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Catasetum queirozii (Orchidaceae: Catasetinae): a new species from the Brazilian Amazon

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ABSTRACT

This study presents a new orchid species of the genus *Catasetum* belonging to the group of species with symmetrical and parallel antennae. It was found in *terra-firme* and floodplain forests in the Brazilian states of Amazonas and Pará. We provide a formal description of the new species, images, and notes on distribution, habitat, phenology, flower visitors and preliminary conservation status. We compare it with *C. cristatum* and *C. barbatum*, both sympatric and morphologically most similar to the new species. It was preliminarily classified in the Endangered (EN) category according to IUCN criteria based on the extent of occurrence, area of occupation, number of occurrence locations and the risks that the known populations are exposed to (deforestation and predatory collection).

KEYWORDS: Amazonas, dense ombrophilous forest, epiphyte, orchids, Pará, taxonomy

Catasetum queirozii (Orchidaceae: Catasetinae): uma nova espécie da Amazônia brasileira

RESUMO

Este estudo apresenta uma nova espécie de orquídea do gênero *Catasetum*, do grupo de espécies cujas antenas são simétricas e paralelas. Foi encontrada em florestas de terra-firme e igapó nos estados do Amazonas e Pará, Brasil. Fornecemos uma descrição formal da nova espécie, imagens e comentários referentes à distribuição, habitat, fenologia, visitantes florais e estatus de conservação. A comparamos com *C. cristatum* e *C. barbatum*, que ocorrem em simpatria e são morfologicamente mais semelhantes à nova espécie. Ela foi preliminarmente classificada na categoria Em Perigo (EN) segundo os critérios da UICN, com base na extensão de ocorrência, área de ocupação, número de localidades de ocorrência e os riscos a que as populações conhecidas estão expostas (desmatamento e coleta predatória).

PALAVRAS-CHAVE: Amazonas, floresta ombrófila densa, epífita, orquídeas, Pará, taxonomia

INTRODUCTION

Catasetum Rich. ex Kunth (Orchidaceae) is endemic to the Neotropics, occurring from Mexico to southern Brazil and northern Argentina (Romero and Carnevali 2009). Among the genera belonging to the subtribe Catasetinae, it stands out for its high species diversity, with 190 accepted species and 35 known natural hybrids (Krahl *et al.* 2022a; 2023a,b,c; Govaerts *et al.* 2023). The diversity center of *Catasetum* is in the Amazon basin, where many species have been recorded (Romero and Carnevali 2009), especially in the Brazilian Amazon (Silva and Silva 1998; Valsko *et al.* 2019), where 76 species have been recorded (Petini-Benelli and Chiron 2020; Krahl *et al.* 2021a,b, 2022a,b, 2023a,b,c; Petini-Benelli 2023). Some of these species are considered rare, e.g., *C. meeae* Pabst (Krahl *et al.* 2023d). Furthermore, the genus is also strongly represented by several nothospecies, with a total of 21 hybrids

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natural to the Brazilian Amazon (Krahl *et al.* 2020a; Cantuária *et al.* 2021; Petini-Benelli 2023).

The genus is usually divided into two subgenera based on the characteristics of the staminodes (antennae) present in the column of the staminate (male) flowers. The subgenus *Pseudocatasetum* is defined by poorly developed or absent staminodes whereas the subgenus *Catasetum* has clearly developed staminodes. The latter subgenus is divided into two sections: *Catasetum*, with asymmetrical and crossed staminodes, and *Isoceras*, with symmetrical staminodes. *Isoceras* is organized into three subsections: *Isoceras* (parallel staminodes), *Divaricatae* (diverging staminodes) and *Convergentia* (staminodes converging and in contact) (Bicalho and Barros 1988; Senghas 1990, 1991). However, a recent study on the phylogeny of the genus does not support this classification (from subgenra to subsections) and all species are better grouped according to area of occurrence, i.e., based on species sympatry (Mauad *et al.* 2022).

This study proposes a new *Catasetum* species from the Brazilian Amazon, in the states of Amazonas and Par*á*, which we relate to two other sympatric species presenting a similar morphology, *C. cristatum* Lindl. and *C. barbatum* (Lindl.) Lindl. We provide images of the new species and the comparative diagnostic characters of the three species, as well as information on the geographical distribution, habitat, phenology, flower visitors and preliminary conservation status of the new species.

