Vegetation-plot data and databases in Europe: an overview

Přehled vegetačních dat a databází v Evropě

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During the last decade many electronic databases of vegetation plots, mainly phytosociological relevés, were established in different European countries. These databases contain information which is extremely valuable for both testing various macroecological hypotheses and for nature conservation surveying or monitoring. The aim of this paper is to provide estimates of the number of vegetation plots there are in Europe, how many are stored in an electronic format and to assess their distribution across European countries and regions. We sent a questionnaire to the managers of national or regional databases of vegetation plots and other prominent vegetation ecologists. Meta-data obtained in this way indicate that there are > 4,300,000 vegetation-plot records in Europe, of which > 1,800,000 are already stored electronically. Of the electronic plots, 60% are stored in TURBOVEG databases. Most plot records probably exist in Germany, the Netherlands, France, Poland, Spain, Czech Republic, Italy, UK, Switzerland and Austria. The largest numbers of plots per unit area are in the Netherlands, Belgium, Denmark and countries of central Europe. The most computerized plots per country exist in the Netherlands (600,000), followed by France, the Czech Republic and the UK. Due to its strong phytosociological tradition, Europe has many more vegetation plots than any other part of the world. This wealth of unique ecological information is a challenge for future biodiversity studies. With the alarming loss in biodiversity and environmental problems like global warming and ongoing changes in land use, there is an urgent need for wide-scale scientific and applied vegetation research. Developments of information systems such as SynBioSys Europe and facilitation of data flow between the national and regional databases should make it easier to use these vegetation-plot data.

Keywords: biodiversity, eco-informatics, Habitats Directive, macroecology, nature conservation, phytosociology, relevé, TURBOVEG

Introduction

Vegetation research based on plot sampling has a long tradition in Europe, dating back to the late 19th and early 20th century. Among the basic approaches, the floristic-sociological, or phytosociological, approach became the standard for many European vegetation scientists (e.g., Braun-Blanquet 1928, Westhoff & van der Maarel 1973, Mueller-Dombois & Ellenberg 1974, Dengler et al. 2008). This approach consists of the description of vegetation, including total species composition, in plots ranging in size from < 1 m^2 to a few hundreds m^2 (Chytrý & Otýpková 2003), so-called relevés, and the subsequent analysis of the data. Phytosociological studies resulted in local and regional overviews of vegetation types, based on the classification of the sampled relevés. In addition to phytosociological and classification studies, vegetation plots were extensively sampled for other purposes, including forest site analysis, monitoring of vegetation change, and assessing the resources of vegetation at the landscape level, like the Countryside Survey in Great Britain (e.g., Firbank et al. 2003, Smart et al. 2003).

For many years, vegetation-plot data had to be sorted and analyzed by hand. At the end of the 1980s, the digital storage and numerical analysis of data, which had started in the 1960s, became very much easier with the development of personal computers and specialized software (Mucina & van der Maarel 1989). At present, there are many large electronic databases of vegetation plots across Europe, most of them organized on a national or regional basis. These databases are an extremely rich source of information on European vegetation and how it has changed over the last one hundred years. Linking these databases together to support quantitative analyses of patterns and trends in vegetation diversity across Europe is a big challenge. The first step towards meeting this challenge is an inventory of the existing data and databases.

The aims of this paper are to (i) describe the background of vegetation data banking in Europe, (ii) provide estimates of the number of existing and computerized vegetation plots in Europe, (iii) describe the spatial distribution of existing and computerized vegetation plots across Europe, and (iv) review the major vegetation data banking initiatives in Europe. Finally, the relevance of vegetation-plot data for wider-scale scientific and applied studies is briefly reviewed.

