Hacquetia 15/2 • 2016, 79–104 DOI: 10.1515/hacq-2016-0018

Syntaxonomy of the *Festuco-Brometea* class vegetation of the Azov sea coastal zone

Vitaliy Kolomiychuk[1] & Denys Vynokurov[2,*]

Key words: bunchgrass steppe, classification, diagnostic species, dry grasslands, Eastern Europe, numerical analysis, TWINSPAN, vegetation.

Ključne besede: stepe z bodalico, klasifikacija, diagnostične vrste, suha travišča, vzhodna Evropa, numerična analiza, TWINSPAN, vegetacija.

Abstract

Syntaxonomy of the class *Festuco-Brometea* in Ukraine has barely been still explored. There are some scattered and local data, mainly within the Forest-Steppe zone, which need to be compiled and critically reviewed. Similarly, the Azov Sea coastal zone, which, despite the considerable diversity of habitats, remains unstudied phytosociologically. We have carried out large-scale comparisons of relevés from the Sea of Azov coastline with data from other regions of Ukraine, Europe, and Russia. In total, 2336 relevés were used for the analysis. For the analysis, Modified TWINSPAN classification was used. Diagnostic species were determined by means of the phi fidelity index. In total, 9 associations and 4 subassociations, belonging to four alliances, were identified and categorised as follows: *Artemisio-Kochion prostratae* (ruderalized steppes), *Artemisio tauricae-Festucion valesiacae* (saline steppe vegetation on sites affected by the sea or saline ground water), *Stipo lessingianae-Salvion nutantis* (forb-bunchgrass steppe vegetation) and *Tanaceto millefolii-Galatellion villosae* (bunchgrass steppes). The last alliance is proposed as a new one.

Izvleček

Sintaksonomija razreda *Festuco-Brometea* je bila dosedaj v Ukrajini slabo raziskana. Obstaja nekaj razpršenih in lokalnih podatkov, predvsem v coni gozdne stepe, ki pa jih je potrebno združiti in kritično ovrednotiti. Podobno velja za obalno območje Azovskega morja, ki kljub veliki raznolikosti habitatov ostaja fitocenološko neraziskano. Naredili smo obsežno primerjavo popisnega gradiva z obal Azovskega morja in podatki iz ostalih predelov Ukrajine, Evrope in Rusije. Skupaj smo v analizi zbrali 2336 popisov. Za analizo smo uporabili modificirano TWINSPAN klasifikacijo. Diagnostične vrste smo določili s pomočjo fi indeksa navezanosti. Ugotovili smo 9 asociacij in 4 subasociacije, ki jih uvrščamo v štiri zveze: *Artemisio-Kochion prostratae* (ruderalizirane stepe), *Artemisio tauricae-Festucion valesiacae* (slana stepska vegetacija na rastiščih z morsko vodo ali slano podtalnico), *Stipo lessingianae-Salvion nutantis* (stepska vegetacija z zelišči in bodalico) in *Tanaceto millefolii-Galatellion villosae* (stepe z bodalico). Zadnjo zvezo smo opisali na novo.

Received: 20. 10. 2015
Revision received: 22. 3. 2016
Accepted: 19. 5. 2016

Co-ordinating Editor:
Idoia Biurrun

1 O.V. Fomin Botanical Garden, the National Taras Shevchenko University of Kyiv, Ukraine, 1 Simon Petlura St., 01032 Kyiv, Ukraine. E-mail: vkolomiychuk@ukr.net

2 M.G. Kholodny Institute of Botany, National Academy of Sciences of Ukraine, 2 Tereschenkivska St., 01601 Kyiv, Ukraine. E-mail: phytosocio@ukr.net

* Corresponding author

Introduction

The coastal zone of the Azov Sea lies in a unique region, both in origin and natural conditions. It is characterised by high diversity of species and ecosystems. The dominating type of vegetation is formed by a particular kind of steppe vegetation. It is characterised by lower floristic richness and less aboveground biomass compared to steppe vegetation further north. Moreover, its vegetation shows a lower average height, and less flowering aspects during the year (Dembicz et al. 2016) thought to be due to the decreasing moisture gradient.

Under the influence of human activity in the 19th and especially the 20th century, the landscape of the Azov sea coast was significantly transformed (Matishov et al. 2011). Residues of natural vegetation (steppe, meadow, halophytic and psammophytic communities, etc.) has only remained in some areas, particularly, at the coast, near the outputs of rocks, in areas of special protection (e.g. military sites, nature reserves, national parks) or in places inaccessible to humans (gullies, ravines, floodplains).

There are four types of steppes in the study area according to the Map of the natural vegetation of Europe (Bohn et al. 2004): 1) West and Central Pontic herb-rich grass steppes (Eastern Pryazov'ya); 2) West and central herb-grass steppes (Northern and Don Pryazov'ya); 3) West Pontic grass steppes (Northern, Kerch and Taman Pryazov'ya); 4) West and Central Pontic desert steppes (Syvash and Kerch Pryazov'ya).

Steppe vegetation of the steppe zone is considered to belong within *Fescuco-Brometea* class (Solomakha 2008). The majority of authors attributed this type of vegetation to the *Festucetalia valesiacae* order (Kostyliov et al. 1984, Tyshchenko 1996, 2000, 2006, Grechushkina et al. 2012, Korotchenko & Peregrym 2012, Vynokurov 2014a,b). But, recent studies have shown that it should be considered as a new separate order *Galatello villosae-Stipetalia lessingianae* nom. prov. (Vynokurov 2016). The syntaxonomy of *Festuco-Brometea* for the coastal zone of the Sea of Azov has previously not been developed in full. However, there are some known studies about classification of the Eastern Crimean steppes (Korzhenevskij & Kljukin 1986, 1991, Korzhenevskij et al. 2003) from some areas of Prysyvashshia (Dubyna & Dziuba 2007) and from Northern and Eastern Pryazov'ya (Demina 2012, Grechushkina et al. 2012, Tyshchenko 2006).

In view of the current rudimentary state of available information, the authors propose to develop and complement the classification of steppe communities of *Festuco-Brometea* class of the coastal area of the Sea of Azov by characterising selected syntaxa.

Methods

Study area

The Sea of Azov is a small sea (approx. 39,000 km^2) in south-eastern Europe (Figure 1) and lies southeast of Ukraine and southwesterly of Russia. The region includes the coastal areas of southern Donetsk and Zaporizhzhia, "Northern Pryazov'ya" and "Prysyvashshia" (east of the Kherson region), "Crimean Pryazov'ya" (east of the Crimea), "Don Pryazov'ya" (northwest of the Rostov region) and the region west of the Krasnodar ("Eastern Pryazov'ya"). The basin of the Sea of Azov is mostly shallow. Its topography is broken up by subsea elevations emerging in submeridional direction and by a broad belt of about 20–30 km in width of very shallow water (6–7 meters).

The area of the sea without Syvash Bay and the estuaries amounts to 37 802 km^2 (Tyshchenko 2006). The coast of

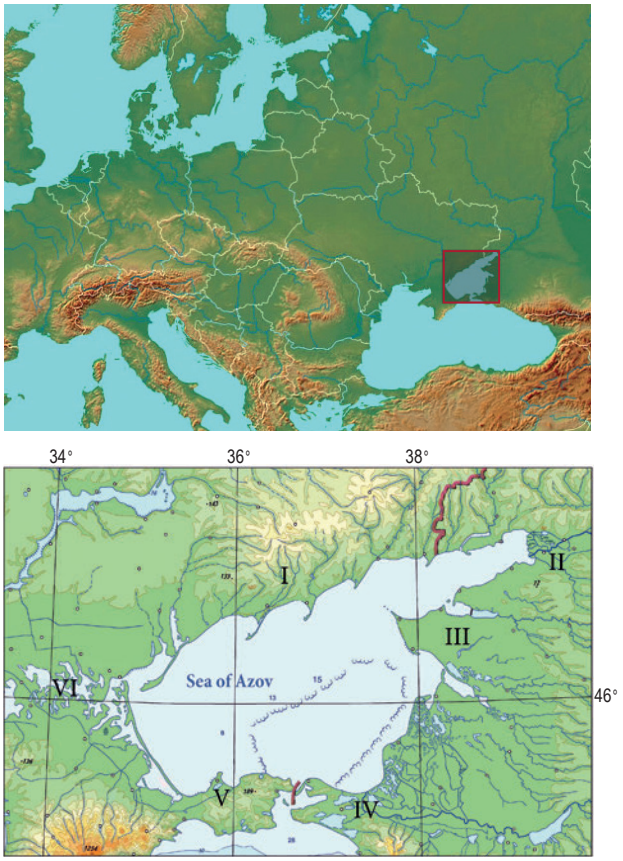

Figure 1: Location of the study area within Europe. I – Northern Pryazov'ya, II – Don Pryazov'ya, III – Eastern Pryazov'ya, IV – Kerch Pryazov'ya, V – Taman Pryazov'ya, VI – Syvash.

Slika 1: Lokacija preučevanega območja v Evropi: I – severni del Pryazov'ya, II – Don Pryazov'ya, III – vzhodni del Pryazov'ya, IV – Kerch Pryazov'ya, V – Taman Pryazov'ya, VI – Syvash.

the Sea of Azov are mainly composed of friable abrasive rocks of the Neogene and the Quaternary (Kaplin et al. 1991) intensively influenced by erosion of the sea. Steppe alluvial and loess plains reach close to the sea almost along the entire coastline. They are formed on structures of ancient (Russian Precambrian) and younger (Scythian) platforms. Bedrock coast mainly takes the form of a cliff. It is formed by rocks of the Upper Neogene and Quaternary (Shnyukov et al. 1974).

According to the geobotanical zoning of Ukraine the study area belongs to the Prychornomor'ya (Pontic) steppe province of the Eurasian steppe region (Didukh & Shelyag-Sosonko 2003). The sea coast lies within one of the three stripes of the Chornomor'ya-Azov steppe subprovince in the Pontic province (Barbarych 1977), namely: forb-bunchgrass (Pryazov'ya district and part of Kerch-Taman geobotanical district); bunchgrass (Dnieper-Azov, Azov-Egorlyk and part of Kerch-Taman geobotanical districts); and strip of sagebrush steppes (Prysyvashshia geobotanical district), which covers the territory adjacent to Syvash Bay in the Sea of Azov.

Data collection

The classification of steppe vegetation of the class *Festuco-Brometea* of the coastline of the Sea of Azov has been developed on the basis of own geobotanical research carried out from 2002 to 2014 in the Ukraine (Donetsk, Zaporizhzhia, and Kherson regions, the Autonomous Republic of Crimea) and in Russia (Rostov region and Krasnodar territory). 478 relevés of 16 to100 m^2 plot size were sampled in the study area according to the Braun-Blanquet approach (Braun-Blanquet 1964, Westhoff & van der Maarel 1973). Most importantly, the vegetation samples had to meet the criterion of homogeneity. In addition to that, published data from other syntaxonomy studies on coastal steppe vegetation of the Azov Sea was implemented into the data set (62 relevés) (Tyshchenko 1996, 1998, 2000, Dubyna & Dziuba 2007, Grechushkina et al. 2012). Plot sizes ranged from 16 to 100 m^2.

Furthermore, 1758 relevés of *Festuco-Brometea* class from other regions were also used. 466 of them, sampled by D. Vynokurov (2009–2013) in neighbouring areas of the steppe zone of Ukraine, were obtained from the Ukrainian Grassland Database (EU-UA-001) (Chytrý et al. 2016). The rest of relevés (1292) from Ukraine, Eastern Europe and Russia were compiled from different literature sources (bibliographic references listed in Vynokurov 2014a). The final data set of 2336 relevés in total was arranged using TURBOVEG 2.0 (Hennekens & Schaminée 2001).

Further on, only relevés clearly suborded to the class *Festuco-Brometea* were included in the data set: This means that relevés with more than 50% of their species diagnostic to other related classes (e.g. to the *Artemisietea vulgaris* Lohmeyer et al. ex Von Rochow 1951 or *Festucetea vaginatae* Soó ex Vicherek 1972) were removed from the dataset. Because of this, all communities described by Grechushkina et al. (2012), for example, were rejected as they are transitional between steppe, psammophytic and ruderal vegetation.

For the analysis, species which were only determined to genus level and cryptogams were removed from the dataset. Also, some taxonomically ambiguous species were combined into aggregates (Table 1). Nevertheless, species names are given in narrow understanding without combining into aggregates for the description of the considered syntaxa.

Data analysis

Vegetational classification was conducted by means of Modified TWINSPAN (Roleček et al. 2009), implemented in the software package JUICE 7.0 (Tichý 2002). We used the default settings of JUICE (with three pseudospecies cut levels: 0%, 5% and 15%; minimum group size: 5; Whittaker's beta) and tried cluster numbers of up to 15. The analysis was conducted in two steps. First, the entire data set was processed with Modified TWINSPAN to identify the high level syntaxa at alliance level. Secondly, each cluster with relevés from the study area was analysed separately using Modified TWINSPAN with the same parameters as above. Next, associations and subassociations were identified. The type relevés of the associations were used to identify associations within clusters. New associations were established when no types were matched with a cluster.

To identify diagnostic species, the phi fidelity index was used (Chytrý et al. 2002). It was calculated using presence-absence data with standardization of all groups of relevés to equal size. Non-essential values of fidelity (less than 0.001) were removed on the basis of Fischer's exact test. Fidelity indices were calculated first for the level of association and subassociation. Diagnostic species for the alliance level were calculated after merging associations in alliances. We considered species as diagnostic when phi > 25% and as highly diagnostic when phi > 50% (written in bold letters in the current article); constant species, with frequencies > 25%; highly constant species with frequencies > 50% (also bold). As dominant species we considered those with a mean cover of more than 25%, with a 10% threshold of frequency.

Syntaxa names were specified according to the International Code of Phytosociological Nomenclature (Weber et al. 2000). Species names are given by "Vascular plants of Ukraine. A nomenclatural checklist" (Mosyakin & Fedoronchuk 1999).

Results

The most fitting cluster pattern divided the entire data set into 8 clusters, which could be interpreted as alliances (except cluster D which includes 3 alliances) as they had clear ecological and floristical differences (A-H in the dendrogram, Figure 2). Clusters A (ruderal steppe communities of *Artemisio-Kochion prostratae*), B (saline steppes of alliance *Artemisio tauricae-Festucion valesiacae*), C (bunchgrass steppes) and H (forb-bunchgrass steppes of *Stipo lessingianae-Salvion nutantis*) consisted of relevés from the coast of the Sea of Azov, as well as other relevés from the south of the steppe zone. Cluster C did not correspond to any syntaxonomical unit at alliance level. Therefore, we propose a new alliance *Tanaceto millefolii-Galatellion villosae* for the communities of this cluster. Details of the remaining clusters (D, E, F, G), which do not contain any relevés from the study area, are outlined in our earlier publications (Vynokurov 2014a, 2014b).

