

# Biodiversity patterns of dry grasslands at the meeting point of Central Europe and the Balkans: Impressions and first results from the 9<sup>th</sup> EDGG Field Workshop in Serbia

Svetlana Aćić<sup>1\*</sup>, Jürgen Dengler<sup>2,3</sup>, Idoia Biurrun<sup>4</sup>, Thomas Becker<sup>5</sup>, Ute Becker<sup>6</sup>, Asun Berastegi<sup>7</sup>, Steffen Boch<sup>8</sup>, Iwona Dembicz<sup>2,9</sup>, Itziar García-Mijangos<sup>4</sup>, Riccardo Guarino<sup>10</sup>, Monika Janišová<sup>11</sup>, Ute Jandt<sup>12,3</sup>, Martin Magnes<sup>13</sup>, Corrado Marcenò<sup>14</sup>, Salza Palpurina<sup>14</sup>, Mariya Polyakova<sup>15</sup>, Yulia Vasheniak<sup>16</sup>, Kiril Vassilev<sup>17</sup>, Nikolay Velev<sup>17</sup>, Verica Stojanović<sup>18</sup>, Predrag Lazarević<sup>19</sup>, Mirjana Krstivojević Čuk<sup>20</sup>, Zora Dajić Stevanović<sup>1</sup>

<sup>1</sup> University of Belgrade, Faculty of Agriculture, Department of Agrobotany, Nemanjina 6, 11080 Belgrade-Zemun, Serbia; [acic@agrif.bg.ac.rs](mailto:acic@agrif.bg.ac.rs); [da-jic@agrif.bg.ac.rs](mailto:da-jic@agrif.bg.ac.rs)

<sup>2</sup> Plant Ecology, Bayreuth Center of Ecology and Environmental Research (BayCEER), University of Bayreuth, Universitätsstr. 30, 95447 Bayreuth, Germany; [juergen.dengler@uni-bayreuth.de](mailto:juergen.dengler@uni-bayreuth.de); [iwona.dembicz@uni-bayreuth.de](mailto:iwona.dembicz@uni-bayreuth.de)

<sup>3</sup> German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig, Deutscher Platz 5e, 04103 Leipzig, Germany.

<sup>4</sup> Department of Plant Biology and Ecology, University of the Basque Country UPV/EHU, PO. Box 644, 48080 Bilbao, Spain; [idoia.biurrun@ehu.es](mailto:idoia.biurrun@ehu.es)

<sup>5</sup> Geobotany, Faculty of Geography and Geosciences, University of Trier, Behringstr. 21, 54296 Trier, Germany; [beckerth@uni-trier.de](mailto:beckerth@uni-trier.de)

<sup>6</sup> Green School in the Botanic Garden, University of Mainz, Anselm-Franz-von-Bentzel-Weg 9b, 55128 Mainz, Germany; [beckeru@unimainz.de](mailto:beckeru@unimainz.de)

<sup>7</sup> Department of Biodiversity, Gestión Ambiental de Navarra, S.A., Padre Adoain 219 Bajo, 31015 Pamplona, Spain; [aberastg@ganasa.es](mailto:aberastg@ganasa.es)

<sup>8</sup> Institute of Plant Sciences and Botanical Garden, University of Bern, Altenbergrain 21, 3013 Bern, Switzerland; [steffen.boch@ips.unibe.ch](mailto:steffen.boch@ips.unibe.ch)

<sup>9</sup> Department of Plant Ecology and Environmental Conservation, Faculty of Biology, University of Warsaw, Al. Ujazdowskie 4, 00-478 Warszawa, Poland

<sup>10</sup> Dept. STEBICEF- Botanical Unit, University of Palermo, via Archirafi, 38, 90123 Palermo, Italy; [guarintrotro@hotmail.com](mailto:guarintrotro@hotmail.com)

<sup>11</sup> Institute of Botany, Slovak Academy of Sciences, Ďumbierska 1, 97411 Banská Bystrica, Slovakia; [monika.janisova@gmail.com](mailto:monika.janisova@gmail.com)

<sup>12</sup> Institute for Biology, Geobotany and Botanical Garden, Am Kirchtor 1, 06108 Halle/Saale, Germany; [ute.jandt@botanik.uni-halle.de](mailto:ute.jandt@botanik.uni-halle.de)

<sup>13</sup> Institute of Plant Sciences, Department of Systematic Botany and Geobotany, Karl-Franzens- University of Graz, Holteigasse 6, 8010 Graz, Austria; [martin.magnes@uni-graz.at](mailto:martin.magnes@uni-graz.at)

