Зборник Матице српске за природне науке / Matica Srpska J. Nat. Sci. Novi Sad, № 131, 145—155, 2016

UDC 574.5:004(497.11)
DOI: 10.2298/ZMSPN1631145C

Dušanka Lj. CVIJANOVIĆ[1], Milica M. ŽIVKOVIĆ[1], Maja Z. NOVKOVIĆ[1], Ana A. ANĐELKOVIĆ[1,2], Snežana B. RADULOVIĆ[1], Dmitar V. LAKUŠIĆ[3]*

[1] University of Novi Sad, Faculty of Sciences, Department of Biology and Ecology, Trg Dositeja Obradovića 2, 21000 Novi Sad, Serbia
[2] Institute for Plant Protection and Environment, Teodora Drajzera 9, 11040 Belgrade, Serbia
[3] University of Belgrade, Faculty of Biology, Institute of Botany and 'Jevremovac' Botanical Garden, Takovska 43, 11000 Belgrade, Serbia

THE DIGITAL DATABASE OF AQUATIC AND SEMIAQUATIC VEGETATION IN SERBIA

ABSTRACT: Despite the absence of a centralized national phytocoenological database of Serbia, over 16,000 relevés of all vegetation types have been gathered and stored in the database "Phytocoenosis of Serbia" as a result of the Project "Habitats of Serbia". However, as the data on aquatic and semiaquatic vegetation comprise only 5% of the collected relevés, the aim of this paper is to expand on this, complete the database and present the data on these vegetation types in Serbia. The work included the expansion of the existing database with the addition of relevant sources, their digitalization, using Flora and Turboveg programs, and their subsequent georeferencing, using OziExplorer and DIVAGIS softwares. Consequently, the phytocoenological database on aquatic and semiaquatic vegetation in Serbia now stores 1,720 relevés from 243 phytocoenological tables, collected and published by 24 authors during the period of 70 years (1940–2010), with the majority of the relevés collected over the last decade (56.40%). *Phragmito-Magno-Caricetea* Klika in Klika et Novák 1941 (Syn: *Phragmitetea communis* R. Tx. et Prsg. 1942), *Potametea* Klika in Klika et Novák 1941 (Syn: *Potametea* R. Tx. et Preising 1942) and *Lemnetea* de Bolós et Masclans 1955 (Syn: *Lemnetea minoris* W. Koch et R. Tx. 1955) have proven to be the most represented classes, while *Scirpo-Phragmitetum* W. Koch 1926 (nomen ambiguum) and *Salvinio natantis-Spirodeletum polyrrhizae* Slavnić 1956 are associations with the highest number of relevés in the database. Accordingly, the most common species (>500 relevés) are *Ceratophyllum demersum* L. subsp. *demersum, Lemna minor* L. and *Spirodela polyrhiza* (L.) Schleiden.

KEYWORDS: aquatic and semiaquatic vegetation, phytocoenological database, Serbia

INTRODUCTION
PHYTOCOENOLOGICAL DATABASES

Vegetation databases have a very wide range of applications, from the classical study of vegetation classification to predictive mapping and tests of

* Corresponding author. E-email: dusanka.cvijanovic@dbe.uns.ac.rs

fundamental ecological hypotheses regarding functional traits, assembly rules and biodiversity patterns (Dengler *et al*., 2008), as well as patterns and processes of global change caused by anthropogenic climate warming, land-use changes and biotic invasions (Schaminée *et al*., 2009).

There are over 80 regional, national and local phytocoenological and other vegetation databases for the territory of Europe (Schaminée *et al*., 2009), with over 4,300,000 relevés, out of which 1,600,000 have already been digitized in the Turboveg format (Dengler *et al*., 2011). Turboveg represents a standard software for the storing of phytocoenological data and is compatible with most of the programs used for their subsequent analysis.

