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VASCULAR PLANT BIODIVERSITY OF THE NATURAL
NON-FOREST HABITATS IN THE NATURA 2000
PROTECTED SITES *KAMCHIA* (BG0000116) AND
SHKORPILOVTSI BEACH (BG0000100)

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Abstract. The current state of the vascular plant biodiversity of four natural non-forest habitats in the protected sites *Kamchia* and *Shkorpilovtsi Beach* was evaluated. The study was carried out in the framework of the *propel Mapping and determination of the environmental status of natural habitats and species-phase I*. Contract Nr. 04-014/05.04.2011. Totally 96 species of vascular plants were recorded, 47 in *Kamchia* and 81 in *Shkorpilovtsi Beach*. Among them fifteen species were with conservation status. Due to the negative impact of the intensive development of tourism and urbanization, construction works, waste, camping and sand thickening, the future permanent monitoring of both sites is strongly recommended.

Key words: anthropogenic factors, Black Sea coast, flora, non-forest habitats, protected species, threatened species

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INTRODUCTION

The coastal Natura 2000 protected sites *Kamchia* (BG0000116, 129 199.37 dka) and *Beach Shkorpilovtsi* (BG0000100, 51256.53 dka) were declared as such in 2007 (State Gazette 107/2007). Both sites are protected according to Directive 92/43/EEC (1992) (more popular as the Habitat Directive) and Directive 2009/147/EC (Birds Directive) under the names *Complex Kamchia* (BG0002045) and *Kamchia Mountains* (BG0002044).

The plant biodiversity of *Complex Kamchia* was studied by Ivanov et al. (2002) who found 442 species from 79 families. Data on vascular plant species occurring as dominants or accompanying taxa were

Table 1. Geographical coordinates of the experimental plots (EP) in the non-forest natural habitats recorded in the Natura 2000 protected sites *Kamchia* (K) and *Shkorpilovtsi Beach* (S).

Date N E

Experimental Plots

Geographical coordinates Altitude [m]

Geographical coordinates of phytocenological descriptions of natural habitat 1240

EP 1 S 42.92084 27.89738 0 23.07.2011 **Geographical coordinates of phytocenological**

descriptions of natural habitat 2110 EP 1 K 42.98357 27.89254 0 1.08.2011 EP 2 K

42.98954 27.89139 0 1.08.2011 EP3 K 43.01356 27.88931 0 2.08.2011 EP4 S 42.94431

27.90174 0 21.07.2011 EP5 S 42.95154 27.89968 2 22.07.2011 EP6 S 42.92026 27.89664

1 23.07.2011 EP7 S 42.97901 27.89347 6 25.07.2011 **Geographical coordinates**

of phytocenological descriptions of natural habitat 2120 EPIK 43.02508 27.88885 2

2.08.2011 EP 2 K 43.02017 27.88876 4 2.08.2011 **Geographical coordinates of**

phytocenological descriptions of natural habitat 2130

EP 1 K 42.99013 27.88729 0 1.08.2011 EP 2 K 43.01715 27.88831 4 2.08.2011 EP3

K 42.99861 27.88650 0 6.08.2011 EP4 S 42.97836 27.89257 9 21.07.2011

EP5 S 42.94812 27.90052 3 22.07.2011 EP6 S 42.96499 27.89629 2 24.07.2011

EP7 S 42.94899 27.89990 0 25.07.2011

provided by Tzonev et al. (2005) in a more general study of the psammophyte vegetation along the Black Sea coast. The conservation importance of plant diversity of the dune complexes of the Northern Black Sea coast was evaluated and led to the classification of the outflow of the Kamchiya river as an Important Plant Area - IPA (Peev et al. 2003, 2009). The aim of the present paper is to provide recent data on the vascular plant biodiversity of the non-forest natural habitats of both protected sites and its

conservational significance.

MATERIAL AND METHODS

The field work was carried out in the period July-September 2011. The complete floristic inventory was done in 17 experimental plots (EP), each 16 m² (4x4 m). The plots were situated in the non-forest habitats of both sites. In addition, the cover of each taxon was evaluated by percent coverage and abundance after the scale of Braun-Blanquet (1964). The identification of habitats was done according to Kavrukova et al. (2008), Bulgarian Red Data Book (Biserkov 2015) and the EUNIS classification. Choosing the places for description was done after visual evaluation of typical sectors within a plant community. GPS coordinates, including altitude, were scored for each EP with the dates of visits and descriptions (**Table 1**).

