Cryptogamie, Bryologie, 2014, 35 (1): 77-92

Additions to the Catalogue of Hepaticae of Colombia II

Laura V. CAMPOS [a*], *Robbert GRADSTEIN* [b], *Jaime URIBE-M.* [a] *& Hans ter STEEGE* [c]

[a] *Instituto de Ciencias Naturales. Universidad Nacional de Colombia. Apartado 7495, Bogotá D.C. Colombia*

[b] *Muséum National d'Histoire Naturelle, Dépt. Systématique et Évolution, Case Postale 39, 57 rue Cuvier, 75231 Paris cedex 05, France*

[c] *Naturalis Biodiversity Center, Einsteinweg 2, P.O. Box 9514, 2300 RA Leiden, The Netherlands*

Abstract – Eighteen liverwort species, including seventeen members of Lejeuneaceae and one of Lepidoziaceae, are reported new to Colombia. All the new records are from lowland rainforests in the Colombian Amazon region. Illustrations and brief discussions of diagnostic morphological characters are given for each species. Information about localities, elevation and occurrence of the species in the different tree height zones is also given.

New floristic report / Liverworts / Marchantiophyta / Colombia / Amazonia

INTRODUCTION

The flora of liverworts (Hepaticae, Marchantiophyta) in Colombia is a very rich one and it is characterized by a high diversity. With 713 accepted species of liverworts recorded (Gradstein & Uribe, submitted), Colombia ranks second among the countries of tropical America, after Brazil (*ca* 725 accepted species; Gradstein & Costa, 2003). Ecuador ranks third with *ca* 700 accepted species and about 80 doubtful ones (Léon Yánez *et al*., 2006, Benitez & Gradstein, 2011, Benitez *et al*., 2012; Schäfer-Verwimp *et al*., 2013), followed by Costa Rica with 574 species (Dauphin, 2005) and Bolivia with 477 species and numerous doubtful ones (Churchill *et al*., 2009).

The Catalogue of Hepaticae and Anthocerotae of Colombia (Uribe & Gradstein, 1998) reported 832 species of liverworts. After this publication many species additions of liverworts have been reported for Colombia. Ninety one species were newly recorded from Colombia, including 63 species of Lejeuneaceae, 7 of Lepidoziaceae, 6 of Frullaniaceae, 3 of Plagiochilaceae, 2 of Calypogeiaceae, Metzgeriaceae and Ricciaceae, and 1 of Acrobolbaceae, Cephaloziaceae, Cephaloziellaceae, Lophocoleaceae, Pallaviciniaceae and Scapaniaceae. Four species from Colombia were described as new to science: *Acrobolbus caducifolius* R.M. Schust. (Schuster, 2001), *Frullania dulimensis* Uribe (Uribe, 2006),

* Correspondence and reprints: lvcamposs@unal.edu.co

doi/10.7872/cryb.v35.iss1.2014.77

Harpalejeunea grandis Grolle *et* M.E. Reiner (Grolle & Reiner-Drehwald, 1999) and *Harpalejeunea scabra* Gradst. *et* Schäf.-V. (Gradstein & Schäfer-Verwimp, 2011). In addition, more than 200 species were reduced to synonymy or are considered doubtful records (Gradstein & Uribe, submitted). This paper provides illustrations and a short description of diagnostic characters of the new reports for the liverwort flora of Colombia.

MATERIAL AND METHODS

All the species were collected in the framework of the project "Diversity of Epiphytic Bryophytes in the Colombian Amazon". The purpose of this study was to determine the effect of the dispersal and niche assembly on community structure of epiphytic bryophytes in the Colombian Amazon region.

Fieldwork was carried out in four upland rainforest ("Tierra Firme") sites in Colombian Amazonia. Tierra Firme forest occupies fairly well drained soils that are relatively rich in available nutrients. Canopy height varied from 30 to 40 m. All new records were collected in forest at elevations between 100-250 m.

Locality 1 is located in the southeastern part of the Putumayo department, in the corregimiento Puerto Colombia; locality 2 in the southeastern region of the Caquetá department near the Yarí River, raudal La Gamitana; locality 3 in the northeastern section of the Vaupés department, in Macaquiño community; and locality 4 in the eastern part of the "trapezio amazonico", in the Reserve El Zafire (Fig. 1).

Epiphytic bryophytes were sampled on mature rainforest trees in 6 height zones (1: tree base; 2: lower trunk; 3: upper trunk; 4: inner canopy; 5: middle canopy; 6: outer canopy) as described by Mota de Oliveira et al (2009). Specimens were deposited in COAH (Herbario Amazonico Colombiano) and COL (Herbario Nacional Colombiano).

Species are listed in alphabetical order according to family. Comments, illustrations and description of diagnostic characters are provided for each taxon. Information about localities, altitude and distribution on the trees is also given.

RESULTS AND DISCUSSION

Eighteen species new to Colombia were collected: seventeen species of Lejeuneaceae and one of Lepidoziaceae. The new records of Lejeuneaeaceae include *Ceratolejeunea ceratantha* (Nees *et* Mont.) Steph., *Ceratolejeunea confusa* R.M. Schust., *Ceratolejeunea desciscens* (Sande Lac.) Schiffn., *Ceratolejeunea laetefusca* (Austin) R.M. Schust., *Cheilolejeunea aneogyna* (Spruce) A. Evans, *Cheilolejeunea clausa* (Nees *et* Mont.) R.M. Schust., *Cheilolejeunea neblinensis* Ilk.-Borg. *et* Gradst., *Cololejeunea cardiocarpa* (Mont.) A. Evans, *Cololejeunea diaphana* A. Evans, *Diplasiolejeunea buckii* Grolle, *Drepanolejeunea anoplantha* (Spruce) Steph., *Leptolejeunea exocellata* (Spruce) A. Evans, *Microlejeunea aphanella* (Spruce) Steph., *Schiffneriolejeunea amazonica* Gradst., *Verdoornianthus griffinii* Gradst., *Verdoornianthus marsupifolius* (Spruce) Gradst. and *Vitalianthus urubuensis* Zartman *et* Ackerman. *Telaranea pecten* (Spruce) J.J. Engel *et* G.L. Merr. is the single new record in Lepidoziaceae.

Fig. 1. Map of the study area, showing the sampling localities in the Colombian Amazon. **1.** Puerto Colombia; **2.** La Gamitana; **3.** Macaquiño; and **4.** El Zafire.

NEW RECORDS TO COLOMBIA

Lejeuneaceae

Ceratolejeunea ceratantha (Nees *et* Mont.) Steph. **Figs 2-4**

Plant characterized by leaves with seriate ocelli in a broken row, a toothed leaf apex and ovate underleaves. This species may be confused with *C. cubensis* but the latter species has leaves with 1-2 basal ocelli, which are not arranged in a row. *Ceratolejeunea ceratantha* can also be confused with *C. rubiginosa* but the latter has moniliate ocelli (in an unbroken row) and a toothed dorsal leaf margin (Dauphin, 2003).

In tree height zones 1, 2 and 3, alt. 115-190 m. *L.V. Campos 720* (El Zafire, Amazonas), and *731* (Macaquiño, Vaupés) (COL). General distribution: tropical America (Dauphin, 2003).

