------	------	3-----3----22-333--	-----	----------	------	14
Campanula albanica	222--	---2222-322222-------	----------	------	----------	-----	----------	------	13
Asyneuma limonifolium	--2-3	32232-----3----------	2333332---22	---3--	------32--3--232---	--2-2	--------2--	------	13
Sedum sp.	-----	--22-22-----2--------	3-2--2------	------	----------22--	-----	---2-2-----	----3-	12
Pistacia terebinthus	-----	----------	----------	------	----------	-----	-2--2223---	323223	11
Festuca polita	-----	---3332---353--------	-223-55---3-	---2--	----------	-----	----------	------	11
Melica ciliata	---3-	----------	----2-3-----	----32	----2---2--2--3----	-----	2--2-------	------	11
Alyssum montanum repens	-----	---2----------	---32-----2-	2-----	----2----2----223--	--2--	----------	------	11
Geranium subcaulescens	-----	-3322--2-3--2--22---3	--2---------	------	----------	-----	----------	------	10
Leontodon crispus asper	2---3	32--------2----------	-533-3-2----	------	----------	-----	----------	------	10
Pterocephalus perennis perennis	-----	----------	55-3------5-	33----	----------2-	---53	2----2-----	------	10
Acinos alpinus meridionalis	----3	----------	-22232----3-	------	----------3	--2--	----------	------	9
Asperula aristata thessala	----2	-2--3---222----------	--2-----3---	---2--	----------	-----	----------	------	9
Rosa pulverulenta	----2	--2----2----------	-2----------	--322-	----------	-----	----------	------	7
Bromus cappadocicus lacmonicus	--22-	---23-----33---------	----2------	------	----------	-----	----------	------	7
Poa trivialis sylvicola	-----	-----2-323---5-------	----------	------	----------5	--2--	----------	------	7
Juniperus communis nana	-----	-----22--2-3-23------	---2-------	------	----------	-----	----------	------	7
Sesleria vaginalis	---3-	----2-2-2----------	-3----------	-----2	----------	----2	----------	------	7
Thymus longicaulis chaubardii	--2--	----------	----2-----3-	---2--	----------	2--2-	----------	------	6
Jurinea mollis	----2	----------	----22------	-----2	----------	---33	----------	------	6
Muscari comosum	-----	----------	----------2-	------	------3---2-2--2---	--2--	----------	-----2	6
Piptatherum coerulescens	-----	----------	----------	------	----------	-----	---35------	333--5	6
Silene italica peloponnesiaca	-----	----------	----------	2-----	---2--3--------22--	--2--	----------	------	6
Juniperus oxycedrus	-----	----------	2----------	--2--2	----------	---22	-2---------	------	5
Geranium lucidum	-----	----------2-----	----------	--2---	2---------2------	-----	----------2	------	5
Acer monspessulanum	-----	----------	2----------	----2-	--------2------2---	--2--	2----------	------	5
Allium guttatum	-----	----------2-------	------2-----	-----2	----------2----	2----	----------	------	5
Sanguisorba minor muricata	-----	----------	32----------	----2-	---------2----2----	3----	----------	------	5
Prunus webbii	-----	----------	----------	------	----------	-----	1------32-2	-----3	5
Hypericum empetrifolium	-----	----------	----------	------	----------	-----	-----23--2-	---2-5	5
Myosotis alpestris suaveolens	-----	--2--2------2--3--22-	----------	------	----------	-----	----------	------	4
Polygala nicaensis mediterranea	-----	----------	--3222-----	------	----------	-----	----------	------	4
Erysimum cephalonicum	----2	----------	---22---3---	------	----------	-----	----------	------	4
Aethionema saxatilis oreophilum	-----	----------	2----------	------	---------2---2--2-2	-----	----------	------	4
Ornithogalum montanum	-----	----------	----------	------	----------2223	-----	----------	------	4
Hesperis laciniata	-----	----------	----------	------	-------2------22---	-----	---------2-	------	4
Sedum acre	-----	----------	----------	------	----------2-----2--	2----	------2----	------	4
Ballota acetabulosa	-----	----------	----------	------	-------2------2--2-	-----	------2----	------	4
Phagnalon graecum	-----	----------	----------	------	----------	-----	--------3--	---332	4
Hippocrepis comosa	---22	----------	--2-2-------	------	----------	-----	----------	------	4
Acantholimon ulicinus	-----	-323-------3-----2--3	----------	------	----------	-----	----------	------	4
Hieracium cymosum heldreichianum	-----	----------2----	--223-------	------	----------	-----	----------	------	4

