Department of Biology and Ecology,
Faculty of Sciences and Mathematics, University of Niš
Biological Society “Dr Sava Petrović” Niš

# 12th Symposium on the Flora of Southeastern Serbia and Neighboring Regions

Kopaonik 16 to 19 June 2016

# 12. Simpozijum o flori jugoistočne Srbije i susednih regiona

Kopaonik 16. do 19. jun 2016.

# ABSTRACTS
# APSTRAKTI

Niš, 2016

Department of Biology and Ecology,
Faculty of Sciences and Mathematics, University of Niš
Biological Society “Dr Sava Petrović” Niš

# 12th Symposium on the Flora of Southeastern Serbia and Neighboring Regions

Kopaonik Mt. 16th-19th June, 2016

Book of abstracts

This Symposium is organized with the financial support of the Ministry of Education, Science and Technological Development of Republic of Serbia

**12th Symposium on the Flora of Southeastern Serbia and Neighboring Regions**

# Book of Abstracts

**Organizers**

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

**Biological Society "Dr Sava Petrović", Niš**

**Editors**

Vladimir Ranđelović, Zorica Stojanović-Radić

**Scientific Committee**

Dörte Harpke, Germany
Lorenzo Peruzzi, Italy
Flavia Landucci, Czech Republic
Beata Papp, Hungary
Sanja Savić, Sweden
Nebojsa Simić, Norway
Hasan Akan, Turkey
Chavdar Gussev, Bulgaria
Vladimir Valchev, Bulgaria
Nejc Jogan, Slovenia
Antun Alegro, Croatia
Zlatko Bulić, Montenegro
Danijela Stešević, Montenegro
Adisa Parić, Bosnia & Herzegovina
Sonja Gadžovska-Simić, Macedonia
Dmitar Lakušić, Serbia
Gordana Tomović, Serbia
Marko Sabovljevic, Serbia
Zora Dajić-Stevanović, Serbia
Ružica Igić, Serbia
Biljana Božin, Serbia
Goran Anačkov, Serbia
Milan Stanković, Serbia
Nedeljko Manojlović, Serbia
Niko Radulović, Serbia
Vladimir Ranđelović, Serbia
Bojan Zlatković, Serbia
Perica Vasiljević, Serbia
Marina Jušković, Serbia
Zorica Stojanović-Radić, Serbia

**Printed by**

Štamparija Punta – Niš

**Number of copies**

150

# **PROGRAMME** - PROGRAM

| **Thursday, June 16th, 2016** | |
|---|---|
| 19.00 - 22.00 | Registration |

| **Friday, June 17th, 2016** | |
|---|---|
| 08.00-10.00 | Registration |
| 10.00-10.30 | Opening ceremony |
| 10.30-13.20 | Plenary session |
| 15.00-17.00 | Taxonomy and Systematic |
| 17.00-18.30 | Phytochemistry and Phytotherapy |
| 18.30-20.00 | Poster session 1<br>Phytochemistry and Phytotherapy |

| **Saturday, June 18th, 2016** | |
|---|---|
| 10.00-12.40 | Phytogeography, Floristics and Phytoecology |
| 12.40-13.00 | Agriculture, Forestry and Landscape Architecture |
| 15.00-15.50 | Nature Protection and Environment |
| 15.50-16.10 | Zoology (plant – animal interactions) |
| 16.15-17.45 | Poster session 2<br>Phytogeography, Floristics and Phytoecology |
| 18.00-19.30 | Poster session 3<br>Genetics, Selection and Biotechnology<br>Nature Protection and Environment<br>Agriculture and Forestry<br>Zoology (Animals and Plants Interactions) |

| **Sunday, June 19th, 2016** | |
|---|---|
| 08.00 – 16.00 h | Excursion |

# Plenary Session
## Friday, June 17th, 2016.

10.00-10.20

Opening ceremony

10.20-10.30

**Suzana Komatović**, National park "Kopaonik", Serbia

***National park Kopaonik***

10.30-10.45

Ranđelović, N., Stamenković, V., Mihajilov-Krstev, T.

**Tatjana Mihajilov-Krstev**, Faculty of Science and Mathematics, University of Niš, Department of Biology and Ecology, Niš, Serbia

***Spas Krumov Sotirov – naturalist and biologist***

10.45-11.00

Ranđelović, N., Hristovski, N., Ranđelović, V.

**Novica Ranđelović**, Faculty of Science and Mathematics, University of Niš, Department of Biology and Ecology, Niš, Serbia

***Rujan Mountain - center of diversity of the genus Crocus L. on the Balkan Peninsula***

11.00-11.15

**Dmitar Lakušić**, Faculty of Biology, University of Belgrade, Institute of Botany and Botanical Garden "Jevremovac", Belgrade, Serbia

***The plant life of Mt. Kopaonik***

11.15-11.30

**Flavia Landucci**, Masaryk University, Department of Botany and Zoology, Brno, Czech Republic

***When the common sense meets vegetation science: the experience of the project WetVegEurope***

11.30-12.00 Coffee break

12.00-12.15

**Ana Džamić**, Faculty of Biology, University of Belgrade, Institute of Botany and Botanical Garden "Jevremovac", Belgrade, Serbia

***Trends in biological activity research of wild-growing aromatic plants from Central Balkans***

12.15-12.30

**Niko Radulović**, Faculty of Science and Mathematics, University of Niš, Department of Chemistry, Niš, Serbia

***The flora of Southeastern Serbia: a phytochemist's gold mine***

12.30-12.45

Žikić, V., Ilić Milošević, M., Lazarević, M., Stanković, S.S.

**Vladimir Žikić**, Faculty of Science and Mathematics, University of Niš, Department of Biology and Ecology, Niš, Serbia

***Plants and insects in multitrophic associations***

12.45-13.00

**Steve Quarrie**, Faculty of Biology, Belgrade University, Belgrade, Serbia

***H2020 projects for plant scientists - the "easy" way to get involved***

13.00-13.15

**Sofija Pekic Quarrie**, Commission for accreditation and quality assurance, Belgrade, Serbia

***Quality assurance in higher education – is Serbia in Europe?***

13.20-15.00 Pause

## Taxonomy and Systematics
**Friday, June 17th, 2016.**

### Oral presentations

15.00-15.10

**Beata Papp**, Hungarian Natural History Museum, Botanical Department, Budapest, Hungary

***Collections Self-Assessment Tool (CSAT) -SYNTESYS 3***

15.10-15.20

Rajčević, N., Janaćković, P., Marin, P.D.

**Nemanja Rajčević**, Faculty of Biology, University of Belgrade, Institute of Botany and Botanical Garden "Jevremovac", Belgrade, Serbia

***Are terpenes useful chemotaxonomic markers in differentiation of Juniperus communis L. and J. deltoides Adams?***

15.20-15.30

Kovački, M., Anačkov, G.

**Marija Kovački**, University of Novi Sad, Faculty of Sciences, Department for Biology and Ecology, Novi Sad, Serbia

***Preliminary checklist of Rubus L. (Rosaceae) in Vojvodina (Serbia) based on revised herbarium data***

15.30-15.40

Vestek, A., Luković, J., Karanović, D., Anačkov, G.

**Ana Vestek**, University of Novi Sad, Faculty of Sciences, Department of Biology and Ecology, Novi Sad, Serbia

***Leaf anatomical characteristics of Prospero autumnale (L.) Speta (Hyacinthaceae) complex***

15.40-15.50

Harpke D., Peterson A., Tison J-M., Ranđelović V., Peruzzi L.

**Dörte Harpke**, Leibniz Institute of Plant Genetics and Crop Research (IPK), Gatersleben, Germany

***Species and species boarders in Gagea sect. Gagea***

15.50-16.00 Pause

16.00-16.10

Radak, B., Bokić, B., Knežević, J., Rat, M., Vestek, A., Anačkov, G.

**Boris Radak**, University of Novi Sad, Faculty of Sciences, Department of Biology and Ecology, Novi Sad, Serbia

***Anthropomorphic orchids of the Balkans - preliminary morphometric study***

16.10-16.20

Raca, I., Ljubisavljević, I., Jušković, M., Ranđelović, N., Ranđelović, V.

**Irena Raca**, Faculty of Science and Mathematics, University of Niš, Department of Biology and Ecology, Niš, Serbia

***Comparative anatomical study of the taxa from series Verni Mathew (Crocus L.) in Serbia***

16.20-16.30

Milekić, T., Kuzmanović, N., Lakušić, D.

**Tijana Milekić**, Faculty of Biology, University of Belgrade, Institute of Botany and Botanical Garden "Jevremovac", Belgrade, Serbia

***Anatomical differentiation of populations of Sesleria juncifolia complex (Poaceae) on the Balkan Peninsula***

16.30-16.40

Bulić, Z., Pulević, V.

**Zlatko Bulić**, Doclean Academy of Sciences and Arts, Podgorica, Montenegro

***Activities on working on botanical bibliography of Montenegro (1822-2016)***

16.40-16.50

Miljković, M., Raca, I., Harpke, D., Ranđelović, V.

**Milica Miljković**, Faculty of Science and Mathematics, University of Niš, Department of Biology and Ecology, Niš, Serbia

***Morpho-anatomical differentiation of the Balkan endemic species Crocus veluchensis Herb. (Iridaceae)***

# Phytochemistry and Phytotherapy
**Friday, June 17th, 2016.**

## Oral presentations

17.00-17.10

Zlatanović, I., Zrnzević, I., Jovanović, O., Stojanović, I., Petrović, G., Stojanović, G.

**Ivana Zlatanović**, Faculty of Science and Mathematics, University of Niš, Department of Chemistry, Niš, Serbia

***GC-MS profile of Umbilicaria crustulosa (Ach.) Frey and Umbilicaria cylindrica (L.) Duby extracts***

17.10-17.20

Stojanović, G., Jovanović, O., Zlatković, B., Jovanović, S., Zrnzević, I., lić, M.

**Snežana Jovanović**, Faculty of Science and Mathematics, University of Niš, Department of Chemistry, Niš, Serbia

***GC-MS profile of volatiles obtained from fresh root of Peucedanum longifolium Waldst. & Kit.***

17.20-17.30

Živković, M., Genčić M., Radulović N.

**Milena Živković**, Faculty of Science and Mathematics, University of Niš, Department of Chemistry, Niš, Serbia

***Comparative study of epicuticular alkane profiles of Primula veris L. and Primula vulgaris Huds. (Primulaceae)***

17.30-17.40

Pejčić, M., Stojanović-Radić, Z., Stojanović, N., Stanković, N., Radulović, N.

**Milica Pejčić**, Faculty of Science and Mathematics, University of Niš, Department of Biology and Ecology, Niš, Serbia

***Antibiofilm potential of Ocimum basilicum and Salvia officinalis commercial essential oils***

17.40-17.50

Stojanović-Radić, Z., Matejić, J., Stojanović, J., Džamić, A., Radulović, N.

**Zorica Stojanović-Radić**, Faculty of Science and Mathematics, University of Niš, Department of Biology and Ecology, Niš, Serbia

***Interference of the ordinarily used solvents in the outcome of plant extract's antimicrobial testing***

17.50-18.00 Pause

18.00-18.10

Kladar, N., Rat, M., Srdjenović, B., Gavarić, N, Anačkov, G., Božin, B.

**Nebojša Kladar**, Faculty of Medicine, University of Novi Sad, Department of Pharmacy, Novi Sad, Serbia

***Quality control of Hyperici herba samples from Republic of Serbia***

18.10-18.20

Božin B., Kladar N., Bjelan M., Kozić D.

**Biljana Božin**, University of Novi Sad, Faculty of Medicine, Department of Pharmacy, Novi Sad, Serbia

***Neuroprotective potential of lemon balm (Melissa officinalis L., Lamiaceae) in amnesic mild cognitive impairment***

18.20-18.30

Janjić, Đ., Rat, M., Bokić, B., Radak, B., Anačkov, G., Božin, B.

**Djurdjica Janjić**, University of Novi Sad, Faculty of Sciences, Department for Biology and Ecology, Novi Sad, Serbia

***Traditional use of native plants from the municipality of Surdulica (southeastern Serbia) - Ethnobotanical study***

## Poster Session 1: Phytochemistry and Phytotherapy

18.30-20.00 **Friday, June 17th, 2016.**

1

Stojiljković, M., Stanojević, Lj., Cvetković, D., Nikolić, G. Stojiljković, S.

***Antioxidant activity of aqueus-ethanolic extracts of white willow young shoots from Southeastern Serbia***

2

Stojiljković, M., Mitić, N., Petrović, S., Stojiljković, S.

***Drying of cherries by a combination of convective drying with microwave heating***

3

Veličković, D., Ristić, M., Milosavljević, N., Davidović, D., Milenović, D., Veličković, A.

***Volatiles of quince (Cydonia oblonga Mill.)***

4

Nikolić, N., Karabegović, I., Stojanović, G., Savić, S., Veličković, D., Lazić, M.

***The content and composition of minerals in porcino (Boletus edulis) flour***

5

Matović, M., Tešević, V., Todosijević, M., Nikolić, B., Stanković, J., Cvetković, M.

***Effects of different essential oil extraction methods on the terpenic profiles of Achillea millefolium, Tanacetum macrophyllum and Thymus serpyllum***

6

Stojković, M., Nikolić, V., Stanojević, Lj., Nikolić, Lj., Tačić, A., Stanojević, J., Danilović, B.

***The chemical composition and antimicrobial activity of essential oil from birch buds***

7

Stanojević, Lj.P., Stanojević, J.S., Cvetković, D.J., Ilić, D.P.

***Antioxidant activity of oregano essential oil (Origanum vulgare L.)***

8

Veselinović, J.B., Matejić, J.S., Veselinović, A.M., Sokolović D.

***Coumarin structure as a lead scaffold for antibacterial agents – molecular docking***

9

Blagojević, P., Pešić, M., Radulović, N.S.

***Variability of the volatile profile of commercially available "Rtanjski čaj" (Satureja sp., Lamiaceae) from Serbia***

10

Đorđević, A., Jovanović, O., Jovanović, S., Lazarević, J., Palić, I., Mitić, V., Stankov-Jovanović, V.

***Chemical composition of Ballota macedonica Vandas essential oils***

11

Filipović, S., Radulović, N.S.

***Chemical composition of the leaf essential oil of Crithmum maritimum L. (Apiaceae) from Montenegro***

12

Mladenović, M., Radulović, N.S., Filipović, S.

***The essential oil of Achillea ageratifolia (Sm.) Boiss. subsp. serbica (Nyman) Heimerl (Asteraceae) revisited: structural elucidation and synthesis of (new) sabinyl esters***

13

Stojanović, N.M., Randjelović, P.J., Živković, M., Nešić, M., Genčić, M., Djordjević, N., Radulović, N.S.

***Hypericum perforatum essential oil alters experimentally induced anxiety in mice***

14

Markoska, E., Tusevski, O., Matevski, V., Stefova, M., Gadzovska Simic, S.

***Phenolic compounds production and antioxidant activity of leaflet and spine extracts from Astragalus parnassi Boiss. wild growing plants***

15

Ickovski J., Palić I., Djordjevic A., Petrovic G., Ljupković R., Zlatanovic I.

***HPLC profile of methanolic extract of Cynara scolymus L.***

16

Dimitrijević, M., Mitić, V., Mitić, M., Stankov Jovanović, V., Cvetković, J., Stojanović, G.

***Boletus impolitus as a natural source of phenolic acids and antioxidants***

17

Dimitrijević, M., Mitić, V., Stankov Jovanović, V., Cvetković, J., Đorđević, A., Stojanović, G.

***ICP-MS assessment of toxic elements in Lactarius volemus, collected from Southeastern Serbia***

18

Tačić, A., Nikolić, V., Stanojević, Lj., Stanojević, J., Nikolić, Lj., Danilović B.

***The chemical composition and antimicrobial activity of nutmeg (Myristica fragrans Houtt.) seeds essential oil***

19

Stamenković, J., Kostevski, I., Petrović, G., Stojanović, G., Palić, I., Zlatković, B.

***Chaerophyllum temulum: Differences between headspace volatile profiles of fresh and air dried plant***

20

Petrović, G., Vukadinović, N., Stamenković, J., Kostevski, I., Stojanović, G., Jovanović, O.

***Chemical profile of Scandix pecten-veneris L. headspace volatiles***

21

Nikolić, M., Radulović, N.

***Chemical composition of the inflorescence and leaf essential oil and root diethyl-ether extract of Bellis perennis L. from southeastern Serbia***

22

Genčić M., Živković, M., Radulović N.

***Homologous very long-chain alkanes and aldehydes in cuticular waxes of Salvia sclarea L. (Lamiaceae) fruits***

23

Todorovska, M., Radulović, N.S.

***Leaf and flower epicuticular alkanes from Draba lasiocarpa Rochel (Brassicaceae)***

24

Todorovska, M., Dekić, M., Radulović, N.S.

***Benzyl thiocyanate – autolysis product of glucotropaeolin or an artefact of the isolation procedure?***

25

Kalaba, V., Gojković, V., Balaban Marjanović, Ž., Kalaba, D.

***The antimicrobial properties of white lily (Lilium candidum)***

26

Krstić, M., Miltojević, A., Radulović, N.

***Wax alkanes of Galanthus nivalis L. (Amaryllidaceae)***

27

Mladenović, K., Muruzović, M., Stefanović, O., Čomić, Lj., Žugić-Petrović T.

***In vitro determination of antioxidant and antimicrobial activity of extracts of Agrimonia eupatoria L.***

28

Muruzović, M., Mladenović, K. , Stefanović, O., Čomić, Lj., Žugić-Petrović T.

***Interaction between Agrimonia eupatoria L. extracts and antibiotic and antibiofilm activity of two extracts***

29

Žugić-Petrović, T., Ilić, P., Muruzović, M. , Mladenović, K., Stanisavljević, D., Čomić, Lj.

***Antimicrobial activity of rakija travarica „Sante“***

30

Stanisavljević, D., Ristić, M., Đorđević, S., Veličković, D., Ranđelović, N., Zlatković, B.

***Chemical analysis of the herb extract of Nepeta nuda L.***

31

Zlatković, D.B., Radulović, N.S., Ilić -Tomić, T., Senerović, L.

***Cytotoxic isothiocyanates from Reseda lutea L.***

32

Zlatković, D.B., Radulović, N.S.

***Diesters of a highly oxygenated germacrane derivative from Daucus carota L.***

33

Đorđević M., Radulović N.

***Chemical Composition of the Root Essential Oil from Conium maculatum L. (Apiaceae)***

34

Đorđević M., Radulović N., Stojanović N., Stojanović-Radić Z.

***Chemical composition of the essential oil of Heracleum sphondylium L. (Apiaceae) from the settings of the city of Niš (SE Serbia)***

35

Marčetić, M., Lakušić, B., Lakušić, D.

***The influence of the sampling method (individual vs. composite sample) on the chemical characteristics of Seseli rigidum Waldst. & Kit. essential oil***

36

Stojanović-Radić, Z., Pejčić, M., Ničić, S., Ristić, J., Mihajilov-Krstev, T.

***Efficacy of Ocimum basilicum L. and Rosmarinus officinalis L. essential oils against the growth of Salmonella enterica subsp. enteritidis in meat***

37

Stanojević, J.S., Stanojević, Lj.P., Marjanović-Balaban, Ž.R., Kalaba, V.D. Cvetković, D.J.

***Chemical composition, antioxidant and antimicrobial activity of chamomile flowers essential oil (Matricaria chamomilla L.)***

38

Jovanović, N., Cvetković, V., Mitrović, T., Mladenović, M., Arsić, J., Stanković, M., Stamenković, S.

***The influence of ethyl acetate extract of lichen Hypogymnia physodes (L.) Nyl. on survival rate of Drosophila melanogaster***

39

Stojanović-Radić, Z., Stanković, M.S., Salas, J.B., Vázquez, F.M., Téllez, T.R.

***Biological activity of Mentha spicata L. (Lamiaceae) plant extract***

40

Arsenijević, J., Slavkovska, V., Lakušić, B.

***Anatomical and Chemical Analyses of Stem and Leaf of Frangula rupestris (Scop.) Schur (Rhamnaceae)***

41

Jakovljević, D., Stanković, M., Bojović, B., Topuzović, M.

***Seedling peroxidases activity in relation to the variability of nitrogen content in sweet basil (Ocimum basilicum L.)***

42

Jakovljević, D., Stanković, M., Bojović, B., Zlatić, N., Topuzović, M.

***Screening selected compositae species for antioxidant activity in relation to phenolic content of plant extracts***

43

Sovrlić, M., Vasiljević, P., Jušković, M., Mašković, P., Manojlović, N.

***Phytochemical and antibacterial screening of methanol and chloroform extracts of the leaves of Daphne kosaninii (Stoj.) Stoj. (Thymeleaceae)***

44

Conić, J., Žabar-Popović, A., Nikolić, M., Jušković, M., Zlatković, B., Vasiljević, P.

***Antihemolytic effects of water extract of Hypericum rumeliacum Boiss. on rat erythrocytes***

45

Nikolova, M., Aneva, I., Berkov S.

***Gas-chromatography mass-spectrometry (GC-MS) metabolic profiling and free radical scavenging activity of Micromeria dalmatica***

46

Stanković, N., Matejić, J., Joković, N., Rajković, J., Đorđević, Mihajilov-Krstev, T.

***Antimicrobial and antioxidant activity of Allium cepa L. dried scales extracts***

47

Rajković, J., Đorđević, Lj., Joković, N., Matejić, J., Stanković, N., Zlatković, B., Mihajilov-Krstev, T.

***Topical anti-inflammatory activity of essential oils of Petasites hybridus subsp. Ochroleucus***

## Phytogeography, Floristics and Phytoecology
**Saturday, June 18th, 2016.**

### Oral presentations

10.00-10.10

Šegota, V., Alegro, A., Vuković, N., Sedlar, Z.

**Vedran Šegota**, Faculty of Science, University of Zagreb, Division of Botany, Department of Biology, Zagreb, Croatia

***Rare ephemeral bryophytes in Mediterranean part of Croatia***

10.10-10.20

Papp, B., Szurdoki, E., Sabovljević, M., Sabovljević, A., Pantović, J., Ódor, P.

**Beata Papp**, Hungarian Natural History Museum, Botanical Department, Budapest, Hungary

***Exploration of the bryophyte flora of Serbia last five years***

10.20-10.30

Đurović, S., Tomović, G., Buzurović, U., Niketić, M.

**Sanja Đurović**, Faculty of Biology, University of Belgrade, Institute of Botany and Botanical Garden "Jevremovac", Belgrade, Serbia

***Phenotypic variability and plasticity of Silene waldsteinii Griseb. (Caryophyllaceae)***

10.30-10.40

Tomović, G., Niketić, M.

**Gordana Tomović**, Faculty of Biology, University of Belgrade, Institute of Botany and Botanical Garden "Jevremovac", Belgrade, Serbia

***Genus Viola L. (Violaceae) in Vojvodina based on specimens from the collection of the Faculty of Sciences, University of Novi Sad, Serbia (BUNS)***

10.40-10.50

**Sretko Milanović**, Muzej Banata Temisvar, Temisvar, Romania

***Orchid flora of the Muntele Mic (Caraş – Severin Country, Romania)***

10.50-11.10 Coffee break

11.10-11.20

Baykal, H., Atamov, V.

**Hüseyin Baykal**, Pazar Vocational School, Recep Tayyip Erdogan University, Department of Plant and Animal Breeding, Pazar-Rize, Turkey

***Floristic diversity in Bashemsin valley of Kachkar mountains national park of Rize, Turkey***

11.20-11.30

Doğu, S., Dinç, M.

**Süleyman Doğu**, Ahmet Keleşoğlu Faculty of Education, Necmettin Erbakan University, Department of Biology, Konya, Turkey

***Endemic Plants of Balkusan Valley (Ermenek-Karaman) Turkey***

11.30-11.40

Uzunov, B.A., Gärtner, G., Stoyneva-Gärtner, M.P.

**Blagoy Angelov Uzunov**, Faculty of Biology, University of Sofia "St Kliment Ohridski", Department of Botany, Sofia, Bulgaria

***A recent floristic account of Pirin mountain algae and their conservation value***

11.40-11.50

Jogan, N., Strgulc-Krajšek, S., Bačič, M.

**Nejc Jogan**, University of Ljubljana, Biotechnical Faculty, Department of Biology, Ljubljana, Slovenia

***Vascular plant flora of Ljubljana (Slovenia)***

11.50-12.00

Tmušić, G., Radak, B., Bokić, B., Anačkov, G.

**Goran Tmušić**, University of Novi Sad, Faculty of Sciences, Department of Biology and Ecology, Novi Sad, Serbia

***Vascular flora of the Natural Monument "Sopotnica Waterfalls" (Southwestern Serbia)***

12.00-12.10 Pause

12.10-12.20

Alegro, A., Šegota, V., Vuković, N.

**Antun Alegro**, Faculty of Science, University of Zagreb, Division of Botany, Department of Biology, Zagreb, Croatia

***Invasive flora of the Medvednica Mt (Croatia)***

12.20-12.30

Doderović, M., Bulić, I., Bulić, Z., Burić, D.

**Miroslav Doderović**, Faculty of Philosophy, University of Montenegro, Department of Geography, Nikšić, Montenegro

***Ecological problems of karst areas of Montenegro***

12.30-12.40

Bulić, Z., Doderović, M., Markišić, H., Glomazić Bulić, Lj., Bulić, I.

**Zlatko Bulić**, Doclean Academy of Sciences and Arts, Podgorica, Montenegro

***Importance and protection of botanical gardens of mountain flora in Montenegro***

## Agriculture, Forestry and Landscape Architecture
**Saturday, June 18th, 2016.**

### Oral presentations

12.40-12.50

Özel, H.B.

**Halil Barış Özel**, Bartın University, Faculty of Forestry, Department of Silviculture, Bartın, Turkey

***Effects of silvicultural application on flora oriental beech (Fagus orientalis Lipsky.) and uludag fir (Abies nordmanniana subsp. bornmülleriana Mattf.) mixed forest in the Bartin-Kumluca district in Turkey***

13.00-15.00 Pause

## Nature Protection and Environment
**Saturday, June 18th, 2016.**

### Oral presentations

15.00-15.10

**Miloš Popović**, Faculty of Science and Mathematics, University of Niš, Department of Biology and Ecology, Niš, Serbia

***Distribution, ecology and local spatial ecology of the scarce large blue butterfly in Serbia***

15.10-15.20

Bojčić, S., Tmušić, G., Bogdanović, S., Rat, M., Anačkov, G.

**Slobodan Bojčić**, University of Novi Sad, Faculty of Sciences, Department for Biology and Ecology, Novi Sad, Serbia

***Monitoring and suppression of common ragweed (Ambrosia artemisifolia L. 1753) in the territory of City Novi Sad, during the 2010 – 2015***

15.20-15.30

Stamenković S., Ristić S., Marković M., Cvetković, V., Novković, V., Mitrović, T.

**Slaviša Stamenković**, Faculty of Science and Mathematics, University of Niš, Department of Biology and Ecology, Niš, Serbia

***Monitoring of air quality at selected urban areas (Southern Serbia)***

15.30-15.40

Panjković, B., Stojšić,V., Perić,R., Rilak, S.

**Biljana Panjković**, Institute for Nature Conservation of Vojvodina province, Novi Sad, Serbia

***The conservation status of subcontinental peri-pannonic scrub identified in the "Veliki Rimski Šanac" site (Vojvodina Province, Serbia)***

# Zoology

## Saturday, June 18th, 2016.

### Oral presentations

15.50-16.00

Lazarević, M., Ilić Milošević, M., Stanković, S.S., Žikić, V.

**Maja Lazarević**, Faculty of Science and Mathematics, University of Niš, Department of Biology and Ecology, Niš, Serbia

***Comparative morphology of forewings of the genera Trioxys Haliday and Binodoxys Mackauer (Hymenoptera: Braconidae: Aphidiinae)***

16.00-16.10

Đurđević, A., Milošević, Dj., Žikić, V.

**Aca Đurđević**, Faculty of Science and Mathematics, University of Niš, Department of Biology and Ecology, Niš, Serbia

***The shape of mandibles in the Chironomidae family (Insecta: Diptera) as a predictor of feeding type***

# Poster Session 2: Phytogeography, Floristics and Phytoecology

16.15-17.45 **Saturday, June 18th, 2016.**

1

Abdii, N., Xhulaj, M.

***Medicinal plants of the Sharr Mountains***

2

Akdağ, T., Doğu, S., Dinç, M.

***The ornamental plants in the Seydişehir campus area of Necmettin Erbakan University***

3

Akdağ, T., Doğu, S., Dinç, M.

***Ecological and Anatomical Investigations on Hyacinthella campanulata K.Perss. & Wendelbo in Turkey***

4

Barudanović, S., Mašić, E.

***Ecological properties of algae in mine pit lakes of Bosnia and Herzegovina***

5

Mijić, J., Jenačković, D., Nikolić, D., Ranđelović, V.

***Morphological differentiation of the South Serbian Bolboschoenus taxa***

6

Štubňová, E., Mártonfiová, L., Hodálová, I., Kochjarová, J., Kučera, J., Valachovič, M., Slovák, M.

***Karyological variation in the genus Soldanella L. (Primulaceae)***

7

Olšavská, K., Slovák, M., Marhold, K., Štubňová, E., Kučera, J.

***Disentangling the evolution of the Balkan endemic Cyanus napulifer group (Asteraceae)***

8

Sarajlić, N.

***Checklist of grasses (Poaceae) of Bosnia and Herzegovina***

9

Janković, I., Lakušić, D., Kuzmanović, N.

***Nomenclatural notes on Campanula versicolor (Campanulaceae) and related names***

10

Kajevska, I., Kuštera, M., Cvijetan, I., Stojanović, D.

***Contribution to the knowledge of Ascomycota from southeast Serbia***

11

Lazarević, J., Terzić, S., Zorić, L., Karanović, D., Jocković, M., Jocić, S., Miladinović, D., Luković, J.

***Achene and receptacle micro-morphological characters and pericarp anatomy of wild annual sunflower species***

12

Kuzmanović, N., Lakušić, D.

***Diversity of Sesleria species (Poaceae) and their habitats on vertical profile of Mt. Pirin (Bulgaria)***

13

Nikolić, D., Marković, M., Raca, I., Ljubisavljević, I.

***Taxonomical analysis of herbarium specimens deposited in HMN (Herbarium Moesiacum Niš)***

14

Jušković, M., Mitić, M., Ranđelović, V.

***Comparative leaf anatomical investigations of species Crocus alexandrii Ničić ex Velen. (Iridaceae) from Serbia***

15

Jušković, M., Savić, A., Manić, A., Vasiljević, P.

***Comparative analysis of leaf epidermis of three species of the genus Paeonia L.***

16

Novaković, J., Zlatković, B., Marin, P.D., Lakušić, D., Janaćković, P.

***Distribution and variability of Centaurea kotschyana Heuffel ex Koch from Central Balkans***

17

Xhulaj, S.

***Diatom flora of the Narta Lagoon and effectiveness of diatom indices in water quality assessment***

18

Simić, S., Đorđević, N.

***First record of Pithophora oedogonia (Montagne) Wittrock (Pithophoraceae) in Aleksandrovac Lake, Serbia***

19

Guttová, A., Fačkovcová, Z.

***The genus Solenopsora (Leprocaulaceae, lichens) in Balkan peninsula: species diversity and genetic variability of taxa confined to calcareous habitats***

21

Veljković, B., Preljević, N., Krivošej, Z.

***Epipactis palustris (L.) Crantz (Orchidaceae), the new locality on Serbian territory***

20
Asenov, A.
***Echium russicum J. F. Gmel in the flora of Greece***

22
Prodanović, D., Stanojević, M., Krivošej, Z.
***Silene noctiflora, present in the flora of Kosovo and Metohija (Serbia)***

23
Bancheva, S., Delcheva, M., Trifonov, V., Nikolov, M.
***New locality of Centaurea pichleri (Asteraceae) in Bulgaria***

24
Duraki, Š., Prodanović, D., Krivošej, Z.
***Sorbus semipinnata (Roth.) Hedlund (Rosaceae), in the flora of the Serbian part of the Šara Mountains?***

25
Duraki, Š., Prodanović, D., Krivošej, Z.
***Galium demissum Boiss. (Rubiaceae), a new species in the flora of Serbia***

26
Zlatković, B., Nešić, M., Naelbandian, A., Šarac, Z.
***Sedum L. (Crassulaceae, Sempervivoideae) in Serbia: species distribution and diversity centers***

27
Aneva, I., Zhelev, P., Nikolova, M., Evtimov, I.
***The ecological and floristic characteristics of natural population of Micromeria juliana (L.) Benth. ex Rchb. in Eastern Rhodopes Mts, Bulgaria***

28
Zlatković, I., Jenačković, D., Ranđelović, V.
***Ecological characteristics of halophytes at salt marshes of Southern and Central Serbia***

29
Stanojević, M., Prodanović, D., Krivošej, Z.
***A Supplement to the Knowledge of the Flora of Sirinićka Župa at the Bottom of the Šara Mountains***

30
Ilić, T.
***A syntaxonomic review of coniferous forests and subalpine heaths of the Balkan Peninsula***

31
Mesiti, A., Dinga, L.
***Floristic Investigation of the "Grand Park of Tirana" flora***

32

Jenačković, D., Lakušić, D., Ranđelović, V.

***Helophytic vegetation of the Smilovska lakes (Southeastern Serbia)***

33

Nikolić, N., Pantović, J., Janković, I., Sabovljević, M.

***Arctic-alpine Elements in the Serbian Bryophyte Flora***

34

Papović, O., Miljković, M., Ranđelović, N., Ranđelović, V.

***Analysis of the flora and phytogeographical affiliation of the Rogozna mountain***

## Poster Session 3: Genetics, Selection and Biotechnology; Nature Protection and Environment; Agriculture and Forestry; Zoology

18.00-19.30 **Saturday, June 18th, 2016.**

1

Sabovljević, M., Vujičić, M., Sabovljević, A.

***Biotechnological approach to bryophyte protection: case studies on two Sphagnum species***

2

Savić, A., Mitrović, A., Donaldson, L., Simonović Radosavljević, J., Bogdanović Pristov, J., Steinbach, G., Garab, G., Radotić, K.

***Cellulose fibril order in radial wood cell walls of juvenile Serbian spruce: estimation of compression wood severity***

3

Spasić, S.Z., Mitrović, A.Lj., Janošević, D., Budimir, S.

***2D fractal analysis in plant analytical morphology and microscopy***

4

Savić S., Petrović S., Petronijević Ž.

***Analysis of macro- and microelements in chamomile teas (Matricaria chammomilla L.)***

5

Gadzovska Simic, S., Tusevski, O., Maury, S., Delaunay, A., Joseph, C., Hagège, D.

***The influence of auxins on hypericin and pseudohypericin production in Hypericum perforatum L. callus cultures***

6

Nemati, Z., Harpke, D.

***Identification of parental species of allotriploid saffron (Crocus sativus)***

7

Memišević Hodžić, M., Prijić, V., Ballian, D.

***Intrapopulation and interpopulational variability of characteristics of cones and seeds of silver fir (Abies alba Mill.) in Forest management unit "Koprivničko"***

8

Žabar Popović, A., Nikolić, M., Stanković, S., Đorđević, D., Aleksić, M., Conić, J., Vasiljević, P.

***The cytotoxic and hemolytic properties of a stevia sweetener***

9

Šućur, J., Prvulović, D., Malenčić, Dj., Anačkov, G.

***Oxidative stress in bromus seedlings treated with Salvia sclarea L. aqueous extract***

10

Ivanova, I., Ivanova, V.

***New habitats of Goniolimon dalmaticum (C. Presl) Rchb. F. in Bulgaria***

11

Zaprianova, N., Ivanova, V., Atanassova, B.

***The response of Bulgarian spray-carnation (D. caryophyllus f. spray, Hort.) cv RUSALKA to drought - in vitro induced by different PEG concentrations***

12

Radovanović, V., Andjelković, M., Radovanović, B.

***RSM optimization of ultrasound-assisted extraction of polyphenols from grape by-products***

13

Çakmak, N.M.

***Effects of Renewable Energy Generation on Flora and Fauna***

14

Evren, Ç.C.

***General Overview On The Protection Of Envrioment In Turkısh Law***

15

Radovanović, V., Andjelković, M., Radovanović, A., Milenković-Anđelković A., Sivčev B., Ilić D.

***Monitoring the antioxidants of the Vranac variety during grape ripening***

16

Šućur, J., Prvulović, D., Malenčić, Dj., Anačkov, G.

***The effect of Satureja montana L. aqueous extract on soybean seedlings***

17

Nikolić, N., Vujičić, M., Pantović, J., Papp, B., Sabovljevic, A., Sabovljevic, M.

***Active protection of rare moss species Entosthodon hungaricus in Serbia***

18

Petrova, G., Petrov, S., Bancheva, S.

***Genetic diversity of the critically endangered Verbascum davidoffii Murb. (Scrophulariaceae) and implications for conservation***

19

Đelić, G., Timotijević, S., Simić, Z., Branković, S.

***Adoption and distribution of metals in the species of genus Populus***

20

Jovanović, F., Obratov-Petković, D., Mačukanović-Jocić, M.

***Palynomorphological study of Galanthus nivalis L. from Serbia***

21

Vitkova, A., Delcheva, M.

***Medicinal plants in Rila National Park (Bulgaria)***

22

Stanković, M., Bojović, B., Ćurčić, S., Čutura, I.

***The Park of the Faculty of Education in Jagodina: natural protected area and botanical teaching resource***

23

Terziu, R., Baraj, E., Yu, S., Xhaxhiu, K. Come, M.

***An analytical study of marble consolidation by oxalate precipitation using density, ftir and powder-xrd measurements***

24

Marković, M., Tošić, S., Stankov-Jovanović, V., Stamenković, S., Mitić, V., Gnjatović, I., Ilić, M.

***Stress impact of fire on chloroplasts pigments content in post fire grown plants***

25

Cvijetan, I., Kajevska, I., Kuštera, M.

***Biodiversity of macromycetes in an urban environment - Niš, Serbia***

26

Ilić, M., Nikolić, M., Savić, D., Crnobrnja-Isailović, J.

***Amphibians on the territory of Niš***

27

Savić, A., Đorđević, M., Jušković, M.

