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Special Issue Palaearctic grasslands
Editorial

Classification of Palaearctic grasslands

Monika Janišová*, Jürgen Dengler & Wolfgang Willner

Abstract

Along with a brief introduction to the four research articles of the Special Issue "Classification of Palaearctic grasslands", we present a bibliometric analysis of publication trends regarding classification of Palaearctic grasslands in journals included in the Web of Science database. Regional studies (covering only a part of a country's territory) prevailed (51%), but supra-national studies were more numerous (34%) than national overviews (15%). Four European countries (Austria, the Czech Republic, Italy and Slovakia) were included in the highest number of grassland classification studies (12 each). The publication of grassland classification studies in Web of Science journals continuously increased during the last 15 years. *Festuco-Brometea* and *Molinio-Arrhenatheretea* were the most frequently studied grassland classes. *Phytocoenologia* and *Tuexenia* were the most popular outlets for original grassland classification studies, while *Journal of Vegetation Science* had a leading position in publishing methodological articles with relation to grassland vegetation. Methods of unsupervised hierarchical classification were most common in grassland classification studies. Publications outside the Web of Science were not analysed although they represent an important source of knowledge in grassland classification.

Keywords: bibliometric analysis; classification method; grassland; *Journal of Vegetation Science*; Palaearctic biogeographic realm; peer-reviewed journal; *Phytocoenologia*; phytosociology; publication trend; vegetation classification; Web of Science; *Tuexenia*.

Abbreviation: WoS = Web of Science Core Collection.

Introduction

The Palaearctic biogeographic realm is the largest of the eight Earth's biogeographic realms and consists of Europe, northern Africa and Asia north of the Himalaya (Olson et al. 2001; Fig. 1). Four major categories of grasslands can be distinguished here (Dengler et al. 2014; Wesche et al. 2016): (a) zonal steppes (in areas too dry for forests), (b) arctic-alpine grasslands (in areas too cold for forests), (c) azonal and extrazonal grasslands (where hydrology, soil conditions, relief or natural disturbances within the forest biomes prevent tree growth locally) and (d) secondary grasslands (which replace natural forests in consequences of human land use). The difficult task to describe and understand the huge variability and diversity of Palaearctic grasslands – for the European part alone Rodwell et al. (2002) listed 19 grassland classes with 326 alliances, while Mucina et al. (in press) listed 27 classes with 365 alliances − can only be achieved by use of proper study approaches and efficient classification tools.

Since the early decades of the last century, phytosociologists have tried to apply a standardised approach to the tasks of sampling and characterising vegetation types (Braun-Blanquet 1928) and to use a formal framework for naming and organising them within a syntaxonomic hierarchy of associations, alliances, orders and classes (Weber et al. 2000). The recent establishment of the European Vegetation Archive (EVA; Chytrý et al. 2016) aimed at facilitating the use of the enormous phytosociological knowledge accumulated throughout Europe and adjacent areas. National and supra-national vegetation surveys have brought a measure of regional stability to the classification of vegetation types, especially during the recent decades (Rodwell et al. 2002; Dengler et al. 2011, 2013). However, outside Europe, the focus of phytosociological studies is much less ambitious and large regions remain completely un-investigated. The main reason why we need a consistent system of vegetation classification is that it will provide a sound scientific basis for international initiatives in nature conservation. Accordingly, we need to know the grassland vegetation in the Palaearctic biogeographic realm in reasonable detail to be able to ensure its conservation and maintenance of its life-supporting functions (Wesche et al. 2016).

