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THE WESTERN-PONTIC STEPPE VEGETATION IN BULGARIA

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Abstract
The paper presents results of a syntaxonomic analysis of the herbaceous phytocoenoses on the steep stony slopes and the plainy watersheds along the Northern Black Sea Coast and in the internal part of the South Dobrudzha (North-Eastern Bulgaria). The specific patterns of the vegetation in this part of the Balkan-Moesian (Lower-Danubian) forest-steppe province of the Eurasian steppe area is discussed. The comparatively preserved relict steppe vegetation includes relatively high numbers of endemic, rare and threatened species, which is the reason for its importance for conservation of biodiversity and the specific habitats. Two new associations are described: 1) *Alysso caliacrae – Atremisietum lerchianae* with two subassociations – *typicum* and *camphoresmetosum monspeliacae,* and 2) *Paeonio tenuifoliae-Koelerietum brevis* with three variants. The associations belong to the alliance *Pimpinello-Thymion zigoidi* – an endemic syntaxon for Bulgarian and Romanian Black Sea coasts.
Key words: syntaxonomy, *Festuco-Brometea*, *Festucetalia valesiacae*, NATURA 2000

Izvleček
V članku je predstavljena sintaksonomska analiza zeliščnih fitocenoz na strmih kamnitih pobočjih in ravninskih predelih ob severnih obalah Črnega morja in v notranjosti Južne Dobrudže (severovzhodna Bolgarija). Obravnava poseben vzorec vegetacije v tem delu Balkansko-Mezijske (Spodnje donavske) gozdno-stepske province Evroazijskega stepskega območja. Primerljivo ohranjen relikt stepske vegetacije vsebuje relativno veliko število endemnih, redkih in ogroženih vrst, zato je pomemben za ohranjanje biodiverzitete in posebnih habitatov. Opisani sta dve novi asociaciji: 1) *Alysso caliacrae-Atremisietum lerchianae* z dvema subasociacijama – *typicum* in *camphoresmetosum monspeliacae,* in 2) *Paeonio tenuifoliae-Koelerietum brevis* s tremi variantami. Asociaciji uvrščamo v zvezo *Pimpinello-Thymion zigoidi* – endemni sintakson na obalah Črnega morja v Bolgariji in Romuniji.
Ključne besede: sintaksonomija, *Festuco-Brometea*, *Festucetalia valesiacae*, NATURA 2000

1. INTRODUCTION

The object of study is the region of the Bulgarian Black Sea coast of Southern Dobrudzha. According to the flora and vegetation of this area, phyto-geographically it belongs to the western border of the Pontic-Kazakhstanian sub-area of the vast Eurasian steppe and forest-steppe area. It is in fact transitional between the southern part of the Balkan-Moesian (Lower-Danubian) forest-steppe province (which is more clearly presented within the interior part of the country), and the Black Sea (Pontic) province (Stefanov 1943, Gribova et al. 1980, zenda 1994, Bozhilova 1982, 1985, Bozhilova & Filipova 1986). In Bulgaria two subtypes represent typical steppes: meadow steppes (more mesophilous and rich in *Dicotyledons*) and mixtoherbose – *Stipa-Festuca* steppes, which include the vegetation studied. In these steppes the species of genus *Stipa* are accompanied by *Festuca valesiaca* and many other cereals (*Koeleria, Cleistogenes, Agropyron*). The communities have a very characteristic, rich, flowering spring spectrum composed by species of the genera *Tulipa, Gagea, Potentilla, Astragalus, Paeonia,*

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Adonis, Iris etc. The subtype of *Artemisia – Festuca – Stipa* steppes also occurs, even though scarcely, as an edaphic phenomenon on the steep slopes. It is different than the semi-desert steppes along the Northern Black Sea regions, distributed on flat and saline surfaces (Gribova et al. 1980).

The flora on the territory of Southern Dobrudzha – between the towns of Balchik and Shabla – was partly investigated by Kozhuharov et al. (2001, 2002.). More general information about the flora and vegetation of the region could be found in the works of Davidov (1914), Yordanov (1936), Stoyanov (1940, 1941a, 1941b, 1950), Stefanov (1943) etc. Phytocoenotic analysis of the vegetation be means of the dominant method was published by Velchev (2002).

The steppes and forest-steppes along the Black Sea parts of Russia and Ukraine share similar characteristics with the studied vegetation (Gribova et al. 1980), but the most similar is the vegetation in Northern Dobrudzha (Romania). However, the petrophyllous steppes in Babadag (Dihoru & Donita 1970, Ivan et al. 1993) have been formed on green shists, while those along the Bulgarian Black Sea coast are on marls and limestone. These and some other ecological conditions affected the development of different groups of phytocoenoses in Northern and Southern Dobrudzha.

2. MATERIAL AND METHODS

The region of study includes the territory starting from the northern part of Balchik and reaches northward to the village of Kamen bryag and the "Yaylata" locality (the whole territory of "Kaliakra" reserve falls into it). To the west, in goes to the inner part of Southern Dobrudzha and reaches the surroundings of the villages Vidno and Irechek ("Gyorensko dere" locality). The relief includes slopes with rocky (saltificated to a different extent Sarmatian marls as well as chalks) revelations near the Black Sea coast. They are mainly landslides (Balchik-Kavarna) and flat calcareous watersheds. The latter ones are specific forms along the line over the Black Sea cliff coast (Kaliakra – Kamen bryag) and in the interior of the studied territory – the slopes of the dry valleys named "kayryatsi"(Gyorensko dere), in Dobrudzha plateau.

The climate along the Bulgarian Black Sea coast north from Balchik is transitional – Continental-Mediterranean. Temperature amplitudes are lower than inside the country and air humidity is higher, because of the sea breeze. The strong northern and eastern winter winds are typical for the region. The mean annual rainfalls are lower than in other regions of the country, which is the reason for the xerothermic peculiarities of the vegetation (Dimitrov & Vekilska 1966, Galabov 1982, Velev 1990).

On the carbonate basic rocks, the soils are rendzic leptosols with xerotermic soil processes; on the molds (chernozems and haplic chernozem) the soil processes are mezothermic. (Tanov 1968, Ninov 1997).

The investigation of the vegetation was performed during the year 2004 according to the methods of the sigmatic school (Braun-Blanquet 1964, Westhoff & Maarel 1978). A total of 82 phytocoenotic relevés were described, but 19 of them were rejected during the process of analysis. The expanded scale of Braun-Blanquet for abundance/dominance (Barkman et al. 1964) was used, transformed according to Maarel (1979) during the statistical processing. The cluster analysis was perfomed by means of the software Syntax (Podani 2002). Average linkage method (UPGMA) was used and floristic similarity among relevés was evaluated according to Horn's index (Krebs 1999).

The taxonomic nomenclature followed Kozhuharov, ed. (1992). The new syntaxa were compared with the similar syntaxa from Northern Dobrudzha (Dihoru & Donita 1970, Ivan et al. 1993, Sanda et al. 1999) and were described according the rules of the International Code of Phytosociological Nomenclature (Weber et al. 2000).

