

FLORISTIC CHARACTERISTICS OF VIŠNJIČKA KOSA NEAR BELGRADE, SERBIA

KSENIJA JAKOVLJEVIĆ¹, D. LAKUŠIĆ¹, SNEŽANA VUKOJIČIĆ¹, ANICA TEOFILOVIĆ², and S. JOVANOVIĆ¹

¹*Institute of Botany and Jevremovac Botanical Garden, Faculty of Biology, University of Belgrade, 11000 Belgrade, Serbia*

²*Institute of Urbanism, 11000 Belgrade, Serbia*

Abstract — As a result of floristic investigations of Višnjička Kosa, 568 plant taxa belonging to 304 genera and 74 plant families were recorded. Phytogeographical analysis showed that this flora can be characterized as being of the Holarctic chorological type (53.00%). Ecological analysis indicated that the flora of the investigated area is of the hemicryptophyte type. Analysis of floristic changes in the last few decades in the investigated area showed declining diversity and strong qualitative changes.

Key words: Flora, analysis, floristic changes, Višnjička Kosa, Belgrade, Serbia

UDC 581.9(497.111)

INTRODUCTION

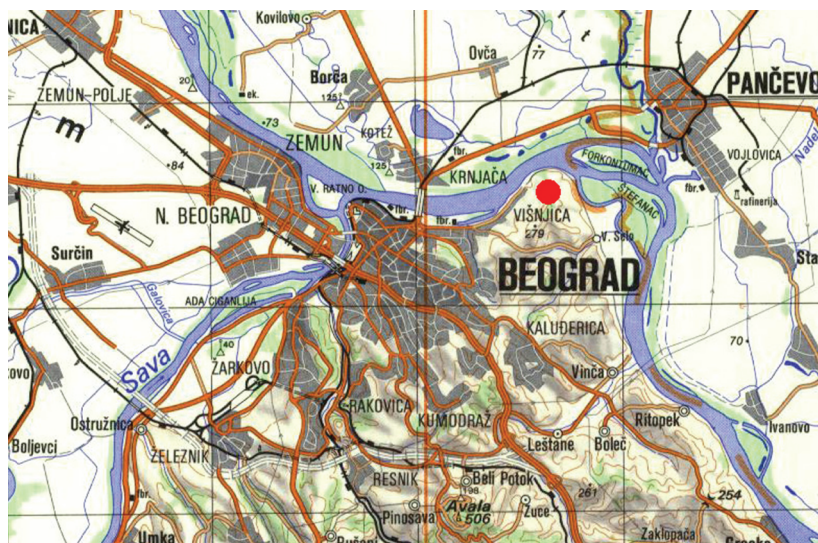
Višnjička Kosa is a floristically very interesting area in view of the fact that it is situated in the northwest part of Belgrade on the southern edge of the Pannonian lowland and right bank of the Danube river. Biogeographically, it belongs to the Pontic-South-Siberian steppe region. With respect to terrain configuration, the investigated area is exposed and surrounded by the Pannonian lowland on the west, northwest, north, northeast, and east. In regard to ecological and phytogeographical features, Serbia is generally characterized by a significant number of arid and thermophilic habitats, which generate suitable conditions for development and establishment of Pontic plant species on this territory (Tomović et al., 2003; Jovanović, 1988).

However, despite its obvious accessibility and short distance from the center of Belgrade, Višnjička Kosa has not been well explored. The first data on the flora of this area were given by Pančić (1865) during his investigations of the Belgrade region in the middle of the 19th century. Detailed floristic-vegetation investigation was continued during the last century by Bogojević (1968), Jovanović (1994), Tomanović (2004), and Jakovljević (2006).

The investigated area is situated in the northwest part of Belgrade on the edge of the Pannonian lowland and right bank of Danube river (Map 1). The geographical position of this area is from 44° 48' 52" to 44° 50' 67" N and from 20° 31' 68" to 20° 37' 22" E. Višnjička Kosa represents the edge of Pannonian lowland and the terrain is exposed and surrounded by it on the west, northwest, north, northeast, and east. The relief is characterized by gentle land forms, with wide shallow valleys and spacious rolling hills that come down to the Danube. The highest point is Milićevo Brdo (279 m) (Bogojević, 1968).

The oldest geological products in this area are Middle Miocene-Tortonian deposits with different lithological structure and deposition. There are deposits of deeper water, known as the Višnjica clay, in and near the Danube riverbed. In higher places, calcareous rocks come to the surface. The given rocks are covered by younger low Sarmatian calcareous rocks (Bogojević, 1968). These Miocene structures are covered by deposits from the Upper Pleistocene and Lower Holocene. Loess deposits, 2-15 m thick, are composed of sand, dust, powder, and clay particles (Bogojević, 1968).

