



## Taxonomic revision of *Elaphoglossum* subsection *Muscosa* (Dryopteridaceae)

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### Key words

ferns  
floristics  
pteridophytes  
taxonomy

**Abstract** The present paper provides a monograph of *Elaphoglossum* subsect. *Muscosa*, a monophyletic group supported by molecular phylogenetic analyses. The monograph includes keys, full synonymy, descriptions, representative specimens examined, an index to collectors' names and numbers, illustrations, spore photomicrographs, and distribution maps for all species. Morphologically, the subsection is recognized by scaly rhizomes, petioles and laminae, obtuse leaf apices, and spores that are about twice as long as in other species of *Elaphoglossum*. Fifteen species of subsect. *Muscosa* are here recognized, with no subspecies or varieties. All of the species are Neotropical occurring from southern Mexico to Bolivia and Southeastern Brazil, with three species in the West Indies. Most of the species occur in the Andes from 1500–4000 m, primarily in cloud forests and páramos. Three new species are described: *E. novogranatense*, *E. oreophilum*, and *E. quisqueyanum*. The name *E. glabrescens* A. Vasco, nom. & stat. nov. is proposed. Lectotypes are designated for *E. aschersonii*, *E. bellermannianum*, *E. blandum*, *E. caulolepis*, *E. corderoanum*, *E. decipiens*, *E. ellipsoideum*, *E. engelii*, *E. gardnerianum*, *E. lehmannianum*, *E. muscosum*, *E. viscidulum*, *E. yarumalense*, and *E. yatesii*.

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### INTRODUCTION

*Elaphoglossum* Schott ex J.Sm. (*Dryopteridaceae*) is one of the most species-rich genera of ferns with nearly 600 species (Mickel 1990). It is pantropical and most diverse in the Neotropics where about 450 described species occur (Mickel 1990). Morphologically most species of *Elaphoglossum* can be easily distinguished from other fern genera by their simple entire leaves, acrostichoid sori, transversely elongated ventral meristele in the rhizomes, dimorphic fertile and sterile leaves, and free veins. The monophyly of the genus and its placement within *Dryopteridaceae* have received strong support from several molecular phylogenetic studies (Rouhan et al. 2004, Liu et al. 2007, Schuettpelz & Pryer 2007, Moran et al. 2010).

There have been several attempts to split *Elaphoglossum* into subgroups to make it more manageable taxonomically (Fée 1845, Sodiro 1893, Christ 1899, Mickel & Atehortúa 1980). The most recent and comprehensive of these (Mickel & Atehortúa 1980) recognized nine sections and 21 subsections. More recently, phylogenetic molecular analyses have shed some light on relationships within *Elaphoglossum* (Rouhan et al. 2004, Skog et al. 2004) and supported five of the nine sections originally proposed by Mickel & Atehortúa (1980) on the basis of morphology.

At the species level, the morphological similarity of *Elaphoglossum* species continues to hinder the recognition of small natural groups within the genus. As a consequence, taxonomic revision within the genus has been slow. The only monographic treatment of the genus is that by Christ (1899), which included 142 species – all those known at the time. Over the past 25 years there have been many regional or country-wide floristic studies, such as for Mexico (Mickel & Smith 2004), Mesoamerica (Mickel 1995a), Venezuela (Mickel 1995b), Peru (Mickel 1991), the Mascarene Islands (Lorenz & Rouhan 2004), and French

Polynesia (Rouhan et al. 2008). Yet no monographic treatments either of the entire genus or of natural small groups within it were published until 2009 (Vasco et al. 2009b).

The present monograph resulted from an effort to use chloroplast-DNA data to find clades of convenient size for monographic study within *Elaphoglossum* sect. *Lepidoglossa* Christ (Vasco et al. 2009a, Vasco & Moran in prep.). This section was recognized on the basis of morphology by Mickel & Atehortúa (1980) and recovered in the molecular phylogenetic analyses of Rouhan et al. (2004) and Skog et al. (2004). Section *Lepidoglossa* contains species with blades covered mostly or entirely by flat scales with acicular marginal teeth (all other *Elaphoglossum* species have laminar scales with marginal teeth consisting of glandular or bulbous marginal cells or gland-tipped marginal processes), veins ending at or close to the margin but not ending in hydathodes, and phyllospadix. The monophyly of sect. *Lepidoglossa* was further supported by the molecular phylogenetic analysis of Vasco & Moran (in prep.). This study recovered 13 monophyletic clades within the section, some of which with suitable sizes for monographic study. Two of those clades were selected for monographic revision: the *Elaphoglossum ciliatum* clade (Vasco et al. 2009b), and *Elaphoglossum* subsect. *Muscosa* Mickel & Atehortúa, the subject of the present paper.

### Taxonomic history of *Elaphoglossum* subsection *Muscosa*

Fée (1845) was the first to present a treatment of *Elaphoglossum* (as *Acrostichum*). He knew only two species that are now recognized in subsect. *Muscosa*: *A. muscosum* Sw. and *A. gardnerianum* Kunze. These he placed within his scaly group, *Polylepidae*. Under the name *Acrostichum*, Sodiro (1893) cited four species of the ones currently recognized in subsect. *Muscosa* from Ecuador: *A. bellermannianum* Klotzsch, *A. corderoanum* Sodiro, *A. muscosum* Sw., and *A. yatesii* Sodiro. These he placed in the group *Polylepida*, along with all species with densely scaly blades. Christ (1899) placed most of the species

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that are here recognized as part of the subsect. *Muscosa* in his “Ordo” *Stenoneura* (plants lacking hydathodes), “Sectio” *Lepidoglossa*, “Subsectio” *Polylepidea*, “Divisio” *Muscosa* and *Bellermanniana*. In his “Divisio” *Muscosa* he included *E. muscosum* (Sw.) T.Moore, *E. cuspidatum* (Willd.) T.Moore, *E. lepidotum* (Willd.) J.Sm., and *E. tomentosum* (Bory) T.Moore (the three last species do not belong to subsect. *Muscosa* as recognized here, but were included in the “Divisio” by Christ because of their short-ciliate blade scales). The bulk of the species that are here recognized as part of subsect. *Muscosa* were placed by Christ within his “Divisio” *Bellermanniana*: *E. bellermannianum* (Klotzsch) T.Moore, *E. corderoanum* (Sodiro) Christ, *E. engelii* (H.Karst.) Christ, *E. lehmannianum* Christ, and *E. yatesii* (Sodiro) Christ. Christ (1899) placed *E. gardnerianum* (Kunze ex Féé) T.Moore within the “Ordo” *Condyloneura* (species with hydathodes), “Sectio” *Gymnoglossa*, “Subsectio” *Pilosa*, “Divisio” *Gardneriana*. This placement seems strange and was probably due to the fact that Christ did not see the type of this species (although he cites some collections from Brazil that correspond to *E. gardnerianum*). Mickel & Atehortúa (1980) recognized and formally described subsect. *Muscosa*, including within it nine species: *E. aschersonii* Hieron., *E. bellermannianum*, *E. blandum* Rosenst., *E. corderoanum*, *E. decipiens* Hieron., *E. engelii*, *E. lehmannianum*, *E. muscosum*, and *E. platicatum* (Cav.) C.Chr. (this last species does not belong to subsect. *Muscosa* as circumscribed by this study). They stated that some of Christ’s groups, including “Divisio” *Gardneriana*, were of unknown relationships with their subsections. This was again probably because they did not have access to the type of this last species and were following Christ’s opinion.

## MATERIAL AND METHODS

This study is based on an examination of over 2400 herbarium sheets which represent approximately 1200 individual collections borrowed from 35 herbaria (see Acknowledgements). For most of the specimens, geographic coordinates were estimated using geographical gazetteers because this information was often not provided on the labels. These coordinates were used to make dot distribution maps for the species and are given in brackets for the herbarium specimens cited below. Illustrations and spore microphotographs were prepared from herbarium specimens for all species. Fieldwork was carried out in Colombia, Venezuela, and Costa Rica.

The descriptions and comments for the species included in this monograph are available at the “*Elaphoglossum Pages*” at <http://sweetgum.nybg.org/elaphoglossum/index.php>. Also given is information on all specimens examined (also available from

the author upon request), photographs of all the types and of selected specimens, copies of all protogues, and additional spore microphotographs.

## RESULTS

Fifteen species are here recognized (see Identification List), of which three are described as new (*E. novogranatense*, *E. oreophilum*, and *E. quisqueyanum*), and one is a new name and status (*E. glabrescens*). Additionally 12 lectotypes are designated. No infraspecific taxa are recognized. The 15 recognized species are provided with a key, described, discussed, and illustrated below. A synopsis of their distributions is given in Table 1. A list of collectors and their numbers for all examined specimens is given in the Identification List.

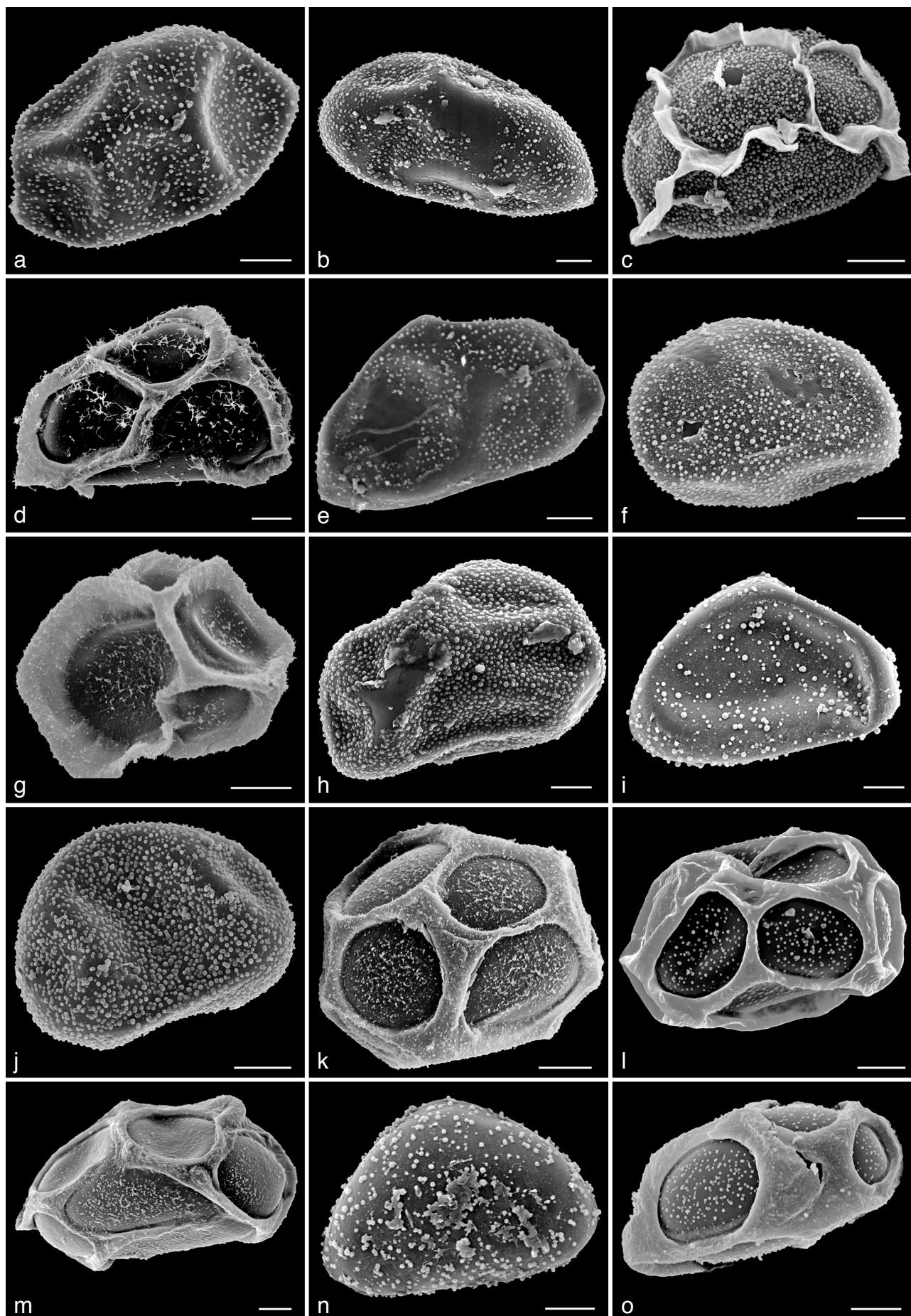
### Morphology

*Elaphoglossum* subsect. *Muscosa* comprises small to medium-size ferns that are often covered by different types of scales. Species of the group are distinguished by a tendency to have obtuse leaf apices (never long-acuminate as in nearly all other species of sect. *Lepidoglossa*) and papillate spores about twice as long (more than 70 µm) as in other species of *Elaphoglossum* (Fig. 1). The only exception is *E. engelii*, which has irregular deposits instead of papillate spores (Fig. 1d). Other morphological characters that distinguish subsect. *Muscosa* but that also occur either in its sister group *Elaphoglossum* subsect. *Petiolosa* (Vasco & Moran in prep.) or in other species of sect. *Lepidoglossa* are broad, flat (i.e. not subulate) scales on the rhizomes and leaves, and green spores. Most species of the subsection vary greatly in size and scale density. Given this, the more consistent characteristics of morphology of scales and spores are emphasized in the keys and comparative discussions included in this revision.

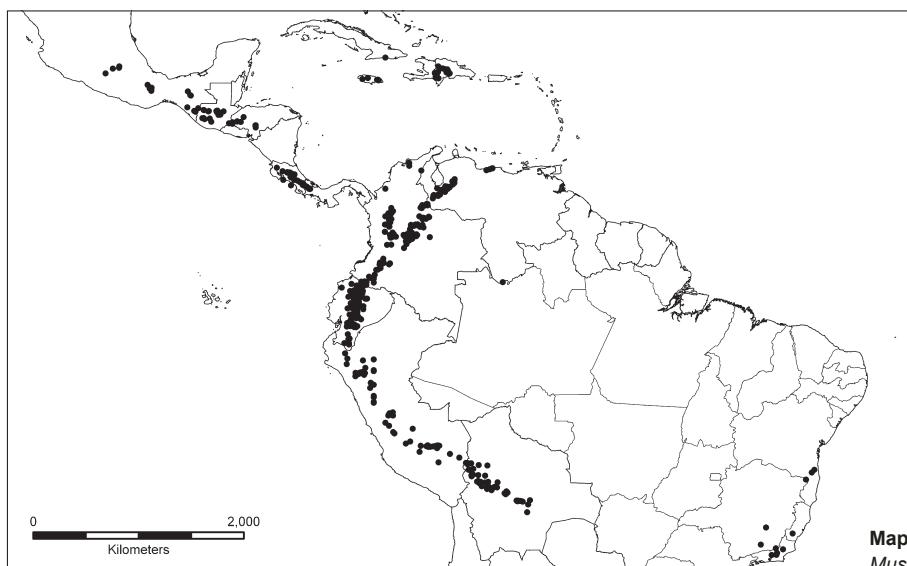
Scales in subsect. *Muscosa* are important for distinguishing species. Usually, on a single plant, the scales differ on the rhizomes, petioles, abaxial and adaxial laminae, lamina costae, and fertile laminae, but there is a continuum from scales on the rhizomes to petioles to blades. Thus, the best place to look for the scales is in the middle of each structure. In the key, descriptions, and discussions, the petiole scales are divided into two categories: large and small. This division is artificial and was made only for the purpose of describing the two extremes of scale morphology on the petiole, which are generally different. Nevertheless, there is a continuum between these larger and smaller scales, and usually all intermediate morphologies can be found on a single plant. In the descriptions the term imbricate means that the surface of the lamina is obscured by the

**Table 1** Distribution of *Elaphoglossum* subsect. *Muscosa* species by country.

Bolivia	4 species	<i>bellermannianum</i> , <i>engelii</i> , <i>glabrescens</i> , <i>ruficomum</i> .
Brazil	2 species	<i>gardnerianum</i> , <i>muscosum</i>
Colombia	8 species	<i>aschersonii</i> , <i>bellermannianum</i> , <i>engelii</i> , <i>laxisquama</i> , <i>lehmannianum</i> , <i>novogranatense</i> , <i>oreophilum</i> , <i>yatesii</i> .
Costa Rica	3 species	<i>bellermannianum</i> , <i>engelii</i> , <i>lehmannianum</i> .
Cuba	1 species	<i>muscosum</i> .
Dominican Republic	3 species	<i>bellermannianum</i> , <i>muscosum</i> , <i>quisqueyanum</i> .
Ecuador	9 species	<i>aschersonii</i> , <i>bellermannianum</i> , <i>corderoanum</i> , <i>engelii</i> , <i>laxisquama</i> , <i>lehmannianum</i> , <i>novogranatense</i> , <i>oreophilum</i> , <i>yatesii</i> .
El Salvador	1 species	<i>muscosum</i> .
Guatemala	2 species	<i>engelii</i> , <i>muscosum</i> .
Haiti	1 species	<i>muscosum</i> .
Honduras	1 species	<i>muscosum</i> .
Jamaica	1 species	<i>muscosum</i> .
Mexico	2 species	<i>engelii</i> , <i>muscosum</i> .
Panama	2 species	<i>bellermannianum</i> , <i>lehmannianum</i> .
Peru	5 species	<i>bellermannianum</i> , <i>engelii</i> , <i>laxisquama</i> , <i>oculatum</i> , <i>ruficomum</i> .
Venezuela	4 species	<i>aschersonii</i> , <i>bellermannianum</i> , <i>engelii</i> , <i>lehmannianum</i> .



**Fig. 1** Spores of *Elaphoglossum* subsect. *Muscosa*. a: *E. aschersonii*; b: *E. bellermannianum*; c: *E. corderoanum*; d: *E. engelii*; e: *E. gardnerianum*; f: *E. glabrescens*; g: *E. laxisquama*; h: *E. lehmannianum*; i: *E. muscosum*; j: *E. novogranatense*; k: *E. oculatum*; l: *E. oreophilum*; m: *E. quisqueyanum*; n: *E. ruficomum*; o: *E. yatesii* (a: Moran 7645, NY; b: Meier 302, NY; c: Holm-Nielsen 3260, AAU; d: Sánchez 465, US; e: Wacket 186, UC; f: Buchtien 2725, US; g: Vásquez 28162, NY; h: Ruiz-Terán 976, NY; i: Underwood 3212, NY; j: Vasco 746, NY; k: Hutchison 1629, UC; l: Holm-Nielsen 19071, AAU; m: Zanoni 20917, NY; n: Sagástegui 12091, NY; o: Navarrete 1402, NY). — Scale bars = 10 µm.



**Map 1** General distribution of *Elaphoglossum* subsect. *Muscosa*.

scales. In describing the scale margin, I followed the terminology presented by Lellinger (2002).

The perispore distinguishes species within the subsection. The presence (Fig. 1k) or absence (Fig. 1a) of perisporal ridges is easy to determine if spores are put under a light microscope, and with an experienced eye even under a good dissecting microscope. The presence of irregular deposits (Fig. 1d) vs papillae (Fig. 1c) is almost impossible to distinguish without the SEM. Both spore characters are included in the key, but neither is essential to key out the species. In most cases, the key can be used with specimens lacking fertile leaves. The descriptions do not repeat the characteristics that are constant for the subsection.

### Geography

*Elaphoglossum* subsect. *Muscosa* is a Neotropical group of species distributed from southern Mexico to Bolivia and Southeastern Brazil, with three species in the West Indies (Map 1). Most species of subsect. *Muscosa* occur in the Andes from Venezuela to Bolivia, from 1500–4000 m, primarily in cloud forests and páramos. The subsection is absent from Amazonia and the lowlands of Bolivia, Brazil, Colombia, Ecuador, Peru, and Venezuela.

### TAXONOMIC TREATMENT

#### *Elaphoglossum* subsect. *Muscosa* Mickel & Atehortúa

*Elaphoglossum* subsect. *Muscosa* Mickel & Atehortúa (1980) 62. — Type: *Acrostichum muscosum* Sw. [= *Elaphoglossum muscosum* (Sw.) T.Moore].

Plants epiphytic, terrestrial or saxicolous. Rhizome short- to long-creeping, erect or compact; rhizome scales orange to dark brown, basally attached (sometimes appearing peltate because of the large auricles), entire to long-ciliate, marginal teeth acicular. Sterile leaves (4.5–)10–55(–63) cm long, approximate to 2 cm apart, erect; phylloodia present (sometimes obscured by the petiole base); petiole scaly, scales flat, marginal teeth acicular; lamina simple, linear-lanceolate to oblanceolate, base broadly cuneate to rounded, apex obtuse (less frequent acute); veins free, simple to 2-forked; hydathodes absent; laminar scales frequently different from those of the rhizomes or the petioles, abundant to scattered, base sessile or stalked, marginal teeth acicular. Fertile leaves longer, with narrower blades, and proportionally with longer petioles than the sterile leaves; intersporangial scales generally present. Spores (55–)70–90 µm, monolete, green, with papillae or irregular deposits.

### Key to the species of

#### *Elaphoglossum* subsection *Muscosa*

1. Larger petiole scales ciliate, the teeth well differentiated from the body, often as long as or longer than the width of the scale (especially in the distal half of the scale) ..... 2
1. Larger petiole scales entire, denticulate, erose, or laciniate, the teeth when present often shorter than the width of the scale (especially in the distal half of the scale) ..... 9
2. Petioles 1/6–1/3 the length of the sterile leaves. — Brazil ..... 5. *E. gardnerianum*
2. Petioles 2/5–2/3 the length of the sterile leaves. — Guatemala, Costa Rica, Dominican Republic, Venezuela, Colombia, Ecuador, Peru, Bolivia ..... 3
3. Abaxial laminar scales present, funnel-shaped throughout (without flattened body), patent, the base inrolled; petiole and laminar scales of the sterile and fertile leaves when bicolorous with dark apex (including the cilia) and lighter base and point of attachment ..... 7. *E. laxisquama*
3. Abaxial laminar scales present or absent, when present round, ovate, oblanceolate, or lanceolate with the body flat, slightly elevated above the surface of the lamina, the base cordate or stalked; petiole and laminar scales of the sterile and fertile leaves when bicolorous mottled or with dark centre or point of attachment, and lighter margin and cilia (those never darker than the centre of the scale) ..... 4
4. Abaxial laminar scales absent or present but not imbricate ..... 5
4. Abaxial laminar scales present, imbricate ..... 6
5. Abaxial costal scales pointing forward to the apex or at right angles, slightly elevated, orange to dark-brown or mottled with lighter margin or darker at the point of attachment; intersporangial scales absent ..... 6. *E. glabrescens*
5. Abaxial costal scales pointing forward to the apex, not elevated, dark-brown to black; intersporangial scales present ..... 10. *E. novogranatense*
6. Rhizomes compact; spores without ridges ..... 14. *E. ruficomum*
6. Rhizomes short- to long-creeping; spores with ridges ..... 7
7. Rhizome scales denticulate; abaxial costal scales pointing forward to the apex, becoming spreading towards the base, not elevated, always darker and very well differentiated from the laminar scales ..... 12. *E. oreophilum*
7. Rhizome scales denticulate to more commonly ciliate; abaxial costal scales pointing forward to the apex or more typi-

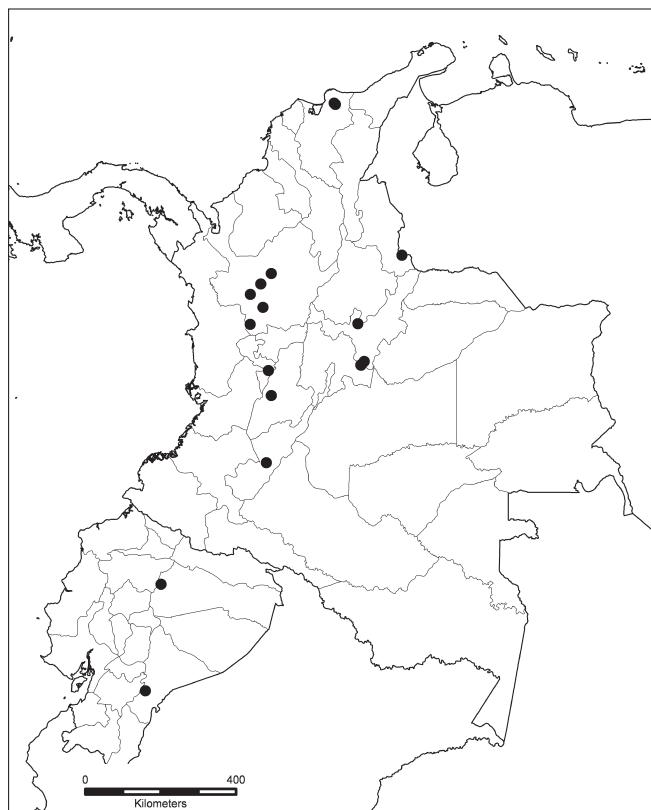
- cally at right angles, slightly elevated, generally the same colour or slightly darker than the laminar scales ..... 8
8. Rhizome scales ciliate, cilia up to 0.4 mm long; spores with irregular deposits. — Central and South America ..... 4. *E. engelii*
8. Rhizome scales denticulate to ciliate, cilia up to 0.6 mm long; spores papillate. — Dominican Republic ..... 13. *E. quisqueyanum*
9. Rhizome scales denticulate to ciliate, teeth numerous, 0.2–0.6 mm long ..... 13. *E. quisqueyanum*
9. Rhizome scales entire to denticulate, teeth absent to sparse, less than 0.2 mm long ..... 10
10. Rhizomes long-creeping; leaves 1–2 cm apart ..... 11
10. Rhizomes compact, erect, or short-creeping; leaves approximate to 1 cm apart ..... 12
11. Rhizomes 3–5 mm wide; petiole and abaxial laminar scales with the cells of the body differentiated with the central portion formed of irregular, isodiametric cells, and the broad border formed of elongated cells that have their long axis perpendicular to that of the scale (use magnification), laciniate to long-ciliate ..... 12. *E. oreophilum*
11. Rhizomes 1–3 mm wide; petiole and abaxial laminar scales with isodiametric cells, erose to ciliate ..... 15. *E. Yatesii*
12. Abaxial laminar scales (at least some) highly dissected, the cilia longer than the width of the scale; larger petiole scales oblanceolate to ovate; spores papillate, ridged ..... 13
12. Abaxial laminar scales absent or present, when present, lanceolate to round (without well-developed cilia), when ciliate, the cilia as long as or less than the width of the scale; larger petiole scales linear-lanceolate to lanceolate; spores papillate, without ridges ..... 14
13. Laminar scales 0.5–2.5 mm; abaxial costal scales light-brown. — Ecuador ..... 3. *E. corderoanum*
13. Laminar scales 0.2–0.5 mm; abaxial costal scales dark-brown or mottled with white margin. — Peru ..... 11. *E. oculatum*
14. Abaxial costal scales oblanceolate to round; abaxial laminar scales absent to scattered, when present never obscuring the surface of the laminae; small petiole scales not obscured by the larger ones, not imbricate; phylloodia easily seen, not obscured by the basal petiole scales ..... 1. *E. aschersonii*
14. Abaxial costal scales lanceolate to round; abaxial laminar scales absent to dense, when present sometimes obscuring the surface of the laminae; small petiole scales mostly obscured by the larger ones, imbricate; phylloodia usually obscured by the petiole-base scales ..... 15
15. Abaxial costal scales of sterile and fertile leaves mostly basally sessile, thus the scale body not elevated above the surface of the lamina; rhizome scales with acuminate apex; petiole and laminar scales usually bicolorous or mottled with white margin ..... 2. *E. bellermannianum*
15. Abaxial costal scales of sterile and fertile leaves mostly basally stalked, thus the scale body elevated above the surface of the lamina; rhizome scales with filiform apex (often broken); petiole and laminar scales usually concolorous, when bicolorous only darker at the point of attachment ..... 16
16. Rhizome scales orange to dark-brown, denticulate, the teeth 0.1–0.2 mm long. — Costa Rica, Panama, Venezuela, Colombia, Ecuador ..... 8. *E. lehmannianum*
16. Rhizome scales reddish orange, entire or occasionally denticulate, the teeth when present less than 0.1 mm long. — Mexico, Guatemala, Honduras, El Salvador, Cuba, Jamaica, Haiti, Dominican Republic, Brazil ..... 9. *E. muscosum*

**1. *Elaphoglossum aschersonii* Hieron.** — Fig. 1a, 2; Map 2

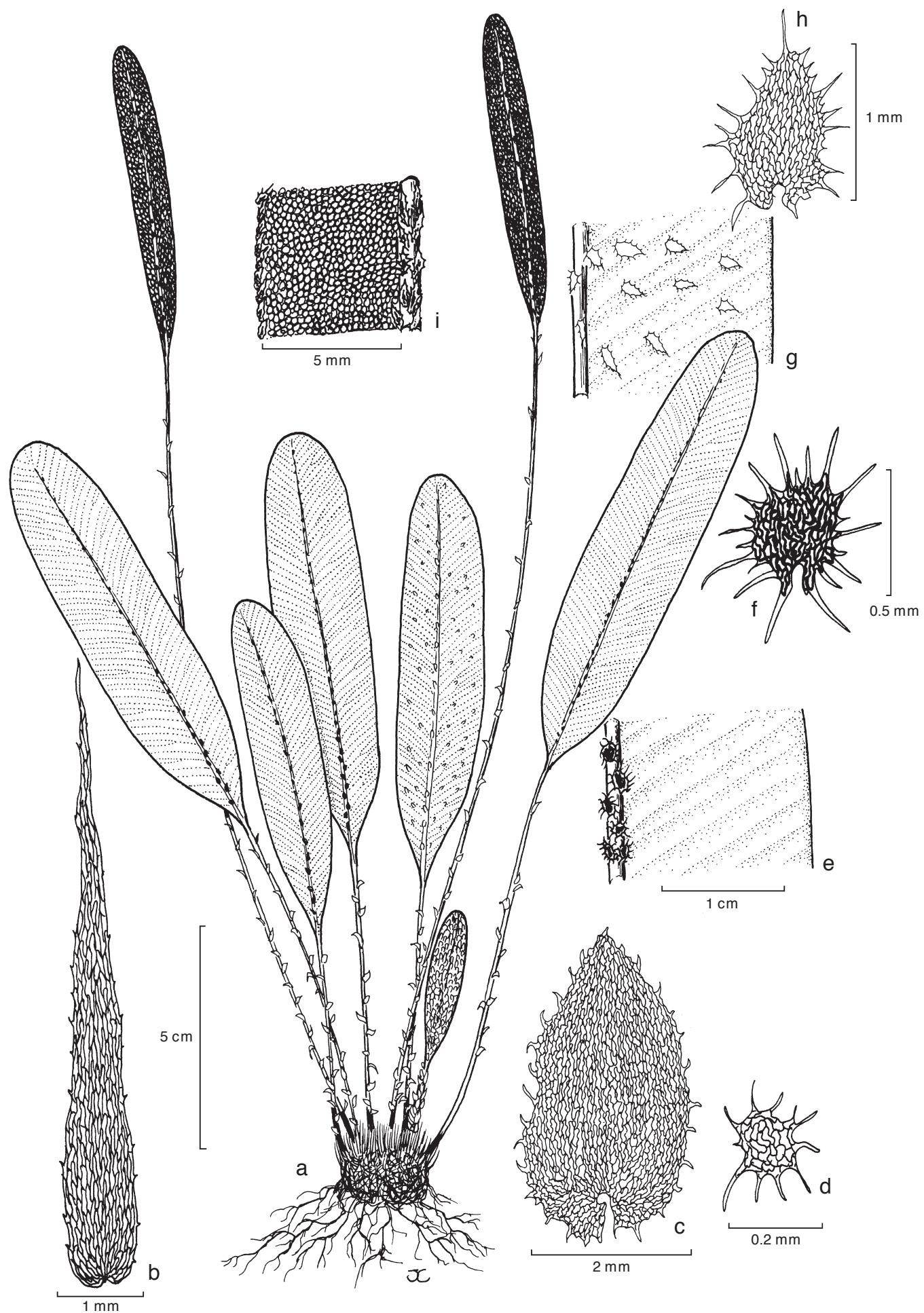
*Elaphoglossum aschersonii* Hieron. (1905) 555. — Type: Lehmann 5074 (lecto B, designated here; iso F, GH, US), Colombia, Cauca, auf Bäumen in parkartigen Wäldern auf dem Hochland von Popayán, 1600–1800 m, s.d.