3. RESULTS AND DISCUSSION

The cluster and syntaxonomic analysis of the steppe vegetation in North-Eastern Bulgaria revealed that the syntaxa could be included into the next hierarchical syntaxonomic classification:

Festuco-Brometea Br.-Bl. et R. Tx. in Br.-Bl. 1949
- *Festucetalia valesiacae* Br.-Bl. et R. Tx. in Br.-Bl. 1949
  - *Pimpinello-Thymion zygoidi* Dihoru 1970
    - *Alysso caliacrae-Atremisietum lerchianae* ass. nov. *typicum* subass. nov.
    - *Alysso caliacrae-Atremisietum lerchianae camphoresmetosum monspeliacae* subass. nov.
    - *Paeonia tenuifoliae-Koelerietum brevis* ass. nov. var. typicum
      - *Teucrium chamaedrys* var. nov.
      - *Rhodax canus* var. nov

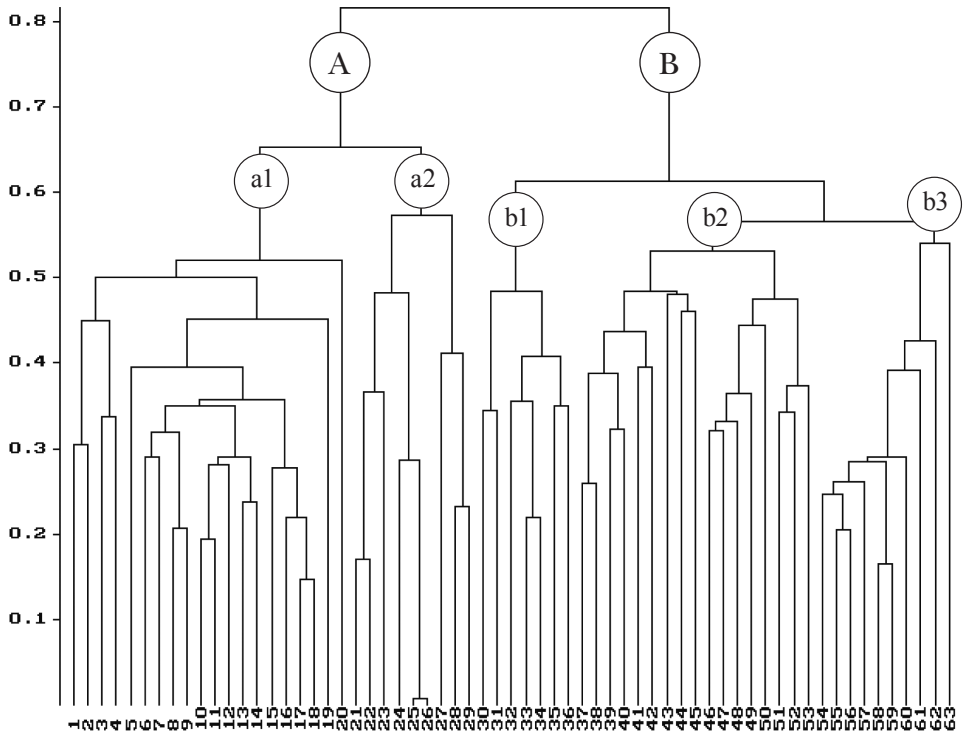

Figure 1: Classification of all relevés. Average linkage method and Horn`s index of dissimilarity. A – ass. *Alysso caliacrae-Atremisietum lerchianae,* a1 – subass. *typicum,* a2 – subass. *camphoresmetosum monspeliacae*; B – ass. *Paeonio tenuifoliae-Koelerietum brevis,* b1 – var. typicum, b2 – var. *Teucrium chamaedrys*, b3 – var. digressive.

Slika 1: Klasifikacija vseh popisov. Kopičenje na osnovi povezovanja srednjih razdalj in Hornov indeks različnosti. A – asociacija *Alysso caliacrae-Atremisietum lerchianae,* a1 – subasociacija *typicum,* a2 – subasociacija *camphoresmetosum monspeliacae*; B – asociacija *Paeonio tenuifoliae-Koelerietum brevis,* b1 – var. typicum, b2 – var. *Teucrium chamaedrys*, b3 – odstopajoča varianta.

Western-Pontic wormwood steppes

Ass. *Alysso caliacrae-Atremisietum lerchianae*

The phytocoenoses forming this group (cluster A – Figure 1) are distributed on the steep slopes (60–90°) with carbonate rocks (Sarmatian marls), along the Black sea coast between Balchik and Kavarna. The most representative of them were in the region of Balchik Tuzla and between the village of Topola and Kavarna ("Chirakman" locality). The exposition is mostly eastern and the soil cover is poorly developed or lacking. Most of the phytocoenoses occur on the acting landslides (Figure 2).

This type of vegetation is of natural origin. Typical chasmophyte plants (adapted for poorly developed soils) predominate: *Achillea clypeolata, Agropy-*

Figure 2: Most of the phytocoenoses occur on the acting landslides.

Slika 2: Večina rastlinskih združb se pojavlja na aktivnih plaziščih.

ron cristatum ssp. *brandzae, Artemisia lerchiana, Astragalus spruneri, Cephalaria uralensis, Kochia prostrata, Satureja coerulea, Ephedra distachya* etc (Table 1). One interesting fact is the participation of the Pontic-Turanian, very rare (only in this region) species *Matthiola odoratissima*. The range of distribution of the dominant species, the halophyte *Artemisia lerchiana* includes the Pontic and Aralo-Caspian regions (Figure 3). Another typical steppe species with a high abundance and constancy is the Pontic geo-element *Agropyron cristatum* ssp. *brandzae*. More important accompanying species are *Astragalus glaucus, A. vesicarius, Jurinea stoechadifolia, Linum austriacum, L. tauricum* subsp. *tauricum, Echinops ritro*. Species such as *Alyssum caliacrae* (Figure 4), *Aster oleifolius, Astragalus spruneri, Festuca valesiaca, Teucrium polium, Thymus zygoides* possess comparatively high constancy, but low abundance. Most of these species are typical steppe elements.

The syntaxonomic analysis of the relevés allowed us to describe a new association *Alysso caliacrae-Artemisietum lerchianae*. Diagnostic species are *Artemisia lerchiana, Agropyron cristatum* ssp. *brandzae, Alyssum caliacrae, Aster oleifolius, Kochia prostrata, Astragalus spruneri and Mathiola odoratissima*. Two groups of relevés (Figure 1) with a high floristic similarity (more than 40%) are distinguished. The presence of differentiating species and the ecological differences define the sub-associations *typicum* and *camphoresmetosum monspeliacae*.

The phytocoenoses from the typical sub-associations (subcluster a1 – Figure 1) are distributed on the slopes north from Balchik ("Tuzlata" locality), south from Kavarna (the villages of Topola and Bozhurets) and those with southern exposition in the Bolata Inlet. The basis rocks are white non-saltificated marls and chalks. This sub-association contains more autochthonous species than the sub-association *camphoresmetosum monspeliacae* (Table. 1), for example, the Balkan endemic *Astragalus spruneri* and the Balkan-Crimean species *Astragalus glaucus*.

The main reason for the difference between the typical sub-association and subassociation *camphorosmetosum monspeliacae* (subcluster a2 – Figure 1) is the character of saltificated Sarmatian marls in the "Chirakman" locality, south from Kavarna. Diagnostic species of the second subass. are *Astragalus vesicarius, Camphorosma monspeliaca* and *Brassica elongata*. Many species, well-presented in the typi-

Figure 3 (Slika 3): *Artemisia lerchiana.*

Figure 4 (Slika 4): *Alyssum caliacrae.*

cal sub-association, are not presented here or else occur at very low constancy. These are: *Salvia nemorosa, Alyssum caliacrae, Astragalus glaucus, Astragalus spruneri, Dianthus pseudoarmeria, Euphorbia nicaensis, Jurinea stoechadifolia, Linum austriacum.* Many ruderals or semi-ruderals as *Brassica elongata, Adonis flammea, Thlaspi arvense, Valerianella pumila* could also be found in this subassociation.

The participation of *Artemisia lerchiana, Agropyron cristatum* subsp. *brandzae, Thymus zygoides, Dianthus pseudoarmeria, Pimpinella tragium* and *Cephalaria uralensis* indicates that this association should be included into the alliance *Pimpinello-Thymion zygoidi* Dihoru 1970, described in Northern Dobrudzha. Thus the range of distribution of this alliance is extended to the Southern Dobrudzha. It is of specific transitional Mediterrano-Pontic origin and is distributed on poor soils and rocky substrates.

