

Hay meadows with *Trisetum flavescens* in Bulgaria: syntaxonomy and implications for nature conservation

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Abstract. *Trisetum flavescens* has relatively wide distribution in the country, but seldom dominates in the communities. It has not been studied syntaxonomically so far. On the basis of 37 relevés the current analysis reveals that *T. flavescens* communities are related to the *Arrhenatheretum elatioris* association. While otherwise similar to the Central European *Arrhenatheretum elatioris*, a significant portion of the species composition belongs to the Balkan floristic elements. Additionally, the presence of many south affiliated species is observed. This finding ascertains a Central-Balkan variant of the association which has not been reported so far. Some of the ecological peculiarities of the studied sites in the Rhodopes are very similar to those of *Trisetum-Polygonion* in Central Europe, but we have failed to find sufficient proofs for the presence of the alliance in Bulgaria. The studied vegetation has high floristic diversity. It is maintained as hay meadows. The conservation value of the *Arrhenatheretum elatioris* merits protection under the Habitats Directive by means of an extension of the definition of Habitat 6520 to include *Arrhenatherion* as well.

Key words: *Arrhenatherion*, habitat, mountain hay meadows, *Trisetum flavescens*

Introduction

Trisetum flavescens is widely distributed in Europe, reaching northwards as far as South Scandinavia, where, according to Dixon (1995), it is probably naturalised. Meusel (1978) relates this species as a sub-Mediterranean – montane – Atlantic – Central European element. Irrespective of its distribution in the Balkans, east of Serbia, Republic of Macedonia and Northern Greece, these authors mention only scattered localities for the territory of Bulgaria. Dixon (1995: 896) explicitly underlines that in Bulgaria this taxon has a “very limited distribution”. According to Assyov & Petrova (2006), *T. flavescens* is spread in most floristic regions, excepting the Black Sea Coast, Danubian Plain, Forebalkan, Mt Slavyanka, Mt Sredna Gora, and Eastern Rhodopes. Regardless of these cho-

rological data, the species is not so important for the vegetation of Bulgaria, as it is in the Central European countries. That is why it features neither as dominant, in the communities described following the dominance approach (Apostolova & Slavova 1997), nor as an accompanying species in the floristic composition of the studied associations (Ganchev & al. 1964). No communities dominated by *Trisetum flavescens* have been described in Bulgaria so far, following the Braun-Blanquet approach.

These considerations have provoked us to find out and gather information on the communities where *T. flavescens* takes part as dominant or a co-dominant. In 2005 we found such communities on relatively wide territories in the Rhodopes. This encouraged us to proceed with looking out further for such communities in other parts of the country.

The purposes of this study are: (i) to present the syntaxonomic status of the communities with high quantitative share of *T. flavescens* in Bulgaria, and (ii) to contribute to the habitat type 6520 *Mountain Hay Meadows* identification on the territory of Bulgaria.

Methods

During the vegetation season of 2005 a total of 17 relevés were sampled in the Western Rhodopes and at the foot of the Balkan Range (northwest of Sofia), following the methodological instructions of the Zürich-Montpellier school (Braun-Blanquet 1964; Westhoff & van der Maarel 1973). The sample plots were sized 4 × 4 m. These relevés were included in the Bulgarian Vegetation Database. A total of 1901 relevés were subject of further analyses. They were exported to the JUICE programme (Tichy 2002) and clustered by TWINSpan (Hill 1979) on the basis of the presence/absence data. As a result, within the general data bulk the above-mentioned 17 relevés formed a distinct group, along with other 20 floristically similar relevés collected earlier during the National Grassland Inventory (Meshinev & al. 2005). The obtained group of 37 relevés became the object of further syntaxonomical analysis. The diagnostic species group definitions follow the literature data (Horvatić 1930; Marschall 1951; Horvat & al. 1974; Dierschke 1981; Theurillat 1992; Oberdorfer 1993; Chytrý & Tichy 2003).

The rich species composition forced data reduction in the tables and in the comparative analysis. Species with constancy lower than 20% were removed. The results are estimated by comparison to data from Central Europe (Blažková 1973; Oberdorfer 1993), Western Balkans (Horvatić 1930) and Romania (Borza 1959; Gergely 1964). The taxon nomenclature is after Kozuharov (1992), while the floristic elements nomenclature is after Assyov & Petrova (2006) and Oberdorfer (1994).

Results

Table 1 contains ordered relevés, sampled in the country. The diagnostic species of the alliance *Arrhenatherion elatioris* Koch 1926 and the class *Molinio-Arrhenatheretea* R. Tx. 1937 are convincingly presented in our data set (see Table 1). The high number of di-

agnostic species for *Arrhenatheretum elatioris* Br.-Bl. 1915 association is the reason to assign all the 37 relevés to the same syntaxon. Such decision is verified by the comparison to data sources from other geographical regions (Table 2). Like in Central Europe, the high species diversity in the described communities is characteristic for that vegetation in Bulgaria too. European and Euro-Asiatic floristic elements take significant place in the community structure. Some Boreal species are related to the higher altitudes. The joint presence of Balkan, Mediterranean, sub-Mediterranean and Pontic floristic elements forms a group of southern type species which is better represented in Bulgaria as compared to Central Europe (Fig. 2).

Particularly the presence of some Balkan species outlines a relevé group sampled in the Rhodopes. The presence of *Pastinaca hirsuta*, *Lathyrus hallersteinii*, *Knautia midzorensis*, *Trifolium velenovskyi*, *Armeria rumelica*, *Silene frivaldskyana* and *Achillea pannonica*, gives rise to a specific Southeast European character to the analysed association in that region. We consider that the *Arrhenatheretum elatioris* is represented in the Rhodopes by a distinct geographical variant. It could be typified by relevé No 22 (Table 1). The diagnostic for this variant species group is completely lacking in other data sources, including samples collected in the Sofia region, as it can be seen on Table 2.

