

Cactaceae: recent molecular systematic studies and their taxonomic implications

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The molecular systematic “revolution” of the past two decades is, inevitably, also affecting the higher classification of the family Cactaceae. Ancestor-descendant relationships are inferred by phylogenetic investigations on the basis of comparative sequence data and are depicted in the form of tree diagrams (i.e., hypothetical phylogenies). These diagrams provide the outline for a genealogical classification system that reflects the hierarchical pattern of the corresponding phylogenetic hypotheses. In a second step, and mainly motivated by maintaining conventions, the different groups (i.e., taxa) are ranked based on the “Linnaean” classification system. Major disagreement continues to smoulder concerning the recognition of paraphyletic extant supraspecific taxa and the relative importance of (1) objectivity, (2) stability, and (3) practicability in biological classification systems. A phylogenetic classification system – as proposed here – is based on the following three premises: (1) only synapomorphies are important for inferring phylogenetic relationships, (2) classification systems must be based directly and exclusively upon hypothesized phylogenies, and (3) only holophyletic (= monophyletic) supraspecific taxa are recognized and named.

Depicting hypothesized relationships in the form of tree diagrams has an extensive tradition in cactus systematics, dating back to the work by William F. Ganong on the morphology of embryos and seedlings in Cactaceae at the very end of the 19th century. The current suprageneric classification system of Cactaceae, recognizing three or four subfamilies (i.e., Cactoideae, Maihuenioideae, Opuntioideae, and Pereskioideae) and a variable number of tribes in the two larger subfamilies, is still to a large extent based on the studies by Franz Buxbaum during the 1950s and 1960s. Two decades of molecular systematic studies in Cactaceae allow us now to come up with a refined classification system that better reflects the phylogenetic relationships among the major lineages as currently understood.

We propose to recognize four subfamilies (tough!) keeping in mind that Pereskioideae (and hence the genus *Pereskia*) is paraphyletic. Furthermore, we suggest that Cactoideae and Opuntioideae are classified into several tribes (i.e., Blossfeldieae, Cacteeae, Cereae, Notocacteeae, Phyllocacteeae, Rhipsalideae as well as Cyllindropuntieae and Opuntieae) and, if they are diverse and rich in species, a few subtribes. However, our current knowledge still is fragmentary and, hence, a few genera, both in Cactoideae and Opuntioideae, remain “unplaced” and are recognized as orphans (i.e., *Calymmanthium*, *Copiapoa*, *Frailea*, *Maihueniopsis* p.p., and *Pterocactus*).