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Syntaxonomy of chalk outcrop vegetation of the order *Thymo cretacei-Hyssopetalia cretacei*

Yakiv Didukh[1], Olga Chusova[1,*] & Olga Demina[2]

Keywords: Central Russian Upland, *Hyssopus* flora, lowered alpine plants classification.

Ključne besede: Srednjerusko višavje, flora rodu *Hyssopus*, klasifikacija nizkih alpinskih rastlin.

Abstract

The order *Thymo cretacei-Hyssopetalia cretacei* Didukh 1989 combines chalk outcrop plant communities of the southwestern Central Russian Upland. Its specificity can be attributed to a rather peculiar and heterogeneous flora with a large number of endemic species. The question about its origin has caused a lively discussion, which has been going on since the late nineteenth century. Since 1989 works on the classification of these communities have frequently been carried out, but until today no unanimous decision could be reached. The purpose of our research was to conduct a critical analysis of the syntaxonomical structure of Cretaceous outcrop vegetation and to show its difference from the steppe vegetation of the class *Festuco-Brometea* Br.-Bl. et Tx. ex Soó 1947. The territory of our research covers the southwestern foothills of the Central Russian Upland and the Donetsk Range, located only within the steppe zone and characterised by Cenomanian chalk outcrops. In total 354 relevés were used for the analysis. The modified TWINSPAN classification was used for the analysis. Our research has shown that the order *Thymo cretacei-Hyssopetalia cretacei* includes twelve associations belonging to three alliances: *Artemisio hololeucae-Hyssopion cretacei* Romashchenko et al. 1996, *Euphorbio cretophilae-Thymion cretacei* Didukh 1989 and *Centaureo carbonatae-Koelerion talievii* Romashchenko et al. 1996.

Izvleček

V red *Thymo cretacei-Hyssopetalia cretacei* Didukh 1989 združujemo rastlinske združbe, ki jih najdemo na krednih izdankih v jugozahodnem Srednjeruskem višavju. Njegova specifičnost je posledica posebne in heterogene flore z velikim številom endemitov. Njen izvor je povzročil živahno diskusijo, ki traja že od konca 19. stoletja. Številne raziskave o klasifikaciji teh združb so izvajali od leta 1989, vendar do danes ni prišlo do soglasnega pojasnila. Namen naše raziskave je narediti kritično sintaksonomsko analizo vegetacije krednih izdankov in prikazati razlike od stepske vegetacije razreda *Festuco-Brometea* Br.-Bl. et Tx. ex Soó 1947. Območje raziskav obsega jugozahodna vznožja Srednjeruskega višavja in gorske verige Doneck, ki se nahaja znotraj stepske cone na cenomanijskih krednih izdankih. V analizi smo uporabili 354 vegetacijskih popisov in modificirano TWINSPAN klasifikacijsko metodo. Pokazali smo, da v red *Thymo cretacei-Hyssopetalia cretacei* uvrščamo 12 asociacij, ki pripadajo trem zvezam: *Artemisio hololeucae-Hyssopion cretacei* Romashchenko et al. 1996, *Euphorbio cretophilae-Thymion cretacei* Didukh 1989 in *Centaureo carbonatae-Koelerion talievii* Romashchenko et al. 1996.

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Orsolya Valkó

1 M.G. Kholodny Institute of Botany, National Academy of Sciences of Ukraine, 2 Tereschenkivska St., 01601 Kyiv, Ukraine. E-mail: olgachusova@gmail.com
2 Karachay-Circassian State University, 29 Lenina St., 369200 Karachaevsk, Russia. E-mail: ondemina@yandex.ru
* Corresponding author

Introduction

The specificity of chalk outcrop flora and vegetation has been noted by botanists since the late nineteenth century and caused a heated debate about its origins (Tsinger 1885; Litvinov 1891, 1902, Taliev 1897, 1904, 1905, Pachos'kyy 1910, Kozo-Polyansky 1910, 1925, 1931, Szafer 1928, Kleopov 1930, Lavrenko 1932, Grosset 1935, Hryn' 1938). While Taliev (1905) regarded cretaceous flora as young and associated with human activities, most scientists accept the theory according to which its main core is relict and had formed long before the ice age. Because of the large number of endemic species confined to Cretaceous outcrops, this flora was called "Hyssopus flora" (after its typical element *Hyssopus cretaceus* Dubj) (Kozo-Polyansky 1931). Also, Kozo-Polyansky showed that the flora of Cretaceous outcrops is heterogeneous and includes another component besides "Hyssopus flora", which he called "lowered alpine plants" (the unit of periglacial Pleistocene steppe). Typical representatives of this complex are *Carex pediformis* C. A. Mey., *Carex humilis* Leyss., *Clausia aprica* (Stephan) Trotsky, *Alyssum lenense* Adams and others. The core of this flora is formed by specific xerophytic endemic surface plants and squat plants confined to dry chalky substrates. They are characterised by grey stellate and weblike pubescence or waxy coating (*Hyssopus cretaceus*, *Linaria cretacea* Spreng., *Scrophularia cretacea* Spreng., *Silene cretacea* Spreng), which shows the processes of speciation in such conditions. Typical components of the flora are mountainous Mediterranean species, whose nearest occurence is in the Crimean Mountains (*Euphorbia petrophila* C. A. Mey., *Asperula tephrocarpa* (incl. *A. cretacea*, *A. supina*), *Silene supina* M. Bieb., *Polygala mediterranea*, *Hedysarum ucrainicum* (incl. *H. tauricum*)), and species of broader South European distribution (*Helianthemum canum* s.l. (L.) Hornem., *Jurinea stoechadifolia* (M. Bieb.) DC., *Pimpinella tragium* ssp. *titanophylla* (Woronow) Tutin, *Linum czernjaevii* Klok., *Taraxacum serotinum* (Waldst. & Kit.) Fisch., *Scutellaria supina* L.). On the other hand, there are Pontic-Siberian steppe species (*Artemisia salsoloides* Willd., *Psephellus marschallianus* (Spreng.) K. Koch, *Gypsophila altissima* (incl. *G. oligosperma*), *Cephalaria uralensis* (Murray) Roem. & Schult., *Astragalus albicaulis* DC., *Clausia aprica* (Stephan) Korn.-Trotzky, *Hedysarum grandiflorum* Pall., *Alyssum lenense* Adams, *Androsace villosa* (incl. *A. kozopoljanskyi*), *Polygala sibirica* L.) and even Central Asian species (*Atrophaxis frutescens* (L.) K. Koch, *Artemisia salsoloides*, *Krascheninnikovia ceratoides* (L.) Gueldenst.). Thus, the floristic composition of Cretaceous outcrops is rather peculiar and heterogeneous, and it vastly differs from zonal steppe vegetation. As for taxonomy, it is characterised by the presence of endemic races, which sometimes get species status (Dobrochayeva et al.1987, Klokov & Dobrochayeva 1974, Cvelev 1996).

The vegetation classification of the dominant basis is reflected in the works of Semenova-Tian-Shanskaya (1954), Golitsyn et al. (1963), Golitsyn (1965), Hryn' (1973), Kondratyuk et al. (1988), Shelyag-Sosonko et al. (1991), Tkachenko et al. (1998) and Vakarenko & Dubyna (2006). It was found that the main dominant species of these groups are *Hyssopus cretaceous*, *Thymus calcareus*, *Asperula tephrocarpa*, *Scrophularia cretacea*, *Pimpinella tragium* ssp. *titanophylla*, *Artemisia hololeuca*, *A. salsoloides, Plantago maritima* ssp. *ciliata* Printz, *Jurinea stoechadifolia*, *Krascheninnikovia ceratoides*, *Silene cretacea* and *Festuca cretacea* T. I. Popov & Proskor., which form together a variety of combinations. Cretaceous outcrop vegetation is quite different from zonal steppe vegetation (Didukh 1996). Based on the specific conditions of substrate formation and apparent characteristics, H. Vysots'kyy (1915), B. Kozo-Polyanskyi (1931) and E. Lavrenko (1961) named it "thymyannyky" (after the genus name *Thymus*). Ya. Didukh (1981) considered it an analogue of Mediterranean tomillares.

The first floristic classification of Cretaceous vegetation was obtained by Ya. Didukh (1989). It was attributed to the order *Thymo cretacei-Hyssopetalia cretacei* Didukh 1989 and considered as part of the class *Festuco-Brometea*. Later, in 1996 and in virtue of additional studies, the chalky outcrop communities were assigned to the new class *Helianthemo-Thymetea* Romashchenko et al. 1996, in which there are three alliances: *Artemisio hololeucae-Hyssopion cretacei, Euphorbio cretophilae-Thymion cretacei* and *Centaureo carbonatae-Koelerion talievii*. After that studies have been conducted both in Ukraine (Didukh & Korotchenko 1996) and in Russia (Averinova 2005, 2011, 2012, 2014, Demina, 2011, 2012, 2014, 2016; Poluyanov 2009, 2012, Sereda 2003, 2008, 2009) that made some alterations to this classification. In the later construction EuroVegChecklist (Mucina et al. 2016), the order *Hyssopetalia cretacei* was included in the class *Festuco-Brometea*. Purpose of our research was to conduct a critical analysis of the syntaxonomical structure of Cretaceous outcrop vegetation and to show its difference from the steppe vegetation of the class *Festuco-Brometea*.

Our key task was to critically analyse the classification of syntaxa described in previous years and to add novel information based on new data representing the whole research area within Ukraine and the Russian Federation.

Description of the research territory

The Central Russian Upland extends from Northwest to Southeast from the right bank of the Oka River to the Donetsk Range. In the West it is adjacent to the Dnieper Lowland and in the East to the Oka-Don Lowland; in the North its frontier follows the watershed of the rivers Desna, Oka and Don, and in the South it follows the watershed of the rivers Dnieper, Siversky Donets and Don (Karandeeva 1957). The foothills of the Central Russian Upland are the plane inclined to the South and Southwest with elevations of about 190–200 m. It is deeply dissected by draws and ravines. In the South-East it borders with the Donetsk Range and the Siversky Donets valley. The Donetsk Range can be considered as foothills of the Central Russian Upland. It is located in the Donetsk region and the South of the Lugansk region, which belong to Ukraine and to the Rostov region of the Russian Federation. In the Donetsk Range, cretaceous outcrops appear only in the valleys of Siversky Donets and some of its feeders.

The south-western foothills of the Central Russian Upland are located within the forest-steppe and steppe zones and cover the territory of the Kharkiv, Donetsk and Luhansk regions of Ukraine and Kursk and the Voronezh, Belgorod and Rostov regions of the Russian Federation (Baranov 1969). The research territory, 50° 52' 21" N, 38° 4' 26" E to 49° 30' 44" N, 36° 41' 48" E and 49° 30' 53" N, 43° 26' 04" E to 47° 27' 31" N, 40° 27' 30" E, covers the southwestern foothills of the Central Russian Upland and the Donetsk Range. It comprises only the steppe zone and is characterised by Cenomanian chalk outcrops. To the North, Cretaceous outcrops occur within the forest-steppe zone, featuring hyper-carbonatophiles (*Thymus calcareus* Klokov & Des.-Shost., *Inula ensifolia* L., *Polygala sibirica*, *Bupleurum falcatum* L.), but in species composition and structure, these communities are very different from *Hyssopetalia cretacei* (Golitsyin 1936, Honcharenko 2000).

The recent terrain of the Central Russian Upland is a result of the Neogene-Quaternary neotectonic surface emergence on the height of 200 meters, which was accompanied by tectonic and erosion-accumulative deformation. Tectonic deformations are the result of structural heterogeneity of submerging basal complex, the presence of deep lateral and transverse crust fractures and inherited geological structure of the platform's sedimentary sheath.

River valleys of the Siversky Donets and its feeders (Krasna, Aidar, Oskol) are wide, with steep right banks, which can be up to 100 m high. The right banks are dissected by a system of ravines and gullies. The ravines are fairly long for the most part and sometimes have the shape of a "circus". These formations indicate intense erosion processes in the past and present. The left banks are gently sloping, with well-developed upland terraces.

The research area is under conditions of sub-continental (subarid) climate, characterised by large temperature amplitudes between winter and summer periods. The average annual temperature is 7–8 °C, the average January temperature ranges from –4 to –6 °C, the average July temperature from +21 to +24 °C. Annual precipitation is in the range of 450–500 mm in most parts of the research territory, ranging up to 550 mm in the northwestern part in the Russian Federation (Figure 1a). The central part of the reseach territory is characterised by considerable continentality and longer droughts in the summer period (Figure 1b). The most continental and most arid territory is the south-eastern part of the Donetsk Range (Figure 1c) with fairly irregular precipitation of 400–420 mm per year. The largest is the spring and early summer rainfall, followed by a sharp decline in the second half of summer and a subsequent rise in winter (Hrytsenko 2004, Weather in Ukraine, 2014).

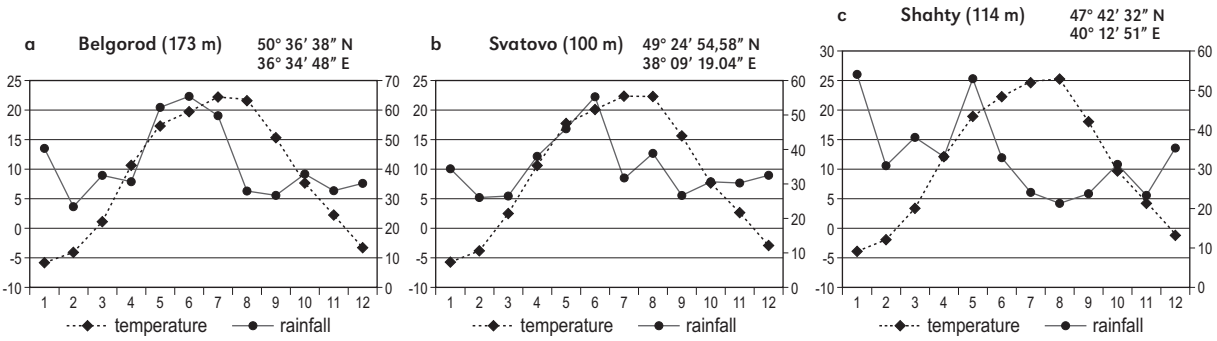

Figure 1: Walter climographs based on climatic data from Hrytsenko (2004) and Weather in Ukraine (2014) for the northern (a), central (b) and southern (c) part of the research territory.

