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RESEARCH ARTICLE

The genera of Cyperaceae of Madagascar

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Abstract

Background and aims – The rise of DNA sequencing in systematics has brought more understanding of the Cyperaceae family worldwide. Through these studies, it has been possible to delineate major clades and classify its species into subfamilies, tribes, and genera. Today, we have a good understanding of the species diversity and geographic distribution of the genera. However, in the case of Madagascar, the only complete taxonomic treatment of Cyperaceae dates from 1937. Although recent monographs exist for some genera in Madagascar, the taxonomic treatment of the Cyperaceae of Madagascar has not been updated until now. Hence, the present work aims to produce an updated treatment at the generic level including descriptions and an identification key of all Cyperaceae genera in Madagascar.
Material and methods – Books and scientific articles containing descriptions of the genera of Cyperaceae of Madagascar, and information on their ecology and distribution were consulted, as well as herbarium specimens, collections, and data available from online herbaria and aggregator portals.
Key results – Madagascar is very rich in Cyperaceae. The species of the Cyperaceae family on the island are distributed in 24 genera, including one endemic genus, i.e. *Trichoschoenus*. Ten genera are monotypic on the island. Sixteen of the 29 genera described in the Flore de Madagascar remain accepted but the others are now either synonyms of *Cyperus*, or no longer apply because they are absent from Madagascar, such as *Scirpus*. Regarding their habitat and ecology, some genera are specific to a particular habitat, like *Costularia*, while others that are very broadly distributed, like *Cyperus* and *Scleria*.
Conclusion – Our study provides an updated overview of the genera of Cyperaceae of Madagascar, including an identification key, descriptions, and illustrations.

Keywords

Cyperaceae, genera, identification, Madagascar, taxonomy

INTRODUCTION

Madagascar, with its area of 592,000 km^2, is home to ca 310 species of the Cyperaceae family (Larridon et al. 2021a). These 310 species are classified into two subfamilies, i.e. Cyperoideae and Mapanioideae, each of which includes several tribes and genera (Larridon et al. 2021b). The evolution of technology in systematics has brought much more understanding for the Cyperaceae family worldwide. Through these studies, major groups such as the two subfamilies (Cyperoideae and Mapanioideae) and different tribes and genera have been delineated (Larridon 2022a). Although much taxonomic work remains at the species level, we have a good understanding of species diversity per genus and the geographic distribution of species (Jung et al. 2016; Semmouri et al. 2019; Muasya and Larridon 2021; Larridon 2022a). However, in the case of Madagascar, the only taxonomic treatment of the family, Chermezon's Flore de Madagascar, dates from 1937, although research has been done since then on a few genera (Díaz et al. 2019; Larridon et al. 2019), the taxonomic treatment of the Cyperaceae of Madagascar

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Table 1. Overview of the genera occurring in Madagascar and their subfamily and tribal placement following Larridon et al. (2021b), and ordered according to Larridon (2022a).

Subfamily	Tribe	Subtribe	Genus
Mapanioideae	Chrysitricheae		*Lepironia* Pers.
	Hypolytreae		*Hypolytrum* Pers.
Cyperoideae	Trilepideae		*Coleochloa* Gilly
	Cladieae		*Cladium* P.Browne
	Bisboeckelereae		*Diplacrum* R.Br.
	Sclerieae		*Scleria* P.J.Bergius
	Carpheae		*Carpha* Banks & Sol. ex R.Br.
	Schoeneae	Oreobolinae	*Costularia* C.B.Clarke
		Lepidospermatinae	*Machaerina* Vahl
	Rhynchosporeae		*Rhynchospora* Vahl
	Cariceae		*Carex* L.
	Eleocharideae		*Eleocharis* R.Br.
	Abildgaardieae		*Bulbostylis* Kunth
			Trichoschoenus J.Raynal
			Actinoschoenus Benth.
			Abildgaardia Vahl
			Fimbristylis Vahl
	Bolboschoeneae		*Bolboschoenus* (Asch.) Palla
	Fuireneae		*Fuirena* Rottb.
	Schoenoplecteae		*Schoenoplectus* (Rchb.) Palla
	Pseudoschoeneae		*Schoenoplectiella* Lye
	Cypereae	Ficiniinae	*Isolepis* R.Br.
			Ficinia Schrad.
		Cyperinae	*Cyperus* L.

has not yet been updated. This makes identification of Cyperaceae very difficult, even at the genus level. Certainly, the information contained in the Flore de Madagascar (Chermezon 1937) is still very useful, but it needs to be reformulated to adapt it to the results of the recent work done on the family. Hence, the present work aims to produce an updated overview of the genera of Cyperaceae of Madagascar, including an identification key, descriptions, and illustrations.