The localities in the Rhodopes (Fig. 1–1) are distributed at higher altitudes (average of 1400 m). The basic rocks are marbles. The soil cover consists of brown forest soils (rendzinas), with a modestly powerful humus horizon (Ninov 2002). The average annual temperature is 5–8 °C, with –1.5 °C average in January and 17.7 °C – in July. Annual precipitation varies between 900 and 1200 mm (Stanev 1991). The high soil

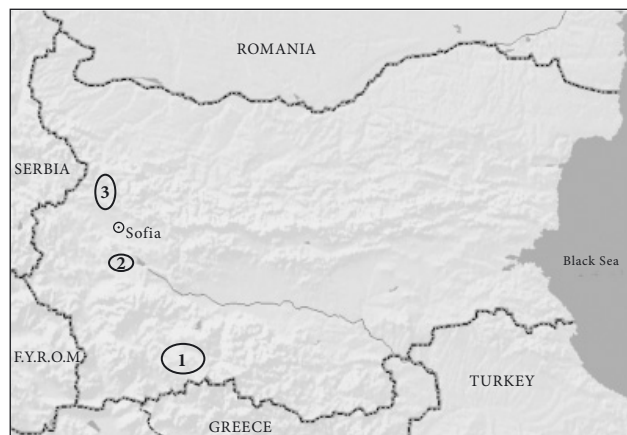


Fig. 1. The studied regions: 1, Rhodopes; 2–3, Sofia Region.

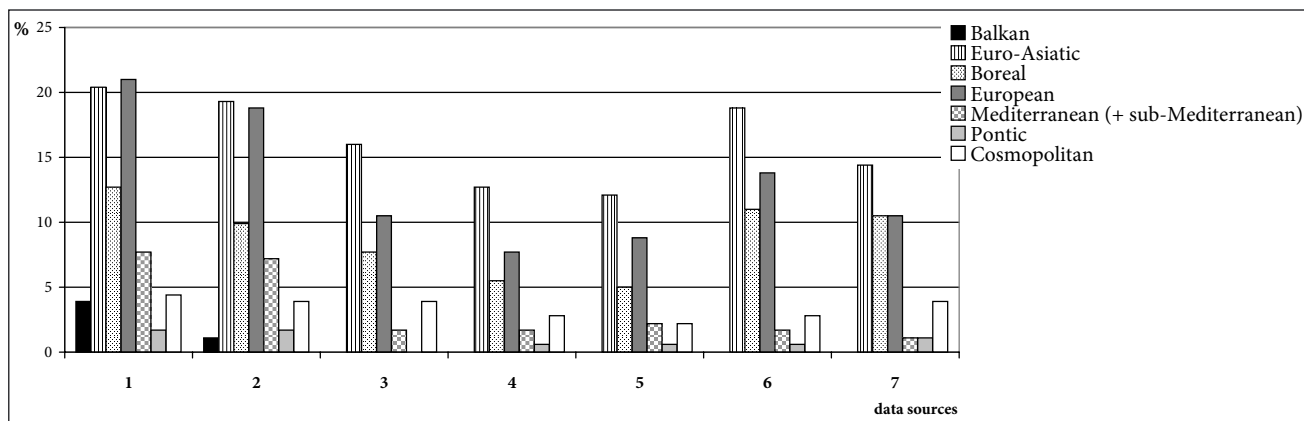


Fig. 2. Floristic elements: 1, Rhodopes; 2, Sofia Region; 3, Serbia (Horvatić 1930); 4–5, Romania (Gergely 1964; Borza 1959); 6–7, Central Europe (Oberdorfer 1993; Blažková 1973).

moisture is kept almost all year long not only by air humidity and precipitation, but also by the high underground waters, which at certain locations (as, for instance, North of the Mouglia village) form marshlands of the *Caricion davallianae* type.

The relevés sampled in the Sofia region are rather related to the classical association. In Serbia, some 100 km westwards of these localities, *T. flavescens* takes place in a community dominated by *Chrysopogon gryllus*, referred to *Chrysopogono-Danthonion calycinæ* Kojić 1957 (Randelović 1975). The presence of many diagnostic species of the class *Molinio-Arrhenatheretea* is a characteristic feature of that alliance with a markedly mesophilous character within the framework of *Festuco-Brometea* Br.-Bl. & R. Tx. in Br.-Bl. 1949. Irrespective of the fact that the association described by Randelović (1975) differs from that established for the studied localities in Bulgaria, their species composition contains certain elements in common as, for instance, *Rhinanthus rumelicus*, *Leucanthemum vulgare*, *Anthoxanthum odoratum*, *Rumex acetosella*, *Hieracium praealthum* subsp. *bauchinii*, etc.

The localities in the Sofia region (Fig. 1–2, 3) occupy an average altitude of 800 m. The basic rocks are calcareous in the north-western part (Fig. 1–3) and siliceous in the south-eastern part (Fig. 1–2). The soils are medium thick to thick, moist, not eroded. The terrains are mostly plain. The mean annual temperature is 9.7°C and the mean annual precipitation is 612 mm (Stanev 1991).

In both regions the studied communities are managed as hay meadows with low intensity of additional grazing. This management is not quite regular because some years part of the territories remains not mowed.

Discussion

While in Central Europe the association *Arrhenatheretum elatioris* is distributed from lowlands to the foothills of the mountains and the lower parts of the mountains (Dierschke 1997), in Bulgaria it develops at altitudes over 700 m and reaches up to 1600 m in the mountains.