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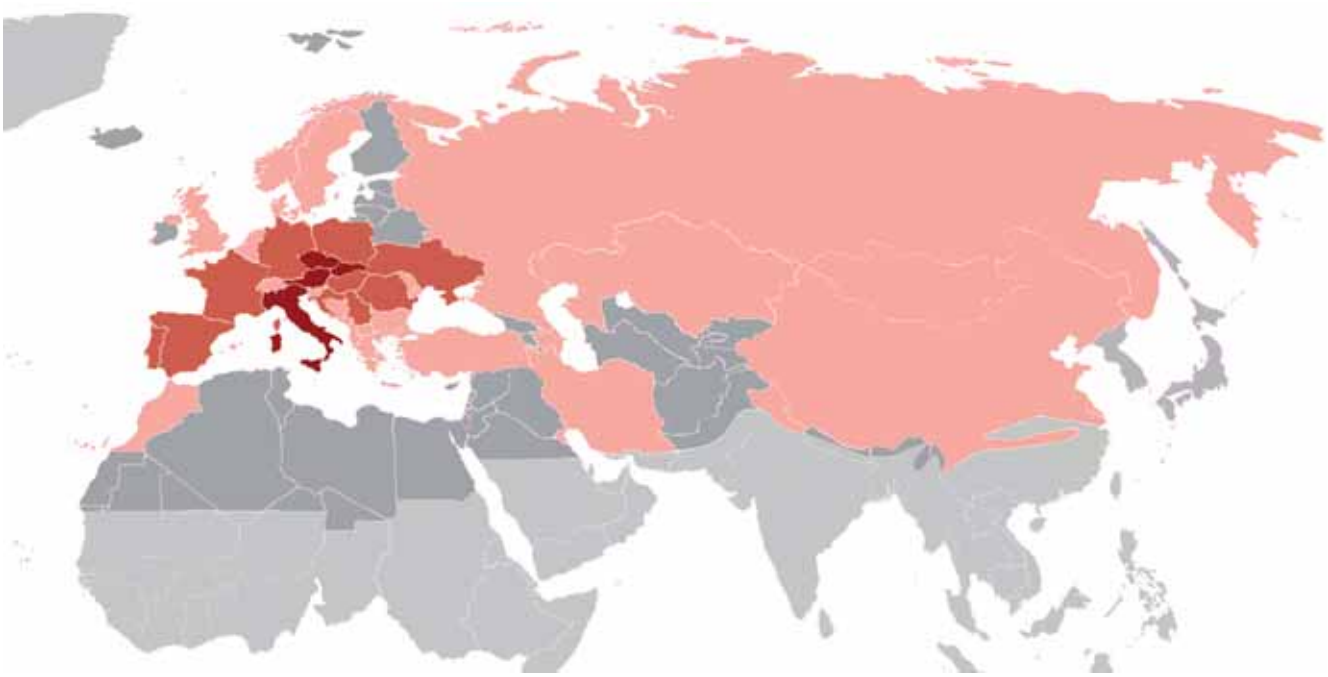

Fig. 1. Map of the Palaearctic biogeographic realm. The intensity of red color reflects the number of original grassland classification studies published in WoS journals (> 10: dark red, 5−10: red, 1−4: pink), dark grey color depicts countries, from which no such study was published in a WoS journal and light grey countries are located outside the Palaearctic realm.

Fig. 2. Corpus of the 75 most common words in titles and author keywords of original research articles on grassland classification published in WoS journals. Prepared by Voyant tools environment.

This was also the main motive for initiating this Special Issue on Classification of Palaearctic grasslands. It is the first Special Issue after the re-launch of *Phytocoenologia* (Bergmeier et al. 2015). It was initiated and organised by the *Eurasian Dry Grassland Group* (EDGG; http://www.edgg.org), with more than 1,000 members from more than 60 countries, which is the biggest Working Group of the *International Association for Vegetation Science* (IAVS; http://iavs.org; Venn et al. 2016). This Special Issue is in line with a long series of Special Issues in international journals organised by the EDGG (e.g. Janišová et al. 2011; Habel et al. 2013; Dengler et al. 2014; Török et al. 2016) and is a quasi-continuation of the ongoing Virtual Special Feature on a similar topic in *Applied Vegetation Science* (Dengler et al. 2013). In the following, we start off with an analysis of publication trends regarding classification of Palaearctic grasslands in general, and then we give a brief introduction to the four research articles of the Special Issue.

