

## Species composition and syntaxonomic consideration of two communities of the *Drabo-Cardaminion hirsutae* in the southern part of the Republic of Macedonia

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The paper deals with the vegetation of the association *Drabo-Cardaminion hirsutae* de Foucault 1988 (*Geranio-Cardaminetalia hirsutae*, *Stellarietetea mediae*) in the southern part of the Republic of Macedonia. This is vernal therophytic vegetation that appears early in the spring and disappears later in the beginning of summer. Two associations were determined: *Valeriano carinatae-Calepinetum irregularis* de Foucault 1988 and *Geranio lucidi-Cardaminetum hirsutae* de Foucault et Frileux 1983. *Valeriano-Calepinetum irregularis* is found on sunny sites with deep soil horizons and *Geranio-Cardaminetum hirsutae* on sunny sites with only a shallow soil horizon mixed with small partitions of bedrock. According to the floristic and syntaxonomic analysis, it was decided to classify the communities into these associations, which have been already described in the western part of Europe, but to distinguish two geographical races *Valeriano carinatae-Calepinetum irregularis* var. geogr. *Sisymbrium orientale* var. *orientale* and *Geranio-Cardaminetum hirsutae* var. geogr. *Myosotis ramosissima*.

**Key words:** *Calepina irregularis*, *Cardamine hirsuta*, therophyte, community, syntaxonomy, Macedonia

### Introduction

Early in spring vegetation appears in the southern part of the Republic of Macedonia dominated by vernal therophyte species. It fringes hedges, appears on road slopes, along walls and in similar habitats with a more or less nitrophylic character. The object of our study was the analysis of its floristic composition and its syntaxonomic status.

This type of vegetation is longer neglected by phytosociologists. First RIVAS-MARTÍNEZ (1978) described the alliance *Geranio-Anthriscion caucalis* and classified it into the order *Chenopodietalia muralis* (Br.-Bl. 1931) O. Bolos 1967 em. Rivas-Martínez 1975. Later on Brullo (in BRULLO and MARCENÒ 1985) described the alliance *Valantio-Galion muralis* and

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the order *Geranio-Cardaminetalia hirsutae*, where he unified the vernal fringe vegetation of the (sub)Mediterranean and (sub)Atlantic regions of Europe. Later on DE FOUCAULT (1988) separated the vegetation appearing in the more temperate parts of Europe. He described *Drabo-Cardaminion hirsutae* with following characteristic and differential species: *Valerianella carinata*, *Veronica hederifolia*, *Galium aparine*, *Lamium purpureum*, *Bromus sterilis*, *Lapsana communis*, *Geranium robertianum* and *Draba muralis*.

In Macedonia this vegetation has already been considered by OBERDORFER (1954) and MATEVSKI and ČARNI (2001).

### Investigated area

The Republic of Macedonia is situated in the centre of the Balkan peninsula, bordering FR Yugoslavia in the north, Bulgaria in the east, Greece in the south and Albania in the west. (Fig.1)

The research took place in areas where the potential natural vegetation is forest of *Quercus cocciferae-Carpinetum orientalis* and *Quercus pubescentis-Carpinetum orientalis* (FUKAREK and JOVANOVIĆ 1983). *Quercus cocciferae-Carpinetum orientalis* Oberd. 1948 emend. Ht 1954 is a climazonal community of the eastern part of Macedonia. The commu-