*Elaphoglossum drewianum* Mickel (1987) 318, f. 3a–c. — Type: Steyermark et al. 101131 (holo NY; iso VEN), Venezuela, Apure, a lo largo del Río Talco (Oira) y sus afluentes, en páramo entre Alto de Cruces y Tierra Negra, Páramo de Pata de Judío, en la frontera Colombo-Venezolana, 30 km al S de San Vicente de la Revancha, 32 km al S de Alquitrana, SE del Páramo del Tamá, SW de Santa Ana, [7°23'N, 72°23'W], 3000–3200 m, 19 Jan. 1968.

Plants epiphytic. Rhizome 4–6 mm wide, compact and erect; rhizome scales 4–7 mm long, linear-lanceolate, orange to brown, subentire, with small teeth, base truncate to cordate, apex acuminate to filiform. Sterile leaves 15–37 cm long, approximate; phylloodia present, not obscured by the petiole-base scales; petiole 7–18 cm long, 3/7–3/5 the length of the sterile leaves; larger petiole scales 3–5.5 mm long, scattered to dense, spreading, lanceolate, light brown to dark brown, or mottled, always darker at the point of attachment, margin lighter, erose, base cordate, apex acute; smaller petiole scales 0.2–1.5 mm long, dense, not imbricate, appressed, oblanceolate to round, light brown to black, or mottled, darker at the point of attachment, margin lighter, erose to ciliate, base cordate, apex acute; lamina 8–19 by 2.3–4 cm, oblanceolate to obovate, chartaceous, glabrescent with age, base broadly cuneate to truncate, apex obtuse; veins 1–2 mm apart, at an angle of 70° with respect to the costa; adaxial laminar scales 1–1.5 mm long, scattered, oblanceolate to round, white to dark brown, sometimes darker along the costa, ciliate, base cordate, apex acute; abaxial laminar scales 0.2–1 mm long, absent to scattered, not elevated above the surface of the lamina, oblanceolate to round, light brown to dark brown or mottled, darker at the point of attachment, margin lighter, ciliate, base cordate, apex acute; abaxial costal scales 0.2–1.5 mm long, dense, not imbricate, appressed, oblanceolate to round, dark



Map 2 Distribution of *Elaphoglossum aschersonii* Hieron.



**Fig. 2** *Elaphoglossum aschersonii* Hieron. a. Habit; b. rhizome scale; c. larger petiole scale; d. smaller petiole scale; e. abaxial laminar surface; f. abaxial costal scale; g. adaxial laminar surface; h. adaxial laminar scale; i. fertile lamina (a–h: Atehortúa 1240; a (fertile leave) and i: Callejas 6412, all HUA).

brown to black or mottled, sometimes with lighter margin, erose to ciliate, base cordate to short-stalked, apex acute; *marginal scales* 0.5–1 mm long, dense, not elevated above the surface of the lamina, oblanceolate to round, light brown, erose to ciliate, base cordate to short-stalked, apex acute. *Fertile leaves* longer than the sterile leaves; *petiole* 3/5–5/7 the length of the fertile leaves; *petiole scales* same as the ones of the sterile leaves; *lamina* 6–16 by 0.8–1.5 cm, narrowly elliptic to elliptic, coriaceous, glabrescent with age, base broadly cuneate, apex obtuse; *adaxial laminar scales* 0.5–1.5 mm long, dense, imbricate, oblanceolate to round, light brown to dark brown, sometimes darker along the costa, ciliate, base cordate, apex acute; *abaxial costal scales* 0.5–2 mm long, dense, imbricate, appressed, oblanceolate to round, light brown to black or mottled, sometimes with lighter margin, erose to ciliate, base cordate, apex acute; *intersporangial scales* 0.5–1 mm long, scattered, oblanceolate, orange, ciliate, base cordate, apex acute. *Spores* papillate, without ridges.

**Distribution** — Colombia, Venezuela, Ecuador; 1500–3200 m. Epiphytic in montane forests.

**Selection of other specimens examined.** COLOMBIA, Antioquia, Mun. Urrao, carretera entre Urrao y Caicedo, sitio El Chuscal, cerca al Páramo de Frontino, paraje conocido como El 15, [6°27'N, 76°46'W], 2900 m, 17 May 1985, Atehortúa et al. 1240 (HUA); an Bäumen in mäßig geschlossenen Gebirgswäldern über La Ceja und am Río de Piedras, [6°42'N, 75°45'W], 2500 m, 20 Sept. 1883, Lehmann 3084 (B-20 0069845, syntype of *E. aschersonii*). Boyacá, Mun. Arcabuco, vereda Peñas Blancas, hacienda Las Delicias, [5°45'N, 73°26'W], 2600 m, 11 May 1996, Fernández-Alonso et al. 14130 (COL, HUA). CALDAS, Mun. Manizales, Monteleón, Cordillera Central, 2250 m, 8 Sept. 1984, De Fraume 262 (HUA). CAUCA, bei 'Los Motilones' Westgehänge des Sotará, 3000 m, 21 Feb. 1884, Lehmann 3676 (B-20 0069844, syntype of *E. aschersonii*); forests of Río Huangubio in highlands of Popayán, 1700–2000 m, May 1886, Lehmann BT873 (NY, US). CUNDINAMARCA, Monte Redondo, 1700–2000 m, 15 July 1953, Idrobo 1491 (COL, NY, US). MAGDALENA, Sierra Nevada de Santa Marta, Quebrada Indiana, 10°59'N, 73°58'W, 1600 m, 30 Aug. 1972, Kirkbride 1990 (COL, NY). QUINDÍO, Mun. Salento, carretera Salento-Cocora, [4°38'N, 75°34'W], 2000–2200 m, 10 Sept. 1989, Vélez et al. 535 (COL). RISARALDA, Mun. Pereira, Parque regional Ucumari, vereda La Pastora, trail from El cedro to La Pastora, 4°02'N, 75°30'W, 1900 m, 19 Feb. 1990, Croat 70763 (COL). — ECUADOR, MORONA-SANTIAGO, road from Limón to Azogues, 3°00'35"S, 78°30'25"W, 1980 m, 5 Mar. 2005, Moran et al. 7645 (NY). NAPÓ, Cerro Antisana, NE Borja, [0°28'S, 78°08'W], 1706 m, 29 Aug. 1960, Grubb et al. 1387 (NY).

**Notes** — *Elaphoglossum aschersonii* can be distinguished from all other species in subsect. *Muscosa* by its epiphytic habit, compact, erect rhizomes, petioles with the larger scales scattered to dense, oblanceolate to obovate laminae glabrous to glabrescent, and abaxial costal scales appressed, round, dark brown to black. *Elaphoglossum bellermannianum*, a similar species, can be distinguished by petioles densely scaly, laminae oblong to oblanceolate, and scales typically obscuring the surface of the lamina. The abaxial costal scales of *E. bellermannianum* can range from oblanceolate to round and are generally brown to black or mottled with a white margin.

*Elaphoglossum aschersonii* is similar to *E. novogranatense* in its epiphytic habitat, appressed dark brown abaxial costal scales, evident veins, and papillate spores; however, *E. aschersonii* differs in having compact rhizomes, easily visible phylloodia, erose larger petiole scales, and obovate laminae. In contrast, *E. novogranatense* has short-creeping rhizomes, phylloodia obscured by the petiole-base scales, ciliate larger petiole scales, and oblanceolate to lanceolate laminae.

## 2. *Elaphoglossum bellermannianum* (Klotzsch) T.Moore

— Fig. 1b, 3; Map 3

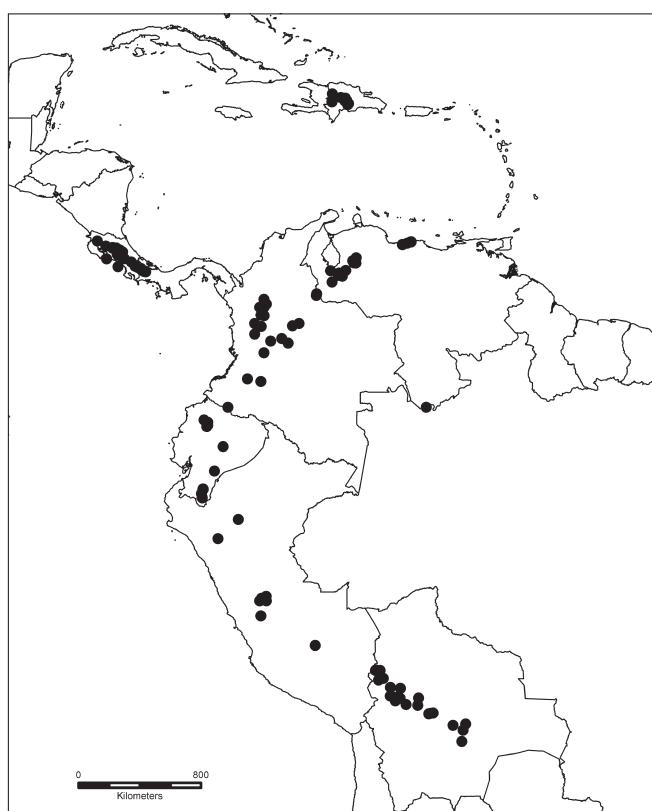
*Elaphoglossum bellermannianum* (Klotzsch) T.Moore (1857a) 352. — *Acrostichum bellermannianum* Klotzsch (1847) 426. — Type: Moritz 259 (lecto, designated here, B; iso HBG n.v. (photo P ex HBG), LE n.v., US), Venezuela, Aragua, Colonia Tovar, [10°23'N, 67°21'W], s.d.

*Elaphoglossum blandum* Rosenst. (1913) 476. — Type: Buchtien 3456 (lecto S, designated here; iso B, US), Bolivia, North Yungas, Polo Polo bei Coroico, [16°24'S, 67°47'W], 1100 m, Oct.–Nov. 1912.

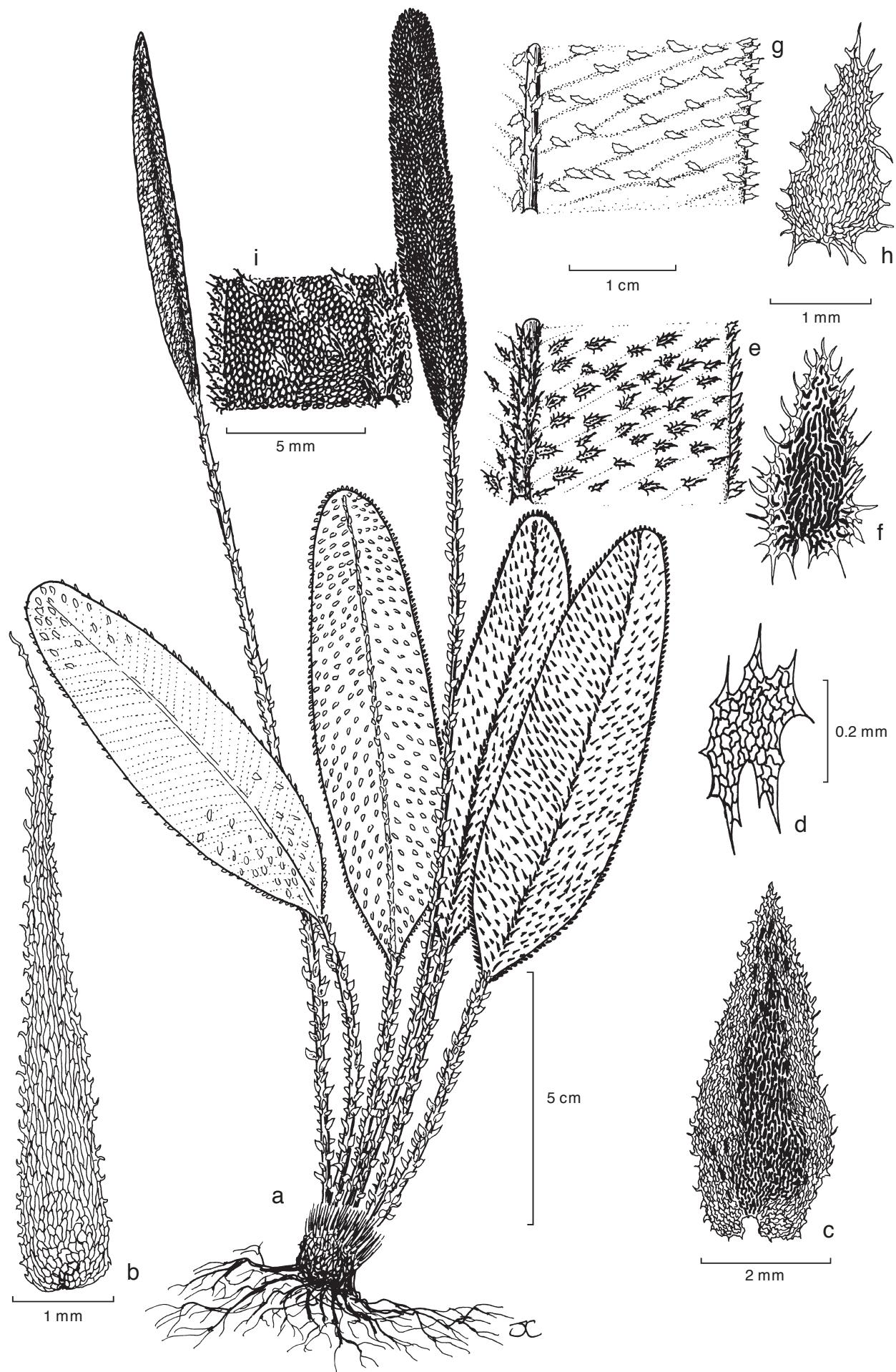
*Elaphoglossum atropunctatum* Mickel (1991) 124. — Type: Smith & Canne 5835 (holo MO), Peru, Pasco, Prov. Oxapampa, 2–4 km N of Mallampampa, 10°32'N, 75°45'W, 2200–2400 m, 22 Jan. 1984.

*Elaphoglossum fuliginosum* Mickel (1992) 374. — Type: Taylor & Taylor 11339 (holo NY; iso US), Costa Rica, San José, c. 3 km NW of Cascajal near the union of the Cascajal and Bajo Maquina Rivers, [10°04'N, 83°57'W], 30 July 1972.

Plants epiphytic. Rhizome 4–6 mm wide, compact to short-creeping; *rhizome scales* 5–10 mm long, linear-lanceolate, brown, lustrous, subentire, with small teeth, base truncate, apex acuminate. Sterile leaves (6–)10–30(–40) cm long, approximate; *phylloodia* present, obscured by the petiole-base scales; *petiole* 5–16 cm long, 2/5–1/2 the length of the sterile leaves; *larger petiole scales* 2–5 mm long, scattered to dense, spreading, lanceolate, light brown to dark brown or mottled, darker at the point of attachment, margin lighter, erose to almost entire, base cordate, apex acute; *smaller petiole scales* 0.3–1.5 mm long, scattered to dense, appressed, oftentimes hidden by the larger ones, oblanceolate to round, from light brown to black or mottled with lighter margin, darker at the point of attachment, erose to ciliate, base cordate, apex acute; *lamina* 6–17 by 1.5–4 cm, oblong to oblanceolate, coriaceous, base broadly cuneate to truncate, apex obtuse; *veins* c. 1 mm apart, at an angle of 75° with respect to the costa; *adaxial laminar scales* 0.5–2 mm long, scattered, lanceolate to round, white, occasionally getting dark at the point of attachment, ciliate, base cordate, apex acute; *abaxial laminar scales* 0.5–2 mm long, scattered, slightly elevated above the surface of the lamina, lanceolate to round, brown to black or mottled with lighter margin, ciliate, base cordate, apex acute; *abaxial costal scales* same as the laminar ones, mostly sessile, thus the scale body not elevated, pointing forward to the apex or at right angles; *marginal scales* same as the laminar ones. *Fertile leaves* longer than the sterile leaves; *petiole* 3/4 the length of the fertile leaves; *petiole scales* same as the ones of the sterile leaves but the larger ones more spreading; *lamina* (2.5–)5–13 by 1.1–2 cm, narrowly elliptic to



Map 3 Distribution of *Elaphoglossum bellermannianum* (Klotzsch) T.Moore.



**Fig. 3** *Elaphoglossum bellermannianum* (Klotzsch) T.Moore. a. Habit; b. rhizome scale; c. larger petiole scale; d. smaller petiole scale; e. abaxial laminar surface; f. adaxial laminar surface; g. adaxial laminar surface; h. fertile lamina (all: Rodriguez 6323, HUA).

elliptic, coriaceous, base broadly cuneate, apex acute to obtuse; *adaxial laminar scales* 0.5–1.5 mm long, dense, lanceolate to round, white to light brown, darker at the point of attachment, ciliate, base cordate, apex acute; *abaxial costal scales* 0.3–1 mm long, scattered, not elevated, lanceolate to round, brown to black, ciliate, base stalked, apex acute; *intersporangial scales* c. 1 mm long, scattered, lanceolate, brown to black or mottled with lighter margin, ciliate, base stalked, apex acute. Spores papillate, without ridges.

**Distribution** — Costa Rica, Panama, Dominican Republic, Venezuela, Colombia, Ecuador, Peru, Bolivia; 1000–3000 m. Epiphytic in montane forests.

**Selection of other specimens examined.** COSTA RICA, **Alajuela**, above Lechería on Volcán Poás, [10°11'N, 84°13'W], 2290 m, 30 July 1932, Stork 3371 (UC, US). **Cartago**, Irazú West, [9°58'48"N, 83°50'60"W], 2000 m, 8 Sept. 1908, Brade 184 (NY, UC). **Guanacaste**, entrance to Finca Montecristo, off. rt. 113, 1800 m, 28 July 1983, Moran 3309 (CR, F, MO, NY). **Limón**, Cordillera de Talamanca, Atlantic slope, valle del Silencio along the Río Terbi, 0.5–1.5 airline km W of the Costa Rican-Panamanian border, 9°08'N, 82°57'W, 9 Sept. 1984, Davidse et al. 28772 (MO). **Puntarenas**, Cantón de Coto Brus, Z.P. Las Tablas, cuenca Terraba-Sierpe, orillas de la quebrada Surú, 8°58'30"N, 82°46'15"W, 1960 m, 11 Feb. 1999, Rojas et al. 4899 (CR, INB, NY). **San José**, Cantón de Desamparados, Cordillera de Talamanca, El Empalme, 9°43'20"N, 83°57'20"W, 2 Oct. 1994, Rojas 1551 (CR, INB, UC). — PANAMA, **Chiriquí**, vic. of Casita Alta, Volcán de Chiriquí, [8°48'N, 82°32'W], 28 June–2 July 1938, Woodson et al. 823 (MO, NY, US). — DOMINICAN REPUBLIC, **Ázua**, Cordillera Central, Valle del Yaque, 1550 m, 5 Oct. 1929, Ekman 13682 (S). **La Vega**, c. 17 km S of Constanza, vía El Convento, on road to San José de Ocoa, at Arroyo La Siberia, 18°50'N, 70°42'W, 1600 m, 24 July 1980, Mejía 7604 (MO, NY). **Peravia**, Loma Los Palos Mojados, NNW de El Bejucal, en la cabecera del Río El Canal, 18°37.5'N, 70°35'W, 1700 m, 4 Aug. 1982, Zanoni et al. 22314 (JSBD, NY). **San Juan**, along Bao river, upper Bao valley, headwaters of Bao river, [19°01'N, 70°59'W], 1700 m, 1–7 Oct. 1968, Liogier 12878 (NY). — COLOMBIA, **Antioquia**, vereda Los Patos, camino hacia el Páramo de Santa Ines, 6°37'07.8"N, 75°40'43.8"W, 2590 m, 30 July 2005, Vasco 561 (HUA, MO, NY). **Boyacá**, Chiquinquirá, bosque detrás del Cuartel, [5°37'N, 73°49'W], 2675 m, 12 Oct. 1967, Jaramillo-Mejía et al. 3474 (COL). **Caldas**, Mun. Manizales, Monteleón, Cordillera Central, 2250 m, 24 Mar. 1984, De Fraume et al. 105 (HUA). **Cauca**, 5 km E of Timbío, [2°21'N, 75°41'W], 2050 m, 29 Dec. 1944, Grant 10663 (US). **Cundinamarca**, carretera Guasca a Gachetá, Km 60–61, 2720 m, 22 Jan. 1974, Acosta-Arteaga 103 (COL). **Nariño**, entre La Victoria, inspección de policía Mun. Apiales, y el Páramo El Consuelo, [0°50'N, 77°37'W], 2900 m, 12 Jan. 1973, Hagemann 1928 (COL, PSO). **Risaralda**, Mun. Santuario, PNN Tatamá, camino que lleva al Páramo de Tatamá, subiendo hacia Morro Zancudo, 5°07'28.1"N, 76°02'30.6"W, 2643 m, 17 Apr. 2007, Vasco et al. 734 (HUA, NY). **Tolima**, Mun. Sta. Isabel, vereda de La Yuca, cerca de Las Bodegas, Finca Buenavista, Alto La Esperanza, [4°43'N, 75°06'W], 2700 m, 31 July 1980, Idrobo 10311 (COL). — VENEZUELA, **Amazonas**, Dpto. Rio Negro, Cerro de la Neblina, CampII 2.5–3.5 km NE Pico Phelps (Neblina), 0°50'N, 65°58'28"W, 16 Feb. 1984, Funk 6313 (VEN). **Aragua**, prope Colonia Tovar, [10°23'N, 67°22'W], 1854–1855, Fendler 270 (GH, MO, NY, US). **Barinas**, Quebrada de Barinitas, 1100 m, 28 July 1960, Vareschi 7427 (VEN). **Distrito Federal**, Cordillera de la Costa, fila del Ávila, lado S, directamente debajo de la estación meteorológica, entre la estación del teleférico y el Hotel Humboldt, 10°32.6'N, 66°52.6'W, 2100 m, 19 Aug. 1991, Meier 302 (NY, VEN). **Lara**, Mun. Morán, vía al Páramo Las Rosas en las inmediaciones de la pica, 9°37'N, 70°05'W, 2400 m, 5 Dec. 1984, Rivero 775 (NY). **Mérida**, Parque Nacional La Culata, En el camino hacia el Cerro Pan de Azúcar, 8°41'52.4"N, 71°05'42.5"W, 2400 m, 26 May 2008, Vasco et al. 799 (NY, VEN). **Portuguesa**, Mun. Sucre, en La Divisoria de La Concepción, 9°18'N, 70°06'W, 23–26 Oct. 1985, Ortega et al. 2782 (NY). **Táchira**, Quebrada La Lejia, S of Quebrada Agua Azul, along and above stream on steep slopes, 15–16 km SE of Delicias, 7°30'N, 72°24'W, 2300 m, 25 July 1975, Steyermark 118596 (MO, VEN). **Trujillo**, carretera Boconó-Trujillo, entrada a Burbusay, 9°26'N, 70°17'W, 1600 m, 23 Nov. 1984, Ortega 2290 (MO, NY, UC). — ECUADOR, **Pichincha**, old road Chiriboga to Sto. Domingo, 14 km from recinto de Las Palmeras, 0°18'S, 78°51'W, 800 m, 13 Feb. 2004, Moran et al. 6843 (NY). **Loja**, trails c. 5 km ENE of San Pedro de Vilcabamba, from El Bosque to Quebrada Romerillos and Banderilla, 4°14'S, 79°10'W, 30 Nov. 1994, Øllgaard 105943 (AAU). **Morona-Santiago**, small ravine c. 7 km N of Limón, disturbed forest, 2°54'42"S, 78°24'03"W, 960 m, 3 Mar. 2005, Moran et al. 7604 (NY). **Napo**, Cantón Quijos, Baeza, along road leading to radio tower behind town, 1°28'18"S, 77°53'51"W, 2016 m, 24 Feb. 2005, Moran et al. 7525 (HUA, NY). **Zamora-Chinchipe**, road Loja-Zamora, Km

24–25, 3°59'S, 79°04'W, 15 Apr. 1973, Holm-Nielsen et al. 3519 (AAU, MO, NY, UC). **Sucumbíos**, Km 15–18, carretera Pun-Aquarico, 13 Aug. 1949, Acosta-Solis 13281 (F). — PERU, **Amazonas**, a few km from Molina Pampa, [6°52'37"S, 78°12'18"W], 14 Mar. 1998, Van der Werff et al. 14960 (MO, UC). **Cusco**, Machupichu, [13°09'S, 72°29'W], Mar. 1936, Soukup 176, 177 (F). **Junín**, Prov. Tarma, Agua Dulce, [11°25'S, 75°41'W], 1900 m, 9 Mar. 1948, Woytkowski 35433 (UC, US). **Pasco**, Prov. Oxapampa, Parque Nacional Yanachaga Chemillén, sector San Alberto, 10°32'S, 75°21'W, 2200 m, 20 Jan. 2003, Vásquez et al. 27857 (MO, USM). **San Martín**, Rioja-Pomacochas road, below Venceremos, c. 20 km NW of Rioja near Restaurant El Amigo, 5°45'S, 77°38'W, 1600 m, 8 Feb. 1984, Gentry 45177 (MO). — BOLIVIA, **Cochabamba**, Prov. Franz Tamayo, Piedra Blanca, 10.4 km al S de Pata, sobre el camino a Sta. Cruz del Valle Ameno, 14°37'44"S, 68°40'19"W, 1900 m, 12 Nov. 2003, Fuentes et al. 5999 (LPB, MO, NY, UC). **Santa Cruz**, Prov. Valle Grande, Loma Larga, 4 km a Masicurí, 18°47'S, 63°53'W, 1600 m, 3 June 1996, Kessler et al. 6289 (LPB, NY, UC).

**Notes** — *Elaphoglossum bellermannianum* can be distinguished by its oblong laminae, bicolorous scales on the petioles and laminae (at least along the costae), fertile leaves twice as long as the sterile, and papillate spores. It differs from *E. muscosum* and *E. lehmannianum* by the bicolorous petiole and/or lamina scales. These scales are bicolorous because they can be darker at the point of attachment, or mottled, or black medially with white borders. In contrast, the scales of *E. muscosum* and *E. lehmannianum* are typically concolorous, or if bicolorous they are darker only at the point of attachment. Another difference is that the costal scales of the sterile and fertile leaves of *E. bellermannianum* are mostly sessile, thus the scale body is not elevated above the surface of the lamina; whereas scales of *E. muscosum* and *E. lehmannianum* have a base typically short-stalked and thus the scale body is elevated above the surface of the lamina. The three species are epiphytes with compact to short-creeping rhizomes, linear rhizome scales with few short teeth up to 0.2 mm, erose petiole scales, and papillate spores without ridges (Fig. 1b, h, i). These characteristics distinguish them from *E. engelii*, which differs by being terrestrial with short- to long-creeping rhizomes and by having linear rhizome scales with many teeth longer than 0.2 mm, ciliate petiole scales, and spores with ridges and irregular deposits (Fig. 1d).

