Referee report to PhD Thesis "Grid Mapping of Flora and its Employment at Various Spatial Scales" submitted by Petr Petřík

General statement:

The PhD thesis submitted by Petr Petřík focuses on various aspects of flora grid mapping as a method widely used today, aiming not only at documenting distribution of plants in a particular area but also at creating basis for further analyses. The thesis is structured into six chapters based on submitted, accepted or published papers. While the Chapter 1 (written in German) focuses on description of main patterns in flora and vegetation in the study area of the Ještědský hřbet Range, the Chapters 2 to 5 (written in English) use numerical approaches to assess floristic pattern and its relationship to environmental factors, to address scaling approach using plant species groups and to discuss consequences of assessing species richness from distribution grid data as well as sources of bias in the field grid mapping. The Chapter 6 (written in Czech) discusses possible links between phytosociological and grid-mapping data and perspectives of grid-mapping in the Czech Republic. A substantial part of the thesis is presented in appendices, among other, a list of plant communities including synoptic tables and a complete list of taxa mapped in the study area of the Ještědský hřbet Range, accompanied by species distribution maps representing the first distribution atlas of vascular plants in the study area.

The main benefit of the thesis consists in a strong emphasis on evaluation and critical assessment of data obtained by means of grid mapping methods. The potential of grid mapping data for further analysis remains, quite frequently, not utilized at all or utilized only to a certain extent. In the Czech Republic, despite of a relatively strong effort devoted to grid mapping activities, most projects consider construction of distribution maps or atlases to be the main or final goal of mapping activities. In the submitted thesis, the author presents not only a wide range of possibilities and methods how the grid mapping data can be evaluated for various purposes but he also presents how the results of grid mapping projects should be critically interpreted because of various reasons, such as scale-effect, sampling bias in field mapping, etc.

Besides the analyses based on regional data from the Ještědský hřbet Range (Chapters 1-3), the author made attempt to review data from a wide range of grid atlases from Central Europe (Chapter 4). This pioneer study focused mainly on the role of so called atlas characteristics, such as duration, resolution, number of records and taxa, etc. This part; together with the Chapter 6, reviewing current state and application of floristic data in the Czech Republic, represents an important basis for considerations concerning perspectives of grid mapping of flora in the Czech Republic. The author's outline of grid mapping project of Czech flora should be understood as a basis for a further discussion concerning this topic.

Conclusion:

The submitted thesis represents a compact set of studies (published, accepted or submitted) on grid mapping of flora. The author succeeded in approaching this traditional subject of botany in a modern way, based on exact methods, critical analyses and reviews of large datasets from Central Europe grid mapping projects. Moreover, the submitted thesis addresses practical recommendations and represents a substantial base for everyone interested in grid mapping of flora or aiming at starting a field mapping project.

As the thesis, according to the referee's opinion, meets criteria required for PhD thesis, it is recommended to accept the set of papers submitted by Petr Petřík as a PhD thesis.

Questions:

Could the author comment the relationship between environmental heterogeneity and species richness, discussed in the Chapter 4 – Consequences of Assessing Species Richness from Grid Data, in relation to various grain of the mapping grid used in the Central European atlases: As he mentioned, it is generally accepted that projects in the areas with a high environmental heterogeneity tend to have many species (and records as well) while studies carried out in the landscapes dominated by forest or intensive agriculture or less urbanized areas have the lowest number of species. However, as the author stressed, species richness is a scale-dependant parameter. And, therefore, various grain of the mapping grid will also enable to reflect environmental heterogeneity at different levels. Nevertheless, the decision how fine the scale used for grid mapping should be is always influenced by trade-off between available capacities on one hand and effort to obtain a geographically precise data on the other hand. Consequently, could the analyses performed by the author in this chapter be used in order to propose an "optimal" grain of mapping grid for a particular area (see also discussion on proposals for grid mapping of flora in the Czech Republic in Chapter 6) to be fine enough to reflect landscape heterogeneity of the particular area on one hand, and acceptable from practical point of view on the other hand? (See also the discussion on Spatial dependence of data: "The grain mosaic in the species data is comparable to that of the variables with the highest spatial dependence. Thus patches of species are not formed by factors other than those used in analysis. This indicates that the grain of the present study was appropriate for studying environmental factors that operate at the meso-scale").

In the Chapter 4, relationships between atlas characteristics (e.g. duration, number of records, number of taxa, resolution, area, natural vegetation, etc.) are discussed. The author found out that potential natural vegetation was surprisingly a significant predictor to duration of study. Perhaps, this could be explained simply by tendency of botanists to spend more time in a certain type of habitats that are attractive for them (e.g. species-rich habitats)?
Did the author consider to use not only potential natural vegetation but also data on land use in order to assess the influence of environmental heterogeneity on species richness in the mapped regions (at least for some of them) (in the Chapter 4) as the potential natural vegetation explains only a part of environmental heterogeneity, particularly in cultural landscapes of Central Europe?

The author concluded that a strong dependence of number of taxa recorded on the duration of given study can be influenced by species-time relationships, i.e. that in case of studies carried out during a long time period, the effect of colonisation/extinction processes, chance occurrence, etc., can play a significant role. This is undoubtedly true. However, could this effect be also influenced by the need to spend simply more time when mapping regions with a higher number of taxa, and at the same time, by the need to simplify methodology, e.g. to use a broader grid for mapping of species-rich areas – this could perhaps explain only slightly correlation between duration of project and number of records?

