

Floristic composition and current state of non-forest natural habitats in Natura 2000 protected sites “Kamchia” (BG0000116) and “Shkorpilovtsi Beach” (BG0000100)

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Abstract: The main aim of the study was to determine the current state of the natural habitats in two Natura 2000 protected sites - “Kamchia” and “Shkorpilovtsi Beach”. Three types of non-forest natural habitats were confirmed in the Protected site “Kamchia” – 2110 “Embryonic shifting dunes”, 2120 “Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)” and 2130 “Fixed dunes with herbaceous vegetation (grey dunes)”. Four natural habitats were confirmed for the Protected site “Shkorpilovtsi Beach”: 1240 “Vegetated sea cliffs of the Mediterranean coasts with endemic *Limonium* spp.”, 2110 “Embryonic shifting dunes”, 2120 “Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)” and 2130 “Fixed dunes with herbaceous vegetation (grey dunes)”. It was determined that mostly strongly anthropogenically impacted are the habitats 2120 “Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)” and 2130 “Fixed dunes with herbaceous vegetation (grey dunes)”. In the both protected sites 96 higher plant species were found (47 in “Kamchia” and 81 in “Shkorpilovtsi Beach”) and fifteen of them were of conservation importance with different threatened status.

Key words: flora, non-forest habitats, EUNIS, Directive 92/43/EC, protected species

Introduction

The objective of the present study was to evaluate the current state of the non-forest natural habitats in the Protected site (PS) “Kamchia” (BG0000116) and PS “Shkorpilovtsi Beach”, to determine their conservation status and to characterize their floristic composition.

Both flora and vegetation of the target territory were studied before. IVANOV et al. (2002) analyzed the flora and vegetation of the natural “Complex Kamchia” and found 442 species from 79 families. The authors outlined three groups in regard to their conservation priority. An evaluation of conservation importance of plant diversity was done also for the dune complexes of Northern Black Sea coast together with the assessment of the anthropogenic effect on

the natural habitat and recommendations for its minimizing (PEEV et al. 2003). Seven associations, six of them endemic to Bulgaria, were found in a study of the psammophyte vegetation along the Black Sea coast (TZONEV et al. 2005). The criteria and requirements for conservation of Important Plant Areas (IPA) were set (PEEV et al. 2003, 2009). The outflow of Kamchiya river was also classified as IPA. It contains one of the longest sand belts in Bulgaria and the largest coastal floodplain forest.

Regarding the climate change and the changes that happened in the composition and structure of plant communities during the last 20 years, the present study aimed at evaluation of the contemporary state of the studied habitats.

Material and Methods

PS “Kamchia” occupies an area of 129 199.37 dka and PS “Shkorpilovtsi Beach” covers 51256.53 dka. They both are part of the European ecological network Natura 2000 and were declared as such with a decree of the Bulgarian Government № 802/04.12.2007 (STATE GAZETTE No.107/2007). The territory of PS “Kamchia” includes a nature reserve with the same name. The zone covers the easternmost parts of the Kamchiya river valley and the foothills of Stara Planina reaching the Black Sea. The zone covers the territories on the riverbanks of Kamchiya from Grozdyovo village in western direction to the river mouth in the Black Sea in eastern direction. The protected zone “Shkorpilovtsi Beach” is situated along the rivers Fundukliyska and Shkorpilovska until their outflows into the Black Sea. Both zones are protected according to DIRECTIVE 92/43/EEC (1992) (Habitat Directive) and DIRECTIVE 2009/147/EC (Birds Directive) and are named “Complex Kamchia” (BG0002045) and “Kamchia Mountains” (BG0002044). The orography is variable – it is plain along the Kamchiya river and becomes hilly in the north and south direction. The studied territory falls in the Continental-Mediterranean climatic area, Black Sea climatic sub-area and Northern Black Sea climatic region (VELEV 2002, 2010). The climate is characterized by warm summer and mild winter, relatively small annual temperature amplitude, and autumn-winter precipitation maximum. The soils are classified as belonging to Carpatho-Danubian soil region, and the East Balkan province (MALINOVA 2010). The predominant soil types are Luvisols, Chromic Luvisols, which form complexes with Rankers and Lithosols in some places. Fluvisols and Alluvial Fluvisols are also found in the region.