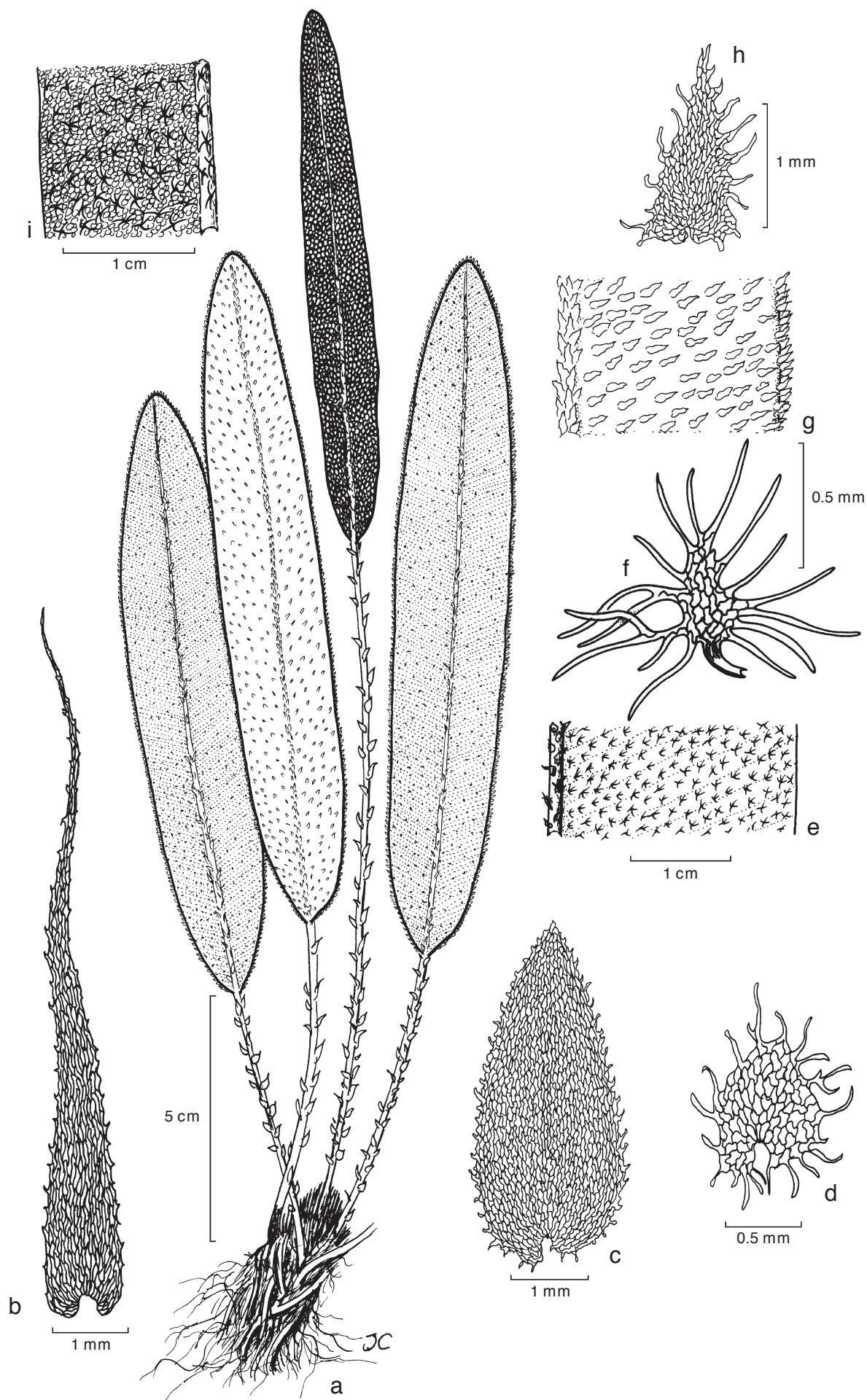
There is considerable variation in the colour of the laminar scales of *E. bellermannianum*. Some plants have all the scales of the abaxial lamina either completely black or mottled; these were described as either *E. atropunctatum* (from Peru) or *E. fuliginosum* (from Costa Rica). Other plants have almost all adaxial laminar scales white and have been named *E. blandum* (type from Bolivia). Throughout the geographic distribution of *E. bellermannianum*, however, scale colour varies from white to black. Because no other differences distinguish these plants, they are treated here as a single species, *E. bellermannianum*.

See *E. gardnerianum* for a comparison with that species.

### 3. *Elaphoglossum corderoanum* (Sodiro) Christ — Fig. 1c, 4; Map 4

*Elaphoglossum corderoanum* (Sodiro) Christ (1899) 81. — *Acrostichum corderoanum* Sodiro (1893) 470. — Type: Sodiro 202 (lecto P (barcode P00577719), designated here; iso QPLS n.v.), Ecuador, Loja, El Toldo (in the protologue: Crece en las pendientes occidentales del Pichincha, Corazón y "el Altar" en la provincia de Ríobamba, 2000 y 3000 m), [4°22'S, 79°31'W], 1891.

Plants epiphytic. Rhizome 3–6 mm wide, compact, erect; rhizome scales 6–9(–14) mm long, linear-lanceolate, orange to dark brown, entire to denticulate, base cordate, apex acuminate. Sterile leaves 15–41 cm long, approximate; phylloodia present, sometimes obscured by the petiole-base scales; petiole (5–)10–22 cm long, 1/3–1/2 the length of the sterile leaves; larger petiole scales 3–6 mm long, dense, spreading, oblanceolate to ovate, light brown to orange, erose to laciniate,



**Fig. 4** *Elaphoglossum corderoanum* (Sodiro) Christ. a. Habit; b. rhizome scale; c. larger petiole scale; d. smaller petiole scale; e. abaxial laminar surface; f. adaxial laminar scale; g. adaxial laminar surface; h. adaxial laminar scale; i. fertile lamina (all: Holm-Nielsen 3256, NY).

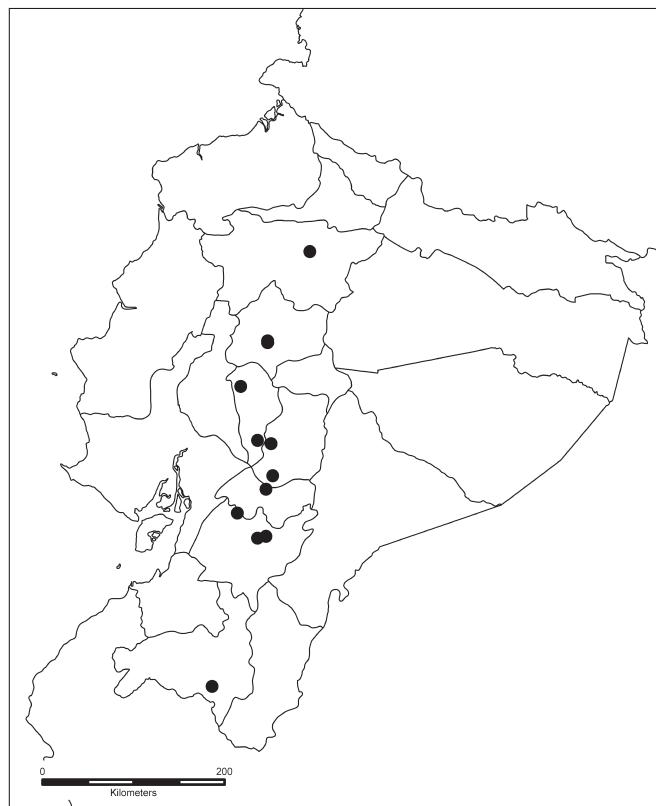
base cordate, apex acute; *smaller petiole scales* 0.5–1.5 mm long, dense, appressed, oftentimes hidden by the larger ones, oblanceolate to round, light brown to slightly mottled, ciliate, base cordate, short-stalked, apex acute; *lamina* 10–22 by (1.8–)2.8–5 cm, oblong to oblanceolate, coriaceous, glabrescent with age, base broadly cuneate to obtuse, apex obtuse to acute; *veins* free, forked, 1–2 mm apart, at an angle of 70–75° with respect to the costa; *adaxial laminar scales* 0.5–2.5 mm long, dense, oblanceolate to ovate, white to light brown, laciniate to ciliate, base cordate, apex acute; *abaxial laminar scales* 0.5–1 mm long, dense, not imbricate, patent, lanceolate to round, highly dissected, orange, long-ciliate, base stalked, apex filiform; *abaxial costal scales* 1–2 mm long, dense, pointing at right angles, not elevated, oblanceolate to round, light brown, ciliate, base cordate, apex acute; *marginal scales* 1–2 mm long, dense, oblanceolate, light brown, ciliate, base cordate, short-stalked, apex acute. *Fertile leaves* longer than the sterile leaves; *petiole* 2/3 the length of the fertile leaves; *petiole scales* same as the ones of the sterile leaves; *lamina* 10–25 by 1.2–2.4 cm, narrowly-elliptic to linear-lanceolate, coriaceous, glabrescent with age, base broadly cuneate to obtuse, apex obtuse; *adaxial laminar scales* 0.5–2.5 mm long, dense, imbricate, oblanceolate to round, white to orange, laciniate to ciliate, base cordate, apex acute; *abaxial costal scales* 0.5–2 mm long, dense, oblanceolate to round, light brown to dark brown with lighter margin, laciniate to ciliate, base cordate, apex acute; *intersporangial scales* 0.7–1.5(–4) mm long, dense, not obscuring the sporangia, oblanceolate to round, orange to dark brown, sometimes mottled towards the apex, ciliate, base cordate, apex acute. *Spores* papillate, with ridges.

**Distribution** — Ecuador; (600–)2100–3400 m. Epiphytic in montane forest and páramos.

**Selection of other specimens examined.** ECUADOR, **Azuay**, Cruz Pampa region above Baños, c. 15 km SW of Cuenca, [2°54'S, 79°04'W], 2750–3050 m, 29–30 June 1945, Camp 3935 (F, GH, MO, NY, US, VEN). **Bolívar**, along first 15 km of road Chillanes-El Tambo, [1°56'S, 79°04'W], 2400 m, 18 July 1991, Van der Werff et al. 12448 (MO, UC). **Cañar**, N of Tipococha, [2°25'S, 78°59'W], 3200 m, 18 Aug. 1933, Diels 629 (B). **Chimborazo**, W slope of Azuay, close to Chunchi, [2°17'S, 78°55'W], 3000 m, s.d., Rimbach 696 (S). **Cotopaxi**, Quevedo-Latacunga road above Pilaló, 0°58'S, 78°58'W, 2850 m, 8 Apr. 1973, Holm-Nielsen et al. 3256 (AAU, MO, NY, UC). **Los Ríos**, Centinela ridge, c. 20 km E of Patricio Pilar, [1°24'S, 79°14'W], 600 m, 16 July 1991, Van der Werff et al. 12431A (MO). **Pichincha**, carretera vieja Chillogallo-San Juan, sitio de colección San Juan-Ventanillas-Las Comunas, 23 June 1980, Jaramillo 2587 (AAU); in silvis suban. Nono-Gualea, [0°04'S, 78°33'W], Sept. 1899, Sodiro s.n. (P).

**Notes** — *Elaphoglossum corderoanum* can be distinguished by its larger petiole scales oblanceolate to ovate, erose to laciniate, abaxial laminar scales lanceolate to (more commonly) round, highly dissected, long-ciliate, and ridged, papillate spores. The abaxial laminar scales, although dense, do not obscure the surface of the lamina.

Some specimens collected by Sodiro and annotated by him as *E. corderoanum* correspond to *E. lehmannianum*; therefore, it might be that the original material is mixed. Sodiro designated all the specimens with large leaves and somewhat glabrous abaxial laminae as *E. corderoanum*. Examination of more material revealed that species with large leaves belong either to *E. corderoanum* or *E. lehmannianum*. To assign the lectotype I took into account the original description in which Sodiro stated that besides the larger leaves, the difference between *E. corderoanum* and *E. bellermannianum* and *E. lehmannianum* (in the original description as *Acrostichum bellermannianum* and *A. muscosum*) is that the abaxial laminar scales of the sterile leaves and the adaxial laminar scales of the fertile leaves of *E. corderoanum* were “round similar to stellate hairs”. Round, highly dissected, long-ciliate laminar scales (similar to stellate hairs) distinguish *E. corderoanum* from *E. bellermannianum*.



**Map 4** Distribution of *Elaphoglossum corderoanum* (Sodiro) Christ.

and *E. lehmannianum*. Another characteristic that distinguishes these species is that *E. corderoanum* has spores with ridges and papillae (Fig. 1c), whereas *E. bellermannianum* and *E. lehmannianum* have papillate spores without ridges (Fig. 1b, h).

Because of its ridged spores and occurrence at high elevations, *E. corderoanum* can be confused with *E. engelii*. These two species are easy to distinguish by their habit, and rhizome and laminar scales. Typically, *E. corderoanum* is epiphytic, has rhizome scales that are entire to denticulate, and abaxial laminar scales that are round, highly dissected, long-ciliate, and spaced far enough apart that they do not obscure the lamina surface. In contrast, *E. engelii* is usually terrestrial, has rhizome scales that bear numerous cilia, and abaxial laminar scales that are lanceolate to oblanceolate and obscure the lamina surface.

See *E. oculatum* for a comparison with that species.

#### 4. *Elaphoglossum engelii* (H.Karst.) Christ — Fig. 1d, 5; Map 5

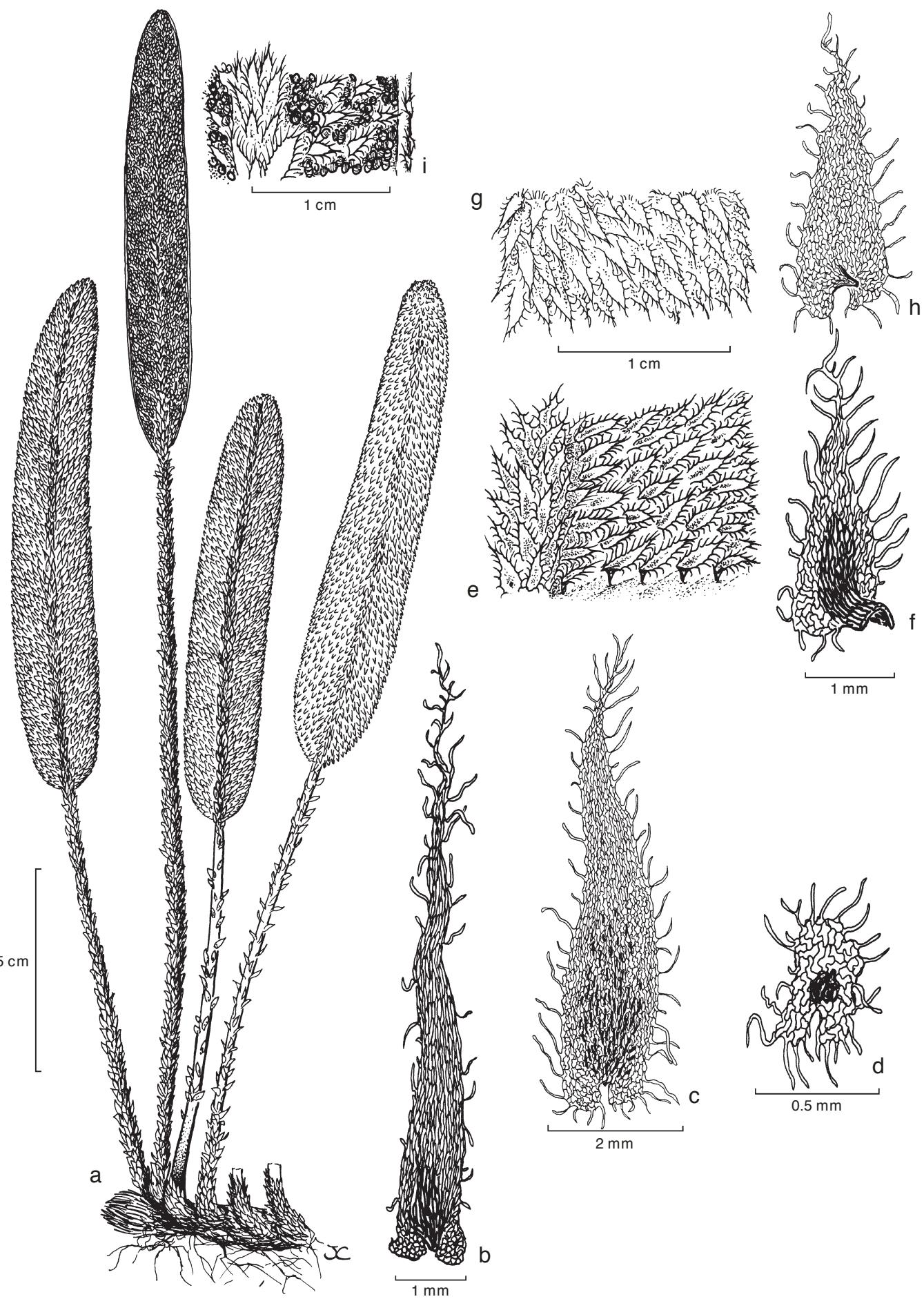
*Elaphoglossum engelii* (H.Karst.) Christ (1899) 81. — *Acrostichum engelii* H.Karst. (1860) 118, t. 59. — Type: Karsten s.n. (lecto B, designated by Mickel (1991) 131; second-step barcode B20 0070391 excluding the fertile leaf portions in the pocket, designated here; iso W [sheet W0018475, excluding the fertile leaf on the right], LE n.v.), Venezuela (in the original description ‘Colombia’), Merida, cordillera Meridensis, s.d.

*Elaphoglossum caulolepis* (H.Karst.) Hieron. (1905) 548. — *Acrostichum caulolepis* H.Karst. (1860) 121, t. 60. — Type: Karsten s.n. (lecto W [sheet W0018476], designated here; iso B n.v., LE n.v.), Colombia, Cundinamarca, Bogotá, s.d.

*Elaphoglossum atrorubens* Mickel (1987) 314, f. 3D, E. — Type: Ruiz-Terán & M. López-Figueiras 1754 (holo NY), Venezuela, Mérida, Distrito Campo Elías, Municipio Pueblo Nuevo, Páramo de Quirorá, alto de las Cruces, [8°20'N, 71°27'W], 3200 m, 23 Apr. 1971.

*Elaphoglossum cristatum* Ballenth., Dudenb. & M.Kessler (2009) 46–49. — Type: Kessler et al. 6875 (holo GOET n.v.; iso LPB n.v., NY, UC), Bolivia, Cochabamba, Prov. José Carrasco Torrico, 63 km antigua carretera Cochabamba-Villa Tunari, 17°15'S, 65°43'W, 3700 m, 2 July 1999.

Plants terrestrial. Rhizome 4–8 mm wide, short to long-creeping; rhizome scales 6–11 mm long, linear-lanceolate, light brown

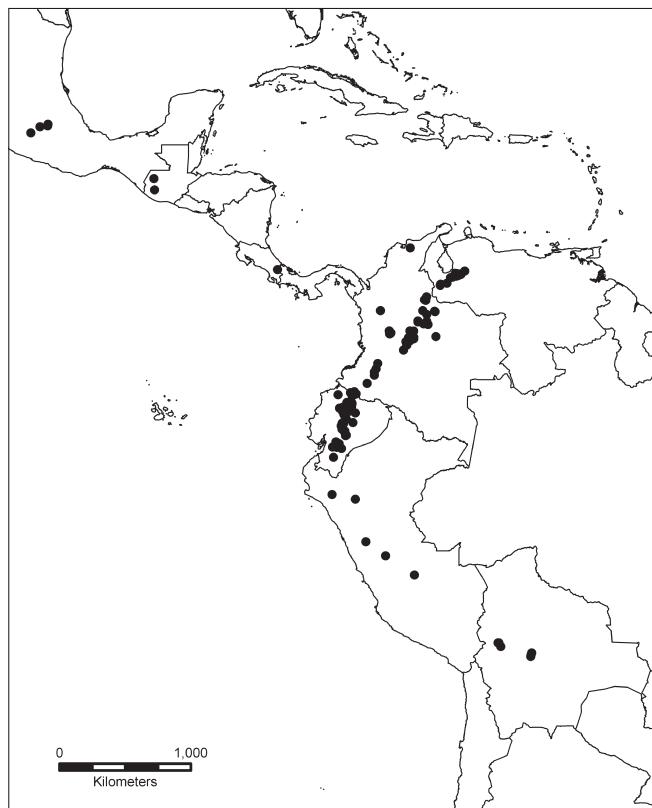


**Fig. 5** *Elaphoglossum engelii* (H.Karst.) Christ. a. Habit; b. rhizome scale; c. larger petiole scale; d. smaller petiole scale; e. abaxial laminar surface; f. adaxial laminar scale; g. adaxial laminar surface; h. adaxial laminar scale; i. fertile lamina (all: Rentería 5387, HUA).

to dark brown, sometimes bicolorous, margin lighter, ciliate, with abundant cilia (up to 0.4 mm long), base cordate, apex filiform and tortuous to acute. *Sterile leaves* 14–47(–63) cm long, approximate to up to 1 cm apart; *phyllodia* present, sometimes obscured by the petiole-base scales; *petiole* 6–25(–41) cm long, 2/5–3/5 the length of the sterile leaves; *larger petiole scales* 4–6 mm long, dense, spreading, sometimes pointing forward, linear-lanceolate to oblanceolate, light brown to dark brown, or mottled, darker at the point of attachment, margin lighter, ciliate, base cordate to truncate, apex acute; *smaller petiole scales* 0.5–1(–3) mm long, scattered to dense, appressed, oftentimes hidden by the larger ones, oblanceolate to round, from light brown to black or mottled with lighter margin, darker at the point of attachment, ciliate, base cordate, apex acute; *lamina* 8–23 by 1.5–4.5 cm, linear-lanceolate to oblanceolate, coriaceous, glabrescent with age, base truncate to broadly cuneate, apex obtuse; *veins* 0.5–1.5 mm apart, at an angle of 70–85° with respect to the costa; *adaxial laminar scales* 1–3 mm long, dense, imbricate, oftentimes pointing downwards, lanceolate, white to light brown, ciliate, base cordate, apex acute; *abaxial laminar scales* 2–3 mm long, dense, imbricate, slightly elevated above the surface of the lamina to patent, lanceolate to oblanceolate, from light brown to black or mottled with lighter margin, darker at the point of attachment, ciliate, base stalked (up to 0.4 mm), apex acute; *abaxial costal scales* same as the laminar ones, pointing forward to the apex or at right angles, slightly elevated, sometimes darker; *marginal scales* same as the laminar ones. *Fertile leaves* longer than the sterile leaves; *petiole scales* same as the ones of the sterile leaves but the larger ones more spreading; *lamina* 7–22 by 1–2 cm, narrowly elliptic, coriaceous, base truncate to broadly cuneate, apex obtuse; *adaxial laminar scales* 0.5–3 mm long, dense, imbricate, lanceolate to round, from light brown to black or mottled with lighter margin, darker at the point of attachment, ciliate, base cordate, apex acute; *abaxial costal scales* 0.5–2(–3) mm long, dense, pointing forward to the apex or at right angles, lanceolate to round, from light brown to black or mottled, darker at the point of attachment, ciliate, base cordate, apex acute; *intersporangial scales* 1–2 mm long, absent to scattered, lanceolate, from light brown to black or mottled with lighter margin, darker at the point of attachment, ciliate, base cordate to short-stalked, apex acute. Spores with irregular deposits and ridges.

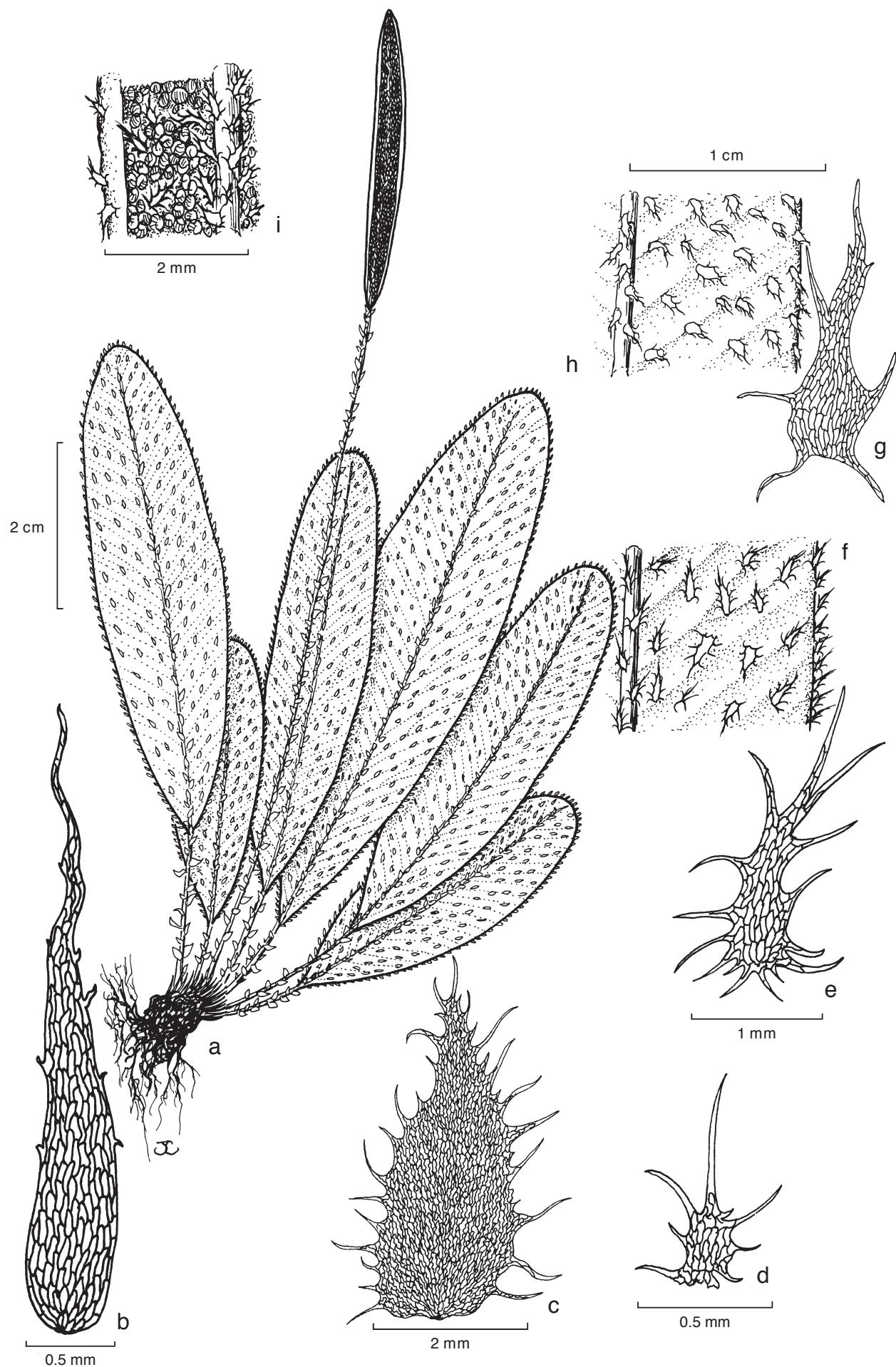
**Distribution** — Mexico, Guatemala, Costa Rica, Venezuela, Colombia, Ecuador, Peru, Bolivia; 1300–4300 m. Mainly terrestrial growing in montane forest and páramos in exposed, rocky, dry areas.