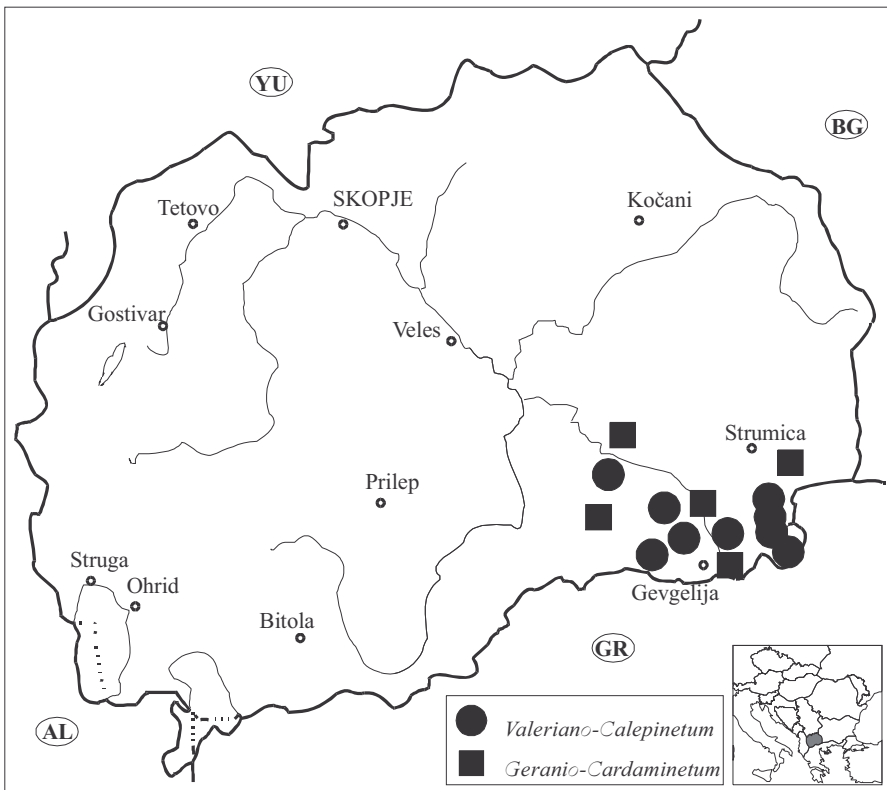


Fig. 1. Research area.

nity develops mainly as an anthropogenous brushwood. In the area the mean annual temperature is between 14 and 15 °C. The main characteristic is given by the evergreen oak *Quercus coccifera*, but the presence of deciduous species like *Carpinus orientalis*, *Quercus frainetto*, *Fraxinus ornus*, etc. is also significant. *Quercus pubescens*-*Carpinetum orientalis* Horvatić 1939 s. lat. is a climatogenic community in the sub-Mediterranean vegetational zone. The main tree species are *Quercus pubescens*, *Q. cerris* and *Carpinus orientalis*. The average annual temperature ranges between 12.7 and 15 °C (ŠUGAR 1986). The climatic division of Macedonia (FILIPOVSKI & al. 1996) corresponds to the vegetation, and the zone of *Quercus cocciferae*-*Carpinetum orientalis* is classified into the sub-Mediterranean (modified Mediterranean) region and *Quercus pubescens*-*Carpinetum orientalis* into the continental – sub-Mediterranean region. Figure 2 represents the climatic diagram for Nov Dojran. The mean annual precipitation is 645 mm and average annual temperature is 14.2 °C.

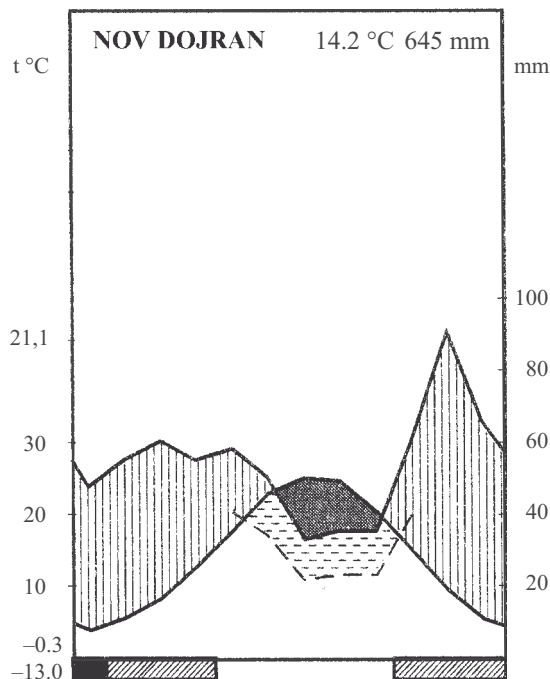


Fig. 2. Climatic diagram for Nov Dojran (after FILIPOVSKI et al. 1996).

### Material and methods

The vegetation was sampled and elaborated according to the standard central European method (BRAUN-BLANQUET 1964). The table was arranged by using the program package SYN-TAX 2000 (PODANI 2001). For the determination of plant species the monographs of HAYEK (1924–1933), TUTIN and al. (1964–1980) and MICEVSKI (1985–2001) were used.