The second step of the analysis yielded only one association for the relevés from the study area within cluster A. It was matched to the *Goniolimono taurici-Poetum angustifoliae*, described by Tyshchenko (1996) for the area of "Obitochna Kosa" Reserve in Northern Pryazov'ya. In cluster B we distinguished between three associations: one was matched to *Ferulo orientalis-Agropyretum pectinati,* described by Tyshchenko (2000) for Stepok Island (Fedotova Spit). The other two associations have to be described as new ones: *Agropyro pectinati-Artemisietum tauricae* and *Cerastio syvashici-Poetum bulbosae*. The third cluster (C), comprising four associations, is the largest one. Two of them did not match any type relevé and should be considered as new: *Stipo brauneri-Bromopsidetum cappadocicae* and *Ephedro distachyae-Stipetum capillatae*. Within these new associations, we further differentiated between four subassociations. The other two units of the cluster C match the associations *Tanaceto millefolii-Salvietum nemorosae* described by Krasova & Smetana (1999) from the northern part of the bunchgrass steppe zone in the Dnipropetrovsk region and *Stipo ucrainicae-Agropyretum pectinati,* described by Tyshchenko (1996) for the area of "Obitochna Kosa" Reserve. Cluster H, yielded only one association for the relevés from the study area and was assigned to our newly defined association *Stipo lessingianae-Salvietum nutantis*. In total, nine associations and four subassociations were identified in the second step of analysis. The corresponding synoptic table is shown in Table 2 and their distribution displayed in Figures 3 and 4. Individual relevés of the new associations are given in Tables 3 and 4.

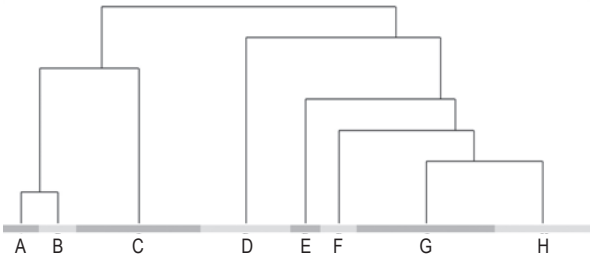

Figure 2: Dendrogram for the steppe vegetation after the first step of the analysis (Modified TWINSPAN, Pseudospecies cut level: 3; cut level values: 0, 5, 15; Minimum group size: 5; Whittaker's beta). A-H – alliances: A – *Artemisio-Kochion prostratae*, B – *Artemisio tauricae-Festucion valesiacae*, C – *Tanaceto millefolii-Galatellion villosae*, D – *Festucion valesiacae*, *Stipion lessingianae*, *Cirsio-Brachypodion pinnati*, E – *Potentillo arenariae-Linion czerniaevii*, F – *Poo bulbosae-Stipion graniticolae*, G – *Festucion valesiacae* (incl. *Fragario viridis-Trifolion montani*), H – *Stipo lessingianae-Salvion nutantis*.

Slika 2: Dendrogram stepske vegetacije po prvem koraku analize (modificiran TWINSPAN, odrezani nivo psevdo vrst: 3; vrednosti odrezanega nivoja: 0, 5, 15; minimalna velikost skupine: 5; Whittaker beta). A-H – zveze glej zgoraj.

Discussion

All of steppe vegetation of the coastline of the Sea of Azov can be categorised to the *Festuco-Brometea* class. Yet, it strongly distinguishes itself from other European steppe vegetation by the absence, or insignificant participation, of xero-mesic species from Central-European and Euro-Siberian forest steppes (e.g. *Anthyllis vulneraria*, *Astragalus monspessulanus*, *Betonica officinalis*, *Carex caryophyllea*, *C. flacca*, *C. humilis*, *Centaurea jacea*, *Festuca rubra*, *Fragaria viridis*, *Galium mollugo*, *Knautia arvensis*, *Linum catharticum*, *Luzula campestris*, *Pimpinella saxifraga*, *Poterium sanguisorba*, *Primula veris*, *Salvia pratensis*, *Salvia verticillata*, *Thymus praecox*, *Trifolium montanum*, *Viola hirta,* etc.) (Dúbravková-Michálková et al. 2008, Dúbravková & Košťál 2012, Vassilev et al. 2012, Foggi et al. 2014, Sopotlieva & Apostolova 2014). Additionally, coastal steppe vegetation of the Sea of Azov is characterised by large number of Pontic species not especially common to Central Europe, namely: *Artemisia lerchiana*, *Artemisia taurica*, *Astragalus ucrainicus*, *Bellevalia sarmatica*, *Euphorbia stepposa*, *Galatella villosa*, *Jurinea arachnoidea*, *Salvia nutans*, *Stipa lessingiana*, *S. ucrainica*, *Tanacetum millefolium*, *T. achilleifolium,* etc. We propose to place this type of vegetation in the new order *Galatello villosae-Stipetalia lessingianae* Vynokurov ord. nov. prov., which includes

Figure 3: Distribution of the associations of the alliances *Artemisio-Kochion prostratae*, *Artemisio tauricae-Festucion valesiacae* and *Stipo lessingianae-Salvion nutantis* along the coastline of the Sea of Azov. A1 – *Goniolimono tauricae-Poetum angustifoliae*, B1 – *Ferulo orientalis-Agropyretum pectinati*, B2 – *Agropyro pectinati-Artemisietum tauricae*, B3 – *Cerastio syvashici-Poetum bulbosae*, H1 – *Stipo lessingianae-Salvietum nutantis*.

Slika 3: Razširjenost asociacij zvez *Artemisio-Kochion prostratae*, *Artemisio tauricae-Festucion valesiacae* in *Stipo lessingianae-Salvion nutantis* vzdolž obale Azovskega morja. A1 – *Goniolimono tauricae-Poetum angustifoliae*, B1 – *Ferulo orientalis-Agropyretum pectinati*, B2 – *Agropyro pectinati-Artemisietum tauricae*, B3 – *Cerastio syvashici-Poetum bulbosae*, H1 – *Stipo lessingianae-Salvietum nutantis*.

Pontic-Caspian true steppe vegetation (Vynokurov 2016). Clusters D-G in the dendrogram (Figure 2) should be placed in the *Festucetalia valesiacea* order.

The alliance *Artemisio-Kochion prostratae* includes steppe communities, which has become ruderal due to overgrazing. Dubyna & Dziuba (2007) suggested two associations for this alliance for the territory of the Azov-Syvash National Park: *Artemisio austriacae-Poetum bulbosae* Pop 1970 and *Agropyro pectinati-Kochietum prostratae* Zólyomi 1958. However, the analysis showed that these names were used not in the proper understanding but as pseudonyms for *Goniolimono tauricae-Poetum angustifoliae,* described by Tyshchenko (1996) for the study area.

Association A1. *Goniolimono tauricae-Poetum angustifoliae*
Diagnostic species: *Elytrigia repens, Euphorbia virgata, Thalictrum minus.*
Constant species: *Achillea millefolium, Agropyron pectinatum, Centaurea diffusa, Dactylis glomerata*, *Falcaria vulgaris*, ***Festuca valesiaca,*** *Medicago falcata, Phlomis pungens, Poa angustifolia, Poa bulbosa,* ***Salvia nemorosa,*** *Senecio vernalis, Silene otites* aggr., *Tragopogon dubius.*
Dominant species: *Elytrigia repens, Festuca valesiaca.*

Communities of the association are distributed mainly on the slopes of the sea cliffs and surrounding uplands in the Northern (from Rostov-on-Don in the east and Prysyvashshia in the west), Eastern and Crimean Pryazov'ya. In particular, they are common for slopes to Kryva, Samsonova, Bilosarayska, Obitochna, Ochakivska spits, and sometimes along the right banks of Molochny and Utlyutsky estuaries (Figure 3). These communities are characterised by the dominance of rhizomatous and loose bunchgrasses (*Elytrigia repens, Poa angustifolia, Agropyron pectinatum*) and the co-dominance of xerophilous forbs

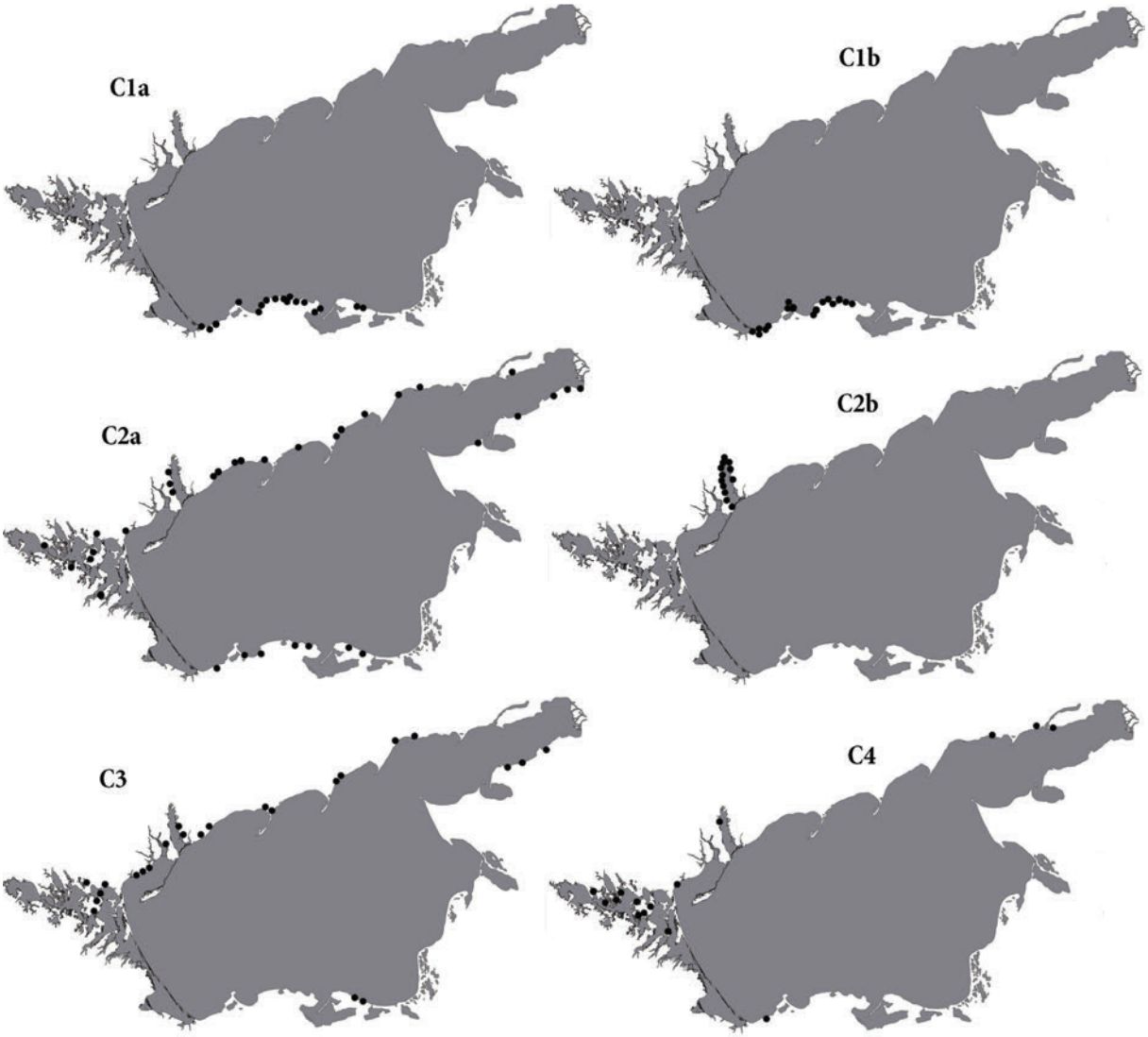

Figure 4: Distribution of the associations and subassociations of the alliance *Tanaceto millefolii-Galatellion villosae* along the coastline of the Sea of Azov. C1a – *Stipo brauneri-Bromopsidetum cappadocicae typicum*, C1b – *Stipo brauneri-Bromopsidetum cappadocicae jurineetosum stoechadifoliae*, C2a – *Ephedro distachyae-Stipetum capillatae typicum*, C2b – *Ephedro distachyae-Stipetum capillatae helichrysetosum arenarii*, C3 – *Tanaceto millefolii-Salvietum nemorosae*, C4 – *Stipo ucrainicae-Agropyretum pectinati*.

Slika 4: Razširjenost asociacij in subasociacij zveze *Tanaceto millefolii-Galatellion villosae* vzdolž obale Azovskega morja. C1a – *Stipo brauneri-Bromopsidetum cappadocicae typicum*, C1b – *Stipo brauneri-Bromopsidetum cappadocicae jurineetosum stoechadifoliae*, C2a – *Ephedro distachyae-Stipetum capillatae typicum*, C2b – *Ephedro distachyae-Stipetum capillatae helichrysetosum arenarii*, C3 – *Tanaceto millefolii-Salvietum nemorosae*, C4 – *Stipo ucrainicae-Agropyretum pectinati*.

(*Marrubium praecox, Kochia prostrata, Salvia nemorosa,* etc.). Firm bunchgrasses of the genera *Stipa* and *Festuca* are few because of erosion processes on the slopes. Total vegetation cover of these communities is about 80%. The accumulative species richness of vascular plants in the communities of the association sums up to 284.

The alliance *Artemisio tauricae-Festucion valesiacae* comprises saline steppe vegetation. It was described on mud volcanoes of the Kerch Peninsula by Korzhenevskij & Kljukin (1991) within the order *Festucetalia valesiacae*. According to the common approach this type of vegetation is classified as desert steppes (Bilyk 1973). In Ukraine such communities are distributed in the far south of the steppe zone, Prysyvashshia, in the lowlands along the Black Sea and along the Sea of Azov, between the Dnieper and Molochna rivers, and in the Crimean Prysyvashshia. In Russia, the communities of the alliance appear in the valley of the Manych river and along the coastline of the Caspian Sea. Korzhenevskij & Kljukin (1991) have suggested one association within this alliance, named *Ferulo orientalis-*

Artemisietum tauricae, which combines specific coenoses on mud volcanoes much less common to the study area. They are quite different floristically from saline-steppe communities prevailing in the Sea of Azov coastline.

Association B1. *Ferulo orientalis-Agropyretum pectinati*

Diagnostic species: ***Artemisia santonicum,*** *Bupleurum marschallianum, Elytrigia elongata, Limonium gmelinii*, *Poa angustifolia.*

Constant species: *Achillea millefolium, Bromus squarrosus, Cardaria draba, Cichorium intybus, Consolida paniculata,* ***Elytrigia repens,*** *Eryngium campestre*, ***Festuca valesiaca,*** *Galium humifusum*, *Plantago lanceolata*, *Poa bulbosa, Tragopogon dubius.*

Dominant species: *Artemisia santonicum, Elytrigia repens, Festuca valesiaca.*

This association was described by Tyshchenko (2000) for Stepok island (loess part of Fedotova Spit), located in the Northern Pryazov'ya. It was included in the *Festucion valesiacae* alliance, but, in our opinion, it should be considered in the alliance *Artemisio tauricae-Festucion valesiacae* because it is characterized by a number of halophilic species: *Artemisia santonicum, Elytrigia elongata, Artemisia taurica, Camphorosma monspeliaca* and others. These communities are distributed in Prysyvashshia, the Crimea, and Pryazov'ya (Figure 3). They are related to alkaline loam ecotopes of the coastline. Total cover of these communities is about 70–80%. The accumulative richness in the communities of the association sums up to 132 vascular plant species.

Association B2. *Agropyro pectinati-Artemisietum tauricae* ass. nov. hoc loco (Holotypus: Table 3, relevé 1; Location: Ukraine, Zaporizhzhia region, Yakymivsky district, neighbourhood of Atmanay village, 19. 07. 2005).

