



## Molecular phylogenetics of Neotropical *Cyanaeorchis* (Cymbidieae, Epidendroideae, Orchidaceae): geographical rather than morphological similarities plus a new species

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### Abstract

We investigated the phylogenetic placement of *Cyanaeorchis* and selected representatives of the tribe Cymbidieae based on nuclear (ITS) and plastid (*matK-trnK* and *rbcL*) DNA sequences. Bayesian and parsimony analyses of separate and combined datasets were largely congruent with each other and showed that the Neotropical *Cyanaeorchis* does not belong in the predominantly Old World subtribe Eulophiinae, where it has previously been placed. Instead, it is strongly supported as a sister to *Grobhya* in Catasetinae. Because Catasetinae are Neotropical and there are no unequivocal morphological similarities between *Cyanaeorchis* and other genera in the subtribe, this relationship reflects a geographical rather than morphological similarity and suggest habitat-driven local diversification. Specimens from central Brazil formerly identified as *Cyanaeorchis minor* are shown to be a distinct species, described here as *C. praetermissa*. Niche modeling indicates that *C. praetermissa* and *C. minor* have different distributions and ecological niches, whereas a third species, *C. arundinae* has broader climatic tolerances and a distribution that encompasses those of the other two species. The distribution of the genus is also predicted to include Bolivia, the states of Rio de Janeiro, Espírito Santo and several areas in northeastern Brazil, from where no collections are currently known.

### Introduction

*Cyanaeorchis* Barbosa Rodrigues (1877: 112) is a small genus of two species distributed from the Espinhaço range in the state of Bahia in northeastern Brazil to central, southeastern and southern Brazil, Argentina and Paraguay. Species of *Cyanaeorchis* are terrestrial and found in humid grasslands, permanent swamps and marshes, usually from 600 to 1700 m, but also near sea level at latitudes greater than 27° S. Flowering is mainly from October to January, from the beginning to the peak of the rainy season. Plants of *Cyanaeorchis* have distinct growth and dormancy phases - a new vegetative shoot, leaves and terminal flowers are produced in the rainy season during the spring and summer. During the dry season or winter, the aerial parts wither and the plant survives as a short underground stem with roots, which makes possible a new cycle of growth in the following rainy season.

The first species of *Cyanaeorchis* was originally described as *Eulophia arundinae* Reichenbach (1850: 854). Barbosa Rodrigues recognized a series of differences with *Eulophia* and proposed the genus *Cyanaeorchis*. The main distinctive characters were the terminal inflorescence, four pollinia and the lack of a spur on the labellum in *Cyanaeorchis*. Cogniaux (1898–1902) and Hoehne (1942) accepted and summarized knowledge of the genus.

solo escuro, hidromórfico, 13 November 2007 (fl), *Batista & Martins 2218* (BHCB!); São Roque de Minas, Parque Nacional da Serra da Canastra, 37 km a partir da portaria principal de São Roque de Minas, em direção a Sacramento, campo limpo úmido, 12 December 2007 (fl), *Batista & Carvalho 2342* (BHCB!).

**Notes:**—As far as we could determine, *C. praetermissa* was first collected by Heringer in Brasília in 1963. Material of this collection was examined by Pabst, who misidentified it as *C. minor* and published a sketch of a flower from this collection in his seminal work of Brazilian orchids, *Orchidaceae Brasilienses* (Pabst & Dungs 1975). This mistake was followed by all subsequent authors who examined and identified material of the species (Menezes 1992, 2004, Batista & Bianchetti 2003, Batista *et al.* 2005) or compiled data on the distribution of the genus (Barros *et al.* 2013, Govaerts *et al.* 2013).

*Cyanaeorchis praetermissa* is the smallest of the three species in the genus (Fig. 6). In terms of size, number and size of leaves and number of flowers, *C. praetermissa* overlaps *C. minor* and small individuals of *C. arundinae*. In size of sepals and petals, *C. praetermissa* overlaps *C. minor*. The main distinctive characteristics are size of the labellum and papillae. In *C. praetermissa*, the labellum is shorter and straighter (6.0–8.0 × 4.5–6.5 mm, versus 8.0–12.0 × 9.0 mm in *C. minor* and 9.0–15.0 × 9.0–12.0 mm in *C. arundinae*), and papillae are shorter. Another difference in *C. minor* is floral colour. *Cyanaeorchis praetermissa* has completely yellow flowers, whereas *C. minor* has whitish sepals and petals and wine-coloured lateral lobes of the labellum. Other differences between the three species are outlined in Table 3.

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**Additional specimens examined:**—*Cyanaeorchis arundinae*: Amaral s.n. (HUFU 18370); Amaral 1224 (SP); Barroso et al. 509-68 (IPA, UB); Batista s.n. (BHCB), 312 (CEN), Batista et al. 2769 (BHCB); Boechat s.n. (ICN 44273); Brade 6855A (RB), 7575 (HB); Carvalho et al. 40 (RB); Duarte 2291 (RB), 4303 (HB, RB), 13911 (HB, HBG, M, NY); Dusen 7500 (HBG, K); Dutra 1015 (ICN), 1098 (ICN); Gaudichaud 175a (P), 176 (P); Glaziou s.n. (P 436668); Harley et al. 24924 (K, SPF); Hassler 5323 (G), 9677 (G, NY, W), 11406 (G); Hatschbach 22888 (F, K), 23285 (NY), 25107 (NY), 35541 (M), 43437 (NY, UB); Irwin et al. 8597 (HB, NY), 9007 (HB, NY, UB); Kirsten s.n. (CEN 46501, SP 28749); J. Klein 126 (BHCB); R.M. Klein 3344 (HB), 3505 (HB), 3562 (HB); Leinig s.n. (HB 41038); Leitão et al. 1350 (UEC); Lutz s.n. (HB 10733); Markgraf & Borges 10337 (HB); Mota & Giacomini 2337 (BHCB); Oliveira 435 (HUFU); Pedersen 5230 (K); Regnell ser. II 264 (S); Reitz & Klein 14195 (HB, RB); Ribas et al. 5769 (RB); Roth s.n. (ICN 68316); Sello 462-1341 (K); Smith & Klein 13627 (HB), 13669 (HB), 13971 (HB, NY, P); Sobral 9460 (RB); Stutzel s.n. (ICN 51518); Ule 7029 (HBG); Waechter 2000 (ICN); Weddell s.n. (P 436670). *Cyanaeorchis minor*: Dusen 15681 (S), 15708 (S), 15840 (AMES, NY); Hassler 9677a (G); Hatschbach 32806 (HBG, M); Hoehne 661 (M, NY); Jonsson 1307a (AMES, F); Klein 124 (BHCB); Paula-Souza et al. 8301 (SPF); Souza et al. 7230 (ESA, SP).