

3. Plants elongate, up to 6 cm long, pale green, weakly and irregularly branched, leaves lax, remote, asymmetric, usually 3-lobed; underleaves with low disc, wider than long but not wider than stem, at insertion 10-28 cells broad, inserted to 6-17 ventral merophyte cells; larger stems with 27-50 cortical and 100-230 medullary cell rows ***L. pearsonii***
- 3*. Plants small to medium-sized, up to 5 cm long but usually shorter, more regularly pinnately branched, leaves remote to imbricate, 3-4-lobed; underleaves with high disc (except *L. stuhlmannii* var. *abyssinica*), at insertion 8-15 cells broad, inserted to 4-9(-10) ventral merophyte cells; larger stems with 23-25 cortical and 58-63 medullary cell rows 4
4. Leaves distant to contiguous, concave, turned inwards towards the stem, shoot threadlike, cells with small trigones at least in the lobes, angle of branches about 60° to the stem, usually yellowish- to olivaceous green plants, underleaves round in outline, widest at their middle, usually much wider than the stem, the sinus between the underleaf lobes usually V-shaped
..... ***L. stuhlmannii***
- 4*. Leaves contiguous to imbricate, plane or slightly concave, only the lobes incurved, shoot flat, cells without small trigones or trigones only slightly visible, angle of branches about 70-90° to the stem, usually pale to dull or dark green plants, underleaves variable in outline, usually narrower or only slightly wider than the stem, the sinus between the underleaf lobes usually U-shaped. In Africa only on Mt. Kahuzi and Mt. Bigugu ***L. reptans***

***Leptoscyphus* Mitt.**

J. Bot. Kew Gard. Misc. 3: 358 (1851).

A genus with 18 to 20 species mainly in the Southern Hemisphere. Three species in Rwanda.

References: Arnell (1956), Jones (1953c), Grolle (1962), Fischer (1993c).

1. Leaves all with two or three spines at the margin, perianth and involucre leaves vesicarious (gibbous) at base ***L. infuscatus***
- 1*. Leaves mostly or all with entire margin, rarely some leaves with one or two spines, leaves ± asymmetric, perianth and involucre leaves not vesicarious2
2. Underleaves with 6-8 spines ***L. hedbergii***
- 2*. Underleaves with 2-4 (rarely 6) teeth or spines ***L. expansus***

Lethocolea Mitt.

In: Hooker, *Handb. New Zeal. Fl.*: 751 (1867).

Southern-temperate genus with ca. five to six species. In Rwanda one species.

Lopholejeunea (Spruce) Schiffn.

In: Engl. & Prantl, *Nat. Pflanzenfam.* 1(3): 129 (1893).

Pantropical genus of 40 species, 19 species present in Africa and Madagascar. Three species in Rwanda.

References: Vanden Berghen (1984b), Tixier (1995).

1. Leaves with obtuse lobe, often apiculate at incurved apex **L. nigricans**
- 1*. Leaves with rounded lobe at incurved apex 2
2. Lobule of female bracts ciliate or dentate, underleaves nearly as wide as the leaf lobes **L. eulopha**
- 2*. Lobule of female bracts entire, underleaves smaller, less than 800 µm wide3
3. Perianth entirely or nearly entirely covered by female bracts .. **L. subfusca**
- 3*. Perianth longly exerted **L. nigricans**

Lophozia (Dumort.) Dumort.

Recueil d'observ. Jung.: 17 (1835).

Cosmopolitan genus with 50-60 species, mainly in the holarctic and few in tropical mountains. One species in Rwanda.

References: Váňa & Watling (2004c).

Marchesinia S. Gray

Nat. Arr. Brit. Pl. 1: 679 (1821).

A genus with 5 species from Atlantic Europe to Africa and South America. Two species in Rwanda.

References: Jones (1970), Vanden Berghen (1976b).

1. Lobule only with 1 tooth (apical tooth) **M. excavata**
1. Lobule with apical tooth and 2(-3) supplementary teeth **M. deslooveri**

Marsupella Dumort.

Com. bot.: 114 (1823).

About 45 species mainly in the northern hemisphere or in the tropics at high elevations. Two species in Rwanda.

References: Váňa (1985, 1993), Váňa & Watling (2004b).

- 1. Leaves ovate, mostly unlobed or retuse, rarely slightly bilobed, lobes blunt ***M. subintegra***
- 1*. Leaves orbicular, distinctly bilobed, lobes acute ***M. emarginata***

Microlejeunea Steph.

Hedwigia 27: 61 (1888).

Pantropical and warm-temperate genus with 20-30 species, one species extending into northern hemisphere. Three species in Rwanda.

References: Jones (1969), Vanden Berghen (1965, 1977), Pócs (1993, 2002).

