

PSAMMOPHILOUS PLANT ASSOCIATIONS FROM THE COASTAL AREA OF THE BLACK SEABETWEEN PERIBOINA AND PERITEAȘCA (DANUBE DELTA BIOSPHERE RESERVE)

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ABSTRACT

The coastal area between Periboina and Periteașca channel is a narrow littoral belt which separates the Black Sea and the Razelm-Sinoe lagoon complex. On the sandy belt, less tall sand dunes (1-2 m) occur, bordered to the west by puddles and swamps more or less salted.

There are four psammophilous plant communities on the embryonic sand dunes of the littoral belt and on the low surfaces of the dunes, in the frame of the habitats 2110 and 1210: *Elymetum gigantei* and *Secali sylvestris-Brometum tectorum*, respectively *Cakilo euxinae-Salsoletum ruthenicae* and *Lactuco tataricae-Glaucietum flavae*.

A detailed description of these plant communities, inclusively of a new subassociation (*Elymetum gigantei* Morariu 1957 subass. *crambetosum maritimae* subass. nova) have been made in the paper. Information regarding the rare species from the psammophilous plant communities, conservation status of the habitats, anthropogenic pressures, risk factors as well as evolution tendencies of the dune habitats will be also given in the paper.

INTRODUCTION

The coastal zone between Periboina and Periteașca channel is the main segment of the narrow littoral belt which separates the Black Sea and the Razelm-Sinoe lagoon complex which is part of the Danube Delta Biosphere Reserve (Fig. 1).

The littoral belt formed in the time by the sands and alluvial deposits brought by the sea and the Danube closed the old golf Halmyris turning it into a freshwater lagoon complex of which the most important lakes are Razelm and Sinoe (Petrescu, 1960).

In the most narrow zones of the littoral belt, the lake Sinoe communicate with the Black Sea by two breaks (at Edighiol and Periboina) which are currently arranged and provided with gates.

The studied area has a length of about 25 km and is bordered to the south by the Periboina break and at the north by Periteașca channel, a short channel which does not communicate in present with the sea. The easiest route towards Portița is by boat from Jurilovca. Portița also known as Gura Portiței is a sand strip arranged as a small resort between Lake Golovița and the Black Sea. Other access roads but less facile (only by bike) are from localities Vadu (through Chituc sandbank) and from Sinoe (through Lupilor sandbank).

Even if the area has the status of protected area as part of the Natura 2000 site ROSCI 0065 Danube Delta, the coastal one from Periboina to Periteașca is vulnerable at some natural and anthropogenic risk factors: grazing, strong waves, invasive species, extension of touristic facilities outside of Portița resort.

Tourism is not the main problem because it is limited within the frame of Portița resort and its neighbourhood. Grazing and compaction of sand dunes under the hoofs of animals is the main threat for the psammophilous vegetation of dunes.



Fig. 1 – The Razelm-Sinoe lagoon complex and the littoral belt between Periboina and Periteașca

The area between Periboina and Periteașca channel was less studied in the past probably because it is less accessible than other coastal areas of the Danube Delta. Contributions to the knowledge of the area have come from more general articles that targeted floristic and phytocoenological aspects of the Danube Delta Biosphere Reserve: Dihoru & Negrean, 1976 a, b; Popescu & Sanda, 1976; Roman, 1992; Ciocârlan, 1994; Popescu et al, 1997; Oprea, 2005; Doroftei et al. 2011; Făgăraș, 2012, 2013.

In the paper, psammophilous plant communities belonging to the habitats 2110 and 1210 will be presented. The plant associations are described on the base of the relevés recorded in the period 2013-2014 in the coastal zone between Periboina and Periteasca channel.

MATERIAL AND METHOD

The name of the plant associations are in according with the book of Sanda et al., 2008. The subassociation has been defined according to Cristea et al., 2004.

Phytosociological surveys were conducted according to the methodology of the Zürich-Montpellier school (Braun-Blanquet, 1964). In each relevé the following data were recorded: species composition, total coverage (%), plant species abundance-dominance (AD) and the number of taxa. After processing the recorded relevés through the tabular method, a new subassociation was described. The name of the plant associations and of subassociation are concordant with the International Code of Phytosociological Nomenclature (Weber et al., 2000).

