Long Database Report

Bulgarian Vegetation Database: historic background, current status and future prospects

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Abstract: For geographical and historical reasons, the Bulgarian vegetation is quite diverse. In the past and up to the beginning of the new millennium, vegetation studies have been conducted in the country basically following the dominance approach. At the end of the 1990s, however, an initiative was started to collect new field data according to European floristic-ecological standards. In 1999, the Bulgarian Vegetation Database (GIVD ID EU-BG-001) was established to collect available data for getting a better insight in the diversity of Bulgarian vegetation. The database uses TURBOVEG software and is located in the Working Group for Vegetation and Habitats in the Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Sofia. In September 2010, this database contained 5,901 relevés, most of them related to grasslands. The major part of the data has been collected after 2000. The geographic distribution of the field data over the country is uneven. Most of the data are derived from particular projects and gathered at locations with a relatively undisturbed environment. Altogether, thirty authors have contributed to the field sampling. Some 25.5% of the relevés were taken from the literature. It has been estimated that some additional 2,900 relevés can be derived from the literature and unpublished sources. For the purposes of the database, a full list of expected syntaxa for Bulgaria has been prepared.

Keywords: classification; phytosociology; plant community; relevé; sampling; vegetation survey.

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Introduction

The first systematic phytosociological studies in Bulgaria were carried out in the early 1950s (Velchev et al. 1989). They have been conducted basically by researchers from the Institute of Botany, Bulgarian Academy of Sciences. During almost half a century, the intensive field work has resulted in the accumulation of a relatively large amount of data (Apostolova & Slavova 1997). The information collected reflects the rich biodiversity of vegetation types in the country. Up to the 1990s, nearly all phytosociological studies in Bulgaria have been based on the dominance approach. This was a reflection of the Russian Phytocoenological School, introduced in the country for historical and political reasons. The Braun-Blanquet approach for describing Bulgarian plant communities was applied by few researchers only, coming from abroad like Horvat et al. (1937), Soó (1957), Simon (1958), Michalik (1985, 1990) and Mucina et al. (1985, 1990).

Since 1994, phytosociologists in Bulgaria started to apply more systematically the Zurich-Montpellier School (Braun-Blanquet 1964). The workshop organized in 1994 by the Department of Phytocoenology and Ecology at the Institute of Botany can be regarded as a starting point, leaded at this time by Tenyo Meshinev. Zdenka Neuhäuslová from the Institute of Botany at the Czech Academy of Sciences was invited as a guest lector.

The necessity for transforming the existing Bulgarian vegetation classification into the Braun-Blanquet system forced our vegetation scientists to intensively collect new relevés in different regions. In the same period, several countries have built their own phytosociological databases, which encouraged the work in Bulgaria (e.g. Brisse et al. 1995, Ewald 1995, Mucina et al. 2000, Wiser et al. 2001, Chytrý & Rafajová 2003, Hrivnák et al. 2003, Dengler et al. 2006, Janišová & Škodová 2007, Lájer et al. 2007, Hegedušová 2007). The development of the software package TURBOVEG (Hennekens & Schaminée 2001) has facilitated the storage of collected relevés worldwide and has strongly enhanced vegetation classification, large database analyses (e.g. Ozinga et al. 2004, Botta-Dukát et al. 2005, Dúbravková et al. 2010), and other vegetation studies, for example on plant invasions in different vegetation types (Chytrý et al. 2005). A comprehensive overview of vegetation databases in Europe has been provided by Schaminée et al. (2009). It reports on the existence of more than 4 million vegetation plot records of which more than 1,800,000 are stored electronically. This situation facilitates an easy exchange of information for large-scale scientific and applied vegetation research.

The aim of our paper is to provide information about the national Bulgarian Vegetation Database as a virtual part of vegetation data banking in Europe.

Historical notes for Bulgarian vegetation database building

At the 1994 workshop of the European Vegetation Survey in Rome, the TURBOVEG software has been accepted as the international standard management system for vegetation relevés (Schaminée & Hennekens 1995). In June 1999, a copy of TURBOVEG was provided by Stephan Hennekens, which actually was the start for building up a national vegetation database.

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The species list was prepared based on Kozhuharov (1992) for the vascular plants and on Petrov (1975) and Natcheva & Ganeva (2005) for the bryophytes. The list includes all accepted names of the Bulgarian flora down to level of subspecies. Some hybrids are included, especially for the genera *Hieracium* and *Mentha*. A large number of synonyms is added and the species list is updated at a regular basis.

