EDGG Grassland research and conservation

IAVS

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Bulletin 31

of the Eurasian Dry Grassland Group

Content

At the top:
Sand dune grassland at the Thyrrhenian coast of Italy
(Photo: Jürgen Dengler)

Dear members of the Eurasian Dry Grassland Group,

We are pleased to present you the new issue of the EDGG Bulletin, which comprises a multi-author paper on mean, minimum and maximum phytodiversity data across all types of Palaearctic grasslands and for seven different spatial grain sizes. This paper is closely connected to EDGG as it is largely based on data sampled during the EDGG Field Workshops. Moreover, there is a Forum paper about an endangered lichen species. We take the opportunity of these two articles, to emphasize that the Bulletin is very open to your scientific articles (Research papers, Forum papers, Reviews, Reports) as well. While we do not provide peer-review, we offer linguistic editing after acceptance, and you can be sure that your paper achieves a high visibility if published in the Bulletin because it is open access and sent to more than 1000 grassland specialists throughout the world. To facilitate your paper preparation, we have compiled Author Guidelines, which you can find in this Bulletin as well as on the EDGG homepage. From July 2016 the Bulletin also has a profile in ResearchGate to which you can contribute by uploading your Bulletin articles in ResearchGate (https://www.researchgate.net/journal/1868-2456_Bulletin_of_the_Eurasian_Dry_Grassland_Group).

We would like also to remind you that our Bulletin is an excellent way to inform the group members about your recent grassland-related publications and forthcoming events relevant for EDGG members. We hope that reading the Bulletin in the midst of the field season will inspire you to new ideas and discoveries that, in turn, will find their place on the pages of future volumes.

Anna Kuzemko, Idoia Biurrun & the Editorial Board

Eurasian Dry Grassland Group (EDGG)

The **Eurasian Dry Grassland Group (EDGG)** is a network of researchers and conservationists interested in Palearctic natural and semi-natural grasslands. It is an official subgroup of IAVS (http://www.iavs.org) but one can join our group without being IAVS member. We live from the activities of our members. Everybody can join EDGG without any fee or other obligation.

The EDGG covers all aspects related to dry grasslands, in particular: plants - animals - fungi - microbia - soils - taxonomy - phylogeography - ecophysiology - population biology - species' interactions - vegetation ecology - syntaxonomy - landscape ecology - biodiversity - land use history - agriculture - nature conservation - restoration - environmental legislation - environmental education.

To become a member of the Eurasian Dry Grassland Group or its subordinate units, please, send an e-mail to Idoia Biurrun, including your name and complete address, and specify any of the groups you wish to join. More detailed information can be found at: http://www.edgg.org/about_us.htm

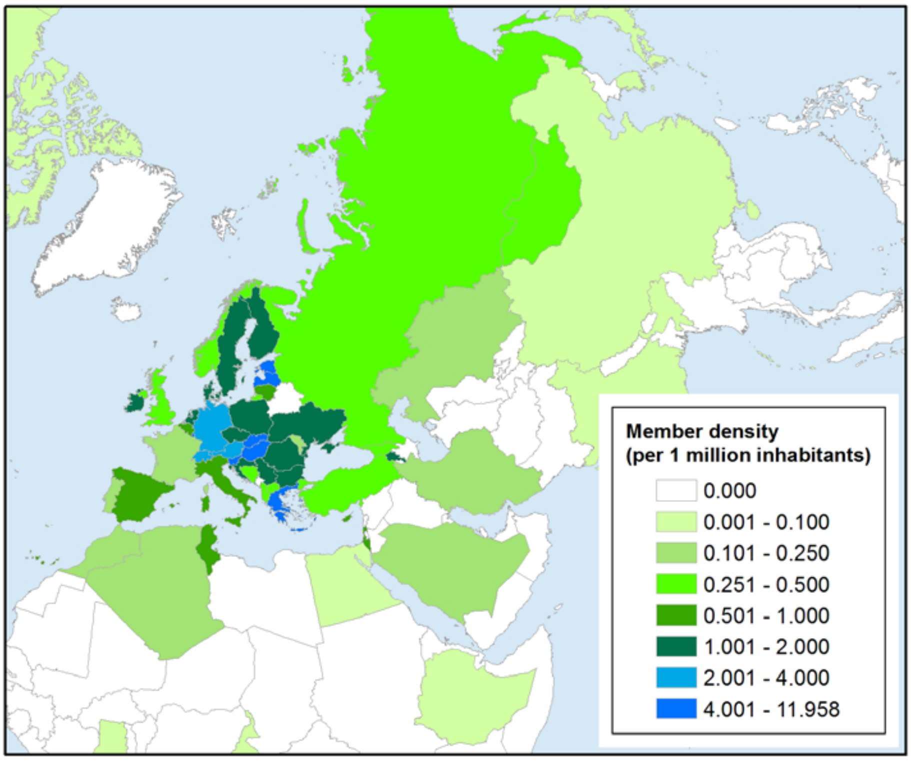
As of 29 July 2016 the EDGG had 1141 members from 64 countries all over the world. While we are well-represented in most European countries, few European countries are still not or hardly covered by members. Moreover, the extra-European part of the Palaearctic realm (which according to our Bylaws is the geographic scope of EDGG!) is still grossly underrepresented.

The basic aims of the EDGG are:

- to compile and to distribute information on research and conservation in natural and semi-natural grasslands beyond national borders;
- to stimulate active cooperation among grassland scientists (exchanging data, common data standards, joint projects).

To achieve its aims, EDGG provides seven instruments for the information exchange among grassland researchers and conservationists:

- **the Bulletin of the EDGG** (published quarterly);
- **the EDGG homepage** (www.edgg.org);
- e-mails via our **mailing list** on urgent issues;
- **the Eurasian Grassland Conference** - organized annually at different locations throughout the Palaearctic Realm;
- **EDGG field workshops** to sample baseline data of underrepresented regions of Europe;
- **EDGG vegetation databases;**
- **Special Features** on dry grassland-related topics in various peer-reviewed journals.



EDGG Subgroups

The members are automatically included in the Regional Subgroup of the region in which they reside. If you additionally wish to join the Topical Subgroup Grassland Conservation and Restoration just send an e-mail to the Membership Administrator (idoia.biurrun@ehu.es or Stephen.Venn@Helsinki.Fi).

Arbeitsgruppe Trockenrasen (Germany) (contact: Thomas Becker - beckerth@uni-trier.de), Ute Jandt - jandt@botanik.uni-halle.de: 239 members

Working Group on Dry Grasslands in the Nordic and Baltic Region (contact: Jürgen Dengler - juergen.dengler@uni-bayreuth.de): 93 members

South-East European Dry Grasslands (SEEDGG) (contact: Iva Apostolova - iva@bio.bas.bg): 280 members

Mediterranean Dry Grasslands (Med-DG) (contact: Michael Vrahnakis - mvrahnak@teilar.gr): 309 members

Topical Subgroup Grassland Conservation and Restoration (contact: Péter Török - molinia@gmail.com): 69 members

EDGG Executive Committee and responsibilities of its members

Didem Ambarlı: Editor-in-Chief of homepage, Deputy Conferences Coordinator, didem.ambarli@gmail.com

Idoia Biurrun: Membership Administrator, Deputy Editor-in-Chief of Bulletin, Deputy Field Workshop Coordinator, Deputy IAVS Representative, Deputy Editor-in-Chief of homepage, idoia.biurrun@ehu.es

Jürgen Dengler: Coordinator for Special Features; Field Workshop Coordinator, juergen.dengler@uni-bayreuth.de

Monika Janišová: Deputy Editor-in-Chief of Bulletin, monika.janisova@gmail.com

Anna Kuzemko: Editor-in-Chief of Bulletin, Book Review Editor, Facebook Group Administrator, anya_meadow@i.ua

Péter Török: IAVS Representative, Contact Officer to other organisations, Deputy Coordinator of Species Features, Deputy Secretary-General, Deputy Book Review Editor, molinia@gmail.com

Stephen Venn: Secretary-General, Deputy Membership Administrator, Deputy Policy Officer, Deputy Facebook Group Administrator, Stephen.Venn@Helsinki.Fi

Michael Vrahnakis: Conferences Coordinator, Policy Officer, Deputy Contact Officer to other organizations, mvrahnak@teilar.gr

Announcement

Save the date – First call for the 10th EDGG Field Workshop

(Central Apennine Mts., Italy)

The 10th EDGG Field Workshop (formerly known as EDGG Research Expedition) will take place in "Abruzzo, Lazio and Molise" National Park and surrounding mountain areas (Central Apennines, Italy) from June 3-June 11, 2017.

The main research aim will be sampling biodiversity data across a continentality gradient. Because of rain-shadow effect, the dry valleys of the Marsica district (L'Aquila province) feature low precipitation values and large temperature excursion: this situation is somewhat similar to the better-known Alpine dry valleys, but while in the Alps the precipitation regime is centred in summer, in the Apennines there is a sub-Mediterranean climate with summer drought. Thus, the grassland vegetation is made up of a very interesting mixture between Pleistocene steppe relicts, Mediterranean species and *Festuco-Brometea* taxa, leading to a high species richness.

Approximate costs: 600-700 euros (including accommodation, full meals, transport from arrival at Rome Fiumicino airport until departure from the same airport). The exact price will be confirmed later (we are currently looking for financial support, so we might be able to reduce it by c. 100 euros).

Please note that EDGG Field Workshops are very intensive *field sampling* events (not guided excursions!), restricted to a small group of highly motivated participants from different countries and all academic levels, aimed at exchanging methodological issues and collecting standardized biodiversity data that will subsequently be available for joint publications by the participants.

Goffredo Filibeck & Laura Cancellieri
(Local organisers),

Jürgen Dengler & Idoia Biurrun
(Field Workshop Coordinators)

A detailed call will be published in the December issue of the Bulletin. If you need any further information in the meanwhile, please contact the local organizer (Goffredo Filibeck, filibeck@unitus.it).

***Salvia argentea* *in a continental and sub-Mediterranean grazed landscape of the Marsica, dominated by* *Stipa dasyvaginata, Phleum ambiguum, etc.* (Photo: L. Cancellieri).**

Report

Towards better representation of SE Europe in the European Vegetation Archive (EVA)

In 2014 I, Milan Chytrý (EVS), and Jürgen Dengler (EDGG) prepared a project proposal to the IAVS for a financial support of 1,500 Euros for the development of vegetation-plot databases in SE Europe and better representation of the data from this region in EVA. The need of such project was due to scarcity of data from SE Europe that were available in the EVA database, despite this region is a hotspot of botanical diversity in Europe.

I used financial support only for travelling and accommodation in Romania, Serbia, Germany & Italy, but I didn't receive any payment for this work.

During last two years, I have been working very intensively on the development of EVA databases in SE Europe. I'm a custodian of the Balkan Dry Grassland Database (BDGD; GIVD ID EU-00-013) and the Balkan Vegetation Database (BVD; GIVD ID EU-00-019). I'm also a deputy custodian of the Romanian Grassland Database (RGD; GIVD ID EU-RO-008). The development of big multinational databases is much more difficult and time-consuming than working on a national database. This is because contributors provide their data with different lists of species, authors and syntaxa. Then the custodians have to standardize the individual contributions according to database structure.

We have created a large consortia of data contributors from the region. Nowadays, the Balkan Dry Grassland Database consortium includes 28 members, the Balkan Vegetation Database consortium - 37 and 30 members are a part of the Romanian Grassland Database consortium.

Dry grasslands (Helianthemetea guttati) on Ograzhden Mt. **(Photo: Sofia Kostadinova)**

Kiril Vassilev in Central Balkan Range National Park. **(Photo: Hristo Pedashenko)**

Due to these efforts, these three databases the number of relevés in the Balkan Dry Grassland Database increased from 5,243 to 8,600 relevés and that in the Romanian Grassland Database from 1,993 to 8,700. The Balkan Vegetation Database was newly established, which now consists of 9,580 relevés. Together with the increasing number of relevés the data quality was improved by adding missing header data information.

In addition, I, Jürgen Dengler and other database contributors developed Data Property and Governance Rules for these three databases. They regulate the governance of the databases, data provision, type of data availability regimes, data requests and terms of data use, authorship rules and relationships with EVA, sPlot and GIVD. These rules are phrased similarly to the EVA and sPlot Data Property and Governance Rules.

Data from the three databases is a good starting point for various studies about flora, vegetation, habitat types and ecosystem services at the local, regional and European level. During the last two years data from the Balkan Dry Grassland Database, the Balkan Vegetation Database and the Romanian Grassland Database was requested from 21, 27 and 21 projects via EVA, respectively. A broad-scale consistent classification of the whole dry grassland vegetation of the Central and Eastern Balkan Peninsula is under way.

Currently, a Long Database Report about the Balkan Vegetation Database is in press in *Phytocoenologia*. We plan to prepare such reports also for the other two databases during the next few months. Everybody who can contribute with some data is welcomed to become a co-author.

Although considerable progress in collecting and standardizing data from the region has been made, there are still thousands of published and unpublished relevés from the region that are not yet digitized. Capturing these relevés is our goal for the near future. During the Eurasian Grassland Conference (EGC) in September 2016 in Sighisoara, Romania, a workshop on managing national and supranational grassland databases in SE Europe will be held, during which data capturing for the RGD and the other two databases shall be stimulated, other national database projects of the region be supported and papers analysing the Romanian grassland dataset be planned.

I am extremely grateful to the International Association for Vegetation Science for their financial support and personally to Jürgen Dengler and Milan Chytrý, who supervised me.

Kiril Vassilev, Bulgaria
kiril5914@abv.bg

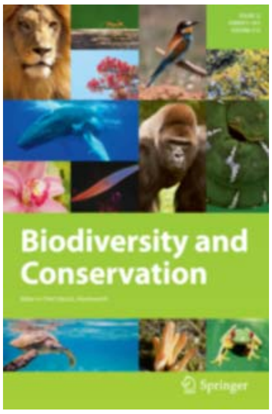
Dry grasslands on Vlahina Mt. **(Photo: Kiril Vassilev)**

EDGG Special Features

Finished and current EDGG-edited Special Features

Three EDGG-edited Special Features have recently been completed or are close to being finished, comprising numerous research and review articles covering a wide field of topics within the EDGG scope. Thus we hope that you, the EDGG members, find them attractive and useful for your own research. To facilitate access to the papers, we provide the e-mail addresses of the corresponding authors if the article is not open access anyway.

Special Issue in *Biodiversity and Conservation*



The Special Issue *Palaearctic steppes: ecology, biodiversity and conservation* (eds. Jürgen Dengler, Didem Ambarli, Johannes Kamp, Péter Török and Karsten Wesche) was initiated at the EDGG conference in Kulikovo Pole, Tula, Russia and will now appear approximately in July 2016. It is our second Special Issue in this international journal (impact factor 2014: 2.365) and the first EDGG Special Feature exclusively dedicated to the natural steppes. It comprises 17 regular papers, one synthesis paper and one editorial.

