



WetVegEurope: a database of aquatic and wetland vegetation of Europe

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Abstract: WetVegEurope is a research project (<http://www.sci.muni.cz/botany/vegsci/wetveg>) whose goal is to provide a synthesized formalized classification of the aquatic and marsh vegetation across Europe at the level of phytosociological associations. In order to achieve the project objective, a WetVegEurope database has been created (GIVD ID: EU-00-020, <http://www.givd.info/ID/EU-00-020>), which currently contains 375,212 vegetation plots of aquatic, marsh and wet vegetation types from 33 European countries. The WetVegEurope database includes datasets from pre-existing national and thematic databases and also 10,616 plots previously not digitalized or even unpublished. This database offers an extensive source of data for future studies on aquatic and marsh plant species and vegetation types at the European scale.

Keywords: databank; hydrophytic vegetation; macrophytic vegetation; marsh; phytosociology; TURBOVEG; vegetation plot; vegetation survey.

Abbreviations: EVA = European Vegetation Archive; EVS = European Vegetation Survey; GIVD = Global Index of Vegetation-Plot Databases.

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Introduction

Europe has long tradition of vegetation surveys using the phytosociological approach (Braun-Blanquet 1964), which ensures the collection of qualitative (plant species occurrence and co-occurrence) and quantitative (abundance) information about plant species and ecological information at stand scale using a relatively uniform sampling protocol. Vegetation plots sampled using this approach are an important source of information useful for vegetation classification and also for other ecological and biodiversity studies (Schaminée et al. 2009). In recent decades, many countries, especially European ones, have developed electronic databases of vegetation plots. This process has been supported especially by the international working groups European Vegetation Survey (EVS) and Ecoinformatics of the International Association

for Vegetation Science (IAVS), which organized various initiatives and provided tools to improve research in vegetation ecology and principally vegetation classification studies (Schaminée et al. 2009; Dengler et al. 2012). The establishment and growth of vegetation databases was promoted by the release of the TURBOVEG software (Hennekens 1995), a program currently largely used in Europe and officially accepted by the EVS as an international standard for database management.

In the last three years, the European Vegetation Archive (EVA; Chytrý et al. 2014; <http://euroveg.org/eva-database>) was developed and several projects using large sets of vegetation plots started within the framework of EVA. One of the first of these projects, started in 2013 and still in progress, is WetVegEurope. This project aims at compiling and synthesizing available syntaxonomic information and producing formalized vegetation classifi-

