

**Vedecká grantová agentúra Ministerstva školstva, vedy, výskumu a športu SR  
a Slovenskej akadémie vied**

**Scientific Grant Agency of the Ministry of Education, science, research and sport of the Slovak Republic  
and the Slovak Academy of Sciences**

REGISTRATION NUMBER

2/0131/16

**GRANT APPLICATION**

Confidential

*Commissions of S.G.A.*

4 VEGA commission for biological sciences

***Title of the project***

Biosystematic study of Carpatho-Pannonian representatives of the genus *Sesleria* (Poaceae)

***Key words***

AFLP, cpDNA, ecology, experimental hybridization, morphology, flow cytometry

**Duration of the project (m/y)**

From	01	2016	to	12	2019
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**Number of - researchers**

4

**- graduate students**

1

**SUMMARY OF THE FINANCIAL MEANS REQUESTED**

**1<sup>st</sup> year**

**2<sup>nd</sup> year**

**3<sup>rd</sup> year**

**4<sup>th</sup> year**

(IN EUROS - €)

**INVESTMENTS (equipment)**

0

0

0

0

**NON-INVESTMENTS COSTS (travels expences including conferences, energies, communications, minor material/immaterial items, consumables, maintenance, services, sub-contracts)**

19 930

19 950

18 665

7 950

**PRINCIPAL INVESTIGATOR (surname, first name, title):**

Budzáková Monika, Mgr., PhD.

**List of scientific co-workers**

Mereďa Pavol, RNDr., PhD.

Hodálová Iva, RNDr., CSc.

Šibík Jozef, RNDr., PhD.

Date .....

Signature of the

principal investigator .....

#### ***Project summary***

The proposed project is focused on comprehensive biosystematic study of representatives of the genus *Sesleria* occurring in the Carpatho-Pannonian region (*Sesleria bielzii*, *S. caerulea*, *S. heufleriana*, *S. hungarica*, *S. sadleriana*, *S. tatrae*, *S. uliginosa*). Although representatives of the genus *Sesleria* play an important role in a number of communities (including endemic or relict syntaxa), the knowledge about them is still insufficient. It is supposed that polyploidization, hybridization and allopatric speciation have played an important role in the evolution of the genus. Despite of it, Carpatho-Pannonian representatives of the genus were not investigated by using modern methods. The main aim of this study is a comprehensive view of the studied species by using both taxonomic methods and ecological approach. Solved questions regard to the level of genetic, karyological, morphological, anatomical, reproductive, and ecological differentiation of the mentioned species.

#### ***Scientific goals for whole period of this project***

1. Determine the level of genetic differentiation among the species *Sesleria bielzii*, *S. caerulea*, *S. heufleriana*, *S. hungarica*, *S. sadleriana*, *S. tatrae*, and *S. uliginosa*.
2. Reveal the mode of origin of octoploid species *S. bielzii*, *S. hungarica*, *S. sadleriana*, and *S. tatrae*: does these species have a monophyletic or a polytopic origin arising within multiple tetraploid populations?
3. Determine the nuclear DNA content of all studied species.
4. Revise the degree of morphological, anatomical and ecological differentiation of all studied species. Evaluate which morphological characters are reliable and which are unreliable for identification of the species, or identify new characters appropriate for their determination. Define the correlations between anatomical and morphological characters and selected environmental factors (altitude, exposition, slope, concentrations of selected soil elements, soil depth, soil grain and pH).
5. Define the frequency of hybridization within sympatric populations of *S. caerulea* and *S. tatrae* in natural conditions.
6. Determine the degree of reproductive isolation of all studied species by using the experimental hybridization; study the vitality and fertility of potential hybrids.