Taxa with 3 presences: Primula veris (210/2, 281/2, 264/2), Senecio squalidus (227/2, 231/3, 235/3), Achillea fraasii (203/3, 253/2, 254/2), Heracleum sphondylium pyrenaicum (212/2, 240/3, 242/2), Cerastium brachypetalum subsp. roeseri (248/2, 249/3, 253/2), Malabaila involucrate (275/2, 277/2, 279/2), Campanula spatulata subsp. spruneriana (245/3, 277/2, 248/3), Allium amethystinum (245/3, 247/2, 250/3), Abies cephalonica (242/2, 245/3, 275/2).

Taxa with 2 presences: Dianthus cruentus (283/2, 284/1), Laserpitium siler subsp. garganicum (281/1, 226/2), Olea europaea (261/3, 270/2), Mercurialis annua (269/2, 270/2), Carum rupestre (269/2, 270/2), Bromus sterilis (269/3, 270/2), Silene latifolia (268/2, 278/2), Cyclamen hederifolium (258/2, 264/3), Rosa canina (240/2, 241/2), Pteridium aquilinum (240/3, 241/2), Anemone blanda (243/2, 279/2), Anchusa hybrida (243/2, 250/2), Anthylis vulneraria subsp. bulgarica (252/3, 250/3), Eryngium amethystinum (237/2, 257/2), Valantia aprica (222/2, 246/3), Saxifraga adscendens parnassica (210/2, 281/2), Cerastium candidissimum (223/2, 224/2), Arrhenatherum elatius (227/3, 236/5), Prunus spinosa (231/2, 233/2).

Taxa with 1 presence: Leontodon cichoriaceus (280, 2), Poa timoleontis (283/3), Sorbus umbellata (280/2), Bupleurum falcatum (238/2), Anthemis tinctoria subsp. parnassica (238/2), Galium taygeteum (237/2), Dasypyrum hordaceum (237/2), Stellaria media (235/3), Lactuca viminea (235/2), Arum maculatum (235/2), Geranium sp. (231/3), Thesium arvense (228/2), Senecio thapsoides (228/2), Cardus tmoleus(227/3), Allium frigidum (224/2), Lotus ornithopodioides (206/2), Sideritis clandestina subsp. peloponnesiaca (204/2), Silene multicaulis (211/2), Saxifraga exarata (210/2), Ptilostemon afer (203/2), Gagea graeca (252/3), Sedum amplexicaule (249/2), Poa nemoralis (248/3), Epilobium lanceolatum (248/2), Crepis sancta (248/2), Armeria canescens (248/5), Taraxacum sect. scariosa (277/2), Bellevalia dubia (276/2), Prospero automnale (258/2), Crupina crupinastrum (257/2), Galium mollugo (247/3), Bromus intermedius (246/5), Brachypodium retusum (246/3), Helleborus odorus (245/2), Helictotrichon convolutum (245/2), Crepis fraasii (245/2), Centaurea cyanus (245/3), Erophila verna (243/2), Achillea grandifolia (242/2), Mycelis muralis (240/3), Acer heldreichii (240/2), Frangula rupestris (239/2), Fumaria officinalis (267/2), Arabis hirsuta (267/2), Sambucus nigra (266/2), Biarum spruneri (263/2), Phillyrea latifolia (259/2), Helianthemum nummularium (259/2), Carex distachya (259/2), Calicotome villosa (259/2), Avena sterilis (274/3), Thapsia garganica (273/2), Sedum sediforme (273/3), Ficus carica (273/2), Lunaria annua (270/2), Geranium robertianum (270/2), Piptatherum miliaceum (269/2), Reichardia picrioides (268/3), Parietaria judaica (268/3), Lactuca sp. (268/2), Cynosurus echinatus (268/3).