**Selection of other specimens examined.** MEXICO, Mexico, cerca de Amealco, camino a Amecameca Tlamacas, vertiente NW del Popocatépetl, [18°38'N, 99°55'W], 3100 m, 9 Oct. 1966, Rzedowski 23279 (NY). Morelos, Zempoala, [19°03'N, 99°18'W], Dec. 1936, Lyonnet 1413 (UC, US); Lagunas de Zempoala, [19°03'N, 99°18'W], Dec. 1946, Sánchez 465 (US). — GUATEMALA, Huehuetenango, Sierra Chuchumatales between Kms 136 to 150 to San Juan Ixcoy, [15°30'N, 91°30'W], 3000–3500 m, 12–23 Jan. 1966, Molina et al. 16539 (F, NY, US). Quezaltenango, NW-facing forested Abies slopes of barranco of Volcán Zunil, [14°44'N, 91°27'W], 3000 m, 22 Jan. 1940, Steyermark 34911 (F, US). — COSTA RICA, Limón, Cordillera de Talamanca, SW foot of Cerro Kámuk, 9°16'N, 83°02'30"W, 3200–3350 m, 24 Mar. 1984, Davidse et al. 25952 (CR, MO, NY, UC). — COLOMBIA, Antioquia, Mun. Urrao, Inspección Jaiperá, vereda El Chuscal, Páramos de Frontino, Sítios Pico de Agüila-La Laguna, 6°27'N, 76°46'W, 3590–3750 m, 6 Apr. 1989, Callejas et al. 7672 (HUA, NY). Arauca, Sierra Nevada del Cocuy, Quebrada El Playón, Hoya S. Luis 1.5 km al NNE de la finca El Playón, [6°23'N, 72°16'W], 3540 m, 13 Mar. 1973, Cleef 9122 (COL, NY). Boyacá, Mun. Chisacá-San Pedro de Iguaque, SFF de Iguaque, sendero subiendo a la laguna de Iguaque, 5°41'03.2"N, 73°26'22.3"W, 3536 m, 30 Apr. 2007, Vasco et al. 765 (HUA, NY). Caldas, PNN los Nevados, Alto del Cisne, 4°51'17.1"N, 75°22'03.5"W, 4127 m, 7 Aug. 2006, Vasco 591 (HUA, MO, NY). Cauca, Páramo de Puracé, [2°15'N, 76°25'W], 3400 m, 22 Sept. 1967, Hagemann 572 (COL, PSO). Cundinamarca, Páramo de Sumapaz, páramo y bosque



Map 5 Distribution of *Elaphoglossum engelii* (H.Karst.) Christ.

alto-andino cerca de Lagunitas al S de San Juan, Alto de Chorreras; 2.5 km al N de la laguna Gobernador, [3°45'N, 74°25'W], 3780 m, 27 Jan. 1937, Cleef 8359 (COL, MO, NY). Magdalena, Sierra Nevada de Santa Marta, S of Cerro Ichachui, Mamancanaca-Camberimena, [10°45'N, 73°58'W], 3900 m, 30 May 1905, Waston 10384 (CR). Meta, Páramo de Sumapaz, hoya de la quebrada Sitiales, [4°05'N, 74°12'W], 3550 m, 26 Jan. 1972, Cleef 1043 (COL). Nariño, Cumbal, Laguna La Bolsa, páramo, [0°54'N, 77°47'W], 3400 m, 21 Jan. 1973, Hagemann 1956 (COL, PSO). Norte de Santander, Páramo de Romeral, 3800–4200 m, 30 Jan. 1927, Killip 18672 (NY, US); Páramo de San Turban, near Vetas, [7°12'N, 72°59'W], 3950–4160 m, 17 Jan. 1927, Killip 17571 (NY, US). Tolima, Mun. Murillo, cerca del Nevado del Ruiz, carretera a Murillo, 4°56'N, 75°17.5'W, 3900 m, 9 May 1991, Churchill 17881 (COL, HUA, NY). — VENEZUELA, Mérida, entre Timote y Pico de Aguila, 3000–3500 m, 24 Nov. 1984, Ortega 2339 (MO, NY, UC). Táchira: carretera Bailadores-La Grita, vía Páramo La Negra, 8°15'20"N, 71°52'46"W, 3000 m, 29 May 2008, Vasco et al. 808 (NY, VEN). Trujillo, Mun. Boconó, Laguna Larga, vía Laguna Las Parias to Laguna Eco. Páramo Motumbo, Monumento Natural Teta de Niquitao-Guirigay, [8°56'N, 70°30'W], 3400–3600 m, 15 Sept. 2003, Stergios et al. 20424 (NY, UC, US). — ECUADOR, Azuay, 16 km NE of Azogues along road to Pindilíq, 2°40'S, 78°50'W, 3340 m, 19 Jan. 1985, Luteyn 11137 (HUA, NY, UC). Carchi, Páramo El ángel, in the pass on road El ángel-Tulcán, 0°41'N, 78°54'W, 3450 m, 15 May 1973, Holm-Nielsen et al. 5504 (AAU, F, MO, NY, UC). Chimborazo, Río Chimbo, 3400 m, Sept. 1905, Rimbach Rosenst. Filices ecuadorenses, No. 7 (B, P, S, US). Cotopaxi, Parque Nacional Cotopaxi, 3–6 km S de la Estación Ferrocarril, 0°40'S, 78°30'W, s.d., Balslev 2655 (AAU, GH, NY). Imbabura, Lago San Marcos, Cayambe, 3413 m, 29 Nov. 1961, Cazalet 5408 (NY, UC, US). Loja, Páramos de Saraguro, 10 km S of Saraguro, [3°36'S, 79°13'W], 3050 m, 2 Jan. 1979, Luteyn et al. 6663 (NY). Napo, Parque Nacional Llanganates, vía Salcedo-Tena, Km 45–55, cabecera del Río Anatenorio, Siete Vueltas, 0°59'S, 78°20'W, 3600 m, 17 Sept. 1998, Vargas et al. 2586 (MO, NY, QCNE, UC). Pichincha, above Hacienda Monjas, Concepción, [0°28'S, 78°35'W], 3962 m, 29 Mar. 1951, Bell 91 (S); in monte Pichincha, [0°10'S, 78°35'W], 3400 m, 1917, Mille s.n. (GH, NY). Tungurahua, Parroquia San José de Poaló, Loma Potrerillos, 1°05'S, 78°20'W, 3200 m, 4 Apr. 1987, Cerón 1122 (MO, UC, US). — PERU, Amazonas, Prov. Chachapoyas, Jalca Calla-Calla, [6°28'S, 77°43'W], 3450 m, 29 July 1991, Mostacero et al. 2634 (MO). Ancash, Prov. Huari, Huascarán National Park, quebrada Pachachaca, a lateral valley of quebrada Rurichinchay, 9°23'S, 77°17'W, 3700–3860 m, 12 June 1986, Smith et al. 12543 (MO). Junín, Prov. Satipo, Cordillera Vilcabamba, Río Ene slope, near summit of divide, 11°39'36"S, 73°40'02"W, 3350–3400 m, 8 June 1997, Boyle et al. 4262 (NY). Lambayeque, Prov. Ferreñafe, Laguna



**Fig. 6** *Elaphoglossum gardnerianum* (Kunze ex Fée) T.Moore. a. Habit; b. rhizome scale; c. larger petiole scale; d. smaller petiole scale; e. abaxial laminar scale; f. abaxial laminar surface; g. adaxial laminar scale; h. adaxial laminar surface; i. fertile lamina (all: Matos 939B, CEPEC).

Tembadera, distrito Incahuasi, [6°09'S, 79°18'W], 3100 m, 11 Sept. 1985, Sagástegui et al. 12780 (GH, MO, NY, UC). **Pasco**, Prov. Oxapampa, Dist. Huancabamba, sector Santa Barbara, 10°20'55"S, 75°39'08"W, 3379 m, 27 Jan. 2005, Mellado 2658 (MO). — **BOLIVIA**, **Cochabamba**, Prov. Carrasco, Km 84 antigua carretera Cochabamba-Villa Tunari, 17°15'S, 65°43'W, 3750 m, 30 June 1996, Kessler et al. 6833 (LPB, NY, UC). **La Paz**, Prov. Murillo, bajando de la cumbre 16,7 km hacia Unduavi, pasando Pongo, [16°19'S, 67°57'W], 3700 m, 28 Apr. 1991, Beck 18754 (HUA, LPB, NY).

**Notes** — *Elaphoglossum engelii* and *E. muscosum* are two names commonly applied to species of subsect. *Muscosa* in the Andes. What has been called *E. muscosum* in the Andes is actually *E. lehmannianum* (see notes under that species for a discussion on the application of this name). The Andean species *E. lehmannianum* and *E. engelii* are often confused in herbaria, but they are easy to differentiate. *Elaphoglossum engelii* is terrestrial with short- to long-creeping rhizomes, linear rhizome scales with many teeth longer than 0.2 mm, ciliate petiole scales, and spores with ridges and irregular deposits (Fig. 1d). In contrast, *E. lehmannianum* is typically epiphytic with compact to short-creeping rhizomes, linear rhizome scales with few short teeth, erose petiole scales, and papillate spores without ridges (Fig. 1h).

In *E. engelii*, density of the laminar scales varies, and there is a slight geographic component to this variation. Typically, the scales of both surfaces of the lamina are imbricate, although the adaxial ones tend to fall off when the leaves get older. Specimens at the southern and northern limits of the distribution (Mexico, Guatemala, and Peru) sometimes have abaxial laminar scales more scattered and not necessarily obscuring the surfaces of the lamina.

Some specimens of *E. engelii* from Ecuador (e.g. Clements 2142, NY) have unusually black rhizome scales. These might be confused with *E. yatesii*, a species restricted to Ecuador and Colombia. *Elaphoglossum yatesii* differs by thinner and longer creeping rhizomes, petiole scales that generally point forward, and papillate spores with ridges (Fig. 1o).

The type material from B and W has some fertile-frond fragments not attached to the sterile parts. These fragments do not belong to *E. engelii* or any other species of subsect. *Muscosa*.

##### 5. *Elaphoglossum gardnerianum* (Kunze ex Féé) T.Moore — Fig. 1e, 6; Map 6

*Elaphoglossum gardnerianum* (Kunze ex Féé) T.Moore (1857b) 357. — *Acrostichum gardnerianum* Kunze ex Féé (1845) 55, t. 15, f. 3. — Type: Gardner 93 (lecto P (barcode P00249740), designated here; iso BM (barcode BM000890236), BM (barcode BM000890238), GCE n.v. (photo NY ex GCE), P (barcode P00249739, specimen on the left), P (barcode P00249741)), Brazil, Rio de Janeiro, Montes Orgãos, (22°16'S, 42°32'W), 1837.

Plants epiphytic. Rhizome 2–5 mm wide, compact; rhizome scales 3–5 mm long, linear-lanceolate, orange to brown, entire to denticulate, base truncate, apex filiform, oftentimes broken. Sterile leaves (4.5–)7.5–17 cm long, approximate; phylloodia present, obscured by the petiole-base scales; petiole 1.5–5 cm long, 1/6–1/3 the length of the sterile leaves; larger petiole scales 2–5 mm long, scattered to dense, spreading, oblanceolate, light brown to orange, ciliate, base truncate, short-stalked (c. 0.1 mm), apex acute; smaller petiole scales 0.3–0.5 mm long, scattered to dense, appressed, oblanceolate to round, light brown to orange, long-ciliate, base truncate, short-stalked (c. 0.1 mm), apex acute; lamina (3–)5.5–13.5 by (1–)1.5–3 cm, oblanceolate, coriaceous, base broadly cuneate, apex obtuse; veins c. 1 mm apart, at an angle of 75° with respect to the costa; adaxial laminar scales 0.5–2.5 mm long, dense, not imbricate, oblanceolate to linear-lanceolate, light brown, long-ciliate, base truncate, short-stalked (c. 0.1 mm), apex acute to filiform; abaxial laminar scales 0.5–2.5 mm long, dense, not imbricate, slightly elevated above the surface of the



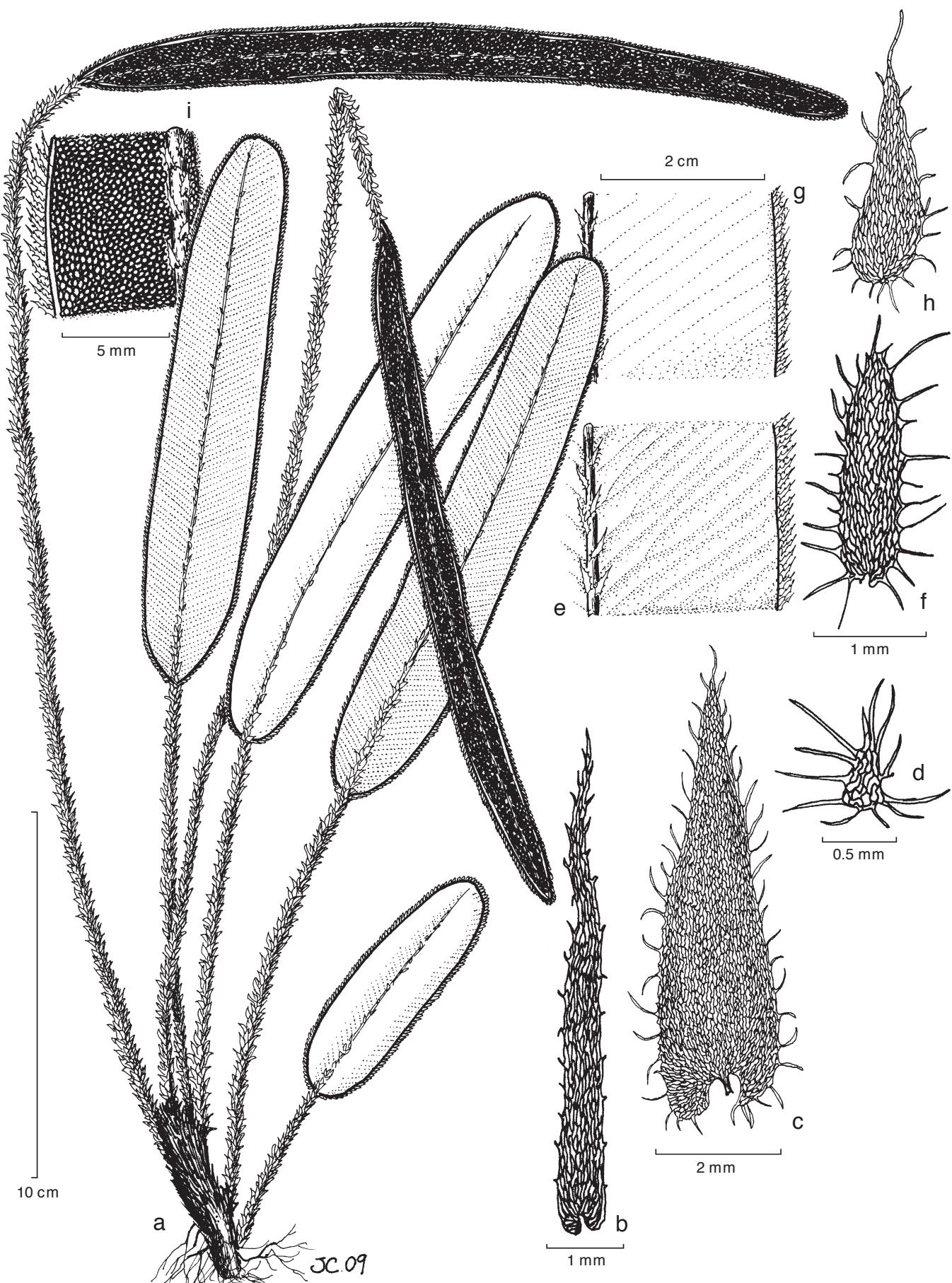
Map 6 Distribution of *Elaphoglossum gardnerianum* (Kunze ex Féé) T.Moore.

lamina to patent, oblanceolate to linear-lanceolate, light brown to orange, long-ciliate, base truncate, short-stalked (c. 0.1 mm), apex acute to filiform; abaxial costal scales same as the laminar ones, pointing at right angles, slightly elevated; marginal scales same as the laminar ones, dense. Fertile leaves longer than the sterile leaves; petiole 1/2–3/5 the length of the fertile leaves; petiole scales same as the ones of the sterile leaves; lamina (2.5–)5–10 by 0.4–2 cm, narrowly elliptic, coriaceous, glabrescent with age, base broadly cuneate, apex obtuse; adaxial laminar scales 0.5–2 mm long, dense, imbricate, lanceolate to round, light brown to orange, long-ciliate, base truncate, short-stalked (c. 0.1 mm), apex acute to filiform; abaxial costal scales 0.5–1.5 mm long, dense, pointing at right angles to apex, oblanceolate to round, light brown to orange, long-ciliate, base truncate, short-stalked (c. 0.1 mm), apex acute to filiform; intersporangial scales 0.5–1.5 mm long, scattered, oblanceolate to round, light brown to orange, long-ciliate, base truncate, short-stalked (c. 0.1 mm), apex acute to filiform. Spores papillate, without ridges.

**Distribution** — Brazil, states of Bahia, Espírito Santo, Minas Gerais, Rio de Janeiro, São Paulo; 900–1700 m. Epiphytic, growing in montane forests.

**Selection of other specimens examined.** BRAZIL, **Bahia**, Arataca, Serra do Peito de Moça, estrada que liga Arataca à Una, ramal c. 22.4 km de Arataca com entrada no Assentamento Santo Antônio, 15°10'25"S, 39°20'30"W, 1000 m, 16 Feb. 2006, Matos et al. 1000 (CEPEC). **Espírito Santo**, Castelo, Braço do Sul, [20°36'S, 41°12'W], 13 Aug. 1948, Brade 19289 (RB). **Minas Gerais**, Serra do Caraça, [20°05'S, 43°28'W], s.d., Damazio 1803 (RB); Santa Maria do Salto, divisa entre Bahia e Minas Gerais, Fazenda Duas Barras, Reserva do Alto Cariri, 16°24'23"S, 40°03'16"W, 950 m, 9 Feb. 2006, Matos et al. 939B (CEPEC). **Rio de Janeiro**, Itatiaia, Maromba, [22°25'S, 42°35'W], 1050 m, May 1950, Brade 20301 (RB). **São Paulo**, Campo Grande, [23°58'S, 46°21'W], 1907, Wackett 186 (UC).

**Notes** — *Elaphoglossum gardnerianum* can be distinguished by its small size (sterile leaves (4.5–)7.5–17 cm long), epiphytic habit, compact rhizomes, short petioles (1/6–1/3 of the sterile leaves), long-ciliate, concolorous petiole and laminar scales,



**Fig. 7** *Elaphoglossum glabrescens* A.Vasco. a. Habit; b. rhizome scale; c. larger petiole scale; d. smaller petiole scale; e. abaxial laminar surface; f. abaxial laminar scale; g. adaxial laminar surface; h. adaxial laminar scale; i. fertile lamina (a: Nee 34051, NY; b–i: Arroyo 61, HUA).

and papillate spores. It has intersporangial scales, which sometimes are difficult to distinguish because their colour is very similar to that of the sporangia. *Elaphoglossum muscosum*, the other species of the group occurring in Brazil, can be distinguished from *E. gardnerianum* by longer leaves (10–35 cm long), longer petioles (1/3–2/5 of the leaves length), erose petiole scales, and ciliate laminar scales. The cilia of the abaxial laminar scales of *E. muscosum* are never longer than the body of the scale, which is always the case in *E. gardnerianum*. Another difference between these two species is that generally *E. muscosum* has imbricate scales that obscure the abaxial surface of the laminae, whereas *E. gardnerianum* has dense to scattered scales that are never imbricate, thus the abaxial surface of the lamina is visible.

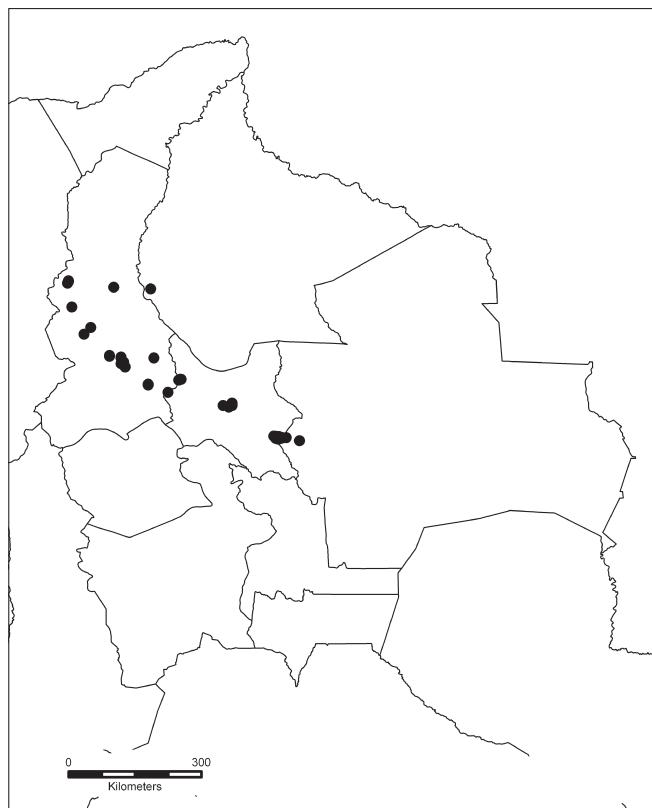
Plants from Brazil that have been identified as *E. bellermannianum* are misidentified; they represent either *E. gardnerianum* or *E. muscosum*. The main difference between *E. bellermannianum*, which does not occur in Brazil, and *E. gardnerianum* is that the former has bicolorous petiole and/or lamina scales (Fig. 3c, f). These are darker at the point of attachment, or mottled, or black medially with white borders. In contrast, scales of *E. gardnerianum* are always concolorous. Another difference is that the larger scales of the petioles and laminae of *E. gardnerianum* are always long-ciliate, whereas those of *E. bellermannianum* are erose.

###### **6. *Elaphoglossum glabrescens* A.Vasco, nom. & stat. nov.**

— Fig. 1f, 7; Map 7

*Elaphoglossum engelii* (H.Karst.) Christ var. *subnudum* Rosenst., Repert. Spec. Nov. Regni Veg. 11 (1912) 59, ('*subnuda*'). — Type: *Buchtien* 2725 (lecto S, designated here; iso US), Bolivia, La Paz, Prov. North Yungas, Unduavi, [16°19'S, 57°54'W], 3300 m, Nov. 1910. Non *Elaphoglossum subnudum* C.Chr.

Plants epiphytic or terrestrial. Rhizome 4–8 mm wide, short-creeping to erect; rhizome scales 4–8 mm long, linear-lanceolate, dark red to dark brown, sometimes with paler margin, denticulate to ciliate (teeth up to 0.3 mm), base truncate to slightly cordate, apex filiform. Sterile leaves 17–40(–58) cm long, approximate to up to 1 cm apart; phylloodia present, not obscured by the petiole-base scales; petiole 9–16(–30) cm long, 2/5–3/5 the length of the sterile leaves; larger petiole scales 3–6 mm long, scattered to dense, spreading, lanceolate, light brown to dark brown, sometimes mottled, ciliate, base cordate (sometimes appearing peltate because of the large auricles), apex acute; smaller petiole scales 0.5–3 mm long, scattered to dense, appressed, oftentimes hidden by the larger ones, oblanceolate to round, light to dark brown, sometimes mottled with lighter margin, ciliate, base cordate, apex acute; lamina 6–17(–28) by 1.8–3.8 cm, linear-oblong to oblong, chartaceous to coriaceous, glabrescent with age, base truncate to obtuse, apex obtuse; veins 1–1.5 mm apart, at an angle of 70° with respect to the costa; adaxial laminar scales 0.5–2 mm long, dense, lanceolate, white to light brown, ciliate, base cordate, apex acute; abaxial laminar scales 0.5–3 mm long, from absent to scattered, when present slightly elevated above the surface of the lamina and never imbricated, lanceolate to round, light to dark brown, sometimes mottled with lighter margin, ciliate, base cordate to short-stalked (up to 0.2 mm), apex acute; abaxial costal scales 0.5–3.5 mm long, dense, pointing forward to the apex or at right angles, slightly elevated, lanceolate to round, orange to dark brown, sometimes mottled with lighter margin or darker at the point of attachment, ciliate, base cordate, apex acute; marginal scales 0.5–1.5 mm long, dense, lanceolate to oblanceolate, orange, ciliate, base cordate to short-stalked (up to 0.1 mm), apex acute. Fertile leaves longer than the sterile leaves; petiole 2/5–3/4 the length of the fertile leaves; petiole scales same as the ones of the sterile leaves, but the small



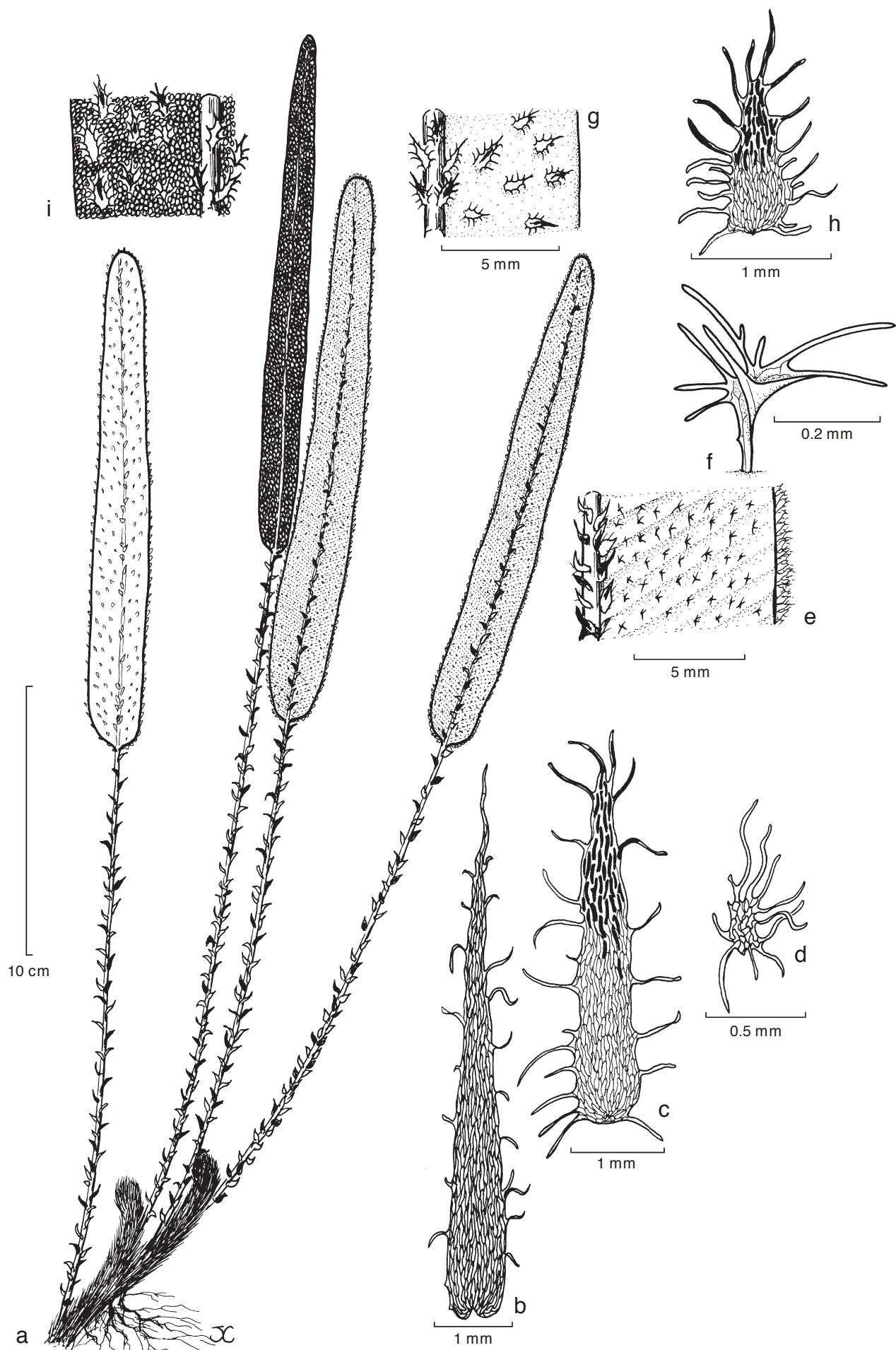
Map 7 Distribution of *Elaphoglossum glabrescens* A.Vasco.

ones tend to be darker, mottled to entirely black; lamina 8–19 by 1–2 cm, narrowly elliptic, chartaceous to coriaceous, glabrescent with age, base truncate, apex obtuse; adaxial laminar scales 0.5–1.2 mm long, dense, lanceolate, light brown to dark brown, sometimes mottled with lighter margin, darker along the costae, ciliate, base cordate, apex acute; abaxial costal scales 0.5–2(–3) mm long, dense, pointing forward to the apex or at right angles, lanceolate to round, orange to black, ciliate, base cordate, apex acute; intersporangial scales absent. Spores papillate, without ridges.

Distribution — Bolivia, departments of Cochabamba, La Paz, Santa Cruz; 2000–3800 m. Epiphytic or terrestrial in montane forests.

*Selection of other specimens examined.* BOLIVIA. **Cochabamba**, Prov. Carrasco, Siberia Oeste, Monte Hotel, 17°47'19"S, 64°47'18"W, 2700 m, 22 Sept. 2003, Fernández et al. 2528 (BOLV, MO); Prov. Carrasco, Km 100 antigua carretera Cochabamba-Villa Tunari, 17°12'S, 65°42'W, 3300 m, 26 June 1996, Kessler et al. 6734 (LPB, NY, UC). **La Paz**, Prov. Nor Yungas, Estación Biológica, de Tunquini, senda nueva del camino de la mina (curva al lado W) al pantanón, 16°11'S, 67°53'W, 3000 m, 14 Sept. 2000, Bach et al. 1042 (LPB, UC); Prov. Nor Yungas, Coscapa, sobre el sendero prehispánico Sillutinkara, 16°12'S, 67°53'W, 3100 m, 27 Apr. 2004, Jiménez 2152 (LPB, NY, UC). **Santa Cruz**, Prov. Caballero, 28 km desde Comarapa camino a la Siberia, 17°50'S, 64°38'W, 2600 m, 15 Aug. 1991, Arroyo et al. 61 (HUA, LPB, NY, UC); Prov. Caballero, 50 km al N de Mataral (en la carretera Santa Cruz-Comarapa) pasando por San Juan del Potrero y bajando a la cuenca del alto Río Ichilo, [17°53'S, 64°16'W], 2000 m, 25–26 May 1989, Smith 13319 (MO, UC).