The diagnostic species for the order *Festucetalia valesiacae* and the class *Festuco-Brometea* are: *Adonis flammea, Alyssum hirsutum, Astragalus glaucus, Astragalus vesicarius, Ephedra dystachia, Festuca valesiaca, Euphorbia nicaensis, Linum austriacum, Stipa capillata, Seseli tortuosum, Teucrium poliumk, Jurinea stoechadifolia,* and some others.

Similar to the described association are the petrophyllous communities of the associations *Agropyro-Thymetum zygoidi, Koelerio-Artemisietum lerchianae, Festycetum callierii* and *Artemisierum caucasicae* prov., established on the territory of Romania (Babadag, Northern Dobrudzha) (Dihoru & Donita 1970). The floristic composition of the phytocoenoses from Northern Dobrudzha indicates that most similar to the petrophyllous steppe vegetation along Bulgarian Black Sea coast are the associations *Agropyro-Thymetum zygoidi* and *Koelerio-Artemisietum lerchianae* (Babadag). Some of the main species of the phytocoenoses from the Bulgarian Black Sea (Southern Dobrudzha) and Babadag (Northern Dobrudzha) are common and are diagnostic species of the alliance *Pimpinello-Thymion zygoidi*: *Artemisia lerchiana, Agropyron cristatum* subsp. *brandzae, Thymus zygoides.* Of the other species only 6 are common for the associations *Agropyro-Thymetum zygoidi* and *Alysso-Artemisietum lerchianae.* Also, species such as *Festuca callieri, Campanula romanica, Gagea callieri, Potentilla bornmuelleri, Euphorbia glareosa, Minuartia viscosa, Artemisia ucrainica* do not occur or are scarcely represented in the association along the Bulgarian Black Sea coast. The differentiating species of the association *Koelerio-Artemisietum lerchianae* are: *Alyssum caliacrae, Astragalus glaucus, A. spruneri, Jurinea stoechadifolia* etc. They do not occur in the associations from Babadag (Romania).

The newly described association *Alysso caliacrae-Artemisietum lerchianae* is endemic for one limited region of the Bulgarian Black Sea coast, mainly on the landslide terrains between Balchik and Kavarna. The main characteristics of the association and the richness in rare, Pontic and endemic species increase its nature-conservation value.

Western Pontic feathergrass steppes

Association *Paeonio tenuifoliae-Koelerietum brevis*

The phytocoenoses of the association *Paeonio tenuifoliae-Koelerietum brevis* (cluster B – Figure 1) are distributed on the plainy, calcareous belt along the Black sea coast in the regions of Kavarna and Cape Kaliakra, Kamen bryag, Bozhuretz, Bulgarevo villages, north from Bolata Inlet, in the "Yaylata" locality; and in the inner part of Southern Dobrudzha – the villages of Bilo, Vidno ("Gyorensko dere" locality) (Figure 5). Most probably it occurs also on some other places inside the calcareous dry valleys of the Dobrudzha plateau, called "kayryatsi".

Figure 5: High degree of soil erosion demonstrates the clear Mediterranean physiognomy of phytocoenosis.

Slika 5: Erozija nakazuje medtieransko fizionomijo te fitocenoze.

The soils are of different depth, strongly eroded and the Miocene calcareous rocky basis is disclosed on the surface in many places. Other reasons for the soil erosion are the strong east and north winds, which blow along the strip near the sea, mainly in winter. Another very important factor is the continuous human impact, especially grazing pressure. The numerous typical forms of the nano-relief change in a short distance. This combination of ecological factors results in irregular, and in

some cases group distribution of the plants. Therefore, Velchev (2002), using the dominant method, described 8 associations within the plant communities studied.

The analysis of results of the present study provided evidence for the existence of a new association – *Paeonio tenuifoliae-Koelerietum brevis* (Table 1). A mixed complex of Pontic, Mediterranean and Submediterranean species, endemics, and many ruderals and semi-ruderals (some of them with a secondary distribution into the natural communities) plays an important role in the formation of this association. Typical species are: *Festuca valesiaca, Koeleria brevis, Iris pumila, Thymus zygoides, Stipa lessingiana, Cerastium bulgaricum, Chamaecytisus jankae, Euphorbia nicaensis, E. myrsinites, Helianthemum salicif lium, Erysimum diffusum, Inula oculus-christi, Paeonia tenuifolia, Potentilla bornmuelleri, Artemisia pedemontana, Tanacetum millefolium, Satureja coerulea, Scandix australis, Scutellaria orientalis* subsp. *pinnatifida*. The participation of many therophytes is indicative for the natural climatic, soil conditions and for the influence of the pasture.

Diagnostic species for the association are: *Koeleria brevis* (Figure 6), *Cerastium bulgaricum, Paeonia tenuifolia, Chamaecytisus jankae, Helianthemum salicifolium, Potentilla bornmuelleri, Stipa lessingiana* and *Scandix australis*.

Many beautiful-flowered spring species such as *Iris pumila, Adonis vernalis, Scutellaria orientalis, Paeonia tenuifolia* participate within the floristic composition of this association. They form a short-term spring aspect. During the rise of the temperature at the beginning of summer this vegetation finishes its development. Many ruderals, such as *Carduus acanthoides, Carthamus lanatus, Centaurea* spp. and other species from *Asteraceae* continue their development during the summer vegetation period. The seasonal dynamic resembles these petrophyllous steppes to the Mediterranean vegetation and distinguishes them from the Northern Pontic steppe, which has a more continuous vegetation season and several aspects.

Some specific successional processes affected the floristic composition of the dominated grass species. In the primary steppe vegetation, the role of *Festuca valesiaca* is more limited or similar to those of the *Stipa* spp. The active grazing impact on the natural vegetation and the soils resulted in *Festuca valesiaca* being the dominant species, and has limited the role of *Stipa* spp. (Gribova et al. 1980). The floristic composition of the presented association and the cluster dendrogram demonstrate the subdivision into three main groups of phytocoenoses, which represent the variants of the pasture regression of the steppe vegetation.

The most similar to the primary vegetation is the group of phytocoenoses (subcluster b2 – Figure 1, Table 1) described in the region between the village of Bulgarevo, Cape Kaliakra and especially on the watershed north from Bolata Inlet, within the game-breeding farm "Kushlata" (relevés 37–53) near the village of Kamen bryag. *Stipa lessingiana* demonstrates a high constancy (IV), although the more frequently dominant species are *Festuca valesiaca* and *Koeleria brevis. Achillea clypeolata, Scandix australis* (more rare species than the ruderal *Scandix pecten-veneris,* which is well-distributed in the other two variants of the association), *Astragalus vesicarius, Chamaecytisus jankae, Artemisia pedemontana* (Figure 7) which have a high presence. We could suppose that this vegetation is most similar to the

Figure 6 (Slika 6): *Koeleria brevis.*

Figure 7 (Slika 7): *Artemisia pedemontana.*

primary petrophyllous steppes, distributed along the whole Black sea coast of South Dobrudzha, although it differs in the degree of anthropogenic degradation. As most representative could be accepted the phytocoenoses between Bolata Inlet and the village of Kamen bryag, especially inside the enclosure region of the game-breeding farm "Kushlata", where *Stipa lessingiana* is dominant, but *Paeonia tenuifolia, Adonis vernalis* and the ruderal species are less presented.