With regard to the database, about 700 original relevés were collected. Important input of additional data was given by the National Grassland Inventory Project (Meshinev et al. 2005). As a result of this inventory, some 1,800 relevés were included in the database. A significant part of the relevés was collected during the PhD studies of D.S. (2008) and K.V. and N.V. (both unpublished). During 2001–2010 there has been a very effective collaboration with colleagues from Masaryk University, Brno, Czech Republic. Substantial datasets were collected in mountain and lowland wet meadows (Hájek et al. 2005, Hájek et al. 2008).

In 2009, a new field was added in the TURBOVEG database for the UTM grid system used in Bulgaria. With the help of Stephan Hennekens, it became possible to compile and export distribution maps of relevés without precise latitude/longitude information.

TURBOVEG offers the possibility to export vegetation data for analyses in other software tools like JUICE (Tichy 2002), CANOCO (ter Braak & Šmilauer 2002) and PC-ORD (McCune & Mefford 1999). We apply these software packages in our regional studies that provide reliable tools for consistent data analyses.

GIVD Database ID: EU-BG-001		**Last update:** 2012-05-30
Bulgarian Vegetation Database		
Scope: Sample plots including full species lists with quantitative estimates and header data. The information collected so far includes only grasslands.		
Status: [NA]	**Period:** 1949-2010	
Database manager(s): Iva Apostolova (iva.apostolova@gmail.com)		
Owner: Vegetation and Habitats Research Group		
Web address: [NA]		
Availability: according to a specific agreement	**Online upload:** no	**Online search:** no
Database format(s): TURBOVEG	**Export format(s):** TURBOVEG	
Publication: [NA]		
Plot type(s): normal plots	**Plot-size range:** 4-100 m²	
Non-overlapping plots: 5,901	**Estimate of existing plots:** [NA]	**Completeness:** [NA]
Total plot observations: 5,901	**Number of sources:** 20	**Valid taxa:** [NA]
Countries: BG: 100.0%		
Forest: [NA] — **Non-forest:** [NA]		
Guilds: all vascular plants: 100%; bryophytes (terricolous or aquatic): 20%; lichens (terricolous or aquatic): 2%		
Environmental data: [NA]		
Performance measure(s): cover: 100%		
Geographic localisation: GPS coordinates (precision 25 m or less): 13%; small grid (not coarser than 10 km): 14%; political units or only on a coarser scale (>10 km): 73%		
Sampling periods: 1940-1949: 0.9%; 1950-1959: 3.0%; 1960-1969: 4.6%; 1970-1979: 1.8%; 1980-1989: 0.2%; 1990-1999: 10.9%; 2000-2009: 75.0%; 2010-2019: 0.9%; unknown: 2.5%		
Information as of 2012-07-18; further details and future updates available from http://www.givd.info/ID/EU-BG-001		

Current database status

The database structure follows the standard header items of TURBOVEG, but additionally several new items were included in order to safeguard information collected in different projects. 'Code', for instance, refers to the original and unique identity of the relevé according to the field protocol. 'Erosion' reflects visual estimation of the process in an easy-to-apply nominal scale (not eroded, slightly eroded, heavily eroded). 'Locality', 'Latitude' and 'Longitude' are related to the location of the relevé. 'Geology' provides information on the bedrock types. 'Soil depth' indicates whether the soil depth is up to 10, 25 or more than 25 cm. The field 'Pasture' contains information about the existence and intensity of grazing animals in four steps (no grazing, low, moderate and high grazing intensity), while the field 'Mowing' indicates the presence or absence of this management regime through a simple 'yes' or 'no'. There are also fields for 'pH', 'Conductivity', 'Humus' and 'Total nitrogen' for data obtained by particular analyses. In most cases, the sample plot size is 16 m^2 which is according the recommendations of Chytrý & Otýpková (2003).

At the beginning of September 2010, the Bulgarian Vegetation Database contained 5,901 relevés. Most of them are new and collected during the last decade by researchers of our working group. The sample plots were selected according to the standards as given by various European vegetation scientists (Braun-Blanquet 1964, Westhoff & van der Maarel 1973, Mueller-Dombois & Ellenberg 1974, Dengler et al. 2008). Exactly 1,491 relevés are from published papers (Velchev 1962, 1971, Drazeva 1963, Ganchev & Kochev 1962, 1964, Ganchev 1963, Ganchev et al. 1964, 1971, Bondev 1966, Kochev 1967, Stanev 1977a, 1977b, 1977c, 1980, Meshinev et al. 1994, 2000, Roussakova 2000, Tzonev 2002, 2009, Tzonev et al. 2008). The relevés included in the database are recorded by 30 authors. The period of relevé sampling is indicated in Figure 1 showing that the active data collecting is still going on. Relevés made before the year 2000 are mostly originating from literature.