Slika 1: Walterjevi klimadiagrami na osnovi podatkov iz Hrytsenko (2004) in Weather in Ukraine (2014) za severni (a), srednji (b) in južni (c) del raziskovanega območja.

As the Walter climograph shows, such distribution determines a rather long (4–5 months) dry season, and its effect is further enhanced on the dry southern chalk slopes. This is one of the factors that determine the specificity of flora and vegetation. Under such conditions, black soils are formed in upland areas and rendzinas (sod-calcareous soils) and regosols (deluvial-carbonate soils) on the slopes with the chalk outcrops.

Materials and Methods

For the analysis we used 354 relevés made by Ya. Didukh and O. Chusova in the Kharkiv, Donetsk and Lugansk region of Ukraine and by O. Demina in the Rostov region of the Russian Federation from 1987 to 2015. In addition, we used 51 relevés from the Kharkiv region kindly provided by O. Bezrodnova as well as 178 relevés published by K. Romashchenko et al. (1996), A. Poluyanov (2009, 2012), E. Averinova (2014) and M. Sereda (2008, 2009). To estimate the situation of Cretaceous outcrop vegetation in relation to other types, we used about 300 relevés of xerophytic herbaceous vegetation from the same territory. The plot sizes for relevés were from 25 to 100 m^2. Unpublished releves were compiled in a TURBOVEG (Hennekens & Schaminee 2001) database. Unpublished relevés sampled by Chusova (112 relevés) were added to the GIVD World Warehouse in the Ukrainian Grassland Database (EU-UA-001). Unpublished releves sampled by Didukh (242 relevés) were added to the Vegetation of Lugansk region, Ukraine (EU-UA-008).

Floristic data were processed by using JUICE (Tichý 2002). Clusterisation and syntaxa extraction were performed using a modified TWINSPAN algorithm (minimum number of groups – 2, pseudospecies cut level – 0 5 25; Simpson coefficient) (Roleček et al. 2009) implemented in the software package JUICE (Tichý 2002). We also used the method of cluster analysis included in the STATISTICA 6.0 software package.

The diagnostic species of clusters were determined by the phi coefficient of fidelity (Chytrý et al. 2002). Using Fisher's exact test at $\alpha = 0.05$, species with a value of phi ≥ 0.3 were considered diagnostic, species with a value of phi ≥ 0.5 highly diagnostic. For dominant species, we adopted a projective coverage threshold of > 25% in the herbage and a 10% threshold of frequency.

We identified selected syntaxa on the basis of a critical analysis of publications (Didukh 1989, Romashchenko et al. 1996, Didukh & Korotchenko 1998, Sereda 2008, 2009, Poluyanov 2009, 2012, Demina 2011, Averinova 2014, Mucina et al. 2016). For the JUICE analysis, we have used the associations' typical relevés to identify them.

Nomenclature of syntaxa follows the International Code of Phytosociological Nomenclature (Weber et al. 2000); nomenclature of taxa is in accordance with the Euro+Med Plant base service (2006) or, in case of taxa not listed there, Flora Europaea (Tutin 1968, 1972, 1976, 1980, 1993). We did use the name *Hyssopus cretaceous* Dubj. instead of *Hyssopus officinalis* L., though. Since the species of chalk outcrops are rather specific and narrowly local, many of them are endemic. However, in the Flora Europaea, these species are only listed as synonyms. Usually we have reduced them to synonyms that are accepted for Europe, but as for *Hyssopus cretaceus*, the situation is different. Within the research territory there are two subspecies of *Hyssopus officinalis*, which both form associations of petrophytic type, but are quite different in terms of morphology and ecology. *Hyssopus cretaceus* is reduced in Flora Europaea and Euro+Med Plant to the synonym *Hyssopus officinalis* ssp. *montanus* (Jord. & Fourr.) Briq., which occurs only on the chalk substrate in communities of the order *Thymo cretacei-Hyssopetalia cretacei*. Another subspecies is sometimes found on sandy soils (Demina 2012). Since *Hyssopus officinalis* ssp. *montanus* plays a very important role in the communities we are considering and in order to separate it from subspecies with a different ecology, we decided to use the synonym here.

In the species composition analysis, it was taken into account that in our study region many species typical for Ukraine and southern regions are replaced by species that are similar in terms of environmental characteristics (e.g. *Euphorbia cretophila* Klokov and *E. petrophila*, *Jurinea brachycephala* Klokov and *J. stoechadifolia*, *Genista tanaitica* P. A. Smirn. and *G. tinctoria* L.).

Results and Discussion

Most communities of Cretaceous outcrops are characterised by small species variety and high diversity of coenoses. The presence of a large number of local endemics among the dominant species is also characteristic for them. Some of the dominant species have diagnostic value at the level of associations, but the most typical species of these groups (*Thymus calcareus*, *Pimpinella tragium* (Woronow) Tutin, *Artemisia hololeuca*, *Hyssopus cretaceus*) are characterised by a fairly wide range. These features are important when selecting syntaxa.

Different authors in various regions described four alliances (Didukh 1989, Romashchenko et al. 1996, Averinova 2014) and 21 associations (Didukh 1989, Romashchenko et al. 1996, Didukh & Korotchenko 1997, Sereda 2009, Poluyanov 2009, 2012, Demina 2011, 2012, Averinova 2014). We conducted a critical analysis whereby it was established that the class *Helianthemo-*

Tymetea is represented by 14 associations within the territory of the south-western foothills of the Central Russian Upland. A tree diagram was built based on the assessment of species similarity. There are two clusters in this diagram (Figure 2). Cluster "A" covers communities of petrophytous steppes ("lowered alpine plants") and falls into the two alliances *Centaureo carbonatae-Koelerion talievii* and *Euphorbio cretophilae-Thymion cretacei*. Cluster "B" corresponds to the alliance *Artemisio hololeucae-Hyssopion cretacei* and covers typical tomillares.

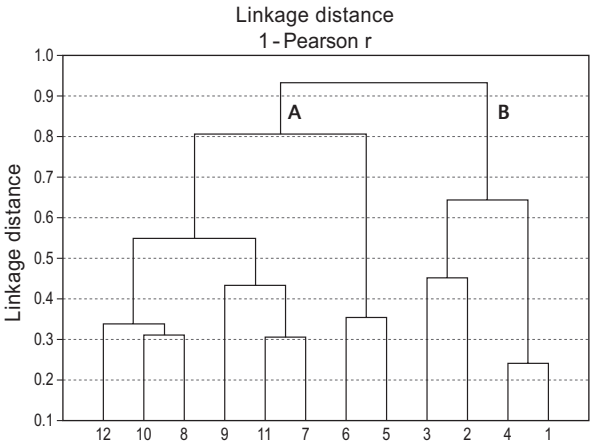

Figure 2: Tree diagram of chalk outcrop vegetation communities' distribution (syntaxa numbering shown in Table 1). A – lowered alpine plants (*Centaureo carbonatae-Koelerion talievii* and *Euphorbio cretophilae-Thymion cretacei*); B –typical tomillares (*Artemisio hololeucae-Hyssopion cretacei*).

Slika 2: Dendrogram vegetacije krednih izdankov (oštevilčenje sintaksonov kot v Tabeli 1). A – nizke alpinske rastline (*Centaureo carbonatae-Koelerion talievii* in *Euphorbio cretophilae-Thymion cretacei*); B – tipični tomiljar (*Artemisio hololeucae-Hyssopion cretacei*).

Table 1: Synoptic table of chalk outcrop vegetation communities with percentage frequencies.
Tabela 1: Sinoptična tabela rastlinskih združb krednih izdankov s frekvencami v odstotkih.

Consecutive number	1	2	3	4	5	6	7	8	9	10	11	12
	15	12	20	107	29	19	24	14	15	26	15	46
Species richness												
D. s. for ass. *Artemisio nutantis-Plantaginetum salsae*												
Plantago maritima	100	.	5	13	.	.	4	7	.	.	4	.
Artemisia nutans	80	8	.	3	.	.	4	7	.	.	.	.
Bassia prostrata	40	.	5	.	.	.	.	.	.	.	4	.
Convolvulus lineatus	53	.	.	2	7	.	17	.	.	.	13	.
D. s. for ass. *Erysimo cretacei-Festucetum cretacei*												
Erysimum ucrainicum	.	58	5	.	.	.	.	.	.	.	.	.
Melilotus officinalis	.	75	.	10	.	.	8	.	.	4	.	.
Festuca cretacea	20	100	40	8	.	.	.	.	.	4	.	.
D. s. for ass. *Lepidio meyeri-Scrophularietum cretacei*												
Lepidium meyeri	.	.	45	.	.	.	.	.	.	.	.	.
Hedysarum cretaceum	13	.	69	.	.	.	8	.	.	.	8	.
Galium octonarium	7	33	85	3	3	.	33	21	.	.	29	.
Artemisia absinthium	.	.	30	.	.	.	4	.	.	.	.	.
Poa compressa	13	42	30	10	10	.	17	.	13	20	4	20
Thesium arvense	7	33	30	11	28	.	17	21	40	.	25	.
D. s. for ass. *Artemisio hololeucae-Polygaletum cretaceae*												
Artemisia hololeuca	73	.	10	64	3	.	29	21	20	16	.	.
D. s. for ass. *Euphorbio cretophilae-Jurinetum brachycephalae*												
Pinus sylvestris	.	.	.	.	7	.	.	.	.	.	.	.
Helianthemum canum	.	.	.	2	59	.	.	29	.	28	13	.
D. s. for ass. *Genisto scythicae-Artemisietum salsoloides*												
Genista scythica	.	.	.	.	.	95	.	.	.	.	4	.
Rhaponticoides taliewii	.	.	.	.	.	53	.	.	.	.	.	.
Leontodon biscutellifolius	.	.	.	.	14	53	.	.	.	4	.	.
Linum tenuifolium	20	.	5	6	7	79	25	.	.	4	8	.
Odontarrhena tortuosa	.	.	.	3	28	84	25	14	.	12	17	26
Linaria vulgaris	.	.	5	1	.	21	.	.	.	.	.	.

Consecutive number	1	2	3	4	5	6	7	8	9	10	11	12
	15	12	20	107	29	19	24	14	15	26	15	46
Diplotaxis cretacea	.	.	5	4	.	47	.	.	.	12	.	.
Polygala comosa	.	.	.	.	.	21	.	.	.	4	.	.
Linum hirsutum	.	.	.	9	7	84	46	43	27	24	46	2
D. s. for ass. *Hedysaro grandiflori-Centauretum sumensis*												
Allium inaequale	.	.	.	.	10	.	.	64	.	40	4	4
Hedysarum grandiflorum	.	.	.	7	31	42	13	100	.	4	4	.
Thymelaea passerina	.	.	.	.	.	.	.	43	.	.	.	.
Asperula cynanchica	.	.	.	3	3	53	4	93	.	4	4	48
Adonis vernalis	.	.	.	.	.	.	.	50	.	8	8	13
Seseli annuum	.	.	.	.	.	.	.	21	.	.	.	.
Pimpinella saxifraga	.	.	.	.	.	.	.	21	.	.	.	.
Phlomis herba-venti	.	.	.	.	.	.	.	21	.	.	.	.
Salvia verticillata	.	.	.	7	10	.	4	71	27	12	4	26
Aster amellus	.	.	.	.	.	.	4	36	.	.	13	.
Asparagus officinalis	.	.	.	.	3	.	.	21	.	.	4	.
Caragana frutex	.	.	.	.	7	.	8	43	.	16	8	.
Centaurea orientalis	.	.	.	2	7	.	29	43	.	.	17	.
Echinops ritro	13	.	25	7	10	.	25	50	.	8	8	15
D. s. for ass. *Androsacio koso-poljanskii-Caricetum humilis*												
Androsace villosa subsp. koso-poljanskii	.	.	.	6	.	.	.	.	100	12	8	57
D. s. for ass. *Bupleuro falcatae-Stipetum capillatae*												
Bupleurum falcatum	13	.	10	23	45	.	21	86	20	76	42	59
Anisantha tectorum	.	.	.	.	3	.	.	.	.	12	.	.
Salvia nemorosa	.	.	.	.	.	.	.	.	.	8	.	.
Scabiosa ochroleuca	7	.	.	11	17	.	8	43	40	84	21	48
D. s. for ass. *Gypsophilo oligospermae-Campanuletum sibiricae*												
Carex pediformis	.	.	.	.	3	.	4	.	.	.	29	.
Koeleria pyramidata	.	8	20	3	24	.	4	.	.	16	71	.

