

***SARCOGLOTTIS WERNERHERZOGII* (SPIRANTHINAE): A NEW SPECIES FROM CUSCO, PERU**

BENJAMÍN COLLANTES¹, JOSÉ D. EDQUÉN², FELICIANO INCAHUAMÁN³
& GERARDO A. SALAZAR^{4,5}

¹Inkaterra, Calle Andalucía 174, Lima 15074, Perú.

²Universidad Nacional Toribio Rodríguez de Mendoza de Amazonas, Chachapoyas, Amazonas, Perú.

³Maranura Alto s/n, La Convención, Maranura 08730, Quillabamba, Cusco, Perú.

⁴Departamento de Botánica, Instituto de Biología, Universidad Nacional Autónoma de México, 04510 Ciudad de México, México.

⁵Author for correspondence: gasc@ib.unam.mx

ABSTRACT. A new species of *Sarcoglottis* from the department of Cusco, Peru is described and illustrated as *S. wernerherzogii*. It is similar to eastern South American *S. fasciculata* but distinguished by its contrasting habitat (high-Andean montane cloud forest as 2050–2500 m a.s.l. vs. Atlantic rain forest near sea level), flowering after the shedding of the leaves (vs. flowering with leaves present); homogeneous green or yellow flowers (vs. whitish or pale green with contrasting reddish veins); rigidly conduplicate-concave lateral sepals that, when spread out are strongly falcate (vs. slightly concave, not rigid, obliquely lanceolate lateral sepals); strongly cymbiform, obovate hypochile as wide as long when spread out (vs. broadly channeled, oblanceolate hypochile about twice longer than wide or longer when spread out); ovate, strongly deflexed epichile provided with a central longitudinal thickening throughout its length (vs. erect or gently arcuate epichile with a thickening only at the apex); and apical anther beak truncate (vs. apical anther beak rounded). The strongly cymbiform hypochile that, when spread out is as wide as long, is unique in the genus. The differences between *S. fasciculata*, the new species, and other Peruvian species of *Sarcoglottis* are contrasted in a table. *Sarcoglottis wernerherzogii* is known from less than a dozen plants in two populations, both under nominal protection in the Machupicchu Historical Sanctuary and the Area of Conservación Regional Choquequirao, respectively. The status “DD” (data deficient) is suggested until an objective assessment of its risk status can be carried out.

RESUMEN. Se describe e ilustra una nueva especie de *Sarcoglottis* del departamento de Cusco, Perú como *S. wernerherzogii*. Es similar a *S. fasciculata* del este de Sudamérica, pero se distingue en sus hábitat contrastante (bosque montano nublado andino a 2050–2500 m s.n.m. vs. bosque lluvioso atlántico cerca del nivel del mar); floración tras la caída de las hojas (vs. floración con las hojas presentes); flores homogéneamente verdes o amarillas (vs. flores blanquecinas o verde pálido con venas rojizas contrastantes); sépalos laterales rígidamente conduplicado-cóncavos, al extender fuertemente falcados (vs. sépalos laterales ligeramente cóncavos, no rígidos, al extender oblicuamente lanceolados); hipoquilo fuertemente cymbiforme, al extenderlo obovado, casi tan ancho como largo (vs. hipoquilo acanalado, al extenderlo oblanceolado, ca. dos veces más largo que ancho o más largo); epiquilo ovado, fuertemente deflexo, provisto de un engrosamiento central longitudinal en toda su longitud (vs. epiquilo triangular, erecto o ligeramente arqueado, engrosado solo en el ápice); y pico de la antera truncado (vs. redondeado). El hipoquilo fuertemente cymbiforme que al ser extendido es tan ancho como largo es único en el género. Las características que distinguen a *S. fasciculata*, la nueva especie y otros *Sarcoglottis* peruanos son contrastados en forma tabular. *Sarcoglottis wernerherzogii* es conocida de menos de una docena de plantas y dos poblaciones, ambas bajo protección nominal en el Santuario Histórico de Machupicchu y el Área de Conservación Regional Choquequirao, respectivamente. Se sugiere el estatus “DD” (datos deficientes) hasta que sea posible llevar a cabo una evaluación objetiva de su estatus de riesgo.

KEYWORDS / PALABRAS CLAVE: Cordillera oriental de los Andes, Eastern Andean Cordillera, Machupicchu Historical Sanctuary, Santuario Histórico de Machupicchu, *Sarcoglottis fasciculata*.

Introduction. The Neotropical orchid genus *Sarcoglottis* C.Presl comprises about 50 geophytic species with fasciculate, fleshy roots (rarely these produced spaced apart along a rhizome), flat broad leaves forming a basal rosette, and fleshy, comparatively large flowers for subtribe Spiranthinae (Salazar 2003, Salazar *et al.* 2018). The flowers are resupinate, often fragrant, with an ascending, shortly pedicellate ovary and horizontal or ascending perianth, and the basal portions of the lateral sepals are connate and decurrent on the ventral surface of the ovary to form a nectary, which can be completely fused with the ovary or form a conspicuous sac (see also Salazar *et al.* 2018). The labellum consists of a proximal, usually spatulate, channeled portion (“hypochile”), the base of which bears two subulate, retrorse nectar glands inserted in the nectary chamber, and an expanded, variously recurved or deflexed distal lobe (“epichile”). The column is straight, obliquely adnate to the ovary, with a triangular to oblong-triangular rostellum, which is truncate or shallowly emarginate after removal of the wishbone-shaped pollinarium, and the anther is semi-ellipsoid, with a distinct apical beak. The scarce information available on natural pollination of species of *Sarcoglottis* indicates that it is carried out by long-tonged bees of tribe Euglossini (Apidae) that probably feed on the nectar present at the bottom of the floral tube (Pérez-Escobar, Roubik & Gerlach 2017, Salazar 2003, Singer & Sazima 1999).