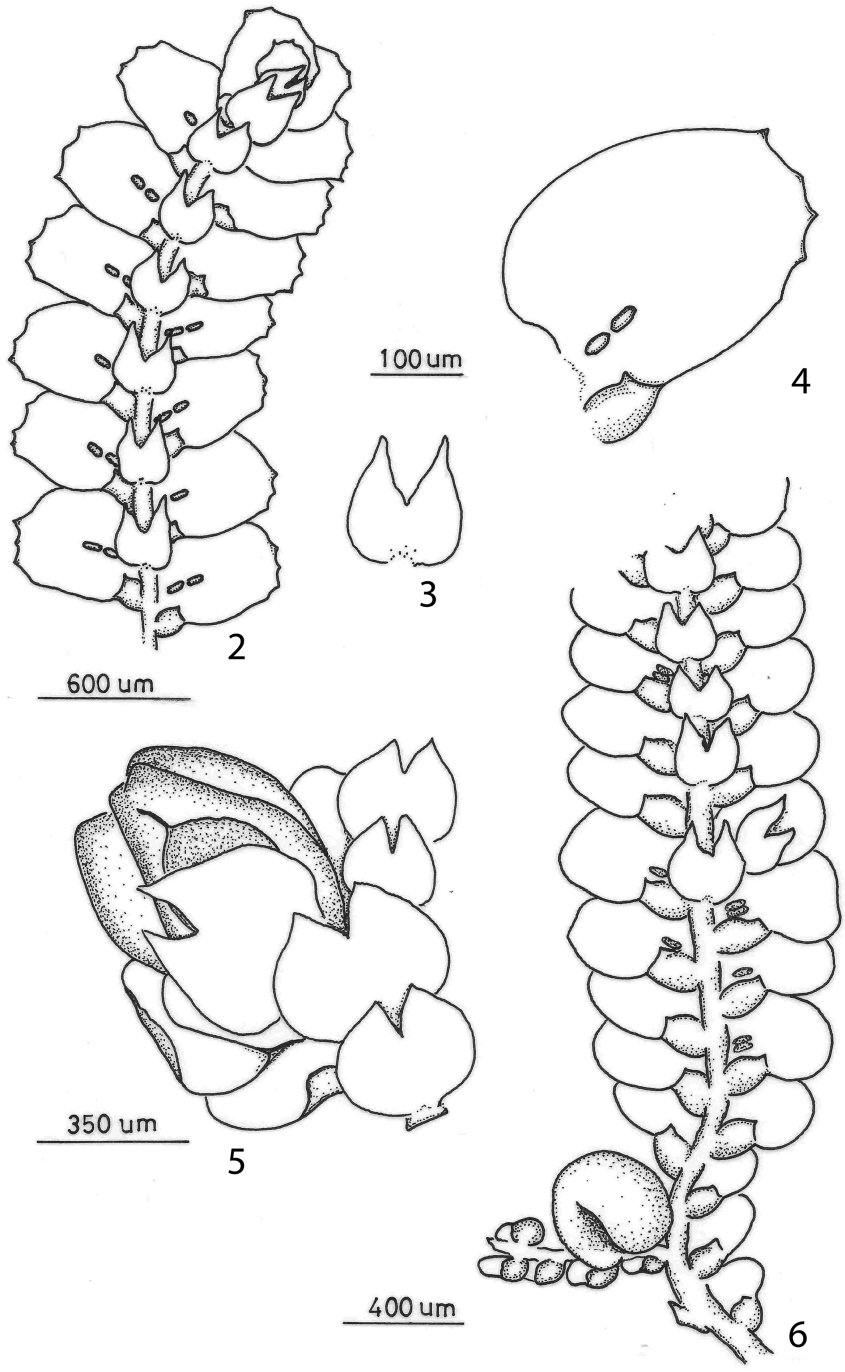
Ceratolejeunea confusa R.M. Schust. **Figs 5-6**

Characterized by underleaves 3-5 × stem width and perianths with 5 rounded keels without horns. *Ceratolejeunea confusa* can be confused with *C. cornuta* but the latter species differs by spherical lobules and horned perianths.

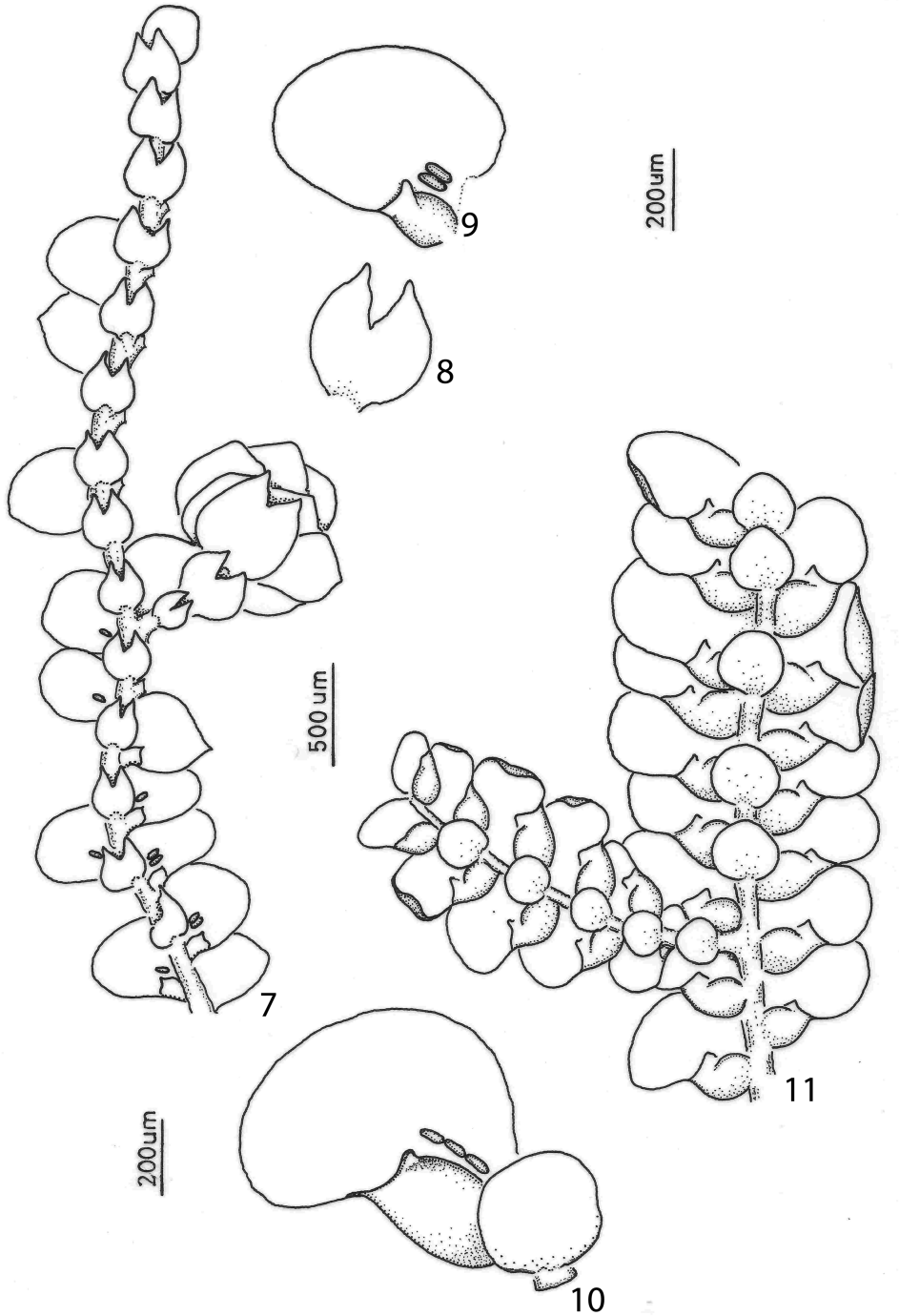
In tree height zones 2, 4, 5 and 6, alt. 140-210 m. *L.V. Campos 721* (La Gamitana, Caquetá), *733* (Puerto Colombia, Putumayo), and *734* (Macaquiño, Vaupés) (COL). General distribution: tropical South America, Costa Rica (Dauphin, 2003).