Dierschke (1981) notes that, irrespective of its mostly dominating role, *T. flavescens* does not have any high diagnostic value. According to Meusel (1978), chorologically *T. flavescens* is closer to *Arrhenatherum elatius*, which presumes considerable similarity in the ecological requirements of both species. However, ecological similarity as a rule is influenced by geographical distinction. Some authors, as for instance Passarge (1969), have defined within the framework of the *Arrhenatheretalia* many alliances and sub-alliances, mostly of regional importance. In his review of the mesophilous meadows in Central Europe, Passarge (1969) suggests two new alliances: *Triseti-Arrhenatherion* and *Agrostio-Festucion rubrae*. However, we support Dierschke (1999) in his view that the four-alliance scheme within *Arrhenatheretalia* is describing now sufficiently well the diversity of the dryer mesophilous meadows of the class *Molinio-Arrhenatheretea* in Europe.

According to Marschall (1951) and Dierschke (1981) initially, the communities dominated by *T. flavescens* are referred to the alliance *Arrhenatherion* of the order *Arrhenatheretalia*. In year 1943 Braun-Blanquet differentiates an independent alliance *Triseti-Polygonion bistortae* within the same order. *Campanula rhomboidalis*, *Alchemilla vulgaris* aggr., *Cardaminopsis halleri*, *Centaurea pseudophry-*

gia, *Crepis mollis*, *C. pyrenaica*, *Crocus albiflorus*, *Geranium sylvaticum*, *Narcissus radiiflorus*, *Phyteuma nigrum*, *P. ovatum*, *Rumex alpestris* are mentioned (Dierschke 1981, 1997) as diagnostic species for that alliance. Such species group, as a matter of fact, lacks in our relevés. This is why we can not attribute our results to *Trisetum-Polygonion bistortae*. Marschall (1951) establishes a very distinct idea about the ecological conditions under which *T. flavescens* develops in Central Europe. In the Alps and the Carpathians it shows a strong affinity to calcareous terrains, but most typically relates to sufficiently moist terrains with high underground waters, retained all year long (Marschall 1951; Kornaś 1967). Presently, in Central Europe *T. flavescens* dominated communities from similar altitudes as those in the Rhodopes are referred to *Trisetum-Polygonion* (cf. Marschall 1951; Dierschke 1981, 1997; Wörz 1989; Theurillat 1992). Such communities should be maintained chiefly as hay meadows since the mowing limits the regeneration of forest vegetation which is the climax phase of the terrains under the analysed communities.

At the start of this analysis we expected to find the *Trisetum-Polygonion* alliance in Bulgaria as well. The ecological conditions of the habitats in the Bulgarian communities, especially in the Rhodopes, are very similar to the above-mentioned. The species such as *Stellaria graminea*, *Alchemilla flabellata*, *As-trantia major*, and *Potentilla erecta* are elements of *Trisetum-Polygonion*, but with their low abundance and frequency they do not prove convincingly the presence of this alliance. Irrespective of the presence of some Eurasian and Boreal species typical for *Trisetum-Polygonion*, there is also a high presence of Balkan, sub-Mediterranean and Mediterranean species, which manifest a definite influence of the South European vegetation over the studied communities. Apparently, at the periphery of its distribution in Europe, *T. flavescens* participates in the formation of communities of Central European type, like those of *Arrhenatherion*, but they contain species specific for the Balkans and the sub-Mediterranean area.

In our opinion, no sufficient evidence exists presently in this part of the Balkans, supporting the presence of *Trisetum-Polygonion*. This corroborates the doubts of Hundt expressed in 1964 (after Dierschke 1981) about the presence of such an alliance in the Balkan mountains.

The presence of *Ranunculus montanus* and *Trifolium badium* in the communities reveals the borderline position of the studied vegetation type with *Poion alpinae* Oberd. 1950.

Following Dierschke's analysis (1999), we assume that presently, for the territory of Bulgaria, it is most suitable to consider the alliances *Arrhenatherion*, *Cynosurion cristati* and *Poion alpinae* within *Arrhenatheretalia*. These alliances are already reported for the country (Horvat & al. 1974; Meshinev & al. 2005).

The mountain hay meadows are regarded by most European authors as floristically rich communities, thus prompting to make them an object of preservation measures (Dierschke 1981). They are protected under Directive 92/43 EC, being listed in its Annex I under code 6520. The Natura 2000 network development in Bulgaria envisages using the habitat 6520 *Mountain Hay Meadows* as an argument for including some zones into the network (Kavrakova & al. 2005). On European scale, this habitat is defined as: "Species-rich mesophile hay meadows of the montane and sub-montane levels (mostly above 600 metres), **usually dominated by *Trisetum flavescens***..." (Interpretation Manual EUR25 2003). Irrespective of the fact that there is no explicit link between this habitat type and the syntaxonomic category, considering the other species listed in the Interpretation Manual, it should be referred to the *Trisetum-Polygonion* alliance of *Molinio-Arrhenatheretea*. Such a view obviously narrows the scope of the habitat 6520. Rodwell & al. (2007) offer a comprehensive overview of the different opinions on the habitat 6520 content when applied for the selection of Natura 2000 sites. According to these authors, the striving of some countries to include the mountain hay meadows in the Natura 2000 network enhances the scope and content of *Habitat 6520*. The same is valid for Bulgaria. The need for more arguments supporting the future preservation of the mountain hay meadows presumes a broader interpretation of *Habitat 6520*. In addition to the emphasized dominating role of *T. flavescens*, the alliance *Arrhenatherion* should be included too. It is also a subject of hay-making management regime. This will allow the inclusion of a greater diversity of mountain hay meadows into the network – meadows of high conservational importance and similarly endangered as *Trisetum-Polygonion*.

