STUDIA GEOBOTANICA
10: 15-58, 1990

THE VEGETATION OF ROCK FISSURES, SCREES, AND SNOW-BEDS IN THE PIRIN PLANINA MOUNTAINS (BULGARIA)

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Keywords: alpine vegetation, Bulgaria, endemic plants, syntaxonomy, *Asplenietea trichomanis, Salicetea herbaceae, Thlaspietea rotundifolii*

Abstract: The vegetation of calcareous rock fissures and crevices, marble screes, and snow-beds on granite, marble and lime-rich schists was studied in the Pirin Planina Mts., SW Bulgaria. Three plant communities of the rock-fissure vegetation were described, including the *Hieracio pannosi-Caricetum, Leontopodio-Potentilletum stojanovii,* and the *Silene pusilla-Saxifraga oppositifolia* community (both in subalpine and alpine altitudes). The syntaxonomic relations of the communities to the *Ramondion nathaliae* were discussed. The scree vegetation on marble in the alpine belt is represented by the *Papaveri-Armerietum* (with several subassociations and variants) which populates shady and moist habitats, and the *Veronico kellereri-Silenetum prostratae* growing on sunny, dry, south-facing screes. They were classified within a new alliance, the *Veronico-Papaverion degenii,* an endemic unit for Bulgaria. The low-altitude screes were classified within the *Bromo lacmonices-Geranietum macrorrhizi (Silenion marginatae).* Snow-bed vegetation on silicate bedrock belongs to the *Salicion herbaceae*. The *Ligustico - Plantaginetum gentianoidis* (concave relief forms, long-lasting snow cover) and the *Omalotheco -Alopecuretum gerardii* (convex relief forms, short-lasting snow cover), were described from this alliance. The marble snow-beds in the Pirin Planina Mts. are classified within the *Salicion retusae* which includes two associations such as the *Bartsio-Salicetum reticulatae* and *Gentiano-Plantaginetum atratae,* characteristic of the long-lasting and short-lasting snow patches, respectively. All of the associations, but the *Leontopodio-Potentilletum stojanovii* and *Ligustico-Plantaginetum gentianoidis,* were described as new. All of the communities house many species endemic to the Pirin Planina Mts., Bulgaria and Balkan Peninsula.

1. Introduction

The high-mountain vegetation of the Balkan Peninsula is an amazingly varied system of "cold islands in the sea of warm air". It is assumed that during the Pleistocene the psychrophilous and oligothermic vegetation in the Balkan Peninsula covered larger areas, and these might have been interconnected also with the Alps and Carpathians. Although the Continental Glacier was not reaching as far as the Balkans, there were many local glaciers covering particular mountain ranges of the Rodopi-Dinarid Region (Frenzel 1967).

After the retreat of the glaciers to higher altitudes and their decay, the territory covered by psychrophilous vegetation shrinked and "an archipelago of the cold islands in the sky" emerged. These geological and climatical processes gave push to allopatric speciation in these small areas and many endemic plants were formed or

old relict species were saved (Walter & Straka 1970).

The "archipelago" is an excellent example of evolutionary laboratory well-suited for studies of vicariance-biogeography aspects as well as vegetation-chorologic phenomena (Horvat et al. 1974, Krahulec 1985). As the alpine and subalpine vegetation of the Balkans is better preserved than that of the Alps, the Carpathians or the Scandinavian mountains, it is also more diversified. This is also reflected in abundance of endemic alliances, orders, and in Greece even classes (Quézel 1964).

The syntaxonomy of the high-mountain vegetation in the Balkans was performed especially in those countries where the Braun-Blanquet approach of floristic-sociological classification of vegetation set up stable roots. These countries include also Yugoslavia where Horvat and many of his pupils and colleagues elaborated the mountain vegetation in numerous papers (for references see Horvat et al. 1974). Much syntaxonomic work has been done in Rumania in the high-mountain areas (Domin 1933, Borza 1959, Puşcaru-Soroceanu et al. 1963, 1981, Boşcaiu 1971, Sanda et al. 1977, Schneider-Binder & Voik 1977, Resmeriţă & Pop 1984, Coldea 1984, 1985, volume of Comunicări de Botanică, Bucureşti, 1977, to mention some important ones). There are a few syntaxonomical papers on the high-mountain vegetation also from Greece (Quézel 1964, 1967). In Bulgaria, on the other hand, vegetation scientists were using other methods of vegetation classification (see for instance Bondev 1959, 1966, Ganchev 1963, Juhász-Nagy 1963, Kochev 1967, Kochev & Nikolov 1976 etc.).

The Pirin Planina Mts. is touristically one of the most popular high-mountain resorts of Bulgaria (the Vikhren Mt. is considered the National Mountain). A national park was declared to preserve the nature of this unique area, and this park was included into the list of Biosphere Reserves (Goodier & Jeffers 1981). In 1958 a seminal paper by Simon was published on the alpine vegetation of the Pirin Planina Mts. This paper remained, however, the only reliable published information on floristic-sociological syntaxonomy of the mountains till today.

Our paper is aimed to supply data on other alpine and subalpine vegetation types of the Pirin Planina Mts. than those given by Simon (1958), and to present a syntaxonomical discussion on the described vegetation types. Some ideas on synecology of the types were presented elsewhere (Mucina et al. 1986).

2. Materials and Methods

2. 1. Study Area

The Pirin Planina Mts. is situated in the southwestern Bulgaria. It is limited by the valley of the Struma (Strimon) River from the west, by the Predel Saddle from the north, by the Mesta River from the east and by the Parilska Sedlovina Saddle from Slavyanka Mts. It is the third highest mountain range of the Balkan Peninsula. The highest peak reaches 2915 m (Vikhren Mt. or El-Tepe Mt.). The total area of the range is 1210 km² (Dushkov 1983). Pirin Planina Mts. is classified into three

parts such as Northern, Central, and Southern. The northern part is situated between the Predel Saddle (1140 m) and the Todorova Polyana Saddle (1883 m), while the central part is divided from the southern one by the Popovi Livadi Saddle (1400 m).

The main mountain range follows the direction NW to SE and ramificates into numerous side-ridges. The NW slopes are very steep, the SE slopes are gentle. The altitudinal belts in the mountains are represented as follows: 600 to 1000 m above sea level - 25%, 1000 to 1600 - 38%, 1600 to 2200 - 24%, and altitudes above 2200 - 13%.

Three of the peaks reach above the altitude 2900 m (Vikhren, Kutelo I - 2907 m and Kutelo II - 2908 m).

The mountain range is a part of the Rila-Rodopi Massif built of crystalline rocks belonging to an old Thracic-Macedonian Massif, and sedimentary rocks (mainly carbonatic) of the Mesosoic origin. The high-mountain modelation of the relief is a result of the glacial activity of a local glacier in the Pleistocene. The main range of the Pirin Planina Mts. in its northern part is built of granitoid rocks, crystalline schists and marbles. The main area of the latter is situated between the Kabata Saddle (2700 m) and Kamenititsa Saddle (app. 2600 m). The marbles are grey or grey-white, and stratified by dark strips. Due to long-term tectonic activities they are disintegrated and broken (Georgiev 1956).

The climate is typical of high-mountain altitudes as the most of the area (over 75%) is situated at altitudes above 1000 m. The highest altitudes are characterized by low temperature, small yearly temperature amplitude, windiness (the prevailing winds are from W and SW directions), high air humidity, long-lasting snow cover, and intensive irradiation. The average yearly temperature in Sandanski (275 m) is 13.3° C, in Bansko (963 m) 9.0° C. On the contrary, the temperature of the coldest month (January) is - 4.2°C (measured at the Vikhren Cottage). For a comparison, the January temperature in Sandanski (in the Struma Valley) is 3.4° C. The warmest month is August (8.7° C at the Khizha Vikhren (Cottage) and 23.5° C in Sandanski). The total precipitation in the area is much higher than that in the adjacent basins. The Sandanski Basin is characterized by yearly precipitation of 541 mm, the Razloshki Basin by 702 mm, while 1571 mm was ascertained at the Vikhren Cottage. The cloudeness is the highest in May (around 70%). Snow cover lasts from 5 to 6 months. There is a permanent snow field considered the only Balkan glacier in the Golemiya Kazan Circle. The snow cover is very uneven (Mironski et al. 1970).

The rivers, brooks and rills emerging in the Pirin Planina Mts. belong to two river basin. The southwestern slopes are drained by the Struma River while the northeastern slopes are drained by the Mesta River. The largest tributaries of the Struma include the Pirinska Bistritsa, Sandanska Bistritsa, Vlakhinska Reka and Melnishka Reka. The Mesta River collects waters of the Byala Reka, Glazne, Retize and Tufcha. The maximal point water stands of the rivers falls within the month of May when the snow fields above timberline are thawing (Mironski et al. 1970).

The Pirin Planina Mts. is well-known for the variety of glacial lakes counting around 176 in summer.

The studied area belongs phytogeographically to the Central European Floristic Region, Balcanic Subregion, Province of *Moesiacum orientale,* region of Pirin (Bondev et al. 1973).

Our phytosociological material comes from the northern part of the area (the crystalline limestone and marble ridge) and some valleys and ridges of the central part (Fig. 1).

2.2. Field Work

The field work was done during 3 phytosociological expeditions to south-Bulgarian mountains (Pirin Planina and Rila Planina Mts.) in July to August in 1978, 1983 and 1984. The relevés were taken from physiognomically relatively homogeneous stands found in homogeneous habitats. The area of the relevés was adjusted to the extent of well-developed stands and kept approximately the same for the same vegetation type.

By sampling seven-grade scale of Braun-Blanquet (1964) ranging from r to 5 was used in 1978, while the grade 2 was subdivided into 2 m, 2 a and 2 b in sampling the alpine vegetation in 1983 and 1984 (according to Barkman et al. 1964).

2.3. Data Treatment

The critical plant taxa were determined according to Flora na Bulgariya (Stoyanov & Stefanov 1948), Flora na NR Bulgariya (Yordanov 1963-1979) and Flora Europaea by Tutin et al. (1964-1980). The nomenclature of phanerogams follows generally Flora Europaea (see Halliday & Beadle 1983 for a list). The nomenclature of mosses follows Frahm & Frey (1983), and that of lichens is according to Wirth (1980).

The abundance-cover classes recorded in the field were unified by using a transformation of van der Maarel (1979) into a scale ranging from 0 to 9. The transformed relevés were entered into community phytosociological tables.

Traditional syntaxonomic methods of the Braun-Blanquet approach, as revised by Westhoff & van der Maarel (1978), were used in the synthetic phase of the work. We adopted character species, differential species and the diagnostic species combination for the characterization and delimitation of the syntaxa, where by also characteristics of habitats were partly taken into consideration as secondary classification criteria.

English romanization was used in transliteration of original Bulgarian names written in cyrilics.

3. Plant Communities

Three groups of plant communities were investigated in the present paper, such as (1) communities of rock rissures of the *Asplenietea trichomanis,* (2) communities

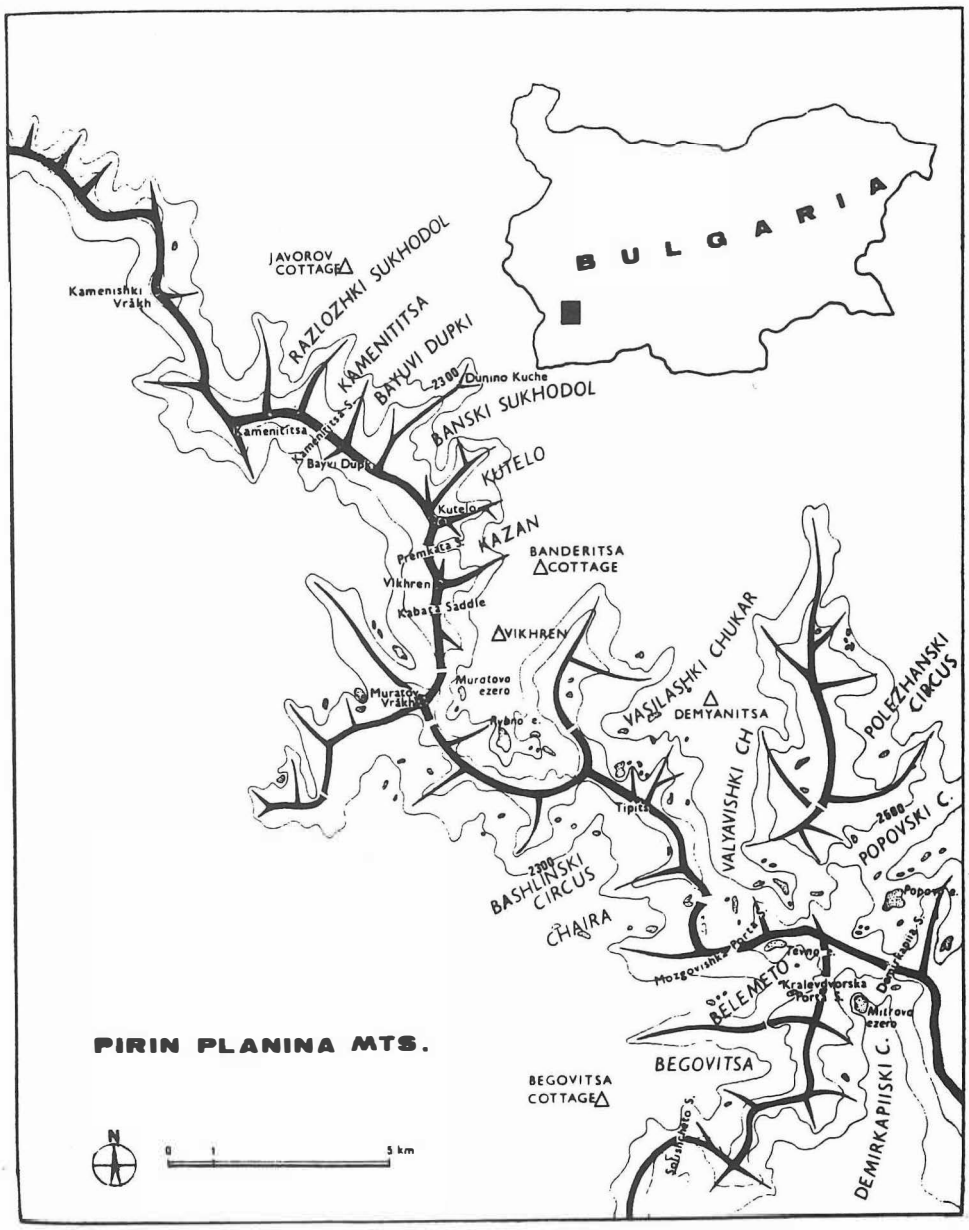

Fig. 1 — A map of the main range system of the Pirin Planina Mts. in southern Bulgaria.

of marble screes of the *Thlaspietea rotundifolii*, and (3) communities of snow beds on siliceous as well as lime-rich bedrocks of the *Salicetea herbaceae*.

3.1. Plant Communities in Rock Fissures and Crevices

In the following paragraphs we bring description and syntaxonomic discussion on plant communities in rock fissures and crevices classified within the *Asplenietea trichomanis*. Only the communities of lime-rich (marble and crystalline limestone schists) in the northern range on the Pirin Planina Mts. were studied. Three communities were distinguished such as the *Hieracio pannosi-Caricetum kitaibelianae* (lower altitudes), *Leontopodio-Potentilletum stojanovii* (higher altitudes), and the *Silene pusilla-Saxifraga oppositifolia* community (schists).

Hieracio pannosi-Caricetum kitaibelianae ass. nova
Nomenclatural type: Tab. 1, relevé 7, hoc loco

The community was recorded at lower altitudes (subalpine and oreal belts) in the close surroundings of the Banderitsa and Vikhren Cottages.

The slopes, rocky ridges and stone walls above the Banderitsa Cottage are formed by crystalline limestones and marbles. At lower altitudes, at around 1900 and 2000 m, these are overshadowed by a *Pinus leucodermis* wood. In the krummholz belt they become exposed to direct insolation and strong winds. The slope aspects and inclination reflect in species distribution pattern. Gentle slopes and broken stony crests are mainly covered by a grassland formation dominated by *Sesleria coerulans* and *Carex kitaibeliana*. Species-rich stands are supported by steep rock faces where the plants dwell in rock crevices and fissures, especially in half-shaded habitats. *Asplenium ruta-muraria, A. trichomanes, Kernera saxatilis, Campanula cochleariifolia* var. *pirinica* Vel. and *Saxifraga paniculata* are typical in these habitats. The open stands of the communities are penetrated by *Sesleria coerulans, Hypochoeris pelivanovicii* Petr., *Minuartia verna, Helianthemum nummularium* subsp. *tomentosum, Euphrasia salisburgensis* and *Paronychia kapela*.

The *Hieracio pannosi-Caricetum kitaibelianae* is limited to eastern aspects of the steep slopes and crests which are rich in fissures and small rocky terraces. The character taxa of the community include *Hieracium pannosum, Asperula pirinica* Stoj. et Acht., *Globularia meridionalis, Draba lasiocarpa, Allium flavum* var. *minus* Boiss. and *Centaurea mannagettae* (Tab. 1, relevés 1-9).

The moss cover is very small (less than 5%); only *Tortella tortuosa* occurs more frequently.