Data banking activities of the European Vegetation Survey

In March 1992, phytosociologists of 15 European countries gathered in Rome to launch an initiative to encourage vegetation surveys at the European level. The mission of the group, as indicated by its name – European Vegetation Survey (EVS) – is to develop a more coherent picture of vegetation across Europe and foster collaboration among vegetation researchers (Pignatti 1990, Mucina et al. 1993, Rodwell et al. 1995). Established as a Working Group of the International Association for Vegetation Science (IAVS), annual workshops have been convened, usually in Rome but sometimes at other places (Erice and Catania, Italy; Ioannina, Greece; Brno, Czech Republic). Besides providing support for national surveys of vegetation, shared commitments to common data standards and the development of software and an electronic network for data exchange, the EVS has devoted particular meetings to understanding the floristic composition and ecology of some major vegetation types across Europe, for example beech woods in 1998, dry grasslands in 2000, salt marshes in 2001 and dwarf-shrub vegetation in 2005. Although initially a small group, the meetings have become a fixed point in the schedule of many European vegetation scientists. The meeting in Brno (May 2008) was attended by over 200 participants, with 32 countries represented (Chytrý 2008). Within the activities of the EVS, an overview of vegetation types in Europe (including Macaronesia) was developed, starting at the highest level, the phytosociological class (Mucina 1997) and then moving down to the level of alliances (Rodwell et al. 2002).

The development of compatible software, one of the objectives of the European Vegetation Survey, encourages the compilation of national or regional vegetation-plot databases and facilitates their linking in a network that would enable easy data exchange. Such a network, or possibly even a comprehensive European database of vegetation-plot data, will provide a solid basis for large-scale vegetation classification, assessment of the processes in vegetation and macro-ecological analyses across the continent. It will also make it possible to produce reliable descriptions of individual types of European vegetation, including their diagnostic species, distribution and habitat relationships (e.g., Zuidhoff et al. 1995).

The major software tool for vegetation database compilation within the European Vegetation Survey is TURBOVEG (Hennekens & Schaminée 2001). This vegetation database management software was originally designed for the purposes of national vegetation classification project in the Netherlands. At the 1994 EVS meeting, TURBOVEG was accepted as an international standard management system for vegetation data (Schaminée & Hennekens 1995). TURBOVEG is used for input, storage, management and retrieval of vegetation-plot data. It also includes functions for data processing and presentation. This software package is currently used in more than 30 countries throughout Europe and beyond, resulting in a series of national vegetation databases. Rapid amassing of vegetation plots in TURBOVEG databases encouraged the development of software tools for the analysis of these data, including both manual sorting of vegetation tables and various methods of statistical analysis. At the beginning, this was done using the MEGATAB program within the TURBOVEG package, and since 1998 by the JUICE program (Tichý 2002), which is fully interfaced with TURBOVEG and contains a plethora of analytical tools for data sets ranging in size from few to tens of thousands vegetation plots.

Previous reports on European vegetation-plot data

There have been two previous attempts to estimate the number of phytosociological relevés existing in Europe. First, Rodwell (1995) sent out a questionnaire to the national representatives of European countries and received responses from 18 countries. Based on these data, he concluded that there were well over one million relevés in Europe at that time, with the largest national estimates being up to 400,000 in France, about 200,000 in Germany and 160,000 in the Netherlands. Second, Ewald (2001) made a world-wide survey of vegetation databases, also based on a questionnaire sent to the database managers. He estimated there were 775,000 computerized relevés in European databases, with largest number in the Netherlands (350,000), France (137,000) and Germany (94,000).

When Rodwell's questionnaire was sent out, only four European countries had a national programme of vegetation surveys (Austria, the Netherlands, Slovakia and the United Kingdom) and only one national vegetation monograph of the new generation (Pflanzengesellschaften Österreichs; Mucina et al. 1993) was completed. The UK National Vegetation Classification had published its first three volumes (Rodwell 1990, 1991, 1992), whereas the first two volumes of De Vegetatie van Nederland and the first one of Rastlinné spoločenstvá Slovenska were in press (Schaminée et al. 1995a, 1995b, Valachovič et al. 1995). Since then, there has been considerable progress in the surveying of vegetation in Europe. Apart from the activities of the European Vegetation Survey, an important development was the UK Darwin Initiative, which assisted a number of Eastern

European countries to start national programmes and establish national vegetation databases (e.g., Solomeshch et al. 1997).

