LANKESTERIANA 23(3): 495–509. 2023. doi: http://dx.doi.org/10.15517/lank.v23i3.58100

TELIPOGON PILLAROPATATENSIS (ONCIDIINAE): A NEW SPECIES FROM THE EAST-CENTRAL ANDES OF ECUADOR

Gabriel A. Iturralde[1,8], Marco F. Monteros[2,3,4,5], Marco M. Jiménez[1], Carlos Martel[6,7] & Luis E. Baquero[1]

[1]Grupo de Investigación en Biodiversidad, Medio Ambiente y Salud (BIOMAS), Carrera de Ingeniería en Agroindustria, Facultad de Ingenierías y Ciencias Aplicadas, Universidad de Las Américas, UDLA, Vía a Nayón, Quito 170124, Ecuador.

[2]Grupo Científico Calaway Dodson: Investigación y Conservación de Orquídeas del Ecuador, Quito, 170510, Pichincha, Ecuador.

[3]Fundación EcoMinga, 270 12 de noviembre and Luis A Martínez, Baños, Tungurahua, Ecuador.

[4]Reserva: The Youth Land Trust, Washington, D.C., USA.

[5]Instituto Nacional de Biodiversidad (INABIO), Rumipamba 341 y Av. De los Shyris, Quito, Ecuador.

[6]Trait Diversity and Function, Royal Botanic Gardens, Kew, Richmond, TW9 3AB, United Kingdom.

[7]Instituto de Ciencias Ómicas y Biotecnología Aplicada, Pontificia Universidad Católica del Perú, Av. Universitaria 1801, San Miguel 15088, Lima, Perú.

[8]Author for correspondence: gabriel.iturralde@udla.edu.ec

Abstract. A new species, *Telipogon pillaropatatensis*, is described from the highlands of east-central Ecuador. It is morphologically similar to *T. octavioi* but differs by having a corolla with longitudinal thick vein lines without reticulations and a column with three dense bundles of equally sized setae. Also, our phylogenetic analyses suggest that they are not closely related. Interestingly, among the analyzed taxa, *T. pillaropatatensis* appears to have a closer phylogenetic relationship with the highly distinct *T. pulcher* and *T. hausmannianus* than with the morphologically similar *T. octavioi*. The new species has been found in a relatively small area, covering just a few square kilometers in east-central Ecuador. Additionally, we documented remarkable variation in the coloration and size of the corolla. Information regarding the species' habitat, ecology, phylogenetic relationships, and conservation status is also provided.

Resumen. Se describe una nueva especie, *Telipogon pillaropatatensis*, de las tierras altas del centro-este de Ecuador. Morfológicamente es similar a *T. octavioi*, pero se diferencia por tener una corola con líneas longitudinales gruesas sin reticulaciones y una columna con tres densos penachos de setas de igual tamaño. Además, nuestros análisis filogenéticos sugieren que ambas especies no están estrechamente relacionadas. Curiosamente, entre los taxones analizados, *T. pillaropatatensis* parece tener una relación filogenética más cercana con las muy distintas *T. pulcher* y *T. hausmannianus* que con la morfológicamente similar *T. octavioi*. La nueva especie ha sido encontrada en un área relativamente pequeña, abarcando solo unos pocos kilómetros cuadrados en el centro-este de Ecuador. Además, documentamos una notable variación en la coloración y el tamaño de la corola. También se proporciona información sobre el hábitat, la ecología, las relaciones filogenéticas y el estado de conservación de la especie.

Keywords / Palabras clave: bosques montanos, Cuenca del Río Pastaza, Llanganates National Park, montane forests, morphological variability, Parque Nacional Llanganates, Pastaza River Basin, Provincia de Tungurahua, *Telipogon octavioi*, Tungurahua Province

Introduction. *Telipogon* Kunth is a diverse Neotropical orchid genus encompassing approximately 240 species that range from Mexico, Antilles, Central America, and the Andes, from Venezuela to Bolivia. The genus is particularly diverse in Colombia, Ecuador, and Peru (Bogarín 2012, Chase 2009, Dod-

ORCID of the Author: GAI, MFM, MMJ, CM, LEB
Received 8 August 2023; accepted for publication 19 December 2023. First published online: 23 December 2023.

son 2004, Martel *et al.* 2020). Plants of *Telipogon* are found exclusively in montane and submontane forests at 500 to 3600 meters of elevation (Chase 2009, Collantes & Martel 2015), and endemic species with very restricted distributions are frequent (Endara 2011, Martel 2020).

Telipogon species are characterized by very small- to medium-sized plants (2–25 cm), with a caespitose, sympodial, epiphytic, or rarely terrestrial habit; the stems are either abbreviated or elongated with conduplicate leaves; the flowers vary from very small to large and born from racemes or panicles; the corolla is usually yellow with dark red tones, and regularly striped; the petals are usually similar to the lip in shape, color, and size; the lip often bears a basal, hirsute callus, enclosing a short, brown to purple column; the column is semiterete and usually bears tufts of setae. This unique feature inspired the genus name *Telipogon*, derived from the Greek words "*telos*" meaning "end or point," and "*pogon*" meaning "beard". Additionally, the pollinarium bears an uncinate sticky viscidium and 2 irregularly-sized pairs of pollinia (Chase 2009, Dodson 2004, Martel *et al.* 2020). Diagnostic characteristics used to discriminate among species are plant and flower size, stem and peduncle length and shape, shape and color of petals, lip (including pattern and color of veins) and lip callus (if present), and the shape of the column (including appendages and setae type, number, and arrangement) (e.g., Dodson & Escobar 1993, Nauray & Galán 2008).

Various classifications of *Telipogon* and its relatives have been proposed throughout the last century. Schlechter (1915) established *Stellilabium* Schltr. based on *Telipogon astroglossus* Rchb.f. and the same author created the subtribe Telipogoninae to include *Stellilabium, Telipogon*, and *Trichoceros* Kunth (Schlechter 1915). Later, Dressler and Dodson (1960) placed these genera, together with *Hofmeisterella,* in the *Ornithocephalus* Alliance. However, Dressler (1993) later placed those genera within their own subtribe Telipogoninae. Nevertheless, genetic evidence showed that *Telipogon* and its allies were embedded within the Oncidiinae, and *Stellilabium* was also embedded in *Telipogon* (Williams *et al.* 2005). Consequently, all former *Stellilabium* species were reclassified under *Telipogon*, and the Telipogoninae subtribe was treated under Oncidiinae, forming the *Telipogon* alliance (Martel *et al.* 2020, Williams *et al.* 2005). This alliance is monophyletic and comprises *Hofmeisterella* as the sister group to the *Trichoceros-Telipogon* clade (Amezcua-Trigos *et al.* 2018, Chase 2009, Neubig *et al.* 2012, Williams *et al.* 2001, Williams *et al.* 2005). Concerning *Telipogon*'s infrageneric relationships, published phylogenies suggest phylogenetic clades that correspond to geographic distribution, distinguishing, for example, a clade comprising Andean *Telipogon* species with large flowers and another clade including Central American *Telipogon* species, along with some former *Stellilabium* species from Central America, Andean *Telipogon* species with elongated stems, and Andean species from the former *Stellilabium* (Neubig *et al.* 2012, Williams *et al.* 2005). However, these phylogenies have primarily focused on Central American *Telipogon* species, with only a limited representation of South American species. Consequently, the infrageneric relationships within *Telipogon* remain incompletely understood.

The Ecuadorian Andes is one of the centers of *Telipogon* diversity. Nevertheless, although much remains to be explored in this region. For instance, the Parque Nacional Llanganates (PNL), located in the Cordillera de Los Llanganates in the Ecuadorian east-central Andes, is known for its rich biodiversity, high levels of plant endemism, and historical significance, as it was believed to conceal the treasure of Atahualpa, the last Inca emperor (Andrade Marín 1970, Spruce 1908, Vargas *et al*. 2000). The buffer zone of the PNL, situated in the upper watershed of the Pastaza River, has served as a key area for biological research in Ecuador, leading to the description of numerous species (Jost 2004, Reyes-Puig *et al*. 2010, 2022, Yánez-Muñoz *et al*. 2010). Therefore, it is considered an important center for plant endemism within the eastern range of the Ecuadorian Andes (Jost 2004).

During a botanical expedition to the PNL, an undescribed species of large-flowered *Telipogon* was discovered near the buffer zone of the park. Here, we describe, illustrate, and compare this new species with other morphologically similar species. Furthermore, we provide genetic evidence to elucidate its phylogenetic relationships. Additionally, we include information about the geographical distribution and conservation status of this newly discovered entity.