<sup>14</sup> Department of Botany and Zoology, Faculty of Science, Masaryk University, Kotlářská 2, 61137, Brno, Czech Republic; [marcenocor-rado@libero.it](mailto:marcenocor-rado@libero.it); [salza.palpurina@gmail.com](mailto:salza.palpurina@gmail.com)

<sup>15</sup> Laboratory of Ecology and Geobotany, Central Siberian Botanical Garden, Russian Academy of Sciences, Siberian Branch, Zolotodolinskaya str. 101, 630090 Novosibirsk, Russia; [galatella@mail.ru](mailto:galatella@mail.ru)

<sup>16</sup> Khmelnytskyi Institute of Interregional Academy of Personnel Management, 29010 Khmelnytsky, Ukraine; [vasheniak@mail.ru](mailto:vasheniak@mail.ru)

<sup>17</sup> Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, 23 Acad. G. Bonchev Str., 1113 Sofia, Bulgaria. [kiril5914@abv.bg](mailto:kiril5914@abv.bg), [nvelev@bio.bas.bg](mailto:nvelev@bio.bas.bg)

<sup>18</sup> Institute for Nature Conservation of Serbia, Dr Ivana Ribara 91, 11070 Belgrade, Serbia; [verica.stojanovic@zzps.rs](mailto:verica.stojanovic@zzps.rs)

<sup>19</sup> University of Belgrade, Faculty of Biology, Institute of Botany and Botanical Garden, Takovska 43, 11000 Belgrade, Serbia; [predrag.lazarevic@bio.bg.ac.rs](mailto:predrag.lazarevic@bio.bg.ac.rs)

<sup>20</sup> University of Novi Sad, Faculty of Sciences, Department of Biology and Ecology, Trg Dositeja Obradovića 2, 21000 Novi Sad, Serbia; [mirjana.krstivojevic@dbe.uns.ac.rs](mailto:mirjana.krstivojevic@dbe.uns.ac.rs)

\*) Corresponding author

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**Abstract:** The 9<sup>th</sup> EDGG Field Workshop took place in Serbia in July 2016. A group of 22 researchers from ten countries sampled the different types of dry grassland vegetation of some protected and non-protected areas of Mt. Rtanj, Mt. Devica and Mt. Ozren near Sokobanja in east Serbia, Mt. Suva planina, Jelašnička and Sićevočka gorge close to the city of Niš in southeast Serbia and Ram and Deliblatska sands in the northern part of Serbia, along the Danube. Standardized EDGG sampling procedures including nested-plot series (biodiversity plots) and phytosociological relevés of 10-m<sup>2</sup> were used. In all plots, vascular plants, bryophytes and lichens were sampled. The data will be used for analyses of scale-dependent diversity patterns, species-area relationships, vegetation-environment relationships and performing phytosociological classification. Preliminary data suggest that Serbian dry grasslands display intermediate richness of vascular plants and below-average richness of bryophytes and lichens across all spatial scales compared to other regions in the Palaearctic.

**Keywords:** Balkan; biodiversity; bryophyte; EDGG sampling method; *Festuco-Brometeta*; *Festucion vaginatae*; grassland; nested plots; Serbia; vascular plant; vegetation classification; vegetation plot database.

**Abbreviations:** EDGG = Eurasian Dry Grassland Group; IAVS = International Association for Vegetation Science; GIVD = Global Index of Vegetation-Plot Databases

## Introduction

EDGG Field Workshops are annual research expeditions that take place in different countries, with the aim of collecting high-quality plant (and sometimes animal) diversity data of different types of grasslands with the standardized EDGG sampling method (Dengler et al. 2016b). Typically they last for one to two weeks and are organised by a team of regional experts. The first expedition was conducted in 2009 in Transylvania (Dengler et al. 2009) and, so far, has been followed by seven more: Central Podolia, in Ukraine (Dengler et al. 2010), NW Bulgaria (Apostolova et al. 2011), Sicily (Guarino et al. 2012), NW Greece (Dengler & Demina 2012), Khakassia in Russia (Janišová et al. 2013), Navarre in Spain (Biurrun et al. 2014) and Poland (Kącki et al. 2014).