The plant taxa were identified according to Jordanov (1963-1989), Kuzmanov (1979), Velchev (1982, 1989), Kozuharov (1995), Delipavlov & Cheshmedzhiev (2011) and Kozuharov & Anchev (2012). The conservation status of each species was evaluated after the Red List of Bulgarian vascular plants (Petrova & Vladimirov 2009), Bulgarian Red Data Book of plants and fungi (Peev 2015), Biological Diversity Act (Act on Amending and Supplementing) /2007/ (Appendices №3 and 4, amended State Gazette №101/22.12.2015), Directive 92/43/EC/21.05.1992 for conservation of natural habitats of the wild flora and fauna, Convention on the Conservation of European Wildlife and Natural Habitats Appendix I. (Bern Convention 1979), List of Rare, Threatened and Endemic Plants in Europe (Lucas 1983) and European Red List of Vascular Plants (Bils et al. 2011).

RESULTS

During this study four types of non-forest natural habitats were recorded: 1) Vegetated sea cliffs of the Mediterranean coasts with endemic *Limoniurn* spp. (1240). EUNIS: B3.3321 Western Pontic herbaceous sea-cliff communities; B3.3322 Western Pontic sea-cliff [*Ficus*] thickets; 2) Embryonic shifting dunes (2110). EUNIS: 1.313 Pontic embryonic dunes; 3) Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) (2120). EUNIS: 1.324 Pontic white dunes; 4) Fixed coastal dunes with herbaceous vegetation (grey dunes) (2130). EUNIS: Southwestern Pontic fixed dunes. Their conservational significance is shown in **Table 2**.

Table 2. Conservation significance of the natural habitats in the Natura 2000 protected areas *Kamchia* and *Beach Shkorpilovtsi*. Abbreviations: CN - Code Natura 2000, BDA- Biodiversity Act (2007), BC - Bern Convention (1979), D92 - Directive 92/43/EEC, BRDB - Bulgarian Red Data Book of habitats (Biserkov 2015) with the following categories: EN - Endangered, CR - Critically Endangered, VU - Vulnerable, NT - Near Threatened.

Natural habitats CN BDA BC D92 BRDB

1 Vegetated sea cliffs of the Mediterranean 1240 + - + EN
coasts with endemic *Limonium* spp.

2 Embryonic shifting dunes 2110 + + + EN

3 Shifting dunes along the shoreline with (grey dunes)

Ammophila arenaria (white dunes) 4 Fixed 2120 + + + EN 2130 + + + EN
coastal dunes with herbaceous vegetation

Table 3. Floristic and phytocenological characterization of natural habitat 1240 *Vegetated sea cliffs of the Mediterranean coasts with endemic Limonium* spp. in the in the experimental plot (EPI) in the protected site *Beach Shkorpilovtsi*.

Species Abundance (after Braun Blanquet 1964)

EPI

Trees

1 *Gleditsia triacanthos* L. 1

2 *Robinia pseudoacacia* L. +

3 *Ulmus minor* Mill. +

Shrubs

4 *Cionura erecta* (L.) Griseb. 1

5 *Colutea arborescens* L. 1

6 *Jasminum fruticans* L. +

Herbaceous plants

7 *Anthemis tinctoria* L. +

8 *Atriplex hastata* L. 1 -2 9 *Avena fatua* L. +

10 *Bromus sterilis* L. +

11 *Cardaria draba* (L.) Desv. +

12 *Chenopodium album* L. +

13 *Chenopodium opulifolium* Schred. ex
Koch & Ziz

+

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Species Abundance (after Braun Blanquet 1964)

EPI

14 *Chondrilla juncea* L. +

- 15 *Convolvulus lineatus* L. +
- 16 *Crithmum maritimum* L. +
- 17 *Cynanchum acutum* L. + - 1 18 *Ecballium elaterium* (L.) A. Rich. 2
- 19 *Erysimum diffusum* Ehrh. +
- 20 *Euphorbia agraria* M. Bieb. +
- 21 *Goniolimon collinum* (Griseb.) Boiss. +
- 22 *Hypericum perforatum* L. +
- 23 *Lactuca tatarica* (L.) C. A. Mey. +
- 24 *Lappula marginata* (M. Bieb.) Gurke +
- 25 *Linaria genistifolia* (L.) Mill. +
- 26 *Melica ciliata* L. +
- 27 *Melilotus albus* Medicus 1 -2 28 *Polygonum aviculare* L. +
- 29 *Reseda lutea* L. +
- 30 *Salsola ruthenica* Ujin. +
- 31 *Scabiosa argentea* L. +
- 32 *Silene euxina* (Rupr.) Hand.-Mazz. +
- 33 *Solanum nigrum* L. +
- 34 *Sonchus oleraceus* L. +
- 35 *Verbascum* sp. +
- 36 *Xanthium italicum* Moretti +
- 37 *Xeranthemum annuum* L. + - 1