TABLE 1. Summary of floral characteristics of *T. pillaropatatensis* and morphological similar *Telipogon* species.

Species	Corolla and vein color patterns	Petals shape	Lip shape	Callus color and shape	Petal (P), lip (L) & callus (C) size (mm)	Number of veins in petals (P) and lip (L)
T. crisariasae Baquero & Iturralde	Yellow with pink and white towards the center. Light red-brown veins and numerous reticulations	Rhomboid, margins undulated, acute and shortly apiculate	Broadly ovate, sub-acute	Pink, cordate, with a longitudinal central ridge, unlobed	P: 23 × 16. L:19–20 × 18–19 C: 8.0 × 5.5	P: 10–12. L: 21–23
T. elizabethiae Iturralde, Baquero & C.Martel	Yellowish-cream, with red-brown narrow veins with few reticulations at the base	Widely obovate to suborbicular, obtuse and shortly apiculate	Transversely obovate, obtuse and shortly apiculate	Purple, sagittate, unridged, unlobed	P: 11–12 × 10–11. L: 11–12 × 12–13. C: 3 × 2.	P: 9. L: 12–15
T. isabelae Dodson & Hirtz	Yellow covered by a red-brown haze with red-brown veins and numerous reticulations	Ovate, obtuse and apiculate	Broadly ovate, obtuse	Dark red to brown, broadly cordate, with a longitudinal central ridge, unlobed	P: 11 × 15. L:20 × 11. C:6 × 5	P: 9. L: 17
T. pillaropatatensis Iturralde, Monteros & Baquero	Yellow, heavily suffused with brown stains and dots. Thick, red-brown veins, and few reticulations only at the base of petals	Sub-rhombic; acute and shortly apiculate	Broadly ovate, obtuse and shortly apiculate	Dark purple to brown, cordiform, swollen in the longitudinal center, sub-trilobed	P: 15-21 × 14-21 L: 15-20 × 19-26. C: 4.5–6.0 × 5.5–6.0.	P: 10–13. L: 17–23
T. octavioi Dodson & R.Escobar	Yellow-brown with broad red-brown veins and numerous reticulations	Broadly ovate, obtuse and shortly acuminate	Broadly ovate, obtuse and apiculate	Wine to dark red, sub-sagittate, tongue-like, not ridged, unlobed	P: 17 × 13. L:18 × 17. C:4 × 4	P: 9–12. L: 14–17
T. thomasii Dodson & R.Escobar	Tan-yellow with red-brown veins and numerous reticulations	Broadly elliptic; obtuse and apiculate	Broadly ovate, obtuse and apiculate	Dark red to brown, subcordiform, with a longitudinal central ridge, sub-trilobed	P: 20 × 20. L:20 × 30. C:3 × 4	P: 10–12. L: 14–17

Materials and methods.

Species information.— Some specimens were collected for ex-situ cultivation, awaiting additional blooming, while other specimens were directly pressed as voucher material. Vegetative parts were dried, and flowers were preserved in a solution containing 70% ethanol, 29% water, and 1% glycerol.

Voucher specimens were deposited in the herbarium of the Museo Ecuatoriano de Ciencias Naturales (QCNE) in Quito, Ecuador. Photographs of floral and vegetative structures were taken using a Nikon D5100 camera with an AF-S DX Micro Nikkor 40mm f/2.8G lens and a Canon EOS T6 camera with a Canon EF-S 35/28 Macro lens.

Telipogon in Ecuador has not been revised, and infrageneric classifications (Brass 1981, Kränzlin 1919) are deficient. Therefore, comparisons are limited to morphologically similar species (see Table 1). Protologues, illustrations and all the available holotype herbarium specimens of similar species were analyzed to compare with the new species. Figures and a composite digital line drawing were prepared us-

Table 2. Sampling and accession information for species used in this study.

Taxon	Source	Voucher	Herbarium	rITS	*matK*
Fernandezia sanguinea (Lindl.) Garay & Dunst.	*NCBI*	-	-	FJ565526	FJ565009
Hofmeisterella eumicroscopica (Rchb.f.) Rchb.f.	*NCBI*	-	-	DQ315823	AF350589
Telipogon acicularis (Dressler) N.H.Williams & Dressler	*NCBI*	-	-	DQ315837	DQ315896
Telipogon ampliflorus C.Schweinf.	*NCBI*	-	-	DQ315850	FJ564870
Telipogon andicola Rchb.f.	*NCBI*	-	-	DQ315851	-
Telipogon ariasii Dodson & D.E.Benn.	*NCBI*	-	-	DQ315852	DQ315902
Telipogon bombiformis Dressler				DQ315854	FJ564866
Telipogon cuyujensis Dodson & R.Escobar	*This study*	GI-2209-5476	QCNE	OR689557	OR689581
Telipogon dalstromii Dodson	*NCBI*	-	-	DQ315861	DQ315906
Telipogon falcatus Linden & Rchb.f.	*NCBI*	-	-	DQ315862	-
Telipogon frymirei Dodson	*NCBI*	-	-	DQ315863	-
Telipogon hausmannianus Rchb.f.	*This study*	GI-2112-0991A	QCNE	OR689558	OR689580
Telipogon helleri (L.O. Williams) N.H.Williams & Dressler	*NCBI*	-	-	MF962882	MF962888
Telipogon pillaropatatensis Iturralde, Monteros & Baquero	*This study*	GI-2210-5757	QCNE	OR689556	OR689582
Telipogon maduroi Dressler	*NCBI*	-	-	DQ315867	FJ564867
Telipogon nervosus (L.) Druce	*NCBI*	-	-	DQ315870	DQ315907
Telipogon octavioi Dodson & R.Escobar	*This study*	GI-2201-1696	QCNE	OR689559	OR689579
Telipogon pogonostalix Rchb.f.	*NCBI*	-	-	AF239392	-
Telipogon pulcher Rchb.f.	*NCBI*	-	-	DQ315875	DQ315910
Telipogon vargasii C.Schweinf.	*NCBI*	-	-	DQ315880	DQ315912
Telipogon venustus Schltr.	*NCBI*	-	-	FJ565183	FJ564703
Telipogon vollesii Dodson & R.Escobar	*This study*	GI-2207-3788	QCNE	OR689560	OR689578
Trichoceros antennifer (Bonpl.) Kunth	*NCBI*	-	-	DQ315883	FJ564953

ing Adobe Photoshop® 2019. Additional pictures and information on the local distribution of the species were provided by Juan Medina, a local tour guide, who has also observed the species for several years.

The conservation status evaluation, the extent of occurrence (EOO), and the area of occupancy (AOO) analysis for this species were developed using the GeoCAT tool and the IUCN criteria (Bachman *et al*. 2011, IUCN 2022). The distribution, extent of occurrence and the area of occupancy map of the new taxon were prepared using ArcGIS (GIS software version 10.8: Redlands, CA: Environmental Systems Research Institute, Inc. https://www.esri.com/).

Phylogenetic analysis.— Fresh leaves of several Ecuadorian *Telipogon* species were collected in the field (Table 2), dried in silica gel, and transported to the research laboratories at Universidad de Las Américas (UDLA). Genomic DNA was isolated from the leaves using a rapid extraction procedure (Kasajima *et al*. 2004).

Two regions of the extracted DNA, nuclear ribosomal internal transcribed spacer (rITS) and plastid Maturase K (matK), were amplified by the Polymerase Chain Reaction (PCR) technique. The PCR reaction consisted of 7.5 µL GoTaq Green Master Mix 2X (Promega), 3 µL of extracted DNA, 7.5 µL ultra-

pure water, and 0.75 µM of each primer. Primers for rITS: ITS1: TCCGTAGGTGAACCTGCGG (Vijayan & Tsou 2010); ITS4: TCCTCCGCTTATTGATATGC (Vijayan & Tsou 2010). Primers for *matK*: *matK*-56F: ACTTCCTCTATCCGCTACTCCTT (Williams *et al*. 2005); *matK*-2.1a-Fw: ATCCATCTGGAAATCTTAGTTC (Vijayan & Tsou 2010); *matK*-2.1a-Fw: GTTCTAGCACAAGAAAGTCG (Vijayan & Tsou 2010). PCR conditions: 95 °C - 2 min, 95 °C - 1 min, 55 °C - 1 min, 72 °C - 1 min, 35 cycles, and final extension of 72 °C - 15 min. PCR products were purified, and Sanger sequenced (ABI 3500xL Genetic Analyzer, Applied Biosystem).