According to Bogojević (1968), the climate of the Višnjička Kosa can be classified as temper-



Map 1. Geographical position of the investigated area.

ate. Because of its geographical position, this area is exposed to influences of Continental, Atlantic, and Mediterranean climate. Since there was no meteorological station in Višnjička Kosa, data from the nearest station in Belgrade for the period of 1996 to 2004 were used. The mean annual temperature of Belgrade is 12.7°C, and the mean annual rainfall for this area is 712.5 mm (Jovanović, 1994). This combination of temperature and rainfall shows characteristics of the temperate climate type.

The forest vegetation of the investigated area belongs to the thermo-mesophilous oak forest zone of the West-Moesian subregion. Associations that were widely distributed in the past, such as *Querceto-Carpinetum serbicum* Rudski, 1940, nowadays are usually present in various degraded forms. The banks of the Danube River are dominated by *Salix alba* and *Populus alba* forests—associations *Salicetum albae* Issler, 1926 and *Populetum albae* Slavnić, 1952. In addition, there is a planted coniferous forest (*Pinus nigrae* community) with very local prevalence. The vegetation of Višnjička Kosa is also marked by the presence of shrubbery of the associations *Euphorbio-Paliuretum spinae-christi* Bogojević, 1969 (as fragments) and *Pruno spinosae-Crataegetum* (Soó, 1927) Hueck, 1931 and a community of *Staphyllea pinnata*. Vegetation of grasslands is represented by several formations, with

dominance of the grass species *Chrysopogon gryllus*, *Arrhenatherum elatius*, *Andropogon ischaemum*, *Festuca* spp., etc.

The aims of this study were to add to the floristic knowledge of this area and determine floristic changes that occurred in the last few decades.

MATERIAL AND METHODS

The study is based on published data (Bogojević, 1968; Jovanović, 1994), herbarium collections (BEO, BEOU), and continuous field observations carried out between 2004 and 2006. Herbarium specimens are deposited at the Institute of Botany and Jevremovac Botanical Garden, Faculty of Biology, University of Belgrade (BEOU).

The nomenclature follows *Flora Europaea* (Tutin et al., 1964-1980). For floristic elements, the chorological groups and chorological type classifications of Jovanović (1994) were used. In determination of life forms, the criteria proposed by Raunkiaer (1934), Mueller-Dombois and Ellenberg (1974), and Stevanović (1992) were employed. For biotope analysis, the classifications of Cvejić et al. (2007) were used. Biotope data are available in MapInfo format with attributive data in the Microsoft Access database.

RESULTS AND DISCUSSION

The flora of Višnjička Kosa includes a total of 568 species of vascular plants, grouped into 304 genera and 74 families.

The class Equisetopsida was represented by two and the class Polypodiopsida by one species. The class Dicotyledones was the richest, with 484 taxa (85.21%) belonging to 255 genera and 63 families. The class Monocotyledones was represented by nine families, 47 genera, and 81 taxa (13.74% of the total flora).

Twenty-four moss species classified into seven families were also recorded in this area (Grdović and Stevanović, 2006).

In the taxonomic spectrum of the flora of the investigated area, the most species-rich families were Asteraceae (80), Poaceae (55), and Fabaceae (50) (Table 1).

For chorological analysis, all taxa are classified into 17 chorological groups and seven wider chorological types. Phytogeographical analysis showed dominance of the Holarctic chorological type, with 292 taxa (53.00%). In second place was the Mediterranean-Continental type, with 107 plant species (19.42%), followed by the Cosmopolitan type, with 44 taxa (7.99%) (Table 2).

In line with the position of this region (in the Northern Hemisphere), more than half of the species belong to the Holarctic area type, with dominance of the Eurasian chorological group. The fact that the Mediterranean-Continental chorological type occupies second place underlines the transitional position of this area, between the Mediterranean—Sub-Mediterranean and Central European regions. The Pontic-South Siberian chorological type is positioned in fifth place, with 29 taxa (5.26%). Participation of these species is expected because of the forest-steppe characteristics of this area, although their presence is less pronounced than earlier owing to human influence and habitat degradation.

Ecological analysis showed that the flora of the investigated area is of the hemicryptophyte type, as is the flora of Serbia (Diklić, 1984)

Table 1. Taxonomic spectrum of the flora of Višnjička Kosa near Belgrade (the 15 largest families in the flora of the investigated area).

Family	No. of species	% of species
Asteraceae	80	19.32
Poaceae	55	13.29
Fabaceae	50	12.08
Lamiaceae	43	10.39
Brassicaceae	29	7.00
Scrophulariaceae	27	6.52
Apiaceae	19	4.58
Boraginaceae	19	4.59
Rosaceae	16	3.86
Caryophyllaceae	15	3.62
Ranunculaceae	15	3.62
Chenopodiaceae	12	2.90
Euphorbiaceae	12	2.90
Liliaceae	12	2.90
Polygonaceae	10	2.42
Total	414	100.00

Table 2. Chorological spectrum of the flora of Višnjička Kosa near Belgrade.