MATERIAL AND METHODS

Numerous scientific works documenting each genus of Cyperaceae occurring Madagascar have been studied. These include Sedges Genera of Africa and Madagascar by Browning and Goetghebeur (2017), Flora of Tropical East Africa by Hoenselaar et al. (2010), Flora Zambesiaca by Browing et al. (2020), Flore de Madagascar by Chermezon (1937), Flore du Gabon by Lye and Thery (2012), Flore d'Afrique centrale (Larridon and Reynders 2020; Larridon 2022b; Larridon et al. 2022), the online Flora of North America and Flora of China (http://www.efloras.org), and the Catalogue of the Vascular Plants of Madagascar (2023). In addition, available recent scientific literature (e.g. Díaz et al. 2019; Larridon et al. 2019, 2021b) and protologues of the genera of Cyperaceae of Madagascar were consulted (e.g. Raynal 1968). To find the type species of each genus, synonyms, etc., we consulted the protologues and online sources such as POWO (2022) and Tropicos.org (2022).

To verify the described characteristics, herbarium specimens were consulted in the following herbaria: TAN, TEF, and the herbarium of the University of Antananarivo in Madagascar including recent collections collected by the first author and Cyperaceae recently collected by the Kew Madagascar Conservation Centre (KMCC) team in different localities of Madagascar. In addition, collections available from online herbaria (e.g. Kew Herbarium Catalogue of the Royal Botanic Gardens, Kew (K), Missouri Botanical Gardens' Tropicos.org (MO), and the Vascular plants catalogue of the Muséum national d'Histoire naturelle (P), and aggregator portals such as Plants of the World Online and JSTOR Global Plants were also consulted. For studies of the ecology and distribution of each genus, online platforms such as POWO (2022), GeoCAT (Bachman et al. 2011), which provides information from GBIF (2022) and iNaturalist, were consulted.

The identification key to subfamilies, tribes, subtribes, and genera follows the classification of Larridon et al. (2021b), and the order of the taxa in the taxonomic treatment follows the linear classification of Larridon (2022a). Only commonly used synonyms are provided when they are relevant to Madagascar.

RESULTS AND DISCUSSION

Twenty-four genera of Cyperaceae currently exist in Madagascar including one endemic genus, i.e. *Trichoschoenus* J.Raynal. Ten genera are monospecific on the island, i.e. *Actinoschoenus* Benth., *Bolboschoenus* (Asch.) Palla, *Carpha* Banks & Sol. ex R.Br., *Cladium* P.Browne, *Coleochloa* Gilly, *Diplacrum* R.Br., *Ficinia* Schrad., *Hypolytrum* Pers., *Lepironia* Pers., and *Trichoschoenus*. Table 1 provides an overview of the genera occurring in Madagascar and their subfamily, tribal, and subtribal placement following Larridon et al. (2021b).

Sixteen of the 29 genera described in the Flore de Madagascar are still accepted and found on the island, i.e. *Actinoschoenus*, *Bulbostylis* Kunth, *Carex* L., *Carpha*, *Cladium*, *Costularia* C.B.Clarke, *Cyperus* L., *Diplacrum*, *Eleocharis* R.Br., *Ficinia*, *Fimbristylis* Vahl, *Fuirena* Rottb., *Hypolytrum*, *Lepironia*, *Rhynchospora* Vahl, and *Scleria* P.J.Bergius. Others are now either synonyms of the genus *Cyperus*, such as *Ascolepis* Nees ex Steud., *Lipocarpha* R.Br., *Mariscus* Vahl, *Pycreus* P.Beauv., and *Torulinium* Desv., or no longer apply because the genus is absent from Madagascar, as in the case of *Scirpus* Tourn. ex L. Many species previously placed in *Scirpus* have since been moved to other genera such as *Bolboschoenus* and *Schoenoplectiella* Lye. Table 2 provides a comparison of the accepted genera of Cyperaceae of Madagascar according to Chermezon (1937) and Larridon et al. (2021b).