Grassland classification studies in the Web of Science

To shed light on the status and trends of classification of Palaearctic grasslands, we conducted a systematic search in the Web of Science Core Collection database (WoS, formerly known as ISI Web of Knowledge) on 5 October 2016, using the search terms "classification" and "grassland". After excluding territories outside the Palaearctic biogeographic realm, studies not focusing on phytosociological classification and survey, and including five recent articles (two in *Applied Vegetation Science*, two in *Phytocoenologia* and one in *Plant Biosystems*) fulfilling the criteria but not yet included in the WoS, we analysed the details of the 98 target publications. They included 82 original research studies, nine methodological articles, three database reports, one editorial, and three vegetation overviews.

Geographical coverage and scope

According to our survey (Fig. 1), four European countries were covered by the highest number of studies: Austria, the Czech Republic, Italy and Slovakia, each included in 12 grassland classification studies. The following European countries were covered by five or more studies: Hungary (8), Germany (7), Spain (7), Croatia (6), France (6), Portugal (6), Romania (6), Serbia (6), Poland (5), and Ukraine (5). The group covered by two to four studies is comprised of both European and Asian countries: Bosnia and Herzegovina (4), Denmark (4), Slovenia (4), Bulgaria (3), Montenegro (3), Albania (2), China (2), Kosovo (2), Netherlands (2), Norway (2), Russia (2), and Turkey (2). The lowest coverage was found in northern Africa and Middle Asia.

Regional studies (covering only a part of a country's territory) prevailed in the WoS journals (51%), but supra-national studies were more numerous (34%) than national overviews (15%). Inclusion of journals not covered by the WoS likely would change the distribution

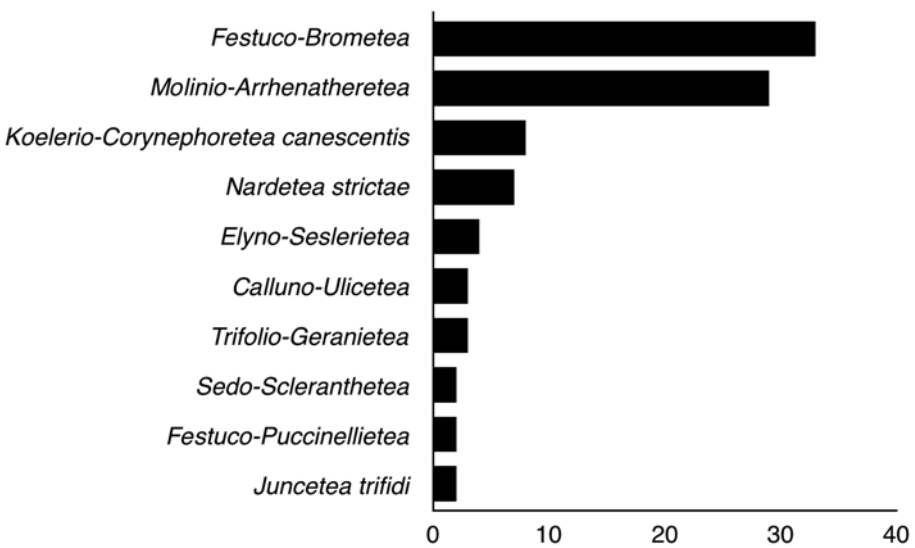

Fig. 3. Phytosociological classes (nomenclature according to Mucina et al. in press) referred more frequently in the original grassland classification studies within the Palaearctic biogeographic realm published in WoS journals. Less frequently referred syntaxa were: *Astragalo-Brometea, Calamagrostietea longsdorfii, Carici rupestris-Kobresietea bellardii, Cleistogenetea squarrosae, Crypsietea aculeatae, Helianthemetea guttati, Hordeetea brevisubulati, Juncetea maritimi, Mulgedio-Aconitetea, Poetea bulbosae, Stipo giganteae-Agrostietea castellanae.*

pattern of grassland classification outputs, especially with regards to local and regional studies. However, the clear prevalence of European countries in national and supra-national syntheses is obvious, which is surely related to a long tradition of phytosociological research, not only in grassland ecosystems. By contrast, vast areas of Asia and northern Africa lack basic information on grassland phytosociology, and our recent knowledge is based only on a few regional studies.

