

## Data management for the Braun-Blanquet project and the European Vegetation Archive

Borja Jiménez-Alfaro<sup>1</sup>, Stephan Hennekens<sup>2</sup>, Milan Chytrý<sup>3</sup> and the partners of the Braun-Blanquet project<sup>4</sup> and the European Vegetation Archive<sup>5</sup>

<sup>1</sup>Masaryk University, Brno, Czech Republic, [borja@sci.muni.cz](mailto:borja@sci.muni.cz);

<sup>2</sup>Alterra, Wageningen, The Netherlands, [stephan.hennekens@wur.nl](mailto:stephan.hennekens@wur.nl);

<sup>3</sup>Masaryk University, Brno, Czech Republic, [chytry@sci.muni.cz](mailto:chytry@sci.muni.cz);

<sup>4</sup>[http://www.sci.muni.cz/botany/vegsci/braun\\_blanquet.php?lang=en](http://www.sci.muni.cz/botany/vegsci/braun_blanquet.php?lang=en)

<sup>5</sup><http://euroveg.org/eva-database>

### Introduction

The Braun-Blanquet project and the European Vegetation Archive are among the first initiatives for analyzing comprehensive datasets of vegetation plots in Europe (Jiménez-Alfaro et al. 2013). Both initiatives are based on the compilation of vegetation data from different collaborators, including national and regional databases and additional data from individual researchers or research groups or the literature. The management of this information is complex since it derives from heterogeneous sources and many different research contexts.

Here we report the conceptual management plan developed for merging European databases and for creating taxonomically consistent outputs to be used for vegetation analyses. The main aim is to develop an archive of data sets which can be regularly updated, allowing to create comprehensive matrices of species x plots, and ensuring that the databases are compatible in terms of species taxonomy and header data.

### Storing data

The data sets are managed separately in Turboveg 2, a software program widely used for storing vegetation data in Europe (Hennekens & Schaminée 2001). Our general procedure is to preserve the original structure of the databases in order to facilitate regular updates from data providers.

Databases provided by partners of the Braun-Blanquet project or the European Vegetation Archive are in most cases linked to one of the species lists available for Turboveg 2, although in some cases they are linked to adhoc lists created by one or more authors for specific projects. As a general rule, we suggest data providers to use one of approximately 30 most commonly used European national or regional checklists. Accordingly, new digitized data are linked to these lists or to the general European checklist for Turboveg which is based on *Flora Europaea* (Tutin et al. 1993).

Header data are also very heterogeneous, and only a few fields (e.g. plot size, total cover and altitude) are regularly assigned to the plots in the databases. For the specific purposes of the Braun-Blanquet project (i.e. the characterization of phytosociological alliances), we prioritized the standardization of only three fields: plot size, geographical coordinates and vegetation or habitat type. However, a more ambitious system of header data harmonization will be created for the European Vegetation Archive, which is expected to provide data for many different purposes.

### Combining data

We are using a prototype of Turboveg 3 (Figure 1) to combine species and header data from the original databases that are regularly managed in Turboveg 2. A copy of each of these databases is imported into Turboveg 3 from a single repository that is shared in GoogleDrive by the data managers. The general settings of Turboveg 3 are then fixed to link any version of the original databases. Thus further update of a given database with the same structure will be automatically integrated into the system.

Figure 1. General view of the main panel of Turboveg 3 prototype (version January 2014).