With respect to their habitat and ecology, there are those that are specific to one habitat, such as the genus *Costularia*, and others that are very widely distributed, such as the genera *Cyperus* and *Scleria*. Our study provides an updated overview of the genera of Cyperaceae of Madagascar, including an identification key, descriptions, and illustrations.

Table 2. Comparison of the accepted genera in Madagascar according to Chermezon (1937) and Larridon et al. (2021b).

Chermezon (1937)	**Larridon et al. (2021b)**
Fimbristylis Vahl p.p.	*Abildgaardia* Vahl
Actinoschoenus Benth.	*Actinoschoenus* Benth.
Bulbostylis Kunth	*Bulbostylis* Kunth
Carex L.	*Carex* L.
Schoenoxiphium Nees	
Carpha Banks & Sol. ex R.Br.	*Carpha* Banks & Sol. ex R.Br.
Cladium P.Browne p.p.	*Cladium* P.Browne
Eriospora Hochst. ex A.Rich.	*Coleochloa* Gilly
Costularia C.B.Clarke	*Costularia* C.B.Clarke
Ascolepis Nees ex Steud.	*Cyperus* L.
Courtoisina Nees (as *Courtoisia*)	
Cyperus L.	
Kyllinga Rottb. (as *Kyllingia*)	
Lipocarpha R.Br.	
Mariscus Gaertn.	
Pycreus P.Beauv.	
Queenslandiella Domin	
Remirea Aubl.	
Torulinium Desv.	
Diplacrum R.Br.	*Diplacrum* R.Br.
Eleocharis R.Br. (as *Heleocharis*)	*Eleocharis* R.Br.
Scirpus L. p.p.	
Ficinia Schrad.	*Ficinia* Schrad.
Fimbristylis Vahl p.p.	*Fimbristylis* Vahl
Fuirena Rottb.	*Fuirena* Rottb.
Hypolytrum Pers.	*Hypolytrum* Pers.
Scirpus L. p.p.	*Isolepis* R.Br.
Lepironia Pers.	*Lepironia* Pers.
Cladium P.Browne p.p.	*Machaerina* Vahl
Rhynchospora Vahl	*Rhynchospora* Vahl
Scirpus L. p.p.	*Schoenoplectiella* Lye
Scirpus L. p.p.	*Schoenoplectus* (Rchb.) Palla
Taxon not included but *Scirpus* L. p.p.	*Bolboschoenus* (Asch.) Palla
Taxon not yet described	*Trichoschoenus* J.Raynal
Acriulus Ridl.	*Scleria* P.J.Bergius
Scleria P.J.Bergius	

TAXONOMIC TREATMENT

Identification key to subfamilies, tribes, subtribes, and genera of Cyperaceae of Madagascar

