PHYTOCOENOSES WITH *CONVOLVULUS PERSICUS* L. ON THE WESTERN COAST OF THE BLACK SEA

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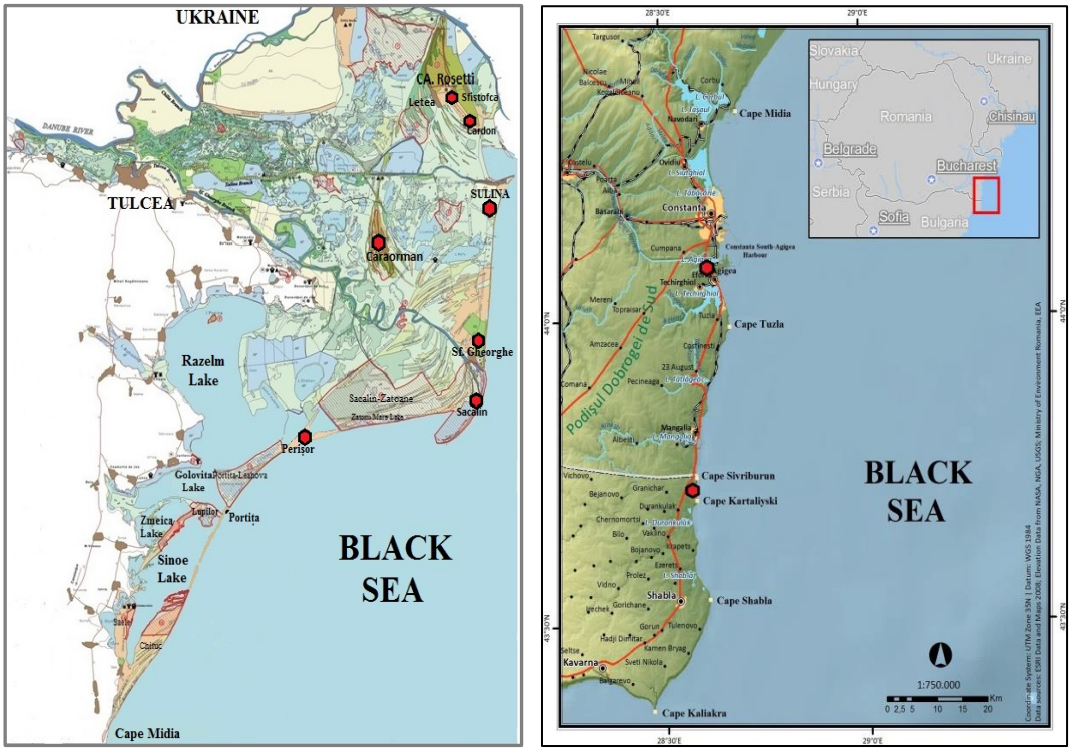
Abstract: Field surveys carried out in Romania and Bulgaria between the years 2012 and 2015 led to the identification of phytocoenoses with *Convolvulus persicus* in some areas of the Danube Delta Biosphere Reserve (Sulina, Sf. Gheorghe, Cardon), in the natural reserve Marine Sand Dunes of Agigea and on Durankulak beach, in Northern Bulgaria. Information regarding floristic composition, ecology and the syntaxonomy of the plant community *Convolvuletum persici* (Borza 1931) Sanda et al. 1998 were presented in the paper. Considerations upon the conservation status and the risk factors which threaten local populations of *Convolvulus persicus* on the western Black Sea coast have been given. Threatened species recorded in the plant association *Convolvuletum persici* in different locations in Romania and Bulgaria, as well as the conservation importance of the plant community, were highlighted in the article.