In the Chapter 1 – Diversity of Flora and Vegetation of the Study Area, the author (in the paper with R. Višňák), as well as in the list of plant communities (in the Appendix), describes a fragmentary occurrence of *Pino-Fagetum* Scamoni (1956) 1960 in the study area and as the main unit of the potential natural vegetation in the adjacent Podještědí Region. As this unit has not been accepted so far in the synoptic publications concerning the vegetation of the Czech Republic (Moravec et al. 1995, Neuhäuslová et al. 2001), could the author explain his view on the potential distribution of this unit (at least in the Northern Bohemia)?

In the Chapter 1, the author carried out comparison of the list of threatened species in his study area with the red list of adjacent Upper Lusatia (Oberlausitz). Such comparison can often lead to the conclusion that red lists published for regions in a neighbouring country can better reflect the degree of species endangerment in particular area than the national (Czech) list. (Therefore, the author calls for a regional red list of flora in Northern Bohemia - this is now under preparation). This can be explained by similar natural conditions, however, it could be also result of general tendency of regional red lists and red books to list species as more threatened ones than it is the lists at national level. This brings the question to what extent is red listing meaningful at regional or even local level? Could the author comment this issue?

In the "Project of grid mapping of flora of the Czech Republic" (Chapter 6), the author recommends, within a minimalist scenario, to organize field mapping based on the 1 km^2 grid. Could the author explain how would be such field mapping project compatible with the currently used Central European Basic Area (CEBA) grid system, based on latitude/longitude system?

Could the author comment advantages and disadvantages of using several levels of resolution (grain of the grid) for mapping flora within a particular area, e.g. 1/64 CEBA and 1/1024 CEBA. This system is used in some Czech regions (Labské pískovce, Lužické hory, Kokořínsko). This approach aims at elimination of a very time-consuming and inefficient mapping of common species on a fine scale on one hand and concentration on mapping of rare, threatened or phytogeografically important species on the other hand. However, such approach can be criticised for several reasons: (i) species have to be split into groups according to their "importance" or even frequency in particular area before starting the project, however, this should be output of mapping, (ii) in order to analyse the whole data set, it is finally necessary to convert data recorded on a finer scale to the basic one anyway.
In some other regions, e.g. Křivoklátsko or Podyjí, a different approach has been used, when distribution of all species is recorded in the 1/100 CEBA. However, this approach is based on division of the ¼ CEBA grid into 25 cells, i.e. in the odd number of cells. Therefore, such records can not be completely converted into the 1/16 CEBA grid (This grid has not been widely used so far in the Czech Republic, but it is used frequently for regional atlases in Germany, e.g. in Saxony).

Comments:

In the discussion under the Chapter 4, the author concludes that the reason why the data sources such as herbarium records are often ignored is the large amount of time required for specimens' revision within larger projects, less so in smaller areas.
Comment: The use of herbarium records for grid atlases in smaller areas is difficult as well, however, the main reason in this case is that only a small part of herbarium records can be assigned explicitly to a definite cell when using a very fine scale of grid mapping, which is, on the contrary, not the main problem in case of larger projects.

Chapter 6 – Linking between the Czech Phytosociological and Grid Mapping Data:
The author comments the current state of grid mapping data in the Czech Republic. There is no central database and most databases do not use a standardised species list and data is often recorded under original species names, i.e., without conversion into valid nomenclature. However, even worse situation occurs when floristic data is stored in databases in a converted

(interpreted) nomenclature, however without possibility to find the original species name used in primary source (e.g. in literature or herbaria), which is, unfortunately, the case of some nature conservation databases. A database software which allows storing species distribution data under original nomenclature, however, using species lists where synonyms are already interpreted and linked to current nomenclature, seems to be an ideal solution. This approach is used for instance in some German database software (WinArt, formerly Florein).

Technical remarks (not expected to be discussed during the defence)
The author uses the term "*Tschechisches Mesophytikum"* ("*České mezofytikum"*) which is correct with regard to the meaning of this term but it could lead to misunderstanding as the phytogeographical division by Skalický (1988) uses consequently the term „*Český"* in sense of Bohemian ("*Böhmisches"*). Therefore, Skalický distinguishes between "*České termofytikum"* (*Theromobohemicum*) and "*Panonské termofytikum"* (*Pannonicum*), and thus the whole area of *Mesophyticum* in the Czech Republic is not named "*České mezofytikum"* but "*Českomoravské mezofytikum"*. The term "*Tschechisches Mesophytikum"* is probably better understandable than "*Böhmisch-Mährisches Mesophytikum"* would be, however, if the author refers to Skalický (1988), it should be explained that "*Českomoravské mezofytikum"* sensu Skalický is meant.

Microsoft Word often fails when dividing German words (e.g., p. 14: zusamme-nhängen, a.o.). Therefore, a control should follow or it is recommended not to use this tool in Word at all.

Libčice nad Vltavou, October 6, 2006

Ing. Handrij Härtel, Ph.D.