Here we report from the 9th EDGG Field Workshop, which was conducted in Serbia from 2 to 9 July 2016. It was organized by a team of Serbian botanists from the Department of Agrobotany, Faculty of Agriculture, University of Belgrade. With 22 researchers from 10 countries (Austria, Bulgaria, Germany, Italy, Poland, Russia, Slovakia, Spain, Ukraine and Serbia), this was so far the largest EDGG Field Workshop (Table 1). The group combined experienced senior scientists, young postdocs and PhD students. Jürgen Dengler, Monika Janišová, Ute Jandt, Itziar García-Mijangos, Idoia Biurrun, Asun Berastegi, Martin Magnes, Thomas Becker, Ute Becker, Riccardo Guarino, Nikolay Velez, Kiril Vasilev, Mariya Polyakova, Iwona Dembicz, Salza Palpurina and Yulia Vasheniak, already participated in previous expeditions, while Corrado Marcenò, Verica Stojanović, Predrag Lazarević, Zora Dajić Stevanović, Mirjana Krstivojević Ćuk and Svetlana Aćić were “newcomers” (Fig. 1).

## The study area

The Republic of Serbia is located in the north-central part of the Balkan Peninsula and covers an area of 88,361 km<sup>2</sup>. The northern part of Serbia (Vojvodina) lies on the south-eastern part of the Pannonian plain, where broad alluvial lowlands and adjacent loess plateaus extend along the rivers Danube, Tisa, Sava, Begej and Tamiš.

In Serbia, the climate is continental in the northern and south-eastern parts, with cold winter and semi-arid summer periods. In the western and south-western regions, the climate is humid temperate, while in the central and eastern parts it is subcontinental or semi-arid temperate continental, with transitional sub-Mediterranean parts (Stevanović & Šinžar-Sekulić



**Fig. 1.** Participants of the 9th EDGG Field Workshop in Serbia. Photo: J. Dengler.

2009). There are four types of geological substrata in Serbia: 1. silicate rocks of alkaline to ultra-alkaline reaction (serpentinites and peridotites, ophiolitic belt); 2. carbonate rocks of neutral to alkaline reactions (sedimentary, clastic); 3. silicate rocks of acidic to neutral pH (sedimentary, igneous, metamorphic); 4. loess and Pleistocene sediments (sands, alluvial fans). Due to the different climatic, geological and edaphic conditions, the flora and vegetation of the territory of Serbia are highly diverse and include 3662 taxa assigned to 141 families (Stevanović & Stevanović 1995).

Grasslands in Serbia occupy about 1.4 million hectares, distributed over a wide altitudinal range from lowland areas to the highest alpine zone. Semi-natural grasslands (hay meadows and pastures) in Serbia are recognized for their high species diversity and significant conservation value (Lakušić & Sabovljević 2005; Dajić Stevanović et al. 2010; Tomović et al. 2014). However, many grassland communities are at present

**Table 1.** Statistics of the past EDGG Expeditions/Field Workshops.

No.	Period	Research area	Elevation (m a.s.l.)	Participants	Countries	Biodiversity plots	10-m <sup>2</sup> plots (total)
1	14-26 July 2009	Romania	321-670	6	3	20	63
2	10-25 July 2010	Ukraine	73-251	18	8	21	226
3	14-24 August 2011	Bulgaria	633-1460	9	5	15	98
4	29 March-5 April 2012	Sicily	4-1200	14	5	21	67
5	15-23 May 2012	Greece	1-1465	16	6	14	31
6	22 July-1 August 2013	Siberia	300-700	14	7	39	133
7	15-24 June 2014	Spain	295-1970	16	10	35	119
8	13-23 June 2015	Poland	108-465	16	6	31	86
9	2-9 July 2016	Serbia	92-1555	22	10	32	141

