

# UNIVERSITY OF PÉCS

PhD/Doctoral School in Biology

Botany Program

## Phytogeography of Gerecse Mts (Hungary), on the base of botanical databases

PhD dissertation

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## 1. Scientific precedents:

Beginning with Pál KITAIBEL, the botanical survey on Gerecse Mts. is more or less continuous up to now. The most significant researchers of the Mountains were Sándor FEICHTINGER, Sándor JÁVORKA, Ádám BOROS, Tibor SEREGÉLYES and Endre JENEY, however, from the examined area more than 80 researchers provided floristic records, coenologic relevés as well as any botanical results.

Important floristic results as the exploration of the population of relict species *Ferula sadleriana* on Mount Pisznicze or the description of the endemic species of Gerecse, *Sorbus gerecseensis*, by Szár settlement drew attention to the fact that the Mountains is worth and necessary to investigate.

The research on the Mountains was not continuous regarding its duration or character. Until the mid 1990s large areas remained almost entirely unknown from the botanical point of view, while several botanists possess data from the parts that are easily accessible and regarded more interesting from the botanical point of view. Until the recent past, also the coenologic surveys were restricted to the relatively known, western parts of the Mountains, however, the majority of even these results remained in manuscript.

Based on his fieldwork, the first detailed phytogeographic description of Gerecse was provided by Ádám Boros. The phytogeographical surveys and evaluations were not extended to the whole area of the Mountains, thus the phytogeographical character of the eastern and northern parts of Gerecse remained completely unknown for long. There

was uncertainty regarding the southern dolomite region of the Mountains, which was treated from the phytogeographical point of view close to Vértes Mountains.

In Hungary, even today, the prevailing attitude in phytogeography is based on characteristic species selected on the grounds of field experience and insists on rigid limits. However, the use of multivariate methods for phytogeographical purposes is rare also in foreign literature. Even these approach the surveyed object from a single point of view, often without laying emphasis on the effect of the sampling and data processing methods on the results.

The relatively unexplored Gerecse and the absence of the application of mathematical methods in the national phytogeographical literature inspired me to start the systematic exploration of the Gerecse in the mid 1990s, to collect and summarize the botanical knowledge on the Mountains and to examine its phytogeographical partition by analysing the databases with mathematical-statistical methods.

## 2. Aims

My aim was the monographic elaboration of the flora of Gerecse Mts. to serve as a base for the phytogeographical analysis of the studied area. Another aim was the representative coenologic sampling of the natural plant communities of the area to be able to carry out the survey based on these.

During my work the clarification of the phytogeographical relations of the examined area, the demonstration of the mesoregional differences, the determination of the phytogeographical borders within the Mountains and the indication of phytogeographical effects from different directions were my goals. In the clarification, as opposed to the former phytogeographical observations regarding the area, my aim was to reach the greatest possible objectivity.

I intended to carry out my research based on both floristic data and the analysis of coenologic relevés as well as to compare the results of the two.

I considered the enumeration of the weaknesses, deficiencies of the applied methods, with this enabling the better understanding on the chorological relations of the area and seeking for the possibilities of the general use of these methods.

The phytogeographical relations of the given area were examined from more viewpoints, to decrease the possibility to draw false conclusions deriving from the differences on the flora and vegetation due to artificial

influences and increase the possibility for the indication of the phytogeographical differences.

To study the detailedness of the results during the utilization of the different methods, data and through this, the application of the methods in phytogeographical surveys were also my goals.

My purpose was to determine the species important in the separation of the phytogeographical regions and the examination of their character.

I intended to know, that the chorological relations on the area change to what extent if the base of the examinations are not a small group of the species (selected subjectively) and coenologic relevés made not only in typical stands but the whole range of occurring species and a large number of coenologic relevés.

## 3. Material and methods

The phytogeographical relations of Gerecse Mountains were examined through the analysis of floristic records and coenologic relevés.

### 3.1. Survey on floristic records

On Gerecse Mountains, literature on floristic data as well as data found in the significant herbariums of Hungary were collected (Hungarian Natural History Museum, Department of Botany, Corvinus University, Szent István University, University of Debrecen, Mátra Museum, Móra

Ferenc Museum). The revision of herbarium specimens and collecting literature data were carried out. Subsequently, these were included to a database together with the own data of the author.

During the survey, cca. 130000 floristic records on more than 1350 species were used from the area of the Mountains. Floristic data were analysed with the aid of UTM-grid of different grid scales. Floristic lists of UTM-quadrants of 5×5 km, 2.5×2.5 km and 1.25×1.25 km were compiled. To the species, the index of their frequency within the quadrants was also attached. Quadrants were evaluated on the bases of different species pools: the whole known species pool of the quadrants, species pool without weed species, species pool without weed and disturbance-tolerant species, pool with occurrence detailed in the flora work of Gerecse and pool with occurrence detailed in the flora monograph of Gerecse without weed species.

### **3.2. Survey on coenologic data**

More than 1500 relevés were set in the whole area of Gerecse in open rocky grasslands, dry grasslands and forests. The relevés were sampled in natural stands. The sampling of coenologically typical associations was not aimed, however, the transitions of different associations were avoided.