***Ecological analysis of macroinvertebrate communities based on functional feeding types: a case study in southeastern Serbia***

# 12th Symposium on the Flora of Southeastern Serbia and Neighboring Regions

Kopaonik Mt. 16th-19th June, 2016

## Plenary presentations

# Spas Krumov Sotirov (1929-2016) - naturalist and biologist

**Ranđelović, N.**[1], **Stamenković, V.**[2], **Mihajilov-Krstev, T.**[1]*

[1]Department of Biology and Ecology, Faculty of Sciences and Mathematics, University of Niš, Višegradska 33, 18000 Niš, Serbia

[2]DD "Zdravlje" Leskovac, Serbia

* tatjanamk@pmf.ni.ac.rs

Prof. dr Spas Sotirov was born on 9th January, 1929 in Dimitrovgrad, where he had finished both elementary and high school. His professional carrier started in Gymnasium where he worked as a professor. Dr Sotirov finished his bachelor biology studies in 1954. at the Faculty of Biology in Belgrade, after which he had finished and defended his Master (1962) and PhD (1970) Theses at the same institution. During the period from 1958 to 1966, he worked as a teaching assistant at the Faculty of veterinary medicine in Belgrade and Faculty of technology in Novi Sad. Over the following years, during the period 1966-1982, he worked in Institute for development of education in Niš. His academic carrier started with his promotion into assistant professor in 1982 at the Faculty of Technology in Leskovac, where he was promoted into associate professor (1987) and finally to full professor in 1990. He was involved as an organizer of many Symposiums, scientific and specialized workshops. Among his organizing activities, one of the most significant place takes Symposium entitled One hundred years of "Flora of Niš surrounding area", where he was plenary speaker on the subject on dr Sava Petrović. He gave high contribution to education of the new generations of faculty and other students. As a member of the National Education Council of the Republic of Serbia he was working on didactic problems in teaching and as a reviewer on many textbooks written for elementary education. Dr Sotirov was coauthor of the capital monography "Encyclopedia od Niš" and worked as a reviewer of special issues of the journals "Politika" and "Savremena biologija". Also, he was a collaborator and a member of Editorial Board in the journals "Bratstvo", "Most" and "Drugarče". His scientific opus includes working and contribution on many scientific projects on the subject on fundamental and also fieldwork researches on flora and vegetation, as well as resolving of significant problems such as possibilities of using autochthonous plant material in alimentary industry, technology of fruits and vegetables, development of food technology concepts and creation of the modern managing, control and production mechanisms in food industry. He was author of over 50 scientific publications and books.

# The plant life of Mt. Kopaonik

**Lakušić, D.[1]***

[1]Institute of Botany and Botanical Garden "Jevremovac", Faculty of Biology, University of Belgrade

* dlakusic@bio.bg.ac.rs

Kopaonik is, undoubtedly, one of the richest and the most diverse mountain of the Central Balkan Peninsula regarding flora and vegetation. Its'relatively isolated position from other mountains in the area, the massiveness, diverse geological structure and very rich wildlife have been attracting many researchers for ages. The first written record about the flora of Kopaonik was written by Ami Boućin 1840. Since then, more than 300 authors wrote about the Kopaonik Mountain and its wildlife, publishing over 600 scientific publications. One of the most notable researchers was Josif Pančić with his comprehensive work on Kopaonik Mountain.

Based on the research done so far, flora of Mt. Kopaonik is represented with more than 1600 species and 160 subspecies of vascular plants, included in 521 genera and 111 families of vascular plants. More than 800 species and subspecies of the afore mentioned taxa belong to high mountain flora of Kopaonik. They constitute one-fifth of the total flora of Serbia, distributed only on one thousandth of its territory which occupies high mountain part of Mt. Kopaonik. This impressive data, along with the fact that on this small area were recorded more than 170 Balkan endemic and subendemic species, indicates that Mt. Kopaonik is one of the centers of diversity of vascular flora of the Balkan Peninsula and the whole of Europe.

Vegetation of the total massif is differentiated into more than 120 plant associations classified into more than 60 vegetation alliances and 24 classes, which makes Mt. Kopaonik significantly rich and diverse. This is, undoubtedly, one of the most significant centers of diversity of vegetation on the Balkan Peninsula.

This considerable diversity of flora and vegetation, located mainly in high mountain region, was the main reasons for establishing Mt. Kopaonik area as National Park in 1981.

Despite the fact that Kopaonik, in terms of flora and vegetation, is one of the best-studied mountains of the Balkan Peninsula, its plant life, still attracts the attention of many researchers. With their hard work, they fulfill the idea of Josif Pančić that his successors complete the work on the study of Mt. Kopaonik, which he started in 1851.

In this work, besides the review of the history of botanical research of Mt. Kopaonik, general characteristics of the mountain and the general characteristics of the flora and vegetation will be presented too, with special emphasis on the results of the latest research of Mt. Kopaonik.

# When the common sense meets vegetation science: the experience of the project WetVegEurope

**Landucci, F.[1]* & WetVegEurope partners****

[1]Department of Botany and Zoology, Masaryk University, Kotlářská 2, CZ-61137 Brno, Czech Republic

* flavia.landucci@gmail.com

** Řezníčková, M., Šumberová, K., Chytrý, M., Tichý, L., Aunina, L., Biţă-Nicolae, C., Bobrov, A., Borsukevych, L., Brisse, H., Čarni, A., Csiky, J., Cvijanović, D., De Bie, E., De Ruffray, P., Dubyna, D., Dimopoulos, P., Dziuba, T., FitzPatrick, U., Font, X., Gigante, D., Golub, V., Hennekens, S.M., Hrivnák, R., Iemelianova, S., Jandt, U., Jenačković, D., Jansen, F., Kącki, Z., Lájer, K., Matulevičiutė, D., Mesterházy, A., Michalcová, D., Paal, J., Papastergiadou, E., Properzi, A., Radulović, S., Rodwell, J.S., Schaminée, J.H.J., Šilc, U., Sinkevičienė, Z., Stančić, Z., Stepanovich, J., Teteryuk, B., Tzonev, R., Venanzoni, R., Weekes, L., Willner, W.

During the last decades, and in particular since the establishment of the European Union, the needs to adopt common classifications of natural systems (vegetation communities, habitats, ecosystems, etc.) at continental and global levels have become one of the priority in nature conservation. WetVegEurope is a project started in 2013 with the goals of reviewing and formalizing the phytosociological classification of European aquatic and marsh vegetation that could be used as a tool for nature conservation. For this purpose a continental thematic database of vegetation plots was created. Forty-seven data contributors and experts from 33 European countries were involved in the project and 375,212 vegetation plots were collected.

The philosophy behind this project has been “keeping the good, improving the improvable, throwing away the bad”. In other words the project has been developed in iterative way trying to take into account all classification systems of aquatic and wetland vegetation in use in different European countries. An improved version of the Cocktail method was used to create a consistent and formalized classification. The final result was an expert-based classification system including a consistent classification protocol made by well-defined classification criteria and formalized units through logical formulas to make the classification repeatable.

Now (hopefully close to the end of the project) we want to tell you the advantages and issues of developing such classification systems.

**Acknowledgements**. This work is financed from the SoMoPro II programme, which has acquired a financial grant from the People Programme (Marie Curie action) of the Seventh Framework Programme of EU according to the REA Grant Agreement No. 291782 and the South-Moravian Region.

# Trends in biological activity research of wild-growing aromatic plants from Central Balkans

**Džamić, A.M.[1]***

[1]University of Belgrade, Faculty of Biology, Institute of Botany and Botanical Garden "Jevremovac",11000 Belgrade, Serbia

* simicana@bio.bg.ac.rs

Flowering plants consists of more than 300.000 species around the world, out of which a small percentage has been sufficiently investigated from phytochemical and biological activity aspects. Plant diversity of the Balkans is very rich, but still poorly investigated. The aim of this paper is survey of current status and trends in research of potential of wild-growing aromatic plants from Central Balkans. Many aromatic plants are investigated from morphological, physiological, ecological, systematic and phytochemical aspects. However, traditionally used medicinal and aromatic plants can also be considered from applicative aspects, concerning their health effects, and from wide range of usage in cosmetics, and as food, agrochemical and pharmaceutical products. In order to achieve all planned objectives, following methodology has been applied: field research, taxonomic authentication and, comparative biologically assayed phytochemical investigations. The total herbal extracts, postdistillation waste (deodorized) extracts, essential oils and individual compounds of some autochthonous plants have been considered as potential source of antibacterial, antifungal, anti-biofilm, antioxidant and cytotoxic agents. Herein, composition of essential oils and extracts was evaluated in a number of species, mostly from the Lamiaceae and Apiaceae families. Extracts which were rich in phenols and flavonoids, often showed high antioxidant potential. Also, phenolic compounds identified in essential oils and extracts were mostly responsible for promising antimicrobial activity. Current worldwide demand is to reduce or, if possible, eliminate chemically synthesized food additives. Plant-produced compounds are becoming of interest as a source of safer and more effective substances than synthetically produced antimicrobial agents (as inhibitors, growth reducers or even inactivators) that control microorganisms' growth. Many different pathogens have developed resistance toward synthetic antibiotics and mycotics, so, there is a need for discovering new antimicrobials. Some pathogens employ quorum-sensing mechanism in regulation of their virulence and pathogenicity, such as biofilm formation, swarming motility, pigmentation, production of pathogenicity factors. Recently, it has been shown that some medicinal plants possess anti–quorum sensing activity. It is worth noting that synergistic effect of components found in essential oils or in various extracts, may pay key role in its biological activities. A multidisciplinary approach is necessary in order to discover, describe and examine wild-growing plants for potential use of natural resources in discovery of new bioactive compounds.

**Acknowledgments**. This work was founded by the Ministry of Education, Science and Technological Development of the Republic of Serbia for financial support Grants No. 173029.

# The flora of Southeastern Serbia: a phytochemist's gold mine

**Radulović, N.S.[1]***

[1]Department of Chemistry, Faculty of Science and Mathematics, University of Niš, Višegradska 33, 18000 Niš, Serbia

* nikoradulovic@yahoo.com

The study of the plant volatilome requires the application and development of both cutting edge analytical and organic synthetical methodologies, as well as a full array of *in vivo* and *in vitro* pharmacological and toxicological assays. Organic synthesis and analysis (OSA) group is a research group situated at the University of Niš (Serbia), consisted of both chemists and biology-oriented scientists, that has gained experience in the field of natural products for almost 15 years. In that time we have investigated several hundreds of plant taxa from many different plant families and this resulted in more than 1000 successfully identified plant metabolites/constituents. Most of the plant species investigated originated from Southeastern Serbia. During these studies, essential oils have been proven to be as either a prolific source of new and interesting chemical compounds with promising biological/pharmacological activities or a fingerprint of the plant genetic makeup. This lecture is intended to provide a glimpse into the most relevant results of the OSA group: the application of small synthetic libraries of compounds for the identification and biological evaluation of essential-oil constituents, the development of novel NMR-based methodologies and the utilization of the average-mass-scan of the total ion chromatograms of essential oils in chemotaxonomy.

**Acknowledgments**. The authors acknowledge the Ministry of Education, Science and Technological Development of the Republic of Serbia for the financial support (Project 172061).

# Plants and insects in multitrophic associations

**Žikić, V.[1]*, Ilić Milošević, M.[1], Lazarević, M.[1], Stanković, S.S.[1]**

[1]Department of Biology and Ecology, Faculty of Sciences and Mathematics, University of Niš, Višegradska 33, Serbia

* vzikic@pmf.ni.ac.rs

The vast majority of plants have evolved together with insects which are pollinators, pests, seed spreaders etc. Simple trophic association can be explained as a connection between primary food producer, plant and primary food consumer, insect. Higher trophic levels include parasites, parasitoids or predators of the primary food consumer forming a multitrophic association. Parasitoids are important in these interactions because they represent a huge number of insects mostly from Hymenoptera. There are various classifications of parasitoids that involve the place of oviposition (ecto- and endoparasitoids), whether they alter hosts behaviour (idiobionts and koinobionts), number of larvae per host (solitary or gregarious) or the number of eggs laid per host (solitary or superparasitoids). Multitrophic associations usually include hyperparasitoids, the species that parasitize primary parasitoids. The level of hyperparasitism is variable reaching the fourth stage as it is recorded until today. The knowledge about interactions among plants, pest insects and their natural enemies could be applied in biological control which is becoming more and more serious in the insecticide free food production.

**Acknowledgments**. We express our gratitude to the Ministry of Education, Science and Technological Development of the Republic of Serbia, Grant no. III43001.

# H2020 projects for plant scientists - the "easy" way to get involved

**Quarrie, S.**[1]*

[1]Faculty of Biology, University of Belgrade, Studentski trg 16, 11000 Belgrade, Serbia

* steve.quarrie@gmail.com

Horizon 2020 is the EU's flagship funding programme for research and innovation. Although more money is available for H2020 than for FP7, the Commission has encouraged scientists to apply for projects by making the topic areas broader and the application process simpler. In consequence, the larger number of applications so far means success rates have been less than for FP7.

Most plant sciences projects (Societal Challenge 2, SFS) are Research and Innovation Actions (RIA), with some Innovation Actions (IA) and support Actions (CSA). So far, the average success rate for SFS RIAs has been only 15%. Therefore, writing a H2020 proposal for plant sciences research and getting it funded is a considerable challenge, and national authorities focus only on persuading scientists to write project proposals.

So far, consortia for funded SFS RIA research projects in H2020 have had on average around 20 participating institutions. Therefore, about 95% of SFS RIA consortium participants do not write proposals themselves, but are partners in other people's consortia. So, the "easy" way to get involved in H2020 is by being invited to join someone else's project consortium. That means effective networking, so others are likely to invite you. Advice on networking will be given.

# Quality assurance in higher education – is Serbia in Europe?

**Pekić Quarrie, S.**[1]*

[1]Commisssion for accreditation and quality assurance

* pekicq@gmail.com

Since its foundation in 2006 Commission for accreditation and quality assurance (CAQA) has developed standards and procedures and implemented 2 cycles of accreditation of higher education institutions and study programs and one cycle of external quality control (audit). In 2013 CAQA become full member of European association for quality assurance (ENQA) and European quality assurance registar for higher education (EQAR). This has proved that standards and procedures run by CAQA are in compliance with European standards and guidelines (ESG) and that our system of quality assurance (QA) is compatible with European. Membership in European associations, means an obligation to maintain and improve what has been achieved, to satisfy the recommendations given by ENQA and EQAR and to implement changes due to the new ESG adopted at the ministerial conference in May 2015 in Yerevan.

The paper sumarises activities taken by CAQA to follow the recommendations of ENQA and EQAR including the concept of changes of CAQA status suggested for the new Law on higher education. Recent changes of ESG also require analysis of our standards and their adjustments what is the present activity of CAQA. All this would improve national QA system and maintain CAQA membership in European associations.

# 12th Symposium on the Flora of Southeastern Serbia and Neighboring Regions

Kopaonik Mt. 16th-19th June, 2016

## Taxonomy and Sistematics

# ORAL PRESENTATIONS

## Are terpenes useful chemotaxonomic markers in differentiation of *Juniperus communis* L. and *J. deltoides* Adams?

**Rajčević, N.[1]*, Janaćković, P.[1], Marin, P.D.[1]**

[1]University of Belgrade, Faculty of Biology, Studentski trg 16, Belgrade, Serbia

* nemanja@bio.bg.ac.rs

The genus *Juniperus* L. is one of the most diverse taxa in Cupressaceae family, with ca. 67 species and 34 varieties. In the Balkans, taxa belonging to section *Juniperus* have the greatest distribution, and can be found from rocky sea beaches to well above tree line in the highest mountains across the Peninsula. Terpenes isolated from conifer needles have been used many times as both ecologic and chemotaxonomic markers. In order to confirm the usability of terpenes as chemotaxonomic markers in species from section *Juniperus*, individuals of *J. communis* L. var. *communis*, *J. communis* L. var. *saxatilis* Pall. and *J. deltoides* Adams from the same locality on Mt. Kopaonik are studied. The essential oil was obtained from 90 individuals (30 from each taxon), using hydrodistillation, and the composition was analysed by GC/MS and GC/FID. Monoterpenes were dominant in all samples, but principal compounds differed between taxa. Multivariate statistical methods are deployed to analyse obtained data. Based on the Principle component analysis (PCA), individuals belonging to different taxa separated clearly in scatter plot, with individuals of *J. communis* varieties grouping closer together in respect to *J. deltoides*. Chemotaxonomic and ecological implications are further discussed.

**Acknowledgements**. This study was supported by a grant from the Ministry of Education, Science and Technological Development of Republic of Serbia (Project 173029)

# Preliminary checklist of *Rubus* L. (Rosaceae) in Vojvodina (Serbia) based on revised herbarium data

**Kovački, M.[1]*, Anačkov, G.[1]**

[1]University of Novi Sad, Faculty of Sciences, Department for Biology and Ecology, Trg Dositeja Obradovića 3, Novi Sad, Serbia

* marijak@dbe.uns.ac.rs

This work presents the synthesis of information on herbarium specimens of the genus *Rubus* from Vojvodina deposited in four collections: Herbarium of Natural History Museum in Belgrade (BEO), Herbarium of the Institute of Botany and Botanical Garden "Jevremovac", University of Belgrade (BEOU), Herbarium of University of Novi Sad (BUNS) and Botanical collection of the Institute for Nature Conservation of Vojvodina Province. Total number of 202 sheets was examined of which only 49.5% were sampled properly and consisted of first year sterile stem (primocane) and second year fertile stem bearing inflorescence (floricane) necessary for accurate identification of *Rubus* species. Revised checklist counts four species from two sections (*R.* sect. *Rubus* and *R.* sect. *Caesii*). Majority of specimens belongs to *R. caesius* (*R.* sect. *Caesii*), whilst section *Rubus* is represented with three series (ser. *Rubus*, ser. *Discolores* and ser. *Canescentes*) each with only one representative.

# Anatomical differentiation of populations of *Sesleria juncifolia* complex (Poaceae) on the Balkan Peninsula

**Milekić, T.[1]*, Kuzmanović, N.[1], Lakušić, D.[1]**

[1]Institute of Botany and Botanical Garden "Jevremovac", Faculty of Biology, University of Belgrade, Takovska 43, 11000 Belgrade, Serbia

* tmilekic@gmail.com

*Sesleria juncifolia* complex is endemic Balkan-apennine group, with linear acute and pungent leaves and dense reticulate-fibrous basal leaf sheaths. Taxonomy, as well as the variability of morpho-anatomical characters of populations of *S. juncifolia* complex on the Balkan Peninsula has not been fully analyzed. Therefore, the main aim of this study was to determine the variability of anatomical characteristics of populations from the Balkan part of the area of this complex.

Morphometric analysis was performed on cross-section of 302 tiller leaves collected from 24 populations. We made a detailed description of the variability of 23

characters of the leaf anatomy. Analysis of variance showed that almost all the characters have statistical significance in the differentiation of analyzed populations. The most significant characters were height of the trichome of adaxial side of tiller leaf, indumentum of adaxial side and the type of the sclerenchyma on abaxial side. Canonical discriminant analysis showed grouping among different populations, corresponding roughly to taxa recognized within this complex by previous authors (*S. juncifolia*, *S. interrupta* and *S. ujhelyii*). The characteristics of leaf anatomy, as in case of many other grasses, has proven to be crucial for differentiation of taxa within *S. juncifolia* complex.

**Acknowledgements**. This work was funded by the Ministry of Education, Science and Technological Development of Republic of Serbia (project no. 173030).

# Comparative anatomical study of the taxa from series *Verni* Mathew (*Crocus* L.) in Serbia

**Raca, I.[1]*, Ljubisavljević, I.[1], Jušković, M.[1], Ranđelović, N.[1], Ranđelović, V.[1]**

[1]Department of Biology and Ecology, Faculty of Science and Mathematics, University of Niš, Višegradska 33, Niš, Serbia

* racairena@gmail.com

The comparative leaf and stem anatomy of three Crocus L. taxa from series Verni Mathew (*Crocus heuffelianus* Herb., *Crocus tommasinianus* Herbert and *Crocus kosaninii* Pulević) in Serbia is introduced. General outlook of the cross-sections of the leaves and stems was defined with photographs. More precisely, keel, arms, mesophyll, parenchyma and vascular bundles features were examined. The biggest differences were found at the level of vascular bundles (xylem area, phloem area, sclerenchyma area) and parenchyma area in cross-sections of the leaves. In general, listed big bundles parameters had the lowest values in *C. tommasinianus* population, while the highest values could be found in some populations of *C. heuffelianus*. Results also suggested possible differentiation between lowland and montane populations of *C. heuffelianus*. Further investigation should be focused on discovering more localities followed by surveying the ecological factors of the habitats.

**Acknowledgements**. This work was funded by the Ministry of Education, Science and Technological Development of Republic of Serbia (project no. 173030).

# Morpho-anatomical differentiation of the Balkan endemic species *Crocus veluchensis* Herb. (Iridaceae)

**Miljković, M.[1]*, Raca, I.[1], Harpke, D.[2], Ranđelović, V.[1]**

[1]Department of Biology and Ecology, Faculty of Science and Mathematics, University of Niš, Višegradska 33, Niš, Serbia

[2]Leibniz Institute of Plant Genetics and Crop Research (IPK); Corrrensstr. 3, Gatersleben, Germany

* milica.zeka@yahoo.com

*Crocus veluchensis* Herb. is an endemic species with a wide distribution on Balkan Peninsula. Inter-population differentiation of the species *C. veluchensis* was analyzed on the basis on morpho-anatomical variability of its four populations from Serbia (Kopaonik Mt., Stara Mt., Šar Mt., Vlasina) and two populatons from Greece (Smolika Mt., Velouchi Mt.). Analysis included 29 quantitative and qualitative characters related to whole plant morphology and leaf morphology and anatomy. In order to establish statistically significant differences between analyzed populations on the basis on analyzed characters, univariate analysis was conducted. Variability and significance of morpho-anatomical differentiation were examined using principal component analysis (PCA), discriminant component analysis (DCA) and cluster analysis.

**Acknowledgements**. This work was funded by the Ministry of Education, Science and Technological Development of Republic of Serbia (project no. 173030).

# Leaf anatomical characteristics of *Prospero autumnale* (L.) Speta (Hyacinthaceae) complex

**Vestek, A.[1]*, Luković, J.[1], Karanović, D.[1], Anačkov, G.[1]**

[1]University of Novi Sad, Faculty of Sciences, Department of Biology and Ecology, Trg Dositeja Obradovića 2, Novi Sad, Serbia

* ana.vestek@dbe.uns.ac.rs

Karyologically very variable complex *Prospero autumnale* over the area of distribution (from the Atlantic coast, southern parts of England, all over the Mediterranean to the Caucasus) is characterized by insufficiently differentiated conspicuous morphological characters, that would indicate differences between populations or species. The differences in morphological features are related to the quantitative and qualitative characteristics of the bulbs, leaves and some parts of the

flower. Nevertheless, it was described a large number of species within the complex throughout the distribution area, primarily based on the number of chromosomes. Thus, three species of this complex (*P. autumnale* s.s., *P. elisae* Speta i *P. paratethycum* Speta) are present in the Pannonian Plain and in the central part of Balkan Peninsula. In order to determine the existence of differences between the populations and mentioned species, detailed anatomical analysis of leaves was conducted. This research included examination of leaf anatomical characteristics of 10 populations collected in Serbia (Pannonian and Balkan part), FYR Macedonia and Montenegro. A total of 27 quantitative characters were analyzed and statistically processed using program Past ver. 3.11. The results of discriminant analysis (LDA) indicate a tendency to separate the populations from Pannonian Plain from the populations of the central part of Balkan Peninsula, which coincides with the distribution of species in the study area.

**Acknowledgements.** This work was funded by the Ministry of Education, Science and Technological Development of Republic of Serbia (project no. 173030).

# Species and species borders in *Gagea* sect. *Gagea*

**Harpke, D.[1]*, Peterson, A.[2], Tison, J-M.[3], Ranđelović, V.[4], Peruzzi, L.[5]**

[1]Leibniz Institute of Plant Genetics and Crop Research (IPK), Corrrensstr. 3, Gatersleben, Germany

[2]Institute of Biology, Martin Luther University of Halle-Wittenberg, Weinbergweg 10, Halle/Saale, Germany

[3]14, Promenade des Baldaquins, L'Isle d'Abeau, France

[4]Department of Biology and Ecology, University of Niš, Višegradska 33, Niš, Serbia

[5]Department of Biology, University of Pisa, via L. Ghini 5, Pisa, Italy

* doerte.harpke@gmx.de

Hybridization and geographical isolation seems to play an important role in the evolution of the species rich (about 60 species) Eurasian *Gagea* sect. *Gagea*. Hence, disentangling species relationships and determining species borders is challenging and often only possible by thoroughly morphological investigations of plants from all life stages as well as molecular investigations using maternal inherited chloroplast markers and bi-parental inherited nuclear markers. However, our morphological and molecular analysis of material from Central Asia and Europe within the last years resulted in the discovery and description of several new species. Also for the Balkan

Peninsula, the presence of a new, still undescribed, species is highlighted by molecular investigations, but more thoroughly morphological investigations are necessary.

We here present a phylogeny of *G.* sect. *Gagea* (including 50 accessions belonging to 28 taxa) focused on the detection of hybridization, speciation and radiation events. The problem of defining species borders in hybrid complexes of the group will be demonstrated and discussed.

## Anthropomorphic orchids of the Balkans - preliminary morphometric study

**Radak, B.[1]*, Bokić, B.[1], Knežević, J.[1], Rat, M.[1], Vestek, A.[1], Anačkov, G.[1]**

[1]Department of Biology and Ecology, Faculty of Sciences, University of Novi Sad, Trg Dositeja Obradovića 2, Novi Sad, Serbia

* boris.radak@dbe.uns.ac.rs

Anthropomorphic orchids belong to genus *Orchis* and present monophyletic group of 11 species that are widespread in the Eurasia, with center of diversity in the Eastern Mediterranean. This group has very specific appearance and relatively weak reproductive isolation mechanisms in some parts of their range and among certain species. Therefore, it provides a good base for exploring of the morphological variability. A total of 222 individuals from 22 populations of five species and two natural hybrid taxa from the southern, central and western part of the Balkan Peninsula and southern part of the Pannonian Plain (Fruška gora Mt.) were sampled. Analyses included 38 characters within the plant generative region (flower and bract). Dissected flowers were scanned and measured using Digimizer software ver. 4.5.2. Basic and multivariate statistical analyses (LDA, PCoA) were performed using the program Past ver 3.11. Results showed separation of *O. italica* as morphologically and geographically isolated species compared to other tested. *Orchis anthropophora* as the basal species of this group, is positioned next to *O. simia*, which according to some researches represents her sister species. The other three species (*O. simia*, *O. militaris* and *O. purpurea*) formed a well defined group of conspecific populations, whereas hybrid taxa (*O.* × *angusticruris* and *O.* × *hybrida*) were in the contact zones of the parent species. Obtained results are consistent with similar studies conducted in the Western Europe and are the basis for further analysis of this intriguing species group.

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

# Activities on working on botanical bibliography of Montenegro (1822-2016)

**ć, Z.[1]*, Pulević, V.[2]**

[1]Doclean Academy of Sciences and Arts, Podgorica, Montenegro

[2]Montenegrin Academy of Sciences and Arts, Podgorica, Montenegro

* zlatkobulic@t-com.me

Activities on collecting of literature and other botanical material in Montenegro have been realized since a long time ago. Till now, four publications regarding on Bibliography of flora and vegetation of Montenegro have been published. Firstly, within CANU edition, in 1980 it has been published basic bibliography by author Vukić Pulević Ph.D. that includes 1055 bibliographic units. Then in 1987 it was published its addition (author V. Pulević Ph.D.), including 428 bibliographic units. In 2004 "Second addition" (by authors V. Pulević and Z. Bulić), with 1357 bibliographic units was published, including not only botanical contributions published from 1987-2003, but all contributions that have been missing in previous bibliographies. "Third addition" (by authors V. Pulević and Z. Bulić) was published in 2012 and it contains 1010 bibliographical units.

Thus, according to previous editions of "Bibliographies" it has been processed 3466 bibliographic units regarding on fanerogams, cryptogams and fungi, as well as vegetation of Montenegro. After 2012 work on addition of bibliography has been continued and it currently includes about 300 units. By these four publications and work on fifth one it has been covered the whole research material since the earliest literature botanical sources from 1822 till current days.

Since the beginning, for work on "Bibliographies" it has been adopted principle that each bibliographic unit has to be shortly commented, making possible for reader to get precious and concise information on contents of each bibliographic unit. It gives specific value to "Biblographies" because each bibliographic unit has essential short review, commenting its most important scientific contribution.

Montenegrin botanists dominate in the long history of floristic and vegetation researches in Montenegro, covering almost all disciplines, such as Algology, Lichenology, Mycology, Bryology, Flora & Vegetation of Vascular Plants. This confirms intensified development of Botanical science and capacity building of the institutions and their professional staff.

# POSTER PRESENTATIONS

## Ecological properties of algae in mine pit lakes of Bosnia and Herzegovina

**Barudanović, S.[1], Mašić, E.[2]***

[1]Department of Biology, Faculty of Science, University of Sarajevo, Zmaja od Bosne 33-35, 71000 Sarajevo, Bosnia and Herzegovina

[2]Center for Ecology and Natural Resources - Academician Sulejman Redžić, 71000 Sarajevo, Bosnia and Herzegovina

* erminmasic@hotmail.com

In the territory of Bosnia and Herzegovina, due to different mining activities, affected by the underground and surface exploitation, permanent water bodies or mine pit lakes, were formed. Today, they are colonised by different types of organisms, where algae hold a special place in their biocenosis. For the purpose of this paper, ecological conditions and phytobenthos assemblages were compared in two mine pit lakes in Bosnia and Herzegovina (Veovača and Bistrik). Samples of the phytobenthos are collected during the summer and autumn season in 2013 and 2014. Analysis of the basic physical and chemical properties of the water was also performed. The research is based on cyanobacteria and algae samples collected in accordance with the methodology in compliance with the standards of the European Union Water Framework Directive (WFD, 200/60/EC). The multivariate statistical analysis was performed by using the software package PRIMER v6. With the aim of understanding the ecological differentiation of the phytobenthos assemblages with reference to the gradient of the measured physical and chemical parameters, the cluster and PCO analyses were used. The aim of the paper is to analyse the algae diversity with reference to different ecological conditions in the research area.

## Contribution to the knowledge of Ascomycota from southeast Serbia

**Kajevska, I.[1]*, Kuštera, M.[1], Cvijetan, I.[1], Stojanović, D.[1]**

[1]Mycological Society of Niš, Somborska 81A/9 Pantelej, 18000 Niš, Serbia

* iskra_kajevska@hotmail.com

Recently started mycological survey on biodiversity of Ascomycota from southeast Serbia resulted with a total number of 63 registered species belonging to 42 genera and 20 families. The aim of this paper was to present available data on

distribution, diversity and ecology of ascomycetes from selected ecosystems in the southeastern region of Serbia thus to contribute the knowledge of Ascomycota in Serbia. The list of species contains available and unpublished data of ascomycetes registered during field surveys conducted in different habitats of selected locations and should be considered as first data of Ascomycota from this part of the country. Among the identified species 10 are highlighted as rare and 4 are protected by national laws. Quantitative analysis of the ecological-trophic feature indicates the humus saprotrophs with the highest number of taxa (26).

# Ecological and Anatomical Investigations on *Hyacinthella campanulata* K. Perss. & Wendelbo in Turkey

**Akdağ, T.[1], Doğu, S.[2]*, Dinç, M.[2]**

[1]Department of Animal and Plants Production, Seydişehir Vocational School, Necmettin Erbakan University, Konya, Turkey

[2]Department of Biology, Ahmet Keleşoğlu Faculty of Education, Selçuk University, 42090 Konya, Turkey

* suleymandogu@gmail.com

The study has been performed on ecological and anatomical characteristics of the species of *Hyacinthella campanulata* K. Perss. & Wendelbo, which is a member of Asparagaceae family and an endemic species for Turkey. Plant and soil samples were taken from three different localities in the province of Konya, where its a natural distribution for the plant. As for, ecological studies, it was observed that this species generally prefers the soils which are clayed-loam-textured, slightly alkaline pH, rich in lime, poor in organic matter, low iron content, very little phosphorus, adequate magnesium and potassium and nonsaline. The studies were carried out on tranverse sections of scape and leaves, and surface sections of the leaves. Scape and leaf anatomy are similar in the studied species. The leaves are amphistomatic with anomocytic type stomata and mesophylles are isolateral.

# Comparative analysis of leaf epidermis of three species of the genus *Paeonia* L.

**Jušković, M.[1]*, Savić, A.[1], Manić, A.[1], Vasiljević, P.[1]**

[1]Department of Biology and Ecology, Faculty of Sciences and Mathematics, University of Niš, Višegradska 33, 18000 Nis, Serbia

* marinaju@pmf.ni.ac.rs

The goal of this study was to analyze variation in morphology of leaf epidermal characteristics (the shape and size of the epidermal cells on the adaxial and abaxial leaf surfaces, stomata type, distribution, number, size and surface area of stomata) three species of the genus Paeonia from Serbia. We analysed following species: *Paeonia tenuifolia* L., *P. peregrina* Mill. and *P. mascula* L. Analysis of variance was used to compare the epidermal characteristics of three species. All species have similar morphological features. However, some differences have been determined in between species. The adaxial and abaxial epidermis cells were usually irregular or polygonal shape. The anticlinal epidermal cell walls are undulating with shallow and deep amplitudes. Stomata of all taxa are anomocytic and occur only on the lower surfaces. Statistical analysis of the obtained data results showed that the surface area of adaxial epidermal cells, length stomata, width stomata and surface area of abaxial stomata have important role in have statistical significance in the formation of the difference between the studied species of the genus *Paeonia*. The morphological variability exhibited by the three species may be interpreted as relevant to the physiological behavior and ecological plasticity of genus *Paeonia*.

**Acknowledgements**. This research was supported by The Ministry of Education, Science and Technological Development (grant No. 173030).

# Nomenclatural notes on *Campanula versicolor* (Campanulaceae) and related names

**Janković, I.[1]*, Lakušić, D.[1], Kuzmanović, N.[1]**

[1]Institute of Botany and Botanical garden "Jevremovac", Faculty of Biology, University of Belgrade, Takovska 43, Belgrade, Serbia

* ijankovic@bio.bg.ac.rs

*Campanula versicolor* Andrews, commonly known as various-coloured bell-flower, is one of the members of *Campanula pyramidalis* complex. It is distributed in the southern part of the Balkan Peninsula - S Serbia, SW Bulgaria, Republic of Macedonia, Albania and Greece with small disjunction in SE Italy - Apulia and

Basilicata regions. Due to its high morphological variability, 19 taxa close to *Campanula versicolor* have been published (at specific and infraspecific level). However, taxonomic status of these taxa is not clear enough. In modern floristic literature and check-lists they are considered as synonyms within broadly defined *Campanula versicolor*. Considering the fact that there may be misinterpretations of their taxonomy in floras and checklists due to unsolved nomenclatural issues, after examination of the specimens from relevant herbarium collections, we are discussing possible type material of some of these names in the present work.

## Karyological variation in the genus *Soldanella* L. (Primulaceae)

**Štubňová, E.[1]*, Mártonfiová, L.[2], Hodálová, I.[1], Kochjarová, J.[1], Kučera, J.[1], Valachovič, M.[1], Slovák, M.[1]**

[1]Institute of Botany, Slovak Academy of Sciences, Dúbravská cesta 9, 845 23 Bratislava, Slovak Republic

[2]Pavol Jozef Šafárik University, Botanical Garden, Mánesova 23, Košice, Slovak Republic

* eliska.stubnova@savba.sk

The genus *Soldanella* (Primulaceae) is endemic to European mountain ranges and harbors ca. 20 taxa. Two sections, *Tubiflores* and *Soldanella*, delimited on the base of morphology and ecology has been traditionally recognized within this genus. Karyologically, have been all taxa reported to be diploids with two chromosome races, 2n=2x=38 and 40. Detail distribution of both races with respect to taxa, geographic pattern and variation in the absolute genome size (AGS) is however still uncertain. We investigated here overall karyological variation in the genus *Soldanella* (chromosome number, DNA-ploidy level and AGS) using direct chromosome counting and propidium-jodide flow cytometry. Chromosome counts for 19 taxa were obtained out of which majority possessed 2n=2x=40. Chromosome race with 2n=2x=38 was confirmed only in four species. The AGS was estimated for 247 individuals (97 populations, 23 taxa) and their 2C values ranged between 2.95 and 4.00 pg (maximum divergence 26.25%). The highest AGS values were detected in south-eastern part of the Balkan Peninsula however regardless of chromosome number. In contrast to previous expectations, no obvious differences in chromosome numbers and AGS were detected between the sections. Species possessing 2n=2x=38 can be separated in to three groups with significantly different AGS and disjunctive distribution area.

# Distribution and variability of *Centaurea kotschyana* Heuffel ex Koch from Central Balkans

**Novaković, J.[1]*, Zlatković, B.[2], Marin, P.D.[1], Lakušić, D.[1], Janaćković, P.[1]**

[1]University of Belgrade, - Faculty of Biology, Institute of Botany and Botanical Garden "Jevremovac", Studentski trg 16, 11000 Belgrade, Serbia

[2]Department of Biology and Ecology, Faculty of Science and Mathematics, University of Niš, Višegradska 33, 18000 Niš

* jelica@bio.bg.ac.rs

Carpatho-Balkanic species, *Centurea kotschyana* Heuffel ex Koch, belongs to subgenus Acrocentron, subtribe Cardueae (Asteraceae). The aim of this work was to integrate all available data of distribution of *C. kotschyana* from Balkan Peninsula and to present results of morphometric study of three natural populations of this species from Central Balkans. The data of distribution of *C. kotschyana* were obtained from the literature and herbaria (BEOU, BEO, BUNS, MKNH, SO, SOA, SOM, ZA, ZAHO, SARA). All data were georeferenced. Morphometric study included three populations - Kopaonik Mt., Šara Mt. and Stara Mt., which were selected as "a priori" defined groups in statistical analysis. The measurements included 60 individuals and 47 traits were analyzed, including morphometric, meristic and qualitative characters. Multivariate statistical analyses (PCA, CDA, CA) were performed. Given results showed that populations from Kopaonik and Šara Mt. (*C. k.* var. *diversifolia* (Murb.) Hayek) are similar, but clearly different in relation to population from Stara Mt. (*C. k.* var. *kotschyana*). Also, taxonomic significance of morphological characters was discussed.

**Acknowledgements**. The authors thank to the Ministry of Education, Science and Technological Development of the Republic of Serbia for financial support (Grants No. 173029 and 173030).

# Disentangling the evolution of the Balkan endemic *Cyanus napulifer* group (Asteraceae)

**Olšavská, K.[1], Slovák, M.[1], Marhold, K.[1,2], Štubňová, E.[1], Kučera, J.[1]***

[1]Institute of Botany, Slovak Academy of Sciences, Dúbravská cesta 9, SK-84523 Bratislava, Slovakia

[2]Department of Botany, Faculty of Science, Charles University, Benátská 2, CZ-128 01 Praha 2, Czech Republic

* jaromir.kucera@savba.sk

The Balkan Peninsula accommodates almost 27% of perennial species of the genus *Cyanus*. A large proportion of them belong to the taxonomically extremely complex *C. napulifer* group. To reconstruct the diversification within the *C. napulifer* group and to uncover its relationships with potential relatives with x = 10 from Europe and Northern Africa, we examined variation in genetic markers (AFLPs; 460 individuals), relative DNA content (DAPI flow cytometry, 330 individuals) and morphology (40 morphological characters, 710 individuals).

