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11th Symposium on the Flora of Southeastern Serbia and Neighbouring Regions

Vlasina Lake 13 to 16 June 2013

11. Simpozijum o flori jugoistočne Srbije i susednih regiona

Vlasinsko jezero 13. do 16. jun 2013.

ABSTRACTS
APSTRAKTI

Niš, 2013

11th Symposium on the Flora of Southeastern Serbia and Neighboring Regions,

Vlasina 13th-16th June, 2013

Book of abstracts

Zbornik apstrakata

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11th Symposium on the Flora of Southeastern Serbia and Neighboring Regions

11. Simpozijum o flori jugoistočne Srbije i susednih regiona

Abstracts – Apstrakti

Organizers – Organizatori

Department of Biology and Ecology, Faculty of Science and Mathematics, University of Niš

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PROGRAMME - PROGRAM

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Friday, June 14th, 2013	
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15.00 – 17.00 h	Taxonomy and Systematic
17.00 – 19.30 h	Nature Protection and Environment Agriculture, Forestry and Landscape Architecture Zoology (plant – animal interactions)
19.30 – 21.00 h	Poster session

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10.30 – 10.45 h	Coffee break
10.45 – 13.00 h	Phytogeography, Floristics and Phytoecology
15.00 – 16.30 h	Phytochemistry and Phytotherapy
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Taxonomic valorization of adaptive evolution forms of plants

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Taxonomy and Systematic

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Morphological analysis of the populations of the *Limonium gmelinii* (Willd.) O. Kuntze Plumbaginales, Plumbaginaceae) from Serbia and Macedonia

15.10 – 15.20 h

Radak, B.

Morphological variability of species *Anacamptis morio* (L.) R. M. Bateman, Pridgeon & M. W. Chase 1997 from Montenegro and Southwestern Serbia

15.20 – 15.30 h

Nikolić, D., Šinžar-Sekulić, J., Ranđelović, V., Lakušić, D.

Eco-morphological differentiation of populations of *Jovibarba heuffelii* (Schott) A. Löve & D. Löve (Crassulaceae)

15.30 – 15.40 h

Krizmanić J., Vidaković, D., Šovran, S., Subakov-Simić, G.

New or rarely recorded diatoms taxa from Serbia (Dojkinačka stream, SE Serbia)

15.40 – 15.50 h

Lakušić, D., Kuzmanović, N., Alegro, A., Frajman, B., Schönswetter, P.

Molecular study of *Sesleria robusta* species complex (Poaceae)

15.50 – 16.00 h

Harpke, D., Kerndorff, H., Ranđelović, N., Ranđelović, V.

New insights into phylogeny of Crocus (Iridaceae) on the Balkan Peninsula

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Amphibian and reptile species richness on Vlasina plateau

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Hlavati-Širka, V., Lakušić, D., Šinžar-Sekulić, J., Nikolić, T., Jovanović, S.

***Reynoutria sachalinensis*: a new invasive species of the flora of Serbia and its distribution in the SE Europe**

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Rasprostranjenje i ekologija vrste *Goniolimon tataricum* (L.) Boiss. (Plumbaginaceae) u Srbiji

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Batanjski, V., Kabaš, E., Kuzmanović, N., Vukojičić, S., Lakušić, D., Jovanović, S.

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Contribution to the flora of the northern part of Prokletije - Prometanj site (Mokra gora)

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Ranđelović, N., Miljković, M., Đorđević, M., Cvijetan, I., Nikolić, M.

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Milosavljević, V., Ranđelović, V., Ranđelović, N.

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Pavlović, D., Lakušić, B., Kitić, D., Milutinović, M., Kostić, M., Miladinović, B., Kovačević, N.

Antimikrobna aktivnost etanolnih ekstrakata odabranih vrsta familije Ericaceae

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Stamenković, J., Radojković, I., Đorđević, A., Jovanović, O., Petrović, G., Palić, I., Stojanović, G.

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Screening of amylase inhibition by selected essential oils components as potential agents in diabetes prevention

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Kladar, N., Srđenović-Čonić, B., Grujić, N., Šefer, E., Anačkov, G., Božin, B.

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Jovanović, S., Đorđević, A., Zlatković, B., Petrović, G., Jovanović, O., Stankov-Jovanović, V., Mitić, V., Stojanović, G.

Phytochemical composition and antibacterial activity of the *Hylotelephium spectabile* (Boreau) H. Ohba x telephium (L.) H. Ohba leaf and flower extracts

11th Symposium on the Flora of Southeastern Serbia and Neighboring Regions, Vlasina 13th-16th June, 2013

Plenary presentations

Plenarna predavanja

Taxonomic valorization of adaptive evolution forms of plants

Bože, P.[1]

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The aim of each species in each ecosystem and in all types of habitats may be covered with survival under certain ecological conditions and ensuring progenies. The plants reach these aims by different forms of adaptive evolution which condition adaptive radiation and which makes the basic line of angiosperms evolution. The forms of adaptive evolution are mirrored in the level of species as well as in the intra-species level. Regardless of the level of adaptive evolution, it is greater mistake not to record than to overrate its forms. The species level of adaptive evolution is not in question in phylogenetic line within the genus *Prunus* in the relation among *Prunus spinosa* L. 1753, *P. fruticosa* Pall. 1784, *P.mahaleb* L. 1753 and *P. padus* L. 1753. During this differentiating path very important changes took place concerning the length of the pedicel and the number of flowers in a cluster or inflorescence with the aim of easier pollination and formation of greater number of flowers and fruits. This fact is even greater if we have in mind that these changes took place within the same or very similar areals: Euro-Asian, South Euro-Asian-Sub Mediterranean, European-Mediterranean-Front Asian. The differences between flowers or inflorescences were recorded by the authors describing species 250-260 years ago. However, the question how long did it take the nature to produce those changes remains unanswered. The problem with evaluations of the forms of adaptive evolution starts with forms, varieties and perhaps also with subspecies. For example, *Lysimachia vulgaris* L. l753 includes the following forms based on the arrangement on the stem: f. oppositifolia Opiz 1841, f. ternifolia Peterm. 1838, f. quaternifolia Peterm. 1838 and f. qiunquefolia Peterm. 1838. This species populates wet and mostly shaded habitats: Phragmitetea, Molinio-Juncetea, Populetalia, Alnetea. The number of leaves on the nodes is smaller on places where these habitats are more illuminated, and vice versa. Very often one individual plant has characteristics of three and even four forms. All this forms of adaptive evolution serve for more efficient photosynthesis, i.e. survival. The plants on salt-affected habitats, which are not succulent euhalophytes, populate salt-affected habitats because of less competition. Since the salt-affected habitats are defect soils because of the high concentration of salt and almost constant physical and physiological drought with plant of salt-affected habitats, the often described adaptive evolutionary forms are named as follows: minor, minimus, patulus, neglectus, pigmeius, tenuis, gracilis, pusillus (for example with *Plantago tenuiflora* W. et K. 1800, *Holosteum umbellatum* L. 1753, *Gypsophyla muralis* L. 1753).These forms flower, produce

fruit and they are much smaller than the typical specimen, but they ensure offspring. *Lotus corniculatus* L. 1753 is the most often in vegetation *Festucetum vallesiacae* but it is very often also on salt-affected habitats which are being turned into steppes. The adaptive forms on more or less illuminated microhabitats are concerned with hairiness of the plant: tomentosa, hirsuta, villosa, pilosa, ciliata, and they serve for survival since they have the ability to decrease transpiration. The example of a small but very important adaptive change with the aim of survival can be seen, for example, on *Taraxacum officinale* Web. in Wieg. 1780. The early spring populations always have very short scape. For example, dandelion is pollinated by very small insects of approximately 1mm in early spring when there are no such insects or they are immovable. The flowers of the inflorescence of these populations are pollinated by some beetles which climb the scape of even 5cm very slowly, which would be much slower on the scapes of approximately 20cm as with populations in April and May. The form with short scape of this species is not described at all, although it serves for more efficient pollination. Apetaly is a well-known occurrence, especially at the early spring representatives of the families Caryophyllaceae and Brassicaceae, or at those species whose flowering phenophase starts early and lasts long (*Capsella bursa pastoris* (L.) Medic. 1792, *Erophila verna* (L.) Chev. 1827, *Stellaria media* (L.) Cyr. 1784, species of genus *Cerastium*, *Spergularia* and so on). At the populations which flower earliest, the petals obstruct the pollination, since there are no flying insects, pollinators, and they represent a barrier to wind which carries the pollen. In other words, it is a very small adaptive form with the most divine aim. There are reasonable grounds to ask what the function of the functional nectaries at the species of the genus *Helleborus* is. In the first place, the structure of the flower requires that the flying insect pollinator, which carries out the pollination during feeding, has to be large. Yet, there are no those kinds of insects during the flowering of hellebore. The other reasonable question is what the function of the nectaries at the species of the genus *Galanthus* is, which flower even earlier. The answers are simple: The hellebore pollination is usually carried out by small forest rodents which eat the whole nectaries and simultaneously carry out the pollination; at the snowdrop, the nectaries do not have function and they are disappearing slowly from the inner perigon petals. The fine, subtle levels of adaptive evolution, especially lately, start being ignored, inclined or totally neglected. This fact is a consequence of unreasonable globalization both in taxonomy and floristics. We can name all these changes the species, i.e. the intra-species ecomorfologic evolutionary adaptation. At the same time, they represent parallel forms at different species, genera and families based on very efficient phenocopies. They confirm the everlasting fact of Roman naturalists: Natura etiam in minimis maxima A special group of adaptive evolution forms encompasses neotenic and teratological forms, which doubtlessly had a crucial role in general evolution of angiosperms in formation of ovaries, stamina and other life forms. Regarding these and many other similar examples, we have to realize the importance and aim of adaptive forms. In order to reach this, we need an answer to question

why these changes took place and what their aim is. For this reason, I recommend Takhtajan's (1960) citation to all florists and taxonomists in this manner: No one has the right to ignore the forms of adaptive evolution which are taking place in front of us and represent an incredibly long-lasting effort of nature, because the road to those forms of adaptation is a rocky road.

Flora Tourism in Turkey

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Turkey has the plant species as much as the European continent. There are also more endemic plants species in Turkey than the Europe possesses. While species number, present in all along Europe is a total of about 12.000, this figure is about 11.000 in Turkey. Today, Turkey is at the intersection point of 3 different plant areas which is not present in either of the European country. The flora varies from lush forests, steps to typical Aegean and Mediterranean vegetation. With nearly eleven thousand species, Turkey is a botanical paradise. Among the many different types of plants, bulbs are of particular interest. Bulbous plants, known in scientific terminology as geophytes, are among the first wild flowers to be benefited for botanical tourism. As a source of many native and endemic species, Turkey is a major area for travel tours of botany. In this presentation, the potential of botanical tours in Turkey will be presented with some practical examples.

11th Symposium on the Flora of Southeastern Serbia and Neighboring Regions, Vlasina 13th-16th June, 2013

Taxonomy and Sistematics

Taksonomija i sistematika

Morphological analysis of the populations of the *Limonium gmelinii* (Willd.) O. Kuntze (*Plumbaginales, Plumbaginaceae*) from Serbia and Macedonia

Vestek, A.[1], Knežević, J.[1], Simin, Đ.[1]

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Multiyear research of the continental halobiomes set aside certain species that are characterized by morphological variability. One of them is *Limonium gmelinii* (Willd.) O. Kuntze, known as a common decorative plant. Field research was complemented with analysis of herbarium specimens, and observing the areal and habitat conditions. Expressed morphological variation in this species is partially consistent with differentiation at the subspecies *L. gmelinii* subsp. *gmelinii* and *L. gmelinii* subsp. *hungaricum* Klokov. Variability of some selected morphological characters exceeds standard diagnoses and indicates on population and infraspecific taxonomic differentiation of this taxon. Based on previous results, three populations of the *Limonium gmelinii* (Willd.) O. Kuntze from Serbia (Slano Kopovo, Okanj, Lalinačka slatina) and one population of the Macedonia (Ovče polje) were morphologically analyzed. Morphological study included a total of 36 characters, 21 quantitative and 15 qualitative characters for 60 individuals. The data were processed by means of multivariate statistics with a priori defined groups based on the principle locality/population - taxon. The correspondence analysis distinguished the sets of qualitative characters, specific for the appropriate samples. Discriminant analysis showed differentiation of the population Lalinačka slatina, while other populations showed similarity in the variability of morphometric characteristics.

Acknowledgement: This work was performed under the project 173030 funded by the Ministry of Education, Science and Technological Development of the Republic of the Serbia.

Morphological variability of species *Anacamptis morio* (L.) R. M. Bateman, Pridgeon & M. W. Chase 1997 from Montenegro and Southwestern Serbia

Radak, B.[1]
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This research focuses on the morphological variability of eight populations of *Anacamptis morio* (L.) R. M. Bateman, Pridgeon & M. W. Chase 1997 originating from southwestern Serbia and Montenegro, in order to determine new characters that could be used for defining infraspecific taxa within this species. A total of 24 characters were analyzed, out of which 17 morphometric and 7 characters that represent indexes calculated based on proper morphometric characters. Analysis of quantitative characters included 240 individuals. After the morphological and morphometric processing, resulting data were analyzed by methods of basic and multivariate statistics. Based on the results obtained by statistical analysis and literature data, populations from Tara, Durmitor and Zlatar mountains can be defined as typical form morio with thicker stem and larger leaves, while populations from Uvac, Morača, Čanj and Kopaonik have characteristics of form elatior with higher and thinner stem. Population from Pešter represents transition in morphological sense between these two groups of populations so represent a basis for further comparative taxonomic study of this taxon.

Acknowledgements: This research was conducted within the project no. 173030, funded by the Ministry of Education, Science and Technological Development of the Republic of Serbia.

New or rarely recorded diatoms taxa from Serbia (Dojkinačka stream, SE Serbia)

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Diatoms (Bacillariophyta) inhabiting different types of substrate including stone surfaces, sand, mud, filamentous algae and submerged mosses in the Dojkinačka stream (SE Serbia) were studied by light microscopy. Among numerous common diatoms taxa we observed 17 rarely recorded taxa from Serbia and 5 new to the Serbian diatom flora (*Brachysira intermedia* (st.) Lange-Bert., *Chamaepinnularia mediocris* (Krass.) Lange-Bert., *Navicula tridentula* Krass., *Eunotia paludosa* Grun., *Eunotia boreoalpina* Lange-Bert. & Nörpel-Schem.). Among rare taxa, the most interesting was *Diatomella balfouriana* Grevill. In Serbia, it was known only from the River Tisa near Titel (Szabados 1966). In the material studied, it was identified only in samples collected from the surface of rocks at the third locality in unpolluted section of the Dojkinačka stream. We observed it in mass, together with *Tetracyclus rupestris* (Braun) Grun.

Molecular study of *Sesleria robusta* species complex (Poaceae)

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The *Sesleria robusta* species complex belongs to *Sesleria* sect. *Argenteae* Deyl,"Turma" (=swarm) *Nitida* Deyl, which comprises the following species: *S. doerflerii* Hayek, *S. italica* (Pamp.) Ujhelyi, *S. nitida* Ten., *S. robusta* Schott, Nyman et Kotschy, *S. vaginalis* Boiss. & Orph., *S. wettsteinii* Dörfl. & Hayek and *S. sillingerii* Deyl. In the strict sense, *S. robusta* complex includes three closely related

and morphologically similar species – *S. doerfleri*, *S. robusta* and *S. wettsteinii*, distributed in the Western and Southern part of the Balkan Peninsula. The main aim of this study was to investigate the relationships among populations of the *S. robusta* species complex based on Amplified Fragment Length Polymorphism (AFLP) analysis. Our study identified several distinct groups, some of which correspond closely to previously established taxonomic treatments while some are identified here for the first time. Morphological, taxonomical, and biogeographical implications of these relationships are also discussed.

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New insights into phylogeny of *Crocus* (*Iridaceae*) on the Balkan Peninsula

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The genus *Crocus* consists currently of about 110 species. Intrageneric taxonomy is traditionally based on differential weighting of morphological characters and flowering time, resulting in quite diverse and often incompatible groups in the past. Currently, the genus is divided into two subgenera, the monotypic subgenus *Crociris* consisting only of *C. banaticus* and subgenus *Crocus* that is split into two sections (*Crocus* and *Nudiscapus*) comprising six and nine series, respectively. Highest species diversity of *Crocus* occurs on the Balkan Peninsula and in south-west Anatolia. Phylogenetic relationships within the whole genus were analyzed using chloroplast trnL-F region, the nuclear rDNA ITS region (ITS1 + 5.8S rDNA + ITS2) and the nuclear single-copy marker region pCOSAt103. The phylogenetic analyses resulted in a monophyletic genus Crocus, probably monophyletic sections *Crocus* and *Nudiscapus*, and inferred monophyly for eight of the 15 series of the genus. The *C. biflorus* aggregate, thought to be consisting of closely related subspecies, was found to be polyphyletic, the taxa occurring within

three major clades in the phylogenetic tree. Therefore the subspecies concept of this taxon cannot longer held upright and let us to estimate that the genus comprises about at least 150 species. However, in comparison to Asia Minor, the Balkan Peninsula is still undersampled regarding *Crocus*. Therefore, the aim of this study is to clarify taxonomy and phylogenetic relationship of Balkan Peninsula crocuses, where also species diversity might be underestimated. Here we will present the first results regarding crocuses from this area.

The phenomenon of parallelism in infraspecific taxonomy – inquiry about phenocopies on the example of taxa of the section *Codonoprasum*, genus *Allium* L. (Amaryllidales, Alliaceae)

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Expressed infraspecific variability and defined paralel series of infraspecific taxa reflect the mechanisms of adaptive radiation of genus *Allium*. Numerous infraspecific taxa are result of evolutionary processes that show spectrum of evolutionary solutions and strategies for survival in nature. The section *Codonoprasum* is represented by several species in central part of Balkan Peninsula. *A. flavum* and *A. carinatum* are considered as common species in this area. Each of this is represented with two subspecies: *A .flavum* subsp. *flavum*, *A. flavum* subsp. *tauricum*, *A .carinatum* subsp. *carinatum* and *A. carinatum* subsp. *pulchellum*. Subspecies *A. flavum* subsp. *tauricum* is characterized by xeric, Mediterranean type of habitat with Aegean character, with a significantly wider area in Macedonia. There are only a few sites in South-eastern Serbia, near the border with Bulgaria and Macedonia where this species is recorded. Other subspecies are common, with significant number of infraspecific taxa that have been ignored in taxonomy so far. This paper includes analyses of morphological characters that are responsible for differentation of infraspecific characteristics and reflect parallel types of evolutionary development of these taxa. The samples were taken in central Balkan area and comprises more then 400 specimens on differential habitat types. The data were compiled in databases and processed using multivariate statistics on a priori defined groups of morphometric and qualitative characters.

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Cypselae micromorphology and anatomy of *Amphoricarpos autariatus* Blečić & Mayer ssp. *bertisceus* Blečić & Mayer

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In this work, micromorphology and anatomy of outher and inner cypselae of *Amphoricarpos autariatus* BleÄiÄ & Mayer ssp. Bertisceus BleÄiÄ & Mayer was examined using scanning electron (SEM) and light microscopy. This endemic taxon for Dinaric Alps (Balkans) is a tertiary relict and has very unresolved taxonomic status related to the Balkans complex of genus *Amphoricarpos*. There is a morphological differences of inner and outher cypselae from the same inflorescence. Inner cypsela is triangular with starisch pappus. The pappus consist of bristles diverging above their base. The bristles held together by the detached upper part of pericarp. Pappus is barbato aristate. Cypsela is dense hair covered. The hairs are dual ostensible, and forked at the tip. Outher cypsela is flat, rarely hair covered (hairs are dual ostensible, and forked at the tip, distributed in three rows), with lateral wings which is ending surmountly above basal part of pappus. Pappus is barbato - aristate. Both cypselae have lateral hilum. Inner cypsela has large amount of sclerenchyma bundles in the pericarp layer. Parenchymatous cells occurs in the pericarp and testa. Testa is not attached to the pericarp. First layer of testa consists of cells with thickened walls. Below parenchymatous cells is residual of perisperm which is forming thin membrane around endosperm. There is no sclerenchyma bundles in the pericarp layer in the outher cypsela (sclerenchyma cells are distributed in the parenchymatous cells of pericarp especially dense in the wings of the cypsela). This is a first report of micromorphology and anatomy of cypselae of this taxon. Observations among the cypselae examined here could be important for resolving taxonomic status of *A. autariatus* Blečić & Mayer ssp. *bertisceus* Blečić & Mayer in relation with other Balkans complex taxa of the genus Amphoricarpos.

Sesleria filifolia Hoppe (Poaceae), a neglected species of the Balkan peninsula

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Taxon *Sesleria filifolia* was originally described by Hoppe (1834) on the basis of the material collected in Carasova in Banat (Romania). Quite surprisingly, more than a century, this taxon was not recognized as something different from the species *S. rigida* Heuff. Ex Rchb., despite the clear morphological differences between them. Today *S. filifolia* is treated as synonym of the species *S. rigida* (Deyl, 1980; Tatić, 1976; Valdes & Scholz, 2011), or at specific rank by some authors (Gergelyi & Beldie, 1972; Assyov & Petrova, 2006; Ciocarlan, 2009). The taxonomic circumscription of *S. filifolia* on the basis of molecular cytological and morphological data was published in Kuzmanović *et al*. (2013), where the name was also lectotypified. This overall study has shown that within *S. rigida* complex four species can be recognized: *S. achtarovii* Deyl, *S. filifolia*, *S. rigida* and *S. serbica* (Adam.) Ujhelyi. The aim of this work was to describe anatomical, morphological, ecological and phytogeographical specialty of taxon *S. filifolia*. Our analyses have shown that populations from Muntii Banatului in Romania and Balkan Mts. in eastern Serbia and western and northern Bulgaria, corresponding to the species *S. filifolia*, show a significant degree of differentiation in regard to the populations from the rest of the area of the complex. After comprehensive studies on *S. rigida* complex, we can conclude that on the territory of Serbia are distributed only the two species *S. serbica* and S. *filifolia*, while *S. rigida* is restricted to the Romanian Carpathians, which is novelty compared to previous understandings of this complex in floristic literature.

Geometric morphometrics - a useful tool in grass taxonomy. A case study on representatives of *Sesleria* sect. Calcariae

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Due to their conservatism, morphological characters of the vegetative and reproductive organs of many grass taxa are not sufficient for establishing satisfactory systematics of taxonomically problematic groups, but anatomical characters of the leaves proved to be very useful for taxa delimitation. That was recently shown in comprehensive morpho-anatomical studies of. *S. juncifolia* and *S. rigida* species complexes. We wanted to examine whether or not the shape of the transverse section of the leaf could also play an important role in delimitation of closely related taxa within the genus *Sesleria* sect. Calcariae, by comparing the results of traditional and geometric morphometry. Traditional morphometry cannot describe the shape, nor distinguish the differences in shape caused by the differences in size, while geometric morphometry overcomes this problem, defining the geometric shape information after removing the effects of size, position and orientation in space. Our study confirms significant congruence between the results obtained using traditional and geometric morphometrics, implying that geometric morphometry can also be a useful tool in grasses taxonomy.

Silene triflora (Bornm.) Bornm. (Caryophyllaceae), a neglected species from the Central Balkans

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Status of numerous taxa from *Silene* L. sect. Saxifragoideae Willk. is still taxonomically unresolved, especially in the Balkans. In 1925 Bornmüller described a taxon from Northern Macedonia, first as *S. saxifraga* L. var. *triflora* Bornm. and 12 years later as a separate species *S. triflora* (Bornm.) Bornm. This taxon is listed in The flora of the Republic of Macedonia as a variety of *S. saxifraga*. In Floras regarding the Balkans it is not included at any subgeneric level, nor as a synonym. Delimitation between *S. triflora* and *Silene saxifraga* L. is discussed on the basis of multivariate morphometrics analysis. The most significant characters for distinguishing these two taxa are pedicel length, inflorescence length, longest internode length, middle leaf length and the number of internodes. We propose treating *S. triflora* as a species endemic for the Republic of Macedonia. Considering that it was perceived that these two taxa differ significantly only in the number of flowers, addition to the original description of *S. triflora* is given.

Morphological variability of the drupe and stone of wild cherry (*Prunus avium* L.) in a part of its natural distribution in Bosnia and Herzegovina

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The paper discusses morphological variability of the fruit andseed/stone of wild cherry (*Prunus avium* L.) which have been collected in twelve localities of its natural distribution in Bosnia and Herzegovina. A total of 2,926 drupes have been collected, and the following propertieshave been studied: drupe length, drupe width,

stone length, stone widthand stone thickness. A discriminant analysis by groups formed accordingto classes of altitude and ecological and vegetation zoning has shown that there are no separations within the studied populations, which implies the possibility to use seed and planting material from different altitudes and ecological and vegetation zones within the studied area.