The objective identification of the coenologic relevés with plant associations was calculated with similarity indexes.

Relevés were examined by UPGMA classification and PCoA ordination. In the cases of rocky grasslands not only the analysis of the individual relevés but that of the stands was also implemented.

The distribution of the relevés originated from multivariate methods were illustrated also in a map. If the distribution was continuous, the relevés were classified into intervals along the given axis.

With PCoA method, the group of those plant species was determined which are the most important in the segregation of the coenologic relevés.

## 4. Results

### 4.1. Phytogeographical results

Floristic data on the area of Gerecse were collected, their revision was carried out and the critical flora work of the Mountains was compiled (this was issued in an individual volume).

The unified system of the geographical names of Gerecse was prepared with GIS background and the equivalents of the names of former literature and herbarium publications were determined.

In the dissertation the new and novel phytogeographical division of Gerecse Mts were given.

The most significant factors influencing the results of the analysis were also collected, which can modify the distribution of the species presence in the studied area and the composition of the sampled plant communities. The significance and role of urbanisation, transport, mining, agriculture, forestry, game populations, tourism, technical sports and invasive plant species in the alteration of the flora and vegetation of the area were supervised. The fact that due to these artificial processes the phytogeographical differences become largely indistinct was emphasized and makes their indication difficult.

It succeeded to prove the strict relation between the floristical composition of UTM-quadrants and the geographical position of those.

With the analysis of floristic data, using UTM-grid, three main phytogeographical regions within the area of Gerecse Mts was determined:

one includes the central and western parts of the Mts, other the northeastern and northern part, and the third the southern part of the Mts.

The phytogeographical unity of the western region of the Mountains was indicated and the thesis of the former partition of the area (to the subregions of West Gerecse and Central Gerecse) were rejected.

The phytogeographical independence of the subregions Gete Group and Sarmatian Range were also rejected within Eastern Gerecse, but the independence of earlier defined Northern Gerecse was confirmed within the Eastern Gerecse region.

The justification of the southern part of the mountains as an independent phytogeographical area was reinforced, which result is supported by its own phytogeographical character (dolomite vegetation) and its transition features between the western and eastern parts of the Mts.

The dominance of forest species (*Quercus* – *Fagetea*) on the western part, dominance of grassland species (*Festuca* – *Bromion*) in the eastern part and the dominance of dolomite-species in the southern part of the studied area was revealed based on floristic records and also coenologic relevés.

With the analysis of the coenologic relevés the results based on floristic data became more exact.

The fact that the rocky grasslands of the north-eastern part of the Mountains are related to those of the western and also to the southern part of the Gerecse Mts. was indicated.

During my survey the theory of the segregation of the rocky grasslands exclusively on the basis of base rocks was rejected, at the same

time their close relation with the dry grasslands formed on not firm baserock was justified.

Relying mainly the survey on dry grasslands the phytogeographical connectivity of the eastern part of the Mountains and its northern edge region was proven. Within this the slighter separation of the northern edge region from the area between Máriahalom and Mogyorósbánya was also revealed. Based on the results the extensive extrazonal presence of wooded steppe vegetation can be supposed in the latter area.

The definite coenologic continuity of the forest stands of the surveyed area, the weak relation of the difference in the composition of the herb layer and canopy as well as the strong regional and weak coenologic determination of the dominance of the Submediterranean *Smyrnium perfoliatum* were indicated as well.

The great coenological similarity of beech woods and hornbeam-oak woods were reinforced.

It was shown that the floristic approach (sampling the entire flora of the region) and coenologic approach (sampling given populations) led to similar results, which can be explained and extended with each other.

#### **4.2. Methodological results**

It was proved that floristic records linked with UTM-grids, single coenological relevés and merged coenological relevés are alike suitable to reveal phytogeographical boundaries or gradients even within a mountain.

Using different grid scales it was indicated that with the present data structure the segregation of the Mountains into phytogeographical

regions were resulted in the case of all grid scales, on the same bases. However, we gained the most information with medium grid scale, because with rough grid the resolution of the results was weak, while with fine scale certain regions cannot be separated or were fallen out of the survey.

During the examination of various initial data matrix I concluded that the presence of the phytogeographical regions of the Mountains can be detected to different extents.

It was shown, that the restriction of the number of species in the data matrix may be useful, if e.g. the weeds are omitted, but may cause lose of information, if e.g. artificially selected species constitute the data matrix.

Examining the efficiency of different data transformations I demonstrated that with the divisive classification method only the analysis of the binary data matrix resulted interpretable groups, while in the case of agglomerative classification most information could be reached after the standardisation by objects.

There was relation between the data transformation methods and the results regarding coenological relevés also: the UPGMA analysis of rocky grasslands gave discrete groups only with binary or object base standardised data and that for grasslands only with binary data.

A potential method was proposed for the illustration of objects forming not discrete groups in the virtual space as well as the determination of the union of the maps and the species groups responsible for the separation of certain regions.

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