The community *Sorbus aria-Asplenium trichomanes* subsp. *inexpectans* is developed in the lower altitudinal levels of *Silenion auriculatae* (1400 - 1700 m), near forests or places where old forests of *Abies cephalonica* or *Juniperus foetidissima* were growing. It is developed in the summits Barba, Neraidovouni and Profitis Ilias, as well as near the place 'Gremisto Nero', in rocks of small height and restricted total surface, where chasmophytic vegetation does not have the most optimal conditions for its development.

The community is characterized physiognomically by the domination of small trees and shrubs, mainly *Sorbus aria, Ribes uva-crispa, Ostrya carpinifolia, Rosa pulverulenta* and *Rhamnus sibthorpianus*.

It is differentiated by *Sorbus aria* (6/6), *Asplenium trichomanes* subsp. *inexpectans* (4/6), *Ribes uva-crispa* (3/6) and *Saxifraga tridactylites* (2/6), but not with a high fidelity.

Dominating taxa as *Sorbus aria* and *Rhamnus sibthorpianus* are not fidele enough so to order the community in a higher syntaxonomic rank.

It is interesting that the described community receives floristic influence even from deciduous forests (*Ostrya carpinifolia, Sorbus aria, Fraxinus ornus* etc.). The question arising is if the mentioned trees were forming in the past forest communities near the bases of rocks or more widely in the research area.

Although the combination of a fern and a tree seems quite strange, it is important to note that in the research area, *Sorbus aria* has an exclusivelly 'chasmophytic' behavior. It is probable that deciduous forests have been extincted above 1200 m, and the only refuge for trees like *Sorbus aria* was on vertical rocks. Furthermore, the form of *Sorbus* and most tree species on vertical rocks is that of a very small and thin tree or a small shrub.

3.2.2. *Aurinio moreanae-Seseletum aroanici* ass. nova hoc loco (*Silenion auriculatae*, Tab. 3, column S, holotypus sampl. 225)

The association *Aurinio moreanae-Seseletum aroanici* is developed from 1600 up to 1900 m, in the high summits Barba and Kallifoni, in steep limestone rocks, with slopes from 70 until 90° and in variety of expositions. It is a group clearly more alticole than the previous one.

Physiognomically, it is dominated by *Minuartia stellata,* together with *Achillea holosericea, Carum graecum* subsp. *graecum, Potentilla speciosa, Hieracium pannosum, Silene parnassica* etc.

It is characterized by the presence of *Aurinia moreana* (7/12, endemic to Peloponnese), *Seseli aroanicum* (8/12, growing only in Erimanthos and Chelmos), and *Draba lacaitae* (6/12, a S Greece endemic), with a high fidelity. The community is also differentiated in Table 3 by *Koeleria lobata* (8/12) and *Teucrium chamaedrys* subsp. *chamaedrys* (6/12).

The described group has a high percentage of Greek endemic taxa: *Hieracium leithnerii, Centaurea affinis* subsp. *laconiae, Pterocephalus perennis, Viola chelmaea, Rhamnus sibthorpianus, Asperula lutea* etc. have been recorded with a high constancy.

The association *Aurinio moreanae-Seseletum aroanici* has important floristic similarities with the association *Sileno parnassicae-Sedetum magellensi* Georgiadis & Dimopoulos 1993, developed in Killini, between 1800 and 2080 m, where *Draba lacaitae* is one of its diagnostic taxa, while *Silene parnassica, Carum graecum* subsp. *graecum, Achillea holosericea, Pterocephalus perennis, Koeleria lobata* etc. are also present.

Furthermore, *Aurinia moreana* is a diagnostic taxon of the association *Aquilegia ottonis-Saxifraga spruneri* Quézel & Katrabassa 1974, a syntaxon not floristically very similar to the syntaxon described here, developed in the neighboring Mount Chelmos.