### Syntaxonomic scheme

*Valeriano carinatae-Calepinetum irregularis* de Foucault 1988

*Geranio lucidi-Cardaminetum hirsutae* de Foucault et Frileux 1983

*Drabo-Cardaminion hirsutae* de Foucault 1988

*Geranio-Cardaminetalia hirsutae* Brullo in Brullo et Marcenò 1985

*Stellarietea mediae* R. Tx., Lohmeyer et Preising in R. Tx. ex von Rochow 1951

#### *Valeriano carinatae-Calepinetum irregularis* de Foucault 1988

Tab. 1/1–10

The community is found in the southern part of the Republic of Macedonia. In the spring it can be recognised from a distance by the white flowers of *Calepina irregularis*. The vegetation is about half meter high and can be found on sunny sites with deep soil horizons that are more or less rich in nutrients.

The community is dominated by *Calepina irregularis*. Besides *Calepina irregularis* there also appear the differential species of the alliance, such as *Galium aparine*, *Lamium purpureum* and *Bromus sterilis*. Among the species characteristic of the order of vernal fringes *Geranio-Cardaminetalia* only *Geranium molle* appears with a high frequency. Among the class characteristic species, the most constant are *Stellaria media*, *Euphorbia helioscopia*, *Capsella bursa-pastoris*, *Papaver rhoeas*, *Hordeum murinum* subsp. *leporinum*, *Sisymbrium orientale* and *Fumaria officinalis*. Among others *Medicago arabica* and *Carduus pycnocephalus* could be mentioned.

The community under consideration can be distinguished as a new geographical race (MATUSZKIEWICZ 1981): var. geogr. *Sisymbrium orientale* with the following differential species *Sisymbrium orientale* var. *orientale*, *Hordeum murinum* subsp. *leporium* and *Avena barbata*, the elements of *Hordeion leporini* Br.-Bl., Roussine et Negre 1952 which is an alliance of Mediterranean ruderal communities rich in vernal annual grasses. These species show the syntaxonomical relation of the association under consideration.

In Macedonia *Hordeo-Sisymbrietum* Oberdorfer 1954 appears (MATVEJEVA 1982). In our opinion, the transgressive species that characterise the geographical race do not enable us to describe an autonomous association, since there do not appear any characteristic species (OBERDORFER 1968).

#### *Geranio lucidi-Cardaminetum hirsutae* de Foucault et Frileux 1983

Tab. 1/11–15

The association was described in the Atlantic part of Europe. The communities in Macedonia can be classified within this association; although some species are missing (e.g. *Umbilicus rupestris*, *Corydalis claviculata*), the floristic composition shows that there is a close relation between the studied community and *Geranio-Cardaminetum*. The future studies in the area will show whether the communities in the research area should be described as an independent association. So far it has been decided to distinguish the communities as a geographical race var. geogr. *Myostis ramosissima*, characterised by species with the south-European distribution pattern (*Myosotis ramosissima*, *Veronica triloba*, *Valerianella turgida*, *Viola kitaibeliana*, etc.).

Tab. 1. Analytical table of two communities of *Drabo-Cardaminion* in the southern part of the Republic of Macedonia

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Presence
Date	16	18	18	13	16	16	18	13	13	14	13	14	14	14	16	
Month	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
Year (2001)	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	
Aspect	-	NE	-	NW	NW	-	-	E	-	-	NW	NE	-	-	NW	
Inclination (in °)	0	20	0	5	2	0	0	3	0	0	15	3	0	0	30	
Altitude (in m)	61	164	76	98	62	55	146	145	143	146	207	59	107	155	61	
Surface (in m <sup>2</sup> )	7	10	10	10	10	15	10	30	7	10	3	2	10	5	1	
Cover (in%)	100	100	100	100	100	100	100	100	100	100	95	100	100	100	100	A B
Number of species	21	38	20	22	26	21	31	22	22	15	20	15	21	13	18	
Ass. char. species																
<i>Calepina irregularis</i> (Asso) Thell.	5	5	5	5	5	5	5	5	5	5	.	.	.	.	.	10 0
<i>Cardamine hirsuta</i> L.	.	.	.	+	.	.	.	.	.	.	3	3	4	4	4	1 5
<b>DRABO-CARDAMINION HIRSUTAE</b>																
<i>Bromus sterilis</i> L.	2	2	2	1	2	2	1	2	+	+	.	1	.	.	1	10 2
<i>Galium aparine</i> L.	2	+	1	+	+	+	1	+	+	.	.	.	.	+	+	9 2
<i>Lamium purpureum</i> L.	2	+	+	1	1	+	2	.	1	+	+	.	.	.	.	9 1
<i>Valerianella carinata</i> Lois.	.	+	.	.	+	.	+	.	.	.	.	.	.	.	.	3 0
<b>GERANIO-CARDAMINETALIA HIRSUTAE</b>																
<i>Geranium molle</i> L.	+	1	1	+	+	1	2	+	1	.	.	.	+	+	+	9 3
<i>Arabidopsis thaliana</i> (L.) Heynh.	+	.	.	+	.	.	.	.	.	.	+	.	+	+	+	2 4
<i>Myosotis ramosissima</i> Roch.	.	.	.	+	.	.	+	.	.	.	2	.	+	.	1	2 3
<i>Veronica triloba</i> Opiz	+	.	.	.	.	.	.	.	2	2	+	.	+	.	.	2 2
<i>Geranium lucidum</i> L.	.	.	.	+	.	+	+	.	.	.	.	.	.	.	.	2 0
<i>Geranium pusillum</i> L.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	1 0
<b>STELLARIETEA MEDIAE</b>																
<i>Stellaria media</i> (L.) Vill.	+	+	1	1	2	+	1	+	1	2	+	1	3	2	2	10 5
<i>Euphorbia helioscopia</i> L.	+	+	+	+	1	+	+	+	+	+	.	.	.	.	+	10 1
<i>Capsella bursa-pastoris</i> (L.) Med.	+	+	+	+	1	1	+	.	.	.	+	2	.	.	1	7 3
<i>Papaver rhoeas</i> L. ssp. <i>rhoeas</i>	+	+	+	1	+	+	.	+	.	.	.	.	.	.	.	7 0
<i>Convolvulus arvensis</i> L.	.	+	.	.	1	.	.	+	+	+	.	.	.	+	+	5 2