Table 2. Shortened synoptic table of *Arrhenatheretum elatioris* in different geographic regions.

floristic element	Sources*	1	2	3	4	5	6	7					
	number of relevés	27	13	15	9	13	217	14					
<i>Arrhenatheretum elatioris</i>													
Eur-As	<i>Arrhenatherum elatius</i>	V	II	V	V	IV	V	IV					
Boreal	<i>Trisetum flavescens</i>	V	IV	III	.	.	IV	V					
Eur-As	<i>Dactylis glomerata</i>	V	IV	IV	V	III	V	V					
Eur	<i>Campanula patula</i>	IV	II	I	V	III	II	V					
Eur-Med	<i>Tragopogon orientalis</i>	III	II	III	III	.	IV	.					
Eur-Sib	<i>Knautia arvensis</i>	III	II	III	IV	III	III	II					
sMed	<i>Crepis biennis</i>	III	II	V	V	IV	IV	.					
Eur-As	<i>Daucus carota</i>	I	I	V	III	III	III	III					
Eur-As	<i>Galium album (incl. mollugo)</i>	I	I	V	II	I	V	II					
Eur-Med	<i>Geranium pratense</i>	I	I	.	III	.	II	.					
Central Balkan Geographic Variant													
Bal	<i>Trifolium velenovskyi</i>	IV	.	.	.	.	.	.
Bal	<i>Pastinaca hirsuta</i>	IV	II					
Pan-Bal	<i>Achillea pannonica</i>	III	.	.	.	.	.	.
SEur	<i>Lathyrus hallersteinii</i>	II	.	.	.	.	.	.
Bal	<i>Knautia midzorensis</i>	II	.	.	.	.	.	.
Bal	<i>Silene frivaldskyana</i>	II	.	.	.	.	.	.
Bal	<i>Armeria rumelica</i>	I	I					
<i>Arrhenatherion elatioris</i>, Molinio-Arrhenatheretea													
Eur-Sib	<i>Trifolium repens</i>	IV	IV	III	II	III	III	IV					
sBoreal	<i>T. pratense</i>	V	IV	V	V	V	V	V					
Eur-Med	<i>Rhinanthus rumelicus</i>	IV	IV	.	.	III	.	.					
Eur-As	<i>Galium verum</i>	IV	III	III	II	IV	I	III					
Eur-Sib	<i>Leucanthemum vulgare</i>	III	V	V	V	IV	V	V					
Eur-Sib	<i>Achillea millefolium</i>	III	IV	IV	IV	III	IV	IV					
Eur-As	<i>Stellaria graminea</i>	IV	III	I	II	.	I	IV					
Eur-As	<i>Anthoxanthum odoratum</i>	III	V	III	II	IV	IV	V					
	<i>Taraxacum sect. Ruderalia</i>	IV	IV	III	I	I	V	V					
Eur-Med	<i>Trifolium hybridum</i>	IV	III	.	.	.	I	III					
Eur-Med	<i>Lotus corniculatus</i>	III	III	.	IV	II	IV	V					
Eur-Med	<i>Leontodon hispidus</i>	IV	III	IV	I	I	III	V					
Kos	<i>Poa pratensis</i>	III	IV	I	IV	II	V	V					
Eur	<i>Cynosurus cristatus</i>	III	IV	I	I	II	II	IV					
Boreal	<i>Festuca rubra</i>	III	III	IV	II	I	III	IV					
Eur-sMed	<i>Phleum pratense</i>	IV	III	I	.	.	I	.					
Boreal	<i>Rumex acetosa</i>	III	III	III	II	V	V	V					
Eur-As	<i>Veronica chamaedrys</i>	IV	I	.	I	III	IV	V					
Boreal	<i>Plantago media</i>	III	II	II	IV	III	III	II					
Kos	<i>Ranunculus acris</i>	III	II	IV	I	III	V	V					
Boreal	<i>Festuca pratensis</i>						II	IV	III	II	.	V	IV
Eur	<i>Centaurea phrygia</i>						II	III
Eur-As	<i>Vicia cracca</i>						III	I	II	III	II	II	III
Eur	<i>Holcus lanatus</i>						I	IV	IV	I	II	IV	V
Boreal	<i>Deschampsia caespitosa</i>						II	II	.	.	I	I	III
Boreal	<i>Poa trivialis</i>						II	II	I	I	.	IV	II
sMed	<i>Betonica officinalis</i>						II	II	I	.	I	.	II
Eur-As	<i>Carum carvi</i>						II	I	I	.	.	I	II
Kos	<i>Prunella vulgaris</i>						I	II	V	II	.	II	II
Eur	<i>Colchicum autumnale</i>						II	.	I	II	.	III	.
sBoreal	<i>Sanguisorba officinalis</i>						I	II	.	.	.	II	IV
sBoreal	<i>Lathyrus pratensis</i>						I	II	I	I	IV	III	IV
Eur-Sib	<i>Mentha longifolia</i>						I	I
Kos	<i>Potentilla reptans</i>						I	II	II	.	.	I	.
Kos	<i>Carex ovalis</i>						I	I	II
Eur-As	<i>Alopecurus pratensis</i>						I	I	.	I	.	III	V
Eur-Sib	<i>Centaurea jacea</i>						I	.	III	.	II	IV	IV
sBoreal	<i>Filipendula ulmaria</i>						I	I	.
Eur-Sib	<i>Lychnis flos-cuculi</i>						I	I	I	I	III	II	IV
Eur-Sib	<i>Carex tomentosa</i>						I	I
Accompanying species													
Kos	<i>Plantago lanceolata</i>						III	V	V	V	IV	V	V
Boreal	<i>Agrostis capillaris</i>						IV	III	.	.	.	I	IV
Kos	<i>Hypericum perforatum</i>						IV	II	I	.	.	.	I
Eur-As	<i>Silene vulgaris</i>						IV	I	.	.	.	I	.
Pont	<i>Festuca valesiaca</i>						II	III	.	V	.	I	II
Eur	<i>Briza media</i>						III	II	III	II	II	II	IV
Eur-As	<i>Viola tricolor</i>						III	II	.	I	.	.	.
Eur-sMed	<i>Rumex acetosella</i>						III	I
Boreal	<i>Bromus mollis</i>						II	IV	II	I	.	III	I
sPont	<i>Potentilla argentea</i>						II	II	.	.	I	.	I
Eur-As	<i>Veratrum lobelianum</i>						III	I
sMed-cAs	<i>Cruciata glabra</i>						III	I
sMed-cAs	<i>C. laevipes</i>						II	II
Boreal	<i>Elymus repens</i>						I	III	I	I	.	I	I
sMed	<i>Salvia verticillata</i>						III	I
Eur-Sib	<i>Dianthus deltoides</i>						III	II
Eur-As	<i>Campanula glomerata</i>						II	I	.	.	.	I	.
sMed	<i>Trifolium pannonicum</i>						III	I
sMed	<i>Rosa canina</i>						III	I
Eur-Sib	<i>Hypochaeris maculata</i>						II	II	.	.	I	.	.
Eur-Med	<i>Matricaria perforata</i>						III