The screenshot displays the main panel of the Turboveg 3.0.0.3 software. The interface is divided into several sections:

- Top Bar:** Includes the software version 'Turboveg 3.0.0.3 [prototype]', and menu options: DATA, EDIT, IMPORT, SELECT, EXPORT, MANAGE, HELP.
- Left Panel:** A tree view showing the project structure, including 'EUROPEAN VEGETATION ARCHIVE', 'Braun-Blanquet project', and various geographical regions like Austria, Britain, Bulgaria, etc. The 'Czechia\_Slovakia\_2010' folder is expanded, showing 'Czechia\_nvd' and 'Slovakia'.
- Main Panel:** A table listing plant species and their distribution data. The table has columns for 'Species name', 'Stratum', 'Cover', 'Original species name', and 'Taxon uncertainty'. The 'Czech Republic' column is highlighted in blue. The table lists numerous species such as *Actis spiculis*, *Achillea millefolium*, *Agrostis capillaris*, etc.
- Right Panel:** A search bar with the text 'Search from current post' and a 'Bibliography' section with a search icon.
- Bottom Bar:** Shows system information: 'Connected © 2001-2014 Stephan Hennekens, Alterra' and 'Selected observation: 0 Observation 13/30115'.

Species name	Stratum	Cover	Original species name	Taxon uncertainty
Actis spiculis	fl	+		Node
Achillea millefolium agg.	fl	+		Node
Agrostis capillaris	fl	+		Node
Agrostis vernalis	fl	+		Node
Achillea glaucosens	fl	+		Node
Anthoxanthum odoratum	fl	+		Node
Arabis hirsuta	fl	+		Node
Arrhenatherum elatius	fl	+		Node
Astragalus major	fl	+		Node
Avenula pubescens	fl	+		Node
Betonica officinalis	fl	+		Node
Brachypodium pinnatum	fl	+		Node
Briza media	fl	1		Node
Bromus erectus	fl	2b		Node
Calamagrostis arundinacea	fl	1		Node
Campanula glomerata	fl	+		Node
Campanula persicifolia	fl	+		Node
Campanula rapunculoides	fl	+		Node
Carex caryophylla	fl	+		Node
Carex montana	fl	2a		Node
Carex pallens	fl	+		Node
Carex panicea	fl	+		Node
Centaurea jacea	fl	1		Node
Centaurea scabrosa	fl	+		Node
Centaurea stenolepis	fl	+		Node
Cerastium holostoides	fl	+		Node
Chamaecytisus vesicatus	fl	+		Node
Cirsium pinnatifidum	fl	+		Node
Crucata glabra	fl	+		Node
Dactylis glomerata	fl	+		Node
Danthonia decumbens	fl	+		Node
Daucus carota	fl	+		Node
Festuca pratensis s.str.	fl	+		Node
Festuca rubra	fl	1		Node
Festuca rupicola	fl	+		Node
Filipendula vulgaris	fl	+		Node
Fragaria vesca	fl	+		Node
Fraxinus excelsior	fl	+		Node
Galium album s.str.	fl	+		Node
Galium aparine	fl	+		Node
Galium verum	fl	+		Node
Genista tinctoria	fl	+		Node
Geranium sanguineum	fl	1		Node
Hakonechloa macrochaeta	fl	+		Node

Figure 2. Cross-link species system of SynBioSys: integrated in Turboveg 3 prototype (version January 2014).

Manage SynBioSys taxon database (www.synbiosys.alterra.nl)

Menu: Species lists | Distribution | Euro + Med search | The Plant List search | Google search | Help

Species: Fagus  Show Turboveg synonyms  Always show type records

Retrieve  Equal [=]

Zero [0]