Komparativna anatomska analiza lista i stabla vrsta roda *Galatella* L. zastupljenih na području Vojvodine

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Anatomske karakteristike vegetativnih organa vrsta *Galatella cana* Waldst. & Kit., *G. sedifolia* L. i *G. linosyris* L. analizirane su pomoću svetlosnog mikroskopa. Mikromorfološka analiza epidermisa lista izvršena je i pomoću skening elektronske mikroskopije. Cilj ovog rada bio je anatomska analiza lista i stabla ispitivanih vrsta kao i izdvajanje karakteristika koje mogu biti od koristi za identifikaciju vrsta. Analizom je obuhvaćeno 35 karaktera. U cilju utvrđivanja opšte strukture varijabilnosti uzorka kao i doprinosa pojedinačnih karaktera varijabilnosti i diferenciranosti vrsta izvršena je statistička analiza dobijenih podataka. Najveće razlike između analiziranih vrsta dobijene su u anatomskim karakteristikama lista. Zabeležena su dva tipa trihoma – višećelijske neglandularne trihome i višećelijske glandularne trihome. Vrste *G. cana* i *G. sedifolia* poseduju glandularne trihome, sa izvesnim razlikama u njihovoj brojnosti, koje nisu zabeležene kod *G. linosyris*. Od preostale dve vrste *G. linosyris* jasno se izdvaja i na osnovu prisustva ljuspica epikutikularnog voska na površini epidermisa lista. Na osnovu analize velikog broja anatomskih karakteristika može se zaključiti da vrste *G. cana* i *G. sedifolia* pokazuju veću anatomsku sličnost, što se donekle može objasniti i sličnijim uslovima staništa koje one naseljavaju. Rezultati anatomske analize potvrđuju da je *G. linosyris*, sa moćnije izraženim strukturama epidermisa u vidu kutikule, trihoma i voštanih naslaga, kao i sitnijim, tesno zbijenim ćelijama svih tkiva lista i stabla bolje adaptirana na sušne uslove staništa. Karakteri epidermisa lista, ornamentika kutikule, prisustvo epikutikularnog voska kao i tip i brojnost trihoma mogu se izdvojiti kao pouzdani taksonomski karakteri za identifikaciju analiziranih vrsta.

Leaf methanolic extract as taxonomic marker in *Campanula pyramidalis* species complex (Campanulaceae)

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The Balkan isophylloid *Campanula pyramidalis* complex comprises more than 20 taxa, but only four species are accepted: *C. pyramidalis* L., *C. versicolor* Andrew., *C. secundiflora* Vis. & Pančić and *C. austroadiratica* D. Lakušić & Kovačić. Two subspecies of the taxon *C. secundiflora* originally recognized by R. Lakušić, but still not accepted - *C. secundiflora* subsp. *montenegrina* and *C. secundiflora* subsp. *limensis* in this study are considered as separate entities, as shown in recent molecular and morphometric studies. Since chemotaxonomy may be helpful in taxonomic treatment, as the hybrid discipline between chemistry and taxonomy, the aim of this study is to investigate leaf methanolic extract as taxonomic marker in order to see relationship within *Campanula pyramidalis* complex. This is the first insight into chemical compounds of *Campanula pyramidalis* complex. Thirteen compounds (eleven flavonoids and two phenolic acids) were detected using HPLC-DAD analysis. Results are partially consistent with molecular, phylogenetic and morphometric studies. Investigated taxa differ in content of compounds found in leaf methanolic extract.

11th Symposium on the Flora of Southeastern Serbia and Neighboring Regions, Vlasina 13th-16th June, 2013

Phytogeography, Floristics and Phytoecology

Fitogeografija, floristika i fitoekologija

Pannonian endems in flora of pannonian part of Serbia (Vojvodina) - distribution and status revision

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Floristic studies have a long tradition in Vojvodina. The oldest data are from XVIII century and the most intensive period is the second half of the XX century, whereby different systems and criteria were used for proclamation of endemic species and subspecies. Primarily, the approach defined in Flora of Hungary was used, because of similarity between flora of this region and Hungary. However, the geographical characteristics of Vojvodina, its orientation towards the Balkan Peninsula, stronger influence of sub-Mediterranean, also as Balkan and Carpathian elements were overlooked in these analyses. Unresolved taxonomic status of some species and incomplete list of indigenous plant species of Vojvodina were an additional problem. The analyses included 26 taxa which were defined in Flora of Hungary as Pannonian endemic (15 taxa) and subendemic (11 taxa) species and subspecies. Further on, they were traditionally considered as taxa with appropriate endemic status in floristic-phytosociological studies. Data on distribution in Vojvodina of these 26 taxa were collected from the literature and four herbarium collections. Affiliation of these taxa to their appropriate floral elements was determined using geographical distribution method and predefined geoelements. After the comparative analyses with predefined areal diagnoses, revision of endemic status of some taxa was enabled. Distribution data on seven taxa require further tests because they are outdated (before 1925 year) and there is no confirmation of literature references with herbarium specimens. Among the studied taxa, 15 of them can be considered as Pannonian endemic species. Four taxa (from Pannonian-Danubian elements group) could be seen as subendems. Endemic status of seven taxa, although they are traditionally seen as endemic or subendemic, should be rejected because of their distribution outside of Pannonian Plain. In addition, distribution data based on literature, for certain taxa need to be confirmed by herbarium material in order to be included in flora of Vojvodina and listed as endemic plants of Vojvodina and Serbia.

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The flora of Bosilegrad surroundings (Krajište region) in southeastern Serbia

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The investigation of the flora and vegetation of this area was carried out in the period from 1985 to 2012. On this occasion, a critical analysis of the flora was performed and plants growing on the Rhodopes mountains of Krajište were listed. During the 27-year investigation of Krajište, 1473 plant species were allocated into 106 families and 541 genera. The most abundant families of the investigated area are Asteraceae (179), Fabaceae (127), Poaceae (114), Caryophyllaceae (98), Lamiaceae (73), Rosaceae (69), Brassicaceae (67), Scrophulariaceae (65), Apiaceae (60) and Ranunculaceae (45). Quite a different view was provided considering the information about the number of genera within the ten families with most numerous genera: Asteraceae (64), Poaceae (56), Brassicaceae (34), Apiaceae (33), Fabaceae (27), Caryophyllaceae (25), Lamiaceae (25), Rosaceae (20), Scrophulariaceae (17), Liliaceae (17), Ranunculaceae (14), Boraginaceae (14) and Orchidaceae (14). Due to the large number of genera within the families Brassicaceae and Apiaceae and small number of species within them, we can conclude that the speciation was directed to genera, not to species diversity. It is worth mentioning that the most abundant genera are Trifolium (32), Silene (25), Ranunculus (21). Carex (20), Vicia (17), Euphorbia (16), Veonica (16), Centhaurea (16), Lathyrus (15) and Potentilla (14). The flora of Bosilegrad surroundings includes 84 endemic taxa and 35 subendemic taxa. Compared to the neighbour regions (Suva Mt, Kopaonik Mt) that have been declared to be the champions of endemism, this is new information- Bosilegrad surroundings is highly ranked in that sense and represents one of the areas richest in endemic species in the Republic of Serbia.

Eco-morphological differentiation of populations of *Jovibarba heuffelii* (Schott) A. Löve & D. Löve (Crassulaceae)

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This paper presents results of multivariate morphometric study of morphological characters in different populations of *Jovibarba heuffelii* in central part of Balkan peninsula and south Carpathians. Morphometric analyses were performed on 14 populations (299 individuals x 50 characters).
The aim of this work was to morphologicaly analyse collected individuals in detail, to identify differentiation trends of populations and correlation between morphological variability and basic orographic, geological, and bioclimatic habitat characteristics. For these purposes multivariate statistical analyses (PCA, CDA, clustering UPGMA analysis based on Mahalanobis distances, CA and Linear regression) were performed. Statistical analyses (PCA, CDA and Cluster) have shown that differentiation of populations exists and that 4 morphological groups are separated. First group is made up of population from Bulgaria, the second population from Gradac, third one populations from Studenica, Suvaja and Domogled in Romania and the last fourth group is made up from all other populations from Serbia and Macedonia. CA analysis of qualitative characters has shown that characters (glandular hair on leaves, inflorescence and carpels, the spike on the apex of the rosette leaves, the presence of the cartilaginous edge on leaves, interval between nectaries) which were often used for describing different infraspecies taxa vary in such a way so they don't support any of four morphological groups which the previous multivariate statistical analysis has recognized. The regression analysis shows that the altitude, aspect, slope and bioclimatic factors (BIO 8 i BIO 4) of the habitat represent the most significant abiotic factors correlated with the morphological differentiation of populations in the studied region.

Flora and vegetation of the Jovanovačka river valley

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One of the tributaries of the Great Morava river under the town of Ćicevac is Jovanovačka river. On the mountain slopes of Ražanj district, two rivers are flowing into each other making Jovanovačka river: Velika river emerges from the Bukovik (894m) and Rožanj (897m) mountains and the Krčeva river emerges from the Baba (657m) and Samanjac (853m) mountains. Jovanovačka river area in geological terms can be divided into two groups: northern part which includes Baba and Samanjac mountain limestone, and southern, siliceous area of Rožanj and Bukovik mountains. The different geological substrates cause differences in the pedological substrate and hence in flora and vegetation. On the limestone slopes of Baba and Samanjac Mts we found the typical representatives of calciphyle flora, such as: *Ranunculus illyricus*, *Hyascinthella leucophaea f. leucophaea*, *Hyascinthella leucophaea f. balcanica*, *Delphinium fissum*, *Lunaria annua*, *Asplenium ruta-muraria*, *Jurinea mollis*, *Agropyrum cristatum*, *Syringa vulgaris*, *Lonicera xylosteum*, *Aethionema saxatile*, *Centaurea atropurpurea*, *Rhamnus saxatilis*, *Silene densiflora*, *Jurinea mollis*, *Cephalaria uralensis*, etc. The plant species of the Rožanj and Bukovik Mts are siliciphyle and often neutrophyle: *Asparagus tennuifolius*, *Salvia verticillata*, *Heracleum sphondylium*, *Mentha longiflora*, *Symphytum officinale*, *Asarum europaeum*, *Aegopodium podagraria*, *Lathyrus niger*, *Galium schultesi*, *Stellaria holostea*, *Geranium robertianum*, etc. Plant communities of the Jovanovačka river valley tend to be forest communities. On the above mentioned mountains there are riverside willow communities- Salicetum albae-fragilis Soo 1958, meadow communities of the class Molinio-Arrhenatheretea R.Tx. 1937, hill vegetation of oak forest communities-Quercetum frainetto-cerris Rudski 1949, meadows and pastures with domination of plants *Andropogon ischaemum*, *Galium purpureum*, *Poa bulbosa*, stony meadows with *Centaurea atropurpurea*, *Ranunculus illyricus*, *Galeopsis ladanum*, *Veronica jacquinii*, *Erysimum diffusum* etc. as the dominant species, and rock-cliff vegetation with the domination of *Cephalaria uralensis*, *Silene densiflora* and *Jurinea mollis*.

Contribution to the flora of the northern part of Prokletije - Prometanj site (Mokra gora)

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The studied area, Prometanj site, is located in southwestern Serbia, in the municipality of Tutin. It is part of the Mokra gora Mountain which is the northernmost arm of the Prokletije mountain range. On relatively small area (about 2 square kilometers) in just one growing season (2011), 351 plant species were collected. All plant species are grouped into 219 genera and 72 families. The families with the most species are *Fabaceae* with 34 species, *Asteraceae* with 32, *Lamiaceae* 24, *Rosaceae* 18 and *Ranunculaceae* with 17 species. Genus with the largest number of species is *Trifolium* (8), followed by *Campanula* and *Ranunculus* with 7, *Veronica*, *Geranium*, *Vicia* and *Acer* with 6 and *Potentilla*, *Stachys*, and *Lathyrus* with 4 species. These results of taxonomic analysis of flora are a consequence of the overall size of the site, its phytogeographic characteristics, vegetation structure and certainly a small number of vegetation seasons with active research. This area is dominated by floral elements of central European character. A small number of species of Eurasian character is a consequence of the partial closure of habitat for xerophilous and heliophilous species. Biological spectrum of the flora of Serbia is characterized by floristic and vegetation structure of the study area especially the number of hemicryptophytes and species that act as hemicryptophytes in this region (H/T). In the area of the site Prometanj were recorded four Balkan endemics: *Eringium palmatum* Vis. et Panč., *Ramonda serbica* Panč., *Edraianthus jugoslavicus* Lakušić and *Cicerbita pancicii* (L.) Wallr., as well as a number of relicts, some of them are: *Cotinus coggygria* Scop., *Ramonda serbica* Panč., *Hedera helix* L., *Ostrya carpinifolia* Scop. and *Staphylea pinnata* L. Also, this site beside river Ibar gorge is the only habitat for *Adenophora liliifolia* Bess. in the Republic of Serbia. Prometanj is home to four strictly protected and 47 protected species.

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Phytoecological analysis of primary and secondary colonization on copper mine wastes (Bor, Serbia)

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Analysis of floristical diversity, chorology and vegetational preferences, plant life forms and ecological indexes were used in order to ecologically characterize Bor copper mine wastes habitats of diverse edaphic properties and management type. Main patterns of primary and secondary sucession and differentiation of plant cover were discussed. Correspondent and discriminant analysis were used for classification and grouping of vegetation data. They consist of 119 vascular plant species of generally hemicryptophytic character, and are dominated with wide area species. In terms of vegetation preferences species of dry grasslands communities from Festuco-Brometea class prevail. With regard to edaphic properties and management type of existing habitat groups three stages of vegetation development can be distinguished: *Agrostis stolonifera*, *Epilobium dodonaei*, *Robinia pseudoacacia*, *Cirsium eriophorum* and *Robinia pseudoacacia*, *Convolvulus arvensis*. Analysis of diagnostic, highly frequent and species with high coverage index values were used in assesment of their significance in primary and secondary colonization process.

Cabomba caroliniana A. Gray 1837 in Serbia distribution and propagation potential

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Since 2008, *Cabomba caroliniana* A. Gray 1837 has been found in the basic canal network of the Hydro-System Danube-Tisa-Danube, with the distribution restricted only to the canals in Bačka. Along surveyed canal sections on locality Sombor, species occurred sporadically in small, established populations of

average density 42 rooted stems per m^2, and numerous stem fragments free floating along surveyed area. On the locality Mali Stapar, species was very abundant, overgrowing the canal bed. Average population density was 151 rooted stems per m^2, and numerous floating stem fragments. On the localities Vrbas and Odžaci only large number of stem fragments was observed, and many of them had adventitious roots on stem nodes. 104 fragments of stem with one node were grown under controlled conditions: 46% of fragments floated for 27 hours; only fragments with leaves on nodes formed adventitious roots; adventitious roots grew 5.6 mm per day, in average.

New Associations of Serpentine Rocky Grasslands' Vegetation (*Halacsyetalia sendtneri* H. Ritter-Studnička 1970) in Serbia

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Phytosociological characteristics of five invalidly and provisory published grassland communities (*Artemisio-Achnatheretum calamagrostis* R. Jovanović 1984, *Carici humilis-Festucetum pancicianae* R. Jovanović et S. Jovanović 1987 *Artemisio-Silenetum armeriae* prov. D. Lakušić 1989, *Potentillo tomasinianae-Festucetum pancicianae* prov. D. Lakušić 1989 and *Centaureo kosaninii-Euphorbietum glabriflorae* prov. S. Jovanović et V. Stevanović 1990) are analyzed according to Braun-Blanquet methodology. In order to resolve their syntaxonomy and nomenclature, these stands were compared with the total of 217 relevés belonging to 21 syntaxa of serpentine rocky grasslands in Serbia. The Correspondence and the Cluster analyses were performed in order to detect the structure and differentiation of the associations based on the floristic composition. The results suggest the occurrence of floristically well defined new associations in the vegetation of open rocky serpentine grasslands on Mts Kopaonik and Šar Planina in Serbia.

Herbarium collection of Jacob Juratzka at the National Museum of Kikinda - reconstruction, revision and conservation

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Herbarium collection of Jakob Juratzka (1821 -1878) is among the oldest collections on the territory of Serbia with great historical, botanical and conservation importance housed in the Natural History collection of the National Museum of Kikinda. Before its revision and conservation collection was transferred to the BUNS Herbarium, Department of Biology and Ecology, University of Novi Sad. Plant material is arranged according to the recent systematical and nomenclatural criteria, databased and digitized, so the data become available to the scientific and professional community. The collection includes 1630 specimens originating from the territory of Central and South Europe organized in 9 collections: original Juratzka`s specimens (433 sheets), which mainly originate from Lower Austria (410); Juratzka`s specimens obtained by exchange (294), mainly from Austria (62), Czech (52) and Italy (47); two school herbarium collections (646); collection of specimens without information about collector and location (102); mosses (88); algae (12); fungi (33) and lichens (22).

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Rare plant species in special fish-farming ponds in the Czech Republic: distribution and ecology

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The landscape in the Czech Republic is characterized by occurrence of numerous fishponds which are artificial water bodies of mainly medieval origin. Until present, they are serving to fish, in particular common carp breeding. Besides the intensively managed fishponds, there are also fish-farming ponds used for special purposes, e.g. for short-term storage of marketable fish, breeding of fish fry, etc. The conditions of higher altitudes with sources of cold, well oxygenated water poor in nutrients are more suitable for trout and other salmonid breeding which is carried out in so called trout ponds. Within 2008 - 2010 we intensively investigated flora and vegetation of special fish-farming ponds described above. Besides many common wetland and non-wetland plant species we recorded occurrences of rare and threatened wetland plants which are missing or are extremely rare in ordinary fishponds and other types of wetlands in the Czech Republic. Many of these species grow in the Czech Republic on the border of their distribution range, or at least out of the distribution centers in other parts of Europe. As such, these species are much more sensitive on environmental and management changes than commonly distributed species. However, the special fish-farming ponds usually largely differ in their management from ordinary fishponds. There are usually excluded management practices like fertilising and, to the contrary, applied practices like regular summer drainage combined with mowing or grazing. Such a management eliminates strong competitors and favours competitively poor herbs including wetland and aquatic annuals. The examples of species found in special fish-farming ponds are e.g. some species with optimum in warm regions of Europe (e.g. *Cyperus flavescens*, *C. michelianus*, *Lindernia procumbens*, *Najas minor* and *Pulicaria vulgaris*), species of mainly northern-European distribution (e.g. *Elatine hexandra*, *E. orthosperma* and *Tillaea aquatica*) and sub-atlantic species (e.g. *Centunculus minimus*, *Isolepis setacea*). We also found some, in the Czech Republic still poorly known neophytes, e.g. *Gratiola neglecta*, *Lemna turionifera* and *Lindernia dubia*. In our presentation we want to demonstrate the most important ecological characteristics of selected rare species, their distribution in the Czech Republic and possible relationships to the populations in other European countries.

Vegetation survey in the Czech Republic: baseline situation, recent status and future perspectives

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Vegetation survey in the Czech Republic has about 100 years lasting tradition. During this period, thousands of relevé were collected and numerous papers in the field of vegetation science were published by the Czech botanists. Besides many local papers there appeared also national syntheses of some vegetation types, e.g. forest and synanthropic vegetation. However, all of these syntheses were based on table analyses of limited number of relevés and field knowledge of the specialists in particular vegetation types. Along with routine use of computer equipment in all scientific fields, new possibilities appeared in the vegetation science. Numerous relevés could be computerized and new classification approaches were developed. Since the 1990s, activity of European Vegetation Survey (EVS), a Working Group of the International Association for Vegetation Science (IAVS), promoted fast progress of vegetation research in many countries including the Czech Republic. With funding from national grants and logistic support from EVS (e.g. providing the database software Turboveg free of charge), Czech National Phytosociological Database (CNPD) could be established and continuously updated. The database consists of about 103 000 phytosociological relevés up to date; it is the fourth largest phytosociological database in Europe. A few years after the CNPD was established, the number of relevés was high enough to allow testing and further development of new-generation classification tools. The previous experiences had shown that the fully computer-based classification methods working without expert supervision did not give satisfactorily interpretable results in many cases. Therefore there was an attempt to combine computer-based and expert-based approaches. The Cocktail method, included in the vegetation classification software JUICE, simulates an approach of traditional phytosociology because the classification process is supervised by an expert and the classification results are influenced by the expert decision. However, the unequivocal classification of each plant community is enabled by a unique formal definition and the quality of the results produced can be measured statistically. With the help of this software and large national relevé database, a team of specialists from various Czech research institutions could start an ambitious project Vegetation of the Czech Republic. The most important task of the project was preparation of 4 volumes of

vegetation monograph which would include all the vegetation types of the Czech Republic. Until now, 3 volumes were published and the last one is planned for December 2013. The work on the monograph promoted further phytosociological research, including collecting more data, obtaining experiences about poorly known vegetation types of the Czech Republic, and supra-national vegetation surveys based on large datasets. Currently, the Czech phytosociologists are involved in EVS activities directed to the pan-European vegetation survey (e.g. European Vegetation Archive - EVA, European aquatic and marshland vegetation classification - WetVegEurope). The cooperation is open to the phytosociologists from all the European countries.

Effects of *Pteridium aquilinum* growth on herb layer of planted and natural forests of Vidlič Mountain (Serbia)

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Bracken, *Pteridium aquilinum* (L.) Kuhn., is one of the worlds most widely dispersed plant species. It frequently occurs as long-lived clones and has an invasive capacity that can be explained by various competitive attributes such as its extensive rhizome system. The objective of this study was to determinate influence of *P. aquilinum* growth on herb layer of two areas: first in the natural beech and spruce forest (*Fagus moesiacae montanum*); the other in the *Pseudotsuga menziesii* plantation, formed on the beech and spruce habitat. The survey was done on the plots (1000 m^2) on each site in spring, summer and autumn of 2011 and 2012. Comparing two studied sites, the species richness and diversity are higher in the *Pseudotsuga* plantation in spring, but are lower in the peak of the vegetation period, due to competitive species like *P. aquilinum*, and their abundance negatively influence the herbaceous plant species richness and diversity.

Habitats diversity of Genus *Ambrosia* L. (*Asteraceae*) in Vojvodina

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Invasive plants are characterized by high biological potential, strong competitive abilities, exceptional degree of adaptivity and very pronounced aggressiveness, they spread rapidly and became part of the local communities of wild flora. They are usually associated with the semi-autonomous and non-autonomous ecosystems, where they occur in large numbers. Species of the genus *Ambrosia*, especially *A. artemisiifolia*, represent one of the most frequent invasive plants in Vojvodina. In order to achieve a better insight into the distribution of *A. artemisiifolia* and *A. trifida* and their preference to the type of habitat in this part of Serbia, we made an overview of habitat that they currently inhabit. Based on field research, herbarium collections and literature data of the studied taxa distribution, the division of habitats in which they are recorded was made based on the EUNIS classification. In this way, we achieved the chronological image of pace of habitat colonisation, adaptation to different habitat types and geographic regions of Vojvodina, where is pronounced tendency of massive invasion of the genus Ambrosia from artificial to natural habitats.
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Bryophytes in beech forests on Vidlič Mountain

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The research was conducted during 2011 and 2012 on Vidlič Mountain in Southeastern Serbia. The studied area was at 1200 m above the sea level in beech forest. Total number of 49 taxa (7 liverworts, 42 mosses) was recorded. Liverworts belong to 6 families and 6 genera, and mosses belong to 17 families and 31 genera. The most frequent mosses belong to families Brachytheciaceae, Hypnaceae and

Pottiaceae, respectively. Genera with the highest species richness were *Brachythecium*, *Atrichum*, *Encalypta*, *Grimmia*, *Hypnum* etc. Biogeographical analysis showed presence of 6 floristic groups. The largest number of species belongs to boreal, temporal and atlantic floristic group, respectively. Two life forms were detected: Chamaephyte caespitosae (clod like) and Chamaephyte reptant (crawling). Dominant life form on investigated area is Chamaephyte caespitosae. According to the Bryophyte red list of Serbia and Montenegro, two taxa have low risk threat status.