Chorological type	No. of species	% of species
Adventive	37	6.69
Cosmopolitan	44	7.96
Holarctic	292	52.80
Mediterranean-Continental	107	19.35
Central European-Mediterranean	29	5.24
Central European	15	2.72
Pontic-South Siberian	29	5.24
Total	553	100.00

Table 3. Life form spectrum of the flora of Višnjička Kosa near Belgrade.

Life form	No. of species	% of species
Hemicryptophytes	265	47.41
Therophytes	160	28.62
Phanerophytes	59	10.55
Geophytes	41	7.33
Chamaephytes	18	3.22
Scandentophytes	13	2.33
Hydrophytes	3	0.54
Total	559	100.00

Table 4. Biotope spectrum of the flora of Višnjička Kosa near Belgrade.

Code	Biotope types	No. of species	% of species
31	Urban ruderal land (abandoned urban area)	153	45.67
41	Urban cultivated green areas	8	2.39
63	Wet urban ruderal land with high shrubs	20	5.97
71	Arable land and market gardens	35	10.45
72	Abandoned arable land covered by herbaceous weed vegetation	114	34.03
74	Natural and seminatural grasslands	119	35.52
79	Boundaries	17	5.07
81	Hedgerows	20	5.97
82	Thickets	50	14.93
84	Deciduous forests	44	13.13
87	Forest edges	18	5.37

Table 5. Floristic diversity on the territory of Višnjička Kosa near Belgrade.

	No. of species
Total number of recorded species	568
Number of species recorded by previous investigations (up to 1994)	442
Number of species confirmed by our recent field investigations (after 2004)	207
Number of species unconfirmed by our recent field investigations (after 2004)	235
Species new for the investigated area (after 2004)	126

and that of the Balkan Peninsula (Turill, 1929). Hemicryptophytes were represented with 47.41%, therophytes with 28.62%, and phanerophytes with 10.55% (Table 3). Climatic characteristics of the area (semi-warm and semi-dry summers and semi-cold winters) caused the high percentage of hemicryptophytes. The high percentage of therophytes results from the sub-Mediterranean—Mediterranean characteristics of some parts of Višnjica's flora and is also a consequence of strong human influence and habitat degradation in the last few decades. The relatively large number of phanerophytes is associated with the forest-steppe nature of this area.

Analysis of species frequency in different biotope types showed that many species (285) were recorded in biotopes belonging to the category of agricultural lands (group VII according to Cvejić et al., 2007), which cover the largest part of the investigated area (Table 4). With 153 species, urban ruderal land, waste deposits, and opencast mineral extraction sites (group III according to Cvejić et al., 2007) rank second, while hedgerows, thickets, and forests (group VIII according to Cvejić et al., 2007) follow with 132 species. The remaining groups are represented with appreciably fewer species (Table 4).

Human influence on the flora and vegetation of the investigated area is strong and intensive. Our recent floristic-vegetation survey of this part of the Belgrade region, showed the presence of 333 species, which is significantly fewer than the number of species recorded in previous investigations (Table 5). However, besides declining diversity, we also noticed serious qualitative changes in the flora, since the presence of 235 species could not be confirmed, while 126 species new for this area were recorded (List 1).

List 1. Species recorded for the first time for the flora of Višnjička Kosa after 2004.

(legator and *voucher number* of plant specimens deposited in BEOU)

1. *Agrostemma githago* L. (Lakušić, D., Vukojičić, S., Jakovljević, K. **497**)
2. *Althaea cannabina* L. (Jakovljević, K., Đorđević, V. **104**)
3. *Ambrosia artemisifolia* L. (Jakovljević, K., Đorđević, V. **61, 285**)
4. *Arctium minus* Bernh. (Jakovljević, K., Đorđević, V. **350**)
5. *Arrhenatherum elatius* (L.) Beauv. ex J & C. Presl. (Jakovljević, K. **566**)
6. *Artemisia vulgaris* L. (Jakovljević, K. **177**, Jakovljević, K., Đorđević, V. **329**)
7. *Aster novi-belgii* L. (Jakovljević, K. **187**)
8. *Aster tradescanti* L. (Jakovljević, K., Đorđević, V. **118**)
9. *Atriplex tatarica* L. (Jakovljević, K., Đorđević, V. **76**)

