



***Aulonemia insolita* (Bambusoideae: Bambuseae: Arthrostylidiinae) a new remarkable woody bamboo species with internode dimorphism endemic to Bolivia and Peru**

IVAN JIMÉNEZ-PÉREZ^{1,6}, NATALIA REÁTEGUI^{2,7}, CELIA FIORELLA MALPARTIDA-GARAY^{3,8} & EDUARDO RUIZ-SANCHEZ^{4,5,9,*}

¹Independent researcher, Avenida del Arquitecto, zona Ferropetrol, El Alto, Bolivia

²Herbario de la Facultad de Ciencias Forestales, Universidad Nacional Agraria La Molina Av. La Molina s/n, apartado 12–056, Lima 12, Perú

³Independent researcher, Prolongación San Martín s/n, Aucayacu, Leoncio Prado, Perú

⁴Departamento de Botánica y Zoología, Centro Universitario de Ciencias Biológicas y Agropecuarias, Universidad de Guadalajara, Camino Ing. Ramón Padilla Sánchez 2100, Nextipac, Zapopan, Jalisco, 45200, Mexico

⁵Laboratorio Nacional de Identificación y Caracterización Vegetal (LaniVeg), Centro Universitario de Ciencias Biológicas y Agropecuarias, Universidad de Guadalajara, Camino Ing. Ramón Padilla Sánchez 2100, Nextipac, Zapopan, Jalisco, 45200, Mexico

⁶✉ suniruna@gmail.com; <https://orcid.org/0000-0003-4501-3342>

⁷✉ nataliareateguiecheverri@gmail.com; <https://orcid.org/0000-0002-7790-6850>

⁸✉ fiory1994mg@gmail.com; <https://orcid.org/0000-0001-5159-8709>

⁹✉ ruizsanchez.eduardo@gmail.com; <https://orcid.org/0000-0002-7981-4490>

*Author for correspondence: ✉ ruizsanchez.eduardo@gmail.com

Abstract

Species belonging to the genus *Aulonemia* have distribution across Mexico, Central America, northern and central Andes, the Guiana shield and southern Brazil. Three *Aulonemia* species: *Aulonemia hirtula*, *A. queko*, and *A. herzogiana* are known to have dimorphic internodes. In this study, we describe a new species of *Aulonemia*, characterized by culms with a pattern of one long internode followed by four to five shorter internodes. Notably, this species exhibits erect culm leaf blades, an uncommon trait within the genus. This study provides a comprehensive description of this new *Aulonemia* species, along with a distribution map, photographs and a morphological key to the species of *Aulonemia* with dimorphic internodes.

Key words: Central Andes, dimorphic internodes, erect culm leaf blades, reflexed culm leaf blades

Resumen

Las especies pertenecientes al género *Aulonemia* se distribuyen en México, América Central, los Andes del norte y centro, el escudo guayanés y el sur de Brasil. Se sabe que tres especies de *Aulonemia*; *Aulonemia hirtula*, *A. queko* y *A. herzogiana* tienen entrenudos dimórficos. En este estudio, describimos una nueva especie de *Aulonemia*, caracterizada por culmos con un patrón de un entrenudo largo seguido de cuatro a cinco entrenudos más cortos. Cabe destacar que esta especie exhibe láminas foliares erectas, un rasgo poco común dentro del género. Este estudio proporciona una descripción completa de esta nueva especie de *Aulonemia*, junto con un mapa de distribución, fotografías y una clave morfológica para las especies de *Aulonemia* con entrenudos dimórficos.

Palabras clave: Andes centrales, entrenudos dimórficos, láminas de las hojas del culmo erectas, láminas de las hojas del culmo reflexas

Introduction

Aulonemia Goudot (1846: 76) is one of the 19 described genera classified within the subtribe Arthrostylidiinae (Bambuseae; Bambusoideae; Poaceae) (Jesus-Costa *et al.* 2024). Arthrostylidiinae is a diverse subtribe of the Neotropical woody bamboos, with 203 described species (Ruiz-Sanchez *et al.* 2021a,b, Vinicius *et al.* 2021, Ruiz-

Sanchez *et al.* 2022, Jiménez-Pérez & Vinícius-Silva 2023). Two genera account for more than the 50% of the total diversity of this subtribe; *Aulonemia* with 43 described species (Jesus-Costa *et al.* 2024) and *Merostachys* Sprengel (1825: 132) with 59 described species (Viana & Filgueiras 2014, Vinicius *et al.* 2021, Jiménez-Pérez & Vinícius-Silva 2023). The geographical distribution of *Aulonemia* species is characterized by disjoint, patchy areas in Mexico, Central America, northern and central Andes, the Guiana Shield, and central and southern Brazil (Atlantic forest) (Viana & Filgueiras 2014, Judziewicz *et al.* 1999). Phylogenetically, *Aulonemia* and *Colantheia* McClure & Smith in McClure (1973: 77) are sister genera, with both being sister to *Aulonemiella* Clark *et al.* (2020: 26) (Tyrrell *et al.* 2012, 2018, Jesus-Costa 2018, Jesus-Costa *et al.* 2024).

Aulonemia species are erect, scandent or clambering bamboos with pachymorph rhizomes. The culms range from 0.3 to 15 m in length and 0.15 to 8 cm in diameter. Internodes can be either thin- or thick-walled and are typically hollow or solid in two species (Viana & Filgueiras 2014), either all subequally elongated or with a pattern of one long internode alternating with two to four very short internodes. Culm leaves are not always distinct from foliage leaves and usually have reflexed blades, although erect blades are also observed in some species. The upper sheath margin of the culm leaves is characterized by well-developed fimbriae. Branching is intravaginal, with one branch per node that sometimes rebranches, appearing subequal to the main culm and much larger than any lateral branches. Branches arise from a single bud, and although the promontory is absent in most species, some present a main branch accompanied by two to numerous smaller lateral branches. Foliage leaf sheaths auricles are present or absent, while the fimbriae are either short or long, straight or curly, and can range from pectinate to spreading. The blades are pseudopetiolate, linear-lanceolate to broadly ovate, symmetric or strongly asymmetric around the midrib, and may be ascending or reflexed. Synflorescences are panicleate, varying from contracted to open, and can be ovate or pyramidal in shape. Spikelets are long-pedicellate and laterally compressed (Ruiz-Sanchez *et al.* 2021a).