Sarcoglottis has never been revised, little information has been published on almost any aspect of its biology, and the taxonomy of the species is far from thoroughly studied, especially that of the South American taxa. As for Peru, Schweinfurth (1958) recorded a single species, *S. acaulis* (Sm.) Schltr. [as *Spiranthes acaulis* (Sm.) Cogn.], listing Peruvian *S. speciosa* C.Presl, the type species of the genus, as its synonym. Then Brako & Zarucchi (1993) recorded three species, including *S. acaulis*, *S. homalogastra* (Rchb.f. & Warm.) Schltr., and *S. villosa* (Poepp. & Endl.) Schltr., but they did not cite specimens of the last two species and stated that they were unconfirmed for the country. Bennett & Christenson (1995) reported *S. neglecta* Christenson, but the specimen from Moyobamba they illustrated represents a different species, which was described later as *S. portillae* Christenson based on a cultivated plant without precise locality but said to have been found in Ecuador “near the Peru-

vian border” (Christenson 2003a: 243). Subsequently, Bennett & Christenson (1998) “resurrected” *S. speciosa*, indicating as its distribution Peru and probably the neighboring countries. A further Peruvian species, *S. micrantha* Christenson, was distinguished by its very small flowers with a 5-lobed apical labellum (Christenson 2001). A recent compilation of the Peruvian Orchidaceae listed five species, namely *S. acaulis*, *S. grandiflora*, *S. homalogastra*, *S. micrantha*, and *S. villosa* (Goicochea *et al.* 2019). A recent addition was *S. neillii* Salazar & Tobar, discovered on the Ecuadorian side of the Cordillera del Cóndor but also known from Peruvian herbarium specimens (Salazar *et al.* 2019).

During fieldwork conducted in the department of Cusco, Peru, in 2017, two populations of a *Sarcoglottis* that did not correspond to any of the species previously known either for Peru or anywhere else were discovered. In the following, we describe and illustrate the unknown entity as a new species, highlight the features that distinguish it from *S. fasciculata* (Vell.) Schltr., to which it shows similarities in the appearance of the flowers, provide a table contrasting the features that distinguish the new species from *S. fasciculata* and its Bolivian and Peruvian congeners, and present a preliminary assessment of its conservation status.

Materials and methods. The morphological description and the measurements were made from live plants and flowers preserved in 70% ethanol. Fresh flowers were dissected and photographed with a digital camera (Sony SLT- α 58 with type mount and sensor APS-C, Sony Group Corporation, Tokyo, Japan) provided with a SLT-A58Y 18-55 mm lens). Image processing and plate preparation was done with Photoshop v. 24.1.0. Two specimens collected at Machupicchu were deposited in CUZ and USM; and a specimen (flowers in spirit) from Sawayacu (district of Santa Teresa) was deposited in KUELAP. The new species was compared with the protologues and original material of all previously known South American species of *Sarcoglottis*, and with specimens or digital images of specimens of this genus housed in Peruvian and other international herbaria examined such as AMES, AMO, ANDES, BHCB, BHZB, BM, COL, CUZ, ECUAMZ, F, GH, HB, HOXA, K, KUELAP, M, MEXU, MO, NY, P, QCA, QCNE, R, RB, SEL, SP, US, USM, VEN, and W.

TAXONOMIC TREATMENT

Sarcoglottis wernerherzogii Collantes, Edquén et Salazar, *sp. nov.* (Fig. 1–4).

TYPE: PERU. Department of Cusco: Province of Urubamba, district of Machupicchu, Santuario Histórico de Machupicchu, Ilaqta Machupicchu, 2446 m., 21 Oct 2017, *B. Collantes & F. Incahuamán 344* (holotype: USM!; isotype: CUZ!).

DIAGNOSIS: The new species is similar to eastern South American *Sarcoglottis fasciculata* (Vell.) Schltr., from which it is distinguished by inhabiting in Andean montane cloud forest at 2050–2500 m a.s.l. (*vs.* inhabiting in Atlantic rain forest near sea level); flowering after the shedding of the leaves (*vs.* flowering with the leaves present); homogeneously dull greenish- to yellowish perianth segments (*vs.* whitish or pale green background with contrasting greenish or reddish veins); rigidly conduplicate-concave lateral sepals that, when spread out, are strongly falcate (*vs.* slightly concave, not rigid, obliquely lanceolate lateral sepals); strongly cymbiform hypochile that when spread out is obovate, as long as wide (*vs.* broadly channeled hypochile that when spread out is oblanceolate, about twice longer than wide or longer); ovate, strongly deflexed epichile provided with a central longitudinal thickening throughout its length (*vs.* triangular, erect or gently arcuate epichile with a thickening only at the apex); and apical anther beak truncate (*vs.* apical anther beak rounded).