Diagnostic species: *Artemisia santonicum, Artemisia taurica, Cardaria draba, Consolida paniculata, Ferula euxina*, *Limonium gmelinii.*

Constant species: *Achillea millefolium, Agropyron pectinatum, Bromus squarrosus, Centaurea diffusa,* ***Elytrigia repens,*** *Eryngium campestre, Falcaria vulgaris,* ***Festuca valesiaca,*** *Galium humifusum, Plantago lanceolata, Poa angustifolia, Poa bulbosa, Salvia nemorosa, Tragopogon dubius.*

Dominant species: *Artemisia taurica, Elytrigia repens, Festuca valesiaca.*

This association combines desert-steppe communities on chestnut (loam) soils dominated by *Festuca valesiaca*, *Elytrigia repens* and *Artemisia taurica* that occur mostly on upper part of the slopes (Figure 5). Such communities in the study area were referred to *Ferulo orientalis-Artemisietum tauricae* Korzhenevskij & Kljukin 1991 by Dubyna & Dziuba (2007). However, the floristic composition of these communities is quite different from the original ones described by Korzhenevskij & Kljukin (1991) for mud volcanoes of the Kerch peninsula. Thus, we describe a new association which combines these communities. They are distributed in Prysyvashshia on Kerch and Taman peninsulas within the study area (Figure 3) characterised by a relatively high total cover of vegetation (65–90%). The accumulative richness in the communi-

Figure 5: *Agropyro pectinati-Artemisietum tauricae* (B2), Ukraine, Kherson region, Genichesky district, Kuyuk-Tuk Island, Azov-Syvash National Park, 18.04.2014 (Photo: D. Vynokurov).

Slika 5: *Agropyro pectinati-Artemisietum tauricae* (B2), Ukrajina, območje Kherson, okrožje Genichesky, otok Kuyuk-Tuk, narodni park Azov-Syvash, 18.04.2014 (foto: D. Vynokurov).

ties of the association sums up to 132 vascular plant species. Therefore, this association distinguishes itself by a poor floristic diversity, similar to the previous one. The reason for this being the limiting factor of salinity.

Association B3. *Cerastio syvashici-Poetum bulbosae* ass. nov. hoc loco (Holotypus: Table 3, relevé 12; Location: Ukraine, Kherson region, Novotroitsky district, south suburbs of Druzhelyubovka village, Kutara Cape, 09. 05. 2003).

Diagnostic species: *Caroxylon laricinum*, *Cerastium syvaschicum, Erodium ciconium, Galium tenuissimum, Lamium amplexicaule, Lepidium perfoliatum, Leymus ramosus, Linaria macroura, Ornithogalum kochii*, *Prangos odontalgica*, *Taraxacum erythrospermum*, *Trifolium arvense, Vicia tetrasperma, Viola kitaibeliana.*

Constant species: ***Agropyron pectinatum,*** *Artemisia austriaca,* ***Carduus uncinatus,*** *Crepis tectorum, Elytrigia repens, Falcaria vulgaris,* ***Festuca valesiaca,*** *Galatella villosa*, *Kochia prostrata, Phlomis pungens,* ***Poa bulbosa,*** *Salvia aethiopis, Senecio vernalis,* ***Stipa capillata.***

Dominant species: *Agropyron pectinatum, Festuca valesiaca.*

This association combines transitional communities from saline-steppes to real steppes which are spread on the upper slopes of the coastal zone. The distribution of these coenoses ranges as far as Prysyvashshia (Figure 3). In comparison to the other communities of the alliance, they are characterised by the lowest number of species indicative for saline steppes. Most of them are presented by *Leymus ramosus*, *Caroxylon larinicum*, *Cerastium syvaschium*, *Artemisia taurica,* etc. Conversely, they are characterised by the highest number of true steppe species – *Prangos odontalgica, Artemisia austriaca, Falcaria vulgaris, Galatella villosa, Phlomis pungens, Stipa capillata, S. ucrainica* and others. The significant number of ephemeral plants and ephemeroids (*Cerastium syvaschicum, Poa bulbosa, Myosotis micrantha, Lamium amplexicaule, Ornithogalum kochii, Tulipa gesneriana, Bellevalia sarmatica*) is a characteristic feature of the sagebrush steppes (Figure 6). The accumulative richness in the communities of the association sums up to 205 vascular plant species. The average total vegetation cover is 70%.

The alliance *Tanaceto millefolii-Galatellion villosae* Vynokurov all. nov. hoc loco (Holotypus: *Ephedro distachyae-Stipetum capillatae* Kolomiychuk et Vynokurov 2016 (see below), Table 4, relevés 21–40) includes the vegetation of bunchgrass steppes. Diagnostic species: *Agropyron pectinatum, Alyssum hirsutum, Dianthus elongatus, Dichodon viscidum, Ephedra distachya, Galatella villosa, Pleconax subconica, Tanacetum millefolium*.

According to our preliminary data (Kolomiychuk & Vynokurov 2014), communities of *Tanaceto millefolii-Galatellion villosae* are distributed in the bunchgrass steppe subzone of Ukraine (according Barbarych 1977), which stretches from the Danube estuary in the west to Taganrog Bay in the east. In the North it is replaced by *Stipo lessingianae-Salvion nutantis* (forb-bunchgrass steppes). We distinguish between four associations of the alliance and four subassociations in the study area.

Figure 6: *Cerastio syvashici-Poetum bulbosae* (B3), Ukraine, Kherson region, Novotroitsky district, Churiuk Island, Azov-Syvash National Park, 18.04.2014 (Photo: D. Vynokurov).

Slika 6: *Cerastio syvashici-Poetum bulbosae* (B3), Ukrajina, območje Kherson, okrožje Novotroitsky, otok Churiuk, narodni park Azov-Syvash, 18.04.2014 (foto: D. Vynokurov).

Association C1. *Stipo brauneri-Bromopsidetum cappadocicae* ass. nov. hoc loco (Holotypus: Table 4, relevé 6; Location: Ukraine, Autonomous Republic of Crimea, Leninsky district, the eastern neighbourhood of Hlazovka village, Shyroka Balka stow, slope to the Kerch strait, 18. 09. 2010).

Diagnostic species: *Dactylis glomerata, Orchis picta, Ornithogalum flavescens, Plantago lanceolata, Scorzonera mollis, Stipa brauneri, Teucrium chamaedrys.*

Constant species: *Agropyron pectinatum, Artemisia taurica, Bromus squarrosus, Carduus uncinatus, Centaurea diffusa, Dianthus elongatus, Elytrigia repens,* ***Eryngium campestre, Euphorbia seguieriana,*** *Falcaria vulgaris,* ***Festuca valesiaca, Galatella villosa,*** *Galium verum, Jurinea mollis*, ***Koeleria cristata,*** *Linum perenne, Phlomis pungens, Poa bulbosa, Potentilla recta, Salvia nemorosa, Securigera varia, Silene otites aggr.*

Dominant species: *Festuca valesiaca, Galatella villosa.*

This association combines communities on black soils, which cover Pontic and Meiotic limestones the Pliocene. These coenoses are distributed on slopes facing various directions on the Kerch Peninsula (Figure 4). They can be described as an intermediate type of limestone vegetation community . Total vegetation cover is approximately 70%. The accumulative richness in the communities of the association sums up to 241 vascular plant species.

Subassociation C1a. *Stipo brauneri-Bromopsidetum cappadocicae typicum* subass. nov. hoc loco (Holotypus, diagnostic species: identical with the type of the association) (Figure 7).

Figure 7: *Stipo brauneri-Bromopsidetum cappadocicae typicum* (C1a), Ukraine, Crimea, Leninsky district, east of Zolote village, Karalarsky Regional Landscape Park, Shovkovytseva bay, 28. 05. 2010 (Photo: V. Kolomiychuk).

Slika 7: *Stipo brauneri-Bromopsidetum cappadocicae typicum* (C1a), Ukrajina, Krim, okrožje Leninsky, vzhodno od vasi Zolote, regionalni krajinski park Karalarsky, zaliv Shovkovytseva, 28. 05. 2010 (foto: V. Kolomiychuk).

Subassociation C1b. *Stipo brauneri-Bromopsidetum cappadocicae jurineetosum stoechadifoliae* subass. nov. hoc loco (Holotypus: Table 4, relevé 18; Location: Ukraine, Autonomous Republic of Crimea, Leninsky district, between Kamyanske and Zavods'ke villages, steppe slope to Arabatska Bay, 08. 06. 2009).

Diagnostic species: *Alyssum tortuosum,* ***Artemisia lerchiana,*** *Astragalus pubiflorus,* ***Bromopsis cappadocica, Dianthus capitatus,*** *Ephedra distachya*, ***Jurinea stoechadifolia,*** *Koeleria cristata, Scorzonera mollis, Stipa brauneri, Veronica verna.*

Constant species: *Agropyron pectinatum, Bromus squarrosus, Centaurea diffusa, Cephalaria uralensis*, ***Eryngium campestre,*** *Euphorbia seguieriana,* ***Festuca valesiaca, Galatella villosa,*** *Galium verum, Kochia prostrata, Linum perenne, Medicago falcata* aggr., *Phlomis pungens, Pleconax subconica*, *Potentilla recta, Silene otites* aggr., *Teucrium polium, Veronica triphyllos.*

In contrast to the previous subassociation, the communities of the subassociation *Stipo brauneri-Bromopsidetum cappadocicae jurineetosum stoechadifoliae* are formed on steeper slopes of limestone, and are characterized by more sparse vegetation (50–60%). Just as communities of the previous subassociation, they are distributed exclusively on the Kerch Peninsula (Figure 4). The accumulative richness in the communities of the association amounts to 213 vascular plant species.

Association C2. *Ephedro distachyae-Stipetum capillatae* ass. nov. hoc loco (Holotypus: Table 4, relevé 21; Location: Ukraine, Zaporizhzhia region, Yakymivsky district, neighbourhood of Bogatyr village, steppe slope to Molochny estuary, 28. 05. 2008).

Diagnostic species: *Linaria genistifolia, Stipa capillata.*

Constant species: ***Agropyron pectinatum,*** *Arenaria serpyllifolia, Bromopsis riparia, Carduus uncinatus, Elytrigia repens, Ephedra distachya,* ***Eryngium campestre,*** *Euphorbia seguieriana, Falcaria vulgaris,* ***Festuca valesiaca,*** *Galatella villosa, Goniolimon tataricum*, *Koeleria cristata, Medicago falcata* aggr., *Poa bulbosa,* ***Potentilla recta,*** *Salvia nemorosa, Salvia nutans, Seseli tortuosum, Silene otites* aggr., *Tanacetum millefolium, Teucrium polium, Thalictrum minus*, *Xeranthemum annuum.*

Dominant species: *Festuca valesiaca, Stipa capillata.*

The communities of this association are most advanced of xerosere succession in the region. It is the central association of the alliance, and, accordingly, its distribution area matches with the area of *Tanaceto millefolii-Galatellion villosae*. In the coastal zone of the Sea of Azov these grasslands are mainly to be found on the uplands and upper gentle slopes. They are commonly distributed in North and Crimean Pryazov'ya (Figure 4). The accu-

mulative richness in the communities of the association amounts to 260 vascular plant species. Total vegetation cover is on average 60–70%.

Subassociation C2a. *Ephedro distachyae-Stipetum capillatae typicum* subass. nov. hoc loco (Holotypus, diagnostic species: identical with the type of the association) (Figure 8).

Subassociation C2b. *Ephedro distachyae-Stipetum capillatae helichrysetosum arenarii* subass. nov. hoc loco (Holotypus: Table 4, relevé 32; Location: Ukraine, Zaporizhzhia region, Yakymivsky district, neighbourhood of Bogatyr village, steppe slope to Molochny estuary, 27. 05. 2008).

Diagnostic species: *Achillea leptophylla*, *Artemisia austriaca, Asparagus officinalis, Astragalus varius,* ***Echinops ruthenicus,*** *Ephedra distachya,* ***Helichrysum arenarium,*** *Herniaria besseri, Jurinea multiflora, Kochia prostrata, Limonium sareptanum, Polycnemum arvense, Polygonum aviculare, Thymus x dimorphus, Tragopogon dasyrhynchus*.

Constant species: ***Agropyron pectinatum,*** *Alyssum hirsutum, Eryngium campestre,* ***Euphorbia seguieriana,*** *Falcaria vulgaris,* ***Festuca valesiaca,*** *Galatella villosa, Galium verum, Goniolimon tataricum, Medicago falcata, Poa bulbosa,* ***Potentilla recta, Stipa capillata,*** *Stipa lessingiana, Tanacetum millefolium, Verbascum phoeniceum.*

Dominant species: *Agropyron pectinatum, Festuca valesiaca, Stipa capillata.*

This subassociation comprises pontic hemipsammophytic bunchgrass steppes. They are not widely spread within the observed region and mainly concentrate on the slopes of Molochny estuary, in the Zaporizhzhia region (Figure 4). Next the coastline of the Sea of Azov, such coenoses are distributed in the old estuary of the Dnieper River. The communities form on sandy soils, so they include psammophytic species: *Helichrysum arenarium, Astragalus varius, Echinops ruthenicus* and *Achillea leptophylla*. The accumulative richness in the communities of the association sums up to 159 vascular plant species. The total cover of vegetation is 70–90%.

Figure 8: *Ephedro distachyae-Stipetum capillatae typicum* (C2a), Russian Federation, Rostov region, Azovsky district, west of Semibalky village, steppe slope to the Taganrog bay, 15.09.2010 (Photo: V. Kolomiychuk).

Slika 8: *Ephedro distachyae-Stipetum capillatae typicum* (C2a), Ruska federacija, regija Rostov, okrožje Azovsky, zahodno od vasi Semibalky, stepsko vznožje do zaliva Taganrog, 15.09.2010 (foto: V. Kolomiychuk).

Association C3. *Tanaceto millefolii-Salvietum nemorosae*
Diagnostic species: *Bromopsis riparia, Securigera varia, Tanacetum millefolium.*
Constant species: ***Agropyron pectinatum,*** *Alyssum hirsutum,* ***Artemisia austriaca,*** *Bromus squarrosus, Carduus uncinatus,* ***Elytrigia repens,*** *Eryngium campestre, Euphorbia seguieriana,* ***Falcaria vulgaris, Festuca valesiaca,*** *Galatella villosa, Kochia prostrata, Koeleria cristata,* ***Medicago falcata,*** *Phlomis pungens, Poa bulbosa,* ***Salvia nemorosa, Silene otites aggr.***
Dominant species: *Festuca valesiaca.*

This association represents disturbed communities as a result of overgrazing. They are in the intermediate stages of pasture degradation. Reducing or ceasing the disturbance factors allows communities to restore and change into the association *Ephedro distachyae-Stipetum capillatae*. In the coastal zone of the Sea of Azov, they are widespread (Northern, Eastern Pryazov'ya, and Prysyvashshia) and occupy uplands and retreating slopes (Figure 4). The accumulative richness in the communities of the association sums up to 234 vascular plant species. The average cover is 70%.

Association C4. *Stipo ucrainicae-Agropyretum pectinati*
Diagnostic species: *Serratula erucifolia,* ***Stipa ucrainica.***
Constant species: ***Agropyron pectinatum, Artemisia austriaca,*** *Buglossoides arvensis, Carduus uncinatus, Crepis tectorum, Cruciata pedemontana, Elytrigia repens, Euphorbia seguieriana, Falcaria vulgaris,* ***Festuca valesiaca, Galatella villosa,*** *Goniolimon tataricum, Iris pumila, Kochia prostrata, Lamium amplexicaule, Lepidium perfoliatum, Pastinaca clausii, Phlomis pungens, Poa bulbosa, Scorzonera mollis,* ***Stipa capillata,*** *Tulipa gesneriana, Verbascum densiflorum, Viola kitaibeliana.*
Dominant species: *Agropyron pectinatum, Elytrigia repens, Festuca valesiaca, Galatella villosa, Stipa ucrainica.*

The communities of this association occupy an intermediate position along the salinity gradient between associations *Cerastio syvashici-Poetum bulbosae* and *Ephedro distachyae-Stipetum capillatae*. They are distributed in Northern and Eastern Crimean Pryazov'ya and Prysyvashshia (Figure 4). They occur on medium steep slopes of the coastline. In the study area they do not cover large areas because of ploughing of surrounding upland ecotopes. The accumulative richness in the communities of the association sums up to 122 vascular plant species. The average cover is 70–75%.