10. *Avena compressa* (Heuffel) W. Sauer & Chmelitschek (Jakovljević, K., Đorđević, V. **73, 241**)
11. *Avena fatua* L. (Jovanović, S., Vukojičić, S., Jakovljević, K., Đorđević, V. **8**)
12. *Avena sativa* L. (Jakovljević, K. **355**)
13. *Ballota nigra* L. (Jakovljević, K., Đorđević, V. **60, 72, 315**, Jakovljević, K. **148**)
14. *Brassica nigra* (L.) Koch. (Jakovljević, K. **363**)
15. *Bromus erectus* Hudson (Jakovljević, K. **467**)
16. *Bromus sterilis* L. (Jakovljević, K. **361, 368, 390, 438, 453, 481**, Lakušić, D., Vukojičić, S., Jakovljević, K. **502**)
17. *Bromus tectorum* L. (Jovanović, S., Vukojičić, S., Jakovljević, K., Đorđević, V. **25**)
18. *Broussonetia papyrifera* L'Her ex Vent. (Jakovljević, K., Đorđević, V. **351**)
19. *Bryonia cretica* L. subsp. dioica (Jacq.) Tutin (Jakovljević, K., Đorđević, V. **259, 214**)
20. *Calystegia sepium* (L.) R. Br. (Jakovljević, K., Đorđević, V. **302**)
21. *Campanula patula* L. (Jovanović, S., Vukojičić, S., Jakovljević, K., Đorđević, V. **35**)
22. *Cardaria draba* (L.) Desv. (Jovanović, S., Vukojičić, S., Jakovljević, K., Đorđević, V. **39**; Jakovljević, K. **421 444, 474**)
23. *Carex leporina* L. (Jakovljević, K. **165**)
24. *Celtis occidentalis* L. (Jakovljević, K., Đorđević, V. **258**)
25. *Chamaecytisus heuffelii* (Wierzb.) Rothm. (Jakovljević, K., Vukojičić, S. **522**)
26. *Chamaecytisus hirsutus* (L.) Link. (Jovanović, S., Vukojičić, S., Jakovljević, K., Đorđević, V. **49**, Jakovljević, K., Vukojičić, S. **523**)
27. *Chamaecytisus supinus* (L.) Link. (Jakovljević, K., Vukojičić, S. **557**)
28. *Chenopodium album* L. (Jakovljević, K. **182**;
Jakovljević, K., Đorđević, V. **99, 227, 306**)
29. *Cirsium arvense* (L.) Scop. (Jovanović, S., Vukojičić, S., Jakovljević, K., Đorđević, V. **48**; Jakovljević, K. **161**; Jakovljević, K., Đorđević, V. **333**)
30. *Clematis recta* L. (Jakovljević, K. **362**)
31. *Conyza canadensis* (L.) Cronq. (Jakovljević, K. **169**, Jakovljević, K., Đorđević, V. **201**)
32. *Coronilla emerus* L. (Jakovljević, K., Đorđević, V. **80**; Jakovljević, K., Vukojičić, S. **539**)
33. *Crepis biennis* L. (Jakovljević, K., Đorđević, V. **91, 131**)
34. *Crepis pulchra* L. (Jakovljević, K., Đorđević, V. **108, 336**; Lakušić, D., Vukojičić, S., Jakovljević, K. **507**)
35. *Crepis tectorum* L. (Jakovljević, K. **451**)
36. *Cuscuta campestris* Yuncker (Jakovljević, K., Đorđević, V. **305**)
37. *Datura stramonium* L. (Jakovljević, K., Đorđević, V. **207**)
38. *Deschampsia cespitosa* (L.) Beauv. (Jakovljević, K., Đorđević, V. **334**)
39. *Diplotaxis tenuifolia* (L.) DC (Jakovljević, K. **142, 149**)
40. *Echinochloa crus-galli* (L.) Beauv. (Jakovljević, K. **157**; Jakovljević, K., Đorđević, V. **324, 190**)
41. *Epilobium hirsutum* L. (Jakovljević, K., Đorđević, V. **276**)
42. *Epilobium lanceolatum* Sebastiani & Mauri (Jakovljević, K., Đorđević, V. **289**)
43. *Epilobium parviflorum* Schreber (Jakovljević, K., Đorđević, V. **288**)
44. *Erigeron acer* L. (Jakovljević, K., Đorđević, V. **342**)
45. *Erigeron annuus* (L.) Pers. (Jovanović, S., Vukojičić, S., Jakovljević, K., Đorđević, V. **44**; Jakovljević, K. **147, 375, 430**)
46. *Erodium cicutarium* (L.) L'Her. (Jakovljević, K. **420**)
47. *Eupatorium cannabinum* L. (Jakovljević, K., Đorđević, V. **126, 291**; Jakovljević, K., **164**)