3.2.3. *Hieracio leithneri-Saxifragetum paniculatae* ass. nova hoc loco (*Silenion auriculatae*, Tab. 3, column Sx, holotypus sampl. 213)

The association *Hieracio leithneri-Saxifragetum paniculatae* is described by 21 samplings and is developed from 1800 m up to the high summits (2000 - 2220 m). It is located only in the higher summits of the mountainous complex (Olenos, Barba and Kallifoni). It colonizes limestones rocks of extensive surface, with many pockets and cavities and a slope from 70 up to 100°). It is developed in notherner, eastern and western expositions and it appears that it does not prefer the southern expositions.

It is dominated by the cushion - forming individuals or colonies of *Potentilla speciosa, Saxifraga paniculata, Saxifraga sempervivum* and *Minuartia stellata. Carum graecum* subsp. *graecum* and *Festuca cyllenica* have also quite large covers.

It is diagnosed by a unique floristic sequence of chasmophytic taxa, which find there their ecological optimum: *Saxifraga paniculata* (17/21), *Saxifraga sempervivum* (15/21), *Hieracium leithneri* (13/21), *Galium incanum* (10/21), *Scutellaria alpina* (8/21),

Cotoneaster integerrimus (8/21), *Euphorbia herniarifolia* (6/21), *Arabis bryoides* (4/21) and *Cymbalaria microcalyx* subsp. *minor* (3/21).

It is also clearly included in the alliance *Silenion auriculatae* and the order *Potentilletalia speciosae* (Tab. 3).

It is interesting to mark that *Saxifraga paniculata*, which is an Arctic - Alpine taxon, finds in this syntaxon its ecological optimum and Erimanthos is the southernmost point of its distribution (Strid 1986). Furthermore, *Saxifraga sempervivum* (Balkan - Anatolian), *Arabis bryoides* (Balkan) and *Scutellaria alpina* (Eurasian) have also northern origin. It is clear that northern elements have a strong presence in the higher summits of the mountain. This can be attributed to the extreme wintry stress, with a snow cover from November to April.

Saxifraga sempervirens, Saxifraga paniculata and the rest diagnostic taxa of the described syntaxon are also present in more communities of *Potentilletalia speciosae*, so much in the alliance *Silenion auriculatae*, as much as in the alliance *Galion degenii.*

The association *Hieracio leithneri-Saxifragetum paniculatae* has floristic similarities to the association *Viola chelmaea-Valeriana crinii* Quézel & Katrabassa 1974, which is developed in Chelmos, from 2000 up to 2200 m and is dominated by *Minuartia stellata* and *Potentilla speciosa,* with a quite strong presence of *Saxifraga sempervivum, Viola chelmea, Hieracium pannosum, Arabis bryoides, Euphorbia herniarifolia* etc.

Hieracio leithneri-Saxifragetum paniculatae has also floristic and physiognomic resemblances with the association *Minuartio stellatae-Saturejetum parnassicae* Georgiadis & Dimopoulos 1993, due to the strong domination of *Minuartia stellata* and *Potentilla speciosa*.

It presents also resemblances with the association *Minuartia stellata-Valeriana olenaea* Quézel 1964, described also from Killini, where *Minuartia stellata* and *Potentilla speciosa* also dominate, together with *Valeriana olenaea* and *Linum elegans*. (Associations *Minuartio stellatae-Saturejetum parnassicae* Georgiadis & Dimopoulos 1993 and *Minuartia stellata-Valeriana olenaea* Quézel 1964 are closely related syntaxa).

It presents smaller resemblances with the association *Sileno parnassicae-Sedetum magellensi* Georgiadis and Dimopoulos 1993 (Killini) and the particularly alticole association *Viola poetica-Saxifraga spruneri* Quézel 1964, developed in Parnassos and Giona.

The comparison of the described syntaxon to the association *Achillea clavenae-Minuartia stellata* Quézel 1967 (alliance *Galion degenii*) is also interesting. The latest syntaxon has a strong presence of *Minuartia stellata* (Balkan taxon, with a strict distribution in the mountains of Pindos complex), as well as *Saxifraga sempervivum* (northern origin taxon), *Achillea holosericea* (Balkan) etc.