Fast-evolving AFLP markers proved to be a powerful tool in disentangling the evolution of *Cyanus* perennials. The *C. napulifer* group formed a genetically well-defined unit and remaining samples formed strongly diversified, mostly species-specific genetic lineages characterized by different DNA content. Our results confirmed the outlying position of *C. thirkei* which had until recently been considered a member of the *C. napulifer* group. Suprisingly, there appeared to be a close genetic affinity between the *C. napulifer* group and *C. epirotus* and *C. pindicola*. AFLP analyses showed extensive and recent radiation of the *C. napulifer* group and split it into nine allopatric (sub-)lineages. Incongruences among genetic, DNA content and morphological variation pointed to multiple secondary contacts between genetic lineages in the past.

**Acknowledgements**. This work was financially supported by the Slovak Research and Development Agency (APVV-0320-10) and Scientific Grant Agency of the Slovak Republic (VEGA 2/0096/15).

# Achene and receptacle micro-morphological characters and pericarp anatomy of wild annual sunflower species

**Lazarević, J.[1]*, Terzić, S.[2], Zorić, L.[1], Karanović, D.[1], Jocković, M.[2], Jocić, S.[2], Miladinović, D.[2], Luković, J.[1]**

[1]University of Novi Sad, Faculty of Sciences, Department of Biology and Ecology, Trg D. Obradovića 2, Novi Sad, Serbia

[2]Institute of Field and Vegetable, Crops, Maksima Gorkog 30, Novi Sad, Serbia

* jelena.lazarevic@dbe.uns.ac.rs

In this paper we analyzed five annual species of wild sunflower: *Helianthus annuus* L., *H. argophyllus* Torr. et A. Gray, *H. petiolaris* Nutt., *H. praecox* Engelm et A. Gray and *H. debilis* Nutt. The aim of this research was characterization of species on the basis of micro-morphological and anatomical characteristics of achene and receptacle. Morphological measurement of receptacle and achene were performed using stereoscopic microscope Leica MZ16 with Leica DFC 320 Camera, while micro-morphological diversity of achene surface was assessed using scanning electron microscopy. For anatomical observation cross sections of pericarp were obtained from the middle part of achene with Leica CM 1850 cryostat and observations were performed using Image Analyzing System Motic 2000. Obtained results clearly indicate that the micro-morphological features and colour of receptacle surface were similar among analysed species, except for *H. petiolaris* which had the most pronounced relief and the darkest colour of receptacle surface. Analysed species were differentiated on the basis of achene size, colour and wax development on its surface. In all species pericarp was differentiated into several layers (epidermis, hypodermis, sclerenchyma and parenchyma) with clearly noticeable pigment of phytomelanin between hypodermis and sclerenchyma. *H. annuus* and *H. petiolaris* were species with the most developed layer of hypodermis. Sclerenhyma was made of several layers of thick walls cells, and most developed in *H. annuus* and *H. argophylus*.

**Acknowledgements**. This work is a part of project TR31025, supported by Ministry of Education, Science and Technological Development, R. Serbia. The authors would like to thank Mr Milos Bokorov from Univ. Center for Electron Microscopy, Novi Sad, for his technical assistance and SEM microscopy.

# Comparative leaf anatomical investigations of species *Crocus alexandrii* Ničić ex Velen. (Iridaceae) from Serbia

**Jušković, M.[1]*, Mitić, M.[1], Ranđelović, N.[1], Ranđelović, V.[1]**

[1]Department of Biology and Ecology, Faculty of Sciences and Mathematics, University of Niš, Višegradska 33, 18000 Nis, Serbia

* marinaju@pmf.ni.ac.rs

This research focuses on the inter-population differentiation of the species *Crocus alexandrii* Ničić ex Velen. on the basis of anatomical variability of leaves. The anatomical analysis involved 18 quantitative parameters of leaf, from five populations from Serbia (Mt. Seličevica, Mt. Sokolica, Mt. Pasjača, Bublica, Pržar). Leaves show useful taxonomical features according to mesophyll, vascular bundles, keel and arms of the leaf. Principal component analyses (PCA) and canonical discriminant analysis (CDA) were used to establish the overall anatomical variability and relationships between individuals from all populations. Analysis of variance of the individual character of the populations *C. alexandrii* shows that all the characters have high statistical significance in the formation of the difference between populations. The largest morphological differentiation between populations from Mt. Pasjača and populations from Mt. Sokolica, while the greatest similarity between the populations from Bublica and Pržar. Among other populations comes to partial overlap, where population from Mt. Seličevica overlaps with all study populations, except with a population of Mt. Pasjača.

**Acknowledgements**. This research was supported by The Ministry of Education, Science and Technological Development (grant No. 173030).

# Morphological differentiation of the South Serbian *Bolboschoenus* taxa

**Mijić, J.[1]*, Jenačković, D.[1], Nikolić, D.[1], Ranđelović, V.[1]**

[1]Department of Biology and Ecology, Faculty of Science and Mathematics, University of Nis, Višegradska 33, 18000 Niš, Serbia

* jmjmichy@gmail.com

Twelve populations of *Bolboschoenus* taxa were collected from salt and fresh marches placed in the south Serbia. Standard statistical analysis including Descriptive statistics, PCA and CDA were performed in order to establish differentiation of

populations based on inflorescences and fruits morphology. PCA has shown that variables responsible for the differentiation along the first axis are the following: number of branches in inflorescences, number of spikelets on branches and achene length. Characters contributing to differentiation along second axis are: length of sessile spikelets and length of spikelets on rays. The only character which contribute to the third axis is number of sessile spikelets. According to the results of CDA analysis the populations analyzed are differentiated in two groups which morphologically correspond to taxa *B. maritimus* and *B. glaucus*. The results of this research confirm existence of more than one species of the genus *Bolboschoenus* in Serbia and indicate necessity of the future investigations.

**Acknowledgements**. This work was funded by the Ministry of Education, Science and Technological Development of Republic of Serbia (project no. 173030).

# Diversity of *Sesleria* species (Poaceae) and their habitats on vertical profile of Mt. Pirin (Bulgaria)

**Kuzmanović, N.[1]*, Lakušić, D.[1]**

[1]Institute of Botany and Botanical Garden Jevremovac, Faculty of Biology, University of Belgrade, Takovska 43, 11000 Belgrade, Serbia

* nkuzmanovic@bio.bg.ac.rs

The genus *Sesleria* Scop. (Poaceae) comprises ca. 40 mostly European species, with a centre of diversity on the Balkans. The group ("Turma") *Coerulans* of the genus *Sesleria* belongs to *Sesleria* sect. *Sesleria*, and represents one of the most complicated group within the genus. Species belonging to this group are mostly high mountain species, either indifferent against soil acidity or even acidophilus. They are characterized by significant hairiness of lemmas and paleas, and by this feature they can be easily distinguished from other species in the genus. However, within the group, the distinction is rather difficult.

Based on several years of field experience, we selected a well suited study system for investigating differentiation within the group *Coerulans* of the genus *Sesleria*. It is provided by several sympatric species occurring on Mt. Pirin in Bulgaria. On the vertical profile from cc. 1900 in Banderica valley, up to the peak Vihren (2914 m), we identified the following species: *Sesleria coerulans*, *S. comosa*, *S. klasterskyi*, *S. orbelica* and *S. cf. tenerrima*. The contact zones of these species are developed as "mosaic zones" with different species patchily distributed along different ecological environments.

# Checklist of grasses (Poaceae) of Bosnia and Herzegovina

**Sarajlić, N.[1]***

[1]Ornithological Society "Naše ptice", 71000 Sarajevo, Bosnia and Herzegovina

* nermina_sarajlic@yahoo.com

The first data about the flora of Bosnia and Herzegovina were published during the end of the 19th century and systematized in Beck-Mannagetta's Flora, published between 1903 and 1927, which was later updated by other botanists, notably Maly and Bjelčić. However, in the latest version of Flora of Bosnia and Herzegovina, published between 1967 and 1983, the grass family (Poaceae) was not elaborated. This paper aims to present the complete list of grasses of Bosnia and Herzegovina. The list includes all genera, species and subspecies found in available data, including literature sources, the specimens from the Herbarium of National Museum of Bosnia and Herzegovina (SARA) and specimens originating from Bosnia and Herzegovina deposited in European herbaria and available in virtual herbaria online. All taxa are accompanied by reference data. There are, undoubtedly, errors in identification due to the fact that there are many literature sources in which only plant names (without authors) are given, and it was impossible to determine their synonyms and currently accepted names. Also, since there is no complete botanical bibliography of Bosnia and Herzegovina, it is likely that this list is not complete, so it remains open for completion and revision.

**Acknowledgements**. The author would like to thank prof. dr Vladimir Ranđelović from the Faculty of Science and Mathematics of University of Niš for valuable suggestions and advices and Ermana Lagumdžija and Dražen Kotrošan from the National Museum of Bosnia and Herzegovina for suggestions and examination of plant material deposited in the Herbarium.

# Medicinal plants of the Sharr Mountains

**Abdii, N.[1]*, Xhulaj, M.[2]**

[1]Tetova University, Biology Department, Macedonia

[2]Tirana University, Biology Department, Albania

* nasufabdii@gmail.com

The scientific paper contains data on Sharr Mountain plant species that have medicinal value. Collection of scientific material is carried during the whole vegetative spring-autumn period (March 2013-November 2015) preparing herbarium associated with data for landfill, date, biotope etc. During this scientific research was noticed that the total number of plant species collected at Mount Sharr are about 600 plant species. They belong to 73 families and 217 herbal genders and 75 plant species.

# The ornamental plants in the Seydişehir campus area of Necmettin Erbakan University

**Akdağ, T.[1]*, Doğu, S.[2], Dinç, M.[2]**

[1]Department of Animal and Plants Production, Seydişehir Vocational School, Necmettin Erbakan University, Konya, Turkey

[2]Department of Biology, Ahmet Keleşoğlu Faculty of Education, Selçuk University, 42090 Konya, Turkey

* turanakdag570@gmail.com

Present study was carried out between 2014-2015 years and ornamental plants of Necmettin Erbakan University Seydişehir Campus Area have been identified. Plants belong to area consist of 53 taxa; as 35 tree/ shrub form and 18 are herbaceous form. In addition, Turkish and Latin names of these ornamental plants which belong to family and homeland are indicated.

# Taxonomical analysis of herbarium specimens deposited in HMN (Herbarium Moesiacum Niš)

**Nikolić, D.[1]*, Marković, M.[1], Raca, I.[1], Ljubisavljević, I.[1]**

[1]Department of Biology and Ecology, Faculty of Science and Mathematics, University of Niš, Višegradska 33, Niš, Serbia

* danid@pmf.ni.ac.rs

The collection Herbarium Moesiacum Niš presently includes 25354 specimens collected in the last 60 years, mostly in south-eastern Serbia but also in other countries of Balkan Peninsula. The Collection has not been officially registered yet. The greatest contributions to the Herbarium were by Dr Novica Ranđelović and Dr Vladimir Ranđelović, who transferred their private collection (Herbarijum Mesiacum Doljevac) to HMN. HMN also includes the herbarium collection by Vidak Jovanović (2000 specimens). Collections by Dr Marija Marković (10987 specimens) and Dr Marina Jušković (2087 specimens), analysed within the recent studies, are also deposited in HMN. Another great contribution to formation of HMN was by Dr Bojan Zlatković. Taxonomic analysis was performed on 12280 specimens. The results have shown presence of 2072 species within 666 genera and 130 families. The most abundant families are Asteraceae (246), Poaceae (185), Caryophyllaceae (124), Rosaceae (121) and Lamiaceae (114). Families with the highest number of genera are Poaceae (72), Asteraceae (66), Apiaceae (46), Brassicaceae (39) and Lamiaceae (29). Genera with the highest number of species are *Carex* (40), *Ranunculus* (33), *Centaurea* (30), *Potentilla* (30) and *Crocus* (29).

**Acknowledgements**. This work was funded by the Ministry of Education, Science and Technological Development of Republic of Serbia (project no. 173030).

# 12th Symposium on the Flora of Southeastern Serbia and Neighboring Regions

Kopaonik Mt. 16th-19th June, 2016

## Phytogeography, Floristics and Phytoecology

# ORAL PRESENTATION

## Floristic diversity in Bashemsin valley of Kachkar mountains national park of Rize, Turkey

**Baykal H.[1]*, Atamov V.[2]**

[1]Department of Plant and Animal Breeding, Pazar Vocational School, Recep Tayyip Erdogan University, 53300 Pazar, Rize-Turkey

[2]Department of Biology, Faculty of Arts and Sciences, Recep Tayyip Erdogan University, 53100, Rize-Turkey

***** huseyin.baykal@erdogan.edu.tr

In this study, flora, phytosociology and ethnobotanical features of Başhemşin (Çamlıhemşin/Rize) and its environs were studied. 518 taxa, 36 of them are endemic, were identified included into 260 genera and 74 families. Of the identified taxa it was determined that 1 species belongs to Lycopodiophyta; 14 species belong to Pteridophyta and 410 species, 10 subspecies, 1 variety and 2 hybrid species belong to Spermatophyta division. The richest families about taxa are: Asteraceae (57), Poaceae (50), Fabaceae (29), Brassicaceae (29), Rosaceae (26), Lamiaceae (22), Caryophyllaceae (21), Cyperaceae (17), Apiaceae (15), Boraginaceae (15) and Ranunculaceae (15). It was found that 229 hemicryptophytes, 145 cryptophytes, 62 therophytes, 57 chamaephytes, 17 phanerophytes, 3 nanophanerophytes, 2 vascular parasites, 1 nanophanerophyte/chamaephyte and 1 hydrophyte in life spectra of taxa. It was determined that there are 224 Euro-Siberian, 21 Irano-Turanian and 11 Mediterranean phytogeographic region elements in the study area.

## Endemic Plants of Balkusan Valley (Ermenek-Karaman) Turkey

**Doğu, S.[1]*, Dinç, M.[1]**

[1]Department of Biology, Ahmet Keleşoğlu Faculty of Education, Necmettin Erbakan University, 42090 Konya, Turkey

* suleymandogu@gmail.com

This research was carried out to determine the flora of Balkusan valley. Research area is Balkusan Valley which is located Ermenek province. The research area is in the C4 square according to Davis's Grid system. The study was carried out

between 2010– 2012, and 789 vascular plant samples were collected. As a result of identification of the collected plant specimens 93 endemic taxa have been determined and the endemism ratio is 20.2%. Threat categories of endemic taxa deployed in this study area are as follows; 1 taxa CR, 9 taxa EN, 10 taxa VU,7 taxa NT, 66 taxa LC. Known only from their types, Arenaria speluncarum McNeill and Silene capillipes Boiss et Heldr were collected for the second time.

# Orchid flora of the Muntele Mic (Caraş – Severin Country, Romania)

**Milanovici, S.[1]***

[1]Natural Science Section, Banat Museum Timișoara, Timiș County, Romania

* milanovici.sretco@wildcarpathiangarden.com

Muntele Mic Mountain, part of the mountain massif Retezat - Godeanu, is located in the southeastern part of Romania and belongs to the Southern Carpathians. Although relatively small, Muntele Mic contains most characteristic mountain and high-mountain habitats.

The field researches regarding the orchids family in the Muntele Mic area, the species inventory, the inventory, distribution, size and dynamics of populations as well as the acknowledgment of the threats with impact upon the orchid species and populations have been began in the spring of 2009.

Thanks to easy access (asphalt road that goes to the tourist center of Muntele Mic), although it is classified as part of the European Natura 2000 network, was suported strongly negative anthropogenic impact factors.

Although considered a very antropized, field research, it was concluded that there is growing 10 species of orchids, of which several, rare alpine species, is not mentioned in the literature data.

# Exploration of the bryophyte flora of Serbia last five years

**Papp, B.[1]*, Szurdoki, E.[1], Sabovljević, M.[2], Sabovljević, A.[2], Pantović, J.[2], Ódor, P.[3]**

[1]Hungarian Natural History Museum, Botanical Department, H-1431, Budapest, P.O.B. 137, Hungary

[2]Institute of Botany and Botanical Garden, Faculty of Biology, University of Belgrade, Takovska 43, 11000 Belgrade, Serbia

[3]HAS Ecological Research Centre, Ecological and Botanical Institute, 2163. Vácrátót, Alkotmány u. 2-4, Hungary

* pappbea@nhmus.hu

Thanks to a common project of the Serbian Academy of Science and Art and the Hungarian Academy of Science the study of the bryophyte flora of Serbia has been continued last years in previously bryologically unexplored areas, like Pešter plateau and Ibar valley. Special attention was paid to the European red listed and regionally rare species.

More than 700 bryophyte specimens collected in the studied areas were deposited in the Bryophyte Herbarium of the Hungarian Natural History Museum. In Pešter plateau 211 bryophyte taxa (37 liverworts and 174 mosses) were found, while in Ibar valley 125 taxa (12 liverworts and 113 mosses). Pešter plateau is a limestone area, but serpentine outcrops can also be found; in Ibar valley serpentine rocks predominate. Serpentine has unique bryophyte flora similarly to its higher plant flora; hence several new regional records were explored. 9 bryophyte species were reported for the first time from Serbia: *Riccia canaliculata, Scapania praetervisa, Bryum canariense, Myurella sibirica, Pseudoleskeella rupestris* from Pešter plateau, and *Dialytrichia mucronata, Didymodon nicholsonii, Grimmia lisae, Gymnostomum viridulum* from Ibar valley. New populations of four European red listed species were discovered; *Buxbaumia viridis* was found on both sites, while *Lophozia ascendens, Hamatocaulis vernicosus, Myurella sibirica* in Pešter plateau. In addition, several species rare in the Balkans were also recorded.

# A recent floristic account of Pirin mountain algae and their conservation value

**Uzunov, B. A.[1]*, Gärtner, G.[2], Stoyneva-Gärtner, M. P.[1]**

[1]Department of Botany, Faculty of Biology, University of Sofia "St Kliment Ohridski", 8 Dragan Tsankov Blvd, Sofia-1164, Bulgaria

[2]Botanical Institute, University of Innsbruck, Sterwartestraβe 15, A-6020 Innsbruck, Austria

* buzunov@uni-sofia.bg

The results from the algological studies in Pirin Mt (Bulgaria) carried out during the last 12 years are presented. During this period samples from more than 50 sites in the mountain have been taken and a more than 200 prokaryotic and eukaryotic algal taxa was recorded (except diatoms). The algae found belong to different ecological groups (limnophyton, soil and aerophytic algae). A comparison with previous studies was made and it can be stated that more than 80 taxa are new for the mountain algal flora. According to the Red List of Bulgarian algae 10 recently found taxa have conservation status and for 2 more taxa such status is proposed.

# Vascular plant flora of Ljubljana (Slovenia)

**Jogan, N.[1]*, Strgulc-Krajšek, S.[1], Bačič, M.[1]**

[1]Department of Biology BF UL, Večna pot 111, SI-1000 Ljubljana, Slovenia

* nejc.jogan@bf.uni-lj.si

After more than 250 years of floristic activity, flora of Ljubljana was mapped systematically for the first time in 2015. Wider area of the city was divided into 70 mapping units 1x1 km each, in each unit three working days spent, one in each season. Within mapping units an irregular network of polygons with similar ecological conditions was used for field mapping so more than 1000 species were recorded with 38.000 field records. It is not easy to compare this data with the historical ones that report over 1200 taxa for Ljubljana, because in previous times spatial accuracy of records had been quite low, but there are some reliable older records of taxa that are locally extinct today mostly due to urbanization. On the other hand several new taxa were recorded especially as naturalized alien plants, among them, some invasive taxa that had been overlooked before as e.g. Cornus sericea. But also some rare species not recorded in the vicinity before were found, such is the case of several thermophilous taxa previously known only in the Coastal Slovenia. In addition to already known

spots of high nature conservation value, concentration of threatened taxa suggests some other remnants of well preserved wet forests or other wetland habitats.

**Acknowledgements**. Project was financed by Municipality of Ljubljana.

# Invasive flora of the Medvednica Mt (Croatia)

**Alegro, A.[1]*, Šegota, V.[1], Vuković, N.[1]**

[1]Division of Botany, Department of Biology, Faculty of Science, University of Zagreb, Marulićev trg 20/II, HR-10000 Zagreb, Croatia

* antun.alegro@biol.pmf.hr

Medvednica Mt (1,035 m) is situated in central Croatia and it is an ancient, bulky massif created by Neogene movements. It is mainly in the zone of beech forests (Fagion sylvatice), with lower belt in the zone of sessile oak (Carpinion betuli and Quercion robori-petreae). Although the capital of Croatia, Zagreb, is situated on the southern foothill of Medvednica, the forest vegetation is well preserved. Lower parts and foothills of both slopes are under the stronger and centuries lasting anthropogenic pressure. This process has created a range of secondary habitats suitable for colonization of alien plants. The aim of this work was to gain information about invasive species, their quantity and invaded habitats. In total, 28 invasive species were recorded, but they significantly differ in their invasion potential and distribution. Regarding invaded habitats, edges of roads and paths are those with the highest number of findings, but they are mostly colonized by annuals, weakly concurrent in closed natural or seminatural habitats. In total, on 14 habitat types invasive plants were recorded. Main threat for biodiversity are abandoned fields and grasslands overgrowing by perennial herbaceous invasive species (*Solidago gigantea, S. canadensis, Artemisia verlotiorum*), and later by woody *Robinia pseudoacacia*.

# Vascular flora of the Natural Monument "Sopotnica Waterfalls" (Southwestern Serbia)

**Tmušić, G.[1]*, Radak, B.[1], Bokić, B.[1], Anačkov, G.[1]**

[1]University of Novi Sad, Faculty of Sciences, Department of Biology and Ecology, Trg Dositeja Obradovića 2, 21000 Novi Sad, Serbia

* goran.tmusic@dbe.uns.ac.rs

Natural Monument "Sopotnica Waterfalls" is located in southwestern Serbia, on the western slopes of Jadovnik Mt. This area covers 200 ha in the vicinity of Sopotnica village, around the Sopotnica river, Prijepolje municipality. Field researches were conducted during 2014 and 2015 years, in all vegetation periods. A total of 384 taxa of vascular flora, grouped in 78 families and 243 genera were registered at species and subspecies level. Families with the largest number of taxa were Asteraceae, Poaceae, Fabaceae and Orchidaceae while the richest genera were – *Ranunculus, Veronica, Orchis, Carex* and *Trifolium*. Chorological analysis showed that the greatest number of registered taxa belongs to Centraleuropean and Euroasian areal types. The analysis of the life forms indicates domination of hemicriptophytes, with a large number of geophytes. Our study confirmed 18 species as strictly protected and 49 as protected, from which 29 species are under Directive on control of use and trade of wild plant and animal species. A relatively high percentage of protected species, along with a great diversity of habitats, emphasize floristic importance of this area.

**Acknowledgments**: This research was supported by Scientific Research Society of Biology and Ecology Students "Josif Pančić", Novi Sad.

# Phenotypic variability and plasticity of *Silene waldsteinii* Griseb. (Caryophyllaceae)

**Đurović, S.[1]*, Tomović, G.[1], Buzurović, U.[1], Niketić, M.[2]**

[1]University of Belgrade, Faculty of Biology, Institute of Botany and Botanical garden "Jevremovac", Takovska 43, 11000 Beograd, Serbia

[2]Natural History Museum Beograd, Njegoševa 51, 11000 Belgrade, Serbia

* sdjurovic@bio.bg.ac.rs

*Silene waldsteinii* is endemic to the Balkan Peninsula. It exclusively inhabits silicate rocks in alpine and subalpine regions of the mountain ranges in Albania,

Greece, Bulgaria, Republic of Macedonia and Serbia. We examined morphological variability of *S. waldsteinii* collected on 13 sites, covering the whole species range, using classical morphometrics. Geographically most closely positioned populations were morphologically the most similar, so we analyzed three occurrence sites and common garden set of the material from those sites, to assess the potential role of ecological factors in the evolution of observed morphological patterns. Five morphological characters (length of calyx tooth, capsule, longest internode and pedicel, and number of the flowers) mostly contributed to discrimination between material from occurrence sites and common garden set. Only length of the pedicel showed no correlation with 19 bioclimatic variables (Worldclim). Therefore, geographic patterns of morphological variability of *S. waldsteinii* are most likely the consequence of phenotypic plasticity. However, genetic basis of morphological patterns wasn't examined in this study and can't be disregarded.

# Genus *Viola* L. (Violaceae) in Vojvodina based on specimens from the collection of the Faculty of Sciences, University of Novi Sad, Serbia (BUNS)

**Tomović, G.[1]*, Niketić, M.[2]**

[1]Institute of Botany and Botanical Garden "Jevremovac", Faculty of Biology, University of Belgrade, Belgrade, Takovska 41, 11000 Belgrade, Serbia

[2]Natural History Museum, Njegoševa 51, 11000 Belgrade, Serbia

* gtomovic@bio.bg.ac.rs

This paper presents the information on herbarium specimens of the genus *Viola* L. from Vojvodina province deposited in the collection of the Faculty of Sciences, University of Novi Sad (BUNS). Overall, 713 herbarium sheets were examined of which 484 specimens are from Vojvodina province. Overall, 13 species of the genus *Viola* were registered in the flora of Vojvodina, of which 10 species from the section *Viola* and 3 species from the section *Melanium* Ging. The highest number of herbarium sheets was for V. alba Besser (146 - total, 126 - from Vojvodina) and for *V. arvensis* (127 - total, 105 - from Vojvodina), while for the species *V. elatior* Fr. only two specimens were found (only one from Vojvodina). Distribution maps of all the analyzed species will be presented and commented. In addition, special attention will be paid to the distribution, population size as well as threatened status of three rarest species in the flora of Vojvodina province: *V. elatior* Fr. and *V. pumila* Chaix. and *V. rupestris* F. W. Schmidt.

# Rujan Mountain – center of diversity of the genus *Crocus* L. on the Balkan Peninsula

**Ranđelović, N.[1], Hristovski, N.[2], Ranđelović, V.[1]***

[1]Department of Biology and Ecology, Faculty of Sciences and Mathematics, University of Niš, Višegradska 33, 18000 Niš, Serbia

[2]Faculty of Biotechnological Sciences, University of Bitola, Prilepska, P.O. Box 53, 7000 Bitola, Macedonia

* vladar@pmf.ni.ac.rs

The genus *Crocus* comprises about 180 species, of which there are 43 in Europe and 32 on the Balkan Peninsula. From 32 known species from the Balkan Peninsula, 7 species are distributed on the Rujan Mt., which is situated on the border of Serbia and Macedonia. Those species are *Crocus rujanensis, C. pallasii, C. kosaninii, C. chrysanthus, C. pallidus, C. flavus* and *C. olivieri*. According to number of species, the Rujan Mt. is area with the highest diversity of the genus *Crocus* on the Balkan Peninsula. *C. rujanensis* is local endemic species, while *C. kosaninii* and *C. pallidus* are moesian-scardic-pindhian endemic species. *C. rujanensis* is critically endangered species in flora of the Balkan peninsula. Also, the Rujan Mt. is unique locality in Serbia due to presence of another two species, *C. pallasii* and *C. olivieri*. Populations of those two species have high number of specimen on Macedonian side of the mountain, while populations on Serbian side consist from very small number of specimen inhabiting the area of the Veliki Orljak peak.

# Rare ephemeral bryophytes in Mediterranean part of Croatia

**Šegota, V.[1]*, Alegro, A.[1], Vuković, N.[1], Sedlar, Z.[1]**

[1]Division of Botany, Department of Biology, Faculty of Science, University of Zagreb, Marulićevtrg 20/II, HR-10000 Zagreb, Croatia

* vedran.segota@biol.pmf.hr

Ephemeral mosses and liverworts are common members of Mediterranean bryoflora. Long dry summer season is unfavourable for their yearlong survival; therefore bryophytic communities in the Mediterranean rejuvenate from their spores or dried thali along with late autumn and winter rains. During the winter season 2015-2016 ephemeral bryophlora of Croatian littoral was studied in Northern (southern

Istria) and Central Adriatic (island of Molat). *Ephemerum stellatum* H. Philib was found to be a new taxon for Croatian bryophlora, while locality of *Ephemerum minutissimum* Lindb. is the second known for state territory. For *Fossombronia echinata* Macvicar, known in Balkan only from Greece and Croatia, island of Molat is the third known locality. On the contrary, *Fossombronia caespitiformis* De Not. ex Rabenh. subsp. *caespitiformis* and *Fossombronia caespitiformis* De Not. ex Rabenh. subsp. *multispira* (Schiffn.) J.R. Bray & D.C. Cargill were found to be more frequent. Genus *Riccia* was represented with largest number of ephemeral species: *R. michelii* Raddi, *R. nigrella* DC., *R. sorocarpa* Bisch. and *R. subbifurca* Warnst. ex Croz. Fairly common species (based on historical data), *Oxymitra incrassata* (Brot.) Sérgio & Sim-Sim and *Southbya nigrella* (De Not.) Henriq. were, on the contrary, found very rarely. Croatian bryoflora is generally understudied, therefore future field surveys are of high-priority.

# Importance and protection of botanical gardens of mountain flora in Montenegro

**Bulić, Z.[1]*, Doderović, M.[2], Markišić, H.[3], Glomazić Bulić, Lj.[4], Bulić, I.[5]**

[1]Doclean Academy of Sciences and Arts, Podgorica, Montenegro
[2]Faculty of Philosophy, Department of Geography, University of Montenegro, Nikšić, Montenegro
[3]Gymnasium „30. Septembar“, Rožaje, Montenegro
[4]GLB company, Podgorica, Montenegro
[5]Faculty of Sciences and Mathematics, Department of Biology, University of Montenegro, Podgorica, Montenegro

* zlatkobulic@t-com.me

There are following botanical gardens in Montenegro: botanical garden „Dulovine“ of Vincek's family in Kolašin, botanical garden „Velemun“ of family Praščević in Plav, botanical garden „Bindža“ of family Perić, botanical garden of Vinka Blagojević Bulić and botanical garden NP „Durmitor“ etc. The first mountainous garden of mountainous flora of Montenegro, located in Kolašin on site called Dulovine , is situated on the altitude of around 1000 m and covers the surface area of around 500 m². Thanks to favourable geographical position and climate conditions, as well as to the other factors, around 400 of plant species of mountainous flora is successfully grown in the garden. In course of ten years` garden existence the plants have mainly been collected from Montenegrin mountains: Bjelasica, Sinjavina, Komovi, Durmitor, Hajla, Prokletije, Moračke planine, and successful atempts of

adaptation of plants from coastal mountains: Rumija, Orjen and Lovćen as well as the canyon of the Cijevna River (for example the species: *Tulipa grisebachina, Gymnospermium scipetarum, Fritillaria gracilis* and other) are notable. Special attention has been paid to monitoring of adaptation of protected, endemic and rare plant species, and some phenological observations have been made. In scope of arrangement of physical structure permanent experimental groups of plants have been formed: ephemera, endems, protected and endangered plants, endems of SE Europe, Ilyrian endems in flora of Montenegro, quarryplants (genus *Saxifraga*), plants of Hajla Mountain, bushes and semibushes, groups of more significant genera like: *Daphne, Crocus, Allium, Edraianthus* and other. Botanical Garden "Velemun" is situated in village Brezojevica in municipality of Plav, on the left brink of the river Lim and under the tops of giant mountain Visitor and mountain chain of Prokletije. Idea for forming of Botanical Garden came in 1993 by professor of biology Milutin Praščević, who, together with his friends Daniel Vincek, Nebojša Menković, Halil Markišić and others planted first plants from mountains that gravitate to municipality of Plav. Garden is located on 920 m altitude sea-level with surface of 520 m2. Garden got a name by very decorative plant from the family of gentian – Gentiana kochiana, in the people called velemun. During previous almost vicennial existence significant number of plants has been planted in the Garden, more than 350 species, mostly from mountains of Prokletije massif as well as from other Montenegrin mountains. Big number of endemic, relic, rare, threatened, as in other way important and useful plant species grow in the Garden, as following ones: *Leontopodium nivale, Gymnospermium schipetarum, Iris reichenbachii* var. *bosniaca, Fritillaria graecillis, Crepis dinarica, Amphoricaros autariatus* ssp. *bertisceus, Achillea abrotaoides, Edraianthus tennuifolius, E. montenegrinus, E. vesovicii, Scabiosasa silenifolia, Valeriana pancicii, Plantago reniformis, Pancicia serbica, Viola orphanidis* ssp. *nikolai, Euphorbia montenegrina, Pontetilla montenegrina, Raninculus scutatus, Silene sendtneri, Picea omorika, Pantetilla apennina, Senecio thapsoides* ssp. *visianainus, Centaurea gjurassini* etc. During previous existence Garden became indispensable point for numerous researchers, mostly botanists, mountaineers, as for big number of tourists, studenats and pupils and nature fans. Numerous professional and scientific institutions from Montenegro and abroad dealing with research of flora and vegetation and nature in general have long-term successful collaboration with Botanical Garden in Plav. This paper gives basic characteristics of the Garden, review of previous activities and plans for the next period. It is underlined importance of this botanical object as potential object of the protection of nature accordingly monument of nature. It is expected finalization of procedure for the protection of this space as a new protected object of nature in Montenegro in the collaboration with the Enviromental Protection Agency of Montenegro.

# Ecological problems of karst areas of Montenegro

**Doderović, M.[1], Bulić, I.[2], Bulić, Z.[3]*, Burić, D.[4]**

[1]Faculty of Philosophy, Department of Geography, University of Montenegro, Nikšić, Montenegro

[2]Faculty of Natural Sciences & Mathematics, University of Montenegro, Podgorica, Montenegro

[3]Doclean Academy of Sciences and Arts, Podgorica, Montenegro

[4]Hydrometeorological and Seismological Service of Montenegro, Podgorica, Montenegro

* zlatkobulic@t-com.me

Montenegro is an area of vast mountain ridges and surface, deep and narrow river valleys and only a small number of low level planes. In its total area, with just over 90% share, the area above 200 meters above sea level dominates. Hilly and mountainous areas of 200 - 1000 meters above sea level cover about 35% of the territory. The mountainous region of 1000-1500 meters above sea level covers about 45%, while the highest parts of the mountains over 1500 meters above sea level accounts for about 15% of the territory. Below 1000 m above sea level is approximately 45% of the territory, in which about 15% are areas up to 500 meters above sea level and 29% of the area of 500 - 1000 meters above sea level. The territory of over 1700 meters above sea level as a very high mountain, and thus, in terms of the development of restrictive category area covers about 8.5% of the area.

Waterless end, scarcity of land, nakedness significant parts of the area and the harsh conditions of communication, both internally and with neighboring areas, have strong reflection of the living conditions of the area and its relatively low population density.

On the other hand, the agriculture overpopulation related to the fields, valleys and other sites that offer more conditions for the development of mostly small subsistence farming on small holdings, and to some extent the development of animal husbandry, has long been a major cause of permanent migration from these areas. So today, despite the significant changes, particularly in terms of improving traffic conditions. The result is a tendency, gradual or continuous, leaving relatively numerous villages and contrast, the concentration of the centers, which in the case of Cetinje shows the first signs of saturation.

# POSTER PRESENTATION

## Diatom flora of the Narta Lagoon and effectiveness of diatom indices in water quality assessment

**Xhulaj, S.[1]***

[1]Research Center of Flora and Fauna, Faculty of Natural Sciences, University of Tirana, Bulevardi "Zogu I" 25/1, Tirana, Albania

* skerdilaid.xhulaj@fshn.edu.al

The present study aims to analyze the species composition of the diatom flora, assessing the current state of the Narta Lagoon environment based on indicative properties of diatoms, and evaluating diatom indices in terms of their usefulness in water quality assessment. A total of 207 diatom species of 53 genera were identified in the samples. The Centrales were comprised by 30 species whilst the Pennales contributing 177 species. Light microscope counts were processed with OMNIDIA software to produce diatom indices. The diatom flora structure and relations between assemblages at individual sites were explored with multivariate analyses. Applicability of diatom indices in assessing the state of the Narta Lagoon was confirmed. The conclusion produced by diatom indices were compared with those derived from directly measuring physico-chemical water parameters and from using the diatom bioindicative characteristics. Diatom indices produced conclusions similar to those resulting from standard application of diatom bioindicative potential. Considering the species composition and indicative properties of all diatom taxa inhabiting the investigating area, the Narta Lagoon should be considered eutrophic.

## *Echium russicum* J. F. Gmel in the flora of Greece

**Asenov, A.[1]***

Department of Botany, Faculty of Biology, University of Sofia, Dragan Tsankov 8, Sofia, Bulgaria

* asenasenov71@yahoo.com

A new site for this protected and rare species from the Greek flora was found, situated on Mt Falakron, North-Eastern Greece. A new fragment of the population was found by Asenov on 01.06.2015. The author was observed a small population owning 30 generative and 12 vegetative individuals, in small damp pothole on an area

of 25 m². Echium russicum growing together with *Alchemilla xanthochlora* Rothm., *Anthyllis montana* L., *Carex caryophyllea* Latourr, *Centaurea tuberosa* Vis., *Colchicum autumnale* L., *Dactylorhiza sambucina* (L.) Sóo, *Festuca rubra* L., *Fragaria vesca* L., *Galium verum* L., *Genista carinalis* Griseb., *Gentiana verna* L., *Geranium silvaticum* L., *Hieracium cymosum* L., *Luzula campestris* (L.) Lam. & DC., *Ranunculus montanus* Willd., *Rhodax canus* (L.) Fuss., *Rosa pimpinellifola* L., *Plantago subulata* L., *Serratula tinctoria* L., *Sesleria nitida* Ten., *Taraxacum erythrospermum* Andrz. ex Besser, *Veronica chamaedrys* L. etc.

This is the second known proven site of *Echium russicum* for the Greece flora.

# Ecological characteristics of halophytes at salt marshes of Southern and Central Serbia

**Zlatković, I.[1]*, Jenačković, D.[2], Ranđelović, V.[2]**

[1]College of Agriculture and Food Technology, Prokuplje, Ćirila i Metodija 1, 18400 Prokuplje, Serbia

[2]Department of Biology and Ecology, Faculty of Sciences and Mathematics, University of Niš, Visegradska 33,18000 Niš, Serbia.