*Notes* — *Elaphoglossum glabrescens* is characterized by short-creeping, ascending rhizomes, dark red to dark brown rhizome scales, and linear-oblong to oblong sterile lamina with obtuse apex and truncate to obtuse base. The type of *E. glabrescens* (*Buchtien* 2725) has the lower surface of the laminae completely glabrous, with scales present only on the costa and margin. Specimens with glabrous adaxial surfaces are easy to identify; however, some specimens of *E. glabrescens* are scaly abaxially. The scales range from scattered to dense, but they are small and never obscure the surface of



**Fig. 8** *Elaphoglossum laxisquama* Mickel. a. Habit; b. rhizome scale; c. larger petiole scale; d. smaller petiole scale; e. abaxial laminar surface; f. abaxial laminar scale; g. adaxial fertile laminar surface; h. adaxial fertile laminar scale; i. abaxial fertile lamina (all: Vásquez 28162, NY)

the laminae. Specimens with scaly abaxial surfaces can be confused with *E. laxisquama*, a species endemic to Peru. However, *E. laxisquama* has long-creeping, usually branched rhizomes, linear-lanceolate, acuminate larger petiole scales, that when bicolorous have dark apex (including the cilia) and lighter base and point of attachment. In contrast, *E. glabrescens* has short-creeping, ascending rhizomes that typically do not branch, larger petiole scales that are lanceolate with acute apex, and when bicolorous, it is the centre of the scale, not the apex, that becomes darker (the cilia are never dark). Moreover the spores of *E. laxisquama* are ridged (Fig. 1g), whereas the spores of *E. glabrescens* are not (Fig. 1f).

*Elaphoglossum glabrescens* was originally described by Rosenstock as a variety of *E. engelii*, from which it differs by the dark red to black rhizome scales, oblong laminae, and papillate spores. *Elaphoglossum engelii* has typically light brown to brown rhizome scales, linear lanceolate to oblanceolate laminae, and spores with ridges and irregular deposits. I gave the variety a new status and a new name. I chose a different epithet because *E. subnudum* C.Chr. already exists. However, to acknowledge the fact that Rosenstock noticed the difference and described it, I chose a similar epithet that denotes the glabrous condition of the lower laminae surface of some individuals of this species.

See *E. novogranatense* for a comparison with that species.

### 7. *Elaphoglossum laxisquama* Mickel — Fig. 1g, 8; Map 8

*Elaphoglossum laxisquama* Mickel (1991) 141. — Type: Young 1741 (holo NY; iso USM n.v.), Peru, San Martín, Prov. Mariscal Cáceres, Puerta del Monte, Río Abiseo Nat. Park, [7°45'S, 77°15'W], 3400 m, 19 Nov. 1985.

Plants terrestrial. Rhizome 3–7 mm wide, long-creeping, ascending; rhizome scales 7–11 mm long, linear, maroon to dark brown, sometimes darker at the centre, denticulate to ciliate (teeth up to 0.7 mm), base cordate (appearing peltate because of the large auricles), apex acuminate. Sterile leaves 15–55(–66) cm long, approximate to up to 1 cm apart; phylloodia present, sometimes obscured by the petiole-base scales; petiole 9–32(–41) cm long, 3/5–2/3 the length of the sterile leaves; larger petiole scales 5–8 mm long, dense, spreading, linear-lanceolate to lanceolate, orange to brown, mottled, sometimes black in the centre or in the apical portion (including the cilia), long-ciliate (up to 11 mm), base cordate (appearing peltate because of the large auricles), short-stalked (c. 0.1 mm), apex acuminate to filiform; smaller petiole scales 0.3–2.5 mm long, dense, spreading, oftentimes hidden by the larger ones, lanceolate to round, orange to brown, long-ciliate, base cordate, apex acuminate to filiform; lamina 6–25 by 2–3.5 cm, linear-oblong to oblanceolate, coriaceous, glabrescent with age, base truncate to broadly cuneate, apex obtuse to acute; veins 1–1.5 mm apart, at an angle of 70–80° with respect to the costa; adaxial laminar scales 0.5–3 mm long, scattered to dense, not imbricate, oblanceolate to round, orange to brown, mottled, sometimes black in the centre or in the apical portion (including the cilia), long-ciliate, base cordate, apex acuminate to filiform; abaxial laminar scales 0.2–1.5 mm long, scattered to dense, not imbricate, patent, lanceolate to oblanceolate, funneliform throughout (without flattened body), orange to brown, long-ciliate, base inrolled; abaxial costal scales 0.5–3 mm long, dense, pointing at right angles, slightly elevated to patent, oblanceolate, orange to brown, mottled, sometimes black in the centre or in the apical portion (including the cilia), long-ciliate, base truncate, short-stalked (up to 0.2 mm), apex acuminate to filiform; marginal scales 0.5–1 mm long, dense, patent, ovate to round, orange to brown, mottled, sometimes black in the apical portion or just the apical cilia black, long-ciliate, base truncate, short-stalked (up to 0.1 mm), apex acuminate to filiform. Fertile

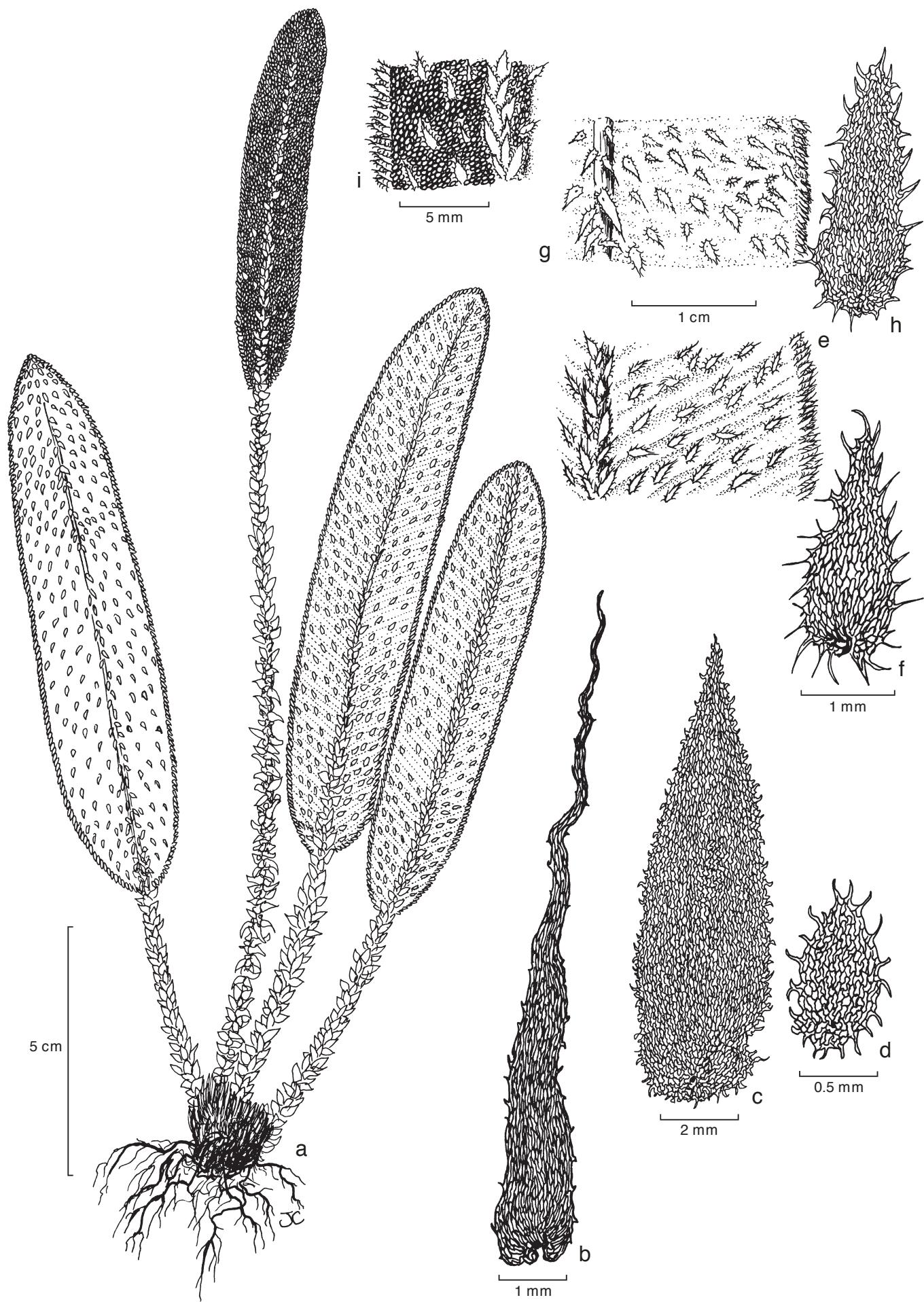


Map 8 Distribution of *Elaphoglossum laxisquama* Mickel.

leaves longer than the sterile leaves; petiole 3/4 the length of the fertile leaves; petiole scales same as the ones of the sterile leaves but the larger ones more spreading; lamina 5–16 by 1–2.5 cm, narrowly elliptic to oblong, coriaceous, base truncate to broadly cuneate, apex obtuse to acute; adaxial laminar scales 0.5–3 mm long, dense to scattered, not elevated to elevated above the surface of the lamina, oblanceolate to round, orange to brown, mottled, sometimes black in the apical portion or just the apical cilia black, long-ciliate, base truncate, short-stalked (up to 0.1 mm), apex acuminate to filiform; abaxial costal scales 1–5 mm long, dense, oblanceolate to round, orange to brown, mottled, sometimes black in the apical portion or just the apical cilia black, long-ciliate, base cordate, short-stalked (up to 0.1 mm), apex acuminate to filiform; intersporangial scales 0.5–1.5 mm long, scattered, oblanceolate to round, orange to brown, mottled, sometimes black in the apical portion or just the apical cilia black, long-ciliate, base cordate, short-stalked (up to 0.1 mm), apex acuminate to filiform. Spores papillate, with ridges.

Distribution — Colombia, Ecuador, Peru; 2400–3800 m. Terrestrial in montane forest and páramos.

Selection of other specimens examined. COLOMBIA, Cauca, c. 28 km E of Totoró, 2°33'N, 76°10'W, 3075 m, 6 May 1984, Luteyn et al. 10179 (JAUM, NY). — ECUADOR, Cañar, road from Gualeceo to Limón, 2°59'58"S, 78°39'36"W, 3410 m, 2 Mar. 2005, Moran et al. 7588 (NY). Carchi, Canton Montufar, Guandera Reserve, c. 6 km E of Fernández Salvador, 0°36'N, 77°42'W, 3500 m, 2 July 1996, Wilson et al. 2812 (UC). Loja, Cerro Toledo, E of Yangana, between Loja and Valladolid, 4°23'S, 79°07'W, 3000–3100 m, 26 Oct. 2004, Lehnert et al. 1457, 1461 (NY, UC). Napo, Oyacachi, 5 km después del paso, bosques en las márgenes de la carretera, 0°12'S, 78°06'W, 3500 m, 28 Dec. 1996, Navarrete 1373 (NY). — PERU, Cusco, Prov. La Convención, Huayopata, in part of the Pistipata drainage called Puncuyo, 10 km SW of Incatambo, 2400 m, 6 Oct. 1982, Peyton 1442 (MO). Pasco, Parque Nacional Yanachaga-Chemillen, Abra Yanachaga, 10°22'S, 75°27'W, 2870–3200 m, 12 June 2003, Vásquez et al. 28162 (NY, UC). San Martín, Prov. Mariscal Cáceres, small forest patch, above timberline, Chochos, 3400 m, 24 Nov. 1985, Young 2536 (NY).



**Fig. 9** *Elaphoglossum lehmannianum* Christ. a. Habit; b. rhizome scale; c. larger petiole scale; d. smaller petiole scale; e. abaxial laminar surface; f. abaxial laminar scale; g. adaxial laminar surface; h. adaxial laminar scale; i. fertile lamina (a, f–i: Rentería 5165; b–d: Rodríguez 5449, all HUA).

**Notes** — *Elaphoglossum laxisquama* can be distinguished by its long-creeping, erect rhizomes, long-ciliate petiole and laminar scales, and papillate, ridged spores. This is the only species of subsect. *Muscosa* in which some of the petiole and laminar scales have black or mottled tips (including the cilia) (Fig. 8c, h). This is a different colour pattern compared to other species of the subsection which, when bicolorous, have their centres black and the margins, including the cilia, lighter. Also, the abaxial laminar scales of this species are unique within subsect. *Muscosa* because they are patent and funnelform throughout their length, without a flattened body (Fig. 8f). Scales of all other species of the subsect. *Muscosa* that have inrolled or stalked base are never inrolled apically, thus the body of the scale remains flat and parallel (or nearly so) to the lamina surface (i.e. Fig. 5e, f).

Some specimens (e.g., Wilson et al. 2812, UC) have rhizome scales that are lighter and more oblanceolate than the typical ones, which are maroon to dark-brown and linear lanceolate. Also, the larger petiole scales of these specimens are more oblanceolate than the typical *E. laxisquama* petiole scales, which tend to be linear-lanceolate to lanceolate. However, these specimens have the typical dark-tipped, funnelform laminar scales that distinguish *E. laxisquama* from all other species of subsect. *Muscosa*. For these reasons I considered the specimens as belonging to this species.

### 8. *Elaphoglossum lehmannianum* Christ — Fig. 1h, 9; Map 9

*Elaphoglossum lehmannianum* Christ (1899) 81, f. 36. — Type: Lehmann 3557 (lecto B, designated here; iso BAS n.v., G.n.v., US), Colombia, Cauca, wächst an Bäumen in lichten Wäldern um Popayán, 1750 m, s.d.  
*Elaphoglossum decipiens* Hieron. (1905) 554. — Type: Lehmann 5075 (lecto B (sheet 070308), designated here; iso F, US), Colombia, Cauca: in a dense forest close to Poblazon supra urbem Popayán, 2000–2500 m, s.d.  
*Elaphoglossum yarumalense* Hieron. (1905) 556. — Type: Lehmann 7675 (lecto B (sheet 072280), designated here; iso US (barcode 00067395), US (sheet 1067595, drawing of B lectotype with a fragment in pocket)), Colombia, Antioquia, Yarumal, habitat ad arborum truncos silvarum pratis interruptarum prope El Yarumal in parte septentrionali provinciae Antioquia, [5°56'N, 75°35'W], 1600–2200 m, s.d.  
*Elaphoglossum squamiferum* A.Rojas (1996) 21, f. 11. — Type: Rivera 28 (holo INB), Costa Rica, Heredia, Parque Nacional Braulio Carrillo, Volcán Barva, 10°07'20"N, 84°06'00"W, 2600 m, 7 Aug. 1989.

Plants epiphytic or terrestrial. Rhizome 2–7 mm wide, short-creeping to erect; rhizome scales 9–12 mm long, linear, orange to dark brown, denticulate, base truncate, apex filiform, sometimes tortuous. Sterile leaves 10–40(–60) cm long, approximate; phyllodia present, obscured by the petiole-base scales; petiole 3–15(–35) cm long, 1/4–1/2 the length of the sterile leaves; larger petiole scales 3–7 mm long, scattered to dense, spreading, linear-lanceolate, light brown, erose to laciniate, base cordate (sometimes appearing peltate because of the large auricles), apex acute; smaller petiole scales 0.5–2 mm long, scattered to dense, appressed, oftentimes hidden by the larger ones, oblanceolate, light brown, erose to ciliate, base cordate (sometimes appearing peltate because of the large auricles), apex acute; lamina 6–25 by (1.5)–2–4(–5.5) cm, oblanceolate to linear-lanceolate, coriaceous, base broadly cuneate to rounded, apex obtuse to acute; veins 1–2 mm apart, at an angle of 75–80° with respect to the costa; adaxial laminar scales 1–2 mm long, scattered to dense, lanceolate, white to light brown, ciliate, base cordate, apex acute; abaxial laminar scales 0.5–2 mm long, dense to absent, not imbricate, slightly elevated above the surface of the lamina, lanceolate, light brown to brown, ciliate, base stalked, apex acute; abaxial costal scales same as the laminar ones, typically pointing at right angles, slightly elevated; marginal scales same as the laminar ones. Fertile leaves longer than the sterile leaves;



Map 9 Distribution of *Elaphoglossum lehmannianum* Christ.

petiole 1/2–3/4 the length of the fertile leaves; petiole scales same as the ones of the sterile leaves but the larger ones more spreading; lamina (5.5)–8–24(–35) by 0.6–2.5 cm, narrowly elliptic, coriaceous, glabrescent with age, base broadly cuneate, apex obtuse; adaxial laminar scales 0.5–3 mm long, dense, imbricate, lanceolate to round, light brown to brown, darker at the point of attachment, ciliate, base cordate, apex acute; abaxial costal scales 0.5–3 mm long, dense to scattered, pointing at right angles, lanceolate to round, brown, ciliate, base truncate, apex acute; intersporangial scales 1.5–4 mm long, scattered to dense, sometimes almost obscuring the sporangia, lanceolate, orange to brown, ciliate, base stalked, apex acute. Spores papillate, without ridges.

Distribution — Costa Rica, Panama, Venezuela, Colombia, Ecuador; 1150–3500 m. Epiphytic or terrestrial, in montane forests and páramos.

**Selection of other specimens examined.** COSTA RICA, Cartago, Cantón de Paraíso, investigation area of the CATIE, 9°33'30"N, 83°41'30"W, 2600–2700 m, 20 Dec. 1990, Bittner 180 (CR, HUA, NY). Heredia, Cantón de Barva, P.N. Braulio Carillo, cuenca del Tárcoles, estación Barva, entre la estación y Laguna del Barva, 10°07'20"N, 84°06'00"W, 2700–2900 m, 30 May 1997, Rojas 3546 (CR, INB, NY). Limón, Cantón de Talamanca, P.N. La Amistad, Tararia, sendero a Cerro Kámuk, entre Cerro Nai y Cerro Dudu, 9°13'39"N, 83°04'23"W, 2750–3100 m, 9 Nov. 1996, Rojas 3227 (CR, INB, NY). San José, Cerro de la Muerte, along the old oxcart trail above the interamerican Hwy, 9°33.23'N, 83°44.439'W, 2963 m, 28 Jan. 2008, Sundue et al. 1707 (HUA, INB, NY). — PANAMA, Chiriquí, above camp Aguacatal, E slope of Chiriquí Volcano, [8°47'N, 82°30'W], 2400–2500 m, 10–13 Mar. 1911, Maxon 5297 (US). — COLOMBIA, Antioquia, Mun. Caramanta, límites con el Mun. de Támesis, sector nascimentos Quebrada El Cóndor, 5°33'27.5"N, 75°40'51.2"W, 2650 m, 16 Apr. 2005, Rodríguez et al. 5449 (HUA, NY). Boyacá, Mun. Villa de Leyva, SFF de Iguaque, bosques secundarios de Robles, cerca al centro de visitantes, 5°41'43.8"N, 73°27'08.4"W, 2850 m, 29 Apr. 2007, Vasco et al. 760 (HUA, NY). Cauca, in parte septentrional altiplanitei popayanensis, 1600–1800 m, Lehmann 5139pp (B-070310, P-00577723, US-1067593, syntypes of *E. decipiens*); Popayán, [2°26'N, 75°37'W], 1500–1800 m, s.d., Lehmann 6945 (B, US, syntype of *E. decipiens*); forests of Popayán, [2°26'N, 75°37'W], 1700–2300 m, Jan. 1901, Lehmann BT1299 (GH, NY). Cesar, Sierra del Perijá, E of Manaure, sabana Rubia, [10°21'N,

72°56'W], 3000–3100 m, 7 Nov. 1959, Cuatrecasas 25092 (US). **Cundinamarca**, Bogotá, D.C. Región del Sumapaz, cerca a Santa Rosa, 4°11'21"N, 74°11'36"W, 3160 m, 19 Feb. 1997, Betancur et al. 7026 (COL, HUA, NY). **Nariño**, Mun. Pasto, Bosque Botana, [1°12'N, 77°16'W], 3100 m, 22 Aug. 1963, Soejarto 480 (COL, GH). **Norte de Santander**, hoja del Río Chitagá en Vega, 2880 m, 28 Nov. 1941, Cuatrecasas 13462 (COL, US). **Quindío**, 'Pinares', above Salento, [4°38'N, 75°34'W], 2600–2800 m, 2–10 Aug. 1922, Pennell 9252 (GH, NY, US). **Risaralda**, Mun. Santuario, PNN Tatamá, camino que lleva al Páramo de Tatamá, subiendo hacia Morro Zancudo, 5°07'28.1"N, 76°02'30.6"W, 2643 m, 17 Apr. 2007, Vasco et al. 737 (HUA, NY). **Santander**, along road between Pamplona and Chorro Colorado vía Chiquirá, at Km 128 marker, 7°22'N, 72°38'W, 2580 m, 4 May 1983, Croat 56407 (JAUM, UC). **Tolima**, Libano-Murillo road., c. 18–24 km W of Libano, 4°45'N, 75°10'W, 2450–2770 m, 18 May 1984, Luteyn et al. 10627A (NY). – VENEZUELA. **Barinas**, Mun. Morán, pica que va desde Buenos Aires al Páramo de Las Rosas, 9°34'N, 70°06'W, 2300–2600 m, 15 Nov. 1984, Van der Werff 7968 (MO, UC). **Mérida**, Páramo de La Negra, [8°16'N, 71°52'W], 2980 m, 13 Feb. 1939, Alston 7000A (COL, MO, VEN). **Táchira**, carretera Bailadores-La Grita, vía Páramo La Negra, 8°15'20"N, 71°52'46"W, 3000 m, 29 May 2008, Vasco et al. 806, 807, 809, 812 (NY, VEN). **Trujillo**, Mun. Carache, Páramo El Jabón, 9°31'N, 70°06'W, 2900–3000 m, 28 May 1988, Rivero et al. 1802 (NY, UC, VEN). – ECUADOR. **Azúay**, E cordillera, 1–8 km N of the village of Sevilla de Oro, [2°48'S, 78°37'W], 2438–2743 m, 27 July–12 Aug. 1945, Camp 4590 (F, NY, US). **Carchi**, Valle de Maldonado, km 53 on the road Tulcán-Maldonado, steep slopes in cloud forest, 0°50'N, 78°03'W, 3150 m, 17–18 May 1973, Holm-Nielsen 5647 (AAU, MO, NY, UC). **Cotopaxi**, in pas c. m. Corazón, [0°53'S, 78°30'W], 3400 m, Sept. 1892, Sodiro s.n. (P). **Imbabura**, N slope of Volcan Cotacachi, protected forest area above town of Peribuela, 0°22'50.7"N, 78°17.787'W, 2879 m, 30 Nov. 2006, Sundue 1066 (NY, QCA). **Loja**, about 10 km SW of Loja, along road past the University towers La Violeta, [4°02'S, 79°10'W], 2950 m, 26 Apr. 1987, Van der Werff 9055 (MO, NY, UC). **Morona-Santiago**, W de la ciudad del Macas, 2°18'S, 78°07'W, 1160 m, 28 Feb. 1986, Baker 6689 (NY). **Napo**, Paso de Guamaní, Río Chalpi, at the bridge on road Papallacta-Baeza, [0°22'S, 78°05'W], 2800 m, 6 May 1967, Sparre 15886 (S). **Pichincha**, Nonogalea, [0°04'S, 78°33'W], Sept. 1899, Sodiro s.n. (S, US); Volcán Corazón, [0°32'S, 78°39'W], Oct. 1903, Sodiro s.n. (B); carretera Quito-Sto. Domingo, [0°28'S, 78°43'W], 2500 m, 24 May 1987, Van der Werff 9581 (MO, NY, UC). **Sucumbíos**, Km 15–18, carretera Pun-Aguarico, 2800–2900 m, 13 Aug. 1949, Acosta-Solis 13283 (F).

**Notes** — *Elaphoglossum lehmannianum* can be distinguished by its epiphytic habit (although it can be terrestrial above 3000 m), short-creeping to erect rhizomes, long, linear, denticulate rhizome scales, erose to lacinate (never ciliate) larger petiole scales, and papillate spores without ridges. It exhibits considerable variation in the density of the abaxial laminar scales. Some plants have their abaxial surfaces completely obscured by the scales, whereas others are subglabrous, with the laminar scales restricted to the margins and costae. The two extremes intergrade completely. Moreover, field observations of the plants in Colombia and Venezuela reveal that scaly and glabrous laminae can be found on the same rhizome (e.g. Vasco 821, NY). The plants with glabrous laminae were described from Costa Rica as *E. squamiferum*, here considered a synonym.

*Elaphoglossum lehmannianum* resembles *E. muscosum*, and the latter name is the one that has been commonly applied to *E. lehmannianum* in Costa Rica, Panama, and northern South America. The differences between these two species, especially in the scaly specimens of *E. lehmannianum*, are extremely subtle. Phylogenetic molecular analyses (Vasco & Moran in prep.), however, recovered these two species in two different clades, and thus they are recognized here as two different entities. Although similar, *E. lehmannianum* and *E. muscosum* can be distinguished by scales of the rhizomes and petioles and by geographic distribution. *Elaphoglossum lehmannianum* has orange to dark brown denticulate rhizome scales with teeth 0.1–0.2 mm long. *Elaphoglossum muscosum* has reddish orange, entire rhizome scales. Occasionally these scales have teeth, but they are less than 0.1 mm long. The larger petiole scales of *E. lehmannianum*, although erose like those of *E. muscosum*, tend to have slightly longer teeth. These teeth are never longer than the scale body, as is the case in

*E. engelii*. As to geographic distribution, *E. lehmannianum* occurs in Costa Rica, Panama, Venezuela, Colombia, and Ecuador (Map 9). In contrast, *E. muscosum* occurs from Mexico to El Salvador, and in Cuba, Jamaica, Haiti, Dominican Republic, and Southern Brazil (Map 10). The two species do not overlap geographically. Because of the variation within each species in scale shape, scale density, and lamina shape, it is difficult to find more characters that distinguish them; however, *E. lehmannianum* has a tendency toward darker rhizome scales, acute leaf apex, and smaller abaxial laminar scales that do not obscure the abaxial surface (especially in specimens of lower elevations). The abaxial laminar scales are stalked in both species, but tend to be longer-stalked, therefore appearing more elevated above the surface, in *E. lehmannianum*.

Another species with which *E. lehmannianum* is likely to be confused is *E. ruficomum*, endemic to Peru and north-western Bolivia. These two species can be distinguished by their rhizome and petiole scales. The rhizome scales of *E. lehmannianum* are less than 12 mm long, orange to dark brown, and dull; in contrast, those of *E. ruficomum* are typically 12–20 mm long, maroon, and lustrous. The petiole scales of *E. lehmannianum* are erose to lacinate, whereas those of *E. ruficomum* are ciliate.

Although Lehmann's main set of specimens is deposited at B, I designated the specimen at US as the lectotype. This specimen is more complete and has a rhizome and fertile leaves all belonging to a single plant. In contrast, the B specimen does not have a rhizome, and the collection consists of one fertile and three sterile leaves detached from each other.

See *E. bellermannianum* and *E. engelii* for a comparison with those species.

## 9. *Elaphoglossum muscosum* (Sw.) T.Moore — Fig. 1i, 10; Map 10

*Elaphoglossum muscosum* (Sw.) T.Moore (1857c) 362. — *Acrostichum muscosum* Sw. (1788) 128. — Type: Swartz s.n. (lecto S, designated by Proctor (1985) 503; second-step sheet P12230, designated here; iso B (barcode W-19514, frond mounted on the right), BM (barcode 000585005), S (sheet R-65)), Jamaica.

*Acrostichum muscosum* var. *latifolium* Hook. (1864) 231. — Syntypes: Macfayden s.n. (K n.v.), Bancroft s.n. (K n.v.), Jamaica.

*Elaphoglossum hookerianum* Underw. ex Maxon (1909) 6. — Type: Von Tuerckheim II 1862 (lecto US, designated here; iso F, NY), Guatemala, Alta Verapaz, Cobán, 1350 m, Aug. 1907.

Plants epiphytic or epipetric. Rhizome 2–6 mm wide, short-creeping to erect; rhizome scales 10–15 mm long, linear, reddish orange, entire or occasionally with small teeth (less than 0.1 mm), base truncate, apex filiform, oftentimes broken. Sterile leaves (7–)10–35(–40) cm long, approximate; phylllopedia present, obscured by the petiole-base scales; petiole 3–15.5 cm long, 1/3–2/5 the length of the sterile leaves; larger petiole scales 2–6 mm long, scattered to dense, spreading, linear-lanceolate, light brown, erose, base cordate (sometimes appearing peltate because of the large auricles), apex acute; smaller petiole scales 0.5–2 mm long, scattered to dense, appressed, oftentimes hidden by the larger ones, oblanceolate, light brown, erose to ciliate, base cordate (sometimes appearing peltate because of the large auricles), apex acute; lamina 7–25 by (1.5–)2–5(–5.5) cm, oblanceolate, coriaceous, base broadly cuneate to rounded, apex obtuse to acute; veins 1–2 mm apart, at an angle of 75° with respect to the costa; adaxial laminar scales 1–3 mm long, scattered to dense, lanceolate, white to light brown, ciliate, base cordate, apex acute; abaxial laminar scales (0.5–)1.5–3 mm long, dense, imbricate, more dense towards the costa, slightly elevated above the surface of the lamina, lanceolate, light brown to brown, ciliate, base cordate (sometimes appearing peltate because of the large

auricles), very short-stalked (c. 0.1 mm), apex acute; *abaxial costal scales* same as the laminar ones, pointing at right angles to apex, slightly elevated; *marginal scales* same as the laminar ones. *Fertile leaves* longer than the sterile leaves; *petiole* 1/2–4/5 the length of the fertile leaves; *petiole scales* same as the ones of the sterile leaves but the larger ones more spreading; *lamina* (14.5)–18–42(–52) by 0.8–2(–2.5) cm, narrowly elliptic, coriaceous, base broadly cuneate, apex obtuse; *adaxial laminar scales* 0.5–2 mm long, dense, imbricate, lanceolate to round, light brown to brown, slightly darker at the point of attachment, ciliate, base cordate, apex acute; *abaxial costal scales* 0.5–2 mm long, dense, pointing at right angles to apex, slightly elevated, lanceolate to round, reddish brown, ciliate, base truncate, apex acute; *intersporangial scales* 0.5–2 mm long, scattered but abundant, not obscuring the sporangia, lanceolate, brown, ciliate, base truncate, apex acute. Spores papillate, without ridges.