It presents smaller resemblances with the association *Campanula oreadum-Saxifraga sempervivum* f. *thessala* Quézel 1967 (alliance *Silenion auriculatae*), described by Mount Olympos, where *Saxifraga sempervivum, Arabis bryoides, Achillea holosericea* etc. have a strong presence, however without the domination of *Minuartia stellata* and *Potentilla speciosa*.

Finally, it is interesting to mark that the association *Aurinio moreanae-Seseletum aroanici,* a syntaxon of smaller altitudes, is characterized by a more 'Peloponnesian' floristic composition, with a large number of endemic taxa. On the contrary, the association *Hieracio leithneri-Saxifragetum paniculatae* has a powerful 'Northern' or 'Balkan' character, with many taxa characteristic of the Pindos mountain complex. Additionally, *Saxifraga paniculata*, an association's diagnostic, characterizes more the alliance *Galion degenii* of Pindos, than *Silenion auriculatae* of S Greece (Dimopoulos *et al*., 1997). This enhances the northern character of the association described.

3.2.4. *Teucrium montanum-Satureja parnassica* subsp. *parnassica* comm. (*Silenion auriculatae*, Tab. 3, column T)

The community *Teucrium montanum-Satureja parnassica* subsp. *parnassica* is a group with particular ecology. It is also developed in the superior altitudinal levels of summits Barba and Olenos (2000 - 2050 metres) and colonizes limestone rocks of particularly steep slope (80 - 90°), with the form of wall and a minimal number of pockets, slots and cavities, so with minimal points of adhesion. Its growth is local and limited in three concrete places of the mentined summits.

It is characterized physiognomically by the strong presence of *Minuartia stellata* and *Potentilla speciosa*, together with *Carum graecum* subsp. *graecum, Koeleria lobata* and *Achillea holosericea*. It is differentiated by *Teucrium montanum* (4/5), *Satureja parnassica* (3/5), *Ramnus saxatilis* subsp. *prunifolia* (3/5) and *Iberis sempervirens* (2/5). It is the community of *Potentilletalia speciosae* with the smaller number of taxa, obviously because of its particular ecology.

The community *Teucrium montanum-Satureja*

parnassica subsp. *parnassica* has floristic similarities to the association *Minuartio stellatae-Saturejetum parnassicae* Georgiadis & Dimopoulos 1993, so much as in the dominating taxa, as much as in the small number of taxa.

Satureja parnassica subsp. *parnassica* is endemic to the mountains of S Greece and participates in the association *Satureja parnassica-Sedum magellense* Quézel 1964, developed in Parnassos, between 1600 - 2000 m, where *Ramnus saxatilis* subsp. *prunifolia, Potentilla speciosa, Achillea holosericea* etc. have also important presence.

Discussion

The present research completes our knowledge about the phytosociology of supra – forest and chasmophytic communities in the mountains of South Greece.

Two new associations and one subassociation are described in *Daphno – Festucetea* (*Marrubio cyllenei – Astragaletum rumelici, Festuco politae – Festucetum cyllenicae* and *Juniperetum foetidissimae Scabiosetosum ochroleucae*) and three more (*Saxifrago chrysosplenifoliae-Athamantetum macedonicae, Aurinio moreanae-Seseletum aroanici* and *Hieracio leithnerii-Saxifragetum paniculatae*) in *Asplenietea trichomanis.*

Many of the described communities have, as a rule, important floristic affinities with other, already described communities. Nevertheless, *Festuco politae -Festucetum cyllenicae, Aubrieta deltoidea-Peucedanum achaicum* comm., *Saxifrago chrysosplenifoliae-Athamantetum macedonicae* etc. have a particular floristic composition, but we expect a number of similar communities to be developed in the mountains of Olenos – Pindos zone. The present work can act as a catalyst for the description of these vegetation units.

