DURANKULAK BEACH, A RESERVOIR OF RARE PLANT SPECIES FOR THE COASTAL AREA OF DOBRUDJA

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ABSTRACT

Durankulak beach is the largest and longest beach of Southern Dobrudja, situated 6 km south from the Romanian-Bulgarian border. Interposed between Lake Durankulak and the Black Sea, Durankulak beach has a high diversity of habitats (sand dunes, grasslands, wetlands and sea cliff in the north and south) and consequently a diverse vegetation. The complex of natural habitats on Durankulak beach and the specific vegetation are presently well preserved in the frame of the Nature 2000 sites BG0000154 Ezero Durankulak (as SCI) and BG0002050 Durankulashko Ezero (as SPA). Plant species such as *Euphorbia paralias, Silene thymifolia, Alyssum borzaeanum, Convolvulus persicus, Verbascum purpureum, Ammophila arenaria subsp. arundinacea* and others, are very rare or even extinct on the Romanian seacoast. However, on Durankulak beach they have important local populations. As a consequence of the high concentration of rare plants, Durankulak beach can be considered a reservoir of rare species for the entire coastal area of Dobrudja (both Bulgarian and Romanian). On Vama Veche beach, the northernmost beach of Romania and very close to Durankulak, excessive development of touristic facilities in the sand dunes area has led to the dissappearance of several rare plant species for Romania, which occur on Durankulak beach more or less abundantly. The species migration towards neighboring coastal areas of Romania will be possible only after the restoration of the habitats strongly affected by human activities and after the implementation of appropriate measures for the conservation of these habitats. Instead, the spreading of the rare plants towards other protected coastal areas of Bulgaria (Shabla, Shablenska-Tuzla) is still possible.

Keywords: Durankulak beach, flora, rare plant species, Dobrudja, coastal area

INTRODUCTION

Dobrogea (Dobrudja or Dobruja in Bulgarian) is a historical region located between the Danube plain in the west and the Black Sea coast in the east, shared today by Romania and Bulgaria. The territory of Dobrudja is divided into Northern Dobrogea, which is part of Romania and Southern Dobrudja, which belongs to Bulgaria.

The coastal area of Southern Dobrudja is very heterogenous from the physico-geographical point of view, made up of large sandy beaches and low loess sea cliffs in

the north and high limestone sea cliffs and small and narrow beaches in the south. The climate is temperate-continental, with sub-Mediterranean influences.

Lake Durankulak is situated in the northeastern part of Bulgaria, approximately 6 km from the Romanian-Bulgarian border and 15 km north of the town of Shabla, in Varna district [1]. It was designated as protected area in 1983, with the purpose of protecting the threatened species of waterbirds. Since 1984 the lake has the status of Wetland of International Importance under the Ramsar Convention.

The Natural Complex Lake Durankulak is a wild area, without touristic infrastructure, well preserved since 2007 into the Nature 2000 sites BG0000154 Ezero Durankulak and BG0002050 Durankulashko Ezero (Fig. 1), one of the most important Sites for Community Importance (SCI) and Special Protection Areas (SPA) in Northern Bulgaria.