The alliance *Stipo lessingianae-Salvion nutantis* includes vegetation of forb-bunchgrass steppes (Vynokurov 2014b). Its distribution roughly coincides with that of forb-bunchgrass steppe subzone of Ukraine (Barbarych 1977). It is marked by the presence of forbs less common for bunchgrass subzone (*Stachys recta*, *Asperula cynanchica, Marrubium praecox, Seseli tortuosum, Potentilla recta, Phlomis pungens, Astragalus onobrychis*). In the examined area, communities of the alliance are spread along the coast of the Taganrog Bay and in the Russian part of the Sea of Azov (Rostov region, Krasnodar territory).

Association H1. *Stipo lessingianae-Salvietum nutantis*
Diagnostic species: *Asperula cynanchica, Medicago falcata, Salvia nutans,* ***Stachys recta, Stipa lessingiana.***
Constant species: *Achillea millefolium, Artemisia austriaca, Astragalus onobrychis, Bromopsis riparia, Dianthus elongatus, Elytrigia intermedia, Elytrigia repens, Ephedra distachya,* ***Euphorbia seguieriana, Falcaria vulgaris, Festuca valesiaca, Galatella villosa,*** *Galium verum, Glycyrrhiza glabra, Kochia prostrata,* ***Koeleria cristata,*** *Linum perenne, Phlomis pungens, Poa angustifolia,* ***Potentilla recta,*** *Salvia nemorosa, Securigera varia, Seseli tortuosum,* ***Stipa capillata,*** *Tanacetum millefolium, Teucrium polium*.
Dominant species: *Festuca valesiaca, Stipa lessingiana.*

This association takes up the central position of the alliance. The presence of these communities at the coast of the Sea of Azov was described by Demina (2012), who included them in *Stipetum lessingianae* Soó 1949. But, cluster analysis separated relevés from Azov and original relevés from Transilvania in different alliances (Soó 1949). Thus, we propose to include them in *Stipo lessingianae-Salvietum nutantis* described in the forb-bunchgrass steppe zone (Vynokurov 2014b). These communities cover upland areas and gentle slopes. They are not widely spread in the area (distributed in Northern, Eastern and Don Pryazov'ya, Figure 3), but they are characterised by the richest floristic diversity of all the identified associations at plot level. The accumulative richness in the communities of the association sums up to 104 vascular plant species. The average total vegetation cover is 75–80%.

In the following, we present a syntaxonomic scheme indicating the most used synonyms and specification of type syntaxa.

Class *Festuco-Brometea* Br.-Bl. & Tx. ex Klika & Hadač 1944
Typus: *Brometalia erecti* W. Koch 1926
Syn.: *Festuco-Brometea* Br.-Bl. & Tx. 1943 nom. inval. (Art. 8), *Festuco-Brometea* Br.-Bl. & Tx. ex Soó 1947 nom. illeg. (Art. 31)
Order *Galatello villosae-Stipetalia lessingianae* Vynokurov ord. nov. prov.
Typus: *Stipo lessingianae-Salvion nutantis* Vynokurov 2014
Syn.: *Carici praecoxi-Elytrigietalia pseudocaesiae* Solomakha et al. 2005 nom. inv. (Art. 5) p.p.

Alliance A. *Artemisio-Kochion prostratae* Soó 1964
Typus: *Agrogyro cristati-Kochietum prostratae* Zólyomi 1958
Syn.: *Artemisio-Kochion* Soó 1959 prov. (art. 3b), *Agropyro-Kochion* Soó 1971 (fantom)

Association A1. *Goniolimono tauricі-Poetum angustifoliae* Tyshchenko 1996
Typus: relevé 2, table 2 in Tyshchenko 1996, p. 69

Alliance B. *Artemisio tauricae-Festucion valesiacae* Korzhenevskij et Kljukin 1991
Typus: *Ferulo orientalis-Artemisietum tauricae* Korzhenevskij et Kljukin 1991

Association B1. *Ferulo orientalis-Agropyretum pectinati* Tyshchenko 2000
Typus: relevé 2, table 2 in Tyshchenko 2000, p. 90

Association B2. *Agropyro pectinati-Artemisietum tauricae* Kolomiychuk et Vynokurov 2016 (this paper)
Typus: relevé 1, table 3 (this paper)

Association B3. *Cerastio syvashici-Poetum bulbosae* Kolomiychuk et Vynokurov 2016 (this paper)
Typus: relevé 12, table 3 (this paper)

Alliance C. *Tanaceto millefolii-Galatellion villosae* Vynokurov in Kolomiychuk et Vynokurov 2016 (this paper)
Typus: *Ephedro distachyae-Stipetum capillatae* Kolomiychuk et Vynokurov 2016 (this paper)
Syn.: *Poo angustifoliae-Ferulion orientale* Solomakha et al. 2005 nom. inv. (Art. 5) p.p.

Association C1. *Stipo brauneri-Bromopsidetum capadocicae* Kolomiychuk et Vynokurov 2016 (this paper)
Typus: relevé 6, table 4 (this paper)

Subassociation C1a. *Stipo brauneri-Bromopsidetum cappadocicae typicum* Kolomiychuk et Vynokurov 2016 (this paper)
Typus: relevé 6, table 4 (this paper)

Subassociation C1b. *Stipo brauneri-Bromopsidetum cappadocicae jurineetosum stoechadifoliae* Kolomiychuk et Vynokurov 2016 (this paper)
Typus: relevé 18, table 4 (this paper)

Association C2. *Ephedro distachyae-Stipetum capillatae* Kolomiychuk et Vynokurov 2016 (this paper)
Typus: relevé 21, table 4 (this paper)

Subassociation C2a. *Ephedro distachyae-Stipetum capillatae typicum* Kolomiychuk et Vynokurov 2016 (this paper)
Typus: relevé 21, table 4 (this paper)

Subassociation C2b. *Ephedro distachyae-Stipetum capillatae helichrysetosum arenarii* Kolomiychuk et Vynokurov 2016 (this paper)
Typus: relevé 32, table 4 (this paper)

Association C3. *Tanaceto millefolii-Salvietum nemorosae* Krasova et Smetana 1999
Typus: Krasova & Smetana 1999, p. 27
Syn.: *Crinitarietum villosae* Krasova et Smetana 1999, *Bromopsidi ripariae-Plantagetum lanceolatae* Smetana 2002 nom. inv. (art. 5) p.p.

Association C4. *Stipo ucrainicae-Agropyretum pectinati* Tyschenko 1996
Typus: relevé 6, table 2 in Tyshchenko 1996, p. 69

Alliance H. *Stipo lessingianae-Salvion nutantis* Vynokurov 2014
Typus: *Stipo lessingianae-Salvietum nutantis* Vynokurov 2014
Syn.: *Astragalo-Stipion* Knapp 1944 sensu auct. ukr., *Phlomenion pungentis* Saitov et Mirkin 1991 nom. inv. (art. 2a), *Chamaecytision ruthenici* Smetana 2002 nom. inv. (art. 5), *Poo angustifoliae-Stipion capillatae* Goncharenko 2003 nom. inv. (art. 5)

Association H1. *Stipo lessingianae-Salvietum nutantis* Vynokurov 2014
Typus: relevé 21, table 2 in Vynokurov 2014b, p. 543.
Syn.: *Stipetum lessingianae* sensu auct. ukr. non Soó 1949.

Conclusions

The vegetational class of *Festuco-Brometea* of the Sea of Azov coastal zone comprises four alliances. Whether steppe communities are transformed as a result of natural or by anthropogenic factors, they are related to the alliance *Artemisio-Kochion prostratae*. They are characterised by a significant number of synanthropic species. The vegetation of saline steppes or desert steppes is classified in the alliance *Artemisio tauricae-Festucion valesiacae*. In this alliance we distinguish three associations, two of which we propose as new ones. The vegetation of bunchgrass steppes, which is marked by a powerful block of diagnostic species, did not meet any currently known syntaxonomical unit. Therefore, we describe a new alliance *Tanaceto millefolii-Galatellion villosae*. It features great coenotic diversity and includes four associations and four subassociations. In our study area, the vegetation of forb-bunchgrass steppes is rerpresented by one association which was ordered to alliance *Stipo lessingianae-Salvion nutantis*.

The loess and limestone coasts of the Sea of Azov have been subject to constant and heavy erosion, which is aggravated by currently rising sea levels caused by global climate change. Key factors accelerating coastal erosion processes are the lack of coastal protection strategies, the destruction of accumulative forms that protect abrasion coasts, persistent violations of environmental and water legislation (i.e. construction projects in the protective coastal belt, soil cultivation close to the cliffs). The

combined impacts of the abovementioned factors lead to increasing incidents of landslides in the coastal area. As a result, steppe ecosystems are lost or replaced by synanthropic ones. Moreover, the flora of the coastal zone of the Sea of Azov loses its natural makeup while it is more and more anthropogenically influenced.

References

Barbarych, A.I. (ed.) 1977: Geobotanical zoning of Ukrainian SSR. Naukova Dumka, Kyiv, 304 pp [in Ukrainian].

Bilyk, G. I. 1973: Desert steppe vegetation. In: Barbarych, A.I. (ed.): The vegetation of USSR. Steppes, rocky outcrops, sands. Naukova Dumka, Kyiv, pp. 229–245 [in Ukrainian].

Bohn, U., Neuhäusl, R., Gollub, G., Hettwer, C., Neuhäuslová, Z., Raus, T., Schlüter, H. & Weber, H. 2004: Map of the Natural Vegetation of Europe scale 1: 2 500 000. Münster, Landwirtschaftsverlag.

Braun-Blanquet, J. 1964: Pflanzensoziologie. Grundzuge der Vegetationskunde. 3 Aufl. Springer-Verlag, Wien-New York, 865 pp.

Chytrý, M., Hennekens, S. M., Jiménez-Alfaro, B., Knollová, I., Dengler, J., Jansen, F., Landucci, F., Schaminée, J. H. J., Aćić, S., (…) & Yamalov, S. 2016: European Vegetation Archive (EVA): an integrated database of European vegetation plots. Applied Vegetation Science 19: 173–180.

Chytrý, M., Tichý, L., Holt, J. & Botta-Dukát, Z. 2002: Determination of diagnostic species with statistical fidelity measures. Journal of Vegetation Science 13: 79–90.

Dembicz, I., Moysiyenko, I. I., Shaposhnikova, A., Vynokurov, D., Kozub, L. & Sudnik-Wójcikowska, B. 2016: Isolation and patch size drive specialist plant species density within steppe islands: a case study of kurgans in southern Ukraine. Biodiversity and Conservation. DOI:10.1007/s10531-016-1077-y.

Demina, O. N. 2012: East Black Sea forb-bunchgrass steppes of the Don River basin (within Rostov region). Vegetation of Russia 20: 27–47 (in Russian).

Didukh, Ya. P. & Shelyag-Sosonko, Yy. R. 2003: Geobotanical zoning of Ukraine and adjacent territories. Ukrainian Botanical Journal 60 (1): 6–17 [in Ukrainian].

Dúbravková, D. & Košťál, J. 2012: Acidophilous Dry Grasslands on the Quartzite Bedrock in Western Slovakia. Hacquetia 11(2): 249–269.

Dúbravková-Michálková, D., Janišová, M., Kolbek, J., Šuvada, R., Virók, V. & Zaliberová, M. 2008: Dry Grasslands in the Slovenský Kras MTS (Slovakia) and the Aggteleki-karszt MTS (Hungary) – A Comparison of Two Classification Approaches. Hacquetia 7(2): 123–140.

Dubyna, D. V. & Dziuba, T. P. 2007: Syntaxonomy of Island's vegetation of the Azovo-Syvaskiy National Nature Park. Classes: Festuco-Brometea, Agropyretea repentis, Chenopodietea, Artemisietea vulgaris. Chornomorski Botanical Journal 3(1): 30–43 [in Ukrainian].

Foggi, B., Lastrucci, L. Gennai, M. & Viciani, D. 2014: The Festuco-Brometea grasslands on sandstone and marl-clay-sandstone substrata in Tuscany (Northern-Central Italy). Hacquetia 13(1): 19–54.

Grechushkina, N. A., Sorokin, A. N. & Golub, V. B. 2012: Plant communities of the class Festuco-Brometea Br.-Bl. et Tx. ex Soó 1947 on the Azov Sea coast of Russia. In: Galiev, R.S. & Rukhlenko, I.A. (eds.) Proceedings of the IX International scientific-practical conference "Tatishchev read: actual problems of science and practice. Actual problems of ecology and environmental protection", Togliatti, pp. 50–56 [in Russian].

Hennekens, S. M. & Schaminée, J. H. 2001: TURBOVEG, a comprehensive data base management system for vegetation data. Journal of Vegetation Science 12: 589–591.

Kaplin, P. A., Leontiev, O. K., Lukyanova, S. A. & Nikiforov, L. G. 1991: Shores. Mysl, Moscow, 480 pp. [in Russian].

Kolomiychuk, V. P. & Vynokurov, D. S. 2014: Previous prodromus of the steppe vegetation of class Festuco-Brometea on the coastal zone of the Azov Sea in Ukraine and Russia. In: Lukash, A.V., Karpenko, Yu.A. & Kirienko, S.V. (eds.), Priorities scientific value of protected areas of Polesie: Materials of International scientific and practical workshop, Chernihiv, pp. 41–44 [in Ukrainian].

Korotchenko, I. A. & Peregrym, M. M. 2012: Ukrainian steppes in the past, at present and in the future. Eurasian Steppes. Ecological Problems and Livelihoods in a Changing World. Plant and Vegetation 6: 173–196.

Korzhenevskij, V. V. & Kljukin, A. A. 1986: Phytoindication of relief of uplands in the Kerch peninsula, taking Kazantip peninsula as an example. Bulletin of the State Nikita Botanical Gardens 98: 111–122 [in Russian].

Korzhenevskij, V. V. & Kljukin, A. A. 1991: Vegetation description of mud volcanoes of Crimea. Feddes Repertorium 102 (1–2): 137–150.

Korzhenevskij, V. V., Bagrikova, N. A., Ryff, L. E. & Levon, A. R. 2003: Prodromus of vegetation of Crimea (20 years on the platform of floristic classification). Bulletin of the State Nikita Botanical Gardens 186: 32–63 [in Russian].

Kostyliov, O. V., Movchan, Ya. I., Osychniuk, V. V. & Solomakha, V. A. 1984: Main associations of the steppe vegetation in the "Khomutovsky steppe" reserve. Ukrainian Botanical Journal 41 (6): 12–17 [in Ukrainian].

Krasova O. O. & Smetana M. G. 1999: Steppe vegetation of the "Kobylna" gully. Ukrainian Phytosociological Collection, Series A, Phytosociology 1–2 (12–13): 21–31 [in Ukrainian].

Matishov, G. G., Golubeva, N. I. & Sorokina, V. V. 2011: Ecological atlas of the Sea of Azov. SSC RAS Publishers, Rostov-on-Don, 328 pp. [in Russian].

Mosyakin, S. L. & Fedoronchuk, M. M. 1999: Vascular plants of Ukraine. A nomenclatural checklist. Specialized printing house of scientific journals of the NAS of Ukraine, Kyiv, 345 pp.