With the aim to standardize them and enable the global exchange of data, The Global Index of Vegetation-Plot Databases (GIVD) was established in 2008 as an internet-based platform (Dengler *et al*., 2011). In addition to the traditional phytocoenological relevés, collected following the Braun-Blanquet method, GIVD also encompasses other vegetation relevés, ranging in size from 1 to 1,000 m^2. By the end of March 2016, GIVD database has encompassed the data from 237 databases, with a total of 3,168,044 relevés. Although a centralized national phytocoenological database for Serbia does not exist (Schaminée *et al*., 2009), over 16,000 phytocoenological relevés, of all vegetation types, were gathered by 2005, as part of the Project „Habitats of Serbia" (Lakušić *et al*., 2005). The relevés were collected in the form of photocopied literature sources and stored in the database called „Phytocoenoses of Serbia", at the Institute for Botany of the Faculty of Biology, University of Belgrade. This database does not hold relevés in an electronic form. A framework for their digitalization, in the form of Excel files, was prepared as part of the project „Habitats of Serbia". The Excel files contain lists of species, with a degree of their frequency from their corresponding phytocoenological tables, information on the name of the phytocoenosis, sintaxonomical affiliation, locality and gathered sources. The aquatic and semiaquatic vegetation comprises only 5% of the relevés in the database, which is far less than their existing number. The database lacks primarily the references for the non-rooted floating vegetation.

Bearing in mind the abovementioned facts, the aim of this paper is to expand, finalize and present the data on the aquatic and semiaquatic vegetation in the database „Phytocoenosis of Serbia", as well as to digitalize these relevés and organize them in a separate database in the Turboveg format.

MATERIAL AND METHODS

DEVELOPMENT OF THE DATABASE

The database „Phytocoenoses of Serbia" (Lakušić *et al*., 2005), has been revised and expanded with the relevant references for the aquatic and semiaquatic vegetation, published until 2010. The phytocoenological data was digitalized first in the format of Excel files, subsequently organized in a separate database, first using the progam package Flora (Karadžić *et al*., 1998), following by the Turboveg software (Hennekens and Schaminée 2001).

THE MAPPING OF DATA

The data were georeferenced in the program OziExplorer (OziExplorer 2009). The distribution maps were produced using the DIVAGIS software (Hijmans *et al*., 2004) and given in UTM map projection. Only those relevés (1,374) from the literature which had a precisely defined locality were georeferenced.

RESULTS
DATABASE FOR AQUATIC AND SEMIAQUATIC VEGETATION

After the revision and data addition, the database of aquatic and semiaquatic vegetation now holds 1,720 phytocoenological relevés, distributed in 243 phytocoenological tables, with a total of 395 species, with an average of 7.63 species per relevé and 13,128 floristic records, while the average number of species per table is 19.68.

The database encompasses the relevés published in the period 1940–2010, in 38 different sources, by 24 authors (Slavnić 1940, 1956; Janković 1953; Babić 1955, 1971; Jovanović 1958, 1965; Danon and Blaženčić 1965; Babić and Parabućski 1971; Horvat *et al.,* 1974; Parabućski and Pekanović 1980; Rauš *et al.,* 1980; Knežević 1980, 1981; Kabić 1985; Vučković 1985; Butorac and Crnčević 1987; Knežević and Boža 1987, 1988; Ranđelović 1988, 2002; Gajić 1989; Stojanović *et al.,* 1990, 1994; Parabućski and Butorac 1994; Butorac *et al.,* 1994; Butorac 1995; Ranđelović and Blaženčić 1997; Radulović 2000, 2005, 2007; Šumatić *et al.,* 2001; Lazić 2003, 2006; Nikolić 2004; Panjković 2005; Polić 2006; Stanković-Kalezić 2006; Jenačković *et al.,* 2010; Ljevnaić-Mašić 2010). The database also holds 26 unpublished relevés (leg.: Vučković Mirjana, period 1994–2000).

The highest percent of relevés in the database originated from Ph.D. theses (57.85%), followed by scientific papers (20.29%) and M.Sc. theses (10.23%). Among the scientific papers, those published in the *Zbornik Matice srpske za prirodne nauke* (*Matica Srpska Journal for Natural Sciences*) are predominant (Slavnić 1956; Babić 1971; Babić and Parabućski 1971; Knežević 1980, 1981; Parabućski and Pekanović 1980; Rauš *et al*., 1980; Butorac and Crnčević 1987; Knežević and Boža 1987), while the Ph.D. theses, M.Sc. theses and final papers have mostly been done at the Department of Biology and Ecology of the Faculty of Sciences, University of Novi Sad (Kabić 1985; Ranđelović 1988; Radulović 2000, 2005; Nikolić 2004; Panjković 2005; Lazić 2006; Polić 2006; Ljevnaić-Mašić 2010).

