Leaf physiognomy and palaeoenvironmental estimates – an alternative technique based on an European calibration

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ABSTRACT:
Physiognomic characters of fossil angiosperm leaf assemblages are believed to represent suitable proxies for palaeoenvironment, and particularly for palaeoclimatic reconstruction. To analyse past environments in Europe, a recently developed approach (ELPA: European Leaf Physiognomic Approach) is used to examine the relationship between angiosperm leaf physiognomy and environmental parameters. Transfer functions for different environmental parameters (e.g. mean annual temperature, temperature of warmest and coldest month, number of ground frost days per year, and proportion of evergreen taxa within the vegetation) have been estimated from leaf physiognomic characters using Redundancy Analysis (a multivariate ordination technique). These transfer functions are applied to three fossil floras from the European Paleogene (Monod-Rivaz, Switzerland, Late Oligocene) and Neogene (Schrotzburg in Germany, middle Miocene and Erdőbénye Kővágó-oldal in Hungary, also Middle Miocene). The results obtained are compared to alternative palaeoenvironmental estimates: (1) transfer functions based on multiple linear regression, (2) the coexistence approach (which is based on the "nearest living relative concept"), and (3) palaeoenvironmental estimates from preceding publications on the three fossil floras. The application of the new transfer functions based on the ordination technique to the three European fossil floras shows realistic results, consistent with other palaeoclimatic reconstructions. The leaf physiognomic transfer functions proposed here thus provide alternative techniques that can be applied in palaeoenvironmental research.

KEY WORDS:
leaf physiognomy, fossil leaf assemblage, ordination, Redundancy Analysis RDA, evergreen leaves, character syndrome, palaeoclimate