Török, P., Wesche, K., Ambarlı, D., Kamp, J. & Dengler, J. 2016. Step(pe) up! Raising the profile of the Palaearctic natural grasslands. *Biodiversity and Conservation* (in press). [e-mail: molinia@gmail.com]

Wesche, K., Ambarlı, D., Kamp, J., Török, P., Treiber, J., Dengler, J. 2016. The Palaearctic steppe biome: a new synthesis. *Biodiversity and Conservation* (in press). [e-mail: karsten.wesche@senckenberg.de]

Kuzemko, A.A., Steinbauer, M.J., Becker, T., Didukh, Y.P., Dolnik, C., Jeschke, M., Naqinezhad, A., Ugurlu, E., Vassilev, K. & Dengler, J. 2016. Patterns and drivers of phytodiversity of steppe grasslands of Central Podolia (Ukraine). *Biodiversity and Conservation*. DOI: 10.1007/s10531-016-1060-7. [e-mail: anya_meadow@i.ua]

Polyakova, M.A., Dembicz, I., Becker, T., Becker, U., Demina, O.N., Ermakov, N., Filibeck, G., Guarino, R., Janišová, M., Jaunatre, R., Kozub, Ł., Steinbauer, M.J., Suzuki, K. & Dengler, J. 2016. Scale- and taxon-dependent patterns of plant diversity in steppes of Khakassia, South Siberia (Russia). *Biodiversity and Conservation*. DOI: 10.1007/s10531-016-1093-y. [e-mail: galatella@mail.ru]

Sutcliffe, L.M.E., Germany, M., Becker, U. & Becker, T. 2016. How does size and isolation affect patches of steppe-like vegetation on slumping hills in Transylvania, Romania? *Biodiversity and Conservation*. DOI: 10.1007/s10531-016-1108-8. [e-mail: sutcliffe.laura@gmail.com]

Dembicz, I., Moysiyenko, I.I., Shaposhnikova, A., Vynokurov, D., Kozub, Ł. & Sudnik-Wójcikowska, B. 2016. Isolation and patch size drive specialist plant species density within steppe islands: a case study of kurgans in southern Ukraine. *Biodiversity and Conservation*. DOI: 10.1007/s10531-016-1077-y. [e-mail: iwodem@op.pl]

Kajtoch, Ł., Cieślak, E., Varga, Z., Paul, W., Mazur, M.A., Sramkó, G. & Kubisz, D. 2016. Phylogeographic patterns of steppe species in Eastern Central Europe: a review and the implications for conservation. *Biodiversity and Conservation*. DOI: 10.1007/s10531-016-1065-2.

Weking, S., Kämpf, I., Mathar, W. & Hölzel, N. 2016. Effects of land use and landscape patterns on Orthoptera communities in the Western Siberian forest steppe. *Biodiversity and Conservation* 25. DOI: 10.1007/s10531-016-1107-9. [e-mail: sarah.weking@uni-muenster.de]

Mathar, W.P., Kämpf, I., Kleinebecker, T., Kuzmin, I., Tolstikov, A., Tupitsin, S. & Hölzel, N. 2016. Floristic diversity of meadow steppes in the Western Siberian Plain: effects of abiotic site conditions, management and landscape structure. *Biodiversity and Conservation*. DOI: 10.1007/s10531-015-1023-4. [e-mail: w.mathar@uni-muenster.de]

Lameris, T.K., Fijen, T.P.M., Urazaliev, R., Pulikova, G., Donald, P.F. & Kamp, J. 2016. Breeding ecology of the endemic Black Lark *Melanocorypha yeltoniensis* on natural steppe and abandoned croplands in post-Soviet Kazakhstan. *Biodiversity and Conservation*. DOI: 10.1007/s10531-015-1041-2. [e-mail: thomaslameris@gmail.com]

Wang, Y. & Wesche, K. 2016. Vegetation and soil responses to livestock grazing in Central Asian grasslands: a review of Chinese literature. *Biodiversity and Conservation*. DOI: 10.1007/s10531-015-1034-1. [e-mail: karsten.wesche@senckenberg.de]

Addison, J. & Greiner, R. 2016. Applying the social–ecological systems framework to the evaluation and design of payment for ecosystem service schemes in the Eurasian steppe. *Biodiversity and Conservation*. DOI: 10.1007/s10531-015-1016-3. [e-mail: jane.addison023@gmail.com]

Niu, K., He, J.-S., Zhang, S. & Lechowicz, M.J. 2016. Grazing increases functional richness but not functional divergence in Tibetan alpine meadow plant communities. *Biodiversity and Conservation*. DOI: 10.1007/s10531-015-0960-2. [e-mail: kechangniu@nju.edu.cn]

Novenko, E.Y., Tsyganov, A.N., Rudenko, O.V., Volkova, E.V., Zuyganova, I.S., Babeshko, K.V., Olchev, A.V., Losbenev, N.I., Payne, R.J. & Mazei, Y.A. 2016. Mid- and late-Holocene vegetation history, climate and human impact in the forest-steppe ecotone of European Russia: new data and a regional synthesis. *Biodiversity and Conservation*. DOI: 10.1007/s10531-016-1051-8. [e-mail: lenanov@mail.ru]

Deák, B., Tóthmérész, B., Valkó, O., Sudnik-Wójcikowska, B., Moysiyenko, I.I., Bragina, T.M., Apostolova, I., Dembicz, I., Bykov, N.I. & Török, P. 2016. Cultural monuments and nature conservation: a review of the role of kurgans in the conservation and restoration of steppe vegetation. *Biodiversity and Conservation*. DOI: 10.1007/s10531-016-1081-2. [e-mail: debalazs@gmail.com]

Ambarlı, D. Zeydanlı, U.S., Balkız, Ö., Aslan, S., Karaçetin, E., Sözen, M., Ilgaz, Ç., Gürsoy Ergen, A., Lise, Y., Demirbaş Çağlayan, S., Welch, H.J., Welch, G., Turak, A.S., Bilgin, C.C., Özkil, A. & Vural, M. 2016. An overview of biodiversity and conservation status of steppes of the Anatolian Biogeographical

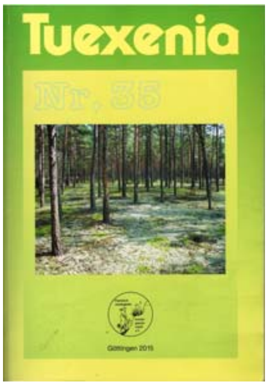
Region. *Biodiversity and Conservation* (in press). [e-mail: didem.ambarli@gmail.com]

Kamp, J., Koshkin, M.A., Bragina, T.M., Katzner, T.E., Milner-Gulland, E.J., Schreiber, D., Sheldon, R., Shmalenko, A., Smelansky, I., Terraube, J. & Urazaliev, R. 2016. Persistent and novel threats to the biodiversity of Kazakhstan's steppes and semi-deserts. *Biodiversity and Conservation*. DOI: 10.1007/s10531-016-1083-0. [e-mail: johannes.kamp@uni-muenster.de]

Brinkert, A., Hölzel, N., Sidorova, T.V. & Kamp, J. 2016. Spontaneous steppe restoration on abandoned cropland in Kazakhstan: grazing affects successional pathways. *Biodiversity and Conservation*. DOI: 10.1007/s10531-015-1020-7. [e-mail: johannes.kamp@uni-muenster.de]

Kämpf, I., Mathar, W., Kuzmin, I., Hölzel, N. & Kiehl, K. 2016. Post-Soviet recovery of grassland vegetation on abandoned fields in the forest steppe zone of Western Siberia. *Biodiversity and Conservation*. DOI: 10.1007/s10531-016-1078-x. [e-mail: i.kaempf@hs-osnabrueck.de]

Grassland Special Feature in *Tuexenia*



The 11th EDGG-edited Grassland Special Feature in *Tuexenia* (impact factor 2014: 1.562; guest editors Thomas Becker, Anikó Csecserits, Balázs Deák, Monika Janišová, Laura M.E. Sutcliffe and Viktora Wagner) will appear approximately in July 2016. It will comprise six regular articles and an editorial. All papers will be freely available on the journal homepage http://www.tuexenia.de/index.php?id=14).

Becker, T., Csecserits, A., Deák, B., Janišová, M., Sutcliffe, L.M.E. & Wagner, V. 2016. Different approarches in grassland analysis – Editorial to the 11th EDGG Grassland Special Feature. Tuexenia 36 (in press). [e-mail: beckerth@uni- trier.de]

Baumann, E., Weiser, F., Chiarucci, A., Jentsch, A. & Dengler, J. 2016. Diversity and functional composition of alpine grasslands along an elevational transect in the Gran Paradiso National Park (NW Italy). *Tuexenia* 36 (in press). [e-mail: juergen.dengler@uni-bayreuth.de]

Deák, B., Hüse, B. & Tóthmérész, B. 2016. Grassland vegetation in urban habitats − testing ecological theories. *Tuexenia* 36 (in press). [e-mail: debalazs@gmail.com]

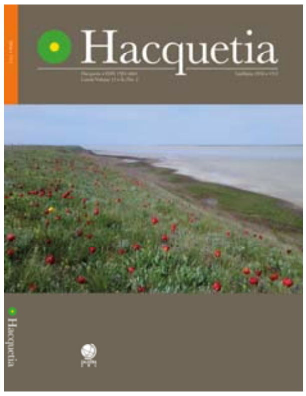
Harzé, M., Mahy, G. & Monty, A. 2016. The extent of intra-population plant functional trait variability in calcareous grasslands. *Tuexenia* 36 (in press). [e-mail: melanie.harze@ulg.ac.be]

Hüllbusch, E., Brandt, L. M., Ende, P. & Dengler, J. 2016. Little vegetation change during two decades in a dry grassland complex in the Biosphere Reserve Schorfheide-Chorin (NE Germany). *Tuexenia* 36 (in press). [e-mail: elli-huellbusch@gmx.de]

Kuzmanović, N., Kabaš, E., Jovanović, S., Vukojičić, S., Aćić, S., Surina, B. & Lakušić, D. 2016. Syntaxonomy and nomenclatural adjustments of steppe-like vegetation on shallow ultramafic soils in the Balkans included in the order *Halacsyetalia sendtneri*. *Tuexenia* 36 (in press). [e-mail: nkuzmanovic@bio.bg.ac.rs, dlakusic@bio.bg.ac.rs]

Valkó, O., Deák, B., Török, P., Kirmer, A., Tischew, S., Kelemen, A., Tóth, K., Miglécz, T., Radócz, S., Sonkoly, J., Tóth, E., Kiss, R., Kapocsi, I. & Tóthmérész, B. 2016. High-diversity sowing in establishment windows: a promising new tool for enhancing grassland biodiversity. *Tuexenia* 36 (in press). [e-mail: valkoorsi@gmail.com]

Special Issue in *Hacquetia*



The third EDGG-edited Special Issue in *Hacquetia* has been edited by lead guest editors Orsolya Valko, Stephen Venn , and the editorial team of Idoia Biurrun, Rocco Labadessa, Jacqueline Loos and Michal Zmihorski, will appear in July 2016. Its theme is Ecology and conservation of steppes and semi-natural grasslands and it will comprise eight peer-reviewed papers, a report about EDGG activities and an editorial. All papers will shortly be freely available on the journal homepage (http://www.degruyter.com/view/j/hacq). Eight following papers have been accepted:

Valkó, O., Zmihorski, M., Biurrun, I., Loos, J., Labadessa, R. & Venn. S. 2016. Ecology and Conservation of Steppes and Semi-Natural Grasslands, Hacquetia 15 (editorial, in press). [e-mail: valkoorsi@gmail.com]

Baranova, A., Schickhoff, U., Wang, S. & Jin, M. 2016. Mountain pastures of Qilian Shan: plant communities, grazing impact and degradation status (Gansu province, NW China). *Hacquetia* 15. DOI: 10.1515/hacq-2016-0014. [e-mail: alina.baranova@uni-hamburg.de]

Belonovskaya, E., Gracheva, R., Shorkunov, I. & Vinogradova, V. 2016. Grasslands of intermontane basins of Central Caucasus: land use legacies and present-day state. *Hacquetia* 15 (in press). [e-mail: belena53@mail.ru]

Ronkin, V. & Savchenko, G. 2016. Flora and vegetation of dry grasslands of Northeastern Ukraine, and problems of diversity conservation. *Hacquetia* 15. DOI: 10.1515/hacq-2016-0013. [e-mail: ronkinvl@discover-ua.com]

Budzhak, V.V., Chorney, I.I., Tokariuk, A.I. & Kuzemko, A.A. 2016. Numeric syntaxonomical analysis of the communities with participation of species from *Molinia caerulea* complex in the south-west of Ukraine. *Hacquetia* 15 (in press). [e-mail: budzhakv@gmail.com, anya_meadow@mail.ru*]

Kolomiychuk, V. & Vynokurov, D. 2016. Syntaxonomy of the *Festuco-Brometea* class vegetation of the Azov Sea coastal zone. *Hacquetia* 15 (in press). [e-mail: vkolomiychuk@ukr.net, phytosocio@ukr.net*]

Bragina, T.M. 2016. Soil macrofauna (invertebrates) of Kazakhstanian *Stipa lessingiana* dry steppe. *Hacquetia* 15: in press. [e-mail: tm_bragina@mail.ru]

Tsiobani, E.T., Yiakoulaki, M.D., Hasanagas, N.D., Menexes, G. & Papanikolaou, K. 2016. Water Buffaloes' grazing behaviour at the Lake Kerkini National Park, Northern Greece. *Hacquetia* 15. DOI: 10.1515/hacq-2016-0015. [e-mail: yiak@for.auth.gr*]

Polchaninova, N. Tsurikov, M. & Atemasov, A. 2016. Effect of summer fire on cursorial spider (Aranei) and beetle (Coleoptera) assemblages in meadow steppes of Central European Russia. *Hacquetia* 15 (in press). [e-mail: polchaninova_n@ukr.net]

Two Special Features on grassland classification

Two further EDGG-edited Special Features are far developed and likely will be completed in 2016: Jointly with the *European Vegetation Survey* Working Group of IAVS, we are publishing a Virtual Special Feature of *Applied Vegetation Science* (impact factor 2014: 2.548; editors: Jürgen Dengler, Erwin Bergmeier, Wolfgang Willner & Milan Chytrý) on *Broad-scale classification of European Grasslands*. A follow-up Special Issue of *Phytocoenologia* (impact factor 2014: 1.742; editors: Monika Janišová, Jürgen Dengler & Wolfgang Willner) is devoted to *Classification of Palaearctic grasslands*.

Call for contributions to two new EDGG-edited Special Features

12th EDGG Grassland Special Feature in *Tuexenia:* Vegetation and conservation of grasslands in Central European s.l.

For the twelfth time EDGG organises a Grassland Special Feature in *Tuexenia* (http://www.tuexenia.de), a respected journal focussed on geobotany, vegetation ecology and related applied sciences. With a reasonable impact factor (2014: 1.516) and the open access publication, the journal provides an excellent opportunity for authors to present their studies to a wide scientific public. For the forthcoming Special Feature, entitled *Maintenance of grassland diversity – Conservation, management and restoration*, papers dealing with the conservation and management of semi-natural and natural grasslands of Central Europe and adjacent regions are especially welcome. We are also open for papers on grassland ecology, biodiversity and restoration (provided the focus is on vegetation and plants; purely zoological contributions cannot be considered). The main focus of the planned Special Feature is on studies about plant species and grassland habitats; however publication of complex studies dealing with the joint study of plant and animal taxa as well as vegetation surveys is also possible. **Abstracts for consideration should be submitted until 31 October 2016** to Thomas Becker (beckerth@unitrier.de) and Balázs Deák (debalazs@gmail.com). For authors who have already published in previous Grassland Special Features of *Tuexenia*, it is sufficient to send a preliminary title of their planned publication. Deadline for **submission of papers is 30 November 2016**, and intended publication is July 2016.

Preliminary Guest Editor Team:
Thomas Becker (DE) (Co-chair)
Balázs Deák (HU) (Co-chair)
Anikó Csecserits (HU)
Viktoria Wagner (CZ)

4th EDGG Special Issue in *Hacquetia* 2018: Fauna, flora, vegetation and conservation of Palaearctic natural and semi-natural grasslands

This is the first call for the submission of manuscripts for the EDGG-edited Special Feature in *Hacquetia* 2018. We welcome manuscripts about both natural and semi-natural grasslands, on all taxa and from any region in the Palaearctic realm (Europe; West, Central and North Asia; North Africa).