#### ***Realisation outputs and output user***

***This project type does not require immediate realisation output in practice.***

#### International scientific co-operation

1. Collaboration in molecular systematics: Dr. Peter Schönswetter, Univ. Prof. (Institute of Botany, University of Innsbruck, Sternwartestraße 15, A-6020 Innsbruck, Austria, e-mail: Peter.Schoenswetter@uibk.ac.at); Dr. Nevena Kuzmanović, PhD. (Institute of Botany and Botanical Garden "Jevremovac", University of Belgrade, Takovska 43, 11000 Belgrade, Serbia, e-mail: nkuzmanovic@bio.bg.ac.rs).
2. Collaboration in the study of herbarium specimens and nomenclature: Dr. Lajos Somlyay (Department of Botany, Hungarian Natural History Museum, H-1476 Budapest, Pf. 222, Hungary, e-mail: somlyay@bot.nhmus.hu).
3. The study of herbarium specimens: Prague – Department of Botany at Charles University, National Museum; Brno – Masaryk University; Moravian Museum; Budapest – Hungarian National Museum; Vienna – University of Vienna, Natural History Museum; Cluj – University and Alexandru Borza Botanical Garden; Sibiu – Natural History Museum.

#### Description of the project (range - maximum 5 pages)

##### a) Present state of subject

##### b) Particular contribution expected

##### c) Proposal of the ways to reach the project goals, including timetable for each individual year of research

##### d) Working group (comment on the choice of the research group)

##### e) Description of applied methods and their explanation

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##### a) Present state of subject:

The genus *Sesleria* (Poaceae) comprises ca 30–40 species and subspecies occurring mostly in Europe, partially extending to adjacent regions in North Africa and West Asia (Deyl 1946, 1980, Ujhelyi 1959, Strgar 1981). Several *Sesleria* species play an important role in forming of plant communities and more of them are (sub-)endemic or endangered (Deyl 1946, 1980, Strgar 1981). Despite of this, the genus is still regarded as taxonomically very complicated. The most important reasons for this taxonomic ambiguity within the genus are: the high level of morphological similarity, phenotypic plasticity of morphological and anatomical characters, and interspecific hybridization (Deyl 1946, Strgar 1981, Lysák & Doležel 1998). Several studies paid attention to the European representatives of the genus *Sesleria* (mostly Deyl, Lysák, Strgar, and Ujhelyi). In spite of it, many problems were still not clarified by using modern systematic methods such as: the study of molecular markers, karyological investigations based on a large number of individuals, assessment of morphological and anatomical variability using multivariate methods, study of environmental factors and their influence on morphological and anatomical variability. Innovators in this fields are mainly Lysák, who studied the genome size and ploidy level variation of selected West-Carpathian species/populations (Lysák et al. 1997, 2000, Lysák & Doležel 1998), and Kuzmanović, who studied anatomy of selected Balkan *Sesleria* species by using multivariate methods and the influence of ecological factors on this anatomical variability (e. g. Kuzmanović et al. 2009). Kuzmanović et al. were also first, who successfully applied molecular markers (AFLP, trnL-ndhF cpDNA regions) in systematic study of the genus (Kuzmanović et al. 2013, Lakušić et al. 2013). However, such studies are still rare, and as a reason, there are several populations, which taxonomic status is not resolved.

A similar lack in knowledge has also been identified within all seven Carpathian and Pannonian species, which all belong to the nominate section *Sesleria*. Many of them play an important role in formation of large number of plant communities, including rare, endemic and relict syntaxa (e.g. the association *Oxyrio digynae-Saxifragetum carpatiae* or the alliance *Pulsatillo slavicae-Pinion*; cf. Uhlířová 1996, 1999, Dúbravcová 2007). From karyological point of view, the studied species can be divided into two ploidy levels: tetraploids ( $2n = 4x = 28$ ) and octoploids ( $2n = 8x = 56$ ). Species *S. caerulea*, *S. heufleriana*, and *S. uliginosa* are referred as tetraploids, whereas species *S. bielzii*, *S. hungarica*, *S. sadleriana* and *S. tatrae* as octoploids. In *S. heufleriana* tetraploid level is the most common, however three octoploid individuals were also recorded (in Slovenský Kras Karst) and assigned tentatively to this species (Lysák & Doležel 1998). *S. caerulea* has wide ecological amplitude from lowlands to high mountain belts and it is distributed across the northwestern and central Europe with eastern boundary in the Western Carpathians; *S. heufleriana* is East- and South-Carpathian species widespread from hilly to montane zones with exclave occurrence in Slovenský and Aggtelec Karst; *S. uliginosa* is species of calcareous swamps occurring from lowlands to submontane zones from the Baltic region to the Balkan Peninsula; *S. bielzii* is typical high mountain species occurring in the East and South Carpathians; *S. hungarica* is endemic to the Bükk and Uppony Mts (Hungary) growing in xerotherm habitats; *S. sadleriana* is endemic species growing on dry foothills of the north-western part of the Carpathian Basin; and *S. tatrae* is endemic species of the Western Carpathians with one exclave population in the Śnieżnik Kłodzki Mts (Poland) growing from the montane to alpine vegetation belt.