Consecutive number	1	2	3	4	5	6	7	8	9	10	11	12
	15	12	20	107	29	19	24	14	15	26	15	46
Nonea pulla	.	.	.	.	.	.	4	14	7	.	33	.
Bromopsis riparia	.	.	.	6	3	11	17	57	33	12	75	11
Salvia nutans	.	.	.	1	38	26	25	50	27	52	83	30
Galatella villosa	.	.	.	.	.	.	.	.	.	.	38	.
Veronica spicata	.	.	.	3	3	.	21	14	.	8	29	.
Inula aspera	.	.	5	.	.	.	8	.	7	.	21	.
D. s. for ass. *Carici humilis-Thymetum calcarei*												
Astragalus austriacus	7	.	.	.	.	.	.	43	33	4	29	41
Thalictrum minus	.	.	.	.	24	42	29	43	.	36	67	17
Oxytropis pilosa	.	.	.	2	.	.	4	.	7	.	17	7
Jurinea arachnoidea	7	.	.	4	3	.	42	29	20	4	46	15
Viola rupestris	.	.	.	.	.	.	.	.	.	4	.	35
Helianthemum nummularium	.	.	.	.	.	.	.	36	.	4	.	59
Asperula tinctoria	.	.	.	2	.	.	.	.	.	.	4	43
Anthericum ramosum	.	.	.	.	21	.	.	21	7	8	.	54
Linum perenne	.	.	.	.	.	.	.	14	.	.	.	26
Echium vulgare	.	.	.	.	.	.	4	.	.	4	.	28
Vincetoxicum hirundinaria	.	.	.	.	3	.	.	.	7	36	8	50
Pilosella officinarum	.	.	.	.	.	.	.	.	7	.	4	26
Euphrasia pectinata	.	.	.	5	.	.	4	.	7	20	4	39
D. s. for alliance *Artemisio hololeucae-Hyssopion cretacei*												
Scrophularia cretacea	33	58	65	45	21	11	17	7	13	16	.	.
Hyssopus cretaceus	80	75	90	95	7	.	4	7	27	.	.	2
Matthiola fragrans	100	.	25	50	10	.	17	.	20	.	.	4
Linaria cretacea	20	.	10	11	14	.	.	.	.	.	.	.
D. s. for alliance *Euphorbio cretophilae-Thymion cretacei*												
Artemisia salsoloides	20	.	85	36	34	100	79	7	.	8	17	.
Jurinea stoechadifolia	.	.	.	1	86	58	.	.	.	12	.	.
Euphorbia petrophila	.	.	30	5	93	100	8	.	.	8	.	.
Brassica elongata	13	.	.	18	52	26	33	21	.	24	25	.
D. s. for alliance *Centaureo carbonatae-Koelerion talievii*												
Stipa capillata	7	.	5	7	3	.	25	79	27	72	46	70
Campanula sibirica	.	.	5	7	59	42	42	71	20	60	88	61
Polygala sibirica	.	.	.	9	3	.	17	36	47	24	58	61
Carex humilis	.	.	.	4	14	.	17	79	27	60	67	87
Stipa pennata	.	.	.	5	3	.	29	86	.	12	25	78
Onosma simplicissima	7	.	.	23	59	53	58	86	27	64	46	67
Koeleria talievii	7	.	.	9	14	.	29	50	13	52	13	61
Psephellus marschallianus	.	.	10	3	41	5	50	57	7	28	42	50
Teucrium polium	20	.	.	36	66	100	96	100	47	76	96	.
D. s. for order *Thymo cretacei-Hyssopetalia cretacei*												
Pimpinella tragium	73	92	90	91	83	95	83	57	93	56	50	37
Gypsophila oligosperma	60	50	70	62	76	89	83	93	67	84	79	85
Cephalaria uralensis	27	8	85	74	45	95	79	57	7	8	25	.
Thymus calcareus	60	.	5	87	97	100	92	86	93	68	33	96
Asperula tephrocarpa	73	.	5	90	93	5	88	14	60	52	50	2
Reseda lutea	7	33	5	28	52	74	58	71	13	20	58	9
Silene supina	33	.	.	50	21	5	33	21	40	52	33	4
Linum pallasianum	27	.	.	56	62	5	63	79	60	52	54	41
Polygala cretacea	20	33	.	36	14	.	63	57	13	36	25	26
Astragalus albicaulis	40	8	55	21	7	.	42	36	13	40	21	54
Genista tinctoria	27	.	5	23	7	.	21	36	.	.	38	7

Consecutive number	1	2	3	4	5	6	7	8	9	10	11	12
	15	12	20	107	29	19	24	14	15	26	15	46
Taraxacum serotinum	20	17	5	6	.	.	13	29	.	4	8	.
Silene cretacea	20	.	.	5	3	.	.	14	.	.	.	.
Orthantha lutea	33	25	.	20	21	.	.	21	.	40	4	.
Hedysarum ucrainicum	7	.	.	7	.	.	.	.	.	.	.	.
Scutellaria supina	.	.	.	2	3	21	8	.	.	.	4	.
Clausia aprica	.	.	.	.	.	.	.	.	.	.	.	7
Syrenia cana	.	.	.	2	.	.	.	.	.	.	.	.
Linaria genistifolia	.	.	.	2	3	.	.	.	.	4	4	.
Schivereckia podolica	.	.	.	.	3	.	.	.	.	.	.	.
D. s. for class *Festuco-Brometea*												
Festuca valesiaca	.	.	5	7	3	.	25	43	20	32	75	76
Euphorbia seguieriana	53	8	10	35	14	5	79	79	67	64	75	80
Galium ruthenicum	.	.	.	2	7	.	29	.	.	8	21	7
Hieracium virosum	.	.	5	1	3	.	13	.	.	8	38	13
Euphorbia nicaeensis	13	8	10	4	7	.	21	.	13	16	46	.
Stachys recta	.	.	.	3	3	.	29	36	7	32	54	22
Medicago falcata	.	17	.	10	.	.	21	43	40	16	29	35
Agropyron cristatum	13	.	5	1	14	.	25	.	.	8	.	.
Securigera varia	.	25	.	6	7	.	29	50	33	12	42	13
Erysimum diffusum	7	.	5	7	10	21	38	43	13	36	17	35
Stipa pulcherrima	.	.	.	.	.	.	38	.	7	4	21	2
Festuca stricta	.	.	.	9	.	5	21	.	.	4	13	.
Elytrigia stipifolia	7	.	.	3	.	.	.	.	7	.	.	.
Stipa lessingiana	.	.	.	8	3	21	38	14	.	20	13	.
Ajuga chamaepitys	.	.	.	.	.	.	8	.	7	.	8	13
Filipendula vulgaris	.	.	.	.	.	.	4	.	.	.	17	.
Elytrigia intermedia	.	.	.	.	.	.	17	.	7	4	13	22
Hieracium umbellatum	.	.	.	.	3	.	.	.	.	12	4	13
Viola ambigua	.	.	.	.	10	.	4	.	.	16	17	9
Pilosella echioides	.	.	.	.	.	.	.	.	7	4	4	11
Astragalus onobrychis	7	.	.	3	.	.	4	29	13	.	17	4
Potentilla humifusa	.	.	.	.	.	.	4	.	7	4	25	28
Rhaponticoides ruthenica	.	.	.	.	.	.	8	.	.	.	8	13
Onobrychis arenaria	.	.	.	1	.	.	4	29	7	4	21	17
Plantago media	.	.	.	.	.	.	4	.	.	.	17	9
Plantago lanceolata	.	.	.	2	3	.	.	.	.	4	8	.
Achillea setacea	.	.	.	.	.	.	.	.	.	8	17	9
Eryngium campestre	.	.	.	.	3	.	13	.	7	4	.	.
Cota tinctoria	.	8	5	1	3	11	8	.	7	.	4	.
Achillea millefolium	.	.	.	.	.	.	13	.	7	4	4	.
Astragalus subuliformis	7	.	.	8	.	.	13	.	.	12	4	.
Potentilla incana	.	.	.	.	.	.	4	.	7	.	13	11
Potentilla recta	.	.	.	.	14	.	.	.	7	8	8	.
Linum austriacum	.	.	.	2	.	.	25	.	.	.	17	.
Centaurea stoebe	.	.	.	1	.	.	.	.	.	4	.	4
Cleistogenes serotina	.	.	.	.	3	.	4	.	.	12	17	.
Hypericum elegans	.	.	.	.	7	.	8	21	.	4	17	.
Potentilla patula	.	.	.	.	.	.	4	.	.	16	17	.
Stipa zalesskii	.	.	.	.	.	.	.	.	13	4	4	.
Other species												
Helichrysum arenarium	7	.	60	11	41	.	46	.	.	44	50	.
Ephedra distachya	.	.	5	.	3	.	4	.	.	.	4	.
Cytisus ruthenicus	.	.	.	2	10	.	17	.	.	12	21	7

Consecutive number	1	2	3	4	5	6	7	8	9	10	11	12
	15	12	20	107	29	19	24	14	15	26	15	46
Melampyrum arvense	.	.	.	8	3	.	13	29	.	4	8	7
Centaurea diffusa	.	.	.	.	3	.	4	21	.	.	13	.
Atraphaxis frutescens	.	.	.	5	.	.	.	.	.	.	.	.
Elytrigia repens	7	.	.	.	.	.	.	.	.	4	13	.
Verbascum lychnitis	.	.	.	2	.	.	.	.	.	8	4	9
Artemisia campestris	.	.	.	.	.	.	.	.	.	.	8	9
Seseli libanotis	.	.	10	2	.	.	.	.	.	4	.	.
Melica transsilvanica	.	.	20	.	.	.	4	.	.	.	4	.
Poa angustifolia	.	.	20	1	.	.	4	.	.	16	13	.
Kraschenninnikovia ceratoides	.	.	20	.	.	.	.	.	.	.	.	.
Hypericum perforatum	.	.	.	.	.	.	.	.	.	20	13	.
Cichorium intybus	.	17	.	.	.	.	.	.	7	4	4	.
Lotus corniculatus	.	.	.	.	.	.	.	.	.	4	.	.
Gypsophila fastigiata	.	.	.	4	.	.	.	.	20	8	.	.
Marrubium peregrinum	.	.	.	.	.	.	4	.	.	12	13	.
Poa bulbosa	.	.	5	1	.	.	.	.	.	20	4	4
Odontites vulgaris	.	.	.	4	.	.	13	.	.	.	.	13
Cotinus coggygria	.	.	.	.	3	.	.	.	.	4	.	.
Calamagrostis epigeios	.	.	.	.	.	.	8	.	.	12	8	.
Gypsophila paniculata	.	.	.	2	.	.	4	.	.	.	4	.
Artemisia austriaca	.	.	15	1	.	.	.	.	.	12	8	.

Associations: 1. *Artemisio nutantis-Plantaginetum salsae*; 2. *Erysimo cretacei-Festucetum cretacei;* 3. *Lepidiomeyeri-Scrophularietumcretacei;* 4. *Artemisio hololeucae-Polygaletum cretaceae*; 5. *Euphorbio cretophilae-Jurinetum brachycephalae*; 6. *Genisto scythicae-Artemisietum salsoloides;* 7. *Pimpinello titanophillae-Artemisietum salsoloides;* 8. *Hedysaro grandiflori-Centauretum carbonatae;* 9. *Androsacio koso-poljanskii-Caricetum humilis*; 10. *Bupleuro falcatae-Stipetum capillatae*; 11. *Gypsophilo oligospermae-Campanuletum sibiricae*; 12. *Carici humilis-Thymetum calcarei*

Classification scheme of chalk outcrop vegetation communities.

Ord. *Thymo cretacei-Hyssopetalia cretacei*

All. *Artemisio hololeucae-Hyssopion cretacei*

1 Ass. *Artemisio nutantis-Plantaginetum salsae* Didukh 1989

2 Ass. *Erysimo cretacei-Festucetum cretacei* Demina 2011

3 Ass. *Lepidio meyeri-Scrophularietum cretacei* Demina 2012 (syn. *Hedysaro cretacei-Melicetum transsilvanicae* Demina 2011)

4 Ass. *Artemisio hololeucae-Polygaletum cretaceae* Didukh 1989 (syn. *Thymo cretacei-Hyssopetum cretacei* Didukh 1989, *Onosmo tanaiticae-Androsacietum kozo-poljanskii* Didukh et al. 1996, *Matthiolo fragransi-Atraphaxietum frutescens* Demina 2011, *Polygalo sibiricae-Hyssopetum cretacei* Poluyanov 2012)

All. *Euphorbio cretophilae-Thymion cretacei* Didukh 1989

5 Ass. *Euphorbio cretophilae-Jurinetum brachycephalae* Didukh 1989 (syn. *Jurineo brachycephalae-Helianthemetum cretophilae* Romashchenko et al. 1996; *Jurineo brachycephalae-Koelerietum talievii* Romashchenko et al. 1996, *Scrophulario cretacei-Helianthemetum cretacei* Didukh et al. 1996)

6 Ass. *Genisto scythicae-Artemisietum salsoloides* Sereda 2009

All. *Centaureo carbonatae-Koelerion talievii* (syn. *Carici humilis-Thymion calcarei* Averinova 2014)

7 Ass. *Pimpinello titanophillae-Artemisietum salsoloides* Didukh 1989

8 Ass. *Hedysaro grandiflori-Psephelletum carbonatae* Averinova 2014 corr. Didukh et al. nom. corr. hoc loco (original name: *Hedysaro grandiflori-Centauretum sumensis* Averinova 2014: 37–47)

9 Ass. *Androsacio koso-poljanskii-Caricetum humilis* Korotchenko & Didukh 1998

10 Ass. *Bupleuro falcatae-Stipetum capillatae*

11 Ass. *Gypsophilo oligospermae-Campanuletum sibiricae* Romashchenko et al. 1996 (syn. *Scrophulario cretacei-Helianthemetum cretacei* Romashchenko et al. 1996)

12 Ass. *Carici humilis-Thymetum calcarei* Poluyanov 2009

The alliance *Artemisio hololeucae-Hyssopion cretacei*.

Typical tomillares of this alliance are represented by communities dominated be chamaephyte subshrubs (*Thymus calcareus*, *Hyssopus cretaceus*, *Pimpinella tragium* and *Artemisia hololeuca*). The communities occupy steep (15–45°) slopes up to 30–50 m, with mostly southern and sometimes eastern exposure. Substrate is a loose, moving chalk. They are confined to the right river banks and are absent in the upland watershed areas. Characteristic features are the processes of denudation and superficial erosion resulting in feeble soil formation or its absence. The plant cover of these communities is quite patchy (30%). Diagnostic species of these communities are, besides the dominant, *Asperula tephrocarpa* Popov & Chrshan., *Linum pallasianum* Schult, *Matthiola fragrans* and *Scrophularia cretacea*.

1. *Artemisio nutantis-Plantaginetum salsae*

Diagnostic species: *Plantago maritima* Printz, *Artemisia nutans* Willd., *Bassia prostrata* (L.) Beck, *Convolvulus lineatus* L.

Dominant species: *Plantago maritima*, *Artemisia nutans*, rarely *Artemisia hololeuca*, *Hyssopus cretaceus.*

Among the described associations, this one occupies the most saline substrates. Communities are encoun-

tered at the foot of the chalk slopes and at their bottom (10–20°) on deluvial, sufficiently coherent sediments, characterised by carbonate-sulfate soil salinisation. Indicators of the salinity are *Artemisia nutans*, *Plantago maritima*, *Convolvulus lineatus*, rarer *Bassia prostrata*. These are also diagnostic species of this association, which is prevalent in the eastern part of the Luhansk region, on the banks of Siversky Donets' left feeders (Aydar, Derkul, Kamyshna).

2. *Erysimo cretacei-Festucetum cretacei*

Diagnostic species: *Erysimum ucrainicum* Desf., *Festuca cretacea* T.I. Popov & Proskor.

Dominant species: *Festuca cretacea*, *Hyssopus cretaceus*, *Pimpinella tragium*.

The community is abundant in the Rostov region. The association is characterised by a limited species composition. Apart from the dominant species mentioned above, obligate erodiophiles (species associated with soil erosion) with powerful caudex are present (*Scrophularia cretacea*, *Gypsophila oligosperma* Krasnova) as well as facultative species with a wide range (*Melilotus officinalis* (L.) Lam., *Poa compressa* L., *Reseda lutea* L., *Securigera varia* (L.) Lassen) (Demina 2012).