MATERIAL AND METHODS

The new species described in here was first collected in 2011 during the survey and rescue of epiphytes in the Saracá-Taquera National Forest (FLONA Saracá-Taquera), a conservation area in Porto Trombetas (1º41'50.3"S, 56º32'50.7"W) (municipality of Oriximiná, Pará state, Brazil) by the Rio do Norte Mining Company (Mineração Rio do Norte - MRN), that has been carrying out similar surveys for over a decade in the area. The new species was later found during an Orchidaceae survey in Ducke Reserve (Reserva Florestal Adolpho Ducke - RFAD) in Manaus (2º57'32.7"S, 59º56'01.6"W) (Amazonas state, Brazil) and in random collections along the Mamuru and Nhamundá rivers (Pará). The specimens were herborized in accordance with the usual process described by Mori *et al.* (1989) for later incorporation of the holotype and paratypes in the herbarium HAMAB (acronym according to Thiers 2023). Measurements, morphological analyses and color determination of all the structures were based on fresh flowers. Descriptive terminology followed Dressler (1993) and Harris and Harris (2001). Plants cultivated for reintroduction programs in the epiphytary of MRN were observed during the flowering season to record floral visitors. Daily observations started from 06:00 until 16:00 hours and floral visitors were photographically recorded.

To select species for morphological comparison with the new species we used the following criteria: I) species belonging to the same infrageneric classification (subgenus *Catasetum* section *Isoceras* subsection *Isoceras*); II) sympatric occurrence with the new species (according to the current phylogeny of the genus in Mauad *et al.* 2022); and III) morphologically similarity with the new species. Following these criteria, the new species was compared with *C. barbatum* and *C. cristatum*, both belonging to the same species complex as the new species. The comparison is based on the available literature (*e.g.*, Cogniaux 1904) including the original description of the related taxa (Lindley 1824, 1836). We have analyzed different holotypes related to *C. barbatum* deposited in K (K000293764!; K000294039!).

Two parameters used to evaluate the conservation status of species, the extent of occurrence (EOO) and the area of occupancy (AOO), were calculated using the online platform Geospatial Conservation Assessment Tool (GeoCAT – http://geocat.kew.org/). Grid cells measuring 2 × 2 km were used to scale AOO (Bachman *et al.* 2011). The conservation status was evaluated in accordance with the criteria of IUCN Guidelines (IUCN 2022) and the global distribution map of the new species was made using QGIS software (Version 3.28 Firenze).

RESULTS

Catasetum queirozii D.R.P.Krahl, Krahl, Cantuária & J.B.F.Silva, sp. nov.

Type: Brazil: Pará: Oriximiná, Porto Trombetas, FLONA Saracá-Taquera, Platô Almeidas, 10/I/2011 (fl.), *J.B.F. da Silva 3516* (holotype HAMAB19536). (Figure 1a–h).

Diagnosis: *Catasetum queirozii* is similar to *C. cristatum* and *C. barbatum*, however it differs in its petals with a narrowly elliptical shape and a narrower lip, entire, oblong with a sparsely ciliated margin, with a globular concentration of fimbriae of thick consistency at the apex and the glabrous proximal surface.

Description: Plant epiphytic caespitose (Figure 1a). Roots basal, thick, whitish. Rhizome inconspicuous (Figure 1a). Pseudobulb 4.4–9.7 × 1.4–2.7 cm, fusiform, entirely covered by leaf sheaths (Figure 1a). Leaves 9.9–31.1 × 2.9–4.6 cm, narrowly oblanceolate, plicate, green, apically acute, with 5–6 more evident veins on the abaxial face and an entire and slightly undulate margin (Figure 1a). Staminate inflorescence 18.1–34.2 cm long, lateral, racemose, 4–24–flowered, erect to arched according to the number of flowers; peduncle cylindrical purplish (Figure 1a); floral bract 0.6–0.8 × 0.2–0.3 cm, oblong, concave, greenish, entire margin, acute apex. Staminate flowers greenish with brownish spots, pedicelled; pedicel 2.6–3.2 cm long, cylindrical, erect, purplish (Figure