Keywords: *Convolvulus persicus*, phytocoenoses, sand dunes, western Black Sea coast

AIMS AND BACKGROUND

Convolvulus persicus (sand morning glory) is a psammophilic species native on the Caspian Sea littoral, reported in Europe only in Romania, Bulgaria and Turkey[1]. The general distribution of this taxa includes different locations around the Black Sea and on the Caspian Sea[2]: South-East Romania, Eastern Bulgaria, European Turkey, North-West Anatolia, Georgia, Russia (Daghestan), Azerbaijan, Iran and Turkmenistan. Because of its rarity, of the small local populations and of its high vulnerability to the anthropogenic impact, *Convolvulus persicus* is considered a Critically Endangered species both in ”The Red Book of the Vascular Plants of Romania”[3] and in ”The Red Data Book of the Republic of Bulgaria”[4].

In Romania, *Convolvulus persicus* has been noticed on the sand dunes in some locations within the Danube Delta Biosphere Reserve - Sulina, Sfântu Gheorghe, Letea, Caraorman[3], Cardon, C.A. Rosetti, Șfiștofca[5], Sacalin[6], Perișor[7] and in the natural reserve Marine Sand Dunes of Agigea (Fig. 1).



a b

Fig.1. Distribution area of *Convolvulus persicus* in Romania and Bulgaria (a = the Danube Delta Biosphere Reserve; b = southern Romanian coast and northern Bulgarian coast)

In Bulgaria, *Convolvulus persicus* was recorded in the last 20 years only on the sandy beach in Durankulak Lake area[4]. Other locations of this taxa in Bulgaria (near the Rezovska river mouth, Silistar bay, and Kamchia river estuary) specified in some old papers[4] were not confirmed after 1995. On the Caspian Sea coast, in the North of Iran, the plant community *Convolvuletum persici* is mentioned in the Miankaleh Biosphere Reserve[8] and in the Boujagh National Park[9]. In accordance with the bibliographical sources[10], the plant association *Convolvuletum persici* (Borza 1931) Sanda et al. 1998 belongs to the order *Cakiletalia maritimae* R. Tüxen apud Oberd. 1949 beside other plant communities of the habitat 1210 (Annual vegetation of drift lines).

EXPERIMENTAL

Observations concerning the phytocoenoses with *Convolvulus persicus* were carried out between the years 2012 and 2015 on the Black Sea coast of Romania and Bulgaria. Field observations and phytosociological releves were achieved according to the methodology of Braun-Blanquet's phytosociological school. The syntaxonomic affiliation of this plant community is according to the book “Phytocoenoses from Romania”[10]. The nomenclature of the species from the floristic composition of the association is in accordance with “Flora Europaea”[1] and “Vascular plants of Romania”[11]. The conservation status of the species *Convolvulus persicus* was assessed based on a 3-level scale as follows: favourable unfavourable-inadequate and unfavourable-totally inadequate[12].

RESULTS AND DISCUSSION

Phytocoenoses with *Convolvulus persicus* have a fragmented range along the Black Sea shore and on the marine sandbanks within the Danube Delta Biosphere Reserve. In many locations of the Danube Delta (Letea, Caraorman, C.A. Rosetti, Șfiștofca, Perișor), *Convolvulus*

persicus has only small local populations. Typical phytocoenoses with *Convolvulus persicus* have been noticed on the sandy beaches of Sulina, Sfântu Gheorghe and Cardon[13], in Sacalin-Zătoane strictly protected area[6], in the natural reserve of Agigea and on Durankulak beach, in northern Bulgaria (Fig. 2). On the wide beaches in Sulina and Sfântu Gheorghe, such types of phytocoenoses occur on the mobile and semi-fixed sand dunes, approximately 30-40 meters from the shoreline, where the sea waters reach only during storms.

a b

Fig. 2. Phytocoenoses with *Convolvulus persicus* on the beaches of Sulina (a) and Durankulak (b)

Convolvulus persicus reach in Sulina a good density of 17-20 individuals/m^2. The flowering period of *Convolvulus persicus* is in June-July. Only approximately 40-50% of individuals have bloomed in the investigated period, the vegetative reproduction being prevalent on the beach of Sulina. The strong attack of the parasitic plant *Cuscuta* sp. could be the reason for the low flowering capacity of the sand morning glory in Sulina.