1. Basic inflorescence unit (= spicoid) usually comprising 2, strongly keeled and opposite basal bracts (rarely 1 and unkeeled), with a further (0–)1–13(–100) scale-like bracts, the bracts subtending 1 stamen, the whole unit with a terminal pistil ...**2** (Mapanioideae)
– Basic inflorescence unit (= spikelet) consisting of a rachilla bearing few to many glumes that may or may not subtend a flower.... **3** (Cyperoideae)
2. Leaf blade absent; inflorescence always a single spike; predominantly in temperate and subtemperate heathlands and swaps ..... Chrysitricheae (***Lepironia***)
– Leaf blade present, inflorescence variable, relatively broad with 3 prominent veins; usually forest plants..... Hypolytreae (***Hypolytrum***)
3. All florets unisexual..... **4**
– At least some florets bisexual..... **7**
4. Female (or more rarely bisexual) spikelet enclosed in a sac-like prophyll (thus forming the utricle or perigynium), usually clustering to form a spike or part of a bisexual spike..... Cariceae (***Carex***)
– Female spikelet not enclosed in a sac-like prophyll or perigynium..... **5**
5. Inflorescence paniculate, densely spiked with many spindly spikelets and with 1 or 2 florets; nutlet fusiform with long beak, surrounded at the base by 3 small long fimbriate scales opposite the sides of the nutlet; plant of granitic rocks..... Trilepideae (***Coleochloa***)
– Inflorescence variable, but not as above; nutlet not surrounded at base by 3 small long fimbriate scales opposite the sides of the nutlet..... **6**
6. Inflorescence a group of sessile to short-stalked spikelets developing in leaf axils (except the lowest 1 or 2 leaves); all spikelets unisexual, the female spikelet 1-flowered, with no evidence of the other sex, the top of the rachilla completely reduced; male flower usually 1-stamened; contraligule usually undeveloped; nutlet surrounded by two subterminal and opposite glumes ..... Bisboeckelereae (***Diplacrum***)
– Inflorescence variable, often paniculate or spike-like on upper part of stem; spikelet bisexual with 1 female floret; if all spikelets unisexual, then female spikelets with reduced male flowers, or with reduced rachilla apex; male flower usually with 3 stamens; contraligule usually well developed; nutlet usually large, well distinct at maturity, smooth or ornamented, egg-shaped, pale and often white, with hypogynium (hardened gynophore) at base sometimes cupuliform (sometimes reduced)..... Sclerieae (***Scleria***)
7. Robust perennial; leaf with very scabrous and sharp margins; inflorescence terminal, paniculate or briefly corymbiform..... Cladieae (***Cladium***)
– Plants of variable size, if robust the leaf sometimes scabrous but not sharp; inflorescence terminal or pseudolateral, anthelate or capitate..... **8**
8. Style base distinct, often thickened and/or distinctly fimbriate **9**
– Style base neither distinct nor thickened and non-fimbriate..... **11**
9. All leaves reduced to bladeless sheaths; inflorescence always reduced to a terminal spikelet without involucral bracts; flower without adaxial and bifid hypogynous scale..... Eleocharideae (***Eleocharis***)
– At least a few leaves or involucral bracts with well-developed leaf blades; inflorescence variable, usually composed of several spikelets, if inflorescence reduced to a terminal spikelet then at least 1 involucral bract larger than the glumes or flower with 1 hypogynous scale, adaxial, flattened, more or less obovate, bifid at apex..... **10**
10. Inflorescence paniculate or corymbiform, rarely capitate and then the spikelet with several empty basal glumes and only the upper glumes fertile; perianth present or absent, formed of 6 hairs ..... Rhynchosporeae (***Rhynchospora***)
– Inflorescence anthelate or capitate; spikelets usually with all glumes fertile; if some basal glumes empty, spikelets with many flowers; perianth absent or flower subtended by a bifid scale..... **15** (Abildgaardieae)
11. Leaf ligulate; glumes distichous and glabrous..... **12** (Schoeneae)
– Leaf eligulate or reduced to sheath; if ligulate, glumes spirally arranged and hairy..... **13**
12. Culms terete, elliptical or partially flattened..... Oreobolinae (***Costularia***)
– Culms highly variable, commonly biconvex, but ranging from flat to terete or quadrangular or occasionally biconvex..... Lepidospermatinae (***Machaerina***)
13. Glumes and spikelets persistent on the plant..... **14**
– Glumes deciduous or the spikelet deciduous as a whole or in pieces..... **19**
14. Inflorescence a reduced panicle; glumes distichously arranged; perianth present..... Carpheae (***Carpha***)
– Inflorescence anthelate, often reduced to a single spikelet; glumes spirally arranged; perianth absent ..... **15** (Abildgaardieae)
15. Leaf sheath apex with long white hairs; style base mostly enlarged and persistent; style glabrous ..... ***Bulbostylis***
– Leaf sheath apex without long white hairs, an adaxial ligule of minute hairs present or absent; style base enlarged and mostly deciduous; style fimbriate, hispidulous, rarely glabrous **16**