A strong relationship between syntaxonomy, ecology and nature conservation is reflected in the frequency of most common words used in titles and authors keywords (Fig. 2). The five most frequent words were grassland (84), vegetation (83), classification (58), species (29) and phytosociology (26). Secondary semi-natural grasslands were studied more frequently than primary grasslands while *Festuco-Brometea* and *Molinio-Arrhenatheretea* were the most frequently studied grassland classes in the analysed articles (Fig. 3).

Temporal trends and publication outlets

The increasing temporal trend in grassland classification studies (Fig. 4) in part certainly reflects a renaissance of interest in grassland classification during the last 15 years, in line with a renewed interest in vegetation classification in general (Chytrý et al. 2011; De Cáceres et al. 2015; Franklin et al. 2016; Jansen et al. 2016). However, the increasing trend is partly also due to the fact that some of the journals that publish vegetation classification studies only relatively recently were added to the WoS, which can be seen as a positive sign. More-over, both *Applied Vegetation Science* and *Phytocoenologia* recently have changed their scopes to give vegetation classification more space (*Applied Vegetation Science*; see Chytrý et al. 2011) or to make vegetation classification the main topic of the journal (*Phytocoenologia*; see Bergmeier et al. 2015).

In our analysis, *Phytocoenologia* and *Tuexenia* were the most popular outlets for original grassland classification studies, followed by *Applied Vegetation Science*, *Plant Biosystems*, *Folia Geobotanica*, *Preslia*, *Plant Ecology* and *Acta Societatis Botanicorum Poloniae*. *Journal of Vegetation Science* had a leading position in publishing methodological articles with relation to grassland vegetation (six out of nine articles), while also some original classification studies were published there in the past. Other journals published grassland classification articles only sporadically (Fig. 5).

Methods

Different methods of unsupervised hierarchical classification (Fig. 6) were most common in grassland classification studies, and in fact were the only methods used in regional studies on insufficiently known vegetation. Supervised and semi-supervised approaches were used with similar frequency in all, regional, national and supra-national studies.