Within the genus *Aulonemia* there are three species with dimorphic internodes: *Aulonemia hirtula* (Pilger 1921: 445) McClure (1973: 56), *A. queko* Goudot (1846: 76) and *A. herzogiana* (Henrard in Herzog 1921: 75) McClure (1973: 56). All three feature reflexed culm leaves with evident fimbriae at the mouth of the sheath (Judziewicz *et al.* 1999, Jiménez Pérez 2016). The culms of these species are traditionally used for basket weaving, and crafting musical wind instruments. Additionally, long internodes, which can be filled with water, are sometimes utilized in the treatment of respiratory diseases (Judziewicz *et al.* 1999, Jiménez Pérez 2016).

During the First International Bamboo Congress held in La Merced, Peru in 2019, local people from the Amazonas department in Peru sold baskets made from the culms of an unknown bamboo species. They also had culm samples used for this handicraft, which featured one long internode followed by four smaller internodes. Jiménez Pérez (2016) previously mentioned a potential new species of *Aulonemia* with four small internodes in Bolivia, which could potentially be the same species found in Amazonas. Following a new collection in the Amazonas and Huanuco regions of Peru, we discovered that this species closely matches the characteristics of the three *Aulonemia* species with dimorphic internodes, although this unknown bamboo displays erect culm leaf blades, an atypical feature in *Aulonemia*. In this study, we provide a comprehensive description of this new *Aulonemia* species, along with information about its distribution, habitat, ecology, phenology, uses and properties. We also include a discussion of its unusual morphological traits, a distribution map, photographs, and a morphological key for identifying species of *Aulonemia* with dimorphic internodes.

Material and methods

Study site:—Fieldwork was conducted between September 2012 and November 2017 in Bolivia, primarily around and within Cotapata National Park and Integrated Management Area (PN-ANMI Cotapata), located in the department of La Paz. Additionally, specimen collection took place in Amazonas, Peru, in October 2019, and in the departments of Amazonas and Huánuco in December 2022. Both vegetative and flowering materials were collected following the procedures outlined by Soderstrom & Young (1983). We examined specimens at the BOLV, LPB, and MOL herbaria, as well as digital specimen images from the F and US herbaria (acronyms following Thiers 2024). Measurements of macromorphological characters were taken using a centimeter ruler, adhering to the morphological terminology of McClure (1973). The base map was provided by Natural Earth.

Taxonomic treatment

Aulonemia insolita I. Jiménez, Reátegui & Ruiz-Sanchez, *sp. nov.* Figs. 1–3.

TYPE:—BOLIVIA. La Paz: provincia Nor Yungas, Parque Nacional Cotapata, sendero Chojllapata, 16°13'27.3"S, 67°52'07.6"O, 2382 m, 14 March 2013 (fl), *I. Jiménez 5841* (holotype BOLV!, isotype LPB!).

Aulonemia insolita belongs morphologically to the group formed by *A. queko*, *A. herzogiana* and *A. hirtula*, which are characterized by dimorphic internodes. However, *A. insolita* has a combination of morphological characters absent in the other species of the group, such as: internal surface of internodes partitioned by white lamellae irregularly distributed, culm leaf sheath apices asymmetric (one side cuneate and other side rounded), culm leaf blades erect, culm and foliage leaf sheaths fimbriae frayed and entangled towards the apex and outer ligule lacinate.

Rhizome pachymorph. Culms erect and apically arched or arching from the base, culms, 4–7(–15) m tall, 2–4.9 cm diameter; midculm internodes dimorphic, long internode 45–100 cm long (first basal internode 170–256 cm long), followed by 3–4(5) short internodes, 0.3–1.1 cm long, apical internodes and dominant branch show 2 short internodes, even sometimes subsidiary branches can show 1 short internode, hollow, walls 1–4 mm thick, wall thickness is not uniform, filled with a gelatinous substance or empty, terete, lineolate, puberulent, mottled, internal surface of internodes showed white lamellas irregularly distributed. Nodal line horizontal and slightly descending below the branch complement, supranodal ridge absent, promontory absent, girdle 15–19 mm thick, glabrous, striate, dark brown; bud single, semi-round, prophyll 0.8–1.1 × 1.4–2 cm, triangular, glabrous, ciliolate. Culm leaves shorter than the large internode and longer than short internodes, persistent, or late deciduous at midculm; stramineous, immature culm leaves green, some areas of margin and surface covered with reddish or purple; sheaths 5.3–11.5 cm long, sheath:blade ratio 0.6–1.6; margin entire, overlapped in the proximal half; adaxially shiny, smooth, and glabrous, slightly striate towards distal half, abaxially shiny, smooth, and glabrous, slightly striate towards apical zone and/or distal half, lateral margins and basal zone, sheath apex asymmetric, one side rounded, the other side cuneate; fimbriae (1.5–)3.5–11 mm long, mainly free, sometimes connate, frayed and entangled; outer ligule absent, inner ligule 0.5–2 mm long, horizontal, symmetric and convex, ciliolate, cilia larger toward the center; blade 5.1–15.0 cm long, erect, initially triangular becoming lanceolate with constricted base, striate, faintly to evidently tessellate, adaxially hirtellous at the grooves, abaxially glabrous, margins of the basal zone densely fimbriate on both sides; fimbriae 2–5 mm long, basal zone black (purple *in situ*), connate or free at the base, entangled toward the apex, then the fimbriae become shorter or break and they are distributed irregularly and progressively becoming ciliolate, scabridulous or entire towards the apical margin, apex subacute to attenuate. Branching intravaginal, 15–42 subsidiary branches plus one dominant branch per node, 15.5–69(–100) cm long (subsidiary branches), terete, not rebranching. Foliage leaves 4–10 per complement (1–6 in flowering branch complement), sheath glabrous, striate, whitish green, mottled, margin entire, brown, overlapped, free near the apex; apex asymmetric, one side narrow (cuneate) and the other side wide (rounded) and fimbriate; fimbriae 3–15 mm long, straight, stramineous but at the base sometimes blackish, purple or dark brown (purple *in situ*), free to connate, frayed from distal half, slightly to very entangled towards the apex, auricles absent; outer ligule 1.5–5.0 mm long, horizontal, deeply bilobed, sinus U-shaped but sometimes narrower and lobules almost overlapped, glabrous, lacinate, frayed and entangled toward the apex, inner ligule 0.3–1.0 mm long, thin stripe, brown, asymmetrically convex towards the wide side, glabrous, ciliolate; pseudopetiole 2–4 mm long, glabrous, adaxially and abaxially blackish or stramineous, a midrib projects like a keel on both sides, pulvinus absent; blade (6.3–)8.0–29.7 × (0.9–)1.2–2.5 cm, L:W ratio (4.4–)4.8–13.9(–25.1), lanceolate, adaxially striate, covered by small white hairs in the grooves of the entire adaxial surface, sometimes scattered or absent, abaxially minute white hairs present all over surface, glaucous surface visible or little obvious (not evident in living plants), base asymmetric (cuneate-rounded), apex attenuate, margin scabridulous, midrib eccentric, visible all along. Synflorescence up to 47 cm long, 9–25.2 cm wide, open panicle, pyramidal to ovoid, subtending bract 0.1–1 mm long, chartaceous stripe, ciliolate, whitish green or greenish brown, dark purple, dark brown, greenish with dark purple border, the bracts are located below the first branch or below it, of similar thickness or thinner at the ends and thicker towards the middle or vice versa, sometimes concave and emarginate at the middle, partially surrounds the rachis, the ends are lobed or without lobes, lobes 0.2–4.0 mm long, dark brown to greenish brown, dark purple or greenish when underdeveloped, ciliolate or entire, similar or different size; branches patent, ascending or reflexed, primary branches with a black and hirtellous pulvinus; pedicel up to 36.6 cm long, triquetrous, scabridulous, ascending or reflexed. Spikelet (12.0–)19–51(–52.5) × (1–)1.5–2.5 mm, laterally compressed, straight (slightly falcate), chartaceous, in immature spikelets the glumes