3. *Lepidio meyeri-Scrophularietum cretacei*

Diagnostic species: *Hedysarum cretaceum* DC., *Lepidium meyerii* Walp., *Hedysarum cretaceum*, *Artemisia salsoloides*.

Dominant species: *Artemisia salsoloides*, *Hedysarum cretaceum*, rarely *Hyssopus cretaceus*, *Gypsophila oligosperma*, *Thymus calcareus*, *Scrophularia cretacea*.

These communities are present on chalk outcrops on the right bank of the Middle Don valley. The association includes two subassociations. *Lepidio meyeri-Scrophularietum cretacei typicum* is formed at the bottom of the slopes on dense delluvial with signs of carbonate-sulfate salinity. Presence of *Lepidium meyerii* and sometimes *Krascheninnikovia ceratoides* is characteristic. Only four species (*Hyssopus cretaceus*, *Artemisia salsoloides*, *Lepidium meyeri*, *Pimpinella tragium*) have significant roles in coenosis formation (Demina 2012, 2016).

The subassociation *L. m.-S. c. hedysaretosum cretacei* is restricted to the upper part of slopes with northern aspect. It is formed on chalk washed-off regosols. These are the most "humid" communities, which are confined to northern slopes. Erodiophiles like *Melica transsilvanica*, *Poa compressa* and *Thesium arvense* have a significant share, whereas typical xerophytes are absent. *Hedysarum cretaceum* and *Artemisia salsoloides* are most frquent in these communities (Demina 2012, 2016).

4. *Artemisio hololeucae-Polygaletum cretaceae*

Diagnostic species: *Artemisia hololeuca*, *Hyssopus cretaceus*, *Matthiola fragrans.*

Dominant species: *Artemisia hololeuca*, *Artemisia salsoloides*, *Festuca cretacea*, *Pimpinella tragium*, *Thymus calcareus.*

These are the most common communities of the alliance. They are confined to Cretaceous eroded steep slopes (15–45°) on the right banks of the Siversky Donets basin with different aspects. These communities are sometimes covered by lime rock of the Upper Eocene in the valleys of the Nagolnaya and Kamyshnaya rivers (Demina 2012). The communities of the association have a low plant cover (50%) and a diverse species composition with the same dominant species as mentioned before. For this reason we have selected five associations with rather poor diagnostic blocks. We consider them variants or facies with specific patterns of distribution, primarily with respect to exposure and steepness of slopes and to structure, mobility and density of the substrate. For example, *Hyssopus cretaceus* and *Pimpinella tragium* are dominant mostly on moving loose substrate on the northern slopes, while the southern slopes with compressed and strong substrate are covered by *Artemisia* spp. Under such conditions *Thymus calcareus* also dominates. It is a characteristic species of the associations of the next alliance. An ongoing involvement of *Asperula tephrocarpa*, *Linum pallasianum* and *Polygala cretacea* Kotov is also characteristic.

The alliance *Euphorbio cretophilae-Thymion cretacei* includes communities formed on looser substrate with evident organic content both on slight (20%) and on steeper slopes. The common name "jurineiniky" used for the communities of this alliance indicates the occurrence of *Jurinea* spp. (*J. stoechadifolia* s.l., *J. arachnoidea* Bunge), which are diagnostic species of this association. *Euphorbia petrophila*, *Helianthemum canum* (L.) Hornem. and *Thymus calcareus* subshrubs also contribute to the communities of this alliance. *Artemisia salsoloides* is dominant on the steeper rocky slopes. With approximately 40–60%, the plant cover of these communities is higher than in the previous alliance.

5. *Euphorbio cretophilae-Jurinetum brachycephalae*

Diagnostic species: *Euphorbia petrophila*, *Helianthemum canum*, *Jurinea stoechadifolia.*

Dominant species: *Helianthemum canum*, *Jurinea stoechadifolia*, *Thymus calcareus.*

This association is common in the South of the research territory, on the right banks of the Siversky Donets River and its left tributaries. The communities occur on steep and moderately steep slopes (up to 15°) in areas adjacent to upland and hilltops. Its communities are characterised by the dominance of the orthotropic chasmophyte *Ju-*

rinea stoechadifolia, among which the plagiotropic *Helianthemum canum* and *Thymus calcareus* occur. The plant cover can reach 70%.

6. *Genisto scythicae-Artemisietum salsoloides*

Diagnostic species: *Odontarrhena tortuosa* (Waldst. & Kit. ex Willd.) C. A. Mey., *Artemisia salsoloides*, *Rhaponticoides taliewii*, *Diplotaxis cretacea* Kotov, *Euphorbia petrophila*, *Genista scythica* Pacz., *Jurinea stoechadifolia*, *Leontodon biscutellifolius* DC., *Linaria vulgaris* Mill., *Linum hirsutum*, *Linum tenuifolium* L., *Reseda lutea*.

Dominant species: *Thymus calcareus*, *Genista scythica*, *Jurinea stoechadifolia*, *Artemisia salsoloides*.

Communities are gappy (plant cover 40–60%) and confined to the middle and upper parts of river valleys slopes (with 30–45° steepness), typically with southern, southeastern or southwestern exposure.

It is a quite rare association with specific diagnostic species. Outcrops along the Tuzlov River in the Rostov region are the only location of petrophytic communities with occurrences of *Genista scythica* in Russia (Sereda 2008). In Ukraine *Genista scythica* grows only on the Donetsk Ridge and does not occur within the research territory.

The communities of the alliance *Centaureo carbonatae-Koelerion talievii* are confined to places with chalk deposits and outcrops. Unlike in case of the alliance mentioned above, carbonaceous rocks are immobile and very dense, but the soil is not formed (regosols) or undifferentiated (rendzinas). The plant cover is much denser, ranging from 30 to 70%. Dominant species are *Thymus calcareus*, *Carex humilis*, *C. pediformis*, *Onosma simplicissima*, *Androsace villosa* (Ovcz.) Fed. and *Hedysarum grandiflorum*. Typical for cretaceous communities are the following species: *Linum pallasianum* L., *L. hirsutum*, *Teucrium polium* L., *Brassica elongata* Ehrh., *Thymus calcareus*, *Onosma simplicissima*, *Silene supina*, *Psephellus marschallianus* (Spreng.) K. Koch. Steppe species (*Carex humilis*, *Stipa capillata* L.) are also part of the floristic composition (Didukh & Chusova 2014). However, there are no such typical carbonatophiles as *Hyssopus cretaceus*, *Scrophularia cretacea* and *Matthiola fragrans*, and occurrence of *Artemisia hololeuca* and *A. salsoloides* is limited.

This peculiarity indicates that it may be included in the order *Stipo pulcherrimae-Festucetalia pallentis*, but to prove this argument, it is necessary to analyse larger samples from other regions. Given that similar groups dominated by *Jurinea stoechadifolia*, *Pimpinella tragium* ssp. *titanophylla* and *Thymus dimorphus* Klokov & Des.-Shost. are distributed more widely, particularly on limestone in the steppe zone of Ukraine and Moldova, the final solution for this issue would be possible through broader analysis. As for now, the presence and dominance of hyper-carbonatophiles and carbonatophiles (*Helianthemum canum*, *Thymus calcareus*, *Brassica elongata*, *Euphorbia petrophila*, *Koeleria talievii*, *Hedysarum grandiflorum*, *Asperula tephrocarpa*) and the minor role of grass and typical steppe species of the order *Festucetalia valesiacae* (*Medicago falcata* L., *Agrimonia eupatoria* L., *Veronica incana* L., *Ranunculus polyanthemos* L., *Achillea millefolium* L., *Potentilla argentea* L., *Falcaria vulgaris* Bernh., *Plantago media* L., *Elytrigia intermedia* (Host) Nevski, *Carex praecox* Schreb., *Tragopogon dubius* (Jacq.) Vollm.) suggest to subsume these communities in the order *Thymo cretacei-Hyssopetalia cretacei*.

An important feature of this alliance is the quite strong floristic variability of its communities. They are based on the diagnostic species of the alliance, but in some associations, the diagnostic species are not clearly marked. That is why it is quite difficult to distinguish such communities solely by the floristic composition.

7. *Pimpinello titanophillae-Artemisietum salsoloides*

Diagnostic species: *Artemisia salsoloides*, *Jurinea arachnoidea*, *Linum austriacum* L., *Polygala cretacea.*

Dominant species: *Artemisia salsoloides*, *Hedysarum cretaceum*, *Onosma simplicissima* L., *Thymus calcareus.*

The communities are visually differentiated from a background of gray aspect due to the dominance of tall (60 cm), dense dark green stands of *A. salsoloides*. They are sporadically abundant in the middle of gentle (20°) slopes along the banks of left tributaries (Krasna, Aidar, Derkul, Kamyshna) of the Siversky Donets.

8. *Hedysaro grandiflori-Psephelletum carbonatae*

Diagnostic species: *Adonis vernalis* L., *Allium inaequale* Janka, *Asperula cynanchica* L., *Carex humilis*, *Hedysarum grandiflorum*, *Phlomis herba-venti* (Willd.) Maire ex De Filipps, *Pimpinella saxifraga* L., *Salvia verticillata* L., *Stipa capillata*, *Stipa pennata* L., *Thymelea passerina* (L.) Coss. & Germ.

Dominant species: *Carex humilis*, *Festuca valesiaca* Gaudin, *Gypsophila oligosperma*, *Thymus calcareus.*

As Averinova (2014) notes, communities are distributed on chalk outcrops of relatively gentle (2–10°) slopes of ravines and river valleys with mainly southern exposure. The substrate is a chalky fine earth with broken rock. The association may be diagnosed by the presence of a number of species. Its communities are described from the Belgorod region (Russian Federation).

The choice of *Psephellus sumensis* (Kalen.) Greuter. as diagnostic species is false because the race distinguished by M. Klokov is psamophytic and bound to boreal sand and pine forest communities. It is replaced by *Psephellus carbonatus* (Klokov) Greuteron on calcareous soil. Both species are included in the complex *P. marschallianus* s.l.

9. *Androsacio koso-poljanskii-Caricetum humilis*
Diagnostic species: *Androsace villosa.*
Dominant species: *Androsace villosa*, *Artemisia hololeuca*, *Carex humilis*, *Thymus calcareus.*

The association is confined to rather steep (30–50°) slopes with different exposures. Its communities occur on a feebly (up to several centimetres) developed rendzina high in carbonate. They are characterised by a high species richness and the presence of species with well-developed sod (*Carex humilis*, *Festuca valesiaca*).

10. *Bupleuro falcatae-Stipetum capillatae*
Diagnostic species: *Carex humilis*, *Koeleria talievii* Lavrenko, *Poa bulbosa* L., *Vincetoxicum hirundinaria* Medik.
Dominant species: *Carex humilis*, *Stipa capillata*, *Thymus calcareus.*

Communities occur at the bottom of gentle slopes and in depressions of slopes with moderate soil moisture. The association is contiguous to communities of the order *Festucetalia valesiacae*. Its communities are diagnosed by the dominance of *Stipa capillata* with species of the order *Thymo cretacei-Hyssopetalia cretacei* being present. The plant cover is more than 60%.

11. *Gypsophilo oligospermae-Campanuletum sibiricae*
Diagnostic species: *Bromopsis riparia* (Rehmann) Holub, *Campanula sibirica* L., *Carex pediformis*, *Galatella villosa* (L.) Rchb. f., *Hieracium virosum* Pall., *Inula aspera* Poir., *Koeleria pyramidata* (Lam.) P. Beauv., *Nonea pulla* DC., *Salvia nutans* L., *Veronica incana*, *Veronica spicata* L.
Dominant species: *Astragalus albicaulis* DC., *Bromopsis riparia*, *Carex humilis*, *Psephellus marschallianus*, *Galatella villosa*, *Festuca valesiaca*, *Gypsophila oligosperma*, *Helianthemum canum*, *Onosma simplicissima*, *Salvia nutans*, *Stipa capillata*, *Stipa pennata*, *Thymus calcareus*.

The communities develop on slightly eroded chalk slopes and hilltops of the chalk mountains, on steppified sites with Cretaceous basis. The association is quite common and widespread. In general the plant cover may reach 80% due to the presence of *Carex humilis* and representatives of the *Poaceae* family. The well-developed vegetation cover prevents surface erosion. The communities are observed to have a high species diversity. *Stipa* spp. or other prevalent grasses act as dominant species. However, due to the general xerophytism and significant contribution of carbonatophiles, these communities belong to the order *Thymo cretacei-Hyssopetalia cretacei*. The association most commonly occupies areas transitional to the steppe vegetation adjacent to upland or steep (15–30°) southern slopes. In such places the plant cover contributes to soil accumulation. This association also includes communities with dominance of *Carex pediformis*, which is an arctic-boreal species. It is on the southern edge of its area here and is found only in a few exclaves. The coenotic range of the communities is quite narrow (Golitsyin 1958, Didukh & Chusova 2014).

12. *Carici humilis-Thymetum calcarei*
Diagnostic species: *Anthericum ramosum* L., *Bupleurum falcatum*, *Carex humilis*, *Euphrasia pectinata* Ten., *Helianthemum nummularium* (L.) Mill., *Pilosella officinarum* Vaill., *Vincetoxicum hirundinaria*, *Viola rupestris* F.W. Schmidt
Dominant species: *Androsace villosa*, *Thymus calcareus.*

This association combines communities that are typical for the Upper Oskol Region on slightly sodded chalky slopes with dominance of calciphilous shrubs and subshrubs. Its communities often occupy the most elevated relief elements, which are well warmed up, i.e. the upper and middle parts of steep (up to 40°) slopes with exposure to the South. They are less common on northern slopes and gentle hilltops (Poluyanov 2012).