All results on the vascular plant biodiversity obtained during the study are presented in **Tables 3-6** for each of the non-forest habitats of both protected sites, respectively. According to the number of species found in each of these habitats it could be stated that habitat 2130 had the highest plant biodiversity (46).

Totally 96 vascular plant species were recorded, 47 in *Kamchia* and 81 in *Shkorpilovtsi Beach*. Fifteen of these, or 16%, were of conservation importance, twelve of which occurred in the PS *Kamchia*, and thirteen - in the PS *Beach Shkorpilovtsi* (**Table 7**).

Table 4. Floristic and phytocoenological characterization of the natural habitat 2110 *Embryonic shifting dunes* in the experimental plots (EP) in the protected sites *Kamchia* (EP1K-EP3K) and *Beach Shkorpilovtsi* (EP4S-EP7S).

Trees

1 *Fraxinus oxycarpa* M. Bieb. ex Willd. - - - - - + - Shrubs

2 *Periploca graeca* L. - 1 - - - - - Herbaceous plants

3 *Alyssum borcaeanum* Nyar. + r + - - - - 4 *Ammophila arenaria* (L.) Link + + -1 + + + -1 2-3 1 5
Anchusa velenovskyi (Gusul.) Stoj. - r - - - - - 6 *Artemisia campestris* L. + 1 2 - - - 1 7 *Bromus tectorum* L,
 - - - + - - - 8 *Cakile maritima* Scop. - - - - - + - 9 *Carex ligERICA* J. Gay - - - - - 1 - 10 *Centaurea arenaria*
 M. Bieb. + + + + - - + 11 *Chondrilla juncea* L. - - - - + + - 12 *Cichorium intybus* L. - - - - - + - 13 *Conium*
maculatum L. - - - - - + - 14 *Conyca canadensis* (L.) Cronquist - - - - - + - 15 *Crambe maritima* L. + + - +
 + 1 +

16 *Ehms farctus* (Viv.) Runeinark ex Meldens

1 1 1 - 2 - +

17 *Eryngium maritimum* L. 2 + - + + - 1 + 1 - 2 18 *Euphorbia paralias* L. + - - - - - 19 *Euphorbia peplis* L,
 + - + - + + - 20 *Galilea mucronata* (L.) Pari. - + - - - - - 21 *Glaucium flavum* Crantz - - - - - + - 22

Jasione heldreichii Boiss. & Orph. + + - - - - - 23 *Jurinea albicaulis* Bunge 1 - 2 1 - 2 1 + - + - 1 24

Lactuca tatarica (L.) C. A. Mey. + - 1 + - - - - - 1 + 25 *Leymus racemosus* (Lam.) Tzvelev 1 1 + 1 + - 1 - 1 26
Linariagenistifolia (L.) Mill. + r + + + + + 27 *Medicago falcata* L. - - - 2 + + - 28 *Medicago minima* (L.)
 Bartal. - - - - - + - 29 *Melilotus albus* Medicus - - - - - + - 1 - 30 *Peucedanum arenarium* Waldst. & Kit. + + -
 - - - - -

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Species Abundance (after Braun-Blanquet 1964) EPIK EP2K EP3K EP4S EP5S EP6S EP7S

31 *Plaiitago scabra* Moench - - + - - - + 32 *Polygomim maritimum* L. + - + - - - + 33 *Salsola riithenica*
 Iljin + + + - 1 + + - + 34 *Scabiosa argentea* ri - - - + - - - 35 *Secale sylvestre* Host + - - + - - - 36 *Silene*
euxina (Rupr.) Hand.-Mazz. + + + + + - - 37 *Silene thymifolia* Sin. + + + 1 + - 1 - - + 38 *Stachys maritima*
 Gouan + - + - - - + 39 *Teiicrium polium* L. - - - + - - - 40 *Tragopogon* sp. - - - - - + - 41 *Tribuhis terrestris*
 L. - - - - - + - 42 *Xanthium italicum* Moretti + - + + + + - 1 +

Table 5. Floristic and phytocoenological characterization of the natural habitat 2120 *Shifting dimes along the shoreline with Ammophila arenaria* (white dimes) in the experimental plots (EP) in the protected site *Kamchia* (EP1K-EP2K).