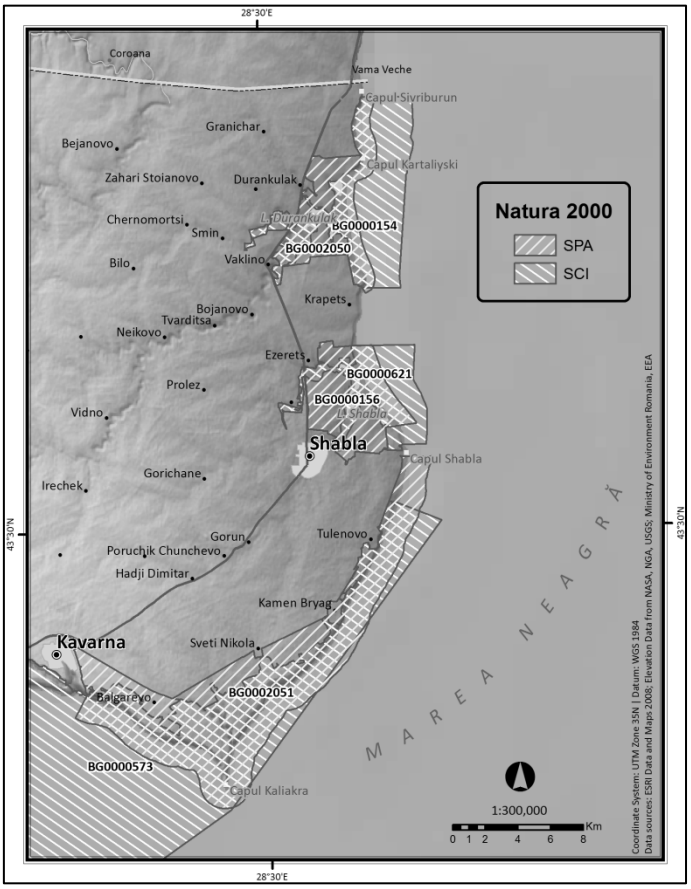

Fig. 1. The Natura 2000 sites in southern Dobrudja, inclusively Lake Durankulak

Durankulak beach, a long and wide strip of sand comprised between Lake Durankulak and the Black Sea shore, is the largest and longest beach of Southern Dobrudja. In the north of Durankulak beach, but outside of sand dune habitats or wetlands, there is a small camping area, known as Cosmos camp. North and south of Durankulak beach, loess cliffs and narrow beaches occur. The sea cliff increase in height to 15-16 meters in the north, in the proximity of the border with Romania. Between the seashore and the eastern bank of the lake, a high diversity of ecosystems and habitats occur: embryonic and shifting sand dunes, stabilized sand dunes, mesophilous and meso-hygrophilous

grasslands, tree and bush plantations (in the southern part of the beach) and wetlands in the lake proximity.

No concrete floristic research had been carried out in the area of Lake Durankulak before preparing the management plan of the protected area [1]. Certain species occurring on Durankulak beach are mentioned in some bibliographical sources [2, 3], [4, 5]. According to the Management Plan of Durankulak Lake Natural Complex [1] the number of the higher species in this site is 300. More recently, floristic observations carried out on Durankulak beach [6] have led to the identification of 282 vascular plant species. Most of the plants with conservation significance are concentrated on the sand dunes.

The informations regarding chorology, the size of populations and the present conservation status of the rare plants are very important for the improvement of the conservation strategies and for a better assessment of the endangerment degree of these plants at national and regional levels. This kind of information are provided in the paper for several plant species which are rare in the coastal area of southern or of northern Dobrudja but which have important local populations on Durankulak beach. Due to the high concentration of rare plants, Durankulak beach can be considered a reservoir of rare species for the entire coastal area of Dobrudja. The species migration towards neighboring coastal areas of Romania will be possible only after the restoration of the habitats strong affected by human activities and after the implementation of appropriate measures for the conservation of these habitats. This path is difficult because the southern coastal area of Romania has a well developed touristic infrastructure. Instead, the spreading of the rare plants towards other protected coastal areas of Bulgaria (Shabla, Shablenska-Tuzla) is still possible.

MATERIAL AND METHODS

The field observations on the flora of Durankulak beach have been carried out between the years 2008-2009 and 2014-2015. The IUCN threat categories for the rare species noticed on Durankulak beach were assessed in accordance with the Red Data Book of Republic of Bulgaria [5], the Red List of Bulgarian Vascular Plants [7] and according to the Red Book of the Vascular Plants of Romania [8]. The chorological data were given on the basis of the field observations and of some bibliographical sources. Population size of some rare species on Durankulak beach was assessed as small, medium or big. The nomenclature of the rare species is in concordance with Flora Europaea [9] and with the book “The Vascular Plants of Romania” [10].

RESULTS AND DISCUSSIONS

As a consequence of varied microclimate conditions and of different types of sandy soils, the vegetation of the sand dunes is very diverse in comparision with other beaches of northern Bulgaria or southern Romania. The diversity of habitats (sand dunes, sea cliffs, salty sands, wetlands) and adequate conservation of the natural habitats within the protected area have facilitated the development of important local populations of some plant species which are rare in southern or in northern Dobrudja. The majority of rare plants are concentrated on the mobile and stabilized sand dunes. "Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)", "Embryonic shifting dunes" and

"Fixed coastal dunes with herbaceous vegetation (grey dunes)", are the most important habitat types on Durankulak beach. The "Annual vegetation of drift lines" is another habitat type interposed between the midlittoral zone and the first strip of sand dunes. The habitat "Mediterranean salt meadows belonging to *Juncetalia maritimi*" can be found in the salty and moist areas of the beach, along the lake banks. The loess cliffs from the northern side of Durankulak beach can be included in the habitat type "Vegetated sea cliffs of the Mediterranean coasts". All these habitat types have conservative value, according with the Annex I of the European Directive 92/43/EEC.