To estimate separated syntaxa in the general classification system of xerophilous grass-undershrub vegetation, we have processed the entire array of relevés and built a tree diagram on the basis of species composition similarity. As a result, there are six allocated clusters (Figure 3), two of which (1 and 2) correspond to alliances of the order *Thymo cretacei-Hyssopetalia cretacei*. Relevés of steppe vegetation (order *Festucetalia valesiacae*) matched the clusters 3–5 and relevés of sandy steppes (class *Koelerio-*

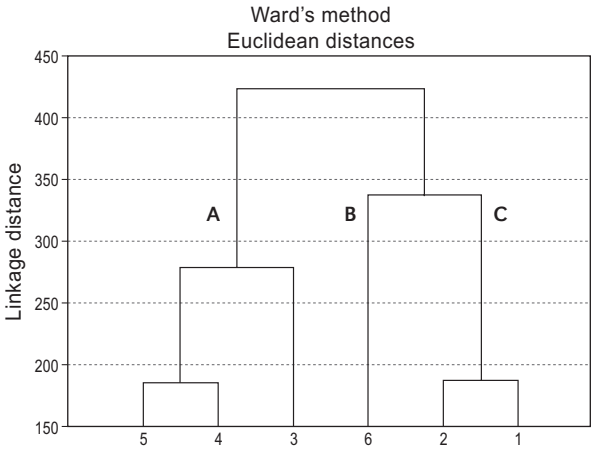

Figure 3: Distribution of Cretaceous outcrop vegetation in relation to the steppe vegetation. A – Ord. *Festucetalia valesiacae;* B – Cl. *Koelerio-Corynephoretea* (all. *Festucion vaginatae*); C – Ord. *Thymo cretacei-Hyssopetalia cretacei.*

Slika 3: Razporeditev vegetacije krednih izdankov glede na stepsko vegetacijo. A – red *Festucetalia valesiacae;* B – razred *Koelerio-Corynephoretea* (all. *Festucion vaginatae*); C – red *Thymo cretacei-Hyssopetalia cretacei.*

Corynephoretea) cluster 6. Thus, this analysis shows that the communities of the order *Thymo cretacei-Hyssopetalia cretacei* differ from the *Festucetalia valesiacae* communities as a *Koelerio-Corynephoretea* in their floristic composition. All these communities have in common the predominance of xerophilous species; however, grasses (*Festuca*, *Stipa*) dominate in *Festucetalia valesiacae* and *Koelerio-Corynephoretea* communities, whereas chasmophilous plants are dominant in the order *Thymo cretacei-Hyssopetalia cretacei*.

The position of Cretaceous outcrop vegetation communities within the modern system of syntaxonomical classification is quite debatable and depends on the interpretation of the size of different syntaxa. Considering *Festuco-Brometea* in a fairly wide range, it should be noted that calciphyte communities are common in the steppe zone and have been in direct contact with zonal vegetation so that some species of the class *Festuco-Brometea* are present in those coenoses. But in general, these events are quite random with low class constancy (I–II). Inclusion of the order *Thymo cretacei-Hyssopetalia cretacei* into the class *Festuco-Brometea* can be considered as substitution of *Stipo pulcherrimae-Festucetalia pallentis* Pop 1968 in the East. However, the difference in ecological conditions between them is that the first is common on dense carbonates (gypsum, dolomite, limestone) and the latter – on idiomorphic soils with different densities – often on loose and mobile regosols. In this respect, the *Thymo cretacei-Hyssopetalia cretacei* communities may be regarded as similar to *Koelerio-Corynephoretea* Klika in Klika et Novák 1941, and *Stipo pulcherrimae-Festucetalia pallentis* as an analogue of *Sedo-Scleranthetea* Br.-Bl 1955. They are similar in structure and growing conditions to the Mediterranean communities of the class *Drypidetea spinosae* Quezel 1964, where Mucina et al. (2016) included Crimean-Caucasian syntaxa of *Onosmo polyphyllae-Ptilostemetalia* Korzhenevsky 1990. But the location and status of this order has not been fully established yet. All of the above shows that a number of syntaxonomical issues are still unresolved and require broader discussion.

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Conclusions

We provided a comprehensive syntaxonomic survey of Cretaceous outcrop vegetation from south-western foothills of the Central Russian Upland. Based on relevés from Ukraine and the Russian Federation, we could conclude that all communities belong to the order *Thymo cretacei-Hyssopetalia cretacei* and are clearly separated from other steppe communities. The order *Thymo cretacei-Hyssopetalia cretacei* includes twelve associations belonging to the three alliances *Artemisio hololeucae-Hyssopion cretacei*, *Euphorbio cretophilae-Thymion cretacei* and *Centaureo carbonatae-Koelerion talievii*.

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Appendix 1a: Characteristic table of syntaxa of the alliance *Artemisio hololeucae-Hyssopion cretacei.*
Priloga 1a: Tabela sintaksonov zveze *Artemisio hololeucae-Hyssopion cretacei.*

Consecutive number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Total vegetation cover (%)	60	15	40	20	50	45	20	50	40	25	70	70	50	40	20	30	50	60	40	50	50
Slope (°)	10	5	5		25	30	45	25	5		15		25					30	30	20	45
Aspect (°)	5	90	180		135	180	135	90	180		180		45					90	90	180	90
Species richness	14	11	15	19	17	15	15	13	11	14	17	9	13	13	11	14	20	16	15	17	16
D. s. of ass. *Artemisio nutantis-Plantaginetum salsae*																					
Plantago maritima	3	1	4	4	3	1	2	2	1	1	.	.	.	.	.	.	.	.	.	.	.
Artemisia nutans	4	2	3	2	1	1	1	1	1	1	.	.	.	.	.	.	.	.	.	.	.
Bassia prostrata	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Convolvulus lineatus	1	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
D. s. of ass. *Artemisio hololeucae-Polygaletum cretacei*																					
Artemisia hololeuca	.	.	.	1	1	1	3	3	3	3	1	2	4	3	3	3	4	3	4	4	3
D. s. of alliance *Artemisio hololeucae-Hyssopion cretacei*																					
Scrophularia cretacea	.	.	.	.	.	1	1	.	.	1	.	.	1	2	2	2	.	1	.	1	.
Hyssopus cretaceus	.	.	1	.	3	3	2	2	3	2	1	3	2	2	2	3	2	1	1	3	1
Matthiola fragrans	1	1	1	1	1	1	1	1	1	1	1	.	.	1	1	2	1	1	1	1	.
Linaria cretacea	.	.	.	1	1	.	1	.	.	.	.	.	.	.	.	.	.	.	2	.	.
D. s. of alliance *Euphorbio cretophilae-Thymion cretacei*																					
Brassica elongata	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Artemisia salsoloides	.	.	.	1	.	.	.	.	2	.	4	2	.	2	.	.	.	.	.	1	.
D. s. of alliance *Centaureo carbonatae-Koelerion talievii*																					
Polygala sibirica	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.
Carex humilis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.
Onosma simplicissima	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	1	.	1	1
Koeleria talievii	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Teucrium polium	.	1	.	.	.	.	.	.	1	.	2	.	.	.	1	.	.	.	2	1	1
D. s. of order *Thymo cretacei-Hyssopetalia cretacei*																					
Pimpinella tragium	1	1	.	1	1	3	.	1	1	1	1	5	2	5	2	1	1	1	2	.	1
Gypsophila oligosperma	.	1	.	.	1	1	1	.	.	1	1	.	.	.	.	.	.	1	2	1	1
Cephalaria uralensis	.	.	.	.	.	1	.	.	.	.	1	2	1	2	.	2	.	1	2	1	1
Thymus calcareus	.	.	.	1	1	2	.	.	1	1	4	1	3	3	2	2	1	3	2	1	4
Asperula tephrocarpa	1	.	1	1	1	2	1	.	1	1	1	2	2	2	.	1	2	1	1	1	1
Reseda lutea	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	1	.	1	1	.
Silene supina	.	.	.	.	1	1	.	.	.	1	2	1	.	.	.	.	2	1	1	1	.
Linum pallasianum	.	.	.	1	1	.	.	.	.	.	2	.	1	1	1	2	2	1	2	1	1
Polygala cretacea	.	.	.	.	.	.	1	1	.	1	1	.	1	2	1	1	1	1	.	1	.
Astragalus albicaulis	1	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1	.	.	1	1
Genista tinctoria	1	1	.	1	.	.	1	.	.	.	.	.	1	.	.	.	1	.	.	.	1
Taraxacum serotinum	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Silene cretacea	.	.	.	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Orthantha lutea	.	1	.	1	.	.	.	1	.	.	.	.	.	.	.	1	.	.	.	.	.
Hedysarum ucrainicum	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	2	.	.
D. s. of class *Festuco-Brometea*																					
Euphorbia seguieriana	1	.	1	1	.	1	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.
Euphorbia nicaeensis	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Medicago falcata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
Astragalus onobrychis	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Plantago lanceolata	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.

Consecutive number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Another species																					
Festuca cretacea	.	.	.	1	.	.	1	1	.	.	.	.	.	.	.	.	.	4	.	2	.
Hedysarum cretaceum	.	.	.	.	1	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.
Galium octonarium	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Poa compressa	.	.	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Helianthemum canum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Linum tenuifolium	1	.	.	.	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Odontarrhena tortuosa	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
Diplotaxis cretacea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
Hedysarum grandiflorum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	1
Androsace villosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.
Bupleurum falcatum	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.
Scabiosa ochroleuca	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
Koeleria pyramidata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
Astragalus austriacus	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Jurinea arachnoidea	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Helichrysum arenarium	.	.	.	1	.	.	.	.	.	.	1	.	.	.	.	.	.	1	.	.	.
Agropyron cristatum	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Melampyrum arvense	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.
Elytrigia repens	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cytisus ruthenicus	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.
Galium humifusum	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Echinops ritro	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Festuca stricta	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.
Erysimum diffusum	1	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
Agrostis capillaris	1	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Melilotus albus	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.
Puccinellia distans	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gypsophila fastigiata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	.	.	.	.
Gypsophila paniculata	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.

Localities: 01 – vil. Stril'tsivka, Milovs'kyy district; Lugansk reg.; Ukraine; 06.1987 (Ya. Didukh)
Localities: 02 – vil. Stril'tsivka, Milovs'kyy district; Lugansk reg.; Ukraine; 27.06.1987 (Ya. Didukh)
Localities: 03 – Bilovodsk, Lugansk reg.; Ukraine; 06.1987 (Ya. Didukh)
Localities: 04 – right bank of Aidar River, vil. Rybiancevo, Lugansk reg.; Ukraine; 06.1987 (Ya. Didukh)
Localities: 05 – vil. Kamyshivka, Lugansk reg.; Ukraine; 06.1987 (Ya. Didukh)
Localities: 06 – Horodysche, Lugansk reg.; Ukraine; 06.1987 (Ya. Didukh)
Localities: 07 – vil. Stril'tsivka, Milovs'kyy district;Lugansk reg.; Ukraine; 06.1987 (Ya. Didukh)
Localities: 08 – Serebryanka, Donetsk reg.; Ukraine; 06.1987 (Ya. Didukh)
Localities: 09 – Bilovodsk, Lugansk reg.; Ukraine; 06.1987 (Ya. Didukh)
Localities: 10 – vil. Stril'tsivka, Milovs'kyy district;Lugansk reg.; Ukraine; 06.1987 (Ya. Didukh)
Localities: 11 – Derkul River, Markivka, Lugansk reg.; Ukraine; 3.07.1987 (Ya. Didukh)
Localities: 12 – vil. Razdollya, Lugansk reg.; Ukraine; 16.07.2009 (L. Borovyk)
Localities: 13 – Nova Duvanka, Lugansk reg.; Ukraine; 06.1987 (Ya. Didukh)
Localities: 14 – vil. Zorykivka, Lugansk reg.; Ukraine; 24.06.2009 (L. Borovyk)
Localities: 15 – Dubovyy ravine, Milovs'kyy district; Lugansk reg.; Ukraine; 22.06.2008 (L. Borovyk)
Localities: 16 – vil. Stril'tsivka, Milovs'kyy district; Lugansk reg.; Ukraine; 23.08.2011 (L. Borovyk)
Localities: 17 – "Striltsivskyi steppe" (Luhansk Natural Reserve); Lugansk reg.; Ukraine; 6.07.2012 (L. Borovyk)
Localities: 18 – Derkul River, Markivka, Lugansk reg.; Ukraine; 3.07.1987 (Ya. Didukh)
Localities: 19 – Krasna River, Svatovo, Lugansk reg.; Ukraine; 06.1987 (Ya. Didukh)
Localities: 20 – Bilovodsk, Lugansk reg.; Ukraine; 06.1987 (Ya. Didukh)
Localities: 21 – Oskil River, Dvorichna, Kharkiv reg.; Ukraine; 06.1995 (Ya. Didukh)

Appendix 1a (extension): Characteristic table of syntaxa of the alliance *Artemisio hololeucae-Hyssopion* cretacei.
Priloga 1a (nadaljevanje): Tabela sintaksonov zveze *Artemisio hololeucae-Hyssopion cretacei*.

Relevé number	1	2	3	4	5	6	7	8	9	10	11	21	12	13	22	14	23	15	18	19	24
Species richness	8	6	4	21	7	16	6	52	31	4	11	14	10	10	15	13	16	11	10	12	15
Slope (°)	50	70	70								7		5	3		3		5	15		
Aspect (°)	45	45	225								250		204	280		289		253	174		
Total vegetation cover (%)	30	30	5	30	25	30	15	65	55	25	15	70	12	10	70	10	45	15	25	30	60
D. s. of ass. *Erysimo cretacei-Festucetum cretacei*																					
Erysimum ucranicum	1	1	1	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Melilotus officinalis	1	1	.	1	.	1	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.
Festuca cretacea	1	2	1	2	1	2	1	4	4	1	1	.	.	1	.	1	.	.	.	1	.
D. s. of ass. *Lepidio meyeri-Scrophularietum cretacei*																					
Lepidium meyeri	.	.	.	.	.	.	.	.	.	.	2	.	2	2	.	2	.	2	1	1	.
Hedysarum cretaceum	.	.	.	.	.	.	.	.	.	.	.	4	.	.	4	.	4	.	2	3	4
Galium octonarium	.	.	.	1	.	.	.	1	1	.	2	1	1	1	1	2	1	2	2	1	1
Artemisia absinthium	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	2	.	.	.	1
Poa compressa	.	.	.	.	1	.	.	2	1	.	.	1	1	.	1	.	1	.	.	.	1
Thesium arvense	.	.	.	.	.	1	.	.	1	.	.	1	.	.	1	.	1	.	.	1	1
D. s. of alliance *Artemisio hololeucae-Hyssopion cretacei*																					
Scrophularia cretacea	2	2	2	.	.	2	2	.	.	2	.	.	2	1	1	1	1	2	2	.	.
Hyssopus officinalis	4	2	1	2	4	4	4	.	.	4	2	1	3	2	1	2	1	2	3	2	1
Matthiola fragrans	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	1	.	.	.
Linaria cretacea	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
D. s. of alliance *Euphorbio cretophilae-Thymion cretacei*																					
Artemisia salsoloides	.	.	.	.	.	.	.	.	.	.	2	5	2	2	2	2	2	2	4	4	4
D. s. of alliance *Centaureo carbonatae-Koelerion talievii*																					
Stipa capillata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Campanula sibirica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
D. s. of order *Thymo cretacei-Hyssopetalia cretacei*																					
Pimpinella tragium	2	4	.	4	1	2	2	2	4	4	2	1	3	2	2	2	2	2	2	2	1
Gypsophila oligosperma	1	.	.	2	.	1	.	.	1	.	2	4	.	.	2	.	4	.	1	2	2
Cephalaria uralensis	.	.	.	.	.	.	.	.	.	.	2	1	1	1	.	1	.	1	2	2	1
Reseda lutea	.	.	.	1	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Polygala cretacea	.	.	.	1	.	.	.	2	1	.	.	.	.	.	.	.	.	.	.	.	.
Astragalus albicaulis	.	.	.	.	.	.	.	.	.	.	1	.	1	1	.	1	.	1	.	.	.
Taraxacum serotinum	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Orthantha lutea	.	.	.	.	.	1	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.
D. s. of class *Festuco-Brometea*																					
Festuca valesiaca	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	.	.	.
Hieracium virosum	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.
Medicago falcata	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.
Achillea nobilis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
Another species																					
Artemisia nutans	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Euphorbia petrophila	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.
Koeleria pyramidata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	.	.	1
Helichrysum arenarium	.	.	.	.	.	.	.	.	.	.	1	1	.	.	1	1	1	1	.	1	1
Echinops ritro	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1	.	1	.	.	.
Melica transsilvanica	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	1	.	.	.	1
Poa angustifolia	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	1	.	.	.	1

Relevé number	1	2	3	4	5	6	7	8	9	10	11	21	12	13	22	14	23	15	18	19	24
Securigera varia	.	.	.	1	.	.	.	2	1	.	.	.	.	.	.	.	.	.	.	.	.
Cichorium intybus	.	.	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Poa bulbosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.