- 1. Leaves of sterile shoots with ventral margin almost in line with keel ***M. africana***
- 1*. Leaves of sterile shoots with ventral margin arched, forming a distinct sinus with keel 2
- 2. Innovations below gynoecium simple, hyaline papilla entally proximal to apical tooth of lobule, ocelli in leaf lobe 1-2(-4) in a line . ***M. kamerunensis***
- 2*. Innovations below gynoecium paired, hyaline papilla entally distal to apical tooth of lobule, ocelli in leaf lobe (1-)2-6(-8) in irregular groups ***M. nyandaruenensis***

Mastigophora Nees

Naturg. Europ. Leberm. 3: 89 (1838).

Disjunct genus with about 10 species, mainly in the Southern Hemisphere, one species extending to atlantic Europe. One species in Rwanda.

Mnioloma Herzog

Ann. Bryol. 3: 119 (1930)

A mostly neotropical genus with about 10 species. Only one species (*M. fuscum*) in Africa and Rwanda.

References: Bischler (1970), Jones (1976b).

Notoscyphus Mitt.

Fl. Vit.: 407 (1873).

About five species in Asia and Africa. One species in Rwanda.

Odontolejeunea (Spruce) Schiffn.

In: Engl. & Prantl, Nat. Pflanzenfam. 1 (3): 127 (1893).

Three species, two of them restricted to the Neotropics. One species in Rwanda.

Omphalanthus Lindenb. & Nees

In: Gottsche et al., Syn. Hep.: 303 (1845).

Synonym: *Evansiolejeunea* Vanden Berghen, *Rev. Bryol. Lichén.* 17: 87 (1948).

Small genus with 4-5 species in the neotropics. One species known from the Albertine Rift region.

References: Vanden Berghen (1948b).

Plagiochila (Dumort.) Dumort.

Recueil Observ. Jung.: 14 (1835).

The largest genus of liverworts with about 400 species worldwide. In Rwanda 13 species.

References: Jones (1962), Vandenberghen (1981), Pócs (1993).

1. Shoots branching only by intercalary innovations, perianths unwinged but sometimes keeled 2
- 1*. Shoots with terminal branches, at least in distal part of plant, perianths with only dorsal, or dorsal and ventral wings 7
2. Leaves oblong-cuneate, bilobed or very rarely trilobed, caducous, lobes 0.2-0.4 x leaf length. **P. exigua**
- 2*. Leaves triangular-ovate, triangular, oval, obovate or oblong, never bilobed or trilobed 3
3. Leaves imbricate, triangular or triangular-ovate, widest at base, the insertion equalling about half of the base, leaf decurrent anticlinal in a broad wing, postical base often ampliate and forming a strong crest, cells with nodular trigones 4
- 3*. Leaves approximate to distant, oval, obovate or oblong, 1.5-2 x as long as wide or more, widest usually near middle, antical bases of leaves scarcely concealing the stem, only shortly decurrent, cell walls with nodular trigones or equally thickened 5

4. Shoots to 3.5 mm wide, rigid, normally ciliate-dentate, postical base shortly decurrent ***P. barteri***
- 4*. Shoots up to 7-9 mm wide, very large, leaf apex closely and finely dentate, postical base longly decurrent in a broad wing ***P. colorans***
5. Leaves narrowly oval or oblong, more than 2 x as long as wide, usually widest near middle, approximate to distant, spreading at 50°-80°, shortly decurrent antically, cell walls strongly and equally thickened .. ***P. pectinata***
- 5*. Leaves oval, obovate or ovate, apex broad, obtuse, rarely more than 1.5 x as long as wide, antical bases of leaves scarcely decurrent, cell walls with nodular trigones 6
6. Leaf-insertion very oblique, mostly on the flank of the stems, not reaching the midline on the antical face, apex broadly rounded, leaf cuneate at base, the postical base diverging widely, antical margin of leaf only weakly convex, leaves shortly and closely serrate or almost entire, never caducous, cell walls thin, trigones small ***P. integerrima***
- 6*. Leaf-insertion nearly transverse, leaves triangular-ovate, widest below middle, distantly spinose-dentate, rather longly decurrent, with numerous microphyllous flagellae with caducous leaves, cell walls with large nodular trigones ***P. subalpina***
7. Dorsal leaf base decurrent in a broad wing inserted very close to and parallel to the midline of stem, thus concealing all or most of them dorsally, ventral base of leaf decurrent as long, often undulate wing, plants robust 8
- 7*. Dorsal leaf base longly or shortly decurrent, inserted obliquely to axis of stem, thus leaving most of stem exposed dorsally 9
8. Plants forming pendant brackets up to 12 cm long, margin sharply dentate, cell wall trigones not nodulose ***P. squamulosa***
- 8*. Plants 6-8 cm long, often pendulous, teeth irregular, cell wall trigones nodulose ***P. lastii***
9. Leaves ligulate, oblong or oval, fronds pinnately branched, dorsal leaf base rather longly but narrowly decurrent 10
- 9*. Leaves triangular-oval or triangular-ovate 11
10. Leaves usually with teeth on ventral margin, longitudinal and transverse cell walls equally thickened ***P. heterostipa***
- 10*. Leaves usually lacking teeth on ventral margin, cells elongate, usually with longitudinal walls thicker than transverse walls ***P. terebrans***