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GIVD Fact Sheet

GIVD Database ID: EU-00-020		Last update: 2015-05-27	
WetVegEurope		Web address: http://www.sci.muni.cz/botany/vegsci/wetveg	
Database manager(s): Flavia Landucci (flavia.landucci@gmail.com)			
Owner: 3% (data not included in other databases) is of the Vegetation Science Group, Department of Botany and Zoology, Masaryk University, 97% is of many different institutions.			
Scope: The database aims to be a collection, as complete as possible, of aquatic and wetland vegetation plots of Europe for vegetation classification studies. Therefore it is constituted by both plots coming from preexisting databases (375,212 plots) and completely new ones (10,616 plots). It contains plots of 33 European countries mainly of Lemnetaea, Potamogetonetea and Phragmito-Magno-Caricetea classes, but also of other related vegetation types.			
Availability: according to a specific agreement		Online upload: no	Online search: no
Database format(s): TURBOVEG		Export format(s): TURBOVEG, MS Access, Excel, CSV file, plain text file	
Plot type(s): normal plots		Plot-size range: 0.1–9000 m ²	
Non-overlapping plots: 375,212	Estimate of existing plots: 450,000	Completeness: 83%	Status: completed and continuing
Total no. of plot observations: 375,212	Number of sources (biblioreferences, data collectors): 4,448		Valid taxa: 7,065
Countries: AT: 2.0%; BE: 0.2%; BG: 0.1%; BY: 0.1%; CZ: 14.9%; DE: 13.6%; EE: 0.2%; ES: 1.1%; FR: 9.7%; GB: 2.7%; GR: 0.1%; HR: 0.9%; HU: 0.2%; IE: 3.3%; IT: 1.7%; LT: 0.6%; LV: 0.5%; NL: 34.5%; PL: 2.5%; RO: 0.2%; RS: 0.2%; RU: 3.9%; SI: 1.1%; SK: 3.6%; UA: 1.6%			
Forest: NA — Non-forest: aquatic: NA; semi-aquatic: NA; arctic-alpine: NA; natural: NA; semi-natural: NA; anthropogenic: NA			
Guilds: all vascular plants: 73%; bryophytes (terricolous or aquatic): 16%; lichens (terricolous or aquatic): 3%; algae (terricolous or aquatic): 2%			
Environmental data: altitude: 28%; slope aspect: 14%; slope inclination: 29%; surface cover other than plants (open soil, litter, bare rock etc.): 1%; soil pH: 0%; other soil attributes: 0%			
Performance measure(s): presence/absence only: 0%; cover: 100%			
Geographic localisation: GPS coordinates (precision 25 m or less): 6%; point coordinates less precise than GPS, up to 1 km: 2%; small grid (not coarser than 10 km): 76%; political units or only on a coarser scale (>10 km): 17%			
Sampling periods: < 1919: 0.0%; 1920–1929: 0.1%; 1930–1939: 0.8%; 1940–1949: 1.0%; 1950–1959: 1.2%; 1960–1969: 5.9%; 1970–1979: 14.4%; 1980–1989: 14.2%; 1990–1999: 14.2%; 2000–2009: 13.8%; 2010–2019: 2.0%; unknown: 21.3%			
Information as of 2015-06-01; further details and future updates available from http://www.givd.info/ID/EU-00-020			

cation of aquatic (*Lemnetaea* and *Potamogetonetea* classes) and marsh (*Phragmito-Magno-Caricetea* class) plant communities of Europe at the level of phytosociological associations using the Cocktail method (Bruehlheide 1997) as extended by Landucci et al. (2015). It further aims at characterizing each association in terms of ecology, distribution and conservation status (Landucci et al. 2014). The present database, which take its name (WetVegEurope) from the project, has been developed to achieve these goals.

Data collection

Because the WetVegEurope project started in parallel to EVA, which at that time was in the stage of developing technical procedures, the first phase of data compilation was achieved through contacting the owners or managers of national, local and thematic databases (concerning aquatic and wetland vegetation types or habitats) from different European countries (WetVegEurope contributors), rather than through data requests to EVA as it is now common. The main databases were identified using the Global Index of Vegetation-Plot Databases (GIVD), a metadata repository of vegetation databases from across the world (Dengler et al. 2011). Additional experts in the

fields of aquatic and wetland vegetation able to provide original data were also contacted and invited to join in the project. The impossibility of using EVA and the initial absence of technical procedures for working with multiple databases meant that the data collection and management took a long time. Nevertheless we were also able to identify and digitalize previously unavailable data even from countries with no national vegetation database or a database that is incomplete with respect to aquatic or wetland vegetation.

Both vegetation plots containing at least one aquatic or marsh species that is, according to the literature, diagnostic of the vegetation of the *Lemnetaea*, *Potamogetonetea* or *Phragmito-Magno-Caricetea* classes, and plots of spatially or successional related vegetation were included in the WetVegEurope database. After the first round of data collection, a gap analysis of missing syntaxa (especially associations) was performed, based on a comparison of the plots assigned to the associations in the database with the national vegetation classifications reported in the literature. In the second round of data collection, the database was supplemented with data extracted from the literature, especially with plots documenting rare vegetation types of the above-mentioned classes and nomenclature type relevés of associations, in order to close the gaps as much as possible.

Table 1. Content of the WetVegEurope database ordered by country, with the corresponding numbers of plots, source database and its GIVD code if applicable. Data not included in the GIVD-registered databases on 15 May 2015 are in bold. For further details on the databases, see Supplement S1.

