Slovenian Phytosociology in a Database: state of the art, basic statistics and perspectives

Slovenska fitocenologija v podatkovni bazi: stanje, osnovna statistika in perspektive

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Abstract: Database of vegetation relevés from Slovenia stored on 2. 2. 2006 and containing 11,144 records is reviewed. Basic statistics: most represented authors, syntaxa and plant species are presented. Syntaxa with only one relevé are also pointed out. The quality of collected data is discussed.

Izvleček: Prikazana je podatkovna baza, ki vsebuje 11,144 vegetacijskih popisov iz Slovenije shranjena na dan 2. 2. 2006. Naredili smo osnovno statistično analizo: najbolj zastopane avtorje, sintaksone in rastlinske vrste. Izpostavili smo tudi sintaksone, ki so predstavljeni samo z enim popisom. Komentirali smo kakovost zbranih podatkov.

1 Introduction

Databases are a hot topic in vegetation science and there has been a lot said about standards, software and necessity of databases (Mucina et al. 2000a, Ewald 2001, 2005). But cross-sections of data in real databases are rarely published (Chytrý & Rafajová 2003). Use of the digital databank enables us to use the universal sampling method of taking vegetation relevés by different authors and at different times. Such a collection of primary data is valuable not only for (national) synthesis of vegetation but also as source of floristic data, for studies of vegetation change in time etc. Above all it is useful for unifying databases within Central Europe and southwards as EU is expanding.

Vegetation science (phytosociology) is a scientific discipline with a longlasting tradition in Slovenia, and the history of phytosociological research has been already summarized in various publications (Zupančič 1995, 2003), but in a descriptive way.

The aim of this article is to review phytosociological data from Slovenia with basic statistical description and quality assessment.

2 Results and discussion

In Slovenia, the Braun-Blanquet (1964) approach is commonly used for vegetation description and classification, although the database contains also 473 relevés made according to the Piskernik method and cover scale.

The research conducted presents the analysis of phytosociological (vegetation plot) data stored in the Turboveg database (Hennekens & Schaminee 2001) at the Institute of Biology on 2. 2. 2006. All the figures reflect data on this date, but a general idea of structure of vegetation data sampled in Slovenia over the time can be drawn. It is estimated that 90% of the published relevé material is collected.

For comparison some figures about stored vegetation plot data from other countries and surface are presented in Table 1. Ewald (2001) estimates that there are one million relevés stored in digital databases, but with an evident lack of databases from northern, eastern and southern Europe (Chytrý & Rafajová 2003).

Table 1: Amount of stored vegetation plots in some countries.
Tabela 1: Število shranjenih popisov v podatkovnih bazah v posameznih državah.

Country	No. of relevés	Surface (km^2)	Releve/km^2
Czech Republic	54310	78495	0.7
France	115000	546729	0.2
Netherlands	320000	35493	9.0
Slovakia	15000	48648	0.3
Slovenia	11144	20246	0.6
South Africa	25000	1223111	0.0

The database contains 11,144 stored relevés, mostly from the published papers and monographs, Master of Science and PhD theses, and only part of them from surveys carried out for the Ministry of the Environment and others. All together 243 biblioreferences (Tab. 2). Only 2 % are from unpublished survey reports. About 25 % are from theses (BSc; MSc and PhD), mainly of researchers who studied at the University of Ljubljana. Other relevés (70 %) are from published sources. It must be pointed out that there are still existing relevés not included into database, mostly unpublished, but their quality varies considerably.

Table 2: Number of bibliographic references and relevés in database.
Tabela 2: Število bibilografskih enot in popisov v podatkovni bazi.

	Number of biblioreferences	Number of relevés
Published papers	212	7867
Theses	23	2964
Survey reports	8	313
Total	243	11144

Nomenclature of species in the database follows the revised and updated checklist of Ehrendorfer (1973) prepared by H. Niklfeld and W. Gutermann and others (Chytrý & Rafajová 2003). This guarantees international compatibility. Some species were added posteriori as the species list was prepared for Central Europe.