Therefore the previous estimates of the numbers of plots quickly became outdated due to ongoing sampling in the field, increasing number of plots added to the electronic databases and errors in previous estimates. In particular, it appears that earlier country-based estimates of the number of vegetation plots tended to be gross underestimates. Establishment of national vegetation databases soon revealed that the actual numbers of vegetation plots are much higher, in some cases by more than a factor of two, than the original estimates.

The current survey of vegetation-plot data and databases in Europe

In order to obtain a more accurate estimate of the total number of vegetation plots existing in Europe, the number of plots already existing in electronic form, and their distribution across the continent, we sent out a questionnaire to the managers of the national vegetation databases and other leading vegetation researchers in 2008 and 2009. We requested information on the total numbers of vegetation plots, numbers of plots in electronic format, whether the electronic plots are stored in TURBOVEG and whether there is a central database in the country. The subject of the enquiry, vegetation plots, were broadly defined as phytosociological relevés of the Braun-Blanquet type (Westhoff & van der Maarel 1973, Mueller-Dombois & Ellenberg 1974, Dengler et al. 2008) or any other vegetation plots that contained records of full species composition of at least vascular plants with some kind of quantitative estimate of species importance (e.g., cover) in plots of sizes up to 1000 m^2. The European Vegetation Survey has accepted standards for relevé sampling (Mucina et al. 2000b), but most of the older records do not meet these standards. Still, these records can be useful for specific purposes even though they lack some of the information currently included when sampling new plots in the field. Therefore the EVS standards were not used to filter the information included in this survey.

We received responses from 35 countries. We did not send requests for information to the smallest European countries (Andorra, Liechtenstein, Monaco, San Marino and the Vatican) and small countries on the border between Europe and Asia (Cyprus, Armenia, Azerbaijan and Georgia), but did include the whole of Russia and Turkey. We did not find a national representative or receive a clear response from Albania, Belarus, Kosovo, Malta, Moldova, Montenegro and Poland. In order to avoid double reporting of the same plots we did not include databases compiled by various individuals or working groups that deal with a particular vegetation type throughout Europe, because such databases often include many plots already contained in national databases. Probably the most outstanding example of such a database is that of the Working Group on Dry Grasslands in the Nordic and Baltic region, containing 11,700 computerized plots (Dengler et al. 2006).

In some cases, the responses were fairly detailed, including information on the number of plots for different vegetation types, as well as total numbers. In other cases, especially for countries where there is no vegetation data banking project, we received very rough estimates of the total numbers of existing plots.

For large countries from which there was no or an unclear response we estimated at least the total number of plots. The estimation for Poland was made assuming a similar tradition of vegetation sampling as in the Czech Republic and Slovakia, adjacent countries for which there were rather reliable figures. A particular problem was estimating the number of plots for Germany, because this country has the strongest tradition of vegetation sampling and, therefore, undoubtedly many more vegetation plots than any other European country. However, there are several data banking projects in Germany, each with specific objectives, and each includes only a small fraction of vegetation plots existing in the country. The only database in Germany which consistently includes all vegetation types over a large area, is the database of the federal state of Mecklenburg-Vorpommern (Berg & Dengler 2004). This database includes 55,000 vegetation plots, but there are still about another 100,000 non-computerized plots in the regional forest bureau (Landesamt für Forstplanung) in Schwerin (C. Berg & F. Jansen, pers. comm.). If we assume that the incidence of sampling of vegetation in Mecklenburg-Vorpommern is the same as in the whole of Germany, we can use these data to estimate the total number of vegetation plots for Germany. Mecklenburg-Vorpommern makes up 6.5% of the total area of Germany and contains 2.1% of the population. If the sampling effort was proportional to area, the total number of plots for Germany would be over 2,300,000. An alternative assumption would be that the number of plots is proportional to the number of vegetation ecologists, which is related to population size; using this assumption the number of plots for Germany would be over 7,000,000, but the tradition of phytosociological research in Mecklenburg-Vorpommern is weaker than in northwestern or southeastern Germany (J. Dengler, pers. comm.). Thus, a very conservative estimate would be 1,500,000 vegetation plots for the other federal states of Germany, but the actual number could be much larger.