Hacquetia (http://www.degruyter.com/view/j/hacq) is the international journal of the Biological Branch of the Slovenian Academy of Sciences. It appears in two issues per year, both in print and online. Through offering longer articles, open access publication and free reproduction of colour figures, it is a very attractive publication venue. Currently it is indexed in the Scopus and BIOSIS literature databases, and it is likely to be included in the Web of Science in the near future (aided by our very international and high-quality Special Issues and your citations of these). Accepted papers will also benefit from complementary linguistic editing by a native speaker, courtesy of the Eurasian Dry Grassland Group.

This Special Issue will be the 4th EDGG-edited Special Issue in *Hacquetia*, following the three successful issues in 2014/1, 2015/1 and 2016/2. This Special Issue will appear as the first issue of 2018, to be published approximately in January 2018, with about 150–250 pages reserved for our articles. It will also contain a report on the EDGG activities of the previous year.

Procedure and deadlines: The **deadline for full-text submission is 28 February 2017** and manuscripts will undergo the normal peer-review process. If you are interested in contributing a manuscript for this comprehensive Special Issue, then please contact the Chair of the editorial team (see below) and submit your manuscript to her. Author guidelines can be found at the journal homepage: http://www.degruyter.com/view/j/hacq.

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Polyommatus bellargus. **(Photo: Didem Ambarlı)**

Author Guidelines for scientific articles in the Bulletin

Scope

The Bulletin of the EDGG publishes original papers (Research Articles, Reviews, Forum Articles, Reports) on all aspects related to natural and semi-natural grasslands of the Palaearctic realm, in particular: plants - animals - fungi - microbia - soils - taxonomy - phylogeography - ecophysiology - population biology - species' interactions - vegetation ecology - syntaxonomy - landscape ecology - biodiversity - land use history - agriculture - nature conservation - restoration - environmental legislation - environmental education. The EDGG Bulletin is characterised by open access, full colour, no article processing charges, no peer-review, i.e. basically all articles that are within the scope and meet the formal requirements below will be published and it is the responsibility of the authors alone to ensure scientific quality.

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Please submit the full manuscript as a single editable text file (MS Word or rtf). Figures and tables should be included together with their captions in the text.

Language

Manuscripts must be written in English language (either British or American throughout).

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The manuscript should be organised in a single continuous document, with a title page, followed by the body of text and the figures and tables directly in the text. Always consult a recent issue of the *Bulletin of the EDGG* for details on format, sequence of headings, citation style and arrangement of the manuscript (http://www.edgg.org/publications.htm) .

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Type: Indicate to which section and type of article (Research Article, Review, Forum Article, Reports) your manuscript should be assigned.

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Abstract: Up to 250 words, no references.

Keywords*:* There should be 6-12 singular keywords, including all relevant terms from the title, in alphabetical order and separated by semicolons, e.g.:

> *Agrostis*; biodiversity; conservation; gradient analysis; grassland; transect

Nomenclature*:* Refer to one (or few) source(s) for unified nomenclature of plant species or vegetation units, unless there are only few names and their authors are given in the text, e.g.:

> Miller (2001) for vascular plants, except Myers et al. (2003) for *Asteraceae*

Abbreviations*:* List and explain any abbreviations that are frequently used in the text, e.g.:

> DCA = Detrended Correspondence Analysis; ICPN = International Code of Phytosociological Nomenclature (Weber et al. 2000)

Main text: Up to three levels of unnumbered section headings are possible. The standard sequence of main sections in *Bulletin of the EDGG* is Introduction – Methods – Results – Discussion, but variation of this structure is acceptable when appropriate.

Author contribution*:* Required for any paper with more than one author, e.g.:

> A.B. planned the research, C.T.F. and Z.K. conducted the field sampling, B.C. performed the statistical analyses and led the writing, while all authors critically revised the manuscript.

Acknowledgements*:* Keep them brief. References to research projects/funds and institutional publication numbers can go here as well as mentioning of individuals who helped but did not make a significant scientific contribution that would warrant authorship.

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Text

Headings, subheadings, and exceptionally third-level headings should be written in regular font (not in capital letters), and their hierarchy must be clearly indicated. Avoid footnotes.

Units of measurement must follow the International System of Units (SI), e.g. mg m^{-2} yr^{-1}. Use words rather than symbols where possible, especially in the Title, Abstract and Keywords, e.g. 'beta' rather than 'β'. One-letter mathematical symbols (p, R^2, z) are given in italics as are any non-English expressions in the English text (*ad hoc*, *a posteriori*).

Numbers with units of measurement must be in digits, e.g. 3.5 g. Numbers in the text of up to ten items (i.e. integers) should be in words, e.g. "ten quadrats", "five sampling times"; above ten in digits, e.g. "11 sampling times". Use '.' (dot) for a decimal separator. Thousands in large numbers (ten thousand and higher) should be indicated by a comma, e.g. 10,000, but 2000.

Scientific names of taxa of any rank are to be given in italics (*Carex curvula* subsp. *curvula, Asteraceae*) and without authorities (the nomenclatural reference(s) should be indicated in the section “Nomenclature” below the Abstract). Formal syntaxon names of the Braun-Blanquet approach are also to be given in italics (*Caricetum curvulae, Querco-Fagetea*). Here the authorities and the year of publication should be presented at first mentioning (but not in the title or headings) or in a syntaxonomic overview unless one nomenclatural reference is used and followed throughout the manuscript.

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Use forms such as: Smith & Jones (2005) or (Smith & Jones 2005); for more than two authors: White et al. (2005); for combinations: (Smith et al. 2005a, 2005b; Jones 2006, 2010). Citations must be chronological by year, except where there is a list of years for the same author(s), e.g. (Zebedee 1950, 1970; Abraham 1960; Smith et al. 1965, 1974; Zebedee et al. 1969). Reference to articles and books should be limited to published work or work in press. Indicate all other material as "unpubl." or "pers. comm." (the latter with date and description of the type of knowledge, e.g. "local farmer"), or web-address (e.g. http://www.greenworld.info/global_redlist; accessed 20 November 2013).

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The References section can contain only material that is published (including “early online”/”PrePub” publications with a DOI) or is a thesis. For books that have been published as numbered volumes within a series, this fact can be indicated in square brackets after the book title (but without series editors); for technical reports issued by institutions, this fact can be indicated in square brackets after the publishing institution. For details, see examples below.

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Weber, H.E., Moravec, J. & Theurillat, J.-P. 2000. International Code of Phytosociological Nomenclature. 3rd edition. *Journal of Vegetation Science* 11: 739–768.

López-Sáez, J.A., Alba-Sánchez, F., Sánchez-Mata, D., Abel-Schaad, D., Gavilán, R.G. & Pérez-Díaz, S. in press. A palynological approach to the study of *Quercus pyrenaica* forest communities in the Spanish Central System. *Phytocoenologia*. DOI: 10.1127/0340-269X/2014/0044-0572.

Blackburn, T.M., Essl, F., Evans, T., Hulme, P.E., Jeschke, J.M., Kühn, I., Kumschick, S., Marková, Z., Mrugała, A., (…) & Bacher, S. 2014. A unified classification of alien species based on the magnitude of their environmental impacts. *PLoS Biology* 12: e1001850.

Ellenberg, H. & Leuschner, C. 2010. *Vegetation Mitteleuropas mit den Alpen in ökologischer, dynamischer und historischer Sicht*. 6th ed. Ulmer, Stuttgart, DE.

Whittaker, R.H. 1969. Evolution of diversity in plant communities. In: Woodwell, G.M. & Smith, H.N. (eds.) *Stability and diversity in ecological systems*, pp. 178–196. Brookhaven National Laboratory, Brookhaven, NY, US.

Whittaker, R.H. 1973. Approaches to classifying vegetation. In: Whittaker, R.H. (ed.) *Ordination and classification of communities* [Handbook of vegetation science 5], pp. 323–354. Junk, The Hague, NL.

Rodwell, J.S., Schaminée, J.H.J., Mucina, L., Pignatti, S., Dring, J. & Moss, D. 2002. *The diversity of European vegetation – An overview of phytosociological alliances and their relationships to EUNIS habitats*. National Reference Centre for Agriculture, Nature and Fisheries [Report no. EC-LNV 2002(054)], Wageningen, NL.

Wallin, G. 1973. *Lövskogsvegetation i Sjuhäradsbygden* [*Deciduous woodlands in Sjuhäradsbygden*]. Ph.D. thesis, Uppsala University, Uppsala, SE.

Euro+Med 2015. *The Euro+Med PlantBase - the information resource for Euro-Mediterranean plant diversity*. URL: http://ww2.bgbm.org/EuroPlusMed/ [accessed 7 December 2015].

Oksanen, J., Blanchet, F.G., Kindt, R., Legendre, P., Minchin, P.R., O’Hara, R.B., Simpson, G.L., Solymos, P., Stevens, M.H.H. & Wagner, H. 2015. *vegan: Community Ecology Package. R package version 2.3-2*. URL: http://cran.r-project.org/package=vegan [accessed 7 December 2015].

References in other languages than English

1. References in languages that use the Latin alphabet are cited in the original language. For languages other than French, German or Spanish, titles of papers, book chapters or books should be followed by an English translation in square brackets. Titles of the journals or books in the citations of book chapters are not translated. Example:

Mucina, L. 1985. Používať či nepoužívať Ellenbergove indikačné hodnoty? [To use or not to use Ellenberg's indicator values?]. *Biológia* 40: 511–516.

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Kholod, S.S. 2007. Klassifikatsiya rastitel´nosti ostrova Vrangelya [Classification of Wrangel Island vegetation]. *Rastitel'nost' Rossii* 11: 3–15. [In Russian.]

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Chiu, C.-A., Lin, H.-C., Liao, M.-C., Tseng, Y.-H., Ou, C.-H., Lu, K.-C. & Tzeng, H.-Y. 2008. A physiognomic classification scheme of potential vegetation of Taiwan. *Quarterly Journal of Forest Research* 30: 89–112. [In Chinese.]

Tables

Numerical results should be presented as either tables or figures, but not both. Table legends should be on the same page as the table to which they refer. The legend should contain sufficient information for the table to be understood without reference to the text of the paper. The first sentence of the legend should comprise a short title for the table. Units should appear in parentheses in the column headings, not in the body of the table. Vertical lines should be avoided. If some part of the table needs to be highlighted (e.g. groups of important species), use background shading (not framing or boldface). All cells with numeric values must be aligned at the decimal separator. For large tables with many empty cells, fill the empty cells with dots to facilitate reading. Tables should be planned in a way that they fit onto the size of the journal pages in readable size.

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Euphydryas orientalis. **(Photo: Didem Ambarlı)**

Research paper

Scale-dependent plant diversity in Palaearctic grasslands: a comparative overview

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Abstract: Here we present an extensive overview of plant diversity values in Palaearctic grasslands for seven standard grain sizes from 0.0001 to 100 m². The data originate from 20 studies, including the Field Workshops of the Eurasian Dry Grassland Group (EDGG), ranging geographically from Spain in the west to Siberia in the east, from Sicily in the south to Estonia in the north and from the sea coast up to 3100 m a.s.l. The majority of data is from dry grasslands (*Festuco-Brometea*, *Koelerio-Corynephoretea*, *Cleistogenetea squarrosae*), but there are also some mesic, wet, saline, acidic, alpine and Mediterranean grasslands included. Among others, we compiled data from 1795 1-m², 1109 10-m² and 338 100-m² plots. In all cases we present mean, minimum and maximum richness for the seven grain sizes, plus, in cases where also terricolous bryophytes and lichens had been recorded, the same values for total "plant" species richness, non-vascular plant species richness and fraction of non-vascular plants. The maximum richness values were 82, 101 and 134 for all "plants", and 79, 98 and 127 vascular plants at grain sizes of 1 m², 10 m² and 100 m², respectively (all in Transylvania, Romania). Our overview comprises new, hitherto unpublished world records of vascular plant species richness at the scales of 0.0001 m² (9) and 0.001 m² (19, both shoot presence), from meso-xeric, basiphilous grasslands in Navarre, Spain, which is much higher than the previously known maxima. The highest values of non-vascular plant richness at 1 m², 10 m² and 100 m², respectively, were 49, 64 and 64, respectively (all in *Sedo-Scleranthenea* communities of Öland, Sweden, and Saaremaa, Estonia). In general, the dry, alpine and Mediterranean grasslands were much richer than the studied mesic, wet or saline grasslands at any spatial scale. The presented set of mean, minimum and maximum values and their metadata is publically available and will be continuously updated. These data can serve as a reference of "normal" richness, both in fundamental and applied research. To facilitate the application, we provide an easy formula based on the power-law species-area relationship that allows the estimation of richness values at intermediate grain sizes not included in our dataset. In conclusion, our data emphasise the role of Palaearctic grasslands as global hotspot of small-scale vascular plant diversity, while at the same time highlighting that in some grassland types also the bryophyte and lichen diversity can be extraordinarily high.

Keywords: alpha diversity; biodiversity; bryophyte; Europe; lichen; Palaearctic biogeographic realm; scale dependence; semi-natural grassland; species-area relationship (SAR); species richness; steppe; world record.

Abbreviations: EDGG = Eurasian Dry Grassland Group; SAR = species-area relationship.

Introduction

Palaearctic semi-natural grasslands are known to host an extraordinarily high plant diversity (Kull & Zobel 1991; Hobohm 1998; Janišová et al. 2011; Michalcová et al. 2014). Some years ago, they were highlighted as world record holders for vascular plant species richness for nearly all grain sizes below 100 m² (Wilson et al. 2012). The call in this paper to beat the given maxima was to our knowledge so far not met by data from any other vegetation type worldwide, while a few slightly higher values have been reported from other Palaearctic semi-natural grasslands meanwhile (Chytrý et al. 2015; Kuzemko et al. 2016).

The reasons for this globally outstanding small-scale diversity are still under debate (Hájková et al. 2011; Merunková et al. 2012; Dengler et al. 2014; Michalcová et al. 2014; Roleček et al. 2014). However, basing the arguments only on single observations of maxima, as largely done in these papers, can provide circumstantial evidence for probable causes of extreme richness, but no statistical support for the assumed reasons. For this purpose, we would need data not only from the richest grassland types in one or a few places, but from many different regions and grassland types. Moreover, maxima alone are problematic because they essentially depend on sampling intensity, i.e. the more plots are analysed the more likely it is that one will find extreme richness values – in any region. Therefore, mean richness values would be more informative for many purposes.

Recent publications about extraordinary richness values largely focussed on semi-natural, semi-dry basiphilous grasslands. This ignores that there is at least some evidence that also natural Palaearctic steppes could be extremely rich at these grain sizes (e.g. Walter & Breckle 1986; Polyakova et al. 2016). Moreover, focussing solely on semi-dry basiphilous grasslands (order *Brometalia erecti* = *Brachypodietalia pinnati* within the class *Festuco-Brometea*), which so far provided most of the records (Wilson et al. 2012), ignores that also in other types of Palaearctic grasslands very high plant species richness can be found (e.g. Hobohm 1998; Chytrý et al. 2015). Last but not least, most recent papers on the diversity of Palaearctic grasslands studied patterns of vascular plant richness, but neglected the ones of bryophytes and lichens, an extremely diverse group in some grassland types (e.g. Dengler 2005; Boch & Dengler 2006; Löbel & Dengler 2008).