Another group of phytocoenoses are those on the "kayryak" near to the village of Bozhurets and in the interior of Dobrudzha – "Gyorensko dere" near the village of Vidno (relevés 30-36) (subcluster b1 – Figure 1, Table 1). The soils in these regions are better developed than in the other two variants, although, in spite of the strong grazing pressure and practically complete lack of *Stipa lessingiana*, their floristic composition is richer. Many species that are absent or have a sporadic occurrence within the other two variants, are well-presented in this one: *Convolvulus cantabrica, Vinca herbacea, Artemisia austriaca, Teucrium chamaedrys, Astragalus onobrychis, Salvia argentea, Thlaspi arvense, Linum austriacum, Achillea millefolium, Bromus racemosus, Lappula barbata, Medicago minima, Poa bulbosa, Trigonella gladiata* etc. Some of these species have a very limited distribution in Bulgaria, but most of them are common and demonstrate the more mesophyte character of the phytocoenoses. The reasons are different, but two are more important. They are developed on richer and deep soils, especially in the interior of Dobrudzha, where the influence of the strong winter winds is less expressed. Also, they are more similar to the communities classified as meadow steppes from the Balkan-Moesian province by Gribova et al. (1980). Their distribution was expanded to the places of the former forests because they are developed on richer and more humid soils.

The phytocoenoses of the third group (mainly from the intensively used pasture near the village of Bulgarevo– relevés 54–63) have the main characteristics of the associations. Many autochthonous species have declined from the floristic composition of these phytocoenoses and they have poorer species structures than the other two groups of communities. The high ratio of such species as *Rhodax canus, Artemisia pedemontana* (Figure 5) and *Scutellaria orientalis* ssp. *pinnatifida* underlines the highest degree of soil erosion, and demonstrates the clear Mediterranean physiognomy of this variant.

Many diagnostic species to the alliance *Festucion valesiacae* occur in the floristic composition of the association *Paeonio tenuifoliae-Koelerietum brevis*. These are: *Festuca valesiaca, Astragalus vesicarius, Inula oculus-christi, Stipa capillata*. The association is composed by diagnostic species to *Festucetalia valesiacae* and class *Festuco-Brometea*. Also, some diagnostic species of the alliance *Pimpinello-Thymion zigoidi* are quite well represented. These are species such as *Thymus zygoides, Scutellaria orientalis, Agropyrum brandzae, Potentilla bornmuelleri* and some others. This fact approximates the communities to the alliance *Festucion valesiacae* and syntaxonomically they could be classified as belonging to it, despite their similarity to *Festucion valesiacae* (Table 1).

Some of the above mentioned species do occur, although scarcely, in the associations established in Northern Dobrudzha (Babadag) *Stipo ucrainicae-Festucetum valesiacae* Dihoru 1970 and *Medicagini-Festucetum valesiacae* Wagner 1941 (Dihoru & Donita 1970), which are most similar from the floristic and territorial point of view to the Bulgarian association. The whole composition and structure of the Babadag's associations are different than the Bulgarian one and only a small number of the species are common for both regions of Dobrudzha. For example – *Cerastium bulgaricum* and the Balkan endemic *Chamaecytisus janka* do not occur in the communities in Northern Dobrudzha. The southern border of the distribution of *Stipa ucrainica* is out of the Bulgarian territory. The anthropogenic influence limited the distribution and abundance of some steppe species including the Genus *Stipa* in Bulgaria. It allowed the penetration of the ruderals (*Scandix pecten-veneris, Marrubium peregrinum, Valerianella pumila, Carduus acanthoides, Erodium cicutarium, Bromus racemosus, Thlaspi arvense, Adonis flammea, Achillea millefolium* etc.) in the plant communities. The increased participation of some poisonous species, such as *Paeonia tenuifolia, Adonis* spp. etc. is probably also a result of the pasture regression of these communities. The evidence of such development is the more restricted participation of these species especially in the region north of Bolata Inlet, which is the most similar to the primary vegetation in the region and there is a clearer dominance of *Stipa lessingiana*.

The association *Paeonio tenuifoliae-Koelerietum brevis* is a successional stage of the pasture regression of the natural steppe vegetation. Such are the associations in Northern Dobrudzha. Many preserved fragments of the forest vegetation, having wilder distribution in the past, are presented in the region of study. They are not only on the northern slopes, but also on the watersheds. Single individu-

als or groups of trees (*Quercus pubescens, Fraxinus ornus* etc.) and shrubs (*Crataegus monogyna, Cornus mas, Carpinus orientalis, Paliurus spina-christis, Cotinus coggygria* etc.) represent refugees of the more mesophylous species as *Poa angustifolia, Phleum phleoides, Fragaria viridis, Oryganum vulgare* etc. This fact could be better established especially in the variant with *Teucrium chamaedrys*, which is the most similar to the more mesophylous meadow steppes.

A secondary phenomenon is the distribution of some mono-dominant phytocoenoses of *Asphodeline lutea* in many places in the region of study. An interesting fact is that they are common near the ancient settlements – cape Kaliakra and the region of "Yaylata". The anthropogenic degradation very probably is connected to the mesophytisation and nitration of the terrain near the former settlements, which was favorable for the development of the phytocoenoses of these species. These communities occur naturally within the open bushes. Similar processes are the reasons for the good population of *Paeonia peregrina* around the Byzantine castle on "Yaylata". This species is typical of the open oak woods, widely available on the seaward facing terraces of "Taukliman" ("Rusalka" Resort). Such forests probably have occurred on "Yaylata" too, which is a big terrace over the sea. After deforestation *Paeonia peregrina* and *Asphodeline lutea* survived around the ruins as semi-ruderals. They are forming now mixed communities with some mesoxerophyllous ruderals, which inhabit within the open forests and some of them are nitrophyllous. Such are *Dactylis glomerata, Galium aparine, Hordeum bulbosum, Tordylium maximum, Ornithogalum narbonense, Vicia grandiflora, Geranium rotundifloium* etc. The positive influence of the nitration of the soils, especially for *Paeonia peregrina* has been established experimentally in Bulgaria (Radulovski 2004).

Phyto-geographic character and history of the Western Pontic steppe vegetation.

The results of the present work confirm the hypothesis of the close connection between the steppes in Southern Dobrudzha and the Pontic steppes, as well as the dominant role of some Submediterranean geo-elements for the floristic composition of the steppe vegetation in the investigated region (Stoyanov 1940, 1941 , 1941b, Kozhuharov et al. 2001, 2002). The species, participating in the discussed phytocoenoses, are of southern origin. Their ranges of distribution are in Southern Europe, the Mediterranean region, Caucasus, Southwestern Asia, but many of them have a clear Pontic origin. They practically belong to the flora of the so named "Ancient Mediterranean region" according to the concept of Popov (1963). This idea strongly corresponds to the earlier work of Stoyanov (1925), where he discuses the origin of many so called "steppe species" with a connection with the refugees of Mediterranean flora during the Pleistocene and their invasion during the Holocene. Some of the species reported by the authors do not occur in the relevés studied in this work, and conversely, some species we found are absent in these works. This fact does not change the common composition of the geoelements within the new associations, which confirms the facts established by the cited authors.