48. *Euphorbia esula* L. (Jakovljević, K., Đorđević, V. **56**)
 49. *Euphorbia peplus* L. (Jakovljević, K. **458**)
 50. *Festuca ovina* L. (Jakovljević, K. **395**)
 51. *Galega officinalis* L. (Jakovljević, K. **353**)
 52. *Galinsoga parviflora* Cav. (Jakovljević, K. **175**)
 53. *Galium schultesii* Vest (Jakovljević, K., Đorđević, V. **87, 263**)
 54. *Genista tinctoria* L. (Jakovljević, K., Đorđević, V. **232**)
 55. *Gleditsia triacanthos* L. (Jakovljević, K., Đorđević, V. **70**)
 56. *Holcus lanatus* L. (Jakovljević, K., Đorđević, V. **296**)
 57. *Hordeum murinum* L. (Jovanović, S., Vukojičić, S., Jakovljević, K., Đorđević, V. **33**; Jakovljević, K., Đorđević, V. **340**; Jakovljević, K. **460**)
 58. *Inula conyza* D.C. (Jakovljević, K., Đorđević, V. **113**)
 59. *Iva xanthifolia* Nutt. (Jakovljević, K. **559**)
 60. *Juglans regia* L. (Jovanović, S., Vukojičić, S., Jakovljević, K., Đorđević, V. **4**; Jakovljević, K., Đorđević, V. **117, 242**)
 61. *Lathyrus pratensis* L. (Lakušić, D., Vukojičić, S., Jakovljević, K. **510**)
 62. *Lathyrus sativus* L. (Lakušić, D., Vukojičić, S., Jakovljević, K. **516**)
 63. *Lepidium ruderales* L. (Jakovljević, K., Đorđević, V. **318**)
 64. *Linaria angustissima* (Loisel.) Borbás (Jovanović, S., Vukojičić, S., Jakovljević, K., Đorđević, V. **34**; Jakovljević, K., Đorđević, V. **348**)
 65. *Lolium perenne* L. (Jovanović, S., Vukojičić, S., Jakovljević, K., Đorđević, V. **28**; Jakovljević, K., Đorđević, V. **347**)
 66. *Maclura pomifera* (Rafin.) C.K. Schneider (Jakovljević, K. **188**)
 67. *Matricaria chamomilla* L. (Jakovljević, K. **461**)
 68. *Matricaria perforata* Mérat (Jakovljević, K., Đorđević, V. **125, 250**)
 69. *Medicago rigidula* (L.) All. (Jakovljević, K. **384, 469**)
 70. *Medicago sativa* L. (Jakovljević, K., Đorđević, V. **65, 344**)
 71. *Melilotus alba* Medic (Jakovljević, K. **166**)
 72. *Odontites verna* (Bellardi) Dumort (Jakovljević, K., Đorđević, V. **78**)
 73. *Oenothera biennis* L. (Jakovljević, K., Đorđević, V. **323**)
 74. *Panicum miliaceum* L. (Jakovljević, K., Đorđević, V. **105**, Jakovljević, K. **150**)
 75. *Papaver dubium* L. (Jakovljević, K. **450**)
 76. *Papaver hybridum* L. (Jakovljević, K. **448**)
 77. *Petasites albus* (L.) Gaertner (Jakovljević, K., Đorđević, V. **136**)
 78. *Phalaris arundinacea* L. (Jovanović, S., Vukojičić, S., Jakovljević, K., Đorđević, V. **38**; Jakovljević, K., Đorđević, V. **209**)
 79. *Picris hieracioides* L. (Jovanović, S., Vukojičić, S., Jakovljević, K., Đorđević, V. **42**; Jakovljević, K., Đorđević, V. **195**)
 80. *Plantago major* L. (Jakovljević, K. **180**, Jakovljević, K., Đorđević, V. **314**)
 81. *Poa annua* L. (Jakovljević, K., Đorđević, V. **55**)
 82. *Poa nemoralis* L. (Jakovljević, K. **374, 464**)
 83. *Poa pratensis* L. (Jakovljević, K. **410**)
 84. *Poa trivialis* L. (Jakovljević, K., Đorđević, V. **53, 123**)
 85. *Polygonatum multiflorum* (L.) All. (Jakovljević, K., Đorđević, V. **90**)
 86. *Polygonum hydropiper* L. (Jakovljević, K. **159**)
 87. *Polygonum lapathifolium* L. (Jakovljević, K., Đorđević, V. **115**)
 88. *Polygonum patulum* Bieb. (Jakovljević, K. **171**)
 89. *Populus nigra* L. (Jakovljević, K. **138, 386**)