Table 2. Continuation

Eur-As	<i>Euphrasia rostkoviana</i>	II	I	I	.	.	I	III		
Boreal	<i>Hypericum maculatum</i>	II	I	.	.	.	.	.	.	.
Med	<i>Cirsium ligulare</i>	II	I	.	.	.	.	.	.	.
Eur-Sib	<i>Cichorium intybus</i>	II	II	III	II	II	I	.	.	.
Eur-Med	<i>Vicia varia</i>	I	III	.	.	.	.	.	.	.
Eur-Med	<i>Verbascum speciosum</i>	III	.	.	.	.	.	.	.	.
Eur-Med	<i>Coronilla varia</i>	II	I	I	.	.	.	.	II	.
Eur	<i>Prunella laciniata</i>	II	II	.	.	.	.	.	.	.
Eur	<i>Festuca nigrescens</i>	II	I	.	.	.	.	.	.	.
Eur-Sib	<i>Agrostis canina</i>	I	III	.	.	.	.	.	.	.
Eur-Sib	<i>Leontodon autumnalis</i>	I	III	I	I	I	I	III	.	.
Kos	<i>Convolvulus arvensis</i>	I	II	III	II	II	.	.	.	.
Eur-As	<i>Heracleum sibiricum</i>	II	.	.	.	.	.	.	.	.
Eur-As	<i>Medicago lupulina</i>	I	II	II	IV	III	II	.	.	.
sBoreal	<i>Juniperus communis</i>	II	I	.	.	.	.	.	.	.
Eur-Med	<i>Chaerophyllum hirsutum</i>	II	.	.	.	.	.	.	.	.
Eur	<i>Campanula rapunculoides</i>	II	.	.	.	.	.	.	.	.
sBoreal	<i>Calamagrostis arundinacea</i>	II	.	.	.	.	.	.	.	.
Eur-Med	<i>Crepis foetida</i>	II	.	.	.	.	.	.	.	.
Eur-As	<i>Echium vulgare</i>	II	.	.	.	.	.	.	.	.
sMed	<i>Teucrium chamaedrys</i>	II	I	.	.	.	.	.	.	.
Eur	<i>Chamaespartium sagittale</i>	I	II	.	.	.	.	.	.	.
Eur-As	<i>Nepeta nuda</i>	II	.	.	.	.	.	.	.	.
Boreal	<i>Lerchenfeldia flexuosa</i>	II	.	.	.	.	.	.	.	.
sBoreal	<i>Clinopodium vulgare</i>	II	I	.	.	.	.	.	.	.
Eur-As	<i>Trifolium medium</i>	II	.	.	.	.	.	.	.	.
Eur-Med	<i>T. dubium</i>	.	III	.	.	.	III	IV	.	.
sBoreal	<i>Epilobium angustifolium</i>	II	.	.	.	.	.	.	.	.
Med	<i>Muscari comosum</i>	II	.	.	.	.	.	.	.	.
Alp-Med	<i>Helianthemum nummularium</i>	II	I	.	.	.	.	.	.	.
Eur	<i>Luzula luzuloides</i>	II	.	.	.	.	.	.	.	.
Eur-Med	<i>Hypochaeris radicata</i>	I	II	I	.	I	I	II	.	.
sBoreal	<i>Potentilla neglecta</i>	I	II	.	.	.	.	.	.	.
Eur-Med	<i>Hieracium pilosella</i>	II	I	.	.	.	I	II	.	.
Pan-Bal	<i>Achillea crithmifolia</i>	I	I	.	.	.	.	.	.	.
Eur	<i>Holcus mollis</i>	I	II	.	.	.	.	.	.	.
sBoreal	<i>Luzula campestris</i>	II	I	I	.	.	II	.	.	.
Eur-Sib	<i>Polygala major</i>	II	.	.	.	.	.	.	.	.
Eur	<i>Euphorbia cyparissias</i>	I	I	.	.	II	.	.	.	.
Eur-sMed	<i>Stachys germanica</i>	II	.	.	.	.	.	.	.	.
Bal	<i>Dianthus cruentus</i>	II	.	.	.	.	.	.	.	.
Alp-Carp	<i>Alchemilla flabellata</i>	II	.	.	.	.	.	.	.	.