According to Kozhuharov et al. (2002) inside the biggest group of Sub-Mediterranean geo-elements are the following species: *Aegilops geniculata, Crepis sancta, Nonea pulla, Sideritis montana, Valerianella pumila, Xeranthemum annuum, Ligustrum vulgare, Cornus mas, Carpinus orientalis, Acinos suaveolens, Campanula sibirica, Euphorbia nicaensis, Festuca valesiaca, Linum austriacum, Salvia nemorosa, Scutellaria orientalis, Teucrium chamaedrys, Digitalis lanata, Vicia grandiflora* etc. The second position keep the Eurasian (s. lat.) species: *Adonis wolgensis, Daucus carota, Dactylis glomerata, Hyacinhtella leucophaea, Matthiola odoratissima* (rather Pontic-Turanian species), *Medicago falcata, M. minima, Poa bulbosa, Scandix pecten-veneris* etc. Euro-Mediterranean geoelement are: *Asperula cynanchica, Astragalus vesicarius, Carduus acanthoides, Filipendula vulgaris, Stachys recta* etc. Pontic-Mediterranean and Mediterranean species are: *Carduus pycnocephalus, Crupina vulgaris, Iris pumila, Medicago disciformis, Satureja coerulea, Ziziphora capitata, Ajuga chamaepytis, Asphodeline lutea, Centaurea napulifera* subsp. *thirkei, Cephalaria uralensis, Eryngium campestre, Euphorbia myrsinites, Fraxinus ornus, Haplophyllum suaveolens, Jasminum fruticans, Potentilla bornmuelleri, Salvia argentea, Stipa capillata, Tanacetum milleflium, Trigonella gladiata* ect. The species belonging to the Euro-Siberian group and other geo-elements are less represented.

The Sub-Mediterranean aspect of the investigated vegetation is the reason that Rodwell et al. (2002) defined the alliance *Pimpinello-Thymion zigoidi* as "semi-evergreen 'phrygana'-like vegetation of the east Balkan steppes".

Many rare and endemic species to Bulgaria or the Balkan Peninsula participate in the floristic composition of the investigated phytocoenoses. This fact increases their value for the conservation

of biodiversity on national and international level. The group of the rare species includes: *Adonis wolgensis, Matthiola odoratissima, Avena eriantha* and *Bellevalia ciliata* (they both have only one locality in the country in "Kaliakra" Reserve), *Scandix australis, Artemisia pedemontana, A. lerchiana, Ruta graveolens, Convolvulus lineatus, Anchusa stylosa, Nepeta parviflora, Scabiosa atropurpurea, Koeleria brevis, Paeonia tenuifolia, Stipa lessingiana, Goniolimon besseranum.* Some of these species, not occurring or being very rare in other places in Bulgaria, are dominants in the part of the phytocoenoses in Dobrudzha. The percentage of the endemics and sub-endemics is high, too: *Alyssum caliacrae, Astragalus spruneri, Achillea clypeolata, Chamaecytisus jankae, Satureja coerulea, Koeleria davidovii, Jurinea stoechadifolia.*

Another interesting question is that of the origin and the phyto-geographycal relations of this vegetation with the steppes north from it. These steppes are a continuation of the cold, often saltificated steppes distributed during the Ice Age, which were dominated by *Artemisia, Chenopodiaceae.* Contrary to other places in Bulgaria, the forest invasion during the Holocene with the improvement of the climatic conditions was not so active, and the dominated landscape was the forest-steppes. (see Bozhilova 1982, 1985, Bozhilova & Filipova 1986). Inside the interior of Dobrudzha, probably during the improvement of the climatic and soil conditions, the forest vegetation increased. Therefore, Davidov (1914) considered wrongly that the whole Dobrudzha was covered by forests in the past, which were destroyed by the humans. The most deforested one is the strip near the sea, where the forest vegetation has survived only on some wet slopes and valleys ("Taukliman", "Kushlata"). Only strongly xerophytic species participate in their floristic composition. The main reason for this condition is the poor soil cover, which was caused by the strong winds and the human influence over the vegetation. As was already mentioned, according to Gribova et al. (1980) the Bulgarian steppes (and forest-steppes) belong to Balkan-Moesian (Lower-Danubian) meadow and various-grass – *Festuca - Stipa* steppes. However, we should note also their high similarity to the typical Black sea steppes (Pontic province) and especially to their edaphic (petrophyllous) subtype. The main difference is the strong Mediterranean influence in Bulgaria. We could presume that the invasion of Mediterranean species (mainly aromatic semi-shrubs, terophytes and ruderals) happened during the improvement of the climatic conditions in Holocene under the increase of the anthropogenic degradation of the vegetation. The successional changes of this vegetation were connected with the exchange of the steppes dominated by *Stipa* spp. with these rich in *Festuca* spp., as well as ruderal, thorny and poisonous species, mainly as a result of the grazing of domestic animals. Similar processes have been established not only in Russia (Keller 1923, Gribova et al. 1980), but in Bulgaria too. Yordanov (1936) notes that the exchange of the communities of *Stipa* spp. has been realized by Sub-Mediterranean "andropogonide" grasses – *Chrysopogon gryllus, Dichanthium ischaemum*, and the reasons are mainly climatic. This process is more typical for the forest-steppe vegetation in the interior of Bulgaria. The disappearance or limitation of the distribution of some species from genus *Stipa* in Southern Dobrudzha and their replacement by the more flexible *Festuca* spp. was connected also to the human influence as well as to the climatic changes during the Holocene.

4. CONCLUSIONS

The steppe vegetation had a wider distribution on the territory Bulgaria in the past. Only small fragments have survived today. Many typical steppe species, like those of the genus *Stipa*, have vanished from the studied territory as a result of the pasture pressure. The recent steppe vegetation is presented by different successional stages of development. However, as a whole, the steppe character of the grass vegetation in the investigated regions of Southern Dobrudzha remained.

Despite the human degradation, the survived fragments of the steppe vegetation not only demonstrate the evolution of steppe vegetation in the region, but they have special importance because of the participation of many rare, threatened species, Bulgarian and Balkan endemics. This fact increases their value for the conservation of biodiversity in Bulgaria and Europe. The steppe syntaxa in Bulgarian Dobrudzha are represented into the Directive 92/43/ EEC by the unique code for the Pontic bio-geographical region – 6290 Western Pontic Paeonia steppes.

The results of this study provide the reasons for the following conclusions:

The steppe phytocoenoses on the steep slopes and the plane watersheds along the Bulgarian Black-sea coast as well as in the interior of Southern Dobrudzha have special peculiarities. They differ

to the mixed Pontic-Submediterranean origin, but they have a strong connection with the steppes of the Pontic province. Two associations were distinguished from a syntaxonomical point of view. The syntaxa from the higher ranks are common with the steppe vegetation in Northern and Southern Dobrudzha.

The results from this work could be used in the classification of the natural habitats and for the purposes of the European ecological network NATURA 2000 in Bulgaria.

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Table 1: The syntaxa of Western - Pontic Steppes in Bulgaria: association *Alysso caliacrae-Artemisietum lerchianae* and association *Paeonio tenuifoliae-Koelerietum brevis.*

Tabela 1: Sintaksoni Zahodno-Pontske stepe v Bolgariji: asociacija *Alysso caliacrae-Artemisietum lerchianae* in asociacija *Paeonio tenuifoliae-Koelerietum brevis.*