16. Fertile flowers per spikelet more than 2 ..... **17**
– Fertile flowers spikelet 1(–2) **18**
17. Lowermost involucral bract glume-like, inflorescence of 1–3 spikelets; nutlets 2–3.4 mm long (always trigonous, stipitate) ..... ***Abildgaardia***
– Lowermost involucral bract not glume-like, inflorescence of 1–many spikelets; nutlets 0.5–1.8 mm (rarely up to 2.2 mm) long (many species trigonous some biconvex, stipitate or not) ..... ***Fimbristylis***
18. Style base persistent, spreading over apex of nutlet; leaves, stem and glumes with many long erect hairs ..... ***Trichoschoenus***
– Style base deciduous with rest of style, slightly enlarged ..... ***Actinoschoenus***
19. Perianth absent; glumes usually distichous or reduced to 1 per spikelet (and then spikelet bract larger or smaller than glume), rarely spirally arranged; ligule always absent; if glumes spirally arranged and primary involucral bract erect, then stem capillary, not compressible and less than 1 mm wide ..... **20** (Cypereae)
– Perianth present or absent, glumes always spirally arranged; ligule present or, if absent, the inflorescence always with erect primary involucral bract and cylindrical, compressible stem, more than 1 mm wide **23**
20. Glumes usually spirally arranged; anatomy C3. If distichously arranged, then 2 or more parallel veins prominently visible on glume and/or nutlet bearing a distinct gynophore ..... **21** (Ficiniinae)
– Glumes usually distichously arranged; anatomy C3 or C4. If spirally arranged, then either with elongated anther filaments, usually pale or white head-like inflorescences or parallel veins not strongly visible on glume and no gynophore ..... Cyperinae (***Cyperus***)
21. Leaf blades and inflorescence bracts scabrid, nutlets with gynophore ..... ***Ficinia***
– Leaf blades and inflorescence bracts smooth, nutlets without gynophore **22**
22. Glumes cartilaginous ..... ***Ficinia***
– Glumes chartaceous to hyaline ..... ***Isolepis***
23. Culm with more than 3 nodes **24**
– Culm nodeless or with less than 1–3 nodes above the base **25**
24. Glumes puberulent, apex entire to emarginate or deeply 2-fid, awned or mucronate ..... Bolbochoeneae (***Bolboschoenus***)
– Glumes often pubescent, apex entire and mucronate to awned ..... Fuireneae (***Fuirena***)
25. Inflorescence bracts often large, erect, stem-like, rarely leaf-like, and patent to reflexed ..... Schoenoplecteae (***Schoenoplectus***)
– Inflorescence bracts culm-like, erect, or patent while fruiting, rarely short, rigid and sheathing ..... Pseudoschoeneae (***Schoenoplectiella***)

Subfamily Mapanioideae

Tribe Chrysitricheae

Lepironia Pers. (Persoon 1805: 70)

Type species. *Lepironia mucronata* Rich. [= *Lepironia articulata* (Retz.) Domin]

Description of the genus. Medium-sized to tall perennials; rhizomes woody, creeping with thick roots. Culms scapose, erect, terete, with transverse septa. Basal leaves, reduced to a sheath, open in front, the margins overlapping, eligulate. Involucral bracts 1, large, subulate, cylindric, erect, culm-like. Inflorescence a single spike, pseudolateral, with many spirally arranged imbricate glume-like bracts; basal glume-like bracts empty, most subtending spicoids. Spicoids with 2 outer strongly keeled glumes and many non-keeled glumes, most subtending 1 stamen and a solitary apparently terminal female flower; rachilla thick and spongy. Florets unisexual; perianth absent. Stamens 1; anthers linear, apiculate; filaments highly accrescent. Style deeply 2-fid, long, slender; base not distinct, slightly thickened, persistent. Nutlets obovoid, dorsiventrally compressed, plano-convex, ± winged along the margins, beaked.

Distribution and ecology. *Lepironia* occurs in Madagascar, and in tropical and subtropical Asia to the Western Pacific (POWO 2022). It grows in freshwater wetlands near sea level. In Madagascar, the single species of *Lepironia*, i.e. *Lepironia articulata* (Fig. 1), occurs along the east coast.

Tribe Hypolytreae

Hypolytrum Pers. (Persoon 1805: 70)

Type species. *Hypolytrum latifolium* Rich. ex Pers. [= *Hypolytrum nemorum* (Vahl) Spreng.]

Description of the genus. Perennials, moderately robust to robust; rhizomatous or stoloniferous; rhizomes often woody, roots coarse. Culms trigonous or cylindrical, either laterally scapose and bearing reduced leaves at the base (cataphylls), or central with 1-several nodes and bearing well-developed leaves. Leaves eligulate, 3-ranked, sometimes pseudopetiolate; leaf sheath of basal leaves open adaxially; leaf sheath of cauline leaves tubular; blade linear to oblong-lanceolate or reduced (often in basal leaves), with 3, well developed principal veins, margin entire or many small teeth, gradually or abruptly narrowed at apex. Involucral bracts small, scale-like, or large and leaf-like, not sheathing, patent to reflexed. Inflorescence terminal, paniculate, corymbose or capitate, the ultimate branches subtending small clusters of spikes. Spicoids composed of 2(–3) floral bracts, each subtending 1 stamen (male flowers), often connate to varying degrees, the lower two followed by a bare pistil (female flower). Florets unisexual; perianth absent. Stamens 1; anthers oblong to linear, latrorsely dehiscent, without extended

connective tip; filaments filiform, exceeding spicoid bract. Style 2-fid, exserted; base distinct or not, thickened or not, more or less persistent. Nutlets obovoid to ellipsoid, dorsiventrally biconvex, smooth, costate, wrinkled, tuberculate or spongious.