We thus conclude that it would be highly beneficial, both for basic research and biodiversity conservation, to have benchmarks of mean and maximum richness values of different grassland types throughout the Palaearctic realm at different spatial grain sizes. The wealth of phytosociological legacy data that is now available in large vegetation-plot databases (Chytrý et al. 2016; Dengler et al. 2016), can serve as a good basis for such an overview and subsequent analyses of underlying drivers. However, such phytosociological data are often biased by incomplete records and by the tendency of some researchers, particularly in the past, to increase plot sizes in

Fig. 1: ***Photos showing multi-scale plant diversity sampling in different Palaearctic grasslands: (a) 1st EDGG Research Expedition 2009 in Transylvania*** **(Photo: J. Dengler);** ***(b) 4th EDGG Research Expedition 2012 in Sicily*** **(Photo: J. Dengler);** ***(c) 6th EDGG Research Expedition 2013 in Khakassia*** **(Photo: M. Janišová);** ***(d) 7th EDGG Field Workshop 2014 in Navarre*** **(Photo: M. Janišová).**

naturally species-poor subtypes (e.g. Chytrý 2001). Therefore, we base the overview provided here on sampling schemes that were specifically devoted to study diversity patterns, i.e. where we assume that researchers precisely delimited the plots and very thoroughly sampled them in order not to overlook some species that occur only with few tiny non-flowering individuals, which can contribute significantly to a plot's species richness. Since species richness increases with plot size, our aim was to compile data for a wide range of different plot sizes, ranging from 1 cm² to 100 m². The overview provided here builds on previous compilations of some of the authors (Dengler 2005; Kuzemko et al. 2016). It is the so far most comprehensive reference database of such information, although we certainly missed many relevant datasets. We thus hope that this overview spurs others to contribute their already existing data for future updates or to collect new data with similar protocols in grassland types and regions that are still missing in our overview.

Methods

We aimed at collecting richness data from any type of natural and semi-natural grasslands of the Palaearctic realm. To ensure high-quality data, we only included sampling schemes that were devoted to studying biodiversity patterns, excluding typical phytosociological plots sampled for classification purposes only. To achieve comparability and to be able to report data in a condensed but still informative format, we chose seven standard plot sizes that are used in various standardised sampling schemes: 0.0001 m² − 0.001 m² − 0.01 m² − 0.1 m² − 1 m² − 10 m² − 100 m² (Peet et al. 1998; Dupré & Diekmann 2001; Dengler 2009b). These comprise some of the plot sizes most frequently used in vegetation science for different purposes, but through the "geometric scaling" also allow optimal assessment of species-area relationships and interpolation of richness data to other grain sizes (Dengler 2009a).

Generally we gave preference to data sources that studied more than one of the target grain sizes (usually with nested-plot design) and did so not only in one location and one grassland type but for a representative set of plots of a larger variety of grassland types in a region to allow the presentation of meaningful statistics. We appreciated if the sampling also included terricolous non-vascular plants (bryophytes, lichens and macro-"algae"), but accepted also richness data of vascular plants only. The majority of our data originates from the so-called Field Workshops (formerly Research Expeditions) of the Eurasian Dry Grassland Group (EDGG; http://www.edgg.org; see Vrahnakis et al. 2013; Fig. 1). They started in 2009 in Transylvania (Dengler et al. 2012a; Turtureanu et al. 2014), implementing a variant of the nested sampling design proposed by Dengler (2009b). Since then these events have been conducted on a more or less annual basis in various understudied regions of the Palaearctic realm (Vrahnakis et al. 2013; Fig. 2), originally focussing on dry grasslands (classes *Festuco-Brometea* and *Koelerio-*

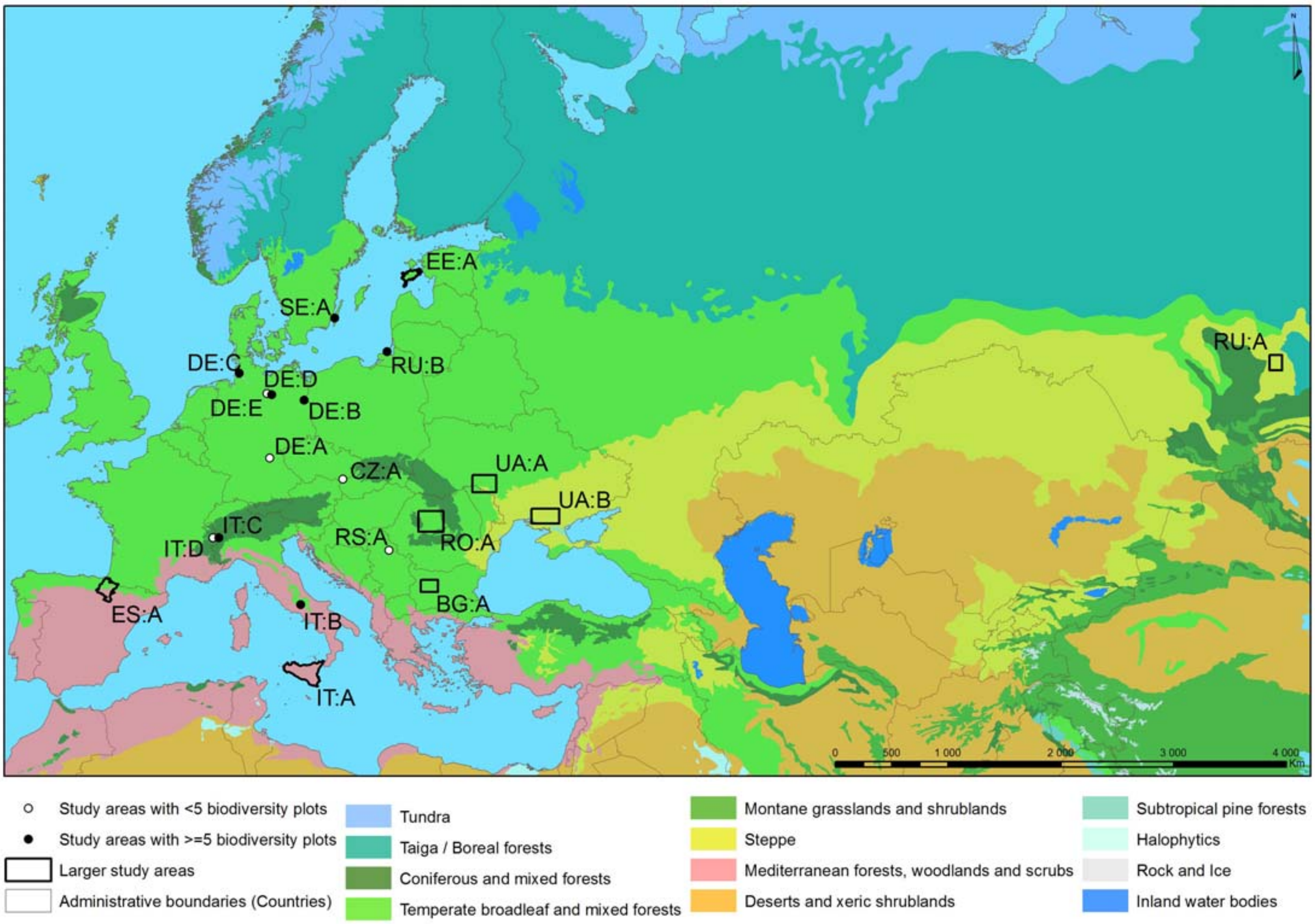

Fig. 2: ***Map showing the location of the 20 study areas of those studies evaluated for this paper. The site labels are those defined in Table 1. Open circles refer to smaller study areas with fewer than five big plots, closed circles to smaller study sites with five and more big plots, while rectangles and irregular polygons delimit larger study areas. The biome map in the background is based on Olson et al. (2001).***

Corynephoretea), but recently including more and more other grassland types, too. In addition, we included data from the co-authors, e.g. in the framework of academic theses or research projects, that were sampled with similar designs. Tables 1−2 and Fig. 2 provide an overview of the sources, qualities and spatial distribution of the compiled data. The majority of the underlying vegetation-plot data are stored in and available from the *Database Species-Area Relationships in Palaearctic Grasslands* (GIVD ID EU-00-003; Dengler et al. 2012b).

For all datasets, we extracted and present the information on country, region, vegetation type(s) and number of replicates that were used to derive minimum, maximum and mean values. We further present the statistics of vascular plant species richness for the seven standard grain sizes (0.0001−100 m²), as far as they were available in the individual studies. Data for 9 m² instead of 10 m², 0.09 m² instead of 0.1 m² or 0.0009 m² instead of 0.001 m² were also considered, but marked as such. Depending on the precise slope of the species-area relationship (SAR), plots with 9/10 of the area of a standard grain size are expected to have 1.6−3.1% species less. This range is based on *z*-values of 0.15 and 0.30 respectively, which are already outside the normal values for plot-scale SARs in Palaearctic grasslands (Dengler 2005: 0.193−0.249; Dengler & Boch 2008: 0.173−0.281), i.e. one can simply assume that 9 m² have 2% fewer species than 10 m². Another methodological variation concerns shoot presence vs. rooted presence sampling (Williamson 2003; Dengler 2008; Güler et al. 2016), which is indicated in Table 2. Shoot presence sampling was used in the EDGG expeditions and also most of the other included studies. In these studies, great effort was made to record shoot presence in vegetation that was not affected by the surveyor. Since rooted presence is easier to record, it is preferred in many other small-scale studies, but it has the disadvantage that it does not well reflect the number of interacting species at such small scales and it also poses problems on the analysis of SARs (see Dengler 2008). Rooted species richness is always smaller (or at maximum equal) to shoot presence, and the relative difference between both sampling methods increases towards small grain sizes very strongly (Williamson 2003; Güler et al. 2016).

For studies that included terricolous bryophytes, lichens and macro-"algae", we additionally report total species richness

Table 1: Region, ID, geographic origin, grassland types and sources of the included studies. The studies are grouped into broad geographic regions, and within these according to the ISO country codes. Syntaxa are given according to Mucina et al. (in press), except for the *Koelerio-Corynephoretea* s.l. that follow Dengler (2003). Usually, we provide the class or subclass names, but add order or alliance identity if only a single subunit occurring in the region was included. BR = Biosphere Reserve; NP = National Park; NR = Nature Reserve.

Region	ID	Country	Study area	Latitude (°)	Longitude (°)	Elevation (m a.s.l.)	Diameter of study region (km)	Main grassland type(s)	Main syntaxa	Reference(s)	Year(s) of sampling	No. of EDGG Field Workshop
Asia	RU:A	Russia	Khakassia: northern part	54.2-54-9 N	89.6-90.6 E	391-682	75	dry	*Festuco-Brometea, Cleistogenetea squarrosae*	Janišová et al. (2013), Polyakova et al. (2016)	2013	6
Central Europe	CZ:A	Czech Republic	White Carpathians: Čertoryje	48.8 N	17.4 E	380	0	dry	*Festuco-Brometea*	J. Dengler & K. Fajmon (unpubl.)	2008	-
Central Europe	DE:A	Germany	Upper Franconia: Bayreuth	49.9 N	11.6 E	388	0.02	dry	*Festuco-Brometea: Bromion erecti*	Hopp & Dengler (2015)	2015	-
Central Europe	DE:B	Germany	BR Schorfheide-Chorin: Gabow - Altglietzen	52.8 N	14.1 E	10-50	0.5	dry	*Koelerio-Corynephorenea, Festuco-Brometea*	Dengler et al. (2004)	2004	-
Central Europe	DE:C	Germany	Schleswig-Holstein Wadden Sea NP: southern part	53.9-54.2 N	8.8-9.1 E	0-3	25	saline, wet, mesic	*Juncetea maritimi, Spartinetea maritimae, Molinio-Arrhenatheretea, Phragmito-Magnocaricetea*	K. Jensen & J. Dengler (unpubl. A)	2010	-
Central Europe	DE:D	Germany	Middle Elbe BR: near Lenzen	53.0-53.1 N	11.4-11.6 E	16-20	4.5	mesic, wet	*Molinio-Arrhenatheretea, Phragmito-Magnocaricetea*	K. Jensen & J. Dengler (unpubl. B)	2009	-
Central Europe	DE:E	Germany	Middle Elbe BR: Höhbeck	53.1 N	11.4 E	17-19	1.3	dry	*Koelerio-Corynephorenea*	Schuhmacher & Dengler (2013)	2012	-
Central Europe	IT:C	Italy	Gran Paradiso NP: Valnontey - Col Lauson	45.6 N	7.3 E	1700-3100	3.5	alpine	*Festuco-Brometea, Elyno-Seslerietea, Juncetea trifidi, Molinio-Arrhenatheretea: Poo alpinae-Trisetetalia*	Baumann et al. (2016)	2014	-
Central Europe	IT:D	Italy	Aosta Valley: Cogne	45.6 N	7.4 E	1880	0.04	dry	*Festuco-Brometea*	Wiesner et al. (2015)	2014	-
East Europe	RU:B	Russia	Kaliningrad Oblast: Curonian Spit NP	54.9-55.2 N	20.5-20.9 E	1-35	48	dry, mesic	*Koelerio-Corynephorenea, Molinio-Arrhenatheretea*	Dolnik (2003)	2000	-
East Europe	UA:A	Ukraine	Central Podolia	48.1-49.0 N	27.5-29.4 E	73-251	155	dry	*Festuco-Brometea, Koelerio-Corynephorenea, Sedo-Scleranthenea*	Kuzemko et al. (2014, 2016)	2010	2
East Europe	UA:B	Ukraine	Kherson region	46.4-47.2 N	32.2-34.4 E	17-87	170	dry	*Festuco-Brometea*	Dembicz et al. (2016)	2012-2013	-
North Europe	EE:A	Estonia	Saaremaa	57.8-58.6 N	21.7-23.4 E	1-54	80	dry	*Festuco-Brometea, Koelerio-Corynephorenea, Sedo-Scleranthenea*	Boch (2005), Boch & Dengler (2006), Dengler & Boch (2008)	2004	-
North Europe	SE:A	Sweden	Öland: southern part	56.4-56.7 N	16.3-16.7 E	1-40	30	dry	*Festuco-Brometea, Sedo-Scleranthenea*	Löbel (2002), Löbel & Dengler (2008)	2001	-
South Europe	ES:A	Spain	Navarre	42.7-42.9 N	0.7-2.1 W	581-1795	120	Mediterranean, dry, alpine	*Festuco-Brometea, Lygeo sparti-Stipetea tenacisssimae, Festuco hystricis-Ononidetea striatae, Sedo-Scleranthenea, Elyno-Seslerietea, Juncetea trifidi, Molinio-Arrhenatheretea: Arrhenatheretalia elatioris*	Biurrun et al. (2014)	2014	7
South Europe	IT:A	Italy	Sicily	37.0-38.3 N	12.4-15.2 E	4-1200	240	Mediterranean	*Lygeo sparti-Stipetea tenacissimae, Helianthemetea guttati, Stipo-Trachynietea distachyae, Chenopodietea: Brometalia rubenti-tectorum, Poetea bulbosae, Ammophiletea*	Guarino et al. (2012)	2012	4
South Europe	IT:B	Italy	Abruzzo NP	41.7-41.9 N	13.7-13.9 E	1100-1900	22	dry	*Festuco-Brometea*	L. Cancellieri & G. Filibeck (unpubl.)	2013-2015	-
Southeast Europe	BG:A	Bulgaria	NW Bulgarian mountains	42.5-43.2 N	23.4-24.7 E	633-1460	125	dry	*Festuco-Brometea, Koelerio-Corynephorenea, Sedo-Scleranthenea, Nardetea strictae*	Pedashenko et al. (2013)	2011	3
Southeast Europe	RO:A	Romania	Transylvania	45.9-47.1 N	23.2-25.2 E	321-670	180	dry	*Festuco-Brometea*	Dengler et al. (2012a), Turtureanu et al. (2014)	2009	1
Southeast Europe	RS:A	Serbia	Vojvodina: NR Deliblatska Peščara	44.9 N	21.1 E	142	0.02	dry	*Koelerio-Corynephorenea: Festucion vaginatae*	Krstivojević Ćuk et al. (2015)	2015	-

Table 2: Region, ID, methodological peculiarities and number of replicates per grain size. The studies are grouped into broad geographic regions, and within these according to the ISO country codes.