Comparative analysis of steppe vegetation of Titel hill and Srem loess plateau

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Titel hill is a specific geomorphological unit, and lonely loess plateau in South-East Backa, between the Danube and the Tisa rivers. There are different concepts of origin and evolution of this unique geographical phenomenon. Halavać and Cvijić considered that Titel hill formed by separating from Srem loess plateau due to fluvial erosion of the Danube. This assertion is supported by the morphology of the loess sections at Stari Slankamen and Titel. Some other authors (Bukurov, 1976) considered that Titel hill and Srem loess plateau has been always separated, and they are deposits of loess which are formed by the Tisa and Danube River. The aim of this study is to compare the steppe vegetation of two loess plateau separated by Danube. The analysis included elaboration of 200 relevés collected from literature sources and independent research in the 2011, 2012 and 2013 year. All relevés are collected in TURBOVEG software package. In research are established similarities and differences between the differential species of communities of this region. With the help of software platform JUICE and R 3.0 software was we performed DCA analysis of the ecological characteristics of species.

Morphological differentiation within section *Biflori* Mathew from genus *Crocus* L. on territory of Serbia

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Crocus section Biflori is a group of four species endemic or subendemic to the Balkan peninsula: *C. adamii, C. alexandri, C. pallidus* and *C. chrysanthus*. In this paper analyzed morphological differences between these four species. We analyzed the following characteristics: width of tubers, perigon tube length, color of throat of perygon, length of outer and inner segments of perigon, presence / absence stripes on the outer segments of perigon, anther length, anther / stigma relationship, length of stigama lobes, leaf width, color of flowers, number of leaves and number of flowers. The results were statistically analyzed using the program FLORA. On the basis of these results, it was found that all of these species clearly differentiated.

Merging relevant floristic databases for Atlas of Slovenian flora

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In 2001 a draft atlas (Gradivo za Atlas flore Slovenije) was published representing 3200 distribution maps of vascular plant flora of Slovenia. Despite its virtual quality and quite high level of usefulness repeatedly proven in the following decade, there were several remaining gaps which could be easily recognized by thorough analysis. Geographical coverage of the territory was quite good with no clear-cut empty gaps bigger than a 'quadrant', but within this coverage, quality of floristic data was quite biased. Temporal bias can be easily recognized especially in the areas with good floristic coverage in the second half of 19th and first half of 20th Century (e. g. Primorska covered by Pospichal's and Marchesetti's monographs at the end of 19th Cent. and Štajerska covered by Hayek between 1908 and 1956) where recent data are scarce. Geographical bias is a result of intense floristic work in "more promising" areas like the Alps, Slovenian Istria, floodplains along Mura river etc. and on the other hand very good coverage of the areas near botanists' home towns. Interestingly there is a remaining gap in the circle between 20 and 40 km

from Ljubljana. Ecological bias is often a result of specific interest of field worker (e.g. in forest communities) or a very banal reasons of "inaccessible" habitat types like wetlands or rocks. Here we can mention also general neglect for ruderal communities by several botanists. Seasonal gap as could be expected, early spring flora with not so many species, but several of them recognizable only early in the season, is simply not covered in many parts of Slovenia, as floristic activities mostly start at the end of May or even in July for the high mountains. On the other hand also autumnal flowering species are quite scarcely recorded, especially those, that are really not recognizable before September, as e.g. N American *Aster spp.* with a couple of naturalized taxa but almost without information on their distribution. Taxonomic bias: on one hand several taxonomically critical groups as *Hieracium, Rubus, Festuca* etc. are mostly recorded in the field only by specialists or a thorough systematic mapping, on the other hand there are simply 'not popular' groups like all grasses and grasslike plants, ferns, compositae, Amaranthaceae s. lat. etc. which are quite often simply avoided in the field by botanists. With agreement to merge floristic data from 4 relevant databases for Slovenian flora, we will reach much better quality and completeness of the knowledge, which was already shown by the test set of data for a couple of species. But before systematic field work a thorough analysis of gaps of the merged database is needed again to prepare a priority list of focuses for each of the sampling units. Only results of such analyses can serve as a firm base for systematic (additional) mapping which can produce a critical Atlas in the near future.

CO_2 assimilation during different phenophases of four invasive species

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Four annual plant species: *Ambrosia artemisiifolia* L., *Ambrosia trifida* L., *Reynoutria japonica* Houtt. and *Asclepias syriaca* L., not native in Europe, produce high quantities of pollen and can cause serious respiration distress such as allergies and asthma in human population. Some reports state that the populations of these species are expanding throughout many European countries. In this research, photosynthetic and transpiration rates, water use efficiency (WUE), field water capacity (FWK) and air temperature, where measured during different phenophases of one vegetation season, at several different localities in North Serbia. Both species

of the genus *Ambrosia*, and species *A. syriaca* had the highest levels of CO_2 assimilation during the flowering phase when pollen is produced, whereas the lowest was determined when the mature fruit was developed. Air temperatures at localities during measurements, had high positive correlation with the transpiration rates, and therefore negative correlation with the efficiency of water use. It seems that different values of field water capacity did not had any significant influence on plants CO_2 assimilation and transpiration, in spite of quite low levels of available water at several analysed localities (values of FWK between 20-25 %). All analysed species managed to sustain stabile bioproduction levels in wide span of ecological abiotic conditions, survive and produce pollen and fruits inspite of often dry soil on the habitat. *Ambrosia artemisiifolia* had the highest levels of photosynthetic rate, up to 25.74 μmol CO_2 m^{-2} s^{-1}. Inspite of wide temperature span (28.32-40.90 °C) and variable, often low field water capacities (28.32-40.90 % of FWC), bioproduction was very high, indicating broad temperature and hydrological amplitude that this species can adapt to, always resulting in pollen and fruit production. These results suggest that the possible drought occurrence, predicted to be more frequent in the years to come, will not act as a limitation factor to further spread of analysed species in Europe, especially *Ambrosia artemisiifolia* L.

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Typhetum laxmannii (Ubrizsy 1961) Nedelcu 1968 – its distribution and phytosociology in South-eastern Europe

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Typha laxmannii Lepechin (Typhaceae) is Eurasian species with uncertain status in Europe. In Southern and Eastern Europe is rather widespread (most likely

native to Bulgaria, Romania, Ukraine and south-western part of Russia), whilw in Central and Southern Europe its occurs sporadically and ephemerally, somewhere considered a neophytic, adventive or even invasive species, exhibiting a tendency to expand (Czech Republic in 1966, Slovakia in 1968, Serbia in 1978, France in 1978, Italy in 1982, Poland in 1988, Germany and Slovenia in 1990, Austria 1n 1993, Croatia in 2000). The ass. *Typhetum laxmannii* is so far recorded in Hungary, Romania, south-western Siberian taiga, Slovakia, Czech Republic, Ukraine, Malta and Poland, either as a native or a xenospontanic community. It occupies habitats mainly in old quarries and flooded sand pits, where it grows within semi-natural reed-swamp communities. In 2011 a comprehensive phytosociological of *Typhetum laxmannii* in Croatia and Serbia has been undertaken. The habitats of *T. laxmannii* in Croatia are superficial excavations, channel banks, or unofficial waste dumps, with a progressive vegetation succession toward bush formation. The habitats are constantly wet or periodically flooded. In Serbia, the community is developed mostly on wet habitats near rivers or periodical rivulets. The floristic composition is characterized by prevalence of species of the class *Phragmitetea* and presence of ruderal companion species of the class *Bidentetea triparitae*. The comparison with the data from other countries is presented and commented. The role of bird migrations in expansion of *T. laxmannii* from South-eastern toward Central Europe is assumed. In some cases in Western Europe it is spreading by escape from ornamental ponds, where it is grown as a decorative plant.

Reynoutria sachalinensis: a new invasive species of the flora of Serbia and its distribution in the SE Europe

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During an extensive field mapping of *Reynoutria* taxa that was carried out in Serbia and Montenegro in the 2006–2012 period, an interesting specimen was collected in the vicinity of the Special Nature Reserve and Ramsar site "Carska bara" (Vojvodina, Serbia). The recorded plant was identified as giant knotweed *Reynoutria sachalinensis* (F. Schmidt) Nakai, and it is the first certain record of this

invasive species for Serbia. Species covers an area of 1748 m² on the bank of the canal connected to the river Begej, forming a six separate compact stand on the edge of poplar-willow forest, wet grasslands and near agricultural fields, just 3 km far from the northern border of Ramsar site "Carska bara".
This finding indicates a range extension of the *R. sachalinensis* in the Balkan Peninsula. All distribution data of *Reynoutria sachalinensis* in Serbia and SE Europe are presented and critically analized.

Rasprostranjenje i ekologija vrste *Goniolimon tataricum* (L.) Boiss. (Plumbaginaceae) u Srbiji

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U flori Srbiji navode se dve vrste iz roda Goniolimon: *G. collinum* (Griseb.) Boiss. i *G. tataricum* (L.) Boiss. (Gajić, 1972, Ranđelović, Stamenković, 1986). Terenskim istraživanjima obavljenim na više lokaliteta u Srbiji, Makedoniji, Bugarskoj i Turskoj, kao i pregledom i upoređivanjem herbarskog materijala u zbirkama BEO i BEOU, utvrđeno je da primerci iz Srbije, Makedonije i zapadne Bugarske nemaju karakteristike vrste *G. collinum* (gola čašica i brakteje), već da se odlikuju manje-više dlakavim braktejama i pri osnovi ili u celosti dlakavim čašicama, što odgovara karakteristikama vrste *G. tataricum*. Rasprostranjenje *G. tataricum* u Srbiji utvrđeno je u ukupno 25 UTM kvadrata 10x10 km. Ova vrsta raste u asocijacijama *Diantho-Centauretum diffusae* (Ranđelović et Ružić, 1982), *Potentilletum arenariae* (Ružić, 1978), *Sedo-Dianthetum serbici* (Z. Pavlović, 1967), *Potentillo-Fumanetum bonaparti* (Rexhepi, 1979) i *Stipeto-Convolvuletum compacti* (Millaku *et al.* 2011) u dijapazonu nadmorskih visina od 280 m do 850 m na serpentinitskoj, krečnjačkoj i dolomitskoj geološkoj podlozi.

Floristic and phytocoenological characteristics of the forests dominated by invasive species *Acer negundo* l. and *Fraxinus pennsylvanica* Marshall in Ramsar site Carska bara (Vojvodina, Serbia)

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Phytocoenological investigation of habitats with highly invasive tree species *Acer negundo* L. and *Fraxinus pennsylvanica* Marshall were performed in Ramsar site Carska bara, in order to point out the high degree of degradability of this protected wetland. A total of 168 species was noticed within 51 relevés. Each releve was georefferenced using GIS tools. The results of the different numerical analysis suggest the existance of floristically and coenologically well defined forest community. All of the recorded relevés are differentiated into three diverse stands. From the conservation point of view, the increasing dispersal rate of this invasive plant community is detected as a problem amongst many fragile wet habitats across the Serbia and SE Europe.

Study on flora from Meledic – Manzalesti Natural Reserve (Buzau County, Romania)

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The present study took place in the "Meledic Plateau", a natural reserve of 151 hectares, delimitated by four rivers, laying at a medium altitude of 530 m. and situated in the central-eastern part of Romania, in Buzau County, 60km north from town of Buzau. Because of the remarkable forms of relief, appeared as a result of

dissolution of salt, the presence of a salt cave unique in Europe and of a number of lakes with fresh water, this area was included in Natura 2000 network; site has the ROSCI 0199 code and is classified under category IV (according to UICN) as Special Conservation Area. The reserve is part of the Continental Biogeographical Region; its existence is trying to protect the "Ponto-sarmatic deciduous thickets" habitats. The present study took place over a period of several years, with field trips in various periods of the year. A very diverse and rich flora was identified, with taxa belonging to more than 100 genera. Most species belong to Fabaceae, Asteraceae, Lamiaceae, Rosaceae and Umbelliferae families. Analyzing the spectrum of the biological forms, the predominance of hemicrytophytes was observed. The analysis of the floristic elements mark out the dominant Euro Asiatic and Central European elements, and as regarding the ecological preferences (humidity, temperature and soil reaction) it has been observed the domination of xeromesophytic, mezotermal and euriionical species. Studies are to be done in the future to analyze the interesting and diverse flora of the region.

Wild growing medical plants in the area of northern Kosovo and Metochia, in middle course of Ibar river valley

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From 3662 taxa of Serbian flora (in the range of species and subspecies) over 700 species (19,65%) have some healing properties. About 420 species of medical plants (11,8% of the flora) are explored and registered; around 250 species of medical and aromatic plants are turnover. Many years of field studies (from 2005 until 2013) on the vascular flora of serpentine terrain in the middle course of Ibar river valley, in the area of northern Kosovo, the presence around 1000 taxa was recorded. Out of thie number, 127 species potentially can be used as medical plants. Plants affiliation to the group of medical plants is done on the basis of relatively numerous and available literature on medical plants. In accordance with the Legislation on the use and trade of wild flora and fauna recommendations were given on species can be controlled to collect, to ensure their sustainable survival.

Contribution to the alien flora of Montenegro and supplementum to the Preliminary list of plant invaders

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This contribution is based on the field observations from 2011 and 2012. Besides new data about distribution of some known plant invaders (*Ambrosia artemisifolia*, *Impatiens parvilfora*, *Helianthus x laetiflorus*, *Reynoutria japonica* etc.), one new alien for the flora of Montenegro is reported - *Solidago gigantea*. This plant was recorded in 2011, on two distinct localities near the road side in peri-urban area of Nikšić and Mojkovac, in the vicinity of gardens, were it has been grown as ornamental. In 2012 survey, species was again reported for Mojkovac, but it disappeared from Nikšić, due to environmental changes caused by road construction. Remaining locality is placed near Tara river bank, so considering ecological preferences (roadsides, distrurbed river banks and moist soils), this species might become more frequent in the area. It is included into the EPPO list of invasive alien plants. In addition, alien plant *Tagetes minuta* is added to the preliminary list of plant invaders in Montenegro.

Globulario coridifoliae-Edraianthetum wettsteinii ass. nova: new association in the alpine rock vegetation in Montenegro

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During the vegetation survey on mountain Rumija (coastal part of Montenegro) one new association *Globularia coridifoliae-Edraianthetum wettsteinii* was described. According to up-to-date investigations named association is restricted to the mountain range where it was described. It inhabits fissures in calcareous rocks and skeletal soils in rocky habitats, above the timber line, in altitudinal belt from 850 m to 1550 m. In association the highest degree of constancy have the following species: *Edraianthus wettsteinii*, *Globularia cordifolia*,

Danthoniastrum compactum, *Moltkea petraea*, *Bromus erectus*, *Koeleria splendens*. An association is characterised with high level of endemism. Up to 50% taxa are Balkan endemics (39.3%) or sub-endemic (10.7%). In this paper phytocoenologal releves, analysis of the biological spectrum and chorological analysis will be presented.

New chorological data of some macrophytes in Serbia

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During floristical and phytocoenological researching in the vicinity of Niš and Dimitrovgrad, new chorological data of the following macrophytes: *Hydrocharis morsus-ranae* L., *Najas marina* L., *Potamogeton lucens* L., *Bidens cernua* L. were obtained. In past, *Hydrocharis morsus-ranae* L. was found only on teritory of Vojvodina, so that, the new locality is the southest point of distribution for this species in Serbia. On the area south of Sava and Danube rivers, *Najas marina* L., *Potamogeton lucens* L., *Bidens cernua* L. were discovered earlier.

Diversity of macromycetes of Mt. Suva Planina in the Quercetum frainetto-cerris association

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The investigated area Ploče is located 16 km southeast of Niška Banja, on the slopes of the mountain called Suva Planina. The material was collected during the period from June to November 2010. A total of 65 species of macromycetes has been recorded in the association Quercetum frainetto-cerris. The species belong to 41 genera, 28 families and 8 orders. The taxonomic analysis shows that: Boletaceae (9), Russulaceae (9) and Amanitaceae (6) are the families with the largest number of species. Among the identified species, 34 are mycorrhizal fungi, 24 are saprobic fungi, while 7 species can be saprobic and

parasitic fungi. *Gymnopus fusipes* and *Lactarius quietus* are typical for oak forests.

Flora and phytogeographical characteristics of Vidlič mountain (E. Serbia)

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A relatively spacious, limestone massif of Vidlič Mountain, mostly located in eastern Serbia was investigated. Mountain rises above the Pirot, occupying a NW-SE direction up to the border, and continuing trough the territory of Bulgaria. On the basis of detailed, multi-year field study and review of literature material, it was found that the vascular flora of the study area makes 1265 species and subspecies, arranged in 55 orders, 93 families and 442 genus. The present study comprises range of biological flora of the area, which was compared with the biological spectrum of flora of Serbia, the Balkan Peninsula, the Mediterranean region and temperate zone of Europe. The Mt. Vidlič is characterised by high presence of hemicryphytes, which fits into the range of Serbia flora, and in ecological sense is closer to the floras of the temperate zone. In addition to the dominant Euroasian influence on the mountain Vidlič flora, powerful impact is achieved by the Pontic region and weakened Mediterranean influences that comes from the valley of Sruma river through Sofija field. Presence of mountain flora elements is registered, witnessing strong contact with the floras of E and SE Serbia limestone mountains on one side and Stara mountains on the other side. We recorded 25 endemic taxa, representing 8,71% of the total number of Balkan endemic flora of Serbia, representing 1,98% of total flora of Vidič mountain. During the study, a large number of data on distribution of significant and rare representatives of Serbian flora where recorded (*Ophrys insectifera*, *Orchis pallens*, *Galanthus elewesii*, *Paeonia peregrina*, *P. tenuifolia*, *Prunus tenella*, *Ribes multiflorum*, *Euphrasia hirtella*, *E. Illyrica*, *Malcolmia serbica*, *Salvia austriaca* etc.)

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Morphological differentiation within section *Biflori* Mathew from genus *Crocus* L. on territory of Serbia

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Crocus section *Biflori* is a group of four species endemic or subendemic to the Balkan peninsula: *C. adamii*, *C. alexandri*, *C. pallidus* and *C. chrysanthus*. In this paper analyzed morphological differences between these four species. We analyzed the following characteristics: width of tubers, perigon tube length, color of throat of perygon, length of outer and inner segments of perigon, presence / absence stripes on the outer segments of perigon, anther length, anther / stigma relationship, length of stigama lobes, leaf width, color of flowers, number of leaves and number of flowers. The results were statistically analyzed using the program FLORA. On the basis of these results, it was found that all of these species clearly differentiated.

The analysis of the flora of Tepoš plateau around Pirot

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The flora of the karst plateau Tepoš, which is the part of Vidlič mountain (eastern Serbia) was studied. Based on the analysis of the collected material and data from the literature, it was noted that the flora of Tepoš plateau is represented by 486 species, distributed in 284 genera and 68 families of vascular plants. The biological spectra was shown. The hemicriptophytic-terophytic character was established by analyzing the presence of plant life forms. By phytogeographical analysis the presence of 25 area types was established. The euroasian florystic chorion with 276 species of eurasian area type is the most abundant, followed by mediterranean-

submediterranean (58 species), central-european (47 species), cosmopolitan (27 species) and pontian area type (24 species). In the flora of Tepoš plateau the 9 balkan endemic taxa were recorded, which is 3,14% of total balkan endemic taxa in flora of Serbia. A small number of endemic taxa is expected, considering the low diversity of habitats. Balkan endemic taxa recorded in this area are: *Acer hyrcanum* subsp. *intermedium*, *Bupleurum flavicans*, *Crucianella graeca*, *Eryngium palmatum*, *Pastinaca hirsuta*, *Hypericum rumeliacum* subsp. *rumeliacum*, *Thymus praecox* subsp. *jankae*, *Linaria rubioides* subsp. *nissana* and *Viola tricolor* subsp. *macedonica*.

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Allelophatic potential of invasive species *Aster lanceolatus* Willd.

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Aster lanceolatus Willd. is one of the most invasive plant in Serbia. However, mechanisms that allow *A. lanceolatus* to suppress native flora and to become dominant in riverine plant communities are not clear. This invasive plant has impact on some soil properties and reason for this could be due to its allelopathic effect. In this paper, allelopathic potential of *A. lanceolatus* was studied. *Lactuca sativa* and *Sinapis alba* were selected as the bioassay species. Different concentrations of aqueous extracts of *A. lanceolatus* were applied to determine their effect on *Lactuca sativa* and *Sinapis alba* seed germination and seedlings growth under laboratory conditions. The results indicate that allelochemicals of *A. lanceolatus* could be present in the soil under *A. lanceolatus* stands and that those allelochemicals could contribute to competitive ability of *A. lanceolatus* against native plants. Keywords: *Aster lanceolatus* Willd., invasive plants, allelopathy, *Lactuca sativa*, *Sinapis alba*.

Morpho-anatomical differentiation populations of *Daphne cneorum* L. (Thymelaeaceae) from Serbia

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Daphne cneorum L. (Thymelaeaceae) is an evergreen shrub distributed in western, central and eastern Europe, the Mediterranean and South-West Asia. The comparative morphoanatomic investigations have included three distantly separated populations of the species *D. cneorum*. The analysis of variance included 20 quantitative characters related to the leaf and stem anatomy and morphology. The results of morphoanatomical studies have shown the presence of general adaptive characteristics of the xeromorphic type, slightly differing in each population. The Principal Component Analysis (PCA), Canonical Discriminant Analysis (CDA) and cluster analysis using the Mahalanobius' distance of morphoanatomical characteristics of the leaves and stems have shown a clear distinction between the carbonate populations of *D. cneorum* from eastern Serbia (Mt. Rtanj and Mt. Suva planina) and the serpentine populations from western Serbia (Mt. Zlatibor).

Endemična i reliktna flora Šljivovičkog Visa u istočnoj Srbiji

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U flori Šljivovičkog Visa prisutno je 48 subendemita i 25 endemita Balkanskog poluostrva, što čini 9% ukupne flore ovog područja. Fitogeografska klasifikacija endemita i subendemita izvršena je na osnovu ekološko-florogenetskog principa, pod kojim se podrazumeva objedinjavanje informacija o vegetacijskoj pripadnosti, geografiji i poreklu vrsta u jednu kategoriju. Svi endemiti i subendemiti

Šljivovičkog Visa su klasifikovani u četiri areal-tipa: srednjeevropski, mediteransko-submediteranski, pontski i srednje-južnoevropsko planinski areal tip, koji obuhvata dva areal-podtipa (južnoevropsko planinski i srednjeevropsko planinski). Fitogeografska analiza je pokazala da najveći broj endemita i subendemita pripada mediteransko-submediteranskom areal tipu (11 endemita i 22 subendemita). Nakon njih, sa gotovo ravnopravnim učešćem se javljaju i elementi srednje-južnoevropsko planinskog areal tipa (10 endemita i 18 subendemita). Od vrsta reliktne starosti, na području Šljivovičkog Visa nalazi se 38 taksona (4,7% ukupne flore). Područje Šljivovičkog Visa predviđeno je za uključivanje u botanički značajna područja Republike Srbije.

Floristic analysis of the Miljkovačka gorge (Eastern Serbia)

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As a result of two-year investigation of the Miljkovačka gorge flora, carried out during the 2010. and 2011., 331 plant species belonging to 70 family and 245 genera were collected. Families with the greatest number of species are Asteraceae (43), Lamiaceae (38), Poaceae (21), Caryophyllaceae (19) and Fabaceae (18), while the most abundant genera are *Trifolium* (6), *Euphorbia* (5), *Sedum* (5), *Potentilla* (5) and *Arthemisia* (5). The analysis of the life forms shows the domination of hemicriptophytes with a significant presence of therophytes. The presence of 24 plant species which conclude relicts, endemic, subendemic and rare species accentuates the importance of preserving this area with an emphasis on the habitat of endemorelict *Ramonda serbica* first noticed by the botanist Spas Sotirov (1977).