**Distribution** — Mexico, Guatemala, Honduras, El Salvador, Cuba, Jamaica, Haiti, Dominican Republic, Brazil; 1300–3200 m. Epiphytic or epipetric, in montane and cloud forests.

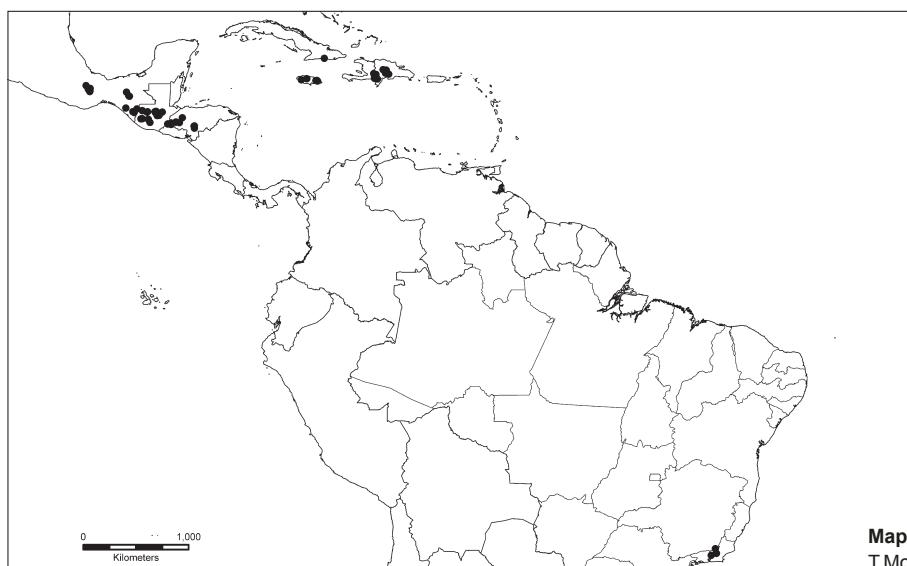
**Selection of other specimens examined.** MEXICO. **Chiapas**, near residences at Yerba Buena Mission, near Pueblo Nuevo Solistahuacan, along route 195, [17°06'N, 92°53'W], 1524–1829 m, 18 Dec. 1972, Somers et al. 199 (NY). **Oaxaca**, Dto. of Villa Alta, 2.3 miles S of Villa Alta on trail toward Betaza, [17°21'N, 96°09'W], 1520 m, 5 Aug. 1962, Mickel 1126 (NY). **Veracruz**, Cerro del San Martín, 28 Sept. 1971, Calzada 572 (F, MEXU). — GUATEMALA. **Alta Verapaz**, Cobán, Chicu'sha'b 8 km al SW de Cobán, 15°26'N, 90°27'W, 22 July 1988, Tenorio et al. 14731 (MO, NY); Cobán, [15°28'N, 90°22'W], 1310 m, July 1886, Von Tuerckheim II 1001 (US). **Baja Verapaz**, Chilasco, in forest on Concepción Road, [15°07'N, 90°06'W], 28 July 1971, Contreras 10916 (MO, US). **Chimaltenango**, Cerro de Tecpám, region of Sta. Elena, [14°47'N, 91°01'W], 2700 m, 4 Dec. 1938, Standley 58696 (F, US). **Huehuetenango**, above San Juan Ixcoy, Sierra de los Cuchumatanes, [15°31'N, 91°32'W], 2400 m, 4 Aug. 1942, Steyermark 50016 (F, US). **Quezaltenango**, El Pocito S of San Martín Chile Verde, on road to Colombia, [14°49'N, 91°39'W], 2200 m, 27 Jan. 1941, Standley 84988 (F). **Quiché**, Nebaj, c. 13 km on Sacopulas Road, [15°24'N, 91°08'W], 2440 m, 13 June 1964, Contreras 4978 (US). **Totoncapán**, Pacajá, region of Desconsuelo, mountains above Totoncapán, [14°50'N, 91°32'W], 3100–3200 m, 23 Jan. 1940, Standley 84561 (F). **Zacapa**, summit of Sierra de las Minas, vic. of Finca Planadas, 2500 m, 14 Oct. 1939, Steyermark 29999 (F). — HONDURAS. **Francisco Morazán**, on Cerro La Tigra near Tegucigalpa, [14°12'N, 87°07'W], 11 Apr. 1972, Clewell s.n. (NY); Cerro de Uyuca, [14°01'N, 87°05'W], 1650–2000 m, 10–20 Mar. 1951, Morton 7170 (US). **Intibucá**, cut over cloud forest of Sierra Opalaca above El Duraznillo, [14°30'N, 88°22'W], 1800 m, 8 Aug. 1971, Molina 26084 (F, NY). **Lempira**, Celaque National Park, trail from camp 1 to Río Naranjal, 14°33'N, 88°40'W, 2000 m, 14 Nov. 1991, Moran 5540 (MO). **Ocotepeque**, cloud forest of El Portillo on Cordillera Meredó, 20 km from Nueva Ocotepeque, [14°28'N, 89°04'W], 1800 m, 28 Aug. 1968, Molina 22327 (F). **Santa Bárbara**, 7 km N of El Mochito, on the E slopes of Mt Santa Bárbara, 14°55'N,

88°07'W, 2200–2500 m, 23 Nov. 1991, Moran 5710 (MO). — EL SALVADOR. **Chalatenango**, El Pital, [14°20'N, 89°05'W], 2600 m, 16 Nov. 1978, Seiler 740 (NY). **Santa Ana**, Bosque Montecristo, [14°23'N, 89°22'W], 2200 m, 10 Oct. 1978, Seiler 653 (F, NY, UC). — CUBA. **Oriente**, Sierra Maestra, Pico de La Bayanesa, N slope, 1530 m, 16–19 July 1955, Schultes et al. 560 (GH). **Santiago de Cuba**, crest of Sierra Maestra between Pico Turquino and La Bayanesa, [19°59'22" N, 76°50'09" W], 1350 m, 27–29 Oct. 1941, Morton 3792 (US). — JAMAICA. **Portland**, vic. of Portland Gap, [18°03'N, 76°36'W], 1650 m, 16 Mar. 1920, Maxon 1094 (US). **St. Andrew**, vic. of Cinchona, summit Sir John Peak, [18°06'N, 76°38'W], 2–10 Sept. 1906, Underwood 3212 (NY, US). — HAITI. Guimbi Galata, Morres des Commissaires, 1800 m, 24 Oct. 1943, Holdridge 1796 (US). — DOMINICAN REPUBLIC. **Ázua**, Sierra de Ocoa, San José de Ocoa, Loma Sucia, [18°38'N, 70°30'W], 2300 m, 21 Mar. 1929, Ekman 11998 (S). **Elias Piña**, Sierra de Neiba, 31–34 km by road NNW of La Descubierta, 11–14 km N of El Angel Felix, [18°38'N, 71°46'W], 1850–1900 m, 21 Feb. 1983, Mickel et al. 8773 (NY). **Independencia**, Sierra de Neiba, entre cerros de Plan Ciquen and Loma El Hoyazo, 34 km de la Descubierta en la carretera de la frontera a Aniseto Martínez y Valle Hondo, 18°41'N, 71°47'W, 1800 m, 15 Dec. 1982, Zanoni et al. 24902 (JBSD, NY). **La Vega**, Loma de Mono Mojao y arroyo Las Piedras, 36 km S de Constanza, 18°43'N, 70°47'W, 2150 m, 10 June 1982, Zanoni 20879 (JBSD). **Pedernales**, Sierra de Baoruco, 45 km S of Jimani-Duverge Hwy (cruce del escondido), 8 km S of El Aguacate, 7.2 km N of the ridge top, [18°17'N, 71°43'W], 1700 m, 22 Feb. 1983, Mickel et al. 8870 (NY). **Peravia**, Río La Nevera, arriba del Vivero La Nevera de la Dirección Nacional Forestal, 41 km N de San José de Ocoa, 18°41'N, 70°35'W, 2200 m, 7 Feb. 1984, Zanoni et al. 29051 (NY, US). **San Juan**, trail between Lagunita (Lagüita) and Pico Duarte, [19°01'N, 70°59'W], 2250 m, 20 July 1967, Gastony et al. 376 (GH, NY). — BRAZIL. **Rio de Janeiro**, Serra dos Órgãos, Picada do Rancho Frio, [21°52'S, 42°38'W], 1400 m, 24 July 1940, Brade 16466 (RB).

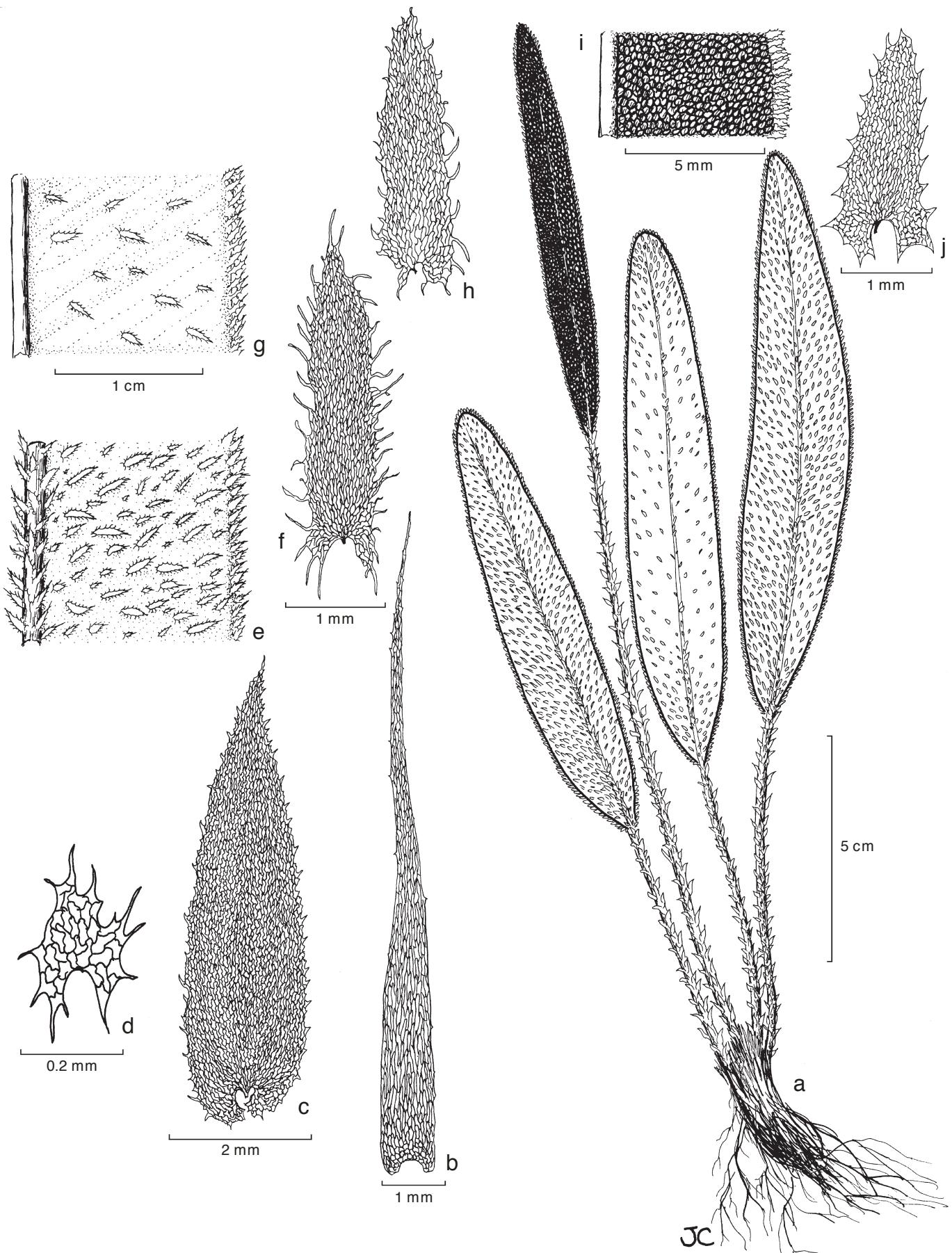
**Notes** — *Elaphoglossum muscosum* is characterized by compact rhizomes, rhizome scales linear with long-filiform apex, erose petiole scales, and papillate spores. The density of the laminar scales is variable. Specimens from Jamaica (where the type was collected), Cuba, Dominican Republic, and Brazil have laminae completely covered by scales, whereas specimens from Mexico, Guatemala, El Salvador, and Honduras tend to have smaller and more dissected abaxial laminar scales that do not always obscure the surface of the lamina.

*Elaphoglossum muscosum* has been the name previously applied to specimens from Costa Rica, Panama, and northern South America that I recognize here as *E. lehmannianum*. The two species are subtly different morphologically, and their differences are further supported by molecular phylogenetic analysis (Vasco & Moran in prep.). See notes under *E. lehmannianum* for a comparison of these two species. Also, see *E. bellermanianum* for a comparison with that species.

The application of the name *E. muscosum* has been confusing because, in the protologue, Swartz (1788) provided a Latin



Map 10 Distribution of *Elaphoglossum muscosum* (Sw.) T.Moore.



**Fig. 10** *Elaphoglossum muscosum* (Sw.) T.Moore. a. Habit; b. rhizome scale; c. larger petiole scale; d. smaller petiole scale; e. abaxial laminar surface; f. abaxial laminar scale; g. adaxial laminar surface; h. adaxial laminar scale; i. fertile lamina; j. fertile adaxial laminar scale (all: Maxon 657, NY).

description of plants he had collected in Jamaica, but cited an illustration from Plumier (1705) t. 139. The specimens annotated by Swartz and the Latin description agree with the present use of the name, whereas the illustration probably corresponds to *E. eggersii* (Baker) Christ.

The isotype of *E. muscosum* at B (B-W-19514) is the frond mounted on the right side of the sheet. The frond on the left is the fertile lamina of another species of *Elaphoglossum*. Apparently, the frond of *E. muscosum* was mounted on this sheet by mistake, instead of on sheet B-W-19523. The B-W-19523 sheet has information about *E. muscosum*, but it has a sterile frond that presumably should have been mounted with the fertile frond of sheet B-W-19514.

#### 10. *Elaphoglossum novogranatense* A.Vasco, sp. nov.

— Fig. 1j, 11; Map 11

Haec species quoad habitum epiphyticum, rhizomata breviter repentina usque erecta, petiolorum squamas ciliatas majores, laminam abaxialiter glabram vel subglabram squamis sparsim dispersis nunquam imbricatis et sporas papillatas *Elaphoglosso glabrescenti* similis, sed ab eo squamis costalibus adaxialibus atrobrunneis, venis prominentibus et praesentia squamarum inter sporangia differt. — Typus: Vasco et al. 746 (holo HUA; iso COL, NY), Colombia, Risaralda, Mun. Santuario, PNN Tatamá, camino que lleva al Páramo de Tatamá, 5°07'22.0"N, 76°02'45.2"W, 3060 m, 17 Apr. 2007.

Plants epiphytic. Rhizome 3–5 mm wide, short-creeping to erect; rhizome scales 5–9(–13) mm long, linear-lanceolate, orange to dark brown, denticulate to ciliate, base truncate to slightly cordate or stalked, apex filiform to tortuous. Sterile leaves 20–36(–50) cm long, approximate; phylloodia present, not obscured by the petiole-base scales; petiole 8–15(–21) cm long, 1/3–1/2 the length of the sterile leaves; larger petiole scales 3–5 mm long, dense, spreading, lanceolate to oblanceolate, orange to dark brown, sometimes mottled or darker at the point of attachment, ciliate, base truncate, sometimes short-stalked, apex acute; smaller petiole scales 0.5–1 mm long, dense, oftentimes hidden by the larger ones, oblanceolate to round, orange to dark brown, or mottled, ciliate, base truncate to stalked, apex acute; lamina 11–24(–30) by 3–5 cm, oblanceolate to lanceolate, coriaceous, base broadly cuneate to obtuse, apex obtuse; veins 1–2 mm apart, at an angle of 75–80° with respect to the costa; adaxial laminar scales 1–2 mm long, scattered, oblanceolate, white to light brown, ciliate, base cordate to truncate, apex acute; abaxial laminar scales 0.5–3 mm long, from absent to scattered, when present slightly elevated above the surface of the lamina and never imbricate, lanceolate to round, orange to dark brown, sometimes mottled with lighter margin, ciliate, base truncate to short-stalked, apex acute; abaxial costal scales 0.5–2.5 mm long, dense, pointing forward to the apex, not elevated, lanceolate to round, dark brown, sometimes mottled, ciliate, base cordate to truncate, apex acute; marginal scales 0.5–1 mm long, dense, oblanceolate, orange, ciliate, base truncate, short-stalked, apex acute. Fertile leaves longer than the sterile leaves; petiole 3/5–5/7 the length of the fertile leaves; petiole scales same as the ones of the sterile leaves; lamina 9–15 by 1.5–2 cm, narrowly-elliptic to linear-lanceolate, coriaceous, base truncate, apex obtuse; adaxial laminar scales 0.5–1.5 mm long, dense, oblanceolate to round, orange to dark brown, sometimes mottled, long-ciliate, base truncate to cordate, apex acute; abaxial costal scales 0.5–1.5 mm long, dense, pointing forward to the apex, slightly elevated, oblanceolate to round, orange to dark brown, sometimes mottled, long-ciliate, base truncate to short-stalked, apex acute; intersporangial scales 0.5–1.5 mm long, scattered, not obscuring the sporangia, lanceolate to oblanceolate, orange, sometimes mottled, long-ciliate, base truncate, apex acute to filiform. Spores papillate, without ridges.



Map 11 Distribution of *Elaphoglossum novogranatense* A.Vasco.

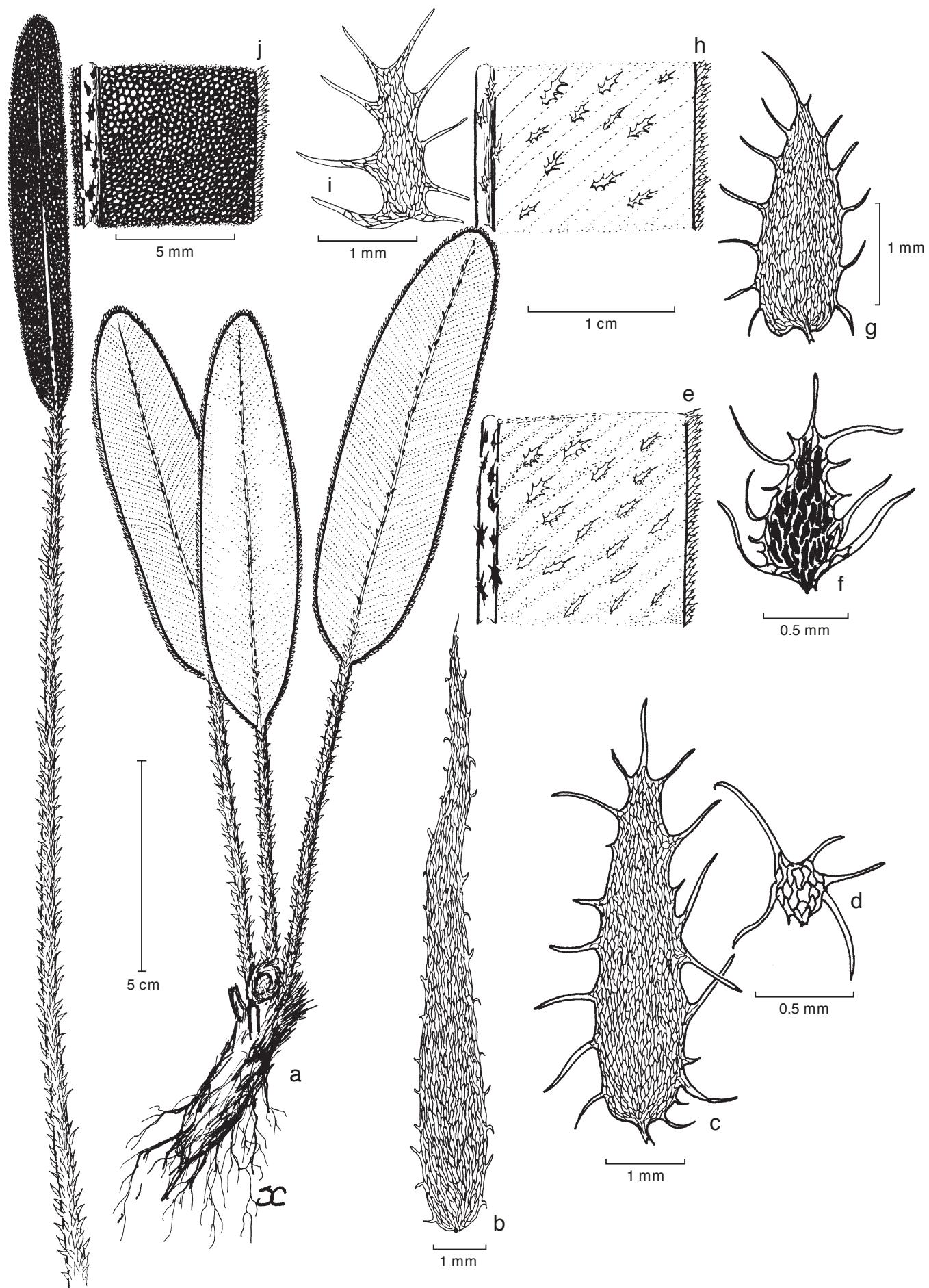
Distribution — Colombia, Ecuador; 2600–3300 m. Epiphytic in montane and cloud forests.

*Selection of other specimens examined.* COLOMBIA, Antioquia, Mun. Bello, Corregimiento de San Felix, Alto de Las Baldías, sector antenas de El Colombiano, 6°20'38"N, 75°38'54"W, 2950–3050 m, 1 Oct. 2005, Rodriguez et al. 5500 (HUA, NY). Cauca, Km 55 on road from Totoró to Inzá, E of Páramo de Guanacas, [2°31'N, 76°11'W], 2 Aug. 1972, Barrington 484 (COL); Mun. Puracé, San Rafael Km 149, vía La Plata-Popayán, margen derecha del Río Cocuy, [2°20'N, 76°30'W], 3300 m, 16 Apr. 1982, Torres 884 (COL). Huila, Macizo Colombiano, Páramo de Las Papas, cerros y alrededores de la laguna La Magdalena, [1°54'N, 76°39'W], 3530 m, 16 Oct. 1958, Idrobo et al. 2947pp (COL). Risaralda, Mun. Santuario, PNN Tatamá, camino que lleva al Páramo de Tatamá, subiendo hacia Morro Zancudo, 5°07'28.1"N, 76°02'30.6"W, 2643 m, 17 Apr. 2007, Vasco et al. 735 (HUA, NY); same locality, 5°07'22.7"N, 76°02'40.5"W, 3060 m, 17 Apr. 2007, Vasco et al. 742 (HUA, NY). — ECUADOR, Carchi, Valle de Maldonado, km 67 on the road Tulcán-Maldonado, 0°53'N, 78°04'W, 2600 m, 21 May 1973, Holm-Nielsen et al. 6246 (AAU); border area Prov. Carchi and Sucumbíos, road Julio Andrade-Playón de San Francisco, [0°36'N, 77°38'W], 3300 m, 9 Aug. 1989, Van der Werff 11067 (MO). Chimborazo, along road Julio Andrade-El Carmelo-Tulcán, 2900–3200 m, 7 Aug. 1989, Van der Werff 10962 (MO, UC).

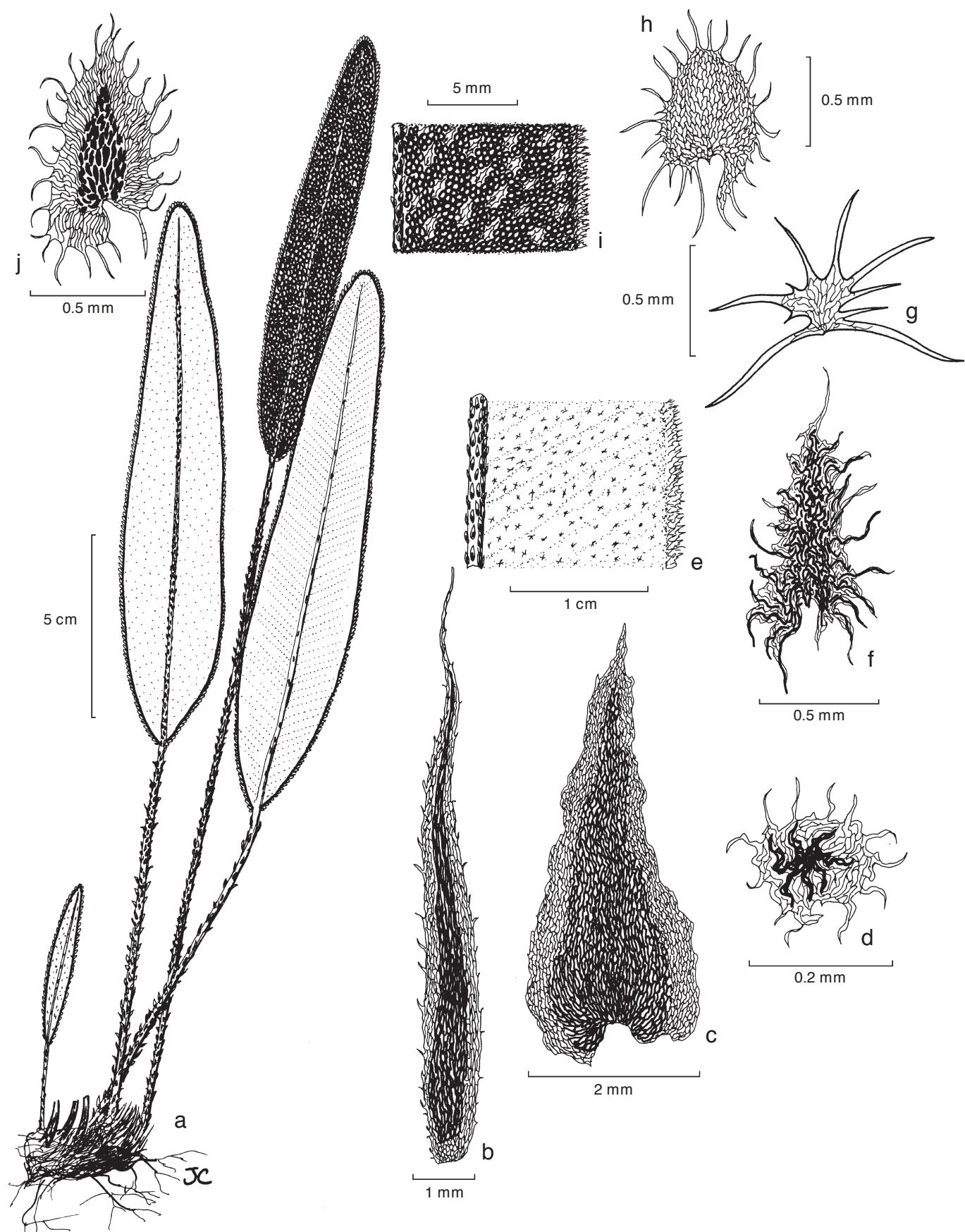
*Notes* — *Elaphoglossum novogranatense* can be distinguished by its epiphytic habit, short-creeping to erect rhizomes, appressed, dark brown abaxial costal scales, and papillate spores. The abaxial lamina surface is always visible, prominently veined, and either glabrous or sparsely scaly. *Elaphoglossum novogranatense* is similar to *E. glabrescens*, from which it can be distinguished by its appressed, dark brown adaxial costal scales, and the presence of intersporangial scales. In contrast, *E. glabrescens* has appressed to spreading, orange to dark brown, sometimes mottled with lighter margin or darker at the point of attachment costal scales, and lacks intersporangial scales.

See *E. aschersonii* for a comparison with that species.

The specific epithet refers to New Granada (Nueva Granada), a former name for Colombia, after which the species is named.



**Fig. 11** *Elaphoglossum novogranatense* A.Vasco. a. Habit; b. rhizome scale; c. larger petiole scale; d. smaller petiole scale; e. abaxial laminar surface; f. abaxial costal scale; g. abaxial laminar scale; h. adaxial laminar surface; i. adaxial laminar scale; j. fertile lamina (all Vasco et al. 746, HUA).



