ANN. INST. GEOL. PUBL. HUNG. | vol. LXX. | Budapestini, 1987

Proceedings of the VIIIth RCMNS Congress

A COMPREHENSIVE STUDY OF THE HUNGARIAN NEOGENE FLORAS

by

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This paper reports on the complex computer-assisted study of the 31 most significant Hungarian Neogene flora assemblages based partly on literature as well as the scientific investigations of the author. The evaluation includes the change of the Arctotertiary/Palaeotropical elements' ratio, the evolution of the lamina margin types, the relation (descent) of the floras, as well as their distribution according to biotopes. The dendrogram obtained by cluster analysis presents the similarity relations of the floras.

Fig. 1 demonstrates the ratio of Palaeotropical and Arctotertiary elements in the 31 floras studied. It is conspicuous that the number of *P* elements in the Lower Miocene floras are higher than or equal to that of the *A* elements. This is especially prominent in case of the Ipolytarnóc flora. Subsequently, *A* elements are always more important than the *P* ones.

Fig. 2 shows the evolution of the leaf lamina margin. Three categories were established that is the entire leaf toothed leaf and needle-leaf types. The line corresponding to the entire leaf and toothed leaf categories run roughly parallel to the *P* and *A* lines, respectively, as one could suppose. This means that the majority of the palaeotropical elements are entire-leaf types, with the laurels dominating, corresponding to the laurels forests characteristic of the subtropical climate.

In case of the grouping according to biotopes we can see, that the number of lacustrine and palustrine species can be high in case of some Lower Miocene and Sarmatian floras, becoming generally high, however, in the Pannonian period. Some Sarmatian floras might contain species characteristic of the flood plain areas, while the species of laurophyllous forests dominate in the Lower Miocene, floras as well as some in Lower Sarmatian ones. Alpine species are generally rare, while dry biotopes are common in case of the Lower and Upper Sarmatian floras.

In the genetical grouping of the species those geographical regions are named which are the present areas of the modern equivalents of the fossil species. As it is apparent from Fig. 3, species with SE Asian (SEA), North American (NAM), and Caucasian (CAU) affinity were the most important in the Neogene. These were followed by the Mediterranean species and those of Asia Minor. The Central European, South European and East Mediterranean elements were subordinate. The SEA elements are present in almost any Neogene flora, and dominate the Lower Miocene and Lower Sarmatian assemblages. Caucasian elements are scarce in the Lower Miocene floras but they are represented in considerable numbers in the Lower Sarmatian and younger assemblages. The North American affiliation species reach the highest values in some Sarmatian floras as well as on a Pannonian locality. Mediterranean elements are present in course of the whole Neogene, especially increasing, in the Lower Sarmatian. Eastern Mediterranean elements are met in the

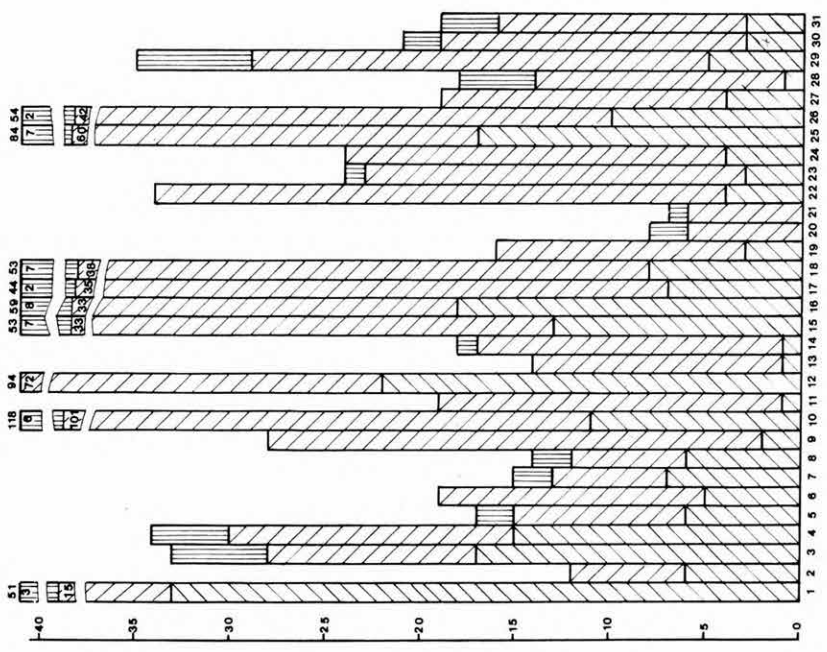

Fig. 1. The ratio of arctotertiary and palaeotropical elements in the Neogene floras of Hungary