The field work was done in the period July-September 2011. Totally 17 phytosociological descriptions were performed in typical plant communities. The identification of habitats was done according to KAVRUKOVA et al. (2008) and to the Natural habitats in the Bulgarian Red Data Book (BISERKOV 2015). Each natural habitat was checked also using EUNIS classification. Choosing of the places for description was done after visual evaluation of typical sectors within a plant community. The area of description was 16 m² (4x4 m experimental plots – EP). Full floristic inventory was done in each plot and cover of each taxon was evaluated by percent coverage and abundance according to the Braun-Blanquet scale (BRAUN-BLANQUET 1964). GPS coordinates, including altitude, were scored for each description plot.

The plant taxa were identified according to JORDANOV et al. (1963-1989), VELCHEV (1982,1989), KOZUHAROV (1995), DELIPAVLOV & CHESHMEDZHIEV (2011) and KOZUHAROV & ANCHEV (2012). The data were analyzed according to the habitat type. Species of conservation status have been identified following PETROVA & VLADIMIROV (2009), PEEV (2015), the BIOLOGICAL DIVERSITY ACT (2007) with Appendices № 3 and 4 (amended in STATE GAZETTE 101/22.12.2015) and according to DIRECTIVE 92/43/EC/21.05.1992 for conservation of natural habitats of the wild flora and fauna. Also, the CONVENTION ON THE CONSERVATION OF EUROPEAN WILDLIFE AND NATURAL HABITATS Appendix I. (or BERN CONVENTION 1979), EUROPEAN RED LIST OF VASCULAR PLANTS (BILS et al. 2011) and 1997 IUCN Red List of Threatened Plants (GILLET & WALTERS 1998) were considered. The categories of conservation status were scored for each species.

Results

A short general characteristics and description of the floristic composition and phytosociological peculiarities of the studied non-forest natural habitats is presented below.

1. Vegetated sea cliffs of the Mediterranean coasts with endemic *Limonium* spp. (1240). EUNIS: B3.3321 Western Pontic herbaceous sea-cliff communities; B3.3322 Western Pontic sea-cliff [*Ficus*] thickets

During the study this natural habitat was confirmed for the PS “Shkorpilovtsi Beach”. The phytosociological descriptions (relevés) include 3 trees, 3 shrubs and 31 herbaceous species, with observed occurrence of ruderal and weed species (*Chenopodium album* L., *C. opulifolium* Schrad. ex Koch & Ziz, *Hypericum perforatum* L., *Cephalaria transilvanica* (L.) Roem. & Schult., *Avena fatua* L., *Euphorbia agraria* M. Bieb., *Ecbalium elaterium* (L.) A. Rich., *Xeranthemum annum* L., *Reseda lutea* L., *Solanum nigrum* L., *Xanthium italicum* Moretti, *Chondrilla juncea* L.) and also of the invasive species *Gleditsia triacanthos* L. and *Robinia pseudoacacia* L.

2. Embryonic shifting dunes (2110). EUNIS: B1.133 Pontic embryonic dunes

This habitat includes all orographic forms along the coast, representing the first stage of dune formation. They are developed in the zone between the typical sand beach and the white dunes. The habitat was confirmed for both studied zones, with three phytosociological descriptions performed in PS „Kamchia“ and four on the territory of the

„Beach Shkorpilovtsi“. One tree, one shrub and 40 herbaceous species were identified in this habitat. Many species of conservation importance were recorded, like *Alyssum borzaeanum* Nyár., *Anchusa velenovskyi* (Guşul) Stoj., *Centaurea arenaria* M. Bieb., *Lactuca tatarica* (L.) C.A. Mey., *Silene euxina* (Rupr.) Hand. Mazz., *Silene thymifolia* Sm. and *Stachys maritima* Gouan.

3. Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) (2120). EUNIS: B1.324 Pontic white dunes

The habitat 2120 is distributed along the whole Black Sea coast, where the processes of dune stabilization are hampered by strong winds and storms. Most frequently, the habitat is represented by a system of dune chains covered by plant communities of the alliance *Elymion gigantei*, situated parallel to the beach. The dynamics of white dunes are well expressed and are shaped by the wind direction, strength of sea storms and changes in water levels in the adjacent rivers. These dunes are more stabilized than the embryonic ones and are formed by phytocoenoses of cereals. The white dunes were confirmed for PS „Kamchia“, but they did not occur in PS „Beach Shkorpilovtsi“. Two phytosociological relevés were found and one shrub and 11 herbaceous species were identified near the outflow of Kamchiya river. Species of conservation importance were *Centaurea arenaria* M. Bieb., *Eryngium maritimum* L., *Euphorbia peplis* L. and *Lactuca tatarica* (L.) C. A. Mey.

4. Fixed coastal dunes with herbaceous vegetation (grey dunes) (2130). EUNIS: Southwestern Pontic fixed dunes

The fixed coastal dunes are stabilized and colonized by different plant communities dominated by perennial species. They are distributed along the whole Black Sea coast, mostly southward from the mouth of Kamchiya river. The grey dunes are more common than the white ones in both protected areas. Three phytosociological relevés were examined in PS „Kamchia“ and four in PS „Shkorpilovtsi Beach“. One tree, two shrubs and 42 herbaceous species were recorded. This habitat type usually contains also mosses and lichens, which cover a substantial part of its territory. The studies revealed a trend for ruderalization, illustrated by the presence of species like *Chondrilla juncea* L., *Trifolium arvense* L., *Anthemis tinctoria* L., *Gnaphalium luteo-album* L., *Lactuca serriola* L., *Papaver rhoeas* L., *Bromus* spp. and *Daucus guttatus* Sm. The habitat territory is crossed by tourist paths, coastal pubs and small restaurants and is therefore, polluted by waste. Invasion of alien species was detected, such as *Amorpha fruticosa* L., *Elaeagnus angustifolia* L.,

Robinia pseudacacia, as well as a forestation with exotic tree species.

In the present study the **conservation significance of the established natural habitats in protected areas „Kamchia“ and „Shkorpilovtsi Beach“** was assessed. All habitats recorded on the territory of Natura 2000 protected areas „Kamchia“ and „Shkorpilovtsi Beach“ are included in Appendix 1 of the BIOLOGICAL DIVERSITY ACT (2007), in the DIRECTIVE 92/43/EEC (1992) and in the Red Data Book of Bulgarian natural habitats with category Endangered (BISERKOV 2015). Strictly protected habitats included in the Bern Convention (1979) are three types.

The **conservation status of the species** in the flora of PS „Kamchia“ and PS „Shkorpilovtsi Beach“ is presented in Table 1, where the information is subdivided into two blocks – conservation status (columns 3-6) and measures for conservation (columns 7-9). Fifteen species are with conservation status: two species are strictly protected according to BERN CONVENTION (Annex I, 1979) – *Alyssum borzaeanum* Nyár. and *Aurinaria uechtritziiana* (Bornm.) Cullen & Dudley; 11 species are protected by BIOLOGICAL DIVERSITY ACT (2007), 10 species are included in the Bulgarian Red Data Book (PEEV 2015) with the category Endangered, three species are Balkan endemics, four plants are included in the List of Rare Threatened and Endemic Plants in Europe (LUCAS 1983) and two species are in the EUROPEAN RED LIST OF VASCULAR PLANTS (BILS et al. 2011).

Discussion

In the present study, it was found that habitat 1240 is affected by anthropogenic activities like fishing, camping and construction of illegal huts. This has resulted in occurrence of a large number of ruderal and weed species. In habitat 2110 a large number of species of conservation importance was found. This reflects the high conservation status of the habitat and underlines the necessity of its conservation at national and international level. The threats registered in this habitat are related to beaching, camping and construction works, as well as with the penetration of cars into the beach belt. All this results in the pollution of the habitat with waste and could lead to its destruction. Habitat 2120 (white dunes) was confirmed for PS „Kamchia“, but did not occur in PS „Shkorpilovtsi Beach“. Many species with conservation status were found in this habitat, but it was threatened by the invasion of *Amorpha fruticosa* and by anthropogenic waste pollution as a result of beaching activities. The present study found that the habitat 2130 is also

Table 1. Conservation status of the species of higher plants found in non-forest natural habitats on the territory of the protected sites „Kamchia” and „Shkorpilovtsi Beach“. Legend: Index 1 – the species was recorded on the territory of PS „Kamchia”; Index 2 – the species was recorded on the territory of PS „Beach Shkorpilovtsi”.