Many issues concerning the Carpatho-Pannonian *Sesleria* species stay unresolved for the following reasons: (a)

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taxa have been not studied genetically yet, (b) genome sizes of the species *S. bielzii* and *S. hungarica* was still not established, and in case of *S. sadleriana*, the known genome size vary widely among their populations indicating the existence of two different species, (c) the studied species exhibit very similar anatomy and morphology, (d) experimental hybridization was not carried out and presumed hybrids were identified only based on the morphological characters, (e) morphological and anatomical characters of individual species were still not been associated with environmental factors. Parts of these questions were already studied in our previous study of the species *S. caerulea* and *S. tatrae*. We demonstrated that combinations of taxonomic methods and ecological approach could be successful to get valuable information about the study taxa (Budzáková & Šibík 2012, 2015, Budzáková et al. 2014). Our study also revealed, that hybridization between the two studied species is not such common as previously assumed, and *S. tatrae* exhibits a greater similarity in morphology to *S. sadleriana* than was previously documented (Budzáková et al. 2014).

b) Particular contribution expected:

Our research will bring out more comprehensive and clear view to the complicated group of the Carpatho-Pannonian representatives of the genus *Sesleria*. Our results will clarify the genetic differentiation of the studied species and consequently, we will be able to answer two crucial questions: (1) Are the studied species genetically well differentiated? (2) Does each of the octoploid species *S. bielzii*, *S. hungarica*, *S. sadleriana*, and *S. tatrae* have a monophyletic or a polytopic origin? We will also reveal, if tetraploid populations of the studied species are cytologically uniform, or within them the octoploids could arise as was supposed in the case of three octoploid individuals of *S. heufleriana* in Slovenský kras Karst (Lysák & Doležel 1998). For the first time, we will determine the 2C DNA content of *S. bielzii* and *S. hungarica*. The nuclear DNA contents of the remaining species will be evaluated on a larger scale compared to previous studies. Thus, we contribute to the question whether the studied species can be recognized by using this parameter. Morphological and anatomical characters will be evaluated in more detail for all studied species. We will verify which traditionally used morphological characters are really suitable for their distinguishing, and we will try to find if there are some new characters reliable for morphological identification of the species. As a result we will provide determination key to the studied species. Anatomical characters are also often used as distinguishing characters between some *Sesleria* taxa and their importance in the species differentiation was already highlighted in several studies (cf. Kuzmanovič et al. 2009, 2012a,b, 2013). We also plan to study species in more detail from ecological point of view. Correlation investigations between environmental factors and morphological and anatomical characters will be also an important and interesting part of this project. Dependence of species on individual vegetation types and selected environmental conditions will be evaluated as well. Often mentioned interspecific hybridization between *S. caerulea* and *S. tatrae* (cf. Bělohávková 1980, Lysák 1996) will be clarified by experimental approach as well as by detailed karyological analyses of large number of individuals from suspect populations. Finally the project will prove if does exist reproductive barriers between the individual Carpatho-Pannonian representatives of the genus. We will define fitness and fertility of resulting hybrids. At last but not least, we get answer regarding the systematic position of the following problematic Slovak populations: (a) octoploid population from Vršatec hill, which was identified as *S. sadleriana* despite of some atypical morphological characters and exclave occurrence (Lysák & Doležel 1998); (b) octoploid population from Holíč hill, which was provisionally assigned to *S. tatrae* (Budzáková et al. 2014); (c) several octoploid individuals from Slovenský kras Karst provisionally assigned to tetraploid species *S. heufleriana* (Lysák & Doležel 1998). Results of the study will be summarized in three papers published in international peer reviewed journals.

c) Proposal of the ways to reach the project goals, including timetable for each individual year of research:

January 2016 – December 2016

Synthesis of current knowledge and relevant literature; revision of herbarium specimens in selected Central European Herbaria (Prague – PR, PRC; Brno – BRNM, BRNU; Vienna – W, WU; Bratislava – BRA, SAV, SLO; Budapest – BP; Cluj – CL; Sibiu – SIB); starting with collection of plant material and ecological data (mostly in Slovakia and Hungary); cultivation of living plants; anatomical analysis of cultivated material; ploidy level measuring of silica gel dried samples and identification of nuclear DNA content of cultivated plants (both using flow cytometry, FCM); chromosome counting; optimisation of AFLP protocols, selective primer screening and cpDNA analyses in Innsbruck.

January 2017 – December 2017

Collection of plant material and ecological data mainly from the Alps, East and West Carpathians (including the type localities of all studied species); cultivation of plants in greenhouse; experimental hybridization of cultivated individuals collected in previous year, offspring fitness and FCM estimations; morphological and anatomical analyses – measuring/scoring of selected characters, preliminary assessments of morphological results; karyological analyses – chromosome counting, DNA ploidy level and nuclear DNA content estimations; molecular

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analysis – isolation of DNA, AFLP and cpDNA analyses.

January 2018 – December 2018

Completing plant and ecological data sampling; cultivation of plants in greenhouse; experimental hybridization, offspring fitness and FCM estimations; synthesis of morphological, anatomical, karyological, molecular, and ecological analyses; presentation of the results on scientific symposia; preparation of the manuscripts for international peer-reviewed journals.

January 2019 – December 2019

Summarization of the results; presentation of the results on scientific symposia; publishing of the results in international peer-reviewed journals.

d) Working group (comment on the choice of the research group):

Mgr. Monika Budzáková, PhD., principal investigator

Monika Budzáková has an extensive experience in the systematic research on the genus *Sesleria*. In the years 2009–2014 her dissertation thesis was dedicated to morphological, karyological and ecological study of the species *S. caerulea* and *S. tatrae*, and their potential hybrids in the Western Carpathians and adjacent mountains. Results of this study are presented in three papers published in CC journals. From 2014 she works as a researcher at the Institute of Botany of Slovak Academy of Science (SAS). Beside of the genus *Sesleria*, she is involved also to other projects regarding mostly to vegetation changes in montane and alpine areas. She is also specialized on application research considering management practice in the national parks after wind and fire disturbances. Within the project, she will be responsible for co-ordination of work with scientific co-investigators in Belgrade, Budapest and Innsbruck, for field research, study of herbarium specimens, realization and evaluation of hybridization experiments, measuring of morphological and anatomical characters, obtaining of environmental variables, synthesis of molecular, karyological, morphological, anatomical, ecological, and phytosociological measurements and evaluations, and writing the manuscripts.

RNDr. Pavol Mered'a, PhD., scientific co-worker

Pavol Mered'a is currently a head of the Department of Vascular Plant Taxonomy at the Institute of Botany of SAS. He is specializing on taxonomy, chorology, morphometrics, karyology (including flow cytometry), and molecular systematics of vascular plants. He was responsible for preparation of Karyological database of ferns and flowering plants of Slovakia, actually he co-ordinates works on the Slovak floristic database "Dataflos". From 2005 he is scientific secretary of the Slovak Botanical Society. His research is focused on taxonomically complicated genera such as *Chenopodium*, *Epipactis*, *Senecio*, *Silene*, *Viola*. Within the project he will be responsible for karyological analyses (DNA ploidy level and nuclear DNA content estimations), evaluation of molecular, morphometric and karyological analyses.

RNDr. Iva Hodálová, PhD., scientific co-worker

Iva Hodálová currently works as a scientific researcher at the Institute of Botany of SAS in Bratislava. She is specialized on vascular plant taxonomy, morphometrics, karyology (including flow cytometry), and molecular systematics. Her research is focused on taxonomic revisions of the genera *Atriplex*, *Cyanus*, *Pilosella*, *Sagina*, *Senecio*, *Viola*. She has extensive experiences with field research in the Alps, the Carpatho-Pannonian region, the Balkan region, the Mediterranean Basin, North Europe and East Russia. As a co-author she was several times awarded, namely by the price of the Literary Fund and price of the SAS for publication "Flora of Slovakia VI/1" (2012). She was also awarded as a member of "Excellent working group of SAS" led by prof. K. Marhold (2013). Within the presented project she will be responsible for karyological analyses (chromosome counting), evaluation of morphometric and karyological analyses, and field research.