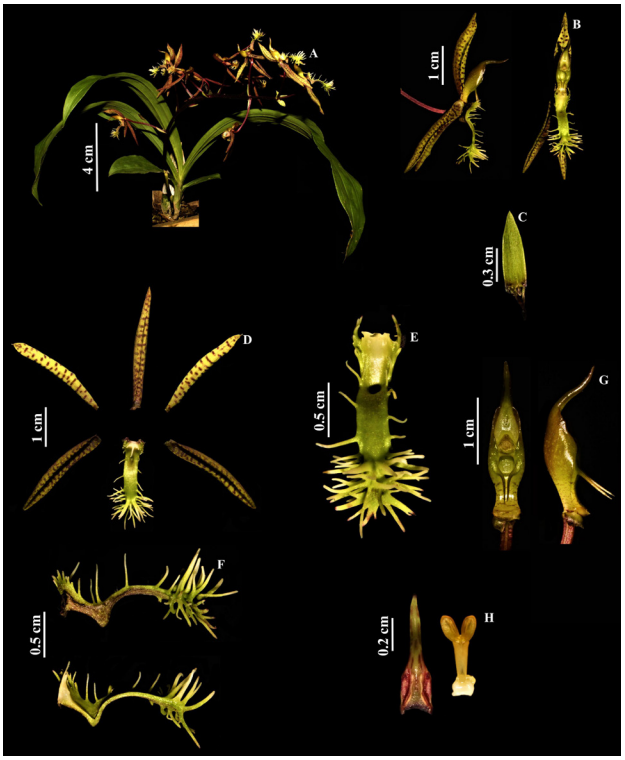

Figure 1. *Catasetum queirozii* sp. nov. A – habit; B – flower in front and side view; C – floral bracts; D – perianth; E – lip in front view; F – lip in lateral view; G – column in ventral and lateral view; H – anther cap and pollinarium. Credit: A.H. Krahl.

1b,c); sepals 2.5–2.7 × 0.9–1.1 cm, elliptic, involute, the dorsal symmetrical and the laterals slightly asymmetrical, entire margin, acute apex (Figure 1d); petals 2.4–2.6 × 0.4–0.5 cm, narrowly elliptic, revolute, entire margin, acute apex (Figure 1d); lip 1.9–2.2 × 0.4–0.5 cm (fimbriae excluded), entire, oblong, margin sparsely ciliate (Figure 1e), apex with a globular concentration of fimbriae with a thick consistency, proximal surface glabrous (Figure 1f); sac bottom 0.3–0.4 cm deep, ovoid, small (Figure 1f); basal callosity 0.4–0.5 × 0.2–0.3 cm, oblong, falcate, acute, flanked on each side by two small denticles; column 1.9–2.2 cm long, subtriangular, fleshy, rostrate, brownish green (Figure 1g); antennae 0.6–0.7 cm long, symmetrical, parallel (Figure 1g); anther cap 0.9–1 × 0.3–0.4 cm, rostrate, greenish to reddish brown (Figure 1h); viscidium 0.1–0.15 × 0.1–0.15 cm, sticky, whitish (Figure 1h); stipe 0.3–0.4 × 0.1–0.15 cm, laminate, rolled inwards, yellowish (Figure 1h); pollinia 2, 0.2–0.3 × 0.1–0.15 cm, yellowish, oblong, hard, compressed, sulcate (Figure 1h). Female and hermaphrodite inflorescences not observed. Fruit not observed.

Additional material examined (paratypes): Brazil. **Amazonas:** Manaus, Reserva Florestal Adolpho Ducke, 15/II/2019 (fl.), *A.H. Krahl & D.R.P. Krahl 1082* (HAMAB19545). **Pará:** Aveiro, Rio Mamuru, 05/III/2018 (fl.), *J.B.F. da Silva 5283* (HAMAB19537); Oriximiná, Porto Trombetas, FLONA Saracá-Taquera, Platô Almeidas, 15/I/2011 (fl.), *J.B.F. da Silva 3522* (HAMAB19538); idem, Platô Bela Cruz, 26/XI/2017 (fl.), *J.B.F. da Silva 5187* (HAMAB19539); idem,02/XII/2017 (fl.), *J.B.F. da Silva 5197* (HAMAB19540); idem, Platô Aviso, 15/II/2018 (fl.), *J.B.F. da Silva 5229* (HAMAB19541); idem, Platô Monte Branco, 12/III/2018 (fl.), *J.B.F. da Silva 5338* (HAMAB19542); idem, 23/IX/2018 (fl.), *J.B.F. da Silva 5355* (HAMAB19543); Faro, Rio Nhamundá, 16/II/2018 (fl.), *J.B.F. da Silva 5252* (HAMAB19544).

Additional material examined (other): Brazil. Pará: Melgaço, FLONA Caxiuanã, Estação Científica Ferreira Penna, próximo ao trapiche, I/1996 (fl.), *J.B.F. da Silva 517* (MG).