Survey results

The current survey (Table 1) suggests that there are records of more than 4,300,000 vegetation plots in Europe, of which more than 1,800,000 are already computerized. Of the computerized plots, about 75% are stored in central databases of the countries or regions concerned and 60% in TURBOVEG format. Most of the records of vegetation plots are for countries in central and western Europe (Fig. 1a), particularly Germany, followed by the Netherlands (625,000 plots) and France (more than 350,000 plots). Total numbers of plots of between 100,000 and 200,000 are estimated to exist for Poland, Spain, Czech Republic, Italy, UK, Switzerland and Austria. There are relatively few vegetation plots recorded for Scandinavia, except Denmark, and some Balkan countries. The highest density of vegetation plots (number of plots per unit area; Fig. 1b) is recorded for the Netherlands, followed by several north-western and central European medium-sized countries such as Denmark, Belgium, Czech Republic, Slovakia and Slovenia. The highest number of computerized plots per country is also recorded for the Netherlands (600,000), followed by France, the Czech Republic and the United Kingdom (Fig. 1c). The highest number of computerized plots per unit area is available in medium-sized countries in north-western and central Europe, namely the Netherlands, Belgium, Denmark, Switzerland, Czech Republic and Slovakia (Fig. 1d). TURBOVEG is used for storing vegetation-plot data in different parts of Europe, most widely in the Netherlands, Belgium, Czech Republic and Slovakia (Figs. 1e, f). References to more detailed information on national or regional vegetation databases are summarized in Table 2.

Table 1. – Overview of vegetation-plot data in European countries and regions compiled from the information provided in response to a questionnaire. Countries for which information is missing are not included.

Country/region	Respondent	Total no. of plots	No. of computerized plots	No. of plots in central database	No. of plots in other databases	% of plots in TURBOVEG format of all computerized plots	No. of published but not computerized plots	No. of unpublished and not computerized plots	Vegetation types in central database or other large databases
Austria	W. Willner	100,000	47,000	37,000	10,000	80%	40,000	13,000	all types, mainly forests
Belgium (Flandres)	M. Hoffmann	58,000	45,300	40,700	4600	73%	unknown	unknown	all types
Bosnia and Herzegovina	S. Redžić	27,000	7000	7000	0	20%	10,000	10,000	all types
Bulgaria	I. Apostolova	> 6600	> 3700	3700	unknown	100%	2900	unknown	grasslands
Croatia	Z. Stančić	> 12,000	9000	6000	3000	100%	3000	unknown	mostly grasslands, wetlands and forests
Czech Republic	M. Chytrý	150,000	140,000	135,000[1]	5000	99%	2000	8000	all types
Denmark	R. Ejrnæs	85,000	78,000[2]	70,000	8000	0%	2000	5000	all types of terrestrial vegetation
Estonia	J. Paal	4500	3500	1200	2300	0%	0	1000	forests, grasslands, wetlands and watercourses
Faeroe Islands	A.-M. Fossaa	1000	700	700	0	70%	300	0	all types
Finland	R. Virtanen	> 15,000	> 5000	no central DB	> 5000	unknown	> 10,000	unknown	forests, agricultural habitats
France	J.-C. Gégout	> 350,000	> 310,000	300,000[3]	> 10,000	0%	unknown	40,000	all types
Germany: Mecklenburg-Vorpommern	C. Berg, F. Jansen	155,000	55,000	55,000	0	98%	0	100,000	all types
Germany: other federal states[4]		1,500,000							
Germany: other federal states	U. Jandt[5]		25,000	0	25,000	30%	unknown	unknown	mainly grasslands and forests
Germany: Wadden Islands	J. Petersen		4500	0	4500	100%	unknown	unknown	mainly dunes, salt marshes, and grasslands
Germany: VegetWeb	R. May		8000	0	8000	0%	unknown	unknown	mainly forests
Greece: Crete	E. Bergmeier	6800	6500	3500	3000	60%	0	300	all types
Greece: mainland	P. Dimopoulos, E. Bergmeier	25,000	19,500	4500	15,000	100%	3000	2500	mainly forests
Hungary	J. Csiky	45,000	26,000	11,000	15,000	50%	8000	11,000	all types, mainly natural and semi-natural vegetation
Iceland	Á. Elmarsdóttir	> 1050	1050	1050	0	0%	unknown	unknown	all types
Ireland	U. Fitzpatrick	24,000	7000	7000	unknown	100%	2000	15,000	all types
Italy	R. DiPietro	150,000	20,000	no central DB	20,000	5%	30,000	100,000	–