Country	No. of plots	Source databases	GIVD code
Andorra	104	Sophy	EU-FR-003
Austria	7,395	Austrian Vegetation database	EU-AT-001
	20	Sophy	EU-FR-003
Belarus	390	New Data	
Belgium	742	FlaWet 1.0 [part of INBOVEG]	EU-BE-002
	623	Sophy	EU-FR-003
Bosnia and Herzegovina	64	New Data	
Bulgaria	356	New Data	
Croatia	3,487	Phytosociological Database of Non-Forest Vegetation in Croatia	EU-HR-001
	16	CoenoDat Hungarian Phytosociological Database	EU-HU-003
	7	New Data	
Czech Republic	55,739	Czech National Phytosociological Database	EU-CZ-001
	34	Slovak Vegetation Database	EU-SK-001
Estonia	750	Estonian Vegetation Database	EU-EE-001
France	29,584	Sophy	EU-FR-003
	77	Iberian and Macaronesian Vegetation Information System (SIVIM)	EU-00-004
Germany	28,376	VegMV	EU-DE-001
	351	BioChangeMeadow	EU-DE-009
	7,000	VegetWeb	EU-DE-013
	14,817	German Vegetation Reference Database (GVRD) [including also private data of T. Sperle]	EU-DE-014
	2,089	Sophy	EU-FR-003
	23	New Data	
Greece	352	Hellenic Natura 2000 Vegetation Database (HelNatVeg)	EU-GR-005
	453	New Data	
Hungary	832	CoenoDat Hungarian Phytosociological Database	EU-HU-003
	16	Slovak Vegetation Database	EU-SK-001
	14	New Data	
Ireland	12,381	Irish Vegetation Database	EU-IE-001
	73	New Data	
Italy	6,348	VegItaly	EU-IT-001
	326	Sophy	EU-FR-003
Latvia	1,896	Mire Vegetation Database of Latvia	EU-LV-002
Lithuania	2,244	Lithuanian Vegetation Database	EU-LT-001
Luxembourg	53	Sophy	EU-FR-003
Macedonia	24	New Data	
Monaco	5	Sophy	EU-FR-003
Netherlands	128,760	Dutch National Vegetation Database	EU-NL-001
Norway	180	Sophy	EU-FR-003

Table 1. cont.

Country	No. of plots	Source databases	GIVD code
Poland	9,679	Polish Vegetation Database	EU-PL-001
	5	Slovak Vegetation Database	EU-SK-001
	4	New Data	
Portugal	182	Iberian and Macaronesian Vegetation Information System (SIVIM)	EU-00-004
Romania	764	New Data	
Russia	14,853	Lower Volga Valley Phytosociological Database	EU-RU-002
	1,438	New Data	
	3	Sophy	EU-FR-003
Serbia	1,846	Serbian vegetation database of D. Cvijanović, D. Jenacković, V. Randelović, S. Radulović, M. Vucković & M. Zivković	Not in GIVD
	10	New Data	
Slovakia	12,985	Slovak Vegetation Database	EU-SK-001
	59	New Data	
Slovenia	4,110	Vegetation Database of Slovenia	EU-SI-001
	15	New Data	
Spain	3,867	Iberian and Macaronesian Vegetation Information System (SIVIM)	EU-00-004
	929	Sophy	EU-FR-003
	147	New Data	
Switzerland	2,310	Sophy	EU-FR-003
	8	New Data	
Ukraine	1,066	Aquatic vegetation of the western part of Ukraine	EU-UA-003
	4,921	Private database of D. Dubyna, T. Dziuba & S. Iemelianova	Not in GIVD
United Kingdom	9,959	UK National Vegetation Classification Database	EU-GB-001
	25	Sophy	EU-FR-003
Outside Europe	26	Lower Volga Valley Phytosociological Database	EU-RU-002

The database management system TURBOVEG 2 (Hennekens & Schaminée 2001) and the prototype of TURBOVEG 3 have been used to store and manage the database. TURBOVEG 3 is particularly suitable for managing data coming from different sources. It allows the preservation of the original structure and metadata of the primary databases and the management and unification of species nomenclature from different sources.