Ceratolejeunea desciscens (Sande Lac.) Schiffn. **Figs 10-11**

This species can be easily recognized by its entire underleaves, leaves with (1-)2-6 ocelli in an unbroken row, usually entire leaf margins and perianths with bulbous horns (Fulford, 1945; Dauphin, 2003). Utriculi are apparently absent. *Ceratolejeunea desciscens* is a member of subg. *Ceratolejeunea* and the only species of this subgenus occurring in lowland areas, the other members are montane taxa.



Figs 2-6. *Ceratolejeunea ceratantha* (Nees *et* Mont.) Steph.: **2.** Habit, ventral view. **3.** Underleaf. **4.** Leaf, showing ocelli. - *Ceratolejeunea confusa* R.M. Schust.: **5.** Gynoecium and perianth. **6.** Habit, ventral view.



Figs 7-11. *Ceratolejeunea laetefusca* (Austin) R.M. Schust.: **7.** Habit, ventral view. **8.** Underleaf. **9.** Leaf, showing ocelli. - *Ceratolejeunea desciscens* (Sande Lac.) Schiffn.: **10.** Portion of the stem, showing leaf and underleaf. **11.** Habit, ventral view.

In tree height zones 1, 2, 3, 4 and 5, alt. 120-225 m. *L.V. Campos 702* (La Gamitana, Caquetá), *735* (Puerto Colombia, Putumayo), and *736* (Macaquiño, Vaupés) (COL). General distribution: northern South America (Dauphin, 2003).

Ceratolejeunea laetefusca (Austin) R.M. Schust. **Figs 7-9**

This species is recognized by caducous leaves, small underleaves that are only two times wider than the stem and perianths without horns. By the lack of perianth horns and caducous leaves this species can be confused with *C. guianensis*, from which it can be distinguished by its plane leaves, ovate underleaves with spreading segments, and the absence of flagelliferous branches (Dauphin, 2003).

In tree height zones 2, 3, 4 and 5, alt. 130-210 m. *L.V. Campos 703* (El Zafire, Amazonas), and *737* (Puerto Colombia, Putumayo) (COL). General distribution: tropical America (Dauphin, 2003).

Cheilolejeunea aneogyna (Spruce) A. Evans **Figs 12-13**

This species can usually be recognized by the leaves with a flat and rounded leaf apex, paired lobule teeth, underleaves 2.5-4 × stem width and frequent presence of microphyllous branches with caducous leaves. *Cheilolejeunea aneogyna* can be confused with *C. oncophylla,* which shares with *C. anaeogyna* the somewhat recurved, obtuse leaf apex and mamillose leaf cells with somewhat thickened outer wall. However, *C. oncophylla* has a much more strongly thickened outer cell wall, smaller underleaves (usually less than 2.5 × stem width), smaller trigones and lacks microphyllous branches and caducous leaves. Moreover, *C. oncophylla* occurs mainly in montane forests (rarely in lowland rainforests; Gehrig-Downie *et al.*, 2013) whereas *C. anaeogyna* is restricted to lowland rain forests areas of tropical South America (Schäfer-Verwimp *et al.*, 2013).

In tree height zones 1, 2, 3, 4, 5 and 6, alt. 100-210 m. *L.V. Campos 704* (La Gamitana, Caquetá), *738* (El Zafire, Amazonas), *739* (Puerto Colombia, Putumayo), and *740* (Macaquiño, Vaupés) (COL). General distribution: Amazonia, southeastern Brazil, coastal Ecuador (Schäfer-Verwimp *et al.*, 2013).

Cheilolejeunea clausa (Nees *et* Mont.) R.M. Schust. **Figs 14-15**

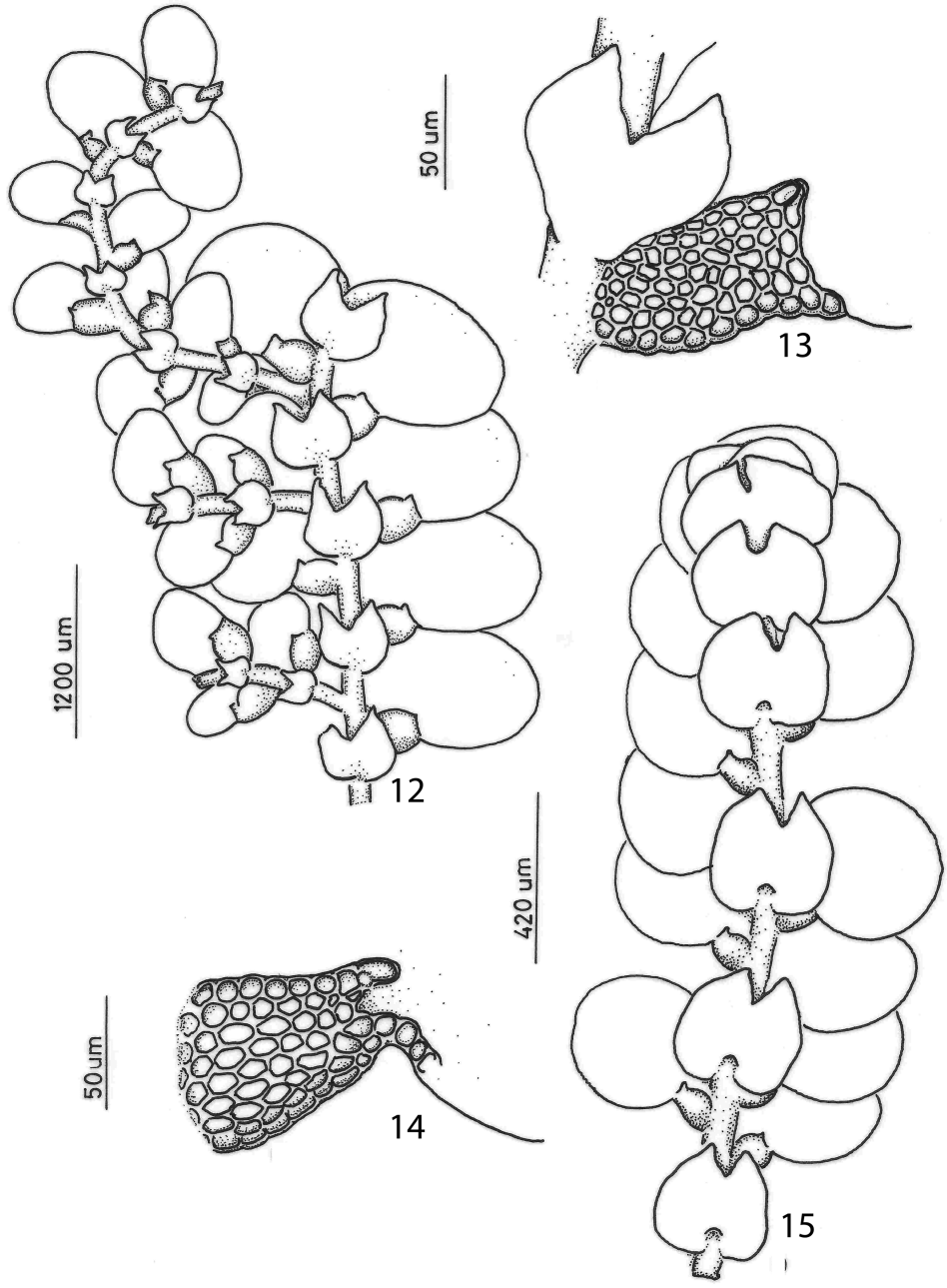
Plants large, with some caducous leaves. The outstanding character of *C. clausa* are the large underleaves which are as wide as long or longer than wide, with the base widely rounded and insertion line deeply arched. This species may be confused with *C. trifaria* but in the latter the underleaves are wider than long. Moreover, *C. trifaria* is autoicous (*C. clausa* is dioicous) (Gradstein & Costa, 2003).