The communities of class *Asplenietea trichomanis* differentiate according to the altitude, with the most alticole one (*Hieracio leithnerii-Saxifragetum paniculatae*) concentrating a large number of northern elements, while *Aurinio moreanae-Seseletum aroanici* having a more local character, with many endemic taxa as diagnostic.

Furthermore, it is concluded that chasmophytic communities of neighboring and ecologicaly similar mountains of S Greece can have physiognomic resenblences, with a few dominating taxa (*Minuartia stellata, Potentilla speciosa etc.*) but they differ considerably from the phytosociological point of view, due to the isolation of the high summits and the large number of localy endemic taxa.

The altitude, together with the slope and soil factors must explain the variability in the composition of supra – forest meadows. *Festuca* meadows prefer higher altitude and steeper slopes, *Marrubio cyllenei-Astragaletum rumelici* prefer lower altitude and gentler slopes, while *Stipa pennata* subsp. *pulcherrima* communities prefer the most rocky sites. *Juniperus foetidissima* stands are developed above the fir forest timberline, while grassy meadows of *Trifolietalia parnassii* are connected with deep soil and slopes close to zero.

Concerning the vegetation dynamics it can be noted that *Festuca cyllenica* seems to be an invading taxon, which can penetrate in scree formations. This results to the stabilization of screes and the consequent succesion of *Valantia aprica-Scrophularia myriophylla* comm. by rocky meadow formations.

A gradient analysis is in preparation and it can conclude about the factors influencing the floristic variability of supra – forest meadows and their dynamic relations.

A synopsis of syntaxa developed in Greece, in the level of alliance, is given in Tab. 4.

It is clear that in the mountains of Peloponnisos and Sterea Hellas are developed high – altitude communities with large similarities to the communities described in the present paper. As we move northwards, flora is changing and the phytosociological affinities with Erimanthos get weaker, with the exception of some chasmophytic communities of the Pindos zone mountains.

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Tab. 4 - Syntaxonomic Table of the described communities:

Class: *Daphno – Festucetea* Quézel 1964
Order: *Daphno – Festucetalia* Quézel 1964
Alliance: *Stipo – Morinion* Quézel 1964
Association: *Juniperetum foetidissimae* Georgiadis & Dimopoulos 1993
Subassociation: *scabiosetosum ochroleucae* subass. nova
Community: *Hippocrepis comosa – Stipa pennata* subsp. *pulcherrima*
Community: *Stipa pennata* subsp. *pulcherrima.*
Alliance: *Eryngio – Bromion* Quézel 1964
Association: *Marrubio cyllenei – Astragaletum rumelici* ass. nova
Association: *Festuco politae – Festucetum cyllenicae* ass. nova
Class: *Juncetea trifidae* Hadac in Klika & Hadac 1944
Order: *Trifolietalia parnassii* Quézel 1964
Alliance: *Trifolion parnassii* Quézel 1964
Association: *Alopecuro gerardii – Crocetum sieberi* Quézel 1964
Class: *Drypetea spinosae* Quézel 1964
Order: *Drypidetalia spinosae* Quézel 1964
Alliance: *Silenion caesiae* Quézel 1964
Community: *Valantia aprica – Scrophularia myriophylla*
Class: *Asplenietea trichomanis* (Br. – Bl. in Meyer & Br. – Bl. 1934) Oberdorfer 1977
Order: *Onosmetalia frutescentis* Quézel 1964
Alliance: *Campanulion versicoloris* Quézel 1964
Association: *Inulo parnassicae – Ptilostemetum chamaepeuce* Theocharopoulos *et al*. 2001
Community: *Aubrieta deltoidea – Peucedanum achaicum*
Association: *Saxifrago chrysosplenifoliae – Athamantetum macedonicae* ass. nova
Order: *Potentilletalia speciosae* Quézel 1964
Alliance: *Silenion auriculatae* Quézel 1964
Community: *Sorbus aria – Asplenium trichomanes* subsp. *inexpectans*
Association: *Aurinio moreanae – Seseletum aroanici* ass. nova
Association: *Hieracio leithneri – Saxifragetum paniculatae* ass. nova
Community: *Teucrium montanum – Satureja parnassica* subsp. *parnassica*

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