Localities: 1 – right bank of the Don River, Rostov reg.; Russia; 07.2009 (M. Sereda)
Localities: 2 – right bank of the Don River, Rostov reg.; Russia; 07.2009 (M. Sereda)
Localities: 3 – right bank of the Don River, Rostov reg.; Russia; 07.2009 (M. Sereda)
Localities: 4 – Verkhnedonskoy district, 3 km west of the village Demidovskiy, Chayka, Rostov reg.; Russia; 27.06.2009 (O. Demina)
Localities: 5 – Verkhnedonskoy district, vicinity of village Stogovskoy, Rostov reg.; Russia; 02.06.2008 (O. Demina)
Localities: 6 – Verkhnedonskoy district, vicinity of village Stogovskoy, Belogorskoe hole, Rostov reg.; Russia; 04.06.2009 (O. Demina)
Localities: 7 – Verkhnedonskoy district, 1km north of the village Stogovskoy, Rostov reg.; Russia; 05.06.2009 (O. Demina)
Localities: 8 – Verkhnedonskoy district, 3 km west from of the Demidovskiy, Chayka, Rostov reg.; Russia; 27.06.2009 (O. Demina)
Localities: 9 – Chertkovskiy district, 2 km north of the village Mankovo-Kalitvenskoe, Rostov reg.; Russia; 07.06.2009 (O. Demina)
Localities: 10 – Verkhnedonskoy district, vicinity of village Stogovskoy, Belogorskoe hole, Rostov reg.; Russia; 04.06.2009 (O. Demina)
Localities: 11 – Zatonsky, Rostov reg.; Russia; 25.08.2014 (O. Demina)
Localities: 21 – Sholokhovskiy district, vicinities of village Zatonskiy, Rostov reg.; Russia; 06.07.2009 (O. Demina)
Localities: 12 – Zatonsky, Rostov reg.; Russia; 25.08.2014 (O. Demina)
Localities: 13 – Zatonsky, Rostov reg.; Russia; 25.08.2014 (O. Demina)
Localities: 22 – Sholokhovskiy district, vicinities of village Zatonskiy, Rostov reg.; Russia; 06.07.2009 (O. Demina)
Localities: 14 – Zatonsky, Rostov reg.; Russia; 25.08.2014 (O. Demina)
Localities: 23 – Sholokhovskiy district, vicinities of village Zatonskiy, Rostov reg.; Russia; 06.07.2009 (O. Demina)
Localities: 15 – Zatonsky, Rostov reg.; Russia; 25.08.2014 (O. Demina)
Localities: 18 – Zatonsky, Rostov reg.; Russia; 25.08.2014 (O. Demina)
Localities: 19 – Zatonsky, Rostov reg.; Russia; 25.08.2014 (O. Demina)
Localities: 24 – Sholokhovskiy district, vicinities of village Zatonskiy, Rostov reg.; Russia; 06.07.2009 (O. Demina)

Appendix 1b: Characteristic table of syntaxa of the alliance *Euphorbio cretophilae-Thymion cretacei*.
Priloga 1b: Tabela sintaksonov zveze *Euphorbio cretophilae-Thymion cretacei*.

Consecutive number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Total vegetation cover (%)	20	70	80	60	70	60	20	60	31	20	50	60	60	50	50	40	60	60	50	50
Slope (°)		30	15	10	20	8	20	5		40	40	40	30	30	40	30	30	45	40	40
Aspect (°)		135	155	180	225	315	180	135		315	180	135	135	135	135	225	135	180	225	180
Species richness	16	24	19	12	18	15	19	20	29	19	19	18	19	17	19	15	19	19	20	19
D. s. of ass. *Euphorbio cretophilae-Jurinetum brachycephalae*																				
Helianthemum canum	2	.	2	4	.	1	.	4	1	3	.	.	.	.	.	.	.	.	.	.
D. s. of ass. *Genisto scythicae-Artemisietum salsoloides*																				
Genista scythica	.	.	.	.	.	.	.	.	.	.	2	1	2	3	1	2	2	2	3	2
Rhaponticoides taliewii	.	.	.	.	.	.	.	.	.	.	1	.	1	.	1	1	.	1	1	1
Leontodon biscutellifolius	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	1	1	.	1	.
Linum tenuifolium	.	1	.	.	.	.	.	.	.	.	.	1	1	.	1	1	1	1	1	1
Odontarrhena tortuosa	.	2	.	.	.	.	.	.	.	.	1	1	1	1	2	2	1	2	1	1
Linaria vulgaris	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	.	.	1	.
Diplotaxis cretacea	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	1	1	.	1
Polygala comosa	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	1
Linum hirsutum	.	.	.	.	.	.	.	.	.	.	2	2	1	1	1	1	1	1	1	1
D. s. of alliance *Artemisio hololeucae-Hyssopion cretacei*																				
Scrophularia cretacea	1	.	.	.	.	.	.	.	.	1	.	.	.	.	1	.	1	.	.	.
Hyssopus cretaceus	1	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
Matthiola fragrans	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Linaria cretacea	.	.	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
D. s. of alliance *Euphorbio cretophilae-Thymion cretacei*																				
Jurinea stoechadifolia	1	4	4	2	3	4	4	3	1	2	1	3	1	2	3	.	2	1	.	2
Euphorbia petrophila	1	2	1	1	1	1	1	2	1	2	2	2	1	2	2	1	2	2	2	1
Artemisia salsoloides	1	3	.	.	3	1	.	.	.	.	2	2	3	2	3	1	2	2	2	2
Brassica elongata	1	.	.	.	1	1	.	2	1	1	.	.	.	.	.	.	1	.	1	.
D. s. of alliance *Centaureo carbonatae-Koelerion talievii*																				
Campanula sibirica	.	1	.	.	1	1	1	.	1	.	.	1	.	.	.	.	1	.	.	1
Carex humilis	.	.	2	.	.	.	.	.	2	1	.	.	.	.	.	.	.	.	.	.
Stipa pennata	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Onosma simplicissima	2	.	2	1	.	.	.	1	1	1	2	.	.	.	1	.	.	1	2	1
Koeleria talievii	.	.	.	.	.	.	1	.	2	.	.	.	.	.	.	.	.	.	.	.
Psephellus marschallianus	.	1	.	.	.	.	1	1	1	.	.	.	.	.	.	.	.	.	.	.
Teucrium polium	.	1	2	.	1	1	1	.	1	1	1	2	2	1	1	1	1	1	1	1
D. s. of order *Thymo cretacei-Hyssopetalia cretacei*																				
Pimpinella tragium	1	1	.	1	1	3	1	1	1	1	3	1	2	2	2	2	3	2	1	2
Gypsophila oligosperma	1	1	3	1	1	1	2	.	1	2	1	1	1	1	1	1	1	1	1	1
Cephalaria uralensis	.	1	1	1	.	.	.	1	.	.	1	1	1	2	1	1	1	1	1	.
Thymus calcareus	4	4	2	3	5	.	1	2	4	4	1	2	2	2	2	3	3	3	2	2
Asperula tephrocarpa	1	1	1	3	2	1	1	1	1	1	.	.	.	.	.	.	.	.	.	.
Reseda lutea	.	1	1	.	.	1	.	.	.	.	2	1	1	1	1	.	1	1	2	1
Silene supina	.	1	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Linum pallasianum	2	1	2	.	.	.	.	1	.	2	.	.	.	.	.	.	.	.	.	.
Orthantha lutea	1	.	.	.	.	.	1	.	1	1	.	.	.	.	.	.	.	.	.	.
Scutellaria supina	.	.	.	.	.	.	1	.	.	.	.	.	1	.	.	.	.	.	1	.
Linaria genistifolia	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.

Consecutive number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
D. s. of class *Festuco-Brometea*																				
Euphorbia seguieriana	.	.	.	.	.	.	1	1	1	1	.	.	.	.	.	.	.	.	.	.
Galium ruthenicum	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.
Potentilla recta	.	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.
Astragalus sulcatus	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Adonis volgensis	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Another species																				
Polygala cretacea	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Convolvulus lineatus	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Thesium arvense	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Artemisia hololeuca	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Allium inaequale	.	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.
Hedysarum grandiflorum	1	1	1	.	.	.	.	.	.	.	1	1	.	1	1	.	.	1	.	1
Asperula cynanchica	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	1	1	.
Salvia verticillata	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Caragana frutex	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Centaurea orientalis	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bupleurum falcatum	.	.	.	1	1	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.
Anisantha tectorum	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Scabiosa ochroleuca	1	.	.	.	.	.	1	.	1	1	.	.	.	.	.	.	.	.	.	.
Koeleria pyramidata	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Bromopsis riparia	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1	.	.	.	.
Salvia nutans	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	1	1	.	.
Thalictrum minus	.	1	.	.	1	.	.	1	.	.	.	1	1	1	.	.	.	.	.	1
Helichrysum arenarium	.	.	1	1	1	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Cytisus ruthenicus	.	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.
Viola ambigua	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Echinops ritro	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.
Stipa lessingiana	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	.	.	.	.	.
Erysimum diffusum	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	1	.	.	.	.
Ephedra distachya	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Localities: 1 – vil. Zakotnoe, Donetsk reg.; Ukraine; 08.1994 (K. Romashchenko)
Localities: 2 – vil. Nyzhnye, Lugansk reg.; Ukraine; 06.1987 (Ya. Didukh)
Localities: 3 – "Kreidova flora", Donetsk reg.; Ukraine; 08.2016 (O. Chusova)
Localities: 4 – "Kreidova flora", Donetsk reg.; Ukraine; 08.2016 (O. Chusova)
Localities: 5 – "Kreidova flora", Donetsk reg.; Ukraine; 08.2016 (O. Chusova)
Localities: 6 – vil. Kryva Luka, Donetsk reg.; Ukraine; 22.06.1987 (Ya. Didukh)
Localities: 7 – vil. Bogorodychnoe, Donetsk reg.; Ukraine; 08.1994 (K. Romashchenko)
Localities: 8 – vil. Kryva Luka, Donetsk reg.; Ukraine; 22.06.1987 (Ya. Didukh)
Localities: 9 – vil. Bogorodychnoe, Donetsk reg.; Ukraine; 08.1994 (K. Romashchenko)
Localities: 10 – "Kreidova flora", Donetsk reg.; Ukraine; 28.08.1994 (K. Romashchenko)
Localities: 11 – right bank of Tuzlov River, vil. Lysogorka, Rostov reg.; Russia; 4.06.2002 (M. Sereda)
Localities: 12 – right bank of Tuzlov River, vil. Lysogorka, Rostov reg.; Russia; 4.06.2002 (M. Sereda)
Localities: 13 – right bank of Tuzlov River, vil. Lysogorka, Rostov reg.; Russia; 4.06.2002 (M. Sereda)
Localities: 14 – right bank of Tuzlov River, vil. Lysogorka, Rostov reg.; Russia; 4.06.2002 (M. Sereda)
Localities: 15 – right bank of Tuzlov River, vil. Lysogorka, Rostov reg.; Russia; 4.06.2002 (M. Sereda)
Localities: 16 – right bank of Tuzlov River, vil. Lysogorka, Rostov reg.; Russia; 4.06.2002 (M. Sereda)
Localities: 17 – right bank of Tuzlov River, vil. Lysogorka, Rostov reg.; Russia; 4.06.2002 (M. Sereda)
Localities: 18 – right bank of Tuzlov River, vil. Lysogorka, Rostov reg.; Russia; 4.06.2002 (M. Sereda)
Localities: 19 – right bank of Tuzlov River, vil. Lysogorka, Rostov reg.; Russia; 4.06.2002 (M. Sereda)
Localities: 20 – right bank of Tuzlov River, vil. Lysogorka, Rostov reg.; Russia; 4.06.2002 (M. Sereda)

Appendix 1c: Characteristic table of syntaxa of the alliance *Centaureo carbonatae-Koelerion talievii*.
Priloga 1c: Tabela sintaksonov zveze *Centaureo carbonatae-Koelerion talievii*.