**Fig. 12** *Elaphoglossum oculatum* Mickel. a. Habit; b. rhizome scale; c. larger petiole scale; d. smaller petiole scale; e. abaxial laminar surface; f. abaxial laminar costal scale; g. abaxial laminar scale; h. marginal laminar scale; i. fertile lamina; j. intersporangial scale (all: Hutchison 1629, UC).

### 11. *Elaphoglossum oculatum* Mickel — Fig. 1k, 12; Map 12

*Elaphoglossum oculatum* Mickel (1991) 150. — Type: Hutchison 1629 (holo U; iso GH), Peru, Piura, Prov. Huancabamba, above Huancabamba, road to Canchaque, [5°14'S, 79°27'W], 3100 m, 10 Oct. 1957.

Plants epiphytic. Rhizome 3–5 mm wide, compact; rhizome scales 5–10 mm long, linear-lanceolate, dark brown, darker at the centre, denticulate, base truncate, apex acuminate. Sterile leaves 22–35 cm long, approximate; phylloodia present, obscured by the petiole-base scales; petiole 8–13 cm long, 2/5 the length of the sterile leaves; larger petiole scales 3–4.5 mm long, dense, ascending, ovate, with the point of attachment dark brown, or mottled with lighter margin, erose to laciniate, base cordate, apex acute; smaller petiole scales 0.2–1 mm long, dense, ovate to round, with the point of attachment dark brown, or mottled with lighter margin, erose to laciniate, base cordate, apex acute; lamina 13–22 by 3–4 cm, oblong to oblanceolate, coriaceous, glabrescent, base broadly cuneate to rounded, apex obtuse; veins 1–1.5 mm apart, at an angle of 75–80° with respect to the costa; adaxial laminar scales 0.2–0.5 mm long, scattered, round, some highly dissected, white to light brown, long-ciliate, base cordate to truncate; abaxial laminar scales 0.2–0.5 mm long, scattered, round, some highly dissected, light brown, long-ciliate, base cordate to truncate; abaxial costal scales 0.5–1.5 mm long, dense, pointing forward to the apex, not elevated, ovate to round, dark brown or mottled with white margin, laciniate to ciliate, base strongly cordate, apex acute; marginal scales 0.5–1.5 mm long, dense, obovate to oblanceolate, light brown to slightly mottled, laciniate, base cordate to short-stalked (up to 0.1 mm), apex acute. Fertile leaves longer than the sterile leaves; petiole 1/2–3/5 the length of the fertile leaves; petiole scales same as the ones of the sterile leaves; lamina 8–19 by 1–2 cm, narrowly elliptic to oblong, coriaceous, base broadly cuneate to truncate, apex obtuse; adaxial laminar scales 0.5–1.5 mm long, dense, oblanceolate to round, dark brown or mottled with lighter margin, laciniate to ciliate, base

cordate, apex acute; abaxial costal scales 0.5–2 mm long, dense, imbricate, not elevated, oblanceolate to round, orange, laciniate to ciliate, base cordate, apex acute; intersporangial scales 0.5–1.5 mm long, dense, almost covering the sporangia, oblanceolate to round, orange, ciliate, base cordate to truncate, apex filiform. Spores papillate, with ridges.

Distribution — Peru, known only from two collections from Piura, Prov. Huancabamba; 3000–3100 m. Epiphytic in cloud forests.

Other specimen examined. PERU, Piura, Prov. Huancabamba, above Canchaque on road to Huancabamba, below summit, [5°14'S, 79°27'W], 3000 m, 10 Oct. 1957, Hutchison 1651 (UC, USM).

Notes — *Elaphoglossum oculatum* can be distinguished by its large petiole scales that are ovate, have a dark point of attachment, and are mottled with a white margin. Furthermore, the laminar scales are 0.2–0.5 mm long, round, highly dissected, long-ciliate, and the abaxial costal scales are dark brown or mottled with white margin. The spores are ridged and papillate. The laminar scales are more abundant on the abaxial surface, but they are so small that the surfaces appear glabrous to the naked eye.

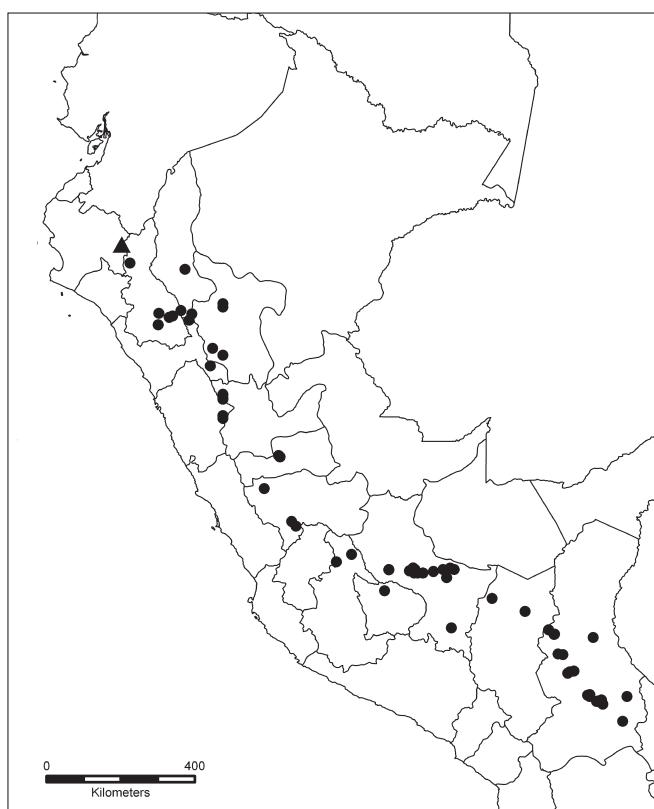
This species is similar to *E. corderoanum* but differs by its shorter (0.2–0.5 mm long) laminar scales and dark-brown abaxial costal scales. *Elaphoglossum corderoanum* has larger (0.5–2.5 mm long) laminar scales and light-brown abaxial costal scales.

*Elaphoglossum oculatum* is only known from two collections collected in north-western Peru, in a cloud forest at 3000–3100 m. The two paratypes of *E. oculatum* (Mickel 1991), Woykowsky 35433 (UC, US) and Soukup 176 (F), are *E. bellermannianum*.

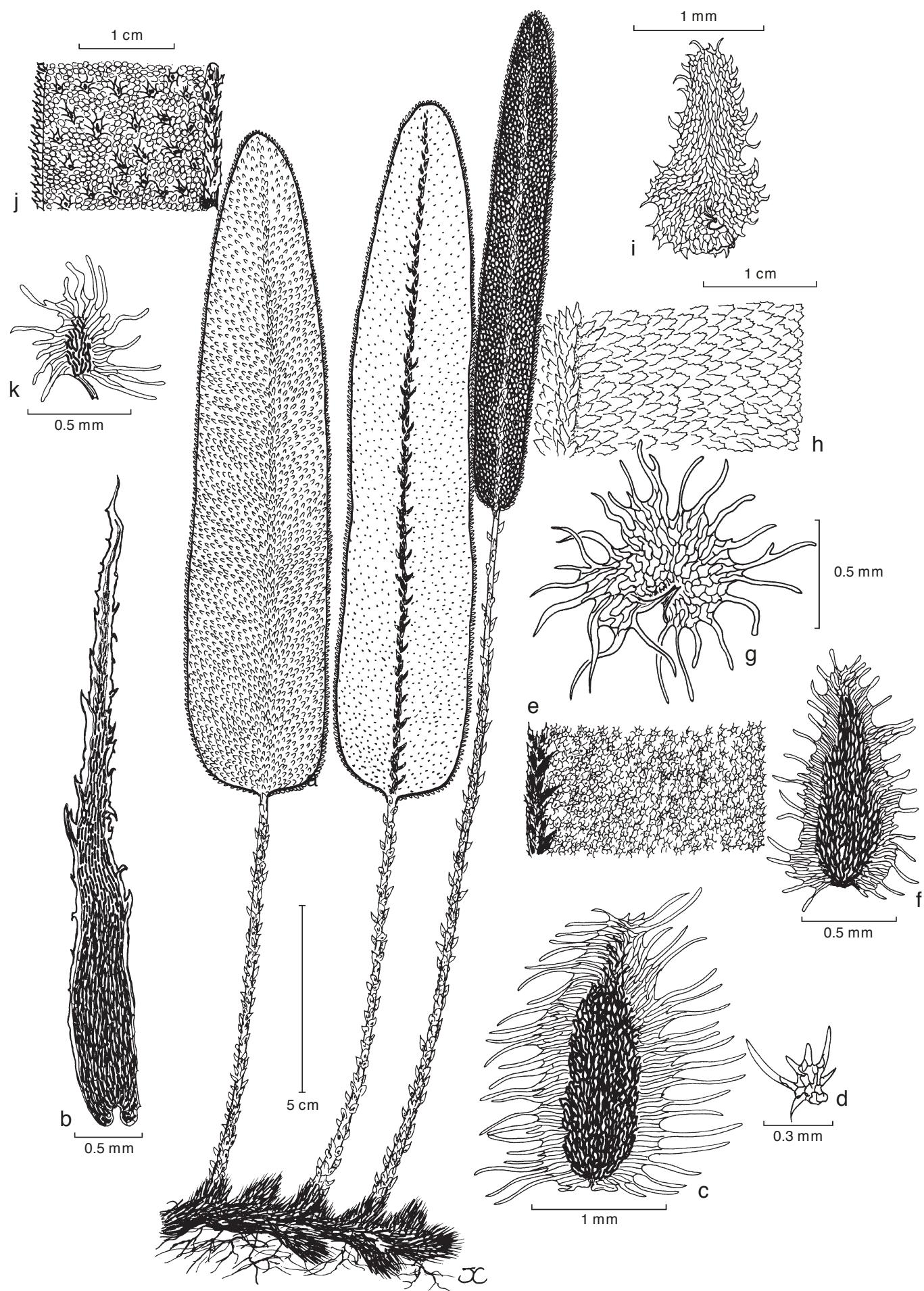
### 12. *Elaphoglossum oreophilum* A.Vasco, sp. nov. — Fig. 1l, 13; Map 13

Haec species quoad habitum terrestrem, rhizoma longirepente, laminas foliares oblanceolatas usque oblongas apicibus obtusis basibus truncatis et sporas papillatas porcatae *Elaphoglosso yatesii* similis, sed ab eo rhizomatis crassioris (3–5 mm) squamis fuscis vel atrofuscis saepe bicoloribus marginibus pallidioribus, petiolo marginato sicut laminae squamis abaxialibus longiciliatis et squamis costalibus abaxialibus adpressis differt. — Typus: Øllgaard & Balslev 8149 (holo NY; iso AAU, GH), Ecuador, Napo, road Quito-Baeza, 7–8 km NW of Laguna de Papallacta, Páramo de Guamaní, 0°19'S, 78°08'W, 3800 m, 20 July 1976.

Plants epiphytic or terrestrial. Rhizome 3–5 mm wide, long-creeping; rhizome scales 3–9 mm long, linear-lanceolate, light brown to dark brown, bicolorous with the margin lighter or mottled, denticulate, base cordate, apex filiform. Sterile leaves 20–45 cm long, approximate to up to 1 cm apart; phylloodia present, sometimes obscured by the petiole-base scales; petiole 9–28 cm long, c. 1/2 the length of the sterile leaves; larger petiole scales 4–8 mm long, dense, spreading, sometimes pointing forward to the petiole, linear-lanceolate to oblanceolate, light brown to dark brown, or mottled, darker at the point of attachment, margin lighter, laciniate to long-ciliate, base cordate, apex acute; smaller petiole scales 0.2–1(–3) mm long, dense, appressed, oblanceolate to round, mottled to dark brown, always with lighter margin, long-ciliate, base cordate, apex acute; lamina 9–27 by 2–6 cm, oblanceolate to oblong, coriaceous, glabrescent with age, base truncate to obtuse, apex obtuse; veins 0.7–1.5 mm apart, at an angle of 75–80° with respect to the costa; adaxial laminar scales 0.5–2 mm long, dense, imbricate or not, lanceolate to round, white to brown, sometimes darker along the costa, erose to long-ciliate, base cordate, apex acute; abaxial laminar scales 0.5–1 mm long, dense, imbricate, not elevated to slightly elevated above the surface of the lamina, oblanceolate to round, light brown to orange, ciliate to long-ciliate, base stalked (up to 0.2 mm), apex acute; abaxial costal scales 0.2–3 mm long, dense, pointing forward to the apex,



Map 12 Distribution of *Elaphoglossum oculatum* Mickel (▲) and *E. ruficomum* Mickel (●).



**Fig. 13** *Elaphoglossum oreophilum* A. Vasco. a. Habit; b. rhizome scale; c. larger petiole scale; d. smaller petiole scale; e. abaxial laminar surface; f. abaxial costal scale; g. abaxial laminar scale; h. adaxial laminar surface; i. adaxial laminar scale; j. fertile lamina; k. intersporangial scale (all: Øllgaard 8149, NY).

becoming spreading towards the base, not elevated, oblanceolate to round, dark brown with lighter margin or mottled, ciliate to long-ciliate, base cordate to truncate, apex acute; *marginal scales* same as the laminar ones. *Fertile leaves* longer than the sterile leaves; *petiole* 3/5–2/3 the length of the fertile leaves; *petiole scales* same as the ones of the sterile leaves; *lamina* 10–24 by 1.5–3.6 cm, narrowly elliptic to oblong, coriaceous, base truncate to obtuse, apex obtuse; *adaxial laminar scales* 0.4–1 mm long, dense, imbricate, lanceolate to round, white to light brown sometimes mottled, ciliate, base cordate, apex acute; *abaxial costal scales* 0.5–2 mm long, dense, pointing forward to the apex, slightly elevated, lanceolate to round, dark brown with lighter margin or mottled, erose to ciliate, base cordate to short-stalked, apex acute; *intersporangial scales* 0.2–2 mm long, scattered, sometimes inconspicuous, lanceolate to round, light brown to mottled, ciliate, base cordate to truncate, apex acute. *Spores* papillate, with ridges.

**Distribution** — Colombia, Ecuador; 3000–4200 m. Mainly terrestrial or growing in mats of bryophytes in páramos.

**Selection of other specimens examined.** COLOMBIA, **Caldas**, PNN los Nevados, Alto del Cisne, 4°57'44.8"N, 75°21'15.1"W, 4050 m, 8 Aug. 2006, Vasco 600 (HUA, MO, NY). **Cauca**, en el alto del Volcán Puracé, [2°15'N, 76°25'W], 3000 m, 7 Nov. 1948, Yepes-Agredo et al. 18 Ca. 123 (COL, MEDEL, US). **Nariño**, Mun. Pasto, Volcán Galeras, páramo al S de la cima, [1°13'N, 77°22'W], 3700 m, 24 Dec. 1972, Hagemann 1780 (COL, PSO). **Quindío**, Mun. Salento, vereda Cocora below Nevado del Quindío, 4°40–45'N, 75°20–25'W, 3500 m, 20–22 May 1989, Luteyn et al. 13052 (COL, NY). **Risaralda**, Mun. Sta. Rosa, vertiente Occidental, hacienda La Sierra, [4°50'N, 75°32'W], 3700 m, 22 Jan. 1980, Jaramillo-Mejía et al. 5846 (COL). **Valle**, hoya del Río Bugalagrande, Bargaán, Páramo de Bavaya, [4°01'N, 75°52'W], 3600 m, 16 Mar. 1946, Cuatrecasas 20043 (US). — ECUADOR, **Azúay**, Páramo de Soldados, at highest point of road W of Soldados, 2°57'S, 79°18'W, 3700–4000 m, 3 Mar. 1985, Øllgaard et al. 58524 (AAU). **Carchi**, Páramo El Angel, in the pass on road El Angel-Tulcán, very humid Espeletia-páramo, 0°41'N, 78°54'W, 3750–3850 m, 15 May 1973, Holm-Nielsen et al. 5482 (AAU, MO, NY). **Chimborazo**, Cerros Yuibug-Pailacajas, E side of the mountain ridge, 1°45'S, 78°27'W, 4100–4200 m, 30 July 1997, Sklenar 3077 (NY). **Esmeraldas**, between Río Blanco and Río Quinindé, near the town of

Quinindé, [0°22'N, 79°44'W], 1980, De Vélez 4016 (COL). **Imbabura**, timber line vegetation on Hacienda Yura Cruz, 10 km N of Ibarra, 0°22'N, 78°05'W, 3700–3800 m, 25 May 1973, Holm-Nielsen et al. 6501 (AAU, UC). **Napo**, road Quito-Baeza, 5 km NW of Laguna de Papallacta, Páramo de Guamán, 0°19'S, 78°07'W, 3700–3750 m, 18 July 1976, Øllgaard 8068 (AAU, NY). **Pichincha**, road Olmedo-Laguna San Marcos, W of the pass, 0°05'N, 78°01'W, 3600 m, 10 July 1980, Øllgaard et al. 34375 (AAU); along road Quito-Papallacta, in páramo near Papallacta, [0°25'S, 79°10'W], 2800–3900 m, 27 Feb. 1994, Van der Werff 13359 (MO, NY). **Tungurahua**, Santiago de Pillaro, Parque Nacional Llanganates, W of Cerro Hermoso, near saddle between headwaters of Río Topo, 1°11'40"S, 78°19'34"W, 3950 m, 12 Nov. 1999, Neill et al. 11995 (MO, UC).

**Notes** — *Elaphoglossum oreophilum* can be distinguished from all other species of subsect. *Muscosa* by its petiole scales and by its abaxial laminar scales. These scales have the cells of the body differentiated (Fig. 13c, f, g, k). The central portion is formed of irregular, usually darker isodiametric cells, and the broad border is formed of usually lighter, elongated cells. The latter cells have their long axes perpendicular to that of the scale. This characteristic is not easily detected with the naked eye and even with a dissecting microscope sometimes can be difficult to discern. Another peculiarity is that the laminar scales tend to be round instead of oblanceolate to lanceolate as in most species in the group. The species is further characterized by long-creeping rhizomes, abaxial costal scales not elevated, darker and differentiated from the laminar scales, and papillate, ridged spores. It is terrestrial and always occurs over 3000 m.

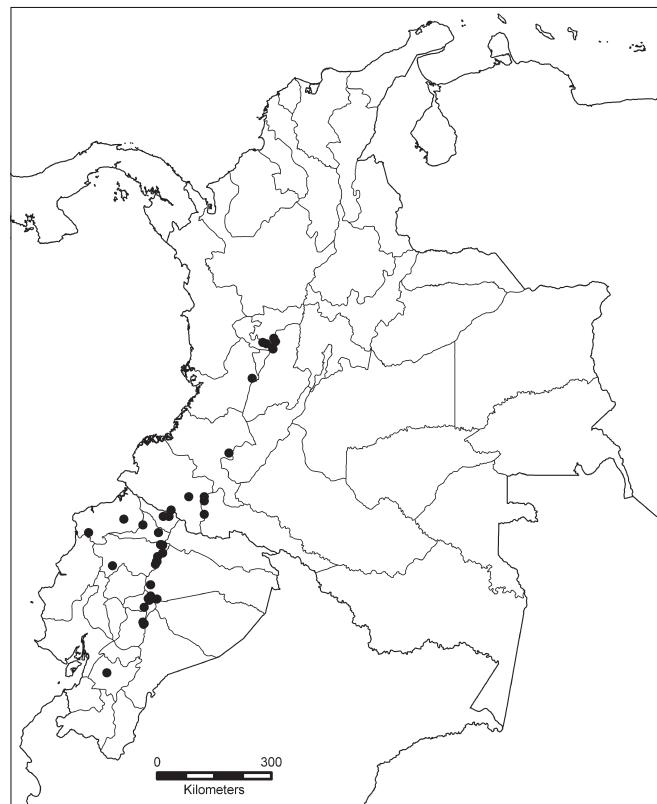
*Elaphoglossum oreophilum* is similar to *E. yatesii*. Both species occur only above 3000 m in Colombia and Ecuador. They share a mainly terrestrial habit, long-creeping rhizomes, oblanceolate to oblong laminae with obtuse apex and truncate base, and papillate, ridged spores. They can be distinguished by their rhizome diameter and scales of the rhizomes, petioles, and laminae. *Elaphoglossum oreophilum* has thicker rhizomes (3–5 mm), brown to dark-brown rhizome scales often bicolorous with lighter margin, lacinate to long-ciliate petiole and abaxial laminar scales, and abaxial costal scales not elevated. In contrast, *E. yatesii* has thinner rhizomes (1–3 mm), typically dark-brown rhizome scales, erose to ciliate petiole and abaxial laminar scales, and abaxial costal scales elevated.

The specific epithet comes from the Greek *oreo-*, which means pertaining to mountains, and *-philus* meaning loving. It refers to the restricted occurrence of this species in mountains of Ecuador and Colombia.

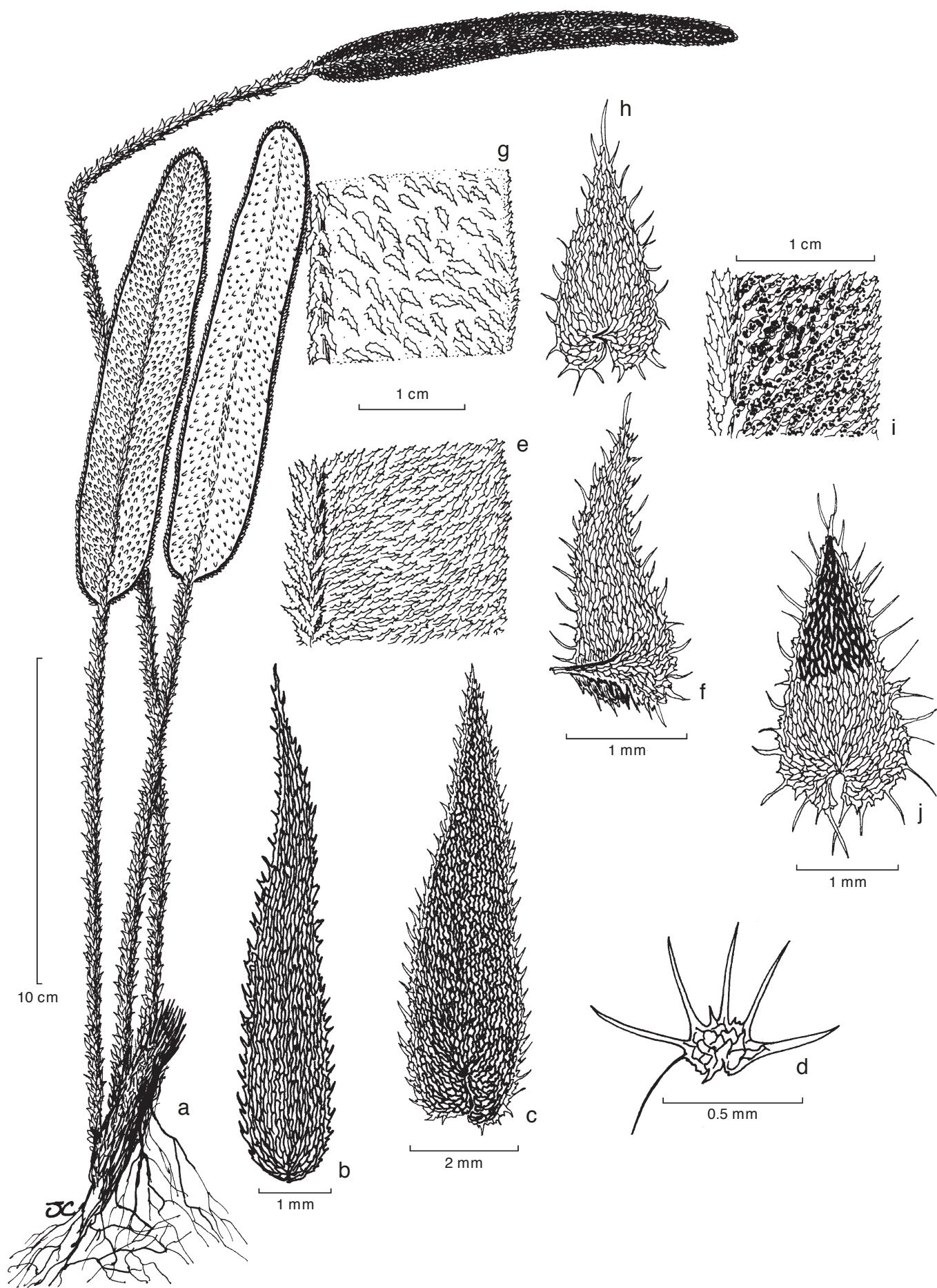
### 13. *Elaphoglossum quisqueyanum* A.Vasco, sp. nov. — Fig. 1m, 14; Map 14

Haec species quoad habitum terrestrem, squamas rhizomatis ciliatas et laminae foliaris squamas abaxiales densas imbricatas leviter arcuatas *Elaphoglossum engelii* similis, sed ab eo rhizomatis crassioris ramosi squamarum ciliis paucioribus longioribus (usque ad 0.6 mm) et sporis papillosis porcatis differt. — Typus: Ekman 13556 (holo NY; iso F, GH, US), Dominican Republic, Ázua, Cordillera Central, Loma de la Mediania, [19°04'N, 71°07'W], 2600 m, 15 Sept. 1929.

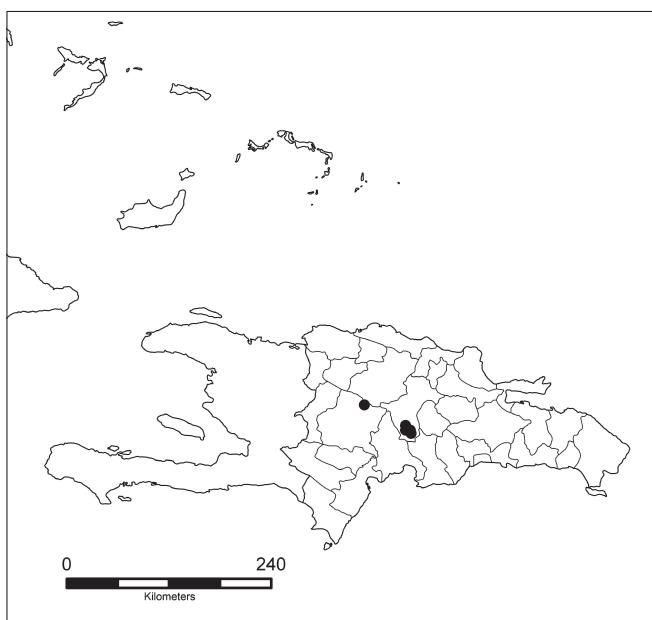
**Plants** terrestrial. **Rhizome** 5–10 mm wide, long-creeping; **rhizome scales** 8–11 mm long, linear-lanceolate, maroon to dark brown, sometimes bicolorous, margin lighter, ciliate, denticulate to ciliate (the cilia up to 0.6 mm long), base truncate, apex filiform. **Sterile leaves** 20–45 cm long, approximate to up to 1 cm apart; **phyllodia** present, sometimes obscured by the petiole-base scales; **petiole** 8–25 cm long, 2/5–3/5 the length of the sterile leaves; **larger petiole scales** 4–7 mm long, dense, spreading, sometimes pointing forward, linear-lanceolate to oblanceolate, from orange to brown or mottled, darker at the point of attachment, erose to ciliate, base cordate (sometimes appearing peltate because of the large auricles), apex acute; **smaller petiole scales** 0.5–2(–3) mm long, dense, appressed,



Map 13 Distribution of *Elaphoglossum oreophilum* A.Vasco.



**Fig. 14** *Elaphoglossum quisqueyanum* A. Vasco. a. Habit; b. rhizome scale; c. larger petiole scale; d. smaller petiole scale; e. abaxial laminar surface; f. abaxial laminar scale; g. adaxial laminar surface; h. adaxial laminar scale; i. fertile lamina; j. intersporangial scale (all: Ekman 13556, US).



Map 14 Distribution of *Elaphoglossum quisqueyanum* A. Vasco.

ob lanceolate to round, from orange to brown, darker at the point of attachment, ciliate, base cordate, apex acute; *lamina* 9–28 by 2.1–4.2 cm, linear-lanceolate to ob lanceolate, coriaceous, glabrescent with age, base truncate to rounded, apex obtuse; *veins* 1–1.5 mm apart, at an angle of 75° with respect to the costa; *adaxial laminar scales* 1.5–3 mm long, dense, imbricate, oftentimes pointing downwards, lanceolate, white to light brown, ciliate, base cordate, apex acute; *abaxial laminar scales* 1–3.5 mm long, dense, imbricate, slightly elevated above the surface of the lamina, lanceolate to ob lanceolate, from orange to brown, darker at the point of attachment, ciliate, base stalked (up to 0.4 mm), apex acute; *abaxial costal scales* same as the laminar ones, longer; *marginal scales* same as the laminar ones. *Fertile leaves* longer than the sterile leaves; *petiole* 3/5–3/4 the length of the fertile leaves; *petiole scales* same as the ones of the sterile leaves but the larger ones more spreading; *lamina* 9.5–20 by 1–2.1 cm, narrowly elliptic, coriaceous, base truncate to broadly cuneate, apex acute to obtuse; *adaxial laminar scales* 1–3 mm long, dense, imbricate, lanceolate, from orange to brown, darker at the point of attachment, ciliate, base cordate, apex acute; *abaxial costal scales* 1–4 mm long, dense, pointing forward to the apex or at right angles, slightly elevated, lanceolate to round, from light to dark brown, darker at the point of attachment, ciliate, base cordate (sometimes appearing peltate because of the large auricles), apex acute; *intersporangial scales* 1–2.5 mm long, scattered, lanceolate, from light to dark brown, ciliate, base cordate to truncate, apex acute. *Spores* papillate, with ridges.