	Species	Conservation significance					Conservation measures taken	
		Red Data Book of the Republic of Bulgaria (2015)	Eur. List (1983)		Eur. List (2011)	Balkan endemic	Biodiversity Act (2007)	Bern convention (1979)
			BG	EU				
1	2	4	4	5	6	7	8	9
1 ^{1,2}	<i>Alyssum borzaeanum</i>	EN	R	I	DD	-	+	+
2 ¹	<i>Anchusa velenovskiyi</i>	-	-	-	-	+	+	-
3 ^{1,2}	<i>Aurinia uechtritiziana</i>	EN	V	V	DD	-	+	+
4 ^{1,2}	<i>Centaurea arenaria.</i>	-	-	-	-	-	+	-
5 ²	<i>Convolvulus lineatus</i>	EN	-	-	-	-	+	-
6 ²	<i>Crithmum maritimum</i>	EN	-	-	-	-	-	-
7 ^{1,2}	<i>Eryngium maritimum</i>	EN	-	-	-	-	+	-
8 ^{1,2}	<i>Euphorbia peplis</i>	-	-	-	-	-	+	-
9 ^{1,2}	<i>Galilea mucronata</i>	EN	-	-	-	-	-	-
10 ²	<i>Goniolimon collinum</i>	-	-	-	-	-	+	-
11 ^{1,2}	<i>Lactuca tatarica</i>	EN	-	-	-	-	+	-
12 ^{1,2}	<i>Silene euxina</i>	EN	-	-	-	-	+	-
13 ¹	<i>Silene frivaldszkyana</i>	-	-	-	-	+	-	-
14 ^{1,2}	<i>Silene thymifolia</i>	EN	-	-	-	+	-	-
15 ^{1,2}	<i>Stachys maritima</i>	EN	-	-	-	-	+	-
	Total	10	2	2	2	3	11	2

strongly influenced by the increased anthropogenic pressure. Tourism development, construction works and pollution lead to its destruction and change in the natural dynamics of sand substrates. The data obtained during this study showed that urgent conservation measures should be taken.

The assessed conservation significance of the established natural habitats proves the high conservation status of both Natura 2000 protected areas „Kamchia“ and „Shkorpilovtsi Beach“. More strict measures are necessary for their conservation and maintaining of favorable nature conservation state. The assessment of the conservation status of the species in the flora of PS „Kamchia” and PS „Beach

Shkorpilovtsi” demonstrates the substantial richness in species of conservation importance in the studied natural habitats. We claim that presence of these species is due to the specific ecological niches, allowing their distribution in the zones and this is an additional argument for their protection and priority conservation.

Conclusions

Four types of non-forest natural habitats were established and described during the studies of PS „Kamchia” and PS „Shkorpilovtsi Beach” and all of them are of high international and national

conservation importance. The floristic inventory in PS „Kamchia” and in PS „Beach Shkorpilovtsi” resulted in documentation of 96 higher plant species, 47 of which in PS “Kamchia” and 81 - in PS „Beach Shkorpilovtsi”. Totally fifteen species of conservation importance occurred in both studied PA: twelve in PS „Kamchia” and thirteen in PS „Beach Shkorpilovtsi”. These results prove the conservation significance of both studied habitats. In the same time the field studies showed that the anthropogenic pressure affected mostly habitats 2120 „Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)” and 2130 „Fixed coastal dunes with

herbaceous vegetation (grey dunes)”. This is due to the intensive development of tourism and urbanization, construction works, waste pollution, camping and sand thickening. All this leads to destruction of the structure of dune plant communities and changes in the natural dynamics of sand substrates and serves as alarm for taking of urgent conservation measures.

Acknowledgments: The field work was performed within the framework of the project „Mapping and determining the nature conservation status of natural habitats and species – Phase I. The project was funded by European Fund for regional development of EU, Operational Program Environment 2007-2013”.

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