Country/region	Respondent	Total no. of plots	No. of computerized plots	No. of plots in central database	No. of plots in other databases	% of plots in TURBOVEG format of all computerized plots	No. of published but not computerized plots	No. of unpublished and not computerized plots	Vegetation types in central database or other large databases
Latvia	M. Pakalne	12,700	8200	no central DB	8200	35%	500	4000	all types
Lithuania	V. Rašomavičius	34,000	16,000	no central DB	16,000	45%	3000	15,000	all types
Luxembourg	C. Ries	18,000	17,000	no central DB	unknown	90%	unknown	unknown	all forest types
Macedonia	R. Kusterevska, V. Matevski	3800	700	no central DB	700	11%	1700	1400	all types
Netherlands	J. H. J. Schaminée	625,000	600,000	490,000	110,000	100%	20,000	5000	all types
Norway	R. Halvorsen, A. Moen	25,000	6000	no central DB	6000	unknown	unknown	unknown	–
Poland[6]	–	180,000	15,000	no central DB	15,000	unknown	unknown	unknown	–
Portugal	X. Font	20,000	1500	1500[7]	unknown	unknown	unknown	unknown	all types
Romania	A. Szabó, E. Ruprecht	> 70,000	unknown	no central DB	unknown	<1%	60,000	10,000	–
Russia	N. Ermakov, A. Sorokin	57,000	35,000	no central DB	35,000	75%	16,000	6000	most types
Serbia	D. Lakušić	> 16,000	300–400	no central DB	300–400	unknown	16,000	unknown	all types
Slovakia	K. Hegedüšová, J. Šibík	85,000	55,000	50,000	5000	100%	20,000	10,000	all types
Slovenia	A. Čarni	> 22,000	>12,000	12,000	unknown	100%	4000	6000	all types
Spain	X. Font	165,000	77,000	77,000	0	20%	73,000	15,000	all types
Sweden	M. Diekmann	8000	1000	no central DB	1000	unknown	3000	4000	–
Switzerland	T. Wohlgemuth, P. Vittoz	112,000	68,000	47,500	20,500	0%	21,000	23,000	forests and mires
Turkey	E. Uğurlu	20,000	1200	no central DB	1200	100%	8800	10,000	forests
Ukraine	D.M. Yakushenko	43,000	10,000	8000	2000	8%	3500	29,500	all types
United Kingdom	J. S. Rodwell, L. C. Maskell	132,000	107,000	82,000[8]	25,000	24%	20,000	5000	all types
Total		**> 4,364,000**	**> 1,852,000**	**> 1,451,000**	**> 384,000**				