The nomenclature of the higher plant taxa is according to Sârbu et al., 2013; Ciocârlan, 2009; Tutin et al., 1964-1980 and Tutin et al., 1993. The floristic rarities are considered by the Red Book of Vascular Plants from Romania (Dihoru & Negrean, 2009).

The sand dune habitats have been recognized on the base of typical plant associations (Gafta, Mountford et al., 2008).

The conservation status of habitats was assessed on the base of the following scale: favourable, inadequate, unfavorable and unknown. According to the EU Habitats Directive (<http://eur-lex.europa.eu>), the conservation status of a natural habitat will be considered as „favorable” when the natural range and areas it covers is stable or increasing and the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future.

Pressures which may threaten the conservation status of the habitats are rated as major (if significantly changes occur in habitats structure), moderate (if does not produce major changes upon the habitats) or insignificant (if it has only a negligible effects upon habitats structure). Evolution trend of the habitats is considered as stable (if the current status of habitat does not change significantly), increasing (if the current status of habitat is improving) or decreasing (if the current status of habitat is damaged).

RESULTS AND DISCUSSION

The narrow littoral belt between Periboina and Periteașca is bordered to the east by the Black Sea and to the west by the Razelm Sinoe lagoon complex. Between the sand dunes and the lakes of the lagoon complex there are more or less salty puddles and swamps. The vegetation of the dunes is bordered to the west by reeds and halophilous vegetation and therefore it is formed by an interesting mix of psammophilous, halophilous and hygrophile species, less common in the other areas of the Romanian littoral.

Two psammophilous plant associations were observed on the embryonic sand dunes, in the frame of the habitat 2110: *Elymetum gigantei* Morariu 1957 and *Secali sylvestris-Brometum tectorum* Harghitai 1940. Other two plant associations of the habitat 1210, *Cakilo euxinae-Salsoletum ruthenicae* Vicherek 1971 and *Lactuco tataricae-Glaucietum flavae* Dihoru et Negrean 1976, occupy lower surfaces from the base of the sand dunes, in the proximity of the sea and nearby some coastal salty puddles.

The conservation status of the dune habitats is inadequate only near Portița resort (Table 1) due to the cattle and horses grazing but it is favorable in the rest of the studied area. The main risk factors in regards to the dune habitats are natural (strong waves, floods the low areas) and anthropogenic, close to Portița where the dune vegetation is grazed. The anthropogenic pressure is generally low in the studied area because the human activities are limited in the area of Portița resort and surroundings and it does not determine major changes in the composition and structure of the dune habitats. The evolution tendencies of the habitats 2110 and 1210 are generally stable along the littoral belt, lacking new pressures and significant threats, less near Portița, where the evolution tendencies are decreasing due to the anthropogenic factors.

Table 1 – Characteristics of the habitats from the sandy belt between Portița and Periteașca (CR-Critically endangered, EN-Endangered, VU-vulnerable)

Habitat/ code Natura 2000 habitat	Characteristic plant associations	Conservation status	Anthropogenic presures/ Risk factors	Vulnerable and endangered plants from studied habitats (according to Dihoru & Negrean, 2009)
The habitat 1210 – Annual vegetation of drift-lines	- <i>Cakilo euxinae-Salsoletum ruthenicae</i> Vicherek 1971; - <i>Lactuco tataricae-Glaucietum flavae</i> Dihoru et Negrean 1976	Favorable/ Inadequate only close to Portița resort	Generally low and moderate only close to Portița resort/ Strong waves, floods, invasive species, touristic facilities (only in Portița resort)	<i>Argusia sibirica</i> (CR) <i>Limonium meyeri</i> (CR) <i>Cakile maritima</i> subsp. <i>euxina</i> (EN) <i>Euphorbia peplis</i> (EN) <i>Crambe maritima</i> (EN) <i>Eryngium maritimum</i> (VU) <i>Polygonum oxyspermum</i> subsp. <i>raii</i> (VU) <i>Polygonum maritimum</i> (VU) <i>Gypsophila perfoliata</i> (VU)
The habitat 2110 - Embryonic shifting dunes	- <i>Elymetum gigantei</i> Morariu 1957; - <i>Secali sylvestris-Brometum tectorum</i> Hargitai 1940;	Favorable/ Inadequate only close to Portița resort	Generally low and moderate only close to Portița resort/ Strong waves, floods, grazing, invasive species, touristic facilities (only in Portița resort)	<i>Artemisia tschernieviana</i> (EN) <i>Elymus farctus</i> subsp. <i>bessarabicus</i> (CR) <i>Stachys maritima</i> (CR) <i>Cakile maritima</i> subsp. <i>euxina</i> (EN) <i>Argusia sibirica</i> (CR) <i>Dianthus bessarabicus</i> (EN) <i>Astrodaucus littoralis</i> (EN) <i>Syrenia montana</i> (EN) <i>Crambe maritima</i> (EN) <i>Silene exaltata</i> (EN) <i>Eryngium maritimum</i> (VU) <i>Gypsophila perfoliata</i> (VU) <i>Astragalus varius</i> (VU) <i>Polygonum oxyspermum</i> subsp. <i>raii</i> (VU)