Leontopodio-Potentilletum stojanovii Simon 1958
Nomenclatural type: Simon (1958: Tabelle I, relevé 1), lectotypus

This association replaces the *Hieracio pannosi-Caricetum kitaibelianae* at altitudes above 2300 m. The typical habitats of the community are insolated marble

outcrops and steep, prevailingly south-facing, slopes.

Potentilla apennina subsp. *stojanovii* is the dominant taxon of the community. This chamaephytic dwarf shrub forms compact carpets in some places covering also the bare rocks. It is characterized by a stout and branched woody rhizone which as a worm penetrates the fissures and crevices in marble.

The distribution area of *Potentilla apennina* is limited to mountains of the central Apennines (eg. Majella Mts.) and those of the Balkan Peninsula (see below). Flora Europaea (Ball et al. 1968) distinguishes two subspecies, *P. apennina* subsp. apennina (Italy) and subsp. *stojanovii* (Bulgaria and Greece). The *Saxifrago-Potentilletum apenninae* was reported from The Šar, Jakupica and Nidža Mts. (Horvat 1936, see also Horvat et al. 1974). Jovanovič - Dunjič (1953-1955) described the *Potentillo apenninae - Saxifragetum paniculatae* from the Suva Mts. However, the species cannot be considered characteristic of the latter association as it penetrates also other *Ramondion nathaliae* communities, eg. *Erysimo - Ramondietum nathaliae* in that region (Tab. 2). Frequent companions are *Campanula cochleariifolia* var. *pirinica, Saxifraga juniperifolia, Leontopodium alpinum* subsp. *nivale, Thymus cherlerioides* and *Helianthemum canum* (Tab. 1, relevés 10-16). Many *Festuco-Seslerietea* species are also found in stands of the *Leontopodio-Potentilletum stojanovii*. Unlike in the *Hieracio pannosi-Caricetum kitaibelianae*, more cryptogams are found in the *Leontopodio-Potentilletum stojanovii*, such as *Tortella tortuosa, Hymenostylium recurvirostre, Toninia candida*. The average cover of mosses and lichens is 5-10%.

Silene pusilla-Saxifraga oppositifolia community

In the area of the Bayuvi Dupki (2820 m) and the Kamenititsa Mt. (2710 m) a rare community *Silene pusilla - Saxifraga oppositifolia* is encountered. This community is limited to steep wall outcrops composed of parallel strata of lime-rich schists. The cracks separating the schist blocks are containing plenty of water, thus the bare rock-face (usually from 0.5 to 2 m high) resembles a low-capacity water-spring as the rock-face is soaked with water even when the surrounding habitats are dry.

Several *Saxifraga* (sub) species are found to share the site: *Saxifraga oppositifolia, S. adscendens* subsp. *discolor* (Vel.) Kuzm., *S. luteoviridis, S. exarata* subsp. *pirinica* (S. Pawl.) Kuzm. and *S. ferdinandi-coburgi* (Tab. 3). All of them have their coenologic optima in other communities (screes, alpine grasslands), but this is probably the only safe site they can grow together. The fissures house small specimens of *Galium stojanovii, Asplenium fissum* and *Silene pusilla* which, when in optimal phenological stage, dictate the appearance of the community. The striking species-richness of mosses and lichens is also characteristic of the community. Among other species, the *Thlaspietea rotundifolii* diagnostic taxa, such as *Poa pirinica, Veronica saturejoides* subsp. *kellereri* (see Fischer & Fischer 1981), *Papaver degenii* (Urum. et Jáv.) Kuzm., *Thlaspi bellidifolium, Arabis caucasica* and *Doronicum columnae* are frequently found here.

Tab. 1 - Plant communities of the Asplenietea trichomanis in the Pirin Planina Mts.

No. of relevés	123456789	1111111 0123456	C1 %	C2 %
Exposition	NNS S S	E S S E S		
	EEEEEEEEE	WSESEEE		
Slope °	755686784	8578786		
	000500005	0000000		
Sampled area m²	1 1121	2		
	969272585	9012293		
Cover of herb layer %	656546434	2361634		
	000000000	5005000		
Cover of moss layer %	<<<< 1	<< 1<		
	111151055	5515505		
HIERACIO-CARICETUM KITAIBELIANAE				
Hieracium pannosum (Ch)	422423432	12	100	29
Hypochoeris pelivanovicii (Ch)	222323332	.....2.	100	14
Asperula suberosa (Ch)	222.23322	22	89	29
Carum rigidulum agg. (Ch)	2.233.222	.....2.	78	14
Centaurea mannagettae (Ch)	2222.32.2	2	78	14
Allium * minus (Ch)	2222.22..	.....	67	0
Globularia cordifolia (Ch)	..3.53535	.....	67	0
Micromeria cristata (Ch)	22224.2..	.....	67	0
Minuartia verna (D)	3322.4232	2	89	14
Teucrium montanum (D)	2243...35	.....	67	0
Helianthemum * tomentosum (D)	2342..22.	.2.....	67	14
Paronychia kapela (D)	32...2.22	.....	56	0
Sedum album (D)	2.23.35..	.....	56	0
Dianthus petraeus (D)	2.2..25..	.....	44	0
Knautia sp. (D)	.2.2..2.2	.....	44	0
Draba lasiocarpa (D)	2..2..2..	.....	33	0
Stipa pulcherrima (D)	....25..3	.....	33	0
LEONTOPODIO-POTENTILLETUM STOJANOVII				
Potentilla * stojanovii (Ch)	.....2.	5583757	11	100
Saxifraga juniperifolia (Ch)	.....	...32..	0	29
Hymenostylium recurvirostre (D)	.....	33...3.	0	43
Fulgensia bracteata (D)	.....	2..22..	0	43
Leskea polycarpa (D)	.....	.22.2..	0	43
Dianthus microlepis (D)	.....	.22....	0	29
ASPLENIETEA TRICHOMANIS				
Carex kitaibeliana	55335.255	6634464	89	100
Helianthemum canum	323355325	33.3433	100	86
Tortella tortuosa	3.232.532	322.534	78	86
Euphrasia salisburgensis	3233332.3	.33..42	89	57
Achillea * aizoon	333254333	.2.3.2.	100	43
Thymus cherlerioides	322..23.2	232..23	67	71
Campanula * pirinica	...2...33	222...2	33	57
Encalypta streptocarpa	343	22..4..	33	43
Asplenium ruta-muraria	2.22.222.	.....	67	0
Leontopodium * nivale	..2....2.	22.2...	22	43
Genista albida	.....3..5	..2.2..	22	29
Jurinea glycacantha	....2..22	.2.....	33	14
Sedum dasyphyllum	222	.....1.	33	14
Kernera saxatilis	......22.	.....	22	0
Sedum ochroleucum	..2...3..	.....	22	0
Seseli rigidum	..3..2...	.....	22	0
Asplenium trichomanes	.....2.	.....	11	0
Brassica jordanoffi	.....3.	.....	11	0
Iberis pruitii	2	.....	11	0
Silene saxifraga	2	.....	11	0
FESTUCO-SESLERIETEA				
Saxifraga ferdinandi-coburgi	35333..23	344.454	78	86
Festuca * pirinica	43332433.	3324...	89	57
Sesleria coerulans	3..6.4634	.42.323	67	71
Anthyllis vitellina	.22..2.22	222.22.	56	71

Androsace * arachnoidea	25	22....3	22	43
Aster * dolomiticus	...2...2.	.2...21	22	43
Hieracium bifidum	...22.22.	2	22	14
Oxytropis urumovii	332.....	2	33	14
Poa alpina	.....3..2	..2.2..	22	29
Acinos alpinus	.....2..	....2.2	11	29
Calamagrostis varia	2.....	.....	11	0
Carex sempervirens	5	.....	11	0
Centaurea achtarovii	.....	.....2.	0	14
Koeleria eriostachya	.....2..	.....	0	0
Linum extraaxillare	.....2.	.....	11	0
Saxifraga paniculata	.....2..	.....	11	0
Scutellaria alpina	.....3...	.....	11	0
Sedum annuum	2	.....	11	0
Silene * graefferi	.....	....2..	0	14
Silene * pirinica	.2.....	.....	11	0
THLASPIETEA ROTUNDIFOLII				
Saxifraga luteoviridis	2..23332.	123..2.	67	57
Thlaspi bellidifolium	333...3..	.....	44	0
Viola grisebachiana	.....22.	....2.2	22	29
Bromus * lacmonicus	332	.....	33	0
Thalictrum minus	.....2.22	.....	33	0
Arabis ferdinandi-coburgi	2.....2.	.....	22	0
Senecio rupestris	...2.....	.....	11	0
Saxifraga exarata	.....	.....2.	0	14
Galium stojanovii	.....	..2....	0	14
SALICETEA HERBACEAE				
Sedum atratum	2.....	.....1.	11	14
Dryas octopetala	.....	.....5.	0	14
ERICO-PINETEA				
Daphne oleoides	...2...3.	.....3.	22	14
Pinus leucodermis juv.	..2..1...	.....	22	0
OTHER PHANEROGAMS				
Campanula velebitica	.2.2.3...	.....	33	0
Sonchus sp.	2.4.....	.....	22	0
Euphorbia cyparissias	2.....2..	.....	22	0
Campanula rapunculoides	2.....2..	.....	22	0
Alyssoides graeca	.....2..	.....	11	0
Pedicularis sp.	.....2.	.....	11	0
Scabiosa cf. webbiana	....2....	2	11	0
Sempervivum arachnoideum	.....2...	.....	11	0
Thymus sp.	....2....	.....2.	11	0
Carduus scardicus	1	.....	11	0
Epipactis helleborine	..1.....	.....	11	0
Juniperus * nana	.....1..	.....	11	0
OTHER CRYPTOGAMS				
Ditrichum flexicaule	..2.2..4.	2.23222	33	86
Hypnum cupressiforme	22.....	2.22...	22	43
Psora decipiens	33.....4	....4.2	33	29
Squamarina gypsacea	....4...3	...23.3	22	43
Toninia coeruleonigricans	.3.....2	...3...	22	14
Collema sp.	....2....	2.....	11	14
Peltigera rufescens	22	.....	22	0
Solorina bispora	.....2.2.	.....	22	0
Cirriphyllum tenuinerve	.....	..2....	0	14
Tortula muralis	.....	...2...	0	14
Myurella jullacea	.....	...2...	0	14
Timmia bavarica	.....	..2....	0	14
Cladonia pocillum	.....	.....2.	0	14
Schistidium apocarpum	.....3..	.....	11	0
Ceratodon purpureus	.....2..	.....	11	0
Grimmia tergestina	....3....	.....	11	0
Fissidens cristatus	.....3.	.....	11	0
Pseudoleskea nervosa	2	.....	11	0
Dermatocarpon miniatum	2	.....	11	0
Endocarpon miniatum	2	.....	11	0
Placynthium nigrum	.2.....	.....	11	0

Notes: C - constancy; Ch - character species; D - differential species; * - subspecies.

Tab. 2 - Asplenietea trichomanis of the Balkan Peninsula (a short version). The species importance is given in constancy classes according to Braun-Blanquet (1964).

No. of source table	1	2	3	4	5	6	7	8	9	10	11	12	13
No. of relevés per table	8	10	14	7	5	5	7	9	20	10	10	5	2
ASSOCIATIONS OF THE RAMONDION NATHALIAE (Ch & D):													
Viola kosaninii	V	.	.	.	.	.	.	.	.	.	.	.	.
Saxifraga scardica	V	.	.	.	II	.	.	.	.	.	.	.	.
Potentilla speciosa	.	V	.	.	.	.	.	.	.	.	.	.	.
Minuartia graminifolia	.	III	I	.	.	.	.	.	.	.	.	.	.
Asyneuma limonifolium	.	II	.	.	I	.	.	.	.	.	.	.	.
Saxifraga marginata	.	.	IV	.	.	.	.	.	.	.	.	.	.
Arenaria cretica	.	.	.	III	.	.	.	.	.	.	.	.	.
Draphne alpina	.	.	.	I	.	.	.	.	.	.	.	.	.
Jurinea consaguinea	.	.	.	.	III	.	.	.	.	.	.	.	.
Inula * aschersoniana	.	.	.	.	II	.	.	.	.	.	.	.	.
Saxifraga juniperifolia	.	.	.	.	.	.	III	.	.	.	.	.	.
Hypochoeris * pelivanovicii	.	.	.	.	.	.	.	V	.	.	.	.	.
Asperula pirinica	.	.	.	.	.	.	.	V	.	.	.	.	.
Centarea mannagettae	.	.	.	.	.	.	.	IV	.	.	.	.	.
Globularia meridionalis	.	.	.	.	.	.	.	IV	.	.	.	.	.
Allium * minus	.	.	.	.	.	.	.	IV	.	.	.	.	.
Saxifraga * brevifolia	.	.	.	.	.	.	.	.	V	.	.	.	.
RAMONDION NATHALIAE													
Carex kitaibeliana (D)	I	II	III	.	.	V	IV	V	.	.	.	.	.
Silene saxifraga agg. (Ch)	II	III	III	I	I	.	II	.	I	V	.	.	.
Hieracium pannosum (Ch)	II	II	.	.	III	.	I	V	.	.	.	.	.
Ramonda nathaliae (Ch)	V	.	III	V	V	.	.	.	.	V	.	.	.
Saxifraga grisebachii (Ch)	III	.	.	III	IV	.	.	.	.	.	.	.	.
Campanula formanekiana (Ch)	.	.	.	V	V	.	.	.	.	.	.	.	.
Saxifraga porophyla (Ch)	I	I	IV	.	.	.	.	.	.	.	.	.	.
Alyssum corymbosum (Ch)	I	.	.	.	I	.	.	.	.	.	.	.	.
Frangula rupestris (D)	I	I	.	III	III	.	.	.	.	.	.	.	.
Draba elongata (D)	II	II	I	.	.	.	.	.	.	.	.	.	.
Campanula versicolor (D)	II	III	.	.	.	.	.	.	.	.	.	.	.
Minuartia verna (Ch)	.	.	.	.	IV	.	V	I	.	.	.	.	.
Achillea ageratifolia agg. (Ch)	.	.	.	.	II	.	II	V	.	.	.	.	.
Potentilla * stojanovii (Ch)	.	.	.	.	.	III	V	I	.	.	.	.	.
Leontopodium * nivale (Ch)	.	.	.	.	.	IV	III	I	.	.	.	.	.
Campanula * pirinica (Ch)	.	.	.	.	.	II	II	II	.	.	.	.	.
ASSOCIATIONS OF THE EDRAIANTHO-ERYSIMION (Ch & D)													
Ramonda serbica	.	.	.	.	.	.	.	.	.	.	V	.	.
Alyssum * orientale	.	.	.	.	.	.	.	.	.	.	IV	.	.
Viola grisebachiana	.	.	.	.	.	.	II	II	.	.	.	V	.
Thymus serbicus	.	.	.	.	.	.	.	.	.	.	.	IV	.
EDRAIANTHO-ERYSIMION COMATAE													
Carum rigidulum (incl. graecum)	.	.	.	.	.	III	I	V	.	IV	II	IV	2+-1
Sedum ochroleucum	.	.	.	.	.	I	.	I	III	.	IV	.	2+-1
Campanula rotundifolia	.	.	.	.	.	IV	.	II	.	IV	IV	IV	2+
Dianthus petraeus	.	.	.	.	.	.	.	III	V	IV	V	II	2+-1
Aster alpinus (incl. dolomiticus)	.	.	.	.	.	.	III	II	II	.	I	.	.
Sesleria rigida (D)	.	.	.	.	.	.	.	.	IV	V	V	IV	2+-1
Erysimum comatum (Ch)	.	.	.	.	.	.	.	.	IV	V	IV	IV	2+
Edraianthus graminifolius (Ch)	.	.	.	.	.	.	.	.	.	V	II	II	2+
Cerastium banaticum (Ch)	.	.	.	.	.	.	.	.	III	.	III	I	.
Edraianthus serbicus (Ch)	.	.	.	.	.	.	.	.	.	.	.	II	2+-1

POTENTILLETALIA CAULESCENTIS														
Micromeria cristata	IV	II	.	V	III	.	.	IV	.	.	II	.	.	
Seseli rigidulum	IV	.	.	.	.	.	.	I	IV	.	II	IV	.	
Asplenium viride	.	.	III	.	.	I	.	.	.	III	I	.	2+-1	
Potentilla * apennina	.	.	V	.	.	.	.	.	.	IV	.	.	22-3	
ASPLENIETEA TRICHOMANIS														
Asplenium ruta-muraria	III	IV	III	V	III	.	.	.	.	II	IV	IV	2+	
Asplenium trichomanes	.	.	I	I	II	.	.	I	IV	.	IV	II	.	
Sedum dasyphyllum	.	IV	I	III	III	.	.	II	.	.	.	.	.	
Silene pusilla	.	I	II	.	.	.	.	.	.	III	I	.	2+-1	
Asplenium fissum	.	I	I	.	.	II	.	.	.	.	.	.	.	
Draba aizoides	.	I	.	III	.	.	.	.	.	.	.	.	.	
Cystopteris fragilis	.	.	.	.	.	.	.	.	.	IV	I	.	.	