Number of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		21	22	23	24	25
Date	7V	7V	7V	7V	7V	7V	7V	8V	8V	8V	8V	8V	8V	8V	7V	7V	7V	7V	8V	9V		8V	8V	8V	8V	8V
Relevé area, m2	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	50		100	100	100	100	100
Exposition	И	И	И	И	И	И	СИ	И	И	И	СЗ	СИ	И	И	И	И	И	И	СИ	И		И	И	И	И	СИ
Slope, degrees	70	80	60	70	70	60	20	50	70	60	15	50	30	70	50	80	70	70	20	90		60	70	60	30	50
Total cover, %	80	60	80	80	70	60	80	40	60	80	40	80	50	60	80	85	80	70	90	10		60	70	50	40	30
Number of taxa	16	18	22	28	21	22	18	25	22	21	14	23	11	17	19	14	15	18	28	7		21	26	30	18	11
Diagnostic taxa of associations, subassociations and variants																										
Ass. *Alysso caliacrae-Artemisietum lerchianae* ass. nova, type nom. rel. 10 holotype																										
Agropyron cristatum (L.)Gaertn. ssp. *brandzae* P.et S.	2b	2a	3	3	3	1	2a	1	2b	2b	2a	2b	2a	3	3	2a	3	3	+	+	V	3	3	3	3	3
Artemisia lerchiana Weber.	3	3	2a	2a	3	2a	2a	3	1	3	2a	2a	3	2a	2a	3	2b	1	+	+	V	3	2b	2a	2a	2b
Alyssum caliacrae Nyar.	+	.	.	2m	+	2m	2a	+	2m	2m	+	2a	.	2m	2a	2m	2m	2m	+	+	V	.	+	.	.	.
Astragalus spruneri Boiss.	+	1	2a	2a	2a	1	1	2a	2a	1	.	1	.	+	1	1	+	2a	1	.	V	.	.	.	+	.
Kochia prostrata (L.) Schrader.	.	3	2b	1	2a	2a	.	2a	.	2a	2b	3	2a	2a	.	.	.	.	.	+	III	2a	2a	1	.	.
Aster oleifolius (Lam.) Wagenitz	.	.	+	.	.	1	1	2a	2b	1	.	2a	2a	2a	.	.	1	1	2a	.	III	.	2a	1	.	1
Mathiola odoratissima (Bieb.)R.Br.	.	.	.	.	.	.	.	.	.	1	+	.	.	.	.	.	.	.	.	.	I	.	.	.	2a	2a
Subass. *Alysso caliacrae-Artemisietum lerchianae camphorosmetosum monspeliacae* subass. nova, type nom. rel. 22 holotype																										
Astragalus vesicarius L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		2a	2b	2b	2a	2b
Camphorosma monspeliaca L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		2a	2a	2a	2a	.
Brassica elongata Ehrh.	1	+	.	.	.	+	.	.	1	.	.	.	.	.	.	.	.	.	1	.	II	+	1	+	+	+
Ass. *Paeonio tenuifoliae-Koelerietum brevis* ass. nova, type nom. rel. 39 holotype																										
Potentilla bornmuelleri Borbas	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	I	.	.	.	.	.
Helianthemum salicifolium (L.) Miller.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Koeleria brevis Steven.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Cerastium bulgaricum Uechtr.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Paeonia tenuifolia L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Scandix australis L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	+	.	.	.
Stipa lessingiana Trin. et Rupr.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Chamaecytisus jankae (Velen.) Rothm.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
var. *Teucrium chamaedrys*																										
Teucrium chamaedrys L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	I	.	.	.	.	.
Scandix pecten-veneris L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	+	.	.
Alyssum alyssoides (L.) L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Salvia argentea L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Lappula barabata (Bieb.) Gurke	+	+	+	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	+	.	II	.	.	+	+	.
var. *Rhodax canus*																										
Rhodax canus (L.) Fuss	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Scutellaria orientalis L. subsp. *pinnatifida*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Artemisia pedemontana Balbis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Diagnostic taxa of higher units																										
Al. *Pimpinello-Thymion zygoidi*																										
Thymus zygoides Griseb.	.	2a	.	.	.	3	2b	2a	2m	+	2a	.	.	2a	.	.	2a	2a	+	.	III	2a	2a	2a	2b	3
Dianthus pseudoarmeria Bieb.	.	.	+	1	2a	.	.	1	1	1	.	2a	1	+	1	3	2a	1	.	.	IV	.	.	.	.	.
Pimpinella tragium Vill.ssp. *titanophila* (Wor.)Tutin	.	+	.	.	.	.	.	2a	1	+	2a	.	.	.	.	.	.	.	+	.	II	.	.	.	1	2a
Satureja coerulea Janka	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Scorzonera mollis Bieb.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.

26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
8V	8V	8V	8V	8V	8V	10V	10V	10V	10V	10V	8V	8V	9V	9V	9V	9V	9V	9V	9V	9V	9V	9V	9V	9V	9V	9V	9V	9V	9V	9V	9V	9V	9V	9V	9V	9V	9V
100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	200	100	100	100	100	100	100	100	100	100	100	100
СИ	И	И	И	0	0	С3	0	0	3	3	0	0	0	0	0	0	0	0	0	0	И	0	И	0	0	0	0	0	0	C	0	0	0	C	0	0	0
50	70	80	80	0	0	5	0	0	10	5	0	0	0	0	0	0	0	0	0	0	10	0	5	0	0	0	0	0	0	10	0	0	0	5	0	0	0
50	70	60	60	90	95	95	90	90	70	85	90	90	90	80	100	90	80	95	100	80	60	90	70	70	90	95	60	90	90	70	80	90	75	70	95	60	80
11	21	11	14	43	36	52	55	50	50	45	24	22	30	32	33	36	49	35	27	27	32	36	32	37	37	34	33	37	34	33	35	31	25	28	26	23	24