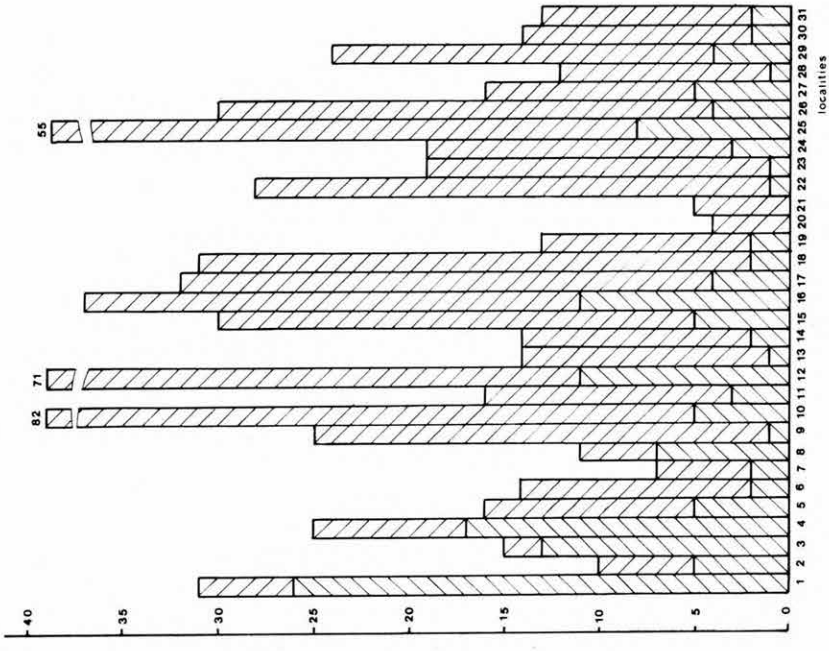

Fig. 2. Types of lamina margins in the Neogene floras of Hungary

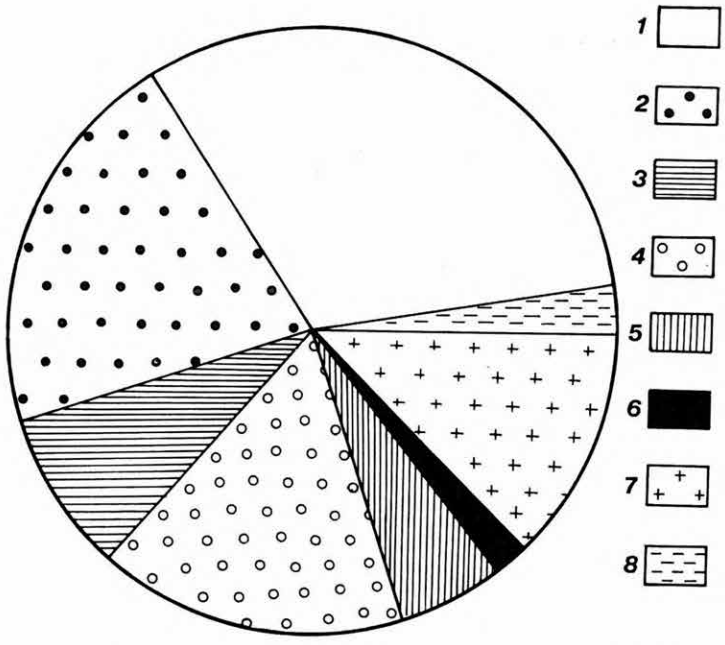

Fig. 3. The geographical distribution of the species in the Neogene floras of Hungary
1 Southeast Asia, *2* North America, *3* Asia Minor, *4* Caucasus, *5* Central America, *6* East Mediterranean, *7* Meditteranean, *8* South Europe