* gajevicivana@yahoo.com

In Serbia salt marshes are extremely local in character, and outside of Pannonian Plain they are present only at a few localities in valleys of rivers Toplica and Južna Morava. The results of cluster analysis performed on physical-chemical characteristics of soil (pH reaction of soil in water and KCl solution, soil humidity, EC, concentration of $Cl^-$, $HCO_3^{2-}$, $CO_2$, $P_2O_5$ and $K_2O$) indicate that salt marshes of the study area include 6 habitat types. Indicator species analysis was used to define the indicator species for each habitat type. There were 13 indicator species. The results of CCA analysis have shown that distribution of halophytic indicator species depends on EC, soil humidity and concentration of $P_2O_5$, $CO_3^{2-}$ and $K_2O$. The least saline habitats (0–2 mS/cm) with alkaline substrate (7.23 ± 0.56) poor in potassium (14.36 ± 4.57 mg $K_2O$/100 g soil), phosphorus (2.92 ± 2.33 mg $P_2O_5$/100 g soil) and bicarbonates (58.97 ± 19.61 mg/l) are dominated by species *Taeniatherum caput-medusae*, *Xeranthemum annuum* and *Bromus commutatus*. Habitats with the greatest concentration of salt (8–16 mS/cm) and high concentrations of carbonates (102.40 ± 134.78 mg/l) and bicarbonates (298.09 ± 266.17 mg/l) are characterized by the species *Puccinellia distans*. Species *Camphorosma monspeliaca* and *Puccinellia festuciformis* subsp. *convolute* are indicators of weakly saline soils (2– 4 mS/cm).

**Acknowledgements**. This work was funded by the Ministry of Education, Science and Technological Development of Republic of Serbia (project no. 173030).

# *Epipactis palustris* (L.) Crantz (Orchidaceae), the new locality on Serbian territory

**Veljković, B.[1]*, Preljević, N.[1], Krivošej, Z.[2]**

[1]State University of Novi Pazar, Vuka Karadžića bb, 36300 Novi Pazar, Serbia

[2]Faculty of Sciences and Mathematics, Department of Biology, University of Priština (temporary in Kosovska Mitrovica), Serbia

* bojana.radulovic@yahoo.com

Marsh helleborine (*Epipactis palustris*) populates wetland habitats such as meadows with ponds, pond watersides, sandy valleys and wet woods. It is widespread through almost whole Europe, moderate parts of Asia and north Africa. When it comes to Serbian territory, *Epipastis populates* these regions: Pannonian Basin, sporadically; Transdanubia, between the river Danube and the river Tisa; by the river Tisa (Soó 1973, 1980), Backa vineyards (Degen 1904, Lányi 1914; Lengyel 1915).

In east and southeast Serbia its presence is noted in following localities: Jelašnica, Niš, Resava, Balkan Mountains, Strmosten, estuary of the rivers Zlotska and Beljanska, Visok Izatovac, Peštersko - Sjenička tableland, Šar Mauntains (Lakušić, D. 1999), Grmija near Prishtina (Krasniqi 1972) and Koritnik. In Belgrade *Epipastis* populates Veliko Blato (Lazarević 2012).

*Epipactis palustris* is vulnerable species which is going to become endangered soon, if harmful factors continue to affect it.

This species is protected by The Convention on International Trade in Endangered Species of Wild Fauna and Flora. It is also protected in Serbian area - by the law - and belongs to the group of internationally significant species (Stevanović, V. et al. 1995).

During floristic research of the base of Golija Mountain, in summer 2013, *Epipactis palustris* has been noted in the area of village Trnava, nearby Raška. The population consisted of cca. 80 individuals. This finding indicates that there is one more locality of this species on the area of Southeast Serbia.

# The genus *Solenopsora* (Leprocaulaceae, lichens) in Balkan peninsula: species diversity and genetic variability of taxa confined to calcareous habitats

**Guttová A.[1]*, Fačkovcová Z.[1]**

[1]Institute of Botany, Slovak Academy of Sciences, Dúbravská cesta 9, Bratislava, Slovakia

* anna.guttova@savba.sk

Balkan Peninsula, along with Apennine and Iberian Peninsulas, has traditionally been recognized as evolutionary hotspot of the European continent featuring overall stability of ecosystems often accompanied by long-term isolation from adjacent biogeographic regions. Members of the lichen genus *Solenopsora* occurs predominantly in Mediterranean, Macaronesian and Madrean floristic regions. The European taxa are successful and widespread in the circum-Mediterranean and Atlantic Europe, whereas their occurrence is limited in continental parts of Europe. So far eight taxa have been reported from Balkan peninsula (*S. candicans, S. cesatii, S. grisea, S. marina, S. olivacea* subsp. *olivacea, S. olivacea* subsp. *olbiensis, S. holophaea, S. vulturiensis*), which represents major part of European diversity of this genus. First six taxa are confined to calcareous habitats. We characterize their preferences regarding to altitude, ecology and climate in Balkan peninsula. We analyse genetic diversity of a model species S. candicans with special focus on the Balkan populations. Preliminary nrITS data show substantial variation, with predominating unique ribotypes from Croatia, Montenegro and Republic of Macedonia (FYROM). The data suggest linkage of Balkan populations with the Pannonian ones.

**Acknowledgements**. This work was supported by the projects VEGA 2/0034/13 and APVV SK-PT-2015-0027.

# New locality of *Centaurea pichleri* (Asteraceae) in Bulgaria

**Bancheva, S.[1]*, Delcheva, M.[1], Trifonov, V.[1], Nikolov, M.[1]**

[1]Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Acad. G. Bonchev Str., bl. 23, 1113-Sofia, Bulgaria

* sbancheva@yahoo.com

*Centaurea pichleri* Boiss. belongs to subgenus *Cyanus* of Asteraceae and has a very complex taxonomy. It is distributed in Turkey (mainly in Central Anatolia), Greece and Bulgaria. The species is protected by the national Biodiversity Act and included in the Red List of vascular plants in Bulgaria with conservation status "Vulnerable". For the first time *C. pichleri* was reported for the Bulgarian flora (3 floristic regions) in 2000 by Bancheva and Genchev. During field investigations in the spring of 2016 a new locality of the species in Toundzha hilly country (SE Bulgaria), near to Kostur village, Haskovo district, was found. The taxon inhabit the periphery of dry, stony meadows in termophilous oak forest and brushwood situated in a Site of the Ecological Network NATURA 2000. This habitat type named "Eastern white oak forests – 91AA" is included in Annex I of the "Habitat" Directive 92/43/EEC. The new population of *C. pichleri* is in a good state and numbers over then 1000 individuals. From the spatial location of individuals can be assumed that the reproduction of the species in this locality combined vegetative and seed model. In the new locality were not registering threats to the species' population.

# *Silene noctiflora*, present in the flora of Kosovo and Metohija (Serbia)

**Prodanović, D.[1]*, Stanojević, M.[2], Krivošej, Z.[2]**

[1]Faculty of Agriculture, University of Priština, with temporary seat in Kosovska Mitrovica, Lešak, Kopaonička nn, Serbia

[2]Department of Biology, Faculty of Natural Science, University of Priština, with temporary seat in Kosovska Mitrovica, Lole Ribara 29, 38220 Kosovska Mitrovica, Serbia

*danijela.prodanovic@gmail.com

Studying the flora of the plain part of Kosovo and Metohija, in the village of Gračanica, on the eastern rim of the Kosovo basin (approximately 10 km to the south

of Priština), near the Gračanka stream, we identified a weed and ruderal species, Silene noctiflora.

The part of the stream bank is urbanised and turned into a quay. The quay is regularly maintained implying that the banks are regularly weeded and the riverbeds are cleaned as the *Typha latifolia* species rapidly grows; it may be the reason why this species was not immediately detected and appropriately determined.

Except for the afore mentioned locality, the species was also reported on the neglected arable fields and tilths, around the unkempt orchards, along the new tarmac road between Gračanica and Laplje Selo, on the locality called Labura.

*Silene noctiflora* is not mentioned for the region of Kosovo and Metohija in the new and revised edition of the book Flora of Serbia 2.

# A supplement to the knowledge of the flora of Sirinićka Župa at the bottom of the Šara Mountains

**Stanojević, M.[1]*, Prodanović, D.[2], Krivošej, Z.[1]**

[1]Department of Biology, Faculty of Natural Science, University of Priština, with temporary seat in Kosovska Mitrovica, Lole Ribara 29, 38220 Kosovska Mitrovica, Serbia

[2]Faculty of Agriculture, University of Priština, with temporary seat in Kosovska Mitrovica, Lešak, Kopaonička nn, 38219 Lešak, Serbia

* milosstanojevic655@gmail.com

The intensive preliminary floristic studies, carried out between March and August, 2015, yielded the herbaric material consisting of 261 taxa collected at the bottom of the northern slopes of the Šara mountain massif, in the region of Sirinićka Župa. The analysis of the gathered material detected two species, interesting particularly in the flora of the Šara Mountains.

*Epipactis palustris* (L.) Crantz (Orchidaceae), is a rare species of the swamp orchid, legally protected in the flora of Serbia, and even rarer in the Šara Mountains flora. The village of Sevce can be found in the vicinity of Dragaš and Rastelica, towards little Borce, on the slopes of Ostrovica. The newly-found locality on the left bank of the Lepenac river, is also a new locality of this species, which is uncommon not only in Sirinićka Župa, but also in the flora of the Šara Mountains and Serbia.

*Carex ventricosa* Curtis (syn. *Carex depauperata* With.) (Cyperaceae) belongs to the group of forest narrow-leaved ash, which is a new species in the flora on the Šara Mountains, and most probably a new species in the flora of Kosovo and Metohija, as a new, reliable locality for the flora of Serbia.

Due to the highly appealing looks of the Šara Mountain peaks of Ljuboten, Ošljak and Ostrovica, the bottom of these mountains is still floristically unrecognized. Therefore, we consider that the already commenced researches should be expanded to the whole region of Sirinicka Zupa so as to gain a more comprehensive picture of all flora of the Sara Mountains starting from the foot of the mountain up to the highest peaks.

# A syntaxonomic review of coniferous forests and subalpine heaths of the Balkan Peninsula

**Ilić, T.[1]***

[1]Institute of Botany and Botanical Garden, Faculty of Biology, University of Belgrade, Takovska 43, Belgrade, Serbia

* tijana.d.ilic@gmail.com

Coniferous forests and subalpine heaths are to be found in the mountains of the central Balkan Peninsula. Studied area comprises (in alphabetical order) Bosnia and Herzegovina, Bulgaria, Croatia, Macedonia, Montenegro and Serbia. A thorough literature research of phytocoenological papers was conducted. The classes Vaccinio-Piceetea Br. – Bl. et al. 1939 emend. Zupančič (1976) 2000 and Loiseleurio-Vaccinietea Eggler ex R. Schub. 1960 were included in the study, with alliances Vaccinio-Piceion Br.-Bl. 1939, Pinion sylvestris Lakušić 1972, Pinion peuces Horvat 1950, Piceion omorikae Tregubov 1941, Pinion mugi Pawlowski 1928, Juniperion sibiricae Br.-Bl. 1939, Bruckenthalion spiculifoliae Horvat 1949 emend. Zupančič 1992, Vaccinion uliginosi Lakušić 1979 and Rhododendro-Vaccinion A. Schnyd. 1930. A total of 105 associations were collected. The aim of this paper is to show a comparative review of the described communities based on geographic, and not political boundaries, to point out data availability and discuss further field research where needed.

# Analysis of the flora and phytogeographical affiliation of the Rogozna mountain

**Papović, O.[1]*, Miljković, M.[2], Ranđelović, N.[2], Ranđelović, V.[2]**

[1]Department of Biology, Faculty of Natural Science, University of Priština, with temporary seat in Kosovska Mitrovica, Lole Ribara 29, 38220 Kosovska Mitrovica, Serbia

[2]Department of Biology and Ecology, Faculty of Sciences and Mathematics, University of Niš, Višegradska 33, 18000 Niš, Serbia

* olja.bio@mts.rs

Based on analysis of plant material it was identified one species of the phyllum Psilotophyta, 3 species of the horsetails (Equisetophyta), 14 species of the ferns (Polypodiophyta), 3 species of the gymnosperms (Pinophyta) and 794 species of the angiosperms (Magnoliophyta). Family Asteraceae, is presented with 107 species (13,16% from flora of Rogozna). With high representation stand out families Fabaceae (8,98%), Poaceae (6,03%), Caryophyllaceae (5,90%) and Lamiaceae (5,66%). Analysis of taxonomic structure of genera it was concluded that genus which have most species is *Trifolium* (20). Far behind him were genera *Euphorbia* (13), *Campanula* (12), *Carex* (11) and *Silene* (11).

Phytogeographic analysis showed that most of the species have euroasian type of distribution (368 taksona), but, there is many taxa with mediterranean (128) and meridional-submeridional type of distribution (121). 52 species are Balkan endemic species. For 36 of them, Rogozna is newfound locality. Also, on the Rogozna Mt. was detected one local endemic species, *Tulipa serbica*.

Based on representation of the basic life forms of vascular plants in the flora of Rogozna Mt. was detected that it has hemicryptophytic character, with significant percentage of therrophytes and geophytes. Dominant representation of hemicryptophytes matches with biological spectra of the flora of Serbia and temperate zone, but deviates from normal spectrum.

It was detected that 51 taxa (6.17%) is on red list of flora Serbia and Montenegro. Rogozna Mt. is a unique locality for species *Tulipa serbica* in Serbia, and second known locality for species Fibigia clypeata. These two species were therefore classified as an extremely endangered species in flora Serbia.

Based the analysis of the flora of mountain Rogozna, it was found that in this region live 264 species of edible and medicinal plants, of which to edible plants belonging 206 species and to medicinal 246, while 182 species are edible and medicinal simultaneously.

# Floristic Investigation of the "Grand Park of Tirana" flora

**Mesiti, A.[1]*, Dinga, L.[1]**

[1]Researche Center of Flora and Fauna, Faculty of Natural Science, University of Tirana, Albania

* ajola_mesiti@yahoo.com

This article shows a general view over the Tirana "Grand Park" flora. The purpose of this article is to record the "Grand Park" native flora and the native main plant communities. Also our objective is to investigate the ability of plants to adapt from human impact. The studied paramether is the plants urbanity called anthropotelerance.

This park is found in the southern part of Tirana city and because of its total surface of 203 ha it is one of the biggest urban parks in the capital. It is accessible from most of the residents for different reasons, such as: relaxing, sport, recreation etc. Obviously, inside of it, is preserved an important natural capital for our city.

The used methodology is observed form such as marsh root, recording the native plants and their geographical position according to the human presence. In this research are registered 233 spontaneous species and 146 cultivated species, which appertain to 87 families.

Even for those quadrants with an elevated number of urbanophile plants (18% of studied flora) the spontaneous plants number is bigger than the cultivated one.

These groups can be used for future analysis and monitoring of environmental conditions in the parks.

These concepts are relatively difficult to be established and therefore it is necessary to do more elaborated studies in other urban areas in Albania. Nevertheless, from this study some initial indices for our country resulted.

# *Sorbus semipinnata* (Roth.) Hedlund (Rosaceae), in the flora of the Serbian part of the Šara Mountains?

**Duraki, Š.[1]*, Prodanović, D.[2], Krivošej, Z.[3]**

[1]Eight Belgrade Grammar School, Grčića Milenka Street 71, 11000 Belgrade, Serbia

[2]Faculty of Agriculture, University of Priština, with temporary seat in Kosovska Mitrovica, Lešak, Kopaonička nn, 38219 Lešak, Serbia

[3]Department of Biology, Faculty of Natural Science, University of Priština, with temporary seat in Kosovska Mitrovica, Lole Ribara 29, 38220 Kosovska Mitrovica, Serbia

* semijaduraki@gmail.com

The first data on the presence of this exceptionally rare species for the Kosovo part of the Šara mountains are mentioned under the name of *Sorbus dacica* Borbas, for the southern slopes of the Šara mountain massif –Ošljak.

Due to the great similarity with the species Sorbus borbasii and incomplete material for a reliable determinantion the presence of *Sorbus dacica* species on the southern slopes of the Šara mountain massif Ošljak could not be considered and included in the Red Book on Flora of Serbia 1 (1999).

This species was redetected on the northern slopes of the Šara mountains (2014), at the border with Macedonia.

According to Šilic: "There are different views of systematic position of this taxon, and there is a prevailing opinion that it is a natural hybrid between the whitebeam (*Sorbus aria*) and rowan (mountain-ash) (*Sorbus aucuparia*)". What completely coincides with Šilic's note is the presence of both species (*Sorbus aria* and *Sorbus aucuparia*) on Ošljak and on the northern massif of the Šara Mountains towards Macedonia.

If we bear in mind that the species on Macedonian side of the Šara mountains are known for more localities (Cerepašina, Lešnica, Bistra, etc.), it is possible to expect the presence of these species on two more massifs of the Šara Mountains towards Macedonia, than some type of disjunct areal on a relatively small space.

With this floristic data we consider the issue of the distribution of Sorbus dacica on the Šara mountain massifs is definitely resolved for the flora of Serbia

# *Galium demissum* Boiss. (Rubiaceae), a new species in the flora of Serbia

**Duraki, Š.[1]*, Prodanović, D.[2], Krivošej, Z.[3]**

[1]Eight Belgrade Grammar School, Grčića Milenka Street 71, 11000 Belgrade, Serbia

[2]Faculty of Agriculture, University of Priština, with temporary seat in Kosovska Mitrovica, Lešak, Kopaonička nn, 38219 Lešak, Serbia

[3]Department of Biology, Faculty of Natural Science, University of Priština, with temporary seat in Kosovska Mitrovica, Lole Ribara 29, 38220 Kosovska Mitrovica, Serbia

* semijaduraki@gmail.com

Studies on the high peak flora of the northern slopes of the Šar Mountains, along with the Macedonian border, revealed a very rare species in the Balkan Peninsula - *Galium demissum*. According to the sprout hairs, this tiny and subtle plant (8 cm high), with yellow flowers, can be ranked into two subspecies: *G. demissum* Boiss. subsp. *demissum* and *G. demissum* Boiss. subsp. *stojanovii* (Deg.) Ančev. The samples from the Šar mountains are completely bare, and they obviously make up a taxon *G. demissum* ssp. *demissum*. The taxon *G. demissum* ssp. *stojanovii* is mentioned in the flora of Bulgaria. Both of these taxa can be found on the mountain of Pirin. *G. demissum* ssp. *demissum* is mostly reported on the limestones, rarely on the silicate as in the flora of Bulgaria, at the altitude of 2100-2700 m. Our samples were collected on the silicate stones at 2200 m altitude. Besides Bulgaria, the species has also been detected in northern Greece and Turkey (Bitin Olymp). *G. demissum* ssp. *demissum* is a new species in the flora of Serbia, Kosovo and Metohija and the Šar Mountains, which is a very significant biodiversity center of endemic and high mountain flora.

# Helophytic vegetation of the Smilovska lakes (Southeastern Serbia)

**Jenačković, D.[1]*, Lakušić, D.[2], Ranđelović, V.[1]**

[1]Department of Biology and Ecology, Faculty of Sciences and Mathematics, University of Niš, Višegradska 33, Niš, Serbia.

[2]Institute of Botany and Botanical Garden, Faculty of Biology, University of Belgrade, Takovska 43, Belgrade, Serbia.

* draganaj@pmf.ni.ac.rs

The artificial accumulations made in the Odorovsko karst field provide favorable conditions for developing the vegetation composed of reeds and tall sedges. The helophytic vegetation of the Smilovska lakes is separated in four main groups by using a beta flexible method and checking the crispness of classification. The degree of their ecological differentiation was assessed using CCA ordination and Ellenberg indicator values. The differences in floristic composition of the vegetation groups are best explained by moisture and continentality. The results of statistical analysis showed that the community determined by *Typha angustifolia* (Φ=0.91) and *Potamogeton natans* (Φ=0.16) inhabits the wettest habitats. The community with the domination of *Carex riparia* (Φ=0.91) develops on the driest habitats. *Scirpus lacustris* is highly diagnostic species (Φ=0.86) of the community that abounds with helophytic species and prefers either slightly acid or neutral habitats. Absence of a clear ecological differentiation is recorded for a vegetation group that is characterized by the presence of *Sparganium erectum* (Φ=0.54) and *Typha latifolia* (Φ=0.33). It is assumed that involving the field-measured environmental variables in ordination will indicate to the finest between-group and within-group ecological separations.

**Acknowledgement**. This study was supported by the Ministry of Science and Technological Development of the Republic of Serbia (Project No. 173030).

# *Sedum* L. (Crassulaceae, Sempervivoideae) in Serbia: species distribution and diversity centers

**Zlatković, B.[1]*, Nešić, M.[1], Naelbandian, A.[1], Šarac, Z.[1]**

[1]Department of Biology and Ecology, Faculty of Sciences and Mathematics, University of Niš, Višegradska 33, Niš, Serbia

* bojanzlat@yahoo.com

The genus *Sedum* L. with c. 470 species represents one the largest genera of the family Crassulaceae, with almost cosmopolitan distribution. Our study represents the summary of floristic and chorological investigation of its representatives in the territory of Serbia. Considering taxonomic diversity, we gathered information on 20 taxa and 14 diferent Sedum series to described their distribution derived on literature and herbarium data. The results were incorporated in Global Information System (GIS), spatially analyzed and represented in cartographic form. Considering data collected, the most of examined species are widespread throughout the studied areas. However, some of the taxa are recognized as rare (e.g. *S. aetnense, S. villosum*) or consider to be endemics (e.g. *S. stefco, S. tuberiferum*), and that way their distribution is of special concern. Majority of the observations involve the mountain regions of Kosovo and Metochia, as well as eastern, southern and southeastern Serbia. Mapping their distribution on the local scale should be useful as an addition to the forthcoming volumes of the Flora of Serbia, or at least to complete the published by the newly obtained data.

**Acknowledgement.** The studies were carried out under the project 173030 financed by the Ministry of Education, Science and Technological Development of the Republic of Serbia.

# Arctic-alpine Elements in the Serbian Bryophyte Flora

**Nikolić, N.[1]*, Pantović, J.[1], Janković, I.[1], Sabovljević, M.[1]**

[1]Institute of Botany and Botanical Garden, Faculty of Biology, University of Belgrade, Takovska 43, 11000 Belgrade, Serbia

* nada.m.nikolic@gmail.com

Arctic-alpine species are those with disjunct distribution, found in the Northern Europe, as well as in the high mountains southwards, in Central Europe. During the periods of glaciations, they were distributed south from the ice shield, and afterwards

they migrated to the northern arctic regions and southwards to the alpine areas. In bryophyte flora of Serbia there are 6 liverwort and 54 moss arctic-alpine species present. Stara Mt. is locality richest in liverwort species, whilst highest number of arctic-alpine mosses is present on Kopaonik Mt, Stara Mt., Prokletije Mt. and Šara Mt. There are few doubtful literature data for certain species occurring in low altitudes, e.g. in Belgrade area, that should be checked and revised. Many of those species are rare and endangered, with single known records for Serbia being on those high mountains. Although bryological research has increased in recent time, alpine areas are still among least explored habitats, especially on Prokletije and Šara Mts.

# The ecological and floristic characteristics of natural population of *Micromeria juliana* (L.) Benth. ex Rchb. in Eastern Rhodopes Mts, Bulgaria

**Aneva, I.[1]*, Zhelev, P.[2], Nikolova, M.[1], Evtimov, I.[2]**

[1]Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Science, 1113 Sofia, Bulgaria

[2]University of Forestry, 10 Kliment Ohridsky Blvd., 1756 Sofia, Bulgaria

* ina.aneva@abv.bg

*Micromeria juliana* is a rare species in Bulgaria and is also a valuable medicinal plant. It is included in the Red Data Book of Bulgaria with conservation status "endangered" and is protected by the Biodiversity Act of Bulgaria. The present report focuses to the study of natural populations and plant communities of *M. juliana* in Eastern Rhodopes – the only region of its occurrence in Bulgaria. Here the species grows on steep stony slopes, even on walls of ancient fortress constructions in the locality "Kaleto", close to Gugutka village. We present results of a survey on the species composition of plant communities of *M. julinana* together with analyses of geoelements and ecological forms. The floristic composition indicates that the participation ratio of elements with Mediterranean origin is high. The ecological factors that have the highest impact on the floristic composition are intensive light, air temperature and humidity. The area occupied by the species is limited due to its very specific requirements and low competition ability. The studies show that *M. juliana* needs special measures for conservation.

**Acknowledgements**. The authors are grateful to the financial support provided by Program for Supporting Young Scientist, Bulgarian Academy of Sciences and Ministry of Education and Science (Bulgaria).

# First record of *Pithophora oedogonia* (Montagne) Wittrock (Pithophoraceae) in Aleksandrovac Lake, Serbia

**Simić, S.[1]*, Đorđević, N.[1]**

[1]Department of Biology and Ecology, Faculty of Science, University of Kragujevac, R. Domanovića 12, 34000 Kragujevac, Serbia

* snezasi@kg.ac.rs

*Pithophora oedogonia* (Montagne) Wittrock is the only species recorded of the Pithophoraceae family in Serbia. Pithophora specimens were found for the first time in oligosaline, alkaline, microaccumulation in Serbia, Aleksandrovac Lake (N 42º29'22", E 21º53'54"). These green algae forming floating masses in the littoral zone in summer 2011. *Pithophora oedogonium* is macroscopic branched green alga. The specimens showed intercalary akinetes isospores in the same individual. This species constitutes a new citation for the Balkan Peninsula and Serbia first of all.

**Acknowledgements**. This investigation was supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia – Project Grants III 43002.

# Aldomirovsko swamp - macrophyte vegetation

**Gyosheva, B.[1], Valchev, V.[1]***

[1]Institute of Biodiversity and Ecosystem Research at the Bulgarian Academy of Sciences, 2 Gagarin Street, Sofia, Bulgaria
* vlado@bio.bas.bg

Twenty-eight macrophyte species were found in Aldomirovsko swamp during this study. This is 18 % of the total number of determined species published in a previous study by Apostolova et al. (2001). Nevertheless, the macrophytes constitute the largest component of the vegetation cover of this wetland. The described macrophyte assemblages belong to 3 classes, 3 orders, 5 unions and 8 associations. The water body of Aldomirovsko swamp and its macrophyte vegetation represent a typical Natura 2000 habitat 3140 „Hard oligo-mesotrophic waters with benthic vegetation of Chara-formation". Eleven EUNIS habitats were found in the area covered by macrophyte vegetation. The reference index (RI) based on the macrophyte species composition shows that the swamp is in "Good" ecological state in the sense of the Water Framework Directive (WFD). Overall, Aldomirovsko swamp is in good state according to the quality element macrophyte species composition and to the phytosociological structure. However, the existence of this natural complex is threatened because of the periodical drying out of its water due to unfavorable hydrological conditions in the recent years.

# 12th Symposium on the Flora of Southeastern Serbia and Neighboring Regions

Kopaonik Mt. 16th-19th June, 2016

## Nature protection and Environment

## ORAL PRESENTATION

# Distribution, ecology and local spatial ecology of the scarce large blue butterfly in Serbia

**Popović, M.[1]***

[1]University of Niš, Faculty of Sciences and Mathematics, Department of Biology and Ecology, Višegradska 33, 18000 Niš, Serbia

* mpopovic@pmf.ni.ac.rs

The scarce large blue butterfly (*Phengaris teleius*) is Vulnerable in Europe and Near Threatened globally. Although one of the key species for conservation in European Union, it was discovered only in 2012 for Serbia. Here I overview the distribution, habitat requirement and population ecology of the species and present preliminary results on its local spatial ecology in Serbia. Butterfly is restricted to protected areas surrounding Subotica, and mowing is shown to be the most significant factor influencing its distribution. Total population size estimated is shown to be exceptionally large (about 15000 individuals). Butterfly is starting later in the season comparing to other European populations. Life span is the longest recorded for the species (4.8 days) and it is negatively correlated with population density. The average displacement within patch is limited to less than 100 meters, with a maximal distance of 1.9 km. Estimated parameters are used to propose conservation measures according to butterfly local ecology.

**Acknowledgements**. I would like to thank Public Enterprise "Palić-Ludaš" and many of my friends from HabiProt for help with the field studies. Work was financed by the Butterfly Conservation Europe, Rufford Small Grants project No. 14884-2 and Ministry of Education Science and Technological Development of Republic of Serbia grant No. 173025.

# Monitoring of air quality at selected urban areas (Southern Serbia)

**Stamenković, S.[1]*, Ristić, S.[1], Marković, M.[1], Cvetković, V.[1], Novković, V.[1], Mitrović, T.[1]**

[1]Department of Biology and Ecology, Faculty of Sciences and Mathematics, University of Niš, Višegradska 33, Niš, Serbia

* sslavisa@pmf.ni.ac.rs

The aim of the study is to present the difference in air quality over a certain time interval in investigated areas of Southern Serbia. Investigation was done in Vlasotince in 2002 and 2013; in Leskovac in 2002 and 2008 and, for the first time, in Lebane in 2013. The analysis of samples from 142 investigated points in described localities indicates presence of 53 lichens taxa. Using the index of atmospheric purity - IAP values, it has been found that there are air pollution zones: „normal“ zone, "struggle" zone and "lichen desert" zone. The comparison of the results obtained in Vlasotince indicates the presence of „normal“ zone in 2002 but, in 2013, the „normal zone“ area was completely replaced with the „struggle“ zone. In Leskovac, unlike the previous studies, a slightly narrowing “lichen desert" zone is noticed. In Lebane, there is a presence of all lichen zones.

**Acknowledgement**: This work was performed under the project of the Ministry of Education, Science and Development of Republic of Serbia OI 171025

# The conservation status of subcontinental peri-pannonic scrub identified in the “Veliki Rimski Šanac” site (Vojvodina Province, Serbia)

**Panjković, B.[1]*, Stojšić, V.[1], Perić, R.[1], Rilak, S.[1]**

[1]Institute for Nature Conservation of Vojvodina province, Radnička 20a, Novi Sad, Serbia

* biljana.panjkovic@pzzp.rs

The study presents the results of reseach obtained on the basis of identification and analysis of the conservation status of Natura 2000 habitat Subcontinental peri - Pannonic shrub (*40A0) on the “Veliki rimski šanac” site. According to the national classification of habitat types are identified: B2.1c - Shrubs of dwarf Russian almond (*Prunus tenella*), B2.1D - Shrubs of dwarf cherry (*Prunus fruticosa*) and B2.1 -

Shrubs of sloe (*Prunus spinosa*). Pannonic shrubs are a priority habitat for protection in Serbia and the EU. Shrubs of dwarf Russian almond and dwarf cherry representing the rare and representative habitats in Serbia. They are sensitive due to the functional instability and susceptibility to degradation.

Mapping of habitat types and species is done using geographic information system (GIS). Conservation status of identified Natura 2000 habitat types are determined according to the methodology based on the EU guidelines ("Standard Data Forms"). Evaluation of the conservation status is a scientific basis for the establishment of protection regimes and management practices and for defining the particular conservation measures on the species and habitat level.

# Monitoring and suppression of common ragweed (*Ambrosia artemisifolia* L. 1753) in the territory of City Novi Sad, during the 2010 – 2015

**Bojčić, S.[1]*, Tmušić, G.[1], Bogdanović, S.[1], Rat, M.[1], Anačkov, G.[1]**

[1]University of Novi Sad, Faculty of Sciences, Department of Biology and Ecology, Trg Dositeja Obradovića 2, 21000 Novi Sad, Serbia

[2]Public Enterprise for City Construction and Development, Stevana Branovačkog 3, 21000 Novi Sad, Serbia

* slobodan.bojcic@dbe.uns.ac.rs

Common ragweed - *Ambrosia artemisifolia* is invasive alien and allergic plant species. It is widely distributed species originating from North America, characterized by high capacity of environmental adaptation. Due to threaten human health, mapping and removal of common ragweed populations on the territory of Novi Sad, during the 2010-2015 were implemented within the program of City Councilor for Utility Services. The program was carried out on the all types of urban and semi urban habitats. Mechanical removals were carried out from June to October, two or three times per location. Activities were correlated with the variably phenology of common ragweed and specific micro-habitats. Mechanical mowing was conducted during the flowering of the male inflorescences and results dependent on the type of habitats and human activities. Application of this method resulted in the reduction of the populations recorded in the monitored areas. Success of monitoring and suppressing of ragweed represents a timely prioritization of sites and mowing regimes. Years of experience in monitoring, evaluated dynamics of the ragweed populations spread in

the City of Novi Sad, presents the basis for establishing the general method of seasonal mowing that will result in ragweed suppression.

**Acknowledgments**. This research was supported by City Councilor for Utility Services, City of Novi Sad, Serbia, Project: "Mapping of the terrain under ragweed and other allergenic plants, laboratory and field research and monitoring"

# POSTER PRESENTATION

## An analytical study of marble consolidation by oxalate precipitation using density, ftir and powder-xrd measurements

**Terziu, R.[1]*, Baraj, E.[2], Yu, S.[3], Xhaxhiu, K.[1], Come, M.[3]**

[1]Faculty of Natural Sciences, Albania

[2]Department of Chemistry Faculty of Mathematical Engineering and Physics Engineering, Albania,

[3]Intitute Soft Matter and Functional Materials, Helmholtz-Zentrum Berlin

* rihana.terziu@gmail.com

Our recent study on consolidation of marble samples with the purpose of culture heritage protection occurred by periodical calcium oxalate precipitation on top of quasi parallelpipedic samples. The overall processconsisting of three stages of treatment, starting with 5% calcium acetate solution for 60 minutes at 200C, a draining step at 70°C, for 30 min, followed by a treatment with 5% ammonium sulfate solution, revealed a continuous density decrease, determined using ethanol. As the natural samples had aninitial density of 2.6980 g/cm$^3$, it decreased up to 2.5871 g/cm$^3$ for 50 times treatments. The precipitation of oxalate on top of calcium carbonate substrate, in form of calcite, revealed two distinguished infra-red bands, at 1316 cm$^{-1}$ and 1624 cm$^{-1}$ unsymmetrically located around the carbonate one at 1426 cm$^{-1}$. The intensity of the bands was proportional to the number of treatments. The continuous surface coverage investigated in parallel by powder XRD evidenced the presence of whewellite crystallites deposited on top of calcite, where their intensity increased as well with the number of treatments. This method exhibits a reliable oxalate coverage of marble sample surfaces which doesn't influence considerably their water solubility.

# Effects of renewable energy generation on flora and fauna

**Çakmak, N.M.[1]***

[1]Department of Administrative Law, Faculty of Law, University of Gazi, 06500 Teknikokullar, Ankara, Turkey

* muncicakmak@outlook.com

Today we are converting our fossil-based energy production systems into renewable energy production systems. Although producing energy from renewable energy resources is cleaner than fossil-based energy generation, there are some important subjects that should be concerned. Renewable energy generation is not always totally clean and ecofriendly. Renewable energy sources have their advantages only against to fossil fuels. If we do not concern ecosystem issues about renewable energy generation, there will be significant effects on flora and fauna. Obtaining energy from solar, wind, biomass, hydroenergy and sea/ocean (wave energy, ocean thermal...) resources has huge growing rate today but unfortunately the rate of flora and fauna losses is also increasing. Replacing natural areas and ecosystems with agricultural lands for the production of biomass resources, bird deaths because of wind blades, destroying river ecosystem for hydroelectric dams are the most common negative effects of renewable energy generation. By the help of science and administrative planning, these negative effects can be reduced. Flora and fauna must not be sacrificed for cheap and clean energy generation. Conservation of flora and fauna is the duty of the state.

# Medicinal plants in Rila National Park (Bulgaria)

**Vitkova, A.[1], Delcheva, M.[1]***

[1]Institute of Biodiversity and Ecosystem research, Bulgarian Academy of Sciences, 23 Acad. G. Bonchev Str., 1113 Sofia, Bulgaria

* malinad@bio.bas.bg

Rila National Park is the largest in Bulgaria and one of the largest in Europe. It is situated in the Rila Mountain with highest peak in the Balkan Peninsula Musala (2 925 m). Rila NP was established in 1992 with area of 81 046.0 ha. The new management plan was prepared in 2015. The list of medicinal plants includes 398 species belonging to 244 genera and 77 families. The families which are richest of species are: Rosaceae, Asteraceae, Lamiaceae, Fabaceae and Ranunculaceae. The

largest genera are *Alchemilla, Orchis* and *Rumex*. The forest belt is characterized with the greatest diversity of medicinal plants – 202 species, in the sub-alpine belt – 123 species and in alpine belt – 73 species. Forty one medicinal species with conservation status were found in the Park. Twenty five medicinal plants are included in the Red List of Bulgarian vascular plants and 14 in the Red Data Book of the R Bulgaria. 29 species are legally protected by the national Biodiversity Act, 7 species are included in 1997 IUCN Red list of threatened plants, 2 are in the Bern Convention, 7 are covered by the CITES. 19 species are under special regime of protection and use according the Medicinal Plants Act (2000). Two Bulgarian and 7 Balkan endemics have been recorded on the territory of Park. Resource assessment of 7 medicinal species in Rila NP was made. Four medicinal species have the best resource potential. Different regimes and norms of use are proposed based on the results of resource assessment.

# General overview on the protection of environment in Turkısh law

**Çınar Can, E.[1]***

[1]Gazi University Faculty of Law, Administrative Law Section, Emniyet Mahallesi Muhammer Bostancı Caddesi, No. 4, Beşevler Ankara, Turkey

* ccevren@hotmail.com

Being a bridge between Asia and Europe with its large land surface, Turkey hosts all four seasons within its boundaries. Turkey is also a fauna and flora rich country. However, this environmental richness is under threat and should be protected. This need for protection is important not only for Turkey but for the World, because some of the species which are indigenous to Turkey are facing with the threat of extinction. It is surely beyond doubt that the extinction of both plant and animal species will bring harm our whole World.

There are a lot of reasons that endanger the flora and fauna. Emission of the harmful gases like $CO_2$, contamination of water and solid, public or private infrastructure projects, illegal animal hunting, plant and animal smuggling are just a few examples of it. At this point, for minimising the damage given to the environment, some precautions and sanctions are accepted via international agreements and national regulations.

In this study, it is intended to give a brief summary about the international agreements to which Turkey is a part and basic national regulations.

# Active protection of rare moss species Entosthodon hungaricus in Serbia

**Nikolić, N.[1], Vujičić, M.[1]*, Pantović, J.[1], Papp, B.[2], Sabovljević, A.[1], Sabovljević, M.[1]**

[1]Institute of Botany and Botanical Garden, Faculty of Biology, University of Belgrade, Takovska 43, 11000 Belgrade, Serbia

[2]Hungarian Natural History Museum, Botanical Department, H-1431, Budapest, P.O.B. 137, Hungary

* milorad@bio.bg.ac.rs

The moss *Entosthodon hungaricus* (Boros) Loeske, a halophyte funaroid species of salt grassland of continental Serbia is a rare species and nationally protected as endangered species. With intensive field research in Vojvodina province (N. Serbia) in last two years, three new localities were discovered in Serbia after more than 50 years. The active protection of these small tentative populations is urgently needed and also due to habitat degradation and the low competiveness of this species.