2.1 Time scale

The oldest relevé is by Tomažič, dated on 30. 5. 1932. Afterwards there is a drawback of research because of WW II. Only 16 records are from the period 1941-1950. The proportion of relevés made between 1951 and 1970 is rather low. In that period cartographic and operative oriented research was conducted. More than 50 % of the relevés was taken after 1990 and more than 75 % after 1980 (Fig. 1).

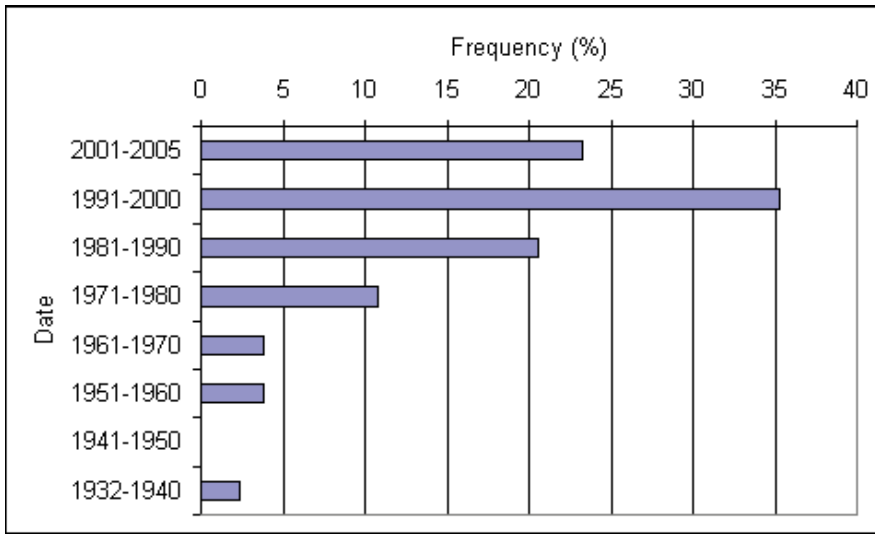

Figure 1: Frequency of relevés made in each decade since 1932 till 2005. Missing dates for relevés were substituted by publication dates.
Slika 1: Frekvenca popisov narejenih v vsakem desetletju od 1932 do 2005. Manjkajoče datume smo nadomestili z letnico publikacije.

Table 3: Ten most frequent authors in database and number of relevés. Each relevé made by several authors is considered by each author.
Tabela 3: Deset avtorjev z največjim številom popisov. Popisi z večjim številom popisovalcev so upoštevani pri vsakem avtorju.

Dakskobler I.	1572	Marković L.	579
Marinček L.	991	Šilc U.	578
Martinčič A.	898	Surina B.	516
Čarni A.	757	Piskernik M.	473
Zupančič M.	732	Zelnik I.	480

2.2 Syntaxa

The survey of syntaxa in database (assigned originally by authors) reflects the general frequency of vegetation types (Tab. 4). It must be noticed that the large proportion of forest syntaxa is not only due to the abundance of forests characteristic for Slovenia, but also due to researchers' interest (cf. ZUPANČIČ 1995) and the economic importance of forest ecosystems.

Table 4: Ten most frequent classes, alliances and associations stored in database.
Tabela 4: Deset najbolj pogostih razredov, redov in zvez v podatkovni bazi.