In tree height zones 3, 4 and 5, alt. 120-210 m. *L.V. Campos 722* (El Zafire, Amazonas), and *741* (Puerto Colombia, Putumayo) (COL). General distribution: tropical America (Gradstein & Costa, 2003).

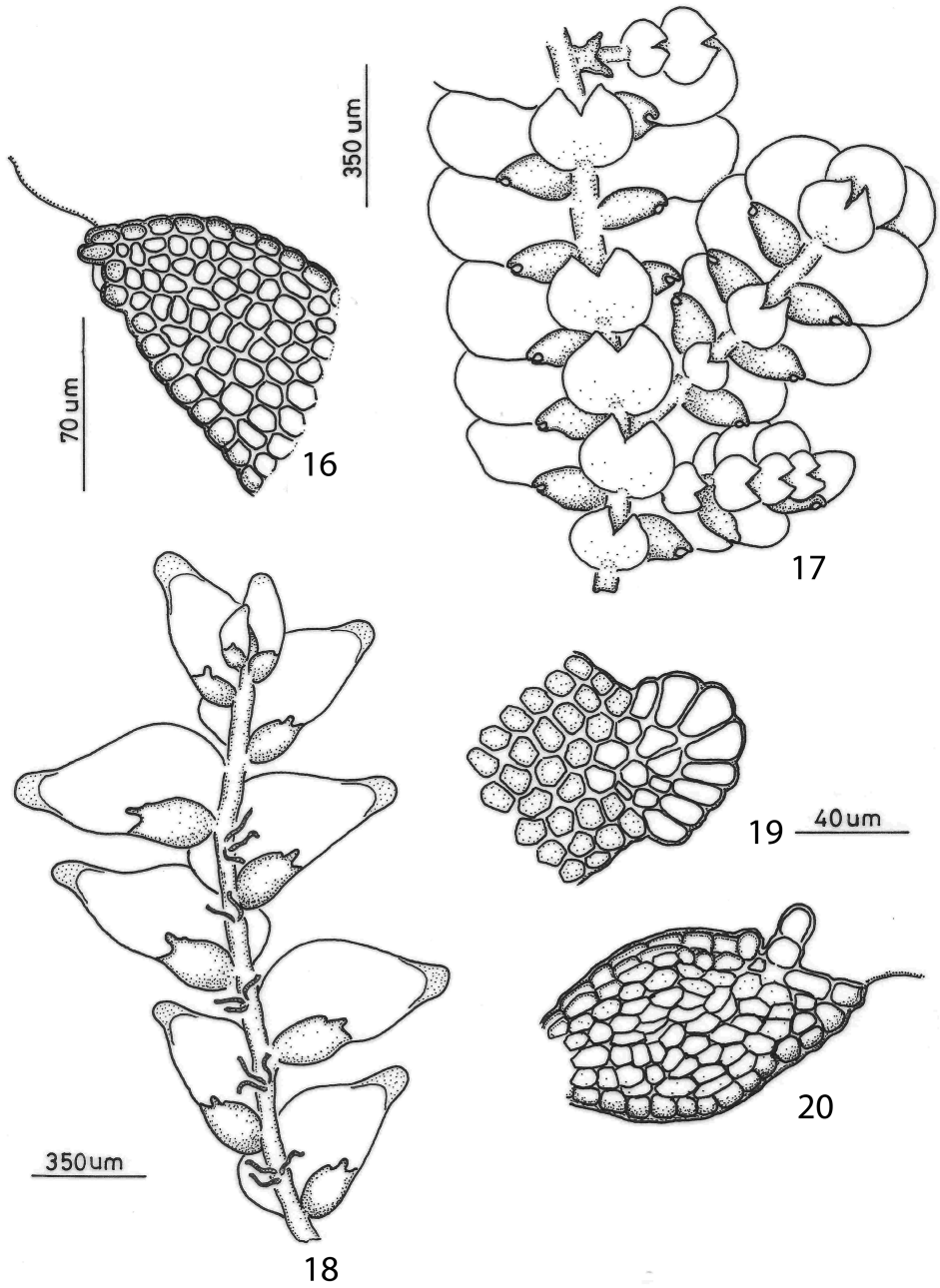
Cheilolejeunea neblinensis Ilk.-Borg. *et* Gradst. **Figs 16-17**

Cheilolejeunea neblinensis is readily recognized by the enlarged cells along the lobule keel, which are usually bulging outward, resulting in a crenate keel (Ilkiu-Borges & Gradstein, 2008). The ovate-triangular lobule is tubular in appearance due to the inrolled free margin, and has paired teeth at the apex like in *Cheilolejeunea anaeogyna*.

In tree height zones 1, 2, 3, 4 and 5, alt. 100-200 m. *L.V. Campos 723* (La Gamitana, Caquetá), *742* (El Zafire, Amazonas), *743* (Puerto Colombia, Putumayo), and *744* (Macaquiño, Vaupés) (COL). General distribution: Amazonia, Guayana Highlands (Ilkiu-Borges & Gradstein, 2008; Mota de Oliveira & ter Steege, 2013).



Figs 12-15. *Cheilolejeunea aneogyna* (Spruce) A. Evans: **12.** Habit, ventral view. **13.** Portion of shoot showing lobule with two overlapping, paired teeth. - *Cheilolejeunea clausa* (Nees *et* Mont.) R.M. Schust.: **14.** Lobule. **15.** Habit, ventral view.