Region	ID	Country	Study area	Recording method	Terricolous cryptogams included	9 instead of 10	0.0001 m²	0.001 m²	0.01 m²	0.1 m²	1 m²	10 m² (biodiversity)	10 m² (all)	100 m²
Asia	RU:A	Russia	Khakassia: northern part	shoot	yes	no	78	78	78	78	78	78	132	39
Central Europe	CZ:A	Czech Republic	White Carpathians: Čertoryje	rooted	yes	yes	1	1	1	1	1	1	1	1
Central Europe	DE:A	Germany	Upper Franconia: Bayreuth	shoot	yes	no	2	2	2	2	2	2	2	1
Central Europe	DE:B	Germany	BR Schorfheide-Chorin: Gabow - Altglietzen	shoot	yes*	yes	245	245	50	50	50	50	50	10
Central Europe	DE:C	Germany	Schleswig-Holstein Wadden Sea NP: southern part	shoot	no	no	-	118	118	118	118	118	118	55
Central Europe	DE:D	Germany	Middle Elbe BR: near Lenzen	shoot	no	no	-	-	54	54	54	54	54	27
Central Europe	DE:E	Germany	Middle Elbe BR: Höhbeck	shoot	yes	no	-	-	-	-	27	-	-	4
Central Europe	IT:C	Italy	Gran Paradiso NP: Valnontey - Col Lauson	shoot	no	no	26	26	26	26	26	26	26	13
Central Europe	IT:D	Italy	Aosta Valley: Cogne	shoot	no	no	4	4	4	4	4	4	4	2
East Europe	RU:B	Russia	Kaliningrad Oblast: Curonian Spit NP	rooted	yes	yes	17	17	17	17	17	17	17	17
East Europe	UA:A	Ukraine	Central Podolia	shoot	yes	no	42	42	42	42	42	42	226	21
East Europe	UA:B	Ukraine	Kherson region	shoot	no	no	-	-	-	-	1000	-	-	40
North Europe	EE:A	Estonia	Saaremaa	shoot	yes	yes	80	80	80	80	80	80	80	16
North Europe	SE:A	Sweden	Öland: southern part	rooted	yes	yes	31	31	31	31	31	31	31	NA
South Europe	ES:A	Spain	Navarre	shoot	yes**	no	70	70	70	70	70	70	119	35
South Europe	IT:A	Italy	Sicily	shoot	yes	no	42	42	42	42	42	42	67	21
South Europe	IT:B	Italy	Abruzzo NP	shoot	no	no	-	-	324	162	81	-	-	-
Southeast Europe	BG:A	Bulgaria	NW Bulgarian mountains	shoot	yes	no	30	30	30	30	30	30	98	15
Southeast Europe	RO:A	Romania	Transylvania	shoot	yes	no	40	40	40	40	40	40	82	20
Southeast Europe	RS:A	Serbia	Vojvodina: NR Deliblatska Peščara	shoot	yes	no	2	2	2	2	2	2	2	1
Total							**710**	**828**	**1011**	**849**	**1795**	**687**	**1109**	**338**

* also non-terricolous taxa included, but their fraction is negligible
** preliminary data, i.e. number of non-vascular plants, total richness and fraction of non-vascular plants will slightly change in the final version, mostly to the positive

Table 3: Mean, minimum and maximum values of vascular plant species richness on the seven "standard grain sizes" found in different studies throughout the Palaearctic realm. For details on the studies, see Tables 1 and 2. For comparison, we added the maxima given by Wilson et al. (2012) and Chytrý et al. (2015) for Palaearctic grasslands and for any vegetation type world-wide. Studies with fewer than five plots of the biggest size are in italics because they can hardly be representative. Maxima of mean and maximum richness at the different grain sizes are highlighted in red and bold; if such a value is from an "italicised" line, the highest value from a more representative study is set in red.

Region	ID	Country	Study area	rooted instead of shoot	9 instead of 10	Statistics	0.0001 m^2	0.001 m^2	0.01 m^2	0.1 m^2	1 m^2	10 m^2 (biodiversity)	10 m^2 (all)	100 m^2
Asia	RU:A	Russia	Khakassia: northern part			Mean	2.1	4.0	8.2	17.3	29.7	45.1	43.9	65.3
Central Europe	CZ:A	Czech Republic	White Carpathians: Čertoryje	#	#	Mean	2.0	4.0	11.0	**31.0**	**58.0**	**79.0**	**79.0**	**105.0**
Central Europe	DE:A	Germany	Upper Franconia: Bayreuth			Mean	**4.0**	**6.5**	**14.0**	25.0	37.0	47.5	47.5	65.0
Central Europe	DE:B	Germany	BR Schorfheide-Chorin: Gabow - Altglietzen		#	Mean	1.6	2.3	4.2	7.5	12.4	19.8	19.8	35.4
Central Europe	DE:C	Germany	Schleswig-Holstein Wadden Sea NP: southern part			Mean	NA	1.7	2.2	3.0	3.9	6.0	6.0	8.3
Central Europe	DE:D	Germany	Middle Elbe BR: near Lenzen			Mean	NA	NA	3.5	5.9	9.6	15.6	15.6	26.2
Central Europe	DE:E	Germany	Middle Elbe BR: Höhbeck			Mean	NA	NA	NA	NA	10.0	NA	NA	26.3
Central Europe	IT:C	Italy	Gran Paradiso NP: Valnontey - Col Lauson			Mean	2.1	3.7	6.2	12.2	18.7	28.0	28.0	43.5
Central Europe	IT:D	Italy	Aosta Valley: Cogne			Mean	2.3	3.8	5.5	7.5	16.3	27.8	27.8	45.5
East Europe	RU:B	Russia	Kaliningrad Oblast: Curonian Spit NP	#	#	Mean	0.8	NA	7.1	NA	19.4	27.1	27.1	35.7
East Europe	UA:A	Ukraine	Central Podolia			Mean	2.5	4.0	7.3	13.8	24.4	39.3	37.2	66.8
East Europe	UA:B	Ukraine	Kherson region			Mean	NA	NA	NA	NA	12.5	NA	NA	45.1
North Europe	EE:A	Estonia	Saaremaa		#	Mean	1.5	2.7	5.0	9.1	15.7	24.0	24.0	38.6
North Europe	SE:A	Sweden	Öland: southern part	#	#	Mean	0.4	1.8	4.6	8.7	15.1	24.2	24.2	NA
South Europe	ES:A	Spain	Navarre			Mean	3.3	5.7	9.7	17.2	28.0	43.0	41.9	64.9
South Europe	IT:A	Italy	Sicily			Mean	1.7	3.2	6.4	12.8	21.0	33.8	35.4	55.4
South Europe	IT:B	Italy	Abruzzo NP			Mean	NA	NA	9.9	18.3	29.0	NA	NA	NA
Southeast Europe	BG:A	Bulgaria	NW Bulgarian mountains			Mean	2.3	3.9	7.6	13.3	22.8	34.7	34.1	56.7
Southeast Europe	RO:A	Romania	Transylvania			Mean	2.3	4.2	9.6	21.1	37.5	57.2	49.7	83.3
Southeast Europe	RS:A	Serbia	Vojvodina: NR Deliblatska Peščara			Mean	0.5	1.0	4.0	12.0	18.5	25.0	25.0	35.0
Asia	RU:A	Russia	Khakassia: northern part			Min	0	0	2	7	15	22	22	35
Central Europe	CZ:A	Czech Republic	White Carpathians: Čertoryje	#	#	Min	2	4	11	31	58	79	79	105
Central Europe	DE:A	Germany	Upper Franconia: Bayreuth			Min	4	4	9	19	31	40	40	65
Central Europe	DE:B	Germany	BR Schorfheide-Chorin: Gabow - Altglietzen		#	Min	0	0	1	2	2	4	4	9
Central Europe	DE:C	Germany	Schleswig-Holstein Wadden Sea NP: southern part			Min	NA	0	0	0	0	1	1	1
Central Europe	DE:D	Germany	Middle Elbe BR: near Lenzen			Min	NA	NA	1	1	2	4	4	9
Central Europe	DE:E	Germany	Middle Elbe BR: Höhbeck			Min	NA	NA	NA	NA	3	NA	NA	22
Central Europe	IT:C	Italy	Gran Paradiso NP: Valnontey - Col Lauson			Min	0	0	1	1	4	9	9	17
Central Europe	IT:D	Italy	Aosta Valley: Cogne			Min	1	2	4	6	9	19	19	39
East Europe	RU:B	Russia	Kaliningrad Oblast: Curonian Spit NP	#	#	Min	0	NA	1	NA	4	7	7	9
East Europe	UA:A	Ukraine	Central Podolia			Min	0	0	3	6	13	26	14	42
East Europe	UA:B	Ukraine	Kherson region			Min	NA	NA	NA	NA	2	NA	NA	21
North Europe	EE:A	Estonia	Saaremaa		#	Min	0	0	0	0	1	3	3	9
North Europe	SE:A	Sweden	Öland: southern part	#	#	Min	0	0	1	3	7	11	11	NA
South Europe	ES:A	Spain	Navarre			Min	0	0	0	2	10	18	18	37
South Europe	IT:A	Italy	Sicily			Min	0	0	0	1	5	9	9	13
South Europe	IT:B	Italy	Abruzzo NP			Min	NA	NA	0	8	17	NA	NA	NA
Southeast Europe	BG:A	Bulgaria	NW Bulgarian mountains			Min	1	1	1	3	7	15	8	38
Southeast Europe	RO:A	Romania	Transylvania			Min	0	0	3	7	16	33	9	52
Southeast Europe	RS:A	Serbia	Vojvodina: NR Deliblatska Peščara			Min	0	0	2	12	17	24	24	35
Asia	RU:A	Russia	Khakassia: northern part			Max	5	9	17	28	52	72	72	94
Central Europe	CZ:A	Czech Republic	White Carpathians: Čertoryje	#	#	Max	2	4	11	31	58	79	79	105
Central Europe	DE:A	Germany	Upper Franconia: Bayreuth			Max	4	9	19	31	43	55	55	65
Central Europe	DE:B	Germany	BR Schorfheide-Chorin: Gabow - Altglietzen		#	Max	5	6	9	15	22	36	36	55
Central Europe	DE:C	Germany	Schleswig-Holstein Wadden Sea NP: southern part			Max	NA	5	8	11	13	17	17	20
Central Europe	DE:D	Germany	Middle Elbe BR: near Lenzen			Max	NA	NA	8	15	19	34	34	48
Central Europe	DE:E	Germany	Middle Elbe BR: Höhbeck			Max	NA	NA	NA	NA	17	NA	NA	34
Central Europe	IT:C	Italy	Gran Paradiso NP: Valnontey - Col Lauson			Max	5	6	12	23	29	42	42	65
Central Europe	IT:D	Italy	Aosta Valley: Cogne			Max	4	6	7	9	23	35	35	52
East Europe	RU:B	Russia	Kaliningrad Oblast: Curonian Spit NP	#	#	Max	4	NA	15	NA	40	61	61	71
East Europe	UA:A	Ukraine	Central Podolia			Max	7	11	13	21	42	56	64	86
East Europe	UA:B	Ukraine	Kherson region			Max	NA	NA	NA	NA	28	NA	NA	73
North Europe	EE:A	Estonia	Saaremaa		#	Max	5	7	14	25	35	49	49	70
North Europe	SE:A	Sweden	Öland: southern part	#	#	Max	2	5	11	20	28	42	42	NA
South Europe	ES:A	Spain	Navarre			Max	**9**	**19**	23	34	50	82	82	104
South Europe	IT:A	Italy	Sicily			Max	4	9	14	27	39	68	68	98
South Europe	IT:B	Italy	Abruzzo NP			Max	NA	NA	20	31	47	NA	NA	NA
Southeast Europe	BG:A	Bulgaria	NW Bulgarian mountains			Max	6	9	14	25	36	58	60	87
Southeast Europe	RO:A	Romania	Transylvania			Max	5	8	18	**43**	79	**98**	**98**	127
Southeast Europe	RS:A	Serbia	Vojvodina: NR Deliblatska Peščara			Max	1	2	6	12	20	26	26	35
Old Palaearctic grassland record			Multiple			Max	5	12	**25**	43	**82**	98	98	**133**
Old world record			Multiple			Max	5	12	25	43	89	98	98	233

Table 4: Mean, minimum and maximum values of total plant species richness on the seven "standard grain sizes" found in different studies throughout the Palaearctic realm. For details on the studies, see Tables 1 and 2. Studies with fewer than five plots of the biggest size are in italics because they can hardly be representative. Maxima of mean and maximum richness at the different grain sizes are highlighted in red and bold; if such a value is from an "italicised" line, the highest value from a more representative study is set in red.