- 11. Teeth spiniform, of 3-4 uniseriate cells, leaves secund and deflexed, strongly spiniformly dentate around the whole of postical base, postical margin and apex, longly decurrent anticlinal in a tapering wing, robust plants ***P. ericicola***
- 11*. Teeth triangular, usually ending in 1-3 uniseriate cells, leaves not secund 12
- 12. Leaves small, usually less than 1.7 mm long, teeth on margin ± triangular, dorsal base of leaf strongly decurrent ***P. fusifera***
- 12*. Leaves large, usually 2-3.5 mm long, teeth on margin spiniform . ***P. kiaerii***

Plicanthus R.M. Schust.

Nova Hedwigia 74: 492 (2002).

Synonym: *Chandonanthus* Mitt., in Hook., *Hdb. N.Z. Flora* 2: 750 (1867) p.p.

5 species, from Indomalaysia to Japan, New Guinea, New Caledonia, British Columbia and Africa. Two species in Rwanda.

References: Vanden Berghen (1965), Váňa (1993), Váňa & Watling (2004c).

- 1. Large plants up to 10-12 cm long, stems with paraphyllia, leaf lobes with 15-20 cilia on each margin ***P. giganteus***
- 1*. Smaller plants up to 2-4 cm long, stems without paraphyllia, leaf lobes mostly with 5-7 cilia on each margin ***P. hirtellus***

Porella L.

Sp. Pl., ed. 1: 1106 (1753).

About 50-60 species worldwide. Two species in Rwanda.

References: Jones (1963), Fischer (1993c).

- 1. Underleaves 2-2,5 x the width of the stem, plant yellowish or brownish, leaves, lobules and underleaves entire, very robust, apex of lobule entire ***P. abyssinica***
- 1*. Underleaves 1-1,6 x the width of the stem, plant greenish, lobules irregularly dentate at apex, underleaves ± dentate ***P. subdentata***

Prionolejeunea (Spruce) Schiffn.

In: Engl. & Prantl, *Nat. Pflanzenfam.* 1(3): 118, 127 (1893).

A genus of 10-20 species with highest diversity in the Neotropics. One species in Rwanda.

Ptychanthus Nees

Naturg. Europ. Leberm. 3: 211 (1838).

Two species in the tropics of the Old World. One in Africa and Rwanda.

Radula Dumort.

Commentat. Bot.: 112 (1822).

About 200 species worldwide. Eight species in Rwanda.

References: Jones (1977), Yamada (1993).

1. Leaf-lobes with gemmae on margins 2
- 1*. Leaf-lobes without gemmae on margins 3
2. Funnel-shaped gemmae occurring on dorsal margins of leaf lobes; leaf-lobules covering the stem for 1/4-1/3 of the stem-width **R. flaccida**
- 2*. Discoid gemmae occurring on dorsal margins of leaf-lobes; leaf-lobules extending far beyond the farther edge of the stem **R. quadrata**
3. Leaf-lobules with auriculate or volute base 4
- 3*. Leaf-lobules without auriculate or volute base 6
4. Leaf-lobules transverse wide rectangular with volute base **R. voluta**
- 4*. Leaf-lobules with auriculate base 5
5. Leaf-lobules elliptical or bluntly triangular with strongly auriculate base; keels very short and sinuate; gynoecia terminal on short gynoecial branches
..... **R. boryana**
- 5*. Leaf-lobules subquadrate with auriculate base; keels long and substraight or somewhat sinuate; gynoecia terminal on long ordinary branches and stems **R. stipatiflora**
6. Leaf-lobules with reflexed apical or adaxial margins 7
- 6*. Leaf-lobules without reflexed margins **R. ankefinensis**
7. Leaf-lobules covering the stem for 4/5-1/2 of the stem-width and with reflexed adaxial margins; cells of stem thin-walled with minute trigones
..... **R. comorensis**
- 7*. Leaf-lobules extending far beyond the farther edge of the stem and with reflexed apical margins; cells of stem thick-walled with large trigones
..... **R. appressa**

Schiffneriolejeunea Verdoorn

Ann. Bryol. 6: 89 (1933).

Pantropical genus with 14 species. Two species in Rwanda.

References: Gradstein & Vanden Berghen (1985), Vanden Berghen (1976b), Pócs (1993).

1. Perianth without keels or only slightly keeled in apical part, rostrum well developed, leaf-lobe obtuse, base of underleaves auriculate .. ***S. pappeana***
- 1*. Perianth with 3 distinct keels in upper third, rostrum very small or absent, leaf-lobe apiculate, base of underleaves not auriculate ***S. altimontana***

Solenostoma Mitt.