are purple or blackish towards the distal half and the margins, the rest greenish yellow, the lemmas have a blackish awns, the mature spikelets are purple-yellow or light brown, consisting of 3 glumes, (1–)2–5(–7) fertile florets and 1 apical rudimentary floret; glume I 2.1–2.6 mm long, 3-nerved, lanceolate, awned, awn 2 mm long, abaxially proximal half glabrous to sparsely puberulent, distal half puberulent between veins, ciliolate at apex and the awn, adaxially sparsely hirtellous above of distal half; glume II 3.8–4.5 mm long, 5-nerved, lanceolate, awned, awn 2.2–2.5 mm long, abaxially puberulent between veins, ciliolate at apex and awn, adaxially sparsely hirtellous above of distal half; glume III 5.0–6.5 mm long, 5-nerved, lanceolate, awned, awn 2–2.1 mm long, abaxially puberulent between veins, more noticeable towards the distal half, ciliolate towards the apex and slightly or nothing in the awn, adaxially hirtellous to puberulent above of distal half or apical zone; rachilla internodes 3.5–7 mm long; lemma 8–10 mm long, 5-nerved, awned, awn 2–4 mm long, puberulent and hirtellous above of distal half or in the apical zone, awn sometimes ciliolate; palea 8.0–8.5 mm long, 3–5-nerved, puberulent in the distal half, ciliolate towards the apex, bicarinate, sulcus well developed for full length, slightly pubescent, apex obtuse; lodicules 3, ca. 3 mm long, glabrous, subulate; stamens 3, 4.8 mm long; fruit caryopsis, ca. 5.4 mm long, dark brown, apiculate, hilum linear.

Etymology:—From Latin *insolitus* = “unusual”. This species is named for its unique set of morphological characteristics that are not observed in other *Aulonemia* species with long and short internodes.

Distribution, habitat and ecology:—This species is distributed in northern and central Peru (in the departments of Amazonas and Huánuco, respectively) and extends in its southern range to western Bolivia (in the department of La Paz), covering an elevational range of 1800 to 2382 m. In Bolivia, most recorded populations of this species are found within the protected area PN-ANMI Cotapata (Fig. 4).

Its habitat consists of humid montane forests on the eastern slopes of the Andes in Bolivia and Peru. In Bolivia, these humid forests are part of the Yungas ecoregion, particularly in the upper belt and transitioning to the lower belt of the montane forest. In PN-ANMI Cotapata, the forest canopy is dense and continuous, reaching heights of 15–20 m, with emergent trees up to 30 m tall. The undergrowth is dense, on steep slopes (Paniagua *et al.* 2003), with annual precipitation of 2500 mm, an average annual temperature ranging from 12.8 to 16.8°C, and relative humidity between 90.1–96.5%. The soils are strongly acidic (pH below 4.5 in all horizons) and have a thick organic layer (Bach *et al.* 2003, Gerold *et al.* 2008). According to the Peruvian ecological map, at the collection sites, the species occurs in tropical low montane humid forests, which occupy the inter-Andean valleys, characterized by steep topography with few flat surfaces, at altitudes between 1800 and 2350 m, with an average temperature between 17.9°C and 12.6°C, and annual precipitation ranging from 790 to 1900 mm (ONERN 1976).

This bamboo species inhabits forests that are minimally to moderately disturbed by natural events or occasionally by extensive livestock farming, in forest gaps, and along roadsides with secondary forest. It is a conspicuous and sometimes dominant element of the humid montane forest subcanopy, often growing alongside one or two other bamboo species from genera such as *Aulonemia*, *Arthrostylidium* Ruprecht (1840: 117), or *Chusquea* Kunth (1822: 151) (especially *C. delicatula* Hitchcock (1927: 309), and *C. yungasensis* L.G.Clark & A.C.Mota in Mota *et al.* (2014: 212), or sometimes forming pure stands.