Querco-Fagetea	**3436**	*Fraxino-Acerion*	**297**
Molinio-Arrhenatheretea	**1035**	*Arrhenatherion*	**266**
Vaccinio-Piceetea	**826**	*Ostryo-Carpinion*	**263**
Stellarietea mediae	**759**	*Errythronio-Carpinion*	**246**
Festuco-Brometea	**538**	*Aegopodion podagrariae*	**213**
Galio-Urticetea	**443**	*Omphalodo-Fagetum*	**371**
Asplenietea trichomanis	**429**	*Homogyno sylvestris-Fagetum*	**293**
Scheuchzerio-Caricetea fuscae	**342**	*Seslerio autumnalis-Fagetum*	**234**
Asplenietea trichomanis	**323**	*Lamio orvalae-Fagetum*	**207**
Artemisietea vulgaris	**287**	*Rhododendro hirsuti-Fagetum*	**156**
Aremonio-Fagion	**2119**	*Panico-Chenopodietum polyspermi*	**154**
Vaccinio-Piceion	**756**	*Alchemillo-Matricarietum*	**138**
Bromion erecti	**372**	*Hacquetio-Fagetum*	**137**
Molinion	**336**	*Cardamine savensi-Fagetum*	**127**
Potentillion caulescentis	**327**	*Onobrychido-Brometum*	**125**

On the contrary, there is a vast number of syntaxa represented only by a single relevé. These syntaxons are either rare in nature or described only provisionally or in the deductive sense of KOPECKÝ (1992). Syntaxonomical nomenclature is according to original description by authors:

Hydrocharitetum morsus-ranae, Ranunculetum fluitantis, Trapetum natantis, Nymphaeetum albo-luteae, Butometum umbellati, Caricetum paradoxae, Eleocharitetum palustris, Ranunculus sardous-Agrostis canina community, *Glycerietum plicatae, Atriplicetum tatarici, Allio globosi-Iberidetum intermediae, Salicetum herbaceae, Centaureetum rhaponticae, Euphorbio-Oxalidetum corniculatae, Malvo neglectae-Chenopodietum vulvariae, Filagini-Vulpietum, Chaerophyllo hirsuti-Filipenduletum, Epilobio hirsuti-Filipenduletum, Aconito-Filipenduletum, Phragmiti-Euphorbietum palustris, Eriophorum latifolium-(Molinietalia), Festucetum rubrae, Libanotido-Laserpitietum sileris, Cirsio pannonicae-Peucedanetum cerviariae, Cirsio-Clematidetum rectae, Veronicetum barrelieri-jacquinii, Seslerio-Keolerietum, Cotinus coggygria* community, *Seslerio-Carpinetum betuli, Pteridio-Betuletum, Seslerio-Pinetum nigrae, Corydalo ochroleucae-Ostryetum, Rhodothamno-Rhododendretum hirsuti, Seslerio albicantis-Piceetum, Erico-Piceetum.*

2.3 Taxa

The average number of taxa per relevé is 28. The most frequent species are presented in Table 3. Multiple occurrences in different vegetation layers are considered as a single occurrence.

Table 5: Thirty most frequent species in database.
Tabela 5: Trideset najbolj pogostih vrst v podatkovni bazi.

Fagus sylvatica	**3328**	**Prenanthes purpurea**	**1720**
Picea abies	**2630**	*Salvia glutinosa*	**1532**
Acer pseudoplatanus	**2611**	*Carex digitata*	**1539**
Oxalis acetosella	**2216**	*Vaccinium myrtillus*	**1561**
Athyrium filix-femina	**1953**	*Hieracium murorum*	**1604**
Daphne mezereum	**1994**	*Gentiana asclepiadea*	**1594**
Dryopteris filix-mas	**1983**	*Dentaria enneaphyllos*	**1485**
Cyclamen purpurascens	**1995**	*Dactylis glomerata* agg.	**1458**
Senecio ovatus	**1783**	*Polytrichum formosum*	**1475**
Abies alba	**1738**	*Corylus avellana*	**1353**
Ctenidium molluscum	**1817**	*Fraxinus ornus*	**1376**
Mercurialis perennis	**1722**	*Urtica dioica*	**1318**
Anemone nemorosa	**1706**	*Cardamine trifolia*	**1338**
Solidago virgaurea	**1645**	*Ostrya carpinifolia*	**1249**
Mycelis muralis	**1627**	*Sorbus aria*	**1262**

It is not surprising that within most frequent taxa there are species characteristic of forests. This presents uniformity of data but also points out the interest of research. Nevertheless there are 315,550 records of vascular plants and 29,919 records of mosses and lichens. Records of taxa in different strata are treated as one.