For the phylogenetic reconstruction, additional nucleotide sequences of the available South American *Telipogon* species, some Central American species, and closely related orchid genera were obtained from NCBI https://www.ncbi.nlm.nih.gov/ (Table 2). Further, we generated sequencing data of another five available Ecuadorian *Telipogon* species were deposited in GenBank (see Table 2). In total, the analyses included 20 species of *Telipogon,* one *Hofmeisterella* Rchb.f., and one *Trichoceros* Kunth, all belonging to the *Telipogon* alliance (Williams *et al.* 2005, Martel *et al*. 2020), were included. *Fernandezia sanguinea* (Lindl.) Garay & Dunst. was used as the outgroup.

The software Geneious Prime 2022.1 (https://www.geneious.com/) was used for the concatenating and editing of the sequences. Sequence alignment was performed using the MUSCLE tool (Edgar 2022). A Bayesian Inference (BI) and a Maximum Likelihood (ML) were conducted with the aligned sequences. For BI, we used BEAST v.1.10.4 (Suchard *et al*. 2018). MCMC analysis was conducted using a GTR substitution model, a Yule speciation model, and a relaxed log-normal clock and run for 10 million generations with tree sampling at every 10,000 generations. Then, we used LogCombiner v.1.10.4 (http://beast.community/logcombiner) to combine resulting trees with a burn-in of 25% and then TreeAnnotator v.1.10.4 (http://beast.community/treeannotator) to generate a single maximum clade credibility tree. Geneious Prime was used to visualize the resultant tree. For ML, we used the PhyML plugin (Guindon *et al.* 2010) in Geneious Prime, under the GTR+G model and 1000 bootstrap replicates. The best substitution model was estimated with the software Mega 11.0.13 (Tamura *et al.* 2021).

Taxonomic treatment

Telipogon pillaropatatensis Iturralde, Monteros & Baquero, ***sp. nov.*** Fig. 1–2.

TYPE: Ecuador. Tungurahua: Above Baquerizo Moreno (coordinates omitted for conservation reasons; detailed data on the herbarium Type specimen), 11 January 2022, *Gabriel A. Iturralde*, *GI-2210-5890* (holotype, QCNE!).

Diagnosis: *Telipogon pillaropatatensis* is morphologically similar to *T. octavioi* Dodson & R.Escobar as they share the yellow, brown-toned flowers, a mostly free, dark callus of the lip, and a setose column. However, *T. pillaropatatensis* is distinguished by the petals and lip with longitudinal vein-lines without reticulations (vs. reticulated lines), the column setae are similarly sized (vs. the column setae from the lateral tufts are longer than those from the dorsal tuft), the three dense tufts of bristles, appearing to be a single large tuft reaching the front and obstructing the view of the anther (vs. three less dense, well-differentiated tufts leaving the anther visible).

Plant epiphytic, caespitose, up to 20 cm in length, including inflorescence. *Roots* 1.0–1.5 mm in diameter, thick, cylindrical. *Stem* abbreviated, up to 1 cm long, laterally compressed, covered by 1–4 distichous, imbricating bracts. *Leaves* 4–8 cm long, 2–4 per stem, sub-coriaceous, distichous, articulated, decurrent, blade 4.0–7.5 × 0.9–1.7 cm, elliptic to very deeply obovate, acute, conduplicate, carinate abaxially, the basal leaves shorter than the upper leaves. *Inflorescence* apical, erect, racemose, 1–5 simultaneously flowered, opening in succession; peduncle 4–16 cm, compressed, ancipitous at the base and gradually widening towards the apex becoming tetragon; rachis ancipitous; floral bracts translucent, yellow-green, 1.0 × 0.9 mm, conduplicate, triangular-ovate, acute, carinate abaxially. *Ovary* 23–34 mm long, pedicellate, triquetrous. *Flowers* 30–42 × 29–35 mm, non-resupinate. *Sepals* 15–18 × 8–9 mm, concave, ovate, acute, light yellow, sometimes with 1–2 red longitudinal stripes, carinate abaxially, 3-veined. *Petals* 15–21 × 14–21 mm, sub-orbicular, sub-rhombic or broadly ovate, 10–13-veined, slightly concave in the center and the apical edge slightly reflex, copper to golden yellow heavily suffused with dark brown stains

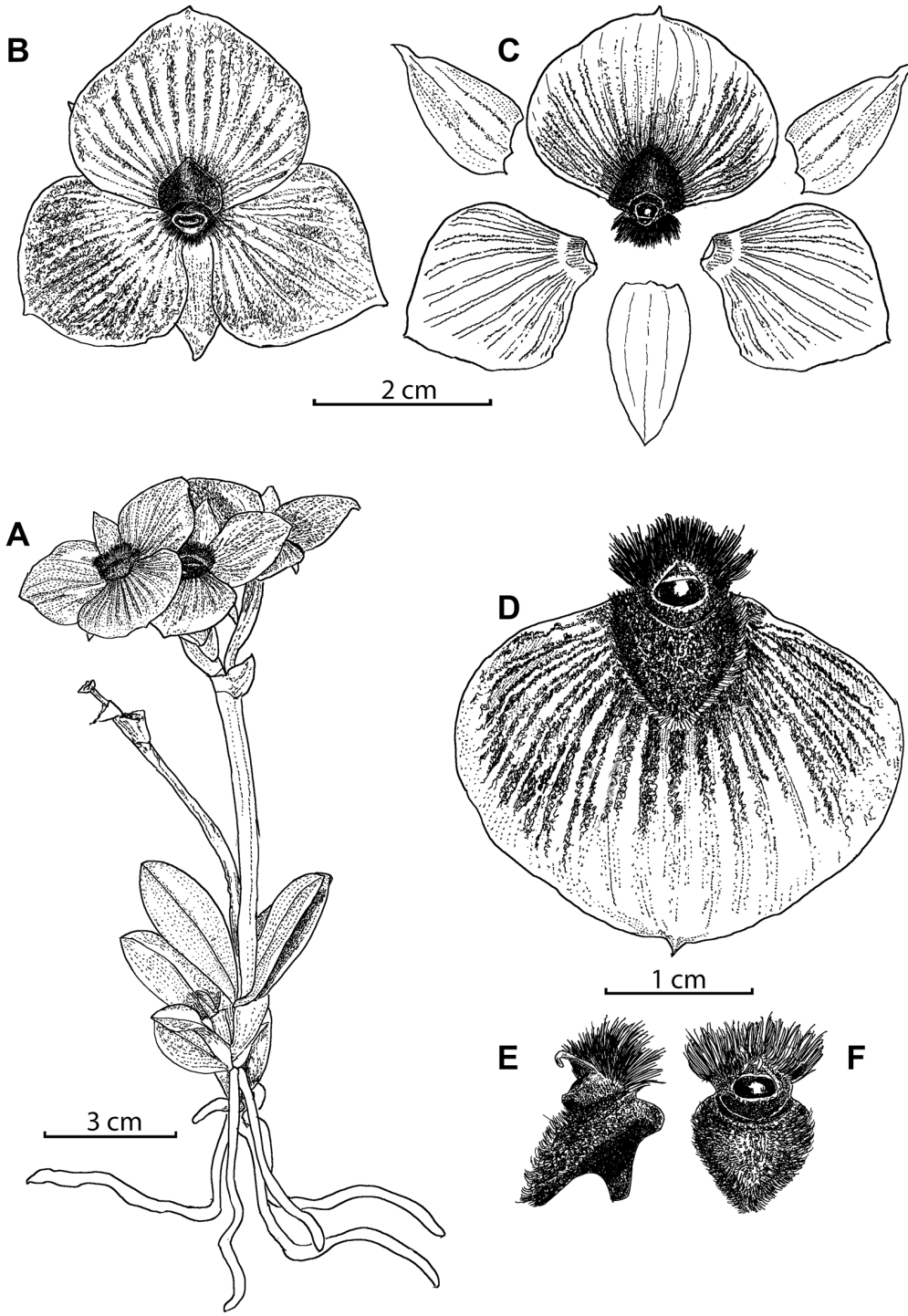

FIGURE 1. Illustration of *Telipogon pillaropatatensis* Iturralde, Monteros & Baquero. **A**. Habit. **B**. Flower, frontal view. **C**. Dissected flower. **D**. Lip and column. **E**. Callus and column, ¾ view. **F**. Callus and column, frontal view. Drawn by L.Baquero from the plant that served as the holotype (GI-2210-5890, QCNE).