J. Linn. Soc. Bot. 8: 51 (1865).

Synonym: *Jungermannia* L., *Sp. Pl.* 1: 1131 (1753), *emend.* Dumort., *Recueil Observ. Jungerm.*: 16 (1835) *p.p.*

Solenostoma has usually been considered a subgenus of *Jungermannia* but recent molecular studies (Hentschel *et al.*, 2007) showed that it represents a genus of its own.

About 108 species, nearly cosmopolitan. Three species in Rwanda.

References: Váňa (1974), Váňa (1993).

1. Plants erect or suberect, paroicous ***S. sphaerocarpum***
- 1*. Plants prostrate to creeping, paroicous or dioicous 2
2. Leaf cells mostly 30-45 µm; cells with distinct trigones; plants dioicous
..... ***S. borgenii***
- 2*. Leaf cells mostly 20-30 µm; cells with trigones almost lacking; plants paroicous ***S. mildbraedii***

Syzygiella Spruce

J. Bot. 14 (new ser. 5): 234 (1876).

A tropical-montane genus with about 20 species, 16 of them in the Neotropics. Two species in Rwanda.

References: Váňa (1985).

1. Leaves contiguous to imbricate, obliquely spreading, triangular-ovate
..... ***S. geminifolia***
- 1*. Leaves distant to moderately contiguous, obliquely to nearly lanceolately spreading, oblong-ligulate or oblong ***S. concreta***

Taxilejeunea (Spruce) Schiffn.

In: Engl. & Prantl, *Nat. Pflanzenfam.* 1(3): 118, 125 (1893).

Mostly neotropical genus with 20-30 species. Two species in Rwanda.

References: Jones (1967, 1976b), Tixier (1995).

1. Underleaves 2-2.5 x as wide as the stem, perianth keels smooth ***T. conformis***
- 1*. Underleaves less than 2 x as wide as the stem, perianth keels cristate with short, acute teeth or cilia ***T. pulchriflora***

Telaranea Spruce ex Schiffn.

In: Engl. & Prantl, *Nat. Pflanzenfam.* 1(3): 103 (1895).

Synonym: *Arachniopsis* Spruce, *On Cephalozia*: 844 (1882).

A mainly southern-temperate genus with 98 species with one species (*T. europaea* J.J.Engel & G.L.S.Merr.) extending to atlantic Europe. Three species in Rwanda.

References: Fischer (1993c), Engel & Merrill (2004).

1. Plants minute and delicate (stem 100 µm in diameter, leaves 500-700 µm long), leaves of 2 lobes, underleaves absent or rudimentary ... ***T. coactilis***
- 1*. Plants larger, leaves of 2-4 lobes, underleaves present 2
2. Leaves usually 2-lobed, lobes narrow, at base up to two cells large ***T. nematodes***
- 2*. Leaves usually 3(-4)-lobed, lobes at base up to four cells large ... ***T. trifida***

Tetralophozia (R.M. Schust.) Schljak.

Novit. Syst. Pl. Non Vasc. 13: 227 (1976).

Three to four species, arctic-alpine in Northern Hemisphere, Himalaya to Japan, East Africa. One species in Rwanda.

References: Váňa (1993), Váňa & Watling (2004c).

Tritomaria Schiffn. ex Loeske

Hedwigia 49: 13 (1909).

About 7 species mainly in Northern Hemisphere and tropical mountains. One species in Rwanda.

References: Váňa (1993), Váňa & Watling (2004c).

***Tylimanthus* Mitt.**

In: Hooker, *Handb. N. Zealand Fl.*: 751 (1867).

About 2-3 species mainly in tropical mountains. In Rwanda one species.

References: Jones (1980), Burghardt & Gradstein (2008).

9.4. Thallose liverworts – Key to Families and Genera in Rwanda

1. Thallus several cells thick over most of transverse section 2
- 1*. Thallus one layer of cells thick, a pluristratose midrib clearly differentiated, thallus either dichotomously branched or dendroid, resembling a filmy fern (*Hymenophyllum*) 13
2. Thallus solid, lacking air chambers and pores 3
- 2*. Thallus with cavities (air chambers) and compound pores, or upper part formed by closely packed parallel vertical filaments
..... **Complex thalloid liverworts** 4
3. Thallus large, 8-10 mm wide x 40-100 mm long, female inflorescences stalked ***Dumortiera***
- 3*. Thallus smaller, female inflorescence not stalked, sporangium on short seta, which elongates shortly before dehiscence, capsule opening with four valves, midrib poorly differentiated, thallus usually pinnately to bipinnately or palmately branched (except in *Aneura pseudopinguis*), male and female inflorescences on very short lateral branches
..... **Simple thalloid liverworts Aneurales (Aneuraceae)**
4. Upper stratum of thallus formed by closely packed parallel vertical filaments, sporangium spherical, embedded in the thallus, thallus star-like
..... **Ricciaceae (*Riccia* subg. *Riccia*)**
- 4*. Upper stratum of thallus with air chambers or air chambers throughout ... 5
5. Pores of air chambers in upper epidermis minute or absent, sporangium spherical, embedded in the thallus causing a bulging of dorsal surface, sometimes upper epidermis disintegrating and appearing spongy, aquatic plants or plants of humid habitats **Ricciaceae**
- 5*. Pores of air chambers in upper epidermis conspicuous and easily observable 6