Roleček, J., Tichý, L., Zelený, D. & Chytrý, M. 2009: Modified TWINSPAN classification in which the hierarchy respects cluster heterogeneity. Journal of Vegetation Science 20: 596–602.

Shnyukov, E. F., Orlovsky, G. N. & Usenko, V. P. 1974: Geology of the Sea of Azov. Naukova Dumka, Kyiv, 247 pp. [in Russian].

Solomakha, V. A. 2008: The syntaxonomy of vegetation of the Ukraine. The third approximation. Phytosociocentre, Kyiv, 296 pp. [in Ukrainian].

Soó, R. 1949: Les associations vegetales de la Moyenne-Transylvanie II. Les associations des marais, des prairies et des steppes. Acta Geobotanica Hungarica 6: 3–107.

Sopotlieva, D. & Apostolova, I. 2014: Dry grassland vegetation in the transition zone between two Biogeographic Regions. Hacquetia 13(1): 79–120.

Tichý, L. 2002: JUICE, software for vegetation classification. Journal of Vegetation Science 13: 451–453.

Tyshchenko, O. V. 1996: Steppe and psammophytic-steppe vegetation of the "Obitochna Kosa" Reserve. Ukrainian Phytosociological Collection. Series A Phytosociology 2 (2): 63–72 [in Ukrainian].

Tyshchenko, O. V. 1998: The vegetation of Kryva Spit (Donetsk region) of the northern coast of the Sea of Azov and peculiarities of its dynamics. Ukrainian Phytosociological Collection. Series A Phytosociology 2 (11): 26–42 [in Ukrainian].

Tyshchenko, O. V. 1998: The vegetation of Samsonova and Bezimenna Spits of the northern coast of the Sea of Azov (Donetsk region) and peculiarities of its dynamics. Ukrainian Phytosociological Collection. Series A Phytosociology 1 (9): 60–77 [in Ukrainian].

Tyshchenko, O. V. 2000: New syntaxons of the nothern Azov Sea coast spits vegetation. Ukrainian Phytosociological Collection. Series A Phytosociology 1 (16): 89–93.

Tyshchenko, O. V. 2006: Vegetation of coastal spits of the Northern coast of the Azov Sea. Phytosociocentre, Kyiv, 156 pp. [in Ukrainian].

Vassilev, K., Apostolova, I. & Pedashenko, H. 2012: *Festuco-Brometea* in Western Bulgaria with an emphasis on *Cirsio-Brachypodion pinnati*. Hacquetia 11(2): 227–248.

Vynokurov, D. S. 2014a: Syntaxonomy of xerothermic vegetation of the Ingul river valley (Class Festuco-Brometea). Part 1. Petrophytic steppe vegetation. Ukrainian Botanical Journal 71 (2): 148–160 [in Ukrainian].

Vynokurov, D. S. 2014b: Syntaxonomy of xerothermic vegetation of the Ingul river valley (Class Festuco-Brometea). Part 2. Meadow, shrub and true steppe vegetation. Ukrainian Botanical Journal 71 (5): 537–548 [in Ukrainian].

Vynokurov, D. 2016: Classification of Pontic-Caspian true steppe vegetation: preliminary overview. In: Agrillo, E., Attorre, F., Spada, F. & Casella, L. (eds.), 25th Meeting of European Vegetation Survey, 6–9 April 2016. Book of Abstracts. Lectures, Roma, p. 74.

Weber, H. E., Moravec, J. & Theurillat J.-P. 2000: International Code of Phytosociological Nomenclature. 3rd edition. Journal of Vegetation Science 11: 739–768.

Westhoff, V. & van der Maarel, E. 1973: The Braun-Blanquet approach. In: Whittaker, R.H. (ed.): Handbook of vegetation science, part 5, Classification and ordination of communities. Junk, The Hague: 617–726.

Table 1: List of broadly-defined taxa used in the numerical analysis.
Tabela 1: Seznam široko opredeljenih taksonov, uporabljenih v numerični analizi.

Achillea millefolium	A. collina, A. euxina, A. millefolium, A. pannonica, A. setacea, A. stepposa, A. submillefolium
Ajuga chamaepitys	A. chamaepitys, A. chia, A. glabra
Allium flavum	A. flavum, A. paczoskianum, A. pseudopulchellum
Allium paniculatum	A. paniculatum, A. podolicum
Allium scorodoprasum	A. rotundum, A. scorodoprasum, A. waldsteinii
Alyssum calycinum	A. calycinum, A. alyssoides
Alyssum desertorum	A. desertorum, A. turkestanicum
Anthemis tinctoria	A. tinctoria, A. tinctoria subsp. subtinctoria
Anthyllis vulneraria	A. vulneraria, A. macrocephala
Arenaria serpyllifolia	A. serpyllifolia, A. leptoclados, A. uralensis, A. zozii
Artemisia campestris	A. campestris, A. marschalliana
Asparagus officinalis	A. officinalis, A. polyphyllus
Asperula supina	A. cimmerica, A. praepilosa, A. supina
Aster amellus	A. amellus, A. bessarabicus
Brassica elongata	B. elongata, Erucastrum armoracioides
Bromopsis pannonica	B. pannonica, B. pannonica subsp. monoclada
Campanula sibirica	C. praealta, C. sibirica, C. taurica
Campanula glomerata	C. glomerata, C. farinose
Caragana frutex	C. frutex, C. mollis
Carduus hamulosus	C. hamulosus, C. pseudocollinus, C. tauricus
Carlina vulgaris	C. biebersteinii, C. intermedia, C. vulgaris
Centaurea scabiosa	C. adpressa, C. apiculata, C. scabiosa, C. scabiosa subsp. spinulosa
Centaurea stoebe	C. biebersteinii, C. pseudomaculosa, C. stoebe, C. stoebe subsp. australis
Cerastium pumilum	C. crassiusculum, C. kioviense, C. pumilum Curtis, C. pumilum subsp. glutinosum, C. ucrainicum
Cerastium fontanum	C. holosteoides, C. fontanum subsp. vulgare
Cerastium semidecandrum	C. heterotrichum, C. semidecandrum
Dorycnium pentaphyllum	D. pentaphyllum, D. herbaceum
Elytrigia intermedia	E. intermedia, E. trichophora
Eremogone saxatilis	E. micradenia, E. saxatilis
Euphorbia nicaeensis	E. glareosa, E. pseudoglareosa, E. stepposa
Euphrasia stricta	E. pectinata, E. stricta
Festuca valesiaca	F. pseudodalmatica, F. pseudovina, F. rupicola, F. valesiaca
Galium aparine	G. aparine, G. spurium, G. vailantii
Galium mollugo	G. album, G. mollugo
Galium verum	G. ruthenicum, G. verum
Gypsophila altissima	G. altissima, G. oligosperma, G. thyraica
Gypsophila fastigiata	G. collina, G. dichotoma, G. fastigiata
Hylotelephium maximum	H. maximum, H. polonicum, H. stepposum
Isatis tinctoria	I. tinctoria, I. praecox
Jurinea mollis	J. arachnoidea, J. calcarea, J. mollis, J. transylvanica, J. mollissima
Jurinea stoechadifolia	J. stoechadifolia, J. brachycephala
Jurinea longifolia	J. longifolia, J. paczoskiana
Knautia arvensis	K. arvensis, K. kitaibelii
Koeleria cristata	K. cristata, K. macrantha
Lathyrus pannonicus	L. lacteus, L. pannonicus
Leontodon crispus	L. biscutellifolius, L. crispus
Limonium tomentellum	L. hypanicum, L. alutaceum, L. tomentellum
Linaria biebersteinii	L. biebersteinii, L. maeotica

Linum flavum	L. czernjajevii, L. ucranicum, L. flavum, L. linearifolium
Linum perenne	L. austriacum, L. perenne
Lotus corniculatus	L. arvensis, L. corniculatus, L. ucrainicus
Minuartia setacea	M. leiosperma, M. setacea, M. thyraica
Nepeta ucranica	N. parviflora, N. ucranica
Nonea pulla	N. pulla, N. rossica
Onobrychis viciifolia	O. arenaria, O. gracilis, O. miniata, O. tanaitica, O. viciifolia
Ononis arvensis	O. spinosa, O. arvensis
Silene otites	Otites artemisetorum, O. borysthenicus, O. chersonensis, O. densiflorus, O. dolichocarpus, O. eugeniae, O. hellmannii, O. orae-syvaschicae, O. wolgensis, Silene baschkirorum, Silene exaltata
Phlomis tuberosa	P. hybrida, P. tuberosa, P. scythica
Pimpinella tragium	P. lithophila, P. tragium, P. titanophila
Pimpinella saxifraga	P. saxifraga, P. saxifraga subsp. nigra
Plantago lanceolata	P. lanceolata, P. lanceolata subsp. lanuginosa
Plantago media	P. media, P. urvillei
Potentilla cinerea	P. cinerea, P. incana
Potentilla argentea	P. argentea, P. inclinata, P. neglecta
Potentilla recta	P. astracanica, P. mollicrinis, P. recta, P. obscura, P. pedata, P. pilosa, P. semilaciniosa, P. taurica
Poterium sanguisorba	P. polygamum, P. sanguisorba
Prunus spinosa	P. spinosa, P. stepposa
Pulsatilla pratensis	P. pratensis, P. bohemica
Ranunculus illyricus	R. illyricus, R. scythicus
Rhinanthus serotinus	R. aestivalis, R. serotinus, R. vernalis
Rosa spinosissima	R. pimpinellifolia, R. spinosissima
Salvia nemorosa	S. nemorosa, S. tesquicola
Salvia pratensis	S. pratensis, S. transsylvanica, S. stepposa
Scutellaria supina	S. creticola, S. verna
Sedum sexangulare	S. borissovae, S. sexangulare
Serratula radiata	S. bracteifolia, S. radiata
Seseli tortuosum	S. campestre, S. tortuosum
Seseli libanotis	S. libanotis, S. libanotis subsp. intermedium
Sideritis montana	S. montana, S. comosa
Teucrium montanum	T. montanum, T. pannonicum
Thalictrum simplex	T. simplex, T. simplex subsp. galioides
Thymus calcareus	T. calcareus, T. cretaceous
Thymus serpyllum	T. glabrescens T. serpyllum
Thymus pulegioides	T. marschallianus, T. pannonicus, T. pulegioides
Tragopogon dubius	T. dubius, T. major
Valeriana officinalis	V. officinalis, V. stolonifera
Verbascum chaixii	V. austriacum, V. marschallianum
Veronica austriaca	V. austriaca, V. jacquinii, V. sclerophylla
Veronica spicata	V. barrelieri, V. maeotica, V. orchidea, V. spicata

Table 2: Shortened synoptic table of steppe communities of the study area with percentage frequencies and phi fidelity indices (in the superscript). Species with frequencies > 20% at least in one cluster or with fidelity > 20% in at least one cluster are included.

Tabela 2: Skrajšana sinoptična tabela stepskih združb v preučevanem območju s frekvencami v odstotkih in fi indeksi (nadpisano). Vključene so vrste s frekvenco > 20% vsaj v enem klastru ali navezanostjo > 20% vsaj v enem klastru.

Codes of syntaxa	A1	B1	B2	B3	C1a	C1b	C2a	C2b	C3	C4	H1
Average total cover of vegetation (%)	80	75	75	70	70	55	70	80	70	75	80
Number of relevés	32	39	35	49	44	26	41	20	51	20	17
Diagnostic species for the association *Goniolimono taurici-Poetum angustifoliae*:											
Elytrigia repens	$94^{30.1}$	62	57	41	30	19	32	20	65	40	50
Thalictrum minus	$41^{28.9}$	.	3	.	11	12	32	25	2	.	.
Euphorbia virgata	$19^{25.3}$	.	.	.	.	.	.	.	12	10	.
Diagnostic species for the association *Ferulo orientalis-Agropyretum pectinati*:											
Elytrigia elongata	3	$44^{41.9}$	$23^{17.4}$	.	7	6	5	.	.	.	.
Bupleurum marschallianum	.	$25^{35.5}$	11	.	5	.	.	.	.	.	.
Poa angustifolia	28	$44^{27.9}$	$31^{16.5}$	.	2	.	.	.	6	.	38
Diagnostic species for the association *Agropyro pectinati-Artemisietum tauricae*:											
Cardaria draba	19	31	46^{30}	20	11	.	.	.	10	10	.
Ferula euxina	.	12	$20^{29.4}$	4	.	.	.	.	.	.	.
Consolida paniculata	19	31	$49^{28.5}$	6	5	.	18	20	25	.	.
Artemisia taurica	12	19	$49^{27.5}$	16	30	19	5	5	6	20	.
Diagnostic species for the association *Cerastio syvashici-Poetum bulbosae*											
Leymus ramosus	.	.	.	$33^{43.1}$	.	.	5	.	2	10	.
Prangos odontalgica	.	.	.	$22^{43.1}$	2	.	.	.	.	.	.
Ornithogalum kochii	6	.	.	$43^{34.3}$	.	6	5	15	4	20	12
Lepidium perfoliatum	.	.	3	$29^{31.7}$	.	.	.	.	.	30	.
Taraxacum erythrospermum	3	12	3	$29^{31.6}$	.	.	5	.	.	10	.
Trifolium arvense	.	6	6	$20^{29.7}$	.	.	.	5	.	.	.
Lamium amplexicaule	25	.	3	$39^{28.9}$	7	.	5	5	4	30	.
Cerastium syvaschicum	12	19	14	$41^{27.8}$	2	6	5	.	14	20	.
Caroxylon laricinum	.	.	.	$8^{27.3}$	.	.	.	.	.	.	.
Vicia tetrasperma	.	.	3	$12^{27.1}$	2	.	.	.	.	.	.
Viola kitaibeliana	9	.	.	$27^{26.6}$	2	.	5	5	10	50	.
Erodium ciconium	.	.	.	$16^{26.1}$	2	.	.	.	2	10	.
Galium tenuissimum	.	6	9	$20^{25.4}$	11	.	.	.	.	.	.
Linaria macroura	.	.	.	$16^{25.1}$	.	.	.	.	6	10	.
Diagnostic species for the subassociation *Stipo brauneri-Bromopsidetum cappadocicae typicum*:											
Stipa brauneri	3	.	.	.	32^{28}	$50^{49.4}$	.	.	2	.	.
Scorzonera mollis	9	.	.	4	$50^{25.8}$	$56^{30.9}$	14	15	12	30	12
Bromopsis cappadocica	.	6	6	.	$25^{14.3}$	$69^{58.6}$	5	.	.	10	.
Teucrium chamaedrys	12	12	6	.	$34^{32.6}$	6	9	.	.	.	.
Orchis picta	3	.	.	.	$23^{31.4}$	6	5	5	.	.	.
Ornithogalum flavescens	6	.	.	2	$23^{31.3}$	6	5	.	.	.	.
Dactylis glomerata	28	6	20	2	$36^{26.4}$	12	5	5	2	.	.
Plantago lanceolata	6	44	37	.	$45^{25.3}$	.	14	.	14	.	12
Diagnostic species for the subassociation *Stipo brauneri-Bromopsidetum cappadocicae jurineetosum stoechadifoliae*:											
Jurinea stoechadifolia	.	.	.	.	5	$88^{89.3}$	.	.	2	.	.
Dianthus capitatus	.	.	.	.	2	$56^{68.7}$	5	.	.	.	.
Artemisia lerchiana	3	.	.	.	.	$38^{51.9}$	5	.	2	.	.
Alyssum tortuosum	.	.	.	.	.	$19^{41.6}$	.	.	.	.	.
Astragalus pubiflorus	.	.	.	.	2	$19^{38.9}$	.	.	.	.	.