With regards to the time frame of the data in the database, the highest percent of the relevés (56.40%) was collected after the year 2000 (Figure 1). In the case of data insufficiency, regarding the time of the data collection, the year of the publication was considered as relevant.

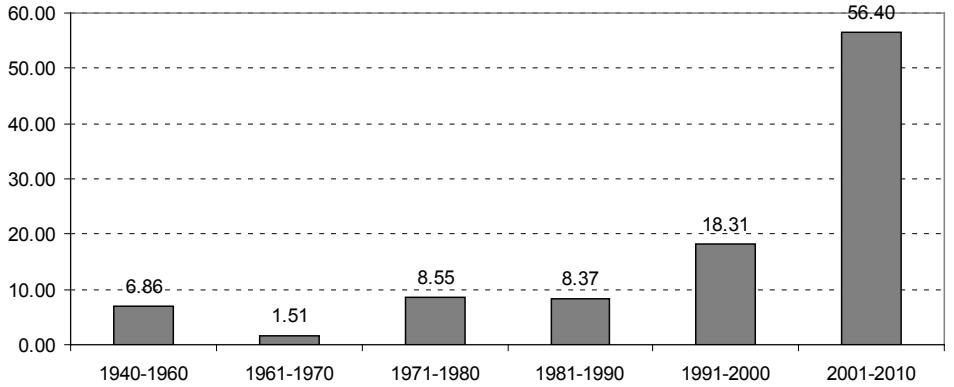

Figure 1. The percent of phytocoenological relevés in the database in decades (%)

Phragmito-Magno-Caricetea Klika in Klika et Novák 1941 (Syn: *Phragmitetea communis* R. Tx. et Prsg. 1942), *Potametea* Klika in Klika et Novák 1941 (Syn: *Potametea* R. Tx. et Preising 1942) and *Lemnetea* de Bolós et Masclans 1955 (Syn: *Lemnetea minoris* W. Koch et R. Tx. 1955) have proven to be the most represented classes, while *Scirpo-Phragmitetum* W. Koch 1926 (nomen ambiguum) and *Salvinio natantis-Spirodeletum polyrrhizae* Slavnić 1956 are associations with the highest number of relevés in the database. Accordingly, the most common species (>500 relevés) are *Ceratophyllum demersum* L. subsp. *demersum, Lemna minor* L. and *Spirodela polyrhiza* (L.) Schleiden.

As expected, the edificators of the typical communities for the area of research are among the most frequent species in the database (Radulović *et al*., 2011). Considering their conservation status (Table 1), out of the total number of 395 species recorded in the database, 45 are considered to be of national conservation concern – 25 as Strictly Protected (6.3%) and 20 species as Protected (5.1%). According to the IUCN assessments, 36.7% of the species are categorized as being of Least Concern by the Red List database, and two species fall into the categories of Near Threatened and Data Deficient (*Elatine alsinastrum* L. and *Alisma gramineum* Lej., respectively). Furthermore, a high frequency of aquatic invasive species in the database, such as *Vallisneria spiralis* and *Azolla filiculoides,* needs to be highlighted. Complying with the Preliminary list of invasive species in Serbia (Lazarević *et al*., 2012), a total of 13 species which are considered invasive have been recorded, the majority of which (8 species) fall under the category of highly invasive species (Table 2).

Table 1. Conservation status of the species in the database

	Number of species	Percent
Total number of species in database	395	
National Conservation Status (NCS)	45	12.7%
SP – Strictly Protected	25	6.3%
P – Protected	20	5.1%
IUCN	147	37.2%
LC – Least Concern	145	36.7%
NT – Near Threatened	1	0.3%
DD – Data Deficient	1	0.3%

Table 2. Overview of the invasiveness status of the species from the database

Invasive species (Lazarević *at al*., 2012)	Number of species	Percent
Total number of invasive species	13	3.29%
Highly invasive	8	2.03%
Sporadically invasive	3	0.76%
Potentially invasive	2	0.51%

The phytocoenological relevés are spread over 210 localities, at an irregular geographical distribution. As high as 87.84 % of the data is concentrated in the Pannonian part of Serbia (Figure 2). The regions which were studied the most are the area of Apatinsko-Monoštorski Rit, Koviljsko-Petrovaradinski Rit, Carska Bara and Stari Begej, and the Vlasina highlands.