Ecological indicators determining distribution of Camphorosma dominated communities in the Central Balkan

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Salt-affected soils, as an essential element for the formation of halophytic and sub-halophytic vegetation, occur particularly in arid and semi-arid regions where the strong concentration of salts in the soil and it could be found in all climates areas and at different altitudes. Diversity and spatial distribution of vegetation dominated by the presence of two halophytic species, the *Camphorosma annua* and *Camphorosma monspeliaca* was analyzed in addition to syntaxonomical and ecological characterization. Both species are distributed in different communities of saline habitats, mainly within the vegetation of extremely salinized soils, such as solonchaks. Data set of all available literature sources concerning the halophytic vegetation in the south-east Europe, as well as our own unpublished results was processed and analyzed. The final dataset contained 601 relevé referred for Serbia, Macedonia, Bulgaria and Romania from halophytic and sub-halophytic habitats were classified using a Cluster Analysis of the dataset in the program PC-ORD 5, using Euclidian distance measure and Ward´s method algorithm for dendrogram construction. Diagnostic species of each of the clusters were determined by calculating the fidelity of each species to each cluster using the phi-coefficient as a fidelity measure. DCA analysis with passive projected explatatory variables was used and CCA with climate data as explanatory variables were applied. Using canonical correspondence analysis (CCA), with log-transformed plant cover values, the relationships between large-scale climate data and species distribution of the vegetation data were tested. The classification was interpreted at the level of 3 clusters. Cluster analysis of the whole data set has resulted in clear distinction of relevés of ass. *Camphorosmetum annuae* developed in north Serbia and communities with *Camphorosma monspeliaca*, identified in southern Serbia, Macedonia, Bulgaria and Romania. Clear differences were obtained between south Serbian and Macedonian as well as south Bulgarian and north Bulgarian communities, whereas certain phytosociological similarity was found between the north Bulgarian and Romanian relevés, probably as a consequence of soil features and salinity level depended on temperature and humidity. The Monte Carlo permutation test in CCA showed that all climate variables obtained from the WorldClim model were significant. The strongest, and nearly equal, relationships

with the species distribution were found with variables BIO18 (Precipitation of Warmest Quarter, explaining 21,7% of the variation explained by all variables), BI O3 (Isothermality; 19,4%), BIO12 (Annual Precipitation; 18,9%). By setting up of all tested climatic variables onto the Camphorosma species occurrence map, the Precipitation of Warmest Quarter was the most relevant parameter for clear distinction between the more continental, Pannonian vegetation with *C. annua* and southeast warmer habitats with *C. monspeliaca* (southern Serbia, Macedonia, Bulgaria and south Romania).

Spatial distribution and abundance of *Stachys milanii* in Serbia: disturbed vs. referent habitats

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A small salt-marsh area in vicinity of Niš (SE Serbia) is a single one habitat of Critically Endengered (CR) and Strictly protected plant species, *Stachys milanii* (*Lamiaceae*), in Serbia. We tested how environmental factors affect spatial distribution and abundance of this species. The line-transect method, at 14 sites, estimated the presence of 4.872 specimens instead of 50 previously reported. NMDS method revealed three groups of sampling sites based on their floristic composition. BIO-ENV analyses presented the best combination of environmental parameters including two factors; the slope and the extent of anthropogenic influence (Rho=0.881; p =0.01). These most important environmental parameters are the main drivers of distribution of *Stachys milanii*. The non-parametric Spearman rank correlation test showed that the population density was highly correlated with both factors, the slope (r=-0,606, p<0.01) and the extent of anthropogenic influence (r=0.737, p<0.01). Such a correlation pointed out that *S. milanii* is more abundant in the contact zone with anthropogenic deteriorated grounds, than salt-marsh habitats with reference conditions.

Genus *Artemisia* L. (Asteraceae; Anthemideae) in Serbia-form of distribution and diversity

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Knowing the facts about the distribution of species of the genus *Artemisia*, many of which are characterized by an wide range and invasive character, both locally and globally. Considering the taxonomic complexity and ecological plasticity of the genus *Artemisia*, as the goal of this work is selected the analysis of distribution of its species recorded on the territory of Serbia. Applying GIS technologies, all available literature and herbarium data about the distribution of 12 taxa of the genus *Artemisia* of flora of Serbia (*A. absinthium*, *A. alba*, *A. annua*, *A. austriaca*, *A. campestris*, *A. maritima*, *A. pancici*, *A. pontica*, *A. santonicum*, *A. scoparia*, *A. umbelliformis*, *A. vulgaris*) are analysed. Most of the species are widespread throughout the studied areas, but the points of distribution are highly unequable. Most of the studied observations involve the area of Belgrade, Vojvodina, eastern and southern Serbia. Such situation is caused by an irregular schedule and intensity of ecological factors on the one hand, and the degree of anthropogenic modification and investigated areas on the other. The urban area of Belgrade is characterized by the largest number of floristic and phytocoenologically recorded data. However, the real center of the taxonomic diversity of this genus in Serbia is the central part of Deliblatska Sands. On this area are present 7 taxa, including the endemic species *A. pancicii*. The largest centers of the genus *Artemisia* are not located in the urban areas as expected, but in conserved or partially human altered areas of nature. Compared to the current image of distribution of mentioned species in Serbia, tends and the possibilities of the future changes are analysed.

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Ecological characteristics and diversity of medicinal flora of the Pčinja River valley in southeastern Serbia

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The article represents taxonomic and ecological characteristics of the medicinal flora of the Pčinja River valley in southeastern Serbia. It includes 191 taxa (species and subspecies) classified into 127 genera and 51 families. Families with the greatest number of taxa are Labiatae (28), Compositae (20) and Rosaceae (17). Detailed taxonomic and phytogeographic investigations, as well as the analyses of life forms are represented. Ecological characteristics and affinity of this valley medicinal flora in relation to geological substrate, types of vegetation, range of altitudes and 8 different types of habitat, as well as spatial species richness were analyzed. Comparative analysis with eleven similar areas in Serbia is also represented. Taxonomic and life form spectra, as well as presence of basic distribution types are compared for all of the areas. Indices of floristic diversity and indices of floristic similarity (ISJ) for medicinal flora of each area in a relati on to medicinal flora of the Pčinja valley are also calculated. Multivariate exploratory techniques were applied in order to describe distribution pattern and floristic similarity of medicinal flora between the areas compared. Effects and use of medicinal plants of the Pčinja River valley is also considered.

Comparative analysis of the vascular flora of the Valley of Mesta River and Struma River Valley, southwestern Bulgaria

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In terms of flora, Bulgaria belongs to the transition zone in which Central European vegetation gradually turns into the Mediterranean. This transition is well pronounced in southern parts of the country where the influence of the Mediterranean climate is reflected in the highest degree. In this area, which includes the Struma River and Mesta river valleys, it is formed a flora of sub-Mediterranean type. The results of the study of the two floras show that they are very close in terms of taxonomic structure, richness of families and genera, chorological and biological spectrum. At the same time, some differences in location, topography, altitude, soil types and bedrock in the two regions have influenced the nature of the vegetation cover. Data from the comparative floristic analysis suggests that the flora of the Struma Valley has more pronounced Mediterranean character determined mainly by the presence of a higher number of Mediterranean floral elements and species with origin and distribution from the Mediterranean and Southern continental center.

Occurrence and conservation of *Artemisia chamaemelifolia* in Bulgaria

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To study the only currently known population of *Artemisia chamaemelifolia* Vill. in Bulgaria and propose effective measures for its conservation. The single population of *Artemisia chamaemelifolia* in Bulgaria is studied. The population is located in Ponor Mountain which is part of the Balkan Range. The altitude varies between 1200 and 1400 m a.s.l. The species was first reported for Bulgaria in 1923 by Jordanoff. This is the only locality of the species on

the Balkan Peninsula. *A. chamaemelifolia* is a glacial relic. Species abundance was estimated and the exact location was recorded by a GPS-device. Maps of the proposed protected area were designed by ArcGis software. The vegetation was sampled following Braun-Blanquet approach. *Artemisia chamaemelifolia* has a limited occurrence in Bulgaria and requires urgent protection actions. The whole population is spread over area of 95 sq. km. Among the main threats are climate change, intentional fires and shrub encroachment into the habitat. The species is protected by the Bulgarian Biodiversity Law. It is evaluated as Critically Endangered at national level and is included in *Red Data Book of the Republic of Bulgaria*. A part of the population has been proposed for declaration of a protected site that will be a part of a network of Small Protected Sites for plants (SPSs, Plant Micro-Reserves). The latter network is currently being developed in Bulgaria within a Life+ project. Maps of the proposed SPS and the whole potential network of SPSs in Bulgaria are presented. The vegetation in which *A. chamaemelifolia* participates is described. The management practices of the area are commented and appropriate conservation measures are proposed. *Artemisia chamaemelifolia* is critically endangered species in Bulgaria. An action plan for the species has been elaborated, containing measures for regulated management of its habitat, long-term monitoring on the population and vegetation dynamics, and raising the awareness of the local people on the conservation significance of the species.

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Leontodon tuberosus L. (*Asteraceae*) a new species of the Serbian flora

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In the valley of Pčinja river, southern Serbia, the presence of species *Leontodon tuberosus* was recoreded. This taxon has not been known from Serbia, so far. By phitogeographic characteristics species *Leontodon tuberosus* belongs to

Mediterranean and Sub-mediterranean areal type. In Zlatković scientific research (2011) ,which had been explored and studied for the years in the valley of Pčinja river, presence of this species has not been observed. The herbaria material will be deposited in the Herbarium of Botany and Botanical Garden University in Belgrade (BEOU). New finding of this taxa represent a significant addition to the knowledge of floristic richness of southern Serbia and Serbia entirely.

11th Symposium on the Flora of Southeastern Serbia and Neighboring Regions, Vlasina 13th-16th June, 2013

Nature protection and Environment
Zaštita prirode i životne sredine

Fungal conservation: Protected species of fungi in South Serbia region

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Protection and conservation of fungi has only recently became an issue of concern. Main motives for increased attention are uncontrolled, mass collecting of edible wild mushrooms and environmental pollution which leads to the rapid decline of their natural habitats, some of which are rich with rare and endangered species. By Serbian Nature Conservation Law 2010, there are 38 strictly protected fungal species of which 17 species are recorded in this paper. 9 of those recorded species are on European and/or National Red List of endangered fungal species. All investigated territories were in South Serbia region. This study is a contribution to conservation of protected and threatened fungi and their respective habitats in Serbia.

GIS Analysis of spatial distribution of invasive tree species in a protected natural area Mt. Avala (Serbia)

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In this paper we present the results of studies of distribution of seven invasive tree species (*Robinia pseudoacacia*, *Acer nagundo*, *Fraxinus pennsilvanica* s.l., *Ailanthus altissima*, *Gleditsia triacanthos*, *Rhus typhina*, *Amorpha fruticosa*) in the protected area Avala in Serbia. Field studies were conducted between May and July 2012. Distribution data of invasive species was collected using GPS positioning with GPS receiver eTrex Vista C (Garmin). Softver Manifold System 5.50 Professional Edition is used for spatial data analysis and creating vector map of the MGRS network with squares of 100 x 100 m. A total of 970 individual occurrence data, which were distributed to 239 MGRS squares 100 x 100 m, we registered. The detailed maps of the distribution of each invasive species, as the results of the analysis of distribution in relation to the zones of protection and habitat types were presented.

The status of *Lycaena helle* and *Phengaris teleius* butterflies in Serbia

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Lycaena helle (Denis & Schiffermuller 1775) and *Phengaris teleius* (Bergstrasser 1779) are regarded as threatened species in Europe, and marked as one of the priority species for conservation. Since only recent discovery in Serbia the butterflies were completely omitted from the legislature, conservation plans and management activities of the protected areas. Trying to resolve this problem some of the quick noted on the distribution, habitat and threat status of butterflies is summarized and a conservation measures are proposed.

Bryophyte flora of the Vlasina lake and its surroundings (SE Serbia)

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216 bryophyte taxa (39 liverworts and 177 mosses) were collected during field trips carried out in 2010 and 2011 in the surroundings of Vlasina lake. Of these collections, four species (*Ditrichum lineare, Grimmia incurva, Physcomitrium eurystomum* and *Pohlia proligera*) were found to be new records for Serbia. Six species are included in the Red Data Book of European Bryophytes (*Amblystegium radicale, Brachythecium geheebi, Grimmia caespiticia, Hamatocaulis vernicosus, Pseudoleskea saviana* and *Taxiphyllum densifolium*). The wetland remnants around the lake and the spring areas in the valleys, the hills of the surrounding area still preserve a high level of bryophyte diversity and considerable richness in rarities of the Balkans and even Europe. In the surrounding mountain areas especially the exposed siliceous rocky habitats have high importance for bryophyte conservation. On the basis of our investigation it can be concluded that this area is worth to be listed as Important Bryophyte Area of the Balkans, as a hotspot of bryophyte diversity and rarities of Europe and the Balkan Peninsula.

Air quality indication in Blace (Southeastern Serbia) using lichens as bioindicators

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Air quality investigations have not been done in Blace until now. Identifying the presence of different types of epiphytic lichens was performed during the summer 2012. in the area of Blace (southeastern Serbia) and selected rural settlements around Blace, in order to point to the air quality of the area. The analysis of samples from described localities indicates presence of 25 lichens taxa from 19 genera. Using the **I**ndex of **A**tmospheric **P**urity (IAP) it has been found that there are 2 different air pollution zones in Blace: "lichen desert" and which includes the periphery of the city. In the "transitional" i.e. "struggle zone" the air is moderately polluted. In the urban area of Blace there is no a "normal" zone, but it was detected in the surrounding rural areas.

Morphometric characteristic of barbel from Jerma river (southeastern Serbia)

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Barbel has extremely unclear taxonomic status in Serbia and, according to some authors and depending on the location, it is determinate as *Barbus peloponnesius, Barbus meridionalis, Barbus balcanicus*. According to some researchers, there are several subspecies. At the same time, a description in the

ichthyological literature is also confusing and cited significantly different meristic and morphometric characters. In addition, data on the distribution of species are drastically different. The research included 104 specimens of barbel, caught in the river Jerma, from the Bulgarian border to the mouth of the river Nišava. Based on the results, determination formula of barbel population from Jerma river would be:
D III – IV, 7- 9; A III 5 -6; P I (12)13-17, V II 7-9;
a.l.l. 9-14(15); l.l. (48)49-66; b.l.l. (6)7-11(12).
By comparative analysis of barbel description given by a number of authors we can state that from given formulas, just the one that Vuković, Ivanović (1973) gave partially corresponds to our findings, while the Šorić formula (1987) is fully consistent, except for the minimum number of scales in the middle line.

"Emerald" plant species of Serbia

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The Berne Convention (Convention on the Conservation of European Wildlife and Natural Habitats), adopted in 1979., regulates the protection of endangered species of wild flora and fauna and certain habitats in Europe and some African countries. Serbia has ratified the Convention by law in 2007. The list of strictly protected flora species (Appendix I of the Convention) includes 547 taxa of plants, mosses and algae, with fifty-one present in Serbia. Along with this one, the list of species found on Resolution 6 Berne Convention which is the basis for determining areas for Emerald ecological network was established (Annex 1, 1998). The list contains 481 taxa. According to the revised list of Resolution 6 of the Berne Convention (Council of Europe, 2011) of total 563 species there are 36 present in Serbia, which are Serbian Emerald species at the same time.
The paper provides background information on the distribution of Emerald plant species in the Serbia, their presence in existing Emerald areas (61), the state of the populations, threatening factors and the protective measures to be taken in order to preserve and improve their abundance.

Plant micro-reserves as a tool for the conservation of bryophytes in Bulgaria

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Micro-reserves are a well established practice for the conservation of plant biodiversity in Europe. The concept has recently been adopted for the protection of some of the rarest and most threatened plants in Bulgaria, including three bryophyte species: *Mannia androgyna*, *Riccia crustata*, and *Trichocolea tomentella*. Here we present how we apply the plant micro-reserve model in the conservation of the three species and their habitats. We describe the national distribution, state of the populations, threats, individual approaches for monitoring of each species, in-situ conservation actions, etc. We conclude that the plant micro-reserve approach is a valuable tool for the conservation of bryophytes in Bulgaria with great potential to be applied to other threatened species.

Conservation of certain threatened plant species in Bulgaria using the micro-reserve model

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Some of the rarest species in the Bulgarian flora are target species of the project "BulPlantNet: A pilot network of small protected sites for plant species in Bulgaria using the plant micro-reserve model". This project aims to conserve species that are unique or have small and/or strongly fragmented populations. Their survival is under serious threat and urgent conservation actions must be undertaken. Seven species that are critically endangered at the national level are presented here. These are *Anthemis argyrophylla* (Bulgarian endemic), *Genista germanica, Lycopodiella inundata, Merendera attica* (Balkan endemic), *Potentilla fruticosa*, *Ranunculus stojanovii* (Bulgarian endemic), and *Tulipa pirinica* (Bulgarian endemic). We note briefly their distribution, habitat requirements, population size and structure, the main threats, as well as some in situ and ex situ actions aiming at conservation of their populations and habitats.

Aethionema arabicum (L.) Andrz. (*Cruciferae*) in Bulgaria - *in situ* and *ex situ* conservation

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Aethionema arabicum (L.) Andrz. is extremely rare species of the Bulgarian flora. This one is included in the Biological Diversity Act of Bulgaria and in the Red Book of Bulgaria (Plants and fungi) with category "Critically endangered". The species is distributed in Balkan Peninsula (Bulgaria and Turkey), Southwest Asia (Asia Minor, Syria, Northern Iran) and the Caucasus. The only population of *A. arabicum* known in Bulgaria is situated in Eastern Stara planina floristic region, near to Sotirya village, Sliven district. The population consists of only dozen individuals. This study provides information on the biology and ecology of the species, its population structure and the measures taken to increase the population. Protected area was designated to preserve this species.

The Balkan endemic species *Lathyrus pancicii* and *Verbascum anisophyllum* in the Bulgarian flora

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The Balkan endemic species *Lathyrus pancicii* and *Verbascum anisophyllum* have very limited distribution on the Balkan Peninsula - Southwestern Bulgaria and Southeastern Serbia. These species are one of the rarest plants of the Bulgarian flora. For the first time *Lathyrus pancicii* is reported for Bulgaria in the region of the village of Kurilo, Sofia district (West Stara planina) at the beginning of 20th century. After that for almost 100 years it has not been found in the abovementioned location and it is considered extinct. In 1998 the species is rediscovered in Lyubash Mountain (Tran district) and in 2008 a second locality is found in Paramunska Mountain. Until recently *Verbascum anisophyllum* has been

known with local distribution in the Viden part of Konyavska Mountain, which is the type locality of the species. In 2010 a second locality is found north of Vukovo village (above Skrino Gorge of the valley of river Struma), Boboshevo district. The poster presents information about the populations and habitats of the two species, as well as the taken measures for their conservation.

Toxicity of a commonly used solvent dimethyl sulfoxide against *Drosophila melanogaster* larvae: Determination of LC_{50}, LOEC and NOEC values

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Genotoxicology studies often involve studies with test substances dissolved in polar aprotic solvents such as dimethyl sulfoxide (DMSO). However, it is well known that DMSO has toxic properties, thus it can affect the results of performed studies, both *in vitro* and *in vivo*, and in the end their validity. In order to eliminate such doubts, DMSO toxicity testing must be performed on the model organism before its application as a solvent in the study. Our goal was to determinate the LC_{50}, NOEC and LOEC values for DMSO on *Drosophila melanogaster* larvae. Twelve concentrations of DMSO were tested in duplicates and each experimental group consisted of 30 three-day old larvae. After 12 days of exposure, number of live hatched adults was counted, Risk Assessment software tool (RA V1.0) and probit analysis were utilized in order to calculate values for LC_{50}, LOEC, and NOEC. It was determined that LC_{50} is 0.42% v/v, LOEC 0.04% v/v, and NOEC is 0.04% v/v. Confidence intervals (95%) were also calculated. These results suggest that DMSO is more toxic to *D. melanogaster* larvae than it was initially thought.

Conservation of the critically endangered species *Plantago maxima* in the Bulgarian flora

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Plantago maxima Jacq. (*Plantaginaceae*) was discovered in 2007 in a single locality in Sofia floristic region in W Bulgaria. This is the only population on the Balkan Peninsula recorded so far. It comprises several hundreds specimens and grows in a habitat listed under the EU Habitats Directive – 6410 *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*). The species was evaluated as Critically Endangered at national level and therefore needs urgent protection measures. It is one of the target species in an ongoing Life+ project "*A pilot network of small protected sites for plant species in Bulgaria using the plant micro-reserve model*" aiming at establishment of a national network of small protected sites for conservation of endangered plants. The poster presents the results of the studies carried out on the species during the past three years – population characteristics, seed germination rate, accompanying species. An Action plan for conservation of the species is under preparation, containing the major threats and measures for conservation of the species, which are presented and discussed.

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Genetics, selection and biotechnology
Genetika, selekcija i biotehnologija

Karakterizacija masnog ulja iz jezgra oraha *Juglans regia* L.

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Orah (*Juglans regia* L.) je, kao vrsta tercijarne starosti, na nekim terenima Srbije spontana vrsta ili vrlo često gajena kao voćka u svim krajevima. Ima veći broj gajenih formi koje se razlikuju prvenstveno po plodu. Plod je okruglasta do eliptična koštunica koja je zrela u septembru. Ovaj rad pokazuje sastav masnog ulja iz jezgra oraha. Izolovanje ulja je vršeno petroletrom (40-65°C) na aparaturi po Soxhlet-u. Uparavanje je vršeno rotacionim vakuum uparivačem na 50°C, nakon čega je dobijeno masno ulje sa prinosom od 77,6%. Masne kiseline su metilovane na način kako opisuje AOAC metoda 965.49. Tako pripremljeni uzorak je analiziran gasnom hromatografijom / masenom spektrometrijom GC-FID / GC-MS. Hromatografskom analizom je dokazano prisustvo 8 estara masnih kiselina, od kojih je identifikovano 6, što iznosi 96,1% od ukupno prisutnih masnih kiselina. Linolna i oleinska kiselina su bile dominantne (59,6 i 25,1%, respektivno). Ostale identifikovane kiseline su: palmitinska (7,9%), stearinska (1,8%), γ-linolenska (1,0%) i palmitoleinska (0,7%). Ljudsko telo može sintetisati sve masne kiseline koje mu trebaju za rast i život osim linolne i linoleinske kiseline. Zato je upotreba oraha u ishrani od velike važnosti jer pored zasićenih (palmitinska i strearinska), sadrži i nezasićene masne kiseline.

Karakterizacija masnog ulja iz jezgra šljive *Prunus domestica* L.

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Cilj ovog rada je bio izolovanje i karakterizacija masnog ulja koštice šljive *Prunus domestica* L. U svetu postoji preko 2000 sorti šljiva. Smatra se da je domaća

šljiva hibrid i poznata je kao gajena biljka. Najviše je rasprostranjena u Šumadiji, zapadnoj Srbiji i Pomoravlju. Nakon sitnjenja u mlinu, biljni materijal je ekstrahovan u aparaturi po Soxhlet-u. Kao rastvarač je korišćen petroletar (40-65°C). Nakon osam ciklusa, ekstrakcija je prekinuta, a dobijeni ekstrakt je filtriran kroz bezvodni natrijum-sulfat i uparen na rotacionom vakuum uparivaču na 50°C. Prinos masnog ulja je iznosio 40,85%. Metil estri masnih kiselina su pripremljeni prema AOAC metodi (965.49). Nakon delimičnog uparavanja, uzorak je analiziran gasnom hromatografijom / masenom spektrometrijom GC-FID / GC-MS. Hromatografskom analizom masnog ulja iz jezgra šljive, utvrđeno je prisustvo osam masnih kiselina, od kojih najveći udeo imaju oleinska (59,5%) i linolna (27,1%). Ostale masne kiseline sa manjim udelom su palmitinska (7,5%), stearinska (1,5%), palmitoleinska (1,4%) i arahidonska (0,1%). Identifikovane masne kiseline čine 96,9% od ukupno prisutnih. Na osnovu dobijenih rezultata može se zaključiti da je jezgro šljive izvor masnih kiselina i da može služiti kao sirovina za njihovo izolovanje. Pored zasićenih (palmitinska i strearinska), sadrži i nezasićene masne kiseline (oleinska, linolna, palmitoleinska i arahidonska).

Varijabilnost morfometrijskih karakteristika jednogodišnjih sadnica različitih linija polusrodnika veza (*Ulmus effusa* Wild.) sa područja Velikog ratnog ostrva

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Vez (*Ulmus effusa* Wild.) je jedna od vrsta koja je u šumskom fondu Republike Srbije označena kao retka i ugrožena. U toku proteklog stoleća nastupilo je masovno sušenje brestova i pojava njihovog izumiranja što je samim tim dovelo do smanjivanja genetičkog diverziteta i opasnosti od pojave genetičkog drifta. Na području Velikog ratnog ostrva zabeleženo je 56 stabala veza koja su prostorno podeljena u tri subpopulacije. U cilju procene genetskog potencijala ove vrste na području Velikog ratnog ostrva i definisanja adekvatnih mera konzervacije obavljena je procena varijabilnosti potomstva odabranih 14 test stabala veza. Na osnovu sprovedenih istraživanja varijabilnosti morfometrijskih karaktersitika jednogodišnjih sadnica, može se konstatovati zadovoljavajući stepen unutarpopulacione varijabilnosti, što predstavlja dobru osnovu za konzervaciju raspoloživog genofonda.