With aim to propagate this moss, an axenic cultures were started from the spores of this species originated from the locus classicus in Hungary, and from two year old herbarium specimen. The real attempt was to establish this moss culture since many xenic co-habitants leave jointly. After establishment, it took additional two years for optimization - to achieve fully developed gametophores. During these attempts the fenomenon of apospory was recorded for the first time in this species. Finally, acclimation to xenic condition and study performed showed that the best yield of this species was achieved on salt soil in moderate temperature (18ºC) and during long day conditions (16h light).

The 15 samples of lab born patches (5x5 cm size) were reintroduced in March 2015 to the salt meadow in Banat in no man-land (between Serbia and Romania) for the purpose of strengthening populations. The site was selected to avoid human land pressure and inadequate bureaucracy. One year later in the same period two lab population survived.

From the preliminary results, it is assumed that the frequency of cows appeared in the field can be positive in opening the grass communities and making new microhabitats, but the over-grazing has negative trends. Also, the selection of microhabitats for reintroduction and direct climate condition after release of the lab populations are the most important factors in establishment of this moss after reintroduction.

# Genetic diversity of the critically endangered *Verbascum davidoffii* Murb. (Scrophulariaceae) and implications for conservation

**Petrova, G.[1]*, Petrov, S.[2], Bancheva, S.[3]**

[1]Institute of Plant Physiology and Genetics, Bulgarian Academy of Sciences, "Acad. G. Bonchev" Str., Bldg. 21, 1113 Sofia, Bulgaria;

[2]Institute of Molecular Biology "Roumen Tsanev", Bulgarian Academy of Sciences, "Acad. G. Bonchev" Str., Bldg. 21, 1113 Sofia, Bulgaria;

[3]Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, "Acad. G. Bonchev" Str., Bldg. 23, 1113 Sofia, Bulgaria

* galiaty@abv.bg

*Verbascum davidoffii* Murb. (Scrophulariaceae), one of the rarest plant species in Bulgarian flora, is a local endemic, protected by the national Biodiversity Act, included in the Red List of vascular plants and in the Red Data Book of Bulgaria with conservation status "Critically Endangered". Its distribution is limited due to anthropogenic pressure, specific ecological requirements and low reproductive capability. In this study, we aimed to measure the genetic diversity level in the unique nowadays population of *V. davidoffii* located in Pirin National Park and to describe its genetic structure. ISSR primers in the initial screening that had a high level of polymorphism, repeatability, and the best scorability were used. The obtained data were combined in a single matrix and genetic coefficients were generated to describe genetic variation. We found high genetic diversity at the species level in the excitant *V. davidoffii* population. The obtained results suggest that small populations of rare and narrow distributed plant species can display high genetic diversity. The present study indicate that the primary objective in *V. davidoffii* conservation is to preserve as much as possible of its evolutionary potential through maintaining as much genetic diversity as possible.

**Acknowledgments**. This work was supported by the Bulgarian NSF under Grant DFNI-BO2/18.

# Adoption and distribution of metals in the species of genus *Populus*

**Đelić, G.[1]*, Timotijević, S.[1], Simić, Z.[2], Branković, S.[1]**

[1]Department of Biology and Ecology, Faculty of Science, University of Kragujevac, Radoje Domanović 12, Kragujevac, Serbia,

[2]Department of Chemistry, Faculty of Science, University of Kragujevac, Radoje Domanović 12, Kragujevac, Serbia,

* gdjelic@kg.ac.rs

In remediation of metals contaminated soil, science increasingly uses fitoaccumulators. As part of our research it was analyzed content of metals (Mn, Fe, Cu, Zn, Cr, Ca, Mg) in plant species *Populus nigra* L. and *Populus tremula* L. and in the soil on which they grow. The aim of the research is that based on the content of metals in plant organs (leaves and branches) and bioaccumulative potential, we determine species differencies between analyzed species, and indicate the possibility of using these species for phytoremediation. Atomic absorption spectrophotometry (wet digestion) is used for the determination of metals in plant material and in soil. The results indicate that the species *P. nigra* adopt higher amounts of Fe and Cr and species *P. tremula* larger amounts of Mn, Cu and Zn.

# The Park of the Faculty of Education in Jagodina: natural protected area and botanical teaching resource

**Stanković, M.[1]*, Bojović, B.[1], Ćurčić, S.[2], Čutura, I.[2]**

[1]Department of Biology and Ecology, Faculty of Science, University of Kragujevac, Radoja Domanovića 12, Kragujevac, Serbia

[2]Faculty of Education in Jagodina, University of Kragujevac, Milana Mijalkovića 14, Jagodina, Serbia

* mstankovic@kg.ac.rs

The Park of the Faculty of Education in Jagodina, formerly a botanical garden, was founded in 1898 as a part of Teacher's school. Its main functions were of educational and recreational character. The principal characteristics of the Park such as floristic composition, historical values, decorative character as well as the status of

protected natural field, contribute to the high importance of this visual natural teaching resource. Authentic elements of the Park are "outdoor classrooms" as specific teaching objects with multiple values in the process of education. Quantitative and qualitative composition of the flora of the Park was changed during their dynamic history; 118 years after its foundation, flora of the Park consists of 70 species of trees, high and low shrubs and several lianas from 49 genera and 26 families, as well as of accompanying spring ephemeral perennial woodland species and many horticultural plant species. The flora of the Park includes some specific elements such as certain relict and endemic plants, among which are several specimens of the Ginkgo biloba species inhabiting the Park since its foundation.

## Stress impact of fire on chloroplasts pigments content in post fire grown plants

**Marković, M.[1], Tošić, S.[1], Stankov-Jovanović, V.[2], Stamenković, S.[1]*, Mitić, V.[2], Gnjatović, I.[1], Ilić, M.[2]**

[1]Department of Biology and Ecology, Faculty of Science and Mathematics, University of Niš, Višegradska 33, Niš Serbia

[2]Department of Chemistry, Faculty of Science and Mathematics, University of Niš, Višegradska 33, Niš Serbia

* sslavisa@pmf.ni.ac.rs

The contents of chloroplast pigments (Chlorophyll *a*, *b*, *a+b*, and Carotenoids) in the leaves of selected species of medicinal plants - *Glechoma hirsuta*, *Chelidonium majus* and *Primula veris*, from a beech forest on Vidlič Mountain, affected by fire and from unaffected habitat (control) were compared. Chloroplast pigments were determined spectrophotometrically in the acetone extracts of plants-material. The contents of Chlorophyll *a*, *b* and *a+b* were higher in *Chelidonium majus* after the fire than in control plants, in contrast to *Glechoma hirsuta*. The leaves of *Primula veris* not exposed to fire had greater Chlorophyll *a* content, while in the area after the fire the content of Chlorophyll *b* and *a+b* was greater. In response to stress conditions, the Carotenoid content was greater in all plant species after the fire, providing the protection of Chlorophyll from photo-oxidation or ultraviolet radiation damage.

**Acknowledgement**. This work was performed under the project of the Ministry of Education, Science and Development of Republic of Serbia OI 171025.

# Biodiversity of macromycetes in an urban environment - Niš, Serbia

**Cvijetan, I.[1]*, Kajevska, I.[1], Kuštera, M.[1]**

[1]Mycological Society of Niš, Somborska 81 A/9 Pantelej, 18000 Niš, Serbia

* ivanacvijetan@hotmail.com

This paper presents data from mycological field surveys conducted on 8 different localities in an urban environment in the city of Niš during the period of 2013-2016. A total number of 87 species belonging to 57 genera and 34 families have been registered. The highest number of species belongs to the following families: Polyporaceae (12), followed by Agaricaceae (8) and Strophariaceae (6); and a majority of them belongs to the genera *Agaricus* and *Polyporus* with 5 species each. Based on ecological-trophic analysis it was concluded that the most numerous species are saprotrophic fungi (57). Among the identified species are *Rubroboletus satanas* and *Amanita vittadini* which are stricly protected species in Serbia.

# 12th Symposium on the Flora of Southeastern Serbia and Neighboring Regions

Kopaonik Mt. 16th-19th June, 2016

## Genetics, selection and biotechnology

## POSTER PRESENTATION

# Biotechnological approach to bryophyte protection: case studies on two Sphagnum species

**Sabovljević, M.[1], Vujičić, M.[1]*, Sabovljević, A.[1]**

[1]Institute of Botany and Botanical Garden, Faculty of Biology, University of Belgrade, Takovska 43, 11000 Belgrade, Serbia

* milorad@bio.bg.ac.rs

The peat-mosses (i.e. Sphagna) are threatened across the Europe due to habitat degradation and thus are included in European Habitat Directive, Annex IV as a priority species for protection. These are mostly species of wet habitat or wetlands with highest diversity in Atlantic and Boreal Europe. In Serbia, 26 species are recorded up to date and many have not been seen for more than 50 years. Due to habitat destruction, climate worming and loss of sexual abilities these species are all red listed and protected in Serbia. Here we chose two vulnerable *Sphagnum* species in Serbia, namely *S. palustre* and *S. squarrosum* with aim to propagate them in lab conditions by developing and applying biotechnological measures prior to release to nature (reintroduction or introduction to potentially adequate sites).

The *in vitro* cultures were started by sporophyte sterilization and spore release to solid basic medium. Bud induction on developed thallous protalium occurred spontaneously in 18ºC during long day conditions (16 h day/8 h night). To achieve fully developed gametophore transfer of bud plantlets to liquid MS medium is needed. There they developed into fully structured *Sphagnum* plants. However, the development of capitula takes over two years. It is slightly quicker if the MS liquid medium contained sucrose.

Prior to release to nature site the plants are adjusted to liquid media solution on pH 5.8, and acclimation procedure is under development. Here, we present the biotechnological achievements used in active conservation of *Sphagnum* in Serbia.

# Cellulose fibril order in radial wood cell walls of juvenile Serbian spruce: estimation of compression wood severity

**Savić, A.[1,2], Mitrović, A.[1]*, Donaldson, L.[3], Simonović Radosavljević, J.[1], Bogdanović Pristov, J.[1], Steinbach, G.[4,5], Garab, G.[4], Radotić, K.[1]**

[1]Institute for Multidisciplinary Research, University of Belgrade, Kneza Višeslava 1, 11000 Belgrade, Serbia

[2]Laboratoire de Spectrochimie Infrarouge et Raman—UMR 8516, Université de Lille, Sciences et Technologies, 59655 Villeneuve d'Ascq Cedex; France

[3]Scion, Private Bag 3020, Rotorua 3010, New Zealand

[4]Institute of Plant Biology, Biological Research Center, H-6701 Szeged, Hungary

[5]Institute of Microbiology, CAS, Centrum Algatech, 379 01 Třeboň, Czech Republic

* mita@imsi.rs

In conifers, leaning stems develop reaction wood known as compression wood (CW). Wood from growth rings that do not contain any CW is termed normal wood (NW). CW occurs in a range of gradations from mild to severe. Juvenile trees produce large amounts of randomly distributed mild CW. CW is characterized by higher amounts of lignin and lower amounts of cellulose. In the forest products industry, compression wood has limited values, and therefore, determination of its amounts is of great importance.

Fluorescence-detected linear dichroism (FDLD) microscopy provides observation of structural order in a microscopic sample and its expression in numerical terms, enabling both quantitative and qualitative comparison among different samples. We applied FDLD microscopy to compare cellulose fibril distribution and alignment in radial and tangential cell walls of tracheids on stem cross-sections of juvenile *Picea omorika* (Pančić) Purkynĕ trees. Our data show a considerable difference in cellulose fibril order between NW and CW, in radial walls gradualy decreasing in relation to CW severity. This suggest cellulose fibril order in radial cell walls of conifers as an indicator of CW severity.

**Aknowledgement**. This work was supported by: grant 173017 from the Ministry of Education, Science and Technology of the Republic of Serbia; bilateral project "Structural anisotropy of plant cell walls of various origin and their constituent polymers, using differential-polarized

laser scanning microscopy (DP-LSM)", Republic of Serbia (IMSI, University of Belgrade) and the Republic of Hungary (Institute of Plant Biology, Biological Research Center, Hungarian Academy of Sciences); project Algain (EE2.3.30.0059), Algatech (CZ.1.05/2.1.00/03.0110) and Algatech Plus (MSMT LO1416); Ministry of Business, Innovation and Employment, New Zealand via Scion CORE funding.

# 2D fractal analysis in plant analytical morphology and microscopy

**Spasić, S.Z.[1], Mitrović, A.[1]*, Janošević, D.[2], Budimir, S.[3]**

[1]Institute for Multidisciplinary Research, Department of Life Sciences, University of Belgrade, Kneza Višeslava 1, 11030 Belgrade, Serbia

[2]Institute of Botany and Botanical Garden "Jevremovac", Faculty of Biology, University of Belgrade, Takovska 43, 11000 Belgrade, Serbia

[3]Institute for Biological Research "Siniša Stanković", University of Belgrade, Bulevar despota Stefana 142, 11060 Belgrade, Serbia

* mita@imsi.rs

Fractals are described as self-similar patterns. Self-similar objects are common in Nature. In botany, application of different fractal methods led to significant progress in analytical morphology and microscopy for understanding the complex structural features characterizing cells and tissues during ontogenesis or in developmental processes.

We examined the precision of 2D fractal analysis using micrographs representing different stages of *Tacitus bellus* (L.) Moran and J. Meyrán, syn. *Graptopetalum bellum* direct shoot organogenesis from leaf explants in vitro. Significantly different fractal dimension values, as a measure of cell organization complexity, demonstrates that the proposed method is efficient for the fine distinction of histologically similar structures. Additionally, we determined the preferable resolution of micrographs for use in 2D fractal dimension analysis.

We suggest this method to be used for quantification of structure complexity in different growth and developmental processes in plants, as well as for the assessment of synchronization of selected processes. Our method is much simpler than other similar methods; it allows fast computational analysis of images and it can be used alone or in combination with other methods.

**Acknowledgements**. This work was supported by projects OI 173045, 173017, 173015 of the Ministry of Education, Science and Technological Development of the Republic of Serbia.

# Analysis of macro- and microelements in chamomile teas (*Matricaria chammomilla* L.)

**Savić, S.[1]*, Petrović, S.[1], Petronijević, Ž.[1]**

[1]Faculty of Technology, University of Niš, Bulevar oslobođenja 124, Leskovac, Serbia

* sasa.savic@tf.ni.ac.rs

In order to verify the content and health benefit of chamomile, we have investigated a chamomile tea samples from a different manufacturers from a southeast of Serbia. The chamomile teas have several health benefits, primarily due to the presence of nutritional elements. On the other hand, even very low concentrations of some metals could be toxic and can cause serious biological disorders and diseases. The macro and micro element concentrations were determined by Inductively Coupled Plasma - Optical Emission Spectrometry (ICP-OES). The preparation of the samples was done by wet digestion. Of all macroelements (Na, Mg, K and Ca), the potassium concentration was the highest in all investigated samples (18161 - 27985 mg/kg). Comparing all heavy metals (copper, zinc, nickel, cadmium and lead) it was determined that the content of zinc was the highest in all samples, in the amount of 12.7-18.0 mg/kg. Based on the results obtained in this work, the presence of micro and macro elements in chamomile tea samples were within the permitted limits that can fulfill the daily needs of these nutrients.

**Acknowledgements**. This work was supported under Projects of the Ministry of Education, Science and Technological development of the Republic of Serbia, Projects No. TR-34012.

# Identification of parental species of allotriploid saffron (*Crocus sativus*)

**Nemati, Z.[1], Harpke, D.[1]***

[1]Leibniz Institute of Plant Genetics and Crop Research (IPK); Corrrensstr. 3, Gatersleben, Germany

* doerte.harpke@gmx.de

Saffron, *Crocus sativus* (*Crocus*, series *Crocus*) is of importance not only as the source of the world's most expensive spice, but it is also of potential pharmaceutical interest. The parental species of this probably allotriploid taxon are still not identified and also the region of its origin remains unclear. The identification

of parental species is a first important step to open ways for an improvement of the sterile, vegetative propagated Saffron. To identify the parental species, we sequenced three nuclear single-copy loci (Topo6, elF2A, uvh1), three chloroplast regions (trnL-trnF, matK-trnK, rps16-trnQ), as well as the nrITS and nrETS of all 15 taxa of series *Crocus*. Phylogenetic analyses of these loci were used to define taxa with identical or nearly identical sequences to what is present in *C. sativus*. The inclusion of chloroplast markers allowed us to determine the crossing direction, i.e. identify *C. cartwirghtianus* as the maternal parent. Also the analysis of single-copy markers confirmed the contribution of *C. cartwirghtianus* to Saffron. The paternal could not be clearly identified yet and additional samples have to be collected and investigated for its clear identification.

## The influence of auxins on hypericin and pseudohypericin production in *Hypericum perforatum* L. callus cultures

**Gadžovska Simić, S.[1]*, Tusevski, O.[1], Maury, S.[2], Delaunay, A.[2], Joseph, C.[2], Hagège, D.[3]**

[1]Department of Plant Physiology, Institute of Biology, Faculty of Natural Sciences and Mathematics, "Ss. Cyril and Methodius" University, Archimedova str. 3, 1000 Skopje, Macedonia

[2]University of Orléans, ITP SBCV, UPRES EA 1207, Laboratoire de Biologie des Ligneux et des Grandes Cultures (LBLGC) INRA USC1328, rue de Chartres, BP6759, 45067 Orléans Cedex 2, France, F-45067, France

[3]Laboratory of Wood and Crop Biology, Antenne Scientifique Universitaire de Chartres (ASUC), Université d'Orléans, 21 rue de Loigny la Bataille, 28000 Chartres, France

* sonjag@pmf.ukim.mk

*Hypericum perforatum* callus cultures were cultured on MS/B5 medium supplemented with 0.5 mg·L-1 of various auxins, particularly, indole-3-acetic acid (IAA), indole-3-butyric acid (IBA) and 1-naphthylacetic acid (NAA). Control calli were established on medium in the absence of auxins. A reversed-phase high performance liquid chromatography (HPLC) method with fluorescence detection was used for naphtodianthrone quantification. The hypericin (HYP) content in calli treated with auxins varied from 65 to 82 $mg \cdot g^{-1}$ dry mass (DM), while control calli had about 63 $mg \cdot g^{-1}$ DM. The amounts of pseudohypericin (PHYP) in treated calli were ranged from 74 to 118 $mg \cdot g^{-1}$ DM, whereas control calli produced about 72 $mg \cdot g^{-1}$ DM.

Callus cultures grown on medium with IBA showed the highest enhancement of HYP (1.3-fold) and PHYP (1.6-fold) production compared to control. Cultivation of calli on medium with NAA resulted in slightly increased production of both naphtodiathrones (1.2-fold) compared to control. The presence of IAA in the medium did not influence naphtodianthrone production in callus cultures. In summary, HYP and PHYP production in *H. perforatum* callus cultures can be partially changed by auxin supplementation and well controlled culture conditions could be used as a source for rapid and increased production of naphtodianthrones with biological properties.

# Intrapopulation and interpopulational variability of characteristics of cones and seeds of silver fir *(Abies alba* Mill.) in Forest management unit "Koprivničko"

**Memišević Hodžić, M.[1]*, Prijić, V.[2], Ballian, D.[3]**

[1]PE "Bosanskohercegovačke šume", Titova 7, 71000 Sarajevo, Bosnia and Herzegovina

[2]Faculty of forestry, University of Sarajevo, Zagrebačka 20, 71000 Sarajevo, Bosnia and Herzegovina

[3]Department of Silviculture, Faculty of forestry, University of Sarajevo, Zagrebačka 20, 71000 Sarajevo, Bosnia and Herzegovina

* mirzeta.memisevic.hodzic@gmail.com

Silver fir (*Abies alba* Mill.) is one of the most important forest tree species in Bosnia and Herzegovina.

For the purposes of this study two populations of silver fir (one on mountain Vranica and on Semešnica) were selected. In selecting population attention was paid that distant among each other is at least 30 kilometers and that they differ according to geological and soil substrates. Then ten phenotypic qualitative trees with abundant yield of cone were selected per population, and 30 cone per tree were collected.

In order to study cone size four traits were measured: length of cones, width of cones in the middle of the length, width of cones 2 cm from the cone base and width of cones 1 cm from the cone top. After cone size measurements dimensions of average cones were determined, and shells with seeds separated from them. Following traits were measured on shells: shell length, shell width, width of sterile shell - bracts and thickness of shell, and on seed: length of seed with wing, length of seed, length of wing, wings width, thickness of seed.

Analysis of variance showed that there were statistically significant differences between populations for all four traits of cones, width of sterile shell - bracts and width of wings of seeds, and for other traits of shells and seeds there were no statistically significant differences between populations.

# The cytotoxic and hemolytic properties of a stevia sweetener

**Žabar Popović, A.[1]*, Nikolić, M.[1], Stanković, S.[1], Đorđević, D.[1], Aleksić, M.[1], Conić, J.[1], Vasiljević, P.[1]**

[1]Department of Biology and Ecology, Faculty of Science and Mathematics, University of Niš, Višegradska 33, Niš, Serbia

* andrea@pmf.ni.ac.rs

*Stevia rebaudiana* (Bertoni) Bertoni (Asteraceae) is a plant native to South America which leaves are used worldwide for production of natural sweetener commercially known as "stevia". Its sweet taste comes from glycosides stevioside and rebaudioside. Commercial sweetener used in this study had 95% of stevioside (according to the manufacturer declaration). Trypan blue dye exclusion method was used to investigate effect of stevia sweetener water suspension on cell viability. Four concentrations were used 25 mg/ml, 50 mg/ml, 75 mg/ml, 100 mg/ml. Results show that cell viability decreases as the concentrations are higher. Viability of 84.13% was observed for the concentration 25 mg/ml and 45.86% for the concentration 100 mg/ml. Hemolytic test showed that stevia suspension had little effect on erythrocyte cell membrane degradation. Percentage of hemolysis was measured after one, two and three hours for all concentrations (25 mg/ml, 50 mg/ml, 75 mg/ml, 100 mg/ml). The percentage of hemolysis for the highest concentration after third hour was 20.61%. All the other concentrations did not cause significant hemolysis and the results were similar with spontaneous (i.e. physiological) hemolytic values.

**Acknowledgement**. The authors acknowledge the financial support of the Ministry of Education, Science and Technological Development of the Republic of Serbia (Grant No.:172047)

# 12th Symposium on the Flora of Southeastern Serbia and Neighboring Regions

Kopaonik Mt. 16th-19th June, 2016

## Phytochemistry and Phytotherapy

# ORAL PRESENTATION

## GC-MS profile of *Umbilicaria crustulosa* (Ach.) Frey and *Umbilicaria cylindrica* (L.) Duby extracts

**Zlatanović, I.[1], Zrnzević, I.[1], Jovanović, O.[1], Stojanović, I.[2], Petrović, G.[1], Stojanović, G.[1]***

[1]Department of Chemistry, Faculty of Science and Mathematics, University of Niš, Višegradska 33, 18000 Niš, Serbia;

[2]Department of Pharmacy, Faculty of Medicine, University of Nis, Bulevar Dr Zorana Djindjica 81, 18000 Niš, Serbia

* stgocaus@yahoo.com

The chemical composition of volatile compounds of ether, ethyl acetate and dichloromethane extracts of *Umbilicaria crustulosa* and *Umbilicaria cylindrica* was determined for the first time by GC-FID and GC-MS. The most abundant component of *U. crustulosa* and *U. cylindrica* ether extracts was orcinol (82.1 and 32.1%) which is also the main component of *U. crustulosa* ethyl acetate extract (40.5%). Orsellinic acid is the second predominant component of *U. crustulosa* ether and ethyl acetate extract (10.5 and 40.5%), while in the dichloromethane extract atraric acid was the second dominant components (12.5%). Dichloromethane extracts of both lichens as well as *U. cylindrica* ethyl acetate extract were characterized by the presence of high amounts of sterols (81.3, 81.1% and 67.5%, respectively). The high amount of dodecanol and tetradecanol was observed in *U. cylindrica* ether extract (21.1 and 22.1%). Additionally, palmitic and linoleic acid were identified in ethyl acetate extract of *U. crustulosa* (1.3% and 0.6%) while their amount were below 0.05% in the other examined extracts.

**Acknowledgments**. The research was supported by the Serbian Ministry of Education, Science and Technology Development (Grant No. 172047).

# GC-MS profile of volatiles obtained from fresh root of *Peucedanum longifolium* Waldst. & Kit.

**Stojanović, G.[1]*, Jovanović, O.[1], Zlatković, B.[2], Jovanović, S.[1], Zrnzević, I.[1], Ilić, M.[1]**

[1]Department of Chemistry, Faculty of Science and Mathematics, University of Niš, Višegradska 33, 18000 Niš, Serbia

[2]Department of Biology and Ecology, Faculty of Science and Mathematics, University of Niš, Višegradska 33, 18000 Niš, Serbia

* stgocaus@yahoo.com

*Peucedanum longifolium* (Sect. *Peucedanum*) is one of the 14 *Peucedanum* L. species growing in the flora of Serbia. The species usually inhabits calcareous, dry grasslands and rocky slopes of medium altitudes in the C, S & E parts of Balkan Peninsula, extending to the mountains of C Romania. However, we have surprisingly found it growing over silicate bedrock. The present study, for the first time, reports chemical composition determined by GC-FID and GC-MS of *P. longifolium* fresh root essential oil (EO) and headspace (HS) volatiles obtained from the individuals growing on siliceous substrate and HS volatiles obtained from the plants growing on the calcareous substrate, in both cases from vegetative growth stage. α-Pinene was the most abundant compound in all three samples (60.3% EO S, 76.3% HS S and 62.6% HS C). The greatest differences are manifested in the content of sabinene (20.9% EO S, 8.1% HS S and 25.2% HS C). The difference in the prevalence of other constituents in all the investigated samples is less than 2%.

**Acknowledgments**: The research was supported by the Serbian Ministry of Education, Science and Technology Development (Grant No. 172047).

# Comparative study of epicuticular alkane profiles of *Primula veris* L. and *P. acaulis* (L.) L. (Primulaceae)

**Živković, M.[1]*, Genčić, M.[1], Radulović, N.S.[1]**

[1]Department of Chemistry, Faculty of Science and Mathematics, University of Niš, Višegradska 33, Niš, Serbia

* mika.zivkovic1987@gmail.com

The genus *Primula* L. (Primulaceae) encompasses more than 400 plant species distributed in temperate and cold regions of the Northern hemisphere. Although a number of *Primula* spp. produce farinas and/or exudates, the epicuticular compounds

have received little attention. Here, for the first time, we analyzed the chloroform leaf surface washings of two species from this genus: *Primula veris* L. and *P. acaulis* (L.) L. The plant material of *P. veris* was collected from the slopes of the mountain Suva planina and that of *P. acaulis* in the vicinity of the village Gornja Slatina, near Leskovac (SE Serbia). A chromatographic separation of the washings yielded a fraction representing a mixture of *n*-, *iso*- and *anteiso*-alkanes. However, both qualitatively and quantitatively, the composition of the alkanes differed between *P. veris* and *P. vulgaris*. Both alkane profiles were dominated by *n*-alkanes with the usual higher plant odd-even ratio, and showed a maximum at $C_{29}$. *Primula veris* was found to produce longer chain-length alkanes ($C_{23}$-$C_{35}$) when compared to *P. acaulis* ($C_9$-$C_{33}$). Interestingly, the branched alkanes were present in a significant relative amount with the approximate ratio of *n*- : *iso*- : *anteiso*- alkanes 67:24:9 and 53:35:12, for *P. veris* and *P. acaulis*, respectively.

**Acknowledgments.** This work was supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia (Project No. 172061).

# Antibiofilm potential of *Ocimum basilicum* and *Salvia officinalis* commercial essential oils

**Pejčić, M.[1], Stojanović-Radić, Z.[1]*, Stojanović, N.[2], Stanković, N.[1], Radulović, N.S.[3]**

[1]Department of Biology and Ecology, Faculty of Science and Mathematics, University of Niš, Višegradska 33, Niš, Serbia

[2]Faculty of Medicine, University of Niš, Bulevar dr Zorana Đinđića 81, Niš, Serbia

[3]Department of Chemistry, Faculty of Science and Mathematics, University of Niš, Višegradska 33, Niš, Serbia

* zstojanovic@pmf.ni.ac.rs

Biofilms are complex communities of microorganisms, responsible for over 60% of chronic human infections and present one of the leading problems in medicine. *Pseudomonas aeruginosa* is human pathogenic bacteria which is a causative agent of a number of human diseases and is known by its biofilm producing ability. *Ocimum basilicum* L. (basil) and *Salvia officinalis* L. (sage) are widely used in traditional medicine for a variety of conditions. Therefore, the aim of this study was to investigate the potential of their commercial essential oils against biofilm development of *P. aeruginosa* strains.

The efficacy of these two essential oils to *P. aeruginosa* biofilm forming ability was determined using crystal violet method. Out of 15 clinical strains, two of them

were strong biofilm producers, 11 were moderate, while one showed weak biofilm producing ability. Results showed good efficacy of sage essential oil to strong and weak biofilm producers, which were not affected by basil essential oil. Considering moderate biofilm producers, 81.81% showed lower biofilm production after contact with the sage oil, while 63.63% showed reduction of biofilm after basil essential oil treatment. The obtained results showed high potential of both oils for the treatment of pseudomonas persistent infections caused by biofilms.

**Acknowledgments**. This work was funded by the Ministry of Education, Science and Technological Development of the Republic of Serbia (Project 172061).

# Interference of the ordinarily used solvents in the outcome of plant extract's antimicrobial testing

**Stojanović-Radić, Z.[1]*, Matejić, J.,[2], Stojanović, J. [1], Džamić, A.M.[3], Radulović, N.S.[4]**

[1]Department of Biology and Ecology, Faculty of Science and Mathematics, University of Niš, Višegradska str., 33, 18000 Niš, Serbia

[2]University of Niš, Faculty of Medicine, Bulevar Dr Zorana Đinđića 81, 18000 Niš, Serbia

[3]University of Belgrade, Faculty of Biology, Institute of Botany and Botanical Garden "Jevremovac", 11000 Belgrade, Serbia

[4]University of Niš, Faculty of Science and Mathematics, Višegradska 33, 18000 Niš, Serbia

* zstojanovic@pmf.ni.ac.rs

Microdilution method takes first place among methods used for antimicrobial testing of the plant crude extracts. In this method, the selection of appropriate solvent for dissolving of plant extract presents the crucial step of assay. Since most of these solvents exert inhibitory effect to the tested microorganisms, they must be used at relatively low concentrations during antimicrobial testing. The goal of this study was to find the most appropriate solvents for different plant extracts and to investigate potential interference of them to the obtained results of antimicrobial testing. Therefore, eight solvents were used for dissolving different extracts obtained from *Ocimum basilicum* L. aerial parts, which were then tested against *Staphylococcus aureus* using microdilution method. Also, to determine the influence of pure solvents to the results, their antimicrobial activity was tested by microdilution method and viable counting of cells from wells containing pure solvent at sub-inhibitory concentrations was performed.

The results showed very variable results depending on the type of extract and solvent used for its dissolving. Our results pointed to acetone as the most convenient diluent for plant extracts, which showed high dissolving potential, low interference with the results and also low impact to the tested organisms, even at high concentrations such as 20%.

**Acknowledgments**. This work was funded by the Ministry of Education, Science and Technological Development of the Republic of Serbia (Project 172061).

# Quality control of *Hyperici herba* samples from Republic of Serbia

**Kladar, N.[1]*, Rat, M.[2], Srdjenović, B.[1], Gavarić, N.[1], Anačkov, G.[2], Božin, B.[1]**

[1]Department of Pharmacy, Faculty of Medicine, University of Novi Sad, Hajduk Veljkova 3, Novi Sad, Serbia

[2]Department of Biology and Ecology, Faculty of Sciences, University of Novi Sad, Trg Dositeja Obradovića 3, Novi Sad, Serbia

* nebojsa.kladar@gmail.com

St. John's wort (*Hypericum perforatum*, Hypericaceae) is a well-recognized medicinal plant with widely established use in the form of oil macerates or water-alcoholic extracts. Therefore, a constant raise of demand for *Hyperici herba* is present at world market. Flowering parts of the plant are usually being collected from nature rather than cultivated and therefore the amounts of secondary biomolecules occurring in a plant are susceptible to influence of abiotic factors characteristic for plant habitat. The aim of the research was to examine the biological potential of water-alcoholic extracts of five *Hyperici herba* samples obtained at territory of Serbia, as well as to chemically characterize them. Two methods of liquid chromatography (HPLC-DAD) were used for quantification of hypericin, hyperforin, apigenin, naringenin, amentoflavone, quercetin, rutin, epicatechin, caffeic, chlorogenic, ferulic, gallic and p-hydroxybenzoic acid. The biological potential was estimated through antioxidant activity and inhibition of acetylcholinesterase, α-amylase, α-glucosidase and monoamine oxidases A and B. Significant variations in the results obtained for different samples were observed.

**Acknowledgements**. Project of Programme of scientific and technological cooperation between Republic of Serbia and Republic of Croatia „New aspects of consumers attitude, safety and quality control of herbal dietary supplements in Serbia and Croatia" supported this research work.

# Neuroprotective potential of lemon balm (*Melissa officinalis* L., Lamiaceae) in amnesic mild cognitive impairment

**Božin, B.[1]*, Kladar, N.[1], Bjelan, M.[2], Kozić, D.[2]**

[1]Department of Pharmacy, Faculty of Medicine, University of Novi Sad, Hajduk Veljkova 3, 21 000 Novi Sad, Serbia

[2]Oncology Institute of Vojvodina, Sremska Kamenica; Put Dr. Goldmana 4, 21204 Sremska Kamenica, Serbia & Department of Radiology, Faculty of Medicine, University of Novi Sad, Hajduk Veljkova 3, 21 000 Novi Sad, Serbia

* bbozin2003@gmail.com

Mild cognitive impairment (MCI) is a heterogeneous entity between normal aging and early dementia. It has been characterized as an objective cognitive complaint in an essentially functional person that does not suffer from dementia. It affects 19% of people aged 65 and over. Around 46% of people with MCI develop dementia within 3 years. It is possible to distinguish subtypes, depending on whether single or multiple cognitive domains are affected, and whether there is a predominant memory complaint. Amnestic MCI (aMCI), in which memory is affected, more often progresses to Alzheimer's disease (AD). Up to now, there is no proven treatment or therapy for MCI.

Previous studies have shown that extracts of Melissa officinalis, Lamiaceae exhibit activity on acetylcholine receptors - nicotinic, as well as muscarinic. Water alcoholic extracts of lemon balm leaves expressed notable *in vitro* ability to displace [3H]-(N)-nicotine and [3H]-(N)-scopolamine from nicotinic and muscarinic receptors located in human neural cell membranes. Also, it is confirmed that the water alcoholic extract of lemon balm inhibits acetylcholinesterase (AChE) time- and dose-dependently. The lack of proven treatment of aMCI coupled with the biological potential and overall safety of lemon balm gives an opportunity for a possible treatment of aMCI.

**Acknowledgments**. The authors are thankful to The Provincial Secretariatm for Science and Technological Development of Vojvodina (grant number 114-451-2730/2016-03) and The Ministry of Science and Technological Development, Republic of Serbia (grant number OI 172058) for financial support.

# Traditional use of native plants from the municipality of Surdulica (southeastern Serbia) - Ethnobotanical study

**Janjić, Đ.[1]*, Rat, M.[1], Bokić, B.[1], Radak, B.[1], Anačkov, G.[1], Božin, B.[2]**

[1]Department of Biology and Ecology, Faculty of Science, University of Novi Sad, Trg Dositeja Obradovića 2 21000 Novi Sad, Serbia

[2]Department of Pharmacy, Faculty of Medicine, University of Novi Sad, Hajduk Veljkova 3, 21000 Novi Sad, Serbia

* djurdjica.simin@dbe.uns.ac.rs

The area of Vlasina extends on the significant part of municipality of Surdulica. The natural habitats of the municipality are characterized by a high diversity of the flora and vegetation. In contrast to preserved natural potentials, this area from its economic aspect presents underdeveloped, poor area and the emigration of the population entails the disappearance of traditional activities (farming, forestry, traditional cooking, collecting plants). For these reasons, the aim of the study was to collect and preserve the knowledge on traditional uses of indigenous flora by local population as well as the emphasis of ethnobotanical importance of the investigated area. The semi-structured questionnaires were conducted on thirty examinees. Among the interviewees females dominated, between the ages 40 to 70 years old. 64 taxons were noted each characterized by different traditional use. Plants used for folk medicine (*Hypericum perforatum, Thymus praecox* subsp. *jankae, Achillea millefolium*) and as food (*Urtica dioica, Urtica urens, Rosa canina*), are dominant ones. In most cases, the knowledge that the interviewees have is inherited from their ancestors and was mainly passed through the first parental line. Results indicate a large accumulation of traditional knowledge on the usage of plants as well as strong connection between human and plants in this area.

**Acknowledgements**. The authors are thankful to the managers of the Protected Landscape area Vlasina "JP Direkcija za javno zemljište i puteve opštine Surdulica", SRSBES "Josif Pančić" from Novi Sad and all interviewees.

# POSTER PRESENTATION

## Antioxidant activity of aqueus-ethanolic extracts of white willow young shoots from Southeastern Serbia

**Stojiljković, M.[1]*, Stanojević, Lj.[1], Cvetković, D.[1], Nikolić, G.[1], Stojiljković, S.[1]**

[1]Faculty of Technology, University of Niš, Bulevar Oslobodenja 124, 16000 Leskovac, Serbia

* milena0919@live.com

White willow (*Salix alba* L., Salicaceae) is used against different types of pain (rheumatic, menstrual, toothaches, headaches). The white willow bark has broad application in the medicine since the presence of phenolic glycosides has been determined. Beside phenolic glycosides, tannins, catechins, flavonoids, p-coumaric acid, gum, wax, resin are also present in the willow.

Extracts of white willow young shoots (fresh and frozen), from Southeastern Serbia (Locality: Duvanište, Niš) were obtained by maceration with 50% v/v ethanol and solvomodule 1:5 w/v. Total phenolics content was determined by Folin-Ciocalteu method, while the content of total flavonoids was determined by method with $AlCl_3$. The antioxidant activity of aqueous-ethanolic extracts was determined spectrophotometrically by DPPH and FRAP assay. Higher yield of extractive matters (5.77 g/100 g of plant material), total phenolics (143.8 mg ECE/g of plant material) and flavonoids (0.403 mg RE/g of plant material) were obtained from frozen shoots of white willow. Extract obtained from frozen shoots has shown better antioxidant activity compared to that obtained from fresh shoots.

The results presented in this work, suggests that obtained extracts can be perceived as a source of natural antioxidants, as well as potential alternative to synthetic antioxidants.