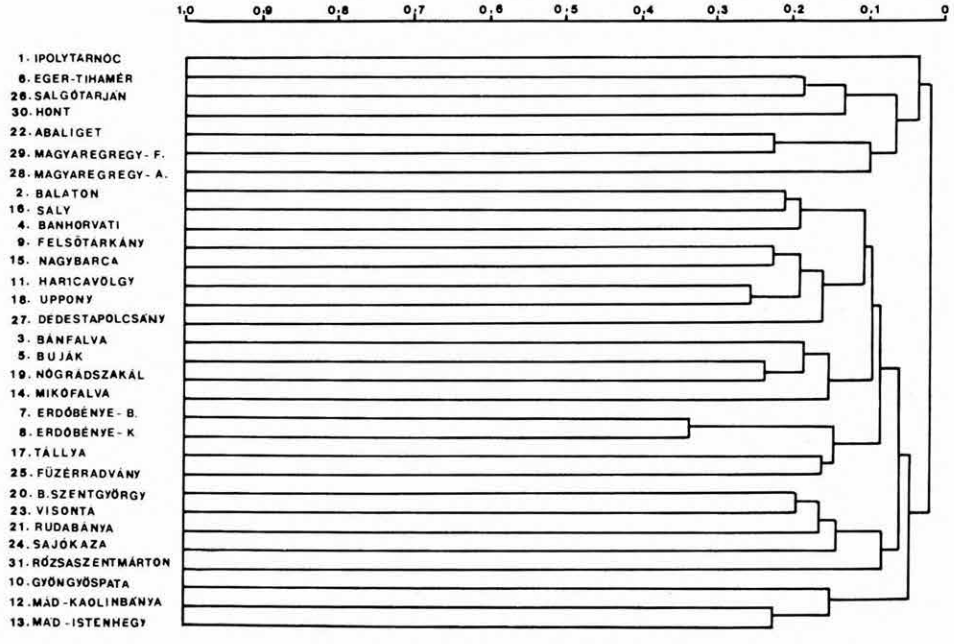

Fig. 4. The Hungarian Neogene leaf flora dendogram of Czekanowski index

Sarmatian only. The Central European elements are constantly present in minor numbers. The South European ones appear in some floras only. Species of Asia Minor occur only sporadically in assemblages preceding the Sarmatian, while they are present, to some extent, in almost all Sarmatian floras. On the dendrogram (Fig. 4) there are four distinct units that can be fairly well separated from each other: I Ipolytarnóc—Magyaregregy, II Balaton—Füzérradvány, III Balatonszentgyörgy—Rózsaszentmárton, IV Gyöngyöspata—Mád (Isten-hegy). In the first group, floras of Ottnangian, Karpatian and Badenian age are assigned only. The second group comprises Sarmatian flora with the exception of one locality, the third group consists of Pannonian assemblages with one Sarmatian locality. The fourth group consists of Badenian and Sarmatian floras.

I The first group comprises seven localities. Their age is Ottnangian, Karpatian and Badenian. The Eger (Tihamér fields = Lower Badenian) and Salgótarján (Ottnangian) floras show greater similarity, to each other than with their respective contemporary floras. The Eger "Tihamér" flora is rather far from the Nógrádszakál flora, belonging also to the Badenian. Its connection with the Salgótarján flora is due to the fact that both of them are dominated by palustrine species. This reflects the effect of factors other than geological age in the similarity values namely climate and ecology. The characteristic plants that are common in these assemblages are Myrica, Phragmites, Typha, Pronephrium stiriacum. The Lower Badenian of Hont flora contains, apart from the palustrine species shared with the above localities considerable amount of laurels like Daphnogene and Laurophyllum. The Lower and Middle Miocene localities of the Mecsek Mountains appear separately from the above north Hungarian sites on the dendrogram. Abaliget (Ottnangian—Karpatian) is nearest to Magyaregregy (Farkasordító ditch) (Karpatian). These floras are composed of swamp vegetation as well as of laurels. The Ottnangian flora of Magyaregregy (Almás fields) is connected to the above localities on account of the laurophylles. As opposed to the above floras, this site contains no palustrine vegetation beside the palaeotropical elements, but that of the flood plain area (Liquidambar, Populus, Parrotia). Floras of northern Hungary and the Mecsek Mts are connected only at this level. The Ipolytarnóc Ottnangian flora can be connected to the above floras at a rather low mean similarity value. It can be attached to the above floras on account of the Lauraceae (Daphnogene, Laurophyllum).