[1]Includes 88,000 plots in the Czech National Phytosociological Database and 47,000 forest plots in the database of the Forest Management Institute.
[2]About 50% of computerized plots are repeated records from permanent plots.
[3]Includes 187,000 plots in SOPHY database, 9000 plots in EcoPlant database and 110,000 plots in the database of the French national forest inventory (i.e. a total of 300,000 plots, accounting for some overlap).
[4]Given that the estimate of the number of plots in Mecklenburg-Vorpommern is 155,000, and this state makes up 6.5% of the total territory of Germany, the number of plots in the whole of Germany would be over 2,300,000. Here we use 1,500,000 as a conservative estimate of the total number of plots for the other federal states of Germany.
[5]Database of the BFG Biodiversity Exploratories Programme.
[6]Estimation of the total number of plots is based on the more reliable estimates for the Czech Republic and Slovakia, countries with a similar phytosociological tradition to Poland
[7]Iberian SIVIM database is considered here as the central database for Portugal.
[8]Includes 33,000 plots from the National Vegetation Classification database and 49,000 plots from the Countryside Survey database.

Table 2. – References to national or regional databases.

Country	Sources
Austria	http://vegedat.vinca.at
Belgium	http://www.inbo.be/content/page.asp?pid=BIO_NT_vlavedat
Croatia	Stančić (2008)
Czech Republic	Chytrý & Rafajová (2003); http://www.sci.muni.cz/botany/vegsci/dbase.php?lang=en
Denmark	http://www.danveg.dk, http://www.naturdata.dk
France	SOPHY database: Brisse et al. (1995); http://jupiter.u-3mrs.fr/~msc41www
	EcoPlant database: Gégout et al. (2005); http://efdp.nancy-engref.inra.fr/bd/ecoplant.htm
	French National Forest Inventory (Inventaire Forestier National, IFN): http://www.ifn.fr/spip
Germany	Ewald (1995), Berg & Dengler (2004)
	http://www.floraweb.de/vegetation/aufnahmen.html
	http://geobot.botanik.uni-greifswald.de/portal/vegetation
Hungary	Lájer et al. (2007)
Ireland	http://nationalvegetationdatabase.biodiversityireland.ie
Netherlands	http://www.synbiosys.alterra.nl/lvd
Slovakia	Hrivnák et al. (2003), Hegedüšová (2007), Janišová & Škodová (2007), Šibíková et al. (2009);
	http://www.ibot.sav.sk/cdf
Spain	Font & Ninot (1995), Font et al. (1998); http://biodiver.bio.ub.es/biocat/homepage.html
	http://biodiver.bio.ub.es/vegana
Spain and Portugal	http://www.sivim.info/sivi
Switzerland	Wohlgemuth (1992)
Ukraine	Solomakha (1996)
United Kingdom	http://www.jncc.gov.uk/page-4259, http://www.countrysidesurvey.org.uk
Nordic and Baltic countries	Dengler et al. (2006)

Relevance of vegetation-plot data for wide-scale scientific and applied studies

As measured by the number of existing vegetation plots and plots stored in electronic format, Europe is far ahead of other continents. None of the larger data banking initiatives outside Europe, e.g., the U.S. VegBank (www.vegbank.org), New Zealand vegetation database (Wiser et al. 2001) or the South African vegetation database (Mucina et al. 2000a), contain more than 100,000 vegetation plots.

The compilation of extensive vegetation databases offers the possibility of carrying out pan-European biodiversity studies based on small-scale species co-occurrence data, which is what vegetation plots essentially provide. This may greatly extend current knowledge of the biodiversity changes that result from global warming, changes in land use, and other natural and anthropogenic processes. Examples include the analysis of temporal shifts in altitudinal distribution of species as a result of global warming (Lenoir et al. 2008), assessing dispersal potential of plant species across a broad range of plant commu-