Tab. 1. – continued

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Presence
<i>Hordeum murinum</i> L. ssp. <i>leporinum</i> (Link) Arcang.	.	.	1	+	+	+	1	3	3	.	.	.	.	.	.	7 0
<i>Veronica persica</i> Poir.	.	.	.	.	1	.	.	+	.	+	.	1	+	1	+	3 4
<i>Fumaria officinalis</i> L.	3	1	2	1	+	.	.	.	2	.	.	.	.	.	.	6 0
<i>Sisymbrium orientale</i> L. var. <i>orientale</i>	1	1	+	.	+	+	.	2	.	.	.	.	.	.	.	6 0
<i>Veronica arvensis</i> L.	.	.	.	.	+	.	.	.	.	.	2	+	2	+	1	1 5
<i>Malva neglecta</i> Wallr.	+	.	+	.	+	1	+	.	.	.	.	.	.	.	.	5 0
<i>Lamium amplexicaule</i> L.	.	.	+	.	+	.	.	.	.	1	.	+	+	.	.	3 2
<i>Vicia sativa</i> L. ssp. <i>nigra</i> (L.) Ehrh.	1	.	.	+	+	.	.	+	.	.	.	.	.	.	.	4 0
<i>Avena barbata</i> Brot.	.	1	.	.	.	.	+	.	+	.	.	+	.	.	.	3 1
<i>Cerastium glomeratum</i> Thuill.	.	+	.	.	.	.	.	.	.	.	1	.	+	.	+	1 3
<i>Buglossoides arvensis</i> (L.) I.M. Johns.	.	.	.	.	.	.	+	.	+	.	.	.	.	+	+	2 2
<i>Crepis sancta</i> (L.) Bab.	.	+	.	.	.	.	+	.	.	.	.	+	.	.	.	2 1
<i>Alopecurus myosuroides</i> Huds.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	+	1 2
<i>Chamomilla recutita</i> (L.) Rauschert	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	2 0
<i>Viola kitabeliana</i> Schultes	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	2 0
<i>Erodium cicutarium</i> (L.) L'Her.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	2 0
<i>Tordylium apulum</i> L.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	2 0
<i>Sisymbrium officinale</i> (L.) Scop.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	1 1
<i>Senecio vulgaris</i> L.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	1 1
<i>Erophila verna</i> (L.) Cheval.	.	.	.	.	.	.	.	.	.	.	1	.	+	.	.	0 2
<i>Valerianella turgida</i> (Stev.) Betcke	.	.	.	.	.	.	.	.	.	.	+	.	.	.	1	0 2
<i>Muscari racemosum</i> (L.) Mill.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	0 2
ARTEMISIETEA																
<i>Lactuca serriola</i> L.	1	+	+	1	.	.	.	+	.	1	.	+	.	.	.	6 1
<i>Carduus pycnocephalus</i> L.	.	+	.	.	+	+	+	.	.	.	.	.	.	.	.	4 0
<i>Cichorium intybus</i> L.	.	+	.	.	.	.	+	+	.	.	+	.	.	.	.	2 1
<i>Daucus carota</i> L.	.	1	+	.	.	+	.	.	.	.	.	.	.	.	.	3 0
<i>Marrubium vulgare</i> L.	.	.	.	+	.	+	.	.	+	.	.	.	.	.	.	3 0