Geophytic, acaulescent *herb* 50–60 cm in height including the inflorescence. *Roots* fasciculate, fleshy, cylindrical-fusiform, dull brownish white, to 12 cm long, 4–6 mm in diameter. *Leaves* 4–6, deciduous, withered and lost at flowering time but a new rosette may be developing laterally as a new shoot, upper surface homogenous bright green with 5 pale yellowish veins, the central one broader, lower surface slightly paler green, oblong-elliptic, cuneate, acute, 6–17 × 3–4 cm. *Inflorescence* scapose, arising from the apex of the shoot, the flowers opening after the shedding of the leaves, 50–55 cm long; scape 4–6 mm in diameter, terete, glabrous below, becoming lanuginose above (trichomes simple, septate, glandular, whitish), partially concealed by bracts, these narrowly lanceolate, semi-tubular, acute to acuminate, 5–7 cm long;

raceme relatively dense, 10–13 cm long, with 12–15 simultaneous flowers. *Floral bracts* subequal to conspicuously longer than the ovary, 27–35 × 6–7 mm, green to pale brown with reddish suffusion towards the apex, concave, slightly incurved, with involute margins, when spread-out lanceolate, acute to long-acuminate, 5–7-veined, sparsely papillose to shortly pubescent on the outer surface near and along the margins, glabrous otherwise. *Flowers* with dull green or yellow sepals and petals, sometimes suffused with brownish green or rusty red, hypochile of labellum whitish with olive green base, epichile olive green with white longitudinal thickening. *Ovary* 26–27 × 5–7 mm, green to pale brownish or golden yellow, ascending, subclavate, twisted at base, densely pubescent, the trichomes simple, septate, tapering, ending in a small, round secretory cell. *Dorsal sepal* abruptly incurved from near the base, forming with the petals a sort of hood tightly covering the column and labellum, concave below the middle, sparsely pubescent near the base, the rest of the outer surface colliculate, lanceolate-oblong, obtuse, 3-veined, the lateral veins branching near the base, 24.0–28.0 × 6.0–6.5 mm. *Lateral sepals* adnate to the distal 2/3 of the ventral surface of the ovary and connate at their bases, forming a rounded, prominent nectary, free portions strongly downcurved, concave, rigidly conduplicate, 3-veined, the lateral veins branching near the base, 27.0–28.5 × 7.0–8.0 mm, densely pubescent outside, the pubescence gradually reduced to papillae towards the apex, falcate-lanceolate, long-acute. *Petals* marginally adherent along their upper margin to the dorsal sepal on their distal 2/3, free below, obliquely oblanceolate-falcate, free part of inner margin waved, apex obliquely acute, surface at and near the outer margin below the middle densely pubescent, with short septate, glandular trichomes, 14.5–22.5 × 4.0–5.0 mm, 3-veined at base, the lateral veins branched above into 5 veins. *Labellum* adnate at its base with the connate portions of the lateral sepals, 25–26 mm total length excluding the nectar glands; hypochile strongly cymbiform, ca. 4 mm wide and deep in natural position, when spread out broadly obovate and expanded at each side into a rounded, membranaceous margin that in natural position is adhered to the respective side of the column, 12.0–13.0 × 12.0–13.5 mm, densely papillose outside, with a concavity at the base of each