90. *Portulaca oleracea* L. (Jakovljević, K., Đorđević, V. **316**)
91. *Pulicaria dysenterica* (L.) Bernh. (Jakovljević, K., Đorđević, V. **63**; Jakovljević, K. **160**)
92. *Pyrus pyraaster* Burgsd. (Jovanović, S., Vukojičić, S., Jakovljević, K., Đorđević, V. **5**)
93. *Robinia pseudoacacia* L. (Jakovljević, K. **565**)
94. *Roripa kernerii* Menyh. (Jakovljević, K., Đorđević, V. **321**)
95. *Roripa lippizensis* (Wulfen) Reichenb. (Jakovljević, K. **414**)
96. *Rubus idaeus* L. (Jakovljević, K. **366**)
97. *Rumex crispus* L. (Jakovljević, K., Đorđević, V. **54**)
98. *Rumex sanguineus* L. (Jakovljević, K., Đorđević, V. **297**)
99. *Salix alba* L. (Jakovljević, K., Vukojičić, S. **550**; Jakovljević, K., Đorđević, V. **281**)
100. *Senecio vulgaris* L. (Jakovljević, K., Đorđević, V. **331**)
101. *Setaria glauca* (L.) Beauv. (Jakovljević, K., Đorđević, V. **97, 293**; Jakovljević, K. **170**)
102. *Setaria verticillata* (L.) Beauv. (Jakovljević, K., Đorđević, V. **67, 337**; Jakovljević, K. **172**)
103. *Setaria viridis* (L.) Beauv. (Jakovljević, K., Đorđević, V. **191, 200**)
104. *Solidago gigantea* Aiton (Jakovljević, K., Đorđević, V. **128, 295**)
105. *Sonchus arvensis* L. (Jakovljević, K. **167**)
106. *Sonchus oleraceus* L. (Jakovljević, K. **151**; Jakovljević, K., Đorđević, V. **303**)
107. *Sorghum halepense* (L.) Pers. (Jakovljević, K. **173**)
108. *Syringa vulgaris* L. (Jakovljević, K., Đorđević, V. **103**)
109. *Tamarix tetrandra* Pallas ex Bieb. (Jakovljević, K. **356**)
110. *Tanacetum vulgare* L. (Jakovljević, K., Đorđević, V. **317**, Jakovljević, K. **484**)
111. *Thlaspi alliaceum* L. (Jakovljević, K., Vukojičić, S. **529**)
112. *Thymelaea passerina* (L.) Cosson & Germ. (Jakovljević, K., Đorđević, V. **253**)
113. *Trifolium medium* L. (Jakovljević, K., Đorđević, V. **57**; Jakovljević, K. **146**)
114. *Triticum aestivum* L. (Jakovljević, K., Đorđević, V. **64**)
115. *Tussilago farfara* L. (Jakovljević, K., Vukojičić, S. **528**)
116. *Typha angustifolia* L. (Jakovljević, K., Đorđević, V. **286**)
117. *Vaccaria hispanica* (Miller) Rauschert (Lakušić, D., Vukojičić, S., Jakovljević, K. **494**)
118. *Verbascum lychnitis* L. (Jakovljević, K., Đorđević, V. **135**)
119. *Veronica agrestis* L. (Jakovljević, K. **463**)
120. *Veronica polita* Fries (Jakovljević, K. **415**)
121. *Vicia cracca* L. (Jakovljević, K. **399**)
122. *Vicia lathyroides* L. (Jakovljević, K. **482**)
123. *Vicia lutea* L. (Lakušić, D., Vukojičić, S., Jakovljević, K. **508**)
124. *Vicia sativa* L. (Jakovljević, K. **441**)
125. *Viola kitaibeliana* Schultes (Jakovljević, K., Vukojičić, S. **545**)
126. *Xanthium strumarium* L. (Jovanović, S., Vukojičić, S., Jakovljević, K., Đorđević, V. **6**, Jakovljević, K., Đorđević, V. **320**)

All of these changes point to a strong ruderalization process involving increase in the number of introduced and cosmopolitan species as a consequence of the natural habitat's degradation. Among these introduced species, invasive ones present a special problem. Some of them are: *Ailanthus altissima*, *Amaranthus retroflexus*, *Ambrosia artemisiifolia*, *Asclepias syriaca*, *Conyza canadensis*, *Cuscuta campestris*, *Galinsoga parviflora*, *Kochia scoparia*, *Oenothera biennis*, *Portulaca oleracea*, *Robinia pseudoacacia*, *Solidago gigantea*, *Sorghum halepense*, *Xanthium strumarium*, etc.

Apart from significant secondary increase of floristic diversity with ruderal and introduced species,

Table 6. Area of occupancy of main biotope groups on the territory of Višnjička Kosa near Belgrade.

Code	Main groups of biotopes	Area (m ²)	Area (%)
1	Physical structure	427,301	4.14
2	Traffic structure	609,358	5.90
3	Urban ruderal land, waste deposits and opencast mineral extraction sites	2,420,066	23.44
4	Urban green structure	894,412	8.66
5	Inland surface water	405,022	3.92
6	Wetlands (mires, bogs, fens)	0	0.00
7	Agricultural land	3,812,343	36.93
8	Hedgerows, thickets, and forests	1,752,130	16.97
9	Unvegetated or sparsely vegetated biotopes	3,402	0.03
0	Unclassified areas	1,479	0.01
Total		10,325,513	100.00

Table 7. Area of occupancy of most important biotope types on the territory of Višnjička Kosa near Belgrade.

Code	Biotope types	Area (m ²)	Area (%)
3	URBAN RUDERAL LAND, WASTE DEPOSITS, AND OPENCAST MINERAL EXTRACTION SITES	2,420,066	23.44
31	Ruderal land	2,110,662	87.22
32	Waste deposits	218,633	9.03
34	Opencast mineral extractions sites	90,771	3.75
7	AGRICULTURAL LAND	3,812,343	36.93
71	Arable land and market gardens	2,082,775	55
72	Abandoned arable land covered by herbaceous weed vegetation	1,178,643	31
73	Orchards and vineyards	207,982	5
74	Natural and seminatural grasslands	105,945	3
75	Abandoned grasslands	17,679	0.5
78	Garden plantation	53,500	1.5
79	Boundaries	89,520	2
7A	Complex of mosaically arranged biotopes of agricultural land	76,299	2
8	HEDGEROWS, THICKETS, AND FORESTS	1,752,130	16.97
81	Hedgerows	206,592	11.79
82	Thickets	700,512	39.98
83	Individual trees and avenues	96,480	5.5
84	Deciduous forests	344,449	19.66
85	Coniferous forests	44,433	2.54
86	Mixed deciduous-coniferous forests	359,664	20.53