Tab. 1. – continued

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Presence
<i>Diplotaxis tenuifolia</i> (L.) DC	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	2 0
OTHER SPECIES																
<i>Medicago arabica</i> (L.) Huds	+	.	.	.	+	2	1	+	1	.	.	.	.	.	.	6 0
<i>Glechoma hirsuta</i> Waldst. et Kit.	+	+	+	.	+	.	+	.	.	.	+	+	.	.	.	4 1
<i>Taraxacum officinale</i> Weber	.	+	.	.	.	.	.	+	.	.	+	.	1	.	.	2 2
<i>Vicia lathyroides</i> L.	.	+	.	.	.	.	.	.	.	.	2	.	1	.	+	1 3
<i>Rumex obtusifolius</i> L.	.	.	+	.	+	.	+	.	.	+	.	.	.	.	.	4 0
<i>Arum italicum</i> Miller	+	.	.	.	+	+	.	.	.	.	.	.	.	.	.	3 0
<i>Pastinaca sativa</i> L.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	2 0
<i>Poa bulbosa</i> L.	+	+	.	.	.	.	+	.	.	.	.	.	.	.	.	2 0
<i>Clematis vitalba</i> L.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	2 0
<i>Sanguisorba minor</i> Scop.	.	+	.	.	.	.	.	.	.	.	1	.	.	.	.	1 1
<i>Medicago rigidula</i> (L.) All.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	1 1
<i>Trigonella corniculata</i> L.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	2 0
<i>Rumex pulcher</i> L.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	2 0
<i>Galium verum</i> L.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	2 0
<i>Thlaspi perfoliatum</i> L.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	1 1
<i>Berteroa orbiculata</i> DC	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	0 2

Localities: 1. Udovo (lat. 412001, long. 222753); 2. Nov Dojran (lat. 411354, long. 224159); 3. Between Negorci and Gevgelija (lat. 411108; long. 222916); 4. Stojakovo (lat. 410854, long. 223519); 5. Mrzenci (lat. 410950, lat. 223020); 6. Negorska banja (lat. 411021, long. 222949); 7. Star Dojran (lat. 411225, long. 224252); 8. Star Dojran (lat. 411106, long. 224343); 9. Between Star and Nov Dojran (lat. 411224, long. 224252); 10. Čiflik (lat. 412324, long. 221355), 11. Bansko (lat. 412256, long. 224636); 12. Bogorodica (lat. 410820, long. 223318); 13. Klišura (lat. 412327, long. 222125); 14. Čiflik (lat. 412313, long. 221349); 15. Mrzenci (lat. 410950, long. 223020).

Less common species: 1. *Aristolochia clematitis* L. +; 2. *Eryngium campestre* L. +, *Leontodon tuberosus* L. +, *Medicago minima* (L.) Bartal +, *Sherardia arvensis* L. +, *Sonchus oleraceus* L. +, *Trifolium purpureum* Loisel. +, *Vicia grandiflora* Scop. +, *Vicia hirsuta* (L.) S.F. Gray; 3. *Geranium rotundifolium* L. +, *Urtica urens* L. +; 5. *Descurainia sophia* (L.) Webb ex Prantl. +; 6. *Verbascum* sp. +; 7. *Bunias erucago* L. +, *Dracunculus vulgaris* Schott. +, *Rhagadiolus stellatus* Willd. +, *Tamus communis* L. +, *Trifolium campestre* Schreb. var. *campestre* +, *Vicia villosa* Roth. subsp. *varia* (Host.) Corb. +; 8. *Bromus hordeaceus* L. +, *Hypecoum pendulum* L. +, *Silene conica* L. ssp. *conica* +; 9. *Poa pratensis* L. 1, *Anemone pavonina* Lam. var. *purpureoviolacea* Boiss. +, *Artemisia vulgaris* L. +, *Potentilla reptans* L. +, *Trifolium repens* L. +, *Cardaria draba* (L.) Desv. +, *Viola arvensis* Murr. +; 11. *Draba muralis* L. +, *Moenchia mantica* (L.) Bartl. ssp. *coerulea* (Boiss.) Claphan 1; 12. *Cerastium brachypetalum* Pers. subsp. *tenoreanum* (Ser.) Soc. 2, *Filago pyramidalis* L. +, 13. *Aphanes arvensis* L. +, *Cynodon dactylon* (L.) Pres. +, *Oxalis corniculata* L. +, *Poa annua* L. +, 14. *Arenaria leptoclados* (Reich.) Guss. var. *viscidua* Will. +, *Chondrilla juncea* L. +; 15. *Scandix pecten-veneris* L. +.