Med	<i>Matricaria trichophylla</i>	I	III	.	.	.	.	.	.	.
Eur-As	<i>Cirsium arvense</i>	I	II	.	.	.	.	.	.	.
Eur-Med	<i>Vicia tetrasperma</i>	.	II	.	.	I	.	I	.	.
Alp-Med	<i>Trifolium badium</i>	II	II	.	.	.	.	.	.	.
Eur-As	<i>Lolium perenne</i>	I	II	I	.	.	II	.	.	.
Eur-Alp	<i>Ranunculus montanus gr.</i>	I	.	.	.	.	.	.	.	.
Eur-Med	<i>Polygala vulgaris</i>	I	I	I	.	.	.	.	.	.
Eur-sMed	<i>Poa compressa</i>	I	I	.	.	.	.	.	.	.
Eur	<i>Cerastium fontanum</i>	.	II	.	III	IV	IV	.	.	.
sBoreal	<i>Potentilla erecta</i>	I	I	.	.	.	.	.	.	.
Eur-As	<i>Poa bulbosa</i>	I	I	I	.	.	.	.	.	.
Eur-Med	<i>Agrimonia eupatoria</i>	I	I	.	.	.	.	.	.	.
Eur	<i>Danthonia alpina</i>	I	II	.	.	.	.	.	.	.
sMed	<i>Astrantia major</i>	I	I	.	.	.	.	.	.	.
sMed	<i>Geranium columbinum</i>	I	.	.	.	.	.	.	.	.
Med	<i>Heracleum ternatum</i>	I	.	.	.	.	.	.	.	.
Eur-Sib	<i>Linaria vulgaris</i>	I	I	I	.	.	.	.	.	.
Eur	<i>Anthriscus sylvestris</i>	I	.	.	.	.	III	.	.	.
sMed	<i>Vicia grandiflora</i>	.	II	.	.	.	.	.	.	.
Bal	<i>Digitalis viridiflora</i>	I	.	.	.	.	.	.	.	.
Eur-As	<i>Euphrasia hirtella</i>	I	I	.	.	.	.	.	.	.
Bal	<i>Campanula moesiaca</i>	I	I	.	.	.	.	.	.	.
Eur-Med	<i>Filipendula vulgaris</i>	I	II	I	.	II	.	.	.	.
sMed	<i>Centaurea rhenana</i>	I	I	.	.	.	.	.	.	.
sBoreal	<i>Sanguisorba minor</i>	I	I	I	.	.	I	.	.	.
Eur-Sib	<i>Hypericum tetrapterum</i>	I	.	.	.	.	.	.	.	.
Bal	<i>Silene roemerii</i>	I	I	.	.	.	.	.	.	.
Eur	<i>Sieglingia decumbens</i>	I	I	.	.	.	.	.	.	.
Med	<i>Hieracium praealtum ssp. bauchinii</i>	I	II	.	.	.	.	.	.	.
sPont	<i>Ajuga genevensis</i>	I	I	.	I	I	.	.	.	.
Eur	<i>Carlina acanthifolia</i>	I	.	.	.	.	.	.	.	.
Eur-Sib	<i>Gentiana cruciata</i>	I	.	.	.	.	.	.	.	.
sBoreal	<i>Crataegus monogyna</i>	I	I	.	.	.	.	.	.	.
Boreal	<i>Carex hirta</i>	.	II	II	.	.	I	II	.	.
Eur-Med	<i>Dorycnium herbaceum</i>	I	I	.	.	.	.	.	.	.
Eur-sMed	<i>Ranunculus polyanthemos</i>	.	II	.	III	I	.	.	.	.
Eur-Sib	<i>Valeriana officinalis</i>	I	.	.	.	.	.	.	.	.
Eur-sMed	<i>Achillea collina</i>	.	II	.	.	.	.	.	.	.
Eur-Med	<i>Inula oculus-christi</i>	I	.	.	.	.	.	.	.	.
Boreal	<i>Arabis hirsuta</i>	I	.	.	.	.	.	.	.	.
Boreal	<i>Plantago major</i>	I	I	.	.	.	I	.	.	.
Eur-Sib	<i>Trifolium alpestre</i>	.	II	.	.	.	.	.	.	.
Pont	<i>Thymus callieri</i>	,	II	.	.	.	.	.	.	.
Eur-Med	<i>Vicia sativa</i>	I	I	.	.	.	.	.	.	.