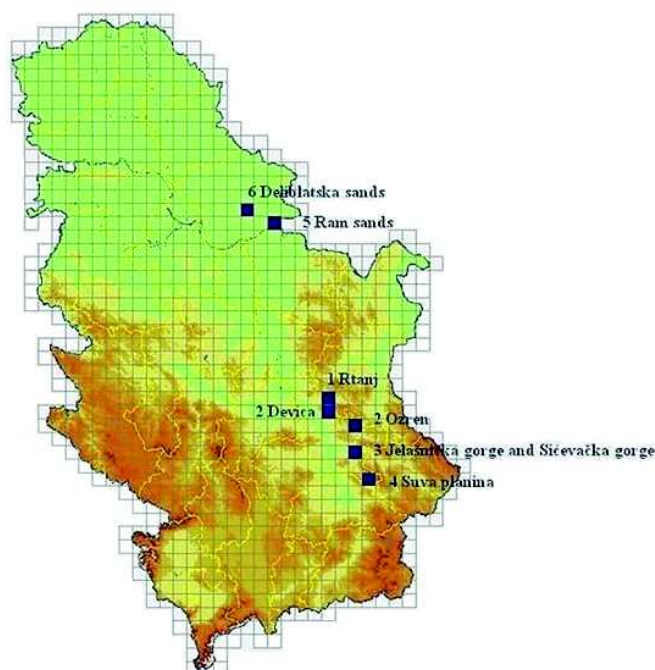


threatened by rapid changes in agricultural practices, especially related to the effects of either land abandonment or eutrophication (Dajić Stevanović et al. 2010). Phytosociological studies of the vegetation of Serbia using the Braun-Blanquet approach have a long tradition, resulting in many publications on vegetation classification of various geographic areas of the country (reviewed by Kojić et al. 1998, 2004). On the basis of these reviews, dry grasslands in Serbia traditionally have been grouped within the classes *Festuco-Brometea* and *Koelerio-Coryneporetea*, whereas its more detailed classification and status has been recently reviewed (Aćić et al. 2015).

The main goal of the 9<sup>th</sup> EDGG field workshop was to assess the floristic composition, biodiversity patterns and ecological drivers of the selected sites (Fig. 2) distributed in protected (Mt. Rtanj, Mt. Suva planina, Mt. Ozren, Jelašnička and Sićevačka gorges, and Deliblatska sands) and non-protected areas (Mt. Devica and Ram sand) typical for dry grassland and steppe vegetation (see the photo diary in the Appendix).

### Sampling methods

As in the previous EDGG expeditions, we applied the standardized sampling approach for biodiversity data (details provided by Dengler et al. 2016b; for equipment, see Fig. 3) allowing large-scale comparisons and syntheses of phytodiversity data (e.g. Dengler et al. 2016a). The core part of the sampling are “biodiversity plots” that consist of nested sampled areas of 0.0001, 0.001, 0.01, 0.1, 1, 10 and 100 m<sup>2</sup>, with the smaller ones always replicated twice within the 100-m<sup>2</sup> plot in two opposite corners. In each plot, all terricolous com-



**Fig. 2.** Map with location of the study sites of the 9th EDGG Field Workshop in Serbia.



**Fig. 3.** The necessary equipment for the EDGG biodiversity sampling, Mt. Rtanj. Photo: C. Marcenò.

ponents of the vegetation were recorded – all perennial and annual vascular plants as well as bryophytes and lichens. Additionally, for the 10-m<sup>2</sup> plots, percentage cover per species and structural data of the vegetation were estimated and a set of environmental parameters related to topography and soil were determined. In each individual study region, the biodiversity plots were placed in homogenous stands of different grassland types with the aim to cover the full environmental gradient. To complement this time-consuming sampling, we additionally surveyed “normal” plots, which have exactly the same parameters as the 10-m<sup>2</sup> corners of the biodiversity plots and thus, can be easily combined for joint analyses.

Mixed soil samples were collected from all 10-m<sup>2</sup> plots to determine texture class, pH, C and N content, and other relevant soil parameters. We also took biomass samples of defined subplots to quantify productivity (by dry weight of standing biomass per m<sup>2</sup>) and elemental composition and nutritional value of plant material. For the first time on an EDGG expedition, we measured mean vegetation height in a standardized way, using a falling plastic disc (for details see Dengler et al. 2016b).

Plant species were mostly identified in the field; some of the species that were not confidently identified *in situ* were collected and identified during the evenings (Fig. 4). The specimens of critical taxa have been identified at the Faculty of Agriculture in Belgrade. Vascular plants were mainly identified using *Flora Europaea* (Tutin et al. 1968-1993), the electronic interactive identification tool of the *Flora d'Italia* second edition (Guarino et al. 2010), *Flora of Bulgaria* (Jordanov 1966-1979) and *Flora of Serbia* (Josifović 1970-1986).

### Workshop presentations and discussions

The field work and plant identification in the evening was complemented by several oral presentations, followed by discussions. Zora Dajić Stevanović presented a lecture about *Biodiversity and conservation of vegetation of Serbia*. Fur-



**Fig. 4. Plant determination and entering the data. Photo: S. Palpurina.**

ther, the four recipients of the IAVS travel grants also gave presentations on studies similar to the topic of the Field Workshop:

- Iwona Dembicz: *Scale- and taxon-dependent patterns of plant diversity in steppes of Khakassia, South Siberia (Russia)*
- Yuliya Vashenyak: *Distribution of limestone outcrops communities on the slopes of Dniester River*
- Kiril Vassilev: *Syntaxonomical diversity of calcareous grassland vegetation west of Sofia*
- Salza Palpurina: *Fine-scale species richness in Eurasian dry grasslands: does nutrient limitation matter?*
- Jürgen Dengler: *Scale-dependent plant diversity patterns - introduction to the EDGG sampling methodology and data entering.*

### Preliminary results

During 7 1/2 days of field work, we surveyed 32 biodiversity plots and 77 additional “normal” plots, resulting in a total of 141 10-m<sup>2</sup> plots which can be compared with the 226, 98 and 119 10-m<sup>2</sup> plots sampled during the expeditions in Ukraine, Bulgaria and Spain, respectively (Table 1).