The communities were found in ruderal places in the early spring. The soil is mixed with small stone partitions. The communities develop mostly on small plots in the urban areas. Later on, in the summer these species disappear and survive the hot and dry season in a form of buds, grains etc.

In these habitats the density of living materials is at a minimum in the early spring and the germination at this time allows the seedling to precede the perennials. Later in the year the perennials take over the dominant role on these sites (e.g. *Cynodon dactylon*) (GRIME 1979).

Beside the dominant species of the communities *Cardamine hirsuta*, *Arabidopsis thaliana*, *Stellaria media* and *Veronica arvensis* also reach high constancy.

## Discussion

It was decided to classify the communities into *Drabo-Cardaminion*. In the communities, nearly all of the species indicated by DE FOUCAULT (1988) as characteristic and differential of the alliance appear, such as *Galium aparine*, *Lamium purpureum*, *Bromus sterilis*, *Veronica triloba* while species characteristic of warmer habitats, such as *Galium spurium*, *Anthriscus caucalis* and *Geranium purpureum* are absent.

OBREDORFER (1954) described the association *Geranio lucidi-Sedetum cepaeae* Oberd. 1954, which was classified into the *Alliarion*. His table is rather inhomogeneous, because some relevés are dominated by perennial species, like *Urtica dioica* and *Dactylis glomerata*, but in the other part of the table annual species prevail, like *Draba muralis* and *Cardamine graeca*, and perennials are mostly missing. This community was classified within *Drabo-Cardaminion hirsutae* (DE FOUCAULT 1988, JULVE 1994).

According to OBERDORFER (1954) *Geranio-Sedetum cepaeae* is a vicariant association to *Alliario-Chaerophylletum temuli* from central Europe. The distinction between *Alliarion* and *Geranio-Cardaminetalia hirsutae* (*Drabo-Cardaminion hirsutae*) is often unclear in regions with a transitional character.

In central Europe in *Alliario-Chaerophylletum* many more biennial and perennial species appear (e.g. *Urtica dioica*, *Geum urbanum*, *Poa trivialis*, *P. nemoralis*, *Ballota nigra*, *Dactylis glomerata* etc. (JAROLÍMEK and al. 1997) than in communities of *Geranio-Cardaminetalia hirsutae*.

The classification is sometimes unclear on the borders of the distribution, like the classification of *Alliario-Chaerophylletum temuli* in Normandy, where DE FOUCAULT and FRILEUX (1983), according to their relevés from the region, propose the classification of *Alliario-Chaerophylletum temuli* within *Stellarietea mediae*, representing the extreme limit of distribution of *Geranio-Cardaminetalia* towards the continental part of Europe.

*Alliario-Chaerophylletum* is signalised from Macedonia (MATVEJEVA 1982, ČARNI et al. 2000), but the habitats are entirely different from those of the communities concerned. The sites are more mesic, humid and rich in nutrients.

MATEVSKI and ČARNI (2001) recognised the community *Veronica cymbalaria-Cardamine graeca* under *Platanus* trees in the southern part of the country and in the northern part of Greece. But this community is more thermophilic and the classification into the alliance with a more thermophilous character is supported by the presence of species like



*Galium spurium*, *Anthriscus caucalis*, *Geranium purpureum* and the absence of species that are found in mesic habitats, such as *Galium aparine* and *Lamium purpureum*. Thus its syntaxonomic position is still under consideration.

These communities are sometimes classified within *Galio-Urticetea* (RODWELL and al. 2002), but since the species of *Stellarietae mediae* outnumber those of the *Artemisietae*, it was decided to accept the classification within *Stellarietea mediae*, like FANELLI (2002)

Our study of *Drabo-Cardaminion* vegetation in the southern part of the Republic of Macedonia showed that the same associations as in the western part of Europe appear. This has already been stated by OBERDORFER (1954) and DE FOUCAULT (1988). Additional studies are needed to reveal the situation in the intermediate territory.

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