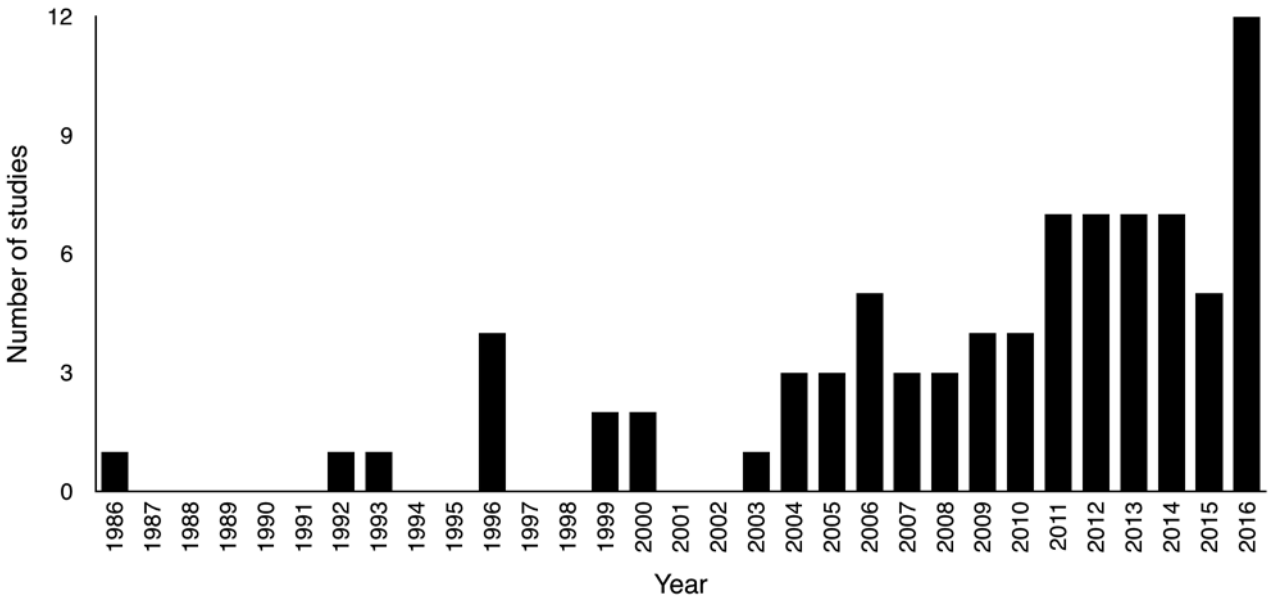

Fig. 4. Number of original grassland classification studies within the Palaearctic biogeographic realm published in WoS journals.

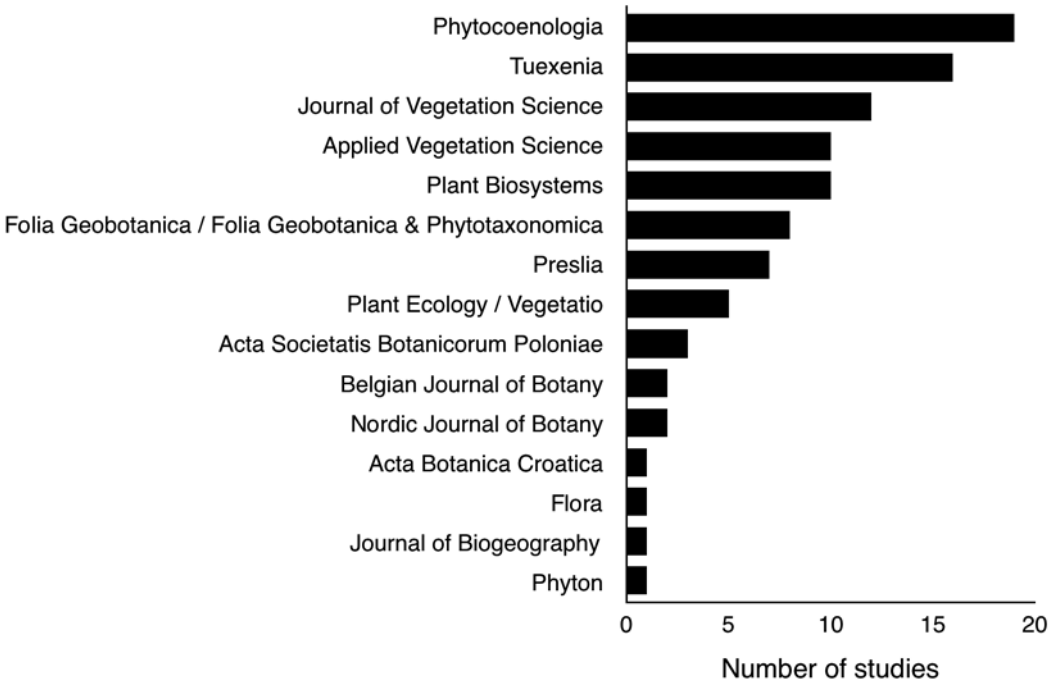

Fig. 5. Number of grassland classification studies (including methodological articles, database reports, vegetation surveys and editorials) within the Palaearctic biogeographic realm published in individual WoS journals.