Table 1: Diversity of classes in the Bulgarian vegetation. To the right, numbers of known alliances and associations are given.

Class	All.	Assoc.
Zosteretea	?	?
Ruppietea maritimae	?	?
Thero-Salicornietea strictae	1	3
Juncetea maritimi	1	1
Saginetea maritimae	?	?
Festuco-Puccinellietea	4	8
Crithmo-Staticetea	1	1
Cakiletea matitimae	1	1
Honckenyo-Elymetea arenarii	1	3
Ammophiletea	1	1
Asplenietea trichomanis	7	5
Adiantetea	1	?
Thlaspietea rotundifolii	7	6
Lemnetea	3	7
Charetea fragilis	2	?
Potametea	7	13
Montio-Cardaminetea	5	5
Isoeto-Littorelletea	1	?
Phragmito-Magnocaricetea	4	12
Scheucerio-Caricetea nigrae	4	15
Oxycocco-Sphagnetea	1	1
Molinio- Arrhenatheretea	12	10
Festuco-Brometea	11	19
Koelerio-Corynephoretea	3	1
Calluno-Ulicetea	1	1
Trifolio-Geranietea sanguinei	2	?
Helianthemetea guttati	4	2
Thero-Brachypodietea ramosi	?	?
Mulgedio-Aconitetea	4	4
Salicetea herbaceae	1	14
Elyno-Seslerietea	3	3
Carici rupestris-Kobresietea bellardii	1	5
Juncetea trifidi	7	13
Cisto-Micromerietea julianae	?	?
Salicetea purpureae	1	1
Populetea albae	3	2
Alnetea glutinosae	1	?
Nerio-Tamaricetea	1	?
Rhamno-Prunetea	3	2
Querco-Fagetea	7	12
Quercetea pubescentis	4	7
Quercetea roboris	2	?
Loiseleurio-Vaccinietea	4	9
Erico-Pinetea	3	3
Pyrolo-Pinetea	1	?
Vaccinio-Piceetea	4	4
Stellarietea mediae	10	22
Polygono-Poetea annuae	2	?
Artemisietea vulgaris	5	7
Galio-Urticetea	2	1
Epilobietea angustifolii	1	1
Bidentetea tripartitae	1	1
Oryzetea sativae	?	?

Up to now, there is no fully developed and authorized vegetation classification in Bulgaria according to the Braun-Blanquet approach. Closest to this goal is the overview of Tzonev et al. (2009). The lack of a complete checklist of syntaxa forced us to create a provisional one that has been included in the database. It goes down to the level of alliances with an indication of some associations published recently. A summary is provided in Table 1.

The major part of the relevés is dealing with herbaceous vegetation. Dry grasslands are represented by 2,614 relevés, halophytic vegetation is recorded by 260 relevés, mesophytic and hygrophytic grasslands are represented by 1,961 relevés, psammophytic vegetation (along the Black Sea coast) is recorded by 53 relevés, whereas plant communities that occur in mountain areas above the tree line are recorded in 820 relevés.

The distribution of relevés over the country territory (Fig. 2) indicates a rather uneven pattern. Quite a number of relevés represent transitional vegetation types, which are difficult to apply for classification purposes, but in the same time provide valuable information about vegetation changes in space and time. The inventory of grasslands (see Fig. 2) covers about 30% of all herbaceous communities in the lowlands up to 1,800 m a.s.l. (Meshinev et al. 2005).

The list of 25 most frequent species in the database ordered in descending value include: *Plantago lanceolata*, *Eryngium campestre*, *Galium verum*, *Lotus corniculatus*, *Achillea millefolium* agg., *Festuca valesiaca*, *Anthoxanthum odoratum*, *Teucrium chamaedrys*, *Agrostis capillaris*, *Trifolium repens*, *Convolvulus arvensis*, *Hypericum perforatum*, *Sanguisorba minor*, *Cichorium intybus*, *Dactylis glomerata*, *Trifolium pratense*, *Poa pratensis*, *Dichanthium ischaemum*, *Euphorbia cyparissias*, *Chrysopogon gryllus*, *Lolium perenne*, *Cynosurus cristatus*, *Potentilla argentea*, *Agrimonia eupatoria* and *Festuca rubra*.