Bryophytes have been sent for identification to Marko Sabovljević, at the Institute of Botany and Botanical Garden, Faculty of Biology of University of Belgrade, whereas lichens have already largely been identified by Steffen Boch from the Institute of Plant Sciences and Botanical Garden, University of Bern, Switzerland. The soil samples were dried and prepared for the set of analyses, which will be carried out in the Department for Soil Science at the Faculty of Agriculture, University of Belgrade. The data have been digitised by several of the participants (M. Magnes, S. Palpurina, M. Polyakova, R. Guarino, U. Jandt and J. Dengler).

The most frequent species in the Serbian dry grasslands were *Teucrium chamaedrys*, *Asperula cynanchica*, *Festuca valesiaca*, *Carex caryophyllaea*, *Bothriochloa ischaemum*, *Asperula purpurea*, *Orlaya grandiflora*, *Petrorhagia saxifraga*, *Acinos*

**Table 2. Statistics of scale-dependent vascular plant species richness (shoot presence).**

Plots size [m <sup>2</sup> ]	n	Min	Mean	Max
0.0001	64	0	1.9	6
0.001	64	0	3.1	9
0.01	64	0	6.1	16
0.1	64	3	12.0	23
1	64	6	20.6	46
10	141	10	30.9	57
100	32	23	56.5	107

*arvensis* and *Artemisia alba*. Other frequent graminoids were *Carex humilis*, *Poa compressa*, *Koeleria splendens*, *Stipa borysthena* and *S. capillata*.

Our data suggest that the mean vascular plant richness of Serbian dry grasslands (Table 2) is intermediate compared to dry grasslands in other regions of the Palaearctic (Dengler et al. 2016a) and quite similar to the values reported from Bulgaria (Pedashenko et al. 2013).

### Conclusion and outlook

The sampled data, as in the case of the previous EDGG Research Expeditions and Field Workshops, will become part of GrassPlot, the Database Scale-Dependent Phytodiversity Patterns in Palaearctic Grasslands (formerly: *Database Species-Area Relationships in Palaearctic Grasslands*; GIVD ID EU-00-003; Dengler et al. 2012), the *Balkan Dry Grasslands Database* (EU-00-013; Vassilev et al. 2012) and additionally of the *Vegetation Database Grassland Vegetation of Serbia* (EU-RS-002; Ačić et al. 2012), all registered in the *Global Index of Vegetation-Plot Databases* (GIVD; <http://www.givd.info>; see Dengler et al. 2011). After our initial publication, these data can also be used by other researchers. Moreover, the data from the Field Workshop will contribute to the data of the emerging global vegetation-plot database sPlot (see <http://www.idiv-biodiversity.de/sdiv/workshops/pastworkshops/splot>) and the *European Vegetation Archive* (EVA, Chytrý et al. 2016).

Once the dataset is complete, we aim to conduct a regional study on phytodiversity patterns and their drivers. It will be interesting to compare the biodiversity patterns and species-area relationships with those of the previous EDGG Expeditions (Pedashenko et al. 2013; Turtureanu et al. 2014; Kuzemko et al. 2016; Polyakova et al. 2016) and similar studies. Additional papers might be devoted to the elemental composition and nutritional value of the different grassland types sampled.

Beyond our regional Serbian studies using only the data from this expedition, our data will likely become valuable in several supraregional studies for which we fill important data gaps. They will be used in studies led by W. Willner and K. Vassilev, respectively, on the broad-scale classification of Pannonian-Pontic *Festuco-Brometea* communities and Balkan dry grass-



land communities, both down to the association level. At continental scale, they are important contributions to analyses of plot-scale alpha diversity (led by M. Večera) and functional composition of grasslands (led by J. Dengler). They will also contribute, through GrassPlot, to a paper on benchmarking plant diversity of Palaearctic grasslands, led by I. Biurrun, quasi a follow-up to Dengler et al. (2016a).