- 6. Pores barrel-shaped in transverse section, polygonal markings on upper thallus surface, gemmae in cup-like involucre (gemma-cup), male receptacle stalked, female receptacle stalked, deeply lobed
..... **Marchantiaceae (*Marchantia*)**
- 6*. Pores not barrel-shaped in transverse section 7
- 7. Gemmae in half-lunulate gemma-cups on upper thallus surface, thallus with polygonal markings, cells of upper epidermis collenchymatous
..... **Lunulariaceae (*Lunularia*)**
- 7*. Gemmae absent 8
- 8. Thalli large, bluish-green, carpocephala dorsal on thallus, away from apex, stalk very short, without rhizoidal furrow ***Plagiochasma***
- 8*. Thalli smaller, often thin and delicate, never bluish-green, carpocephala on long or short stalk arising from apical notch of thallus or bifurcations 9
- 9. Thallus delicate, translucent, differentiated into midrib and thin wings, margins green below, ventral scales small and reduced, air chambers without filaments, plants of rainforests ***Cyathodium***
- 9*. Thallus delicate or firm, not differentiated into midrib and thin wings, ventral scales well-developed, air chambers with or without filaments, plants of montane to subalpine humid or dry habitats 10
- 10. Air chambers without filaments, sporangium surrounded by a conspicuous cage-like pseudoperianth of converging hyaline laciniae, plants of humid montane to subalpine habitats ***Asterella***
- 10*. Air chambers with numerous short green filaments lining their floors, plants of dry habitats 11
- 11. Plants large, 5-10 mm wide, upper surface of thallus smooth, epidermal cells with nodular thickenings..... ***Targioniaceae (*Targionia*)***
- 11*. Plants small, less than 5 mm wide 12
- 12. Air chambers not doomed, thallus with upper surface smooth ***Mannia***
- 12*. Air chambers strongly doomed, upper surface of thallus thus covered with pustules and “volcano-like” protuberances, each with a large pore at apex, cell walls thin ***Exormotheca***

13. Inflorescence on short branches below the midrib, thallus not more than 2 mm wide, with distinct midrib up to 120 µm wide, formed of 2-4 rows of large cortical cells on dorsal side and 2-6 rows of similar cells on ventral side and 3-7 medullary cells, mainly epiphytic.....
 **Simple thalloid liverworts Metzgeriaceae (*Metzgeria*)**
- 13*. Inflorescence on upper surface of thallus, midrib 300-600 µm wide, of 10-15 cell layers in transverse section, tapering gradually into unistratose wings
 **Simple thalloid liverworts Pallaviciniaceae**

9.5. Families of Thallose liverworts with ≥ two genera in Rwanda – Keys to Genera in Rwanda

Aneuraceae

1. Thallus prostrate, simple or scarcely branched, margins undulate or crisped, oil bodies more than 6 per cell, male branches with antheridia in 2-6 rows
 ***Aneura***
- 1*. Thallus prostrate or erect, irregularly or regularly pinnate, margins flat or somewhat undulate, oil bodies up to 5 per cell, male branches with antheridia always in 2 rows ***Riccardia***

Pallaviciniaceae

1. Thallus erect from a prostrate rhizome 2
- 1*. Thallus prostrate or slightly ascending, not erect 3
2. Archegonia surrounded by a ring of scales forming a cup-like involucre, after fertilization a tubular pseudoperianth several times longer than the involucre developing from within the involucre, thallus margin dentate-spinose
 ***Jensenia***
- 2*. Archegonia with a small scale inserted behind them, cup-like involucre and pseudoperianth lacking, thallus margin entire or dentate ***Symphyogyna***
3. Thallus margin with scattered slime hairs 2-4 cells long, midrib with one central strand, archegonia surrounded by a ring of scales forming a cup-like involucre, after fertilization a tubular pseudoperianth several times longer than the involucre developing from within the involucre ***Pallavicinia***
- 3*. Thallus margins without slime hairs (except *S. volkensis* with slime hairs disintegrating soon), midrib with 1-3 central strands, archegonia with a small scale inserted behind them, cup-like involucre and pseudoperianth lacking ..
 ***Symphyogyna***

Ricciaceae

1. Plants typically floating on water, with dorsal surface exposed to air, with long, serrate swordlike or lingulate ventral scales. Air chambers large, pores present. Oil cells in scales and thallus **Ricciocarpus**
- 1*. Plants terrestrial or floating under water surface, never with swordlike or lingulate ventral scales. Air chambers small to vestigial, pores typically lacking. Thallus and scales without oil cells **Riccia**

9.6. Thallose liverwort genera – Keys to Species in Rwanda

Aneura Dumort.