RNDr. Jozef Šibík, PhD., scientific co-worker

Jozef Šibík is a specialist for the alpine vegetation, its ecology and dynamics. He has worked as principal investigator of several projects supported by the national as well as foreign (Rocky Mountain National Park Service) agencies. In the last years he has been the principal investigator of the international project focusing on impact of grazing on alpine tundra ecosystem. The cooperation was developed and supported by RMNP (Colorado) and Colorado State University. In the 2013, he was awarded by Slovak American Foundation (SAF) by annual scholarship for his research activities at Colorado State University (CSU), USA. He was awarded by Pavol Sillinger's Award in 2005 by the Slovak Botanical Society (SBS) for the best original publication of young scientists. As the youngest scientist in history he was awarded by Holuby's commemorative medal by the SBS for his publishing activities in 2008. He received honourable recognition for the best scientific publication of young

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scientists under the age of 35 within SAS. He will participate on the field research, ecological and phytosociological data analyses and preparation of publications.

Mgr. Zuzana Ballová, graduate student

She has gained rich experience studying habitual demands of tatra marmots (*Marmota marmota latirostris*) and alpine plant communities utilized by marmots. She is also specializing on the comparison of vegetation characteristics in various marmot's patch types with different intensity of marmot activities, gaining insights on the impacts of different types of herbivores, large and small one, on alpine vegetation in determined patterns of species richness, and the study of grazing effects on the alpine vegetation along the environmental and geographical gradients. Within the project, she will be responsible for collection and evaluation of phytosociological data.

e) Description of applied methods and their explanation:

1. Study material. All *Sesleria* species occurring in the Carpathians and Pannonia will be included in the study – altogether seven species (their list see above) and from each species 7 populations will be studied. Each population will be simultaneously analyzed genetically, karyologically, morphologically, anatomically, and ecologically. Individuals for experimental hybridization will be chosen from the same populations. From 5 to 7 individuals will be measured for molecular, karyological (absolute DNA content), and anatomical analyses and used in hybridization experiments. Ploidy level and morphological characters will be studied on ca 20 individuals per each population. Significant support in the study of type material from Pannonian region will provide Dr. Lajos Somlyay from Hungarian Natural History Museum in Budapest.

2. Molecular analyses. Genetic differentiation within the species will be studied by using of the highly informative AFLP markers and analysis of selected non-coding regions of chloroplast (cp) DNA (e.g. trnL-ndhF), which are known as very suitable in study of polymorphic plant groups. These markers have been successfully applied already in study of the genus *Sesleria* (Kuzmanović et al. 2013, Lakušić et al. 2013). Especially AFLP markers showed to be useful, since according to current knowledge, variability of DNA sequences of the studied species clearly reflects their ancestral polymorphism and hybridization. Molecular analyses will be carried out in Austria at the Institute of Botany of University of Innsbruck under the guidance of Dr. Peter Schönswetter, prominent European specialist in molecular systematics of vascular plants, and also in cooperation with Dr. Nevena Kuzmanović considered to be specialist in the genus *Sesleria*, currently worked at the Institute of Botany and Botanical Garden of University of Belgrade. Such collaboration is therefore guaranty of successful outcome of this part of the project.

3. Karyological and cytometric analyses. Chromosome number, ploidy level and absolute DNA content estimations is a necessary part of the research, since the studied taxa are karyologically (by ploidy level and genome size) strictly differentiated. Counting of the chromosomes will be done using preparation of permanent squashes according to Murín (1960). The ploidy level estimations will be done by flow cytometry (Doležel et al. 2007).

4. Morphological analyses. Multivariate morphometric research was already successfully applied in our previous study of species *S. caerulea* and *S. tatrae* (Budžáková et al. 2014). Intrapopulation and intraspecific variation and morphological delimitation of the Carpatho-Pannonian species will be evaluated on large number of individuals collected in the field. Consequently, the analysis will be carried out in the program SAS v. 9.1.3 (SAS Institute 2007).