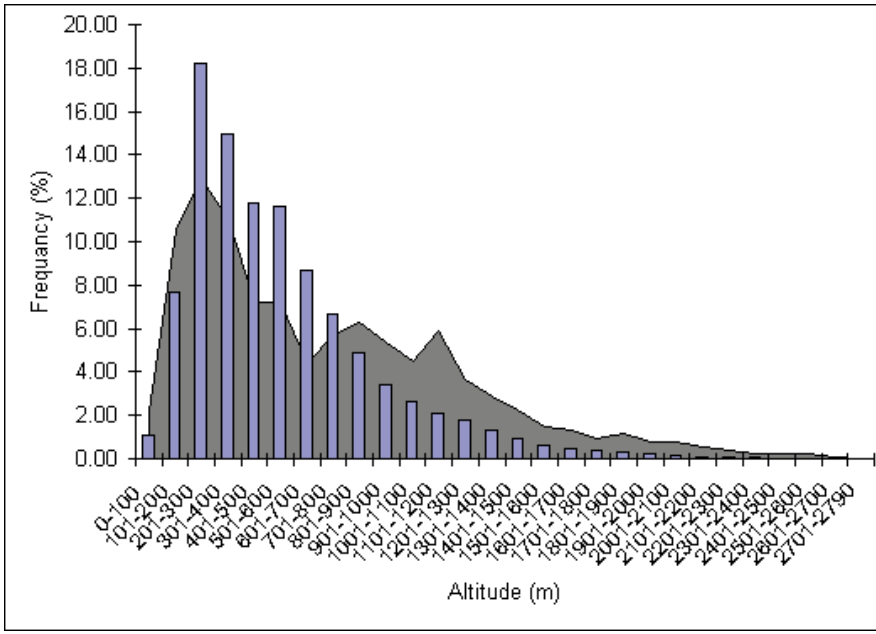

Figure 2: Relevés classified by altitudinal gradient (only relevés with original indication of altitude were used). Percentage of land area in altitudinal classes of Slovenia is presented.
Slika 2: Popisi razvrščeni po višinskem gradientu (uporabili smo samo popise z navedeno nadmorsko višino). Predstavljen je odstotek površine Slovenije v višinskih razredih.

The altitudinal gradient of stored relevés shows (Fig. 2) clear oversampling at lower altitudes (200-600), probably due to greater accessibility and variability of vegetation types. Undersampled areas are at altitudes between 1000-1700, where monotonous forest of the pre-Alpine and Dinaric mountains is found, while lower altitudes are more diversified (also because of human activity).

An important issue is also quality assessment of collected data. Standards proposed by MUCINA et al. 2000b were verified. Similarly to the Czech database (CHYTRÝ & RAFAJOVÁ 2003) relevés in our database mainly lack field-book number, total cover of all vegetation covers and heights of the vegetation layers (if it is present it concerns tree layer). Other missing obligatory values are summarized in Table 6.

Table 6: Missing values in %.
Tabela 6: Manjkajoče vrednosti v odstotkih.

Year of sampling	**37.5 %**
Plot size	**37.6 %**
Altitude	**23.5 %**
Cover trees	**5.5 %**
Cover shrubs	**12.4 %**
Cover herbs	**27.1 %**
Cover cryptogams	**35.9 %**

2.4 Perspectives

As older relevé material is not georeferenced, further work will include retrospective georeferencing of relevés that will allow stratified resampling to avoid oversampled areas. This is very labourious and time consuming but it will increase the value of gathered data.

It is also obvious that further collecting of field data is needed, but the database does enable inventory of white spots in research. This will lead to a national classification of vegetation and numerical verification of existing classification. Another important task in the future will be composition of a red list of vegetation syntaxa.

Large databases are a necessity in modern vegetation science, and use of the longlasting tradition of phytosociology offers the possibilty to gather large amounts of compatible data. Databases are also a chance for phytosociology to re-establish its position within vegetation science (Ewald 2003).

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