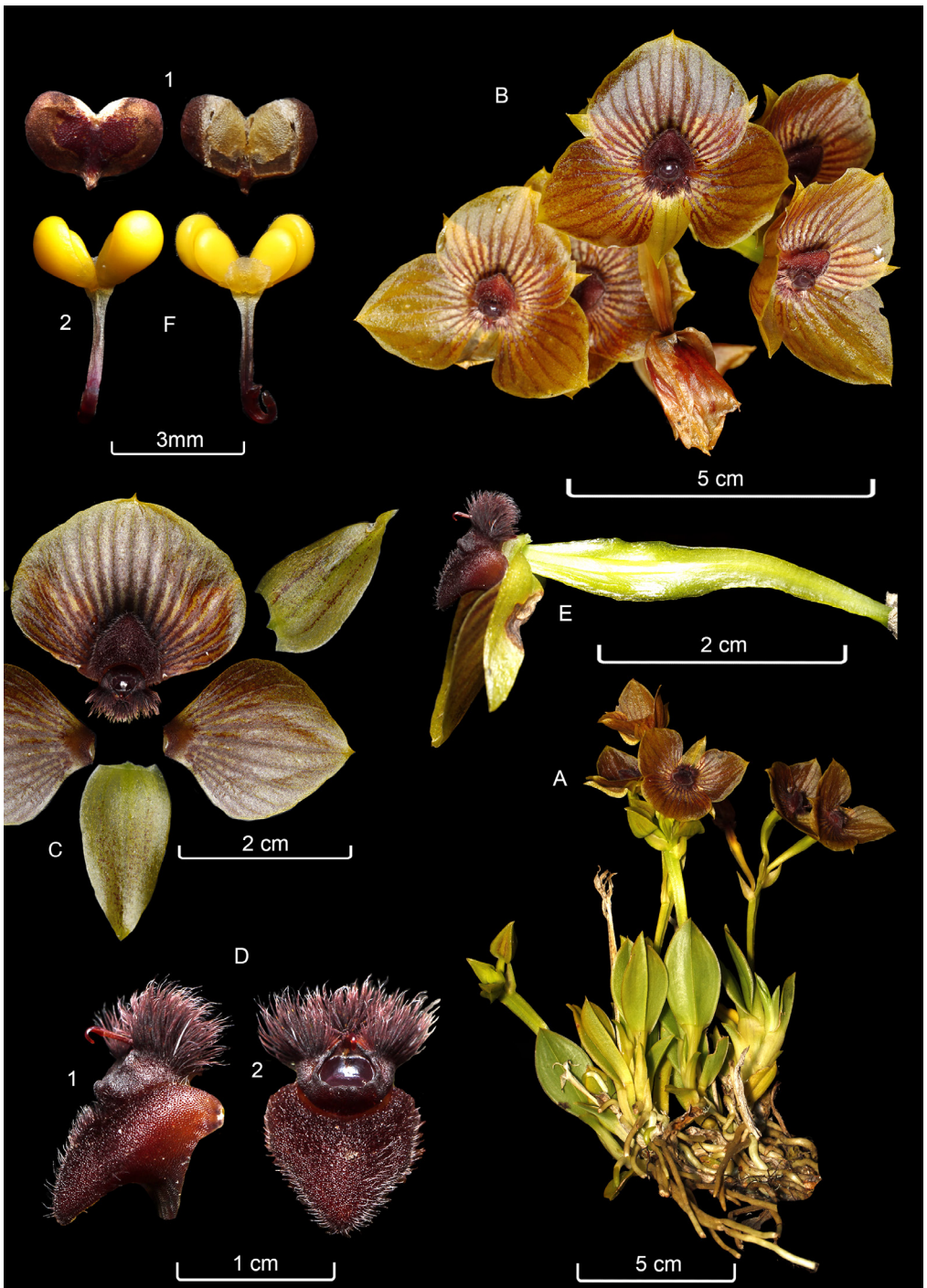

FIGURE 2. Composite plate of *Telipogon pillaropatatensis* Iturralde, Monteros & Baquero. **A**. Habit. **B**. Inflorescence. **C**. Dissected flower. **D**. Column and callus. **D1**. ¾ view. **D2**. frontal view. **E**. Side view of the ovary, column, and lip with callus. **F**. Pollinarium and anther cap, dorsal and ventral view. **F1**. anther cap. **F2**. pollinarium. Photographs by M.F.Monteros from the paratype (*MFM 239*)

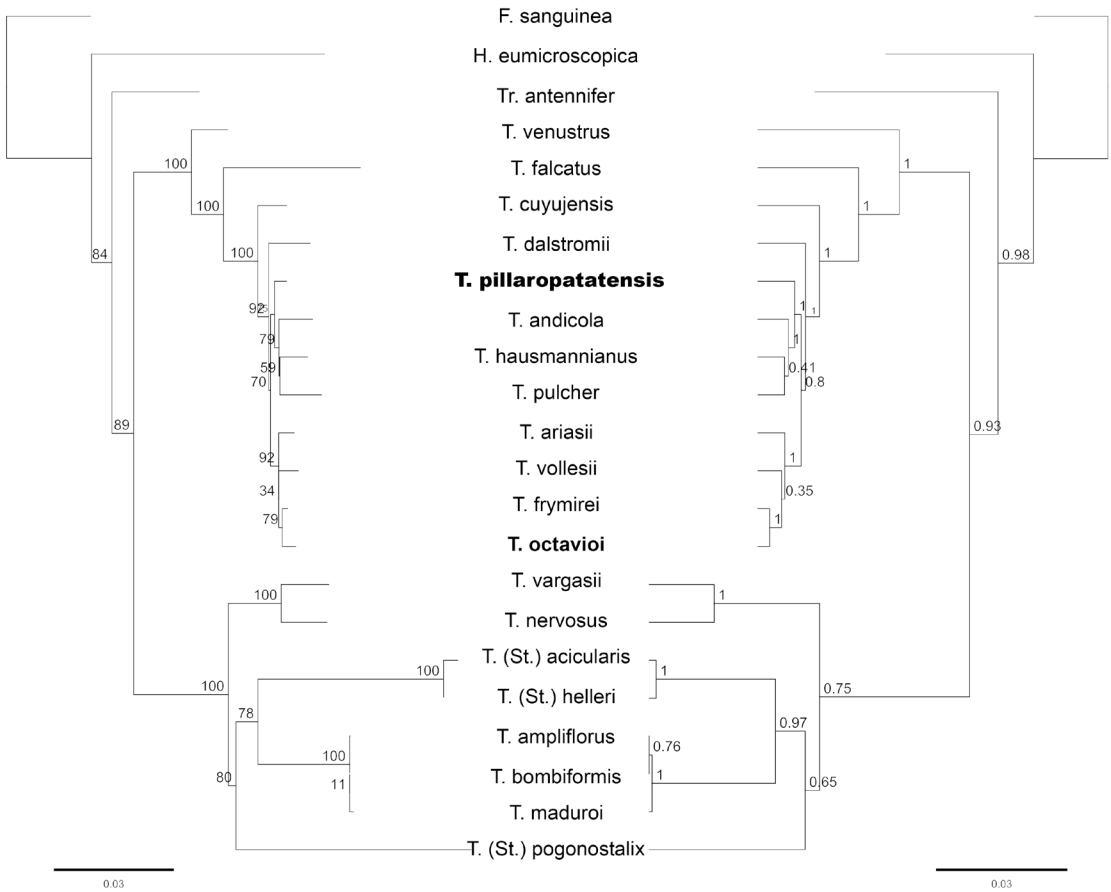

Figure 3. Reconstructed phylogenetic trees of concatenated markers rITS and *matK* including the position of *Telipogon pillaropatatensis* and its relationships. The tree on the left is based on Maximum Likelihood (ML) analysis (numbers at the side of nodes represent bootstrap percentages). Tree on the right is based on Bayesian inference (BI) analysis (numbers at side of nodes represent posterior probability). Scale bars represent the mean number of nucleotide substitutions per site. The abbreviation (St.) stands for former *Stellilabium*.

and dots towards the apical half with thick, sometimes doubled towards apical half, dark red-brown veins, and with very few reticulation-lines between the veins only at the base, the edge papillate, the base obtuse, fleshy and ciliolate, glabrous, shining under direct light, the apex right to acute, shortly apiculate. *Lip* 15–20 × 19–26 mm, broadly ovate, concave, coloration and vein pattern similar to those of the petals, but without reticulations at the base, 17–23-veined, ciliolate margins; the apex rounded, shortly apiculate; callus adnate to the base of the lip, 4.5–6.0 × 5.5–6.0 mm, broad, cordiform, sub-trilobed, pubescent, papillose, dark purple, swollen in the longitudinal center towards the apex, mammate apex, raised 2 mm free from the lip, curved downwards. *Column* 4 × 3 mm, sub-terete, sessile, minutely papillose, dark purple, with three dense tufts of setae of equal size around the anther (one dorsal and two lateral); setae acicular, purple with a white tip, simple, up to 3.0 mm long. *Stigma* sub-trapezoid, dark purple, with thickened and slightly sinuate margins, the margin opposed to the rostellum protruding 0.5 mm. *Anther* 2.0 × 2.6 mm, dorsal, cordiform, red-brown. *Pollinarium* 4 mm long, with two pairs of unequal pollinia; *stipe* 2.2 mm long; *viscidium* uncinate. *Capsule* 3-winged (only immature capsules observed).