Localities of tables (Tab. 2):

1. Micromerio-Violetum kosaninii; Horvat et al. (1974), Tab. 140, column 1; Macedonia
2. Saxifrago-Potentilletum speciosae; Horvat et al. (1974), Tab. 140, column 2; Galičica, Bistra, Korab (Macedonia)
3. Saxifrago karadzicensis-Potentilletum apenninae; Horvat et al. (1974), Tab. 140, column 3; Jakupica (Macedonia)
4. Campanuletum formanekianae; Horvat et al. (1974), Tab. 140, column 4; Nidža (Macedonia)
5. Campanulo formanekianae-Ramondietum nathaliae; Quézel (1967), Tab. 6; Vermion (Greece)
6. Leontopodio-Potentilletum stojanovii; Simon (1958), Tab. I; Pirin (Bulgaria)
7. Leontopodio-Potentilletum stojanovii; Tab. 1 in this study, relevés 10-16; Pirin
8. Hieracio pannosi-Caricetum kitaibelianae; Tab. 1 in this study, relevés 1-9; Pirin
9. Saxifragetum brevifoliae; Horvat et al. (1974), Tab. 140, column 6; eastern Serbia
10. Erysimo-Ramondietum nathaliae; Jovanović-Dunjić (1953), Tab. 1; Suva Planina (Serbia)
11. Ceteracho-Ramondietum serbicae; Jovanović-Dunjić (1953), Tab. 2; Rtanj (Serbia)
12. Saxifrago aizoi-Violetum grisebachianae; Jovanović-Dunjić (1956), Tab. 12; Rtanj (Serbia)
13. Potentilla apennina-Saxifraga aizoon-Ges.; Jovanović-Dunjić (1955); p. 88; Suva Planina (Serbia)

Floristically and synecologically analogous community was reported from the Bucegi Mts. by Domin (1983). This community grows on gentle slopes covered with water-soaked soils on limestone. It is frequented by dominant *Silene pusilla* and *Doronicum carpaticum;* further *Saxifraga paniculata, S. adscendens, S. androsacea, Viola biflora* and *Mysotis alpestris* are also found. The community is also rich in mosses.

Syntaxonomy of the Asplenietea trichomanis communities

The plant communities in rock fissures and crevices of the Balkans ever enjoyed much interest of vegetation systematists. Major motivations for this interest are the high number of endemic and relict species found in the communities as well as diversity of types encoutered over the varied high-mountain landscape of the Balkan Peninsula. The syntaxonomy of the *Asplenietea trichomanis* in the Balkan Peninsula is based mainly on works of Horvat (1931, 1934, 1936, 1937, 1960) who described many types and several high-ranked syntaxa from Yugoslavia (Macedonia, Serbia, Croatia). Quézel (1964, 1967) described rock-fissure communities from

Tab. 3 - Silene pusilla-Saxifraga oppositifolia community.

No of relevé	12
Exposition	WW SS WW
Slope °	89 00
Sampled area m²	94
Cover of herb layer %	12 55
Cover of moss layer %	<3 55
ASPLENIETEA TRICHOMANIS	
Silene pusilla	56
Campanula * pirinica	55
Asplenium fissum	23
Encalypta streptocarpa	22
Euphrasia salisburgensis	11
Thymus cherlerioides	.2
THLASPIETEA ROTUNDIFOLII	
Galium stojanovii	36
Saxifraga oppositifolia	23
Veronica * kellereri	23
Viola grisebachiana	23
Alyssum * pirinicum	22
Armeria * alpina	22
Myosotis alpestris	22
Thlaspi bellidifolium	22
Papaver * degenii	21
Doronicum columnae	6.
Saxifraga * discolor	2.
Saxifraga * pirinica	3.
Arabis caucasica	.2
Saxifraga luteoviridis	.1
FESTUCO-SESLERIETEA	
Cerastium * lanatum	22
Poa alpina	22
Pedicularis verticillata	.1
Saxifraga ferdinandi-coburgi	.1
SALICETEA HERBACEAE	
Poa pirinica	22
Draba scardica	.2
Omalotheca supina	.3
Sedum atratum	.2
OTHER PHANEROGAMS	
Hieracium sp.	.2
Taraxacum sp.	.2
CRYPTOGAMS	
Leskea polycarpa	37
Hymenostylium recurvirostre	35

Tortella tortuosa	33
Bryum caespiticium	22
Collema sp.	22
Toninia sp.	22
Tortula sinensis	22
Bryum elegans	3.
Protoblastenia terricola	2.
Psora decipiens	2.
Hypnum cupressiforme	.2
Leptogium sinuatum	.2
Plagiochila porelloides	.2

Greece. Many papers deal with the *Asplenietea trichomanis* in Rumania (eg. Borhidi 1958, Schneider-Binder 1968, 1969, 1972, 1975, 1980, Schneider-Binder & Voik 1977, Täuber 1985). In Bulgaria Pawlowski et al. (1937) and Simon (1958) brought descriptions of same new associations of the *Asplenietea trichomanis*.

The communities typical of lime-rich substrata (limestone, marble) from Macedonia and Bulgaria were classified within the *Ramondion nathaliae* (cf. Horvat 1936, Jovanović-Dunjić 1953, 1955, 1956, Simon 1958, Blečić & Tatić 1960).

Ramondion nathaliae suggested Horvat (1935, 1936) for south-Macedonian mountain ranges. The descriptions are, however, rather unclear. No diagnostic species are given and the associations supposed to be included within the *Ramondion nathaliae* are also not listed. Horvat (1936) listed only a few species, such as *Ramonda nathaliae, Saxifraga scardica, S. marginata, S. grisebachii, Potentilla apennina, Campanula formanekiana, Micromeria cristata* and some others, as dominants. The same name was used by Jovanović-Dunjić (1953, 1955, 1956) and Blečić & Tatić (1960) for a group of east-Serbian communities. Neither in these papers the validisation of the alliance was performed. *Ramondion nathaliae* was validated by Simon (1958) by listing character species of the alliance (see Tab. I in Simon 1958). He assigned the *Leontopodio - Potentilletum stojanovii* into the *Ramondion nathaliae* sensu Horvat (1935), thus interpreted the alliance as that comprising the fissure plant communities occurring in southern Macedonia (Yugoslavia), Bulgaria and most probably also some mountains of northern Greece and Albania. Quézel (1967) listed *Minuartia verna, Saxifraga grisebachii* (also near Bansko; Kuzmanov 1970), *Micromeria cristata* and *Achillea ageratifolia* subsp. *aizoon* as members of the diagnostic species group for the *Ramondion nathaliae*. Horvat et al. (1974) added also *Hieracium pannosum, Campanula versicolor, Alyssum corymbosum* and *Cerastium banaticum* to the diagnostic species of the alliance.

According to our opinion the use of the *Ramondion nathaliae* for the east-Serbian communities is incorrect because of the floristic differences between the Macedonian and Serbian plant communities of the *Asplenietea trichomanis* (Tab. 2). Therefore we describe a new alliance for the east-Serbian communities, the *Edriantho graminifolii - Erysimion comatae* all. nova (nomenclatural type: *Ceteracho - Ramondietum serbicae* Jovanović-Dunjić 1952). The diagnostic taxa of the alliance comprise *Erysimum comatum* (char.), *Edraianthus graminifolius* (char.), *E. serbicus* (char.), *Cerastium banaticum* (reg. char.), *Sesleria rigida* (dif.), *Sedum ochroleucum* (char.) *Ramonda serbica* (char.), *Alyssum saxatile* subsp. *orientale* (char.), *Viola grisebachiana* (reg. char.) and *Thymus serbicus* (char.).

It should be noted, however, that the Bulgarian communities *(Leontopodio - Potentilletum stojanovii* and *Hieracio pannosi-Caricetum)* are differing from the Yugoslavian Macedonian group by the endemic Bulgarian (and Pirin) species, and at the same time show some floristic relations to the *Edraiantho-Erysimion comatae* by common occurrence of species such as *Aster alpinus, Carum rigidulum* agg., *Campanula rotundifolia, Dianthus petraeus, Sedum ochroleucum* and the like.

According to the syntaxonomic revision summarized in Tab. 2 we suggest the following classification of *Potentilletalia caulescentis* in southeastern Balkan Peninsula:

Asplenietea trichomanis (Br. - Bl. in Meier et Br. - Bl. 1934) Oberd. 1977
Potentilletalia caulescentis Br. - Bl. 1926
Ramondion nathaliae Horvat ex Simon 1958

1. *Micromerio-Violetum kosaninii* Horvat ex Horvat et al. 1974
2. *Saxifrago-Potentilletum speciosae* Horvat et al. 1974 (syn. *Potentilla speciosa-Minuartia graminifolia*-Ass. Horvat 1937)
3. *Saxifrago karadzicensis-Potentilletum apenninae* Horvat ex Horvat et al. 1974
4. *Campanulo-Inuletum candidae* Horvat 1949
5. *Campanuletum formanekianae* Horvat 1938
6. *Campanulo formanekianae-Ramondietum nathaliae* Quézel 1967
7. *Achilleo-Aubrietetum gracilis* Horvat 1936
8. *Leontopodio-Potentilletum stojanovii* Simon 1958
9. *Hieracio pannosi-Caricetum kitaibelianae* Mucina et al. 1990

Edraiantho graminifolii-Erysimion comatae Mucina et al. 1990

10. *Erysimo-Ramondietum nathaliae* Jovanović-Dunjić 1952
11. *Saxifragetum brevifoliae* Blečić et Tatić 1960
12. *Ceteracho-Ramondietum serbicae* Jovanović-Dunjić 1952
13. *Saxifrago aizoi-Violetum grisebachianae* Jovanović-Dunjić ex Mucina et al. hoc loco
    (syn. As. *Saxifraga Aizoon-Viola Grisebachiana* prov.; Jovanović-Dunjić 1956)
    nomenclatural type: Tab. 12, relevé 4 in Jovanović-Dunjić (1956, p. 34), lectotypus
14. *Potentilla appennina-Saxifraga aizoon* community (Jovanović-Dunjić 1955)

3.2. Plant Communities on Marble Screes

High altidudes, both in the subalpine (low-situated sites in glacial valleys) and alpine (slopes of high-elevated glacial circles) belts in the marble part of the Northern Pirin Planina Mts. are rich in scree habitats resembling those in the Alps (Zollitsch 1966). Three associations, including the *Papaveri degenii-Armerietum*

alpinae, Veronico kellereri-Silenetum prostratae (belonging to a new alliance, the *Veronico-Papaverion* degenii), and the *Bromo lacmonices-Geranietum macrorrhizi* (the *Silenion marginatae*) are described in the sequel.

Papaveri degenii-Armerietum alpinae ass. nova
Nomenclatural type: Tab. 4, relevé 12, hoc loco

The *Papaveri degenii-Armerietum alpinae* is a pioneer community of low-grown herbs, grasses and mosses growing on crystalline limestone screes in the alpine belt of the Pirin Planina Mts.

The stands populate foothill screes and slopes of moraines at altitudes between 2200 to 2700 m. The slope of the screes ranks between 25-45° and only exceptionally are more gentle (5-10°); aspect of the slopes is prevailingly north and northeastern, to a lesser extent western or southwestern. The substratum is formed by rocks having 10 to 20 cm in diameter and intermingled with gravel (3 to 5 cm in ∅). Fine-grained soil particles occur in varying quantities. Most of the habitats are well-supplied by water which comes either directly from rainfall or, mainly, from thawing snow and firn patches. Large water streams emerging in spring usually give rise to erosion dells in the scree cones, and aid, together with large boulders, differentiation of the scree into variety of microhabitats. This reflects also in high species richness of the community.

The stands, sometimes more than 50 m² large, and with total cover ranging from 25 to 75%, are dominated by chasmophytes. The stands are bistratal; the lower herb sublayer (1 to 5 cm) is formed by dwarf *Arenaria biflora, Silene pusilla, Cerastium alpinum* subsp. *lanatum, Galium stojanovii, Saxifraga oppositifolia* and rosettes of several *Saxifraga* species. The higher herb sublayer (5 to 15, max. 25 cm high) is formed by the dominants of the community, such as *Armeria pocutica* subsp. *alpina, Doronicum columnae, Papaver degenii, Myosotis alpestris,* and *Veronica saturejoides* subsp. *kellereri.* The moss layer (1 to 4 cm) is also well-developed, mainly in wetter microhabitats, where it may attain 30 to 60%. The most frequent cryptogams include *Ditrichum flexicaule, Hymenostylium recurvirostre, Leskea polycarpa, Tortella tortuosa, Preissia quadrata* and *Tortula sinensis.*

Syndynamically the *Papaveri-Armerietum* is seen as arrested (blocked) successional stage (sensu Moravec 1969) of a pioneer character. In dried and more insolated habitats, after the screes has been partly consolidated by fine-grained soil, the stands become impoverished of typical scree species *(Veronica saturejoides* subsp. *kellereri, Doronicum columnae, Saxifraga adscendens* subsp. *discolor)* while tussock-forming grasses and sedges, such as *Sesleria coerulans, Festuca riloensis* (only rarely), *Carex rupestris, Carex laevis* (frequently) take over. The further succession proceeds in direction to the *Anthyllo-Seslerion klasterskyi* Simon 1958 *(Festuco-Seslerietea* Barbero et Bonin 1969), most probably towards the *Carici rupestris-Seslerietum klasterskyi* Simon 1958 described from the Vikhren Mt. The latter community forms a transition between the *Veronico-Papaverion degenii* and *Anthyllo-Seslerion klasterskyi.* In wetter, shady and gentle-sloped habitats the

Tab. 4 - The communities of the Veronico-Papaverion degenii.

No. of relevé	11111111112222 222222	C1	C2
	12345678901234567890123 456789	%	%
Exposition	NN N NN EE N NN W EE EE		
	NE NNNN NN N NNNSSNN SSS S		
	ENNEEWENEENENWNEEEWWEEN EEEESE		
Slope °	3143313133433 342334441 444444		
	00500005050505555505005 000505		
Sampled area m²	1 1 253232 312233134 486553		
	60885331058586001450650 803006		
Cover of herb layer %	46255253533325446433531 243432		
	00005505055050000000505 000050		
Cover of moss layer %	365<6312< 1<5 <1< << << < <		
	000100505-55555505--15- 15-1-1		
PAPAVERI-ARMERIETUM ALPINAE			
Saxifraga * discolor (Ch)	2.32..255333333233232.3	83	0
Papaver * degenii (Ch)	.2352..255225...2.55355 2.....	70	17
Viola grisebachiana (Ch)	22.22...2222.2.2523522.	70	0
Saxifraga androsacea (Ch)	775775552.....2.....	43	0
Ditrichum flexicaule (D)	23..3552.2322633233....	70	0
Leskea polycarpa (D)	542.62.3..54.5..3...2..	48	0
Sedum atratum (D)	.....2222.2222....21.	43	0
Pedicularis verticillata (D)	.....122...22.2..21.	35	0
Saxifraga exarata (D)	....33.....2.....35.2.	26	0
Draba scardica (D)	...2.....2.1..2...2	22	0
Peltigera rufescens (D)	.....2.....23.2.....1.	22	0
Solorina bispora (D)	..2.22.....2.....2..	22	0
D-TYPICUM			
Arenaria biflora	33232.2222.2255232..... .3.222	70	67
Omalotheca supina	22...2222.23.52535.....	57	0
Hymenostylium recurvirostre	67..7343..53...22..... .2....	39	17
Preissia quadrata	22....3.2.22..32.2.....	39	0
Mnium stellare	24..22..2..2.32.....	35	0
Salix reticulata	23.....5.....22..2.....	26	0
Primula minima	..2.53.....3..2.....	22	0
Carex parviflora	.2.2.....5.....	13	0
Drepanocladus aduncus	..8..7.....	9	0
Plantago atrata	.2.....3.....	9	0
D-FESTUCETOSUM RILOENSIS			
Festuca riloensis	.....3...5253.	22	0
Alyssum * pirinicum (D)	.....3553. .2.2.5	17	50
Pedicularis orthantha	.....2.2..2. 2.....	13	17
Dianthus microlepis	.....2..2..4. ...2..	13	17
VERONICO-SILENETUM PROSTRATAE			
Silene * prostrata (Ch)	.....2. 276776	4	100
Senecio rupestris (D)	..... 223.22	0	83
Festuca valida (D)	.....3... 5426.3	4	83
Linum capitatum (D)	..... .2.522	0	67
VERONICO-PAPAVERION DEGENII			
Poa pirinica	522353332553255355..33. .4.34.	87	50
Veronica * kellereri	22....2.33523325532222. 363655	74	100
Galium stojanovii	3...2....2322335355.33. 2.2322	61	83
Erigeron vichrenensis	.....2..2222...	22	0
Arabis ferdinandi-coburgi	.....2.2..... ...4.3	9	33
THLASPIETEA ROTUNDIFOLII			
Doronicum columnae	355.35775555577352.353. 55523.	87	83
Armeria * alpina	32332.2253.555327755755 22.2..	91	50
Myosotis alpestris	232325275555535555523.25 5...4.	96	50