Of the 282 vascular species noticed on Durankulak beach [6], 22 species are rare plants in accordance with the Red Data Book of Republic of the Bulgaria [5] and the Red List of Bulgarian Vascular Plants [7]. According to the Red Book of the Vascular Plants of Romania [8], 32 plant species are included in different categories of endangerment on the beach of Durankulak (Table 1). Evaluation of the rare plants in accordance with the Red Book of Romania is opportune and adequate because Durankulak beach is situated very close to the border with Romania and both southern and northern Dobrudja belong to the same physico-geographical unit. All the rare plants recorded on Durankulak beach totalize 42 plant taxa, which means a percentage of 14.90%. Most of the rare plants occur on the sand dunes (61.91%) and the rest of rarities can be found on the loess cliff (26.19%) and in the moist areas from the lake proximity (7.15%), including on the salty sands (4.77%).

Table 1. Rare plant taxa recorded on Durankulak beach

No.	Plant taxa	Red Book of Bulgaria	Red List of Bulgaria	Red Book of Romania	Typical habitat
1.	*Alyssum borzaeanum*	EN	EN	CR	sand dunes
2.	*Alyssum caliacrae*	-	-	CR	sea cliff
3.	*Ammophila arenaria* ssp. *arundinacea*	-	-	CR	sand dunes
4.	*Argusia sibirica*	-	VU	CR	sand dunes
5.	*Astrodaucus littoralis*	CR	CR	EN	sand dunes
6.	*Astragalus hamosus*	-	-	VU	sea cliff
7.	*Astragalus varius*	-	-	VU	sand dunes
8.	*Bassia hirsuta*	EN	EN	EN	salty sands
9.	*Cakile maritima* ssp. *euxina*	-	-	EN	sand dunes
10.	*Convolvulus persicus*	CR	CR	CR	sand dunes
11.	*Carex extensa*	-	-	VU	wetlands
12.	*Crambe maritima*	-	-	EN	sand dunes
13.	*Cynoglossum creticum*	-	-	VU	sand dunes
14.	*Ecballium elaterium*	-	-	VU	sea cliff
15.	*Elymus farctus* ssp. *bessarabicus*	-	-	CR	sand dunes
16.	*Elymus pycnanthus*	EN	EN	VU	sand dunes
17.	*Eryngium maritimum*	EN	EN	VU	sand dunes
18.	*Euphorbia paralias*	-	-	CR	sand dunes
19.	*Euphorbia peplis*	-	-	EN	sand dunes
20.	*Festuca beckeri* ssp. *arenicola*	EN	EN	-	sand dunes
21.	*Gypsophyla perfoliata*	-	EN	VU	sand dunes
22.	*Hordeum bulbosum*	-	-	CR	sea cliff
23.	*Lactuca tatarica*	EN	EN	-	sand dunes
24.	*Medicago marina*	-	-	CR	sand dunes
25.	*Polygonum maritimum*	-	-	VU	sand dunes

26.	*Polygonum oxyspermum* ssp. *raii (Polygonum mesembricum)*	NT	NT	VU	sand dunes
27.	*Psilurus incurvus*	-	-	EN	sea cliff
28.	*Scandix pecten-veneris*	-	-	VU	sea cliff
29.	*Senecio grandidentatus*	-	-	CR	sea cliff
30.	*Silene thymifolia*	EN	EN	VU	sand dunes
31.	*Stachys maritima*	EN	EN	CR	sand dunes
32.	*Taraxacum bessarabicum*	EN	EN	-	salty sands
33.	*Torilis nodosa*	-	-	VU	sea cliff
34.	*Triglochin maritima*	CR	CR	-	salty sands
35.	*Verbascum purpureum*	EN	EN	CR	sand dunes
36.	*Vicia narbonensis*	-	-	VU	sea cliff
37.	*Buglossoides arvensis ssp. sibthorpiana*	-	VU	-	sea cliff
38.	*Corispermum nitidum*	-	VU	-	sand dunes
39.	*Samolus valerandi*	-	LC	-	sand dunes
40.	*Scandix australis*	-	NT	-	sea cliff
41.	*Secale sylvestre*	-	VU	-	sand dunes
42.	*Utricularia vulgaris*	-	VU	-	wetlands