Commentat. Bot.: 115 (1822).

About 10 species worldwide. Two species in Rwanda.

References: Jones (1956), Meenks & Pócs (1985), Perold (2001).

1. Thallus dorsally concave, fleshy, in the middle (9-)10-20 cells thick **A. pinguis**
- 1*. Thallus flat, translucent, in the middle only 5-7(-9) cells thick **A. pseudopinguis**

Asterella P. Beauv.

Dict. Sci. Nat. 3: 257 (1805).

About 60 species worldwide. Two species in Rwanda.

References: Bischler-Causse & Long (1993), Long (2006).

1. Carpocephala above with large protruding wart-like air chambers **A. khasyana**
- 1*. Carpocephala above with small and not protruding pores **A. abyssinica**

Cyathodium Kunze

In: Lehmann, *Nov. Stirp. Pug.* 6: 17 (1834)

Pantropical genus with about 14 species. One species in Rwanda.

References: Jones (1952).

Dumortiera Nees

In: Reinw., Blume & Nees, *Nova Acta Phys.-Med. Acad. Caes. Leop.-Carol. Nat. Cur.* 12: 410 (1824).

Widespread tropical and warm-temperate genus with one or two species. One species in Rwanda.

References: Fischer (1993c).

Exormotheca Mitt.

In: Godman, *Nat. Hist. Azor. West. Isl.*: 326 (1870).

Three species in Africa in dry areas, mainly South-Eastern and South Africa. One species in Rwanda.

Fossombronina Raddi

Atti Soc. Sci. Modena 18: 40 (1818).

About 25 species, cosmopolitan. Three species in Rwanda.

References: Perold (1998).

1. Plants large, forming dense mats, stem up to 6 cm long, leaves imbricate, rounded, entire, 4 x 7 mm ***F. pulvinata***
- 1*. Plants smaller, stem not exceeding 2 cm of length, leaves entire to lobed, up to 1.5-2 mm long 2
2. Stems 0.3-1 cm long, plants solitary or gregarious but not forming dense mats, leaves entire to lobed, crisped towards apex, paroicous, spores with lamellae ...
..... ***F. pusilla***
- 2*. Stems up to 2 cm long, forming dense mats, leaves irregular rectangular, not crisped towards apex, dioicous, plants predominantly male, spores with ridges, loops or rarely reticulate, distal face with up to 13 areolae ***F. rwandaensis***

Jensenia Lindb.

Notiser Sällsk. Fauna Fl. Fenn. Förh. 9 : 13 (1867).

Tropical and Southern-Temperate genus with about 10 species. One species in Rwanda.

References: Grolle (1993).

Lunularia Adans.

Fam. Pl. 2: 15 (1763).

Monotypic genus.

Marchantia L.

Sp. Pl., ed. 1: 1137 (1753)

About 50 species worldwide. Three species in Rwanda.

References: Vanden Berghen (1954), Bischler-Causse (1993), Bischler-Causse & Long (1993).

1. Female receptacles (archegoniophores) dissected into 9-11 terete rays, gemmae cups with papillose outer surface (subgenus *Marchantia*) 2
- 1*. Female receptacles (archegoniophores) dissected into flat lobes, gemmae cups with smooth outer surface (subgenus *Chlamidium*) 3
2. Thallus bluish-green, without dark band, gametangiophores rare, plants of alpine habitats in paramo above 2700 m, native to Rwanda
..... ***M. polymorpha* ssp. *montivagans***
- 2*. Thallus dark green, with dark median band, gametangiophores abundant, plants of ruderal and anthropogenic habitats in gardens or on paths, below 2000 m, introduced ***M. polymorpha* ssp. *ruderalis***
3. Thallus c. 3-7.5 mm wide, dorsal side usually with a dark median band, median scale appendage small, cupule margins crenulated or with short cilia up to 3 cells long, female receptacle deeply dissected into lobes, margins of involucre entire or crenulated ***M. debilis***
- 3*. Thallus c. 6-10 mm wide, dorsal side without dark median band, median scale appendage large, cupule margins with cilia up to 6 cells long, female receptacle shallowly dissected into broad lobes, margins of involucre ciliate . ***M. pappeana***

***Metzgeria* Raddi**

Mem. Soc. ital. Sci. Modena 18: 45 (1820).

Cosmopolitan, about 100 species worldwide. Five species in Rwanda.

References: Vanden Berghen (1948a), Pócs (1993), So (2004).