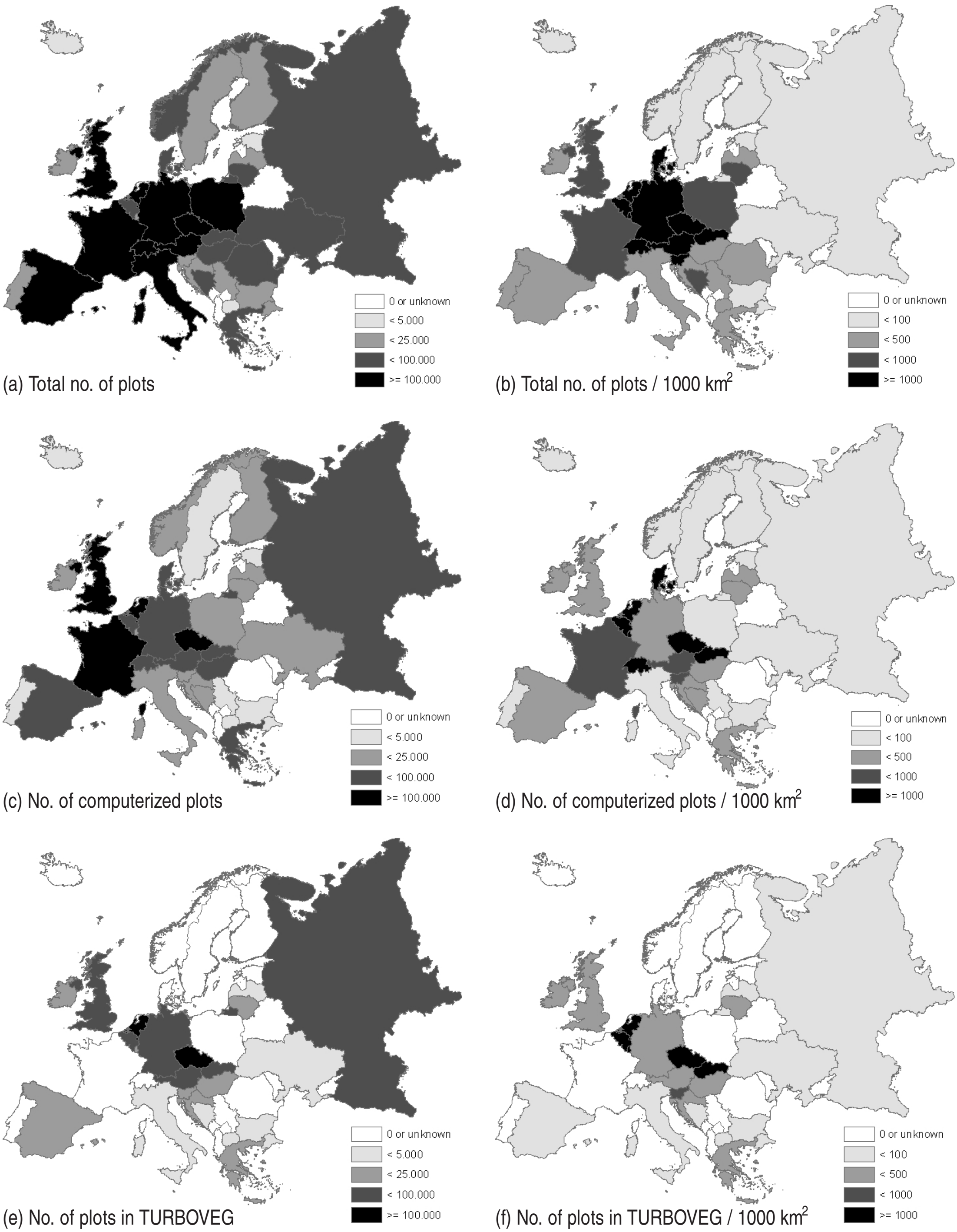

Fig. 1. – Total numbers and densities per unit area of existing vegetation plots, plots stored in electronic format and plots stored in the TURBOVEG format. For Russia and Turkey, densities are calculated relative to the total area of the country, although only European parts of these countries are shown on the map.

nities (Ozinga et al. 2004, 2005, 2009), or quantification of the level of alien plant invasion of European habitats (Chytrý et al. 2008, 2009). It may also result in new paradigms in vegetation classification and give new insights into the functioning and spatial variation of ecosystems.