Figs 16-20. *Cheilolejeunea neblinensis* Ilk.-Borg. *et* Gradst.: **16.** Lobule showing paired teeth at apex. **17.** Habit, ventral view. - *Cololejeunea cardiocarpa* (Mont.) A. Evans : **18.** Habit. **19.** Leaf apex. **20.** Lobule.

Cololejeunea cardiocarpa (Mont.) A. Evans **Figs 18-20**

A common species, easily recognized by the whitish group of elongate dead cells at the leaf apex. Sometimes they are finger-like extending from the apex. The leaf lobes in *C. cardiocarpa* are typically elongate-ovate in shape and tapering to a narrowly rounded apex, the leaf cells are thin-walled and smooth, and the lobule has 2 teeth.

In tree height zone 6, alt. 120-190 m. *L.V. Campos 705* (La Gamitana, Caquetá), *745* (Puerto Colombia, Putumayo), and *746* (Macaquiño, Vaupés) (COL). General distribution: pantropical (Gradstein & Costa, 2003).

Cololejeunea diaphana A. Evans **Figs 24-25**

This species has ovate-lanceolate leaves with entire margins and an obtuse apex. The first tooth of the lobule consists of slightly elongate-rounded cells and is straight, pointing to the leaf apex.

In tree height zone 1, alt. 180-190 m. *L.V. Campos 724* (Macaquiño, Vaupés) (COL). General distribution: pantropical (Gradstein & Costa, 2003, as *Aphanolejeunea truncatifolia* Horik.).

Diplasiolejeunea buckii Grolle **Figs 21-23**

This species can be recognized by the strongly elongate lobules with a T-shaped first tooth and by the large underleaves, which are about three times wider than the stem, with segments 8-10 cells long. The lobules are inflated but never strongly swollen-involute (Grolle, 1992).

In tree height zone 6, alt. 140-200 m. *L.V. Campos 707* (La Gamitana, Caquetá), and *747* (Macaquiño, Vaupés) (COL). General distribution: a rare species from northern Amazonia (Grolle, 1992; this paper).

Drepanolejeunea anoplantha (Spruce) Steph. **Figs 26-27**

This species is characterized by having two elongate ocelli in an unbroken row at the leaf base, well-developed, fully inflated lobules, and narrowly elongated, upright leaves which are usually more than 2 times longer than wide (Gradstein & Costa, 2003).

In tree height zones 1, 2, 3, 4 and 5, alt. 115-220 m. *L.V. Campos 725* (La Gamitana, Caquetá), *748* (El Zafire, Amazonas), *749* (Puerto Colombia, Putumayo), and *750* (Macaquiño, Vaupés) (COL). General distribution: West Indies, tropical South America (Gradstein & Costa, 2003).

Leptolejeunea exocellata (Spruce) A. Evans **Figs 28-29**

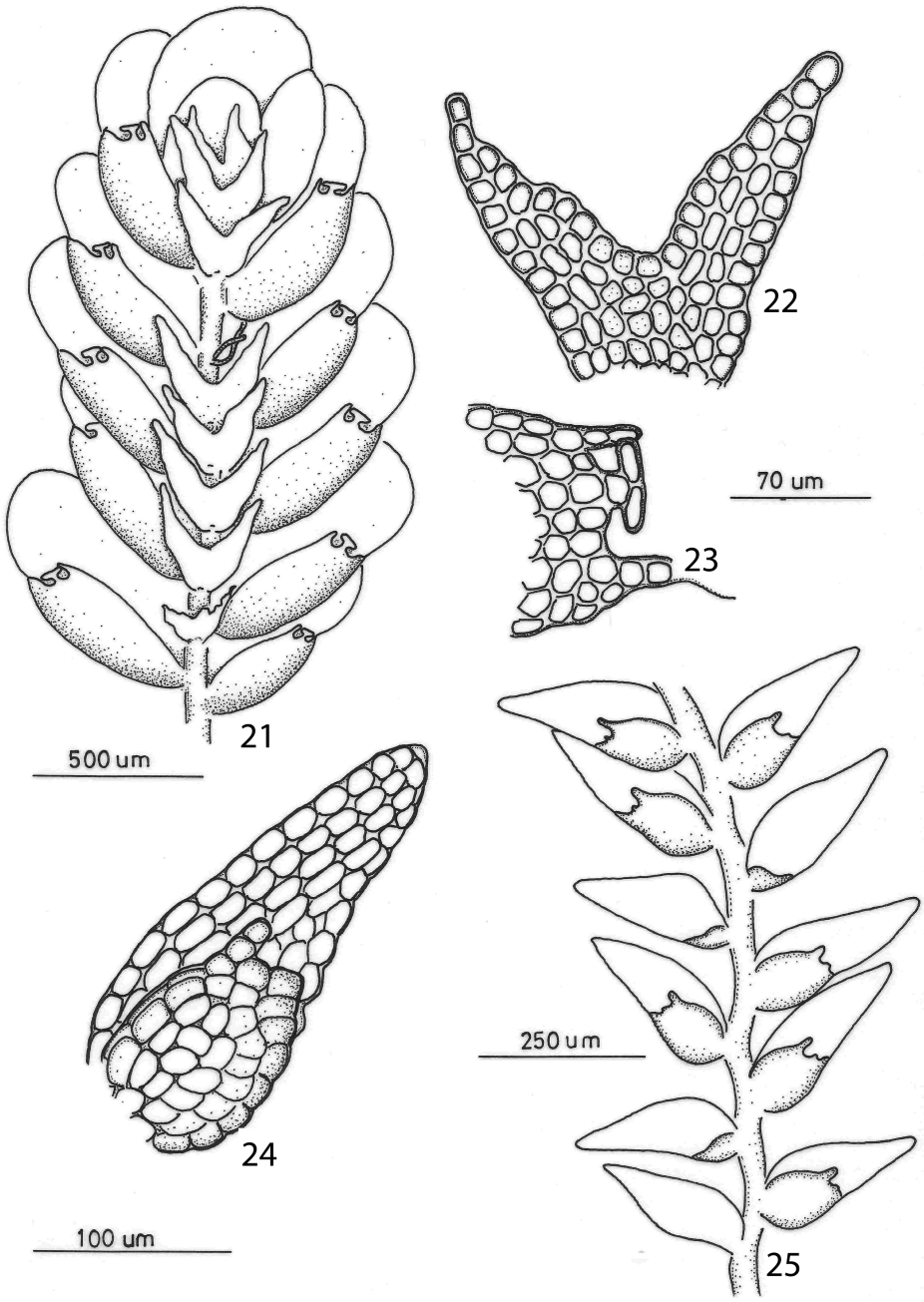
This plant is easily recognized by the entire leaf margins, the rather short leaves with obtuse to acute apices and, especially, by the large ocellus at the leaf base and the lack of any further ocelli in the lamina (Gradstein & Costa, 2003).

In tree height zone 4, alt. 190 m. *L.V. Campos 727* (Puerto Colombia, Putumayo) (COL). General distribution: common throughout tropical America (Gradstein & Costa, 2003).