Consecutive number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Total vegetation cover (%)	70	70	60	90	60	65	65	70	50	70	40	60	50	65	65	45	50	60		80	40	15	40	40	60	10	10	60	80	40
Slope (°)	15	45	45	20	5	10	20	25	30	20	10	5	10	7		7	5	7		5	10	30	25	30	7	25	30	30	5	20
Aspect (°)	45	45	45	270	5	90	90	90	5	180	225		180	180		270	315	135		225	135	180	180	90	180	180	135	45	225	135
Species richness	28	25	23	22	22	23	27	20	31	19	26	46	31	32	37	40	52	41	74	48	15	11	20	12	18	22	11	21	23	15
D.s. ass. *Pimpinello titanophillae-Artemisietum salsoloides*																														
Artemisia salsoloides	5	1	4	1	3	5	.	.	3	4	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Polygala cretacea	1	1	1	.	1	.	.	.	.	.	1	1	.	.	1	.	1	.	.	1	1	.	.	.	.	.	.	1	.	.
Linum hirsutum	1	2	.	.	2	.	.	1	.	.	.	.	.	.	1	1	1	.	.	.	1	.	.	1	.	.	.	.	1	.
D.s. ass. *Hedysaro grandiflori-Psephelletum carbonatae*																														
Allium inaequale	.	.	.	.	.	.	.	.	.	.	1	1	2	.	1	2	1	1	2	.	.	.	.	.	.	.	.	.	.	.
Hedysarum grandiflorum	.	.	.	4	.	.	.	3	.	.	2	3	1	1	3	1	1	1	3	1	.	.	.	.	.	.	.	.	.	.
Thymelaea passerina	.	.	.	.	.	.	.	.	.	.	1	.	1	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Asperula cynanchica	.	.	.	.	.	.	.	.	.	.	1	1	1	1	.	1	1	1	1	1	.	.	.	.	.	.	.	.	.	.
Adonis vernalis	.	.	.	.	.	.	.	.	.	.	.	1	.	1	1	1	.	.	3	2	.	.	.	.	.	.	.	.	.	.
Seseli annuum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Pimpinella saxifraga	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Phlomis herba-venti	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.
Salvia verticillata	.	.	.	.	.	.	.	.	.	.	1	.	1	1	.	1	1	.	1	1	.	.	1	.	.	.	.	.	.	.
Aster amellus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.
Asparagus officinalis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	1	.	.	.	.	.	.	.	.	.	.
Caragana frutex	.	.	.	.	.	.	.	.	.	1	.	1	.	.	.	.	1	1	.	2	.	.	.	.	.	.	.	.	.	.
Centaurea orientalis	.	1	1	1	.	.	.	1	.	.	.	.	.	.	2	.	1	.	1	1	.	.	.	.	.	.	.	.	.	.
D.s. ass. *Androsacio koso-poljanskii-Caricetum humilis*																														
Androsace villosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	2	3	4	3	4	2	3	4	4
D. s. of alliance *Artemisio hololeucae-Hyssopion cretacei*																														
Artemisia hololeuca	.	.	.	.	.	.	.	.	1	.	.	3	.	.	3	.	1	.	.	.	3	.	.	.	4	.	.	3	.	.
Scrophularia cretacea	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	2	.	.	.	.	.	.	2	.	.
Hyssopus cretaceus	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.
Matthiola fragrans	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	.	.	.	.	.	.	.
D. s. of alliance *Euphorbio cretophilae-Thymion cretacei*																														
Brassica elongata	.	.	.	.	.	.	.	.	1	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
D. s. of alliance *Centaureo carbonatae-Koelerion talievii*																														
Stipa capillata	1	.	.	.	.	.	.	1	.	.	1	1	1	1	1	.	1	1	3	2	.	.	.	.	.	2	.	.	1	1
Campanula sibirica	.	1	.	.	1	1	1	1	1	.	1	.	1	1	.	1	1	1	1	1	1	.	.	.	.	1	.	1	.	.
Polygala sibirica	.	1	.	.	.	.	.	.	1	.	1	.	.	.	1	.	.	.	.	.	.	.	2	.	1	1	.	1	.	.
Carex humilis	.	.	.	.	.	.	.	.	1	.	.	1	1	5	4	4	4	3	3	3	.	.	.	.	.	4	.	3	4	1
Stipa pennata	.	.	.	.	.	.	.	.	.	.	2	1	1	1	1	1	.	1	.	3	.	.	.	.	.	.	.	.	.	.
Onosma simplicissima	1	1	.	.	3	.	.	1	1	.	2	1	.	1	3	3	.	1	3	2	.	.	.	.	.	.	.	2	1	.
Koeleria talievii	.	.	.	.	.	.	.	.	.	.	1	1	.	1	.	.	1	1	1	.	.	.	.	.	.	.	1	.	.	1
Psephellus marschallianus	1	.	.	.	2	.	1	.	.	.	.	.	1	.	1	1	1	1	1	1	.	.	1	.	.	.	.	.	.	.
Teucrium polium	1	1	2	1	3	1	1	1	1	1	1	1	1	1	3	1	1	2	1	1	.	1	1	.	1	1	.	1	1	.
D. s. of order *Thymo cretacei-Hyssopetalia cretacei*																														
Pimpinella tragium	.	3	1	.	.	1	4	1	1	1	1	1	1	1	.	.	1	.	.	.	2	1	1	1	2	1	2	2	.	1
Gypsophila oligosperma	2	3	1	1	1	1	.	.	1	.	1	.	1	1	1	1	1	4	1	1	.	.	1	1	1	1	1	.	1	.
Cephalaria uralensis	1	.	1	.	1	.	.	.	1	1	2	.	2	1	.	.	1	1	1	.	.	1	.	.	.	.	.	.	.	.
Thymus calcareus	1	4	1	1	.	3	3	3	3	.	3	1	4	1	3	2	1	1	3	.	3	3	4	4	1	1	2	3	.	1
Asperula tephrocarpa	1	1	1	.	2	1	2	3	1	1	.	1	.	.	.	.	1	.	.	.	2	.	2	1	.	1	1	.	.	.
Reseda lutea	.	1	.	.	.	.	.	1	.	.	1	1	1	.	3	.	1	1	1	.	.	1	.	1	.	.	.	.	.	.

Consecutive number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Silene supina	1	.	1	.	.	.	1	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	1	.	1	1	.	.	1	.
Linum pallasianum	.	.	.	.	2	.	.	1	1	.	1	2	.	.	2	1	1	1	1	1	2	2	1	1	.	1	.	2	.	.
Astragalus albicaulis	2	1	2	.	1	.	.	1	1	.	1	1	.	.	3	.	.	.	3	.	1	.	.	.	.	.	.	.	.	.
Genista tinctoria	1	2	1	.	.	.	.	.	1	.	.	1	.	.	.	.	1	1	1	1	.	.	.	.	.	.	.	.	.	.
Taraxacum serotinum	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Hedysarum cretaceum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Helianthemum canum	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Linum tenuifolium	1	.	1	.	.	1	1	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Odontarrhena tortuosa	.	.	.	.	2	1	.	.	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bupleurum falcatum	.	1	.	.	2	1	.	.	1	.	1	.	1	2	1	1	1	.	1	1	.	.	.	.	1	.	.	1	.	.
Jurinea arachnoidea	1	1	.	1	.	.	1	.	.	1	1	.	.	.	.	1	.	.	.	.	.	.	1	.	.	.	.	.	.	.
D. s. of class *Festuco-Brometea*																														
Festuca valesiaca	3	.	.	5	2	1	.	.	1	3	.	.	.	.	4	1	1	1	1	.	.	.	.	1	.	2	.	.	.	1
Euphorbia seguieriana	1	1	1	1	3	2	1	1	1	1	1	.	1	1	.	1	1	1	1	1	.	.	.	1	1	1	1	1	1	1
Euphorbia nicaeensis	.	.	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
Stachys recta	.	1	1	.	.	.	.	.	.	.	.	.	.	1	.	.	1	1	1	1	.	.	.	.	1	.	.	.	.	.
Medicago falcata	1	.	.	.	2	.	1	.	.	.	.	.	.	.	.	1	1	1	1	1	.	.	1	.	1	1	1	.	2	.
Astragalus onobrychis	.	.	.	.	.	.	1	.	.	.	.	1	.	.	.	.	.	.	1	1	.	.	1	.	.	.	.	.	.	.
Onobrychis arenaria	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	1	.
Scabiosa ochroleuca	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	1	.	1	1	.	2	.	.	.	.	.	.	1	.	1
Bromopsis riparia	.	.	.	.	.	.	1	1	.	.	1	.	1	1	.	.	1	1	.	.	.	.	.	1	.	1	1	.	.	.
Salvia nutans	.	.	.	.	2	2	1	.	.	3	.	1	.	.	1	.	1	1	1	2	.	.	.	.	.	.	.	1	1	1
Veronica spicata	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.
Astragalus austriacus	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	1	1	1	.	.	1	.	1	1	.	.	1	.
Thalictrum minus	1	.	.	1	1	.	.	1	1	.	.	1	1	2	.	.	.	1	1	1	.	.	.	.	.	.	.	.	.	.
Another species																														
Helichrysum arenarium	1	1	1	1	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Agropyron cristatum	1	.	1	3	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Galium octonarium	1	2	2	3	.	1	.	.	1	2	.	.	.	.	.	1	1	.	.	1	.	.	.	.	.	.	.	.	.	.
Thesium arvense	1	1	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	1	.	.	.	1	1	1	1	.	.	1	.
Melampyrum arvense	.	.	.	1	3	.	.	.	1	.	.	.	.	.	.	1	1	.	1	.	.	.	.	.	.	.	.	.	.	.
Elytrigia intermedia	1	3	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.
Echinops ritro	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1	.	.	1	1	.	.	.	.	.	.	.	.	.	.
Stipa lessingiana	.	.	.	.	.	.	.	.	.	3	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stipa pulcherrima	.	.	.	2	.	1	1	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.
Securigera varia	.	.	1	1	.	.	.	.	.	.	.	.	.	.	1	.	1	1	1	1	.	.	2	.	1	1	.	.	.	.
Erysimum diffusum	1	.	.	1	1	.	1	.	.	1	1	.	.	1	.	1	1	.	.	1	.	.	.	.	.	.	1	.	.	1
Gypsophila fastigiata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	.	.	.	.	.	1	.	.
Helianthemum nummularium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	1	.	.	.	.	.	.	.	.	.	.
Anthericum ramosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	2	.	.	.	.	.	.	.	.	1	.
Stipa zalesskii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	2	.	.

Localities: 1 – vil. Baranikivka, Lugansk reg.; Ukraine; 07.1987 (Ya. Didukh)
Localities: 2 – vil. Baranikivka, Lugansk reg.; Ukraine; 07.1987 (Ya. Didukh)
Localities: 3 – vil. Baranikivka, Lugansk reg.; Ukraine; 07.1987 (Ya. Didukh)
Localities: 4 – 5 km South of the Bilovodsk, Lugansk reg.; Ukraine; 07.1987 (Ya. Didukh)
Localities: 5 – vil. Nyzhnya Duvanka, Lugansk reg.; Ukraine; 13.06.2013 (O. Chusova)
Localities: 6 – right bank of Derkul River, Lugansk reg.; Ukraine; 07.1987 (Ya. Didukh)
Localities: 7 – right bank of Kamyshna River, Lugansk reg.; Ukraine; 07.1987 (Ya. Didukh)
Localities: 8 – right bank of Kobylka River, Lugansk reg.; Ukraine; 06.1987 (Ya. Didukh)
Localities: 9 – vil. Stril'tsivka, Milovs'kyy district; Lugansk reg.; Ukraine; 07.1987 (Ya. Didukh)

Localities: 10 – 5 km South of the Bilovodsk, Lugansk reg.; Ukraine; 07.1987 (Ya. Didukh)
Localities: 11 – Oskol River, Belogorie Reserve, Belgorod reg.; Russia; 4.08.2012 (E. Averinova)
Localities: 12 – border between Rossoshinsky and Kantemirovsky districts, Voronezh reg.; Russia; 1.08.1983 (A. Grigorevskaya*)
Localities: 13 – vil Makeshkino, Belgorod reg.; Russia; 1.08.2012 (E. Averinova)
Localities: 14 – vil Makeshkino, Belgorod reg.; Russia; 1.08.2012 (E. Averinova)
Localities: 15 – 0.5 km north-west of the Veidelevka, Belgorod reg.; Russia; 24.08.2012 (E. Averinova)
Localities: 16 – Oskol River, Belogorie Reserve, Belgorod reg.; Russia; 3.08.2012 (E. Averinova)
Localities: 17 – 1 km south-east of the Roven'ki Belgorod reg.; Russia; 6.08.2011 (E. Averinova)
Localities: 18 – 1 km west of the Berezhnyi Farm, Belgorod reg.; Russia; 9.08.2011 (E. Averinova)
Localities: 19 – Oskol River, Belogorie Reserve, Belgorod reg.; Russia; 25.08. 1983 (A. Grigorevskaya*)
Localities: 20 – Oskol River, Belogorie Reserve, Belgorod reg.; Russia; 4.08.2012 (E. Averinova)
Localities: 21 – vil. Kamyanka, Kharkiv reg.; Ukraine; 27.05. 2012 (O. Bezrodnova)
Localities: 22 – vil. Dvorichna, Kharkiv reg.; Ukraine; 26.05. 2012 (O. Bezrodnova)
Localities: 23 – Rogan', Kharkiv reg.; Ukraine; 14.06.1996 (Ya. Didukh)
Localities: 24 – Rogan', Kharkiv reg.; Ukraine; 14.06.1996 (Ya. Didukh)
Localities: 25 – vil. Yaichne, Kharkiv reg.; Ukraine; 06.1996 (Ya. Didukh)
Localities: 26 – south of the Rogan', Kharkiv reg.; Ukraine; 05.1995 (Ya. Didukh)
Localities: 27 – vil. Staromelovoe, Kursk reg.; Russia; 2.08. 2005 (A. Poluyanov)
Localities: 28 – vil. Kamyanka, Kharkiv reg.; Ukraine; 27.05. 2012 (O. Bezrodnova)
Localities: 29 – Pechenigy, Kharkiv reg.; Ukraine; 15.06.1996 (Ya. Didukh)
Localities: 30 – vil. Kamyanka, Kharkiv reg.; Ukraine; 21.08. 2012 (O. Bezrodnova)

* – relevés were taken from Averinova (2014).

Appendix 1c (extension): Characteristic table of syntaxa of the alliance *Centaureo carbonatae-Koelerion talievii*.
Priloga 1c (nadaljevanje): Tabela sintaksonov zveze *Centaureo carbonatae-Koelerion talievii*.