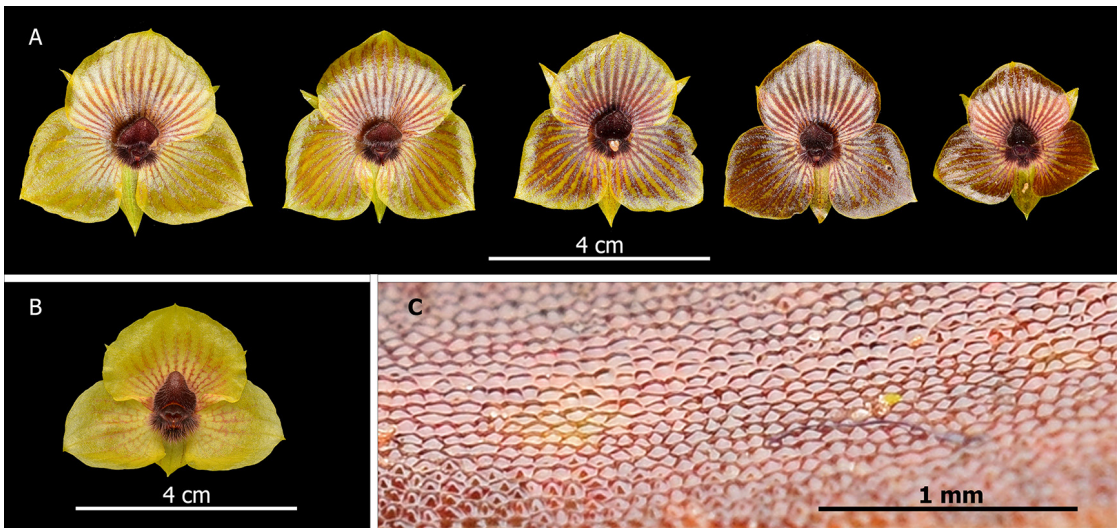

Figure 4. Flower size and color variation of *T. pillaropatatensis* Iturralde, Monteros & Baquero. **A**. Flowers found in situ under natural conditions. **B**. Flower obtained in *ex situ* culture. **C**. Close-up of the surface of a petal blade taken with a Discovery.V12 stereomicroscope, equipped with a plan Apo S 60mm lens, and AxioCam ICc5 digital camera. Photos by G.Iturralde (A, C) and L.Baquero (B).

Additional specimens examined (paratypes): Ecuador. Tungurahua: Above Patate (coordinates omitted for conservation reasons; detailed data on the herbarium specimen), 11 July 2022, *Marco F. Monteros, MFM 239* (QCNE!).

Other *telipogon* species examined: *Telipogon octavioi:* COLOMBIA: Putumayo: paso entre la Laguna de La Cocha y Sibundoy, km 31, 3150 m, 24 Jan 1987, *Dodson et al. 17018* (MO - Holotype). ECUADOR: Sucumbíos: El Mirador, Playón de San Francisco – Julio Andrade Km 12, 3200–3400 m, *Dodson, Williams & Whitten 18786* (MO).

Phylogenetic analyses: The phylogenetic trees constructed from the concatenated markers rITS and *matK* showed high correspondence (Fig. 3). The new entity is genetically distinct from all the analyzed species. Despite being morphologically similar to *T. octavioi*, *T. pillaropatatensis* seems not closely related; furthermore, the new species might be more related to the clearly morphologically distinct *T. pulcher* Rchb.f., *T. hausmannianus* Rchb.f. and *T. andicola* Rchb.f. (Fig. 3).

Etymology: This species is named in honor of the cantons of Píllaro and Patate, in the province of Tungurahua, so that its inhabitants feel inspired and proud to protect the last remnants of nearby high Andean Forest where this beautiful species lives.

Phenology and flower variations: Plants of *T. pillaropatatensis* have been observed with flowers and floral buds between July and October. During the visits in February and March, all plants exhibited only vegetative parts and fruits except one plant with withered flowers. Considering all this, its blooming period might extend from June to December.

A considerable difference in the brightness of the flowers has been observed between plants that grow in the understory (those not directly exposed to sunlight) and those growing under direct sunlight (those growing on the edges of the forest or next to trails). The dark brown stains and spots of the corolla, as well as the intensity of vein marks (especially on the petals) are almost absent in plants growing in the understory. In contrast, plants growing under full sunlight display very pronounced dark stains and vein marks. This color variation is limited to the petals and lip, with no noticeable differences observed in the column and callus, which remained consistent regardless of sunlight intensity (Fig. 4–5). This phenomenon was further confirmed when plants