Only 6.45% of the relevés contain the data for the soil type, dominated by different forms of fluvisol, humogley and solonetz. The date of the collection of the data is given in 13.31% of relevés, the size of the area in question in 76.86%, the exact locality in 93.66% of the relevés, while the information on the altitude was present in an inconsequential number of relevés. The total cover of the relevés was between 20% and 100%, and their area between 3 and 900 m^2.

DISCUSSION

A well designed and complete phytocoenological database enables scientists to perceive the faults and deficiencies in previous vegetation research and to direct the future studies accordingly (Bell *et al*., 2011; Uğurlu *et al*., 2012; Tozer *et al*., 2010, Radulović *et al*., 2011). The basic limitation of the aquatic and semiaquatic vegetation database formed as part of this study is the disproportionate geographical distribution of the phytocoenological relevés, which is not in proportion with the hydrography of Serbia. The vegetation of aquatic ecosystems south of the Danube has been isufficiently studied.

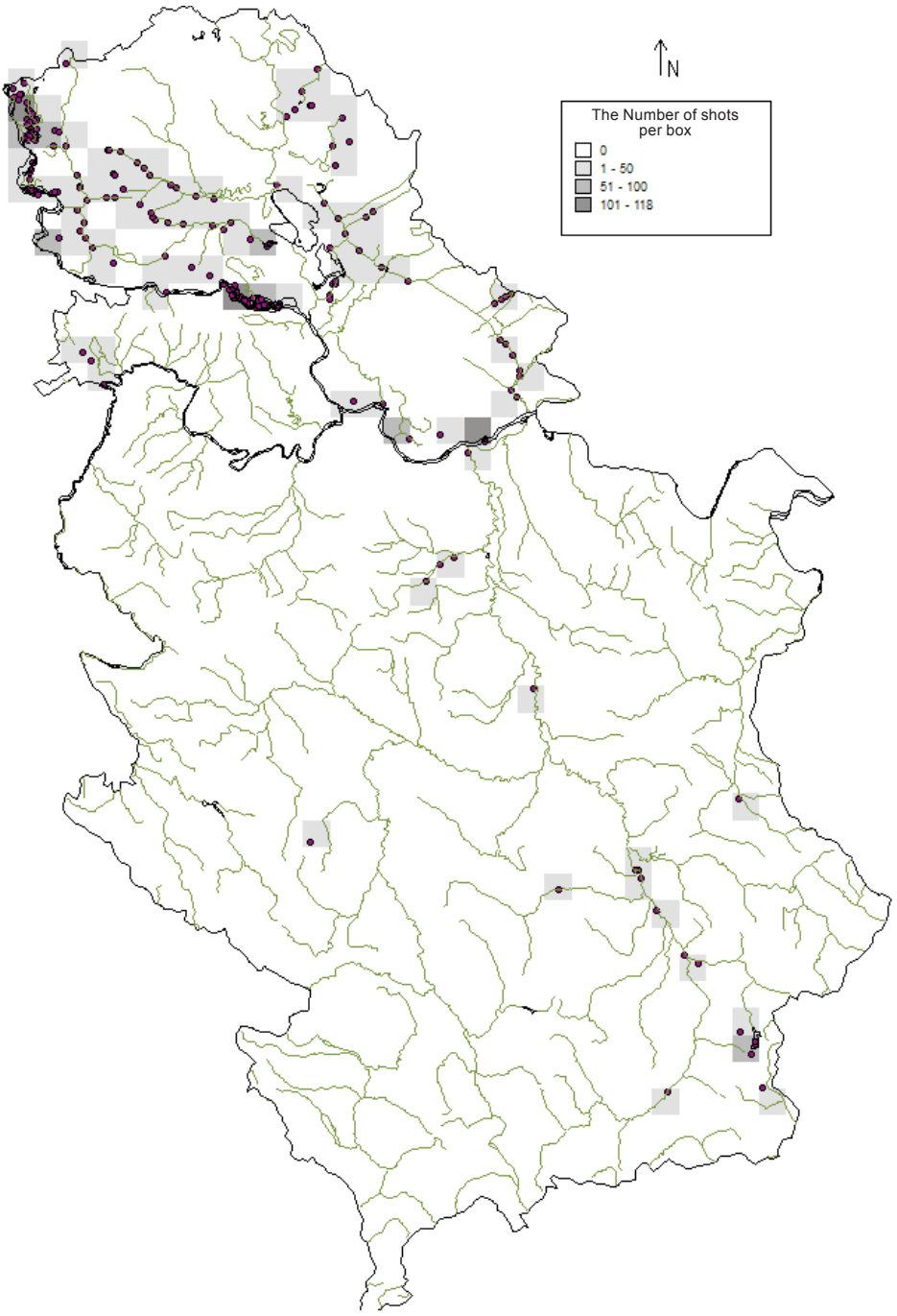

Figure 2. Analysis of the representation of phytocoenological relevés in the database per UTM square grid (10 x 10 km)