**Acknowledgement:** This work is part of the research project "Plant and synthetic bioactive products of new generation" no. TR 34012, financed by the Ministry of Education, Science and Technological Development of Republic of Serbia.

# Drying of cherries by a combination of convective drying with microwave heating

**Stojiljković, M.[1]*, Mitić, N.[1], Petrović, S.[1], Stojiljković, S.[1]**

[1]Faculty of Technology in Leskovac, University of Nis, Bulevar Oslobodjenja 124, Leskovac, Serbia

* milena0919@live.com

The aim of this work is to represent the drying of cherries using the combination of convective drying with microwave heating. Experiments are carried out in laboratory conditions using the vertical convection microwave heating. Cherry must be dehydrated to a suitable degree of humidity (30 to 40%) before microwaved treatment. Microwave drying contributes to the significantly shorten drying time with better yield of active components. Cherry (Burlat) contains about 86% moisture and 14% of dry matter (the result obtained after 3 h at the temperature of 105°C). At the beginning of drying cherries are washed and pitted. Blanching is carried out immediately before drying, and after pitting in hot water at the temperature of 70°C for 2 minutes. Convective drying is performed at the temperature of 50 and 55°C for 4 hours. Thereafter, heating is carried out in a microwave oven for two minutes four times with two minutes breaks in between each heating. The convective drying is carried out for 1.5 h. Cure rate is 0.75 m/s. After 10 hours of convective drying at the temperature of 55°C, cherry contained 15% of moisture. By microwave heating for four hours after the convective drying, cherry was dried in 5.5 to 6 hours.

**Acknowledgement**. This work was supported under Projects of the Ministry of Education, Science and Technological development of the Republic of Serbia, Projects No. TR-34012.

# Antioxidant activity of oregano essential oil (*Origanum vulgare* L.)

**Stanojević, Lj.P.[1], Stanojević, J.S.[1]*, Cvetković, D.J.[1], Ilić, D.P.[1]**

[1]Faculty of Technology, University of Niš, Bulevar Oslobodenja 124, 16000 Leskovac, Serbia

* jelena_stanojevic@yahoo.com

Essential oil obtained from oregano (*Origanum vulgare* L.) leaf, by Clevenger-type hydrodistillation and hydromodulus 1:10 m/v during 180 minutes, has been investigated in this work. Qualitative and quantitative composition of the oil was

determined by GC-MS and GC-FID spectrometry. Antioxidant activity of the obtained oil was examined spectrophotometrically by DPPH test (after 20, 30, 45 and 60 minutes of incubation) and TBA-MDA assay. The yield of essential oil was 4.1 $cm^3$/100 g of plant material.

Seven components were identified: α-thujene, myrcene, α-terpinene, o-cymene, γ-terpinene, thymol and carvacrol. The major components were thymol (45%) and carvacrol (37.4%). Oil incubated for 60 minutes has shown the best antioxidant activity according to DPPH test. The minimal concentrations of essential oil, required for neutralization of 50% of initial DPPH radical concentration ($EC_{50}$), were 0.761, 0.590, 0.360 and 0.326 mg/$cm^3$, after 20, 30, 45 and 60 minutes of incubation, respectively. Lipid peroxidation inhibition of 92.3% was achieved by 1.35 mg/$cm^3$ essential oil concentration.

The results obtained indicate that oregano essential oil is a good source of natural antioxidants with potential application in food and pharmaceutical industries, as a safer alternative to the synthetic antioxidants.

**Acknowledgment**. This work is part of the research project "Plant and synthetic bioactive products of new generation", no. TR 34012, financed by the Ministry of Education, Science and Technological Development of Republic of Serbia.

# Volatiles of quince (*Cydonia oblonga* Mill.)

**Veličković, D.[1]*, Ristić, M.[2], Milosavljević, N.[1], Davidović, D.[1], Milenović, D.[3], Veličković, A.[4]**

[1]College of Agriculture and Food Technology, 1 Ćirila i Metodija St, 18400 Prokuplje, Serbia

[2]Institute for Medicinal Plant Research "Dr. Josif Pančić", 1 Tadeuša Košćuška St, 11000 Belgrade, Serbia

[3]"Zdravlje-Actavis" company, 199 Vlajkova St, 16000 Leskovac, Serbia

[4]Out-patient Clinic Leskovac - Health Center Vučje, Koste Stamenkovića bb, 16203 Vučje, Serbia

* dvelickovic7@ptt.rs

Quince fruit and its products (jam, marmalade, compote, juice, quince-brandy) are highly appreciated in the market. Some studies have shown that the quince is excellent source of natural compounds. The fruit is used in the treatment of dysentery, the leaf can be used as a sedative and seed as an emulsifying agent in hair-fixing lotions.

The subject of this study is the chemical composition of volatile fractions from the fruit and leaf of quince (*Cydonia oblonga* Mill.). Dominant components are ethyl 2-methylbutanoate, (*E*,*E*)-α-farnesene, ethyl-(*2E*,*4Z*)-decadienoate, pentadecanol, β-acoradienol, ethyl decanoate, ethyl octanoate, (*E*)-nerolidol, ethyl dodecanoate, 14-hydroxy-9-epi-(*E*)-caryophyllene, (*2Z*,*6E*)-farnesol, β-cedrene. Volatile fraction of the fruit is also characterized by ethyl-(*4Z*)-decenoate, ethyl 9-dodecenoate, ethyl hexanoate, ethyl nonanoate and β-cyclocitral, where in the leaf *n*-octanal, *n*-hexanol, *n*-nonanal and benzaldehyde are present. The presented results show that the quince fruit and leaf are an extraordinary source of substances, which from the chemical standpoint, belong to different groups of compounds. Among the volatiles, ethyl 2-methylbutanoate and ethyl-(*2E*,*4Z*)-decadienoate were the most abundant which could be responsible for flavor. Quince fruit was rich in fatty acid esters.

**Acknowledgement.** The Ministry of Education and Science of the Republic of Serbia supported this study through the projects no. 172047 and 173021.

# The content and composition of minerals in porcino *(Boletus edulis)* flour

**Nikolić, N.[1]*, Karabegović, I.[1], Stojanović, G.[2], Savić, S.[1], Veličković, D.[3], Lazić, M.[1]**

[1]Faculty of Technology, University of Niš, Bulevar oslobodjenja 124, Leskovac, Serbia

[2]Department of Chemistry, Faculty of Science and Mathematics, University of Niš, Višegradska 33, Niš, Serbia

[3]College of Agriculture and Food Technology, University of Niš, Ćirila i Metodija 1, Prokuplje, Serbia

* nadanikolic64@yahoo.com

Wild-growing porcino mushroom (*Boletus edulis*) have nutritional and medicinal importance. Besides all major macro-nutritiens, porcino also contains minerals, vitamins and bioactive compounds. In order to obtain the porcino flour, the fresh porcino from Piskupovo near Leskovac was dried and milled. The minerals content was determined by dry aching procedure in muffle furnace at 600 co, and the composition by ICP analysis after microwave digestion (nitric acid and hydrogen-peroxide was added to sample and digestion performed by three stage program: at 160˚C during 30 minutes, 180˚C, 15 minutes and at 50˚C during 60 minutes, at power of 800 W). The quantitative analysis of mineral content was performed by ICP-OES spectrometer (ARCOS FHE12, SPECTRO, Germany), according to the

manufacturer's instructions. The moisture content in porcino flour was 11.8%, and the minerals content, 6.81%. The results showed the potassium content was considerably higher than content of other minerals (14875.17 mg/kg). Porcino flour also contained high content of iron (2969.36 mg/kg), manganese (661.87 mg/kg), calcium (388.36 mg/kg) and zinc (22.64 mg/kg). Compare to the wheat flour, porcino flour has higher content of these minerals, and replacement wheat by porcino flour represents good way to increase the minerals content in food products for human nutrition.

**Acknowledgement:** This work is supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia, under the project 172047.

# Effects of different essential oil extraction methods on the terpenic profiles of *Achillea millefolium*, *Tanacetum macrophyllum* and *Thymus serpyllum*

**Matović, M.[1]*, Tešević, V.[2], Todosijević, M.[2], Nikolić, B.[3], Stanković, J.[4], Cvetković, M.[4]**

[1]Faculty of Sciences and Mathematics, Department of Biology with Ecology, Višegradska 33, 18000 Niš, Serbia;

[2]Faculty of Chemistry, Studentski trg 16, P.O. Box 158, 11000 Belgrade, Serbia;

[3]Institute of Forestry, Kneza Višeslava 3, 11000 Belgrade, Serbia;

[4]Institute for Chemistry, Technology and Metallurgy, University of Belgrade, Njegoševa 12, 11000 Belgrade, Serbia;

* smikitis@gmail.com

Herbs of *Achillea millefolium* L., *Tanacetum macrophyllum* (Waldst. & Kit.) Sch. Bip. and *Thymus serpyllum* L. were collected in September 2015 from South-West Serbia, Mt. Zlatar, Gradina locality. Three different methods of essential oil extraction were used: 1. Hydrodistillation via Clevenger apparatus (CL), 2. Simultaneous distillation and extraction with dichloromethane via Likens-Nickerson apparatus (LN), and 3. Extraction via Headspace sampling apparatus (HS). Obtained extracts were processed by GC-MS analysis.

The average terpenic profile of *Achillea millefolium* essential oil obtained by CL and LN extraction methods was as following: β-pinene>>> hamazulene >trans-β-caryophyllene>germacrene D>α-pinene>1.8 cineole. More β-caryophyllene and α-pinene were obtained by CL and LN, respectively. Using HS, more β-pinene and α-

pinene, less β-caryophyllene and abscense of hamazulene were adjusted (β-pinene>>>α-pinene>>1.8 cineole>trans-β-caryophyllene).

Using CL and LN methods almost identical terpenic profiles of *Tanacetum macrophyllum* were obtained (germacrene D>>camphor=1.8 cineole>> camphene=caryophyllene oxide). Using HS, much more 1.8 cineole and camphene, a little more sabinene and less germacrene D were found (1.8 cineole>>>camphene>camphor>> sabinene=caryophyllene oxide).

Using CL and LN terpenic profiles of the main three compounds of *Thymus serpyllum* were identical: α-terpynyl acetate>>>myrcene>*p*-mentha-1,(7),8(10)diene-9-ol. But, more limonene from CL, as well as more trans-β-caryophyllene and 3-octanone from LN were also noticed. In comparison with CL, using HS up to ten times more myrcene and camphene were obtained (myrcene>>>α-terpynyl acetate=camphene).

**Acknowledgements.** This research was supported by a grant from the Ministry of Education and Science of the Republic of Serbia (projects 173029 and 172053).

# The chemical composition and antimicrobial activity of essential oil from birch buds

**Stojković, M.[1]*, Nikolić, V.[1], Stanojević, Lj.[1], Nikolić, Lj.[1], Tačić, A.[1], Stanojević, J.[1], Danilović, B.[1]**

[1]Faculty of Technology, University of Niš, Bulevar Oslobođenja 124, 16000 Leskovac, Serbia

* marijana89@hotmail.co.uk

The Birch tree (*Betula* spp., Betulaceae) has a long history of medicinal use in different countries and cultures to cure skin diseases especially eczema, infections, inflammations, rheumatism and urinary disorders. Birch bud oil is also widely used in cosmetic products as a tonic and antiseptic mainly in hair products.

In the present work, the essential oil was obtained form birch buds (*Betula* pendula) (Vrnjačka Banja, Serbia) with hydromodule 1:5 w/V during 4 h. The qualitative and quantitative composition of the oil was determinated by GC-MS spectrometry. Nineteen compounds were identified in the birch buds essential oil, mainly sesquiterpene hydrocarbons and sesquiterpene alcohols. Total percent of the identified compounds was 88.7%. Major compounds were germacrene D (21.7%) and δ-cadinene (17%). The antimicrobial activity of obtained essential oil was examined by using a disc diffusion method against Gram-positive, Gram negative bacteria and fungi. The results of the antimicrobial activity tests revealed that the essential oil of

*Betula* pendula has antimicrobial activity against *Proteus vulgaris*, *Bacillus luteus* and *Klebsiella pneumoniae*.

**Acknowledgement**. This work is part of the research project "Plant and syntetic bioactive products of new generation" no. TR 34012 financed by the Ministry of Education, Science, and Technological Development of Republic of Serbia

# Coumarin structure as a lead scaffold for antibacterial agents - molecular docking

**Veselinović, J.B.[1]*, Matejić, J.S.[2], Veselinović, A.M.[2], Sokolović D.[2]**

[1]Health Institution Filly Farm, Pharmacy Filly 63, Cara Dušana 31, 18000 Niš, Serbia

[2]Faculty of Medicine, University of Niš, Bulevar Dr Zorana Đinđića 81, 18000 Niš, Serbia

* jovana.veselinovic@medfak.ni.ac.rs

Coumarins owe their class name to "Coumarou", the vernacular name of the tonka bean (*Dipteryx odorata* Willd, Fabaceae), from which coumarin was isolated in 1820. Many molecules based on the coumarin structure have been synthesized utilizing innovative synthetic techniques. The diversity oriented synthetic routes have led to interesting derivatives including the furanocoumarins, pyranocoumarins and coumarinsulfamates which have been found to be useful in photochemotherapy, antitumor and anti-HIV therapy, as stimulants for central nervous system, anti-inflammatory, anti-coagulants, etc. One of important pharmacological activity of coumarin molecules is their potential as antibacterial agents since they show inhibitory activity toward isoleucyl-transfer RNA (tRNA) synthetase. In the presented research molecular docking studies of selected coumarin compounds inside isoleucyl-transfer RNA (tRNA) synthetase active site were performed. Molecular docking scores of all studied compounds was obtained through score functions. Presented results indicate that from all studied coumarin compounds the highest interactions with studied enzyme has 7,8-dihydroxy-4-phenyl coumarin followed by 5,7-dihydroxy-4-phenyl coumarin. Presented results are in accordance to *in vitro* obtained results for their antibacterial activity. Presented findings suggest that 4-phenyl hydroxycoumarins may be considered as good molecular templates for potential antibacterial agents and can also be used for further chemical modifications for improving their antibacterial activity.

# Variability of the volatile profile of commercially available "Rtanjski čaj" *(Satureja* sp., Lamiaceae) from Serbia

**Blagojević, P.[1], Pešić, M.[1]*, Radulović, N.S.[1]**

[1]Department of Chemistry, Faculty of Science and Mathematics, University of Niš, Višegradska 33, Niš, Serbia

* marko.pesic89@yahoo.com

"Rtanjski čaj" is a commercial name for a popular tea blend generally comprised from the herbs of the genus *Satureja* L. (Lamiaceae), readily available on the Serbian market. *Satureja* taxa are widely used in traditional medicine and are occasionally recommended by physicians for the treatment of fever, cold sores, nausea, diarrhea and viral infection. Ethnopharmacological usage of these species was scientifically justified and volatile metabolites (viz. essential oil) were confirmed to be carriers of some of the observed biological activities. However, as commercial "Rtanjski čaj" is produced from a wild-collected plant material, it may suffer from variability/inconsistency of both botanical and chemical composition. Consequentially, biological activity/safety of corresponding tea infusions might also significantly fluctuate. Bearing this in mind, we decided to assess variability of the volatile profile of four commercially available "Rtanjski čaj" samples by analyzing chemical composition of corresponding essential oils. The analyses (GC and GC-MS) showed that analyzed samples differed not only in the relative amount, but also in the identity of the most abundant constituents: *p*-cymene (0.9-10.0%), borneol (6.7-17.6%), terpinen-4-ol (3.1-9.2%), carvacrol (1.9-14.9%), caryophyllene oxide (3.3-6.1%), *p*-cymen-8-ol (0-6.5%), geranyl acetate (0-3.6%). This suggests strict quality control of these and similar plant-based products is needed.

**Acknowledgements**. The authors are grateful to the Ministry of Education, Science and Technological Development, Republic of Serbia (Project number 172061).

# Chemical composition of *Ballota macedonica* Vandas essential oils

**Đorđević, A.[1]*, Jovanović, O.[1], Jovanović, S.[1], Lazarević, J.[2], Palić, I.[1], Mitić, V.[1], Stankov-Jovanović, V.[1]**

[1]Department of Chemistry, Faculty of Science and Mathematics, University of Niš, Višegradska 33, 18000 Niš, Serbia;

[2]Department of Pharmacy, Faculty of Medicine, University of Niš, Bulevar Dr Zorana Đinđića 81, 18000 Niš, Serbia

* sanjadj81@yahoo.com

The genus *Ballota* L. (family Lamiaceae) consists of approximately 30 plant species distributed mainly in temperate and subtropical regions of the world. *Ballota macedonica* Vandas (Sect. *Microselidae* (Briq.) Patzak) is an endemic representative of the genus, which populates limited areas in a few countries of central Balkan Peninsula. This is the very first report on the chemical composition of *B. macedonica* essential oils (EO), analyzed by GC-MS and GC-FID. Two EOs were isolated from fresh aerial parts of *B. macedonica* two populations. Sixty components were identified in *B. macedonica* EO (population from the Former Yugoslav Republic of Macedonia) and 34 components in *B. macedonica* EO (population from the Republic of Serbia), accounting for 93.9% and 98.4% of the total oils, respectively. EO of *B. macedonica* had 25 components in common and were dominated by sesquiterpenoids (80.8 - 84.9%). The most abundant components in *B. macedonica* oils were carotol (13.7-52.1%), germacrene D (8.6-24.6%) and (*E*)-caryophyllene (6.5-16.5%).

**Acknowledgments**. The authors acknowledge the Ministry of Education, Science and Technological Development of Serbia for the financial support (Project no. 172047).

# Chemical composition of the leaf essential oil of *Crithmum maritimum* L. (Apiaceae) from Montenegro

**Filipović, S.[1]*, Radulović, N.S.[1]**

[1]Department of Chemistry, Faculty of Science and Mathematics, University of Niš, Višegradska 33, Niš, Serbia

* sonjafilipovic86@yahoo.com

*Crithmum* is a genus of the Apiaceae plant family with the sole species *Crithmum maritimum* L., known as samphire or sea fennel. This plant, characteristic for the beaches in the Old World, has been used for various purposes, as a medicinal

herb, as a spice and also as everyday food. Eaten raw the leaves have a slightly salty, spicy taste, due to the volatile oil present in leaves. Up to now a number of researchers have analyzed the composition of the essential oil of *C. maritimum*, and these studies have revealed a great variation in the content and identity of volatile secondary metabolites. In this study we analyzed, for the first time, the chemical composition of the hydrodistilled essential oil of *C. maritimum* leaves from Montenegro. Fresh plant material, collected during the flowering period, from rocky coasts of the peninsula Luštica, yielded a yellowish fragrant essential oil (0.14%, v/w). A GC-MS analysis enabled the identification of more than 60 constituents, among which limonene (66.7%), sabinene (8.7%), dill-apiole (6.1%), α-pinene (4.8%) and γ-terpinene (4.0%) were the major ones. Both qualitatively and quantitatively the currently analyzed essential oil differed from those previously published indicating the possible existence of different chemotypes of *C. maritimum.*

**Acknowledgements**. This work was funded by the Ministry of Education, Science and Technological Development of Serbia [Project No. 172061].

# The essential oil of *Achillea ageratifolia* (Sm.) Boiss. subsp. *serbica* (Nyman) Heimerl (Asteraceae) revisited: structural elucidation and synthesis of (new) sabinyl esters

**Mladenović, M.[1], Radulović, N.S.[1]*, Filipović, S.[1]**

[1]Department of Chemistry, Faculty of Science and Mathematics, University of Niš, Višegradska 33, 18000 Niš, Serbia

* nikoradulovic@yahoo.com

Serbian Yarrow (*Achillea ageratifolia* (Sm.) Boiss. subsp. *serbica* (Nyman) Heimerl, Asteraceae) is a poorly investigated taxon, endemic to the Central Balkan Peninsula area. A combination of chromatographic and spectroscopic techniques enabled the identification of, in total, 300 constituents (comprising 95.5–97.2% of the total essential-oil compositions) from the essential oils of *A. ageratifolia* ssp. *serbica* dry aerial parts. A comparison of the essential-oil compositions from plant material collected from two populations (Jelašnička klisura gorge and Suva Planina mountain, SE Serbia) in two consecutive years (2013 and 2014) confirmed that the biosynthesis/accumulation of the volatile metabolites for this species is not dependent on the environmental conditions and suggested the existence of a single chemotype of this species. The essential-oil compositions were dominated by (1R*,3S*,5R*)-sabinyl derivatives, including two completely new natural products: (1R*,3S*,5R*)-

sabinyl nonanoate and (1R*,3S*,5R*)-sabinyl decanoate. The identity of these new esters was unambiguously confirmed by co-injection of the essential-oil samples with synthesized standards and their structure was elucidated by NMR (1D and 2D), IR and MS, whereas the stereochemistry of the esters was studied by an NMR methodology that employed lanthanide-induced shift reagents.

**Acknowledgements**. This work was funded by the Ministry of Education, Science and Technological Development of Serbia [Project No. 172061].

## *Hypericum perforatum* essential oil alters experimentally induced anxiety in mice

**Stojanović N.M.[1]*, Randjelović, P.J.[2], Živković, M.[3], Nešić, M.[3], Genčić, M.[3], Djordjević, N.[4], Radulović, N.S.[3]**

[1]Faculty of Medicine, University of Niš, Zorana Đinđića 81, 18000 Niš, Serbia

[2]Department of Physiology, Faculty of Medicine, University of Niš, Zorana Đinđića 81, 18000 Niš, Serbia

[3]Department of Chemistry, Faculty of Science and Mathematics, University of Niš, Višegradska 33, 18000 Niš, Serbia

[4]Department of Prosthodontics, Clinic of Dentistry, Faculty of Medicine, University of Priština, 38220 Kosovska Mitrovica, Serbia

* nikola.st90@yahoo.com

The usage of St. John's worth, *Hypericum perforatum* L. (HP), Hypericaceae, more specifically of the non-volatile constituents of the plant, in the treatment of a variety of health disorders, is well known. The aim of this study was to evaluate the effect of the essential oil of HP on the behaviour of mice in several standard anxiety models. The essential oil used in this study was analysed using GC/MS and GC. The major constituents of the tested oil were: 2-methyloctane, nonane, α-pinene, 3-methylnonane, β-pinene and myrcene. Female BALB/c mice were, treated with the vehicle – olive oil (10 ml/kg), diazepam (2 mg/kg) or HP essential oil (12.5-200 mg/kg), subjected to the open field, light/dark, hole board, rota-rod and wire grasp tests. The behavioural tests revealed an upside parabolic shaped dependence between the applied doses of HP oil and the response of the animals, i.e. the lowest and the highest doses produced a very similar effect (previously observed for other known activities of HP extracts in different pharmacological tests (e.g. nociception, depression)). Our experiments provided direct proof that the volatiles of HP also

significantly contribute to the overall effect of this plant species on the central nervous system of mice.

**Acknowledgments**. The authors acknowledge the Ministry of Education, Science and Technological Development of the Republic of Serbia for the financial support (Project 172061).

# Phenolic compounds production and antioxidant activity of leaflet and spine extracts from *Astragalus parnassi* Boiss. wild growing plants

**Markoska, E.[1], Tusevski, O.[1], Matevski, V.[1], Stefova, M.[2], Gadžovska Simić, S.[1]***

[1]Institute of Biology, Faculty of Natural Sciences and Mathematics, Ss. Cyril and Methodius University, Arhimedova str. 3, 1000 Skopje, Macedonia.

[2]Institute of Chemistry, Faculty of Natural Sciences and Mathematics, Ss. Cyril and Methodius University, Arhimedova str. 3, 1000 Skopje, Macedonia.

* sonjag@pmf.ukim.mk

This study was focused on the production of phenolic compounds and antioxidant activity (β-carotene bleaching) of leaflet and spine extracts from *Astragalus parnassi* Boiss. wild-growing plants during the vegetation period (spring, summer and autumn). The production of total phenolic compounds and antioxidant activity were significantly higher in leaflet compared to spine (rachis) extracts during the vegetation. The highest contents of total phenolics and flavanols were found in both extracts in summer period. The contents of total flavonoids were enhanced in spring/summer leaflets and summer/autumn spines. The highest antioxidant activity was observed in spring-leaflets and summer-spines. The HPLC analyses showed the presence of two flavones only in spines, namely diosmetin in summer/autumn extracts and chrysoeriol in spring samples. The isoflavone biochanin A was identified in both spine and leaflet extracts in summer/autumn period. The flavonoid aglycones quercetin and kaempferol were identified only in spring-leaflets. Among the identified phenolic acids in leaflets, *p*-coumaric acid was found during entire vegetation period, while caffeic acid was confirmed only in summer extracts. This study revealed, for the first time, the phenolic profile and antioxidant activity of leaflet and spine extracts from *A. parnassi* that will contribute to its usage as a medicinal plant.

# HPLC profile of methanolic extract of *Cynara scolymus* L.

**Ickovski, J.[1]*, Palić, I.[1], Đorđević, A.[1], Petrović, G.[1], Ljupković, R.[1], Zlatanović, I.[1]**

[1]Department of Chemistry, Faculty of Science and Mathematics, University of Niš, Višegradska 33, Niš, Serbia

* jovana.ickovski@hotmail.com

*Cynara scolymus* L., known as artichoke, is a member of the thistle family Asteraceae; it grows to a height of 2 m and has large, violet-green floral heads. Artichoke is used as a remedy; reduces cholesterol and triglycerides, lowers blood pressure, cleanses blood, enhances digestion, stimulates bile, supports liver and gallbladder. Methanol extract of dryed artichoke inflorescence were fractionated by preparative TLC. Six fraction was obtained (F1-F6). Extract and obtained fractions were analyzed by HPLC. Five most abundant components in methanol extract were: catechin (27.1%), hesperidin (24.2%), coumaric acid (18.7%), 1,5-dicaffeoylquinic acid (17.4%) and luteolin (7.8%). The main components of fractions were: quinic acid (30.7%) (F1); malonic and ascorbic acid (total: 16.2% F2, 6.7% F3, 6.2% F5, 2.2% F6) and hesperidin (19.8% F4).

**Acknowledgments**. The research was supported by the Serbian Ministry of Education, Science and Technology Development (Grand No. 172047).

# *Boletus impolitus* Fr. as a natural source of phenolic acids and antioxidants

**Dimitrijević, M.[1]*, Mitić, V.[1], Mitić, M.[1], Stankov Jovanović, V.[1], Cvetković, J.[1], Stojanović, G.[1]**

[1]Department of Chemistry, Faculty of Science and Mathematics, University of Niš, Višegradska 33, 18000 Niš, Serbia

* marija.dimitrijevic@pmf.edu.rs

Despite great progress in modern medicine in recent times, a natural source of antioxidants still plays an important role in medical treatment. People usually use edible mushrooms for meals, consuming them fresh, prepared or even as spices. In this research, we focused on determining and quantifying phenolic acids, by HPLC in wild-grown common edible mushroom *Boletus impolitus*, which belongs to family Boletaceae, from Serbia.

Some mushroom-derived polyphenolic compounds have been found to be powerful antioxidants, with potent free radical scavenging and metal-chelating activities. Antioxidant ability of methanol extracts was estimated applying five different methods: DPPH and ABTS, total reducing power (TRP), ferric reducing antioxidant power (FRAP) cupric reducing antioxidant capacity (CUPRAC). Folin-Ciocalteu total phenolic compounds (TPC) were determined too.

Among analyzed phenolic acids (*p*-hydroxybenzoic acid, chlorogenic acid, vanillic acid, caffeic acid, syringic acid, *p*-coumaric acid and ferulic acid), vanillic acid had the highest contribution, 155.98 mg/kg of total content of phenolic acids, 176.761 mg/kg. All of selected methods showed that mushrooms are great source of antioxidants, 11.9897 μg TE/1 mg DW in DPPH; 1.4093 μg TE/1 mg DW in ABTS, 0.3807 μg AAE/mg DW in TRP; 7.0799 μg Fe/mg DW in FRAP; 12.8968 μg TE/mg DW in CUPRAC; and 68.2742 μg GAE/mg DW in TPC.

**Acknowledgments**. The research was supported by the Serbian Ministry of Education, Science and Technology Development (Grand No. 172047).

# ICP-MS assessment of toxic elements in *Lactarius volemus* (Fr.) Fr., collected from Southeastern Serbia

**Dimitrijević, M.[1]*, Mitić, V.[1], Stankov Jovanović, V.[1], Cvetković, J.[1], Đorđević, A.[1], Stojanović, G.[1]**

[1]Department of Chemistry, Faculty of Science and Mathematics, University of Niš, Višegradska 33, 18000 Niš, Serbia

* marija.dimitrijevic@pmf.edu.rs

One of the ways for humans to be exposed to toxic effect is by consuming contaminated food. Toxic metal concentrations in mushroom are considerably higher than those in agricultural crop plants, vegetables, and fruit. This suggests that mushrooms possess a very effective mechanism that enables them readily to take up some toxic metals from the ecosystem. The accumulation of toxic metals in macrofungi has been found to be affected by environmental and fungal factors. The aim of this study was to determine the content of elements (As, Cd, Hg, Cr and Pb) in wild-grown common edible mushroom *Lactarius volemus*, which belongs to family Russulaceae, from Serbia. Studied elements were performed using an inductively coupled plasma mass spectrometer (ICP-MS), after microwave digestion. The overall results of mushroom sample were 0.103 mg/kg for As, 1.944 mg/kg for Cd, 3.827 mg/kg for Hg, 0.374 mg/kg for Cr and 3.791 mg/kg for Pb. In general, the levels

examined metal in this mushroom samples were found to be higher than previous reported for other Lactarious species. The toxic metal levels of wild edible mushrooms should be analyzed more often in order to evaluate the possible danger to human health from them.

**Acknowledgments**. The research was supported by the Serbian Ministry of Education, Science and Technology Development (Grand No. 172047).

# The chemical composition and antimicrobial activity of nutmeg (*Myristica fragrans* Houtt.) seeds essential oil

**Tačić, A.[1]*, Nikolić, V.[1], Stanojević, Lj.[1], Stanojević, J.[1], Nikolić, Lj.[1], Danilović, B.[1]**

[1]Faculty of Technology, University of Niš, Bulevar Oslobođenja 124, Leskovac, Serbia

* ana.tacic@gmail.com

Nutmeg (*Myristica fragrans* Houtt.), belonging to the family Myristicaceae, is an aromatic perennial plant with various medicinal activities. It is used to treat several disorders of digestive tract, such as indigestion, stomach ulcers and liver disorders. Nutmeg contains 5-10% of the essential oil which has been used as a natural flavoring agent and a perfume in the cosmetic industry.

The aim of this work was isolation of essential oil from nutmeg seeds, determination of its qualitative and quantitative composition as well as antimicrobial activity of isolated essential oil.

The essential oil was obtained by Clevenger-type hydrodistillation from disintegrated nutmeg seeds (hydromodule 1:15 m/v). The qualitative and quantitative composition of the oil was determined by GC-MS analysis. Seventeen compounds were identified in the nutmeg essential oil, mainly monoterpene hydrocarbons, monoterpene alcohols and aromatic compounds. It was identified 92.9% of total oil composition. The major compound of the essential oil was sabinene (41.8%). Disc-diffusion method was used for antimicrobial activity investigation on pathogenic microorganisms. The essential oil showed antimicrobial activity on following microorganisms: *Staphylococcus aureus, Bacillus cereus, Bacillus luteus, Escherichia coli, Klebsiella pneumoniae* and *Candida albicans*. Presented results showed that nutmeg essential oil is a potential source of natural antimicrobial agent.

**Acknowledgements**. This work is part of the research project "Plant and synthetic bioactive products of new generation" TR 34012, financed by the Ministry of Education, Science and Technological Development of the Republic of Serbia.

# *Chaerophyllum temulum*: Differences between headspace volatile profiles of fresh and air dried plant

**Stamenković, J.[1]*, Kostevski, I.[1], Petrović, G.[1], Stojanović, G.[1], Palić, I.[1], Zlatković, B.[2]**

[1]University of Niš, Faculty of Sciences and Mathematics, Department of Chemistry, Višegradska 33, 18000 Niš, Serbia

[2]University of Niš, Faculty of Sciences and Mathematics, Department of Biology and Ecology, Višegradska 33, 18000 Niš, Serbia

* jelena.stamenkovic@pmf.edu.rs

The present study was carried out in order to determine the chemical composition of the headspace (HS) volatiles of *Chaerophyllum temulum* obtained from fresh and air dried plant which has not been previously reported. The aim of this study was to investigate the changes in the headspace volatile profile provoked by drying of plant material. The main difference lies in the number of identified compounds, 29 in fresh plant and only 14 in dry plant. In both samples, the most dominant components were monoterpene hydrocarbons while oxygenated derivatives of terpenes were not even detected. β-Phellandrene was the major volatile representing 30.2% of the fresh and 29.5% of the dry plant. Interesting observation was that although we expect that the content of sesquiterpenes is going to be higher in the dry sample, this was not the case. In fact, in a fresh sample the content of sesquiterpenes was twice as high in relation to the content of sesquiterpenes in the dry sample (21.6% and 9.6% of the total volatiles, respectively). The obtained results suggest that the drying process significantly influenced HS volatiles.

**Acknowledgements**. The authors are grateful to the Ministry of Education, Science and Technological Development for financial support through the grant within frame of basic research, No 172047.

# Chemical profile of *Scandix pecten-veneris* L. headspace volatiles

**Petrović, G.[1], Vukadinović, N.[1], Stamenković, J.[1]*, Kostevski, I.[1], Stojanović, G.[1], Jovanović, O.[1]**

[1]Department of Chemistry, Faculty of Science and Mathematics, University of Niš, Višegradska 33, Niš, Serbia

* jelena.stamenkovic@pmf.edu.rs

Shepherd's needle (*Scandix pecten-veneris* L.) is an edible wild green leafy vegetable widely used in the Mediterranean diet. It is an archaeophyte, native of Eurasia, dicot, an annual scapose herb belonging to the family Apiaceae (Umbelliferae). The aim of this study was set to perform a detailed chemical compositional analysis of the headspace volatiles from the above-ground parts of *S. pecten-veneris*. To the best of our knowledge this is the first report about the chemical profile of its headspace volatiles.

The plant material (in partly flowering phase) was collected at the location Oblačina (Serbia) in June 2015. 500 mg of fresh plant aerial parts were put into 20 mL HS vial and the sample was heated at 80°C for 20 min before the analysis. 500 μL of generated vapor was drawn out from the vial and injected directly into the chromatographic column. The sample was analyzed by an Agilent 7890/7000B GC/MS/MS triple quadrupole system in MS1 scan mode, on HP-5MS column. Headspace analysis showed the presence of 26 components what makes 99.0% of all. The main components were tridecane (51.1%), pentadecane (27.1%) and (*E*)-caryophyllene (5.7%). The extract consisted mainly of alkanes (80.4%), while the rest of constituents were unevenly distributed between the sesquiterpenoid (11.7%) and terpenoid compounds (4.1%).

**Acknowledgment**. The authors are grateful to the Ministry of Education, Science and Technological Development for the financial support through the grant No 172047.

# Leaf and flower epicuticular alkanes from *Draba lasiocarpa* Rochel (Brassicaceae)

**Todorovska, M.[1]*, Radulović, N.S.[1]**

[1]Department of Chemistry, Faculty of Science and Mathematics, University of Niš, Višegradska 33, 18000 Niš, Serbia

* mimatod@gmail.com

*Draba* L., the largest genus in the family Brassicaceae (Cruciferae), comprises over 370 species, commonly known as whitlow-mustards. *Draba lasiocarpa* Rochel

flowers in early spring throughout Carpathians and the mountains of the Balkan Peninsula. The secondary metabolites of *D. lasiocarpa* have never been investigated previously, and, in general, the epiculticular compounds from Brassicaceae have received little attention. In this work, for the first time, we analyzed the chloroform leaf and flower surface washings of *D. lasiocarpa*. The plant material was collected from the gorge of the river Jelašnica, near Niš (SE Serbia). A chromatographic separation of the washings yielded a fraction representing a mixture of solely *n*-, *iso*- and *anteiso*-alkanes. Both qualitatively and quantitatively, the composition of the leaf and flower alkanes differed significantly. The alkane profiles were dominated by *n*-alkanes ($C_{23}$-$C_{35}$) with the usual higher plant odd-even ratio, and showed a maximum at $C_{29}$ and $C_{31}$ for the flowers and leaves, respectively. Interestingly, iso-alkanes were present in a significant share in the flower wax with the approximate ratio of *n*-:*iso*-:*anteiso*- alkanes 59:40:1, while the leaf waxes were practically devoid of branched alkanes. Such a distribution is of a biosynthetic/ecological significance and deserves further study.

**Acknowledgements**. The authors acknowledge the Ministry of Education, Science and Technological Development of the Republic Serbia for financial support (Project No. 172061).

# Chemical composition of the inflorescence and leaf essential oil and root diethyl-ether extract of *Bellis perennis* L. from southeastern Serbia

**Nikolić, M.[1]*, Radulović, N.S.[1]**

[1]Department of Chemistry, Faculty of Science and Mathematics, University of Niš, Višegradska 33, 18000 Niš, Serbia

* milica.nikolic.1990@gmail.com

*Bellis perennis* L. (Asteraceae), common daisy, is a widespread herbaceous perennial plant species that has been used in traditional medicine for the treatment of a variety of conditions such as eczema, skin boils and rheumatism. The plant has been the subject of several phytochemical studies that indicated the presence of a variety of triterpenoid compounds, especially saponins. Up to now only a few studies dealt with the composition of the essential oil of this plant taxon. Herein, we analyzed (by GC-MS) the composition of the essential oil from the aboveground parts and the root diethyl-ether extract of *B. perennis* from a wild-growing population in Serbia (Jelašnica gorge, near Niš). Hydrodistillation of the fresh aboveground parts, collected in the beginning of the flowering phase, yielded a small amount of a greenish essential oil (0.022%) with polyacetylenes as one of the major chemical classes detected. The main constituents of the essential oil were found to be methyl deca-4,6-diynoate (2,8-

tetrahydromatricaria ester; 21.9%), γ-himachalene (19.7%) and (*E*)-phytol (13.4%). Fresh roots were macerated with diethyl ether to give an extract (0.075%) that mainly consisted of triterpenoid hydrocarbons. $C_{10}$ polyacetylenes seem to be typical of Astereae, with matricaria ester as the most widespread compound.

**Acknowledgement**. The authors acknowledge the Ministry of Education, Science and Technological Development of Serbia for financial support (project 172061).