Distribution and ecology. *Hypolytrum* is widely distributed in the tropics (POWO 2022). It grows in humid forests, on the edges of wetlands including mangroves, and in rocky areas near sea level. A single species of the genus, i.e. *Hypolytrum nudicaule* Juss. ex Cherm. (Fig. 2), occurs in eastern and northern Madagascar.

Figure 1. *Lepironia articulata*. **A**. Habit. **B**. Inflorescences. All photos taken in Vatomasina Vohipeno, Vohipeno District, Fitovinany Region by Botovao Auguste Ramiandrisoa, reproduced with permission from the photographer.

Subfamily Cyperoideae

Tribe Trilepideae

Coleochloa Gilly (Gilly 1943: 12)

Type species. *Coleochloa abyssinica* (Hochst. ex A.Rich.) Gilly

Description of the genus. Tufted or cushion-forming perennials; rhizomes extensively branched, infrequently forming a small caudex. Culms scapose or nearly so, compressed below, sometimes subcylindrical; erect or slightly wanting, basal part of culms covered by remains of old leaf sheaths. Leaves basal only, distichous; leaf sheath open on ventral side; ligule a line of fine hairs; contraligule not developed; blade flat or inrolled, deciduous. Involucral bracts more or less leaf-like; sheaths partly closed. Inflorescence terminal, paniculate, with few to many spikelet-like spikes; spikes bisexual, with numerous lateral spikelets subtended by small, densely spirally arranged glume-like bracts. Spikelet unisexual (male) or bisexual; lateral spikelets with an irregularly shaped prophyll. Glumes distichous, persistent, the larger 1–2 each subtending a flower, enclosed by the wings of the next glume. Basal spikelets with 1–2 male florets, apical spikelets mostly with 1 male and 1 female floret, more rarely completely female. Perianth surrounding the style base by 3 small, long fimbriate hypogynous scales, deciduous with the fruit. Stamens 2–3. Style 3-fid; base not distinct, tapering, persistent. Nutlets fusiform, trigonous, long beaked, surface smooth.

Distribution and ecology. *Coleochloa* occurs in tropical and southern Africa and Madagascar (POWO 2022). It grows on inselbergs, between 600 to 2000 m in elevation. A single species of the genus, i.e. *Coleochloa setifera* (Ridl.) Gilly (Figs 3, 4A), occurs in northern and southeastern Madagascar and in the Central Highlands.

Tribe Cladieae

Cladium P.Browne (Browne 1756: 114)

Type species. *Cladium jamaicense* Crantz [= *Cladium mariscus* subsp. *jamaicense* Kük.]

Description of the genus. Robust perennials, up to several meters tall; rhizomatous, sometimes with swollen stolons. Culms with few-noded, internodes hollow. Leaves basal and cauline, V-shaped to flat, midribs and margins scabrid, eligulate. Involucral bracts leaf-like, sheathing. Inflorescence terminal or some lateral, paniculate; partial inflorescences anthelate. Spikelets numerous, short stalked or sessile. Glumes few to many, spirally arranged, persistent, increasing in length, with 2–3 upper glumes fertile. Lower floret mostly functionally male, upper florets bisexual. Perianth absent. Stamens 2–3. Style 2–3-fid, with a thickened persistent base. Nutlets ovoid, with

Figure 2. *Hypolytrum nudicaule*. **A**. Habit. **B**. Inflorescence. **C**. Plant base. All photos taken on Nosy Boraha Island by Justine Faure (https://www.inaturalist.org/observations/132556611), reproduced with permission from the photographer.