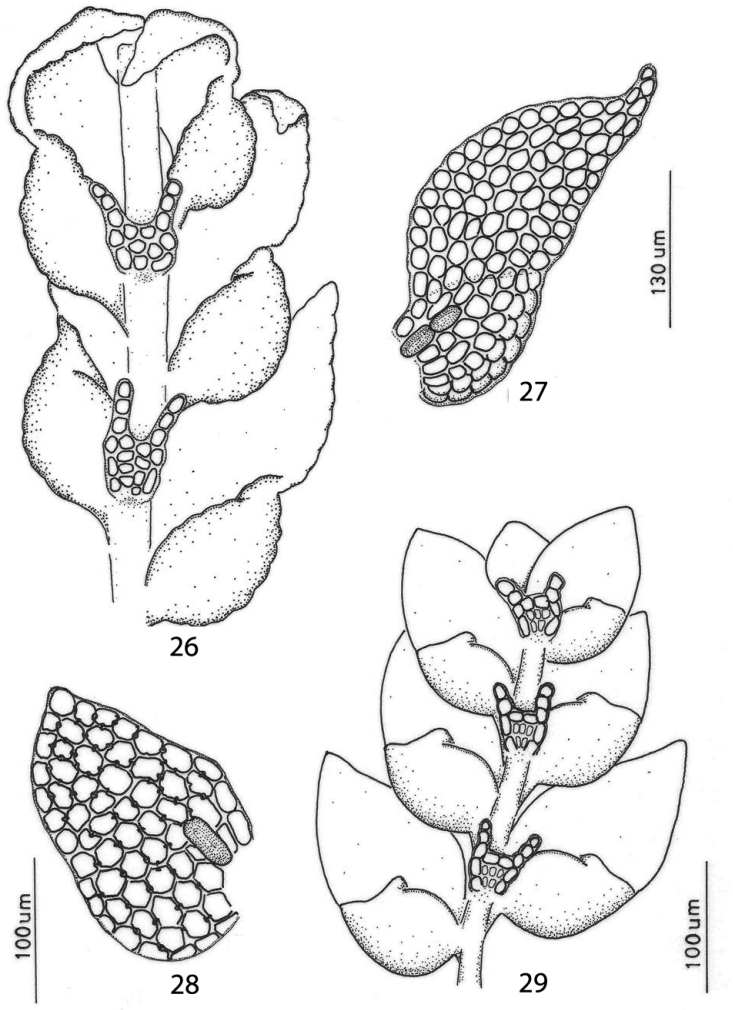
Microlejeunea aphanella (Spruce) Steph. **Figs 30-31**

This minute species is characterized by the obtuse to acute leaf apex, the smooth keel and the presence of reduced lobules (Gradstein & Costa, 2003).

In tree height zone 2, alt. 190 m. *L.V. Campos 728* (Macaquiño, Vaupés) (COL). General distribution: a rare species from Brazil, French Guiana and Colombia (Gradstein & Costa, 2003; this paper).



Figs 21-25. *Diplasiolejeunea buckii* Grolle : **21.** Habit, ventral view. **22.** Underleaf. **23.** Apex of the lobule. - *Cololejeunea diaphana* A. Evans: **24.** Leaf. **25.** Habit, ventral view.

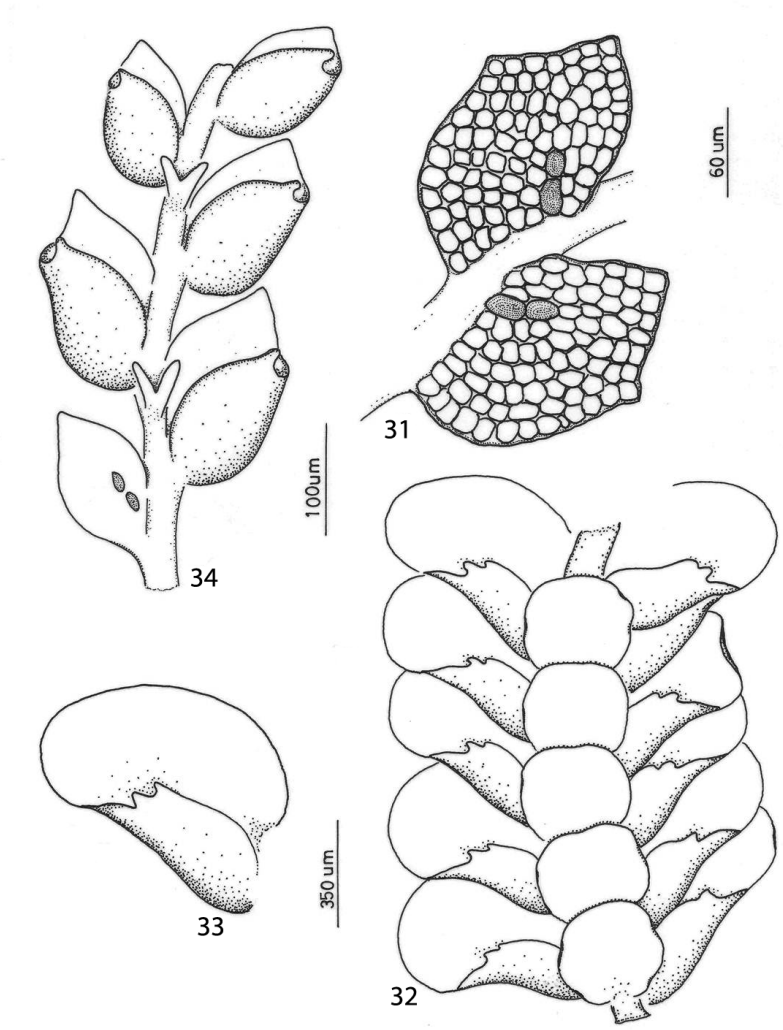


Figs 26-29. *Drepanolejeunea anoplantha* (Spruce) Steph.: **26.** Habit, ventral view. **27.** Leaf, dorsal view, showing ocelli. - *Leptolejeunea exocellata* (Spruce) A. Evans: **28.** Leaf, dorsal view, showing ocellus. **29.** Habit, ventral view.

Schiffneriolejeunea amazonica Gradst. **Figs 32-33**

This species is characterized by the dull brown plant color, rectangular lobules with two teeth, undivided underleaves, gynoecia without innovations and the perianth with two long, sharp ventral keels extending over more than $^1/_2$ the perianth length (Gradstein & Ilkiu-Borges, 2009).

In tree height zone 6, alt. 180 m. *L.V. Campos 729* (Macaquiño, Vaupés) (COL). General distribution: Amazonia, Guianas (Gradstein & Costa, 2003).