Codes of syntaxa	A1	B1	B2	B3	C1a	C1b	C2a	C2b	C3	C4	H1
Average total cover of vegetation (%)	80	75	75	70	70	55	70	80	70	75	80
Number of relevés	32	39	35	49	44	26	41	20	51	20	17
Veronica verna	.	.	6	.	2	$25^{34.9}$	9	.	.	.	.
Koeleria cristata	19	6	11	8	$55^{14.6}$	$75^{28.4}$	36	25	41	10	75
Diagnostic species for the subassociation *Ephedro distachyae-Stipetum capillatae typicum:*											
Stipa capillata	3	12	6	51	11	25	$100^{38.8}$	65	18	60	88
Linaria genistifolia	6	6	6	.	.	.	$36^{29.1}$	25	12	.	12
Diagnostic species for the subassociation *Ephedro distachyae-Stipetum capillatae helichrysetosum arenarii:*											
Helichrysum arenarium	.	.	.	.	.	6	14	$50^{52.1}$	.	10	.
Echinops ruthenicus	3	6	3	.	2	6	.	$50^{50.7}$	.	.	12
Achillea leptophylla	.	6	3	.	.	.	.	$40^{45.5}$	4	.	12
Limonium sareptanum	.	.	3	8	2	.	9	$45^{41.3}$	4	10	12
Herniaria besseri	.	.	.	.	.	.	.	$20^{38.6}$	4	.	.
Tragopogon dasyrhynchus	.	.	.	.	7	6	5	$30^{37.9}$	4	.	.
Jurinea multiflora	.	.	.	2	.	.	9	$40^{37.3}$	2	10	25
Astragalus varius	.	.	.	.	.	.	.	$15^{37.2}$	.	.	.
Polygonum aviculare	.	.	.	.	.	.	.	$15^{34.5}$	2	.	.
Polycnemum arvense	.	.	.	.	.	.	.	$15^{34.5}$	2	.	.
Asparagus officinalis	3	.	.	.	.	.	14	$25^{32.1}$	6	.	.
Thymus x dimorphus	.	.	.	.	16	25	14	$35^{30.6}$	2	.	.
Artemisia austriaca	22	6.	20	45	2	.	23	$75^{29.5}$	$57^{17.2}$	60	38
Kochia prostrata	22	19	23	41	14	38	23	$75^{26.7}$	49	30	50
Diagnostic species for the association *Tanaceto millefolii-Salvietum nemorosae:*											
Bromopsis riparia	3	6	3	.	7	19	36	20	$57^{31.6}$	.	50
Securigera varia	22	.	6	2	36	.	9	10	$47^{27.7}$	.	38
Tanacetum millefolium	16	.	3	14	2	.	32	45	$55^{25.7}$	20	50
Diagnostic species for the association *Stipo ucrainicae-Agropyretum pectinati:*											
Stipa ucrainica	.	.	.	18	9	.	5	15	4	$80^{62.9}$	12
Serratula erucifolia	6	.	.	20	5	12	9	5	14	$70^{48.4}$	25
Diagnostic species for the association *Stipo lessingianae-Salvietum nutantis:*											
Stipa lessingiana	6	.	.	18	7	.	9	35	16	.	$88^{61.1}$
Stachys recta	.	.	.	.	2	.	18	.	6	.	$50^{53.6}$
Salvia nutans	3	.	.	.	.	.	$32^{18.8}$	20	8	10	$62^{48.3}$
Asperula cynanchica	3	.	.	.	11	12	.	10	12	.	$50^{45.4}$
Medicago falcata	38	6	6	8	25	38	27	45	$59^{18.4}$	10	$88^{37.9}$
Diagnostic species for the alliance *Artemisio tauricae-Festucion valesiacae*											
Artemisia santonicum	12	$69^{51.9}$	$46^{30.4}$	6	.	6	.	.	6	.	.
Limonium meyeri	6	$62^{42.9}$	$57^{38.1}$	8	2	6	.	.	8	10	.
Limonium tschurjukiense	.	.	.	$14^{22.4}$	.	.	.	.	6	10	.
Diagnostic species for the alliance *Tanaceto millefolii-Galatellion villosae:*											
Ephedra distachya	.	.	3	6	20	$69^{33.5}$	36	60^{27}	6	10	50
Salvia nemorosa	53	19	26	10	50	12	45	25	$65^{21.3}$	20	38
Tulipa gesneriana	.	.	.	$22^{22.1}$	5	6	.	.	2	30	.
Sideritis montana	.	.	3	.	2	6	.	.	$12^{21.3}$	.	.
Jurinea mollis	3	.	.	2	$27^{23.3}$	25	18	5	4	.	.
Silene otites aggr.	28	6	20	6	41	44	36	10	$53^{19.1}$	20	25
Centaurea diffusa	28	19	34	6	$50^{19.7}$	31	14	20	22	10	25
Pleconax subconica	3	.	.	12	7	31	9	25	4	20	.
Myosotis micrantha	.	6	.	$20^{21.1}$	7	.	14	10	2	.	.

Codes of syntaxa	A1	B1	B2	B3	C1a	C1b	C2a	C2b	C3	C4	H1
Average total cover of vegetation (%)	80	75	75	70	70	55	70	80	70	75	80
Number of relevés	32	39	35	49	44	26	41	20	51	20	17
Euphorbia seguieriana	25	12	14	20	59$^{14.6}$	31	41	65	31	30	75
Dianthus elongatus	3	6	3	.	32$^{18.1}$	.	23	.	25	10	38
Muscari neglectum	3	.	.	.	11$^{23.4}$	.	5	.	.	.	.
Diagnostic species for the order *Galatello villosae-Stipetalia lessingianae:*											
Agropyron pectinatum	34	19	49	59	32	38	64	85	75^{15}	80	25
Galatella villosa	3	6	6	29	80$^{23.4}$	75	41	40	37	80	75
Phlomis pungens	31	6	9	43	30	38	23	20	37	30	50
Poa bulbosa	31	31	29	57	34	19	50	30	45	30	.
Alyssum desertorum	6	.	.	20	14	19	9	10	20	10	.
Carduus uncinatus	12	19	11	57$^{23.4}$	41	25	36	.	33	40	.
Cruciata pedemontana	.	.	3	14^{15}	2	.	.	.	.	30	.
Diagnostic species for the class *Festuco-Brometea:*											
Galium verum	12	.	3	.	34^{14}	44	14	30	6	10	38
Teucrium polium	3	6	9	.	18	44	45$^{21.5}$	25	10	10	38
Filipendula vulgaris	.	.	.	.	11$^{24.6}$	6	.	.	.	.	.
Eryngium campestre	25	50	40	16	57	62	73$^{21.5}$	45	31	10	25
Festuca valesiaca	66	81	57	82	86	81	82	95	96^{12}	80	88
Botriochloa ischaemum	3	.	.	.	16$^{23.2}$	6	9	.	.	.	.
Achillea millefolium	38	31	34	12	23	19	5	10	8	20	38
Falcaria vulgaris	44	19	34	47	27	12	36	40	51	40	62
Linum perenne	12	.	6	6	45$^{23.6}$	38	5	5	25	10	38
Cerastium glomeratum	.	.	.	.	11$^{22.9}$	6	.	.	2	.	.
Seseli tortuosum	12	25	14	6	20	6	32	25	12	20	38
Crepis tectorum	22	12	9	33$^{15.4}$	7	.	5	10	8	50	12
Salvia aethiopis	9	.	17	31$^{24.1}$	7	.	9	15	10	.	.
Potentilla recta	19	.	6	12	34	38	55	30$^{21.1}$	20	20	62
Senecio vernalis	34	6	6	35$^{20.9}$	.	.	5	5	14	10	25
Other species:											
Galium humifusum	22	38	37	8	2	.	.	10	22	10	.
Artemisia absinthium	16$^{24.5}$	.	3	.	.	.	.	.	.	.	12
Galium aparine	9	12	11	20$^{19.8}$	.	.	.	.	.	10	.
Atriplex tatarica	6	.	9	20$^{21.7}$	.	.	.	10	2	10	.

Table 3: Floristic table of the new syntaxa of the alliance *Artemisio tauricae-Festucion valesiacae*: associations *Agropyro pectinati-Artemisietum tauricae* (rel. 1–10), *Cerastio syvashici-Poetum bulbosae* (rel. 11–20).

Tabela 3: Floristična tabela novih sintaksonov zveze *Artemisio tauricae-Festucion valesiacae*: asociaciji *Agropyro pectinati-Artemisietum tauricae* (popisi 1–10), *Cerastio syvashici-Poetum bulbosae* (popisi 11–20).

Relevé №	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Slope (°)	5	1	1	0	1	5	5	5	3	15	1	5	0	10	1	1	3	10	1	2
Aspect (°)	160	20	0	90	90	320	90	50	340	100	200	170	350	350	180	15	180	10	90	270
Cover (%)	60	90	70	90	60	70	70	70	60	70	65	85	70	70	90	80	70	60	90	70
Diagnostic species for the association *Agropyro pectinati-Artemisietum tauricae*																				
Artemisia taurica	3	2	3	3	2	3	4	4	3	3	.	.	3	.	.	.	.	1	1	.
Anisantha tectorum	1	.	1	.	.	.	1	.	1	1	.	1	.	.	.	.	.	1	.	.
Consolida paniculata	1	1	+	.	.	+	1	.	+	+	.	.	.	.	.	.	.	.	1	.
Diagnostic species for the association *Cerastio syvashici-Poetum bulbosae*																				
Ornithogalum kochii	.	.	.	.	.	.	.	.	.	.	+	+	.	1	1	+	1	+	.	+
Cerastium syvaschicum	1	.	.	1	.	.	.	.	.	.	1	1	1	1	1	1	1	1	1	+
Myosotis micrantha	.	.	.	.	.	.	.	.	.	.	1	.	1	.	.	1	.	.	+	1
Stipa capillata	.	.	.	.	.	.	.	.	.	.	1	1	1	2	1	.	1	.	.	.
Taraxacum erythrospermum	.	.	.	1	.	.	.	.	.	.	.	.	+	1	+	1	.	.	.	+
Diagnostic species for the alliance *Artemisio tauricae-Festucion valesiacae*																				
Limonium meyeri	.	1	.	1	.	+	.	.	.	1	.	.	.	.	.	.	.	.	.	.
Agropyron pectinatum	2	2	.	.	1	1	2	.	2	.	.	2	1	.	.	.	3	4	5	.
Atriplex tatarica	.	.	1	1	.	1	.	.	.	.	.	.	1	.	.	.	.	.	.	.
Tulipa gesneriana	.	+	.	.	.	.	.	.	.	.	.	1	1	+	.	.	.	.	.	.
Galium tenuissimum	1	.	.	.	+	.	.	.	.	.	1	.	1	1	.	.	1	.	.	.
Marrubium peregrinum	.	.	.	.	.	.	1	.	1	1	.	.	.	.	.	.	.	1	.	.
Cardaria draba	.	.	1	1	.	+	.	1	.	1	.	1	1	.	.	.	.	.	1	.
Peganum harmala	.	.	.	.	1	.	.	.	1	.	.	.	.	.	.	.	.	.	+	.
Trifolium retusum	.	.	.	1	.	.	.	.	.	.	.	.	1	.	.	.	.	+	.	.
Diagnostic species for the class *Festuco-Brometea*																				
Artemisia austriaca	.	.	.	1	.	.	.	.	.	.	1	.	1	.	.	.	.	.	3	.
Stipa ucrainica	.	.	.	.	.	.	.	.	.	.	3	.	1	2	.	.	.	.	.	.
Serratula erucifolia	.	.	.	.	.	.	.	.	.	.	1	.	1	1	.	.	.	.	.	.
Tragopogon major	1	.	+	.	+	.	.	+	.	+	.	.	.	.	.	.	.	+	.	.
Senecio vernalis	.	.	.	.	.	.	.	.	.	+	+	+	.	.	1	.	1	.	.	+
Salvia nemorosa aggr.	.	.	.	.	1	.	1	.	1	.	.	.	.	.	.	.	.	1	.	.
Potentilla obscura	.	.	.	1	.	.	.	+	.	.	.	+	.	.	.	1	.	.	.	.
Bromus squarrosus	.	.	.	.	.	4	.	1	2	.	.	.	.	.	.	.	2	.	.	.
Crepis tectorum	.	.	+	.	.	.	.	.	.	.	.	.	.	1	.	1	1	1	.	.
Festuca valesiaca	1	3	1	1	.	.	.	.	1	.	2	4	2	3	4	4	1	.	.	3
Centaurea diffusa	1	.	1	.	1	.	.	.	1	.	.	.	.	.	.	+	.	.	+	.
Galatella villosa	.	2	.	.	.	.	.	.	.	.	2	1	.	2	.	.	.	.	.	.
Eryngium campestre	.	.	1	.	1	1	+	.	.	1	.	1	.	.	+	+	.	.	.	.
Kochia prostrate	.	.	.	.	.	+	+	.	.	.	.	1	+	1	.	.	1	1	.	.
Poa bulbosa	1	.	1	.	1	1	1	1	.	.	.	2	.	.	2	2	2	1	.	1
Phlomis pungens	.	.	.	1	.	.	1	1	.	.	1	1	.	.	1	1	.	.	1	.
Carduus uncinatus	.	.	.	.	.	+	.	.	.	.	.	1	2	.	2	+	1	+	1	.
Falcaria vulgaris	.	1	.	.	1	.	.	.	.	1	.	.	1	.	1	.	.	+	.	.
Lactuca serriola	.	1	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Verbascum densiflorum	.	.	+	.	+	.	+	.	+	+	.	.	.	.	1	.	.	.	.	.
Linum austriacum	.	.	1	.	.	.	.	.	1	.	.	1	.	.	1	.	.	.	.	.

Relevé №	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Slope (°)	5	1	1	0	1	5	5	5	3	15	1	5	0	10	1	1	3	10	1	2
Aspect (°)	160	20	0	90	90	320	90	50	340	100	200	170	350	350	180	15	180	10	90	270
Cover (%)	60	90	70	90	60	70	70	70	60	70	65	85	70	70	90	80	70	60	90	70
Other species																				
Elytrigia repens	.	4	1	4	3	.	.	.	1	.	.	.	.	1	1	3	1	1	1	1
Vicia cracca	.	1	.	.	.	.	.	.	.	.	.	.	1	1	1	.	.	1	.	.
Galium aparine	.	1	.	1	.	.	.	.	.	.	.	1	.	.	.	.	.	.	+	1
Lamium amplexicaule	.	.	.	+	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.	1
Viola kitaibeliana	.	1	.	.	.	.	.	.	.	.	.	1	1	.	.	1	.	+	+	.
Salvia aethiopis	1	.	.	.	.	.	.	.	1	+	.	.	.	.	+	.	.	.	.	+
Anthemis ruthenica	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	1	.	.	.	.