Region	ID	Country	Study area	rooted instead of shoot	9 instead of 10	Statistics	0.0001 m²	0.001 m²	0.01 m²	0.1 m²	1 m²	10 m² (biodiversity)	10 m² (all)	100 m²
Asia	RU:A	Russia	Khakassia: northern part			Mean	2.3	4.7	9.6	19.7	33.3	50.0	50.7	73.4
Central Europe	*CZ:A*	*Czech Republic*	*White Carpathians: Čertoryje*	#	#	*Mean*	*4.0*	*6.0*	*14.0*	***34.0***	***65.0***	***88.0***	***88.0***	***117.0***
Central Europe	*DE:A*	*Germany*	*Upper Franconia: Bayreuth*			*Mean*	***7.0***	***10.0***	***20.0***	*31.5*	*45.0*	*55.5*	*55.5*	*77.0*
Central Europe	DE:B	Germany	BR Schorfheide-Chorin: Gabow - Altglietzen		#	Mean	2.3	3.4	6.5	11.1	17.9	27.5	27.5	50.2
Central Europe	*DE:E*	*Germany*	*Middle Elbe BR: Höhbeck*			*Mean*	*NA*	*NA*	*NA*	*NA*	*13.9*	*NA*	*NA*	*33.5*
East Europe	RU:B	Russia	Kaliningrad Oblast: Curonian Spit NP	#	#	Mean	2.2	NA	11.2	NA	29.1	40.9	40.9	56.0
East Europe	UA:A	Ukraine	Central Podolia			Mean	2.9	4.7	8.5	15.9	27.2	43.7	41.1	73.6
North Europe	EE:A	Estonia	Saaremaa		#	Mean	3.2	5.9	10.5	17.2	28.0	42.2	42.2	69.2
North Europe	SE:A	Sweden	Öland: southern part	#	#	Mean	1.1	4.4	12.6	24.5	40.4	56.4	56.4	NA
South Europe	ES:A	Spain	Navarre			Mean	4.0	6.8	11.5	20.5	32.6	47.9	49.8	79.9
South Europe	IT:A	Italy	Sicily			Mean	2.1	3.9	7.6	15.4	25.1	40.5	42.4	67.2
Southeast Europe	BG:A	Bulgaria	NW Bulgarian mountains			Mean	2.7	3.9	8.5	14.8	25.5	39.5	38.5	65.3
Southeast Europe	RO:A	Romania	Transylvania			Mean	2.6	4.6	10.2	22.8	40.0	60.5	52.8	88.2
Southeast Europe	*RS:A*	*Serbia*	*Vojvodina: NR Deliblatska Peščara*			*Mean*	*2.5*	*3.0*	*6.0*	*14.0*	*21.0*	*27.5*	*27.5*	*38.0*
Asia	RU:A	Russia	Khakassia: northern part			Min	0	1	2	7	17	30	28	46
Central Europe	*CZ:A*	*Czech Republic*	*White Carpathians: Čertoryje*	#	#	*Min*	*4*	*6*	*14*	*34*	*65*	*88*	*88*	*117*
Central Europe	*DE:A*	*Germany*	*Upper Franconia: Bayreuth*			*Min*	*7*	*8*	*14*	*25*	*39*	*48*	*48*	*77*
Central Europe	DE:B	Germany	BR Schorfheide-Chorin: Gabow - Altglietzen		#	Min	0	0	1	5	7	10	10	19
Central Europe	*DE:E*	*Germany*	*Middle Elbe BR: Höhbeck*			*Min*	*NA*	*NA*	*NA*	*NA*	*7*	*NA*	*NA*	*29*
East Europe	RU:B	Russia	Kaliningrad Oblast: Curonian Spit NP	#	#	Min	0	NA	2	NA	6	13	13	33
East Europe	UA:A	Ukraine	Central Podolia			Min	0	2	3	6	13	27	15	47
North Europe	EE:A	Estonia	Saaremaa		#	Min	0	1	3	6	9	17	17	34
North Europe	SE:A	Sweden	Öland: southern part	#	#	Min	0	0	3	6	10	26	26	NA
South Europe	ES:A	Spain	Navarre			Min	0	0	0	4	12	19	19	48
South Europe	IT:A	Italy	Sicily			Min	0	0	0	1	5	9	9	13
Southeast Europe	BG:A	Bulgaria	NW Bulgarian mountains			Min	1	1	1	3	7	15	10	47
Southeast Europe	RO:A	Romania	Transylvania			Min	0	0	3	7	18	37	9	58
Southeast Europe	*RS:A*	*Serbia*	*Vojvodina: NR Deliblatska Peščara*			*Min*	*2*	*2*	*4*	*14*	*19*	*26*	*26*	*38*
Asia	RU:A	Russia	Khakassia: northern part			Max	5	11	18	34	54	80	80	106
Central Europe	*CZ:A*	*Czech Republic*	*White Carpathians: Čertoryje*	#	#	*Max*	*4*	*6*	*14*	*34*	*65*	*88*	*88*	*117*
Central Europe	*DE:A*	*Germany*	*Upper Franconia: Bayreuth*			*Max*	*7*	*12*	***26***	*38*	*51*	*63*	*63*	*77*
Central Europe	DE:B	Germany	BR Schorfheide-Chorin: Gabow - Altglietzen		#	Max	6	8	11	18	25	41	41	69
Central Europe	*DE:E*	*Germany*	*Middle Elbe BR: Höhbeck*			*Max*	*NA*	*NA*	*NA*	*NA*	*21*	*NA*	*NA*	*41*
East Europe	RU:B	Russia	Kaliningrad Oblast: Curonian Spit NP	#	#	Max	4	NA	22	NA	50	70	70	75
East Europe	UA:A	Ukraine	Central Podolia			Max	7	11	14	26	48	62	67	108
North Europe	EE:A	Estonia	Saaremaa		#	Max	8	13	22	32	49	72	72	100
North Europe	SE:A	Sweden	Öland: southern part	#	#	Max	4	11	25	43	63	81	81	NA
South Europe	ES:A	Spain	Navarre			Max	**9**	**19**	**26**	43	64	98	98	132
South Europe	IT:A	Italy	Sicily			Max	8	15	22	35	50	72	72	124
Southeast Europe	BG:A	Bulgaria	NW Bulgarian mountains			Max	6	9	17	28	41	61	62	89
Southeast Europe	RO:A	Romania	Transylvania			Max	5	9	20	**45**	**82**	**101**	**101**	**134**
Southeast Europe	*RS:A*	*Serbia*	*Vojvodina: NR Deliblatska Peščara*			*Max*	*3*	*4*	*8*	*14*	*23*	*29*	*29*	*38*

Table 5: Mean, minimum and maximum values of non-vascular plant species richness (i.e. terricolous bryophytes, lichens and macro-"algae") on the seven "standard grain sizes" found in different studies throughout the Palaearctic realm. For details on the studies, see Tables 1 and 2. Studies with fewer than five plots of the biggest size are in italics because they can hardly be representative. Maxima of mean and maximum richness at the different grain sizes are highlighted in red and bold; if such a value is from an "italicised" line, the highest value from a more representative study is set in red.

Region	ID	Country	Study area	rooted instead of shoot	9 instead of 10	Statistics	0.0001 m²	0.001 m²	0.01 m²	0.1 m²	1 m²	10 m² (biodiversity)	10 m² (all)	100 m²
Asia	RU:A	Russia	Khakassia: northern part			Mean	0.2	0.6	1.5	2.4	3.5	4.8	4.6	8.2
Central Europe	*CZ:A*	*Czech Republic*	*White Carpathians: Čertoryje*	#	#	*Mean*	*2.0*	*2.0*	*3.0*	*3.0*	*7.0*	*9.0*	*9.0*	*12.0*
Central Europe	*DE:A*	*Germany*	*Upper Franconia: Bayreuth*			*Mean*	***3.0***	***3.5***	*6.0*	*6.5*	*8.0*	*8.0*	*8.0*	*12.0*
Central Europe	DE:B	Germany	BR Schorfheide-Chorin: Gabow - Altglietzen		#	Mean	0.7	1.1	2.2	3.6	5.5	7.7	7.7	14.8
Central Europe	*DE:E*	*Germany*	*Middle Elbe BR: Höhbeck*			*Mean*	*NA*	*NA*	*NA*	*NA*	*3.9*	*NA*	*NA*	*7.3*
East Europe	RU:B	Russia	Kaliningrad Oblast: Curonian Spit NP	#	#	Mean	1.4	NA	4.2	NA	9.8	13.8	13.8	20.3
East Europe	UA:A	Ukraine	Central Podolia			Mean	0.4	0.6	1.2	2.1	2.8	4.4	3.9	6.8
North Europe	EE:A	Estonia	Saaremaa		#	Mean	1.7	3.1	5.5	8.1	12.3	18.2	18.2	30.6
North Europe	SE:A	Sweden	Öland: southern part	#	#	Mean	0.7	2.6	**7.9**	**15.6**	**25.0**	**32.0**	**32.0**	**NA**
South Europe	ES:A	Spain	Navarre			Mean	0.7	1.1	1.8	3.1	4.6	5.8	6.5	13.3
South Europe	IT:A	Italy	Sicily			Mean	0.4	0.7	1.2	2.6	4.0	6.7	7.0	11.8
Southeast Europe	BG:A	Bulgaria	NW Bulgarian mountains			Mean	0.4	0.5	0.9	1.4	2.7	4.8	4.4	8.5
Southeast Europe	RO:A	Romania	Transylvania			Mean	0.2	0.4	0.6	1.7	2.6	3.3	3.1	4.9
Southeast Europe	*RS:A*	*Serbia*	*Vojvodina: NR Deliblatska Peščara*			*Mean*	*2.0*	*2.0*	*2.0*	*2.0*	*2.5*	*2.5*	*2.5*	*3.0*
Asia	RU:A	Russia	Khakassia: northern part			Min	0	0	0	0	0	0	0	0
Central Europe	*CZ:A*	*Czech Republic*	*White Carpathians: Čertoryje*	#	#	*Min*	*2*	*2*	*3*	*3*	*7*	*9*	*9*	*12*
Central Europe	*DE:A*	*Germany*	*Upper Franconia: Bayreuth*			*Min*	*3*	*3*	*5*	*6*	*8*	*8*	*8*	*12*
Central Europe	DE:B	Germany	BR Schorfheide-Chorin: Gabow - Altglietzen		#	Min	0	0	0	0	1	3	3	10
Central Europe	*DE:E*	*Germany*	*Middle Elbe BR: Höhbeck*			*Min*	*NA*	*NA*	*NA*	*NA*	*1*	*NA*	*NA*	*5*
East Europe	RU:B	Russia	Kaliningrad Oblast: Curonian Spit NP	#	#	Min	0	NA	0	NA	0	3	3	3
East Europe	UA:A	Ukraine	Central Podolia			Min	0	0	0	0	0	0	0	1
North Europe	EE:A	Estonia	Saaremaa		#	Min	0	0	1	2	4	5	5	13
North Europe	SE:A	Sweden	Öland: southern part	#	#	Min	0	0	0	0	1	10	10	NA
South Europe	ES:A	Spain	Navarre			Min	0	0	0	0	0	0	0	1
South Europe	IT:A	Italy	Sicily			Min	0	0	0	0	0	0	0	0
Southeast Europe	BG:A	Bulgaria	NW Bulgarian mountains			Min	0	0	0	0	0	0	0	2
Southeast Europe	RO:A	Romania	Transylvania			Min	0	0	0	0	0	1	0	2
Southeast Europe	*RS:A*	*Serbia*	*Vojvodina: NR Deliblatska Peščara*			*Min*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*3*
Asia	RU:A	Russia	Khakassia: northern part			Max	3	6	8	14	14	22	22	26
Central Europe	*CZ:A*	*Czech Republic*	*White Carpathians: Čertoryje*	#	#	*Max*	*2*	*2*	*3*	*3*	*7*	*9*	*9*	*12*
Central Europe	*DE:A*	*Germany*	*Upper Franconia: Bayreuth*			*Max*	*3*	*4*	*7*	*7*	*8*	*8*	*8*	*12*
Central Europe	DE:B	Germany	BR Schorfheide-Chorin: Gabow - Altglietzen		#	Max	3	4	9	12	14	17	17	26
Central Europe	*DE:E*	*Germany*	*Middle Elbe BR: Höhbeck*			*Max*	*NA*	*NA*	*NA*	*NA*	*8*	*NA*	*NA*	*10*
East Europe	RU:B	Russia	Kaliningrad Oblast: Curonian Spit NP	#	#	Max	4	NA	9	NA	19	26	26	35
East Europe	UA:A	Ukraine	Central Podolia			Max	3	3	5	6	9	16	20	28
North Europe	EE:A	Estonia	Saaremaa		#	Max	**8**	10	17	24	29	45	45	**64**
North Europe	SE:A	Sweden	Öland: southern part	#	#	Max	3	**11**	**22**	**30**	**49**	**64**	**64**	**NA**
South Europe	ES:A	Spain	Navarre			Max	4	7	7	13	14	21	21	27
South Europe	IT:A	Italy	Sicily			Max	5	8	9	10	13	21	21	33
Southeast Europe	BG:A	Bulgaria	NW Bulgarian mountains			Max	3	4	5	6	7	19	19	19
Southeast Europe	RO:A	Romania	Transylvania			Max	1	2	2	6	7	10	13	18
Southeast Europe	*RS:A*	*Serbia*	*Vojvodina: NR Deliblatska Peščara*			*Max*	*2*	*2*	*2*	*2*	*3*	*3*	*3*	*3*

Table 6: Mean, minimum and maximum values of fraction of non-vascular plant species (i.e. terricolous bryophytes, lichens and macro-"algae") on the seven "standard grain sizes" found in different studies throughout the Palaearctic realm. For details on the studies, see Tables 1 and 2. Studies with fewer than five plots of the biggest size are in italics because they can hardly be representative. Extreme values of means are highlighted in blue (minima) and red (maxima).

Region	ID	Country	Study area	rooted instead of shoot	9 instead of 10	Statistics	0.0001 m^2	0.001 m^2	0.01 m^2	0.1 m^2	1 m^2	10 m^2 (biodiversity)	10 m^2 (all)	100 m^2
Asia	RU:A	Russia	Khakassia: northern part			Mean	**6.0%**	11.2%	12.9%	10.9%	10.2%	9.6%	8.9%	11.0%
Central Europe	*CZ:A*	*Czech Republic*	*White Carpathians: Čertoryje*	#	#	*Mean*	*50.0%*	*33.3%*	*21.4%*	*8.8%*	*10.8%*	*10.2%*	*10.2%*	*10.3%*
Central Europe	*DE:A*	*Germany*	*Upper Franconia: Bayreuth*			*Mean*	*42.9%*	*37.5%*	*31.3%*	*21.2%*	*18.1%*	*14.7%*	*14.7%*	*15.6%*
Central Europe	DE:B	Germany	BR Schorfheide-Chorin: Gabow - Altglietzen		#	Mean	29.3%	33.9%	34.3%	33.9%	33.2%	30.7%	30.7%	32.1%
Central Europe	*DE:E*	*Germany*	*Middle Elbe BR: Höhbeck*			*Mean*	*NA*	*NA*	*NA*	*NA*	*28.9%*	*NA*	*NA*	*21.8%*
East Europe	RU:B	Russia	Kaliningrad Oblast: Curonian Spit NP	#	#	Mean	35.0%	NA	37.0%	NA	34.0%	34.0%	34.0%	36.0%
East Europe	UA:A	Ukraine	Central Podolia			Mean	15.3%	14.8%	14.1%	12.3%	10.0%	9.7%	9.3%	8.8%
North Europe	EE:A	Estonia	Saaremaa		#	Mean	56.8%	54.9%	53.4%	49.1%	46.7%	45.9%	45.9%	**46.9%**
North Europe	SE:A	Sweden	Öland: southern part	#	#	Mean	68.2%	55.0%	**56.4%**	**59.5%**	**58.3%**	**54.9%**	**54.9%**	NA
South Europe	ES:A	Spain	Navarre			Mean	18.0%	16.8%	15.9%	15.3%	14.6%	12.0%	13.0%	16.5%
South Europe	IT:A	Italy	Sicily			Mean	10.5%	10.0%	8.9%	12.3%	13.9%	15.2%	15.3%	15.8%
Southeast Europe	BG:A	Bulgaria	NW Bulgarian mountains			Mean	12.5%	12.4%	10.4%	9.5%	10.5%	12.5%	12.2%	13.7%
Southeast Europe	RO:A	Romania	Transylvania			Mean	10.0%	**6.2%**	**5.3%**	**7.6%**	**6.9%**	**5.8%**	**5.6%**	**5.9%**
Southeast Europe	*RS:A*	*Serbia*	*Vojvodina: NR Deliblatska Peščara*			*Mean*	*83.3%*	*75.0%*	*37.5%*	*14.3%*	*11.8%*	*9.0%*	*9.0%*	*7.9%*
Asia	RU:A	Russia	Khakassia: northern part			Min	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Central Europe	*CZ:A*	*Czech Republic*	*White Carpathians: Čertoryje*	#	#	*Min*	*50.0%*	*33.3%*	*21.4%*	*8.8%*	*10.8%*	*10.2%*	*10.2%*	*10.3%*
Central Europe	*DE:A*	*Germany*	*Upper Franconia: Bayreuth*			*Min*	*42.9%*	*25.0%*	*26.9%*	*18.4%*	*15.7%*	*12.7%*	*12.7%*	*15.6%*
Central Europe	DE:B	Germany	BR Schorfheide-Chorin: Gabow - Altglietzen		#	Min	0.0%	0.0%	0.0%	0.0%	6.7%	7.9%	7.9%	17.5%
Central Europe	*DE:E*	*Germany*	*Middle Elbe BR: Höhbeck*			*Min*	*NA*	*NA*	*NA*	*NA*	*1.1%*	*NA*	*NA*	*17.1%*
East Europe	RU:B	Russia	Kaliningrad Oblast: Curonian Spit NP	#	#	Min	0.0%	NA	0.0%	NA	0.0%	6.0%	6.0%	5.1%
East Europe	UA:A	Ukraine	Central Podolia			Min	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.3%
North Europe	EE:A	Estonia	Saaremaa		#	Min	0.0%	0.0%	10.0%	9.5%	11.1%	10.2%	10.2%	15.7%
North Europe	SE:A	Sweden	Öland: southern part	#	#	Min	0.0%	0.0%	0.0%	0.0%	10.0%	22.2%	22.2%	NA
South Europe	ES:A	Spain	Navarre			Min	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.1%
South Europe	IT:A	Italy	Sicily			Min	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Southeast Europe	BG:A	Bulgaria	NW Bulgarian mountains			Min	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.2%
Southeast Europe	RO:A	Romania	Transylvania			Min	0.0%	0.0%	0.0%	0.0%	0.0%	1.6%	0.0%	1.6%
Southeast Europe	*RS:A*	*Serbia*	*Vojvodina: NR Deliblatska Peščara*			*Min*	*66.7%*	*50.0%*	*25.0%*	*14.3%*	*10.5%*	*7.7%*	*7.7%*	*7.9%*
Asia	RU:A	Russia	Khakassia: northern part			Max	100.0%	100.0%	60.0%	48.3%	42.4%	38.6%	38.6%	38.6%
Central Europe	*CZ:A*	*Czech Republic*	*White Carpathians: Čertoryje*	#	#	*Max*	*50.0%*	*33.3%*	*21.4%*	*8.8%*	*10.8%*	*10.2%*	*10.2%*	*10.3%*
Central Europe	*DE:A*	*Germany*	*Upper Franconia: Bayreuth*			*Max*	*42.9%*	*50.0%*	*35.7%*	*24.0%*	*20.5%*	*16.7%*	*16.7%*	*15.6%*
Central Europe	DE:B	Germany	BR Schorfheide-Chorin: Gabow - Altglietzen		#	Max	100.0%	100.0%	90.0%	75.0%	75.0%	69.2%	69.2%	52.6%
Central Europe	*DE:E*	*Germany*	*Middle Elbe BR: Höhbeck*			*Max*	*NA*	*NA*	*NA*	*NA*	*60.0%*	*NA*	*NA*	*28.6%*
East Europe	RU:B	Russia	Kaliningrad Oblast: Curonian Spit NP	#	#	Max	100.0%	NA	88.9%	NA	80.6%	70.4%	70.4%	75.0%
East Europe	UA:A	Ukraine	Central Podolia			Max	100.0%	100.0%	45.5%	37.5%	31.0%	33.3%	52.8%	25.9%
North Europe	EE:A	Estonia	Saaremaa		#	Max	100.0%	100.0%	100.0%	100.0%	91.7%	88.0%	88.0%	73.5%
North Europe	SE:A	Sweden	Öland: southern part	#	#	Max	100.0%	100.0%	88.0%	87.9%	79.0%	81.0%	81.0%	NA
South Europe	ES:A	Spain	Navarre			Max	100.0%	100.0%	50.0%	59.1%	45.5%	40.0%	40.0%	37.9%
South Europe	IT:A	Italy	Sicily			Max	66.7%	66.7%	60.0%	45.5%	34.5%	38.2%	38.2%	35.9%
Southeast Europe	BG:A	Bulgaria	NW Bulgarian mountains			Max	75.0%	80.0%	50.0%	45.5%	31.8%	31.8%	41.4%	28.4%
Southeast Europe	RO:A	Romania	Transylvania			Max	100.0%	40.0%	25.0%	31.6%	22.6%	20.0%	30.2%	23.4%
Southeast Europe	*RS:A*	*Serbia*	*Vojvodina: NR Deliblatska Peščara*			*Max*	*100.0%*	*100.0%*	*50.0%*	*14.3%*	*13.0%*	*10.3%*	*10.3%*	*7.9%*