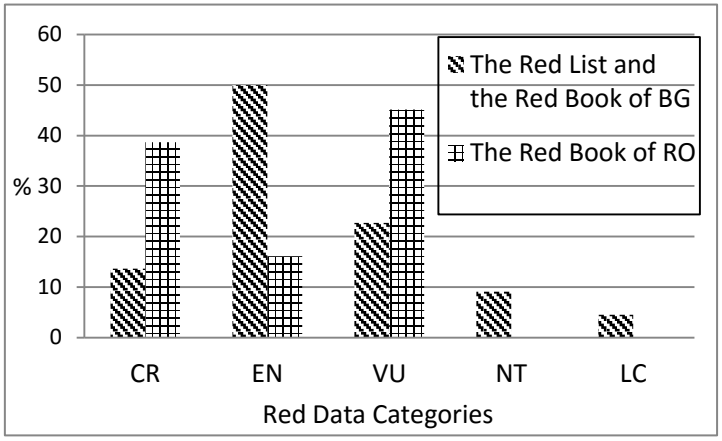

Fig. 2. Percentage of the Red Data categories in the Red Books of Romania and Bulgaria and in the Red List of Bulgaria (CR-Critically Endangered; EN-Endangered; VU-Vulnerable; NT-Near Threatened; LC-Least Concern)

Reported at the total number of rare plant species, the percentage of Endangered taxa on Durankulak beach is the highest (50%) in accordance with the Red Book and the Red List of the Republic of Bulgaria. Instead, the Red Data categories Critically Endangered (38.71%) and Vulnerable (45.17%) are better represented on Durankulak beach in accordance with the Red Book of Romania. Different assessments of the same taxa in the Red Books of Bulgaria and Romania can be explained by the physico-geographical and climatic differences of the two neighbouring countries, by the range of the plant species, by differences related to anthropogenic pressures upon the natural habitats and by the personal opinion of the scientists from Bulgaria and Romania regarding the endangerment level of the rare plant species.

Many southern origin species (Balkan, Sub-Mediterranean, Mediterranean) very rare or even considered extinct on the Romanian Black Sea coast, can be found on the sand dunes of Durankulak beach, some of them with important local populations (*Ammophila*

arenaria subsp. arundinacea, Silene thymifolia, Alyssum borzaeanum, Astragalus varius). Species such as *Euphorbia paralias, Verbascum purpureum, Ammophila arenaria subsp. arundinacea,* reach the north-eastern limit of their range in the border area (Durankulak-Mangalia) at and therefore they are very rare in Romania.

On Vama Veche beach, the northernmost beach of Romania (approximately eight km south of Durankulak), the excessive building of touristic facilities on the sand dunes has lead to the dissapearance of many plant species which are more or less abundant on Durankulak beach. The majority of the plant species recorded on Durankulak beach are cited in the bibliographical sources over 60-80 years old, which refer to the flora and vegetation of Vama Veche beach.

Having a Mediterranean range, *Ammophila arenaria* subsp. *arundinacea* can be now considered extinct on the Romanian Black Sea coast although it is a common species on the Bulgarian Black Sea coast, including on the beach of Durankulak. *Ammophila arenaria* subsp. *arundinacea* is mentioned in over 50 year old bibliographical sources [2, 11] but was not found again on the Romanian seacoast in the last decades [6, 8, 12]. On the sand dunes of Durankulak beach, *Ammophila arenaria* subsp. *arundinacea* is even abundant within some plant communities such as *Ammophilo arundinaceae-Elymetum gigantei* Vicherek 1971 and *Medicagini tenderiensis-Ammophiletum arundinaceae* Tzonev et al., 2005.

Silene thymifolia is another species with Mediterranean range, very rare on the Romanian Black Sea coast but common on the sandy beaches of Bulgaria, including on the sand dunes of Durankulak beach. Mentioned in the past at several points of the Romanian Black Sea coast and of the Danube Delta [11, 13], the only confirmed location of this species in Romania is currently the natural reserve Marine Sand Dunes of Agigea [6]. In the protected site, only two clusters have remained and therefore we consider critical the status of this taxa in Romania.