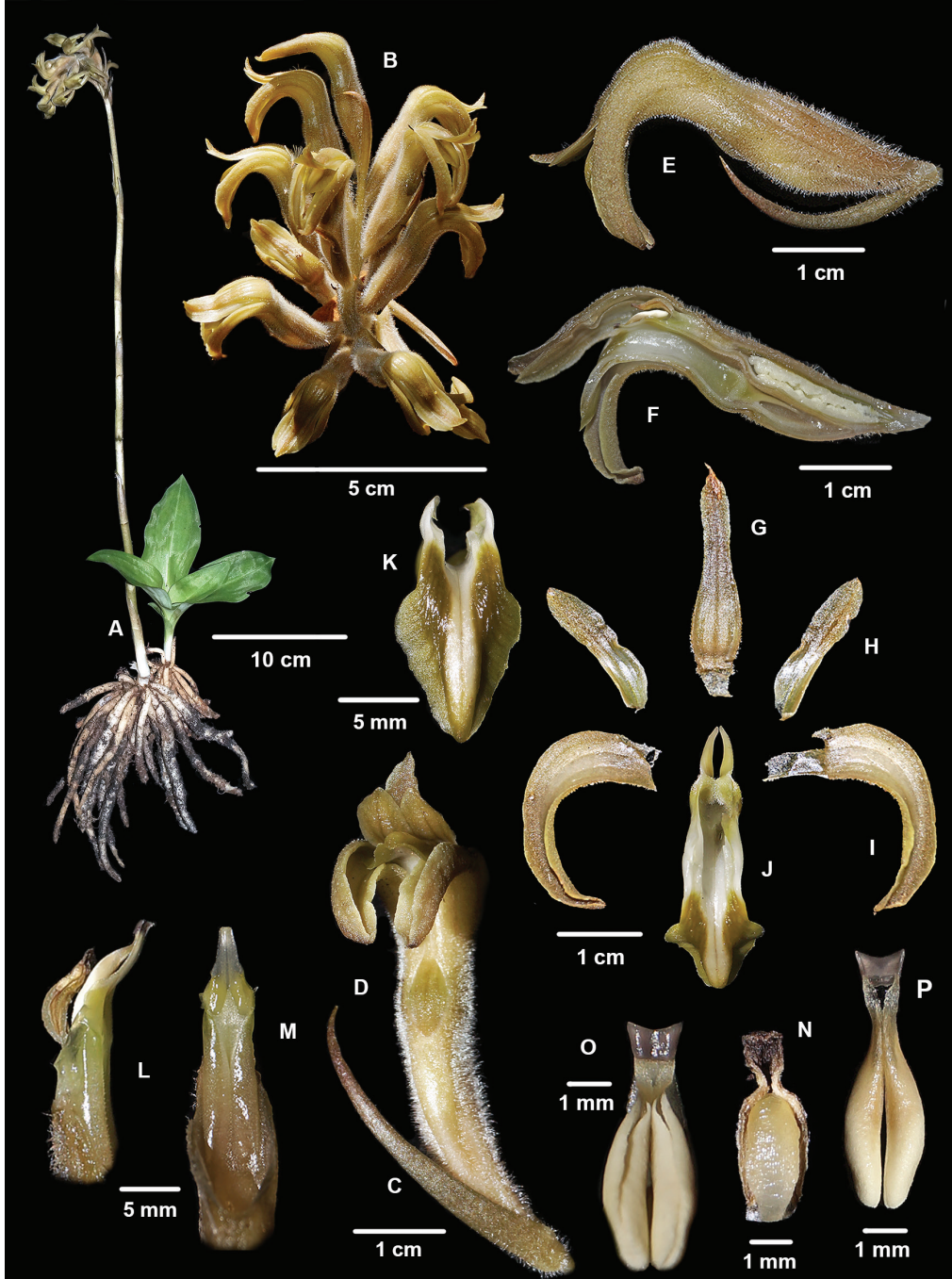


FIGURE 1. *Sarcoglottis wernerherzogii*. A. Flowering plant (left) with its roots mingled with those of another individual with a developing rosette of leaves (right). B. Close-up of the raceme. C. Floral bract. D. Flower, oblique view from front. E. Flower from side with floral bract. F. Longitudinal section of flower from side. G. Dorsal sepal. H. Petal. I. Lateral sepal. J. Labellum from above. K. Labellum from front. L. Column from side prior to removal of the pollinarium. M. Column from below after removal of the pollinarium. N. Anther from above. O. Pollinarium from above. P. Pollinarium from below (all from *Edquén 4165*). Photographs by José D. Edquén.