Both associations of the habitat 1210 belong to the alliance *Euphorbion peplis* R. Tüxen 1950 of the class *Cakiletea maritimae* R. Tüxen et Preising 1950 and they have great conservation value due to the limited distribution at the national level and because they have numerous floristic rarities (Table 1).

The association *Cakilo euxinae-Salsoletum ruthenicae* Vicherek 1971 was recorded for the first time from the Bulgarian seacoast by Vicherek and Tzonev (Vicherek, 1971; Tzonev et al., 2005, 2009). This association represents the first stage of development of psammophitic vegetation in most of the coastal area of the Danube Delta Biosphere Reserve. Despite this, the association is not mentioned in the Romanian classification system (Sanda et al., 2008), even though it is present in the frame of the habitat 1210 (Annual vegetation of drift-lines). *Atripliceto hastatae-Cakiletum euxinae* Sanda et Popescu 1999 is the vicariant association mentioned in the Romanian phytosociological bibliography (Făgăraș, 2013).

On the sandy strip between Periboina and Periteașca, the association can be find on fine or coarse sands rich in nitrates and organic matter, at the base of the eastern slope of the dunes, not very far (5-10 meters) from the shoreline. Other phytocoenoses have been observed on the western side of the dunes, on lowersurfaces in the proximityof some more or less salted puddles.

The characteristic species – *Cakile maritima* subsp. *euxina* and *Salsola kali* subsp. *ruthenica* are most abundant andthey cover 50-70% of the sandy substrate together with the accompanying species. The plant species which belong to coenotaxons *Cakiletalia maritimae*, *Festucetalia vaginatae* and *Elymion gigantei* are the best represented in the floristic composition of the association: *Argusia sibirica*, *Lactuca tatarica*, *Crambe maritima*, *Gypsophila perfoliata*, *Polygonum oxyspermum* subsp. *raii*, *Eryngium maritimum*, *Leymus racemosus* subsp. *sabulosus*, *Polygonum maritimum*, *Corispermum nitidum*, *Xanthium italicum* (Table 2, releves 1-6).

Some species of the order *Puccinellietalia* (*Aeluropus littoralis*, *Bassia hirsuta*, *Lepidium latifolium*) occur in the proximity of salty areas (Table 2, releveé 6).

Of the 24 species that make up the association, the floristic rarities represent a high value (41,66%). The most valuable species from conservation point of view (according to Dihoru and Negrean, 2009) are the following: *Argusia sibirica* (CR), *Cakile maritima* subsp. *euxina* (EN), *Euphorbia peplis* (EN), *Crambe maritima* (EN), *Artemisia tschernieviana* (EN), *Eryngium maritimum* (VU), *Polygonum oxyspermum* subsp. *raii* (VU), *Polygonum maritimum* (VU), *Gypsophyla perfoliata* (VU).

Table 2 - The plant associations of the alliance *Euphorbion peplis* R. Tüxen 1950 – Association *Cakilo euxinae-Salsoletum ruthenicae* Vicherek 1971 (R1-6); Association *Lactuco tataricae-Glaucietum flavae* Dihoru et Negrean 1976 (R7-10);