Species with small frequency: *Achillea setacea* (3: 1; 8: 1; 10: 1), *Acroptilon repens* (3: 2; 18: 1), *Adonis flammea* (17: +), *Alcea rugosa* (8: 1), *Allium guttatum* (18: +), *A. rotundum* (2: 1; 7: 1), *Alyssum desertorum* (11: 1; 12: +; 18: 1), *A. hirsutum* (7: +; 17: 1), *Anthemis cotula* (3: 1), *Arenaria uralensis* (10: +), *Artemisia absinthium* (8: 1), *A. santonicum* (20: 1), *Asparagus polyphyllus* (14: 1), *Astragalus asper* (14: 1), *A. corniculatus* (12: 1), *A. reduncus* (12: 1), *A. ucrainicus* (11: 1), *Bellevalia sarmatica* (11: +), *Bromus hordeaceus* (6: +; 10: 3), *Buglossoides arvensis* (13: +), *Camphorosma monspeliaca* (20: 1), *Capsella bursa-pastoris* (3: 1; 7: +), *Carduus acanthoides* (9: 1), *C. tauricus* (8: +), *Caroxylon laricinum* (2: 1), *Centaurea adpressa* (14: 1), *C. salonitana* (7: +), *Cerastium perfoliatum* (4: 1), *Chondrilla juncea* (7: +), *Cirsium arvense* (3: 1; 8: 1), *Clinopodium vulgare* (8: +), *Conium maculatum* (2: 1), *Convolvulus arvensis* (3: 1; 5: +; 10: 1), *Conyza canadensis* (3: +), *Cruciata pedemontana* (14: 1; 16: 1), *Dactylis glomerata* (8: 3), *Dasypyrum villosum* (6: 2), *Dianthus elongatus* (7: +), *Dichodon viscidum* (3: 1; 4: 1; 20: 1), *Diplotaxis tenuifolia* (9: 1), *Elisanthe viscosa* (13: 1; 19: +), *Ephedra distachya* (7: 2; 14: 1; 17: 1), *Erodium cyconium* (18: +), *Euphorbia leptocaula* (18: +), *E. seguieriana* (15: 1; 16: 1; 20: 1), *Ferula caspica* (12: +), *Galatella dracunculoides* (1: 1; 2: 1; 8: 1), *Galium humifusum* (5: 1; 10: 1; 17: 1), *G. ruthenicum* (7: 1; 8: 1), *Geranium pusillum* (20: 1), *Goniolimon tataricum* (1: 1), *Heliotropium suaveolens* (6: +), *Hyoscyamus niger* (2: 1), *Iris pumila* (11: 1; 12: 1), *Jurinea multiflora* (7: +), *Koeleria cristata* (1: 1; 11: 1; 16: 1), *Kohlrauschia prolifera* (6: +; 9: +), *Lactuca tatarica* (13: 1), *Leopoldia comosa* (5: +), *Lepidium perfoliatum* (12: 1), *Limonium sareptanum* (5: 1; 7: +; 17: 1), *L. tschurjukiense* (19: 1), *Linaria genistifolia* (1: 1), *L. macroura* (16: +), *Malva mauritiana* (6: +), *M. pusilla* (13: 1), *Medicago falcata* (4: 1; 7: 1; 14: 1), *M. lupulina* (13: 1; 15: 1; 16: 1), *M. sativa* (7: +), *Meniocus linifolius* (17: 1), *Nigella arvensis* (5: +), *Ornithogalum ponticum* (18: +), *Otites artemisetorum* (7: +; 9: +), *O. densiflorus* (7: +; 8: +), *Papaver dubium* (2: 1; 5: +; 14: +), *P. hybridum* (9: +), *P. rhoeas* (9: +), *Pastinaca clausii* (15: 1), *Phelipanche lanuginosa* (1: +), *Plantago lanceolata* subsp. *lanuginosa* (1: 1; 5: 1), *Pleconax subconica* (14: 1; 18: +), *Poa angustifolia* (5: 1; 10: 1), *Potentilla argentea* (10: 1), *P. semilaciniosa* (4: 1), *Prangos odontalgica* (2: 1), *Pterotheca sancta* (20: 1), *Ranunculus oxyspermus* (12: +; 16: 1), *R. scythicus* (20: 1), *Scleranthus verticillatus* (16: 1), *Scolymus hispanicus* (5: +; 6: +), *Securigera varia* (1: 1; 14: 1), *Senecio jacobaea* (3: +), *Seseli tortuosum* (1: +; 5: +; 20: 1), *Sisymbrium loeselii* (18: 1), *Stipa lessingiana* (12: 1), *Tanacetum millefolium* (11: 1; 12: 1; 19: 1), *Thlaspi perfoliatum* (10: +), *Thymelaea passerina* (9: +), *Trifolium arvense* (13: 1; 18: 1; 20: 1), *T. dubium* (18: +), *Trinia hispida* (16: +), *Valeriana tuberosa* (4: +; 13: +), *Valerianella costata* (4: 1), *Verbascum blattaria* (1: +; 16: +), *V. phoeniceum* (9: +), *Veronica teucrium* (4: 1), *V. triphyllos* (10: +; 11: 1; 20: 1), *Vicia angustifolia* (4: 1; 6: 1), *V. lathyroides* (4: 1; 14: 1; 17: 1), *V. tetrasperma* (14: 1).

Localities:
1 – 46° 21’ 04.39” N, 35° 05’ 04.35” E (19. 07. 2005); 2 – 46° 08’ 35.17” N, 34° 15’ 57.90” E (04. 07. 2006);
3 – 46° 10’ 56.70” N, 34° 14’ 31.51” E (16. 06. 2005); 4 – 46° 08’ 14.57” N, 34° 16’ 05.60” E (04. 07. 2006);
5 – 45° 21’ 25.33” N, 35° 05’ 23.64” E (12. 08. 2011); 6 – 45° 28’ 51.23” N, 36° 20’ 26.61” E (09. 09. 2011);
7 – 46° 10’ 30.35” N, 34° 45’ 24.84” E (14. 07. 1999); 8 – 45° 21’ 42.42” N, 37° 04’ 53.45” E (22. 05. 2009);
9 – 45° 17’ 12.84” N, 35° 30’ 23.13” E (08. 06. 2009); 10 – 45° 45’ 08.57” N, 34° 42’ 38.55” E (31. 05. 2012);
11 – 46° 13’ 38.07” N, 33° 56’ 10.86” E (09. 05. 2003); 12 – 46° 07’ 27.28” N, 34° 02’ 17.52” E (09. 05. 2003);
13 – 46° 07’ 16.34” N, 34° 27’ 02.99” E (22. 04. 2011); 14 – 46° 04’ 57.31” N, 34° 14’ 36.70” E (12. 05. 2011);
15 – 46° 07’ 36.32” N, 34° 02’ 18.03” E (12. 05. 2011); 16 – 46° 05’ 52.01” N, 34° 01’ 25.51” E (12. 05. 2011);
17 – 46° 23’ 54.82” N, 36° 06’ 34.61” E (13. 05. 2011); 18 – 46° 05’ 16.21” N, 34° 18’ 21.84” E (26. 05. 2010);
19 – 46° 09’ 49.81” N, 33° 48’ 43.18” E (23. 09. 2011); 20 – 46° 35’ 52.25” N, 35° 22’ 01.83” E (27. 04. 2013).

Table 4: Floristic table of the new syntaxa of the alliance *Tanaceto millefolii-Galatellion villosae*: associations *Stipo brauneri-Bromopsidetum cappadocicae* (rel. 1–20), *Ephedro distachyae-Stipetum capillatae* (rel. 21–40).

Relevé №	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Slope (°)	7	3	1	5	7	7	3	2	5	2	7	7	3	3	10	15	3
Aspect (°)	50	270	10	320	320	40	30	270	340	0	10	345	345	360	320	300	0
Cover (%)	70	80	60	60	60	75	80	70	70	60	90	60	70	70	60	60	50
Diagnostic species for the subassociation *Stipo brauneri-Bromopsidetum cappadocicae typicum*																	
Stipa brauneri	1	2	1	.	.	5	5	.	.	5	.	.	.	2	4	2	.
Orchis picta	.	.	+	.	.	.	+	.	+	.	+	.	.	.	.	.	.
Diagnostic species for the subassociation *Stipo brauneri-Bromopsidetum cappadocicae jurineetosum stoechadifoliae*																	
Jurinea stoechadifolia	.	.	.	.	.	.	.	.	.	.	2	+	3	.	.	1	3
Dianthus capitatus	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	1	+
Bromopsis cappadocica	1	.	.	.	.	1	.	2	.	.	1	1	1	3	.	.	.
Cephalaria uralensis	.	.	.	+	.	.	.	.	.	.	1	.	.	1	.	1	1
Diagnostic species for the subassociation *Ephedro distachyae-Stipetum capillatae typicum*																	
Stipa capillata	.	1	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.
Linaria genistifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Diagnostic species for the subassociation *Ephedro distachyae-Stipetum capillatae helichrysetosum arenarii*																	
Helichrysum arenarium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Echinops ruthenicus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Achillea leptophylla	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tragopogon dasyrhynchus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Astragalus varius	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Asparagus polyphyllus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Artemisia austriaca	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Diagnostic species for the alliance *Tanaceto millefolii-Galatellion villosae*																	
Ephedra distachya	.	.	1	1	.	.	.	.	.	.	2	1	2	1	1	1	1
Agropyron pectinatum	.	1	.	.	.	1	.	.	.	.	1	.	.	.	2	1	.
Scorzonera mollis	.	.	1	+	.	.	+	+	+	1	1	+	+	.	1	+	.
Poa bulbosa	1	.	1	1	.	.	.	.	.	1	1	.	.	.	.	1	.
Galatella villosa	2	1	3	3	1	.	4	.	4	2	1	2	1	.	3	3	.
Kochia prostrata	.	.	+	+	.	.	.	.	.	.	.	.	1	.	1	.	1
Bromus squarrosus	.	1	.	1	1	.	.	1	.	1	2	1	.	.	.	1	.
Tanacetum millefolium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stipa lessingiana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Seseli tortuosum	.	+	.	.	+	.	1	.	.	.	.	.	.	.	.	.	.
Limonium platyphyllum	.	+	.	.	1	1	+	.	.	.	.	.	.	.	+	.	.
Jurinea arachnoidea	.	+	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.
Otites densiflorus	.	.	.	+	.	.	.	.	+	+	+	.	.	.	.	+	1
Iris pumila	.	.	.	1	.	.	.	.	.	.	+	.	.	.	+	.	+
Potentilla astracanica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Verbascum blattaria	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Achillea nobilis	.	+	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.
Teucrium polium	.	.	.	.	.	.	.	.	.	1	.	1	1	.	.	.	.
Marrubium peregrinum	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.
Dianthus elongatus	1	.	.	+	.	.	1	.	+	+	.	.	.	.	.	.	.
Goniolimon tataricum	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chondrilla juncea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bellevalia sarmatica	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Kohlrauschia prolifera	.	.	+	1	.	.	.	+	.	.	.	+	.	.	.	.	.
Senecio erucifolius	.	+	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.
Arenaria uralensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Tabela 4: Floristična tabela novih sintaksonov zveze *Tanaceto millefolii-Galatellion villosae*: asociaciji *Stipo brauneri-Bromopsidetum cappadocicae* (popisi 1–20), *Ephedro distachyae-Stipetum capillatae* (popisi 21–40).

18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
3	7	2	3	7	10	7	3	7	5	7	10	5	20	15	25	15	20	5	3	7	5	2
220	0	0	100	80	150	180	150	90	340	320	120	100	100	100	100	90	100	90	100	90	90	0
50	70	60	80	85	55	70	85	75	60	70	70	80	85	85	85	75	75	90	75	70	60	70
2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
3	3	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	1	3	3	3	3	1	4	3	4	3	2	.	+	+	.	.	4	.	1	1	.
.	.	.	.	+	.	1	.	.	1	.	.	.	.	+	.	1	.	.	1	.	+	.
.	.	.	.	.	.	.	.	.	1	.	.	.	1	1	1	1	1	1	2	.	.	1
.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	+	+	+	.	1	+	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	2	1	.	.	1	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	1	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	.	.	.	.	+	.
.	.	.	1	.	.	+	+	.	.	.	.	.	+	1	.	.	.	+	.	.	+	+
.	.	.	.	.	.	.	1	1	.	1	.	.	.	1	1	2	1	1	1	1	1	.
.	.	.	1	.	.	.	.	.	.	1	1	2	2	3	1	3	.	1	1	1	1	1
.	1	.	1	.	.	.	.	2	1	1	.	1	4	4	4	3	1	2	1	2	2	.
1	.	.	.	+	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	+
.	1	.	1	1	1	.	1	.	.	1	.	1	.	.	1	.	.	.	1	.	.	1
.	3	3	1	.	.	.	.	.	1	.	.	.	.	.	.	1	1	2	.	.	2	2
.	1	.	.	.	.	.	.	1	.	.	.	.	1	1	+	.	1	1	.	1	1	.
.	.	1	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.	1	.	1	.	.
.	.	.	1	.	.	.	.	.	.	.	1	1	.	.	.	.	1	.	.	1	.	.
.	.	.	2	.	1	.	.	.	.	.	.	.	.	.	1	1	.	.	.	1	.	.
.	.	.	.	+	.	+	.	1	.	.	+	.	.	.	.	.	.	.	1	+	.	+
.	1	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
1	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	1	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
.	.	.	.	1	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	+	.
1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	1	1	.
.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	1	.	.	.	.
.	.	.	.	.	.	.	.	.	.	+	1	+	.	.	.	.	+	.	.	.	.	.
.	.	.	.	1	1	.	.	1	.	1	.	.	.	.	.	.	1	.	1	1	.	.
+	.	.	.	.	2	.	.	.	1	.	.	.	.	.	1	.	.	.	.	.	.	.
.	.	.	1	.	.	+	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	+	1
.	.	.	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	1	.	1	+
.	.	.	.	.	.	.	1	.	.	.	+	.	+	+	.	.	.	.	.	.	.	.
+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	1	.	1	1	.	.	.	1	.	.	.	.	1	1	.	.	.	.	.

Relevé №	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Slope (°)	7	3	1	5	7	7	3	2	5	2	7	7	3	3	10	15	3
Aspect (°)	50	270	10	320	320	40	30	270	340	0	10	345	345	360	320	300	0
Cover (%)	70	80	60	60	60	75	80	70	70	60	90	60	70	70	60	60	50
Alyssum desertorum	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.
Xeranthemum annum	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
Diagnostic species for the class *Festuco-Brometea*																	
Festuca valesiaca	1	1	3	2	3	.	.	1	3	2	.	1	1	4	1	1	.
Eryngium campestre	.	1	1	+	1	1	1	.	1	.	.	.	1	.	1	.	.
Stipa ucrainica	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.
Euphorbia seguieriana	.	1	+	1	.	1	1	1	.	1	.	.	.	1	.	.	1
Koeleria cristata	1	.	1	1	1	1	1	1	1	.	1	1	1	1	.	.	.
Salvia nutans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Thymus x dimorphus	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	2
Medicago falcata	.	.	.	1	.	1	.	.	1	.	1	.	.	.	1	.	.
Salvia nemorosa aggr.	.	+	.	.	.	1	.	.	1	1	.	.	.	.	.	.	.
Thalictrum minus	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	+
Galium ruthenicum	1	.	.	.	1	1	1	.	1	1	.	+	.	1	1	.	.
Ornithogalum kochii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Tragopogon major	.	+	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.
Bromopsis riparia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1
Stachys recta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Alyssum hirsutum	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
Achillea setacea	1	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.
Oxytropis pilosa	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	+	.
Potentilla obscura	1	+	.	+	.	.	.	.	.	+	.	.	1	.	.	.	.
Potentilla argentea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Asparagus verticillatus	.	.	+	.	.	1	.	.	.	.	.	.	.	+	.	+	.
Veronica triphyllos	.	.	+	.	.	.	.	.	.	1	.	.	+	.	.	.	.
Asperula cynanchica	.	.	.	.	.	.	1	.	.	1	.	.	.	.	.	.	1
Securigera varia	.	1	1	.	.	.	1	.	.	1	.	.	.	.	.	.	.
Phlomis pungens	1	1	.	.	1	.	.	.	.	.	1	.	.	.	.	1	.
Carduus uncinatus	1	+	.	.	.	.	+	1	1	.	+	.	.	.	.	.	.
Convolvulus lineatus	.	.	+	.	.	.	.	3	.	.	.	.	.	.	.	.	.
Falcaria vulgaris	.	.	.	.	.	1	.	.	+	1	.	.	.	.	.	.	.
Erysimum diffusum	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.
Verbascum phoeniceum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pleconax subconica	.	.	.	1	.	.	.	.	.	.	+	.	1	.	.	.	.
Botriochloa ischaemum	.	2	.	2	.	.	.	.	.	.	.	3	.	.	.	.	.
Linum austriacum	.	.	.	1	.	.	.	.	.	.	.	1	1	.	1	.	.
Other species																	
Elytrigia repens	1	.	.	.	1	1	.	.	.	.	.	.	.	.	1	1	.
Consolida paniculata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Centaurea diffusa	.	1	+	+	+	.	+	1	.	.	.	+	+	.	.	.	.
Dactylis glomerata	4	1	.	.	1	1	.	.	.	.	.	1	.	+	.	.	.
Tortula ruralis	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.
Anthemis ruthenica	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.

