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Reaching a compromise between conflicting nuclear and plastid phylogenetic trees: a new classification for the genus *Cattleya* (Epidendreae; Epidendroideae; Orchidaceae)

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Abstract

A new classification for the 114 species *Cattleya* is proposed, based on and compatible with previously published nuclear, plastid and combined phylogenetic trees. *Cattleya* is divided into four subgenera, three sections and five series. A key to the infrageneric categories and a table listing all species and their placement is presented.

Key words: Laeliinae, *Laelia*, *Sophronitis*, infrageneric classification

Introduction

Cattleya Lindley (1824: t. 33) is a Neotropical genus with 114 species of outstanding horticultural importance (van den Berg 2005, 2008). On the basis of molecular phylogenetic results based on nuclear internal transcribed spacer (ITS) and plastid *trnL-F* (intron and intergenic spacer), *matK* and *rbcL* (van den Berg *et al*. 2000 , van den Berg 2009, van den Berg *et al.* 2009), *Sophronitis* Lindley (1828a: t. 1147) and all Brazilian species previously included in *Laelia* Lindley (1831a: 115) were transferred to *Cattleya* (van den Berg 2008). In the last paper, the rationale justifying lumping as a better option than splitting *Cattleya* in smaller genera was presented. The alternative option of splitting into several genera would the number of narrowly defined genera and create many thousand nothogenera in horticulture. Therefore, new combinations for species binomials previously placed in *Sophronitis*, *Hoffmannseggella* Jones (1968: 69) and other genera of Chiron & Castro (2002) were made in *Cattleya* (van den Berg 2008 for species, van den Berg 2010 for natural hybrids). As a result, a new classification was clearly needed, especially because part of the rationale for improving nomenclatural stability was to deal with nomenclatural changes from that point onwards without the need for further species transfers. Various classifications have been proposed for *Cattleya* and *Laelia*, partly reviewed in Withner (1988, 1990), where he provided an intricate system of subgenera and sections. However, in most cases, basionyms were not correctly cited, even in amendments made later (Withner 2000), which rendered several transfers invalid.

I propose here a new system of infrageneric taxonomy for *Cattleya* based previous phylogenetic studies (van den Berg 2009, van den Berg *et al.* 2000, 2005, 2009). The figure comparing plastid and plastid+ITS topologies and phylogenetic relationships among groups of *Cattleya*, which was inadvertently excluded from van den Berg (2009), is published here for the first time, providing a framework for the new classification (Fig. 1). Despite being based on several DNA regions, decisions on infrageneric groupings for *Cattleya* were challenging. Some infrageneric groups display conflicting placements between ITS and plastid trees. Also due to differences in rates of molecular evolution, the combination of all eight plastid regions generated a tree that is less resolved than that of just ITS. On the other hand, the content of each infrageneric group, i.e. the sets of species recovered in both topologies is similar and compatible with various previously recognized groups based on their morphology. For example, the set of species that corresponds to the former Brazilian *Laelias* (*Sophronitis* sensu van den Berg & Chase 2000) is recovered as a clade, and the species groups within this follow closely the classification of Schlechter (1917a). In fact the main conflict between the two trees in Fig. 1 lies in relationships between these main groups and can be summarized by three main points: a) subgenus

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be interpreted as designation of types for several earlier names. He later corrected some of these errors (Withner 2000). In the case of subg. *Bicolores* Withner (2000: 168) the type indicated (*C. violacea*) is against Article 10.2 of the *Code* because this species was not listed by Pfitzer (1889) among the members of the section. In fact Pfitzer (1889) mentioned only *C. bicolor*, which makes it automatically the type species for the section. To avoid further confusion, we provide types and ranking for all names still lacking them, and types were chosen in a manner to cluster the names as much as possible around fewer type species, considering that they are all synonyms of *C.* subg. *Intermediae*.

4. ***Cattleya*** subgenus ***Maximae*** (Withner) Van den Berg, *stat. nov.*

Basionym: *Cattleya* section *Maximae* Withner (1988: 21). Type species: *Cattleya maxima* Lindley (1833: t. 116).

Cattleya maxima is generally considered a relative of the *C. labiata* complex, but phylogenetic trees based on ITS only (van den Berg *et al.* 2000), embedded it in *C.* sect. *Crispae.* In contrast, plastid analyses indicated a position as sister group of all remaining species of *Cattleya* (van den Berg *et al.* 2009). Its subcylindrical pseudobulbs are anomalous for *C.* subg. *Cattleya*, despite having unifoliate leaves. The coastal form of *C. maxima* has tall, cylindrical pseudobulbs that resemble *C.* subg. *Intermediae*. The flowers have narrower petals and sepals than the *C. labiata* complex and are similar to those of species in *C.* ser. *Cattleyodes* such as *C. purpurata* (Lindley & Paxton 1852: 111) Van den Berg (2008: 10) or *C. lobata* Lindley (1848: 403) but with 4 pollinia. The mosaic of morphological characters with *C.* sect. *Cattleya* and *C.* ser. *Cattleyodes* might suggest a hybrid origin for this species, which might then also explain the highly discordant placement in plastid and nuclear topologies.

New combinations

Cattleya alvarenguensis **(**Campacci) Van den Berg, *comb. nov.*

Basionym: *Hoffmannseggella alvarenguensis* Campacci (2014: 382)

Cattleya guanhanensis **(**Campacci) Van den Berg, *comb. nov.*

Basionym: *Hoffmannseggella alvarenguensis* Campacci (2014: 386)

Cattleya vasconcelosiana **(**Campacci) Van den Berg, *comb. nov.*

Basionym: *Hoffmannseggella alvarenguensis* Campacci (2014: 390)

These new combinations are necessary to complete the checklist in Table 2, with the correct accounting and listing of species within ser. *Parviflorae*.

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