Current database content

On 15 May 2015, the database WetVegEurope (GIVD ID: EU-00-020, <http://www.givd.info/ID/EU-00-020>) included 375,212 vegetation plots from 33 European countries. Most plots, 97% of the total dataset, come from the pre-existing national, local or thematic databases registered in GIVD (Table 1). New plots digitalized

from the literature or coming from private databases, some of them unpublished sum up to 10,616 and account for 3% of the total dataset. This subset of new plots includes data representing rare associations from several countries and unique data of aquatic and wetland vegetation from Belarus, Bosnia and Herzegovina, Bulgaria, Romania and Serbia, which were previously unavailable either in a digital format or in the existing literature.

A large proportion of plots (84%) in the database are assigned to phytosociological syntaxa, however each country and even different researchers in the same country follow slightly different classification systems, making it difficult to provide a preliminary overview of the vegetation units included in the database. Nevertheless, about 20% of the plots belong to aquatic vegetation of the *Lemnetea* and *Potamogetonetea* classes, 30% to marsh vegetation of the *Phragmito-Magno-Caricetea* class and the remaining 50% represent other vegetation

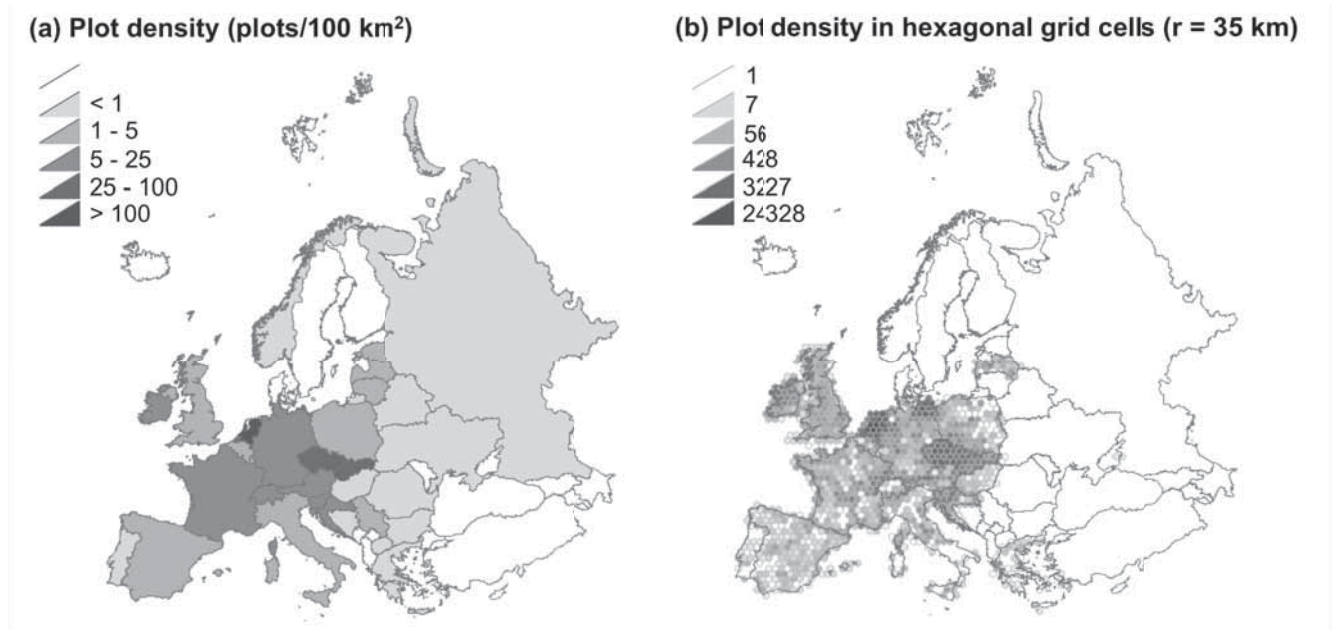


Fig. 1. Density of vegetation plots in the WetVegEurope database by countries recalculated to 100 km² units (a) and density of plots with geographic coordinates in hexagonal grid cells with a radius of 35 km (cell area 3182.64 km²) (b). Discrepancies between the two maps are due to the fact that data from some countries or regions are without precise coordinates.