Thirteen populations were recorded, consisting of 1 to 30 clumps, although it can occasionally form extensive populations that dominate the undergrowth, such as one recorded on the Sillutinkara trail (PN-ANMI Cotapata), which is the largest known population to date.

Phenology:—In *Aulonemia insolita*, a distinctive flowering pattern was observed. The flowering event began in early 2013 and continued until the end of 2014. Initially, only one culm in three recorded populations had inflorescences. In the populations on the margins of the Ecovía path, the inflorescences were still immature, while in the population within the PN-ANMI Cotapata the inflorescences were already mature. By 2014, the flowering had become widespread; for instance, on the Sillutinkara trail (PN-ANMI Cotapata), all the culms in the recorded populations bore inflorescences, with many culms drooping, inclined, or strongly curved due to the weight of the fertile branches. By the end of that year, the culms began to die.

At the beginning of 2015, all the culms in the populations along the Ecovía path were dry, and by the end of that year, no seedlings had been recorded. However, three years after the end of the flowering event, in late 2017, numerous seedlings became evident in the PN-ANMI Cotapata, especially along the Sillutinkara trail.

In May 2024, the *Aulonemia insolita* population in Anexo Ocol, Molinopampa district, Amazonas department, Peru, began flowering. Some individuals were in bloom, and local people reported that the rest of the population would likely follow suit. They also mentioned that this species typically flowers every 7 to 10 years. The life cycle is believed to be about 10 years, which suggests that the Bolivian populations that flowered in 2014 should now be flowering in sync with the Peruvian populations, although this hypothesis could not be confirmed.



FIGURE 1. *Aulonemia insolita*. A. Rhizome. B. Culms. C. Culm leaves with erect leaf blade. D. Fimbriae present on sheath and blade of culm leaves. E. Inner ligule of culm sheath. F. Four short internodes showing buds. G. Internode showing hollow culm with uneven thickness wall. H. Internode filled with gelatinous substance. I. Large internode showing white lamellas irregularly distributed. Photos by Iván Jiménez-Pérez (B, D, F, G, I), Eduardo Ruiz-Sanchez (C), and Natalia Reategui (A, H).

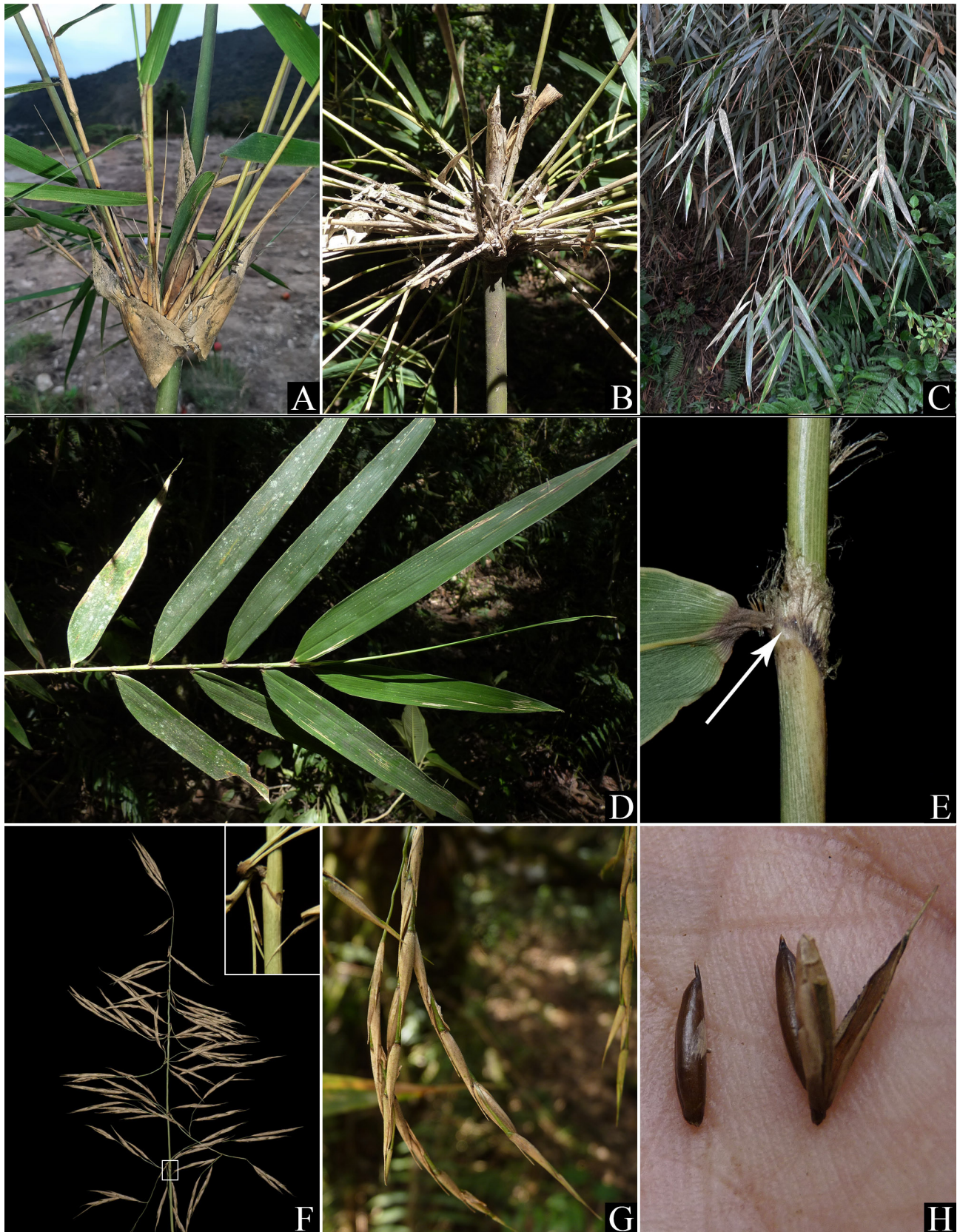


FIGURE 2. *Aulonemia insolita*. A. Intravaginal branch complement. B. Base of branch complement. C. Branch complement. D. Foliage leaf blades. E. Ligular region showing fimbriae at the summit sheath and lacinate outer ligule (white arrow). F. Paniculate synflorescence. Inset shows magnification of the basal bract below the first branch. G. Spikelet. H. Floret and caryopsis. Photos by Iván Jiménez-Pérez (B, D–H) and Eduardo Ruiz-Sánchez (A, C).