Fig. 3: ***Photos showing Palaearctic grasslands that are extreme for certain aspects of plant diversity. (a) World record stand for 0.1-m² and 10-m² vascular plant species richness (43 and 98 species, respectively) (Transylvania, Romania: Cirsio-Brachypodion pinnati, Festuco-Brometea); (b) new world record stand for 0.001-m² vascular plant richness (19 species, Belagua at 939 m a.s.l., Navarre, Spain: intensively grazed, Potentillo-Brachypodion pinnati, Festuco-Brometea); (c) stand of the Tortello tortuosae-Sedion albi, Sedo-Scleranthenea, the Palaearctic grassland type richest in non-vascular plants at all considered spatial scales with e.g. up to 64 species on 9 m² (the photo is from Saaremaa, Estonia, while stands in Öland, Sweden, are known to be slightly richer); (d) dune grassland (Sicily, Italy: Alkanno-Malcolmion parviflorae, Tuberarietea guttatae), which is among the poorest types in our overview in terms of vascular plant species richness, with e.g. only 13 species on 100 m²*** **(Photos: J. Dengler).**

(i.e. terricolous vascular plants, bryophytes, lichens and macro -"algae"), non-vascular plant species richness, and percentage of non-vascular plants (non-vascular plant species richness / total species richness). For the sake of linguistic convenience, we include lichens in the following under the generic term "plants", acknowledging that they actually are symbioses between fungi and photo-autotrophic partners. The data published here as tables, can be requested from the corresponding author in spread sheet format.

Results

The highest mean richness values for vascular plant species richness were reported for all grain sizes between 0.1 and 100 m² in Transylvania, Romania, for 0.01 m² in Central Italy and for the two smallest grain sizes in Navarre, Spain (Table 3). The absolutely highest values, were similarly distributed: 0.1 m² (43 species) and 10 m² (98) are the still valid world records from Transylvania (Wilson et al. 2012), while for 0.0001 m² (9) and for 0.001 m² (19) we report new world records from Navarre, Spain. The three other maxima in Palaearctic grasslands (25 on 0.01 m², 82 on 1 m² and 133 on 100 m²) are from other studies not included here. However, all the maxima belong to the meso-xeric, basiphilous grasslands of the order *Brachypodietalia pinnati* (= *Brometalia erecti*; *Festuco-Brometea*; Fig. 3). When considering total plant species richness (i.e. including bryophytes, lichens and other macroscopic photoautotrophic organisms), the picture remains essentially the same (Table 4).

By contrast, maximum small-scale richness of non-vascular plants at nearly any spatial scale is know so far from the Baltic island of Öland (Table 5). Only at the two smallest grain sizes the similar grasslands of the Baltic island of Saaremaa had higher values. In both cases, the maximum richness values were in communities of the alliance *Tortello tortuosae-Sedion albi* (*Alysso-Sedetalia*; *Sedo-Scleranthenea*, *Koelerio-Corynephoretea*; see Dengler & Löbel 2006, Dengler et al. 2006; Fig. 3). If considering how much vascular and non-vascular plants contribute to overall phytodiversity, it appears that the non-vascular fraction is by far highest in the dry grasslands of the two Baltic islands Öland and Saaremaa in the hemiboreal zone (Table 6). The smallest fraction of non-vascular plants on average was found in the Transylvanian dry grasslands at nearly all grain sizes except the smallest, where Khakassia was the cold spot of this fractional diversity (Table 6).

Discussion

This paper provides the so far most comprehensive overview of plot-scale plant diversity in Palaearctic grasslands from 0.0001 to 100 m² and thus is a valuable reference source for assessing the diversity of a particular grassland stand. While the majority of our datasets are still from dry grasslands (*Festuco-Brometea*, *Koelerio-Corynephoretea*, *Cleistogenetea squarrosae*), we also included several datasets from mesic, wet, acidic, saline, alpine and Mediterranean grasslands. Most importantly, compared to previous overviews such as Wilson et al. (2012) and Chytrý et al. (2015), we provide mean and minimum values, in addition to maxima. While maxima are “exciting”, they depend to a significant part on sampling intensity (i.e. the more plots are recorded, the higher the likelihood to find an extremely rich plot) – this is why we also report the number of replicates on which our maxima are based. By contrast, means (unless based on very few and unrepresative plots) are informative irrespective of sample size. While it would be valuable to have such means, they were hardly available before, one exception being the stratified random grassland plots of the Swiss biodiversity monitoring (Koordinationsstelle Biodiversitäts-Monitoring Schweiz 2009): they reported 95% confidence intervals of 25−31, 31−35 and 41−47 vascular plant species on 10 m², for colline, montane and subalpine grasslands, respectively, while the numbers for bryophytes were 2−4, 4−6 and 9−13. This is well within the ranges found in our studies (Tables 3 and 5).

We could only present values for certain plot sizes and did so for a well-established series of grain sizes that are always separated by one order of magnitude as suggested by Peet et al. (1998) and Dengler (2009b). However, the fact that mean species richness (e.g. Dengler & Boch 2008) and maximum species richness (Wilson et al. 2012) follow power-law species-area relationships rather closely at these scale allows an easy and rather precise interpolation to intermediate grain sizes, such as some that are widely used in grassland research, e.g. 4 m², 16 m² or 25 m² (Chytrý & Otýpková 2003). If the target area is A_t, the expected richness S_t can be estimated from the richness values S_1 and S_2 of the next lower and next bigger area A_1 and A_2 as follows:

$$S_t = S_1 \left(\frac{A_t}{A_1}\right)^z = S_1 \left(\frac{A_t}{A_1}\right)^{(\log S_2 - \log S_1)}$$

For example, mean total plant species richness of 50.0 on 10 m² and 73.4 on 100 m² as in Khakassia (Polyakova et al. 2016) would correspond to the following mean richness at 25 m²:

$$S_{25\,\mathrm{m}^2} = S_{10\,\mathrm{m}^2} \left(\frac{25\ \mathrm{m}^2}{10\ \mathrm{m}^2}\right)^{(\log S_{100\,\mathrm{m}^2} - \log S_{10\,\mathrm{m}^2})} = 50.0 \left(\frac{25\ \mathrm{m}^2}{10\ \mathrm{m}^2}\right)^{(\log(73.4) - \log(50.0))} = 58.3$$

Our paper comprises new world records for vascular plant species richness at 0.0001 m² (9) and at 0.001 m² (19, both shoot presence) from the EDGG Field Workshop in Navarre, Spain (Biurrun et al. 2014) (Table 3). Both are much higher than the old published records (Wilson et al. 2012; Chytrý et al. 2015) of 5 species on 0.0001 m² (+80%) and 12 species on 0.001 m² (+58%). However, at 0.0001 m² the values of Wilson et al. (2012) had already been beaten by the EDGG Research Expeditions in Bulgaria (6 species: Pedashenko et al. 2013) and Ukraine (7 species: Kuzemko et al. 2014), but these records had not been noticed at that time due to the absence of such an overview as the one presented here. With 23 species on 0.01 m² and 34 on 0.1 m², Navarran grasslands are also close to the world records at these scales (25 and 43).

For the first time, we are able to provide mean and maximum richness values for the non-vascular component of grasslands, too. While the partly extraordinarily high small-scale richness of some dry grassland types in bryophytes and lichens was known before (e.g. Dengler 2005), we present now an assessment across various grassland types and regions. The highest richness values at any spatial scale, with maxima about twice as high than in the next-ranked region are found in the dry grasslands of the hemiboreal zone (Öland, Sweden and Saaremaa, Estonia) with extreme values such as 64 species on 10 m² (Table 5). These numbers do not even represent the full bryophyte and lichen richness of these stands because they can contain a significant additional number of saxicolous and epiphytic taxa, which we excluded here to achieve comparability (but see Dengler & Boch 2008). However, the next-richest region in terms of non-vascular plants after the hemiboreal zone turned out to be the Mediterranean and sub-Mediterranean dry grasslands, where we found on 100 m² up to 33 species in Sicily and up to 27 (preliminary count) in Navarre (Table 5). This highlights the great importance of bryophytes and lichens in dry grassland communities, also of southern Europe, where they are usually not considered in phytosociological or biodiversity studies. For considering the relevance of non-vascular plants for total plant species richness of grasslands, the fraction of non-vascular plants is a good parameter. Again the values are highest in the hemiboreal grasslands with a mean of 46% in Saaremaa and 55% in Öland at the 10-m² scale.

Outlook

We hope that the reference data provided here will find wide use and at the same time spur the sampling of similar standardised phytodiversity data from Palaearctic grasslands, but also from other vegetation types and other biogeographic realms. If you have collected similar diversity data in Palaearctic grasslands, matching the methodological standards defined above, and wish to make them freely available to the scientific public (or at least their summary statistics), please submit them in the given format to the first author of this paper. We plan to update the accompanying open access data spread sheet continuously and to publish follow-up articles in peer-reviewed journals once a sufficient number of new datasets have accumulated.

The next EDGG Field Workshops are planned for Central Italy in 2017 (see page 3 in this issue), and preliminarily envisaged for the Eastern valleys of the Alps in 2018 as well as for Armenia in 2019. People interested in joining the EDGG or participating in an EDGG Field Workshop are invited to contact the two first authors of this paper. The ultimate goal of the EDGG Field Workshops is, of course, not only data collection and provision (as here), but also data analysis. There is already a series of papers analysing biodiversity patterns and their drivers within single study areas (Turtureanu et al. 2014; Kuzemko et al. 2016; Polyakova et al. 2016). For the future, however, we also plan to use the combined wealth of data from the EDGG Field Workshops and related sampling approaches to conduct multiple-site analyses of species, phylogenetic and functional diversity as well as community assembly patterns and their drivers, which will strongly benefit from the fact that in each 10-m² plot we also recorded a set of standardised soil and other environmental parameters. Suggestions for such paper projects to the team of data originators are welcome.

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Author contributions

J.D. "invented" the EDGG Field Workshops in 2009 and since then is responsible for them in his function as EDGG Field Workshop Coordinator, supported by I.B. as his Deputy. J.D. also conceived the idea of this paper, planned it and wrote the first draft, which was then revised by the co-authors. H.P. prepared the map. All co-authors contributed significantly to the data underlying this paper, be it as organiser or regular participant of EDGG Field Workshops, as originator of other included studies or as bryophyte and lichen specialist who helped to determine collected material.

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Forum

The starry breck lichen, a dry grassland species on the brink of extinction, gains IUCN status

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Abstract: Soil crusts are an integral part of dry grassland communities. However, in many parts of Europe, their abundance has strongly declined due to habitat loss, sulfur dioxide pollution, and eutrophication. The starry breck lichen *Buellia asterella* embodies this downward trend like no other soil crust: Although once widely distributed in Atlantic-influenced Europe, it is now considered extinct in France, Italy, the U.K. and Switzerland. Recently, it even became the first European lichen red-listed by the IUCN. Adopting a conservation strategy for the species will require an updated population census. It is possible that populations of this soil crust persist in semi-dry grasslands in Germany and surrounding countries but have been overlooked or misidentified by vegetation scientists. EDGG members are encouraged to report any potential sites to the authors but cautioned not to collect it under any circumstances.

Keywords: dry grassland, endangered species, eutrophication, IUCN, lichens, red list, soil crusts.

Hidden beneath the vascular plants that make up the most visible part of dry grasslands is a biotic soil crust community that stabilizes fine particles, prevents erosion and enriches the metabolic diversity of the uppermost soil layers. These biotic soil crusts are often dominated by lichens (Weber et al. 2016). The study of lichen communities in European dry grasslands and Eurasian steppe has a long and rich tradition. However, the study of cryptogamic soil crusts and the vascular plant communities they occur in are often separate and non-overlapping, carried out by specialist groups. Today, vegetation databases of dry grasslands are replete with records of "*Fulgensia* sp.", "*Psora* sp." or even "*Lichen* sp.", the textual residuals of field workers who attempted to capture hints of lichen diversity in their sampling.