# Homologous very long-chain alkanes and aldehydes in cuticular waxes of *Salvia sclarea* L. (Lamiaceae) fruits

**Genčić, M.[1], Živković, M.[1]*, Radulović, N.S.[1]**

[1]Department of Chemistry, Faculty of Science and Mathematics, University of Niš, Višegradska 33, Niš, Serbia

* mika.zivkovic1987@gmail.com

*Salvia sclarea* L. is an aromatic plant species with a long history of medicinal applications. Hitherto, secondary metabolites of *S. sclarea* fruits have not been extensively studied, and, this prompted us to perform detailed analyses of the lipids present both on the surface of or sequestrated within the fruits. Homologous very long-chain (VLC) alkanes (*n-*, *iso-* and *anteiso-*) and aldehydes (reported here for the very first time) were identified as the major constituents in epi- and intracuticular waxes of *S. sclarea* fruits, respectively. *n*-Alkane ($C_{25}$–$C_{35}$) distribution showed an odd-numbered carbon predominance, centred at *n*-$C_{29}$, whereas an even-numbered predominant distribution, with the maxima at *n*-$C_{30}$, was observed for the aldehydes ($C_{24}$–$C_{34}$). Both the alkanes and aliphatic aldehydes represent a direct outcome of the common wax biosynthetic pathway and their similarity (Gaussian-like shape) indicates that these classes are biosynthetically closely related. As opposed to VLC-*n*-alkanes, ubiquitously found on the surface of various plant organs, VLC-aldehydes are much less frequent and are usually present only in trace amounts. Therefore, the noted uncommon accumulation of rare wax components on/in the fruits of this Lamiaceae taxon makes the analysis of fruits-wax constituents important both from biogenetic and (chemo)taxonomic standpoints.

**Acknowledgements**. The authors acknowledge the Ministry of Education, Science and Technological Development of Serbia for financial support (project 172061).

# Benzyl thiocyanate – autolysis product of glucotropaeolin or an artefact of the isolation procedure?

**Todorovska, M.[1]*, Dekić, M.[2], Radulović, N.S.[1]**

[1]Department of Chemistry, Faculty of Science and Mathematics, University of Niš, Višegradska 33, 18000 Niš, Serbia

[2]Department of Chemical and Technological Sciences, State University of Novi Pazar, Vuka Karadžića bb, 36300 Novi Pazar

* mimatod@gmail.com

Glucosinolates (mustard oil glucosides) constitute a well-defined group of specialized plant metabolites found in the order Brassicales. Upon hydrolysis by endogenous thioglucosidases (myrosinases), glucosinolates produce several different products: isothiocyanates, thiocyanates, nitriles, etc. These autolysis products impart characteristic strong flavors and tastes to a great number of cruciferous edible plants. Organic thiocyanates are described from a very limited number of Brassicaceae taxa. Up to now benzyl, (4-hydroxyphenyl)methyl, (4-methoxyphenyl)methyl, 4-methylthiobutyl and allyl thiocyanates were reported as autolysis products of glucosinolates. All of these thiocyanates could form stable carbocationic species that allow an isomerization of an isothiocyanate to thiocyanate and vice versa to occur. We decided to test this hypothesis and synthesized benzyl thiocyanate from benzyl chloride and an inorganic rhodanide, and subsequently subjected it to thermal isomerization, monitored by GC-MS. A prolonged heating of benzyl thiocyanate produced an equilibrium mixture of benzyl thiocyanate and benzyl isothiocyanate. Additionally, over 20 cruciferous species, known to contain glucotropaeolin, were analyzed for the presence of benzyl (iso)thiocyanate. No thiocyanates were detected in the autolyzates. Hence, although we should not dismiss the possibility that under certain conditions the plant can biosynthesize thiocyanates, they can also represent artefacts of thermal isomerization of the original isothiocyanate.

**Acknowledgements**. The authors acknowledge the Ministry of Education, Science and Technological Development of the Republic of Serbia for financial support (Project No. 172061).

# The antimicrobial properties of white lily *(Lilium candidum*)

**Kalaba, V.[1]*, Gojković, V.[2], Balaban Marjanović, Ž.[3], Kalaba, D.[4]**

[1]PI Veterinary Institute of the Republic of Srpska "Dr Vaso Butozan" Banja Luka, Republic of Srpska, Bosnia and Herzegovina

[2]Faculty of Technology Zvornik, Republic of Srpska, Bosnia and Herzegovina

[3]Faculty of Forestry, University of Banja Luka, Republic of Srpska, Bosnia and Herzegovina

[4]Faculty of Medicine-Department of Pharmacy, Banja Luka, Republic of Srpska, Bosnia and Herzegovina

* vesna.kalaba@yahoo.com

The food poisoning with different pathogens is a major problem, both, for consumers and for the food industry production, despite the use of different methods of preservation. Because of the resistance that pathogens developed to many antimicrobial drugs, the interest in natural antimicrobial products such as herbal extracts and spices is growing. Natural extracts made from fresh plant material and biologically active compounds isolated from different plant species have been used for centuries in traditional medicine. They can represent precious sources for the production of new natural preservatives.

Analyzing the available literature that was used in this paper, it was found that there is no confirmed evidence of antimicrobial activity of *Lilium candidum*. That is the reason we have presented the data that provide information about the possession of certain antimicrobial activity.

# Chemical Composition of the Root Essential Oil from *Conium maculatum* L. (Apiaceae)

**Đorđević, M.[1]*, Radulović, N.S.[1]**

[1]Department of Chemistry, Faculty of Science and Mathematics, University of Niš, Višegradska 33, Niš, Serbia

* miljanadjordjevic11@gmail.com

*Conium maculatum* L. (Apiaceae; poison hemlock) is one of the most renowned poisonous plant species. Hemlock is a perennial herbaceous flowering plant

of European origin found throughout many parts of the world. The fresh leaves, fruits and flowers contain a volatile alkaloid, coniine, historically associated with the death of Socrates. The whole plant has a bitter taste and unpleasant odor when mechanically damaged. Strangely, the composition and the associated activities of its essential oils of hemlock were the subject of only several previous studies. Recently, the chemical compositions of the leaf and flower essential oils of *C. maculatum* from Serbia, as well as the essential oil of Iranian hemlock, were published. Herein, we describe the first analysis by GC and GC-MS of the hydrodistilled essential oil of *C. maculatum* L. roots. The yield of the root essential oil was rather low (0.08%, based on fresh root weight, collected near the city of Leskovac). One hundred constituents were successfully identified, representing c.a. 90% of the total detected GC-peak areas. The main constituents of the essential oil were (*Z*)-β-ocimene (25.3%), β-pinene (17.8%), (*Z*)-falcarinol (17.2%), myrcene (13.1%), β-sesquiphellandrene (3.2%) and elemicin (2.4%). No traces of piperidine alkaloids were detected in the roots.

**Acknowledgments**. This work was funded by the Ministry of Education, Science and Technological Development of the Republic of Serbia (Project 172061).

# Wax alkanes of *Galanthus nivalis* L. (Amaryllidaceae)

**Krstić, M.[1]*, Miltojević, A.[1,2], Radulović, N.S.[1]**

[1]Department of Chemistry, Faculty of Science and Mathematics, University of Niš, Višegradska 33, 18000 Niš, Serbia

[2]Faculty of Occupational Safety, University of Niš, Čarnojevićeva 10A, 18000 Niš, Serbia

* milenakrstic991@gmail.com

*Galanthus nivalis* L. (Amaryllidaceae), common snowdrop, is an early spring flower native to Europe. It has attracted considerable attention due to its capability to biosynthesize pharmaceutically important compounds, especially alkaloids such as galanthamine. Despite its popularity, the alkanes of this species have never been previously investigated. Herein, for the first time, we analyzed the chloroform leaf and flower surface washings of *G. nivalis*. GC/MS analyses of the washings revealed the presence of a mixture of hydrocarbons dominated by *n*-alkanes ($C_{23}$-$C_{35}$). Such a distribution reflects the conventional higher plant pattern (odd-numbered carbon dominance) of high carbon preference index (CPI; 4.93/9.38, flower/leaf, respectively) and average chain length (31.35; maximum at *n*-$C_{31}$). Both the leaf and flower waxes were practically devoid of branched alkanes (*iso*-/*anteiso*-), a feature that is relatively rare in higher plants. Also, the differing CPI values of flower and leaf

alkanes is of interest since apparently different elongases are operational in the two plant organs, although both produce the same alkanes and have the same dominant alkane ($n$-$C_{31}$) genetically encoded. Moreover, a comparison of *G. nivalis* alkane distribution with that of other Amaryllidaceae species could provide a chemotaxonomic basis for the discrimination of certain taxonomic categories.

**Acknowledgements**. The authors are grateful to the Ministry of Education, Science and Technological Development of the Republic of Serbia (Project No. 172061) for financial support of this work.

# *In vitro* determination of antioxidant and antimicrobial activity of extracts of *Agrimonia eupatoria* L.

**Mladenović, K.[1]*, Muruzović, M.[1], Stefanović, O.[1], Čomić, Lj.[1], Žugić-Petrović, T.[2]**

[1]Department of Biology and Ecology, Faculty of Science, University of Kragujevac, Radoja Domanovića 12, 34000 Kragujevac

[2]College of Agriculture and Food Technology, Ćirila i Metodija 1,18400 Prokuplje, Republic of Serbia

* katarinamladenovic90@gmail.com

Research conducted in this study showed the influence of water, acetone, diethyl ether and ethanol extracts of *Agrimonia eupatoria* on selected bacteria, as well as the antioxidant activity of extracts using two methods: DPPH and reducing power; and the concentrations of total phenols, flavonoids and tannins and proanthocyanidins. The strongest antimicrobial activity was detected on *Bacillus subtilis*, *B. cereus* and on probiotic species, and the acetone extract demonstrated the highest activity. The concentration of total phenols was measured by the Folin-Ciocalteu reagent and values ranged from 19.61 to 220.31 mgGA/g. In determining the amount of flavonoids, we used the method with aluminum chloride and the obtained values ranged from 20.58 to 97.06 mgRU/g. The total tannins concentration was measured by the PVPP method and the results were in the range of 3.06 to 207.27 mgGA/g, while the concentration of proanthocyanidins was determined by the buthanol-HCl reagent and the values ranged from 4.15 to 103.72 CChE/g. The acetone extract showed good antioxidative efficiency with values of 97.13% determined by DPPH method and with absorbance value of 2.2665 determined by reducing power. All the extracts showed potential for further investigation and use.

**Acknowledgements**. This investigation was supported by the Ministry of Education and Science of the Republic of Serbia, grant No. 41010 and 173032.

# Interaction between *Agrimonia eupatoria* L. extracts and antibiotic and antibiofilm activity of two extracts

**Muruzović, M.[1]*, Mladenović, K.[1], Stefanović, O.[1], Čomić, Lj.[1], Žugić-Petrović, T.[2]**

[1]Department of Biology and Ecology, Faculty of Science, University of Kragujevac, Radoja Domanovića 12, 34000 Kragujevac

[2]College of Agriculture and Food Technology, Ćirila i Metodija 1,18400 Prokuplje, Republic of Serbia

* mirkagrujovic@gmail.com

In this paper, synergy between the *Agrimonia eupatoria* water extract/ampicillin, diethyl ether extract/ampicillin, acetone extract/ampicillin and ethanol extract/ampicillin was studied on selected G- bacteria using the checkerboard assay method. Also, the *in vitro* activity of acetone and water extracts of *A. eupatoria* were examined for possibility of inhibition of biofilm formation of *Proteus mirabilis* and *Pseudomonas aeruginosa* using the crystal violet method. Interactions between antimicrobial agents were determined and quantified by calculating the fractional inhibitory concentration (FIC) index. For every combination of agents, synergism was recorded in relation to *E. coli* (FIC values ranged from 0.03 to 0.29). The results for other tested bacteria showed additive or indifferent interaction between antimicrobial agents. No antagonistic effect was observed. Biofilm inhibitory concentration ($BIC_{50}$) was defined as the lowest concentration of extract that showed 50% inhibition on the biofilm formation calculated graphic. $BIC_{50}$ values for acetone extract were 4315 μg/ml for *P. mirabilis* and 4469.5 μg/ml for *P. aeruginosa*.

**Acknowledgements**. This investigation was supported by the Ministry of Education and Science of the Republic of Serbia, grant No. 41010 and 173032.

# Antimicrobial activity of rakija travarica „Sante“

**Žugić-Petrović, T.[1]*, Ilić, P.[1], Muruzović, M.[2], Mladenović, K.[2], Stanisavljević, D.[1], Čomić, Lj.[2]**

[1]College of Agriculture and Food Technology,1 Ćirila i Metodija St., 18400 Prokuplje, Serbia

[2]Department of Biology and Ecology, Faculty of Science, University of Kragujevac, Radoja Domanovića 12, 34000 Kragujevac, Serbia

* tanja.zugicpetrovic@yahoo.com

Rakija travarica „Sante“ is produce in the basement Živković in Malošište. Produced from high quality “lozova rakija” who containing valuable bioactive ingredients 27 medicinal and aromatic plants, which enables a beneficial effect on the human body and makes it unique in its category. The aim of study was to investigate the antimicrobial activity of rakija "Sante". For this investigation, it was used disc diffusion method. Investigation of antimicrobial activity was conducted on five standard strains ATCC (American Type of Culture Collection) Gram (+) bacteria: *Enterococcus faecalis* ATCC 29212, *Staphylococcus aureus* ATCC 29213, *Listeria monocytogenes* ATCC 19115 and Gram (-) bacteria: *Escherichia coli* ATCC 25922 and *Proteus hauseri* ATCC 13315. The results were compared with the activity of the reference compound (antibiotic gentamicin). Tested undiluted rakija „Sante“ showed activity against Gram (-) bacteria *E. coli*, where the tested sample of rakija „Sante“ and reference compound have the same zone of inhibition (15 mm). The synergistic effect of antibiotics and rakija „Sante“ was 20 mm, while dilution (1: 8) against the species *P. hauseri* was 10 mm.

**Acknowledgements:** We owe special thanks to the family Živković for their contribution to this research.

# Diesters of a highly oxygenated germacrane derivative from *Daucus carota* L.

**Zlatković, D.B.[1]*, Radulović, N.S.[1]**

[1]Department of Chemistry, Faculty of Science and Mathematics, University of Niš, Višegradska 33, RS-18000 Niš, Serbia

* dragan.zlatkovic@gmail.com

*Daucus carota* L. (Umbelliferae) is a widely distributed biennial herb. Flowers of wild-growing *D. carota* were collected from the urban settings of the city of Niš (SE Serbia). Diethyl ether extract of *D. carota* flowers was subjected to several

sequential $SiO_2$ medium pressure column chromatographies and a number of sesquiterpenic esters containing tiglate and angelate moieties were isolated. The structure of these compounds was elucidated by 1D and 2D NMR spectroscopy including a combination of NOESY, gradient HSQC, HMBC, 1H-1H COSY and selective homonuclear decoupling experiments, as well as by EI mass spectrometry. Four major isolated constituents were 6,8-O-ditigloyl- (1), 6-O-angeloyl-8-O-tigloyl (2), 6-O-tigloyl-8-O-angeloyl (3) and 6,8-O-diangeloyl-6β,8α,11-trihydroxygermacra-1(10)*E*,4*E*-diene (4). Analysis of the NMR data also allowed us to gain insight into the conformational states of these molecules. All esters (1-4) showed a pronounced tendency to undergo [3,3]-sigmatropic rearrangement to the corresponding elemane derivatives under the conditions of GC, yielding broad overlapped GC-peaks.

**Acknowledgement**: This work was funded by the Ministry of Education, Science and Technological Development of Serbia (Project 172061).

# Chemical analysis of the herb extract of *Nepeta nuda* L.

**Stanisavljević, D.[1]*, Ristić, M.[2], Đorđević, S.[2], Veličković, D.[1], Ranđelović, N.[3], Zlatković, B.[4]**

[1]College of Agriculture and Food Technology,1 Ćirila i Metodija St., 18400 Prokuplje, Serbia

[2]Institute for Medicinal Plant Research "Dr Josif Pančić", 1 Tadeuša Košćuška St., 11000 Belgrade, Serbia

[3] Department of Biology and Ecology, Faculty of Sciences and Mathematics, University of Niš, 33 Višegradska St., 18000 Niš, Serbia

[4]Faculty of Agriculture, 6 Nemanjina St., 11080 Belgrade, Serbia

* draganastanisavljevic72@gmail.com

*Nepeta nuda* (L.) belongs to the genus *Nepeta*, Lamiaceae family. In medicine, the plant is used for gastrointestinal and respiratory disorders. Due to the taste of lemon and mint, the herb is used in the preparation of teas and in cooking. This paper analyzes the volatile and non-volatile fractions of the extract of *N. nuda* (locality Bosilegrad, Serbia) obtained in the process of percolation (1:2) with 70% ethanol in terms of evaluation of the chemical composition, in order to consider its possible application as a functional supplement to food and drinks. Volatile and non-volatile fractions of extracts were analyzed by GC-FID/GC-MS and HPLC methods, respectively. In the volatile fraction of the extract 25 components have been identified, which represents 80.68% of its total mass. The dominant compound was a

monoterpenoid 1.8-cineole (37.03%). From sesquiterpenoids the most abundant were γ-muurolene (5.51%) and bicyclogermacrene (2.71%). In non-volatile fraction of the extract 10 components were identified (87.45 of its total mass). The dominant compounds were derivatives of kaempferol 3-O-(6"-O-acetilglucoside)-7-O-rhamnoside (32.49%), chlorogenic acid (17.67%) and luteolin 5-O-(6"-O-malonilglucoside) (12.95%). Extract of *N. nuda* added to food or drinks can improve their sensory properties, but also their functional properties.

**Acknowledgements**. The Ministry of Education and Science of the Republic of Serbia supported this study through the project OI 172047and III 46001.

# Cytotoxic isothiocyanates from *Reseda lutea* L.

**Zlatković, D.B.[1]*, Radulović, N.S.[1], Ilić-Tomić, T.[2], Senerović, L.[2], Nikodinović-Runić, J.[2]**

[1]Department of Chemistry, Faculty of Science and Mathematics, University of Niš, Višegradska 33, RS-18000 Niš, Serbia

[2]Institute of Molecular Genetics and Genetic Engineering, University of Belgrade, Vojvode Stepe 444a, PO Box 23, RS-11010 Belgrade, Serbia

* dragan.zlatkovic@gmail.com

*Reseda lutea* L. (Resedaceae) or Wild Mignonette is a widely distributed plant species. Pliny the Elder (AD 23 – AD 79), a Roman scholar and naturalist, reported the use of *R. lutea* for reducing tumors in his Historia Naturalis. However, to date no *in vivo* or *in vitro* evidence exists in support of the alleged properties of *R. lutea*. The composition of autolysates obtained from different organs of *R. lutea* was investigated by GC and GC-MS analyses, as well as IR, 1D and 2D NMR spectroscopy. Benzyl isothiocyanate and 2-(α-L-rhamnopyranosyloxy)benzyl isothiocyanate were identified as the major constituents of the root and flower autolysates, respectively (the later represents a new natural product). Autolysates and their major constituents were screened for cytotoxicity on human A375 (melanoma) and MRC5 (fibroblast) cell lines (MTT-dye reduction assay). Mechanism of the observed cytotoxic effects was studied by cell-cycle analysis and Annexin V assay. The two isothiocyanates showed significant antiproliferative effects against both cell lines, which could also explain the observed high cytotoxic activity of the tested autolysates. Cell-cycle analysis revealed apoptosis as the probable mechanism of cell death. Tumor reducing properties attributed to *R. lutea* in the pre-modern texts were substantiated by the herein obtained results.

**Acknowledgement**. This work was funded by the Ministry of Education, Science and Technological Development of Serbia (Projects 172061 and 173048).

# Chemical composition of the essential oil of *Heracleum sphondylium* L. (Apiaceae) from the settings of the city of Niš (SE Serbia)

**Đorđević, M.[1]*, Radulović, N.S.[1], Stojanović, N.[2], Stojanović-Radić, Z.[3]**

[1]Department of Chemistry, Faculty of Science and Mathematics, University of Niš, Višegradska 33, Niš, Serbia

[2]Faculty of Medicine, University of Niš, Bulevar dr Zorana Đinđića 81, Niš, Serbia

[3]Department of Biology and Ecology, Faculty of Science and Mathematics, University of Niš, Višegradska 33, Niš, Serbia

* miljanadjordjevic11@gmail.com

The genus *Heracleum* L. (Apiaceae) comprises more than 70 species distributed across the Northern Hemisphere, from North America to East Asia. *Heracleum sphondylium* L., known as hogweed, is a perennial plant species occurring throughout Europe (except in the extreme north) and much of the Mediterranean region. Motivated by the traditional use and known biological activities of this plant species, we decided to analyse in detail the composition of the essential oil isolated by hydrodistillation from unripe fruits of *H. sphondylium* by gas chromatography and gas chromatography–mass spectrometry. The investigated plant material originated from populations growing within the urban settings of Niš municipality. One hundred and four components, accounting for 97.3% of the total peak areas detected, were successfully identified. The volatiles were largely made up of aliphatic esters (67.5%) and with smaller amounts *n*-alcohols (16.0%), phenylpropanoids (7.2%) and sesquiterpenoids (4.4%). The major components were found to be octyl acetate (42.0%), 1-octanol (15.5%), octyl butanoate (8.4%) and (Z)-4-octenyl acetate (5.3%). The chemical composition of the essential oil of *H. sphondylium* from the urban area of Niš was very similar to that from previous reports on the volatiles of this taxon from other populations.

**Acknowledgments**. This work was funded by the Ministry of Education, Science and Technological Development of the Republic of Serbia (Project 172061).

# The influence of the sampling method (individual vs. composite sample) on the chemical caracteristics of *Seseli rigidum* Waldst. & Kit. essential oil

**Marčetić, M.[1]*, Lakušić, B.[2], Lakušić, D.[3]**

[1]Department of Pharmacognosy, University of Belgrade-Faculty of Pharmacy, Vojvode Stepe 450, 11221 Belgrade, Serbia

[2]Department of Botany, University of Belgrade-Faculty of Pharmacy, Vojvode Stepe 450, 11221 Belgrade, Serbia

[3]Institute of Botany and Botanical Garden "Jevremovac", University of Belgrade-Faculty of Biology, Takovska 43, 11000 Belgrade, Serbia

* mirasim@pharmacy.bg.ac.rs,

The aim was to investigate the influence of the different sampling method on the chemical composition of root, aerial parts and fruit essential oils of *Seseli rigidum* Waldst. & Kit. (Apiaceae), collected from seven natural populations from Serbia. The first methodological approach (individual sample) involved the collection of samples from each individual ("one individual in one bag – one analysis"), while the second approach (composite sample) means composite collected samples ("all individuals from population in one bag - one analysis"). Individual (207) and composite (28) samples of isolated essential oils were analysed by GC-FID/MS. The PCA and CDA analysis showed correspondence between sampling methods. Meanwhile ANOVA and Cluster analysis revealed the significant differences in the results. Individual samples of essential oils grouped in two clusters based on the different climate, humid or semi-arid. The Cluster analysis of composite samples showed different pattern of relationships and could mislead to assumptions that are not in accordance with the results of individual analysis.

The compositions of *S. rigidum* essential oils, individually or compositely sampled, were similar. Nevertheless, Cluster analysis revealed marked differences depending on sampling method. Composite sampling was not accurate method for the essential oil hemotype determination and for valid insight into the relationships between populations.

# Efficacy of *Ocimum basilicum* L. and *Rosmarinus officinalis* L. essential oils against the growth of *Salmonella enterica* subsp. *enteritidis* in meat

**Stojanović-Radić, Z.[1]*, Pejčić, M.[1], Ničić, S.[1], Ristić, J.[1], Mihajilov-Krstev, T.[1]**

[1]Department of Biology and Ecology, Faculty of Science and Mathematics, University of Niš, Višegradska 33, Niš, Serbia

* zstojanovic@pmf.ni.ac.rs

Pathogens from the *Salmonella* genus belong to the group of the most common food poisoning causative agents. A number of active compounds present in rosemary (*Rosmarinus officinalis* L.) and basil (*Ocimum basilicum* L.) makes them very useful in food and pharmaceutical industries. The numerous studies demonstrated antimicrobial activity of the basil and rosemary essential oils, but at the same time, there are no studies about their preservative effect in different types of food. Therefore, the aim of this study was to investigate their effect on the growth of *Salmonella enterica* subsp. *enteritidis* in chicken meat as a food model.

Antimicrobial activity of the two essential oils (isolated by hydrodistillation) was investigated by determining the minimum inhibitory concentration (MIC) using microdilution method. Obtained inhibitory concentrations (MIC, 4 x MIC and 8 x MIC) were used in the food model experiment on the chicken meat inoculated with salmonella. The test was performed at the room temperature and different incubation periods. It was concluded that after a total incubation period of 72 hours, essential oils did not significantly reduced the number of salmonella cells. Therefore, the preservative effects of basil and rosemary oils cannot be expected in this type of food.

# Chemical composition, antioxidant and antimicrobial activity of chamomile flowers essential oil (*Matricaria chamomilla* L.)

**Stanojević, J.S.[1]*, Stanojević, Lj.P.[1], Marjanović-Balaban, Ž.R.[2], Kalaba, V.D.[3], Cvetković, D.J.[1]**

[1]University of Niš, Faculty of Technology, Bulevar Oslobođenja 124, 16000 Leskovac, Serbia

[2]University of Banja Luka, Faculty of Forestry, Republic of Srpska, Bosnia and Herzegovina

[3]Veterinary Institute of the Republic of Srpska "Dr Vaso Butozan" Banja Luka, Republic of Srpska, Bosnia and Herzegovina

* jelena_stanojevic@yahoo.com

The subject of the present study was determination of chemical composition, antioxidant and antimicrobial activity of essential oil obtained from chamomile flowers (*Matricaria chamomilla* L.) by hydrodistillation on semi-industrial level of production. The plant material was grown in the northwestern Republic of Srpska.

Qualitative and quantitative composition of the oil was determined by GC-MS and GC-FID spectrometry. The antioxidant activity of essential oil was investigated by DPPH assay and antimicrobial activity using the agar diffusion method.

The results obtained proved the presence of 52 components, with the highest content of β-farnesene (29.8%), α-bisabolol and its oxide (15.7%), α-farnesene (9.3%), chamazulene (6.4%), germacrene D (6.2%) and spiroether (5.6%). Essential oil has shown the best antioxidant properties after 90 minutes of incubation with $EC_{50}$ value of 2.07 mg/cm$^3$. The oil has shown antimicrobial activity on following microorganisms: *Listeria monocytogenes*, *Escherichia coli*, *Staphylococcus aureus* and *Salmonella enterica*.

Chemical composition, antioxidant and antimicrobial activity of the investigated chamomile essential oil, indicate a significant phytomedical potential.

**Acknowledgment**. This work is part of the research project "Plant and synthetic bioactive products of new generation," no. TR 34012, financed by the Ministry of Education, Science and Technological Development of Republic of Serbia and project No. 19/6-020/961-169/14, financed by the Ministry of Science and Technology of the Republic of Srpska.

# The influence of ethyl acetate extract of lichen *Hypogymnia physodes* (L.) Nyl. on survival rate of *Drosophila melanogaster*

**Jovanović, N.[1]*, Cvetković, V.[1], Mitrović, T.[1], Mladenović, M.[1], Arsić, J.[1], Stanković, M.[2], Stamenković, S.[1]**

[1]Department of Biology and Ecology, Faculty of Sciences and Mathematics, University of Niš, Višegradska 33, Niš, Serbia

[2]Department of Biology and Ecology, Faculty of Science, University of Kragujevac, Radoja Domanovića 12, 34000 Kragujevac, Serbia

* nikolajov90@gmail.com

Ethyl acetate (EA) extract of lichen *Hypogymnia physodes* (L.) Nyl. was shown to have wide range of biological activities such as antibiotic, antimycotic, antioxidant, cytotoxic, genotoxic and apoptotic. Thus, this type of extract represents a potential source of biologically active factors for pharmaceutical industry. The aim of our study was to evaluate the influence of the EA extract of *H. physodes* on survival rate of *Drosophila melanogaster*. The aqueous suspension of the EA extract was homogenized in ultrasonic bath prior to preparation of feeding medium treatments. Four treatments with different concentrations of the EA extract and water control were prepared in triplicate. Three-day old *D. melanogaster* larvae were transferred on prepared treatments. Total number of pupae and hatched adults were recorded. Statistically significant differences were determined using Kruskal-Wallis test. All statistical analyses were performed using FLORA® 1.0.0 software. Results suggested that EA extract of *H. physodes* had weak toxic effect in an inversely concentration-dependent manner. Toxicity was observed only at larval stage because the mortality at pupal stage was not detected.

**Acknowledgements**. This research was supported by the Ministry of Science and Education of the Republic Serbia during the activities on the following projects: III 41018 and III 41010

# Biological activity of *Mentha spicata* L. (Lamiaceae) plant extract

**Stojanović-Radić, Z.[1]*, Stanković, M.S.[2], Salas, J.B.[3,4], Vázquez, F.M.[3,4], Téllez, T.R.[5]**

[1]Department of Biology and Ecology, Faculty of Science and Mathematics, University of Niš, Višegradska str., 33, 18000 Niš, Serbia

[2]Department of Biology and Ecology, Faculty of Science, University of Kragujevac, Radoja Domanovića str., 12, 34 000 Kragujevac, Serbia

[3]Grupo HABITAT, Instituto de Investigaciones Agrarias Finca La Orden-Valdesequera, CICYTEX, Junta de Extremadura, Autovía A-5 Km 372, 06187 Guadajira, Badajoz, España

[4]FOTEX, Av. José María Alcaráz y Alenda, 47 - 1ª planta.digo Postal: 06011, Badajoz, España

[5]Grupo de Investigación en Biología de la Conservación. Facultad de Ciencias. Universidad de Extremadura. Avda. de Elvas s/n, 06071 Badajoz, España

* zstojanovic@pmf.ni.ac.rs

In the present study, total phenolic content, flavonoid concentration as well as antioxidative and antimicrobial potential of the methanolic extract from *Mentha spicata* (Lamiaceae) were conducted. Plant material for analysis was collected from Badajoz – Guadajira (Spain). Total phenolic content expressed in term of gallic acid equivalent, GAE (mg of GA/g of extract) was 205.14 ± 0.93 mg of GA/g. The concentration of flavonoids expressed in term of rutin equivalent, RuE (mg of Ru/g of extract) was 70.21 ± 0.65 mg of RU/g. Antioxidative activity expressed as $IC_{50}$ values was 38.07 ± 1.11 μg/ml. The assessment of the antioxidant activity based upon obtained results for the standard control antioxidant substances, highlighted an excellent activity of the *Mentha spicata* secondary metabolites. Antimicrobial activity showed significant antimicrobial potential of the tested extract (0.01-10.0 mg/ml), especially against Gram positive species. Presented comparative study of the quantity and activity of phenolic compounds suggest the great value of *Mentha spicata* as a rich source of compounds with an effective biological activity.

**Acknowledgements**. This work is financially supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia (grants No. III 41010 and 172061).

# Anatomical and Chemical Analyses of Stem and Leaf of *Frangula rupestris* (Scop.) Schur (Rhamnaceae)

**Arsenijević, J.[1]*, Slavkovska, V.[2], Lakušić, B.[2]**

[1]Department of Pharmacognosy, Faculty of Pharmacy, University of Belgrade, Vojvode Stepe 450, Belgrade, Serbia

[2]Department of Botany, Faculty of Pharmacy, University of Belgrade, Vojvode Stepe 450, Belgrade, Serbia

* jelenaa@pharmacy.bg.ac.rs

Rhamnaceae species are well known for their anthranoid composition and medicinal usage as laxatives. However, data on *Frangula rupestris*, regarding its anatomy, composition and possible usage, are scarce. In this work we investigated the stem and leaf of *F. rupestris* collected from two localities in Montenegro.

In the anatomical analysis of stem and leaf, beside tissues characteristic for their structure, large cells and cavities with mucilage content were observed, as well as clustered and solitary prismatic crystals of calcium oxalate in parenchyma, collenchyma and phloem, and sclereids.

TLC and HPLC analyses revealed the presense of anthranoids in the stem bark, whereas flavonols (dominant constituent: hyperoside), were identified in both, bark and leaf extracts. Quantitative analysis was performed according to European Pharmacopoeia. Stem bark and leaf contained 2.68-3.03% and 2.22-3.76% of total phenolics, 1.7-2.1% and 0.57-1.54% of tannins, and 0.12–0.36% and 0.57-0.99% of flavonoids, respectively. The bark anthranoid content (0.37-0.40%) was low in comparison with the bark of *F. alnus* (6.55%). Swelling indices of the bark (5.8-11.4) and leaf (5.0-21.0) were higher than those of *Althaeae radix/folium* (4.4-4.8).

The obtained results indicate that the stem bark and, especially the leaf, of *F. rupestris* can potentially be used as mucilaginous drugs.

# Seedling peroxidases activity in relation to the variability of nitrogen content in sweet basil (*Ocimum basilicum* L.)

**Jakovljević, D.[1]*, Stanković, M.[1], Bojović, B.[1], Topuzović, M.[1]**

[1]Department of Biology and Ecology, Faculty of Science, University of Kragujevac, Radoja Domanovića No 12, 34 000 Kragujevac, Republic of Serbia

* draganajakovljevic@ymail.com

Peroxidases (POX) are enzymatic antioxidants which prefer aromatic electron donors. The donors enable them both to perform oxidation of co-substrates and convert $H_2O_2$ to $H_2O$ and $O_2$. In an attempt to understand the mechanism of several peroxidases in the seedling of *Ocimum basilicum*, we cultured seedlings in *in vitro* conditions by treating them with different concentrations of nitrogen (6 mM and 24 mM $KNO_3$) as well as with combinations of different nitrogen sources (5 mM $KNO_3$ + 5 mM $NH_4NO_3$, 20 mM and $KNO_3$ + 20 mM $NH_4NO_3$). The results obtained from the analyzed basil stems demonstrated differences among tested enzymes. In the case of guaiacol peroxidase (GPOX), the higher activity was observed in the medium with 24 mM $KNO_3$ (0.5701 ± 0.02 U/g FW). Similarly, the results showed the higher activity of pyrogallol peroxidase (PPOX), with values of 2.492 ± 0.01 U/g FW. Practically identical values were obtained in all other treatments. Ascorbate peroxidase (APOX) demonstrated similar activity in both nitrogen levels (8.00 ± 0.39 for 24 mM and 7.43 ± 0.22 U/g FW for 6 mM $KNO_3$), while in combination with $NH_4NO_3$ the activity of APOX is more than ten times lower. Varying peroxidase content could be considered as an indicator of nitrogen regime in the basil seedlings.

# Screening selected compositae species for antioxidant activity in relation to phenolic content of plant extracts

**Jakovljević, D.[1]*, Stanković, M.[1], Bojović, B.[1], Zlatić, N.[1], Topuzović, M.[1]**

[1]Department of Biology and Ecology, Faculty of Science, University of Kragujevac, Radoja Domanovića No 12, 34 000 Kragujevac, Republic of Serbia

* draganajakovljevic@ymail.com

This study presents the results of total phenolic content, especially flavonoids and antioxidant activity in the ethanolic extracts of six species from four genera of Compositae family (*Centaurea salonitana* Vis., *C. atropurpurea* Waldst. & Kit.,

*Achillea atrata* L., *A. clavennae* L., *Filago arvensis* L. and *Xeranthemum annuum* L.). Total phenolic content expressed in terms of gallic acid equivalent, GAE (mg of GA/g of extract) is: *Centaurea salonitana* – 119.05, *C. atropurpurea* – 97.11, *Achillea atrata* – 122.32, *A. clavennae* – 100.91, *Filago arvensis* – 83.56 and *Xeranthemum annuum* – 94.60 mg of GA/g of extract. The concentration of flavonoids expressed in terms of rutin equivalent, RuE (mg of Ru/g of extract) is: *Centaurea salonitana* – 81.28, *C. atropurpurea* – 75.36, *Achillea atrata* – 87.95, *A. clavennae* – 55.14, *Filago arvensis* – 48.23 and *Xeranthemum annuum* – 62.44 mg of Ru/g of extract. Antioxidant activity determined using free radical scavenging capacity assay expressed as $IC_{50}$ values is: *Centaurea salonitana* – 107.00, *C. atropurpurea* – 101.74, *Achillea atrata* – 92.66, *A. clavennae* – 131.07, *Filago arvensis* – 139.21 and *Xeranthemum annuum* – 143.12 μg/ml. A significant relation was observed between the investigated parameters of phenolic content and antioxidant activity. Assessment of the obtained results in comparison with the results for control antioxidant substances indicates the significant value of the studied species in relation to biological activity.

# Phytochemical and antibacterial screening of methanol and chloroform extracts of the leaves of *Daphne kosaninii* (Stoj.) Stoj. (Thymeleaceae)

**Sovrlić, M.[1], Vasiljević, P.[2], Jušković, M.[2], Mašković, P.[3], Manojlović, N.[1]***

[1]Department of Pharmacy, Faculty of Medical Sciences, University of Kragujevac, Svetozara Markovića 69, 34000 Kragujevac, Serbia

[2]Department of Biology and Ecology, Faculty of Science and Mathematics, University of Niš, Višegradska 33, Niš, Serbia

[3]Department of Food Technology, Faculty of Agriculture, University of Kragujevac, Cara Dušana 34, 32000 Čačak, Serbia

* mtnedeljko@yahoo.com

*Daphne kosaninii* (Stoj.) Stoj. is an endemic relict of the Balkan flora. It is a perennial evergreen dwarf shrub with short woody branches, short oval pale green leaves and numerous white to rose-pink, fragrant flowers. Information on chemical composition and biological activity of this plant are very poorly. The aim of this study was to perform phytochemical screening as well as evaluate the antimicrobial activity of the methanol and chloroform extracts of the leaves of *D. kosaninii*. High performance liquid chromatography (HPLC) was employed for the identification of

the most abundant metabolites present in the tested extracts. Total phenolic and flavonoid contents were determined spectrophotometrically. Microdilution method was applied to determine the minimum inhibitory concentration (MIC) of the extracts against selected bacteria and fungi. The total phenolic content in the chloroform extract of the plant leaves (73.67 ± 0.67 mg GA/g) were higher than that of the methanol extract (68.79 ± 0.25 mg GA/g). On the other hand, in the case of total flavonoids, a greater value obtained for the methanol extract (30.05 ± 1.25 mg RU/g) compared with the chloroform extract (27.87 ± 1.03 mg RU/g). HPLC analysis of the extracts showed the presence of coumarin metabolite daphnetin (tR= 2.25 ± 0.10 min.) and *p*-hydroxybenzoic acid (tR= 0.96 ± 0.10 min.). The extracts exhibited the strongest antimicrobial effect against *Staphylococcus aureus* and *Proteus mirabilis* with MIC value of 15.62 μg/ml. This study showed that *Daphne kosaninii* leaves have high content of phenols and flavonoids and may potentially be used as an accessible source of natural antimicrobial agents.