the Višnjička Kosa area has suffered a serious loss of the most important elements of the natural flora. The most conspicuous floristic changes pertain to steppe species. Many of them have disappeared: *Anemone silvestris*, *Astragalus onobrychis*, *Crepis pannonica*, *Prunus tenella*, *Sternbergia colchiciflo-*

ra, *Vinca herbacea*, etc. Remaining representatives include *Chrysopogon gryllus*, *Euphorbia pannonica*, *Nonea pulla*, *Potentilla arenaria*, *Salvia aethiopsis*, *Stipa capillata*, etc. This disappearance was closely related to anthropogenic influence, especially strong in the second half of the 20th century, which caused

deterioration of steppe, forest steppe, and sandstone ecosystems (Niketić and Stevanović, 1999). A large number of extinct and critically endangered species belong to association of the *Festuco-Brometea* type (xerophilous grass associations in lowland and mountain regions), and sub-Mediterranean and Pontic-South Siberian floristic elements characteristic of warm and dry regions are the most frequent among them.

Biotope analysis also indicates very strong and intensive antropogenic influence on the flora and vegetation of the investigated area. Agricultural biotopes occupy the largest part of Višnjička Kosa (37%), while the group of biotopes composed of urban ruderal land, waste deposits, and opencast mineral extraction sites is positioned in second place with 23%. Hedgerows, thickets, and forests occupy 17% of the investigated area, while the remaining biotope types occupy less than 25% of territory of Višnjička Kosa (Table 6).

Among agricultural lands, arable land and market gardens are dominant (55%). In second place are abandoned arable lands covered with herbaceous weed vegetation (31%), followed by orchards and vineyards (5%). With 3%, natural and seminatural grasslands occupy only the fourth position, and just a small part of this area is covered by natural dry grasslands (2657 m²) with remnants of the steppe vegetation, previously widespread in this area (Table 7).

In the category of urban ruderal land, waste deposits, and opencast mineral extraction sites, ruderal land is highly dominant (87.22%). In second place are extraction sites (9.03%), and waste deposits follow with 3.75% (Table 7).

Among hedgerows, thickets, and forests, thickets are dominant (39.98%). Biotopes composed of mixed deciduous-coniferous and deciduous forests follow with nearly equal values (20.53% and 19.66%). In fourth place is the hedgerow type of biotope (11.79%). The two remaining biotope types cover just a small part of this area. Individual trees and avenues cover 5.5% and cultivated coniferous forests only 2.54% of the area in question (Table 7).

Acknowledgments — This research was supported by the Ministry

of Science of the Republic of Serbia (Grant 143015: Project «Diversity of Flora and Vegetation in the Central Part of the Balkan Peninsula - Ecology, Chorology, and Conservation»).

REFERENCES

- Bogojević, R. (1968). Floristička i fitocenološka ispitivanja vegetacije na Višnjičkoj kosi kraj Beograda. *Glasn. Bot. Zav. Bašte Univ. Beogr.* 3, 79-99.
- Bogojević, R. (1969). *Euphorbio-Paliuretum spinae-christi* R. Bog., nova termofilna zajednica drača (*Paliurus spina christi* Mill.) i mlečike (*Euphorbia pannonica* Host.) na Višnjičkoj kosi kraj Beograda. *Ekologija*, 4(2), 217-224.
- Bogojević, R. (1970). Ekološka analiza staništa zajednica *Andropogoneto-Euphorbietum pannonicae* R. Bog. i *Querceto-Carpinetum serbicum* Rudski na Višnjičkoj kosi kraj Beograda. *Glasn. Bot. Zav. Bašte Univ. Beogr.* 5(1), 1-104.
- Cvejić, J., Teofilović, A., Jovanović, S., Lakušić, D., and A. Tutundžić (2007). *Ključ za kartiranje biotopa*. Projekat „Zelena regulativa Beograda”, Regulacija podizanja, zaštite i održavanja sistema zelenih površina Beograda, III faza projekta, Sveska 2, 1-155, Urbanistički zavod Beograd, Belgrade.
- Diklić, N. (1984). Životne forme biljnih vrsta i biološki spektar flore SR Srbije, In: *Vegetacija SR Srbije* (Ed. M. Sarić), 1, 291-316. SANU, Belgrade.
- Ellenberg, H., and D. Mueller-Dombois (1967). A key to Raunkier plant life forms with revised subdivisions. *Ber. Geobot. Inst.* 37, 56-73.
- Grdović, S., and V. Stevanović (2006). The moss flora in the central urban area of Belgrade. *Arch. Biol. Sci. (Belgrade)* 58(1), 55-59.
- Jakovljević, K. (2006). Florističko-vegetacijska studija Višnjičke kose kraj Beograda s posebnim osvrtom na antropogeni uticaj i stanje biotopa. Master's Thesis, Faculty of Biology, University of Belgrade, Belgrade.
- Jovanović, S. (1988). Steppe vegetation fragments in the surroundings of Belgrade. *Arch. Biol. Sci. (Belgrade)* 40 (1-4), 9P-10P.
- Jovanović, S. (1994). *Ekološka studija ruderalne flore i vegetacije Beograda*. Faculty of Biology, University of Belgrade, Belgrade.
- Mueller-Dombois, D., and H. Ellenberg (1974). *Aims and Methods of Vegetation Ecology*. John Wiley & Sons, New York.
- Niketić, M., and V. Stevanović (1999). Analiza ugroženosti flore Srbije na osnovu iščezlih i krajnje ugroženih taksona, In: *Crvena knjiga flore Srbije* (Ed. V. Stevanović), 1, 32-39.
- Pančić, J. (1865). *Flora u okolini Beogradskoj po analitičnom*