5. Anatomical analyses. For identification of the *Sesleria* species are commonly used also leaf anatomical features such as the size of the stomata, arrangements of vascular bundles, sclerenchyma fibres, etc. All anatomical characters previously studied by other authors on members of this genus (Kuzmanović et al. 2009) will be included also in our research. Leaf print of the adaxial and abaxial epidermal leaf cells will be done by contact method (cf. Lysák 1996). Anatomical analyses of characters inside of the leaves will be done on the permanent hand made slides, prepared by the standard method for the light microscopy (cf. Kuzmanović et al. 2009). Measurements of anatomical characters will be done at the Department of Plant Physiology at the Institute of Botany of SAS in Bratislava.

6. Ecological data. Selected environmental variables (altitude, aspect, slope, geological substrate, character of relief and soil depth) will be collected directly in the field to reveal correlation between morphological and anatomical characters and different environmental conditions. Selected pedological parameters (soil grain and soil pH and contents of selected soil elements) will be measured additionally in laboratory by using standard methods. Phytosociological relevés will be carried out by using methods of the Zürich-Montpellier school (Braun-Blanquet 1964, Westhof & van der Maarel 1978). Obtained data will be consequently evaluated by several statistical methods in programs JUICE 7.0 (Tichý 2002), SYN-TAX 2000 (Podani 2001), CANOCO 5 program package (ter Braak & Šmilauer 2002), Statistica 8.0 (StatSoft Inc. 2014) and R (R Development Core Team 2007).

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7. Experimental hybridization. The experimental breeding will run in greenhouse at the Institute of Botany of SAS in Bratislava. Individuals collected in the field will be crossed reciprocally under the proposed scheme. Resulted offspring will be analyzed karyologically. Fitness, blooming ability and pollen fertility of resulted offspring will be established as well.

References are attached in supplemental file.

**PRINCIPAL INVESTIGATOR****Enclosure A**

<b>Surname, first name, title</b> Budzáková Monika, Mgr., PhD.	<b>Highest degree &amp; year</b>	<b>PhD.</b> 2014	<b>Age</b>	31
<b>Institution and adress (street, postal code, city)</b> Institute of Botany of SAS Dúbravská cesta 9 845 23 Bratislava				
<b>Selection of 5 most important works of the principal investigator (whole period). Please quote the total numbers of citations / numbers of citations for the last five years with each work.</b>				
<p>Budzáková M. &amp; Šibík J. (2012): Stanovenie ekologických preferencií druhov <i>Sesleria albicans</i> a <i>Sesleria tatrae</i> na modelovom území v Belianskych Tatrách (Západné Karpaty). – <i>Studia Oecologica</i> 1: 3–14. (Citations: 0/0)</p> <p>Budzáková M. &amp; Šibík J. (2012): Habitat and ecological preference of <i>Sesleria albicans</i> Kit. Ex Schult. and <i>Sesleria tatrae</i> (Degen) Deyl in Belianske Tatras model site (the Western Carpathians). – <i>Aktuális Flóra- és Vegetációkutatás a Kárpát-medencében</i> IX. Szent István Egyetem, Gödöllő, 2012. 02. 24-26. <i>Kitaibelia</i> 17/1: 85. (Citations: 0/0)</p> <p>Budzáková M., Galvánek D., Littera P. &amp; Šibík J. (2013): The wind and fire disturbance in Central European mountain spruce forests: the regeneration after four years. – <i>Acta Soc. Bot. Pol.</i> 82(1): 13–24. (Citations: 0/0)</p> <p>Budzáková M., Hodálová I., Mered'a P. Jr., Somlyay L., Bisbing S. M. &amp; Šibík J. (2014): Karyological, morphological and ecological differentiation of <i>Sesleria caerulea</i> and <i>S. tatrae</i> in the Western Carpathians and adjacent regions. – <i>Preslia</i> 86(3): 245–277. (Citations: 0/0)</p> <p>Budzáková M. &amp; Šibík J. (2015): Diversity, variability and habitat characteristics of the communities dominated by <i>Sesleria</i> species (Poaceae) in the Western Carpathians. – <i>Plant Biosyst.</i> (in press). (Citations: 0/0)</p>				
<b>Selection of 5 most important works of the principal investigator in last 5 years - quote the survey of the citations of the most frequently cited work from this selection in the Appendix 1.</b>				
<p>Budzáková M. &amp; Šibík J. (2012): Stanovenie ekologických preferencií druhov <i>Sesleria albicans</i> a <i>Sesleria tatrae</i> na modelovom území v Belianskych Tatrách (Západné Karpaty). – <i>Studia Oecologica</i> 1: 3–14. (Citations: 0)</p> <p>Budzáková M. &amp; Šibík J. (2012): Habitat and ecological preference of <i>Sesleria albicans</i> Kit. Ex Schult. and <i>Sesleria tatrae</i> (Degen) Deyl in Belianske Tatras model site (the Western Carpathians). – <i>Aktuális Flóra- és Vegetációkutatás a Kárpát-medencében</i> IX. Szent István Egyetem, Gödöllő, 2012. 02. 24-26. <i>Kitaibelia</i> 17/1: 85. (Citations: 0)</p> <p>Budzáková M., Galvánek D., Littera P. &amp; Šibík J. (2013): The wind and fire disturbance in Central European mountain spruce forests: the regeneration after four years. – <i>Acta Soc. Bot. Pol.</i> 82(1): 13–24. (Citations: 0)</p> <p>Budzáková M., Hodálová I., Mered'a P. Jr., Somlyay L., Bisbing S. M. &amp; Šibík J. (2014): Karyological, morphological and ecological differentiation of <i>Sesleria caerulea</i> and <i>S. tatrae</i> in the Western Carpathians and adjacent regions. – <i>Preslia</i> 86(3): 245–277. (Citations: 0)</p> <p>Budzáková M. &amp; Šibík J. (2015): Diversity, variability and habitat characteristics of the communities dominated by <i>Sesleria</i> species (Poaceae) in the Western Carpathians. – <i>Plant Biosyst.</i> (in press). (Citations: 0)</p>				