FIGURE 3. Close-up of the ligular region on a foliage leaf. The white arrow indicates the lacinate outer ligule. Photo by Iván Jiménez-Pérez.

Uses:—The authors recorded the use of the long internodes of this species by the community of Molinopampa in Amazonas, Peru. The locals peeled the cortex and wove it into baskets (Fig. 5). A study conducted by Arellano Valdivia (2018) in the PN-ANMI Cotapata evaluated the physical-mechanical properties of the wood of *Aulonemia insolita*. The culm wood of this species has a basic density of 0.44 g/cm³ and is classified as non-structural, with low resistance and soft wood (referring to woods that are generally easy to work with, more flexible, and suitable for general utility). These woods have potential uses in carpentry, furniture, decorative materials, and other applications. The common name of this species is reported as “Shua chica” according to McClure 21439 (US).

Additional specimens examined (paratypes):—BOLIVIA. **La Paz:** provincia Nor Yungas, Bajo Hornuni, subiendo 60 m altitudinales hacia el camino a la mina, 25° SE, 16°12'39"S, 67°53'13"W, 2000 m, 10 August 2002 (veg), *S. Beck* 28399 (LPB); *idem*, Parque Nacional Cotapata, sendero Chojllapata, 16°13'27.3"S, 67°52'07.6"W, 2382 m, 2 September 2012 (veg), *I. Jiménez* 5668 (LPB); *idem*, Ecovía, bajando desde Chuspipata, 16°16'15.3" S, 67°44'00.3"W, 2242 m, 5 March 2013 (veg, fl), *I. Jiménez* 5828 (LPB); *idem*, 16°17'08.0" S, 67°43'59.8"W, 2245 m,

5 March 2013 (veg, fl), *I. Jiménez 5834* (LPB); idem, Parque Nacional Cotapata, sendero Sillutinkara, 16°14'56.0"S, 67°53'28.9"W, 2305 m, 10 August 2014 (fl), *I. Jiménez 6433* (LPB). PERU: **Huánuco**: Pachitea, distrito Humari, tramo Tingo María a Huanuco, zona Carpish, 9°40'37.01"S, 76°4'49.45"W, 2346 m, 12 December 2022 (veg), *Damas-Parra et al. 19* (MOL); idem, tramo Tingo María a Huánuco, zona de recreo, Carpish, 9°40'31.39"S, 76°4'21.45"W, 2356 m, 12 December 2022 (veg), *Damas-Parra et al. 23* (MOL); From Carpish above the Priano tea plantation, hacienda Paty, 50 km north of Huanuco, 3 December 1945, *McClure 21439* (US). **Amazonas**: provincia Chachapoyas, Molinopampa distrito, sector Ocol, 6°14'35.52"S, 78°32'39.97"W, 2390 m, October 2019 (veg), *J. Díaz & A. Vite AM-001* (MOL).