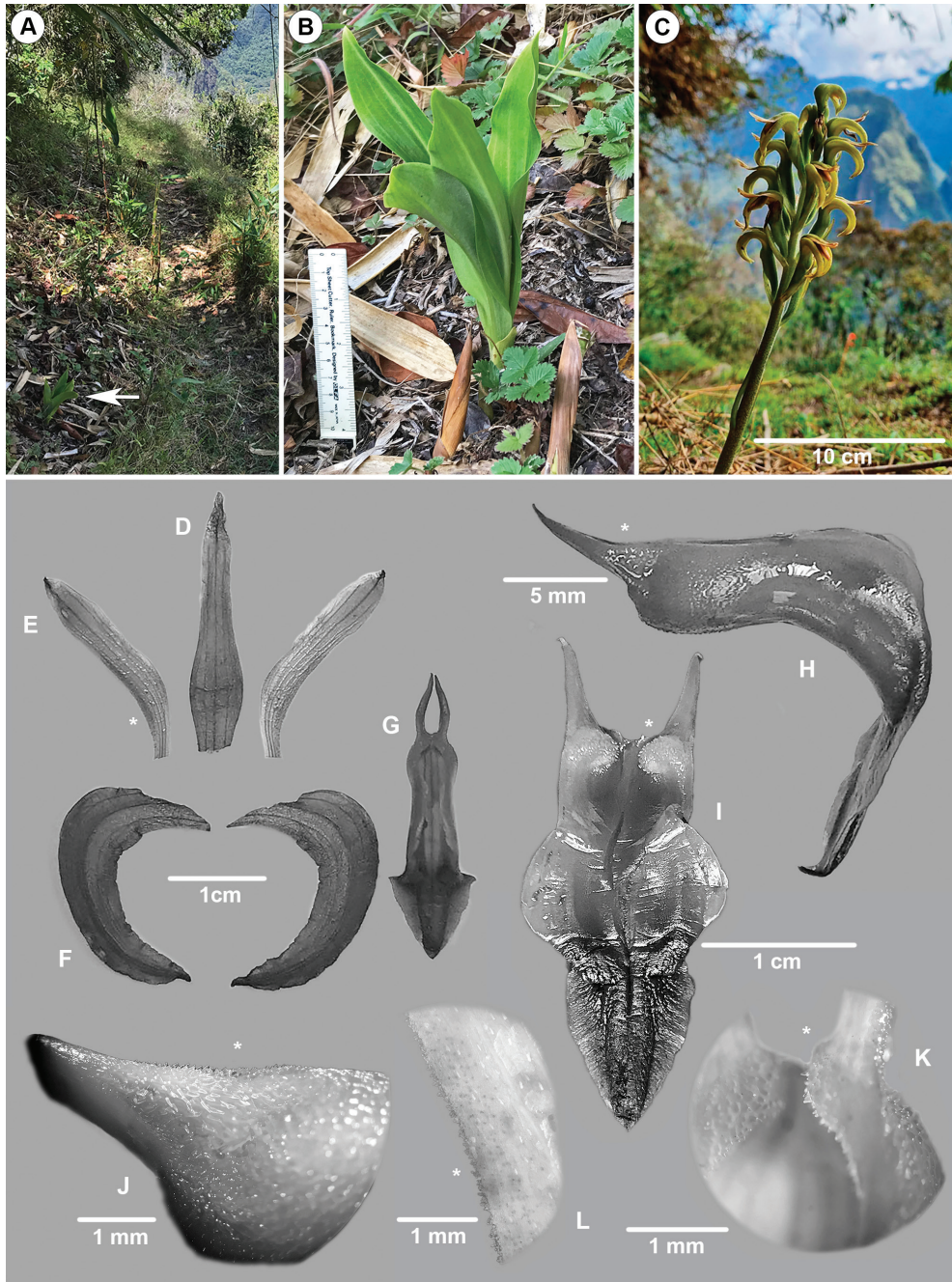


FIGURE 2. *Sarcoglottis wernerherzogii*. **A.** Plant photographed in habitat in early December 2022 (same population as the type; notice the rosette of leaves in the shade near the lower left hand-side corner, pointed to by an arrow). **B.** Rosette of leaves of the plant in **A.** **C.** Inflorescence of the type, photographed in October 2017. **D.** Dorsal sepal. **E.** Petal. **F.** Lateral sepal. **G.** Labellum from above in natural position. **H.** Labellum from side in natural position. **I.** Labellum from above, spread out. **J.** Close-up of the pubescence of the base of the labellum (marked with a * in **H**). **K.** Close up of the papillae on the approximate margins of the base of the cymbiform (basal) part of the labellum (marked with a * in **I**). **L.** Pubescence on the margin of the basal one-half of the petal (marked with a * in **E**). Photographs by Benjamín Collantes.

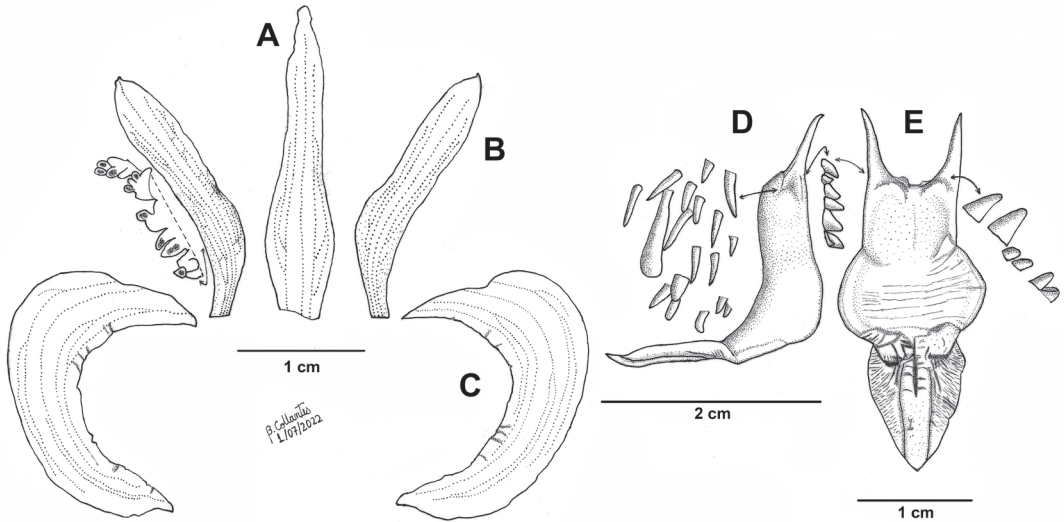


FIGURE 3. Floral analysis of *Sarcoglottis wernerherzogii*. **A.** Dorsal sepal. **B.** Petal. **C.** Lateral sepal. **D.** Labellum from side in natural position. **E.** Labellum from front, spread out. Illustration by Benjamín Collantes based on the type.

nectar gland provided with finger-like trichomes directed opposite to the nectar gland, inside somewhat contracted by effect of the folding inwards of the margins; the bottom of the hypochile protrudes slightly between the bases of the free portions of the lateral sepals; epichile with a fleshy, canaliculate central-longitudinal thickening that reaches the labellum apex, abruptly deflexed more than 90° , ovate, acute and shortly apiculate, with membranaceous margins, $10.0\text{--}11.0 \times 8.0\text{--}8.5$ mm; base of labellum projected into two olive green, retrorse, subulate, smooth nectar glands $5\text{--}6 \times \text{ca. } 1$ mm. *Column* $6.0\text{--}9.0 \times 1.8\text{--}2.5$ mm, dorsally free from the ovary for 1–2 mm, ventral surface with a deep, narrow channel limited at each side by a fleshy, rounded keel, ventral surface of the column foot with a single thickened keel without a channel. *Anther* narrowly ellipsoid, centrally fleshy-thickened, with membranaceous, recurved margins and an oblong, truncate apical beak, $5.0\text{--}7.0 \times 1.5\text{--}2.0$ mm, plus a short free filament about 1.0–1.5 mm long; clinandrium shallow, with membranaceous, rounded margins ending in a short, obtuse projection towards the apex. *Pollinarium* ca. 5.5 mm long, consisting of two creamy white, clavate, deeply cleft pollinia united at apex to a subtrapezoid, gray viscidium reminiscent of a cow's hoof. *Rostellum* ca. 3 mm long, narrowly triangular, broadly and shallowly notched after re-

moval of the viscidium; stigma cordiform, emarginate, with two ovate, convergent receptive areas. *Fruits* not seen.

EPONYMY: The species is named in honor of the great poet and filmmaker Werner Herzog (Munich, 1942), whose iconic films *Aguirre, the Wrath of God* (1972) and *Fitzcarraldo* (1982) reveal the natural magnificence of Machupicchu and the Peruvian Amazon.

DISTRIBUTION AND ECOLOGY: Known only from the Eastern Andean Cordillera in the Department of Cusco, provinces of Urubamba and La Convención, southern Peru. Terrestrial, in deep leaf litter in open areas within the montane cloud forest biome and among coffee and avocado orchards, at 2050–2500 m elevation. Flowering has been observed in the field in September and October. The flowers produce a conspicuous odor during daylight hours, described by one collector as reminiscent of the fruits of *Pouteria lucuma* (Ruiz & Pav.) Kuntze, and by the other as of bleach or semen. No objective characterization of the floral fragrance has been carried out.