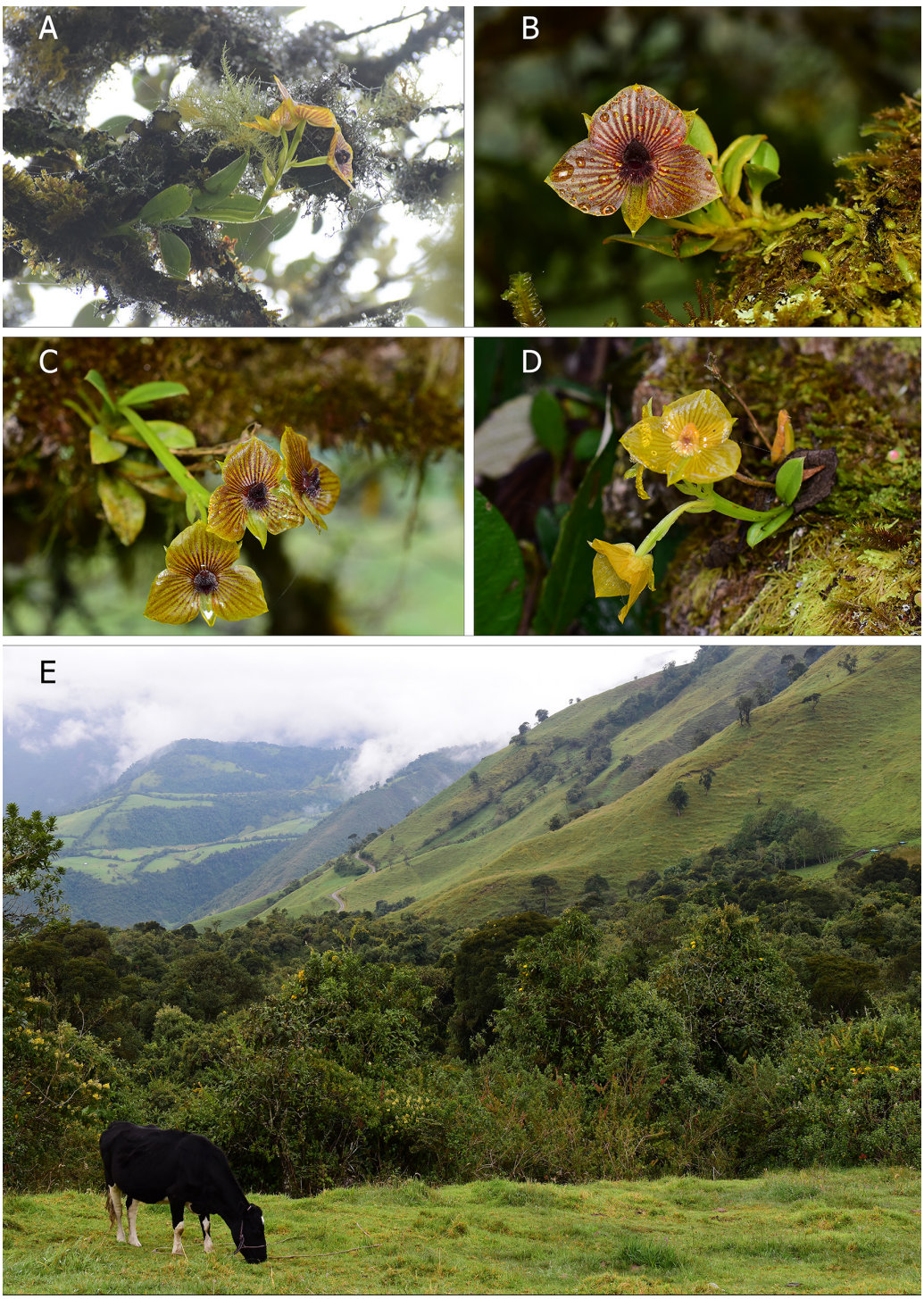

FIGURE 5. Habitat of *T. pillaropatatensis* Iturralde, Monteros & Baquero. **A–C**. Plants with flowers in situ. **D**. Xanthic variant growing in situ. **E**. Disturbed and patchy habitat surrounded by pastures for cattle and agricultural activities. Photos by G.Iturralde.

grown ex-situ under indirect sunlight also produced pale flowers with a weak dark coloration (see Fig. 4B). Therefore, direct sunlight might be critical in inducing the production of the pigments responsible for the dark brown coloration of the petals and lip in this species.

An exceptional individual with xanthic flowers was also recorded in the wild (see Fig. 5D). This flower lacked any dark pigments on the petals and sepals, and its column and callus had a bright yellowish-orange coloration. This individual's lack of dark pigments might be linked to genetic constraints, not environmental conditions associated with sunlight intensity.

Flowers of *T. pillaropatatensis* varied in size. Young plants, characterized by having one inflorescence and one flower, had smaller flowers compared to mature developed plants bearing two inflorescences and several flowers. A range of color variations and sizes in the flower perianth of *T. pillaropatatensis* is depicted in Fig. 4. Floral variation, particularly in the perianth, has also been observed in other *Telipogon* species (e.g., *T. vollesii* Dodson & R.Escobar, *T. semipictus* Rchb.f. ex Kraenzl., *T. thomasii* Dodson & R.Escobar), although not with such pronounced color variability.

DISTRIBUTION, HABITAT, AND ECOLOGY: Plants of *T. pillaropatatensis* have been found above 3000 m in the forest remnants of a small mountain range in the surroundings of Píllaro and Patate, located in the Tungurahua province, southwest of the Cordillera de Los Llanganates (Fig. 6). This area represents the westernmost portion of the upper zone of the Pastaza basin, an important center of plant and animal endemism in the eastern range of the Ecuadorian Andes. Plants of *T. pillaropatatensis* inhabit the evergreen high montane forest ecosystem (Ministerio del Ambiente del Ecuador 2013). Despite intensive explorations, this species has not been found on the eastern slope of the same mountain range, suggesting a restricted distribution facing the Inter-Andean Valley. Plants of the new species grow sympatrically with *T. hausmannianus* Rchb.f. and other orchids such as *Lepanthes monoptera* Lindl., *L. mucronata* Lindl., *Odontoglossum pardinum* (Lindl.) Lindl., *Oncidium cultratum* Lindl., *Pleurothallis llanganatensis* (Luer & Hirtz) J.M.H.Shaw, and *Stellis pusilla* Kunth.

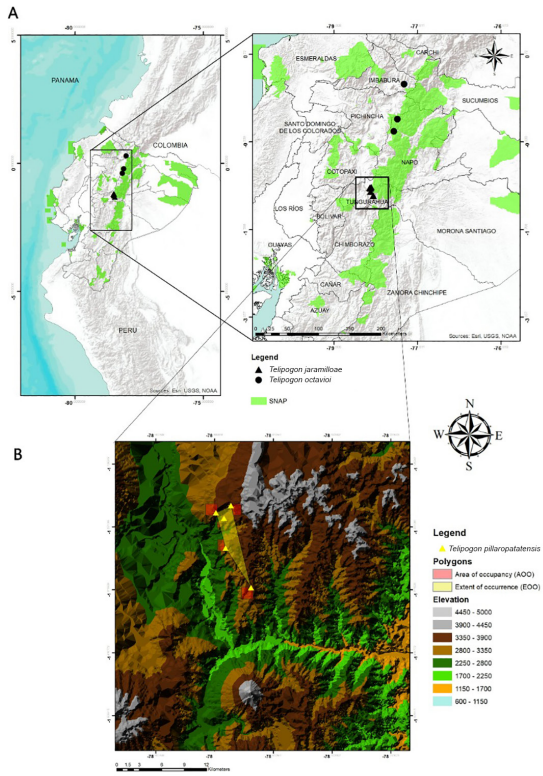

FIGURE 6. Distribution Map of *T. pillaropatatensis* Iturralde, Monteros & Baquero and *T. octavioi* Dodson & R.Escobar in Ecuador. **A**. General view. **B**. Area of occupancy (AOO) and Extend of Occurrence in the restricted distribution of *T. pillaropatatensis* facing the Inter-Andean Valley of the Pastaza basin. Map created by M.F.Monteros.

CONSERVATION STATUS: Plants of *Telipogon pillaropatatensis* grow in montane forests surrounded by farms and pastures for agriculture and livestock. Intense agricultural activities and cattle raising are rapidly and gradually destroying the last natural patches, since farmers cut down the native forest to establish potato and corn crops or new pastures for livestock. Unfortunately, there is minimal to no effort made to restore the impacted regions (Fig. 5E). The extent of occurrence (EOO) calculated for *T. pillaropatatensis* resulted in an area of 26.8 km^2, and an area of occupancy (AOO) of 16 km^2 (Fig. 6B). Considering the potential loss of habitat by human activities and an AOO < 20 km^2 we recommend classifying *T. pillaropatatensis* as Endangered (EN) according to the criteria B2 (IUCN 2022).