types often occurring in contact with the above-mentioned vegetation classes (e.g. *Charetea*, *Ruppietea maritima*, *Spartinetea maritima*, *Thero-Salicornietea*, *Salicornietea fruticosae*, *Juncetea maritimi*, *Montio-Cardaminetea*, *Littorelletea uniflorae*, *Isoeto-Nano-Juncetea*, *Scheuchzerio palustris-Caricetea fuscae*, *Oxycocco-Sphagnetetea*, *Oryzetea sativae*, *Bidentetea*, *Polygono-Poetea annuae*, *Stellarietea mediae*, *Artemisietea vulgaris*, *Galio-Urticetea*, *Epilobietea angustifolii* and *Molinio-Arrhenatheretea*).

Despite the efforts to cover both geographic and syn-taxonomic gaps as much as possible, the data are not uniformly distributed across Europe (Fig. 1) with most plots coming from central Europe. This pattern generally reflects the current data availability, which is related to the different length and strength of the phytosociological tradition in different countries. Of the WetVegEurope vegetation plots, 84% are georeferenced with geographical coordinates, however these plots are mainly those from existing national or international thematic databases.

Data properties and connections to other databases

WetVegEurope is a European thematic database initially established by a consortium of existing national and regional databases to which additional data sets have been added for the purposes of the WetVegEurope project.

Therefore it contains copies of datasets coming from other databases, which are the properties of the original data contributors. The managers and owners of the original databases (<http://www.givd.info>; Supplement S1) are responsible for the management and administration of these data under their internal rules. The new data that were not taken from other databases are under the custody of Flavia Landucci, the leader of the WetVegEurope project.

All large national databases involved in the WetVegEurope database are members of EVA. Also small thematic databases that are not separate members of EVA (3,712 plots in total) were stored in the WetVegEurope. Further data previously not available in database format (10,616 plots) were stored in the WetVegEurope database and contributed to EVA as a part of this database. This means that the WetVegEurope database contributed in total 14,328 new plots to EVA (on 1 April 2015). Requests for the use of these data for scientific purposes or applied research can be handled through EVA under the EVA Data Property and Governance Rules or (for small and local datasets) contacting directly the WetVegEurope manager or the national database managers. WetVegEurope, as well as all the national databases involved, is also a partner of sPlot (Dengler et al. 2014), an initiative hosted by the German Centre of Integrative Biodiversity Research (iDiv), which aims at analyzing plant trait-environment relationships across global biomes.

Future perspectives

Considering the general goal of the project of compiling and synthesizing existing data and providing a formalizing classification of European aquatic (*Lemnetea* and *Potamogetonetea* classes) and marsh (*Phragmito-Magno-Caricetea* class) vegetation, the database WetVegEurope can be considered rather complete, as it already includes about 80% of the syntaxa reported in the literature. Nonetheless new data will be added in the future, especially from less documented regions and vegetation types. After completing the WetVegEurope project the assignments of individual vegetation plots to the phytosociological associations defined using the Cocktail method will be added to the database, in addition to the original classification that is contained in the database now. This additional information together with the set of formal rules that will be created with the Cocktail method will represent an important tool providing consistent classification, applicable also to new data from Europe and neighbouring areas. Beyond the objectives of the WetVegEurope project, the database will be available for other research projects and applications in nature conservation.

Author contributions

F.L., the leader of the WetVegEurope project, and M.Ř., the technical manager of the WetVegEurope database, carried out a large part of the data digitalization. All the other authors contributed to the creation and development of the database by providing published or unpublished data in the electronic format or as various kinds of hardcopies.

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