Further, the Field Workshop in Serbia has already given rise to two third-party grant proposals. The colleagues from Slovakia, Austria and Serbia have applied for a joint project within Multilateral scientific and technological cooperation in the Danube region (2017-2018), entitled: "Grassland phytodiversity in the Danube region" aiming at continuation of survey and writing scientific papers. Thanks to funding from the BayIntAn program of the Bavarian Research Alliance (BayFor) and co-funding from BayCEER, an international workshop on Scale-dependent phytodiversity patterns in Palaearctic grasslands took place in Bayreuth from 6-10 March 2017. The main aims were the organization of the further development of GrassPlot database (see announcement in this Bulletin at pp. 14-18), planning of overarching analyses of the data and papers as well as third-party grant proposals based on them.

After nine successful field workshops, the EDGG will certainly continue the expedition programme. The next 10th EDGG Field Workshop will be held in the Central Apennine Mountains (Italy), from 3 to 11 June 2017 (Filibeck et al. 2017). Criteria for the selection to organize future EDGG Field Workshops are: the lack of methodologically comparable phytosociological and biodiversity data from the particular study region, the interest of potential participants and, most importantly, one or several reliable local organizers who preferably should have participated in at least one previous expedition. Persons interested in organizing future EDGG Expeditions are encouraged to contact the EDGG Field Workshop Coordinator (Jürgen Dengler, [juergen.dengler@uni-bayreuth.de](mailto:juergen.dengler@uni-bayreuth.de)) and Deputy Coordinator (Idoia Biurrun, [idoia.biurrun@ehu.es](mailto:idoia.biurrun@ehu.es)).

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*Dianthus petraeus*. Photo: J. Dengler.



## Appendix: A photo diary of the Field Workshop

### 2 July 2016 - Belgrade

The meeting of all participants of the EDGG Field Workshop in Serbia was on 2 July at the Faculty of Agriculture in Belgrade. From there, we went to Sokobanja where we were accommodated for three days. Sokobanja is a spa town with thermal water situated in eastern Serbia. In the evening we visited the city center and the herbal tea factory "Adonis". During the field work near Sokobanja we visited three Karst mountains (Rtanj, Devica and Ozren Mts) which are located on the south-western part of the Carpathian-Balkan mountain system.



**Photo 1.** Herbal tea factory "Adonis". Photo: S. Palpurina.

### 3 July 2016 - Mt. Rtanj

The first day of our survey we went to mountain Rtanj which is protected as Special Nature Reserve. The cone shaped peak Šiljak, with mountain slopes inclined at different angles, dominates over the entire area. The karst relief includes numerous deep pits and various forms of the exhumed subcutaneous karst. The north-facing slopes are mainly covered with forests, some of which can be very old, e.g. the mixed community of silver fir (*Abies alba*) and Balkan beech (*Fagus moesiaca*), which spreads out as far as to the peak Šiljak. The south-facing slopes are covered with vegetation typical of rocky terrains, pastures and shrubs, characterised by a very diverse flora, with many steppe relict species such as *Sternbergia colchiciflora*, *Hyalcinthella leucophaea*, *Prunus tenella*, and many Balkan endemic species such as *Festuca bosniaca*, *F. panciciana*, *Genista subcapitata*, *Silene sendtneri*, *Viola grisebachiana*. The Balkan endemic *Satureja kitaibelii* is used as medicinal plant, spice and even as aphrodisiac.

The plant drug contains up to 2% of essential oil with very strong antimicrobial activity, acting better than standard antibiotics (Dajić Stevanović et al., unpublished results). *Nepeta rtanjensis* is a strict local endemic of the mountain Rtanj included in the Serbian Red List of the flora.

On the Rtanj Mt. we sampled 10 biodiversity plots and 12 additional normal plots at an altitude of 789-935 m a.s.l. The sampled vegetation belongs to sub-continental steppe grasslands of the *Saturejion montanae* alliance. These are rocky grasslands developed on shallow mountainous soil on limestone with domination of species such as *Carex humilis*, *Potentilla tommasiniana* and *Stipa pulcherrima*. Stands of the associations *Galio purpurei-Festucetum valesiacae* (*Festucion valesiacae*) and *Danthonietum alpinae* (*Chrysopogono-Danthonion alpinae*) were also surveyed.



**Photo 2.** Mt. Rtanj. The Rtanj Mountain has the shape of a three-sided pyramid. According to a legend, it was made by aliens and the members of the UFO Association believe that it is still regularly visited by aliens even nowadays. It is also believed that Mt. Rtanj could act as a shelter for people when the "end of the world" comes. Photo: S. Palpurina.



#### 4 July 2016 - Devica and Ozren Mts.

In the morning we went to the Devica Mt. The relic polydominant forest communities with *Carpinus orientalis* and steppe grassland vegetation (alliances *Saturejion montanae* and *Festucion valesiaca*) are developed on limestone habitats of Devica Mt. Despite the exceptional natural values and locality of many endemic and rare species (such as, for example, the rare and endangered relict species *Paeonia tenuifolia*) the Devica mountain is still unprotected.