The "colored soil lichen community" of dry grasslands

Like many of Europe's lichens, those of dry grasslands have suffered immensely under habitat loss, to say nothing of the one-two punch of sulfur dioxide pollution and airborne eutrophication. The "bunte Erdflechtengemeinschaft" ("colored soil lichen community") recognized as early as Arnold (1868–1897) and made famous by the descriptions of Reimers (1951), Klement (1955), Bornkamm (1958), Marstaller (1968, 1971) and others, was once widespread in central Europe, the hallmark of diverse calcareous grasslands. Today it is increasingly reduced to tiny patches and in some grass-

Fig 1. ***Buellia asterella, once widely distributed in soil crust communities of Central European grasslands, now faces extinction.***

lands, it has disappeared altogether (Günzl 2003). Very soon Europe might face it's first documented lichen species extinction in dry grasslands: *Buellia asterella*, the starry breck lichen (Fig. 1).

The case of the starry breck lichen

Buellia asterella was described as a new species by Poelt & Sulzer (1974) who segregated it from the broader *Buellia elegans* complex. Once recognized, the species' characteristics are striking (Fig. 1): it possesses a snow-white thallus and blackish apothecia, forming star-like patches on mineral soil. Within its species group it is well marked by the combination of norstictic acid chemistry and its anomalous four ascospores per ascus. Unusual among dry grassland lichen species, *B. asterella* is not a Eurosiberian element. Nearly all of the known localities for the starry breck lichen, historic and modern, occur in the Atlantic-influenced western part of Europe. Over 80% of historically recorded sites for the species were within the present boundaries of Germany. Its western limits were reached in eastern England (the brecklands, whence the common name); its southern limits in a 19th century collection from western Italy; and its northern limits in a region of southern Norway known for disjunct dry grassland patches (Du Rietz 1925; Larsen et al. 2006). Remarkably, its eastern limits are not known to have gone any further than Thuringia in eastern Germany.

The first European lichen on the IUCN red list

Such a distribution would be biogeographically quite interesting to study were it not for the fact that *Buellia asterella* has now disappeared from most of that range. The species is now considered extinct in France, Italy, the U.K. and Switzerland. Within Germany, it has been documented only once since the year 2000 and only three times in the last 40 years (e.g. Meinunger 2011; Dietmar Teuber, *pers. comm*.). In fact, the only verifiably extant populations of *B. asterella* at present are in the Vågå region of Norway, where only two of three historical sites have been confirmed, and even these are in sharp decline (E. Timdal, *pers. comm*.). Current data suggest that *B. asterella* may indeed have been reduced to only a few hundred extant thalli globally. The highly imperiled status of this lichen led specialists at the International Union for the Conservation of Nature (IUCN) to propose listing *B. asterella* as critically endangered (CR), a ranking which took effect in the November 2015 update of the IUCN Global Red List (Spribille et al. 2015). The dry grassland lichen *Buellia asterella* thus becomes the first European lichen red-listed by the IUCN.

Call for sightings

Adopting a conservation strategy for *Buellia asterella* will require an updated census of the species in its core range and an assessment of management and restoration potential in the best-preserved habitats. It is possible that populations of starry breck lichen persist in semi-dry grasslands in Germany and surrounding countries but have either (a) not been surveyed in recent decades, (b) have been seen but not recognized by vegetation scientists, or (c) have been misidentified as *Buellia elegans*.

More information about *Buellia asterella* can be obtained in the IUCN Global Red List documentation (http://www.iucnredlist.org/details/70385861/0) and on the website of the Global Fungal Red List Initiative (whttp://iucn.ekoo.se/iucn/species_view/341538).

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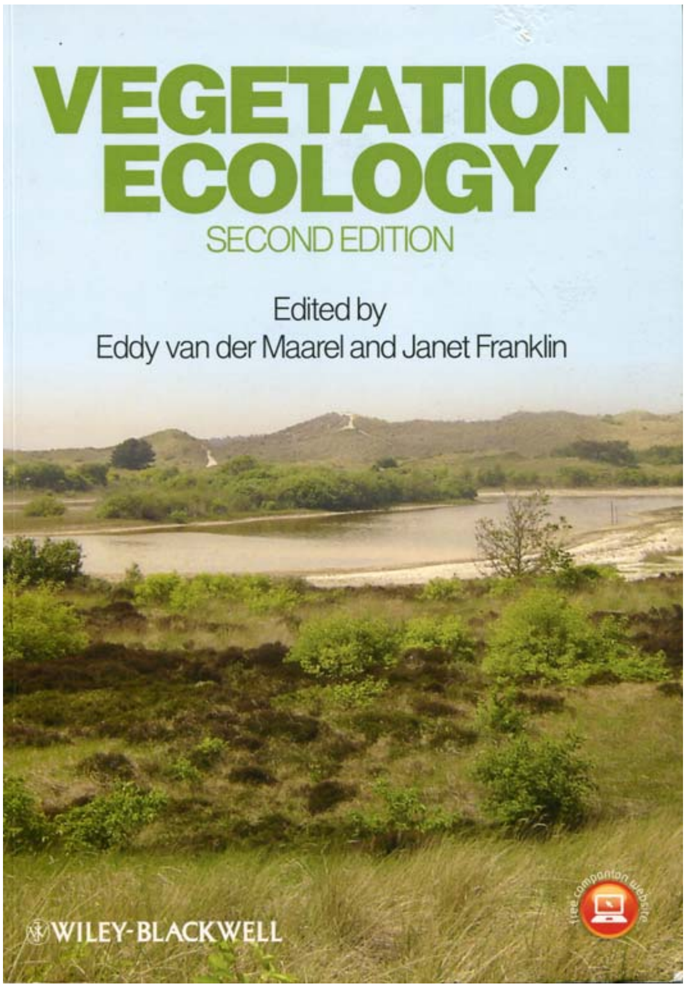
Weber, B., Büdel, B. & Belnap, J. 2016. *Biological Soil Crusts: An Organizing Principle in Dry Grasslands*. Springer, Berlin, DE.

EDGG members can make a contribution by reporting any potential sites for this striking and easily recognized species. Anybody who thinks she/he has discovered Buellia asterella is strongly encouraged not to collect it under any circumstances but instead to photograph it and contact a lichen expert immediately. Potential sightings from outside the expected range are also welcome, as it cannot be ruled out that the species occurs in remote sites in eastern Europe as well.

Book Review

Here we present recently published books that might be relevant for grassland scientists and conservationists, both specific grassland titles and faunas, floras or general books on ecology and conservation biology. If you (as an author, editor or publisher) would like to propose a certain title for review, or if you (as an EDGG member) would like to write a certain review (or reviews in general), please contact the Book Review Editor (anya_meadow@i.ua).



van der Maarel, E. & Franklin, J. (eds.) 2013. Vegetation ecology. 2nd ed. – 556 pp., Wiley-Blackwell, Chicester. ISBN 978-1-4443-3889-8. 70.90 € (paperback), 139.10 € (hardcover), 63.99 (e-book).

Vegetation science or vegetation ecology is the topic of EDGG's mother organisation IAVS. Despite there are hundreds of vegetation scientists teaching in universities worldwide, there was for a long time basically only one English-language text book devoted to the whole field, an excellent one, but meanwhile more than 40 years old: *Aims and methods of vegetation ecology* by Mueller-Dombois & Ellenberg (1974). There are, of course, English textbooks of plant ecology in general, like those of Crawley (1997) and the highly recommendable one by Gurevitch et al. (2006), but since they comprise a much wider field from ecophysiology to global ecology, naturally many aspects of vegetation ecology (or: plant community ecology) are not treated in depth, and some not at all, and this is particularly true for methodological aspects. These gaps on the methodological side could be somehow filled by *Vegetation description and data analysis* (Kent 2012), but in this book, logically, concepts, theories, results and applications are largely underrepresented. There are actually at least two German textbooks of vegetation ecology (*Vegetationsökologie*: Glavac 1996; Pfadenhauer 1997), but they never made it into an English translation.

Therefore, Eddy van der Maarel, founding editor of the *Journal of Vegetation Science*, filled a great gap, when he published the first edition of *Vegetation ecology* a decade ago (van der Maarel 2005). Recently, he joined up with Janet Franklin from Arizona State University to produce the second edition of the textbook, which increased its content compared to the first edition by 40%. Again it is not a classical textbook, written by a team of authors from front to back, but a compilation of now 17 chapters (formerly: 14), each written by a team of one up to six specialists from many different countries, each with a separate reference list.

In their introductory chapter *Vegetation ecology: historical notes and outline* Eddy van de Maarel & Janet Franklin, provide some basic background about terminology and sampling approaches in vegetation science and put the following 16 chapters into context. The methodological part is shortened compared to the first edition and now so superficial that it is not really helpful. Robert Peet & David Roberts contributed a new chapter *Classification of natural and semi-natural vegetation*, a well-balanced and up-to-date overview on classification as a central element of vegetation ecology, but one might wonder why only natural and semi-natural communities should be classified and not also those more strongly influenced by humans, which nowadays dominate large parts of the Earth. Subsequently, Mike Austin's *Vegetation and environment: discontinuities and continuities* presents the other side of the coin, i.e. the theories and analytical procedures, namely ordination techniques, that apply when vegetation is considered rather as continuous gradient than subdivided into different categories. In chapter 4, Steward Pickett and colleagues look into *Vegetation dynamics*, mostly successional dynamics at smaller spatial and temporal scales. Chapters 5 and 6 address the two major dispersal mechanisms of plants and their effects on communities, clonal growth by Brita Svensson and colleagues and seed dispersal by Peter Poschlod and colleagues. Then follows a sequence of three chapters on the mechanisms and resulting patterns of interspecfic interactions, starting with an overview chapter on species interactions in general by Jelte van Andel that mainly introduces terminology, such as competition, facilitation and mutualism, followed by Mahesh Sankaran & Samuel McNaughton on interactions between plants and herbivores and Thomas Kuyper & Ron de Goede on interactions between plants an soil organisms. Christoph Leuschner's chapter *Vegetation and ecosystem* aims at quantifying fluxes and stocks of carbon, water and macronutrients in ecosystems, partly highlighting differences between some major vegetation types. In *Diversity and ecosystem functioning*, Jan Lepš introduces some fundamental diversity metrics to look then into how plant diversity and ecosystem properties are related reciprocally. The new chapter *Plant functional types and traits at the community, ecosystem and world level* (by Andrew Gillison) fills a major gap of the first edition, but has the shortcoming that a significant part of the figures in this chapter are not based on the state-of-the-art international literature in trait-based ecology, but on the author's personal transects worldwide, where he in a "quick-and-dirty", subjective and non-reproducible approach assigns ad-hoc functional types to mostly unknown species in the field. With Marcel Rejmánek, David Richardson and Petr Pyšek the three world-leading experts provide in chapter 13 a very insightful overview on *Plant invasions and invasibility of plant communities*. Jan Bakker provides a rather short overview on *Vegetation conservation, management and restoration*, which largely remains (has to remain) on the conceptual level and does hardly give case studies. One also misses aspects such as legal conservation and Red Lists of plant communities. Elgene Box and Kazue Fujiwara address *Vegetation types and their broad-scale distribution*, which basically means biomes and formations and their abiotic drivers. Who has hoped for a new well-elaborated approach that transcends the differences between previous biome classifications will be disappointed, and the small black and white maps of global patterns (p. 463) should have been presented in colour and much, much bigger to make them informative. The third new chapter *Mapping vegetation from landscape to regional scales* by Janet Franklin is again nicely filling a major gap of the previous edition. The last chapter *Vegetation ecology and global change* finally sheds light on longer-term vegetation dynamics since the Last Glacial Maximum and uses this background to explain how humans in recent decades and centuries influence vegetation on Earth.

All in all the sequence of chapters is partly logical, partly weird: Why are the two closely related methodological papers on vegetation classification and vegetation mapping separated by 13 unrelated chapters? Why are the three chapters on global ecology so widely dispersed in the book (10. *Vegetation and ecosystem*; 15 *Vegetation types and their broad-scale distriution*; 17. *Vegetation ecology and global change*)? A grouping of chapters into some major groups might help here. Organising a textbook as a "paper collection" inevitably comes with the risk of gaps and overlaps as well as inconsistencies between the chapters, but in general the editors have been successful in limiting such problems. Among the few aspects of vegetation ecology that I largely or completely miss in the current edition are (i) methods of vegetation sampling; (ii) vegetation-plot databases and ecoinformatics; (iii) more detailed consideration of diversity patterns and their scale dependence, not restricted to the ecosystem service perspective; and (iv) community assembly rules, taking into account both functional and phylogenetic composition. Despite the multiple and heterogeneous authorship, the book can well serve as a standard text book of the discipline, albeit not all chapter have the same level of quality. The usage in teaching is supported by the fact that all figures and tables of the book are made freely available on a companion webpage. On the other hand, the unusual scarcity of figures (among them only very few in colour) is a serious disadvantage because many of the complex concepts, patterns and processes of vegetation ecology would be much better accessible and understandable with well-developed figures than by text alone. All in all, the book appears to be the currently best option to cover the entirety of present-day vegetation ecology in a single volume, and we can only hope that the editors remain healthy and find the time to prepare a next edition that addresses some of the remaining shortcomings.

Crawley, M.J. (ed.) 1997. *Plant ecology*. 2nd ed. Blackwell, Malden, MA, US: 717 pp.

Glavac, V. 1996. *Vegetationsökologie – Grundfragen, Aufgaben, Methoden*. Fischer, Jena, DE: 358 pp.

Gurevitch, J., Scheiner, S.M., Fox, G.A. 2006. *The ecology of plants*. 2nd ed. Sinauer, Sunderland, Mass., US: 574 pp.

Kent, M. 2012. *Vegetation description and data analysis – a practical approach*. Wiley-Blackwell, Chichester, UK: 414 pp.

Mueller-Dombois, D., Ellenberg, H. 1974. *Aims and methods of vegetation ecology*. Wiley, New York, US: 547 pp.

Pfadenhauer, J. 1997. *Vegetationsökologie – ein Skriptum*. 2nd. ed. IHW-Verlag, Eching, DE: 448 pp.

van der Maarel, E. (ed.) 2005. *Vegetation ecology*. Blackwell, Oxford, UK: 395 pp.

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Forthcoming events

46th Annual Meeting of the Ecological Society for Germany, Austria and Switzerland (GfÖ)
150 years of ecology - lessons for the future
5-9 September 2016, Marburg, Germany
Meeting homepage: http://www.gfoe-2016.de/

13th Eurasian Grassland Conference
Management and Conservation of Semi-natural Grasslands: from Theory to Practice
20-24 September 2016, Sighişoara, Romania
The meeting will be hosted by Fundaţia ADEPT and Babes-Bolyai University

10th EDGG Field Workshop
3–11 June 2017, Central Apennine Mts., Italy
More information at the page 3

14th Eurasian Grassland Conference
4-9 July 2017, Latvia/Lithuania
The meeting webpage is not yet available.

26th European Vegetation Survey Meeting
13-16 September 2017, Bilbao, Spain
The meeting will be hosted by the University of the Basque Country (Javier Loidi and colleagues).
The meeting webpage is not yet available.

1st International Conference on Community Ecology on
28-29 September 2017, Budapest Hungary
Conference homepage www.confcomec.com

60th Symposium of the International Association for Vegetation Science (IAVS)
20-25 June 2017, Palermo, Italy
The meeting webpage is not yet available.

27th European Vegetation Survey Meeting
spring 2018, Wrocław, Poland
The meeting will be hosted by University of Wrocław (Zygmunt Kącki and colleagues).

61th Symposium of the International Association for Vegetation Science (IAVS)
23-27 July 2018, Bozeman (Montana), U.S.A.
The meeting webpage is not yet available.

Spermophilus xanthoprymnus. **(Photo: Didem Ambarlı)**

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Aricia agestis. **(Photo: Didem Ambarlı)**