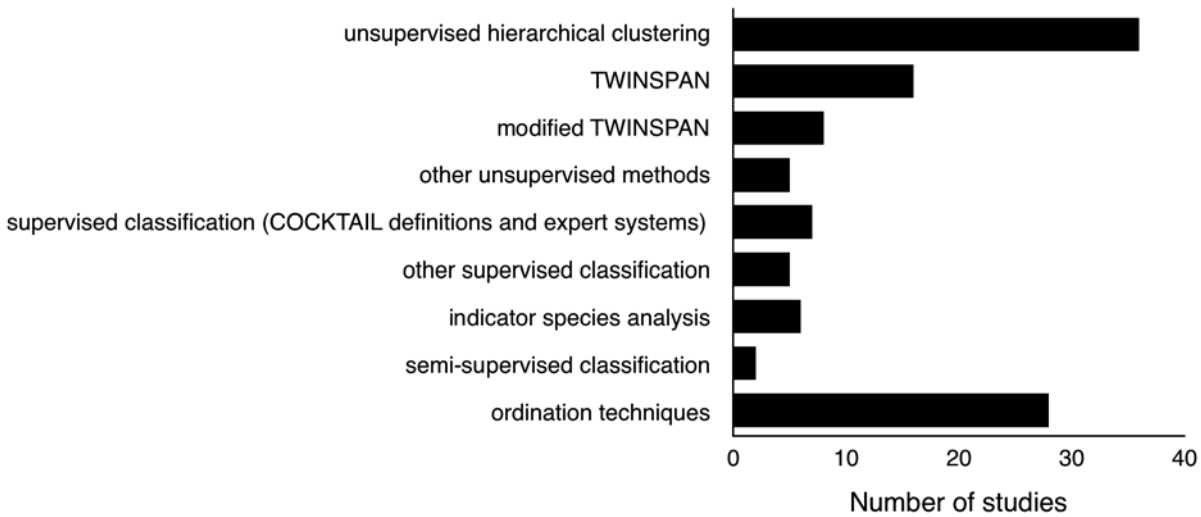

Fig. 6. Methods used in original grassland classification studies within the Palaearctic biogeographic realm published in WoS journals.

Role of monographs and journals not included in the Web of Science

It must be emphasised that the actual number of publications dedicated to grassland classification is several orders of magnitude higher than the 98 articles analysed in our study. However, most of them were published either as monographs or in journals not (yet) included in the WoS. The importance of national and regional publications outside the WoS can be demonstrated, for example, by analysing the references cited in the four articles of our Special Issue. The proportion of publications in the references included in the WoS was generally low and depended on the region: Central Europe and western Ukraine (Zajac et al. 2016) – 27%, Ukraine (Kuzemko 2016) – 13%, Southeastern Europe (Balkan; Dajić et al. 2016) – 35%, Middle Asia (Tajikistan; Nowak et al. 2016) – 33%.

Introduction to the articles of the Special Issue

This Special Issue includes four classification studies on natural and semi-natural grasslands. Two of the studies (Zajac et al. 2016 and Dajić et al. 2016) are supra-national syntaxonomic revisions, one (Kuzemko 2016) is a national revision, while the final study (Nowak et al. 2016) describes grass steppes of a still under-investigated region (Pamir Alai Mts. in Tajikistan), thus filling an important knowledge gap on the grassland vegetation of Middle Asia. The included studies deal with phytosociological material from ten countries (Bulgaria, Hungary, Kosovo, Macedonia, Poland, Romania, Serbia, Slovakia, Tajikistan, Ukraine), ordered to six phytosociological classes (*Astragalo-Brometea*, *Cleistogenetea squarrosi*, *Festuco-Puccinellietea*, *Molinio-Arrhenatheretea*, *Nardetea strictae*, *Thero-Salicornietea*). Two studies (Dajić et al. 2016 and Nowak et al. 2016) use unsupervised hierarchical clustering, while the other two (Kuzemko 2016 and Zajac et al. 2016) use supervised classification by expert systems developed on the Cocktail definitions (Bruelheide 2000). A semi-supervised classification (Tichý et al. 2014) by K-means algorithm was used by Zajac et al. (2016) to apply the classification system developed in one country (Slovakia) for identification of syntaxa in less explored areas of a neighbouring country (Ukraine). Irrespective from the geographical scope (regional, national or supra-national), and the main motivation of the included studies (unification of national classification or reporting from an unexplored region), the ultimate goal of all of the articles is to contribute to our knowledge on grassland biodiversity of the Palaearctic biogeographic realm and to maintain this enormous biodiversity, including conservation of rare and endangered vegetation types.

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Author contributions

All authors jointly planned and organized this Special Issue. The Editorial was planned and mainly written by M.J., while the co-authors revised the text.

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