**SURVEY OF THE CITATIONS**

Citations are in the attachment

**SCIENTIFIC CO-WORKERS**

Surname, first name, title	Highest degree & year	PhD.	Age	
Mereďa Pavol, RNDr., PhD.		2010		40
Institution and adress (street, postal code, city) Institute of Botany of SAS Dúbravská cesta 9 845 23 Bratislava				
Selection of 5 most important works of the co-worker in the last 5 years				
<p>Mereďa P. Jr., Hodálová I., Kučera J., Zozomová-Lihová J., Letz D. R. &amp; Slovák M. (2011): Genetic and morphological variation in <i>Viola suavis</i> s.l. (Violaceae) in the western Balkan Peninsula: two endemic subspecies revealed. – System. Biodivers. 9: 211–231. Number of citations: 8</p> <p>Mereďa P. Jr. &amp; Hodálová I. (2011): Cievnaté rastliny. – Vascular plants, pp. 36–119. In: Ambrós L., Čejka T., Cerný J., Darolová A., Hodálová I., Krištofik J., Kubinská A., Mišíková K., Mereďa P. Jr., Soltés R., Šubová D., Vidlička L.: Atlas druhov európskeho významu pre územia NATURA 2000 na Slovensku. – The atlas of species of european interest for NATURA 2000 sites in Slovakia. SLOVART, Bratislava. 520 pp. ISBN 978-80-556-0220-2. Number of citations: 2</p> <p>Mereďa P. Jr., Eliáš P. jun., Dítě D. &amp; Štrba P. (2012): <i>Silene L.</i> Silenka. In: Goliašová K. &amp; Michalková E. (eds), Flóra Slovenska [Flora of Slovakia] 6/3: 410–533, Veda, Bratislava. Number of citations: 2</p> <p>Budzáková M., Hodálová I., Mereďa Jr. P., Somlyay L., Bisbing S. M. &amp; Šibík J. (2014): Karyological, morphological and ecological differentiation of <i>Sesleria caerulea</i> and <i>S. tatrea</i> in the Western Carpathians and adjacent regions. – Preslia 86: 245–277. Number of citations: 0</p> <p>Hodálová I., Mereďa P. Jr., Kučera J., Marhold K., Kempa M., Olšavská K. &amp; Slovák M. (2015): Origin and systematic position of <i>Jacobaea vulgaris</i> (Asteraceae) octoploids: genetic and morphological evidence. – Plant Syst. Evol. 301: 1517–1541. Number of citations: 0</p>				