2a	3	3	3	V	V	.	1	.	2a	.	.	1	III	.	.	1	2a	+	.	3	.	.	.	1	.	3	.	1	2a	1	III	1	2a	.	1	1	.	2a	.	1	2a	IV	III
2a	2b	3	3	V	V	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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.	3	2b	3	IV	II	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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.	.	.	.	.	.	.	.	+	2m	2a	2m	+	IV	2a	+	2m	2a	2m	2m	+	2a	2m	2b	2m	3	2m	2b	2m	.	+	V	2m	.	+	+	2a	.	2m	+	.	2m	IV	V
.	.	.	.	.	.	.	.	.	2a	3	.	.	II	2b	2a	.	.	2m	+	2b	.	.	3	2b	2b	2b	2a	2a	2a	.	IV	3	2b	3	3	2b	2a	3	3	3	.	V	IV
.	.	.	.	.	.	2m	2a	2a	2a	2a	.	.	IV	+	2a	2m	2b	2a	2m	+	2m	2a	2m	.	.	2a	+	.	.	.	IV	2m	2m	2m	2a	.	+	.	2m	.	.	III	IV
.	.	.	.	.	.	1	2a	2a	2a	1	1	2b	V	.	.	2b	1	.	2b	+	.	.	.	.	.	.	.	.	.	.	II	2b	3	2a	2b	3	3	2a	.	+	.	IV	III
.	+	.	.	II	I	.	.	.	.	.	.	.	.	.	.	2b	2a		3	+	3	.	.	2m	2a	+	3	.	2m	.	III	.	+	+	2m	+	+	+	+	.	.	IV	III
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Number of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		21	22	23	24	25
Goniolimon besseranum (Schult.ex Reichenb.) Kusn.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	I	.	.	.	.	.
Al. *Festucion valesiacae*																										
Festuca valesiaca Schleich.ex Gaudin	.	.	.	.	2m	.	2a	2m	2a	2m	2a	2a	2m	2a	2a	2a	3	3	+	.	IV	2b	2a	2m	+	.
Inula oculus-christi L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Convolvulus cantabrica L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Salvia nutans L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	I	.	.	.	.	.
Adonis vernalis L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Medicago minima (L.) Bart.	.	.	2a	.	2b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.
Chrysopopon gryllus (L.) Trin.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Vinca herbacea Waldst. et Kit.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Scorzonera hispanica L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Ord. *Festucetalia valesiacae*																										
Teucrium polium L.	.	.	.	1	+	.	.	1	2a	2a	1	1	.	+	2a	2a	2a	1	1	.	IV	.	2a	.	.	.
Cephalaria uralensis (Murr.) Roemer et Schultes	.	.	.	.	+	2a	2a	1	1	1	2a	2a	1	+	.	.	.	2a	1	.	III	2a	.	.	1	2b
Iris pumila L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	I	.	.	.	.	.
Stipa capillata L.	.	.	.	.	2a	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	I	.	.	.	.	.
Poa bulbosa L.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	I	.	.	.	.	.
Jurinea mollis (L.) Reichenb.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	I	.	.	.	.	.
Tragopogon dubius Scop.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	I	.	.	+	.	.
Coronilla varia L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Campanula sibirica L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	+	1
Cl. *Festuco-Brometea*																										
Astragalus glaucus Bieb.	+	3	3	2a	2b	2b	3	3	3	2b	3	2b	2b	2a	2b	1	1	1	+	+	V	.	.	.	.	.
Echinops ritro L.	1	+	.	1	+	.	.	.	.	+	.	+	.	.	.	.	.	1	.	.	II	2a	2a	+	.	1
Jurinea stoechadifolia (Bieb.) DC.	1	2a	1	2a	1	2b	3	2b	.	2a	3	3	+	.	3	1	2b	2a	4	.	IV	.	.	.	.	.
Linum austriacum L.	.	.	1	2a	2a	+	1	2a	2a	+	+	1	.	.	1	1	1	+	+	.	IV	.	.	.	.	.
Crupina vulgaris Cass.	.	.	1	2a	.	+	1	.	.	.	.	+	.	.	.	.	.	+	1	.	II	+	+	+	.	.
Alyssum hirsutum Bieb. subsp. *hirsutum*	2a	2a	2m	2m	.	.	+	.	.	.	.	2m	.	.	2m	.	.	.	.	.	II	.	.	+	.	.
Ephedra distachya L.	.	.	2a	2a	.	.	3	.	.	.	.	.	.	+	1	2b	+	2a	.	.	II	.	.	.	.	.
Euphorbia nicaeensis All. subsp. *nicaeensis*	.	2a	.	1	+	+	1	1	1	.	.	.	.	+	+	.	.	.	.	.	III	.	.	.	+	.
Achillea clypeolata Sm.	1	+	.	1	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	I	2a	2a	.	1	.
Seseli tortuosum L.	.	.	.	.	.	.	.	.	.	.	1	.	+	1	.	.	.	.	.	.	I	1	+	+	.	.
Eryngium campestre L.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	I	.	.	+	.	.
Sanguisorba minor Scop.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Erysimum diffusum Ehrh.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.
Centaurea rhenana Boreau	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	+	.	I	.	.	.	.	.
Galium octonarium (Klokov) Soo	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Linaria genistifolia (L.) Miller.	.	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.
Sternbergia colchiciflora Waldst.et Kit.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	+	.	.
Hyacinthella leucophaea (Steven .ex Kunth.) Schur.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	+	.	.
Adonis volgensis DC.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Allium rotundum L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Artemisia austriaca Jacq.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Astragalus onobrychis L. subsp. *chlorocarpus*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Carlina vulgaris L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Filipendula vulgaris Moench.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Galium verum L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Hieracium echioides Lumn.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Medicago falcata L. subsp. *falcata*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Minuartia setacea (Thuill.) Hayek subsp. *setacea*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Plantago media L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Poa angustifolia L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Salvia nemorosa L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
Inula salicina L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	I	.	.	.	.	.
Orobanche purpurea Jacq.	.	.	+	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	+	.	.	.
Silene bupleuroides Chater et Walters	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		r	.	.	.	.

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.	.	.	.	.	.	1	2a	2a	1	1	.	.	IV	.	.	.	.	2a	1	1	1	.	.	.	+	.	1	.	.	.	II	2b	2a	2a	2a	2a	2a	2a	2a	2a	1	V	IV
.	.	.	.	.	.	.	+	2a	+	1	2a	IV	.	.	.	2a	2a	1	2a	1	1	.	.	2a	1	1	2a	.	2a	IV	.	.	.	.	.	.	.	.	.	.	.	.	III
.	.	.	.	I	+	+	1	1	+	+	2a	V	.	.	.	+	+	.	1	.	r	+	2a	.	.	+	+	+	+	III	+	.	.	+	.	.	.	.	.	.	I	III
.	.	.	.	.	.	2a	2a	.	+	1	III	.	.	+	.	.	2a	.	.	.	.	.	.	.	.	.	.	.	.	I	2a	2b	2a	2a	2a	2a	1	.	+	.	IV	III
.	.	.	.	I	.	2a	2a	.	2m	2m	+	IV	.	.	.	.	.	+	.	2a	.	.	.	.	2a	+	.	.	.	II	+	.	.	.	.	.	.	.	.	2m	I	II
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2a	.	.	.	III	III	.	.	.	.	.	.	.	2a	1	.	2a	.	.	1	1	.	.	.	2a	.	.	1	3	2a	III	.	1	.	.	.	.	.	.	.	.	.	I	II
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.	+	+	+	II	I	2a	.	2a	1	2a	.	+	IV	.	1	1	+	+	1	.	1	.	.	1	.	.	1	.	.	.	III	+	2a	.	1	1	1	.	1	.	+	IV	III
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Number of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Other taxa																									
Tanacetum millefolium (L.) Tzvel.	1	1	1	3	.	.	.	.	.	.	.	1	.	+	+	2b	.	.	.	.	II	.	.	1	2a	.
Adonis flammea Jacq.	2m	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	I	+	+	.	.	.
Valerianella pumila (L.) DC.	.	.	.	.	2m	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	2m	+	+	.	.
Onosma echioides L.	.	.	.	2a	.	2a	+	1	1	.	.	.	+	.	1	.	.	.	+	.	II	.	.	2a	.	.
Reseda luteola L.	.	1	.	.	.	1	.	1	+	.	.	.	.	.	1	.	.	.	+	.	II	.	.	.	.	.
Crepis sancta (L.) Babcock	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.
Bromus racemosus L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Crataegus monogyna Jacq.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	+	.	.
Euphorbia helioscopia L.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.
Trigonella gladiata Steven ex Bieb.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.
Thlaspi arvense L.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	+	+	.	+	.
Ziziphora capitata L.	.	.	.	2m	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	I	.	r	r	.	.
Leontodon hispidus L.subsp. *hyspidus*	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	1	.	I	.	.	.	.	.
Vicia peregrina L.	.	.	.	.	2a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	+	.	.
Cichorium inthybus L.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.
Orobanche amethystea Thuill.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.
Xeranthemum annuum L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ornithogalum gussonii kochii Parl.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Senecio vernalis Waldst. et Kit.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.
Achillea millefolium L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	I	.	.	.	.	.
Astragalus hamosus L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.
Avena eriantha Durieu	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.
Alyssum minutum Schleicht. ex DC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	I	.	.	.	.	.
Gypsophilla glomerata Pallas ex Bieb.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2a	1	.	.	.
Bupleurum rotundifolium L.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	r	.	.	.
Euphorbia agraria Bieb.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.
Viola kitaibeliana Schultes	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.
Haplophyllum suaveolens (DC.) G. Donf.	.	.	.	2a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.
Rosa canina L.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.
Erodium ciconium (L.) L'Her.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Asparagus verticillatus L.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.
Bromus tectorum L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	I	.	.	.	.	.
Linum tauricum Willd. subsp. *tauricum*	.	.	.	1	.	2a	.	2a	1	1	.	+	.	.	.	1	.	.	2a	.	II	.	.	.	.	.
Jasminum fruticans L.	.	.	.	2a	.	1	.	.	.	.	.	.	.	.	.	1	1	+	.	.	II	.	.	.	.	.
Galium flavescens Borbas	2a	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.
Paliurus spina-christi Miller	.	.	1	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.
Prunus mahaleb L.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.
Asparagus maritimus (L.) Miller	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.
Coronilla emerus L. subsp. *emeroides*	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.
Cotinus cogyggria Scop.	.	.	.	.	1	2a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.
Fraxinus ornus L.	.	.	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.
Colutea arborescens L.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.
Allium saxatile Bieb.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	+	I	.	.	.	.	.
Genista sessilifolia DC. subsp. *trifoliata*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2a	.	.	.	.	.	I	.	.	.	.	.
Tamarix tetrandra Pallas ex Bieb.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	I	.	.	.	.	.
Carduus pycnocephalus L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.
Papaver dubium L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Medicago disciformis DC.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2m	.	.	.
Acinos suaveolens (Sibth. et Sm.) G. Don	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cladonia rangiformis Hoffm.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Euphorbia nicaeensis All. subsp. *candilathri*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Minuartia hybrida (Vill.) Schischkin	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sedum sartorianum Boiss. subsp. *ponticum*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Euphorbia myrsinites L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Asphodeline lutea (L.) Reichenb.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Marrubium peregrinum L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carduus acanthoides L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ajuga chamaepytis (L.) Schreber	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