The flowering rate of *Convolvulus persicus* is higher (approximately 60-70%) on the Sfântu Gheorghe beach than in Sulina and this fact can be linked to the lower density of the local populations (10-12 individuals/m2), to the favourable ecological conditions and to a low anthropogenic pressure upon the dune habitats.

In the coastal area of the Danube Delta, phytocoenoses with *Convolvulus persicus* are vulnerable to both anthropogenic and natural pressures such as grazing, tourism, the expansion of recreational areas on the beaches[14], storms[15]. The conservation status of this

species can be considered favourable in Sfântu Gheorghe and unfavourable-inadequate on the beach of Sulina where the human impact upon the dune habitats is higher than in Sfântu Gheorghe. In Sulina, one of the most important touristic gates of the Danube Delta, tourism is better developed than in Sfântu Gheorghe village and this fact has some negative consequences on the natural vegetation of the beaches. Approximately 3 hectares of the beach in Sulina were transformed in 2009 by the local authorities in recreational area. Because of this situation, Romania was subject to the "infringement procedure" due to the violation of the European legislation regarding the conservation of the habitats from the Council Directive 92/43/EEC.

On the southern coast of Romania, phytocoenoses with *Convolvulus persicus* have been noticed only in the natural reserve Marine Sand Dunes of Agigea, on the mobile sand dunes from the north-western side of the protected area. Currently, there are different harbour facilities between the protected area and the seashore which diminished the positive influences of the sea breezes upon the dune habitats and, consequently, determined significant microclimate changes in the area of the natural reserve. The steppe grasslands and the disturbed habitats from the vicinity of the protected area have facilitated the infiltration of some steppe and ruderal plants, even of some invasive species in the sand dunes complex. *Convolvulus persicus* has at present a favourable conservation status only due to some effective management measures of the dune habitats. The measures consist mainly in removing the invasive species and of some opportunistic steppe plants from the dunes area.

In Bulgaria, only two phytocoenoses with *Convolvulus persicus* have been noticed on Durankulak beach (5 km south from the border with Romania) and these are the only records on the Bulgarian coast. *Convolvulus persicus* occupies here approximately 400 square meters on the first strips of the shifting sand dunes. The flowering rate of this species is very good on Durankulak beach because more than 70% of the total specimens have bloomed in the period

of survey. *Convolvulus persicus* has generally a favourable conservation status in Bulgaria, the risk factors being mainly natural (storms with big waves, strong winds).

The total number of the plant species from the floristic composition of the association is small (45 taxa) due to the restrictive ecological conditions within the dune habitats area. The majority of plant species are psammophilic (57.79%) but steppe species are also numerous (33.33%) (Fig.3). Most of accompanying species belong to the alliances *Scabiosion ucrainicae* Boșcaiu 1975, *Festucion vaginatae* Soó 1929 and *Elymion gigantei* Morariu 1957. *Convolvulus persicus* is the diagnostic taxa of the association *Convolvuletum persici* and it has high values of the abundance-dominance index [AD = 3-4] and a high constancy compared the accompanying species of the plant community (Table 1).

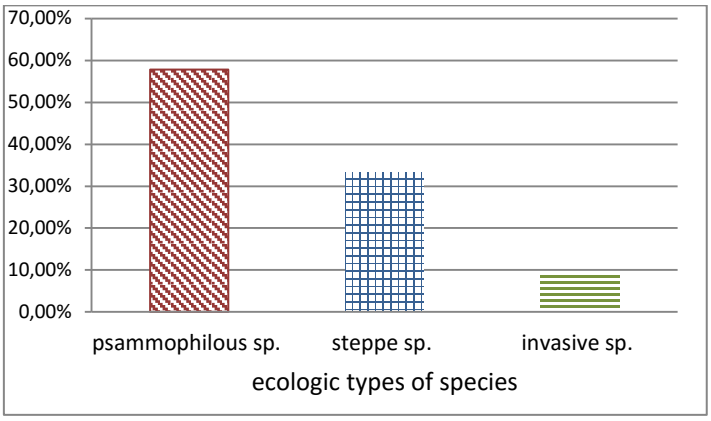


Fig. 3. Comparative values of psammophilic, steppe and invasive species in the plant association *Convolvuletum persici*