Saxifraga oppositifolia	235232232225523.23535.5	2.....	91	17
Arabis caucasica	253222.2235222.2.....	3.....	61	17
Saxifraga luteoviridis	2.....1.1222.2222.2...	...2..	48	17
Thlaspi bellidifolium	.....232....55.33..2	...232	35	50
Tortula sinensis	2...62.5....2...2.....	22....	26	33
Myosotis suaveolens	.....2...2.3..	..42.3	13	50
Silene acaulis	.....3..3...5...2	.....	17	0
Geum reptans	.....5.....52.....	.....	13	0
Veronica alpina	.....5..2.....	.....	9	0
Scrophularia * laciniata	.....	2	0	17
FESTUCO-SESLERIETEA				
Poa alpina	3..2..2.3.2.3..2.235355	5.....	57	17
Sesleria coerulans	54.....23.2.5532.2.2	2..422	48	67
Cerastium * lanatum	..22....22..32....55.23	...2..	43	17
Helianthemum * tomentosum	3.....	...5.2	4	33
Botrychium lunaria	.....25....2.	.....	13	0
Saxifraga ferdinandi-coburgi	.....2...22.....	.....	13	0
Acinos alpinus	.....	...3..	0	17
Silene * graefferi	.....5.	...2..	4	17
ASPLENIETEA TRICHOMANIS				
Silene pusilla	23.2..22.233225323...2.	.....	65	0
Tortella tortuosa	2.....2222.2.32.....	.2.2.2	35	50
Euphrasia salisburgensis	.....1.....2.	...2.2	9	33
Cystopteris regia	22.....2....3.....	.....	17	0
Thymus cherlerioides	.....2.....2.	.....	9	0
Carex kitaibeliana	.....3.3.....	.....	9	0
Potentilla * stojanovii	.....1.....	.....	4	0
Campanula * pirinica	.....	...2.3	0	33
Helianthemum canum	.....	...2..	0	17
Asperula suberosa	.....	...2..	0	17
Carum rigidulum agg.	.....	...2..	0	17
SALICETEA HERBACEAE				
Ligusticum mutellina	.....	23	0	33
Bartsia alpina	.2.....2.....	.....	9	0
Gentiana verna	.....2.....	.....	4	0
Sagina saginoides	.....3.....	.....	4	0
Saxifraga heucherifolia	.3.....	.....	4	0
Potentilla crantzii	.....2.....	.....	4	0
Anthelia juratzkana	.....2.....	.....	4	0
Artemisia eriantha	.....2....	.....	4	0
Polygonum viviparum	.2.....	.....	4	0
Primula halleri	.....1.....	.....	4	0
Soldanella pusilla	.....5.....	.....	4	0
OTHER PHANEROGAMS				
Taraxacum nigricans agg.	55232.235332.3255522232	55223.	91	83
Hieracium Bg24	.....	...22.	0	33
Juniperus * nana	.....	...1..	0	17
Knautia sp.	.....	...2..	0	17
Cerastium sp.	.....2.....	.....	4	0
OTHER CRYPTOGAMS				
Bryum caespiticium	...2.2.5.....2.	.....	17	0
Brachythecium velutinum	.....22..22.....2..	.....	22	0
Bryum elegans	2.....3.....2.....	.....	13	0
Collema sp.	2.....2.....2.....	.....	13	0
Encalypta streptocarpa	2....3.....2.....	.....	13	0
Cladonia sp.	.2.....3.....	.....	9	0
Toninia candida	.22.....	.....	13	0
Anomodon viticulosus	.....6.....	.....	4	0
Bryum sp.	.....3.....	.....	4	0
Catopyrenium cinereum	.....2.....	.....	4	0
Cirriphyllum cirrosum	....2.....	.....	4	0
Cladonia pocillum	.....2.....	.....	4	0
Collema tenax	.....2.	.....	4	0
Hypnum cupressiforme	.....3.....	.....	4	0
Leptogium lichenoides	2.....	.....	4	0
Plerospora hookeri	.....2.....	.....	4	0
Pseudoleskea nervosa	.....5.....	.....	4	0
Tortula intermedia	.....2.....	.....	4	0
Timmia austriaca	.6.....	.....	4	0
Jungermania leiantha	.2.....	.....	4	0

Notes: C1 - constancy of Papaveri-Armerietum; C2 - contsancy of Veronico-Silenetum prostratae; for other abbreviations see Tab. 1.

development might proceed towards the *Salicetea herbaceae,* as also shown by the occurrence of many snow-patch species in the subassociation *typicum*.

The *Papaveri - Armerietum* is a rather common feature of scree slopes of all of the glacial circles in the marble part of the Northern Pirin Planina Mts. It is supposed to be located also at the Sinanitsa Mt.

Papaver degenii, Saxifraga adscendens subsp. *discolor, S. androsacea* and *Viola grisebachiana* are the character taxa of the association, while *Ditrichum flexicaule, Leskea polycarpa, Sedum atratum, Solorina bispora, Pedicularis verticillata, Saxifraga exarata* subsp. *pirinica, Draba scardica* and *Peltigera rufescens* differentiate the *Papaveri-Armerietum* well from the *Veronico-Silenetum prostratae* (see below).

In relation to soil moisture, the degree of scree stabilization and granulometric composition of the soil, the *Papaveri-Armerietum* is differentiated into a series of synecologically and floristically well-discernible units including the subassociation *typicum* (with typical variant and variant with *Saxifraga androsacea)* and the *festucetosum riloensis*.

Papaveri degenii-Armerietum alpinae typicum subass. nova
Nomenclatural type: identical with that of the association.

The soil supporting this community is skeletal, rich in boulders and gravel, and with a varying amount of fine-grained material. The slope of the sites is frequently 30 to 45°. among aspects north is the prevailing one, while east and west occur less frequently. The community occurs in extensive stands (up to 100 m^2); they are 10 to 25 cm high and poor in mosses. The differential species of the subassociation are *Arenaria biflora, Omalotheca supina, Salix reticulata, Primula minima, Carex parviflora, Plantago atrata, Preissia quadrata, Hymenostylium recurvirostre, Mnium stellare* and *Drepanocladus aduncus*.

There are two synecologically well-interpretable variants within the typical subassociation such as the variant with *Saxifraga androsacea* and typical variant. The stands of the former one populate the wettest habitats soaked with percolating water coming from thawing snow patches in upper positions of the scree cones found under steep rocky walls in mouthes of rocky dells and gorges. The fine-grained to gravelly, largely stabilized screes (10 to 30° steep) face north or northeast. The stands are carpet-like, low-grown (5 to 10 cm) and small-sized. At sites with gentle slope these habitats resemble snow patches. The community is characterized by dominance of *Saxifraga androsacea,* which seems to occur more frequently on silicate bedrock in other mountain ranges of Europe (eg. Domin 1930). The high cover values of several moss species such as *Drepanocladus aduncus, Hymenostylium recurvirostre, Leskea polycarpa* and *Tortula sinensis* are also of diagnostic value for the variant.

Along a complex ecocline (from wet habitats with fine-grained soil towards sunny and dried habitats with coarse-grained screes) the typical variant occupies an intermediate position between the *Saxifraga androsacea* variant and the subassociation *festucetosum riloensis*.

Papaveri degenii-Armerietum alpinae festucetosum riloensis subass. nova
Nomenclatural type: Tab. 4, relevé 21 hoc loco

The subassociation is limited to well-insolated habitats enjoying all-day-long sunshine. These are found on convex scree cones and ridges of moraines. The screes are gravelly, with a share of small rocks; the amount of fine-grained material and boulder is very varying. The slopes housing stands of the community usually face south-west to east-north or east aspects. The community occurs frequently at altitudes between 2600 to 2700 m. The are stands rather extensive and only poorly covered (35% on the average). Mosses are rare. The differential taxa of the subassociation include *Alyssum cuneifolium* subsp. *pirinicum, Festuca riloensis, Dianthus microlepis* and *Pedicularis orthantha.* The latter species occurs more frequently on granitic bedrock especially in central and southern parts of the Pirin Planina Mts. or in other Bulgarian mountain ranges, eg. Rila Planina Mts. where it is considered a character species of the *Carici curvulae-Festucetum riloensis* Horvat et al. 1937 *(Seslerion comosae* Horvat 1935, *Caricetea curvulae* Br. - Bl. 1948).

In comparison to other *Veronico-Papaverion* communities, the *festucetosum riloensis* is characterized by higher frequency of occurrence of *Poa alpina* and *Cerastium alpinum* subsp. *lanatum.*

Veronico kellereri-Silenetum prostratae ass. nova
Nomenclatural type: Tab. 4, relevé 27, hoc loco

The *Veronico - Silenetum prostratae* is a pioneer community of herbs populating bouldery marble screes in the alpine belt of the Pirin Planina Mts.

The community was recorded from the Golemiya Kazan Circle on moving screes found on south and southeast-facing steep slopes (40 to 45°). The screes were built of marble skeleton (5 to 30 cm in ∅) and admixed boulders as large as 1 m in diameter. A small amount of fine-grained eroded rocky material flushed on the bottoms of deep cracks among the boulders is also found. The screes are insolated during the most of the day, thus the sites are relatively warm and dry.

The stands of the community are 50 to 100 m² large, with rather loose canopy (cover 20 to 40% of a plot) and are strikingly stratified. The upper-most sublayer (up to 30 cm) is formed by the dominant *Silene vulgaris* subsp. *prostrata* and accompanied by *Doronicum columnae.* The middle herb sublayer (10 to 20 cm) is the species-richest stratum of the stands. *Veronica saturejoides* subsp. *kellereri, Senecio rupestris, Armeria pocutica* subsp. *alpina, Linum capitatum, Myosotis alpestris, M. suaveolens* and *Arabis ferdinandi-coburgi* are found in it. The lower herb sublayer (up to 5 cm) is frequented by dwarf-grown species such as *Galium stojanovii, Arabis biflora* and *Euphrasia salisburgensis.* Due to extreme microclimatic conditions and the overall dryness of its sites the community is poor in mosses.

Silene vulgaris subsp. *prostrata* occurs in highmountains on calcareous screes in many European countries, where it is considered a typical scree element (Hadač et al. 1969, Duvigneaud et al. 1970, Richard 1971, Valachovič 1989).

The dominant taxon, together with *Festuca valida*, *Senecio rupestris* and *Linum capitatum* form the character taxon combination of the *Veronico-Silenetum prostratae*. A synecologically analogous community of lower altitudes is the *Bromo lacmonices - Geranietum macrorrhizi* (see below). The following relevé is a transition between these two units:

Kamenititsa Tsirkus, altitude 2200 m, aspect E, slope 30°, sampled area 30 m², cover of herb layer 40%; August 13, 1984.
Bromus cappadocicus subsp. *lacmonices* 1, *Scrophularia heterophylla* subsp. *laciniata* 2a, *Senecio rupestris* 1, *Silene vulgaris* subsp. *prostrata* 1, *Thalictrum minus* subsp. *olympicum* 3, *Arabis caucasica* 1, *Doronicum columnae* +, *Festuca valida* +, *Mysotis alpestris* +, *Veronica saturejoides* subsp. *kellereri* +, *Sesleria coerulans* 2a, *Poa alpina* 2 m, *Acinos alpinus* 1, *Cirsium appendiculatum* 1, *Hieracium grandiflorum* 1, *Onobrychis montana* subsp. *scardica* +, *Dianthus scardicus* +, *Phleum montanum* +, *Euphorbia cyparissias* +, *E. amygdaloides* +, *Galium anisophyllum* agg. +, *Asplenium fissum* +, *Kernera saxatilis* +, *Hieracium pannosum* r. *Scorzonera rosea* +, *Daphne oleoides* +, *Taraxacum* sp. +.

Bromo lacmonices-Geranietum macrorrhizi ass. nova
Nomenclatural type: Tab. 5, relevé 3 hoc loco

The community populates moving or slightly stabilized screes on east- and south-facing slopes (15 to 40°) that occur mainly in the belt of *Pinus leucodermis* (at altitudes between 1800 to 2000 m). The skeleton building the screes is the marble stones (20 to 30 cm in diameter); also large boulders (up to 1 m in diameter) are present. At lower altitudes, also an admixture of granite stones was observed. Gravel and fine-grained material is scarce and it is concentrated on bottoms of the fissures among the scree rocks.

The stands of the community are from 20 to 100 m² in extent. Usually they are covering the scree in broad belts following the main axis of the scree. The total coverage is dependent on the cover of *Geranium macrorrhizum,* a chasmophyte broadly tolerating the range of soil reaction. Other species occur sparsely. Some epiterrestric mosses occur among the boulders. More frequently occur epilithic lichens and mosses.

The group of character taxa consists of *Geranium macrorrhizum, Bromus cappadocicus* subsp. *lacmonices* and *Moehringia pendula*. The classification of the *Bromo-Geranietum macrorrhizi* is problematic because of the broad habitat requirements of the dominant species (Boşcaiu 1971, Sanda et al. 1977). *Geranium macrorrhizum* is distributed (in Europe) in the Apennines, Southern Alps, Eastern and Southern Carpathians and other Balkan mountains. Most often it is limited to calcareous screes. In southern Greece (the Parnassos Mts.) it is a dominant species in the *Senecioni thapsiformi - Geranietum macrorrhizi* (Quézel 1964), a vicariant unit to the *Bromo-Geranietum macrorrhizi,* occurring in analogous habitats and in the same altitudinal belt. Quézel (l.c.) classified the community within the *Silenion caesiae* Quézel 1967 *(Drypetea spinosae* Quézel 1964). However, both associations share only one species - *Geranium macrorrhizum*. In Southern Alps, *Geranium macrorrhizum* occurs in the *Moehringio-Gymnocarpietum robertiani (Petasition paradoxi* Zollitsch 1966, *Drabetalia hoppeanae* Zollitsch 1966, *Thlaspietea rotundi-*

Tab. 5 - Bromo-Geranietum macrorrhizi (Silenion marginatae).

No. of relevé	12345	C %
Exposition	EE S SSSSS EEEEE	
Slope °	32334 50050	
Sampled area m²	34572 50000	
Cover of herb layer %	< < 555--	
BROMO-GERANIETUM MACRORRHIZI		
Geranium macrorrhizum (Ch)	77785	100
Bromus * lacmonices (Ch)	223.2	80
Moehringia pendula (Ch)	322.4	80
THLASPIETEA ROTUNDIFOLII		
Thalictrum * olympicum	22233	100
Lamium garganicum	2.22.	60
Senecio rupestris	22...	40
Heracleum * verticillatum	..2..	20
Scrophularia * laciniata	2	20
OTHER PHANEROGAMS		
Teucrium chamaedrys	23232	100
Campanula velebitica	22...	60
Festuca sp.	.2.32	60
Melica ciliata	323..	60
Asyneuma canescens	.2.2.	40
Cuscuta sp.	.22..	40
Euphorbia cyparissias	..22.	40
Urtica dioica	32...	40
Bupleurum sibthorpianum	...2.	20
Cirsium appendiculatum	.2...	20
Euphorbia amygdaloides	..2..	20
Galium album	..2..	20
Kernera saxatilis	.2...	20
CRYPTOGAMS		
Tortula intermedia	253..	60
Orthotrichum cupulatum	.22..	40
Tortella tortuosa	23...	40
Campanula rapunculoides	..3..	20
Homalothecium philippeanum	3....	20
Schistidium apocarpum	3....	20
Solorina bispora	.2...	20

Notes: Ch - character species.

folii). Boşcaiu (1971) described the *Geranietum macrorrhizi* from limesone screes with a granite admixture from the Cernei Mts. (the Southern Carpathians). The altitudinal range of the latter community is, however, shifted more to lower altitudes (between 380 to 1400 m) which suggests a classification of the *Geranietum macrorrhizi* Boşcaiu 1971 into the *Peltarion alliaceae* Horvatić 1957 *(Thlaspietea rotundifolii).* Only 5 species are common both to the *Geranietum macrorrhizi* and *Bromo-Geranietum macrorrhizi* (besides the aponymous species, also *Moehringia pendula, Melica ciliata, Senecio rupestris* and *Urtica dioica).* Blečić (1958) described the *Corydalo-Geranietum macrorrhizi* from Montenegro (the Piva Valley in the

Durmitor Mts.), but only *Melica ciliata* and *Geranium macrorrhizum* are shared by the compared communities.

Syntaxonomy of the Thlaspietea rotundifolii communities

The discussed communities apparently belong to 2 alliances having their distributional optima in the alpine and subalpine belts, respectively. The *Bromo lacmonices - Geranietum* belongs to the *Silenion marginatae* Lakušić 1970 described for the calcareous-scree communities of the southern Dinarides by Lakušić (1970) and Lakušić et al. (1982) as suggested by lists of diagnostic species. The *Silenion marginatae* includes also another scree community described from the Pirin Planina Mts. - the *Kenthranthetum kellereri* (Velchev & Vasiliev 1970). This community was reported from the altitudes between 1700 and 1900 m at one locality below the Duninoto Kuche Mt. It is similar to the *Bromo-Geranietum macrorrhizi* by the occurrence of *Teucrium chamaedrys, Lamium garganicum, Heracleum sphondylium* subsp. *verticillatum* and *Scrophularia heterophylla* subsp. *laciniata.* The dominant and character species of the community is *Kentranthus kellereri,* a Bulgarian endemic plant.

The *Silenion marginatae* is probably a geographic vicariant unit to the *Peltarion alliaceae* distributed in the northern Dinarides and Southern Carpathians (see also above).