Relevés	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	K
Surfaces (m2)	25	25	25	25	25	25	25	25	25	25	
Coverage (%)	50	60	50	60	70	60	60	60	80	60	
Number of taxa	11	9	9	10	7	11	10	9	12	9	
<i>Cakiletalia maritimae</i>											
<i>Lactuca tatarica</i>	+	-	+	+	-	-	1	1	1	2	IV
<i>Crambe maritima</i>	+	-	+	+	-	+	-	-	2	1	IV
<i>Cakile maritima</i> subsp. <i>euxina</i>	1	1	+	1	1	1	-	-	-	-	III
<i>Argusia sibirica</i>	-	+	1	-	2	-	-	1	1	+	III
<i>Euphorbia peplis</i>	+	-	-	-	-	-	-	-	-	-	I
<i>Festucetalia vaginatae</i>											
<i>Salsola kali</i> subsp. <i>ruthenica</i>	3	3	3	3	3	3	-	-	-	-	III
<i>Gypsophyla perfoliata</i>	+	+	-	+	-	-	+	+	-	1	III
<i>Polygonum oxyspermum</i> subsp. <i>raii</i>	-	+	-	+	-	+	-	-	-	-	II
<i>Corispermum nitidum</i>		1	-	+	-	-	-	-	-	-	I
<i>Secale sylvestre</i>	-	+	+	-	-	-	-	-	-	-	I
<i>Bromus tectorum</i>	-	-	-	-	-	+	-	-	-	+	I
<i>Alyssum hirsutum</i>	-	-	-	-	+	-	-	-	-	-	I
<i>Melilotus arenarius</i>	-	-	-	-	-	+	-	-	-	-	I
<i>Festucetalia valesiaca</i>											
<i>Glaucium flavum</i>	-	-	-	-	-	+	3	3	3	2	III
<i>Elymion gigantei</i>											
<i>Eryngium maritimum</i>	+	-	+	-	+	-	+	+	+	-	III
<i>Leymus racemosus</i> subsp. <i>sabulosus</i>	+	+	-	1	-	-	+	-	+	-	III
<i>Artemisia tschernieviana</i>	-	-	+	-	1	-	-	-	-	-	I
<i>Polygonum maritimum</i>	+	-	+	-	-	-	-	-	-	-	I
<i>Medicago falcata</i>	-	-	-	+	-	-	-	-	-	-	I
<i>Cynodon dactylon</i>	-	-	-	-	-	-	-	-	-	1	I
<i>Puccinellietalia limosae</i>											
<i>Lepidium latifolium</i>	-	-	-	-	-	+	1	+	1	-	III
<i>Artemisia santonicum</i> subsp. <i>santonicum</i>	-	-	-	-	-	-	-	+	1	+	II
<i>Limonium meyeri</i>	-	-	-	-	-	-	-	+	+	-	I
<i>Atriplex prostrata</i>	-	-	-	-	-	-	+	-	+	-	I
<i>Aeluropus littoralis</i>	-	-	-	-	-	+	-	-	-	-	I
<i>Bassia hirsuta</i>	-	-	-	-	-	1	-	-	-	-	I
Other species											
<i>Xanthium italicum</i>	+	+	-	+	1	-	1	-	1	-	III
<i>Phragmites australis</i>	-	-	-	-	-	+	-	-	+	-	I
<i>Tamarix ramosissima</i>	-	-	-	-	-	-	-	1	-	+	I
<i>Senecio vernalis</i>	+	-	-	-	-	-	-	-	-	-	I
<i>Elaeagnus angustifolia</i>	-	-	-	-	-	-	+	-	-	-	I

Localities and dates of relevés: Portița-Periboina – 14.06.2014 (R5, 6); 22.07.2013 (R7); Portița-Periteașca - 14.06.2014 (R1, 2); 22.07.2014 (R3, 4);

The association *Lactuco tataricae-Glaucietum flavae* Dihoru et Negrean 1976 occur only north to Portița toward Periteașca, on the western side of the dunes or close to some salty coastal puddles. The phytocoenoses with *Lactuca tatarica* and *Glaucium*

flavum occupy small surfaces and are less spread in comparison with phytocoenoses with *Cakile maritima* subsp. *euxina* and *Salsola kali* subsp. *ruthenica*.

The characteristic species of the association, *Lactuca tatarica* and *Glaucium flavum*, have higher values of abundance-dominance index [AD=2-3] compared with the other psammophilous species from the phytocoenoses structure (Table 2, relevés 7-10). Accompanying species which belong to orders *Cakiletales maritimae* and *Puccinelliales limosae* are the best represented within the plant community.

The phytocoenoses between Portița and Periteașca are different compared with those from other coastal areas of the Black Sea (Sârbu et al., 2000) due to the presence of some halophilic species typical for order *Puccinelliales limosae*.