Discussion. *Sarcoglottis wernerherzogii* is similar in outward floral appearance to eastern South American *S. fasciculata* (Vell.) Schltr. (the type from Rio de Janeiro, *J. Velloso s.n.*, drawing!) by its horizon-

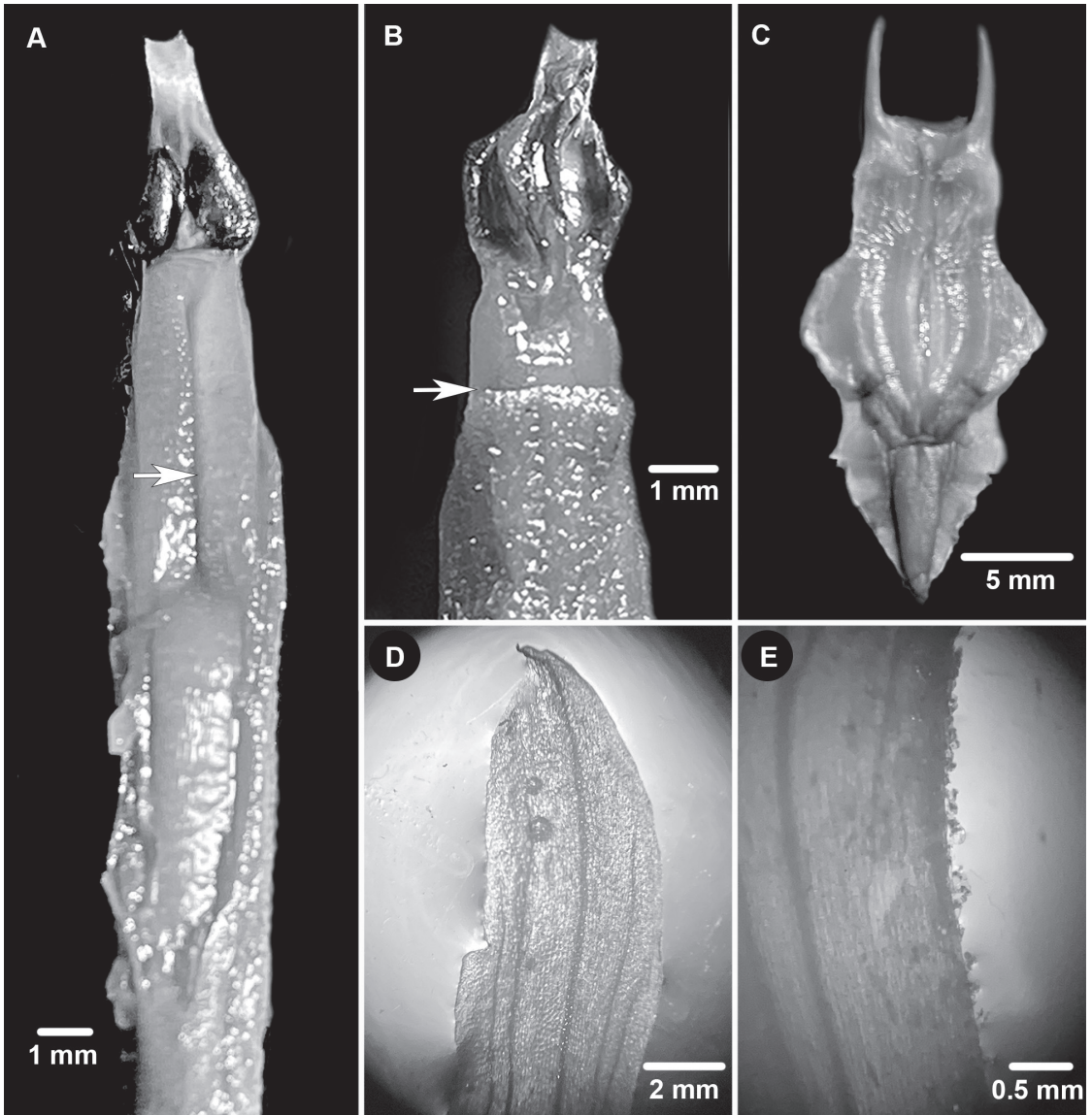


FIGURE 4. Floral details of *Sarcoglottis wernerherzogii*. **A.** Column from below showing the narrow, deep channel on the ventral surface of the column body (arrow) and the broad rounded keel without a channel of the column foot. **B.** Column from above, showing the adnation of ovary tissue to near the base of the anther filament (arrow). **C.** Labellum of a flower from the Sawayacu population, spread out. **D.** Distal part of petal showing the five veins. **E.** Densely ciliate margin of the proximal part of a petal. A–B, D–E, from Collantes *et al.* 344; C from Edquén 4165. Photographs by Gerardo A. Salazar (A–C) and Benjamín Collantes (D–E).

tal perianth, dorsal sepal lanceolate-oblong, incurved, lateral sepals downcurved, but differs from the latter in eco-geographic features (high-Andean cloud forest at 2050–2500 m a.s.l. vs. Atlantic rain forest near sea level), phenology (flowering after the shedding

of the leaves vs. flowering with functional leaves), flower coloration (homogeneously dull green or yellow flowers vs. pale green or rosy-green flowers with contrasting reddish veins, especially on the labellum epichile, and several morphological floral characteris-

tics. These include the strongly cymbiform hypochile that, when spread out, is obovate and as wide as long (Fig. 1J, 2G–I, 3D–E) vs. broadly channeled hypochile that, when spread out, is oblanceolate and about twice as long as wide), the strongly deflexed, centrally thickened epichile (vs. gently arching, thin epichile), and the truncate anther beak (vs. rounded). It is worth nothing that the hypochile characteristics of *S. wernerherzogii* are unique in the genus.