**SCIENTIFIC CO-WORKERS**

Surname, first name, title	Highest degree & year	CSc.	Age	
Hodálová Iva, RNDr., CSc.		1997		51
Institution and adress (street, postal code, city) Institute of Botany of SAS Dúbravská cesta 9 845 23 Bratislava				
Selection of 5 most important works of the co-worker in the last 5 years				
<p>Hodálová I., Mereďa P. Jr., Vinikárová A., Grulich V. &amp; Rotreklová O. (2010): A new cytotype of <i>Jacobaea vulgaris</i> (Asteraceae): frequency, morphology and origin. – Nordic J. Bot. 28: 413–427.</p> <p>Šingliarová B., Hodálová I. &amp; Mráz P. (2011): Biosystematic study of the diploid-polyploid <i>Pilosella alpicola</i> group with variation in breeding system: Patterns and processes. – Taxon 60: 450–470.</p> <p>Olšavská K., Perný M., Kučera J. &amp; Hodálová I. (2011): Biosystematic study of the <i>Cyanus triumfetti</i> group in Central Europe. – Preslia 83: 59–98.</p> <p>Olšavská K., Perný M., Loser C.J., Stimper R. &amp; Hodálová I. (2013): Cytogeography of European perennial species of <i>Cyanus</i> (Asteraceae). – Bot. J. Linn. Soc. 173: 230–257.</p> <p>Hodálová I., Mereďa P. Jr., Kučera J., Marhold K., Kempa M., Olšavská K. &amp; Slovák M. (2015): Origin and systematic position of <i>Jacobaea vulgaris</i> (Asteraceae) octoploids: genetic and morphological evidence. – Plant Syst. Evol. 301: 1517–1541.</p>				

**SCIENTIFIC CO-WORKERS**

<b>Surname, first name, title</b> Šibík Jozef, RNDr., PhD.	<b>Highest degree &amp; year</b>	PhD. 2007	<b>Age</b>	37
<b>Institution and adress (street, postal code, city)</b> Institute of Botany of SAS Dúbravská cesta 9 845 23 Bratislava				
<b>Selection of 5 most important works of the co-worker in the last 5 years</b>				
<p>Šibíková I., Šibík J., Hájek M. &amp; Kliment J. (2010): The distribution of arctic-alpine elements within high-altitude vegetation of the Western Carpathians in relation to environmental factors, life forms and phytogeography. – <i>Phytocoenologia</i> 40(2–3): 189–203.</p> <p>Košuthová-Dingová A. &amp; Šibík J. (2013): Ecological indicator values and life history traits of terricolous lichens of the Western Carpathians. – <i>Ecol. Indicat.</i> 34: 246–259.</p> <p>Svitková I. &amp; Šibík J. (2013): An expert-based classification of high-altitude arctic-alpine vegetation of the class <i>Carici rupestris-Kobresietea Ohba</i> 1974 – achievements and obstacles. – <i>Plant Biosyst.</i> 147/2: 315–327.</p> <p>Ballová Z. &amp; Šibík J. (2015): Microhabitat selection of Tatra marmot (<i>Marmota marmota latirostris</i>) – a case study from the Western Carpathians. – <i>Europe. Arct. Antarct. Alp. Res.</i> 47/1: 169–183.</p> <p>Budzáková M. &amp; Šibík J. (2015): Diversity, variability and habitat characteristics of the communities dominated by <i>Sesleria</i> species (<i>Poaceae</i>) in the Western Carpathians. – <i>Plant Biosyst.</i> (in press).</p>				

**SCIENTIFIC CO-WORKERS**

<b>Surname, first name, title</b>	<b>Highest degree &amp; year</b>		<b>Age</b>	
<b>Institution and adress (street, postal code, city)</b>				
<b>Selection of 5 most important works of the co-worker in the last 5 years</b>				

Graduate students involved in the project (for each of them list selected works, if any and different from those listed by the project leader or scientific co-workers):

Ballová Zuzana, Mgr.