We made six biodiversity plots and 15 additional normal plots at an altitude of 937-978 m a.s.l. The sampled vegetation belongs to steppe grasslands of the *Saturejion montanae* and *Festucion valesiaca* alliances. Among the most interesting plants, the following were recorded: *Hypericum rumeliacum*, *H. rochelii*, *Hyssopus officinalis*, *Gymnadenia conopsea*, *Himantoglossum calcaratum*.



Photo 4. *Himantoglossum jankae*. Photo: J. Dengler.



Photo 5. *Saturejion montanae* at Rtanj Mt. Photo: J. Dengler.



Photo 3. The xerothermic relict species *Paeonia tenuifolia*. Photo: C. Marcenò.



Photo 6. As a break from sampling on Devica Mt., we had lunch in the field. Photo: U. Jandt.





**Photo 7.** Belmuž is an old shepherd's dish and specialty from the mountain regions of eastern and south-eastern Serbia, Mt. Devica. Photo: C. Marcenò.

### Recipe for belmuž

You need about 1 kg of cow or sheep full-fat cheese, teaspoon of salt and a cup of integral corn flour. Melt the cheese in a saucepan, then add salt and flour, and with a wooden spoon stir constantly until belmuž starts to separate from the walls of the saucepan. Stir approximately 20 minutes until the mixture becomes smooth and the fat of the cheese starts to separate. Belmuž was often made in the wild when the shepherds were celebrating the day of beginning the period for milking the sheep.

In the afternoon we went to Ozren Mt. with the highest peak being Leskovik (1174 m a.s.l.). Besides forest communities with *Quercus ceris*, *Q. frainetto* and *Carpinus orientalis*, there are relict communities developed on this mountain such as *Syringo-Carpinetum orientalis* and *Cotino-Syringetum vulgaris*. "Ozren Meadows" is under state protection and the habitat of two strictly protected and 22 protected species, such as endemic coral peony (*Paeonia corallina*). The grassland communities belong to the alliances *Cirsio-Brachypodium pinnati*, *Chrysopogono-Danthonion alpinae* and *Festucion valesiaca*.



**Photo 8.** Grassland vegetation of the alliance *Cirsio-Brachypodium* in the Ozren Mt. Photo: J. Dengler.



**Photo 9.** On the Ozren Mt. Photo: U. Jandt.

We sampled two biodiversity plots and two normal plots on the mountain Ozren at an altitude of 971-1013 m a.s.l. The sampled vegetation belongs to continental steppes of the *Festucion valesiaca* and subcontinental meadow-steppes of the *Cirsio-Brachypodium pinnati* with predominance of the species *Festuca valesiaca*, *Rhinanthus rumelicus*, *Briza media*, *Teucrium chamaedrys*.





Balkan endemic species *Ramonda nathaliae*.

Photo: <http://tesla.pmf.ni.ac.rs/sfses/Ramonda%20nathaliae.htm>



Serbian soldier, photo: Simson Čarnov, 1914. The drawing of the endemic species *Ramonda nathaliae* is a symbol to mark the Armistice Day in First World War. This is the so called "Phoenix flower". Even when it is completely dry, Natalie's Ramonda can be revived when humidified.

This species grows also at Mt. Kajmakčalan where Serbian soldiers had the hardest fighting in the First World War.



**Photo 10.** Jelašnička gorge. Photo: S. Palpurina.

### 5 July 2016 - Jelašnička and Sićevačka gorges

In the morning we travelled to Niš, the largest city in south-eastern Serbia, where we were accommodated for two days. Our first sampling destination was Jelašnička gorge which was formed by the activity of the Jelašnička river and is about 2 km long, and only 30 m wide. It is a nature reserve with more than 65 endemic and rare plants such as *Parietaria serbica*, *Crocus adamii*, *Pyrus nivalis*.

In the Jelašnička gorge we sampled 10 biodiversity plots and six additional normal plots at an altitude of 412-473 m a.s.l. We surveyed rocky dry grassland vegetation of the alliances *Saturejion montanae* and *Festucion valesiaca*. The following species were predominating: *Artemisia alba*, *Satureja montana*, *Achillea clypeolata*, *Galium purpureum*, *Teucrium montanum*.