The species characteristic to the alliance *Cakilion maritimae* are well represented only on the beach of Durankulak because here *Convolvulus persicus* reaches up to 10-15 meters from the seashore, in the area of the habitat 1210. In the Natural Reserve of Agigea, due to the drier microclimate, the typical species of the alliances *Scabiosion ucrainicae* and *Festucion vaginatae* have a good occurrence and high value of the abundance-dominance index in the releves of the association *Convolvuletum persici* (Table 1).

Table 1. Association table of *Convolvuletum persici* (Borza 1931) Sanda et al., 1998

Relevé number	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17	R18	K
Area (m2)	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	
Cover (%)	70	80	80	70	50	50	70	70	60	70	60	80	60	60	60	80	70	80	
Number of taxa	12	13	12	14	13	15	13	13	12	12	10	11	16	13	11	10	16	11	
Characteristic taxa																			
Convolvulus persicus	3	4	4	4	3	3	3	4	3	3	3	4	3	3	3	4	3	4	V
Festucetalia vaginatae, Scabiosion ucrainicae																			
Centaurea arenaria subsp. *borystenica*	+	+	+	-	+	+	+	+	+	+	-	+	-	+	-	+	+	-	IV
Alyssum hirsutum	+	+	+	-	-	-	-	-	-	-	+	-	-	1	1	+	1	+	III
Cynanchum acutum	-	-	-	-	+	+	+	-	-	-	+	-	-	-	+	-	+	-	II
Alyssum borzaeanum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	2	1	II
Silene thymifolia	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	I
Carex colchica	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	I
Festucion vaginatae+ Bassio laniflorae-Bromion tectorum																			
Secale sylvestre	2	2	2	+	1	+	2	+	1	+	+	1	1	2	1	2	+	+	V
Bromus tectorum	+	+	+	-	1	+	+	+	+	-	-	-	1	1	+	1	1	1	IV
Euphorbia segueriana	-	+	-	+	-	+	2	-	1	-	-	-	-	+	-	+	+	-	III
Astragalus varius	-	1	-	+	-	-	-	-	-	-	-	-	-	-	+	+	+	+	II
Silene conica	+	+	+	-	-	-	-	-	-	-	-	-	-	+	+	-	+	-	II
Plantago arenaria	-	-	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-	+	I
Corispermum nitidum	-	-	-	-	-	-	-	-	-	1	+	+	-	-	-	-	-	-	I
Apera spica-venti subsp. *maritima*	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	I
Elymetalia arenariae, Elymion gigantei																			
Eryngium maritimum	+	+	-	+	+	+	+	-	1	2	1	+	+	-	-	-	-	-	IV
Leymus racemosus subsp. *sabulosus*	-	+	-	1	+	+	+	1	-	1	+	1	+	-	-	-	-	-	III
Elymus farctus subsp. *bessarabicus*	1	-	-	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-	I
Ammophila arenaria subsp. *arundinacea*	-	-	+	+		-	-	-	-	-	-	-	-	-	-	-	-	-	I
Polygonum oxyspermum subsp. raii	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I
Cakiletalia maritimae																			
Salsola kali subsp. *ruthenica*	+	-	-	+	+	+	-	-	+	+	-	+	-	-	-	-	-	-	III
Cakile maritima subsp.	1	1	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I