The quality of the information in the Bulgarian Vegetation Database is comparable to that of other national databases (cf. Chytrý & Rafajová 2003). The most serious problem seems to be wrong species identification and overlooking of species in the field. Due to outdated taxonomic concepts in the first three volumes of the *Flora of Bulgaria* (Jordanov 1963–1966) and due to the errors in the *Field guide of Bulgarian vascular plants* (Kozhuharov 1992), many colleagues identify the plants by using additional sources (e.g. *Flora Europaea*: Tutin et al. 1968–1980). In order to avoid biases in further analyses, there is a need to use aggregates which include closely related species and/or subspecies.

Another imperfection of the database is the lack of data for some of the variables. For example 9.5% of the records miss information on altitude, 62.5% on latitude/longitude, 21.1% on total cover and 37.5% on plot size. For the relevés that lack latitude/longitude data we could add a UTM grid indication derived from the description of the locality, but the accuracy is rather low because the cells of the grid are squares with 10 km edge length.

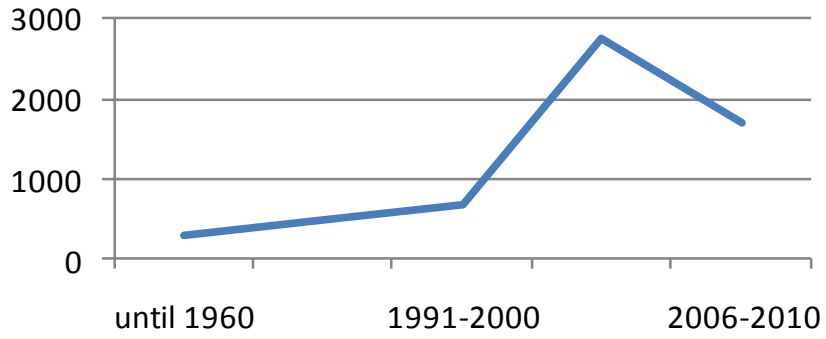


Fig. 1: Relevé sampling activity. For relevés from literature sources, the year of publication is used.

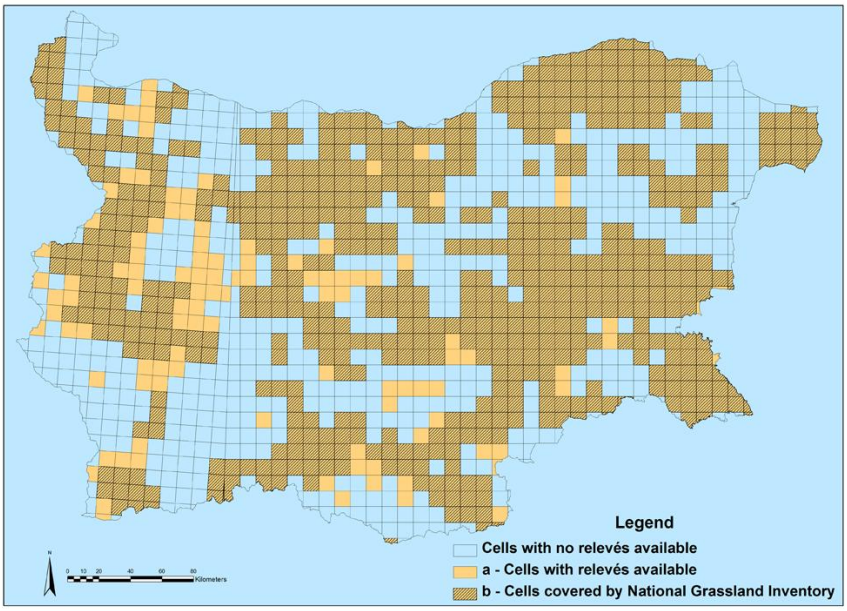
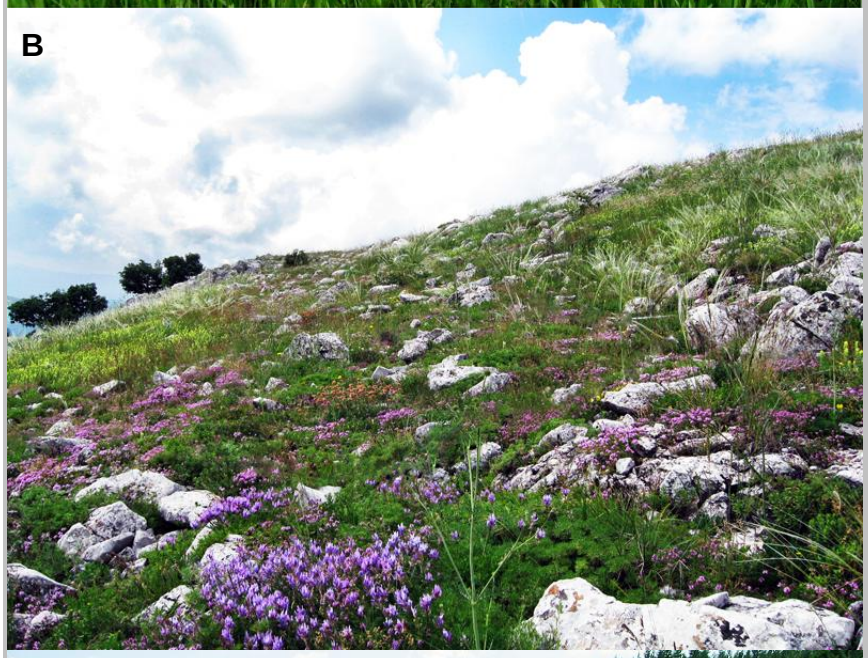