**Photo 11.** Lunch and refreshment near the Jelašnička river. Photo: S. Palpurina.

We had lunch and refreshment near the Jelašnička river and after that we went to the nearby Sićevačka gorge. The limestone Sićevačka gorge has been cut by the activity of the Nišava river into numerous caves, rock shelters and boulders. Jelašnička and Sićevačka gorges are the only locality in Serbia where the two Tertiary relicts and Balkan endemics - *Ramonda serbica* and *Ramonda nathaliae* - can be found growing together. Both gorges harbour a large number of endemic, relict and rare plant species such as *Achillea clypeolata*, *Tragopogon pterodes*, *Ruta graveolens*, *Prunus mahaleb* (tertiary relict), etc.

We sampled eight normal plots in the Sićevačka gorge at an altitude of 369-503 m a.s.l. The majority of the sampled vegetation belongs to steppe grasslands of the alliance *Festucion valesiaca* dominated by *Andropogon ischaemum*. We also surveyed stands of *Saturejion montanae* alliance. We have noticed that dry grassland vegetation in Sićevačka gorge is under serious threat by the spread of the invasive tree species *Ailanthus altissima*.



### 6 July 2016 – Suva planina Mt.

In the morning we went to Suva planina Mt., a Karst massif composed of sediments of different age, rich in fossil flora and fauna. It is a Natural Reserve harbouring 1244 plant species. The flora consists of many endemic, relict or protected species, according to several national and international criteria, such as *Achillea ageratifolia*, *Edraianthus serbicus*, *Lilium jankae*, *Silene sendtneri*, *Eryngium palmatum*, etc. Besides, two local endemics are present, the Pančič's columbine (*Aquilegia pancicii*) and Serbian rose (*Rosa serbica*). The north-exposed, cool and humid foothills slopes of the mountains are mostly covered with forests and the wind-exposed ridgetops and southern slopes are covered mainly by rocky pastures and meadows. The shrubby formation belts of the dwarf mountain pine (*Pinus mugo*) are restricted to the highest peaks, but at much lower altitudes than in other parts of Europe.

On the mountain Suva planina we sampled 10 biodiversity plots and 15 additional normal plots at altitudes from 1319 to 1555 m a.s.l. The majority of the sampled vegetation belongs to subcontinental steppe grasslands of the *Saturejion montanae* alliance. We also surveyed rocky dry grassland vegetation of the *Seslerion rigidae* alliance, including stands dominated by *Sesleria latifolia* or *S. filifolia* as well as stands dominated by *Festuca varia*.



**Photo 12.** Rocky dry grasslands of the Sičevačka gorge. Photo: S. Ačić.



**Photo 13.** Sampling a biodiversity plot at Suva planina Mt. Photo: N. Velev.



**Photo 14.** *Saturejion montanae* at Suva planina Mt. Photo: S. Palpurina.



**Photo 15.** *Seslerietum filifoliae* at Suva planina Mt. Photo: S. Palpurina.



**Photo 16.** Suva planina Mt. Photo: S. Palpurina.





**Photo 17.** Travelling towards Deliblatska sands from Ram sands we had to cross the river Danube by a ferry. Photo: N. Velez.



**Photo 18.** Ram fortress built 1483 by Sultan Bayezid II. Photo: C. Marcenò.



**Photo 19.** Sand steppe vegetation on Ram sands. Photo: J. Dengler.

### 7 July 2016 - Ram sands

Travelling towards the Deliblatska sands the Ram sands were visited. The area of Ram sands contains the last remnants of sandy habitats in central Serbia near Danube river. Despite the presence of endangered flora and fauna, Ram sands are not yet protected. Plant communities with *Polygonum arenarium*, *Bassia laniflora*, *Fumana procumbens* and *Cynodon dactylon* occur in open sites. The sand habitats are characterised by *Festuca vaginata*, *Euphorbia seguieriana*, *Andropogon ischaemum*, *Centaurea arenaria*, *Tragopogon floccosus*. Locally, stands dominated by *Chrysopogon gryllus* occur. The main threat is the occurrence and spread of alien invasive species, such as *Ailanthus altissima*, *Amorpha fruticosa*, *Robinia pseudoacacia* and *Asclepias syriaca*.

On Ram sands, we sampled six biodiversity plots and 10 additional normal plots at altitudes from 92 to 178 m a.s.l. The sampled vegetation belongs to psammophytic steppe grasslands of the *Festucion vaginatae* characterised by the presence of *Festuca vaginata*, *Tragus racemosus*, *Cynodon dactylon*, *Euphorbia seguieriana*, *Centaurea arenaria*, *Bassia laniflora*, etc. We also surveyed stands dominated by *Chrysopogon gryllus* or *Andropogon ischaemum*.



**Photo 20.** *Festucion vaginatae* at Ram sands. Photo: S. Palpurina.