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.	+	+	.	III	II	+	2a	2a	2m	2m	2m	+	V	2m	.	2m	.	+	2m	+	2m	2m	+	2m	+	2m	2m	.	+	+	V	.	.	.	.	2m	.	.	+	+	.	II	IV
.	.	+	+	III	II	2m	.	.	.	+	2a	2a	III	2a	2m	.	.	.	.	2m	2m	2a	.	+	2a	2a	2m	+	2a	+	IV	.	.	.	.	+	.	.	+	.	.	I	III
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.	+	.	.	I	I	.	+	1	+	1	.	1	IV	.	.	.	+	2a	.	.	.	.	.	+	.	.	.	+	.	.	II	1	.	.	.	1	1	.	.	.	.	II	II
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Number of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Erodium cicutarium (L.) L'Her.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aegilops geniculata Rothm.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ruta graveolens L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tortella flavovirens (Bruch) Broth.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Thymus callieri Borbas ex Velen. subsp. *urumovii*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Centaurea marshalliana Sprengel	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Erophila verna (L.) Chevall	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sherardia arvensis L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Filago vulgaris Lam.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cladonia foliacea (Huds.) Schaer.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Muscari racemosum DC.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Thymus pannonicus All.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Arabis recta Vill.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bromus mollis L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carpinus orientalis Miller	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nonea pulla (L.) DC.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Silene conica L subsp. *conica*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Arenaria serpilifolia L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tortulla ruralis (Hedw.) Crome	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sideritis montana L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carthamus lanatus L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Papaver hybridum L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Platago lanceolata L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ajuga genevensis L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Anthemis tinctoria L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Centaurea napulifera Rochel subsp. *thirkei*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Coronilla scorpioides (L.) C. Koch.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lamium amplexicaulis L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus oxyspermus Bieb.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Veronica prostrata L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Centaurea caliacrae Prodan	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Androsace maxima L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bellevalia ciliata (Cyr.) Ness	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dactylis glomerata L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Geranium pusillum L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stachys recta L. subsp. *subcrenata*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Saxifraga tridactilites L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Taraxacum erytrospermum Andrz. ex Besser	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Anthemis ruthenica Bieb.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Digitalis lanata Ehrh.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Localities: 1 – Eastern from the town of Balchik; 2, 3, 5 and 6 – Cape "Ikantulukö; 4, 7, 15, 16, 17 and 18 – north from "Tuzlata" Resort; 8, 9, 10, 11, 12, 13, 14 and 19 – Topola village; 20 – "Bolata dere"; 21, 22, 23, 24, 25, 26, 27, 28 and 29 – "Chirakman" locality; 30 and 31 – "Kayryaka", Bozhuretz village; 32, 33, 34, 35 and 36 – "Gyorensko dere", Vidno village; 37 and 38 – "Kaliakra" Reserve, the Castle; 39, 40, 41, 42, 43, 44, 54, 55, 56, 57, 58, 59, 60, 61 and 62 – "Kaliakra" Reserve, the road to the "Bolata dere"; 45 and 50 – Kamen bryag village, north of "Yaylata" locality; 46, 47, 48, 49, 51, 52 and 53 – game-breeding farm "Kushlata", north of the "Bolata" Inlet; 63 – Taukliman, "Roussalka" Resort.

26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	
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HALOPHILE VEGETATION OF THE SLOVENIAN SEACOAST: *THERO-SALICORNIETEA* AND *SPARTINETEA MARITIMAE*

Mitja KALIGARIČ*,** et Sonja ŠKORNIK*

Abstract
Halophile vegetation of the Slovenian sedimentary seacoast have been sampled with the standard Braun-Blanquet procedure. All the 140 collected relevés have been classified using the SYN-TAX 2000 software. The resulting dendrogram separated 5 well-defined clusters, characterized by different dominant species. Two well separated clusters have been further elaborated in this study. The floristically-poor association *Suaedo maritimae-Salicornietum patulae* Brullo et Funari ex Géhu et Géhu Franck 1984 tend to form monodominate stands with *Salicornia europaea* s.l. on mudflat hypersaline stands. The association *Suaedo maritimae-Bassietum hirsutae* Br.-Bl. 1928, with high abundance of *Suaeda maritima* occupy smaller surfaces on drier stands. Both were classified within halophile annual swards of the class *Thero-Salicornietea. Spartina maritima*-dominated perennial halophyte saltmarshes are represented with association *Limonio-Spartinetum maritimae* (Pignatti 1966) Beeft. et Géhu 1973 (class *Spartinetea maritimae*), which colonizes muddy islets, perturbed by high tide and sea turbulence and supports brackish water, which should be rich in nutrients.
Key words: phytosociology, halophile vegetation, classification, North Adriatic, *Thero-Salicornietea, Spartinetea maritimae.*

Izvleček
S standardno Braun-Blanquetovo metodo smo vzorčili halofitno vegetacijo na sedimentni morski obali v Sloveniji. Vseh 140 zbranih popisov je bilo klasificiranih s pomočjo programa SYN-TAX 2000. Nastali dendrogram je ločil 5 dobro definiranih šopov, okarakteriziranih z različnimi dominantnimi vrstami. Dva dobro ločena šopa sta bila nadalje obdelana v tej študiji. Floristično revna asociacija *Suaedo maritimae-Salicornietum patulae* Brullo et Funari ex Géhu et Géhu Franck 1984 teži h graditvi enovrstnih sestojev z vrsto *Salicornia europaea* s. l. na muljastih hipersalinih rastiščih. Asociacija *Suaedo maritimae-Bassietum hirsutae* Br.-Bl. 1928 z visoko abundanco vrste *Suaeda maritima* zaseda manjše površine na bolj suhih rastiščih. Obe smo uvrstili v razred halofitnih enoletnic *Thero-Salicornietea.* Obmorska močvirja z dominantno vrsto *Spartina maritima* predstavljajo asociacijo *Limonio-Spartinetum maritimae* (Pignatti 1966) Beeft. et Géhu 1973 (razred *Spartinetea maritimae*), ki kolonizira muljaste otočke, izpostavljene plimovanju in valovanju, in dobro prenašajo brakično vodo, ki mora biti bogata s hranili.
Ključne besede: fitocenologija, halofitna vegetacija, klasifikacija, Severni Jadran, *Thero-Salicornietea, Spartinetea maritimae.*

1. INTRODUCTION

Slovenia has only 46 km of seacoast, which is under the pressure of urbanization, tourism and industry (port of Koper). Its peculiarity is the geological substrate. With some exceptions, it consistes of calcareous sandstone – Eocene flysch substrate. This substrate is almost perfectly matching with the territory of Slovenia, only a part, in the Muggia/Milje peninsula and bay are lying predominantly in Italy. Flysch substrate results in a dense hydrological system above ground due to its impenetrable properties. Three streams/rivers have their mouths in the Gulf of Trieste. Alluvial deposits on the mouths

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