euxina																			
Crambe maritima	1	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I
Lactuca tatarica	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I
Scolymus hispanicus	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	I
Festucetalia valesiacae + Festucion rupicolae																			
Medicago falcata	-	-	-	+	-	+	-	-	-	-	+	-	-	+	1	+	+	+	III
Linaria genistifolia subsp. *euxina*	-	+	+	+	-	+	-	+	-	-	-	-	-	+	-	-	+	-	II
Linum austriacum	-	-	-	-	-	+	-	+	+	-	-	-	+	+	-	-	-	-	II
Crepis foetida subsp. *rhoeadifolia*	-	-	-	+	-	+	-	+	-	-	-	-	+	+	-	-	-	-	II
Seseli tortuosum	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	+	+	I
Cerastium brachypetalum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	-	I
Cynodon dactylon	-	-	-	-	-	-	+	-	+	-	-	1	-	+	-	-	-	-	I
Verbascum banaticum	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	I
Cichorium intybus	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	I
Other species																			
Xanthium italicum	-	+	-	+	+	2	+	-	1	1	+	+	-	+	-	-	-	-	III
Hippophae rhamnoides	-	-	-	-	1	-	1	-	-	-	-	+	1	-	-	-	-	-	II
Elaeagnus angustifolia	-	-	-	-	+	-	+	-	-	+	-	-	+	-	-	-	-	-	II
Tamarix ramosissima	-	-	-	-	+	-	-	-	-	+	-	-	+	-	-	-	-	-	I
Senecio vernalis	-	-	-	-	+	-	-	-	-	-	-	-	-	-	+	-	+	-	I
Cuscuta sp.	-	-	-	-	-	-	-	-	-	+	+	1	-	-	-	-	-	-	I
Conyza canadensis	-	-	-	-	-	-	-	-	+	-	-	-	+	-	-	-	-	-	I
Petasites spurius	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	-	I
Amorpha fruticosa	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	I
Calamagrostis epigejos	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	I
Papaver rhoeas	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	I
Teucrium chamaedrys	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	I

Location of the releves: Durankulak beach, Bulgaria (R1-4); Sfântu Gheorghe, Danube Delta (R5-9); Sulina, Danube Delta (R10-13); Cardon, Danube Delta (R14); Marine Sand Dunes Reserve, Agigea (R15-18);

In the phytocoenoses with *Convolvulus persicus* from the Danube Delta, the species belonging to the class *Ammophiletea* Br.-Bl. et R. Tüxen 1943 are better represented than in Durankulak and Agigea. Here, *Convolvulus persicus* occupies the basis of the sand dunes with *Leymus sabulosus, Eryngium maritimum* and *Elymus farctus* subsp. *bessarabicus*.

The invasive and potentially invasive plants (*Amorpha fruticosa, Conyza canadensis*), with the exception of *Xanthium italicum* have a low occurrence in the releves of the association *Convolvuletum persici* (Table 1). *Xanthium italicum*, an invasive species in the sand dunes area, represents one of the threats for the population of *Convolvulus persicus* in the long term. Parasitic species from the genus *Cuscuta* are another major threat for the populations of *Convolvulus persicus*, mainly on the beach of Sulina.

Twelve threatened plant species according to The Red Book of the vascular plants of Romania[3], the Red Data Book of the Republic of Bulgaria[4] and the Red List of Bulgarian vascular plants[16], have been recorded in the phytocoenoses with *Convolvulus persicus*: *Alyssum borzaeanum* (CR in Romania, EN in Bulgaria), *Convolvulus persicus* (CR in Romania, EN in Bulgaria), *Silene thymifolia* (VU in Romania, EN in Bulgaria), *Eryngium maritimum* (VU in Romania, EN in Bulgaria), *Elymus farctus* subsp. *bessarabicus* (CR in Romania), *Petasites spurius* (CR in Romania), *Cakile maritima* subsp. *euxina* (EN in Romania), *Crambe maritima* (EN in Romania), *Polygonum oxyspermum* subsp. *raii* (syn. *Polygonum mesembricum*) (VU in Romania, NT in Bulgaria), *Astragalus varius* (VU in Romania), *Scolymus hispanicus* (VU in Romania), *Ammophila arenaria* subsp. *arundinacea* (CR according to Ref. 3, but most probably already extinct in Romania).