Species of low frequencies: *Achillea millefolium* (3: 1), *Adonis aestivalis* (11: +), *Aegilops triuncialis* (15: 1; 16: 1), *Agropyron cimmericum* (14: +), *A. desertorum* (19: 1), *Ajuga chia* (26: +; 37: 1), *A. orientalis* (27: 1), *Alcea rugosa* (10: +; 27: +), *Allium firmotunicatum* (10: +), *A. paczoskianum* (14: +; 24: +; 38: +), *A. rotundum* (34: 1; 36: +), *Alopecurus vaginatus* (15: +; 17: 2), *Alyssum tortuosum* (17: 1), *Amygdalus nana* (38: 1), *Anisantha tectorum* (16: 1; 39: 1), *Anthemis cotula* (31: +; 32: +; 34: 1), *A. tinctoria* subsp. *subtinctoria* (7: 1), *Artemisia lerchiana* (16: 2; 17: 1), *A. marschalliana* (27: 1; 36: 1; 37: 1), *A. santonicum* (12: +), *A. taurica* (11: 1; 15: 1; 16: 1),

18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
3	7	2	3	7	10	7	3	7	5	7	10	5	20	15	25	15	20	5	3	7	5	2
220	0	0	100	80	150	180	150	90	340	320	120	100	100	100	100	90	100	90	100	90	90	0
50	70	60	80	85	55	70	85	75	60	70	70	80	85	85	85	75	75	90	75	70	60	70
+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.
.	+	.	.	.	.	1	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
2	2	3	4	4	1	3	4	.	.	1	1	4	2	1	3	2	4	1	3	2	2	1
1	1	1	1	.	.	1	.	1	.	+	+	1	.	+	1	1	1	.	.	1	.	.
.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	2
+	.	1	.	.	.	.	1	1	.	1	1	.	1	1	+	.	.	.	.	1	+	.
.	1	1	1	.	.	.	.	1	.	2	.	1	.	.	.	.	.	.	.	.	.	.
.	.	.	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1
1	.	.	.	1	.	.	.	1	.	.	.	.	2	.	1	.	2	.	.	1	1	.
1	.	1	.	.	.	1	.	1	.	1	1	1	1	.	.	.	.	1	.	1	1	.
.	1	.	1	1	1	1	1	1	.	.	1	1	.	.	.	.	.	.	.	1	.	.
.	.	1	.	.	1	.	1	.	.	+	+	.	1	.	.	.	1	.	.	.	+	.
1	.	1	.	.	.	.	.	.	.	.	1	.	1	.	1	.	2	.	.	.	.	2
.	.	.	.	1	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.
.	.	.	.	+	.	.	1	+	.	.	.	.	.	.	1	.	+	.	.	.	.	.
.	.	.	1	1	1	1	.	.	.	.	.	1	.	.	1	.	.	.	.	1	.	.
.	.	.	1	1	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	1	.	.	.	1	.	1	.	.	.	+	1	1	+	.	1	.	.	+	.
.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.
.	.	.	1	.	.	.	.	.	1	.	.	1	.	+	1	.	+	+	.	.	.	.
.	.	.	.	1	.	.	+	.	1	.	.	.	.	.	.	+	.	.	1	.	.	1
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	1	1	.	.	1	.	.	.	.	.	.	.	+	.	.	.	1	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.
.	.	.	1	.	.	.	.	.	.	+	.	.	.	.	.	.	1	.	.	.	.	.
.	1	.	.	.	1	1	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.
.	1	.	.	.	1	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.
1	.	.	1	.	.	1	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	1	.	.	.	.	.	.	1	1	+	.	+	.	1	.	.	+	+	.
.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	1	.	.	+
.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	+
.	1	.	1	.	.	.	.	1	.	.	.	.	+	1	+	.	.	.	.	.	+	.
.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	1	.	3	1	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	+	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	+	+	.
.	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	2	2	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	+	.	.	1	.	.	.	.

Astragalus henningii (13: +), *A. onobrychis* (18: 1; 24: 1; 30: 1), *A. pubiflorus* (9: +; 14: +; 16: +), *A. reduncus* (8: +), *A. ucrainicus* (23: 1; 30: 1), *Buglossoides arvensis* (24: +), *Bupleurum marschallianum* (5: 1; 28: +), *Calophaca wolgarica* (30: +), *Camelina microcarpa* (8: +; 25: 1), *Carduus acanthoides* (13: +; 24: 1), *Carex ligerica* (39: 1), *C. melanostachya* (37: 1), *C. stenophylla* (40: 3), *Centaurea abbreviata* (2: +; 10: 1; 28: +), *C. adpressa* (22: 1), *C. lavrenkoana* (22: +), *C. orientalis* (23: +), *C. salonitana* (1: +), *C. solstitialis* (6: +; 11: 1), *Cerastium heterotrichum* (1: +; 23: 1; 27: 1), *C. pumilum* (15: +), *C. sp.* (5: 1; 14: +; 28: +), *C. syvaschicum* (12: +; 22: 1), *C.*

ucrainicum (33: 1), *Cerinthe minor* (28: +), *Cladonia rangiformis* (21: 1), *C. sp.* (14: +), *Cleistogenes bulgarica* (22: 1), *C. squarrosa* (39: 1), *Convolvulus arvensis* (25: +; 38: +), *Crambe aspera* (7: +), *Crepis tectorum* (8: +; 26: 1; 33: +), *Cruciata pedemontana* (1: 1), *Crupina vulgaris* (4: +; 12: +), *Cynanchum acutum* (23: +), *Cynodon dactylon* (2: 1; 13: 1; 37: 2), *Dianthus carbonatus* (38: +), *Dianthus pallidiflorus* (23: 1; 24: +; 39: +), *D. platyodon* (37: 1; 39: +), *Dichodon viscidum* (22: 1; 33: +), *Echium biebersteinii* (10: +), *E. vulgare* (24: 1), *Elytrigia elongata* (6: 1; 12: 1), *E. maeotica* (39: 1), *Eremogone rigida* (22: 1), *Erodium cyconium* (8: +), *Erophila verna* (27: 1), *Erysimum repandum* (10: +), *Filago arvensis* (26: +), *Filipendula vulgaris* (9: 1; 11: 1), *Gagea dubia* (29: +), *Galatella dracunculoides* (5: 2; 31: 1), *G. rossica* (13: 1), *Galium tenuissimum* (9: +), *G. volhynicum* (22: +), *Glycyrrhiza glabra* (24: 1), *Goniolimon rubellum* (19: +), *Gypsophila paniculata* (16: +; 24: 1; 39: +), *Herniaria besseri* (26: 1; 34: 1; 37: 1; 38: 1), *Hesperis tristis* (2: +; 8: +), *Hieracium* sp. (17: +; 19: +; 20: +), *H. umbellatum* (13: +; 28: +; 34: +), *H. virosum* (34: +), *Hypericum perforatum* (2: +; 6: 1; 39: +), *Inula aspera* (2: +; 5: 1; 31: +), I. *germanica* (6: 1), *I. oculus-christi* (20: +), *Jurinea granitica* (31: +), *J. multiflora* (36: +; 38: +), *J. sordida* (13: +), *Koeleria glauca* (39: +), *Lactuca serriola* (5: +; 26: +), *Lamium amplexicaule* (27: 1), *Lathyrus tuberosus* (1: +; 9: 1), *Ligustrum vulgare* (31: +), *Limonium gmelinii* (12: +), *L. sareptanum* (26: +; 29: +; 39: +), *Linaria vulgaris* (5: +), *Marrubium praecox* (28: +; 36: 1), *Medicago minima* (37: +), *M. praecox* (8: +; 18: +), *Melandrium album* (32: 1; 35: +), *Melica transsilvanica* (14: 1), *Meniocus linifolius* (21: +; 25: 1; 33: +), *Milium vernale* (9: +), *Muscari neglectum* (27: +), *Myosotis micrantha* (25: +; 33: +; 35: 1), *Nonea rossica* (21: +), *Onobrychis viciifolia* (7: 1; 9: 1; 11: +; 40: +), *Onosma rigida* (3: +; 14: +), *O. tinctoria* (7: +; 9: +), *Ornithogalum flavescens* (7: +; 15: +), *O. melancholicum* (23: +), *Pastinaca clausii* (1: 1; 22: +), *Phelipanche lanuginosa* (27: 1), *Phleum phleoides* (39: 1), *Phlomis hybrida* (22: +), *Plantago lanceolata* (2: +), *P. lanceolata* subsp. *lanuginosa* (7: 1; 25: 1), *P. urvillei* (11: 1; 14: +; 27: 1), *Polycnemum arvense* (39: +), *Polygala major* (9: 1), *Polygonum aviculare* (38: +), *Potentilla semilaciniosa* (29: +), *Prangos odontalgica* (1: 1), *Pterotheca sancta* (12: +), *Ranunculus oxyspermus* (21: 1; 23: 1), *Reseda lutea* (23: +; 33: +), *Rosa adenodonta* (21: +), 32: 1), *Syrenia montana* (37: +), *Taraxacum erythrospermum* (27: 1), *Teucrium chamaedrys* (6: 1; 17: 1), *T. krymense* (3: 1; 10: 1; 14: 1), *Thymelaea passerina* (22: +), *Thymus calcareus* (14: 1), *T. marschallianus* (27: 1; 29: 1; 37: 1), *Trifolium arvense* (37: 1), *T. campestre* (5: 1), *Trinia hispida* (4: +; 10: +; 20: +), *Tulipa ophiophylla* (22: +; 32: +), *T. gesneriana* (3: +), *Valeriana tuberosa* (22: +; 31: +), *Valerianella carinata* (15: +; 16: +), *V. costata* (22: 1), *V. turgida* (5: 1; 12: +; 14: +), *Verbascum densiflorum* (23: +; 24: 1; 38: +), *Veronica peregrina* (16: +), *V. polita* (15: 1), *V. praecox* (32: +), V. sp. (4: 1), *V. spicata* (29: 1), *V. triloba* (15: +), *V. verna* (8: +; 12: +; 18: +), *Vicia angustifolia* (1: 1), *V. cracca* (23: +), *V. tetrasperma* (5: 1), *Viola kitaibeliana* (25: 1; 35: +).

Localities:

1 – 45° 28’ 09.81” N, 36° 21’ 35.68” E (28. 05. 2010); 2 – 45° 26’ 37.20” N, 36° 04’ 38.97” E (09. 09. 2011);
3 – 45° 28’ 41.59” N, 36° 17’ 30.57” E (10. 09. 2011); 4 – 45° 27’ 00.14” N, 36° 26’ 21.46” E (10. 09. 2011);
5 – 45° 23’ 56.45” N, 36° 36’ 56.32” E (18. 09. 2010); 6 – 45° 23’ 57.67” N, 36° 36’ 49.89” E (18. 09. 2010);
7 – 45° 26’ 54.06” N, 36° 05’ 36.78” E (07. 06. 2009); 8 – 45° 19’ 16.38” N, 35° 38’ 50.54” E (08. 06. 2009);
9 – 45° 28’ 14.47” N, 36° 12’ 13.17” E (08. 06. 2009); 10 – 45° 17’ 40.71” N, 35° 33’ 23.31” E (30. 06. 2011);
11 – 45° 26’ 59.79” N, 36° 05’ 54.19” E (28. 05. 2010); 12 – 45° 28’ 04.72” N, 35° 49’ 53.06” E (09. 09. 2011);
13 – 45° 28’ 07.46” N, 35° 49’ 55.76” E (09. 09. 2011); 14 – 45° 28’ 46.84” N, 36° 17’ 37.32” E (10. 09. 2011);
15 – 45° 22’ 35.18” N, 36° 02’ 34.31” E (07. 06. 2009); 16 – 45° 22’ 26.34” N, 36° 02’ 10.98” E (07. 06. 2009);
17 – 45° 26’ 50.03” N, 36° 05’ 18.17” E (07. 06. 2009); 18 – 45° 19’ 16.91” N, 35° 38’ 48.55” E (08. 06. 2009);
19 – 45° 19’ 52.46” N, 35° 41’ 41.83” E (30. 06. 2011); 20 – 45° 17’ 45.34” N, 35° 33’ 33.31” E (30. 06. 2011);
21 – 46° 37’ 05.97” N, 35° 17’ 54.90” E (28. 05. 2008); 22 – 46° 34’ 06.99” N, 35° 16’ 53.21” E (27. 05. 2008);
23 – 46° 46’ 32.99” N, 36° 50’ 54.38” E (05. 05. 2002); 24 – 47° 05’ 37.49” N, 37° 42’ 56.80” E (29. 07. 2010);
25 – 46° 56’ 17.96” N, 37° 10’ 35.65” E (05. 06. 2010); 26 – 46° 32’ 29.85” N, 35° 17’ 40.86” E (26. 07. 2011);
27 – 45° 16’ 29.47” N, 36° 57’ 16.26” E (15. 04. 2011); 28 – 45° 25’ 56.81” N, 36° 34’ 21.10” E (10. 09. 2011);
29 – 46° 06’ 24.87” N, 38° 01’ 55.37” E (19. 04. 2012); 30 – 46° 38’ 07.57” N, 35° 50’ 48.16” E (20. 05. 2012);
31 – 46° 34’ 02.76” N, 35° 17’ 01.05” E (27. 05. 2008); 32 – 46° 37’ 05.10” N, 35° 17’ 54.68” E (27. 05. 2008);
33 – 46° 37’ 07.02” N, 35° 17’ 54.58” E (27. 05. 2008); 34 – 46° 37’ 09.27” N, 35° 17’ 54.48” E (15. 06. 2008);
35 – 46° 37’ 06.42” N, 35° 17’ 55.46” E (15. 06. 2008); 36 – 46° 37’ 09.06” N, 35° 17’ 56.17” E (16. 06. 2008);
37 – 46° 33’ 03.85” N, 35° 17’ 41.20” E (02. 07. 2004); 38 – 46° 41’ 42.07” N, 35° 16’ 58.24” E (15. 08. 2010);
39 – 46° 37’ 33.24” N, 35° 17’ 00.10” E (15. 08. 2010); 40 – 46° 42’ 02.42” N, 35° 17’ 08.63” E (21. 05. 2010):