Consecutive number	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Total vegetation cover (%)	70	70	50	45	30	75	30	30	50	60	40	50	45	70	70	85	65	60	80	60	50	65	40	70	50	20	75	50	40	60
Slope (°)	10	15				40				10	5	15	10	15		40	10	10	25	7	22	10	15	20	22	10	20	15	15	20
Aspect (°)			70			45				180	90	5	90	90	5	5	270	5	180	45	45	135	225	45	180	180	180	180	180	180
Species richness	17	25	31	31	25	24	18	14	26	21	30	22	26	25	36	33	27	27	40	25	24	31	30	28	26	27	29	23	27	29
D. s. of ass. *Bupleuro falcatae-Stipetum capillatae*																														
Bupleurum falcatum	1	1	1	1	1	1	1	1	1	.	.	1	1	.	.	.	.	1	.	.	1	.	1	1	1	1	1	1	1	1
Anisantha tectorum	.	.	1	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scabiosa ochroleuca	1	1	1	1	1	.	1	1	1	3	.	.	.	.	.	.	.	.	.	2	.	.	1	1	1	1	1	1	1	.
D. s. of ass. *Gypsophilo oligospermae-Campanuletum sibiricae*																														
Carex pediformis	.	.	.	.	.	.	.	.	.	.	3	3	3	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Koeleria pyramidata	.	.	.	.	.	.	.	.	.	1	2	1	2	2	1	1	.	.	.	3	.	.	.	.	.	.	.	.	.	.
Nonea pulla	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	1	.	2	.	.	.	.	.	.	.	.	.	.
Bromopsis riparia	.	.	.	.	.	.	.	.	.	2	2	.	3	4	1	2	.	1	1	.	1	.	.	2	.	.	1	.	.	.
Salvia nutans	.	.	1	1	1	1	1	2	1	.	1	.	3	2	1	2	1	1	3	3	.	1	.	.	1	.	1	.	.	1
Galatella villosa	.	.	.	.	.	.	.	.	.	.	4	.	1	1	.	4	.	.	1	2	.	.	.	.	.	.	.	.	.	.
Linum hirsutum	1	1	.	1	.	.	.	.	.	.	1	2	2	2	1	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.
D. s. of ass. *Carici humilis-Thymetum calcarei*																														
Androsace villosa	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	3	.	.	4	1	3	4	.	.	3	.	.	.
Astragalus austriacus	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	.	.	1	1	.	.	.	.	.	.	.	1
Thalictrum minus	.	1	.	.	1	1	.	1	1	.	.	.	1	1	1	.	2	1	1	.	.	1	.	.	.	1	1	.	.	.
Oxytropis pilosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	1	.	.	.	.	.	.	1
Jurinea arachnoidea	.	.	.	.	.	.	.	.	.	.	2	.	.	.	1	1	2	.	1	.	.	.	.	.	.	1	.	.	.	.
Viola rupestris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	.	.	.	1	1	1
Helianthemum nummularium	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1	1	1	.	1	1	1	.	1	.
Asperula tinctoria	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	1	.	1
Anthericum ramosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	1	.	1	2	1	.	3	.

Consecutive number	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Linum perenne	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	.
Vincetoxicum hirundinaria	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	1	1	.	1	1	1
Euphrasia pectinata	.	1	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	.	1	.	1	1
D. s. of alliance *Artemisio hololeucae-Hyssopion cretacei*																														
Artemisia hololeuca	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
D. s. of alliance *Euphorbio cretophilae-Thymion cretacei*																														
Brassica elongata	.	1	.	1	.	1	.	.	.	1	2	2	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Jurinea stoechadifolia	.	.	.	.	.	2	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Euphorbia petrophila	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
D. s. of allliance *Centaureo carbonatae-Koelerion talievii*																														
Stipa capillata	.	1	1	1	.	.	4	4	4	1	2	.	2	5	4	.	1	.	.	3	.	.	1	.	1	1	1	1	1	3
Campanula sibirica	1	1	1	1	1	1	.	.	.	2	1	1	2	2	1	2	.	1	1	3	1	.	1	1	1	1	.	1	1	.
Polygala sibirica	.	.	.	1	1	.	.	.	.	.	1	.	1	.	1	1	1	1	.	1	.	.	1	1	1	1	.	.	1	.
Carex humilis	.	.	1	1	4	2	1	.	.	4	.	1	.	.	5	2	4	4	.	4	2	2	3	2	3	3	2	3	3	3
Stipa pennata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	1	3	1	1	.	.	.	.	.	3
Onosma simplicissima	2	.	1	2	1	.	.	1	1	.	.	2	.	.	1	2	2	1	1	.	.	3	2	.	3	3	1	2	2	.
Koeleria talievii	.	1	1	1	1	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	.	.	1	.	1
Psephellus marschallianus	.	.	.	.	1	2	1	.	1	.	.	.	.	.	1	.	1	1	1	.	1	1	1	.	.	1	1	.	1	1
Teucrium polium	1	.	1	1	.	2	1	1	1	2	2	2	2	1	1	1	1	1	1	.	.	.	.	.	.	.	.	.	.	.
D. s. of order *Thymo cretacei-Hyssopetalia cretacei*																														
Pimpinella tragium	1	1	1	1	.	1	.	.	.	.	.	2	.	.	1	1	.	1	1	.	1	.	1	1	.	1	1	.	.	.
Gypsophila oligosperma	1	2	1	1	1	.	.	.	.	2	.	1	.	1	.	.	.	.	.	1	1	1	1	1	1	1	1	1	1	1
Cephalaria uralensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Thymus calcareus	4	4	3	4	2	1	.	.	.	2	.	4	.	.	1	.	1	1	.	.	1	1	2	2	3	1	4	3	1	1
Asperula tephrocarpa	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	.	.	.	.	.	.	.	.	.	.	.
Reseda lutea	1	1	1	1	.	.	.	.	.	2	2	3	1	1	.	1	.	.	1	2	.	.	.	.	.	.	.	.	.	.
Silene supina	.	.	1	.	.	.	.	.	.	.	2	1	1	1	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
Linum pallasianum	1	1	2	2	1	.	.	.	.	2	2	1	3	1	1	2	.	1	1	.	.	.	1	.	.	.	1	.	.	1
Polygala cretacea	1	1	.	.	.	.	.	.	.	.	.	.	.	.	1	.	2	.	.	.	.	1	.	.	.	1	.	.	.	.
Astragalus albicaulis	1	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	2	.	.	1	2
Genista tinctoria	.	.	.	.	.	.	.	.	.	.	2	.	1	.	.	3	.	.	.	3	.	.	.	.	.	.	.	.	.	.
Orthantha lutea	1	1	1	1	1	1	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Helianthemum canum	.	1	1	1	.	.	.	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Odontarrhena tortuosa	.	.	.	.	1	.	.	.	.	.	.	3	.	.	1	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1
Diplotaxis cretacea	.	.	.	.	.	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Artemisia salsoloides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Plantago maritima	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
D. s. of class *Festuco-Brometea*																														
Festuca valesiaca	.	1	2	.	.	1	.	.	1	.	4	1	4	3	1	2	3	1	1	3	.	2	1	1	.	.	2	1	1	1
Euphorbia seguieriana	.	1	.	1	1	1	.	.	2	3	.	2	1	2	1	1	2	1	1	2	.	1	1	1	1	1	1	1	1	1
Hieracium virosum	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1	.	.	.	2	.	.	.	.	.	.	.	.	1	.
Euphorbia nicaeensis	.	.	.	1	.	.	.	.	.	.	3	.	.	.	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stachys recta	.	.	1	1	1	.	.	.	.	.	2	.	2	2	.	.	2	.	1	.	.	.	.	.	1	.	.	.	.	.
Medicago falcata	.	.	1	.	.	.	.	.	.	.	1	.	.	.	.	.	2	.	2	.	1	.	1	.	.	.	.	1	1	.
Potentilla humifusa	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	1	1	.	.	.	1	1	1	.	1	.	.	.	.
Rhaponticoides ruthenica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	.	.	.	.	.	.	.	.	1	.	.	1	.
Onobrychis arenaria	.	2	.	.	.	.	.	.	.	.	1	.	.	.	.	1	.	.	1	.	1	.	.	1	.	.	.	1	.	.
Plantago media	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.
Achillea setacea	.	.	1	.	.	.	.	.	.	.	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Potentilla incana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	2	.	2
Potentilla recta	.	.	.	.	.	1	.	.	1	.	.	.	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.

Consecutive number	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Iris pumila	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Linum austriacum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	1	.	.	.	.	.	.	.	.	.	.	.
Adonis volgensis	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hypericum elegans	.	.	.	.	.	1	.	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Veronica incana	.	.	.	.	.	.	.	.	.	.	2	.	.	1	.	2	.	.	.	1	.	.	.	.	.	.	.	.	.	.
Klasea radiata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.
Another species																														
Allium inaequale	.	.	.	1	1	1	1	1	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
Hedysarum grandiflorum	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Asperula cynanchica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	1	.	.	1	.
Adonis vernalis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	1	.	.	1	.	.	.	.	.
Salvia verticillata	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	.	.	.	.
Inula aspera	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Caragana frutex	.	.	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Centaurea orientalis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.
Pilosella officinarum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	1	.	.	.	.	1
Bassia prostrata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
Festuca cretacea	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hedysarum cretaceum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.
Galium octonarium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.
Poa compressa	.	.	1	1	.	.	.	.	1	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1	.	.	1	.	.	.
Thesium arvense	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	1	1	1	.	.	.	.	.	.	.	.	.	.	.
Helichrysum arenarium	.	.	.	1	1	1	1	.	1	3	2	.	1	.	1	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.
Agropyron cristatum	.	.	.	.	.	1	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Melampyrum arvense	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1	.	.	1	.
Cytisus ruthenicus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
Centaurea diffusa	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Viola ambigua	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	1	2	1	.	.	.	.	.	.	1	.	.	.	.	.
Hypericum perforatum	.	.	.	.	.	.	1	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rhamnus cathartica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.
Polygonatum odoratum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.	.
Hieracium umbellatum	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	.	1	.	.	.	.	.	.
Echinops ritro	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	.	.	.	.	.	.	.	1	.	.	.	.	.
Stipa pulcherrima	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	2	5	.	.	.	.	.	.	.	.	.	.	.
Festuca stricta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	.	2	.	.	.	.	.	.	.	.	.	.	.
Astragalus subuliformis	.	.	.	.	.	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Securigera varia	.	.	1	.	.	.	.	.	.	.	2	.	.	1	.	.	.	.	1	2	.	.	1	.	.	.	.	.	.	.
Erysimum diffusum	.	1	1	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	.	.	1	.	1	.	1
Jacobaea vulgaris	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.
Silene chlorantha	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gypsophila fastigiata	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Potentilla patula	.	.	.	.	.	.	.	.	2	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Poa bulbosa	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1

Localities: 21 – right bank of Oskol River, vil. Znamenka, Kharkiv reg.; Ukraine; 21.08.1994 (K. Romashchenko)
Localities: 22 – right bank of Oskol River, vil. Znamenka, Kharkiv reg.; Ukraine; 21.08.1994 (K. Romashchenko)
Localities: 23 – right bank of Oskol River, vil. Znamenka, Kharkiv reg.; Ukraine; 9.08.1994 (K. Romashchenko)
Localities: 24 – right bank of Oskol River, vil. Topolya, Kharkiv reg.; Ukraine; 08.1994 (K. Romashchenko)
Localities: 25 – right bank of Oskol River, vil. Nyzhnya Melnitsa, Kharkiv reg.; Ukraine; 08.1994 (K. Romashchenko)
Localities: 26 – vil. Lavrentievka, Donetsk reg.; Ukraine; 1.08.1994 (K. Romashchenko)
Localities: 27 – vil. Kryva Luka, Donetsk reg.; Ukraine; 26.08.1994 (K. Romashchenko)
Localities: 28 – vil. Kryva Luka, Donetsk reg.; Ukraine; 26.08.1994 (K. Romashchenko)

Localities: 29 – vil. Kryva Luka, Donetsk reg.; Ukraine; 26.08.1994 (K. Romashchenko)
Localities: 30 – vil. Preobrazhenne, Lugansk reg.; Ukraine; 11.07.2013 (O. Chusova)
Localities: 31 – vil. Preobrazhenne, Lugansk reg.; Ukraine; 14.06.2013 (O. Chusova)
Localities: 32 – vil. Fomovka, Lugansk reg.; Ukraine; 14.06.2013 (Ya. Didukh)
Localities: 33 – vil. Fomovka, Lugansk reg.; Ukraine; 14.06.2013 (Ya. Didukh)
Localities: 34 – vil. Fomovka, Lugansk reg.; Ukraine; 14.06.2013 (Ya. Didukh)
Localities: 35 – 5 km South of the Bilovodsk, Lugansk reg.; Ukraine; 06.1987 (Ya. Didukh)
Localities: 36 – vil. Preobrazhenne, Lugansk reg.; Ukraine; 14.06.2013 (O. Chusova)
Localities: 37 – right bank of Volchya River, vil. Ohrymivka, Kharkiv reg.; Ukraine; 06.1995 (Ya. Didukh)
Localities: 38 – right bank of Oskol River, vil. Dvorichna, Kharkiv reg.; Ukraine; 06.1995 (Ya. Didukh)
Localities: 39 – vil. Kalynivka, Lugansk reg.; Ukraine; 06.1987 (Ya. Didukh)
Localities: 40 – vil. Preobrazhenne, Lugansk reg.; Ukraine; 14.06.2013 (O. Chusova)
Localities: 41 – 1 km South of vil. Aleksandrovka, Kursk reg.; Russia; 4.09. 2005 (A. Poluyanov)
Localities: 42 – right bank of Oskol River, 1 km North of vil. Kun'e, Kursk reg.; Russia; 11.05. 2005 (A. Poluyanov)
Localities: 43 – 6 km South of vil. Novomelovoe, Kursk reg.; Russia; 1.08. 2005 (A. Poluyanov)
Localities: 44 – 1 km South of vil. Aleksandrovka, Kursk reg.; Russia; 4.09. 2005 (A. Poluyanov)
Localities: 45 – 0.5 km East of vil. Midlle Apochka, Kursk reg.; Russia; 4.09.2005 (A. Poluyanov)
Localities: 46 – 2 km North of vil. Midlle Apochka, Kursk reg.; Russia; 5.09.2005 (A. Poluyanov)
Localities: 47 – 6 km South of vil. Novomelovoe, Kursk reg.; Russia; 1.08.2005 (A. Poluyanov)
Localities: 48 – 1 km North of vil. Nizhnedorozhnoe, Kursk reg.; Russia; 4.08.2005 (A. Poluyanov)
Localities: 49 – 2 km North of vil. Midlle Apochka, Kursk reg.; Russia; 5.09.2005 (A. Poluyanov)
Localities: 50 – left bank of Bystrik River, 1 km East of vil. Beketovo, Kursk reg.; Russia; 27.05.2006 (A. Poluyanov)