Bolivian *S. herzogii* Schltr. (the type from Tigüipa, department of Chuquisaca, 700 m a.s.l., *T. Herzog 1154*, not located) also flowers after the leaves are shed, but it is distinguished from *S. wernerherzogii* in its dry, lowland Amazonian habitat at 400–700 m a.s.l. (Vásquez, Ibsch & Gerkmann 2003; <https://tropicos.org/name/23511337>, accessed 15 Nov 2023), the 1-veined, glabrous petals (vs. 5-veined, prominently ciliate petals; Fig. 4 D–E), and the much smaller, narrowly oblanceolate labellum 18 × 4.5 mm (*vide* Schlechter 1925: 333).

The main differences of *S. wernerherzogii* to *S. fasciculata* and to other Peruvian species of the genus are highlighted in Table 1. We omitted from that table *S. acaulis*, *S. homalogastra*, and *S. villosa* since we have been unable to find any specimens or other cogent evidence of their presence in Peru. As noted by Bennett & Christenson (1998), *S. acaulis* is known with certainty only from northern South America, including the island of Trinidad, Venezuela, the Guyanas, and probably neighboring Brazil. On the other hand, the first report of *S. homalogastra* and *S. villosa* for Peru was based on an unconfirmed personal communication by Dodson (Brako & Zarucchi 1993: 850), and their inclusion in Goicochea et al.'s (2019) compilation merely followed them. *Sarcoglottis homalogastra* (the type from Brazil, Minas Gerais, Lagoa Santa, *E. Warming s.n.*, W-R, microfiche of flower and floral analysis!) is widespread in open fields in northern Argentina, eastern Brazil, and Paraguay (Schinini 2010). On the other hand, *S. villosa*, described from a plant collected near the mouth of the Amazon River, on the Atlantic coast of Brazil (Pará, Colares, *Poepig s.n.*, W, digital image!), is known with certainty only from northeastern Brazil (Ceará and Pará; Hoehne 1945).

ADDITIONAL SPECIMEN EXAMINED: PERU. Department of Cusco: Province of La Convención: Distrito Santa

Teresa, parte alta del sector Sawayacu, 2064 m, 30 Sept 2017, *J. D. Edquén 4165* (photographs and flowers in spirit, KUELAP!); province of Urubamba, district of Machupicchu, Santuario Histórico de Machupicchu, al lado derecho del Camino Inca, cerca y rumbo a Intipunku, 21 Oct 2004, *B. Collantes s.n.* (photograph!); same locality, without date, *J. G. Ochoa s.n.* (photograph!)

CONSERVATION STATUS: The population of Machupicchu consists of about ten plants found over about 30 m along the sides of the *Camino Inca* (Inca Trail) within the historical sanctuary, hence under nominal legal protection. However, there are two potential threats to that population: first, the increasingly frequent forest fires escaped from crop fields of the surrounding areas, where farmers set fire to the vegetation during the dry season in the belief that it will improve soil fertility. Second, the even more frequent trimming of the vegetation along the Inca Trail by personnel of the sanctuary to ease the transit of tourists. The last practice could, and should, be supervised to avoid inadvertent damage to the rosettes or inflorescences of the plants of this species. There is also a possibility of damage by trampling by the tourists, which could be reduced by adequate signaling and the placement of discrete barriers. On the other hand, the population of Sawayacu is located in the adjacent “Área de Conservación Regional [ACR] Choquequirao,” but among coffee and avocado orchards.

It is worth noting that *S. wernerherzogii* was not recorded in the several recent inventories and guides to the orchids (and other plants) of Machupicchu (Christenson 2003b; Collantes, Soto & Koechlin 2007, Ochoa Estrada 2021) and the ACR Choquequirao (Vilca et al. 2023), which suggests either that the species is very rare, or that it is easily overlooked, perhaps because of flowering when the leaves are absent and the dull coloration of its flowers. In any event, further field work is required to objectively determine the conservation status of this species. For the time being, we suggest its inclusion in the category of “data deficient” (DD, IUCN 2019).

ACKNOWLEDGEMENTS. We thank Peru's Servicio Nacional Forestal y de Fauna Silvestre (SERFOR) of the Ministerio de Agricultura y Riego (MINAGRI) for the permits for

scientific collecting (No. 099-2019-MINAGRI-SERFORD-GGSPFFS; No. 009-2017-SERNANP-JEF); Federico Rizo-Patrón and Ricardo Fernández for hospitality and assistance during our study of Peruvian herbaria; the Curators and staff of AMES, AMO, ANDES, BHCB, BHZB, BM, COL, CUZ, ECUAMZ, F, GH, HB, HOXA, K, KUELAP, M, MEXU, MO, NY, P, QCA, QCNE, R, RB, SEL, SP, US, USM, VEN, and W for courtesies extended while studying the collections in their charge; Abel Monteagudo for providing high-quality digital images of the specimens of *Sarcoglottis* housed at CUZ; Julio Ochoa for providing a copy

of his photographic guide to the flora of Machupicchu and an unpublished photograph of the new species; Lucely L. Vilca for sharing a copy of his digital guide to the orchids of Choquequirao; and two anonymous reviewers for constructive criticisms to the manuscript. BC thanks José Koechlin, Chair of Inkaterra, for continued support to his orchid studies, and José Bastante, Chief of the Parque Arqueológico de Machupicchu and Rosa Huilleanina, of the Oficina de Atención al Visitante y Servicio Turístico, for access to the protected area and authorization to visit and study the population of the new species.