Micropropagation of *Micromeria pulegium*

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Micromeria pulegium (Rochel) Benth. is an endemic species of Southern Carpathians, it is, as well, protected by low in category of protected species in Serbia (gazetted under the No. 36/09). To the best of our knowledge, the micropropagation of *M. pulegium* has not previously been reported. The aim of this study was to elaborate the possibility of plant regeneration through axillary buds on nodal explants *M. pulegium* by using different growth regulators. The most efficient hormone combinations were benzyladenine and indole-3-acetic acid. The rooting of regenerated shoots was obtained by transferring them to the media supplemented with auxins (indole-3-acetic acid or indole-3-butyric acid). All tested concentrations stimulated the rooting of *M. pulegium* shoots. Rooted shoots were successfully acclimatized under greenhouse conditions.

Acute oral toxicity of *Artemisia absinthium* essential oil on female BALB/c mice

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Artemisia absinthium is the common plant in the south east part of Balkan peninsula with strong repellent effects and multiple use in traditional medicine. This study was performed in order to show the chemical composition and acute oral toxicity of essential oil isolated by hydrodistillation from the aerial parts of *A. absinthium* collected in the surroundings of Niš. Chemical composition was examined using Gas chromatography /mass spectrometry analysys. Female BALB/c

mice (25-30 g) were used for evaluating acute toxicity of *A. absinthium* essential oil given by gavage. Essential oil was dissolved in corn oil and each mouse received a single dose. Examined doses were between 300 and 7500 mg/kg. Mice in the control group received the pure corn oil while one group remained untreated. Lethality and different types of poisoning behavior were monitored throughout the experiment. Histopathological examination of liver, kidney and spleen morphology was done. The mice were observed during seven days. After that period all surviving ones were killed and examined equally. Low doses of essential oil were not lethal on examined mice, produced no adverse effects on their behavior and had no effect on examined tissues.

Biochemical parametars and CT scanner analysys as indicators of experimental model of postmenopausal osteoporosis induced by ovariectomy

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Osteoporosis is the most common type of bone disease that leads to a bone loss. One of the ways of its formation is a lack in estrogen in women at the time of menopause. The experimental model of osteoporosis, obtained in a rat, is one way to test the healing of broken bones affected by osteoporosis as well as finding potential therapies for improving conditions in postmenopausal women. The aim of this study was to obtain a model of osteoporosis by ovariectomy (surgical removal of ovaries) in order to monitor a different ways of osteoporotic bone regeneration. Ovariectomy was performed on 20 female Wistar rats, 3 months old. Rats were sacrificed in groups after 1 month, 2, 3 and 4 months. Each group had its own control group

without ovariectomy, which was sacrificed at the same time as the corresponding experimental group. Serum biochemical parameters (estrogen, calcium, phosphorus, alcaline phosphatase and acid phosphatase) were measured every month, during 4 months, while femures were monitored using Medica 3DCT scanner. Based on the decrease in estrogen levels, increase in alkaline phosphatase as well as the visual thinning of femur, observed on 3DCT scanner, we can conclude that experimental model at 3 months after removal of ovaries is suitable for further investigations of the disease and the manner of its treatment.

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Phytochemistry and Phytotherapy
Fitohemija i fitoterapija

Content of chlorogenic acid in the commercial coffee samples present on the Serbian market

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Coffee is a bitter drink made from roasted seeds of *Coffea sp*., Rubiaceae. It is considered to be one of the most widely consumed beverage in the world, due to its beneficial health effects, which are largely associated to the presence of purine alkaloids, but also phenolic compounds composition, recently including chlorogenic acid as one of most important. The main goal of this study was to determine chlorogenic acid content, as one of the major antioxidants, in various commercial coffee samples present at the Serbian market. A high-performance liquid chromatography (HPLC) method for determination of chlorogenic acid in plant extracts was applied to determine the content of 5-caffeoylquinic acid (5-CQA) in examined commercial samples. The analytical method was modified and re-validated. Mobile phase was aqueous 1.5% acetic acid - methanol (80:20) with a flow rate of 0.8 mL/min. Run time was 15 min and column temperature 25° C. The detection was performed at 240 nm. The content of 5-CQA in commercial coffee samples ranged 0-46.98 mg/100 mL. The results of coffee samples analysis indicated that the content of chlorogenic acid depended on the type of coffee (*Coffea canephora* species showed higher chlorogenic acid content), the technological processing of coffee (higher amount of chlorogenic acid was present in coffee treated with semi-dry process) and the technological formulation. The study showed that the formulation was the most important factor determining the amount of chlorogenic acid in the final coffee products.

Antimikrobna aktivnost etanolnih ekstrakata odabranih vrsta familije Ericaceae

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Najpoznatiji i najviše korišćeni biljni uroantiseptik je list medvеđeg grožđa (Uvae-ursi folium). U literaturi se često spominje da i druge vrste familije Ericaceae

ispoljavaju antiseptičko delovanje. Provera antimikrobne aktivnosti je izvršena za sledeće biljne vrste ove familije koje samostalno rastu u flori Balkana: *Arbutus unedo, Bruckentalia spiculifolia, Calluna vulgaris, Erica arborea* i *Erica carnea*. Antimikrobna aktivnost etanolnih ekstrakata listova je ispitivana disk difuzionom metodom korišćenjem 10 sojeva mikroorganizama. *Pseudomonas aeruginosa, E. coli* i *Klebsiella pneumoniae* nisu osetljive ni na jedan od ispitivanih ekstrakata. Ostali mikroorganizmi daju male zone inhibicije i to uglavnom kada su u pitanju najveće korišćene koncentracije ekstrkata. Kao najbolji rezultati mogu se izdvojiti aktivnosti ekstrakta *Calluna vulgaris* i *Erica carnea* na soj *Staphylococcus aureus* koje u najvišoj aplikovanoj koncentraciji dosežu 60% aktivnosti antibiotika na koji je bakterija osetljiva. Testirani uzorci uglanom ispoljavaju antimikobnu aktivnost prema Gram-pozitivnim sojevima. Izuzetak je etanolni ekstrakt vrste *Arbutus unedo* koji ispoljava određenu antimikrobnu aktivnost prema Gram-negativnoj bakteriji: laboratorijskom soju divlje *E. coli*. Iako je HPLC analizom utvrđeno prisustvo arbutina (koji je odgovoran za uroantiseptično dejstvo lista medvеđeg grožđa) u listovima vrste *Arbutus unedo*, ovaj etanolni ekstrakt nije ispoljio značajniju antimikrobnu aktivnost ni prema jednom od testiranih sojeva.

Optimization of HPLC method for the isolation of *Hypericum perforatum* L. methanol extract

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St. John's Wort (*Hypericum perforatum* L.) is one of the most studied plant species in the family Clusiaceae. Healing effects of this plant were described in ancient and medieval times when it was used as a "cure for all" (panacea). St. John's Wort has very complex chemical composition and contains many bioactive components in different amounts. Main constituents of *H. perforatum* extracts are: naphtodiantrones, flavonoids, xanthones, coumarins, phenolic acids and phloroglucin derivatives. The aim of this study was the identification of the constituents of methanol extract of *H. perforatum* and optimization of conditions for their isolation. Experimental methods *Hypericum perforatum* L. was collected in the vicinity of Leskovac during the June of 2011. Dry aerial part of the plant was chopped and extracted with methanol twice. Methanol extract was reextracted with hexane. HPLC analysis was performed on Agilent 1200 HPLC chromatograph with DAD detector and ZORBAX Eclipse XDB C18 column. The main components of

the methanol extract were isolated on the above mentioned chromatograph on preparative ZORBAX Eclipse XDB C18 column with solvent system consisting of methanol and 0.01 M ammonium acetate in water. Constituents of the extract were identified by comparing their retention times with the retention times of the standards, with the literature data and the UV spectra. Results By the extraction of dried plant material with methanol, dry extract was obtained in a yield of 27.1%. Methanol extract was reextracted using hexane and dry hexane extract was obtained in a yield of 1.7 %. By HPLC analysis the following components were identified: chlorogenic acid, gallic acid, trans-p-coumaric acid, rutin, hyperoside, isoquercitrin, quercitrin, quercetin, pseudohypericin, hypericin and hyperforin. By varying the conditions of chromatography the optimal conditions for isolating the methanol extract constituents were determined: mobile phase consisting of methanol and 0.01 M ammonium acetate in water in ratio 1 : 1, sample concentration 100 mg/mL, sample volume 30 ďL, flow 2 mL/min. Under these conditions 7 components of the methanol extract were isolated. In this paper the chemical composition of the methanol extract of the plant species *H. perforatum* as well as the optimization of the conditions for the isolation of its constituents using preparative HPLC method were determined.

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Screening of amylase inhibition by selected essential oils components as potential agents in diabetes prevention

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Diabetes mellitus or diabetes is a metabolic disorder characterized by the inability to transport glucose from the bloodstream into the cells. This disease can distinguish between two types: Type 1 or insulin-dependent diabetes and Type 2 diabetes or insulin-independent, which is dominant because it affects 90% of all patients. Studies in the previous 20 years have shown that the control of stimulated insulin secretion is extremely important for the prevention of complications caused by diabetes. Glucose absorption delay from the digestive tract is one of the therapeutic approaches in this regard. For this purpose, enzymes for digestion of carbohydrates, that is amylase, should be inhibited in the process of food digestion,

and this was done with some components of essential oils. The inhibitors prepared by the ultrasonic mixing, and which inhibited up to 38% of the amylase enzyme activity, turned out to be better, whereas the inhibitors prepared by hand-mixing inhibited up to 25% of the amylase activity. Mean values of inhibition show that citral is the best and that eugenol is the weakest inhibitor.

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Quality of herbal drugs in relation to the origin of plant material – the example of St. John's wort (*Hypericum perforatum* L., Hypericaceae)

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St. John's wort (*Hypericum perforatum* L.., Hypericaceae) is one of the most recognized plants in both, traditional and conventional medicine. However, although there are strict regulations related to the content of active principles which have to be fulfilled during the process of preparation and registration of phytopreparations, the content of components responsible for pharmacological effects could vary depending on the exact biological source and the origin of plant material. The aim of the study was to examine influence of the origin of the five herb samples of *Hypericum perforatum* subsp. *perforatum* collected at different localities, and one sample of Hyperici herba purchased from local herbalist on quality of ethanol extracts. Furthermore, the content of total phenolics and flavonoids and some individual components responsible for the pharmacological effects of St. John's wort phytopreparations are evaluated. In addition, the ability of obtained extracts to neutralize different free radicals (DPPH, NO, OH) and the impact on the processes of lipid peroxidation (LP) were analyzed. Also, the inhibition of acetylcholinesterase (AChE) *in vitro*, which could be important in the prevention and treatment of Alzheimer's disease, is evaluated. The total phenolic content ranged from 14.35 to 19.41 mg of GAE/g d.e., while the content of flavonoids ranged from 1.33 to 2.85 mg of QE/g d.e. Using the method of high-performance liquid chromatography (HPLC) the content of chlorogenic and caffeic acid, rutin, quercitrin, hyperforin and hypericin was determined. The concentration

of extract reached 50% of inhibition of DPPH, OH and NO radicals (IC_{50}values) were ranged from 1.36 to 5.68 mg/mL, from 43.07 to more than 70.00 mg/mL, and from 92.82 to more than 170.00 mg/mL, respectively. IC_{50}values needed for the inhibition of LP ranged from 29.48 to 74.06 mg/mL, and for the inhibition of AChE ranged from 432.74 up to more than 1500.00 mg/mL of examined extracts. Differences in the content of the total phenolics and flavonoids, as well as in the content of individual components in the tested extracts were observed. The obtained results confirmed the assumption that the quality of the herbal remedy can significantly vary depending on the origin of the plant material. However, all examined extracts exhibited significant antioxidant activity, as well as *in vitro* ability to inhibit AChE.

Phytochemical composition and antibacterial activity of the *Hylotelephium spectabile* (Boreau) H. Ohba x *telephium* (L.) H. Ohba leaf and flower extracts

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Hylotelephium genus have been described as bitter and cool in nature with the several pharmacological effects (anti-inflammatory, haemostatic, detumescent, nourishing of the heart and kidney, anti-radiation, antiviral, enhancing of the immune system, and anticancer). *Hylotelephium spectabile* (Boreau) H. Ohba x *telephium* (L.) H. Ohba, a taxon of hybrid origin is grown as an ornamental and medicinal plant across Serbia. It is known by the common names: debela koka (fat han), ranjenik (wounded) and kravlje vime (cowâs teat). Plant is very popular in Serbian folk medicine. The aim of this research was to investigate chemical composition of *H. spectabile* x *telephium* flower and leaf extracts as well as to evaluate their antibacterial activities. Fresh leaf and flower was grounded and separately extracted with methanol. The methanol extracts were partitioned with *n*-hexane, EtOAc, *n*-BuOH, successively. Hydrolysis was performed by dissolving extract or fraction in 0.05 M H_2SO_4 in MeOH. HPLC analysis was performed by a HPLC Agilent 1200 chromatograph. Antibacterial activity was evaluated against two Gram-positive and three Gram-negative bacteria by disk diffusion assay. The Gram-positive bacteria used were: *Bacillus subtilis* ATCC 6633 and *Staphylococcus*

aureus ATCC 6538. The Gram-negative bacteria utilized in the assay were: *Escherichia coli* ATCC 8739, *Pseudomonas aeruginosa* ATCC 9027 and *Salmonella typhimurium* ATCC 14028. The extracts contain mostly quercetin and kaempferol glycosides, as confirmed by the composition of hydrolysates whose main components were quercetin and kaempferol. The obtained results indicate that quercetin and kaempferol 3-glucosides dominate in the leaf extracts while corresponding 3-rhamnosides prevail in the flower extracts. The results of antibacterial assay showed that flower MeOH extract and its fractions have no antibacterial activity except EtOAc fraction. Weak bactericidal activity exhibited EtOAc and BuOH leaf fractions with slightly higher activity of EtOAc fraction. Only leaf MeOH extract showed bacteriostatic activity in relation to *S. aureus*. Hexane leaf fraction showed negligible bactericidal activity against *S. aureus* and *B. subtilis*. The major components of the investigated extracts were quercetin and kaempferol 3-glucosides and 3-rhamnosides. Samples containing mainly 3-O-ramnoside do not show antibacterial activity while samples with higher content of 3-O-glucoside showed weak antibacterial activity.

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The effect of plant growth regulators on the secondary metabolite production and antioxidative properties by shoot culture of *Origanum vulgare* L.

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Origanum vulgare L. (Lamiaceae) is widely used culinary herb, well known for its medicinal properties. It has strong antioxidant properties due to the presence of phenolic acids and flavonoids. In conducted study, effects of BAP and IBA on flavonoid production and antioxidative activity of in vitro cultivated plants were investigated. Our data suggested that treatments with plant growth regulators decreased accumulation of flavanols, flavones and flavonols when compared to control. Application of IBA in combination with lower concentrations of BA (0.1

mg/l IBA + 0.1 mg/l BA) had stimulating effect on the level of the lipid peroxidation.

Fatty acid compositions of four wild edible mushroom species from Serbia

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Edible mushrooms represent excellent sources of various nutritive and medicinal substances in humansâ diet. Four wild growing edible mushroom species (Agrocybe aegerita - AeF, AeZ), Lycoperdon perlatum (Lyc), Macrolepiota procera (Map), Armillaria mellea (Am) were collected from different forest regions in Serbia. Fatty acids compositions of the samples were analyzed by GC Agilent 7890A system with flame-ionization detector (FID). Obtained results proved some presumptions that fatty acids composition varied among species. Linoleic acid (C18:2n6c) was dominant fatty acid in fruit bodies in all analyzed species while percentage of this acid among species varied from 34.30- 75.90%. The other detected major fatty acids were oleic acid, palmitic acid, palmitoleic acid and stearic acid, respectively. Fatty acid analysis of four mushroom species showed that unsaturated fatty acids were present at higher concentrations than saturated acids. Relation between polyunsaturated (PUFA) and saturated (SFA) fatty acids were the following: AeF- 3.85, AeZ- 4.49, Lyc- 2.43, Map- 1.62 and Am-4.19. This analysis documented the presence of omega-3 and omega-6 fatty acid in some mushroom species.

Antioxidant activity and total phenolic content of *Salvia jurisicii* Košanin

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Salvia jurisicii Košanin (*Lamiaceae*) (endemic species for NE part of Republic of Macedonia, is a perennial herb inhabiting arid habitats. This species was previously investigated for its anatomical and micromorphological characteristics and for the antioxidant activity of aqueous-methanol extract. The aim of the present study was to examine the *in vitro* antioxidative activity and total phenolic content of ethanol-aqueous (EA) extracts (10%, 30% and 50%) of *S. jurisicii* whole plant, leaves and stems. The aerial parts of *S. jurisicii* were collected in July of 2011. at Štip locality (Macedonia) at the end of the flowering season. The antioxidant activity was measured by ABTS test and expressed as mg ascorbic acid equivalents (AAE/g of dry extract). Total phenolic content was evaluated using Folin-Ciocalteu reagent and expressed as mg gallic acid equivalents (GAE)/g of dry extract. ABTS scavenging activity and total phenolic content were ranged in similar order for different extracts, i.e. 50%>30%>10%. The strongest antioxidant activity was obtained for 50% EA extract of leaves; slightly weaker against ABTS radical were whole plant and stems (1.651, 1.420, 1.183 mg AAE/g of dry extract, respectively). The richest in phenols was 50% extract of leaves, followed by whole plant and stems (141.65, 119.07, 106.97 mg GAE/g of dry extract). According to the obtained results, the leaves contributed to antioxidant potential of whole plant extracts more than stems. More efficient extraction of phenolics and higher antioxidant capacity of extracts were achieved by increasing of ethanol percentage in the extraction procedure. In addition, positive correlation (r = 0.915) was confirmed between the antioxidant activities and the total phenol contents of the extracts. The results showed that *S. jurisicii* herb, especially its leaves, can be regarded as notable source of natural antioxidants.

Alkanes of *Jurinea mollis* L., a panonnian subendemic species

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The genus *Jurinea* Cass. (Asteraceae, subfamily Cichorioideae), with about 200 species, is taxonomically complex having unsolved problems with taxa surrounding *Jurinea mollis* (L.) Reichb. This chemically poorly investigated taxon is a Pannonian subendemic species widespread in C and SE Europe and W Anatolia.
Here in, we present the results of detailed GC/MS and IR analyses of the *n*-hexane fraction of a hexane/methanol/diethyl-ether extract of air-dried aboveground parts of *J. mollis*. This fraction contained a mixture of hydrocarbons (*n*-, *iso*- and *anteiso*-alkanes) dominated by *n*-alkanes (C_{17}-C_{39}). Such distribution reflects the conventional higher plant pattern of high carbon preference index (17.31), average chain length (29.85) and odd-numbered carbon dominance (maximum at *n*-C_{31}).
As variability in wax alkane profiles is often used in chemotaxonomic treatment of many taxa, a comparison of *J. mollis* alkanes' distribution with that of other Asteraceae species could provide a chemotaxonomic basis for the discrimination of the subfamilies.

Analyses of waxes from *Hyacinthella leucophaea* (K. Koch) Schur.

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Hyacinthella is a small, bulbous genus of the Asparagaceae found mostly in Turkey and the near east. Here we report, for the first time, the composition of waxes from the above- and underground parts of *Hyacinthella leucophaea* (K. Koch) Schur. Sixty-three and forty-eight constituents, accounting for 97.2 and 95.0% of the waxes, respectively, were identified by GC and GC-MS. n-Alkanes were the major components of the wax of the aerial portion of the plant, representing more than 90% of the total wax content. The distribution of higher alkanes was dominated by compounds with an odd carbon number (odd-to even ratio: 5.5) with a

Gaussian curve centered at nonacosane. The waxes of the epigeal parts were also mostly comprised of hydrocarbons (>90%), but this time with all-trans-squalene (25.2%) as the major contributor. Normal distribution of higher alkanes was also observed (odd to even ratio of 8.0 with the maximum at C29).

Salix rosmarinifolia, Salicaeae – a potential novel source for isolation of salicylic acid and its derivatives

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The white willow bark (*Salix alba*, Salicaceae) is used since ancient times in folk medicine for conditions that caused inflammation, fever and pain. Today, willow species (*Salix spp.*, Salicaceae) are mostly used to obtain the raw materials for isolation of salicylic acid and its derivatives in the pharmaceutical industry. However, many of the *Salix* species, sometimes widely distributed in the nature, are until now poorly investigated, especially from the point of presence of simple phenolic compounds responsible for antipyretic properties of the drug. Furthermore, the leaf composition, which is the waste material after the collection of the bark, is mainly not studied for the chemical composition and the content of salicylic acid and its derivatives. Also, there is no available data for the influence of the polarity of the solvent and the time of extraction on the content of active principles. Thus, the objective of this work was the extraction of active principles from the leaves and bark of *Salix rosmarinifolia* and the determination of caffeic, chlorogenic, coumaric, salicylic and acetylsalicylic acid content in the extracts prepared in different patterns. The extraction was carried out in chopped drugs (bark and leaf) using a mixture of ethanol and water at different ratios for 24, 48 and 72 hours (18 different extracts). Identification and quantification of active principles was performed by high-performance liquid chromatography (HPLC). The total yield of dry extract ranged from 7.8 to 14.2 g/100g of the drug. Chlorogenic acid was detected in 7 examined extracts and varied from 0.0225 to 0.032 g/100 g of dry extract. Caffeic acid (0.0047 to 0.0539 g/100 g of dry extract), coumaric (0.1979 to 0.9347 g/100 g of dry extract) and salicylic acid (0.041 to 0.24 g / 100g of dry extract) were detected in all 18 extracts. Acetylsalicylic acid was not detected in any sample. Extraction yield and the amount of the extracted active principles depended on the

extraction time and solvent polarity. Increased time of extraction led to increased total extraction yield and the content of active principles in the extracts. The highest extraction yield was achieved with 60% ethanol. The most selective solvent for chlorogenic, caffeic and p-coumaric acid was 60% ethanol. That can be explained by the fact that the acids were associated with sugars in the form of glycosides, which are more polar than in aglycone form. The most selective solvent for salicylic acid was 40% ethanol. Phenolic acids content also depended on the type of drug used for extraction, and was notably higher in bark extracts. However, the investigation showed that leaves also contain significant amount of phenolic constituents and could be used for industrial extraction.

The influence of the way of drying on the chemical composition of *Mentha longifolia* (L.) Hudson herbal extracts

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Wild mint, horsemint (*Mentha longifolia* L. Hudson, Lamiaceae) is appreciated medicinal, aromatic and melliferous plant. It is used in pharmaceutical, tobacco, and food industry (in production of liqueurs, candies and different sweets). In this contribution the influence of the manner of drying of starting row material on the chemical composition of extracts isolated from the herb of *M. longifolia* was studied. Drying was alternatively derived in natural way, in shady and windy place, in laboratory type drying oven at 45°C, and using condensing low-temperature drying oven at 35°C. Plant material was collected from the southern region of Serbia. Extracts were prepared by percolation procedure (1:2) using 70% ethanol as a solvent. Qualitative and quantitative analysis of volatile fraction of prepared extracts was accomplished by GC/FID and GC/MS techniques. In all three extracts monoterpene fraction was more abundant than esquiterpene one. The biggest content of the most abundant constituent, piperitone, was recorded in the extract prepared from herb dried in the low-temperature oven (61.12 %), and then in those obtained from drug dried in natural way (53.87 %), and in the laboratory oven (18.53 %).

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Changes in photosynthetic pigment caused by plant growth regulators in shoot cultures of basil and oregano

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The goal of this study was to investigate the effect of plant growth regulators on the photosynthetic pigment content of in vitro cultures of basil and oregano. The effect of BA was tested by cultivation of in vitro grown shoots on Murashige and Skoog media with addition of different BA concentrations (0.1; 0.5; 1.0; 2.0; 4.0 mgL^{-1}) alone or in combination with 0.1 indole-3-butyric acid (IBA). Changes of photosynthetic pigment content were treatment and species dependent. For both species BA treatments were stimulating for photosynthetic pigments production. For oregano treatments with 0,1; 0,5 and 1.0 mgL^{-1} were suitable for pigment production, but the concentration of the pigments was still lower than in control plants. Basil shoots cultivated on 2.0 mgL^{-1} BA concentrations of photosynthetic pigments was elevated when compared to control. The application of IBA decreased the pigment concentration in both species.

Antioxidant and antimicrobial potencial of essential oil and extracts from *Heracleum sphondylium* L.