From the aspect of the relevance of the database data, all of the used literature sources can be characterized as the so-called „grey literature“, as they generally originate from the scientific papers published in national scientific journals, and Ph.D. and M.Sc. theses. Considering the significant time span (1940–2010) of the collected data, such a bibliography is excpected. A similar relation of sources also exists in the case of the phytocoenological database of the Czech Republic (Chytrý and Rafajová 2003), where, in addition to the „grey literature“, unpublished relevés comprise a significant portion of the database. Regardless of this, all of the data from this database were subjected to some kind of a review, and therefore there was no selection done based on their relevance.

Although a certain number of taxa was only listed to the genus level, the taxonomical resolution and data quality in the database are satisfactory, and due to the selective approach of the authors while collecting the phytocoenological relevés, the cryptogamic flora was mostly eliminated. The lack of general data necessary for phytocoenological relevés, e.g. sampling year, size of the relevés, altitude and soil type, limits the scope of analyses which can be conducted based on the given set of data (Chytrý and Rafajová 2003).

With regards to the time frame of the data in the database, the highest portion of data was collected during the last three decades, which coincides with the period of a rapid transition to the computerised numerical analysis in phytocoenology (Podani 1997). An identical trend can be observed in the example of the phytocoenological database of the Czech Republic (Chytrý and Rafajová 2003).

REFERENCES

Babić N (1955): Nizinske livade u Podunavlju. *Rad Vojvođanskih muzeja* 4: 155–164.

Babić N (1971): Močvarna i livadska vegetacija Koviljskog rita. *Зборник МС за природне науке (Matica Srpska J. Nat. Sci.)* 41: 19–87.

Babić N, Parabućski S (1971): Prikaz vegetacija Šajkaške. In: B. Bukurov (ed.), *Šajkaška – Priroda kraja*, Matica srpska, Novi Sad, 114–140.

Bell FW, Kershaw M, Aubin I, Thiffault N, Dacosta J, Wiensczyk A (2011): Ecology and traits of plant species that compete with boreal and temperate forest conifers: An overview of available information and its use in forest management in Canada. *For. Chron*. 87: 161–174.

Butorac B (1995): Review of aquatic vegetation of the regional park “Stari Begej“. *Tiscia* 29: 27–32.

Butorac B, Crnčević S (1987): Zajednice *Acoreto-Glycerietum* Slavnić 56 i *Sparganio-Glycerietum fluitantis* Br.-Bl. 25 na području jugozapadnog Banata. *Зборник МС за природне науке (Matica Srpska J. Nat. Sci.)* 72: 169–183.

Butorac B, Stojanović S, Žderić M (1994): Vegetacija klase Potametea Tx. et Prsg. 1942 u barama Petrovaradinskog rita. *Glasnik Instituta za Botaniku i Botaničke bašte Univerziteta u Beogradu/ Bull. Inst. Jard. Bot. Univ. Belgrade* 28: 137–146.

Chytrý M, Rafajová M (2003): Czech National Phytosociological Database: basic statistics of the available vegetation-plot data. *Preslia* 75: 1–15.

Danon J, Blaženčić Ž (1965): Ekološka analiza livadskih zajednica vlažnih i poluvlažnih staništa Stare planine. *Arhiv bioloških nauka* 17: 101–112.

Dengler J, Chytry M, Ewald J (2008): Phytosociology. In: Jorgensen, SE, Fath, B.D. (eds.), *Encyclopedia of Ecology*, Elsevier, Oxford, UK, 2767–2779.

Dengler J, Jansen F, Glöckler F, Peet RK, De Cáceres M, Chytrý M, Ewald J, Oldeland J, Lopez-Gonzalez G, Finckh M, Mucina L, Rodwell JS, Schaminée JHJ, Spencer N (2011): The Global Index of Vegetation-Plot Databases (GIVD): a new resource for vegetation science. *J. Veg. Sci*. 22: 582–597.