Species Abundance (after Braun^Blanquet 1964)

EPIK EP2K

Shrubs

1 *Amorpha fruticosa* L. + - Herbaceous plants

2 *Ammophila arenaria* (L.) Link 2-3 2 3 *Artemisia campestris* L. - 1 4 *Centaurea arenaria* M.
 Bieb. - + 5 *Elymns farctis* (Viv.) Runemark ex Meldens - + - 1

6 *Eryngium maritimum* L. 1 + 7 *Euphorbia peplis* L. - + 8 *Lactuca tatarica* (L.) C. A. Mey. 1 - 2 1 9
Leymus racemosus (Lam.) Tzvelev + + - 1

10 *Phragmites australis* (Cav.) Trin. ex Steud. + - 11 *Salsola riithenica* Iljin - + 12 *Xanthium*

Table 6. Floristic and phytocoenological characterization of the natural habitat 2130 *Fixed coastal dunes with herbaceous vegetation (grey dunes)* in tire in the experimental plots (EP) in the protected areas *Kamchia* (EP1K-EP3K) and *Beach Shkorpilovtsi* (EP4S-EP7S).

Species Abundance (after Braun-Blanquet 1964)		EP1K	EP2K	EP3K	EP4S	EP5S	EP6S	EP7S
Trees								
1 <i>Pyrus pyraister</i> Burgsd.		-	-	+	-	-	-	-
2 <i>Chamaecytisus heuffelii</i> (Wierzb.) Rothm.		-	-	-	-	-	+	-
3 <i>Crataegus monogyna</i> Jacq.		-	-	+	-	-	-	-
Herbaceous plants								
4 <i>Agrostis capillaris</i> L.		-	-	1	-	-	-	-
5 <i>Allium flavum</i> L.		-	-	-	-	-	+	+
6 <i>Allium</i> sp.		+	+	+	-	-	-	+
7 <i>Alyssum borzaceanum</i> Nyar.		-	2	-	3	-	1	+
8 <i>Artemisia campestris</i> L.		1	-	2	1	2	1	-
& Dudley ¹		-	2	+	1	-	+	+
9 <i>Aurinia uechtritziana</i> (Bomm.) Cullen		-	2	+	1	+	+	1
10 <i>Bromus tectorum</i> L.		-	-	-	+	+	+	+
11 <i>Carex ligerica</i> J. Gay		+	-	1	-	-	-	-
12 <i>Centaurea arenaria</i> M. Bieb.		+	-	2	+	+	+	+
13 <i>Cerastium</i> sp.		+	-	-	-	-	-	-
14 <i>Chondrilla juncea</i> L.		-	-	+	-	1	-	+
15 <i>Chrysopogon gryllus</i> (L.) Trin.		-	-	1	-	2	-	-
16 <i>Conyza canadensis</i> (L.) Cronquist		-	-	-	-	-	+	+
17 <i>Daucus guttatus</i> Sin.		-	-	-	-	-	-	-
18 <i>Erysimum diffusum</i> Ehrh.		-	-	+	-	-	-	-
19 <i>Festuca valesiaca</i> Schleich, ex Gaudin		+	-	1	-	-	-	-
20 <i>Galileo mucronata</i> (L.) Pari.		-	-	2	2	1	-	2
21 <i>Gnaphalium luteo-album</i> L.		+	-	-	-	-	+	+
22 <i>Iris pumila</i> L.		-	-	+	-	-	-	-
23 <i>Jasione heldreichii</i> Boiss. & Orph.		+	-	1	+	1	2	+
24 <i>Jurinea albicaulis</i> Bunge		-	+	-	+	-	1	1
25 <i>Lactuca serriola</i> L.		-	-	-	-	-	-	+
26 <i>Lerchenfeldia flexuosa</i> (L.) Schur		-	-	-	+	-	-	-
27 <i>Linaria genistifolia</i> (L.) Mill.		+	+	+	+	+	+	+
28 <i>Linum tauricum</i> Willd.		-	-	-	+	-	-	+
29 <i>Medicago falcata</i> L.		-	-	-	+	+	+	+