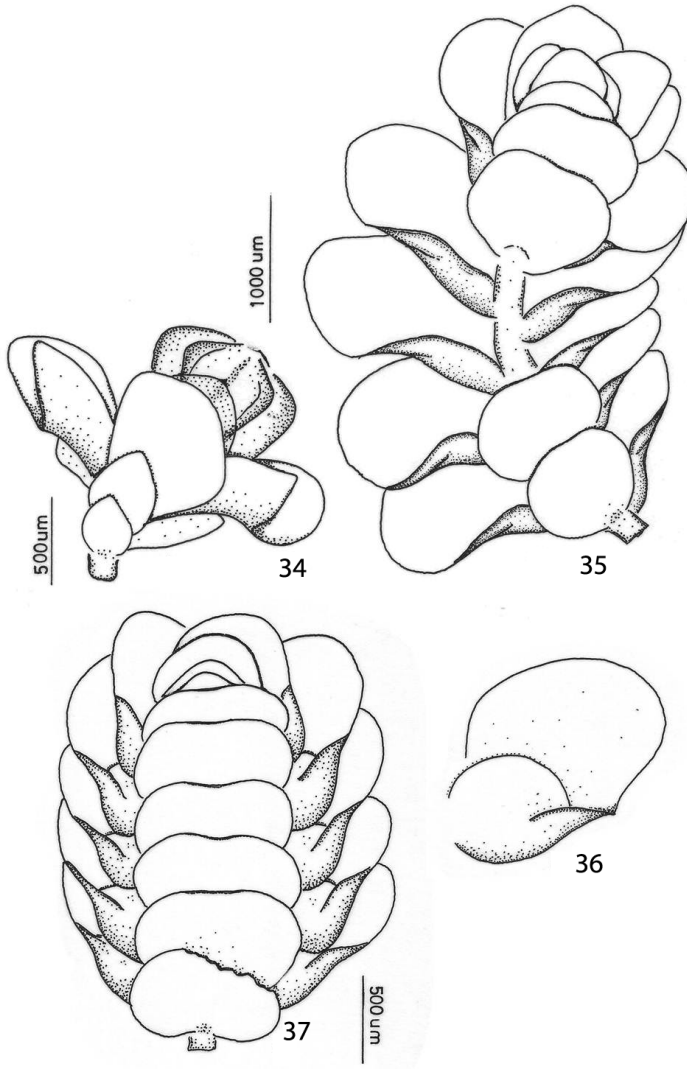


Figs 30-33. *Microlejeunea aphanella* (Spruce) Steph.: **30.** Habit, ventral view, showing one reduced lobule. **31.** Portion of shoot, showing ocelli, dorsal view. - *Schiffneriolejeunea amazonica* Gradst.: **32.** Habit, ventral view. **33.** Leaf, showing the lobule.

Verdoornianthus griffinii Gradst. **Figs 34-35**

This plant is characterized by the olive-green to brownish plant color, entire leaves with ± isodiametric cells, one-toothed lobules, undivided underleaves, gynoecia without innovations and perianths with 4-5 entire to slightly toothed keels. The leaf lobule in *V. griffinii* is rectangular, about twice longer than wide and inflated over its whole length, with a plane apex (Gradstein, 1994).

In tree height zone 6, alt. 100-210 m. *L.V. Campos 711* (La Gamitana, Caquetá), *751* (El Zafire, Amazonas), *752* (Puerto Colombia, Putumayo), and *753*

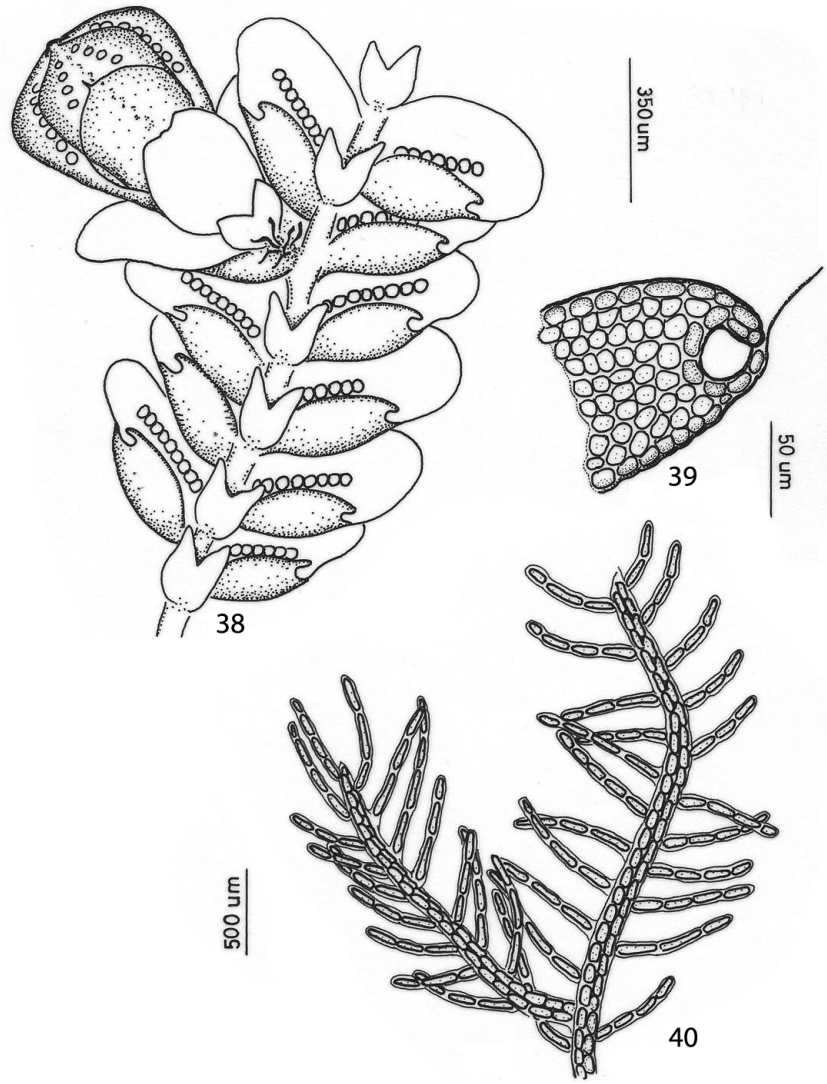


Figs 34-37. *Verdoornianthus griffinii* Gradst.: **34.** Gynoecium and perianth, ventral view. **35.** Habit, showing leaves with inrolled lobules. – *Verdoornianthus marsupifolius* (Spruce) Gradst.: **36.** Leaf, showing orbicular lobule with inflexed apex. **37.** Habit, ventral view.

(Macaquiño, Vaupés) (COL). General distribution: Amazonia, French Guiana (Gradstein, 1994; Mota de Oliveira & ter Steege, 2013).

Verdoornianthus marsupifolius (Spruce) Gradst. **Figs 36-37**

This species is close to *V. griffinii* but differs from the latter by the shorter, ovate-orbicular lobule with the free margin folded inwards at the apex, forming a small apical pouch (Gradstein, 1994).



Figs 38-40. *Vitalianthus urubuensis* Zartman *et* Ackerman: **38.** Habit with perianth, ventral view. **39.** Apical portion of lobule. – *Telaranea pecten* (Spruce) J.J. Engel *et* G.L. Merr.: **40.** Habit, showing uniseriate leaves.

In tree height zones 5 and 6, alt. 100-225 m. *L.V. Campos 712* (La Gamitana, Caquetá), *754* (El Zafire, Amazonas), *755* (Puerto Colombia, Putumayo), and *756* (Macaquiño, Vaupés) (COL). General distribution: northern Amazonia (Gradstein, 1994).