Gajić M (1989): *Flora i vegetacija Golije i Javora*. Šumarski fakultet Beograd i OOUR Šumarstvo Golija, Ivanjica.

Hennekens SM, Schaminée JHJ (2001): TURBOVEG, a comprehensive data base management system for vegetation data. *J. Veg. Sci*. 12: 589–591.

Hijmans RJ, Guarino L, Bussink C, Mathur P, Cruz M, Barrentes I, Rojas E (2004): DIVA-GIS. Version 5.0. A geographic information system for the analysis of species distribution data. Available at: http://www.diva-gis.org.

Horvat I, Glavač V, Ellenberg H (1974): *Vegetation Südosteuropas*. Gustav Fischer Verlag, Stuttgart.

Janković M (1953): Vegetacija Velikog Blata. *Glas. Prirod. muzeja srpske zemlje B* 5–6: 59–111.

Jenačković D, Dimitrijević D, Ranđelović V (2010): Macrophytic flora and vegetation of the rivers Svrljiški and Beli Timok (Eastern Serbia). *Biologica Nyssana* 1: 23–26.

Jovanović R (1958): Tipovi močvarne vegetacije u Jasenici. *Zborn. Rad. Biol. Inst. R. Srbije* 2: 1–36.

Jovanović R (1965): „Tipologija, ekologija i dinamika močvarne i livadske vegetacije u dolini Velike Morave". Doktorska diseracija. Univerzitet u Beogradu.

Kabić D (1985): „Slatinska vegetacija u okolini Riđice". Diplomski rad. Prirodno-matematički fakultet, Univerziteta u Novom Sadu, Novi Sad.

Karadžić B, Šašo-Jovanović V, Jovanović Z, Popović R (1998): FLORA database and software for floristic and vegetation analyzes. In: Tsekos, I., Moustakas, M. (eds.), *Progress in Botanical Research*, Kluwer Academic Press, Dordrecht, 69–72.

Knežević A (1980): Slatinska vegetacija stepsko-livadskog karaktera u okolini Kruščića. *Зборник МС за ūриродне науке (Matica Srpska J. Nat. Sci.)* 59: 101–129.

Knežević A (1981): Zajednica *Bolboschoenetum maritimi continentale* Soo na slatini u okolini Kruščića. *Зборник МС за ūриродне науке (Matica Srpska J. Nat. Sci.)* 60: 35–43.

Knežević A, Boža P (1987): Cenološka pripadnost vrsta *Suaeda maritima* (L.) D U M i *Suaeda pannonica* B E C K na lokalitetu kod Melenaca (Vojvodina-Banat). *Зборник МС за ūриродне науке (Matica Srpska J. Nat. Sci.)* 72: 153–168.

Knežević A, Boža P (1988): Horološki, sinekološki i cenološki aspekt ekspanzije karakterističnih vrsta zajednica sveze *Thero-Salicornion* Br.-Bl. (30) 1933 Pign. 1953 u srednjem Banatu. *Зборник МС за ūриродне науке (Matica Srpska J. Nat. Sci.)* 74: 123–134.

Lakušić D, Blaženčić J, Ranđelović V, Butorac B, Vukojičić S, Zlatković B, Jovanović S, Šinžar-Sekulić J (2005): *Fitocenoze Srbije – Baza podataka*. Institut za botaniku i Botanička bašta Jevremovac, Biološki fakultet, Univerzitet u Beogradu.

Lazarević P, Stojanović V, Jelić I, Perić R, Krsteski B, Ajtić R, Sekulić N, Branković S, Sekulić G, Bjedov V (2012): Preliminarni spisak invazivnih vrsta u Republici Srbiji sa opštim merama kontrole i suzbijanja kao potpora budućim zakonskim aktima. *Zaštita prirode* 62: 5–31.

Lazić D (2003): „Florističko-fitocenološka proučavanja biljnog sveta vodotoka Jegrička“. Magistarska teza, Poljoprivredni fakultet, Univerzitet u Novom Sadu, Novi Sad

Lazić D (2006): „Vaskularna flora i vegetacija OKM Hs DTD na području Bačke“. Doktorska disertacija, Prirodno-matematički fakultet, Univerzitet u Novom Sadu, Novi Sad

Ljevnaić-Mašić B (2010): „Hidrofite Osnovne kanalske mreže Hidrosistema DTD na području Banata“. Doktorska disertacija, Prirodno-matematički fakultet, Univerzitet u Novom Sadu, Novi Sad.