Species such as *Ammophila arenaria* subsp. *arundinacea*, *Polygonum oxyspermum* subsp. *raii*, *Cakile maritima* subsp. *euxina* and *Crambe maritima* have been recorded only on Durankulak beach while *Alyssum borzaeanum, Petasites spurius* and *Scolymus hispanicus* were noticed only in the releves in Romania.

Of the twelve threatened taxa, five are Critically Endangered (in Romania), six are Endangered (4 in Bulgaria and 2 in Romania), five are Vulnerable (in Romania) and one is Near Threatened (in Bulgaria) (Fig. 4).

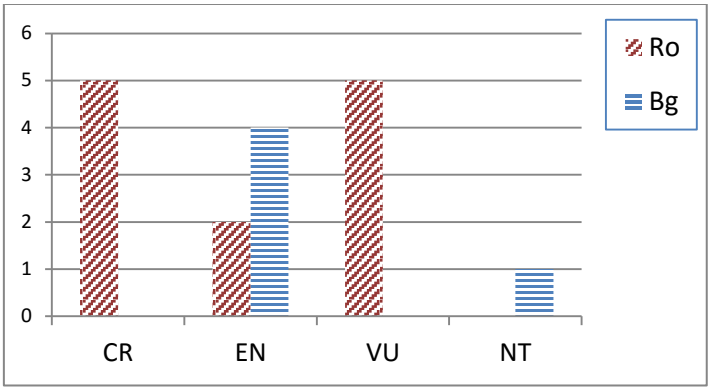


Fig. 4. Number of species belonging to different Red Data Categories in Romania and Bulgaria (CR-Critically Endangered, EN-Endangered, VU-Vulnerable, NT-Near Threatened)

The high percentage of rare species (26%), compared with the total number of recorded taxa within the plant association (46 taxa), emphasizes the conservation importance of the plant community *Convolvuletum persici*. According to Table 1, the most numerous rare plants are on the beach of Durankulak (9 taxa) and fewer of them on the beach of Sulina (4 taxa), in the natural reserve of Agigea (4 taxa) and on the beach of Sfântu Gheorghe (3 taxa).

CONCLUSIONS

Phytocoenoses with *Convolvulus persicus* are very rare on the western coast of the Black Sea. Such type of plant communities have been noticed in the Danube Delta, in the natural reserve of Agigea and on Durankulak beach in Bulgaria.

The plant association *Convolvuletum persici* can be generally found in the habitat 2110 but on the Durankulak beach, phytocoenoses with *Convolvulus persicus* reach the area of habitat 1210.

In the Danube Delta Biosphere Reserve, the phytocoenoses with *Convolvulus persicus* are vulnerable mainly to anthropogenic pressures such as grazing, tourism or expansion of the

recreational areas on the beaches. The parasitic plant *Cuscuta sp*. is another serious threat for the local populations of *Convolvulus persicus*, especially on the beach of Sulina.

On the southern coast of Romania, *Convolvulus persicus* is well preserved in the Natural Reserve of Agigea where its favourable conservation status is a consequence of some effective management measures for the dune habitats.

The Durankulak beach is currently the only location in Bulgaria in which *Convolvulus persicus* was confirmed in the last twenty years; here, it has a favourable conservation status in the frame of the Nature 2000 protected site BG0000154 Ezero Durankulak.

The ecological preferences of *Convolvulus persicus* for the dune habitats and the syntaxonomic affiliation of the accompanying species indicate that the association *Convolvuletum persici* should rather be included in the order *Festucetalia vaginatae* Soó 1957 than in *Cakiletalia maritimae* R. Tx. apud Oberd. 1949.

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