Table 2. Continuation

Eur-As	<i>Origanum vulgare</i>	I
Eur-As	<i>Gymnadenia conopsea</i>	I I
Boreal	<i>Agrostis stolonifera</i>	I . I . . I .
Eur-As	<i>Brachypodium sylvaticum</i>	I
sPont	<i>Campanula cervicaria</i>	I
Arct-Alp	<i>Nardus stricta</i>	I I
Eur-Med	<i>Salvia pratensis</i>	I I II III I III .
Eur-Sib	<i>Veronica officinalis</i>	I I
sSib	<i>Brachypodium pinnatum</i>	I I
Kos	<i>Luzula multiflora</i>	I I
Bul	<i>Sedum kostovii</i>	I
Eur	<i>Thymus pannonicus</i>	I I
Eur	<i>Potentilla obscura</i>	I I
Eur-Med	<i>Verbascum longifolium</i>	I I
Eur-As	<i>Rosa dumalis</i>	. II
Eur-As	<i>Myosotis stricta</i>	I
sMed	<i>Dianthus carthusianorum</i>	I . . II III . .
Eur	<i>Thymus pulegioides</i>	I I II
sBoreal	<i>Myosotis caespitosa</i>	I . . . III . .
Eur-As	<i>Vicia angustifolia</i>	. I . . . I .
Boreal	<i>Carex pallescens</i>	I II
Eur-Sib	<i>Campanula rapunculus</i>	. I . . . I .
Eur-Med	<i>Cirsium canum</i>	I I I
sPont	<i>Ajuga genevensis</i>	. . . I I . .
Eur-Med	<i>A. reptans</i>	. . I . . II II
Eur	<i>Alchemilla monticola</i>	. . . . . IV
Eur-Med	<i>Anthylis vulneraria</i>	I . II
sSib	<i>Avenula pubescens</i>	. . . . IV IV
Eur-As	<i>Bellis perennis</i>	. . I . . III II
Eur-As	<i>Bistorta major</i>	. I . . . I .
sMed	<i>Bromus commutatus</i>	. . . II . . .
Eur	<i>B. racemosus</i>	. I II . I I .
Boreal	<i>Campanula rotundifolia</i>	. . . . II .
Boreal	<i>Cardamine pratensis</i>	. . . . II II
Boreal	<i>Carex caryophyllea</i>	. . . . I II
Eur-As	<i>C. glauca</i>	. . II
	<i>Centaurea macroptilon</i>	. . II
Eur-Sib	<i>C. scabiosa</i>	I I .
Boreal	<i>Cerastium arvense</i>	. I III . III . I
Kos	<i>C. glomeratum</i>	. . . . . V
Eur-As	<i>Dactylorhiza majalis</i>	. . I . . I .
Boreal	<i>Equisetum arvense</i>	. I III I III I II
Boreal	<i>E. palustre</i>	. I I . . I .

Eur-As	<i>Glechoma hederacea</i>	. . I . . II .
Eur	<i>Heracleum sphondylium</i>	. . I . . IV I
sBoreal	<i>Linum catharticum</i>	I . I I I I .
Eur	<i>Lysimachia nummularia</i>	. I I . . I .
sBoreal	<i>Lythrum salicaria</i>	. . I . . I .
Eur-As	<i>Medicago falcata</i>	. . III . . I .
	<i>M. sativa</i>	. . . II II . .
Eur-Med	<i>Moenchia mantica</i>	. I I
Eur-As	<i>Myosotis arvensis</i>	. I II . . I .
sMed-As	<i>M. nemorosa</i>	. . . . . II
Eur-As	<i>Ononis spinosa</i>	. . III . II . .
Eur-Sib	<i>Pastinaca sativa</i>	I . V II I II .
Eur-As	<i>Picris hieracioides</i>	. . I . . I .
Eur	<i>Pimpinella major</i>	. . I . II III II
Eur-As	<i>P. saxifraga</i>	. . . . . I III
Eur-Med	<i>Primula veris</i>	I I .
Eur-Med	<i>Ranunculus auricomus</i>	. . . . . I III
Eur	<i>R. bulbosus</i>	. . . . . II II
Eur	<i>R. nemorosus</i>	I I .
sMed	<i>R. repens</i>	. I . . . II .
Eur	<i>Rhinanthus glaber</i>	. . . III . . .
Eur-Sib	<i>Rhinanthus minor</i>	. I IV II II I V
Eur	<i>R. serotinus</i>	. . . . I I .
sMed	<i>Rorippa pyrenaica</i>	. I . . . I .
sMed	<i>Saxifraga granulata</i>	. . . . . I III
Eur-Med	<i>Scabiosa columbaria</i>	I I .
Eur-Sib	<i>S. ochroleuca</i>	. . . IV . . .
Eur-Med	<i>Sedum boloniense</i>	. . III
	<i>Senecio barbaraeifolius</i>	. . . . . II
Eur-Med	<i>S. jacobea</i>	. . I . . I .
Eur-As	<i>Symphytum officinale</i>	. . II I III I .
	<i>Thymus chamaedrys</i>	III
Eur-Med	<i>Trifolium campestre</i>	. I II I . . .
sMed	<i>T. patens</i>	. I III
Kos	<i>Verbena officinalis</i>	. I I
Eur-Sib	<i>Veronica arvensis</i>	. I I . . II III
sMed	<i>V. triphyllos</i>	. . . . III . .
Eur-Med	<i>Vicia hirsuta</i>	. . . I I . .
Eur-As	<i>V. sepium</i>	. . . . . III .

* 1, Rhodopes; 2, Sofia Region; 3, Horvatić (1930); 4, Gergely (1964); 5, Borza (1959); 6, Oberdorfer (1993); 7, Blažková (1973).