Etymology: The specific epithet is given in honor to the agronomist, orchidist and orchid enthusiast Sérgio Alberto Queiroz Costa who has been developing an admirable research work on orchids in the Amazon. He was also the first to call our attention to the true identity of the taxon proposed in this paper.

Distribution and habitat: The species is currently known to occur from eastern Amazonas state to the north-central part of Pará state, along the basin of the Negro and Amazonas rivers and some of their tributaries (*e.g.*, Mamuru River, Nhamundá River and Xingu River). In Ducke Reserve and in FLONA Saracá-Taquera, it was only observed in "terra firme" forest. By the Mamuru River and the Nhamundá River, it was found in floodplain forests. It was also recorded in Caxiuanã National Forest (FLONA Caxiuanã) (see Koch *et al.* 2014; treated as *C.* aff. *barbatum*). Its occurrence at the large curve of the Xingu River (Pará) is supported by the record of Abreu *et al.* (2015) (treated as *C. barbatum*) (Figure 2).

Phenology and floral visitors: Blooming of *C. queirozii* sp. nov. was observed to start in November and last until March, which corresponds to the rainy season in the Amazonian region (Braga 1977). According to our personal observations, the flowers are visited by male individuals of various bee species of *Euglossa* looking for aromatic compounds on the lip, mainly between 09:00 and 12:00 h. Visits by these bees have also been recorded by Abreu *et al.* (2015) (treated as *C. barbatum*).

Conservation status: EOO of *C. queirozii* sp. nov. was estimated as 135,486.423 km². According to the IUCN criteria, this EOO corresponds to criterion B1 and a classification of Least Concern (LC). AOO was 24.000 km², corresponding to criterion B2 and a classification as Endangered (EN). The global population (as defined in art. 4.1 – criterion C of the guidelines) was estimated as 100–200 mature individuals, corresponding to a classification as Critically Endangered (CR). This global population is distributed in nine locations, corresponding to criterion Ba and a classification as Vulnerable (VU) with and estimated number of mature individuals in each subpopulation of less than 50 (CR category – criterion C2a). The populations are subjected to risk factors such as continuing deforestation

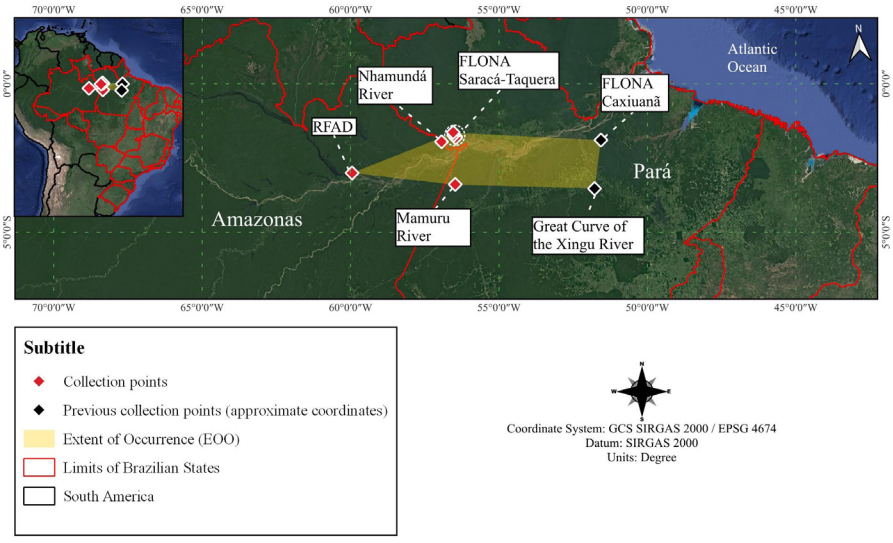

Figure 2. Global geographic distribution of *C. queirozii* sp. nov. Map by A.H. Krahl.

(leading to a continuing decline observed and projected in AOO – criterion B2b[ii]), and illegal predatory collection for the orchid trade. However, three subpopulations occur in conservation units, and are therefore somewhat protected. Overall, we may infer a continuing decline of the number of mature individuals (criterion B2b[v]) and opted for a provisional classification as EN based on criteria B2ab(ii,v) C2a.