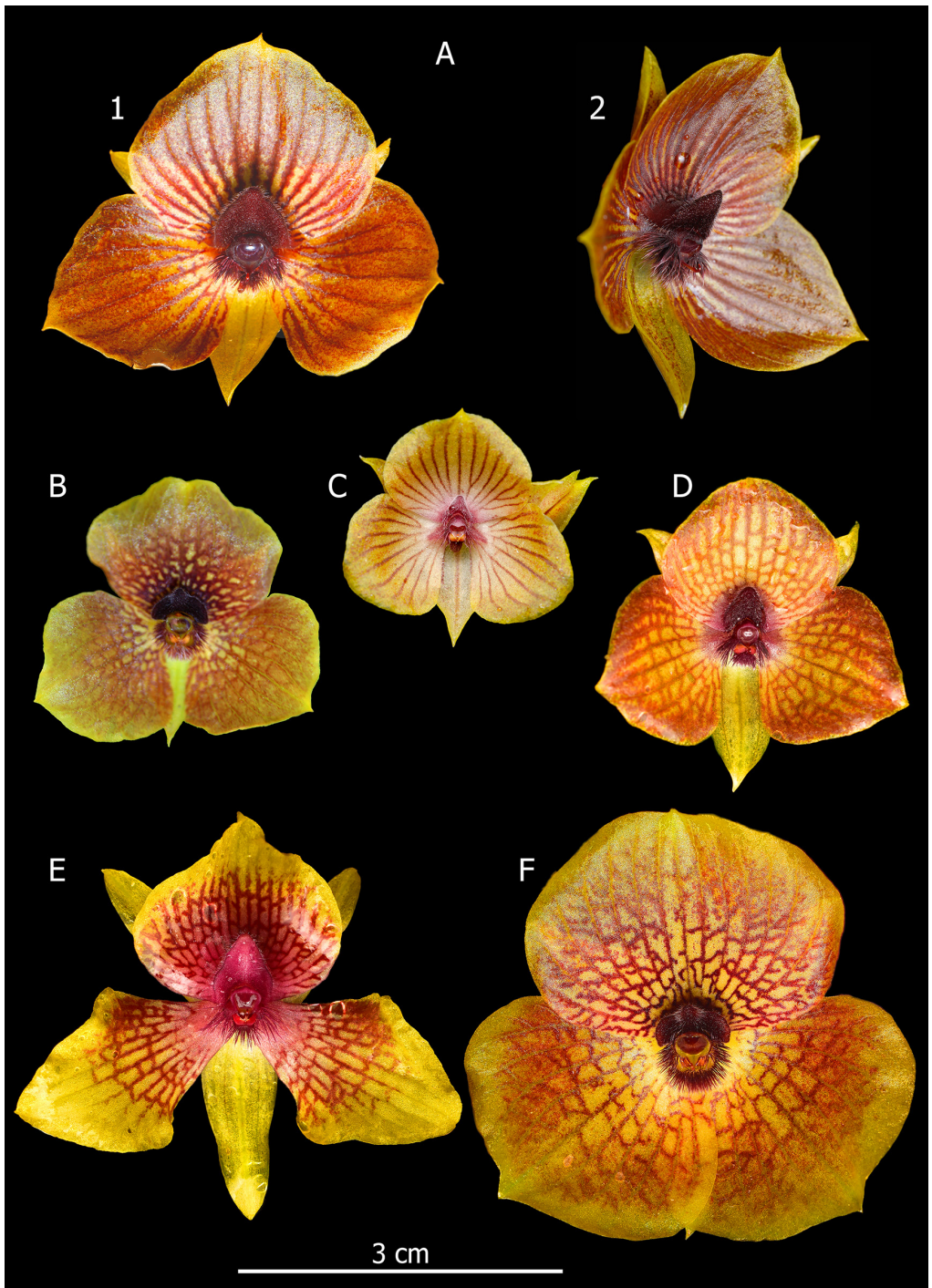

FIGURE 7. *Telipogon* species with cordiform to sagittate callus. **A**. *Telipogon pillaropatatensis* Iturralde, Monteros & Baquero. **B**. *T. isabelae* Dodson & Hirtz. **C**. *T. elizabethiae* Iturralde, Baquero & C.Martel. **D**. *T. octavioi* Dodson & R.Escobar. **E**. *T. crisariasiae* Baquero & Iturralde. **F**. *T. thomasii* Dodson & R.Escobar. Photos by G.Iturralde (A, C–F) and L.E.Baquero (B).

Discussion. Like most Ecuadorian *Telipogon* species, *T. pillaropatatensis* shows a sympodial growth with short, flattened stems, ancipitous-at-the-base inflorescences, and a triquetrous ovary. When exposed to sunlight, the corolla of *T. pillaropatatensis* flowers produces a silvery reflection. This optical effect is attributed to the papillate epidermis (Fig. 4C), which might also occur in other *Telipogon* species. *Telipogon pillaropatatensis* is morphologically similar to *T. octavioi* (Dodson & Escobar 1993). Both species share common characteristics such as the yellow suffused with brown petals and lip, markedly brown veins, the free, dark, cordiform, hirsute callus, and the setose column. Nevertheless, *T. pillaropatatensis* can be distinguished from *T. octavioi* by the thick, longitudinal, sometimes doubled vein-lines without reticulations except at the petal base (vs. thick veins with reticulations along the corolla in *T. octavioi*), the minutely papillose column ventrally and at the sides (vs. glabrous in *T. octavioi*), the similar sized setae arranged in an apparent single tuft (vs. three tufts of differentiated setae, lateral ones longer than those of the dorsal bundle in *T. octavioi*), and the denser tufts of setae that reach the front and obstructs the view of the anther (vs. less dense tufts allowing view of the anther in *T. octavioi*). Other species from Ecuador with similar perianth coloration and a thick sagittate or cordiform callus include *T. isabelae* Dodson & Hirtz, *T. thomasii*, *T. elizabethiae* Iturralde, Baquero & C.Martel, and *T. crisariasiae* Baquero & Iturralde (see Fig. 7; for detailed descriptions see Baquero *et al*. 2022, Dodson 2004, Iturralde *et al*. 2021, Dodson & Dodson 1989). Nevertheless, there are distinct differences in the apex of the callus lobes among these species. In *T. thomasii*, the apex is ovate, while in *T. crisariasae* it is truncate. In contrast, in *T. pillaropatatensis* the apex is broadly subfalcate. Furthermore, the callus shape varies, with *T. pillaropatatensis* having a cordiform callus, *T. isabelae* with a broadly cordiform callus, and *T. elizabethiae* displaying a sagittate callus. A detailed morphological comparison of the floral pieces of each species is shown in Table 1.

The topology of the phylogenetic trees constructed using Bayesian Inference (BI) and Maximum Likelihood (ML) analyzes was almost identical. The correspondence obtained, regardless of the statistical approach used, supports the results presented here. Additionally, the reconstructed phylogenetic trees are coherent with the tree topologies obtained in previous studies (Martel *et al*. 2020, Neubig *et al*. 2012, Williams *et al*. 2005). In these studies, two clades of South American *Telipogon* were identified: 1) the former Central and South American *Stellilabium* together with the caulescent *T. nervosus* (L.) Druce group, and 2) the other big flowered South American *Telipogon* species. Our results indicate that *T. pillaropatatensis* belongs to the second clade and show a closer phylogenetic relationship with *T. pulcher*, *T. hausmannianus* and *T. andicola* Rchb.f. than to the morphologically similar *T. octavioi* (Fig. 3). It is worth noting that the results presented here are insufficient to further infer the phylogenetic relationships of the Ecuadorian *Telipogon* species. However, our results support the proposal of *T. pillaropatatensis* as a new species.

ACKNOWLEDGMENTS. The authors thank Lou Jost for his critical review of a previous draft of this manuscript. We thank Juan Miguel Iturralde for his assistance during the field exploration. We also thank Juan Medina, a local tour guide and orchid enthusiast who provided important information on the occurrence, ecology, and potential factors that can affect the conservation of the new species. We thank Yanua Ledesma, Salomé Guerrero, Vinicio Armijos and Byron Freire for their help with the molecular analysis. We thank Universidad de Las Américas (UDLA) for funding orchid research in Ecuador, grant No. AGR.GID.22.01. The Ministerio del Ambiente del Ecuador is acknowledged for issuing the Environmental Contract for access to genetic resources No. MAATE-DBI-CM-2021-0187. C.M. is supported by a research grant from the Programa Nacional de Investigación Científica y Estudios Avanzados – Prociencia (Convenio Nº 126-2020-Prociencia) and The Max Planck Partner Group. The anonymous reviewers are thanked for their valuable comments to improve the manuscript.

LITERATURE CITED

Amezcua-Trigos, M., Pérez-Farrera, M. A., Archila, F., Cházaro-Basáñez, M. & Sosa, V. (2018). A new species of *Telipogon* (Orchidaceae) from Mexico and its phylogenetic position among Mesoamerican species. *Systematic Botany*, 43(1), 9–16. http://dx.doi.org/10.1600/036364418X697067

Andrade-Marín, L. (1970). *Viaje a las misteriosas montañas de Llanganati: expedición italo-ecuatoriana*. Segunda Edición. Quito: Editorial Santo Domingo.

Bachman, S., Moat, J., Hill, A. W., de Torre, J. & Scott, B. (2011). Supporting Red List threat assessments with

GeoCAT: geospatial conservation assessment tool. *ZooKeys*, 150, 117–126. https://doi.org/10.3897/zookeys.150.2109.

Baquero, L. E, Iturralde, G. A. & Martel, C. (2022). *Telipogon crisariasae* (Orchidaceae) a new species from northern Ecuador. *Phytotaxa*, 564(2), 248–256. https://doi.org/10.11646/phytotaxa.564.2.8

Bogarín, D. (2012). A new *Telipogon* from Mexico close to *Telipogon standleyi* (Orchidaceae: Oncidiinae). *Lankesteriana*, 12(2), 115–119. http://dx.doi.org/10.15517/lank.v0i0.11761

Braas, L. A. (1981). Ergänzungen zur Gattung *Telipogon* HBK (Orchidaceae). *Die Orchidee* (Hamburg), 32, 238–248.