Many species from the floristic composition of this association are rarities (37,5%): *Crambe maritima* (EN), *Argusia sibirica* (CR), *Gypsophyla perfoliata* (VU), *Eryngium maritimum* (VU), *Polygonum oxyspermum* subsp. *raii* (VU), *Limonium meyeri* (CR).

Elymetum gigantei Morariu 1957 is the most common plant association on the fine, dry and slightly salted sands of the first two rows of embryonic dunes between Periboina and Periteașca. The phytocoenoses with *Leymus racemosus* subsp. *sabulosus* have a medium coverage (50-80%).

The typical phytocoenoses of the association (Table 3, relevés 1-15) are easily recognized due to the high value of the abundance-dominance index of the characteristic taxa - *Leymus racemosus* subsp. *sabulosus* [AD = 3-4] (Fig. 1). Other phytocoenoses are distinguished from those typical through the low covering index of the taxa *Leymus racemosus* subsp. *sabulosus* [AD = +, 2] and the high value of abundance-dominance index in case of the taxa *Crambe maritima* [AD = 3-4]. *Crambe maritima* (sea cabbage) can be considered as differential species for a new reported subassociation called *Elymetum gigantei* Morariu 1957 subass. *crambetosum maritimae* subass. *nova* (Table 3, relevés 16-24, holotypus relevé № hoc loco) (Fig. 2). The subassociation is widespread on the sand dunes between Portița and Periboina but can also be observed sporadically north of Portița.



Fig. 1 – *Elymetum gigantei* typicum Fig. 2 – *Elymetum gigantei* subass. *crambetosum maritimae*

Other subassociation such as *Elymetum gigantei* Morariu 1957 subass. *eryngietosum maritimae* has been identified on the embryonic sand dunes of the littoral belt between Portița and Periteașca. In the phytocoenoses which belong to this coenotaxon, *Eryngium maritimum* is prevalent [AD=3] compared with *Leymus racemosus* subsp. *sabulosus* [AD = 1-2] (Table 3, relevés 25-28). This subassociation was also seen on the sand dunes of the wide beach of Sulina (Făgăraș, 2013) and Sfântu Gheorghe (coastal area of Danube Delta).

The plant species which have a high value of the presence and abundance-dominance index in phytocoenoses composition are the following: *Leymus racemosus* subsp. *sabulosus*, *Eryngium maritimum*, *Cakile maritima* subsp. *euxina*, *Lactuca tatarica*, *Gypsophila perfoliata*, *Salsola kali* subsp. *ruthenica*, *Glaucium flavum*, *Medicago falcata* (Table 3). Psammophilous species which belong to the alliance *Elymion gigantei* and the orders *Cakiletalia maritimae* and *Festucetalia vaginatae* are very well represented in the plant association structure. Invazive species as *Xanthium italicum* have a low abundance within phytocoenoses.

Many species from the association composition (4,5%) are rarities (Table 3): *Stachys maritima* (CR), *Argusia sibirica* (CR), *Astrodaucus littoralis* (EN), *Elymus farctus* subsp. *bessarabicus* (CR), *Crambe maritima* (EN), *Silene exaltata* (EN), *Artemisia tschernieviana* (EN), *Cakile maritima* subsp. *euxina* (EN), *Polygonum oxyspermum* subsp. *raii* (VU), *Eryngium maritimum* (VU), *Gypsophila perfoliata* (VU). One of the most rare species is *Astrodaucus littoralis* which has the biggest local population on the Romanian Black Sea coast between Portița and Periboina (60-100 individuals). *Stachys maritima* is another very rare species with sporadically distribution and very few individuals (10-20 individuals) between Portița and Periboina and generally on the Romanian seacoast.

The association *Secali sylvestris-Brometum tectorum* Hargitai 1940 was recorded in the northern part of the littoral belt between Portița and Periteașca, on the lower sand dunes situated behind embryonic dunes with *Leymus racemosus* subsp. *sabulosus*. The psammophitic and steppic plants belonging to the orders *Festucetalia vaginatae* and *Festucetalia valesiaca* are well represented in the floristic composition of the association (Table 4). The high number of steppe species indicates a more pronounced steppic characteristic of this association compared with *Elymetum gigantei*.