In the group discussed above the Nógrádszakál Badenian assemblage as well as the Gyöngyöspata Lower Badenian flora are missing. These differ not only from the other Lower and Middle Miocene floras, but from each other as well. In Nógrádszakál, the dominating species are typical of the flood plain area environment, especially the higher river flats. Palustrine species, as well as the laurels ones are missing or they are present in very low numbers. As it is apparent from the dendrogram, the flora stands nearest to the Sarmatian floras of group II. The Gyöngyöspata flora assemblage is the nearest to the floras of Mád—Kaolinbánya and Mád (Isten-hegy), both of them preserved in kaolinite (Group IV); however, the mean similarity values are rather low. These floras comprise, on one hand, the swamp vegetation, on the other hand, some xerophilic elements. Their similarity can be explained by the latter. The flora of these three sites are, due to their special biotopes, clearly distinct from all other assemblages.

II Floras of the greatest similarity belong to this group. Except for the Nógrádszakál locality, all assemblages are the Sarmatian. Harica valley with Uppony and Felsőtárkány with Nagybarca: similarity here is apparent. Environment must have been a decisive factor. Most of the species are of the food plain area, they are do-

minating the assemblages. Beside the species characteristic of the river flats, the xerophilic *Quercus pontica-miocenica* is also significant in the flora. The Dédestapolcsány assemblage is only slightly different from these. Balaton—Dellő with Sály and with Bánhorváti form a slightly separate unit, differing from the other assemblages on account of the presence of *Zelkova zelkovaefolia*, *Fagus* div. sp., *Carpinus grandis*. Their similarity arises from the presence of the flood plain area elements like Parrotia, Alnus, Betula, Ulmus. Buják with Nógrádszakál: The Nógrádszakál flora of Badenian age shows the greatest similarity with that of the Sarmatian Buják assemblage. This is due partly to the presence of the species *Parrotia pristina*, *Quercus pontica-miocenica*, both of them belonging to the east Mediterranean food plain area types, as well as the high river flats' Ulmus species. Essential differences between the two floras are, for example the absence of the Liquidambar at Nógrádszakál, which is dominating in the Buják flora. The Buják flora is connected to the Sarmatian ones by the presence of *Zelkova zelkovaefolia*, *Quercus kubinyii*, that are not present in the Nógrádszakál assemblage. The flora of Bánfalva is connected to the above assemblages by the presence of the east Mediterranean elements. The Mikófalva flora is fairly different from these. Their connection can be demonstrated in the species characteristic of the flood plain area biotope, such as *Populus* div. sp. Within group II, the following 4 localities are very close to each other. Erdőbénye (Barnamáj) with Erdőbénye (Kővágó-tető) are, naturally enough, the most similar among the Neogene floras. They are very near to each other in time and space. Xerophillic elements are dominating here. Tállya with Füzérradvány: these two essentially different floras are linked together with the Erdőbénye flora by *Gleditsia knorrii*. The flora of Tállya is fairly similar to that of Erdőbénye. From the presence of the laurophyles (*Daphnogene* div. sp.), however, it can be inferred that a subtropical vegetation of higher humidity requirements existed contemporary to these assemblages at Tállya. In the Sarmatian flora of Füzérradvány, supposed to be younger, swamp vegetation had also some role. The presence of the *Quercus* div. sp. and the *Gleditsia knorrii*, however, connect this assemblage to the above mentioned floras.

III Five assemblages belong to this group. Apart from the Sarmatian Sajókaza, they represent Pannonian sites. All of them contain typical swamp vegetation. In the Sarmatian flora of Sajókaza as well as the Lower Pannonian of Rudabánya, the species Pterocarya can still be found, but it is already absent from the younger floras. Typical Pannonian swamp vegetation is formed by the species *Glyptostrobus europaeus*, *Byttneriophyllum tiliaefolium*, *Phragmites* sp., *Typha* sp., *Salix* div. sp. (Balatonszentgyörgy with Visonta). We find same young flora assemblage in the Upper Pannonian of Rózsaszentmárton as well. From more distant areas, a Daphnogene leaf had been drifted to the sedimentary basin. This is the youngest occurrence known for the genus Daphnogene in Hungary.

The floras belonging to Group IV have been already analysed in connection with the Gyöngyöspata Badenian assemblage.

As we can see from the above discussion cluster analysis cannot be used for a chronological ordering of the localities, i.e. for biostratigraphical purposes. Its biostratigraphical relevance is only approximate, ecological and climatological factors are also taken into consideration.

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