Species Abundance (after Braun-Blanquet 1964) EPIK EP2K EP3K EP4S EP5S EP6S EP7S

30 <i>Orobanchaceae</i> sp.	-	-	+	-	-	-	-	-
31 <i>Papaver rhoeas</i> L.	-	-	-	+	-	+	+	+
32 <i>Papaver</i> sp.	-	-	-	-	+	+	+	+
33 <i>Peucedanum arenarium</i> Waldst. & Kit.	-	-	-	-	+	+	+	+
34 <i>Plantago scabra</i> Moench	-	-	-	-	+	+	+	+
35 <i>Rumex temifolius</i> (Wallr.) A. Love	+	-	1	+	+	+	+	+
36 <i>Scabiosa argentea</i> L.	-	1	+	+	1	+	+	+
37 <i>Secale sylvestre</i> Host	-	-	-	-	-	-	-	-
38 <i>Sideritis montana</i> L.	-	-	+	-	-	-	-	-
39 <i>Silene euxina</i> (Rupr.) Hand.-Mazz.	+	+	+	+	+	+	+	+
40 <i>Silene frivaldszkiana</i> Hampe	+	-	2	-	-	-	-	-
41 <i>Silene thymifolia</i> Sm.	-	1	-	2	-	+	1	+
42 <i>Stachys maritima</i> Gouan	-	-	-	-	-	+	-	-
43 <i>Teucrium polium</i> L.	-	+	-	1	-	+	+	-
44 <i>Trifolium arvense</i> L.	-	-	-	-	-	-	-	-
45 <i>Xeranthemum annuum</i> L.	-	-	+	-	-	-	-	-
46 Bryophyta	-	4	5	3	-	-	-	-

Table 7. Conservation status of the species of higher plants established on the territory of the

protected areas *Kamchia* and *Beach Shkorpilovtsi*: Abbreviations: BRDB - Bulgarian Red Data Book of Plants and Fungi (Peev 2015) with the following categories: EN - Endangered, CR - Critically Endangered, VU - Vulnerable, NT - Near Threatened, E - List of Rare, Threatened and Endemic Plants in Europe (Lucas 1983) for Bulgaria (E-BG) and Europe (E-EU) with I - Indeterminate and V - Vulnerable; EPL - European Red List of Vascular Plants (Bils et al, 2011) with the category Data Deficient - DD; EL2 - European List (2011); BE - Balkan Endemic, BDA- Biodiversity Act (2007), BC - Bern Convention (1979). Species indexed by 1 -the species was recorded on the territory of *Kamchia*, Index 2 -the species was recorded on the territory of *Beach Shkorpilovtsi*.

Species BRDB E-BG E-EU EPL BE BDA BC I* *Alyssum borzaeanum* Nyar. EN R I

DD - + + 2 *Anchusa velenovskii* (Guss.) Stoj. - - - - + + -

1-2 *Aurinia uechtritzi* (Bornm.) Cullen & (Bornm.) Velen.)

Dudley (Syn.: *Lepidotrichum uechtritzi* EN V V DD + +

4,2 *Centaurea arenaria* M. Bieb. - - - - + - 52 *Convolvulus lineatus* L. EN - - - - + - 62
Crithmum maritimum L. EN - - - - -

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Species BRDB E-BG E-EU EPL BE BDA BC 7,2 *Eryngium maritimum* L. EN - - - - + -

8,2 *Euphorbiaeplis* L. - - - - - + -

9,2 *Galileo mucronata* (L.) Pari. (Syn.: EN - - - - - - - - + -

Schoenus mucronatus (L.) 102 *Goniolimon*

collinum (Griseb.) Boiss.

11,2 *Lactuca tatarica* (L.) C. A. Mey. EN - - - - + - 12,2 *Silene euxina* (Rupr.) Hand.-Mazz. EN

- - - - + - 13, *Silene frivaldszkiana* Hampe - - - - + - - 14,2 *Silene thymifolia* Sm. EN - - - + -

- 15,2 *Stachys maritima* Gouan EN - - - - + - **Total 10 2 2 2 3 11 2**

DISCUSSION

The results obtained during this study confirm the rich biodiversity of vascular plants (96 species) and the natural conservation significance of all four non-forest natural habitats with 15 conservationally important plant species in both Natura 2000 protected sites *Kamchia* and *Shkorpilovtsi Beach*. However, the intensive development of tourism and urbanization, construction works, waste, camping and sand thickening could be outlined among the most important anthropogenic factors with a negative impact in the area. Therefore, the future permanent monitoring of both sites is strongly recommended.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interests regarding the publication of this article.

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