Eight taxa (5.8%) from the floristic composition of the association are rarities at national level as follows: *Dianthus bessarabicus* (EN), *Silene exaltata* (EN), *Syrenia montana* (EN), *Crambe maritima* (EN), *Astragalus varius* (VU), *Gypsophila perfoliata* (VU), *Polygonum oxyspermum* subsp. *raii* (VU), *Eryngium maritimum* (VU) (Table 4).

CONCLUSIONS

Four plant communities have been identified on the littoral belt between Portița and Periboina, in the frame of two habitats with conservation significance: Annual vegetation along drift-lines (the habitat 1210) and Embryonic shifting dunes (the habitat 2110).

Two psammophilous plant communities of the habitat 2110 occupy the embryonic sand dunes between Periboina and Periteașca. *Elymetum gigantei* is present on the entire length of the shoreline between Periboina and Periteașca while the association *Secali sylvestris-Brometum tectorum* is present only north of Periteașca, in the wider areas of the littoral belt.

Some of phytocoenoses with *Elymus sabulosus* are typical on the embryonic sand dunes between Periboina and Periteașca; other phytocoenoses belong to some subassociations: *Elymetum gigantei* subass. *crambetosum maritimae* subass. *nova* and *Elymetum gigantei* subass. *eryngietosum maritimae*.

Within psammophilous plant associations numerous rarities occur, some of which are very rare along the Romanian Black Sea coast (*Astrodaucus littoralis*, *Stachys maritima*, *Euphorbia peplis*, *Syrenia montana*, *Dianthus bessarabicus*, *Cakile maritima* subsp. *euxina*).

On the low surfaces at the base of the sand dunes there are two psammophilous plant associations characteristic to the habitat 1210: *Cakilo euxinae-Salsoletum ruthenicae* and

Lactuco tataricae-Glaucietum flavae. The rare species within these plant communities are numerous (32,25%).

The conservation status of the habitats is in general favorable, inadequate only close to Portița mainly due to occasional grazing. Other risk factors that may affect psammophilous vegetation are strong waves, floods, invasive species, extension of touristic facilities outside of Portița resort.

The evolution tendencies of the habitats 2110 and 1210 are generally stable along the littoral belt and are decreasing near of Portița due to the anthropogenic factors.

Improving of conservation measures of dune habitats and a better control of some activities such as grazing (by Administration of Danube Delta Biosphere Reserve) should be immediately done for the preservation of rare species and psammophilous plant communities with conservation significance on the littoral belt between Periboina and Periteașca.

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Table 3 - Association *Elymetum gigantei* Morariu 1957 *typicum* (R1-15); Association *Elymetum gigantei* Morariu 1957 subass. *crambetosum maritimae* subass. *nova holotypus relevé* (R16-24) and subass. *eryngietosum maritimae* (R25-28)