Vitalianthus urubuensis Zartman *et* Ackerman **Figs 38-39**

This unusual species is easily recognized by the presence of a long unbroken row of large and bright, golden-brown ocelli in the leaves, female bracts

and perianths. The leaf apices in *V. urubuensis* are rounded, the lobules rectangular with a long curved tooth, the underleaf lobes elongate, obtuse and slightly diverging, and the perianths are rather flat, widened to the apex and 4-keeled with two wide lateral keels. By the characters of the leaves, lobules, underleaves and perianths *V. urubuensis* is very different from *V. bischlerianus*, the type species of the genus *Vitalianthus* (Zartman & Ackerman, 2002).

In tree height zones 5 and 6, alt. 100-220 m. *L.V. Campos 713* (La Gamitana, Caquetá), *757* (El Zafire, Amazonas), *758* (Puerto Colombia, Putumayo), and *759* (Macaquiño, Vaupés) (COL). General distribution: Amazonia (Zartman & Ackerman, 2002; Mota de Oliveira & ter Steege, 2013).

Lepidoziaceae

Telaranea pecten (Spruce) J.J. Engel *et* G.L. Merr. **Fig. 40**

Plants very small, made up of filamentose leaves consisting of only one single row of 3-5 cells. The perianths are elongate and laciniate at mouth (Fulford, 1968).

In tree height zone 1, alt. 135-215 m. *L.V. Campos 730* La (Gamitana, Caquetá), and *760* (Macaquiño, Vaupés) (COL). General distribution: a rare species from northern Amazonia and Guyana; in addition, the species has been recorded without voucher from Puerto Rico (Engel & Smith-Merrill, 2004).

Acknowledgments. We thank the Instituto de Ciencias Naturales and Herbario Nacional Colombiano COL of the National University of Colombia for laboratory facilities and collections. The first author would like to express her thanks to COLCIENCIAS for sponsoring her doctoral study, to Instituto de Estudios Amazonicos SINCHI, especially to Dairon Cárdenas, for help and suggestions in the organization of the fieldwork, to Maklin Muñoz for invaluable field assistance and safe climbing of the trees, and to Dr. Bill Carr and Mary Lou Price for corrections of the manuscript and suggestions.

REFERENCES

BENITEZ A. & GRADSTEIN S.R., 2011 — Adiciones a la flora de briófitas del Ecuador. *Cryptogamie, Bryologie* 32: 65-74.

BENITEZ A., GRADSTEIN S.R., PRIETO M., ARAGÓN G., LEÓN-YÁNEZ S., MOSCOSO A. & BURGHARDT M., 2012 — Additions to the bryophyte flora of Ecuador 2. *Tropical bryology* 34: 99-106.

DAUPHIN G., 2003 — Ceratolejeunea. *Flora Neotropica Monography* 90: 1-86.

DAUPHIN G., 2005 — Catalogue of Costa Rican Hepaticae and Anthocerotae. *Tropical bryology* 26: 141-218.

ENGEL J.J. & MERRILL G.L., 2004 — Austral Hepaticae. 35. A taxonomic and phylogenetic study of *Telaranea* (Lepidoziaceae), with a monograph of the genus in temperate Australasia and commentary on extra-Australasian taxa. *Fieldiana*, *Botany*, New Series, 44: 1-265.

FULFORD M., 1945 — Studies on American Hepaticae VI. *Ceratolejeunea*. *Brittonia* 5: 368-403.

FULFORD M., 1968 — Manual of the Leafy Hepaticae of Latin America III. *Memoirs of the New York Botanical Garden* 11: 277-392.

GEHRIG-DOWNIE C., OBREGÓN A., BENDIX J. & GRADSTEIN S.R., 2013 — Diversity and vertical distribution of epiphytic liverworts in lowland rain forest and lowland cloud forest of French Guiana. *Journal of bryology* 35: 243-254.

GRADSTEIN S.R., 1994 — Lejeuneaceae: Ptychantheae, Brachiolejeuneae. *Flora Neotropica Monography* 62: 1-216.

GRADSTEIN S.R. & COSTA D.P., 2003 — The Hepaticae and Anthocerotae of Brazil. *Memoirs of the New York Botanical Garden* 87: 1-318.

GRADSTEIN S.R. & ILKIU-BORGES A.L., 2009 — Guide to the plants of Central French Guiana, part 4. Liverworts and Hornworts. *Memoirs of the New York Botanical Garden* 76: 1-140.

GRADSTEIN S.R. & SCHÄFER-VERWIMP A., 2011 — A new species of *Harpalejeunea* (Spruce) Schiffn. (Lejeuneaceae) from montane cloud forest of Colombia and Costa Rica. *Cryptogamie, Bryologie* 32: 101-106.

GROLLE R., 1992 — Zwei neue Arten der Lebermoosgattung *Diplasiolejeunea* aus der Neotropis. *Beiträge zur Phytotaxonomie* 15: 105-110.

GROLLE R. & REINER-DREHWALD M.E., 1999 — Review of the genus *Harpalejeunea* (Lejeuneaceae) including the description of *H. grandis*, a new species from the páramos ofColombia. *Journal of bryology* 21: 31-45.

ILKIU-BORGES A.L. & GRADSTEIN S.R., 2008 — A new species of *Cheilolejeunea* (Spruce) Schiffn. (Lejeuneaceae) from Cerro de la Neblina, Venezuela. *Nova Hedwigia* 87: 521-528.

LEÓN-YÁNEZ S., GRADSTEIN S.R. & WEGNER C., 2006 — *Hepáticas (Marchantiophyta) y Antoceros (Anthocerotophyta) del Ecuador, catálogo*. Quito, Publicaciones del Herbario QCA, Pontificia Universidad Católica del Ecuador.

MOTA de OLIVEIRA S., ter STEEGE H., CORNELISSEN J.H.C. & GRADSTEIN S.R., 2009 — Niche assembly of epiphytic bryophyte communities in the Guianas: a regional approach. *Journal of biogeography* 36(11): 2076-2084.

MOTA de OLIVEIRA S. & ter STEEGE H., 2013 — Floristic overview of the epiphytic bryophytes of *terra firme* forests across the Amazon basin. *Acta botanica Brasilica* 27: 347-363.

SCHÄFER-VERWIMP A., LEHNERT M. & NEBEL M., 2013 — Contribution to the knowledge of the bryophyte flora of Ecuador. *Phytotaxa* 128: 1-63.

SCHUSTER R.M., 2001 — Revisionary studies on austral Acrobolbaceae, I. *Journal of the Hattori Botanical laboratory* 90: 97-166.

URIBE J. & GRADSTEIN S.R., 1998 — Catalogue of the Hepaticae and Anthocerotae of Colombia. *Bryophytorum bibliotheca* 53: 1-99.

URIBE J., 2006 — Type studies on *Frullania* subgenus *Meteoriopsis* (Hepaticae). V. *Frullania dulimensis* sp. nov. from Colombia. *Cryptogamie, Bryologie* 27(3): 309-312.

ZARTMAN C.E. & ACKERMAN I.L., 2002 — A new species of *Vitalianthus* (Lejeuneaceae, Hepaticae) from the Brazilian Amazon. *The bryologist* 105: 267-269.