Euphorbia paralias is a very rare plant on the Romanian coast which dissappeared from the Vama Veche beach (the classic location of this taxa) as a consequence of touristic infrastructure development in the sand dunes area; in the locations from the Danube Delta Biosphere Reserve [3, 8] the presence of this species is uncertain and must be reconfirmed. In Bulgaria, this taxa with Atlantic-Mediterranean range is not threatened.

Convolvulus persicus is a rare plant both in Romania and Bulgaria. According to the Red Data Book of the Republic of Bulgaria, Durankulak beach is the only confirmed site for *Convolvulus persicus* in Bulgaria [5]. Other locations of this taxa in Bulgaria (near Rezovska river mouth, Silistar bay, Kamchia river estuary) specified in some older papers were not confirmed after 1995 [5]. Only two clusters with *Convolvulus persicus* have been noticed on Durankulak beach [6] and this justifies the Critically Endangered status of this species in Bulgaria. In Romania, *Convolvulus persicus* was recorded only in some locations within the Danube Delta Biosphere Reserve [8, 14] and in the natural reserve Marine Sand Dunes of Agigea.

Alyssum borzaeanum is a plant species considered Endangered in Bulgaria, Critically Endangered in Romania and listed as Data Deficient in the European Red List of Vascular Plants. Since 1998, *Alyssum borzaeanum* has been included in Annex I of the Bern Convention. In Durankulak area, this species is abundant north of Durankulak beach (on Anna Maria beach) forming plant communities such as *Secali sylvestri-Alyssetum borzaeani* (Borza 1931) Morariu 1959 [15] and *Alysso borzaeani-*

Ephedretum distachyae Tzonev et al. 2005. Other populations of this species in Bulgaria are small and fragmented [5]. In Romania, *Alyssum borzaeanum* is very rare, currently known only in three coastal locations: in the natural reserve Marine Sand Dunes of Agigea, on Lupilor sandbank and on Saele sandbank [15].

Verbascum purpureum is a Balkan endemic species occuring in Bulgaria, Romania and European Turkey. In Bulgaria, it is found along the Black Sea coast and in the Tundza hill area [5]. On Durankulak beach there is only a small population of *Verbascum purpureum*. This rare species was cited in Romania only in the area of Mangalia town [8] but was not reconfirmed in the last 50 years. Mangalia is probably the northern limit of the range for this species.

Astrodaucus littoralis is a very rare species both in Romania and in Bulgaria. In Romania, it was mentioned in the area of the Danube Delta Biosphere Reserve and in some localities of the southern coast of Romania [8]. The biggest population of this taxa in Romania was noticed on the shifting sand dunes between Portița and Periboina. On the beach of Durankulak, only few specimens of *Astrodaucus littoralis* occur. In other sites of the northern Bulgaria, this species was recorded in Shablenska Tuzla and in Pasha-dere, near Varna [5]. The small and scattered populations justifies the Critically Endangered status of this species in Bulgaria.

CONCLUSIONS

The remarkable diversity of the natural habitats and of the vegetation on the Durankulak beach is presently well conserved in the frame of the Natura 2000 sites BG0000154 Ezero Durankulak and BG0002050 Durankulashko Ezero.

All the rare plants recorded on Durankulak beach totalize 42 plant taxa, which means a percentage of 14.90%; most of the rare plants occur on the sand dunes.

As a consequence of the high concentration of rare plants, Durankulak beach can be considered a reservoir of rare species for the entire coastal area of Dobrudja (both Bulgarian and Romanian).

Many very rare species or even considered extinct on the Romanian Black Sea coast, can be found on the sand dunes of Durankulak beach, some of them with important local populations.

On Vama Veche beach, the northernmost beach of Romania and very close to Durankulak, the excessive development of touristic facilities in the sand dunes area has led to the disappearance of several rare plant species for Romania, which occur more or less abundantly on Durankulak beach.

The species migration towards neighboring coastal areas of Romania will be possible only after the restoration of the habitats strong affected by human activities and after the implementation of appropriate measures for the conservation of these habitats. Instead, the spreading of the rare plants towards other protected coastal areas of Bulgaria is still possible.

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