Ecological information systems are promising tools for integrating the vegetation data with lower and higher levels of the ecological hierarchy (species, landscapes). An example of such an information system is SynBioSys, which has been developed in the Netherlands. The structure of the system and its underlying databases allows one to determine the various relationships between vegetation units, species and landscapes. It incorporates a geographical information system for the spatial analysis of data and their integration with geographical information. The Dutch system is serving as an example for the development of such a system for Europe, called SynBioSys Europe (Schaminée et al. 2007). At the species level, a species checklist for the European flora is being developed. Currently records of more than 300,000 species or subspecies names have been imported from about 30 national species lists and the taxa synonymized. Thus, the SynBioSys species checklist allows the integration of vegetation and species databases from various countries. The Map of the Natural Vegetation of Europe is used to define the landscape level, using its 699 mapping units, each documented by extensive descriptions (Bohn et al. 2003). At the vegetation level, SynBioSys Europe integrates the conspectus of European vegetation types (Rodwell et al. 2002), comprising 933 vegetation units at the alliance level. In the proposed expert system for SynBioSys, extensive information will be stored on each vegetation unit, including synoptic vegetation tables from different areas, as well as single plot records from numerous sites throughout Europe. A standardized parameter frame for the vegetation units will allow easy cross-reference to existing European classifications of climate, soils and anthropogenic impacts (e.g., Mücher et al. 2009).

Integrating vegetation-plot data within SynBioSys Europe should greatly assist in the protection and management of biodiversity in Europe. Already, it is possible to relate phytosociological alliances to the EUNIS classification, which underlies the EU Habitats Directive (Rodwell et al. 2002) and uses vegetation-plot data to define the favourable conservation status of habitat types and identify indicators of their condition. This could help ensure that we sustain the richness of European vegetation for future generations.

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Souhrn

Během posledního desetiletí vzniklo v Evropě mnoho databází uchovávajících záznamy o vegetaci výzkumných ploch, zpravidla fytocenologické snímky. Tyto databáze obsahují velmi hodnotné informace, které mohou být použity pro testování nejrůznějších makroekologických hypotéz a aplikace v ochraně přírody, jako je inventarizace a monitoring. Cílem tohoto článku je odhadnout, kolik fytocenologických snímků a podobných záznamů o vegetaci z výzkumných ploch v Evropě existuje, kolik z nich je uloženo v elektronickém formátu a jaké je jejich rozložení mezi různými evropskými zeměmi a regiony. Informace o databázích jsme získali prostřednictvím dotazníků zaslaných správcům národních a regionálních databází a dalším významným vegetačním ekologům. Na základě

shrnutí takto získaných dat se ukázalo, že v Evropě existuje více než 4 300 000 fytocenologických snímků, z nichž více než 1 800 000 je už převedeno do elektronického formátu. Z elektronických snímků je 60 % uloženo v databázích programu TURBOVEG. Nejvíce snímků pravděpodobně existuje v Německu, Nizozemsku, Francii, Polsku, Španělsku, České republice, Itálii, Spojeném království, Švýcarsku a Rakousku. Nejvíce snímků v poměru k velikosti země existuje v Nizozemsku, Belgii, Dánsku a zemích střední Evropy. Nejvíce snímků v elektronickém formátu je k dispozici v Nizozemsku (600 000), dále ve Francii, České republice a Spojeném království. Díky silné fytocenologické tradici je dnes v Evropě mnohem více fytocenologických snímků než v kterékoliv jiné části světa. Tyto snímky obsahují jedinečné ekologické informace, které budou stále více využívány při výzkumu biodiverzity. Vývoj informačních systémů jako je SynBioSys Europe a usnadnění výměny dat mezi národními a regionálními databázemi by měly podpořit širší využití těchto dat v budoucnu.

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