**Acknowledgements**. This work study financially supported by Ministry of Education and Science of the Republic of Serbia (Grant no. 172015) and Junior Project grant (no. 06/11) from Faculty of Medical Sciences, University of Kragujevac, Serbia.

# Antihemolytic effects of water extract of *Hypericum rumeliacum* Boiss. on rat erythrocytes

**Conić, J.[1]*, Žabar Popović, A.[1], Nikolić, M.[1], Jušković, M.[1], Zlatković, B.[1], Vasiljević, P.[1]**

[1]Department of Biology and Ecology, Faculty of Science and Mathematics, University of Niš, Višegradska 33, Niš, Serbia

* conicka91@gmail.com

Species within *Hypericum* genus have been used in traditional medicine for ages because of their antiinflamatory, antibacterial and antiviral activity, as well as for healing flash burns and stomach problems. *Hypericum rumeliacum* Boiss (Hypericaceae) is medium sized, perennial plant with comparatively short, erect to decumbent stems. According to its narrow distribution in central, eastern and southern part of Balkan Peninsula it is considered to be endemic species. The plant inhabits dry, usually calcareous, stony places. Genus *Hypericum* is characterized with presence of secondary metabolites, from which naphtodianthrones, derivatives of phloroglucinol and flavonoids are most present. Hemolytic activity of *H. rumeliacum* extract was analyzed on erythrocytes of Wistar rat. Erythrocytes were isolated and washed from full blood sample. After washing, 4% suspension of erythrocytes was prepared. The suspension was treated with *H. rumeliacum* water extract, with

concentrations of: 1 mg/ml, 2 mg/ml, 3 mg/ml, 4 mg/ml and 5 mg/ml. The results show that the increase of concentration of *H. rumeliacum* water extract causes the decrease of erythrocyte hemolysis. The percentage of hemolysis is within the range from 23.66% at concentration of 1 mg/ml, to 20.26% at concentration of 5 mg/ml. The results obtained show that examined *H. rumeliacum* water extract has antihemolytic activity.

**Acknowledgements**. The authors acknowledge the financial support of the Ministry of Education, Science and Technological Development of the Republic of Serbia (Grant No.: 172047)

# Gas-chromatography mass-spectrometry (GC-MS) metabolic profiling and free radical scavenging activity of *Micromeria dalmatica*

**Nikolova, M.[1], Aneva, I.[1]*, Berkov, S.[1]**

[1]Institute of Biodiversity and Ecosystem Research Acad. G. Bonchev 23 Sofia 1113 Bulgaria

* ina.aneva@abv.bg

As a part of comprehensive survey of chemical composition and biological activity of Bulgarian species of genus *Micromeria* in the present study the metabolite profile and free radical scavenging activity of *Micromeria dalmatica* Benth were examined. Acetone exudate and methanolic extract from aerial parts of the species were analyzed by GC/MS. In the acetone exudate of the sample 174 chemical peak signals were detected. A part of them was identified as representatives of flavonoid aglycones, alkanes, fatty alcohols, fatty acids, triterpenes and other. Quercetagetin 3,6,7-trimethyl ether, palmatic acid, α-linolenic acid, sucrose were identified among the main components. In the methanolic extract of *M. dalmatica* more than 100 chromatographic peaks were detected, including organic acids, phenolic acids, saccharides, polyoles, phytosterols and other. Most of the compounds were reported here for the first time for the species.

Hydromethanolic extract of *M. dalmatica* was studied for *in vitro* antioxidant 2,2-diphenyl-1-picrylhydrazyl (DPPH) free radical-scavenging activity. The inhibitory concentration ($IC_{50}$) of extract needed to inhibit 50% of the DPPH radicals was calculated to be 21.36 μg/mL. The received result shows high antioxidant potential of *Micromeria dalmatica* extract which provide scientific support to the use of the plant as a medicinal and aromatic plant.

**Acknowledgements**. The authors are grateful to the financial support provided by Program for Supporting Young Scientist, Bulgarian Academy of Sciences and Ministry of Education and Science (Bulgaria).

# Topical anti-inflammatory activity of essential oils of *Petasites hybridus* subsp. *ochroleucus*

**Rajković, J.[1], Đorđević, Lj.[1], Joković, N.[1], Matejić, J.[2], Stanković, N.[1]*, Zlatković, B.[1], Mihajilov-Krstev, T.[1]**

[1]University of Niš, Faculty of Science and Mathematics, Višegradska 33, 18 000 Niš, Serbia;

[2]University of Niš, Faculty of Medicine, Bul. Dr Zorana Đinđića 81, 18 000 Niš, Serbia.

* nikola.stankovic@pmf.edu.rs

*Petasites hybridus* (butterbur) is perennial herbaceous plant which is traditionally used for the treatment of various painful and inflammatory conditions. Different species of *Petasites* have showed anti-inflammatory, antispasmodic and anti-allergy activity which justifies its folcloric use in allergic rhinitis, asthma and migraine headache. The aim of our study was to examine the topical anti-inflammatory effect of the essential oils obtained from rhizomes and leaves of *Petasites hybridus* subspecies *ochroleucus*. Anti-inflammatory activity of the oils was assayed in concentrations of 10%, 20% and 40%, by applying them on the carrageenan induced paw edema in rats. Edema thickness and percent of anti-inflammatory activity were calculated during the six hours after carrageenan injection. Essential oil obtained from rhizome significantly reduced edema thickness in concentrations of 10 and 20%, while the concentration of 40% didn't show significant reduction. Essential oil from leaves caused significant decrease in edema thickness only in concentration of 40% with high efficiency during the whole examined period. The highest level of anti-inflammatory activity was noticed after the fourth hour at above mentioned concetrations. After the topical application at the inflammatory site, both essential oils, obtained from rhizome and from leaves, acted anti-inflammatory, with the rhizome oil noticed to have higher efficiency in lower concentrations.

**Acknowledgments**. The authors are grateful to the Ministry of Science and Technological Development of the Republic of Serbia for financial support (Grant No. III-41018 and 172047).

# Antimicrobial and antioxidant activity of *Allium cepa* L. dried scales extracts

**Stanković, N.[1]*, Matejić, J.[2], Joković, N.[1], Rajković, J.[1], Đorđević, Lj.[1], Mihajilov-Krstev, T.[1]**

[1]University of Niš, Faculty of Science and Mathematics, Višegradska 33, 18 000 Niš, Serbia;

[2]University of Niš, Faculty of Medicine, Bul. Dr Zorana Đinđića 81, 18 000 Niš, Serbia.

* nikola.stankovic@pmf.edu.rs

*Allium cepa* L. is one of the oldest cultivated plants, used worldwide as a food, spice and as medicinal plant. This study describes antimicrobial and antioxidant activity of methanol, ethanol, ethyl acetate and acetone extracts from dry scales of this plant. Antimicrobial activity testing were evaluated by microdilution method. Minimum inhibitory (MIC) and minimum bactericidal concentrations (MBC) were determined against 9 gastrointestinal pathogens (ATCC strains) and 9 human stool isolates. The antioxidant potential was evaluated by means of DPPH and ABTS radical scavenging method and effect of antioxidant activity was determined spectrophotometrically. The highest phenolic and flavonoid content was found in acetone extract. The radical scavenging activity was shown that the lowest IC50 value has Vitamin C (0.05 mg/mL), followed by methanol extracts and BHA. The obtained values from the ABTS assay ranged from 1.95 to 2.26 mg VitC/g of extract. The highest activity was noted for methanol extract and the lowest in ethyl acetate extract. Testing of antimicrobial activity of the extracts showed relatively moderate antimicrobial effect. The ethanol extract exhibited the highest antimicrobial potential, then methanol extract, and acetone extract showed the lowest. Given results suggest that dry scales of *A. cepa* can be considered as a source of antimicrobial and antioxidants agents.

**Acknowledgments**. The authors are grateful to the Ministry of Science and Technological Development of the Republic of Serbia for financial support (Grant No. III-41018 and 173029).

# 12th Symposium on the Flora of Southeastern Serbia and Neighboring Regions

Kopaonik Mt. 16th-19th June, 2016

## Agriculture, Forestry and Landscape Architecture

# ORAL PRESENTATION

## Effects of silvicultural application on flora oriental beech (*Fagus orientalis* Lipsky.) and uludag fir (*Abies nordmanniana* subsp. *bornmülleriana* Mattf.) mixed forest in the Bartin-Kumluca district in Turkey

**Özel, H.B.[1]***

[1]Bartın University, Faculty of Forestry, Department of Silviculture, Agdacı Campus, 74100-Bartın, Turkey

* halilbarisozel@yahoo.com

Turkey is a richness country respect to the natural forest resources. According to the last official data, Turkey have been 22.7 million hectares natural forest area. But the 50% of these area is low production and degraded form. This degraded forest area must be regenerated and rehabiliated using by true silvicultural treatment for conversion production form. In this research the effects of natural group regeneration treatments were made in 2002 in the oriental beech and Uludag fir mixed forests in 101a compartment of Bartın Kumluca Forest Range District on the forest ground flora. In this context, number of species, life form and values of species diversity have been compared between 2002 and 2015. In this purpose Shannon-Weiner, Simpson indexes and Raunkiaer life form classification equations were used. According to results, 35.6% of Hemicryptophyte, 21.7% of Therophyte, 12.4% of Hamephyte and 4.3% of geophyte of total forest stand ground vegetation in the sama sampling plots. On the other hand, plant species diversity was determined 4.13 (Shannon-Weiner index) and 2.68 (Simpson index) in 2002, but this diversity value was determined 3.17 (Shannon-Weiner index) and 2.14 (Simpson index) in 2015 respectively. In addition to number of total species have been decreased 28.7% according to 2002.

# POSTER PRESENTATION

## Palynomorphological study of *Galanthus nivalis* L. from Serbia

**Jovanović, F.[1]*, Obratov-Petković, D.[1], Mačukanović-Jocić, M.[2]**

[1]Department of Landscape Architecture and Horticulture, Faculty of Forestry, University of Belgrade, Kneza Višeslava 1, Belgrade, Serbia

[2]Department of Agrobotany, Faculty of Agriculture, University of Belgrade, Nemanjina 6, Belgrade-Zemun, Serbia

* filip.a.jovanovic@gmail.com

*Galanthus nivalis* has a large distribution in Serbia. It occurs in various forest communities, at altitudes ranging from 70 m to over 2,100 m. It is a very variable species, and different patterns of morphological variation have been recorded in the territory of Serbia. Pollen morphology of *G. nivalis*, originating from two distant populations (Mt. Fruška Gora, and Pčinja), has been studied in order to provide taxonomically informative data. Symmetry, polarity, size, shape, aperturation, and ornamentation were examined by scanning electron microscopy (SEM). The results show that the pollen grains are bilaterally symmetrical, monosulcate, heteropolar, elliptical in polar view, and medium in size (28.05 ± 1.436 μm). The sculpturing pattern of exine is microperforate-microrugulate. In addition, comparative morphometric analysis revealed significant differences in size of perforations and in rugulae width between the two investigated populations (Mt. Fruška Gora – perforations 0.19 ± 0.027 μm, rugulae 0.14 ± 0.023 μm; Pčinja – perforations 0.22 ± 0.038 μm, rugulae 0.12 ± 0.019 μm).

**Acknowledgements**. This study was supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia (Project Nos. 46009, 173018 and 43007), as well as by EU Commission Project AREA, No. 316004.

# Oxidative stress in bromus seedlings treated with *Salvia sclarea* L. aqueous extract

**Šućur, J.[1]*, Prvulović, D.[1], Malenčić, Dj.[1], Anačkov, G.[2]**

[1]Department of Field and Vegetable Crops, Faculty of Agriculture, University of Novi Sad, Trg Dositeja Obradovića 8, Novi Sad, Serbia

[2]Department of Biology and Ecology, Faculty of Science, University of Novi Sad, Trg Dositeja Obradovića 3, Novi Sad, Serbia

* jovana.sucur@polj.edu.rs

Extensive use of synthetic pesticides has negative effects on the environment and on human and animal health. Knowledge of allelopathic interactions could provide powerful tools for a better exploitation of natural resources in the management of weeds without using herbicides. One of highly resistant weed species is bromus. Therefore effect of two concentrations (0.1% and 0.2%) of *Salvia sclarea* L. aqueous extract on the activity of the antioxidant enzymes superoxide dismutase (SOD) and catalase (CAT) in leaves and roots of bromus (*Bromus mollis* L.) seedlings were examined. Our results showed that both concentrations of the extract used (0.1% and 0.2%) stimulated the significant increase of the superoxide dismutase activity in leaves and roots of bromus 72 h and 120 h after the treatment. The significant increase of the catalase activity was recorded in roots of bromus 72 h after the treatment. Two tested extract concentrations affected activity of the antioxidant enzymes in the same way, but the higher activity was observed in the roots treated with higher concentration (0.2%). The increases in the activities of antioxidant enzymes probably occur in response to stress induced by *S. sclarea* aqueous extract.

# The effect of *Satureja montana* L. aqueous extract on soybean seedlings

**Šućur, J.[1]*, Prvulović, D.[1], Malenčić, Dj.[1], Anačkov, G.[2]**

[1]Department of Field and Vegetable Crops, Faculty of Agriculture, University of Novi Sad, Trg Dositeja Obradovića 8, Novi Sad, Serbia

[2]Department of Biology and Ecology, Faculty of Science, University of Novi Sad, Trg Dositeja Obradovića 3, Novi Sad, Serbia

* jovana.sucur@polj.edu.rs

The aim of this study was to examine the impact of *Satureja montana* L. aqueous extract on soybean antioxidant properties so as to assess its possible side effects when applied as biohebicide in soybean organic production. The effect of two concentrations (0.1% and 0.2%) of *Satureja montana* L. aqueous extract on the activity of the antioxidant enzymes superoxide dismutase (SOD) and catalase (CAT) in leaves and roots of soybean (*Glycine max* L.) seedlings were examined 24, 72 and 120 h after the treatment. Our results showed that the significant increase of the catalase activity was recorded in roots of soybean treated with higher concentration of the extract used (0.2%). On the other hand, both concentrations of *S. montana* aqueous extract stimulated the significant increase of the superoxide dismutase activity in leaves and roots of soybean. Higher activity of the antioxidant enzymes in the roots of soybean compared with activity of the antioxidant enzymes in leaves showed that roots were more affected than leaves.

# New habitats of *Goniolimon dalmaticum* (C. Presl) Rchb. F. in Bulgaria

**Ivanova, I.[1]*, Ivanova, V.[2]**

[1]Institute of Ornamental Plants, 1222 Negovan, Sofia, Bulgaria

[2]Department of Horticulture, Agricultural University, bul. Mendeleev 12, 4000 Plovdiv, Bulgaria

* iva_ivanka@abv.bg

The conducted research was focused on monitoring three new habitats of Balkan endemic species *Goniolimon dalmaticum*, all three found in the Hadjidimovo Municipality, Blagoevgrad in 2011. The habitats are located near the villages Nova Lovcha, area “Polianite” and “Kosharite”, and Gaitaninovo, area “Omaya”. The

habitats in "Kosharite" and "Omaya" occupy an area of about 2 ha and "Polianite" – 2.5 ha. The populations contain 2400, 3750, and 2850 plants, respectively.

All three populations are very well developed, with one to three flowering stems per plant. Over the years no change was observed in the ratio of generative and vegetative plants within the populations. Generative individuals dominated in the populations, which is an indicator of the population stability.

# The response of Bulgarian spray-carnation (D. caryophyllus f. spray, Hort.) cv Rusalka to drought - *in vitro* induced by different PEG concentrations

**Zaprianova, N.[1], Ivanova, V.[2]*, Atanassova, B.[1]**

[1]Institute of Ornamental Plants, Sofia, Bulgaria

[2]Agricultural University, Plovdiv, Bulgaria

* valeriasi1@abv.bg

Water deficiency is the major component of drought that causes a range of morphological and physiological changes in the plants leading to deterioration of their productive and economic parameters. By studying the physiological mechanisms of plant resistance in laboratory conditions, the specific responses of the plant culture to a single stress factor can be observed. In our study, to simulate water deficit induced by osmotic stress, different concentrations of polyethylene glycol (PEG-6000) were used: 10%, 20%, 30% and 40% at different durations of treatment (1, 3 and 6 days) *in vitro* conditions.

The model plant was Bulgarian spray-carnation (*D. caryophyllus* f. *spray*, Hort.) flowers, cv Rusalka. The response to drought stress was studied based on the following end-points: plant growth reactions, relative water content (RWC%), and electrolyte leakage (conductivity). The water deficit varied from 16% (control) to 75% (40% PEG-6 days). The growth of the explants proportionally decreased with the increase of polyethylene glycol concentration from 10% to 40% and the fresh weight was below 50% vs. the control at 30% and 40% PEG. The relative water content of the plant tissues decreased depending on PEG quantity, the lowest values – 25.16 ±2.06% being reported at 40% PEG concentration on the 6th day. The highest values of electrolyte leakage up to 1712 μS/g fresh weight were reported on the 6th day at 40% PEG concentration.

# RSM optimization of ultrasound-assisted extraction of polyphenols from grape by-products

**Radovanović, V.[1]*, Andjelković, M.[2], Radovanović, B.[1]**

1Department of Geography and Department of Chemistry, Faculty of Natural Sciences and Mathematics, University of Niš, Višegradska 33, Niš, Serbia,

2Training Center for NBCD staff, Balkanska 59, Kruševac, Serbia

* vlad_maxa@yahoo.com

Wine production generated significant quantities of wine by-products. In 2012 world vineyards reached a total area surface (which includes areas not yet in production or harvested) of 7,528,000 ha, global grape production of 69,200,000 tonnes and world wine production (excluding juice and musts) of 252,000,000 hL. After processing of grape into wine, certain amounts of bioactive compounds as polyphenols remain in the grape residues. These natural antioxidants from waste material deriving from wine production may be used in pharmaceutical and food industry. The object of this research was to optimize ultrasound-assisted extraction (UAE) by statistical response surface methodology (RSM) to maximize polyphenols in extracts obtained from grape by-products. The predicted values of the model were in accordance with experimental data under the same conditions (RSD was 0.74%). Results confirmed that UAE gives better yields than conventional solvent extraction (23.76% increases). Secondly, UAE permits higher yields in shorter periods of time, thereby reducing the energy input and thermal degradation of polyphenols. Thirdly, the extracts obtained by UAE showed significantly stronger antioxidant activity than extracts obtained by conventional extraction (34.54% stronger). RSM proved to be a very powerful statistical method for optimization of extraction conditions for obtaining natural antioxidants from agro-industrial waste.

**Acknowledgments**. The present research was supported by the EU, FP7 - Regpot - 2007- 3-01, the project «Chromlab-Antioxidant» No. 204756 and by the Ministry of Education and Science of the Republic of Serbia, the project No. 34012 and 31020.

# Monitoring the antioxidants of the Vranac variety during grape ripening

**Radovanović, V.[1]*, Andjelković, M.[2], Radovanović, A.[1], Milenković-Anđelković, A.[1], Sivčev, B.[3], Ilić, D.[4]**

[1]Department of Geography and Department of Chemistry, Faculty of Natural Sciences and Mathematics, Višegradska 33, Niš, Serbia,

[2]Training Center for NBCD staff, Balkanska 59, Kruševac, Serbia;

[3]Department of Viniculture, Faculty of Agriculture, Nemanjina 6, Belgrade, Serbia;

[4]Faculty of Pedagogy, University of Niš, Partizanska 14, Vranje, Serbia

* vlad_maxa@yahoo.com

In recent decades, antioxidants (polyphenols) cause great interest because of their chemical impact on the quality of grape and wine (sensory taste and color of red wine) and their biological activity (antitumor, antiallergenic and positive impact on coronary heart disease). In this study the monitoring the content of polyphenols f the autochthonic Vranac variety during grape ripening was explored. Vranac cluster is cylindrical cone, with weight from 150 to 300 g. In Vranac juice of ripe grapes is collected from 20 to 24% sugar and total acids 6 to 7 g $dm^{-3}$. The results show that the highest content of polyphenols was increasing during ripening of grapes. The content of total polyphenols was recorded in range from 138.27 to 324.15 0 mg $g^{-1}$ of seeds extract, from 129.32 to 213.33 mg $g^{-1}$ of skin extracts, and from 38.46 to 88.76 mg $g^{-1}$ of pulp extracts. Antioxidant activity was the highest in seeds and the lowest in pulp, and increasing during the ripening of grapes was 80.73 – 82.34 % in seeds and 21.96 - 39.78% in pulp extracts. The harvest in optimal period ensures that a good portion of antioxidants into wine where they affect much on wine quality and color.

**Acknowledgments**. The present research was supported by the EU, FP7 - Regpot - 2007- 3-01, the project «Chromlab-Antioxidant» No. 204756 and by the Ministry of Education and Science of the Republic of Serbia, the project No. 34012, 31020, 3106 and 43007.

# 12th Symposium on the Flora of Southeastern Serbia and Neighboring Regions

Kopaonik Mt. 16th-19th June, 2016

## Zoology (animal and plant interactions)

# ORAL PRESENTATION

## Comparative morphology of forewings of the genera *Trioxys* Haliday and *Binodoxys* Mackauer (Hymenoptera: Braconidae: Aphidiinae)

**Lazarević, M.[1]*, Ilić Milošević, M.[1], Stanković, S.S.[1], Žikić, V.[1]**

[1]Department of Biology and Ecology, Faculty of Science and Mathematics, University of Niš, Višegradska 33, Niš, Serbia

* majalazarevic9@gmail.com

Subfamily Aphidiinae represents exclusive parasitoids of aphids (Hemiptera: Aphididae) among other members of a large family Braconidae. In this study we analyzed the selected species of two morphologically very similar genera, Binodoxys which is present with five species and Trioxys with two species. For this study 80 right forewings have been analyzed using the geometric morphometrics method. Sixteen landmarks were digitalized to calculate the shape and size changes in the analyzed wings. The results of comparative analysis of the forewings revealed statistically significant differences between the genera, and even more conspicuous discrimination of the species. In the morphospace defined by the CV1 vs CV2, the Canonical Variate Analysis (CVA) polarized analyzed species in two groups; Trioxys, which has narrow wings, along the negative part of the CV1 axis while Binodoxys species are distributed along the positive end of the CV1 axis with rather wider wings. It is noticed that the species of the genera Trioxys have long and narrow wings, which show a tendency to narrow it down and at the same time the radial sector vein tends to be longer. On the other hand, Binodoxys species have shorter wings which are more rounded, with shorter veins. In conclusion, the specimens of Binodoxys acalephae are the most prominent group on the CVA graph, no overlapping with other species. This method has proved its sensitivity in discrimination of analyzed species when the morphological details have major role in the identification.

**Acknowledgments.** This work was funded by the Ministry of Education, Science and Technological Development of the Republic of Serbia, Grant no. III43001.

# The shape of mandibles in the Chironomidae family (Insecta: Diptera) as a predictor of feeding type

**Đurđević, A.[1]*, Milošević, Dj.[1], Žikić, V.[1]**

[1]Department of Biology and Ecology, Faculty of Science and Mathematics, University of Niš, Višegradska 33, Niš, Serbia

* djukiamphibia@gmail.com

The Chironomidae family presents the most divers and abundant group of aquatic insects. At the larval stage, chironomids have very important role in aquatic ecosystems regarding detritus processing, and present an important part food chains. Exhibiting different ecological profiles and feeding types, chironomids belong to all previously defined functional feeding groups (FFG). However, due to the huge diversity, the information about feeding type for many species is still unknown. In addition, revealing autecology of chironomids could be more difficult because many species can optionally switch the FFG depending on the environmental conditions or different larval instars. The aim of this study was to test whether the feeding type of particular chironomid species is in function of the mouth parts shape. We use geometric morphometrics method to analyze the mandible shape for 14 species belonging to three subfamilies and four FFG. The Cannonical variante analysis (CVA) based on the shape of mandibles, entirely discriminated species belonging to the 'shredders' FFG, while other three analyzed FFGs (gatherer/collector, grazer/scraper and predator) overlapped in some parts. According to the results, the variability of mandibles shape in chironomids larvae shows the pattern which is concordant to some extent with particular feeding type. However, to model the variability shape and define types of mandibles, in terms of predicting the FFG, more chironomid species, with different autecological preferences, should be included in the analysis.

# POSTER PRESENTATION

## Amphibians on the territory of Niš

**Ilić, M.[1,2]*, Nikolić, M.[1,2], Savić, D.[1,2], Crnobrnja-Isailović, J.3**

[1]Faculty of Sciences and Mathematics, University of Niš, Višegradska 33, 18000 Niš, Serbia

[2]Biological Society "Dr. Sava Petrović", Visegradska 33, 18000 Nis, Serbia

[3]Institute for Biological Research "Siniša Stanković", University of Belgrade, Despota Stefana 142, 11000 Beograd, Serbia

* ilicmaja.991@gmail.com

List of amphibians in Serbia includes 21 species: 8 species of tailed amphibians (order Urodela) and 13 species of tailless amphibians (order Anura). Research undertaken during year 2015 on the territory of all five municipalities of Niš, the capital of Southeastern Serbia, confirmed presence of 3 species of Urodela (Salamandra salamandra, Lissotriton vulgaris, Triturus macedonicus) and 9 species of Anura (*Bombina bombina, B. variegata, Bufo bufo, Pseudepidalea viridis, Hyla arborea, Pelophylax ridibundus, P. kl esculentus, Rana dalmatina* and *R. graeca*). *B. bombina* was recorded for the first time on this territory. *B. bufo* inclined toward small reproductive centers (Spearman's R = - 0.78 for the ratio of the size of the reproductive center and the presence of species, $p < 0.05$). There was nearly significant correlation between the type of reproductive center and the presence/absence of *R. dalmatina* (Chi square = 3.73, df = 1, p = 0.053), also between depth and presence/absence of *B. bufo* (Chi square = 3.73, df = 1, p = 0.053); However, the only significant correlation was found between the size of the reproductive center and the presence/absence of *Bombina* sp. (Chi square = 7.00, df = 2, p = 0.030).

**Acknowledgements**. The authors wish to express their gratitude to the students from the Biological Society "Dr. Sava Petrović", for the support on the field work.

# Ecological analysis of macroinvertebrate communities based on functional feeding types: a case study in southeastern Serbia

**Savić, A.[1]*, Đorđević, M.[2], Jušković, M.[1]**

[1]Department of Biology and Ecology, Faculty of Sciences and Mathematics, University of Niš, Višegradska 33, 18000 Niš, Serbia

[2]Department of Mathematics, Faculty of Sciences and Mathematics, University of Niš, Višegradska 33, 18000 Niš, Serbia

* anka@pmf.ni.ac.rs

To examine if the macroinvertebrate community is consistent with the RCC (River Continuum Concept), which describes longitudinal patterns in allochthonous and autochthonous energy input and associated feeding categories of macroinvertebrates along the lotic continuum, it was necessary to determine the functional feeding groups – FFG. Macroinvertebrate samples and physicochemical data were analyzed for 12 sites along the 151 km long stretch of the Nišava River in southeastern Serbia during a one-year period. Among all collected specimen (10519 individuals) 48.99% belongs to shredders, 31.49% to scrapers, 13.02% to collectors and 6.5 % to predators. Based on FFG we determined stream ecosystem attributes: autotrophic/heterotrophic character of the localities; channel stability; typical predator to prey ratio i.e. top-down control; and CPOM/FPOM (coarse particulate organic matter/fine particulate organic matter). On the annual level only locality nine belongs to autotrophic type; relation P/R=1.44. Locality four is with most heterotrophic character, and, also with the lowest channel stability and with the most disturbed relation predator-prey. Relation CPOM/FPOM reflected fact that in the Nišava River existed regular assemblages of shredders (on each locality this ratio is >0.25) and that is connected with condition of riparian zone.

# 12th Symposium on the Flora of Southeastern Serbia and Neighboring Regions

Kopaonik Mt. 16th-19th June, 2016

## Index of authors

Abdii, N., 30
Akdağ, T., 21, 30
Alegro, A., 39, 42
Aleksić, M., 83
Anačkov, G., 14, 16, 18, 40, 65, 91, 93, 139, 140
Andjelković, M., 142, 143
Aneva, I., 59, 131
Arsenijević, J., 127
Arsić, J., 125
Asenov, A., 46
Atamov V., 35
Atanassova, B., 141
Bačič, M., 38
Balaban Marjanović, Ž., 114
Ballian, D., 82
Bancheva, S., 50, 70
Baraj, E., 66
Barudanović, S., 20
Baykal H., 35
Berkov, S., 131
Bjelan, M., 92
Blagojević, P., 101
Bogdanović Pristov, J., 78
Bogdanović, S., 65
Bojčić, S, 65
Bojović, B., 71, 128
Bokić, B., 18, 40, 93
Božin, B., 91, 92, 93
Branković, S., 71
Budimir, S., 79
Bulić, I., 43, 45
Bulić, Z., 19, 43, 45
Burić, D., 45
Buzurović, U., 40
Çakmak, N.M., 67
Çınar Can, E., 68
Come, M., 66
Čomić, Lj., 116, 117, 118
Conić, J., 83, 130
Crnobrnja-Isailović, J., 149
Ćurčić, S., 71
Čutura, I., 71
Cvetković, D., 94
Cvetković, D.J., 95, 124
Cvetković, J., 106, 107
Cvetković, M., 98
Cvetković, V., 64, 125
Cvijetan, I., 20, 73
Danilović, B, 99
Danilović, B., 108
Davidović, D., 96
Dekić, M., 113
Delaunay, A., 81
Delcheva, M., 50, 67
Đelić, G., 71
Dimitrijević, M., 106, 107
Dinç, M., 21, 30, 35
Dinga, L., 54
Djordjević, N., 104
Doderović, M., 43, 45
Doğu, S., 21, 30, 35
Donaldson, L., 78
Đorđević, A., 102, 106, 107
Đorđević, D., 83
Đorđević, Lj., 132, 133
Đorđević, M., 114, 121, 150
Đorđević, N., 60
Đorđević, S., 119
Duraki, Š., 55, 56
Đurđević, A., 148
Đurović, S., 40
Džamić, A.M., 6, 90
Evtimov, I., 59
Fačkovcová Z., 49
Filipović, S., 102, 103
Gadžovska Simić, S., 81, 105
Garab, G., 78
Gärtner, G., 38
Gavarić, N., 91
Genčić, M., 88, 104, 112
Glomazić Bulić, Lj., 43

Gnjatović, I., 72
Gojković, V., 114
Guttová A., 49
Hagège, D., 81
Harpke, D., 16, 17, 80
Hodálová, I., 23
Ickovski, J., 106
Ilić Milošević, M., 8, 147
Ilić, D., 143
Ilić, D.P., 95
Ilić, M., 72, 149
Ilić, P., 118
Ilić, T., 52
Ilić-Tomić, T., 120
Ivanova, I., 140
Ivanova, V., 140, 141
Jakovljević, D., 128
Janaćković, P., 13, 24
Janjić, Đ., 93
Janković, I., 22, 58
Janošević, D, 79
Jenačković, D., 27, 47, 57
Jocić, S., 26
Jocković, M., 26
Jogan, N., 38
Joković, N., 132, 133
Joseph, C., 81
Jovanović, F., 138
Jovanović, N., 125
Jovanović, O., 87, 88, 102, 110
Jovanović, S., 88, 102
Jušković, M., 15, 22, 27, 129, 130, 150
Kajevska, I., 20, 73
Kalaba, D., 114
Kalaba, V., 114
Kalaba, V.D., 124
Karabegović, I., 97
Karanović, D., 16, 26
Kladar, N., 91, 92
Knežević, J., 18
Kochjarová, J., 23
Kostevski, I., 109, 110
Kovački, M., 14
Kozić, D., 92
Krivošej, Z., 48, 50, 51, 55, 56
Krstić, M., 115
Kučera, J., 23, 25
Kuštera, M., 20, 73
Kuzmanović, N., 14, 22, 28
Lakušić, B., 122, 127
Lakušić, D., 4, 14, 22, 24, 28, 57, 122
Landucci, F., 5
Lazarević, J., 26
Lazarević, J., 102
Lazarević, M., 8, 147
Lazić, M., 97
lić, M., 88
Ljubisavljević, I., 15, 31
Ljupković, R., 106
Luković, J., 16, 26
Mačukanović-Jocić, M., 138
Malenčić, Dj., 139, 140
Manić, A., 22
Manojlović, N., 129
Marčetić, M., 122
Marhold, K., 25
Marin, P.D., 13, 24
Marjanović-Balaban, Ž.R., 124
Markišić, H., 43
Markoska, E., 105
Marković, M., 31, 64, 72
Mártonfiová, L., 23
Mašić, E., 20
Mašković, P., 129
Matejić, J., 90, 132, 133
Matejić, J.S., 100
Matevski, V., 105
Matović, M., 98
Maury, S., 81
Memišević Hodžić, M., 82
Mesiti, A., 54
Mihajilov-Krstev, T., 3, 123, 132, 133

Mijić, J., 27
Miladinović, D., 26
Milekić, T., 14
Milenković-Anđelković, A., 143
Milenović, D., 96
Miljković, M., 16, 53
Milosavljević, N., 96
Milošević, Dj., 148
Miltojević, A., 115
Mitić, M., 27, 106
Mitić, N., 95
Mitić, V., 72, 102, 106, 107
Mitrović, A., 78, 79
Mitrović, T., 64, 125
Mladenović, K., 116, 117, 118
Mladenović, M., 103, 125
Muruzović, M., 116, 117, 118
Naelbandian, A., 58
Nemati, Z, 80
Nešić, M., 58, 104
Ničić, S., 123
Niketić, M., 40, 41
Nikodinović-Runić, J., 120
Nikolić, B., 98
Nikolić, D., 27, 31
Nikolić, G., 94
Nikolić, Lj., 99, 108
Nikolić, M., 83, 111, 130, 149
Nikolić, N., 58, 69
Nikolić, N., 97
Nikolić, V., 99, 108
Nikolov, M., 50
Nikolova, M., 59, 131
Novaković, J., 24
Novković, V., 64
Obratov-Petković, D., 138
Ódor, P., 37
Olšavská, K., 25
Özel, H.B., 137
Palić, I., 102, 106, 109
Panjković, B., 64
Pantović, J., 37, 58, 69
Papović, O., 53
Papp, B., 37, 69
Pejčić, M., 89, 123
Pekić Quarrie, S., 10
Perić, R., 64
Peruzzi, L., 17
Pešić, M., 101
Peterson, A., 17
Petronijević Ž., 80
Petrov, S., 70
Petrova, G., 70
Petrović S, 80
Petrović, G., 87, 106, 109, 110
Petrović, S., 95
Popović, M., 63
Preljević, N., 48
Prijić, V., 82
Prodanović, D., 50, 51, 55, 56
Prvulović, D., 139, 140
Pulević, V., 19
Quarrie, S., 9
Raca, I., 15, 16, 31
Radak, B., 18, 40, 93
Radotić, K., 78
Radovanović, A., 143
Radovanović, B., 142
Radovanović, V., 142, 143
Radulović, N.S., 7, 88, 89, 90, 101, 102, 103, 104, 110, 111, 112, 113, 114, 115, 118, 120, 121
Rajčević, N., 13
Rajković, J., 132, 133
Ranđelović, N., 3, 15, 27, 42, 53, 119
Ranđelović, V., 15, 16, 17, 27, 42, 47, 53, 57
Randjelović, P.J., 104
Rat, M., 18, 65, 91, 93
Rilak, S., 64
Ristić, J., 123
Ristić, M., 96, 119
Ristić, S., 64
Sabovljević, A., 37, 69, 77

Sabovljević, M., 37, 58, 69, 77
Salas, J.B., 126
Šarac, Z., 58
Sarajlić, N., 29
Savić S., 80
Savić, A., 22, 150
Savić, A., 78
Savić, D., 149
Savić, S., 97
Sedlar, Z., 42
Šegota, V., 39, 42
Senerović, L., 120
Simić, S., 60
Simić, Z., 71
Simonović Radosavljević, J., 78
Sivčev, B., 143
Slavkovska, V., 127
Slovák, M., 23, 25
Sokolović D., 100
Sovrlić, M., 129
Spasić, S.Z., 79
Srdjenović, B., 91
Stamenković, J., 109, 110
Stamenković, S., 64, 72, 125
Stamenković, V., 3
Stanisavljević, D., 118, 119
Stankov Jovanović, V., 106, 107
Stanković, J., 98
Stanković, M., 71, 125, 128
Stanković, M.S., 126
Stanković, N., 89, 132, 133
Stanković, S., 83
Stanković, S.S., 8, 147
Stankov-Jovanović, V., 72, 102
Stanojević, J., 99, 108
Stanojević, J.S., 95, 124
Stanojević, Lj., 94, 99, 108
Stanojević, Lj.P., 95, 124
Stanojević, M., 50, 51
Stefanović, O., 116, 117
Stefova, M., 105
Steinbach, G., 78
Stojanović N.M., 104
Stojanović, D., 20
Stojanović, G., 87, 88, 97, 106, 107, 109, 110
Stojanović, I, 87
Stojanović, J.,, 90
Stojanović, N., 89, 121
Stojanović-Radić, Z., 89, 90, 121, 123, 126
Stojiljković, M., 94, 95
Stojiljković, S., 94, 95
Stojković, M., 99
Stojšić, V., 64
Stoyneva-Gärtner, M. P., 38
Strgulc-Krajšek, S., 38
Štubňová, E., 23, 25
Šućur, J., 139, 140
Szurdoki, E., 37
Tačić, A., 99, 108
Téllez, T.R., 126
Terzić, S., 26
Terziu, R., 66
Tešević, V, 98
Timotijević, S., 71
Tison, J-M., 17
Tmušić, G., 40, 65
Todorovska, M., 110, 113
Todosijević, M., 98
Tomović, G., 40, 41
Topuzović, M., 128
Tošić, S., 72
Trifonov, V., 50
Tusevski, O., 81, 105
Uzunov, B. A., 38
Valachovič, M., 23
Vasiljević, P., 22, 83, 129, 130
Vázquez, F.M., 126
Veličković, A., 96
Veličković, D., 96, 97, 119
Veljković, B., 48
Veselinović, A.M., 100
Veselinović, J.B., 100

Vestek, A., 16, 18
Vitkova, A., 67
Vujičić, M., 69, 77
Vukadinović, N., 110
Vuković, N., 39, 42
Xhaxhiu, K., 66
Xhulaj, M., 30
Xhulaj, S., 46
Yu, S., 66
Žabar Popović, A., 83, 130
Zaprianova, N., 141
Zhelev, P., 59
Žikić, V., 8, 147, 148
Živković, M., 88, 104, 112
Zlatanović, I., 87, 106
Zlatić, N., 128
Zlatković, B., 24, 58, 88, 109, 130, 132
Zlatković, B., 119
Zlatković, D.B., 118, 120
Zlatković, I., 47
Zorić, L., 26
Zrnzević, I., 87, 88
Žugić-Petrović, T., 116, 117, 118