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References

- Apostolova, I. & Slavova, L.** 1997. A Compendium of Bulgarian Plant Communities Published during 1891–1995, Sofia.
- Assyov, B. & Petrova A.** (eds). 2006. Conspectus of the Bulgarian Vascular Flora. Distribution Maps and Floristic Elements. Ed. 3. BBF, Sofia.
- Blažková, D.** 1973. Pflanzensoziologische Studie über die Wiesen der Südböhmischen Becken. – Stud. Českosl. Akad. Ved., **10**: 1-170.
- Borza, A.** 1959. Flora and vegetation Şebeşului Valley. Romanian Acad. Sci., Bucharest (in Romanian).
- Braun-Blanquet, J.** 1964. Pflanzensociologie. Grundzüge der Vegetationskunde. Springer, Wien & New York.
- Chytrý, M. & Tichý, L.** 2003. Diagnostic, constant and dominant species of vegetation classes and alliances of the Czech Republic: a statistical revision. – Folia Fac. Sci. Nat. Univ. Masarykianae Brun., Biol., **108**: 1–231.
- Dierschke, H.** 1981. Syntaxonomische Gliederung der Bergwiesen Mitteleuropas (*Polygono-Trisetion*). – Ber. Int. Symp. Vereinigung Vegetationsk. 1980, pp. 311-341.
- Dierschke, H.** 1997. *Molinio-Arrhenatheretea* (E1). Teil:1 *Arrhenatheretalia*. – In: **Dierschke, H.** (ed.), Synopsis der Pflanzengesellschaften Deutschlands. Heft 3, pp. 1-74. Florist.-Zool. Arbeitsgem., Göttingen.
- Dierschke, H.** 1999. Short survey of *Arrhenatheretalia* grassland in Germany. – Ann. Bot. (Rome), **57**: 7-14.
- Dixon, J.** 1995. Biological flora of the British Isles: *Trisetum flavescens* (L.) Beauv. (*T. pratense* Pers., *Avena flavescens* L.). – J. Ecol., **83**: 895-909.
- Ganchev, I., Bondev, I. & Ganchev, S.** (eds). 1964. Vegetation of Meadows and Pastures of Bulgaria. Bulg. Acad. Sci. Press, Sofia (in Bulgarian).
- Gergely, I.** 1964. Die mesophilen Weiden der Trăscău-Senke. – Contr. Bot. Univ. “Babeş-Bolyai” Cluj-Napoca, pp. 225-228 (in Romanian).
- Hill, M.** 1979. TWINSPAN – a FORTRAN program for arranging multivariate data in an ordered two-way table by classification of individuals and attributes. Section of Ecology and Systematics. Cornell Univ., Ithaca.
- Horvat, I., Glavač, V. & Ellenberg, H.** 1974. Vegetation Südosteuropas. G. Fisher Verlag, Stuttgart.
- Horvatić, S.** 1930. Sociologische Einheiten der Niederrungswiesen in Kroatien und Slavonien. – Acta Bot. Inst. Bot. Univ. Zagreb, **5**: 57-118.
- Interpretation Manual of European habitats** 2003. EUR25. European Commission, DG Environment, Brussels.
- Kavrakova, V., Dimova, D., Dimitrov, M., Tzonev, R. & Belev, T.** 2005. Manual for Determination of Habitats with European importance in Bulgaria. Geosoft EOOD, Sofia (in Bulgarian).
- Kornaš, J.** 1967. Montane hay-meadow *Gladiolo-Agrostidetum* in Polish Western Carpathians. – Contr. Bot. Univ. “Babeş-Bolyai” Cluj-Napoca, pp. 167-176.
- Kozhuharov, S.** (ed.) 1992. Field Guide to the Vascular Plants in Bulgaria. Naouka & Izkoustvo, Sofia (in Bulgarian).
- Marschall, F.** 1951. Beiträge zur Kenntnis der Goldhaferwiese (*Trisetum flavescens*) der Schweiz – Vegetatio, **3**: 195-209.
- Meshinev, T., Apostolova, I., Georgiev, V., Dimitrov, V., Petrova, A. & Veen, P.** 2005. Grasslands of Bulgaria. Final Report on the National Grassland Inventory Project – Bulgaria 2001-2004. Dragon Ltd. Publishers, Sofia.
- Meusel, H.** (ed.) 1978. Vergleichende Chorologie der Zentraleuropäischen Flora. Karten, Band 2. Gustav Fischer, Jena.
- Ninov, N.** 2002. Soils. – In: **Koprarev, K.** (ed), Geography of Bulgaria. Physical Geography. Socio-Economic Geography. Pp. 277-303. ForCom, Sofia (in Bulgarian).
- Oberdorfer, E.** 1993. Süddeutsche Pflanzengesellschaften. Gustav Fischer Verlag, Jena & Stuttgart.
- Oberdorfer, E.** 1994. Pflanzensociologische Exkursionsflora. Verlag Eugen Ulmer, Stuttgart.
- Passarge, H.** 1969. Zur soziologischen Gliederung mitteleuropäischer Frischwiesen – Feddes Repert., **80** (4-6): 357-372.
- Randelović, N.** 1975. *Trifolio-Trisetum flavescens* Rand. 1974., ass. nov. aus dem Verband *Crhysopogono-Danthonion calycynae* Kojic 1957. – Glasn. Prir. Muz. Srpske Zemlje, Ser. B, Biol. Nauke, **30**: 167-169 (in Serbian).
- Rodwell, J.S., Morgan, V., Jefferson, R.G. & Moss, D.** 2007. The European Context of British Lowland Grasslands. JNCC Report, No 394.
- Stanev, S.** 1991. Overall characteristics of the climate in Bulgaria. – In: **Stanev, S., Kyuchukova, M. & Lingova, S.** (eds), The climate of Bulgaria. Pp. 27-89. Publishing House Bulg. Acad. Sci., Sofia (in Bulgarian).
- Theurillat, J.-P.** 1992. Les prairies à *Trisetum flavescens* (L.) P. Beauv. (*Triseto-Polygonion*) dans la région d'Aletsch (Valais) et en Suisse. – Candollea, **47**: 319-356.
- Tichý, L.** 2002. JUICE software for vegetation classification. – J. Veg. Sci., **13**: 451-453.
- Westhoff, V. & van der Maarel, E.** 1973. The Braun-Blanquet approach. – In: **Wittaker, R.** (ed.), Classification of Plant Communities. Pp. 287-399. Junk, The Hague.
- Wörz, A.** 1989. Zur geographischen Gliederung hochmontaner und subalpiner Hochstaudenfluren und Goldhaferwiesen. – Tuexenia, **9**: 317-340.