Nikolić Lj (2004): „Biljni svet, biomasa i primarna produkcija kao pokazatelji eutrofizacije u jezeru Provala“. Doktorska disertacija, Departman za biologiju i ekologiju, Prirodno-matematički fakultet, Univerzitet u Novom Sadu, Novi Sad.

OziExplorer (2009): OziExplorer version 3.95.4b. GPS Mapping Software. Available at: http://www.oziexplorer.com/

Panjković B (2005): „Akvatična i semiakvatična vegetacija Apatinskog i Monoštorskog rita“. Doktorska disertacija, Departman za biologiju i ekologiju, Prirodno-matematički fakultet, Univerzitet u Novom Sadu, Novi Sad.

Parabućski S, Butorac, B (1994): General review of vegetation along the lower course of the river Tisa. *Thaiszia – J. Bot.* 4: 99–106.

Parabućski S, Pekanović V (1980): *Cirsium brachycephallum* Jurr. na nekim lokalitetima u Bačkoj. *Зборник МС за природне науке (Matica Srpska J. Nat. Sci.)* 58: 63–69.

Podani J (1997): A measure of discordance for partially ranked data when presence/ absence is also meaningful. *Coenoses* 12: 127–130.

Polić D (2006): *Florističko-fitocenološko proučavanje Labudovog okna*. Zadužbina Andrejević, Beograd.

Radulović S (2000): „Vodena vegetacija Koviljskog rita“. Magistarska teza, Departman za biologiju i ekologiju, Prirodno-matematički fakultet, Univerzitet u Novom Sadu, Novi Sad.

Radulović S (2005): „Ekologija i disribucija akvatičnih fitocenoza Carske bare u GIS tematskom modelu“. Doktorska disertacija, Departman za biologiju i ekologiju, Prirodno-matematički fakultet, Univerzitet u Novom Sadu.

Radulović S (2007): „Limnološka istraživanja Parka prirode „Ponjavica“ na prostoru Banatskog Brestovca i Omoljice u cilju zaštite životne sredine“. Elaborat. The National Comitee of IAD for Serbia and Montenegro.

Radulović S, Laketić D, Teodorović I (2011): A botanical classification of standing waters in Serbia and its application to conservation. *Aquat. Conserv.: Mar. Freshw. Ecosyst*. 21: 510–527.

Ranđelović V (1988): „Močvarna vegetacija uz gornji tok Južne Morave“. Diplomski rad. PMF, Univerzitet u Novom Sadu.

Ranđelović V (2002): „Flora i vegetacija Vlasinske visoravni“. Doktorska disertacija, Biološki fakultet, Univerzitet u Beogradu, Beograd.

Ranđelović V, Blaženčić J (1997): Hidrofilna flora i vegetacija Vlasinskog jezera. In.: Blaženčić, J (ed.): *Vlasinsko jezero – hidrobiološka studija*. Biološki fakultet, Beograd, 208–230.

Rauš Đ, Šegulja N, Topić J (1980): Vegetacija bara i močvara u šumama jugozapadnog Srijema. *Зборник МС за природне науке (Matica Srpska J. Nat. Sci.)* 58: 2–51.

Schaminée JHJ, Hennekens1 SM, Chytry M, Rodwel JS (2009): Vegetation-plot data and databases in Europe: an overview. *Preslia* 81: 173–185.

Slavnić Ž (1940): Prilog halofitskoj flori i vegetaciji Jugoistočne Srbije. *Glas. Skop. nauč. društva* 22: 65–77.

Slavnić Ž (1956): Vodena i barska vegetacija Vojvodine. *Зборник МС за ūриродне науке (Matica Srpska J. Nat. Sci.)* 10: 5–72.

Stanković-Kalezić R (2006): „Sinekološka studija ruderalne vegetacije na području Pančevačkog rita“. Doktorska disertacija, Poljoprivredni fakultet, Univerzitet u Beogradu, Beograd.

Stojanović S, Butorac B, Kilibarda P (1990): Zajednica *Salvinio-Spirodeletum polyrrhizae* Slavnić 1956 na delu kanala Dunav-Tisa-Dunav. *Bilten Biološkog društva BiH, ser. B*, vol. 5.