Fig. 2: Distribution of data collected over the country.

Future perspectives

Although considerable progress on national level has been gained, there are still much data waiting to be digitized from published and unpublished sources. A rough estimation of published data to be included in the database amounts to 2,900 relevés. About half of these are related to forest vegetation, most of the other half to grasslands. It is rather unclear how many unpublished records are still not included in the database. It should be mentioned that the number of Bulgarian scientists who do field recording on a regular basis is not very high and at the moment numbers less than 10 persons.

The Bulgarian Vegetation Database is still the only centralized information source of its kind on the Balkan Peninsula, but we expect that in the near future neighbouring countries will compile compatible databases and thus will provide opportunities for joint analyses on a regional level.



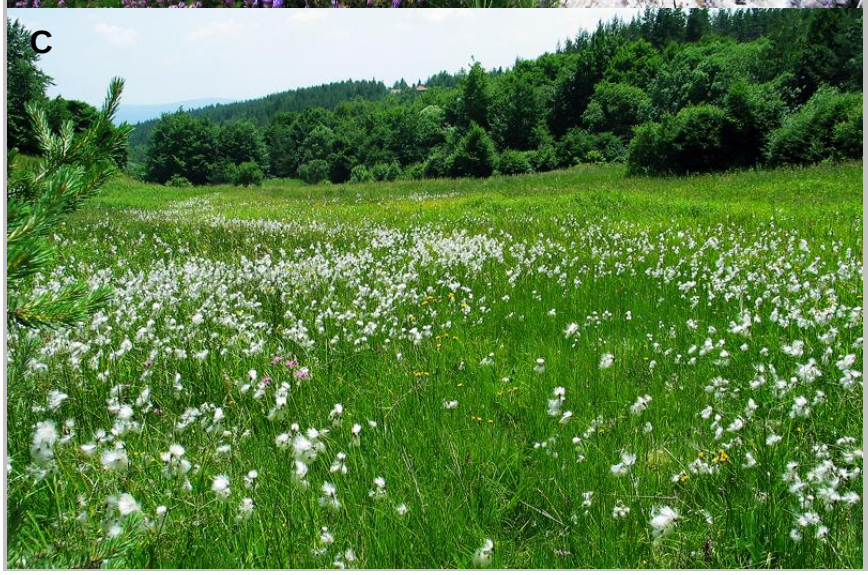


Plate: Vegetation types featured by the vegetation-plot database GIVD EU-BG-001.

A: Mesic grassland (*Molinio-Arrhenatheretea*) with *Orchis elegans* in the area of Sofia city. (Photo: I. Apostolova).

B: Dry grassland (*Festuco-Brometea*) with *Astragalus onobrychis, Anthylis vulneraria, Scabiosa triniifolia, Artemisia alba, Stipa eriocaulis* in Chepan Mt., Western Bulgaria (Photo: K. Vassilev).

C: Wet grassland (*Scheuchzerio-Caricetea fuscae*) with *Eriophorum latifolium* in Rhodope Mts. (Photo: I. Apostolova).

Our database is registered in the Global Index of Vegetation-Plot Databases (GIVD; Dengler et al. 2011). In conjunction with the 9th international Meeting on Vegetation Databases, which took place in 2010 at the University of Hamburg, a South-East European Subgroup of European Dry Grassland Group (SEEDGG within EDGG; http://www.edgg.org) was established at a particular workshop. One of the aims of this subgroup is the construction of a comprehensive database for dry grasslands in this part of Europe. Due to status of the Bulgarian Vegetation Database, it was decided that this database should be hosted in our working group.

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