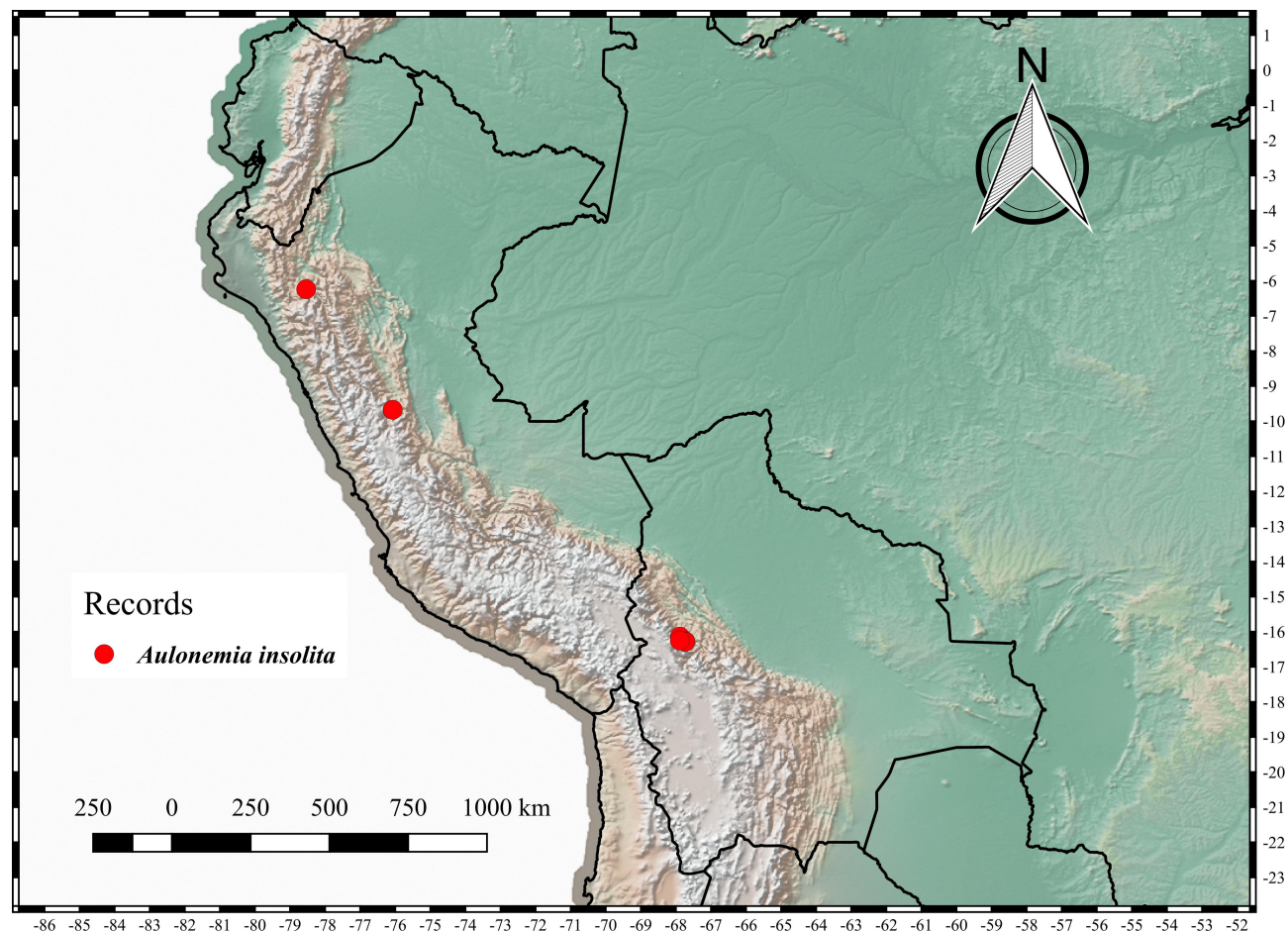


FIGURE 4. Geographical distribution of *Aulonemia insolita* (red circles).

Key to the species of *Aulonemia* with dimorphic internodes based on vegetative morphological features

1. Culm leaves with erect blades, culm sheath blade basally fimbriate; outer ligule of foliage leaf lacinate; foliage leaf abaxially covered with minute white trichomes..... *Aulonemia insolita*
- Culm leaves with reflexed blades; culm sheath blade fimbriae absent; outer ligule of foliage leaf entire or ciliate; foliage leaf abaxially glabrous or hirtellous2
2. Branch complement not rebranching; branch complements with 36–116 branches; few fimbriae on the apex of foliage leaf sheath (up to 4), these 1.1–1.6 cm long; foliage leaf blade 0.9–1.6(1.8) cm wide..... *Aulonemia hirtula*
- Branch complement rebranching; branch complements with 6–24 branches; numerous fimbriae (> to 4) in the apex and upper margin of the foliage leaf sheath, these 2–3.7 cm long; foliage leaf blade 2.3–5.0 cm wide.....3
3. Foliage leaves outer ligule ciliate, 0.4–0.5 mm long; foliage leaf blade abaxially hirtellous..... *Aulonemia herzogiana*
- Foliage leaves outer ligule lacerate, 5 mm long; foliage leaf blade abaxially glabrous.....*Aulonemia queko*

Key to the species of *Aulonemia* with dimorphic internodes based on reproductive morphological features

1. Synflorescence paniculate, slightly constricted, 11.5–15 cm long; glumes mucronate *Aulonemia hirtula*
- Synflorescence paniculate, open, 15–47 cm long; glumes aristate2
2. Glume III 5-nerved; lemmas 8–10 mm long, 5-nerved..... *Aulonemia insolita*
- Glume III 7-nerved; lemmas 10–12 mm long, 7-nerved.....3
3. Spikelets with three glumes followed with fertile florets; glume I 5-nerved *Aulonemia herzogiana*
- Spikelets with three glumes followed by a sterile lemma, then fertile florets; glume I 7-nerved.....*Aulonemia queko*



FIGURE 5. Handicrafts made of *Aulonemia insolita* culms at comunidad campesina de Taulia, anexo Ocol, Molinopampa, Chachapoyas, Peru. Photos by Raphael Paucar.

Discussion

Three atypical morphological features stand out in *Aulonemia insolita*: the presence of lamellae on the internal surface of the internodes (Fig. 11), foliage leaves with lacinate outer ligules (Figs. 2E, 3), and erect culm leaves (Fig. 1C). The presence of lamellae has been observed only in *Glaziophyton mirabile* Franchet (1889: 277) and *Arthrostylidium cachimboense* Lopes-Neto & Viana (2022: 104), two different genera within the subtribe Arthrostylidiinae, which exhibits unequal lengths of culm internodes and are endemic to Brazil. This is the first report of such membranes in the internodes of *Aulonemia* to date.

There were formerly three species with erect culm leaves included in *Aulonemia*: *A. setigera* (Hackel 1903: 73) McClure (1973: 58), *A. setosa* (Londoño & Clark 2002: 719) Viana & Filgueiras (2011: 104), and *A. ulei* (Hackel 1903: 75) McClure & Smith (1967: 57). Molecular analyses have revealed a distant relationship among these species and the *Aulonemia* + *Colanthesia* clade (Tyrrell *et al.* 2012, Jesus-Costa *et al.* 2024). Consequently, *A. setigera* and *A. setosa* were reclassified into new genera: *Stelanemia* Tyrrell *et al.* (2024: 18) and *Cambajuva ulei* (Hack.) Viana *et al.* (2013: 98) for *A. ulei* (Viana *et al.* 2013, Jesus-Costa *et al.* 2024). Jesus-Costa *et al.* (2024) suggest that reflexed leaf blades may be a consistent character for members of the *Aulonemia* + *Colanthesia* clade.

The outer ligule in Neotropical woody bamboos may consist solely of cilia (Judziewicz *et al.* 1999). In the Poaceae family, the outer or dorsal ligule exhibits three distinct morphologies: a stiff rim with no cilia, a membranous-ciliate structure, and a fringe of hairs (Edson-Chaves *et al.* 2023). A lacinate outer ligule (Figs. 2E, 3) is reported for the first time in woody bamboos.

TABLE 1. Morphological comparison between *Aulonemia insolita*, *A. herzogiana*, *A. hirtula*, and *A. queko*.