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Heracleum sphondylium L. (Apiaceae) is perennial plant native to Europe, western and northern Africa and Asia. This species contains essential oils,

glutamine, arginine, choline, sterols, coumarinheterosides and used in folk medicine for strengthening and appetite stimulating, resolving diarrhea and catarrhal congestion. Methanol, ethyl acetate, acetone and water extracts were prepared from dried plant collected on Kopaonik Mt. (Serbia). The present study describes the total phenolic and flavonoid content and in vitro antioxidant and antimicrobial activity of essential oil and various extracts from *H.sphondylium* L.The total phenolic content in the extracts was determined using Folin-Ciocalteu reagent and their amountsranged between 38.04 to 110.15 mg GA (gallic acid)/g. The concentrations of flavonoids in the extracts varied from 27.57 to 82.54 mg Qu (quercetin)/g. Antioxidant activity was analyzed using DPPH reagent. Antioxidant activity ranged from 2.50 to 24.16 IC_{50}(mg/ml) and from 1.16 to 3.13 mg VitC (vitamin C)/g when tested with the DPPH and ABTS reagents, respectively, using BHA and VitC as controls. The antimicrobial activity of the essential oil and extracts was investigated using a micro-well dilution assay for the most common human gastrointestinal pathogenic microbial strains: *Escherichia coli, Pseudomonas aeruginosa, Salmonella enteritidis, Bacillus cereus, Listeria monocytogenes, Staphylococcus aureus* and yeast *Candida albicans*. The results show that, minimal inhibitory concentrations (MIC) and minimal fungicidal concentrations of essential oil and extracts ranged from 1.56 mg/ml (for the most sensitive *B. cereus*) to above 50 mg/ml for *S. enteritidis* and *E. coli*. This finding suggests that *H. sphondylium* L. may be considered as a natural source of antioxidants and antimicrobial agents.

Uticaj termike obrade na sadržaj pigmenata u zelenom lisnatom povrću

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Voće i povrće su zbog svog raznovrsnog hemijskog sastava značajan deo ljudske ishrane. Značajnu grupu povrća predstavlja zeleno lisnato povrće, kao nezamenjiv izvor minerala, vitamina i vlakana. Zeleno povrće sadrži hlorofil i karotenoide, za koje je potvrđeno da smanjuju rizik od raka. Kod viših biljaka zastupljeni su hlorofil a i b, dok hlorofil c i d sređemo kod algi. Karotenoidi su pomoćni fotosintetski pigmenti. Cilj rada bilo je određivanje sadržaja hlorofila a i b i karotenoida u svežem i kuvanom povrću. Za ispitivanje su odabrane sledeće biljne vrste: kupus (*Brassica oleracea* var. *capitata* fam. Brassicaceae), spanać (*Spinacia*

oleracea fam. Amaranthaceae), kelj (*Brassica oleracea* var. *sabauda* fam. Brassicaceae), prokelj (*Brassica oleracea* var. *gemmifera* fam. Brassicaceae), brokoli (*Brassica oleracea* var. *silvestris* fam. Brassicaceae), blitva (*Beta vulgaris* fam. Chenopodiaceae) i zelje (*Rumex patientia* fam. Polygonaceae). Svo analizirano povrće je lokalnog porekla. Analizom svežeg povrća utvrđeno je da najveći sadržaj hlorofila a ima zelje (0,837 mg/g), dok je najmanje hlorofila a nađeno u prokelju (0,047 mg/g). Količina hlorofila b u povrću manja je u odnosu na hlorofil a, pri čemu maksimalan sadržaj hlorofila b ima spanać (0,363 mg/g), a minimalan prokelj (0,033 mg/g). Najveći sadržaj karotenoida primećen je kod spanaća (0,191 mg/g), a najmanji kod prokelja (0,024 mg/g). Svi prikazani rezultati se odnose na 1 g povrća. Količina biljnih pigmenata u zelenom lisnatom povrću analizirana je i nakon termičke obrade. Primećeno je smanjenje sadržaja biljnih pigmenata kod svog analiziranog povrća, sa izuzetkom hlorofila a kod prokelja i karotenoida kod prokelja i blitve. Količina analiziranih pigmenata najviše se smanjila u kelju (10 puta za hlorofil a, 27 puta za hlorofil b i čak 52 puta za karotenoide) što ukazuje da ispitivano povrće u svežem stanju ima veći sadržaj pigmenata, pa time i veću nutritivnu vrednost.

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Essential oil composition and antibacterial activity of *Artemisia judaica* L.

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The essential oil of *Artemisia judaica* L. grown in Libya obtained using hydrodistillation with Clevenger-type apparatus was analyzed by GC-MS. Eighty-two compounds were identified, representing 94.97% of the total of oil. The main components of the oil were piperitone (30.21%) and chrysantenone (9.13%). According to our results this taxon could be determined as piperitone-chrysantenone chemotype. The bacterial growth inhibitory properties of the isolated essential oil were determined against seven bacterial species: *Bacillus cereus*

(clinical isolate), *Micrococcus flavus* (ATCC 10240), *Listeria monocytogenes* (NCTC 7973), *Staphylococcus aureus* (ATCC 6538), *Escherichia coli* (ATCC 35210), *Pseudomonas aeruginosa* (ATCC 27853), *Salmonella typhimurium* (ATCC 13311), *Enterobacter cloacae* (human isolate). The essential oil showed significant antibacterial activity against bacteria *Bacillus cereus*, *Micrococcus flavus* and *Listeria monocytogenes*.

Antimicrobial activity of Absinthii herba essential oils

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In the present study, the antimicrobial activity of essential oils isolated from Absinthii herba drugs from two different sources (commercial and wild growing), was investigated. The antibacterial activity was determined by microdilution method. Minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) were tested against bacterial strains isolated from urine: *Escherichia coli, Proteus mirabilis, Pseudomonas aeruginosa, Klebsiella oxytoca* and *Enterobacter aerogenes.* Multiresistant bacterial strains isolated from wounds were also tested: *Pseudomonas aeruginosa*, *Staphylococcus aureus, Enterobacter aerogenes, Escherichia coli* and *Klebsiella oxytoca.* The highest inhibitory and bactericidal effect of the oil from the commercial sample were manifested against *Enterobacter aerogenes* (clinical isolate from urine), where MIC was <0.01 μl/ml and MBC=0.01 μl/ml. Significant minimal inhibitory concentrations and minimal bactericidal concentrations were obtained against *Proteus mirabilis* (urine, MIC\MBC=0.29\0.29), *Pseudomonas aeruginosa* (urine, MIC\MBC=0.29\0.29), *Klebsiella oxytoca* (urine, MIC\MBC=0.04\0.15), *Pseudomonas aeruginosa* (wound, MIC\MBC=0.15\0.15) and *Staphylococcus aureus* (wound, MIC\MBC=0.15\0.58). The essential oil showed low activity against *Escherichia coli* (both isolates) and *Enterobacter aerogenes* (wound). *Klebsiella oxytoca* (clinical isolate from wounds) was resistant to the highest tested concentration. Essential oil of the wild growing sample showed activity at the lowest tested concentration (MBC<0.1 μl/ml) against *Staphylococcus aureus* (wound), *Enterobacter aerogenes* (urine), *Pseudomonas aeruginosa* (urine) and *Proteus*

mirabilis (urine). For other bacterial strains MIC activity was in the range from 0.1 to 1.56 µl/ml and MBC from 0.2 to 6.25 µl/ml. Based on the obtained results, it can be concluded that both samples posess similar antimicrobial activities and that they can successfully be used for the treatment of the urinary and wound infections.

Biological activity of Inulae radix water decoction and extracts

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Inula helenium L. (Asteraceae) is widely spread herb in East Asia and Europe. Commonly used part of this plant in ethnopharmacology is root (Inulae radix). The aim of this study was to evaluate whether the water decoction and different extracts of Inulae radix have biological activity. In this work, the biological effect of different concentrations of water decoction of *Inula helenium* L. on RBC membrane were investigated. Five different concentrations were used and presence of hemoglobin was recorded spectrophotometrically. To our knowledge this study was the first to investigate the effect of *Inula helenium* L. root decoction on oxidative degradation of RBC membrane. Low levels of hemolysis were observed in RBC suspension samples incubated with water decoctions of Radix Inulae. Ethanol, methanol and acetone extracts from root were tested for their antimicrobial activity against American Type Culture Collection strains: *Clostridium perfringens* 19404, *Klebsiella pneumoniae* 10031, *Shigella sonnei* 25931, *Escherichia coli* 8739, *Pseudomonas aeruginosa* 9027, *Listeria monocytogenes* 7644 and *Candida albicans* 10231. The antimicrobial activity was determined by microdilution method in 96-well plates to present minimum inhibitory concentration (MIC) and minimum microbicidal concentration (MMC). Results showed that the highest inhibitory effect to all tested microorganisms had acetone extract and the most susceptibility bacterial strain was *Shigella sonnei* 25931.

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Phenolic and flavonoid content and antioxidant capacity of extracts of *Echinophora sibthorpiana* Guss

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In Europe, the genus *Echinophora* (fam. Apiaceae = Umbelliferae) is represented by two species (*E. spinosa* L. and *E. tenuifolia* L.), distributed from Mediterranean region eastwards to Crete and Krym. *E. tenuifolia* consists of two subspecies (subsp. *tenuifolia* and subsp. *sibthorpiana* (Guss.) Tutin) [1]. According to some authors, later subspecies should be treated as separate species – *Echinophora sibthorpiana* Guss. [2]. It is perennial herbaceous plant, densely hairy with short trichomes, long and strong roots [2]. Recently, antioxidant activity of *E. tenuifolia* subsp. *sibthorpiana* oil was assessed by ABTS (0.032 g TEAC/kg plant) and DPPH (IC50 = 2.84 g/L) assays. Total phenol content of essential oil determined by Folin-Ciocalteu method was calculated as 1.32 g GAE/kg plant [3]. Analysis of the essential oil from Greece was reported by using GC and GC-MS and it was dominated by the presence of α-phellandrene (43.8%), followed by methyl eugenol (28.6%) [4]. In this work several different extracts of aerial parts and roots of *E. sibthorpiana* (= *E. tenuifolia* ssp. *sibthorpiana*), collected in surrounding of Štip city (Macedonia), were studied for their antioxidant activity, total phenolic and flavonoid content. The radical scavenging activity of extracts was evaluated spectrophotometrically, using DPPH (2.2-diphenyl-1-picrylhydrazil) and ABTS (2.2'-azino-bis-3-ethylbenzothiazoline-6-sulphonic acid) assays. Synthetic antioxidant butylated hydroxyanisole (BHA) was used as control. The obtained results in DPPH test showed that the strongest antioxidant activity had aqueous extract of aerial parts pretreated with chloroform and aqueous extract, with values of IC50 = 0.96 mg/ml and IC50 = 1.67 mg/ml of solution, respectively. Using in vitro ABTS test, the most effective was ethanol extract of aerial parts (1.11 mg Vit.C/g of plant extract) followed by both types of water extracts of the plant (1.02 and 0.98 mg Vit.C/g of extract). Total phenolic and flavonoid content evaluation indicated that their amounts were ranged from 21.1 to 60.72 mg GA/g of dry extract for phenols and from 3.15 to 19.00 mg QE/g of plant extract for flavonoids. These findings indicate that plant extracts can be used as alternative for synthetic preservatives because of their potent activities and reduced toxicity.

Characterization of phenolic compounds in the extracts of houseleek

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Sempervivum marmoreum L. (Houseleek or Liveforever), the member of *Crassulaceae* family occurs at Karpathian-Balkan peninsula, were used in traditional medicine for the tretment of ear inflammation, warts, to herpetic eruptions of the skins, minor burns and wounds. The main objective of this study was to investigate the effect of solvent polarity on the content of phenolic compounds in the extracts of houseleek obtained by direct ultrasound-assisted extraction. Methanol, acetone and 2-propanol were used, extraction lasted for 20 minutes at room temperature and at the power and frequency of ultrasound, 75 W and 211 kHz, respectively. Identification of phenolic compounds in extracts of houseleek after acid hydrolysis was performed by HPLC analysis using external standards. Maximum yield of extract (2.57 g/ 100 g of fresh plant material) was obtained by methanol, while lowest extract yield was found with 2-propanol (1.65 g/ 100 g of fresh plant material). Analysis of the houseleek extracts revealed the presence a kaempherol, quercetin and luteolin. Extraction of plant material with methanol was obtained the extract with the highest content of biactive compounds while the most common was kaempherol (9.78 mg/100 g fresh plant material), followed by quercetin (3.00 mg/100 g fresh plant material) and luteolin (0.03 mg/100 g fresh plant material). In the extract obtained by acetone the most common flavonoid is a luteolin (2.79 mg/100 g fresh plant material)followed kaempherol (0.14 mg/100 g fresh plant material) and quercetin (0.03 mg/100 g fresh plant material), while in the extract obtained by the least polar solvent luteolin (2.91 mg/100 g fresh plant material) and kaempherol (0.01 mg/100 g fresh plant material) were identified. These results indicate that the leaves of houseleek are good sources of phenolic compounds which is easier to dissolve in polar solvents.

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Influence of selected terpenes on diagnostically significant enzymes

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Determination of specific enzymatic activities (aspartate aminotransferase, alanine aminotransferase, amylase, alkaline phosphatase, lactate dehydrogenase, gamma glutamyl transferase, creatine/phospho/kinase), significantly improved diagnosis of many diseases, as long as obtained activity is result only of physiological/pathological and biochemical processes in the organism. Considering wide application of essential oils in every days life, it is important to examine whether some components of commonly applied essential oils, may affect the enzyme activity. Geraniol, nerol and linalool in the serum with normal enzymes activities, inhibited all studied enzymes up to 25.00% when mixed manually, and up to 36.73% when the homogenization is performed by ultrasound, while carvacrol inhibited tested enzymes up to 42.49 % and 50.00%, respectively. The terpenes solutions prepared in the form of emulsions showed a higher degree of inhibition in the serum of normal enzymatic activity for all studied enzymes.
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Phytochemical study of *Lycopus exaltatus* L. (Lamiaceae)

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Species of the genus *Lycopus* (Lamiaceae) have ethnopharmacological significance and are listed as medicinal plant species in many pharmacopeias as rich sources of poly(phenols) and terpenoids. In Serbia, this genus is represented by two species: *Lycopus europaeus* L. and *Lycopus exaltatus* L. There are limited data on *L. exaltatus* secondary metabolites. For this reason the aim of this study was set to

provide more detailed phytochemical data on *L. exaltatus*. Chromatographic fractionations of the aerial parts' extract resulted in the isolation and successful identification of many wax constituents, two pentacyclic triterpenes, ursolic and oleanolic acids, and three polyphenolic compounds, caffeic acid, apigenin and luteolin. The structures of these compounds were established by extensive spectroscopic analyses (1D and 2D-NMR and MS). Previous phytochemical studies of *Lycopus* species have shown that (poly)phenolic compounds are very frequent within this genus, whereas pentacyclic triterpenes were up to now found only in *L. lucidus* Turcz.

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Korelacija različitih metoda za određivanje antioksidacione aktivnosti odabranih vrsta voća

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Voće je izvor esencijalnih nutrijenata, minerala i vitamina. U isto vreme, značajan su izvor i polifenolnih jedinjenja za koje je dokazano da imaju antioksidaciono dejstvo. Zbog velikog značaja voća u ishrani i njegove velike upotrebe kako u svežem tako i u prerađenom stanju, cilj ovog rada bilo je ispitivanje antioksidacione aktivnosti plodova maline (*Rubus ideaus*, fam. Rosaceae), kupine (*Rubus fruticosus* fam. Rosaceae), višnje (*Prunus cerasus*, fam. Rosaceae), trnjine (*Prunus spinosa* fam. Rosaceae) i aronije (*Aronia melanocarpa*, fam Rosaceae). Voće je lokalnog porekla, brano je u doba pune zrelosti i do ispitivanja čuvano u zamrznutom stanju na -18 ºC. Antioksidaciona aktivnost etilacetatnih ekstrakata navedenog voća je ispitivana sledećim metodama: redukciona moć prema Fe(III)/Fe(II) redoks paru, DPPH, FRAP i ABTS metoda. Rezultati su izraženi na 1mg suvog ekstrakta. DPPH i ABTS metoda zasnivaju se na reakciji antioksidanasa sa stabilnim, sintetskim, slobodnim radikalima. Prema DPPH metodi, kupina pokazuje najveću antioksidacionu aktivnost (0.2125 µmol TE/mg SE), a malina najmanju (0.0725 µmol TE/mg SE). ABTS metoda potvrdila je dobre antioksidacione osobine kupine. Slaganje ovih rezultata je očekivano, s obzirom na sličan princip metoda. Regresionom analizom utvrđeno je da je koeficijent korelacije (r) između ove dve metode 0,941. Određivanjem redukciona moć prema Fe(III)/Fe(II) redoks paru utvrdili smo da najveću antioksidacionu aktivnost

pokazuje etilacetatni ekstrakt kupine (0,192 mg AAE/mg SE), a najmanju ekstrakt maline (0,118 mg AAE/mg SE). Rezultati dobijeni FRAP metodom potvrdili su rezultate dobijene određivanjem redukcione moći prema Fe(III)/Fe(II) redoks paru, i izdvojili kupinu kao biljku visoke antioskidacione sposobnosti (1,090 μmol Fe/mg SE). Kako se obe metode zasnivaju na redoks reakciji Fe(III)/Fe(II) , očekivano je slaganje dobijenih rezultata, što potvrđuje i koeficijent korelacije (r) 0,868. Prema svim korišćenim metodama kupina se pokazala kao voće sa navećim sadržajem antioksidanasa, tako da je njena upotreba u ishrani poželjna i preporučljiva.

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A low-level chemotaxonomic analysis of the plant family *Apiaceae*: the case of *Scandix balansae* Reut. ex Boiss. (tribe *Scandiceae*)

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Analyses by GC and GC/MS of an essential oil sample obtained from dry fruits of *Scandix balansae* Reut. ex Boiss. allowed the identification of 81 components, comprising 91.4% of the total oil composition. Interestingly, the major identified volatile compounds were medium-chain length n-alkanestridecane (6.7%), pentadecane (13.4%) and heptadecane (19.3%) and a long-chain homologuenonacosane (7.6%). A number of minor oil constituents, among them tetradecyl 3-methylbutanoate and octadecyl 2-methylpropanoate, 3-methylbutanoate and pentanoate, turned out to have a restricted natural occurrence not only in umbellifers but also in the Plant Kingdom, whereas the last ester is a new natural compound in general. The identity of these rare plant constituents, that present excellent chemotaxonomic marker candidates for Scandix species, was unambiguously confirmed by co-injection of the oil sample with appropriate standards, which were for this purpose synthesized and fully spectrally characterized (1H- and 13C-NMR, IR, MS). To explore the possible applicability of the essential oils compositional data in the taxonomy of *Apiaceae*, the herein studied and additional 58 oils obtained from *Scandiceae taxa* and 57 from other *Apiaceae* species were compared using multivariate statistical analyses (MVA). MVA demonstrated that the evolution of the volatiles metabolism of *Scandiceae taxa* was neither genera-specific nor follows their morphological evolution.

Chemical composition of *Chaenomeles japonica* (Thunb.) Lindl. ex Spach flower diethyl ether extract

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Chaenomeles japonica (Thunb.) Lindl. ex Spach is a commonly cultivated thorny deciduous shrub of Japanese Quince belonging to the family Rosaceae. This edible plant species has received little scientific attention and there are only a few investigations done on its chemical composition, mostly of the fruits. In the present study we analyzed the diethyl ether extract of the fresh flowers of *C. japonica* by detailed GC and GC/MS. The extract was mostly comprised of wax *n*-alkanes with odd-numbered carbon dominance (C_{22}-C_{30}, maximum at C_{29} with 17.3%). The second in abundance group of detected compounds-benzaldehyde (22.8%), benzaldehyde cyanohydrin (1.1%), benzoic acid (10.7%), methyl benzoate (0.1%), benzoyl nitrile (0.1%) and lactonitrile (0.4%), represented hydrolytic products of glycosides of benzaldehyde cyanohydrin or acetaldehyde cyanohydrin typical for Rosaceae species. Other minor constituents detected were the ubiquitous green leaf compounds with hexanal (<0.05%), octanal (0.1%), nonanal (0.1%) and decanal (0.1%) present in the highest percentage.

Long chain 5-alkylresorcinols from *Scilla bifolia* L.

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Scilla bifolia L. (Asparagaceae) is a herbaceous perennial native to Europe and western Russia. The two-leaf squill or alpine squill grows in shady places, woods of beech or deciduous trees, and mountain grasslands. Uses of squill are cited in the pharmacopoeias of many countries but this particular species is poorly chemically investigated. Herein, we describe the first GC and GC-MS analysis of the diethyl ether extract obtained from the aerial parts of *S. bifolia*. We identified in total seventeen compounds belonging to five series of homologous alkylresorcinols (mono- or di- *O*- and *C*-methylated 5-alkylresorcinols) with the aliphatic chain of 15 to 23 carbons. These were found for the first time in this species, whereas a number

of them represent new natural compounds. Up to now secondary metabolites of this type have been detected in 11 families of higher plants, and are also known to be produced by rhizosphere associated bacteria.

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Comparative analysis of DPPH scavenging capacity of chickpea and lentil

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Legumes such as the chickpea and lentil are rich sources of nutritional protein and dietary fibber and contribute to the phenolic compounds intake. Plant phenolic are secondary plant metabolites synthesized by plants during their normal development or in response to stress. They have free radical scavenging abilities, anti-mutagenic and anti-carcinogenic activities, the ability to reduce the risk of cardiovascular and carcinogenic diseases. Recently it was determined that the antiproliferative effect of legumes can be associated with the presence of phenolic compounds. The most commonly used methods for determining antioxidant activity, are based on spectrometric measurements of the disappearance of free radicals, such as 2, 2 diphenil-1-picrylhydrazyl radical (DPPH radical). In this research the content of phenolic compounds (PCC) and DPPH radical scavenging capacity of 80% (v/v) water-ethanol extract obtained from chickpea and lentil are investigated and compared. The phenolic compounds content (PCC) was determined by spectrophotometric method based on a standard curve for five chlorogenic acid (Sigma Chemical, St. Louis, Missouri, USA) concentrations, covering a range from 50 to 300 µM/L: PCC=(A-0.1083)/(4.89x10-4). The extract obtained from lentil had almost three times higher content of PCC than chickpea (2.82 and 0.93 µmol of chlorogenic acid per g of plant material, respectively) and higher maximal achieved DPPH scavenging capacity at extract concentration of dry residue of 8 mg/ml (93.2 and 36.5%, respectively). The EC50 value for extract obtained from lentil was 2.16 and for extract from chickpea, 21.97 mg/ml.

Comparative studies of leaf volatile compounds of three *Cinnamomum* species cultivated in greenhouses of Belarus

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The genus *Cinnamomum* comprises several hundred species, which occur in Asia and Australia. These are evergreen trees and shrubs and most of the species are aromatic. This has recently attracted the attention of many scientists and encouraged them to screen plants to study the biological activities of the *Cinnamomum* leaf oils from chemical and pharmacological investigations to therapeutic aspects which are expressed particularly in term of antibacterial activity of leaves and in this case leaf volatile compounds are consequence. In the Central Botanical Gardens this aspect is studied in connection with creation of winter gardens in interiors of varios functions. Leaves of *Cinnamomum* species were dried up in air at 20°C and crushed. Qualitative analysis of dried leaf volatile compositions of the *Cinnamomum camphora* (L.) Sieb., *C. tamala* (Buch.-Ham.) Nees & Eberm. and the *C. glanduliferum* (Wall) Meissn., which are cultivated in Greenhouses of Botanical Gardens (Minsk, Belarus) were analyzed with hardware-assisted Agilent Technologies 6850 Ser.II (Network GC System /5975B (VL MSD)with HP-5MS capillary column (30 m x 0,25 mm), and 0, 25 µm film thickness. Injector and detector temperatures were set at 250 and 290°C, respectively. Oven temperature was kept at 40°C for 8 min, then gradually raised to 240°C at 10°C/min. Helium was carrier gas, at a flow rate of 0, 5 ml/min. Sample preparation for GC-analysis carried out with a solid-phase micro extractor Supelco TM (5733-U), which is syringe with installed inside filament plated with DVB/Carboxen /PDMS Stable FleshTM (Supelco, 57328-U) as the adsorbent. Active constituents were identified by comparison of their retention time (RT) and retention indices and evaluated as a percent content of the total identified leaf volatile compositions. In subtropical greenhouse of the CBG NAS of Belarus introduced Cinnamomum species are cultivated at 13°C – 15°C in winter and 20°C – 30°C in summer as evergreen plot plants with uninterrupted leaf change. The main limiting factor in the temperate zone for light-requiring subtropical plants is the insufficient light intensity, and in these conditions plants of *Cinnamomum genera* have the length leaf life during two years and never come into flower. The ten constituents have been identified in *C. camphora* leaf volatile compounds and as it established the camphor (75, 0%) and

the eucalyptol (18.9%) are dominant components. About twenty volatile compounds have been identified in *C. tamala* leaves in which the same components are basic too (66% and 16% correspondingly). More than fifty constitutens have been identified in *C. glanduliferum* leaves and four are dominant. There are the Camphor (22. 5%), the edicine s (14, 7%), the caryophyllene (19, 7%), and the benzene, 1-methyl-2-(methylethyl)- (6, 7%). The camphor is a edicine s with the chemical formula C10 H16 O. It is a white crystalline substance, obtained from the wood of *Cinnamomum camphora* and so occurs in some other related trees in the laurel family. The eucalyptol is a natural compound. It is cyclic ether and a monoterpenoid which is found in bay leaves, tee tree, rosemary and other aromatic plant foliage. Among minor substances which fix a leaf fragrance of these plants are notable so as β-myrcene, α- pinene, β-pinene, copaene, camphene and others. Aroma volatiles of leaves which fix a plant fragrance have a large usable area in medicine and food industry. But some from its may be also significant for plant systematic delineation in current botany investigations. These investigation have too a great significance for introduction of tropical plants in interiors of buildings and creation of winter gardens in conditions of temporate zone.