1. Thallus branches of two forms, one strongly tapered with acute ends and the other non tapered with broad lamina and rounded ends. The thallus branches with tapering wing have both laminal gemmae (strongly concave or plane) concentrated along the tapering thallus ends and mucilaginous gemmae produced at thallus apices, 2 rows of cortical cells on both sides of the midrib (increasing up to 4 only near to the thallus apices) ***M. consanguinea***
- 1*. Thallus uniform consisting of only non tapered branches with broad lamina and rounded, obtuse or emarginated apices 2
2. Costa of mature thallus with 3-4(-5) rows of dorsal cortical cells and 3(4-6) rows of ventral cortical cells ***M. quadrifaria***
- 2*. Costa of mature thallus with 2 rows of dorsal cortical cells and 2-3(-4) rows of ventral cortical cells 3

- 3. Marginal hairs of thallus almost all single, rarely paired hairs present
..... ***M. furcata***
- 3*. Marginal hairs of thallus often paired 4
- 4. Marginal hairs of thallus straight or weakly curved ***M. madagassa***
- 4*. Marginal hairs of thallus distinctly curved or falcate, usually geminate
..... ***M. leptoneura***

Pallavicinia S. Gray

Nat. Arr. Brit. Pl. 1 : 775 (1821), *nom. cons.*

About 10 species worldwide. One species in Rwanda.

References: Grolle (1993).

Riccardia S. Gray

Nat. Arr. Brit. Pl. 1: 679, 683 (1821).

About 100 species worldwide. Five species in Rwanda.

References: Jones (1956), Meenks & Pócs (1985), Müller *et al.* (2000), Perold (2001, 2002, 2003).

- 1. Plants large, relatively robust, 15-40 mm long, not growing closely attached to the substrate, main axis or main branches 0.8-1.4 mm wide, thalli pinnate to bipinnate, thallus apices deeply dissected, main axis distinctly winged ...
..... ***R. longispica***
- 1*. Plants small, relatively slender, 6-20 mm long, growing closely attached to the substrate, main axis or main branches 0.15-0.9 mm wide, thalli palmate to pinnate or irregularly branched 2
- 2. Thalli not winged or sometimes with 1 cell-wide wing of elongated cells, often lunate in cross-section, apices of branches usually gemmiferous
..... ***R. spec.***
- 2*. Thalli at least along the branches with an unistratose 3-6 cells wide wing 3
- 3. Main axis not or only slightly winged, the wing cells of branches equal in size, branches tongue-like, palmate and often ending bifurcate
..... ***R. amazonica***
- 3*. Main distinctly winged, the margin cells of wing distinctly smaller than the other cells branching pinnate, never bifurcate ***R. limbata***

Riccia L.

Spec. Pl., ed. 1: 1138 (1753).

About 150 species worldwide, mainly in drier tropical to temperate regions. Nine species in Rwanda.

References: Jones (1957), Fischer (1993d, 1995), Perold (1986, 1990, 1992, 1993, 1995).

1. Assimilative tissue composed of cell-pillars surrounded of very narrow interstitial air spaces. Frequently in dry habitats (Subgenus *Riccia*) 2
- 1*. Assimilative tissue composed of \pm large air-chambers, epidermis smooth or with age cavernous. Frequently in wet habitats or aquatic (Subgenus *Ricciella*) 7
2. Margin of thallus with long hyaline cilia 3
- 2*. Thallus margin and sporangia without cilia 4
3. Thallus branches 5 x 1-1.5 mm, margin of thallus with long hyaline cilia and a few shorter cilia on upper surface of thallus above sporangia, cilia never arching and channelled. Spores triangular-globose, 100-120 μ m in diameter **R. crinita**
- 3*. Thallus branches 1-3 x 0.6-0.8 mm, margin of thallus with long hyaline cilia in several rows, crowded at apex, cilia arched and channelled. Spores triangular-globose, 80-92 μ m in diameter **R. microciliata**
4. Ventral scales prominent, black, greatly exceeding the margin of thallus and usually inflexed over the thallus, at least at its apex, when dry. Thallus bluish green. Spores wingless, densely papillose **R. okahandjana**
- 4*. Ventral scales not greatly exceeding the margin of thallus nor inflexed so as to cover the apex of thallus. Spores areolate 5
5. Ventral scales large and conspicuous, 0.9 x 0.8 mm, entirely dark violet or sometimes with hyaline base. Thallus bluish or greyish green, large, 6-12 (-15) x 3-5 mm. Spores yellowish brown, without wing and triradiate mark, surface with 6-8(-10) angular areolae across diameter **R. congoana**
- 5*. Ventral scales smaller, up to 0.4 x 0.5 mm, deep violet with hyaline edges extending to thallus. Thallus glaucous green to green, smaller, 4-8.5 x 1.5-2.5 mm. Spores reddish brown to blackish brown, areolae thick walled or sometimes incomplete 6