The alpine scree communities show a great degree of resemblance and should be classified within one upper-ranked unit, the *Veronico-Papaverion degenii* all. nova hoc loco (nomenclatural type: *Papaveri degenii-Armerietum alpinae* Mucina et al. 1990). The character taxa of the *Veronico-Papaverion degenii* comprise *Veronica saturejoides* subsp. *kellereri, Poa pirinica, Galium stojanovii, Alyssum cuneifolium* subsp. *pirinicum, Erigeron vichrenensis* and *Arabis ferdinandi-coburgi* as well as the character species of the *Papaveri - Armerietum* and *Veronico-Silenetum* (see Tab. 4). This alliance, endemic to Bulgarian mountains (Pirin, probably also Rila and Slavyanka) is a vicariant to the *Saxifragion prenjae* and *Bunion alpini* described by Lakušić (1970) from the Dinarides. The synoptic table of the Dinaride scree communities (Lakušić 1970: Tab. 10a) supports the separate syntaxonomic position of the *Veronico-Papaverion degenii.* The discussed units are floristically different as they contain many endemic species characteristic of respective distribution areas of the alliances. The *Bunion alpini, Saxifragion prenjae, Silenion marginatae* and *Veronico-Papaverion degenii* belong to the *Arabidetalia alpinae-flavescentis* Lakušić 1970 *(Thlaspietea rotundifolii)* which is a geographic vicariant to the *Thlaspietalia rotundifolii* of the Alpic-Carpathian Mountain System.

3.3. Plant Communities of Snow-bed Vegetation

The snow-patch (snow-bed) vegetation was studied both on granites, schists and marbles in the central and nothernmost parts of the Northern Pirin Planina Mts. Two associations belonging to the *Salicion herbaceae,* such as the *Soldanello*

pusillae-Plantaginetum gentianoidis and *Omalotheco - Alopecuretum gerardii* were described from siliceous bedrocks. The *Gentiano-Plantaginetum atratae* and *Bartsio-Salicetum reticulatae* were found on calcium-rich bedrock; these latter belong to the *Salicion retuso reticulatae*.

Soldanello pusillae-Plantaginetum gentianoidis Boşcaiu 1971
Nomenclatural type: Boşcaiu (1971; Tab. 12, relevé 3), lectotypus

The *Soldanello-Plantaginetum gentianoidis* is a snow-patch plant community supported by siliceous bedrocks. It was noted in the southern part of the Northern Pirin Planina Mts. in the Smirnenski and Belemeto Tsirkus. The habitats of the community are found in concave relief forms; these are shallow depressions hidden among large boulders, as a rule. The snow cover persists longer than in habitats of the *Omalotheco-Alopecuretum gerardii*.

The shallow alpine tangel soils, rich in fine-grained soil material are derived from granite. The soil has higher moisture retention than that supporting the *Omalotheco-Alopecuretum gerardii*. This is indicated also by the occurrence of *Nardus stricta* and *Cerastium cerastoides* as well as high cover values of *Arenaria biflora, Taraxacum nigricans* agg. and *Carex curvula*. *Plantago gentianoides* is a good moisture indicator itself. In comparison to the drier *Omalotheco-Alopecuretum gerardii,* the abundance of drought-tolerant taxa such as *Omalotheca supina, Alopecurus gerardii, Dianthus microlepis* and *Scleranthus perennis* subsp. *marginatus* decreases.

The stands are composed of two layers, including the low-grown herb layer dominated by *Plantago gentianoides* and subdominated by *Arenaria biflora, Nardus stricta, Taraxacum nigricans* agg. and *Carex curvula*. Mosses and lichens are represented by dominant *Polytrichum piliferum; Lepraria incana, Stereocaulon alpinum* and *Cetraria islandica* are also frequent, although their cover values are lower than with the *Omalotheco-Alopecuretum gerardii*.

Plantago gentianoides and *Cerastium cerastoides* are regional character species of the *Soldanello-Plantaginetum gentianoidis* in the Pirin Planina Mts.

As seen from Tab. 7 the Bulgarian *Plantago gentianoides* community can be identified with the *Soldanello-Plantaginetum gentianoidis* Boşcaiu 1971. The floristical differences within the *Soldanello-Plantaginetum gentianoidis* are depicted by geographical races. The community described from the Ţarcu, Godeanu and Cernei Mts. (Boşcaiu 1971), Făgăraş Mts. (Csürös 1957, Puşcaru-Soroceanu et al. 1977) and the Retezat Mts. (Csürös et al. 1956) is the *Luzula alpino-pilosa* race, characteristic of the Rumanian Carpathians (Tab. 7 hoc loco, columns 1-3). It is differentiated by *Luzula alpino-pilosa, Festuca supina, Polytrichum norvegicum, Carex pyrenaica, Rhododendron myrtifolium* (syn. *R. kotchyi)* and *Phyteuma confusum*. The *Soldanello-Plantaginetum gentianoidis* from the Pirin Planina Mts. is assigned to the *Alopecurus gerardii* race (Tab. 7, column 5). It is differentiated by *Alopecurus gerardii, Carex curvula, Achillea clusiana, Scleranthus perennis* subsp. *marginatus* and *Jasione bulgarica*.

The *Nardo-Plantaginetum gentianoidis* (Lakušić et al. 1979) from the Vranica Mts. (Yugoslavia) is identical with the *Soldanello-Plantaginetum*. Based on taxa such as *Crepis aurea* subsp. *glabrescens* (incl. *C. bosniaca* Maly), *Carex curta, Festuca picta* and *Sedum alpestre* (incl. *S. horakii)*, an eastern - Dinaride race (Tab. 7, column 4) within the *Soldanello - Plantaginetum* can be recognized. The homonymous "Association *Nardus stricta - Plantago gentianoides*" (Ganchev 1963) from the Rila Planina Mts. is a transition-mire community found at peaty margins of glacier lakes.

Omalotheco-Alopecuretum gerardii ass. nova
Nomenclatural type: Tab. 6, relevé 11, hoc loco

The *Omalotheco-Alopecuretum gerardii* is a widely distributed snow-bed community of the Pirin Planina Mts. It was found in broad glacial valleys and circles of the granitic Pirin Planina Mts. (the Solishcheto Saddle, Smirnenski and Belemeto Tsirkus, the Tipits Mts.). The community was sampled also in the Rila Planina Mts. as documented by the following relevé:

Rila Planina Mts., a saddle near the Vazela Mt., 2600 m, aspect ENE, slope 35°, area 16 m^2, cover of herb layer: 75%, cover of moss layer: < 1%; August 11, 1978.
Alopecurus gerardii 3, *Omalotheca supina* 2-3, *Campanula alpina* subsp. *orbelica* 2, *Dianthus microlepis* 1, *Poa media* 1, *Sedum alpestre* 1, *Taraxacum* sp. 1, *Luzula spicata* +, *Scleranthus perennis* subsp. *marginatus* +, *Arenaria biflora* +, *Polytrichum* sp. +, *Cetraria islandica* +.

References to snow-bed communities with *Alopecurus gerardii* from the Rila Planina Mts. were made by Rusakova (1977) and Rusakova-Anastasova (1983). Grebenshchikov (1965) and Jovanović et al. (1975) mentioned the occurrence of these communities also from other south-Balkan mountains.

Unlike the *Soldanello-Plantaginetum gentianoidis,* this community prefers convex forms of relief. The sites face various aspects; the slopes have a gentle inclination, but are still well-insolated and exposed to winds. Especially in saddles, cryoturbation forms a great variety of habitats suitable for the community. In some places the development of deeper soils is prevented by co-action of wind and snow cover, and large soil-free patches are formed. The bottom of the patches is covered by denuded granite boulders and gravel-like eroded material derived form the granitic rocks. Thick rhizomes of *Alopecurus gerardii* penetrate to the ground surface to form a unique worm-like plexus solidifying the substratum. Among these, abundant *Omalotheca supina, Dianthus microlepis, Campanula alpina* subsp. *orbelica* and *Scleranthus perennis* subsp. *marginatus* occur. The lower herb sublayer is only few cm high. The culms of *Alopecurus gerardii, Luzula spicata* and flowering shoots of *Achillea clusiana* attain the maximal height of 10 to 15 cm, and form the upper herb sublayer. The cryptogamic layer covers usually a quarter of the surface, and is composed of few mosses (the abundant one is *Polytrichum alpinum)* and lichens, which dominate the stands in the driest habitats (the *euphrasietosum minimae).*

Most of the stands are grazed by sheep and sustain heavy trampling as becomes obvious along touristic tracks.

The character species of the association is *Alopecurus gerardii*. The group of the association differential species includes drought-tolerant taxa characteristic of acid grasslands of the *Seslerion comosae*, such as *Festuca riloensis, Thymus balcanus, Campanula alpina* subsp. *orbelica, Vaccinium gaultheroides, Euphrasia minima, Festuca supina* and *Agrostis rupestris*. Also a lichen - *Baeomyces roseus* - should be listed among the differential species.

Three subassociations were distinguished within the *Omalotheco -Alopecuretum gerardii* such as the *plantaginetosum gentianoidis*, the *typicum*, and the *euphrasietosum minimae*. The differentiation of the subassociations is underlied by soil-moisture gradient, and is stressed by the degree of drought tolerance of differential species groups.

The *Omalotheco-Alopecuretum plantaginetosum gentianoidis* subass. nova (nomenclatural type: relevé 6 in Tab. 6 hoc loco) is a transitional unit to the *Soldanello-Plantaginetum gentianoidis*. It occurs in the Belemeto Tsirkus and on the north-facing slope of the Mozgoviskhi Chukar Mt. (2605 m). The stands on gentle slopes and the soils are the richest in fine material within the range of the association. The community houses a number of moisture-loving species which occur only with low abundance values in the other subassociations of the *Omalotheco-Alopecuretum gerardii*. It is the species-poorest snow-bed community. *Plantago gentianoides, Alopecurus gerardii, Omalotheca supina* and *Taraxacum nigricans* agg. are the dominants of the *Omalotheco-Alopecuretum gerardii plantaginetosum*. The differential species of the subassociation are *Plantago gentianoides* and *Ligusticum mutellina*. *Taraxacum nigricans* agg. has the highest cover values in this subassociation.

The subassociation *typicum* subass. nova (the nomenclatural type is identical with that of the association) is a widely distributed vegetation type occupying an intermediate position within the *Omalotheco-Alopecuretum gerardii* along gradients of soil-moisture and content of fine-soil particles. The group of differential species of the subassociation consist of *Acinos alpinus, Luzula spicata* and *Lophozia ventricosa*.

The subassociation *euphrasietosum minimae* subass. nova (nomenclatural type: relevé 18 in Tab. 6 hoc loco) occupies the driest positions along the soil-moisture gradient within the association. It was located in the Demirkapiiska Reka Valley and at the Tipits Mt. The stands of this community are extremely low-grown (2-5 cm); the cryptogamic layer is rich in lichens such as *Lepraria incana, Stereocaulon alpinum, Cetraria islandica, Cladonia macrophyllodes* and *Solorina crocea*. The differential species of the subassociation include *Euphrasia minima, Agrostis rupestris, Festuca supina, Ranunculus pseudomontanus, Potentilla aurea* subsp. *chrysocraspeda, Nardus stricta, Plantago atrata* and *Hypnum cupressiforme* and *Rhacomitrium canescens*. The *Omalotheco-Alopecuretum euphrasietosum* is a snow-bed community of siliceous substrata, with a high abundance of *Plantago atrata* which, however, is more frequent in snow-beds on calcareous bedrocks. Incidental-

Tab. 6 - Snow bed communities on siliceous substrata.

No. of relevé	1234	111111111122 56789012345678901	C1 %	C2 %
Exposition	----	W E N N S N SS WWNWWWWSESWWNW-WN		
Slope °	----	1 11<1215<1 11 12 55005050050505-50		
Sampled area m²	8904	1 11 1 1 1 22933342608928649		
Cover of herb layer %	9997 0050	1111 1 00008669795678906 00000000000050000		
Cover of moss layer %	1001	<22 2 2 11 <33321< 2 0550-555500000555		
CARICETEA CURVULAE				
Dianthus microlepis		..3. ..2322.352223453.	25	76
Carex curvula		7343 32.2.23..2.53...3	100	53
Poa media		2.35 ..4.22....553..42	75	47
Scleranthus * marginatus		.12. ....2..52...323.2	50	41
Primula minima		.... 3.....	0	6
Jasione * bulgarica		..4. .....2.....3.	25	12
Juncus trifidus		....3.....	0	6
Poa laxa		....1.....	0	6
LIGUSTICO-PLANTAGINETUM GENTIANOIDIS				
Plantago gentianoides (Ch)		8887 778.....2.....	100	24
Cerastium cerastoides (Ch)		2..2	50	0
OMALOTHECO-ALOPECURETUM GERARDII				
Alopecurus gerardii (Ch)		.2.3 77778777777887777	50	100
Campanula * orbelica (D)		.... 2.22223322.223246	0	88
Geum montanum (D)		.... 2.....1.22...12	0	35
Festuca riloensis (D)		....2.323.....5	0	29
Thymus * polytrichus (D)		....322.2.....2.	0	29
Baeomyces roseus (D)		.... 4.....222.....	0	24
Vaccinium gaultheroides (D)		.... 2.....2..2.....	0	18
D-EUPHRASIETOSUM MINIMAE				
Euphrasia minima		4334	0	24
Agrostis rupestris		3223	0	24
Festuca supina		....456.	0	18
Rhacomitrium canescens		....4..2	0	12
Ranunculus pseudomontanus		..3. 22....21.2.2.555.	25	53
Nardus stricta		3743 ....2....2..553.	100	29
Potentilla * chrysaspeda		3.4. ...2..22.....343.	50	35
Plantago atrata		..3. ...2.....442.	25	24
Hypnum cupressiforme		.2.. .....242.	25	18
SALICETEA HERBACEAE				
Omalotheca supina		2323 73375557374778767	100	100
Arenaria biflora		7474 .2223....2323..2.	100	53
Achillea clusiana		2..2 ...5....32322....	50	35
Sedum alpestre		...2 .....1222.3..22	25	41
Ligusticum mutellina		32.. .22.....	50	12
Luzula spicata		....232.....	0	18
Soldanella pusilla		...3 .....2.....	25	6
Ranunculus crenatus		...2 .....1.....	25	6
Luzula spadicea		2	0	6
OTHER PHANEROGAMS				
Taraxacum sp.		7237 553.2...12333....	100	53
Acinos alpinus		....22.2.....	0	18
Jovibarba heuffelii		....1.....	0	6

Thymus x pilisiensis	....3.....	0	6
OTHER CRYPTOGAMS			
Polytrichum piliferum	2752 2245.33..67744444	100	82
Cetraria islandica	2... 2..2.222...222222	25	65
Lepraria incana	.34. ..2.....3345236	50	47
Stereocaulon alpinum	.22. .2...23...2..22..	50	35
Lophozia ventricosus	...2 .....345....	25	18
Cladonia macrophyllodes	..2. .....22.2.	25	18
Solorina crocea	....2...2	0	12
Cladonia pyxidata	....2.....	0	6
Cladonia sp.	2	25	18
Lecidea sp.	....2.....	0	6
Myurella julacea	2... .....3...	25	6

Notes: x - hybrid; for other abbreviations see Tab. 1.

ly, this is the only calciphilous species which does occur on silicate snow-beds. On the other hand, the number of the acidophilous elements growing also on calcareous bedrocks is much higher (eg. *Gentiano-Plantaginetum atratae trifolietosum orbelici;* Tab. 7).

Simon (1958) considered *Alopecurus gerardii* to be a character species of the *Seslerietalia comosae*. Horvat (in Horvat et al. 1974) described the *Alopecuro-Plantaginetum* from Pelister Mts. (Yugoslavia Macedonia). According to Horvat et al. (l.c.) this community has an outrageous position within the *Seslerion comosae* as it occurs on fine-grained soil and at less exposed habitats then other communities of the alliance. It differs from the *Omalotheco-Alopecuretum* by presence of the association character species such as *Plantago holosteum, Lotus corniculatus* and *Thesium alpinum,* and by absence of many species of the snow-bed habitats. *Alopecurus gerardii* (var. *pantocsekii)* is one of the dominating species of the *Ranunculetum crenati* Lakušić 1966 described from Bjelasica Mts. in Yugoslavia.

Quézel (1964, 1967) regarded *Alopecurus gerardii* as a character species of the *Caricetea curvulae*. Three associations dominated by the species were described by Quézel (l.c.) from the Greece mountains, belonging to the *Trifolion parnassi* Quézel 1964 (the *Trifolietalia parnassi* Quézel 1964, *Caricetea curvulae).* The community group is vicariant to the *Nardion* Luquet 1926 of the temperate Europe. The communities are confined to shallow hollows or small-sized dolinas filled by silt. These habitats contain snow longer than the surrounding environments although they cannot be classified as true snow-beds characteristic of the temperate and boreal mountain ranges. In summer, the soil surface in the sites desiccates. The *Croco sieberi - Alopecuretum gerardii* Quézel 1964 (syn. *Beto nanae-Alopecuretum gerardii* (Quézel 1964) Horvat et al. 1974) was described from the Taygetos, Kyllini and Parnassos Mts., the *Gnaphalio hoppeani-Alopecuretum gerardii* Quézel 1967 is known from the Thessalian Olymbos, and the *Croco veluchensis-Alopecuretum gerardii* Quézel 1967 was found to occur in the central and northern parts of the Pindos Mts. (Quézel 1964, 1967, Horvat et al. 1974).