Antibacterial and antioxidant activity of methanol, ethanol and ethyl acetate extracts of endemic *Aster albanicus* Deg

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The present study was carried out to determine the possible in vitro antioxidant and antibacterial activity of methanol, ethanol and ethyl-acetate extracts prepared from endemic *Aster albanicu*s Deg. Plant material was collected in field from Mt. Rogozna. The results of the free radical scavenging activity of total methanol, ethanol and ethyl-acetate extracts was quantitatively determined using a DPPH assay. Extract concentration providing 50% inhibition (IC50) was calculated from the graph plotting inhibition percentage against extract concentration. Butylated hydroxytoluene (BHT) and ascorbic acid (AA) were used as positive controls. The methanol extract showed significant activity (0.255mg/ml), while ethanol and ethyl-acetate showed moderate (0.539mg/ml) to low activity

(4.480mg/ml). For antibacterial test following bacteria were used: Gramm-negative (*Escherichia coli* ATCC35210, *Pseudomonas aeruginosa* ATCC27853, *Salmonella typhimurium* ATCC13311, *Listeria monocytogenes* NCTC7973, *Enterobacter cloacae* (human isolate)) and Gramm-positive (*Bacillus cereus* (clinical isolate), *Micrococcus flavus*, ATCC10240, *Staphylococcus aureus* ATCC6538). All of the extracts showed strong antibacterial activity against all of the studied bacteria, with MIC 0.2-0.4 mg/ml and MBC 0.4-0.8mg/ml.

Susceptibilities of *Candida* spp. oral cavity clinical isolates to essential oils from Burseraceae family

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Limitations of synthetic antifungal drugs force development of a new class of antifungal medications based on potent bioactive molecules of natural origin, such as plant essential oils. The aim of this study was to investigate the chemical composition and antifungal activity of two commercial essential oils samples of *Boswelia carterii* from Burseraceae family; GC/MS analysis showed that major components of tested oils were: *trans*-Caryophyllene (5.35%; 8.29%), limonene (10.91%; 17.94%) and α–pinene (23.04%; 31.84%), respectively. Minimum inhibitory (MIC) and minimum fungicidal (MFC) concentrations were determined by microdilution standardized method. All tested *Candida* species showed susceptibility to applied oils in a dose dependent manner; the stronger antifungal activity was shown by *B.carterii*[2] oil (MIC 1.25-2.50; MFC 2.50-5.00 mg/ml) compared to *B. carterii*[1] (MIC 2.50-5.00; MFC 5.00-10.00 mg/ml). It is evident that there is a relationship between the chemical composition of the oil and antimicrobial activity. This study estimates possible use of essential oils from Bursecaceae family in reduction and elimination of *Candida* spp. populations in patients with oral cavity fungal infection.

Chemical composition, antitumor, antioxidant and antimicrobial activity of *Thymus vulgaris* and *T. algeriensis* essential oils

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Plants from genus *Thymus* are often used in traditional medicine. Some of these species are important medicinal plants that are used in ethnomedicine. In this work, analysis of phytochemicals and bioactivity evaluation of *Thymus vulgaris* and *T. algeriensis* essential oils were done. The chemical composition of oils were evaluated using GC/MS; cytotoxic activity was tested against five human tumor cell lines MCF-7 (breast adenocarcinoma), NCI-H460 (non-small cell lung cancer), HCT-15 (colon carcinoma), HeLa (cervical carcinoma), HepG2 (hepatocellular carcinoma) and non-tumor cell line PLP2 (porcine liver cell culture); DPPH scavenging activity, reducing power, β-carotene bleaching inhibition and TBARS inhibition were used to assessed the antioxidant potential of oils; antimicrobial activity, minimum inhibitory (MIC) and minimum bactericidal/fungicidal (MBC/MFC) concentrations, were determined using microdilution method. Eight bacterial species isolated from oral cavity were used: *S. mutans, S. sanguis, S salivarius, S. pyogenes, S. aureus, P. aeruginosa, L. acidophilus* and *E. feacalis* and fifty eight clinical oral *Candida spp*. along with two reference strains were used. The dominant constituents of *T. vulgaris* oil were: *p*-cymene (18.99%) and thymol (48.92%). The major component of *T. algeriensis* oil was: thymol (38.50%). Both essential oils inhibited the growth of human tumor cell lines tested. *T. algeriensis* showed greater potential (GI_{50} 0.062±3.11 – 0.064±1.51 mg/ml), compared to *T. vulgaris* (GI_{50} 0.076±5.98 –0.18±2.68 mg/ml). None of the oils showed hepatotoxicity in the porcine liver primary cell culture (GI_{50} > 0.40 mg/ml). *T. algeriensis* oil showed stronger antioxidant activity in DPPH scavenging activity and reducing power measurements (EC_{50} 1.64±0.05; 0.68±0.01 mg/ml) versus *T. vulgaris* (EC_{50} 4.80±0.18; 1.54±0.04 mg/ml). However, *T. vulgaris* oil showed

stronger activity in β-carotene bleaching inhibition and TBARS inhibition methods (EC_{50} 0.18±0.04; 0.05±0.00 mg/ml) compared to *T. algeriensis* (EC_{50} 1.56±0.12; 0.31±0.01 mg/ml). *T. algeriensis* showed higher antimicrobial activity towards the selected bacterial species (MIC 0.02-0.08; MBC 0.04-0.16 mg/ml) compared to *T. vulgaris* (MIC 0.08-0.16; MBC 0.16-0.32 mg/ml). Fungi appeared to be more sensitive and again *T. algerienesis* oil showed higher activity (MIC 0.005-0.010; MFC 0.010-0.020 mg/ml) than *T. vulgaris* oil (MIC 0.04-0.08; MFC 0.08-0.16 mg/ml). The data of this study suggested that the both essential oils, especially *T. algeriensis* have great potential as natural agents for microbial infections. However, since essential oils are complex mixture of compounds, further study toward single components and their synergism and antagonism is needed. These investigations will be helpful for further utilization of the plant essential oils for their safe use in the pharmaceutical, food and cosmetics industries.

Antinociceptive activity of *Amorpha fruticosa* L. (Fabaceae) essential oil

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Inflammation and pain are two kinds of defense reactions of living systems in reply to any invasive factor. Acetic acid-induced writhing test represents a model that can reveal both antinociceptive and anti-inflammatory properties of substances. The essential oil of *Amorpha fruticosa* L. (at 400, 200 and 100 mg/kg) was evaluated for its antinociceptive activity using this test in BALB/c mice (n=6), alongside of aspirin (200 mg/kg) and olive oil (negative control). All tested essential oil doses reduced the number of writhings induced by acetic acid. The calculated percent of inhibition for the 400 mg/kg dose of the oil (54.4%) statistically differed from the positive control, aspirin (90.2%). As the injection of acetic acid produces the release of prostaglandins, such as $PGE_{2\alpha}$ and $PGF_{2\alpha}$, and sympathetic nervous system mediators in peritoneal fluid, the inhibition of prostaglandin release might represent one of the possible mechanisms of action exerted by the oil.

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Ispitivanje uticaja metanolskih ekstrakta vrsta *Daphne laureola* I *Daphne malyana* na vijabilnost HeLa ćelija

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Biljke roda Daphne se u tradicionalnoj medicini koriste kao diuretik, purgativ, antikoagulant kao I u tretmanima protiv kožnih bolesti, zubobolje I malarije. Cilj ovog rada je da se utvrdi citotoksični potencijal metanolskih ekstrakta lista *D. laureola* I *D malyana* I grančica *D. malyana*. Ispitivanje potencijalne citotoksične aktivnosti ekstrakata koncentacija od 10, 25, 50, 100 I 200 µg/ml posle 24 I 72 sati od kultivacije obavljeno je MTT testom na HeLa-S3 ćelijama. Sva tri ekstrakta posle 24 sata ne pokazuju značajnu inhibitornu aktivnost, dok posle 72 sata od inkubacije sa ekstraktima jasno se uočava linearna zavisnost između smanjenja ćelijske vijabilnosti I doze. Pad ćelijske vijabilnosti najuočljiviji je kod MeOH ekstrakta grančica *D. malyana*, gde već od koncentracije 50 µg/ml ćelijska vijabilnost iznosi 94,34%, sve do koncentracije od 200 µg/ml kada vijabilnost iznosi 72,96%. Sličan pad ćelijske vijabilnosti prisutan je I kod ekstrakta lista *D. malyana*, gde pri koncentraciji od 200 µg/ml ćelijska vijabilnost iznosi 89,94%. Ekstrakt *D. laureola* deluje blago antiproliferativno, jer tek pri većim koncetracijama od 100 µg/ml I 200 µg/ml procenat ćelijske vijabilnost pada na 98,74%.

Rubus caesius L. var. *arvalis* Rchb.: Antioxidative capacity of leaf extracts

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The aim of this study was determination of antioxidative properties of different leaf extracts and total phenol and flavonoid content in *Rubus caesius* L. var. *arvalis* Rchb. It is known that *Rubus* species are rich in these compounds and widely used in traditional medicine. In this study methanol, methanol 80% and ethanol leaf extracts were investigated. Antioxidative scavenging activity was determined against 2,2-diphenyl-1-picrylhydrazil (DPPH) and 2,2-azino-bis (3-ethylbenzthiazoline-6-sulfonic acid) (ABTS). In general, phenols and flavonoids are compounds responsible for antioxidative properties of plants and, therefore, evaluation of their total content in these extracts is important as first step in identification of most active compounds. Calculated IC50 values against DPPH radicals are: for methanol extract 0.026 mg/ml, methanol 80% 0.016 mg/ml and ethanol 0.019 mg/ml and against ABTS radicals are: for methanol extract 0.193 mg/ml, methanol 80% 0.19 mg/ml and ethanol 0.19 mg/ml. It is notable that antioxidative capacity of three leaf extracts of *R. caesius* var. *arvalis* are in similar correlation estimated by both radical scavenging methods. The most powerful antioxidative capacity showed 80% methanol extract, then methanol and the lowest ethanol. Obtained results show that total flavonoid content is the highest in ethanol, then methanol and the lowest in 80% methanol leaf extract. The richest in phenol compounds is ethanol, then 80% methanol, while the poorest is methanol leaf extract. These results indicate that the highest antioxidative activity of 80% methanol leaf extract is mainly due to phenolic compounds and some other compounds and that fact opens the field for further investigation.

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Chemodiversity of *n*-alkanes in the needle wax of *Pinus nigra* ssp. *nigra* from Tara mountain

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The alkane pattern of needle waxes of 90 tree samples corresponding to three native populations of *Pinus nigra* ssp. *nigra* from Mt. Tara was analysed. In general, the size of the *n*-alkanes ranged from C_{18} to C_{33}. The most abundant *n*-alkanes were C_{25}, C_{27}, C_{23} I C_{29} (19.36, 17.46, 12.22 and 16.63% in average, respectively). The carbon preference index (CPI_{total}) of *Pinus nigra* ssp. *nigra* ranged from 0.5 to 11.0 (3.1 in average), while the average chain length (ACL_{total}) ranged from 24.1 to 27.6 (25.6 in average). Long-chain (68.8% on average) prevailed over mid- and short-chain *n*-alkanes (22.5 and 8.7% in average, respectively). The differences between studied populations of *P. nigra* ssp. *nigra* were not significant for most of the characteristics of the *n*-alkane pattern (e.g. most abundant *n*-alkanes, CPI, ACL, and relative proportion of short-, mid-, and long-chain *n*-alkanes), which implies that this taxon has a distinct and conservative *n*-alkane distribution.

The bioconcentration of some metals in species *Potentilla visianii* Pančić

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The aims of this study were to determine content and bioaccumulation of eleven metals (Ca, Mg, Fe, Mn, Cu, Zn, Ni, Pb, Cd, Co, and Cr) in serpentine-

obligate species *Potentilla visianii* Pančić and serpentine soil where it grows. The results our study showed that the concentrations of all examined metals were higher in soil than in species *P. visianii* (excepting Ca). Our study exhibited different metal bioconcentration in species *P. visianii*, depending on kinds of metal as well as differences in content of investigated metals in soil and mentioned plant. In soil samples metal concentrations had the following order: Mg>Fe>Ca>Ni>Cr>Mn>Co>Zn>Pb>Cu>Cd. The general trend of metal accumulation in plants was: Ca>Mg>Fe>Ni>Mn>Cr>Zn>Co>Cu>Pb>Cd. The Ca:Mg ratio in soil was 0.02 and in plant 1.32. The Biological Absorption Coefficient was below one (except for Ca and Zn). The metal uptake and metal bioaccumulation does not necessarily correlate with metal content in the soil. The serpentine-obligate species *P. visianii* have had different capacity in uptake and bioaccumulation of investigated metals. Selective absorption of certain ions, combined with it sedentary nature makes this plant suitable as biological monitors used in ecosystem quality studies to monitor heavy metals and other pollutants of serpentine soils.

Antioxidative potential of different extracts of *Stachys iva* Griseb. (Lamiaceae)

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Stachys iva Griseb. is a white lanate perennial herb inhabiting stony slopes, rocks and cliffs in Macedonia and North Greece. Some *Stachys* species were traditionally used as astringent, wound-healing, antidiarrhoeal, antinephritic, anti-inflammatory and antioxidative agent. In the present study comparative analysis on polyphenol content and antioxidant activity of methanol, ethanol (10, 50 and 96%) and aqueous extracts of *S. iva* were investigated. The total phenolic content (TPC) was determined spectrophotometrically using Folin-Ciocalteu reagent and ranged between 0.0316 and 0.1155 mg GAE/mg dw (dry weight). The total flavonoids concentrations (TFC) varied from 0.013 to 0.047 mg QuE/mg dw. The highest TPC showed 50% and 96% ethanol extracts. Antioxidant activity was analyzed using ABTS reagent and absorbance was read at 734 nm. Synthetic antioxidant BHA and Vit. C was used as control. Antioxidant activity is expressed as EC50 and obtained results ranged between 0.220-0.586 mg/ml. The best antioxidative activity showed 50% and 96% ethanol extracts.

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Upotreba biljaka u detoksikaciji organizma u srpskoj srednjevekovnoj medicini

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U ovom radu su analizirani farmakološki spisi Hilandarskog medicinskog kodeksa, najznačajnijeg dela srpske srednjevekovne medicine. Analiza je pokazala da je fitoterapeutsku namenu imalo 135 biljnih vrsta, od kojih se za detoksikaciju organizma primenjivalo 5 nativnih vrsta sa prostora Srbije: iđirot (*Acorus calamus*), pelin (*Artemisia absinthium*), divlji krastavac (*Ecbalium elaterium*), perunika (*Iris florentina*), dženarika (*Prunus cerasifera*) I 2 alohtone poreklom iz Azije: rabarbara (*Rheum rhabarbarum*) koja se kultiviše I cimet (*Cinamomum zeylanicum*) koji se uvozi. Koristili su se različiti biljni delovi: rizom (iđirot, perunika), koren (rabarbara), herba (pelin, divlji krastavac), stablova kora (cimet) ili plod (dženarika). U spisima Hilandarskog medicinskog kodeksa posebno se ističe značaj droge cimeta I rabarbare za detoksikaciju krvi, dok je u lečenju bolesti jetre I žuči naročitu ulogu imao osušen rizom perunike (Rhizoma Iridis), prerađen u prah. Sve navedene vrste se I danas primenjuju u iste svrhe u etnomedicini, izuzev divljeg krastavca, koji je nedovoljno hemijski ispitan, nepouzdan za upotrebu I nema dovoljno podataka o njegovoj lekovitosti. Korišćenje ovih biljaka u fitoterapiji (izuzev divljeg krastavca) vekovima unazad, zasniva se na količini I sastavu aktivnih supstanci što je uslovljeno korelisanim odnosom genotipa, ekoloških faktora I stadijuma u razviću biljke.

Antioxidant activity of different extracts *of Satureja adamovicii* Šilić

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Three extracts (n-hexane, ethyl-acetate and ethanol 70%) of *Satureja adamovicii* Silic were obtained by Soxlet apparatus. Antioxidant activities of these extracts were evaluated using different assays (DPPH, ABTS test and FRAP). In addition, the total phenolic and flavonoid content in the extracts was determined. Total flavonoid and phenolic content was 263.78 μg/ml and 338.41 μg/ml, respectivly. Ethyl-acetate extract showed the highest flavonoid content, 114.54

μg/ml while ethanol 70% extract showed the highest phenolic content 229.79 μg/ml. DPPH test showed IC_{50} values ranging from 0.146 mg/ml, for 70 % ethanol extract, to 3.975 mg/ml, for n-hexane. In ABTS assay the AAEC values ranged from 0.049±0.025 mg/ml, n-hexene, to 0.266±0.044 mg/ml, 70% ethanol extract. Results of FRAP assay showed, similar trend as previous two, the higest antioxidant activitie was for 70 % ethanol extract 1.187±0.047 mM/g. 70% ethanol extracts of *S. adamovicii* showed significat antioxidant activities.

Surface flavonoids of *Centaurea stenolepis* and the local endemics *Centaurea davidovi* and *C. parilica* (Asateraceae, sect. Lepteranthus) from Bulgaria

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The species of Asteraceae have been found to be rich source of externally accumulated flavonoid aglycones. This type of compounds attracts attention except for their importance as chemotaxonomic markers as well as with their ecological role. In the present study two local endemic species *C. davidovi* and *C. parilica* and one widespread species from the same group, *C. stenolepis*, were analyzed for their exudate flavonoid composition. Flavonoid profiles were analyzed inflorescences and leaves separately. The exudate of inflorescences displayed more complexity flavonoid profile. Ten flavonoid aglycones were identified by thin layer chromatography (TLC) with authentic markers using three different sorbent (silica gel, polyamide, cellulose) and several combinations of mobile phases. Differences were observed in the classes of flavonoids that accumulate in the exudates of examined species- predominantly methylated derivatives of 6-hydroxyflavones in the exudates of *C. davidovi* and *C. parilica* and methylated derivatives of 6-hydroxyflavonols of *C. stenolepis*. *C. davidovi* and *C. parilica* exhibited similar flavonoid profiles. They yielded apigenin, luteolin, scutelarein-6,4'-dimethyl ether, 6-OH luteolin-6-methyl ether, kaempferol-3-methyl ether. In addition in the exudates of *C. davidovi* scutelarein-6-methyl ether and scutelarein-6,7,4'-trimethyl ether were detected. Most of the flavonoids of *C. stenolepis* are methylated flavonols - kaempferol 3-methyl ether, 6-OH kaempferol 3,6-dimethyl ether and quercetagetin 3,6,4'-trimethyl ether. The examined species were studied for the first time for their flavonoid aglycone composition.

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Poljoprivreda, šumarstvo i pejzažna arhitektura

Mogućnost primene anatomskih parametara korena i stabla u proceni bujnosti podloge za trešnju

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Definisanje mehanizama koji smanjuju bujnost nadzemnog dela biljke od velikog je značaja prilikom selekcije podloga za kalemljenje trešnje, čime se postiže veća produktivnost i efikasnost u proizvodnji. S tim ciljem izvršena je mikroskopska analiza anatomskih karakteristika korena i stabla različitih podloga za trešnju, čija bujnost je poznata. Parametri histološke analize korelirani su sa porastom nadzemnog dela ispitivanih biljaka. Posebno detaljno su analizirani parametri sekundarnog ksilema, koji definišu hidrauličnu provodljivost. Koren, u odnosu na stablo, ima veću teoretsku hidrauličnu provodljivost (kh) ksilema zbog značajno krupnijih provodnih elemenata. Ustanovljeno je da procentualno učešće ksilema i drveta u korenu i stablu nije uvek u pozitivnoj korelaciji sa provodljivošću i bujnošću stabla. Stoga se ovi parametri, iako su smatrani pouzdanima kod mnogih drvenastih vrsta voćaka, ne mogu koristiti u predikciji bujnosti stabala trešnje. Slabobujne podloge su imale značajno manju vrednost kh ksilema korena i stabla zbog niskog procentualnog učešća traheja i prisustva traheja malog lumena, a u manjoj meri i zbog niske proporcije drveta i kore. Dokazano je da veličina traheja, njihova frekvencija i procentualno učešće u drvetu predstavljaju najznačajnije anatomske faktore u regulaciji bujnosti nadzemnog dela biljke. Stoga preporučujemo da se ovi parametri koriste za potrebe predikcije bujnosti u procesu oplemenjivanja i stvaranja novih podloga za trešnju. Na osnovu podataka dobijenih za podloge poznate bujnosti ustanovljena je mogućnost primene anatomskih parametara u procesu predselekcije, za procenu bujnosti stabala selekcija stepske i oblačinske višnje, što je i praktični značaj dobijenih rezultata.

Samonikle biljke u sistemu zelenila Beograda

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Opšta definicija ukrasnih biljaka sugeriše da su to biljne individue koje koristimo zbog njihovih ekoloških i vizuelnih vrednosti, a ne zbog utilitarnih razloga, zbog hrane ili sirovinsko-građevinskih potreba. Zato se podrazumeva da je većina ukrasnih biljaka smišljeno sađena na određenom položaju. To plansko raspoređivanje, međutim, nije obavezan preduslov da se biljna individua smatra ukrasnom biljkom, jer funkcionisanje u okviru urbanog sistema zelenih površina mogu obavljati i samonikle individue, drveće, žbunje i zeljaste biljke koje su spontano porasle na određenom položaju. Šta više, u mnogim slučajevima samonikle i polusamonikle individue najstarijeg drveća u brojnim gradovinma sveta predstavljaju u vizuelnom, istorijskom i kulturnom smislu najverdnije elemente urbanog zelenila. I u gradovima Srbije brojne zelene površine često su sastavljene pretežno od drvenastog materijala, drvea posebno, koje je samoniklo poraslo na određenoj lokaciji. Ponekad čak ovakva stabla predstavljaju ekološke i estetske vrednosti znatno veće od ukrasnog biljnog materijala koji je planski, smišljeno posađen u okviru izgradnje urbanih zelenih površina. U radu se izlaže značaj samoniklog drveća kao najvažnijeg sastavnog elementa urbanog zelenila i potencijal ovog sadnog materijala u ekološkom i vizuelnom pogledu, a zatim se sprovodi analiza rasprostranjenosti samoniklog drveća i drveća koje je posađeno od strane anonimnih pojedinaca u prošlosti, koje danas ima ozbiljan ekološki, estetski i urbanistički značaj u gradu. Na osnovu terenskih podataka izvedena je i analiza središnjeg dela Beograda sa gledišta rasprostranjenosti, rasporeda, statusa i opšteg pozitivnog uticaja samoniklog i polusamoniklog drveća u formiranju pojedinih kategorija gradskih zelenih površina i pozitivnog uticaja ovog drveća na ukupno posmatranu funkcionalnost beogradskih zelenih površina.