DISCUSSION

The Amazon region houses about 50% of the planet's biodiversity (Davidson *et al.* 2012; Vasconcelos *et al.* 2017). However, this biome is strongly threatened by increasing anthropic impacts (Fearnside 2003; Davidson *et al.* 2012) such as deforestation, disorderly growth of cities, real estate speculation, livestock farming, illegal logging and mechanized agriculture (Laurance *et al.* 2004), leading to continuous loss of biodiversity (Portela and Rademacher 2001). In this context, *C. queirozii* sp. nov. may be already under severe threat. The collection rate in the Amazon region is still the lowest in Brazil (Hopkins 2019), even taking into account the increase in collection effort that has resulted in new descriptions and/or new geographic records in recent years (*e.g.*, Valsko *et al.* 2014a,b,c; Krahl *et al.* 2016a,b; Hágsater and Krahl 2020; Krahl *et al.* 2020b; Krahl *et al.* 2021a,b; Pessoa and Karremans 2022; Krahl *et al.* 2022a,b, 2023a,b,c). Further surveys will better establish the distribution range, population trends and conservation status of *C. queirozii* sp. nov.

According to tradition, *C. queirozii* sp. nov. is included in subg. *Catasetum* sec. *Isoceras* subsec. *Isoceras*, in which the species present symmetrical and parallel antennae (Bicalho and Barros 1988; Senghas 1991). It belongs to the *Catasetum cristatum* alliance (Lacerda 1998), which present resupinate flowers, membranous, greenish and usually brown–spotted petals and sepals, a fleshy lip with fimbriae on the margin, a saccate cavity usually placed before the median portion, and two bumps known as basal and apical calli, the latter being absent in some species (Franken *et al.* 2016). It presents some similarities with *C. cristatum*, but it can be distinguished by its narrowly elliptical (*vs*. elliptical) petals and by its narrower (0.4–0.5 *vs.* 0.6–0.7 cm broad), entire, oblong lip with a sparsely ciliate margin, an apex with a globular concentration of fimbriae with a thick consistency and a proximal surface glabrous (*vs*. lip oblong to ovate with a surface densely covered with papillate crests). Besides, the basal callus is oblong, falcate, acute, flanked by two small denticles (*vs*. flanked by various denticles) (see Lindley 1824; Cogniaux 1904; Petini-Benelli 2023) (Figure 3a–d).

The new species is also part of the complex of species associated with *C. barbatum*, which are defined mainly by the structure of the labellum (mainly shape and set of fimbriae) (Krahl et al. 2021a,b, 2022a) and is sometimes erroneously determined as being *C. barbatum* (*e.g.*, Koch *et al.* 2014; Abreu *et al.* 2015). Based on our analysis of the different holotypes related to *C. barbatum* deposited in the K herbarium (K000293764!; K000294039!), we may exclude the possibility of *C. queirozii* sp. nov. being a variation of *C. barbatum*. *Catasetum queirozii* sp. nov. is distinguished from *C. barbatum* by having narrowly elliptical petals (*vs*. elliptical) and an entirely oblong lip (vs. oblong to triangular) with a proximal surface always glabrous (*vs*. glabrous or densely fimbriate), a margin sparsely (*vs*. densely) fimbriate, an apex with a globular concentration of fimbriae with a thick consistency (*vs*. densely and finely fimbriate). The basal callus is oblong, falcate and flanked by two small denticles, whereas in *C. barbatum* it is trifurcated. Moreover, in the lip apex, we can see in *C. barbatum* a simple or bifurcated callus, whereas

Figure 3. Comparison of flower and lip of *C. queirozii* sp. nov. (A-B), *C. cristatum* (C-D) and *C. barbatum* (E-F). Credits: A, B, E, F by A.H. Krahl, C by F. Ferlin, D by J. Fernández.

C. queirozii sp. nov. does not present any callus (see Lindley 1836; Cogniaux 1904; Oliveira *et al.* 2021; Petini-Benelli 2023) (Figure 3a,b–e,f).

CONCLUSIONS

The description of a new species of *Catasetum* for the Brazilian Amazon reinforces the idea that this biome is the center of diversity of the genus, where many species can be observed in the most different types of vegetation. It also reinforces the need for investment in sampling effort of Amazonian flora and in the training of specialized human resources in Amazonian plant taxonomy. The conservation status of *C. queirozii* sp. nov. also indicates the need to implement conservation measures in order to promote the protection of this species and consequently many others associated with its geographic distribution and habitat.

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DATA AVAILABILITY

The data that support the findings of this study are not publicly available.