- metodu*. State Printing Office, Belgrade.
- Raunkiaer, C. (1934). *The Life Forms of Plants and Statistical Plant Geography; Being the Collected Papers of C. Raunkiaer, Translated into English*. Clarendon, London.
- Stevanović, V. (1992). Klasifikacija životnih formi flore Srbije. In: *Flora Srbije* (Ed. M. Sarić), 1, 39-46, SANU, Beograd.
- Tomanović, S. (2004). Alohtona adventivna flora na području Beograda. Master's Thesis, Faculty of Biology, University of Belgrade, Belgrade.
- Tomović, G., Randelović, V., Niketić, M., Vukojičić, S., and B. Zlatković (2003). New distribution data of some Pontic and sub-Mediterranean plant species in Serbia. *Arch. Biol. Sci. (Belgrade)* 55(1-2), 45-54.
- Turril, W. B. (1929). *The Plant-life of the Balkan Peninsula. A Phytogeographical Study*. Oxford.
- Tutin, T. G., Heywood, V. H., Burges, N. A., Valentine, D. H., Walters, S. M., and D. A. Webb (Eds.) (1964). *Flora Europaea 1*. University Press, Cambridge.
- Tutin, T. G., Heywood, V. H., Burges, N. A., Moore, D. M., Valentine, D. H., Walters, S. M., and D. A. Webb (Eds.) (1968-1980). *Flora Europaea 2-5*. University Press, Cambridge.

ФЛОРИСТИЧКЕ КАРАКТЕРИСТИКЕ ВИШЊИЧКЕ КОСЕ КРАЈ БЕОГРАДА

КСЕНИЈА ЈАКОВЉЕВИЋ¹, Д. ЛАКУШИЋ¹, СНЕЖАНА ВУКОЈИЧИЋ¹,
АНИЦА ТЕОФИЛОВИЋ², и С. ЈОВАНОВИЋ¹

¹Институт за ботанику и Ботаничка башта "Јевремовац", Биолошки факултет,

Универзитет у Београду, 11000 Београд, Србија

²Урбанистички завод, 11000 Београд, Србија

Анализом флоре истраживаног подручја утврђено је присуство 568 таксона на нивоу врсте, подврсте или варијетета васкуларних биљака, сврстаних у 304 рода и 74 фамилије. По броју врста најбогатије су фамилије Asteraceae, Poaceae, Fabaceae и Lamiaceae што је у складу са њиховом бројношћу и у флори целе Србије.

Биљногеографском анализом укупне флоре истраживаног подручја утврђено је присуство 305 различитих флорних елемената који су обједињени у 7 основних ареал типова, односно 17 различитих ареал група. Најбројнија је група холарктичког ареал типа са 292 представника (53,00%), док се на другом месту по заступљености налази ареал тип медитеранско-континенталних врста са укупно 107 представника (19,42%).

Анализом заступљености појединих животних форми у саставу флоре истраживаног подручја утврђен је њен хемикриптофитско-терофитски карактер. Хемикриптофите су високо доминантне

са 265 врста или 47,41% укупног броја врста, док се животна форма терофита налази на другом месту по бројности са 160 таксона, односно 28,62% од укупног броја врста.

Анализа бројности врста у појединим типовима биотопа показала је да највећи број њих припада групи пољопривредних станишта (VII група). Рудерални биотопи (III група) са 158 врста налазе се на другом месту, док за њима следе они из групе живица, шибљака и шума (VIII група) са 139 представника.

Као последица интензивног антропогеног утицаја током протеклих неколико деценија, дошло је до значајних промена које су ишле у правцу рудерализације флоре, односно повећања броја адвентивних и космополитских врста, а нестанка бројних, раније присутних степских врста (нпр. *Anemone sylvestris*, *Aster linosyris*, *Campanula sibirica*, *Medicago minima*, *Prunus tenella*, *Sternbergia colchiciflora*, *Veronica spicata*, *Vinca herbacea*, *Crepis pannonica*).