Ekološki i estetski potencijali drvoreda Niša

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Niš kao jedan od najvećih gradova Srbije ne raspolaže zelenim površinama koje bi odgovarale njegovom značaju i veličini. Ovaj zaključak odnosi se i na broj i površinu gradskih parkova, ali mnogo više na stanje i sastav gradskih drvoreda. Prvi korak u unapređivanju ovakvog stanja jeste sprovođenje standardnog terenskog istraživanja odabranog urbanog segmenta, odnosno uzorka koji obuhvata reprezentativne niške drvorede, koji će prikazati njihovu funkcionalnost u objektivnom smislu i omogućiti analizu rezultata istraživanja, u svemu prema metodici izrade standardne bioekološke osnove, kakva se koristi u domaćoj praksi proteklih pedeset godina. U okviru izloženog istraživanja utvrđeno je da je konstatovano stanje drvoreda istraživanih ulica, iako trenutno ne izrazito loše, u velikoj meri posledica nedostatka stručnog pristupa izgradnji drvoreda i njihovog slabog negovanja. Izloženi rezultati koji demonstriraju funkcionalnost drvoreda odabranih ulica u Nišu poslužili su za utvrđivanje preciznih postupaka koje treba preduzeti da bi se unapredila njihova funkcionalnost, zbog čega samo istraživanje ima značaj ne samo za Niš, nego i za mnoge druge gradove Srbije čiji se drvoredi nalaze u stanju sasvim niske opšte funkcionalnosti.

Zelene površine posebne namene kao deo zelene infrastrukture Beograda

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Značaj zelene infrastrukture u ublažavanju negativnih uticaja urbane sredine iz godine u godinu sve je veći, naročito zato što uslovi života u gradovima ne postaju povoljniji, uprkos nastojanjima da se poboljša komfor stanovanja, efikasnost saobraćaja ili efikasnost filtara koji se postavljaju na dimnjake industrijskih objekata u gradskom okruženju. Pored velikih gradskih parkova koji imaju poseban pozitivan efekat na popravljanje mikroklimatskih, zdravstvenih i

psiholoških okolnosti u kojima provode život stanovnici gradova, veoma velike koristi pružaju i male, neuobičajene ili specijalne zelene površine, obuhvaćene sintagmom zelena infrastruktura. Među brojnim specifičnim kategorijama ovih zelenih površina ističu se po funkcionalnosti privatni vrtovi, zelene terase, zeleni krovovi, privatne bašte, biznis i industrijski parkovi, ozelenjeni krovovi podzemnih garaža, malena zelena ostrva na uglovima ulica, trgovački centri, zeleni zidovi, itd. Gotovo da nema razlika u blagodetima koje stanovnici grada imaju od ovih površina u odnosu na klasične gradske parkove i drvorede. Mikroklimatski uticaj njihov direktno je srazmeran njihovom broju i veličini, dok su njihov estetsko-vizuelni i psihološko-kulturni značaj i funkcija možda i veći nego kad je reč o tradicionalnom gradskom zelenilu. Najuži centar Beograda, područje grebena u čijem centru se nalaze Terazije područje je koje, kao i drugi delovi Beograda i drugih naših gradova ima mnogo primera neiskorišćenih malih i velikih površina koje su umesto biljnim materijalom okupirane različitim nepotrebnim predmetima (betonirane privatne bašte i javne bašte, terase ispunjene starim stvarima, ravni krovovi pretrpani ugostiteljskim mobilijarom, skromno ili nikako ozelenjeni trgovački centri, itd.). U radu se prikazuje analiza sa ulica vidljivih i svakom dostupnih elemenata zelene infrastrukture u ovom delu Beograda, kao paradigma potencijala kojim Beograd u budućem ozelenjavanju raspolaže i utvrđuju se uslovi i okolnosti koje će dovesti do unapređenja statusa i funkcionalnosti sastavnih elemenata ove ekološki možda i najvažnije urbane strukture.

In-situ analysis of macro and micronutrient elements distribution in *Dioscorea balcanica* stem by synchrotron radiation X-ray fluorescence mapping

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Dioscorea balcanica Košanin (Dioscoreaceae) is an endemic species, a Tertiary relict and the only wild *Dioscorea* species currently surviving on the Balkan Peninsula. It is a herbaceous monocotyledonos dioecious tuberous perennial liana, growing up to 5 m. Synchrotron radiation X-ray fluorescence (SR-XRF) is an analytical method well-suited for *in situ* investigations of micro and macronutrient

elements distributions within whole, unstained, biological samples, e.g. single cell, and tissues with sub-ppm detection limit. SR-XRF may be useful method in furthering knowledge of the changes in elements distribution in plants under various environmental conditions. We obtained various elements quantity, distribution and grouping/collocation in straight and twisted *D. balcanica* internodes. Macronutrient elements (K, P, Ca, Cl) are distributed homogenously in both straight and twisted internodes. Micronutrient elements (Cu, Zn Mn, and Fe) are mostly grouped in the vasculature scattered trough parenchyma cells and in the sclerenchyma cell layer. Collocation of micronutrients is much more expressed in twisted than in straight internodes. Differences between straight and twisted internodes, observed by combination of SR-XRF and statistical/image analysis provide an additional aspect to research on mechanism and properties of twining system in climbing plants. SR-XRF may be useful method in furthering knowledge of the changes in elements distribution in plants under various environmental conditions.

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Fluorescence detected linear dichroism of cellulose fibers in *Picea omorika* stems as a measure of mechanical stress

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Picea omorika (Pančić) Purkynč is a Balkan endemic coniferous species and Tertiary relict of the European flora. Resistance of trees to breakage or overturning depends on its structural modifications for mechanical strength. In gymnosperms, leaning stem develops reaction wood on the compression side of the lean (compression wood). Compression wood contains higher amounts of lignin and lower amounts of cellulose compared to normal wood. In order to illuminate the adaptive strategy facilitating *P. omorika* trees survival in their natural cliff habitats, characterized by strong wind, snow or rockfall, we analyzed distribution and orientation of cellulose fibers, as a measure of structural order in cell walls, in stems subjected to static bending stress. Fluorescence detected linear dichroism (FDLD) microscopy represents a unique technique that provides anisotropic molecular

architecture of different microscopic objects beyond the classical fluorescence emission microscopy. Such approach provides the examination of the finest orientation properties of the material. In our measurements FDLD microscopy exploits fluorescence originated from cellulose fibers stained by Congo red. The FDLD measurements show that structural order in the cell walls is higher in the compression wood in comparison with normal wood. Cellulose fibers in cell walls of compression wood show higher complexity in arrangement, alignment and orientation, as well as changes in microfibrilar angle in middle lamella, primary and secondary wall. Image analysis points out reinforcement of cell walls oriented normally to the direction of bending force, as opposed to weakening of cell walls parallel to the force direction.

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Oxidative stress in soybean seedlings treated with *Thymus serpyllum* aqueous extract

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The aim of this study was to examine the impact of *Thymus serpyllum* L. aqueous extract on soybean antioxidant properties so as to assess its possible side effects when applied as bioherbicide in soybean organic production. The effect of different concentrations of *Thymus serpyllum* L. aqueous extracts (0.05, 0.1 and 0.2 %) on lipid peroxidation process (LP), as well as reduced glutathione content (GSH) in leaves and roots of 14-days-old soybean seedlings were examined 24 and 72 h after the treatment. Our results showed that only highest concentration of the extract used (0.2%) induced process of lipid peroxidation in soybean leaves 72 h after the treatment. However, 24 and 72 h after the treatment with 0.1% *T. serpillym* aqueous extracts, soybean leaves had the highest GSH content, which indicate to possible stimulative effect of *T. serpillym* aqueous extracts on antioxidant system of soybean when applied in low concentration.

Analiza uspeha reznica test stabala crne topole (*Populus nigra* l.) u klonskom testu u cilju oplemenjivanja vrste

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Crna topola predstavlja jednu od najugroženijih vrsta u Evropi. Naseljava plavna područja, koja su sve više kontrolisana od strane čoveka, tako da se njena prirodna staništa gube, a mogućnost prirodnog obnavljanja znatno redukuje. Stoga je potrebno intenziviranje aktivnosti na njenoj zaštiti i usmerenom korišćenju preostalog genofonda. U cilju osnivanja klonskog arhiva crne topole sa područja Srema, obavljen je izbor 10 test stabala sa kojih su sakupljene reznice. Ukupno je pikirano 282 reznice, između 20 i 30 po stablu. Tokom prvog vegetacionog perioda obavljena je analiza: uspeha ožiljavanja, procenta preživljavanja i dinamika razvoja reznica na mesečnom nivou. Na osnovu sprovedenih istraživanja može se konstatovati da se procenat prijema reznica kreće između 13,79-96,43%, a prirast od 70,8 do 108,24 cm. Najviše se ističu test stabla 1 (uspeh 96,43% , prirast 108,24 cm), 10 (uspeh 75,00% , prirast 105,04 cm) i 7 (uspeh 70,97%, prirast 97,16 cm), koja kao stabla dobre adaptibilnosti mogu biti osnova za dalju proizvodnju i usmerno korišćenje genofonda ove vrste.

Nektarska produkcija vrste *Galanthus elwesii* Hook. iz istočne Srbije

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U Srbiji su zastupljene tri vrste roda *Galanthus* L., od kojih je vrsta *G. elwesii* Hook. prisutna u istočnoj i jugoistočnoj Srbiji, najčešće u regionu brdskih bukovih šuma, na krečnjačkoj podlozi. U ovom radu prikazana je nektarska produkcija vrste *G. elwesii*, poreklom sa tri lokaliteta iz okoline Pirota, kao doprinos proučavanju apiflore Srbije. Intenzitet nektarske sekrecije utvrđen je metodom

mikrokapilare. Analiza medonosnog potencijala vrste uključila je ukupnu dnevnu količinu nektara po cvetu, kao i dinamiku sekrecije nektara tokom dana i tokom ontogenije cveta. Rezultati istraživanja pokazuju da je ukupna dnevna količina nektara po cvetu mala i iznosi u proseku 0.05 µl, a što potvrđuje literaturne podatke da su vrste roda *Galanthus* slabe nektarice. S obzirom na dinamiku nektarske sekrecije, u datim uslovima ispitivanja, cvetovi su medili samo jednom u toku dana (u jutarnjim časovima), odnosno nije dolazilo do formiranja nove količine nektara nakon prvog uzorkovanja. Isto tako, nektar je bio izlučen samo jednom u toku ontogenetskog razvića cveta, koje je prosećno trajalo 5 dana. Međutim, bez obzira na male količine nektara, rod *Galanthus* predstavlja dragocen izvor nektara u kasnozimskom i ranoprolećnom periodu. Takođe, mada je *G. elwesii* u Srbiji znatno ređe zastupljena u prirodi, predstavlja najčešće gajenu vrstu visibabe u nas, te je njena uloga u pčelinjoj paši nezanemarljiva.

Taxonomic analysis of weed flora in a conventional and organic potato production

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In plant production weeds are special plant category that develop against human will, and as they regularly accompany crops and mainly cause damages in quantity and quality of agricultural products, occupy specific position. Composition of weed florae is highly dynamic and depends upon great number of factors, of which cultural practices that are applied by humans in certain crops are the most important. One of the most frequently grown plants in the world and in our country is potato (*Solanum tuberosum* L., Solanaceae), due to its high biological and nutritive value. Therefore, in the paper was presented taxonomic analysis of weed flora in potato grown conventionally and according to the principles of organic agricultural production, with the intention to point out to eventual differences between present weeds. Of the total number of identified species, from phylum Equisetophyta and class Equisetopsida, in organic potato crop, was determined only one, Equisetumarvense. Of remaining 38 weeds from phylum Magnoliophyta, classified into two clases, i.e. into class Magnoliopsida represented by four subclasses, such as Caryophyllidae, Dillenidae, Lamiidae and Asteridae and class Liliopsida represented only by the subclass Commelinidae, were identified in different number in conventional as well as in organic potato crop. On both of potato growing systems, 39 weed species were found, classified into 16 families and 32

genus. Of the total number, 31 species was identified in conventional potato crop, and only 23 species in potato crop grown according to organic principles, which is for about quarter less. Of the total number, 15 common species were found, while 8 differential for organic, i.e. 16 for conventional potato crop. Biological spectrum of weed flora in both potato growing systems is pronouncedly of terrophytic â geophytic type. In the spectrum of area types were recorded differences, i.e. in the conventional potato crop represented are only widely distributed species, while in the organic crop, beside species of wide distribution are also present elements of Pontic group (Pontic- Submediterranean, Pontic - East – Submediterranean and Subpontic Submediterranean. The obtained results provide only basis for long-term monitoring and studies of possible differences in composition of weed flora of conventional crops in relation to the crops grown on organic principles that include prohibition of the herbicide use.

Botaničko poreklo meda iz okoline Leskovca

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Istraživanje je obuhvatilo polensku analizu uzorka meda sa južnomoravskog područja Srbije (okolina Leskovca). Cilj rada je bio da se na osnovu spektra polena u medu poreklom sa istraživanog područja utvrdi botaničko poreklo meda, tj. identifikuju medonosne vrste koje su bile osnovni izvor nektara za njegovu proizvodnju. Primenom standardne metode kvalitativne melisopalinološke analize izvrđena je determinacija tipova polena u medu i ustanovljena njihova procentualna zastupljenost, na osnovu čega su utvrđene osnovne klase učestalosti polena za svaku medonosnu vrstu. U uzorku meda identifikovano je devetnaest tipova polena, od čega 2 na nivou vrste, 8 na nivou roda i 9 na nivou familije. Rezultati melisopalinološke analize su pokazali da, uzevši u obzir osnovne klase učestalosti, u uzorku meda nije zastupljen predominantan tip polena. Procentualno najzastupljeniji je polen bagrema (*Robinia pseudacacia* - 42%), koji predstavlja sekundarni polen u medu. Ovo ukazuje na činjenicu da je u datom periodu bagrem bio najatraktivnija drvenasta cvetnica za pčelinju pašu i najznačajniji izvor nektara. U klasu značajne manjine spada polen najvećeg broja vrsta: *Malus/Pyrus* (13%), *Prunus*-tip (8%), *Rubus*-tip (3%), *Salix* (7%), *Tilia* (5%) i *Trifolium repens*-tip (3%), *Asteraceae* (tip-H - 7% i tip-J - 4%). Četvrta klasa učestalosti, koja predstavlja manjinski polen sa učešćem 1-2%, obuhvatila je *Asteraceae* tip-A, *Asteracea*e tip-S

(1%) i *Asteraceae* tip-T (2%), dok sporadičan polen, sa učešćem manjim od 1% čine *Loranthus, Rosaceae i Apiaceae*. U uzorku je bio prisutan i nizak procenat polena anemofilnih vrsta (*Artemisia, Plantago, Oleaceae* i *Poaceae*), kao i malo elemenata medljike (spore i hife gljiva). Polenskom analizom ustanovljeno je da uzorak meda ima najveći procenat polena vrste *Robinia pseudoacacia*, što ukazuje na činjenicu da se radi o monoflornom bagremovom medu. Osim polenske analize, za korektno i precizno određivanje botaničkog porekla meda, neohodne su dodatne senzorne i fizičko-hemijske analize.

11th Symposium on the Flora of Southeastern Serbia and Neighboring Regions, Vlasina 13th-16th June, 2013

Zoology (animal and plant interactions)
Zoologija (međusobni odnosi biljaka i životinja)

A contribution to the knowledge of the Neuroptera fauna (Insecta) of Serbia

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The record of rare species *Libelloides lacteus* (Brullè 1832) (Ascalaphidae, Ascalaphinae) in the Jelašnica Gorge was presented. According to available literature, there is only one recorded site in Serbia placed in Kosovo and Metohia. Furthermore, literature data regarding the distribution of this species in Balkan Peninsula were summarized. We also made drawings of adult and larval stadium of specimens from Jelšnička Gorge. Drawings consists morphological and anatomic parameters important for identification process of the species. The conditions in the habitat were determined using vegetations units and NATURA 2000 classification system. The conclusion is that population from Jelašnička Gorge have an inland distribution on Balkan Peninsula. We suggested further investigation especially those of ecology and relationship with other species.

Amphibian and reptile species richness on Vlasina plateau

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The Vlasina Plateau is protected as a nature reserve of special interest. It harbours more than 850 plant species and more than 180 species of vertebrate animals. Local species list contains 12 amphibian and 12 reptile species. Our research, conducted from 2010. to 2013., confirmed occurence of 10 amphibian and 6 reptile species and added another reptile species – a Smooth Snake (*Coronella austriaca*) – on the list. Two reptile species from the list were not seen, but they were, however, confirmed by local inhabitants interviewed during the study. Most of listed species belong to typical elements of either boreal forests of taiga type or

middle European mostly deciduous forests. We recognized *Ichthyosaura alpestris*, *Bufo bufo* and *Lacerta agilis* as the most common species. Common species were *Salamandra salamandra*, *Bombina variegata*, *Rana temporaria,* and *Anguis fragilis*. Among the rarest species were *Triturus macedonicus, Rana dalmatina*, *Coronella austriaca* and *Vipera berus*. However, some of them were assigned as common according to the questionarry. All the amphibian and reptile species detected on Vlasina plateau are proclaimed as currently non-threatened by international standards and thus assigned Least Concerned (LC) on IUCN Red List of Threatened Species. The only exception is *Triturus macedonicus*. This recently described crested newt species has no defined conservation status yet and its global distribution is restricted on central parts of the Balkan peninsula.

Qualitytive and quantitative composition of Ephemeroptera community in lotic systems of urban and suburban areas: the role of environmental factors (City of Niš, southeastern Serbia)

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Sampling of Ephemeroptera larvae was conducted at 10 river sites, located in urban and suburban area of city of Niš, during the winter season. The investigation was conducted during the winter season due to the higher concentraion of pollutants as a concequence of the lower watertable. Together with community data, several physical, chemical and hydro-morphological parameters were estimated at each sampling station. The main goal of this study was to determine changes in Ephemeroptera community depending on the extent of anthropogenic alteration, since species from this group show the full range of sensitivity. Ephemeroptera larvae are one of the most diverse and abundant group of macroinvertebrate fauna within the investigated area. Out of total number of speciments, 41.5% belong to mayflies. Six families of Ephemeroptera were detected, presenting the 20% of the total number of macroinvertebrata families observed (30). Speciments belonging to family Beatidae were detected on both, near pristrine sites and those under the severe anthropogenic influence. In contrast, representans of family Caenidae were obseved at only one site.

Macroinvertebrate community structure and their utility in water quality assesment of lotic ecosystems in urban and suburban area (City of Niš, Southeastern Serbia)

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The investigation was conducted at 10 sampling sites at lotic systems in urban and suburban area of the city of Niš. Sampling sites was selected to establish clear gradient of athropogenic impact. Sampling period was winter time, since in this season environmental stress is reduced (lower discharge, higher channel stability and higher transparency). On the other hand, lower discharge leeds to higher concentraion of pollutants. The main goal of the study was to determine to which extent macroinvertebrate community structure change in accordiance to the increase of athropogenic infulence. Family biotic index (FBI) was used to estimate water quality. The lowest values of FBI was recorded at Dušnička reka (FBI=1.7), presenting habitat with excellent water quality. In contrast, the highest FBI value was observed at site placed in urban area of Nišava river (FBI=6), indicating fairly poor water quality. The result revealed that number of families is not positively correlated with water quality. The highest family richness was recorded at Nišava river, downstream the Sićevo gorge (FBI=4.27) due to the high number of different microhabitats.

Community composition of trichoptera (Caddisfly): how environmental factors affect community structure in lotic systems of urban area (City of Niš, Southeastern Serbia)

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Sampling campaign was conducted monthly at 10 sampling sites, along four rivers, distributed within urban and suburban area of city of Niš. The main goal of the study was to determine the community composition of Trichoptera larvae in wide variety of environmental factors. All sampling sites can be separated into three

groups: thermal, severely anthropogenicly disturbed and near-pristine streams. Also, we aimed to select enrivonmental parameters, having the main role in structuring Trichoptera community. During investigation period, 10 Trichoptera families were detected. Out of 19 recorded species, the majority of them (7) belong to Hydropsychidae family. The highest species richness was observed at Dusnicka reka (16 species) and at springhead of Dušnička reka (14), both characterized as near-pristine sites. Distribution pattern of Trichoptera larvae along disturbance gradient justify their incorporation in bioassessment programs.

Preliminary researches of wetland "Ezerani" (R. Macedonia)

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Wetland "Ezerani" is a natural wetland area on the northern shoreline of Lake Prespa, which is situated between the villages of Sir Han and Asamati. The wetland Ezerani covers an area of approximately 1917 ha (of which 1066 ha are on land and 851 ha in the waters of Lake Prespa). However, the wetland area is much less, today covering approximately 325 ha due to Lake Prespas fluctuating lake surface. In this paper was researched biodiversity of flora and fish. List of flora and fish species has been based on data obtained during field surveys in course of spring-summer 2011 and 2012 on wetland "Ezerani". According to our research in this wetland ecosystem wer evidenced total of 85 different plant species, and 12 different fish species (8 native and 4 introduced).

Qualitative composition of cyprinid fish and macrophyte vegetation in lake Ohrid in localities with different anthropogenic influence

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The main objective in this paper was to research the qualitative composition of cyprinid fish and macrophyte vegetation in three localities (Radozda, Grasnica, and Metropol) which are with different anthropogenic influence. The

materials for these researches was collected during 2011 and 2012. A total of 28 collecting of fish were realized (by day and nighttime experimental fishing) with various fishing gear. Also, in the researched localities were performed collections of macrophyte vegetation, by application of the standard limnological methods. In the researched localities were evidenced 8 different species of cyprinid fish and 25 different macrophyte species which serve as a food, habitat, shelter, and spawning ground for many species of cyprinid fish. Received results indicated that qualitative composition of cyprinid fish and macrophyte vegetation is different and depend from ecological conditions which are present in researched localities.

Effect of density dependence on seed predation in dryland cereals

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In arable fields, a direct density dependent response of seed predators to increasing seed densities patches may playing a key role in weed control. In dryland cereals in NE Spain, the harvester ant, *Messor barbarus* L., is responsible for a high percentage of seed predation (46%-100%). In this study, we investigated if seed predation rate by harvester ants is influenced by weed seed density. For this reason, 50 circular areas of 1 m^2 were created inside in four 50x50 m blocks after cereal harvest. *Lolium multiflorum* L. seeds were applied at 1000, 2000, 5000, 10000 and 20000 seeds m^{-2}, in ten randomly selected circular areas each. After 24 h, the remaining seeds were collected using vacuum cleaners and a suction device and seed predation rates were estimated. Harvester ant nests in each block were counted. In three of the four blocks, seed predation was extremely high (99-100%). Here, nest densities ranged from 468 to 900 nest ha^{-1}. Only in one block, seed predation ranged from 82 to 100%, and here nest density was lower (284 nests ha^{-1}). Harvester ants did not respond to seed density. The lack of response was mainly caused by the extremely high predation rates, caused by high ant nest density. Lower nest density resulted in lower predation rate only in one seed density of 20000 seeds m^{-2}. Therefore, the type of response can not be determined.

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Influence of lead on the moss *Atrichum undulatum* development

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Bryophytes are well known as a heterogeneous group of plants with special morpho-physiological features widely used in environment indication. Thus, they are used in 5 year period in monitoring passive atmospheric deposition throughout Europe. However, there are differences among various species. Here, we tested the influence of lead on the developmental features of the acrocarpous moss *Atrichum undulatum.* It is one of the biggest moss in the temperate areas of Serbia, suitable for the environment changes biomonitoring. Lead is added to the axenically grown culture in controled condition in the form of lead-acetate. As expected, the decrease of moss production is achieved with the increase of lead concentration or the time of exposure to the lead. Also, index of multiplication decrease almost exponentially with the lead exposure increase. The plants exposed to lead do not produce extensively secondary protonema, as do the control moss plants. Thus, it seems that lead rather block the development of secondary protonema than bud induction.

Some interesting bryophyte records for Slovenia

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Slovenia is among the richest country in Europe, according to the number bryophyte species that can live in such a small area. Slovenia is considered to be the richest in South-Eastern Europe with the 595 moss and 160 hepatic species recorded. However many area are still under-recorded and many species are considered as extinct simply because not seen since reported or erroneously reported. Here we report two species considered to be erroneously reported for Slovenia *Pohlia filum* and *Rhynchostegiella litorea* and two species recently rediscovered (not seen more than 60 years) in Slovenia, namely *Barbula commutata*

and *Grimmia trichophylla*. The ecology and distribution of these species will be discussed.

Contribution to the bryophyte flora of Jastrebac Mt. (Serbia)

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Jastrebac is a mountain in the central Serbia that is bryologically completely under-recorded. Geologically it is very interesting region since it is quite diverse from predominantly basic Serbia. Although it is not among the highest mountains, some interesting bryophyte flora were expected. Indeed, with only a few collecting trips to the various parts of Jastrebac 54 bryophyte species were recorded among which some new and interesting. Mediterranean species *Lunularia cruciata* is recorded for the second time in the open wide in Serbia and *Bryum mildeanum* was recorded for the first time in Serbia and second time in the Balkan peninsula. It is expected that on-going further research in this area will contribute to a better understanding of bryophyte distribution in Serbia and that the total number of bryophyte species will increase both within the region and in Serbia.