Stojanović S, Butorac B, Vučković M, Stanković Ž, Žderić M, Kilibarda P, Radak Lj (1994): *Biljni svet kanala Vrbas–Bezdan*. Prirodno-matematički fakultet, Institut za biologiju, Univerzitet u Novom Sadu, Novi Sad.

Šumatić N, Topalić Lj, Pavlović-Muratspahić D (2001): Zajednica *Polygono-Bidentetum tripartitae* (W. Koch 26) Lohm. 50 na Bardači. *Zbornik radova naučnog skupa, „Zasavica 2001“*, Sremska Mitrovica, Srbija, 122–128.

Tozer MG, Turner K, Keith DA, Tindall D, Pennay C, Simpson C, MacKenzie B, Beukers P, Cox S (2010): Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands. *Cunninghamia* 11: 359–406.

Uğurlu E, Roleček J, Bergmeier E (2012): Oak woodland vegetation of Turkey–a first overview based on multivariate statistics. *Applied Vegetation Science* 15: 590–608.

Vučković R (1985): „Fitocenoze slatinske vegetacije istočnog Potamišja, njihova produkcija i hranljiva vrednost“. Doktorska disertacija, Prirodno-matematički fakultet Univerziteta u Beogradu, Beograd.

ДИГИТАЛНА БАЗА ПОДАТАКА АКВАТИЧНЕ И СЕМИАКВАТИЧНЕ ВЕГЕТАЦИЈЕ СРБИЈЕ

Душанка Љ. ЦВИЈАНОВИЋ[1], Милица М. ЖИВКОВИЋ[1], Маја З. НОВКОВИЋ[1], Ана А. АНЂЕЛКОВИЋ[1,2], Снежана Б. РАДУЛОВИЋ[1], Дмитар В. ЛАКУШИЋ[3]

[1] Универзитет у Новом Саду, Природно-математички факултет
Департман за биологију и екологију
Трг Доситеја Обрадовића 2, 21000 Нови Сад, Србија
[2] Институт за заштиту биља и животну средину
Теодора Драјзера 9, 11040 Београд, Србија
[3] Универзитет у Београду, Биолошки факултет
Институт за ботанику и Ботаничка башта „Јевремовац”
Таковска 43, 11000 Београд, Србија

РЕЗИМЕ: Иако у Србији не постоји централизована национална фитоценолошка дигитална база, до 2005. године, као резултат пројекта „Станишта Србије“ прикупљено је и похрањено у базу података „Фитоценозе Србије“, преко 16.000 фитоценолошких снимака свих типова вегетације. Међутим, како су подаци о акватичној и семиакватичној вегетацији заступљени у бази са само 5% фитоценолошких снимака, циљ овог рада је допуна ових података, комплетирање базе и приказ података о овим типовима вегетације у Србији. Рад је укључио проширење постојеће базе података додавањем одговарајућих референци, уз њихову дигитализацију, применом Flora и Turboveg програма, и након тога њихово георефернцирање, уз примену софтвера OziExplorer и DIVAGIS. Након ревизије и допуне,

фитоценолошка база података о акватичној и семиакватичној вегетацији у Србији сада броји 1.720 фитоценолошких снимака, из 243 фитоценолошке табеле, прикупљене и публиковане од стране 24 аутора, током периода од 70 година (1940–2010), при чему је већина фитоценолошких снимака сакупљена током последње деценије (56,40%). Најзаступљеније класе у бази биле су *Phragmito-Magno-Caricetea* Klika in Klika et Novák 1941 (Syn: *Phragmitetea communis* R. Tx. et Prsg. 1942), *Potametea* Klika in Klika et Novák 1941 (Syn: *Potametea* R. Tx. et Preising 1942) и *Lemnetea* de Bolós et Masclans 1955 (Syn: *Lemnetea minoris* W. Koch et R. Tx. 1955), док су асоцијације са највећим бројем фитоценолошких снимака у бази *Scirpo-Phragmitetum* W. Koch 1926 (nomen ambiguum) и *Salvinio natantis-Spirodeletum polyrrhizae* Slavnić 1956. У складу с тим, најфреквентније врсте у бази (>500 фитоценолошких снимака) биле су *Ceratophyllum demersum* L. subsp. *demersum, Lemna minor* L. и *Spirodela polyrhiza* (L.) Schleiden.

КЉУЧНЕ РЕЧИ: акватична и семиакватична вегетација, фитоценолошка база података, Србија