Relevés	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17	R18	R19	R20	R21	R22	R23	R24	R25	R26	R27	R28	K
Surfaces (m2)	50	50	50	50	50	25	50	50	25	25	50	50	50	50	25	50	50	25	50	50	25	25	50	50	25	50	50	25	
Coverage (%)	60	70	70	70	80	60	70	60	80	80	70	80	80	70	80	70	80	50	60	80	80	70	80	50	70	60	60	70	
Number of taxa	10	8	13	7	9	9	9	15	13	9	13	14	10	12	14	11	8	11	11	16	10	13	9	11	13	9	8	11	
<i>Elymion gigantei</i>																													
<i>Leymus racemosus</i> subsp. <i>sabulosus</i>	3	4	4	3	3	3	3	3	4	4	3	4	4	3	4	2	2	+	2	3	2	+	3	1	2	2	1	2	V
<i>Eryngium maritimum</i>	+	+	+	1	-	1	2	+	+	+	+	+	-	1	1	+	-	-	-	+	+	+	1	-	3	3	3	3	IV
<i>Artemisia tschernieviana</i>	-	-	-	-	-	1	-	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	1	-	I
<i>Elymus farctus</i> subsp. <i>bessarabicus</i>	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I
<i>Cakiletales maritimae</i>																													
<i>Crambe maritima</i>	2	+	1	2	2	1	-	1	2	1	+	2	2	2	2	3	3	3	3	3	4	4	3	3	1	1	+	+	V
<i>Cakile maritima</i> subsp. <i>euxina</i>	-	-	+	-	+	-	+	-	+	+	1	+	1	1	+	+	1	-	+	+	+	+	-	+	1	-	-	-	IV
<i>Lactuca tatarica</i>	+	-	-	1	2	+	-	+	+	-	+	-	+	+	+	1	-	+	+	1	-	+	+	-	-	-	-	+	IV
<i>Astrodaucus littoralis</i>	-	-	+	-	+	-	-	-	+	-	+	+	-	-	-	+	+	-	+	+	+	-	-	-	-	-	-	-	II
<i>Argusia sibirica</i>	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	+	-	-	-	-	+	-	+	I
<i>Festucetalia vaginatae</i>																													
<i>Gypsophyla perfoliata</i>	+	-	+	-	-	+	2	+	1	+	+	+	-	+	-	1	-	-	+	+	-	-	+	+	1	-	1	1	IV
<i>Salsola kali</i> subsp. <i>ruthenica</i>	-	-	-	+	+	-	+	+	-	+	-	-	-	+	+	-	-	-	+	-	-	+	-	-	+	+	-	-	III
<i>Centaurea arenaria</i> subsp. <i>borysthenica</i>	+	+	-	-	-	-	+	-	+	-	-	+	-	+	-	-	-	+	+	-	-	+	-	-	+	-	-	+	II
<i>Melilotus arenarius</i>	-	-	+	1	+	-	-	-	+	-	+	-	-	-	-	2	-	+	+	-	-	-	-	-	-	-	-	-	II
<i>Alyssum hirsutum</i>	-	+	-	-	-	-	+	-	-	+	-	-	-	-	-	+	+	-	-	-	+	-	-	-	-	+	-	-	II
<i>Euphorbia seguieriana</i>	-	-	+	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	+	-	I
<i>Bromus tectorum</i>	-	-	-	-	-	-	-	+	-	-	-	-	+	-	-	+	-	1	-	-	-	+	-	-	-	-	-	-	I
<i>Silene conica</i>	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	+	I
<i>Corispermum nitidum</i>	-	-	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	I
<i>Stachys maritima</i>	-	-	-	-	-	-	+	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	I
<i>Onosma arenaria</i>	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	I
<i>Secale sylvestre</i>	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	I
<i>Polygonum oxyspermum</i> subsp. <i>raii</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	I
<i>Festucetalia valesiaca</i>																													
<i>Glaucium flavum</i>	-	-	+	-	-	+	-	+	+	-	+	+	-	-	-	-	-	+	-	+	1	+	+	+	+	+	-	-	III
<i>Medicago falcata</i>	+	-	-	-	-	-	+	-	-	-	-	-	+	-	-	-	-	-	+	+	-	-	-	-	+	-	-	+	II
<i>Cerastium semidecandrum</i>	-	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	+	-	-	I
<i>Vincetoxicum hirundinaria</i>	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	I
<i>Cynodon dactylon</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	+	-	-	-	-	I
<i>Linaria euxina</i>	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	I
<i>Verbascum banaticum</i>	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I
<i>Chondrilla juncea</i>	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I
<i>Crepis foetida</i>	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I