Character	<i>A. insolita</i>	<i>A. herzogiana</i>	<i>A. hirtula</i>	<i>A. queko</i>
Position of culm leaf blades	erect	reflexed	reflexed	reflexed
N° branch complements	15–42	9–24	36–116	70 to many
Foliage leaves outer ligule margin (types of ligule sensu Edson-Chaves <i>et al.</i> 2023)	llaciniate (type not included) or sometimes entire	ciliolate (membranous-ciliate)	entire (stiff rim with no cilia)	lacerate (medium ligule with lacerate apex)
Foliage leaves outer ligule length (mm)	1.5–5	0.4–0.5	0.4	5
Foliage leaves blade indument abaxial side	scabridulous	glabrous or hirsute	notably to sparsely hirsute, sometimes glabrous	glabrous
longest internode length (cm)	256	85	150	up to 90

Acknowledgements

We would like to thank Gilberto Fernández and Mayumi Tello for their help during the fieldwork carried out in Huánuco and Jover Diaz and Alex Vite from the National Forestry and Wildlife Service (SERFOR) in Amazonas, Peru. We also thank SERFOR, which supported financially the first collection of this specie in Peru. To Raphael Paucar Cárdenas for providing us with pictures of handicrafts made of *Aulonemia insolita*. In Peru, the first collection and specimen deposition was made possible by SERFOR in 2019. The field work in Bolivia was partially supported by the projects “Bases para el aprovechamiento sostenible de bambúes nativos del Parque Nacional y Área Natural de Manejo Integrado Cotapata” and “Investigación de aspectos biológicos para el aprovechamiento sostenible de bambúes nativos del Parque Nacional y Área Natural de Manejo Integrado Cotapata y alrededores”, both funded by the Impuesto Directo a los Hidrocarburos (IDH) of the Bolivian government given to the Universidad Mayor de San Andrés in La Paz. We sincerely thank Pedro Viana and an anonymous reviewer for their valuable comments on the manuscript.

References

- Arellano Valdivia, A.E. (2018) *Conocimiento del uso potencial de la madera de bambú (Aulonemia sp.) proveniente del Parque Nacional ANMI cotapata del departamento de La Paz-Bolivia*. Bachelor Thesis. Universidad Tecnológica Boliviana.
- Bach, K., Schawe, M., Beck, S., Gerold, G., Gradstein, S.R. & Moraes, M. (2003) Vegetación, suelos y clima en los diferentes pisos altitudinales de un bosque montano de Yungas, Bolivia: primeros resultados. *Ecología en Bolivia* 38: 3–14.
- Clark, L.G., Londoño, X., Tyrrell, C.D. & Judziewicz, E.J. (2020) Convergence strikes again in the Neotropical woody bamboos (Poaceae: Bambusoideae: Bambuseae): a new Andean genus and a new species. *Botanical Journal of the Linnean Society* 192: 21–33. <https://doi.org/10.1093/botlinnean/boz047>
- Edson-Chaves, B., da Silva, O.L.M., Clark, L.G. & Melo-de-Pinna, G.F. de A. (2023) The ligule in Poaceae: a historical and evolutionary review. *The Botanical Review* 89: 19–58. <https://doi.org/10.1007/s12229-022-09285-3>
- Franchet, M.A. (1889) Sur deux nouveaux genres de bambusées. *Journal de Botanique* 3: 277–281. [<https://www.biodiversitylibrary.org/page/2164468>]
- Gerold, G., Schawe, M. & Bach, K. (2008) Hydrometeorologic, Pedologic and vegetation Patterns along an Elevational Transect in the Montane Forest of the Bolivian Yungas. *Die Erde* 139: 141–168.
- Goudot, J. (1846) *Aulonemia*, nouveau genre de la tribu des Bambusées. *Annales des Sciences Naturelles (Botanique)* 3: 75–77.
- Hackel, E. (1903) Neue Gräser. *Oesterreichische Botanische Zeitschrift* 53: 67–76. [<https://www.biodiversitylibrary.org/page/28306631>]
- Herzog, T. (1921) Die von Dr. Th. Herzog auf seiner zweiten Reise durch Bolivien in den Jahren 1910 und 1911 gesammelten Pflanzen, Teil V. *Mededeelingen van 's Rijks-Herbarium* 40: 1–77.