Analogous *Alopecurus gerardii* communities were described from the Djurdijura Mts. in north Africa (Quézel 1957), Maritime Alps in France (eg. Guinochet 1938, Barbero 1970, Lacoste 1975: *Ranunculo pyrenei - Alopecuretum gerardii)* and Pyrenées (Lüdi 1943, Braun-Blanquet 1948: *Trifolio - Phleetum gerardii).*

Tab. 7 - Communities of the Salicetea herbaceae (with Plantago gentianoides. Ranunculus crenatus and Alopecurus gerardii) in the Balkan Peninsula.

Number of column	1	2	3	4	5	6	7	8	9	10	11	12	13
Relevés per table	8	5	6	4	4	7	10	4	9	8	10	9	17
SALICETEA HERBACEAE													
Plantago gentianoides	V24	V+3	V15	434	434	V+	.	II23	II+	III+	.	.	II+4
Ranunculus crenatus	I+	II+1	II+	1+	1+	V23	V24	423	V13	V24	V+3	V14	Ir
Alopecurus gerardii	.	.	.	.	2+1	.	.	.	III13	.	II12	V13	V34
Omalotheca supina	III+	III+	IIIr+	21	4+1	V+2	V+1	2+3	IV+2	II+	V15	V14	V24
Geum montanum	IV+	II+	III+1	2+1	.	V+2	III+	11	II+	V+1	V+2	V+2	IIr+
Luzula alpino-pilosa	V+1	I+	II1	.	.	III+	V+1	2+	II+1	IV+2	.	.	I+
Sedum alpestre	.	.	.	III+	1+	V+1	II+	11	I+	I+	III+2	IV12	IIIr1
Soldanella pusilla	V+2	V13	V+1	.	11	.	.	4+2	.	V14	.	.	I+
Ligusticum mutellina	V+2	III+	V13	412	2+1	V23	IV+2	4+3	II+	IV+1	IV+2	.	I+
Polytricum norvegicum	.	I+	III+1	.	.	.	IV+2	.	I+	II+	.	.	.
Arenaria biflora	.	.	IV+	.	423	.	.	2+2	.	.	.	I2	III+1
Tanacetum alpinum	I+	.	.	.	.	.	I+	.	III12	IV+	I2	.	.
Cerastium cerastoides	.	I+	.	.	2+	.	.	.	II1	.	.	IV+2	.
Plantago atrata	.	.	.	.	11	I+	.	.	.	.	I13	II13	II+2
Achillea clusiana	.	.	.	.	2+	.	.	.	.	.	.	.	II+1
Luzula spicata	.	.	.	.	.	.	.	.	.	.	.	I+	I+
Salix herbacea	.	.	.	.	.	.	I1	.	I+	.	.	.	.
Kiaeria starkei	.	.	.	.	.	.	III+3	.	.	.	I4	.	.
Soldanella hungarica	.	.	.	.	.	.	V+2	.	.	.	.	.	.
Kiaeria falcata	.	.	.	.	.	.	III23	.	.	.	.	.	.
Anthelia juratzkana	.	.	.	.	.	.	III+2	.	.	.	.	.	.
Polygonum viviparum	.	.	.	.	.	.	.	.	.	.	I+	.	.
Veronica alpina	.	.	.	.	.	.	.	.	.	.	I1	.	.
CARICETEA CURVULAE													
Potentilla * chryocraspeda	IV+1	I+	III+2	31	212	V+2	.	12	II+	IV+	IV+2	V13	II12
Festuca supina	.	I1	III+5	.	.	IV+	.	1+	II+	.	.	I+	I2
Primula minima	I+	.	.	.	.	V+2	IV+1	1+	III+1	IV+1	.	.	rI
Agrostis rupestris	.	.	.	.	.	V12	I+	.	III2	I+	I1	.	II+1
Juncus trifidus	.	.	.	.	.	II+	.	.	II+	I+	.	II+	I1
Carex curvula	.	.	.	.	413	.	II+1	12	I+	.	.	.	.
Poa media	.	.	.	11	3+3	.	.	.	.	.	I12	.	III+3
Ranunculus montanus agg.	.	.	.	.	11	.	I+	.	.	.	II+1	.	IIIr2
Campanula * alpina	II+	.	.	.	.	.	.	.	I+	II+	.	.	.
Hieracium alpinum	I+	.	.	.	.	II+	.	.	I+	.	.	.	.
Pulsatilla alba	II+	.	.	.	.	II+	.	.	.	I+	.	.	.
Phyteuma confusum	.	.	II+1	.	.	.	.	.	II+	.	I+1	.	.
Scleranthus * marginatus	.	.	.	.	2r+	.	.	.	.	.	.	II1	III+3
Festuca riloensis	.	.	.	.	.	.	.	.	.	.	V+2	.	II+2
Jasione orbiculata	.	.	.	.	.	.	.	.	.	.	III+2	V+4	.
Anthoxanthum alpinum	.	.	.	11	.	.	.	.	.	I+	.	.	.
Leontodon helveticus	.	.	.	11	.	.	.	.	.	.	I1	.	.
Dianthus microlepis	.	.	.	.	11	.	.	.	.	.	.	.	III+2
Jasione bulgarica	.	.	.	.	12	.	.	.	.	.	.	.	I+1
Poa disparilis	.	.	I1	.	.	.	III+2	.	.	.	.	.	.
Campanula tatrae	.	.	.	.	.	III+	.	.	.	.	.	.	.
Campanula * orbelica	.	.	.	.	.	.	.	.	.	.	.	.	V+2
Avenula versicolor	.	.	.	.	.	.	.	.	.	I+	.	.	.
Gentiana punctata	.	.	.	.	.	.	I+	.	.	.	.	.	.
Oreochloa disticha	.	.	.	.	.	.	I+	.	.	.	.	.	.
Anthemis carpatica	.	.	.	.	.	.	.	1+	.	.	.	.	.
Festuca * scardica	.	.	.	.	.	.	.	.	.	.	.	II12	.
Jovibarba heuffelii	.	.	.	.	.	.	.	.	.	.	.	.	Ir
Euphrasia minima	.	.	.	.	.	.	.	.	.	.	.	.	II12
THLASPIETEA ROTUNDIFOLII													
Cardamine rivularis	.	.	.	.	.	.	.	1+	.	.	.	.	.
Saxifraga muscosa	.	.	.	.	.	.	.	.	I+	.	.	.	.
Doronicum carpaticum	.	.	.	.	.	.	.	1+	.	.	.	.	.
Poa laxa	.	.	.	.	.	.	.	.	.	.	.	.	I1
Crepis * glabrescens	.	.	.	31	.	.	.	.	.	.	II13	II14	.
Myosotis alpestris	.	.	.	.	.	.	.	.	.	.	I+	.	.
Festuca picta	.	.	.	412	.	.	.	.	.	.	.	.	.
Cardaminopsis ovirensis	.	I+	.	.	.	.	.	.	.	.	.	.	.
Arabis alpina	.	.	.	.	.	.	I+	.	.	.	.	.	.
Saxifraga androsacea	.	.	.	.	.	.	I+	.	.	.	I1	.	.
OTHER PHANEROGAMS													
Nardus stricta	V+2	I1	.	434	413	.	I+	.	III	V12	II+2	I+	II+2
Taraxacum sp. div.	II+	.	.	.	4+3	V+	.	2+1	I+	II+	I1	.	I+
Poa alpina	I+	IV+2	II+	2+2	.	III+	.	.	III+1	IV+1	II+1	.	.
Homogyne alpina	V+1	.	.	21	.	V+	.	.	.	IV+1	I1	.	.
Deschampsia caespitosa	.	.	.	11	.	I+	II+1	.	.	.	I1	.	.
Phleum alpinum	.	I+	.	1+	.	IV+2	.	.	.	.	.	.	.

Carex pyrenaica	II13	I+	.	.	.	.	.	.	I+	.	.	.	.
Alchemilla glaucescens	.	I+	.	2+1	.	.	.	.	.	.	.	.	.
Veratrum album	.	.	I+	.	.	.	I+	.	.	I+	.	.	.
Soldanella alpina	.	.	.	2+	.	.	.	.	.	.	I1	.	.
Avenella flexuosa	.	.	.	1+	.	.	.	.	.	.	I1	.	.
Luzula sudetica	.	.	.	11	.	.	.	.	.	.	I1	.	.
Carex foetida	.	.	.	.	.	.	.	.	.	.	II13	II14	.
Crocus heuffelianus	II+	.	.	.	.	.	.	.	.	.	+	+	.
Saxifraga heucherifolia	.	I+	.	.	.	.	.	.	.	.	.	.	.
Trifolium pallescens	.	I+	.	.	.	.	.	.	.	.	.	.	.
Carex curta	.	.	.	3+1	.	.	.	.	.	.	.	.	.
Poa sp.	.	.	.	11	.	.	.	.	.	.	.	.	.
Gentiana acaulis	.	.	.	1+	.	.	.	.	.	.	.	.	.
Crocus neapolitanus	.	.	.	11	.	.	.	.	.	.	.	.	.
Euphrasia stricta	.	.	.	.	.	IV+	.	.	.	.	.	.	.
Achillea distans	.	.	.	.	.	I+	.	.	.	.	.	.	.
Alchemilla glabra	.	.	.	.	.	.	I+	.	.	.	.	.	.
Saxifraga stellaris	.	.	.	.	.	.	I+	.	.	.	.	.	.
Sesleria bielzii	.	.	.	.	.	.	.	.	II+	.	.	.	.
Primula veris	.	.	.	.	.	.	.	.	.	I+	.	.	.
Homogyne discolor	.	.	.	.	.	.	.	.	.	.	I1	.	.
Alchemilla plicatula	.	.	.	.	.	.	.	.	.	.	I1	.	.
Silene pusilla	.	.	.	.	.	.	.	.	.	.	I1	.	.
Luzula campestris	.	.	.	.	.	.	.	.	.	.	I+	.	.
Ligusticum albanicum	.	.	.	.	.	.	.	.	.	.	.	III+1	.
Thymus * pilisiensis	.	.	.	.	.	.	.	.	.	.	.	.	I1
Thymus * polytrichus	.	.	.	.	.	.	.	.	.	.	.	.	II+1
CETRARIO-LOISELEURIETEA													
Cetraria islandica	II+	.	I+	.	1+	.	.	.	I+	IV+1	II12	.	IV+
Vaccinium gaultheroides	.	.	.	.	.	.	.	.	.	.	I+	I+	I+
Vaccinium myrtillus	I+	.	.	1+	.	.	.	.	.	.	.	.	.
Rhododendron myrtifolium	.	.	II+1	.	.	I+	.	.	.	.	.	.	.
OTHER CRYPTOGAMS													
Polytrichum piliferum	.	.	.	11	4+3	.	.	.	.	.	.	I+	V+3
Polytrichum juniperinum	.	.	.	11	.	.	.	.	.	II+	V+3	.	.
Dicranum scoparium	II+	.	.	.	.	.	.	.	.	II+	.	.	.
Lepraria incana	.	.	.	.	212	.	.	.	.	.	.	.	III+2
Stereocaulon alpinum	.	.	.	.	2+	.	.	.	.	.	.	.	II+1
Cladonia macrophyllodes	.	.	.	.	1+	.	.	.	.	.	.	.	I+
Myurella julacea	.	.	.	.	1+	.	.	.	.	.	.	.	I1
Lophozia ventricosa	.	.	.	.	.	.	.	.	.	.	I2	.	I12
Hypnum cupressiforme	.	.	.	.	1+	.	.	.	.	.	.	.	I+2
Sanionia uncinata	.	.	.	.	.	.	I+	.	.	I+	.	.	.
Polytrichum alpinum	I+	.	.	.	.	.	.	.	.	.	.	.	.
Oligotrichum hercynium	.	.	.	.	.	.	II23	.	.	.	.	.	.
Diplophyllum taxifolium	.	.	.	.	.	.	II+1	.	.	.	.	.	.
Dicranella heteromalla	.	.	.	.	.	.	II+1	.	.	.	.	.	.
Cladonia pyxidata	.	.	.	.	.	.	.	.	.	.	I+	.	.
Tortella tortuosa	.	.	.	.	.	.	.	.	.	.	I1	.	.
Rhacomitrium canescens	.	.	.	.	.	.	.	.	.	.	.	.	I+2
Solorina crocea	.	.	.	.	.	.	.	.	.	.	.	.	I+
Cladonia sp.	.	.	.	.	.	.	.	.	.	.	.	.	I+
Baeomyces roseus	.	.	.	.	.	.	.	.	.	.	.	.	II+2

Localities of tables (Tab. 7):

1. Soldanello (pusillae)-Plantaginetum gentianoidis; Resmeriţă (1976), Tab. 8; Rodna (Rumania)
2. Soldanello pusillae-Plantaginetum gentianoidis; Resmeriţă (1979), Tab. 6. Rodna (Rumania)
3. Ligustico-Plantaginetum gentianoidis; Mucina (ined.); Făgăraş (Rumania)
5. Ligustico-Plantaginetum gentianoidis; Tab. 6 in this study, relevés 1-4; Pirin
6. Agrosteto (alpinae)-Ranunculetum crenati; Resmeriţă (1975), Tab. 2; Maramureş (Rumania)
7. Soldanello hungaricae-Ranunculetum crenati; Coldea (1985); Tab. 1; Rodna (Rumania)
8. Soldanello pusillae-Ranunculetum crenati; Mucina (ined.); Făgăraş (Rumania)
9. Soldanello (pusillae) - Ranunculetum crenati; Boşcaiu (1971), Tab. 24, Ţarcu, Godeanu & Cernei Mts. (Rumania)
10. Soldanello (pusillae)-Ranunculetum-crenati; Resmeriţă (1976), Tab. 3; Retezat Ms. (Rumania)
11. Ranunculetum crenati vranicensis; Lakušić et al. (1979), Tab. I (7 rels.); Vranica (Yugoslavia)
12. Ranunculetum crenati; Lakušić (1964-1966), Tab. 2, relevés 1-2, 6-12; Bjelilo (Yugoslavia)
13. Omalotheco-Alopecuretum gerardii; Tab. 6 in this study, relevés 5-21; Pirin

Gentiano-Plantaginetum atratae ass. nova
Nomenclatural type: Tab. 8, relevé 9, hoc loco

The *Gentiano-Plantaginetum atratae* is a typical snow-bed community of the northern range of the Pirin Planina Mts. It is limited to habitats which are covered app. 6 months by snow and occur at altitudes between 2400 and 2600 m. The community is found, unlike the *Bartsio-Salicetum reticulatae,* on convex relief forms, usually with gentle (10 to 15°), east to south - (southeast) - facing slopes. The habitats are more insolated but also windier than those of the *Bartsio-Salicetum reticulatae.*

The soils, shallow alpine rendzinas, are derived from two types of rocks such as calcium-rich schists and crystalline limestones (marble). The substratum is very skeletal; the skeleton covers a small part of the soil surface. On schists, the upper soil layer is rich in gravel-like skeleton.

The stands of the community and low-grown and two-layered. The herb layer, usually with high cover (70 to 90%) is composed of two sublayer which are not always developed. The low sublayer (3 to 5 cm) is dominated by *Plantago atrata* which gives the stands an outlook of a silvery carpet. Only occasionally some grasses and sedges, such as *Alopecurus gerardii, Poa pirinica, Sesleria coerulans* and *Carex kitaibeliana* overtop the sublayer and form the higher herb sublayer usually attaining 10 to 15 cm in height. The dense carpet of *Plantago atrata* is penetrated by dwarf herbs such as *Gentiana verna, Ranunculus carinthiacus* (see Kožuharov & Petrova 1988), *Omalotheca supina, Arenaria biflora, Sedum atratum, Potentilla crantzii, P. aurea* subsp. *chrysocraspeda, Dianthus microlepis, Campanula alpina* subsp. *orbelica, Euphrasia minima, Galium stojanovii, Oxytropis urumovii* and *Draba scardica.*

The community is found in patches aminds of calcareous alpine grasslands. The appearance of stands of this community indicates a good potential to sustain trampling as we also observed in areas heavily affected by mountain walkers and alpinists, for intance in the Premkata Saddle (2650 m). The stands of the *Gentiano - Plantaginetum* have not changed markedly in this location during the observed period of 1978-1984, although the number of tourists kept increasing year to year. The dense low-grown carpet serves a good anti-erosion function.

The character taxa of the *Gentiano-Plantaginetum* are *Plantago atrata, Gentiana verna, Potentilla crantzii* and *Ranunculus carinthiacus.* The group of differential species of the *Gentiano-Plantaginetum* is composed of a number of indicators of siliceous substrata, such as *Alopecurus gerardii, Dianthus microlepis, Campanula alpina* subsp. *orbelica, Acinos alpinus, Euphrasia minima, Trifolium repens* subsp. *orbelicum* and the like (Tab. 8). *Asplenium fissum* and *Alyssum cuneifolium* subsp. *pirinicum,* which are characteristic of skeletal soils or rocky habitats, can be also considered differential for the *Gentiano-Plantaginetum.* Of cryptogams *Leskea polycarpa, Psora decipiens* and *P. lurida* are also differential for the *Gentiano-Plantaginetum.*

Two subassociations were distinguished within the association, the *typicum*

Tab. 8 - Communities of the Salicion retusae.