117 records

sbs_spec_rank	genus_name	species_name	family	group	flora_list	by_species	type_r	tv_sibs	prov_excl	split	not_considered	full_name	name
►	Fagus	grandifolia	Fagaceae	Vascular plants	VegItaly	867						Fagus grandifolia Ehrh.	
84545	Fagus	moesiaca	Fagaceae	Vascular plants	Flora Europaea+	22483						Fagus moesiaca (K. Maly) Czerc.	
84545	Fagus	moesiaca	Fagaceae	Vascular plants	Greece	9230						(K.Maly) Czerczt	
84545	Fagus	moesiaca	Fagaceae	Vascular plants	Slovenia	90195						Fagus moesiaca (K. Maly) Czerc.	
44643	Fagus	orientalis	Fagaceae	Vascular plants	Europe_Lenor	22483						Fagus orientalis Lpsky	
44643	Fagus	orientalis	Fagaceae	Vascular plants	Bulgaria	2249						Fagus orientalis Lpsky	
44643	Fagus	orientalis	Fagaceae	Vascular plants	Romania	2941						Fagus orientalis Lpsky	
44643	Fagus	orientalis	Fagaceae	Vascular plants	Former USSR	9711						Fagus orientalis Lpsky	
44643	Fagus	orientalis	Fagaceae	Vascular plants	Turkey	8145						Fagus orientalis Lpsky	
44643	Fagus	orientalis	Fagaceae	Vascular plants	Slovenia	91070						Fagus orientalis Lpsky	
22485	Fagus	silvatica	Fagaceae	Vascular plants	Switzerland	7275						Fagus silvatica L.	
22485	Fagus	silvatica	Fagaceae	Vascular plants	France_SOPHY	2840						FAGUS SILVATICA L.	
22482	Fagus	silvatica v. silvatica	Fagaceae	Vascular plants	France_SOPHY	2842						FAGUS SILVATICA L. VAR. SILVATICA	
22482	Fagus	sp.	Fagaceae	Vascular plants	Austria	4222						Fagus sp.	Fagus
22482	Fagus	species	Fagaceae	Vascular plants	Flora Europaea+	22482	<input checked="" type="checkbox"/>					Fagus species	
22482	Fagus	species	Fagaceae	Vascular plants	The Netherlands	6210						Fagus species	
22482	Fagus	species	Fagaceae	Vascular plants	Central Europe	4222						Fagus species	
22482	Fagus	species	Fagaceae	Vascular plants	Ehrnberg	6880						Fagus species	
22482	Fagus	species	Fagaceae	Vascular plants	Ehrensdorf	6846						Fagus species	
22482	Fagus	species	Fagaceae	Vascular plants	Italy	3147						Fagus species L.	
22482	Fagus	species	Fagaceae	Vascular plants	Latvia	2799						Fagus species L.	
22482	Fagus	species	Fagaceae	Vascular plants	Lithuania	4150						Fagus species	
22482	Fagus	species	Fagaceae	Vascular plants	Poland	8724						Fagus species	

Species: Fagus

11:03 19.2.2014

The most important issue for combining the databases is to crosslink the various species checklists. We followed the general procedure developed for SynBioSys Europe (Schaminée et al. 2007) to create a crosslink between taxon concepts of different species checklists (Figure 2). On the one hand, species names from different checklists that fit at 100% are linked automatically and identified by the same alphanumeric code. On the other hand, species that are not matched must be linked manually to harmonize taxon concepts. This process is dynamic and can be continuously reviewed by data contributors under the supervision of a number of taxonomical authorities selected among regional experts. At the moment, more than 80% of the species included in 30 European checklists have been taxonomically harmonized, although more effort is still necessary to create formal guidelines for the harmonization of taxon concepts in SynBioSys Europe and Turboveg 3.

Under this system, we are able to perform queries in Turboveg 3 based on the presence or cover of a given species that is systematically checked in more than 40 individual databases. This allows us to create outputs in form of species x plot matrices including the associated header data for each plot (when existing). These outputs can be then used for performing analyses based on species composition (e.g. ordination or classification) or the properties of vegetation (e.g. distribution patterns of plots assigned to the same community type).

### Further steps

Under the proposed data management plan, new functionalities of Turboveg 3 are being developed, and a more detailed procedure for managing European databases will be developed in the year 2014. Among the main priorities for the integration of vegetation databases into the Braun-Blanquet project, the European Vegetation Archive or any other initiative, we highlight the following:

- Quality control of the original datasets
- Feedback with data providers for improvement of header data
- Involvement of new databases from underrepresented regions
- Continuous updating of species crosswalks in SynBioSys Europe
- New functionalities for exporting output matrices and associated data in Turboveg 3
- Project-specific analyses at continental scale

### References

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