- Hitchcock, A.S. (1927) The Grasses of Ecuador, Peru and Bolivia. *Contributions from the United States National Herbarium* 24: 291–556. [<https://www.jstor.org/stable/23492519>]
- Jesus-Costa, C. (2018) *Estudos filogenéticos moleculares e taxonômicos na subtribo Arthrostylidiinae (Poaceae: Bambusoideae: Bambuseae)*. PhD Thesis, Universidade Federal de Vicosa.
- Jesus-Costa, C., Tyrrell, C.D., Viana, P.L., Lobato Afonso, E.A., de Oliveira, L.O., Clark, L.G. & Santos-Gonçalves, A.P. (2024) A multi-locus plastid phylogeny of the Aulonemia clade (Poaceae: Bambusoideae: Bambuseae: Arthrostylidiinae) reveals three new genera of bamboo. *Systematic Botany* 49: 334–363. <https://doi.org/10.1600/036364424X17194277229638>
- Jiménez Pérez, I. (2016) Taxonomic identity of “Tocoro”, a large hollow bamboo from Yungas of Bolivia (Poaceae, Bambusoideae, Aulonemia). *Phytotaxa* 263: 68–72. <https://doi.org/10.11646/phytotaxa.263.1.8>
- Jiménez-Pérez, I. & Vinícius-Silva, R. (2023) A new Andean species of *Merostachys* Spreng. from Bolivia (Poaceae: Bambusoideae: Bambuseae): *Merostachys nigricans*. *Nordic Journal of Botany* 11: e04043. <https://doi.org/10.1111/njb.04043>
- Judziwicz, E.J., Clark, L.G., Londoño, X. & Stern, M.J. (1999) *American Bamboos*. Smithsonian Institution Press, Washington D.C., 392 pp.
- Kunth, K.S. (1822) Notice sur le genre Bambusa. *Journal de Physique, de Chimie, d'Histoire Naturelle et des Arts* 95: 148–151.
- Londoño, X. & Clark, L.G. (2002) A revision of the Brazilian bamboo genus *Eremocaulon* (Poaceae: Bambuseae: Guaduinae). *Systematic Botany* 27: 703–721. <https://doi.org/10.1043/0363-6445-27.4.703>
- Lopes-Neto, R.B. & Viana, P.L. (2022) Flora of the Serra Do Cachimbo (Eastern Amazon, Brazil): Bambusoideae (Poaceae), including the description of two new species. *Phytotaxa* 550: 99–129. <https://doi.org/10.11646/phytotaxa.550.2.2>
- McClure, F.A. & Smith, L.B. (1967) Gramíneas (Suplemento Bambúseas). In: Reitz, R. (Ed.) *Flora Ilustrada Catarinense*. Herbário Barbosa Rodrigues, Itajaí, pp. 1–78.
- McClure, F.A. (1973) Genera of bamboos native to the New World (Gramineae: Bambusoideae). *Smithsonian Contributions to Botany* 9: 1–148. <https://doi.org/10.5479/si.0081024X.9>
- Mota, A.C., Jiménez Pérez, I., Oliveira, R.P. & Clark, L.G. (2014) *Chusquea yungasensis* (Bambusoideae, Poaceae): a new species of woody bamboo from South America and the first record of subgenus *Rettbergia* in Bolivia. *Phytotaxa* 161: 211–218. <https://doi.org/10.11646/phytotaxa.161.3.4>
- ONERN (1976) *Mapa Ecológico del Perú. Guía explicativa*. Lima, Perú, 146 pp, lams. mapa.
- Paniagua-Zambrana, N., Maldonado-Goyzueta, C. & Chumacero-Moscoso, C. (2003) Mapa de vegetación de los alrededores de la Estación Biológica de Tunquini, Bolivia. *Ecología en Bolivia* 38 (1): 15–26.
- Pilger, R. (1921) Drei neue andine Gräser. *Repertorium Specierum Novarum Regni Vegetabilis* 17: 445–448. <https://doi.org/10.1002/fedr.19210171933>
- QGIS.org (2016) QGIS Geographic Information System. Open Source Geospatial Foundation Project. Available from: <http://qgis.org> (accessed 12 May 2024)
- Ruiz-Sanchez, E., Tyrrell, C.D., Carrillo-Reyes, P. & Nuño-Rubio, A.T. (2022) A striking new species of *Rhipidocladum* (Poaceae: Bambusoideae: Bambuseae: Arthrostylidiinae) with single, terminal-spikelet synflorescences, endemic to Jalisco, Mexico. *Plant Ecology and Evolution* 155: 417–424. <https://doi.org/10.5091/plecevo.86519>
- Ruiz-Sanchez, E., Tyrrell, C.D., Londoño, X., Oliveira, R.P. & Clark, L.G. (2021a) Diversity, distribution, and classification of Neotropical woody bamboos (Poaceae: Bambusoideae) in the 21st Century. *Botanical Sciences* 99: 198–228. <https://doi.org/10.17129/botsci.2722>
- Ruiz-Sanchez, E., Tyrrell, C.D. & Vigosa-Mercado, J.L. (2021b) An overlooked new endemic species of *Rhipidocladum* (Poaceae: Bambusoideae: Bambuseae: Arthrostylidiinae) from Mexico. *Systematic Botany* 46: 333–328. <https://doi.org/10.1600/036364421X16231782047569>
- Ruprecht, F.J.I. (1840) Bambuseas. Mémoires de l'Académie impériale des sciences de St.-Petersbourg. 6e série. *Sciences mathématiques, Seconde partie. Sciences naturelles* 5: 91–166.
- Soderstrom, T.R. & Young, S.M. (1983) A guide to collecting bamboos. *Annals of the Missouri Botanical Garden* 70: 128–136. <https://doi.org/10.2307/2399010>
- Sprengel, K.P.J. (1825) *Systema Vegetabilium. Ed. 16. Vol. 1. Librariae Dieterichianae*, Gottingen, 992 pp. <https://doi.org/10.5962/bhl.title.822>

- Thiers, B. (2024) *Index Herbariorum*: A global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. Available from: <http://sweetgum.nybg.org/science/ih/> (accessed 12 May 2024)
- Tyrrell, C.D., Londoño, X., Prieto, R.O., Attigala, L., McDonald, K. & Clark, L.G. (2018) Molecular phylogeny and cryptic morphology reveal a new genus of West Indian woody bamboo (Poaceae: Bambusoideae: Bambuseae) hidden by convergent character evolution. *Taxon* 67: 916–930.
<https://doi.org/10.12705/675.5>
- Tyrrell, C.D., Santos-Gonçalves, A.P., Londoño, X. & Clark, L.G. (2012) Molecular phylogeny of the arthrostylidioid bamboos (Poaceae: Bambusoideae: Bambuseae: Arthrostylidiinae) and new genus *Didymogonyx*. *Molecular Phylogenetics and Evolution* 65: 136–148.
<https://doi.org/10.1016/j.ympev.2012.05.033>
- Viana, P.L., Filgueiras, T.S. & Paiva, E.A.S. (2011) A new combination in *Aulonemia* (Poaceae: Bambusoideae: Bambuseae) based on floral analysis, anatomical features, and distribution. *Brittonia* 63: 102–112.
<https://doi.org/10.1007/s12228-010-9138-0>
- Viana, P.L. & Filgueiras, T.S. (2014) Three new species of *Aulonemia* (Poaceae: Bambusoideae) from the Brazilian Atlantic rainforest. *Phytotaxa* 156: 235–249.
<https://doi.org/10.11646/phytotaxa.156.4.6>
- Viana, P.L., Filgueiras, T.S. & Clark, L.G. (2013) *Cambajuva* (Poaceae: Bambusoideae: Bambuseae: Arthrostylidiinae), a new woody bamboo genus from southern Brazil. *Systematic Botany* 38: 97–103.
<https://doi.org/10.1600/036364413X662097>
- Vinicius-Silva, R., Clark, L.G., Fregonezi, J.N. & Santos-Gonçalves, A.P. (2021) Two new species of *Merostachys* (Poaceae: Bambusoideae: Bambuseae) from the Brazilian Atlantic Forest in the states of Espírito Santo and Minas Gerais. *Brittonia* 73: 167–177.
<https://doi.org/10.1007/s12228-020-09642-9>