Table 4 - Association *Secali sylvestris-Brometum tectorum* Hargitai 1940

Relevés	R1	R2	R3	R4	R5	R6	R7	K
Surfaces (m2)	100	100	100	100	100	100	100	
Coverage (%)	70	70	60	70	80	80	70	
Number of taxa	22	20	26	22	21	23	22	
<i>Festucetalia vaginatae</i>								
<i>Secale sylvestre</i>	2	3	2	3	3	3	2	V
<i>Bromus tectorum</i>	1	1	2	1	2	1	1	V
<i>Euphorbia seguieriana</i>	3	2	+	1	2	1	3	V
<i>Gypsophyla perfoliata</i>	-	+	+	1	+	-	+	IV
<i>Apera spica-venti</i> subsp. <i>maritima</i>	+	1	-	1	1	-	-	III
<i>Alyssum hirsutum</i>	+	+	+	-	-	+	-	III
<i>Centaurea arenaria</i> subsp. <i>borysthenica</i>	-	-	1	-	+	+	+	III
<i>Dianthus bessarabicus</i>	+	+	-	+	-	-	+	III
<i>Silene conica</i>	+	-	-	+	+	-	-	III
<i>Plantago arenaria</i>	-	-	+	+	-	-	+	III
<i>Silene exaltata</i>	+	-	-	+	-	-	1	III
<i>Melilotus arenarius</i>	-	-	+	-	-	+	-	II
<i>Bassia laniflora</i>	-	+	-	+	-	-	-	II
<i>Onosma arenaria</i>	-	-	-	-	+	+	-	II
<i>Polygonum arenarium</i> subsp. <i>arenarium</i>	+	-	-	-	+	-	-	II
<i>Seseli tortuosum</i>	-	-	-	+	-	-	+	II
<i>Stachys atherocalyx</i>	+	-	-	-	-	+	-	II
<i>Alyssum desertorum</i>	-	+	-	-	-	-	+	II
<i>Scirpoides holoschoenus</i>	-	-	-	-	-	1	-	I
<i>Salsola kali</i> subsp. <i>ruthenica</i>	-	-	-	-	+	-	-	I
<i>Astragalus varius</i>	-	-	-	+	-	-	-	I
<i>Polygonum oxyspermum</i> subsp. <i>rarii</i>	+	-	-	-	-	-	-	I
<i>Scabiosion argenteae</i>								
<i>Carex colchica</i>	+	-	+	-	-	+	-	III
<i>Scabiosa argentea</i>	-	-	-	-	+	+	-	II
<i>Syrenia montana</i>	-	-	-	+	-	-	-	I
<i>Elymion gigantei</i>								
<i>Eryngium maritimum</i>	+	-	+	-	-	+	+	III
<i>Leymus racemosus</i> subsp. <i>sabulosus</i>	-	-	1	1	-	-	+	III
<i>Festucetalia valesiacae</i>								
<i>Medicago falcata</i>	+	+	+	+	-	+	-	IV
<i>Teucrium chamaedrys</i>	+	+	1	-	1	-	+	IV
<i>Linum austriacum</i>	-	+	+	+	+	-	+	IV
<i>Glaucium flavum</i>	+	+	-	-	+	-	+	III
<i>Linaria euxina</i>	+	-	+	-	+	+	-	III
<i>Cynodon dactylon</i>	-	-	1	-	-	1	+	III
<i>Crepis foetida</i> subsp. <i>rhoeadifolia</i>	-	-	+	+	-	-	+	III
<i>Verbascum banaticum</i>	+	+	-	+	-	-	+	III
<i>Chondrilla juncea</i>	+	+	+	-	-	-	+	III
<i>Cerastium semidecandrum</i>	-	-	+	+	-	-	-	II
<i>Daucus guttatus</i> subsp. <i>zahariadi</i>	-	-	+	-	-	-	+	II
<i>Galium humifusum</i>	-	-	+	-	-	+	-	II
<i>Bromus squarrosus</i>	-	-	1	-	+	-	-	II
<i>Bromus hordeaceus</i>	-	-	+	-	-	-	-	I
<i>Cakiletea maritima</i>								
<i>Crambe maritima</i>	-	-	+	-	-	+	-	II
<i>Lactuca tatarica</i>	-	-	-	+	-	-	-	I
Other species								
<i>Artemisia santonicum</i> subsp. <i>santonicum</i>	-	-	+	+	+	-	-	III
<i>Carduus acanthoides</i>	-	-	+	-	+	-	+	III
<i>Erysimum repandum</i>	-	+	-	-	-	+	-	II
<i>Senecio vernalis</i>	-	+	-	-	+	-	-	II
<i>Rumex crispus</i>	+	-	-	-	-	+	-	II
<i>Daucus carota</i> subsp. <i>carota</i>	-	-	-	+	+	-	-	II
<i>Elaeagnus angustifolia</i>	-	+	-	-	-	2	-	II
<i>Xanthium italicum</i>	-	-	-	-	-	-	+	I
<i>Parapholis incurva</i>	+	-	-	-	-	-	-	I
<i>Carduus nutans</i> subsp. <i>nutans</i>	-	+	-	-	-	-	-	I
<i>Cichorium intybus</i>	-	-	-	-	-	+	-	I
<i>Conyza canadensis</i>	-	-	-	-	+	-	-	I
<i>Sisymbrium orientale</i>	-	-	-	-	-	+	-	I

Localities and dates of relevés: Portița-Periteașca - 14.06.2014 (R1, 2, 5, 6); 22.07.2013 (R3, 4, 7);