- 6. Spores distinctly polar, winged, proximal face with well-defined triradiate mark, reddish brown, facets and distal face often with incomplete areolae .
.....**R. lanceolata**
- 6*. Spores not distinctly polar, blackish brown with thick walled areolae
.....**R. atropurpurea**
- 7. Thalli in partial rosettes, branches broadly subquadrate-obovate, rounded obtuse, 3-4 x 1.7-3 mm, becoming cavernous proximally. Spores with areolar walls on both faces and triradiate mark on proximal face
.....**R. vulcanicola**
- 7*. Thalli not in rosettes, branches linear or lanceolate, air chambers inconspicuous, never cavernous 8
- 8. Thallus light green, with linear branches, 5-10(-15) x 0.5-0.8(-1.2) mm, distal face of spores with prominent areolae, proximal face with thick triradiate mark **R. stricta**
- 8*. Thallus pale glaucous green, with violet ventral scales, branches lanceolate, 4-5 x 1.5-2.5 mm, spores with distal face regularly areolate, areolae on proximal face incomplete or absent **R. moenkemeyeri**

Ricciocarpus Corda

In: *Opiz, Beitr. zur Naturg.*: 651 (1829).

Monotypic genus.

Symphyogyna Nees & Mont.

Ann. Sci. Nat., Bot., 2^e sér., 5: 66 (1836).

Tropical and Southern-Temperate genus with about 25 species. Three species in Rwanda.

References: Vanden Berghen (1965), Grolle (1993).

- 1. Dendroid, but less well-developed phases sometimes ascendent or almost procumbent, frond margin dentate with ± coarse, acute teeth; marginal slime-hairs lacking **S. podophylla**
- 1*. Procumbent, frond margin entire (rarely with a few small broadly hump-shaped processes with a rounded tip) 2

2. Marginal slime-hairs lacking. Frond green to yellowish green, often slightly tinted with orange or red, with usually weakly-incurved margins, 2.5-4.5(-5.5) mm wide. Spores distally with many small short, ± curved ridges ... **S. brasiliensis**
- 2*. Marginal slime-hairs present (often, however, soon disappearing at some distance from shoot tip). Frond grass-green (without secondary pigmentation), usually flat, (3-)5-9(-10) mm wide. Spores distally with few coarse long sinuate ridges **S. volkensis**

Targionia L.

Sp. Pl., ed. 1, 2: 1136 (1753).

Subtropical-mediterranean genus of two or three species. One species in Rwanda.

9.7. Hornworts – Key to Genera and Species in Rwanda

1. Sporophytes short, usually less than 5 mm, lying more or less horizontally on thallus, almost entirely covered by involucrem **Notothylas**
- 1*. Sporophytes long, usually more than 10 mm long, erect, much longer than involucrem 2
2. Thallus with cavities, spores dark brown or black **Anthoceros**
- 2*. Thallus solid, spores yellow **Phaeoceros**

Anthoceros L.

Sp. Pl., ed. 1, 1: 1139 (1753).

Cosmopolitan. Due to lack of a modern revision, the exact number of species is difficult to estimate. Four species in Rwanda.

References: Hasegawa (1993), Fischer (2007).

1. Thallus-margin densely dissected into narrow rectangular, truncate lobes, spores 50-60 µm in diameter, distal surface with baculate to spinate up to 4 µm long tubercles, proximal surface covered with small subglobose tubercles **A. myriandroecius**
- 1*. Thallus-margin remotely or somewhat pinnately dissected into broad rectangular lobes, spores different 2

2. Spores 34-42 μm in diameter, distal surface covered with spinulate tubercles less than 3 μm long, often united at base, proximal surface with indistinct reticulate ridges and small subglobose tubercles..... **A. sambesianus**
- 2*. Spores 42-62 μm in diameter, distal surface either with numerous spines or tubercles, tubercles compressed and often divided distally or distal surface with short, often sinuate and shortly branched lamellae, or a network of lamellae forming ridges and peaks, proximal surface either foveolate and nearly smooth or with conspicuous trilete ridges and sinuate lamellae 3
3. Spores (42-)45-50(-55) μm in diameter, distal surface with short, often sinuate and shortly branched lamellae, or a network of lamellae forming ridges and peaks, proximal surface with conspicuous trilete ridges and sinuate lamellae **A. caucasicus**
- 3*. Spores 42-62 μm in diameter, distal surface with numerous spines or tubercles, tubercles compressed and often divided distally, proximal surface foveolate and nearly smooth **A. punctatus**

Notothyias Sull.

Mem. Amer. Acad. Arts & Sci. N.S. 3: 65 (1848).

Cosmopolitan genus with c. 20 species, Three to four species in Africa. One species in Rwanda.

Phaeoceros Prosk.

Bull. Torrey Bot. Club 78: 346 (1951).

Cosmopolitan. The exact number of species is difficult to estimate. Two species in Rwanda.

References: Hasegawa (1993), Fischer (2007).

1. Spores with distal surfaces densely papillate to spinulate throughout **P. carolinianus**
- 1*. Spores with distal surfaces densely papillate with scattered lamellae consisting of several papillae united at base **P. fulvisporus**