Chase, M. W. (2009). Subtribe Oncidiinae: *Telipogon*. In: A.M. Pridgeon, P.J. Cribb, M.W. Chase, & F.N. Rasmussen (Eds.) *Genera Orchidacearum, Vol. 5 Epidendroideae (Part Two)*. (pp. 362–366). Oxford: Oxford University Press. https://doi.org/10.1111/j.1095-8339.2010.01057.x

Collantes, B. & Martel, C. (2015). *Telipogon koechlinorum (*Orchidaceae), a new species from Machu Picchu, Peru. *Brittonia*, 67, 113–117. http://dx.doi.org/10.1007/s12228-015-9363-7

Dodson, C. H. (2004). *Native Ecuadorian Orchids, Vol. 5 (Rodriguezia – Zygosepalum)*. Sarasota, Florida: Dodson Publishing. 1187 pp.

Dodson, C. H. & Dodson, P. M. (1989). *Orchids of Ecuador. Icones Plantarum Tropicarum*. Missouri Botanical Garden, Sarasota, 1989, Series II. Fascicle 5, pl. 586–597.

Dodson, C. H. & Escobar, R. (1993). Ocho especies nuevas del género *Telipogon* en Colombia. *Orquideología,* 18, 237–271.

Dressler, R. L. (1993). *Phylogeny and classification of the orchid family*. Portland, Oregon: Dioscorides Press. 176 pp.

Dressler, R. L. & Dodson, C. H. (1960). Classification and phylogeny in the Orchidaceae. *Annals of the Missouri Botanical Garden*, 47(1), 25–68.

Edgar, R. C. (2022). Muscle5: High-accuracy alignment ensembles enable unbiased assessments of sequence homology and phylogeny. *Nature Communications*, 13(1), 6968. https://doi.org/10.1038/s41467-022-34630-w

Endara, L. (2011). Orchidaceae. Pp. 441–702 In: S. León-Yánez, R. Valencia, N. Pitman, L. Endara, C. Ulloa Ulloa & H. Navarrete (eds.), *Libro rojo de las plantas endémicas del Ecuador*, 2ª edición. Quito: Publicaciones del Herbario QCA, Pontificia Universidad Católica del Ecuador.

Guindon, S., Dufayard, J. F., Lefort, V., Anisimova, M., Hordijk, W. & Gascuel, O. (2010). New algorithms and methods to estimate maximum-likelihood phylogenies: assessing the performance of PhyML 3.0. *Systematic biology*, 59(3), 307–321

Iturralde, G. A., Sanchez, E., Martel, C. & Baquero, L. E. (2021). A new species of *Telipogon* (Orchidaceae: Oncidiinae) from the eastern Andes of Ecuador. *Phytotaxa*, 513(4), 295–300. https://doi.org/10.11646/phytotaxa.513.4.3

IUCN. (2022). *Guidelines for Using the IUCN Red List Categories and Criteria*. Version 15.1. Prepared by the Standards and Petitions Committee. Retrieved from: https://www.iucnredlist.org/documents/RedListGuidelines.pdf. (Accessed 15 March 2022).

Jost, L. (2004). Explosive local radiation of the genus *Teagueia* (Orchidaceae) in the upper Pastaza watershed of Ecuador. *Lyonia*, 7(1), 41–47.

Kasajima, I., Ide, Y., Ohkama-Ohtsu, N., Hayashi, H., Yoneyama, T. & Fujiwara, T. (2004). A protocol for rapid DNA extraction from *Arabidopsis thaliana* for PCR analysis. *Plant Molecular Biology Reporter*, 22(1), 49–52. https://doi.org/10.1007/BF02773348.

Kränzlin, F. (1919). *Beiträge zur Kenntnis der Gattung Telipogon HBK*. Annalen des Naturhistorischen Museums in Wien, 33, 9–38.

Martel, C. (2020). Análisis de la categorización del estado de conservación de las orquídeas en el Perú: el caso del género *Telipogon*. *Revista Peruana de Biología*, 27(2), 267–270.

Martel, C., Neubig, K. M., Williams, N. H. & Ayasse, M. (2020). The uncinate viscidium and floral setae, an evolutionary innovation and exaptation to increase pollination success in the *Telipogon* alliance (Orchidaceae: Oncidiinae). *Organisms Diversity & Evolution* 20, 537–550. https://doi.org/10.1007/s13127-020-00457-w

Ministerio del Ambiente del Ecuador. (2013). *Sistema de Clasificación de los Ecosistemas del Ecuador Continental*. Quito; Subsecretaría de Patrimonio Natural. 232 pp.

Nauray, W. & Galán, A. (2008). Ten new species of *Telipogon* (Orchidaceae, Oncidiinae) from southern Peru. *Anales del Jardín Botánico de Madrid*, 65(1), 73–95. http://dx.doi.org/10.3989/ajbm.2008.v65.i1.247

Neubig, K. M., Whitten, W. M., Williams, N. H., Blanco, M. A., Endara, L., Burleigh, J. G., Silvera, K., Cushman, J. C. & Chase, M. W. (2012). Generic recircumscriptions of Oncidiinae (Orchidaceae: Cymbidieae) based on maximum likelihood analysis of combined DNA datasets. *Botanical Journal of the Linnean Society*, 168(2), 117–146.

Reyes-Puig, J. P., Recalde, D., Recalde, F., Koch, C., Guayasamin, J. M., Cisneros-Heredia, D. F. & Yánez-Muñoz, M. H. (2022). A spectacular new species of *Hyloscirtus* (Anura: Hylidae) from the Cordillera de Los Llanganates in the eastern Andes of Ecuador. *PeerJ*, 10, e14066. https://doi.org/10.7717/peerj.14066.

Reyes-Puig, J. P., Yánez-Muñoz, M. H., Cisneros-Heredia, D. F. & Ramírez-Jaramillo, S. R. (2010). Una nueva especie de rana *Pristimantis* (Terrarana: Strabomantidae) de los bosques nublados de la cuenca alta del río Pastaza, Ecuador. *ACI Avances en Ciencias e Ingenierías*, 2(3), B78–B82. https://doi.org/10.18272/aci.v2i3.48

Schlechter, R. (1915). *Aufzählung und Beschreibung der Gattunge und der hauptsächlichsten Arten. Die Orchideen: ihre Beschreibung, Kultur und Züchtung Handbuch für Orchideenliebhaber*, Züchter und Botaniker. Berlin: P. Parey. 529–530 pp.

Spruce, R. (1908). *Notes of a Botanist on the Amazon and Andes*, ed. A.R. Wallace. Cambridge.

Suchard, M. A., Lemey, P., Baele, G., Ayres, D. L., Drummond, A. J. & Rambaut, A. (2018). Bayesian phylogenetic and phylodynamic data integration using BEAST 1.10. *Virus Evolution*, 4(1), vey016. Doi: 10.1093/ve/vey016.

Tamura, K., Stecher, G. & Kumar, S. (2021). MEGA11: Molecular Evolutionary Genetics Analysis version 11. *Molecular Biology and Evolution* 38(7), 3022–3027.

Vargas, H., Neill, D., Asanza, M., Freire-Fierro, A., Narváez, E., Vázquez, M. A. & Larrea, Y. M. (2000). *Vegetación y flora del Parque Nacional Llanganates. Biodiversidad en el Parque Nacional Llanganates: un reporte de las evaluaciones ecológicas y socioeconómicas rápidas*. Quito: EcoCiencia, Herbario Nacional del Ecuador, Museo Ecuatoriano de Ciencias Naturales e Instituto Internacional de Reconstrucción Rural.

Vijayan, K., & Tsou, C. H. (2010). DNA barcoding in plants: taxonomy in a new perspective. *Current science*, 99(11), 1530–1541. Retrieved from https://www.jstor.org/stable/24069450 (Accessed 10 April 2022).

Williams, N. H. (2001). Molecular systematics of the Oncidiinae based on evidence from four DNA sequence regions: expanded circumscriptions of *Cyrtochilum*, *Erycina*, *Otoglossum*, and *Trichocentrum* and a new genus (Orchidaceae). *Lindleyana*, 16(2), 113–139.

Williams, N. H., Whitten, W. M. & Dressler, R. L. (2005). Molecular systematics of *Telipogon* (Orchidaceae: Oncidiinae) and its allies: nuclear and plastid DNA sequence data. *Lankesteriana*, 5(3), 163–184. http://dx.doi.org/10.15517/lank.v5i3.19754

Yánez-Muñoz, M. H., Cisneros-Heredia, D. F. & Reyes-Puig, J. P. (2010). Una nueva especie de rana terrestre *Pristimantis* (Anura: Terrarana: Strabomantidae) de la cuenca alta del Río Pastaza, Ecuador. *ACI Avances en Ciencias e Ingenierías*, 2(3), B28–B32. https://doi.org/10.18272/aci.v2i3.41.