LITERATURE CITED

- Bennett, D. E. & Christenson, E. A. (1995). *Sarcoglottis neglecta* Christenson. *Icones Orchidacearum Peruvianarum*, pl. 374.
- Bennett, D. E. & Christenson, E. A. (1998). *Sarcoglottis speciosa* Presl. *Icones Orchidacearum Peruvianarum*, pl. 561.
- Brako, L. & Zarucchi, J. (1993). Catálogo de las angiospermas y gimnospermas del Perú. *Monographs in Systematic Botany of the Missouri Botanical Garden*, 45. St. Louis: Missouri Botanical Garden Press. Retrieved from <https://archive.org/details/mobot31753003155055>.
- Christenson, E. A. (2001). *Sarcoglottis micrantha* E.A.Christenson *sp. nov.* *Orchid Review*, 109, 103–104.
- Christenson, E. A. (2003a). Three showy new orchids from Ecuador. *Orchid Review*, 111, 243–246.
- Christenson, E. A. (2003b). *Machu Picchu: Orchids. A Manual to the Orchids of the Machu Picchu Historical Sanctuary*. Cusco: Fondo Nacional para Áreas Naturales Protegidas, INRENA.
- Collantes, B., Soto, C. & Koechlin, J. (2007). Orchids in Inkaterra at Machu Picchu Pueblo Hotel. Cusco: Inkaterra Association.
- Goicochea, A., Gutiérrez, A. D., Ruiz, A. & Salas, M. (2019). *Orquídeas de Perú: relación de especies y sus sinónimos*. Lima: Corporación G & G.
- Hoehne, F. C. (1945). Spiranthineas. In: F. C. Hoehne (ed.), *Flora Brasílica, São Paulo*, vol. 12, part 2, 152–337. São Paulo: Departamento de Botânica do Estado, Secretaria da Agricultura, Indústria e Comércio de São Paulo.
- IUCN. (2019). Guidelines for Using the IUCN Red List Categories and Criteria. Version 14. Prepared by the Standards and Petitions Committee. Retrieved from <http://www.iucnredlist.org/documents/RedListGuidelines.pdf>.
- Ochoa Estrada, J. G. (2021). *Machupicchu en flor*. Cusco: printed by the author.
- Pérez-Escobar, O. A., Roubik, D. & Gerlach, G. (2017). New records on pollen vectors and visitors from the tropical lowland forests of Mexico and Panama. *XIX International Botanical Congress, ShenZhen, China abstract book II*. Retrieved from <http://www.abc2017.cn/Download/>.
- Salazar, G. A. (2003). *Sarcoglottis*. In: A. M. Pridgeon, P. J. Cribb, M. W. Chase & F. N. Rasmussen (eds.), *Genera Orchidacearum vol. 3, Orchidoideae part 2, Vanilloideae* (pp. 246–250). Oxford: Oxford University Press.
- Salazar, G. A., Batista, J. A. N., Cabrera, L. I., van den Berg, C., Whitten, W. M., Smidt, E. C., Buzatto, C. R., Singer, R. B., Gerlach, G., Jiménez-Machorro, R., Radins, J. A., Insaurralde, I. S., Guimarães, L. R. S., de Barros, F., Tobar, F., Linares, J. L., Mújica, E., Dressler, R. L., Blanco, M. A., Hágsater, E. & Chase, M. W. (2018). Phylogenetic systematics of subtribe Spiranthinae (Orchidaceae, Orchidoideae, Cranichideae) based on nuclear and plastid DNA sequences of a nearly complete generic sample. *Botanical Journal of the Linnean Society*, 186, 273–303. <https://doi.org/10.1111/1365-2664.13151>
- Salazar, G. A., Tobar, F., Jiménez-Machorro, R., Freire, E. & Peñafiel Cevallos, M. (2019). *Sarcoglottis neillii* (Orchidaceae: Spiranthinae), a new species from the Andean tepui region of Ecuador and Peru. *Phytotaxa*, 427, 1–8. <http://doi.org/10.11646/phytotaxa.427.1.1>
- Schlechter, R. (1925). Orchidaceae novae et criticae. Decas LXXVIII–LXXIX. *Repertorium Specierum Novarum Regni Vegetabilis*, 21, 330–343.
- Schinini, A. (2010). Orquídeas nativas del Paraguay. *Rojasiana*, 9, 11–316.
- Schweinfurth, C. (1958). Orchids of Peru. *Fieldiana, Botany*, 30, 1–260.
- Singer, R. B. & Sazima, M. (1999). The pollination mechanism in the ‘*Pelexia* alliance’ (Orchidaceae: Spiranthinae). *Botanical Journal of the Linnean Society*, 131, 249–262. <https://doi.org/10.1111/j.1095-8339.1999.tb00768.x>

Vázquez, R., Ibisch, P.L. & Gerkmann, B. (2003). Preliminary list of Bolivian orchid species. *Organism's Diversity and Evolution*, 3, Electr. Suppl. 3, 1–14.

Vilca, L. L., Villafuerte Arriaga, M. & Yuca, J. A. (2023). Orquídeas del Área de Conservación Regional Regional Choquequirao, Cusco, Perú. Cusco: Gobierno Regional de Cusco.