**Distribution** — Dominican Republic, provinces of Ázua and La Vega; 2000–2800 m. Terrestrial in cloud forests.

**Selection of other specimens examined.** DOMINICAN REPUBLIC, Ázua, between Valle Nuevo and Azua, [18°47'N, 70°38'W], 2000–3000 m, 24 Dec. 1964, Jones 1119 (GH, NY). La Vega, in Loma Rosilla, 2700 m, 6 Aug. 1912, Fuertes 1808 (GH, NY, US); Valle Nuevo, [18°48'N, 70°41'W], 2300 m, 5 Apr. 1947, Jiménez 1379 (NY, US); 11 km S of Constanza, vía el Convento, on road to San José de Ocoa, vic. of El Convento, 18°51'N, 70°41'W, 1500 m, 24 July 1980, Mejía 7650 (NY); Pico Alto de la Bandera, E de Valle Nuevo, 18°48'N, 70°38'W, 2790–2800 m, 14 May 1982, Zanoni 20681 (JBSD); Cordillera Central, 31.9 km S de Constanza (camino vía Río Grande), 6 km N del monumento La Pirámide, 18°46'N, 70°37.5'W, 2225 m, 11 June 1982, Zanoni 20917 (JBSD, MO, NY).

**Notes** — *Elaphoglossum quisqueyanum* is characterized by a terrestrial habit, long-creeping rhizomes, maroon to dark brown, linear, denticulate to ciliate rhizome scales, erose to ciliate

larger petiole scales, and papillate, ridged spores. It resembles *E. engelii*, a species from Central and South America, but differs by its thicker (5–10 mm wide) rhizomes, rhizome scales denticulate to ciliate, the cilia up to 0.6 mm long, and papillate, ridged spores. In contrast, *E. engelii* has thinner (4–8 mm wide) rhizomes, scales that when ciliate, have abundant cilia that are no longer than 0.4 mm, and spores with ridges and irregular deposits.

The specimen Jones & Norris 1119 (NY) is a small form of this species, with thinner rhizomes and smaller leaves, but is otherwise typical.

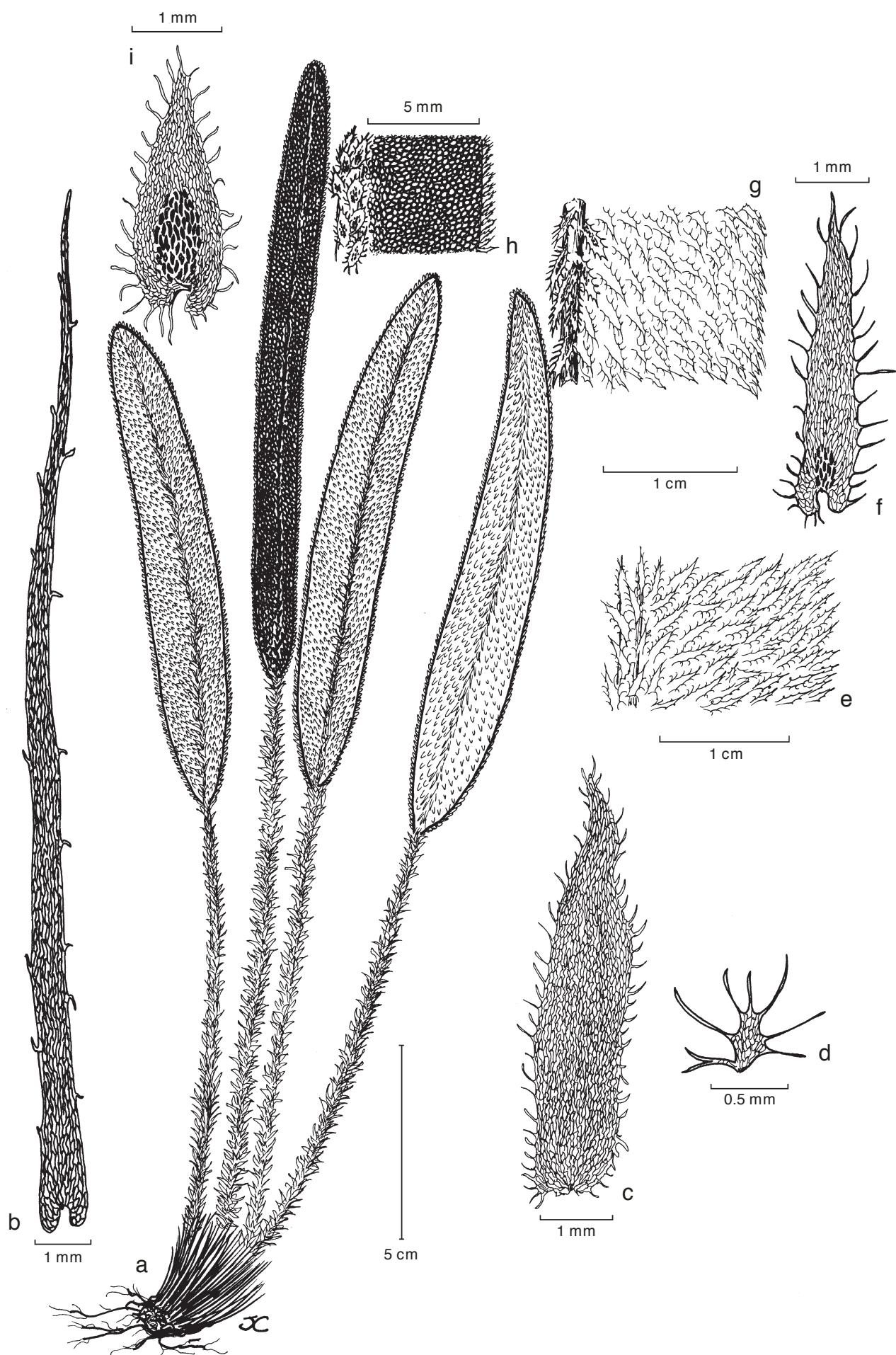
The specific epithet refers to Quisqueya, the name given by the indigenous peoples, the Tainos, to the Dominican Republic, where this species is endemic. In the Taino language *quisqueya* means ‘Mother of the Earth’.

#### 14. *Elaphoglossum ruficomum* Mickel — Fig. 1n, 15; Map 12

*Elaphoglossum ruficomum* Mickel (1991) 159 ('*ruficomus*'). — Type: Sa-gástequi et al. 12091 (holo NY; iso GH), Peru, Cajamarca, Celendín, Sendamal, ruta a Celendín, 3050 m, 17 Aug. 1984.

Plants terrestrial. Rhizome 8–11 mm wide, compact; rhizome scales (6–)12–16(–20) mm long, linear, red-orange, lustrous, entire to denticulate, base truncate, apex filiform. Sterile leaves (8–)16–30(–55) cm long, approximate; phylloodia present, obscured by the petiole-base scales; petiole (3.5–)7–17(–27) cm long, 1/3–2/5 the length of the sterile leaves; larger petiole scales (3–)4–6 mm long, dense, spreading, linear-lanceolate, light brown, sometimes dark brown or mottled, ciliate, base cordate (sometimes appearing peltate because of the large auricles), apex acute; smaller petiole scales 0.5–1(–3) mm long, dense, appressed, oftentimes hidden by the larger ones, ob lanceolate to round, light brown, sometimes black or mottled with lighter margin, ciliate, base cordate (sometimes appearing peltate because of the large auricles), apex acute; lamina (5–)10–17(–27) by 1.4–3.5 cm, narrowly elliptic to ob lanceolate, coriaceous, glabrescent with age, base broadly cuneate to rounded, apex obtuse to acute; veins 1–2 mm apart, at an angle of 75–80° with respect to the costa; adaxial laminar scales 1–3 mm long, dense, imbricate, pointing downwards, lanceolate, white, the costal ones sometimes darker at the point of attachment to completely black, ciliate, base cordate to short-stalked, apex acute; abaxial laminar scales 1–3 mm long, dense, imbricate to scattered, slightly elevated above the surface of the lamina to patent, lanceolate to ob lanceolate, light brown, sometimes darker at the point of attachment, ciliate, base cordate to short-stalked (up to 0.2 mm), apex acute; abaxial costal scales same as the laminar ones, pointing forward to apex or at right angles, slightly elevated; marginal scales same as the laminar ones. Fertile leaves equal to longer than the sterile leaves; petiole 2/5–3/5 the length of the fertile leaves; petiole scales same as the ones of the sterile leaves but the larger ones more spreading; lamina 8–20(–25) by 0.8–2.5 cm, narrowly elliptic, coriaceous, base truncate to broadly cuneate, apex obtuse; adaxial laminar scales 1–2.5 mm long, dense, imbricate, lanceolate, white to light orange, ciliate, base cordate to short-stalked (less than 1 mm), apex acute; abaxial costal scales 1–3 mm long, dense, pointing forward to the apex or at right angles, slightly elevated to patent, lanceolate to round, orange to black with lighter margin, ciliate, base cordate to short-stalked, apex acute; intersporangial scales 1–2 mm long, absent to scattered, lanceolate, orange, sometimes darker at the point of attachment, ciliate, base cordate, apex acute. Spores papillate, without ridges.

**Distribution** — Peru, Bolivia; 1900–4300 m. Usually terrestrial in montane and cloud forests and in páramos.



**Fig. 15** *Elaphoglossum ruficomum* Mickel. a. Habit; b. rhizome scale; c. larger petiole scale; d. smaller petiole scale; e. abaxial laminar surface; f. adaxial laminar surface; g. fertile costal scale; h. fertile lamina; i. fertile costal scale (all: Boeke 2970, HUA and NY).

*Selection of other specimens examined.* PERU, **Amazonas**, Prov. Chachapoyas, Cerros Calla Calla, E side, 19 km above Leimebamba on road to Balsas, [6°55'N, 77°45'W], 3100 m, 6 June 1964, Hutchison 5567 (GH, NY, UC). **Ancash**, Prov. Yungay, Huascarán National Park, quebrada Paria, 8°57'S, 77°33'W, 4200 m, 13 Jan. 1985, Smith et al. 9174 (MO, NY). **Apurímac**, 5 km N of Huancarama, [13°38'S, 73°05'W], 3500 m, 6 Nov. 1935, West 3801 (UC). **Ayacucho**, Prov. La Mar, E massi of the Cordillera Central opposing the cordillera Vilcabamba between Tambo San Miguel, Ayna and the Hacienda Luisiana, 12°45'S, 73°53'W, 24 Aug. 1968, Dudley 12057 (GH, MO, US). **Cajamarca**, Prov. Cajabamba, Cajabamba-Luchubamba, 3800 m, 17 Nov. 1983, Sagástegui et al. 11200 (GH, MO, NY). **Cusco**, Prov. La Convención, Dist. Vilcabamba, Vilcabamba La Vieja, 13°07'S, 72°59'W, 1892 m, 20 Sept. 2003, Calatayud et al. 1873 (MO, NY, UC). **Huánuco**, Pampayacu, [11°09'07"S, 76°36'15"W], 17 Jan. 1927, Kanehira 164 (GH, US). **Junín**, Prov. Huancayo, Torre-Torre, [12°04'S, 75°14'W], Feb. 1948, Soukup 3593 (F, US). **La Libertad**, Prov. Sánchez Carrión, road from Trujillo to Huamachuco, at edge of escarpment where road begins descent toward Aricapampa, 4000 m, 22 Feb. 1982, Dimmitt 1135 (NY). **Lambayeque**, Prov. Ferreñafe, c. 7 km NW of Incahuasi, near Cerro Punamachay on trail to laguna Ualtaco, [6°14'S, 79°19'W], 16 Nov. 1984, Dillon 4116 (F, GH). **Pasco**, Prov. Oxapampa, Dist. Huancabamba, sector Santa Barbara-Milpo, 10°22'55"S, 75°37'19"W, 1 Feb. 2005, Mellado 2725 (MO, NY). **Puno**, Prov. Carabaya, 10 km S of Ollachea, [13°49'S, 70°29'W], 13 Aug. 1980, Boeke 2970 (HUA, MO, NY). **San Martín**, Prov. Mariscal Cáceres, Puerta del Monte valley, Rio Abiseo National Park, [7°45'S, 77°15'W], 3550 m, 11 Mar. 1988, León 1441 (NY). — BOLIVIA, **La Paz**, Prov. Murillo, Valle de Zongo, Santa Rosa, 3 km hacia La Paz, [16°09'S, 68°07'W], 3030 m, 8 Apr. 1979, Beck 1094 (LPB, NY); Prov. Larecaja, Gran Poder, small gold mine about 40 km N of Sorata, below Tacacoma, [15°38'S, 68°39'W], 3000 m, 7 June 1950, Brooke 6447 (BM, F, NY); Prov. Nor Yungas, Unduavi, [16°19'S, 67°54'W], 3200 m, Feb. 1914, Buchtien s.n. (F, NY); Prov. Murillo, Zongo Valley, c. 62 km from La Paz, the Chaca, Pampa turn off, 16°11'10"S, 68°08'10"W, 3500 m, 5–6 Aug. 1990, Fay 2868 (LPB, MO, NY, UC).

Notes — *Elaphoglossum ruficomum* can be distinguished from all other species of subsect. *Muscosa* by its long ((6)–12–20 mm), linear, bright red-orange rhizome scales. Also distinctive are its terrestrial habit and compact rhizomes. It differs from *E. engelii* by the long, entire to denticulate rhizome scales and papillate spores. *Elaphoglossum engelii* has scales that are typically up to 12 mm long, ciliate, with many teeth longer than 0.2 mm, and spores with ridges and irregular deposits.

See *E. lehmannianum* for a comparison with that species.

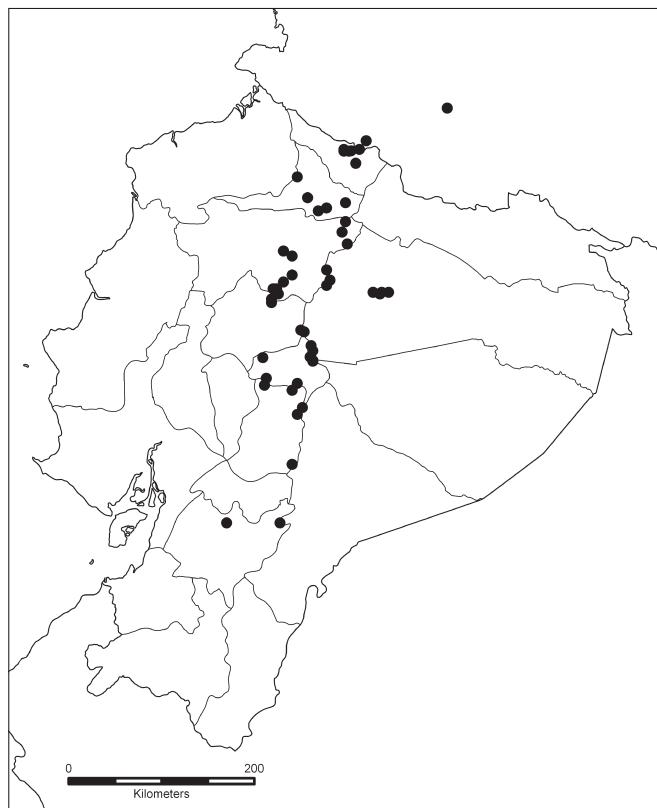
### 15. *Elaphoglossum yatesii* (Sodiro) Christ — Fig. 10, 16; Map 15

*Elaphoglossum yatesii* (Sodiro) Christ (1899) 83, f. 37. — *Acrostichum yatesii* Sodiro (1890) 174. — Type: Sodiro s.n. (lecto P (barcode P00577720), designated here; iso P (barcode 00577721), QPLS n.v.), Ecuador, Pichincha, Crece en la pendiente occidental del Pichincha a 3900 m en el sitio llamado 'Tablahuasi', s.d.

*Elaphoglossum ellipsoideum* (Sodiro) C.Chr. (1913) 42. — *Acrostichum ellipsoideum* Sodiro (1908) 164. — Type: Sodiro s.n. (lecto QPLS, designated here), Ecuador, Napo, Crescit in silvis suband. Andinum or ppe. Oacachi, s.d.

*Elaphoglossum viscidulum* (Sodiro) C.Chr. (1913) 43. — *Acrostichum viscidulum* Sodiro (1908) 165. — Type: Sodiro s.n. (lecto QPLS, designated here), Ecuador, Tungurahua, Crescit in silvis suband. Occid. vulc. Tungurahua, s.d.

Plants terrestrial or epipetric. Rhizome 1–3(–4) mm wide, long-creeping; rhizome scales 4–5 mm long, linear-lanceolate to lanceolate, maroon to dark brown, sometimes bicolorous with lighter margin, denticulate to ciliate, base cordate (appearing peltate because of the large auricles), apex acuminate to filiform. Sterile leaves 13–33 cm long, 1–2 cm apart; phyllo-podia present, not obscured by the petiole-base scales; petiole 6.5–20 cm long, 1/2–3/5 the length of the sterile leaves; larger petiole scales 3–5 mm long, dense, spreading, to most of the times pointing forward to the petiole, lanceolate to oblanceolate, light brown to dark brown, or mottled, always darker at the point of attachment, margin lighter, erose, base cordate, apex acute; smaller petiole scales 0.2–1(–3) mm long, dense,

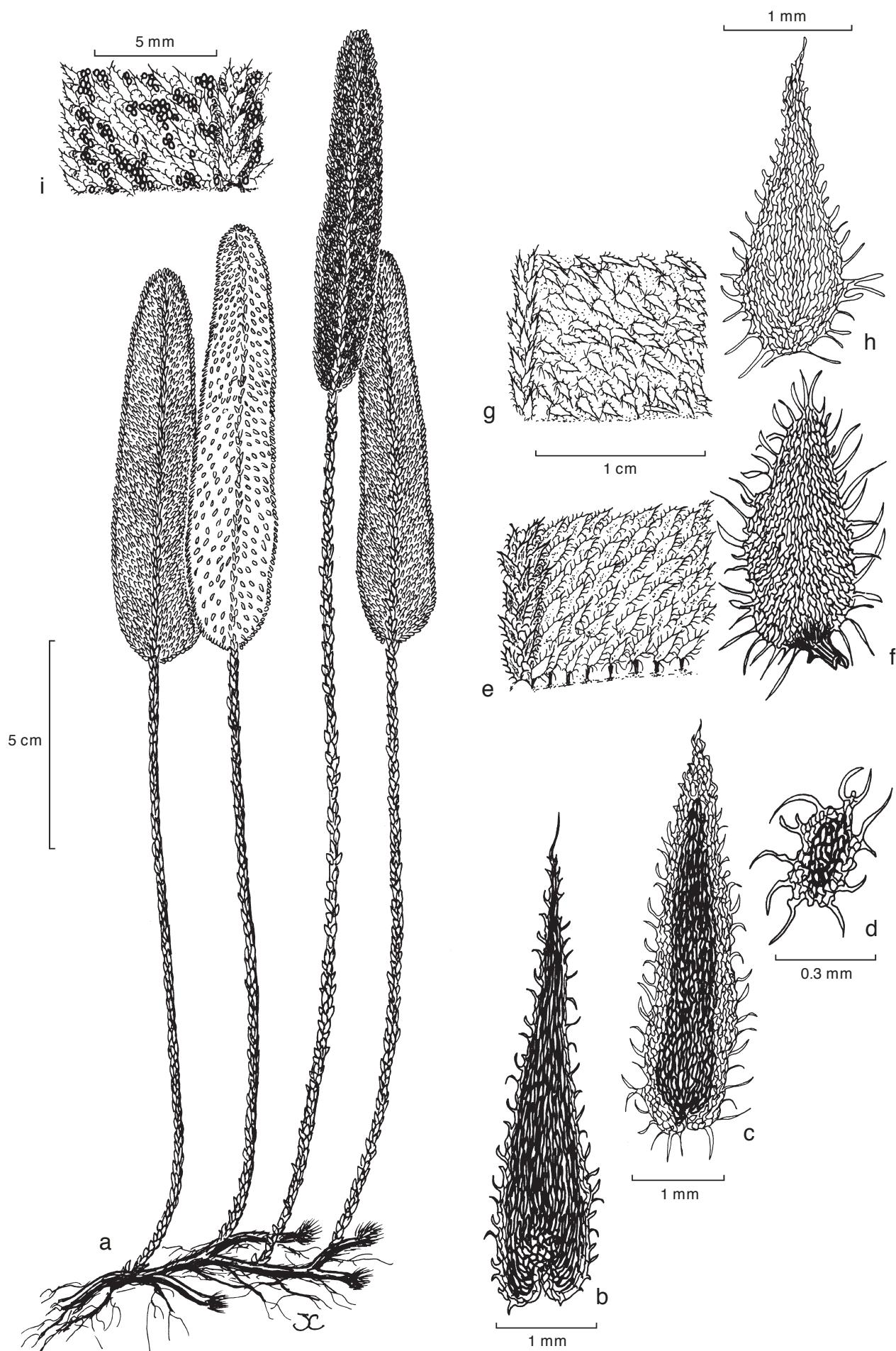


Map 15 Distribution of *Elaphoglossum yatesii* (Sodiro) Christ.

appressed, oblanceolate to round, light brown to dark brown, or mottled, darker at the point of attachment or bicolorous with the centre dark brown and the margin lighter, erose to ciliate, base cordate, apex acute; lamina 6.5–13 by 1.7–3 cm, linear-lanceolate to ovate, coriaceous, glabrescent with age, base truncate to obtuse, apex obtuse; veins c. 1 mm apart, at an angle of 75–80° with respect to the costa; adaxial laminar scales 0.5–2 mm long, dense, imbricate, oblanceolate to round, white to black or mottled, erose to lacinate, base cordate, apex acute; abaxial laminar scales 0.5–2.5 mm long, dense, imbricate, elevated above the surface of the lamina to patent, oblanceolate to round, light brown to orange, sometimes dark brown, ciliate, base stalked (up to 0.3 mm), apex acute; abaxial costal scales 2–3 mm long, dense, pointing at right angles, elevated, linear-lanceolate to oblanceolate, dark brown to black, always with lighter margin, erose to ciliate, base cordate to short-stalked, apex acute; marginal scales same as the laminar ones. Fertile leaves longer than the sterile leaves; petiole 2/3–3/4 the length of the fertile leaves; petiole scales same as the ones of the sterile leaves; lamina 4.5–13 by 1.2–2 cm, narrowly elliptic to oblong, coriaceous, glabrescent with age, base truncate to broadly cuneate, apex obtuse; adaxial laminar scales 0.3–2.5 mm long, dense, imbricate, oblanceolate to round, white to black, sometimes mottled, erose to lacinate, base cordate (appearing peltate because of the large auricles), apex acute; abaxial costal scales 0.5–2 mm long, dense, pointing at right angles, elevated, oblanceolate to round, dark brown with lighter margin or mottled, lacinate to ciliate, base cordate, apex acute; intersporangial scales 1–2.5 mm long, scattered to dense, sometimes almost obscuring the sporangia, lanceolate to oblanceolate, light brown to dark brown with lighter margin or mottled, ciliate, base stalked (up to 0.3 mm), apex acute. Spores papillate, with ridges.

Distribution — Colombia, Ecuador; 3000–4500 m. Terrestrial or epipetric in montane forest and páramos.

*Selection of other specimens examined.* COLOMBIA, **Nariño**, Mun. Pasto, Volcán Galeras, páramo al S de la cima, [1°13'N, 77°22'W], 3700 m, 24 Dec.



**Fig. 16** *Elaphoglossum yatesii* (Sodiro) Christ. a. Habit; b. rhizome scale; c. larger petiole scale; d. smaller petiole scale; e. abaxial laminar surface; f. abaxial laminar scale; g. adaxial laminar surface; h. adaxial laminar scale; i. fertile lamina (all: Mille 202, US).

1972, *Hagemann* 1782 (COL, PSO); Mun. Pasto, Volcán Galeras, [1°13'N, 77°22'W], 4000 m, 22 Oct. 1968, *Plowman* 1949 (F, GH, NY, US). — ECUADOR, **Azuay**, Cuenca, Área Nacional de Recreación Cajas, Laguna Toreadora, 2°48'S, 79°08'W, 3800 m, 10 Oct. 1995, *Alexander* 31 (MO, UC). **Carchi**, road Tulcán-Maldonado, W of the pass, base of Volcán Chiles, 0°49'N, 78°00'W, 3650 m, 3 Aug. 1976, *Øllgaard* 8411 (AAU, NY, UC). **Chimborazo**, Cerro Altar, [1°31'S, 78°30'W], 3700 m, 9 Aug. 1935, *Heinrichs* 899 (B); Carro Yanaurcu, N ridge of the mountain, 2°14'S, 78°30'W, 4200 m, 29 Oct. 1995, *Sklenar* 1438 (AAU, NY). **Cotopaxi**, near origin of Río Langoa, E of Latacunga, Laguna Salayambo Cocha, 0°56'S, 78°25'W, 30 Sept. 1976, *Øllgaard* 9888 (AAU, GH, NY, UC). **Imbabura**, Cerro Imbabura, E and S sides of the volcano just below the rocky escarpment, 0°15'N, 78°10'W, 5 June 1995, *Sklenar* 568 (AAU). **Napo**, Cerro Sumaco, upper 100 m of cone, 0°34'S, 77°43'W, 1 May 1979, *Holm-Nielsen et al.* 17586 (AAU, HUA, NY, QCA). **Pichincha**, NE Pasocha, en bosque a 50 m de la cúspide, [0°24'S, 78°30'W], 30 July 1980, *Jaramillo et al.* 3181 (AAU, MO). **Tungurahua**, Santiago de Pillaro, Parque Nacional Llanganates, W of Cerro Hermoso, near saddle between headwaters of Río Topo, 1°11'40"S, 78°19'34"W, 3950 m, 12 Nov. 1999, *Neill et al.* 11997 (MO, UC).

**Notes** — *Elaphoglossum yatesii* can be distinguished by its thin long-creeping rhizomes, dark brown rhizome scales, petiole scales appressed-ascending, and papillate, ridged spores. It occurs above 3000 m.

*Elaphoglossum yatesii* is similar to *E. oreophilum* in its distribution (Colombia and Ecuador, above 3000 m), habit (mainly terrestrial), rhizome type (long-creeping), and spores micro-morphology (ridges and papillae); however, the species can be easily distinguished by their petiole and laminar scales. *Elaphoglossum oreophilum* has long-ciliate petiole and laminar scales, with the cells of the body differentiated. In contrast, *E. yatesii* has erose to ciliate petiole and laminar scales, whose cells are all isodiametric. Some specimens of *E. yatesii* have glabrescent abaxial laminar surfaces, whereas those of *E. oreophilum* are always scaly.

See *E. oreophilum* for a further comparison.

## NAMES OF UNCERTAIN APPLICATION

*Elaphoglossum dichroum* Mickel (1991) 129. — Type: León & Young 1510 (holo USM n.v.; iso NY), Peru, San Martín, Marrisal Cáceres, Parque Nac. Río Abiseo, Puerta del Monte, 13 Mar. 1988.

I was only able to see the isotype of this species, which is sterile, and a photo of the holotype. Based on this evidence, plus Mickel's (1991) description (which does not cite any paratypes), I cannot discern if it is a distinct species or if it should be considered as a synonym of either *E. glabrescens* or *E. oculatum*. Mickel (1991) thought *E. oculatum* was the most similar species because of its concentration of scales along the margin, ciliate intersporangial scales, bicolorous petiole and costal scales, and the reduced scales of the abaxial lamina surface. However, the larger size and the shape of the laminae, the lanceolate adaxial laminar scales, and the ciliate petiole scales suggest that the isotype of *E. dichroum* might correspond also to *E. glabrescens*. Thus, until more material is available from *E. oculatum* and *E. dichroum*, I refrain from recognizing the last name as a species or from synonymizing it with either of the species mentioned above.

*Acrostichum muscosum* var. *macropodium* Sodiro (1893) 473. — Type: Sodiro s.n. (?), Ecuador, Cerro de Puntas, sobre 3800 m, s.d.

I was unable to find any specimens of Sodiro that were annotated with this name, and from Sodiro's description I am uncertain to what species this name belongs.

*Acrostichum lepidotum* var. *engelii* (H.Karst.) Kuntze (1898) 376. — Type: Kuntze s.n. (?), Bolivia, Tiraqui-Santa Rosa, 3000 m, s.d.

I was unable to find the type of this variety. The only information the original description gives is that it is glabrescent. This characteristic and the provenance of the type suggest that the plant might be *E. glabrescens*, but I cannot be sure.

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## IDENTIFICATION LIST

Numbers behind the species numbers refer to the species as treated in this revision. Species numbers in **bold** are type species.

- |                              |                           |                            |
|------------------------------|---------------------------|----------------------------|
| <i>Elaphoglossum</i>         | 4. <i>E. engelii</i>      | 12. <i>E. oreophilum</i>   |
| 1. <i>E. aschersonii</i>     | 5. <i>E. gardnerianum</i> | 13. <i>E. quisqueyanum</i> |
| 2. <i>E. bellermannianum</i> | 6. <i>E. glabrescens</i>  | 14. <i>E. ruficomum</i>    |
| 3. <i>E. corderoanum</i>     | 7. <i>E. laxisquama</i>   | 15. <i>E. yatesii</i>      |

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