No. of relevé	123456789	1111111 0123456	C1 %	C2 %
Exposition	N SS ESEEEESEW	SS E N N EN-ENW-		
Slope °	1111221 1 500005050	23 223< 00-0005		
Sampled area m²	1111111 042652289	111 4750226		
Cover of herb layer %	999789799	1 0899887		
	055050005	0000505		
Cover of moss layer %	1<21< 05051-150	<1 <1< 1 6 1055050		
GENTIANO-PLANTAGINETUM ATRATAE				
Plantago atrata (Ch)	888778888	.2.32..	100	43
Gentiana verna (Ch)	244433323	.3.22..	100	43
Acinos alpinus (D)	22.5.4.2.	.....	56	0
Leskea polycarpa (D)	...3..22.	.....	33	0
D-TRIFOLIETOSUM ORBELICI				
Campanula * orbelica	222.23...	.....	56	0
Draba scardica	.12222...	.....	56	0
Trifolium * orbelicum	.362.5...	.....	44	0
Alopecurus gerardii	..6346...	.....	44	0
Euphrasia minima	.352.....	.....	33	0
Botrychium lunaria	.2.4.....	.....	22	0
Dianthus microlepis	222.3....	.....2.	44	14
Artemisia eriantha	.3.6.2...	.1...3.	33	29
Potentilla * chrysaspeda	..55.....	..23...	22	29
BARTSIO-SALICETUM RETICULATAE				
Salix reticulata (Ch)	.....	9899848	0	100
Bartsia alpina (Ch)	.....	.22.43.	0	57
Polygonum viviparum (Ch)	.....	33.52.2	0	71
Erigeron vichrenensis (Ch)	..2.....	.122..2	11	57
Dryas octopetala (Ch)	.....	.....7.	0	14
Ditrichum flexicaule (D)	.....	.532335	0	86
Mnium stellare (D)	.....	.3..322	0	57
Pinguicula balcanica (D)	.....	.2..52.	0	43
Saxifraga androsacea (D)	.....	.3....2	0	29
Saxifraga ferdinandi-coburgi (D)	.....	2....2.	0	29
Silene * graefferi (D)	.....	2..2...	0	29
Saxifraga oppositifolia (D)	...2...2.	.42.335	22	71
Primula minima (D)	..2.....	....5.5	11	29
ARABIDETALIA CAERULEAE				
Carex kitaibeliana	.525.2.32	.32557.	67	71
Carex * pirinica	..22...56	.3323.2	44	71
Poa pirinica	..5.2342.	3.3...2	56	43
Potentilla crantzii	364444.37	3.23...	89	43
Ranunculus carinthiacus	.2332..53	3..3...	67	29
Sedum atratum	22122....	.22....	56	29
Primula halleri	...2...22	3111...	33	57
Viola grisebachiana	...2.....	23.....	11	29
SALICETALIA HERBACEAE & SALICETEA HERBACEAE				
Omalotheca supina	.22422253	222....	89	43
Arenaria biflora	2322.2355	2222..2	89	71
Phleum * rhaeticum	22	...2...	22	14
Veronica alpina	2	..2...2	11	29
Achillea clusiana	.....3...	.....	11	0
Geum montanum	..2.....	.....	11	0
Sedum alpestre	.....2...	.....	11	0
Luzula spadicea	....2....	.....	11	0

ARABIDETALIA ALPINAE-FLAVESCENTIS

Armeria * alpina	.2252.352	24..323	78	71
Galium stojanovii	24252325.	2322...	89	57
Myosotis alpestris	..22.2322	32.2..2	67	57
Veronica * kellereri	.2.33.3..	232...2	44	57
Thlaspi * bellidifolium	22.2..2..	.2.....	44	14
Saxifraga * discolor	....2.1..	2	22	14
Alyssum * pirinicum	......22.	....	22	0
Arenaria pirinica	....23..	....	22	0
Saxifraga luteoviridis	...2.....	.....3.	11	14
Arabis caucasica	......2..	....	11	0
Myosotis suaveolens	....	2	0	14

THLASPIETEA ROTUNDIFOLII

Doronicum columnae	......3..	.2..1.2	11	43
Polystichum lonchitis	......2..	....	11	0
Sagina saginoides	2	..2....	11	14
Geum reptans	....	..5....	0	14

FESTUCO-SESLERIETEA

Cerastium * lanatum	753233.22	3.22..3	89	57
Sesleria coerulans	.2323.42.	433443.	67	86
Pedicularis verticillata	...2...2.	22.332.	22	71
Poa alpina	.3.2...63	.235...	44	43
Oxytropis urumovii	.5..3....	2..2...	22	29
Androsace * arachnoidea	.....2...	2.....	11	14
Anthyllis * vitellina	3.....	...2...	11	14
Aster * dolomiticus	2.....	....1..	11	14
Onobrychis * scardica	.....3...	2.....	11	14
Trifolium badium	..3.....	....	11	0
Carex rupestris	....6....	33.....	11	29

CARICETEA CURVULAE

Saxifraga * exarata	...2.....	3	11	14
Scleranthus * marginatus	2.....	....	11	0
Festuca riloensis	2.....	....	11	0
Hieracium alpicola	2.....	....	11	0
Leontodon * riloensis	..4.....	....	11	0
Poa ursina	2.....	....	11	0
Sesleria comosa	2.....	....	11	0
Knautia midzorensis	...2....	....	11	0
Juniperus * nana	....	..1....	0	14

ASPLENIETEA TRICHOMANIS

Silene pusilla	...2.....	.2....3	11	29
Asplenium fissum	...2..2..	....	22	0
Euphrasia salisburgensis	...2.....	....	11	0
Minuartia verna	2.....	....	11	0
Potentilla * stojanovii	....	.....1.	0	14
Thymus cherlerioides	.2.....	....	11	0

OTHER PHANEROGAMS

Taraxacum nigricans agg.	.2.23.432	232.2..	67	57
Gentianella sp.	....	...2...	0	14

OTHER CRYPTOGAMS

Tortella tortuosa	..32..2.2	22.2.5.	44	57
Hymenostylium recurvirostre	...5....5	.52.53.	22	57
Cladonia sp.	332.....	...2...	33	14
Polytrichum juniperinum	.35.3....	...5...	33	14
Bryum caespiticium	...2.....	.2.....	11	14
Psora decipiens	.2......2	....	22	0
Psora lurida	...3...2.	....	22	0
Catopyrenium cinereum	.2.....	....	11	0
Cladonia symphycarpa	3	....	11	0
Tortulla sinensis	.2.....	....	11	0
Trichostomum crispulum	......2..	....	11	0
Bryum elegans	....	2...2..	0	29
Cetraria islandica	....	23	0	29
Cladonia pocillum	....	37	0	29
Peltigera rufescens	....	..2...3	0	29
Preissia quadrata	....	.2....2	0	29

Solorina bispora	.....	.2...3.	0	29
Blepharostoma trichophyllum	.....	.....2.	0	14
Collema sp.	.....	....2..	0	14
Crataneuron filicinum	.....	.3.....	0	14
Distichum capillaceum	.....	2.....	0	14
Hypnum cupressiforme	.....	...3...	0	14
Lepraria incana	.....	.....2.	0	14
Lophocolea minor	.....	2	0	14
Stereocaulon alpinum	.....	2	0	14

Notes: C1 - constancy of Gentiano-Plantaginetum; C2 - constancy of Bartsio-Salicetum; for other abbreviations see Tab. 1.

subass. nova (the nomenclatural type is identical with that of the association) and the *trifolietosum orbelici* subass. nova (nomenclatural type: relevé 3 in Tab. 8 hoc loco). The differentiation of the subassociations is based both on character of bedrock and presence of species groups. The typical subassociation occurs on marble, where as the *trifolietosum orbelici* is found on calcium-rich schists characteristic by plate separation of comparative more fragile bedrock. This type of bedrock is found usually along tectonic faults at contact zones between granites and crystalline limestones. The community was localized in the Kabata and Premkata Saddles, south and north of the Vikhren Mt., respectively, and near to the Kamenishki Vrakh Mt. (2533 m). The stands were found on gentle, prevailingly east-facing slopes. The south aspect is common with the typical subassociation. The *trifolietosum orbelici* is a typical ecotone community housing the highest number of vascular species of all snow-bed communities in the area regardless the bedrock. The community is a transitional unit between the *Gentiano-Plantaginetum atratae* and *Omalotheco-Alopecuretum gerardii*. The differential taxa of the *trifolietosum orbelici (Trifolium repens* subsp. *orbelicum, Alopecurus gerardii, Sedum atratum, Dianthus microlepis, Campanula alpina* subsp. *orbelica, Potentilla aurea* subsp. *chrysocraspeda, Euphrasia minima)* are typical of the silicate substrata (see Simon 1958). Further also *Acinos alpinus, Thymus cherlerioides, Artemisia eriantha, Draba scardica, Botrychium lunaria* and *Arenaria pirinica,* which are limited to calcareous substrata, are considered differential of this subassociation. *Achillea clusiana, Scleranthus perennis* subsp. *marginatus, Sedum alpestre, Primula minima, Geum montanum, Festuca riloensis, Luzula alpino-pilosa, Poa media, Hieracium alpicola, Sesleria comosa* and *Leontodon croceus* subsp. *riloensis* are found only in this type of snow-bed communities on calcareous bedrock, but their ecological optimum lies either in snow-bed habitats on silicate bedrock or on acid alpine grasslands of the *Seslerietalia comosae*.

Plantago atrata includes several subspecies and varieties limited to particular mountain ranges in the Central and south Europe and form a vicariant group of taxa (Hayek 1931, Casper 1974). Feoli-Chiapella & Feoli (1977) reported on a *Plantago atrata* var. *tenuis* dominated community from the Majella Mts. in the Central Apennines. According to the character of habitats and floristic composition (several vicariant taxa occurring in respective communities) the *Gnaphalio-Plantaginetum atratae* Feoli-Chiapella et Feoli 1977 is a vicariant to the *Gentiano-Plantaginetum atratae*.

The *Trifolio-Plantaginetum angustifoliae,* described by Lakušić (1966) from Bjelasica Mts. in Yugoslavia is floristically probably the most similar community to

the *Gentiano-Plantaginetum atratae*. From the *Gentiano - Plantaginetum* the former one differs by dominance of *Crepis aurea* subsp. *glabrescens* (syn. *C. columnae), Soldanella alpina, Taraxacum* spp. and *Trifolium pallescens* and other species of limited distribution (see Tab. 7).

Other *Plantago atrata* dominated communities from the Balkan Peninsula were described from silicate snow-beds. The *Plantaginetum atratae* studied in the Durmitor, Čvrsnica and Prenj Mts. in Yugoslavia by Horvat et al. (1974) differs from the *Gentiano-Plantaginetum atratae* by presence of taxa such as *Crepis aurea* subsp. *glabrescens, Arenaria rotundifolia, Armeria canescens* and *Viola calcarata* subsp. *zoysii* and several other, mostly acidophilous, taxa. The *Soldanello-Plantaginetum durmitorei,* mentioned from the Durmitor Mts. without a relevé table (Lakušić 1984), is probably identical with the *Plantaginetum atratae.* The *Thlaspi microphylli-Plantaginetum atratae* (see Horvat et al. 1974) known from the Yugoslavian Macedonia is characterized by *Androsace hedraeantha* and *Ranunculus crenatus.* Together with the *Plantaginetum atratae* are, unlike the *Gentiano-Plantaginetum atratae,* classified within the *Salicion herbaceae.*

Bartsio-Salicetum reticulatae ass. nova
Nomenclatural type: Tab. 8, relevé 11,hoc loco

The *Bartsio-Salicetum reticulatae* is another type of a snow-bed community on calcareous substrata. The habitats of the association are exposed to longer-lasting snow period than in the case of the *Gentiano-Plantaginetum atratae.* The community inhabits concave forms of relief sheltered from direct solar irradiation. The stands are found in shallow depressions among large boulders on bottoms of glacial circles or on small-sized terraces with a gentle north-facing slopes.

The soils are alpine rendzinas which contain more silt than those supporting *Gentiano-Plantaginetum atratae.* As a result of higher contents of finer soil particles and long-lasting snow cover the soils are wetter and keep moisture even during hot summers. The desiccation is prevented also by high plant cover which attains 80 to 100% as a rule. The soils are derived from crystalline limestones in all of the studied stands.

The *Bartsio-Salicetum reticulatae* is formed by low-grown stands composed of the herb and moss layers. The lower herb layer is dominated by *Salix reticulata.* Only in one relevé the dominating species was *Dryas octopetala.* The dominants are accompanied by dwarf alpine plants such as *Bartsia alpina, Erigeron vichrenensis* Pawlowski, *Polygonum viviparum, Primula minima, P. halleri, Veronica saturejoides* subsp. *kellereri, Pedicularis verticillata* and other. The stands of the community are recognizable as dark-green patches. The upper herb sublayer is species-poor (*Carex kitaibeliana, C. parviflora* subsp. *pirinica, Sesleria coerulans, Poa pirinica, Armeria pocutica* subsp. *alpina),* and does not overshoot the height of 15 cm. The moss layer is richer in species than with the *Gentiano-Plantaginetum atratae* stands, which also points upon the higher soil moisture. *Saxifraga oppositifolia, S. androsacea, Pedicularis verticillata* and *Primula minima* also prefer moister

habitats. The stands of the *Bartsio-Salicetum reticulatae* do not suffer from sheep-grazing (perhaps only from slight grazing of mountain goats) as they occur in remote sites in bouldery glacial circles and on exposed terraces.

The character species of the *Bartsio-Salicetum reticulatae* are *Salix reticulata, Bartsia alpina, Dryas octopetala, Polygonum viviparum, Gentianella aspera* and *Erigeron vichrenensis*. The latter taxon, endemic to the Pirin Planina Mts. (Pawlowski 1969), has its sociological optimum in the *Bartsio-Salicetum reticulatae* and to a lesser extend it also occurs in the *Papaveri-Armerietum*. The other character species of the *Bartsio-Salicetum* are typical regional character species which occur also in other European high-mountain systems where they show varying sociological valency. *Saxifraga oppositifolia, S. androsacea, S. ferdinandi-coburgi, Pinguicula balcanica, Silene ciliata, Primula minima, Ditrichum flexicaule, Mnium stellare, Bryum elegans, Cladonia pocillum, Peltigera rufescens, Preissia quadrata* and *Solorina bispora* differentiate the *Bartsio-Salicetum reticulatae* from the *Gentiano-Plantaginetum atratae*.

The *Bartsio-Salicetum reticulatae* belongs to a group of vicariant plant associations where in also the *Salicetum reticulatae* from the West Carpathians, *Salicetum retuso-reticulatae* from the Alps, *Dryado-Salicetum reticulatae* and *Salicetum retuso-kitaibelianae* from Yugoslavia (Braun-Blanquet & Jenny 1926, Szafer et al. 1927, Horvat 1936, Beldie 1967, Lakušić 1970) are classified. The *Saxifrago sempervivi-Salicetum reticulatae* (Horvat 1936) appears as floristically close to the *Bartsio-Salicetum reticulatae*, although the occurrence of *Saxifraga sempervivum, Omalotheca hoppeana, Androsace hedraeantha* and *Saxifraga glabella* in the *Saxifrago-Salicetum* emphasize an important floristic difference between the discussed units. Whereas the *Salicetum retuso-reticulatae, Salicetum reticulatae* and *Dryado - Salicetum reticulatae* belong to the *Arabidion caeruleae* Br.-Bl. 1926, the *Saxifrago-Salicetum reticulatae, Salicetum retuso-kitaibelianae* and *Bartsio-Salicetum reticulatae* are classified within the *Salicion retusae* Horvat 1949.

Syntaxonomy of the Salicetea herbaceae communities

All known snow-bed communities in Europe are classified within the *Salicetea herbaceae* (Braun-Blanquet 1976, Dierssen 1984). The bedrock differentiation is reflected on the level of orders. The *Salicetalia herbaceae* and *Arabidetalia caeruleae* comprise communities on silicate and calcareous bedrocks, respectively. A number of vicariant alliances were described within each order (see Dierssen 1984 for a review).

The snow-bed plant communities of the Balkan mountain ranges (including the Southern and Eastern Carpathians) used to be separated into the *Ranunculion crenati* (Lakušić 1966, 1970), supposedly a geographic analogon to the *Salicion herbaceae* of the Alps and Carpathians (Lüdi 1921, Braun-Blanquet & Jenny 1926, Krajina 1922, Rübel 1933, Oberdorfer 1977). *Ranunculus crenatus, Soldanella pusilla, Plantago gentianoides* were listed by Lakušić (1966) as character species of the *Ranunculion crenati*. *Ranunculus crenatus* is distributed mainly in the Balkan

Peninsula, but also occurs in Styria (Steiermark, Austria) in the Rottenmanner Tauern Mts. and Schladminger Tauern Mts. (Müller & Baltisberger 1984). *Plantago gentianoides* is a Balkan endemic, but it occurs also in the *Caricion fuscae* Koch 1926 em. Klika 1934 (Juhász-Nagy 1963, Mucina ined.); *Soldanella pusilla* is common to many Balkan mountains, but occurs also in the Alps in the *Salicion herbaceae* (Braun-Blanquet & Jenny 1926, Braun-Blanquet 1954, Oberdorfer 1977).

Salix herbacea, Polytrichum norvegicum, Kiaeria starkei, K. falcata, Sibbaldia procumbens, Anthelia juratzkana and many others (Dierssen 1984), considered the character species of the *Salicetea herbaceae* and *Salicion herbaceae,* occur in many snow-bed communities in the Balkans (Horvat et al. 1937, Simon 1958, Lakušić 1966, 1970, Resmeriţă 1975, 1978, Coldea 1985, Coldea et al. 1981 etc.). Horvat et al. (1937), Beldie (1967), Puşcanu-Soroceanu et al. (1956), Popescu et al. (1983), Resmeriţă (1975, 1978, 1979) and many other report also the *Salicetum herbaceae* Br. - Bl. 1913, *Luzuletum spadiceae* Br. - Bl. 1926 and *Polytrichetum sexangularis* from the Rumanian Carpathians and Bulgaria. However, we do not identify the *Salix herbacea, Luzula alpinopilosa* and *Polytrichum norvegicum* dominated communities of the Alps (belonging to the *Salicion herbaceae)* with those of the Balkans. The latter should be considered vicariant units, like in the case of the West-Carpathian snow-patch communities (Dúbravcová in Mucina & Maglocký 1985).

We do not consider the separation of the *Salicion herbaceae* and *Ranunculion crenati* for readily documented, because besides a group of snow-bed communities with their distribution areas exclusively located in the Balkan Peninsula (see the references above and Tab. 7), there are some others (eg. the *Poo-Cerastietum cerastoidis* (Söyrinki 1954) Oberd. 1957 and *Nardo - Gnaphalietum supini* Bartsch 1940) which occur both in the Alps as well as Southern and Eastern Carpathians (already in the Balkans).

It is a general phenomenon that the syntaxa characteristic of calcareous bedrocks in the Balkans can be classified into more vicariant units than those from silicate rocks. This probably goes on the account of high endemism on calcium-rich substrata, relict character of the habitats, higher species-richness, the extent of calcareous substrata especially in the Dinarides, and long-lasting isolation of the mountain summits.

Also the floristic differentiation of the high-ranked syntaxa of communities on the calcareous bedrock is more pronounced. This holds also for the differentiation of the *Arabidion caeruleae* (the Alps, West Carpathians) from the *Salicion retusae* (the Balkan mountains).

Both *Gentiano-Plantaginetum atratae* and *Bartsio-Salicetum reticulatae* are classified within the *Salicion retusae,* an alliance originally described from the Dinarides by Horvat (1949). Balkan endemics such as *Saxifraga sedoides* subsp. *prenja, S. sempervivum, S. glabella, Plantago atrata* var. *angustifolia* Hal. et Bald. and *Androsace hedreantha* are very typical of the alliance.

The *Salicion retusae* belongs to the *Arabidetalia coeruleae.* The status of the *Salicetalia retusae,* a unit suggested by Lakušić (1970), still remains to be cleared.

The syntaxonomic relations of the syntaxa of snow-bed communities in the Balkan Peninsula can be summarized as follows:

Salicetea herbaceae Br.-Bl. 1947
Salicetalia herbaceae Br.-Bl. 1926
Salicion herbaceae Br.-Bl. 1926
(syn. *Ranunculion creanti* Lakušić 1966)

1. *Ranunculo crenati - Salicetum herbaceae* (Horvat 1936) Mucina et al. nom. novum hoc loco
   (basionym: *Salicetum herbaceae balcanicum* Horvat 1936; syn. *Salicetum herbaceae* sensu auct. balcan.)
2. *Ranunculo crenati - Polytrichetum sexangularis* (Horvat 1936) Mucina et al. nom. novum hoc loco
   (basionym: *Polytrichetum sexangularis balcanicum* Horvat 1936)
3. *Soldanello pusillae-Plantaginetum gentianoidis* Boşcaiu 1971
   (syn. *Nardo-Plantaginetum gentianoidis* Lakušić et al. 1979; non *Nardo - Plantiaginetum gentianoidis* Ganchev 1963)
4. *Soldanello pusillae-Ranunculetum crenati* Borza ex Boşcaiu 1971
   (syn. *Agrostio rupestris-Ranunculteum crenati* Resmeriţă 1975 corr. 1978, *Agrostio alpinae-Ranunculetum crenati* Resmeriţă 1975)
5. *Soldanello hungaricae-Ranunculetum crenati* Coldea 1985
6. *Ranunculetum crenati* Lakušić 1966
7. *Soldanello pusillae - Luzuletum spadiceae* (Borza 1934) Mucina et al. nom. novum hoc loco
   (basionym: *Luzuletum spadiceae retezaticum* Borza 1934)
8. *Soldanello hungaricae-Salicetum kitaibelianae* Coldea 1985
9. *Ligustico-Caricetum foetidae* Horvat 1960 prov.
10. *Thlaspio microphylli-Plantaginetum atratae* Horvat 1936
11. *Plantaginetum atratae* Horvat in Horvat et al. 1974
    (syn.? *Soldanello-Plantaginetum durmitorei* Lakušić 1984 nom. nudum)
12. *Omalotheco-Alopecuretum gerardii* Mucina et al. 1990
13. *Trifolio - Phleetum pantocsekii* Lakušić 1984 nom. nudum?
14. *Nardo - Gnaphalietum supini* Bartsch 1940
15. *Agrostio rupestris-Gnaphalietum supini* Resmeriţă corr. 1978
    (syn. *Agrostio alpinae-Gnaphalietum supini* Resmeriţă 1975)
16. *Poo-Cerastietum* (Söyrinki 1954) Oberdorfer 1957

Arabidetalia caeruleae Rübel 1933
(syn. *Salicetalia retusae* Lakušić 1968)
Salicion retusae Horvat 1949

17. *Saxifragetum prenjae* Horvat 1931 (here?)
18. *Saxifrago-Rumicetum nivalis* Horvat 1936
19. *Geo-Oxyrietum digynae* Horvat 1936
20. *Bartsio-Salicetum reticulatae* Mucina et al. 1990

21. *Saxifrago sempervivi-Salicetum reticulatae* (Horvat 1936) Mucina et al. nom. novum hoc loco
(basionym: *Salicetum retuso-reticulatae macedonicum* Horvat 1936)
22. *Dryado-Salicetum reticulatae* Beldie 1967
(syn. *Salicetum reticulatae* sensu Puşcaru-Soroceanu 1956
23. *Soldanello-Salicetum retusae* Horvat 1933
(syn. *Soldanello - Salicetum retusae bosniacum* Lakušić et al. 1979)
24. *Anemono-Salicetum retusae* Horvat 1953
25. *Salicetum retuso-kitaibelianae* Lakušić 1970
26. *Gentiano-Plantaginetum atratae* Mucina et al. 1990
27. *Trifolio-Plantaginetum angustifoliae* Lakušić 1966

Acknowledgements

The authors thank to all friends who have supported us by their company during the expeditions to Bulgarian mountains, namely to P. Demeš, V. Lovásová-Demešová, L'. Košt'ál, K. Husár, A. Kövér, P. Pišút. Part of the herbarium material was determined or revised by J. Dvorák (mainly grasses and sedges), J. Čáp *(Thymus)*, V. Grulich *(Sedum)*, M. Kovanda *(Campanula)* and H. Šípošová *(Galium)*. Some less excessible literature sources were provided by G. Coldea, R. Lakušić, Lj. Marković and S. Nemenz and the Library of Zoologisch - Botanische Gesellschaft in Österreich. Several drafts of the paper were retyped by B. Wolfovà and later computer edited by D. Mucina, S. Mucina and B. Mucina.

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Appendix

Localities of the relevés:

Tab. 1. *Hieracio-Caricetum kitaibelianae* (1-9) and *Leontopodio-Potentilletum stojanovii* (10-16).

1. Banderitsa Cottage, Djamdjievite Skali, 2000 m; 8-8-1983 (LM2694).
2. Banderitsa Cottage, Djamdjievite Skali, 2050 m; 8-8-1983 (LM2695).
3. Banderitsa Cottage. Djamdjievite Skali, 2050 m; 8-8-1983 (LM2696).
4. Banderitsa Cottage, Djamdjievite Skali, 2100 m; 8-8-1983 (LM2697).
5. Banderitsa Cottage, Djamdjievite Skali, 1900 m; 8-8-1984 (LM3107).
6. Ridge between Banderitsa Cottage and Malkiya Kazan, 2100 m; 9-8-1983 (LM2699).
7. Banderitsa Cottage, Djamdjievite Skali, 1900 m; 8-8-1984 (LM3106).
8. Banderitsa Cottage, direction Vikhren, 1980 m; 8-8-1984 (LM3110).
9. Malkiya Kazan, direction Banderitsa Cottage, 2000 m; 9-8-1984 (LM3113).
10. Golemiya Kazan, Zaslon Eltepe, 2450 m; 9-8-1984 (LM3117).
11. Golemiya Kazan, flanks of Kutelo Mts., above Zaslon Eltepe, 2500 m; 10-8-1984 (LM3133).
12. Saddle Kabata, 2500 m; 9-8-1983 (LM2707).
13. Banderitsa Cottage, Djamdjievite Skali, 2300 m; 8-8-1983 (LM2698).
14. Malkiya Kazan, 2300 m; 9-8-1983 (LM2702).
15. Ridge between Malkiya and Golemiya Kazan, 2380 m; 10-8-1984 (LM3123).
16. Malkiya Kazan, 2300 m; 9-8-1983 (LM2700).

Tab. 3. *Silene pusilla-Saxifraga oppositifolia* community.

1. Ridge between Banki Sukhodol Mt and Bayuvi Dupki Mt., 2600 m; 13-8-1984 (LM3157).
2. Ridge between Bayuvi Dupki Mt. and Kamenititsa Mt., 2600 m; 13-8-1984 (LM3158).

Tab. 4. *Papaveri-Armerietum alpinae* (1-23) and *Veronico-Silenetum prostratae* (24-29).

1. Golemiya Kazan, 2450 m; 10-8-1984 (LM3127).
2. Golemiya Kazan, 2420 M; 10-8-1984 (LM3132).
3. Tsirkus Kamenititsa, flanks of Bayuvi Dupki Mt., 2750 m; 12-8-1984 (LM3150).
4. Tsirkus Kamenititsa, saddle between Bayuvi Dupki Mt. and Kamenititsa Mts., 2650 m; 12-8-1984 (LM3156);
5. Golemiya Kazan, 2500 m; 10-8-1984 (LM3130).
6. Tsirkus Bayuvi Dupki, 2680 m; 11-8-1984 (LM3145).
7. Golemiya Kazan, 2400 m; 10-8-1984 (LM3125).
8. Tsirkus Kamenititsa, 2500 m; 12-8-1984 (LM3152).
9. Tsirkus Bayuvi Dupki, 2680 m; 11-8-1984 (LM3146).
10. Tsirkus Bayuvi Dupki, 2650 m; 11-8-1984 (LM3147).
11. Malkiya Kazan, 2200 m; 9-8-1984 (LM3115).
12. Golemiya Kazan, 2500 m; 10-8-1984 (LM3128).
13. Golemiya Kazan, S of Zaslon Eltepe, 2500 m; 10-8-1984 (LM3129).
14. Golemiya Kazan, bottom, 2500 m; 10-8-1984 (LM3120).
15. Golemiya Kazan, 2350 m; 10-8-1984 (LM3141).
16. Malkiya Kazan, 2200 m; 9-8-1984 (LM3114).
17. Tsirkus Kamenititsa, 2500 m; 12-8-1984 (LM3153).
18. Golemiya Kazan, 2400 m; 10-8-1984 (LM3124).
19. Kutelo Mt., 2700 m; 11-8-1984 (LM3143).
20. Koncheto Ridge, 2700 m; 11-8-1984 (LM3144).
21. Tsirkus Bayuvi Dupki, 2620 m; 11-8-1984 (LM3148).
22. Golemiya Kazan, 2400 m; 10-8-1984 (LM3140).
23. Tsirkus Kamenititsa, saddle between Bayuvi Dupki Mt. and Kamenititsa Mt., 2650 m; 13-8-1984 (LM3159).
24. Golemiya Kazan, 2400 m; 10-8-1984 (LM3139).
25. Golemiya Kazan, 2400 m; 10-8-1984 (LM3138).
26. Golemiya Kazan, 2400 m; 10-8-1984 (LM3137).

27. Golemiya Kazan, 2450 m; 10-8-1984 (LM3134).
28. Golemiya Kazan, 2450 m; 10-8-1984 (LM3135).
29. Golemiya Kazan, 2400 m; 10-8-1984 (LM3136).

Tab. 5. *Bromo-Geranietum macrorrhizi.*

1. Banderitsa Cottage, gorge near Baikushevata mura (old specimen of *Pinus leucodermis*), 1850 m; 8-8-1984 (LM3105).
2. Banderitsa Cottage, 1900 m; 9-8-1984 (LM3111).
3. Banderitsa Cottage, direction Malkiya Kazan, 1950 m; 9-8-1984 (LM3112).
4. Banderitsa Cottage, 1950 m; 8-8-1984 (LM3109).
5. Banderitsa Cottage, 1930 m; 8-8-1984 (LM3108).

Tab. 6. *Ligustico-Plantaginetum gentianoidis* (1-4) and *Omalotheco-Alopecuretum gerardii* (5-21).

1. Smirnenski Tsirkus, Mitrovo Ezero; 6-8-1983 (LM2681).
2. Smirnenski Tsirkus, Mitrovo Ezero; 6-8-1983 (LM2683).
3. Smirnenski Tsirkus, Mitrovo Ezero; 6-8-1983 (LM2684).
4. Tsirkus Belemeto, 2450 m; 7-8-1983 (LM2687).
5. Saddle between Kralev Dvor Mt. and Kamenitsa Mt., 2550 m; 2-8-1978 (LM1619).
7. Saddle between Kralev Dvor Mt. and Kamenitsa Mt., 2550 m; 2-8-1978 (LM1621).
8. South flank of Mozgovishki Chukar Mt., 2520 m; 7-8-1983 (LM2690).
9. Saddle Solishcheto (between Arabski Grab Mt. and Kuklite Mt.), 2410 m; 31-7-1978 (LM1599).
10. Saddle Solishcheto, 2410; 31-7-1978 (LM1608).
11. Saddle Solishcheto, 2350 ; 31-7-1978 (LM1610).
12. Tevnoto Ezero, Zaslon, 2510 m; 1-8-1978 (LM1615).
13. Saddle between Kralev Dvor Mt. and Kamenitsa Mt., 2600 m; 2-8-1978 (LM1618).
14. Saddle between Kralev Dvor Mt. and Kamenitsa Mt., 2550 m; 2-8-1978 (LM1620).
15. Smirnenski Tsirkus, below Kralevodvorska Porta; 7-8-1983 (LM2685).
16. Tsirkus Belemeto, 2500 m; 7-8-1983 (LM2686).
17. Tsirkus Belemeto, 2500 m; 7-8-1983 (LM2688).
18. Treta Reka Valley; 6-8-1983 (LM2678).
19. Treta Reka Valley; 6-8-1983 (LM2679).
20. Smirnenski Tsirkus, Mitrovo Ezero; 6-8-1983 (LM2680).
21. Ridge between Malk Tipits Mt. and Tipits Mt., 2600 m; 7-8-1983 (LM2691).

Tab. 8. *Gentiano-Plantaginetum atratae* (1-9) and *Bartsio-Salicetum reticulatae* (10-16).

1. Kamenishki Vrakh Mt. (2533 m), 2400 m; 7-8-1978 (LM1654).
2. Premkata Saddle, 2600 m; 11-8-1984 (LM3142).
3. Tsirkus Kamenititsa, 2550 m; 12-8-1984 (LM3154).
4. Tsirkus Kamenititsa, 2550 m; 12-8-1984 (LM3155).
5. Premkata Saddle, 2610 m; 9-8-1983 (LM2706).
6. Kabata Tsirkus, 2450 m; 9-8-1983 (LM2708).
7. Golemiya Kazan, 2400 m; 9-8-1983 (LM2701).
8. Golemiya Kazan, Zaslon Eltepe, 2400 m; 9-8-1984 (LM3118).
9. Golemiya Kazan, Zaslon Eltepe, 2400 m; 9-8-1984 (LM3119).
10. Kazana Tsirkus, 2400 m; 9-8-1983 (LM2703).
11. Ridge between Malkiya and Golemiya Kazan, 2350 m; 9-8-1984 (LM3116).
12. Ridge between Malkiya and Golemiya Kazan, 2400 m; 10-8-1984 (LM3121).
13. Ridge between Malkiya and Golemiya Kazan, 2350 m; 10-8-1984 (LM3122).
14. Golemiya Kazan, 2450 m; 10-8-1984 (LM3126).
15. Golemiya Kazan, 2500 m; 10-8-1984 (LM3131).
16. Tsirkus Kamenititsa, flanks of Bayuvi Dupki Mt., 2750 m; 12-8-1984 (LM3149).