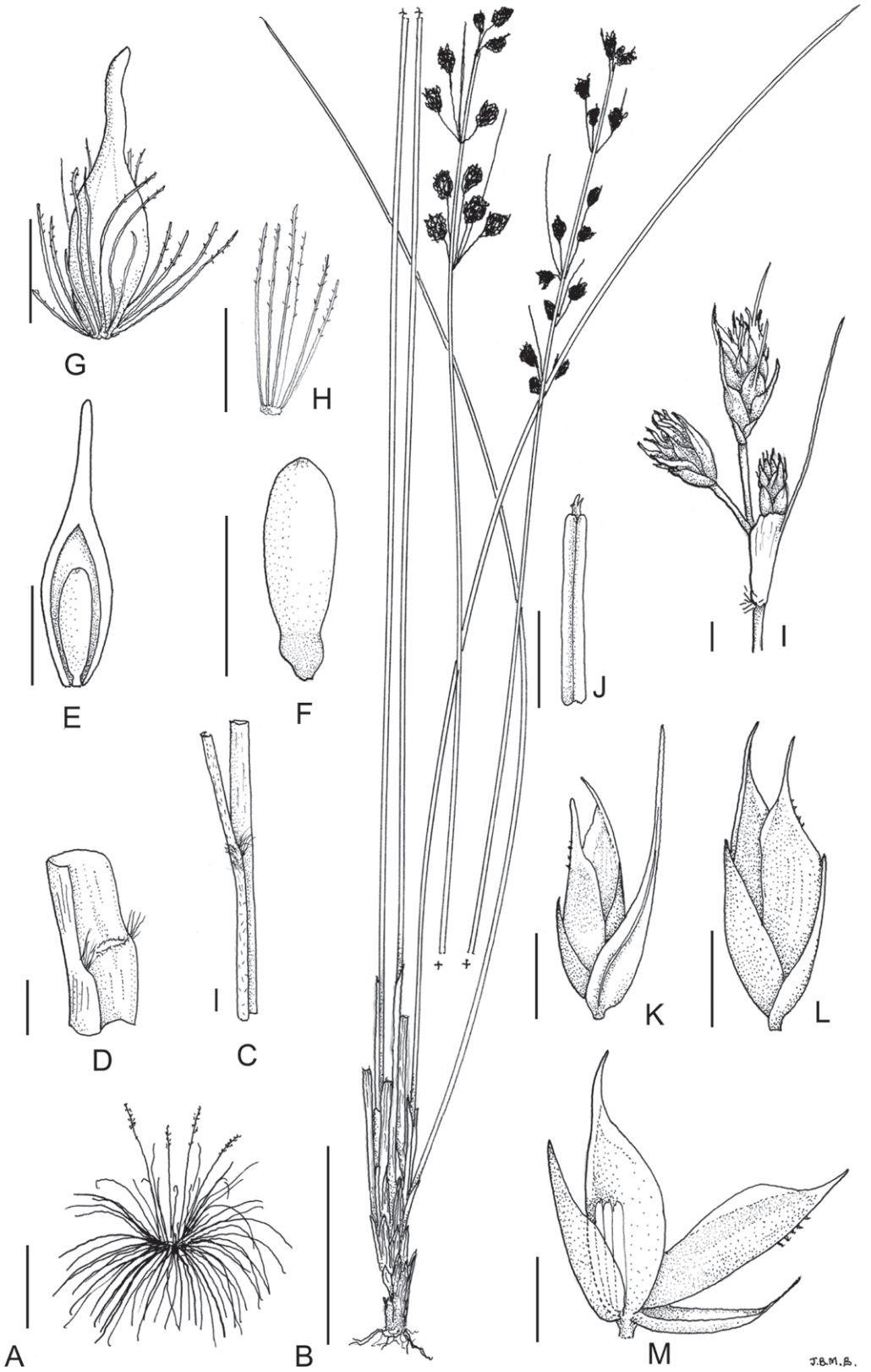

Figure 3. *Coleochloa setifera*. **A**. Habit, entire plant. **B**. Habit. **C**. Part of culm and leaf sheath. **D**. Leaf sheath opened to show ligule. **E**. Nutlet split open, seed enclosed. **F**. Seed. **G**. Nutlet, some bristles removed. **H**. Bristles detached from base of nutlet. **I**. Three fascicles of spikelets. **J**. Mature anther. **K**. Spikelet and bract, abaxial view. **L**. Spikelet, bract removed, adaxial view. **M**. Spikelet, glumes displaced, adaxial view. A–D, I–L from *Browning 560*; E–H from *Pawek 13626a*. Scale bars: A = 250 mm; B = 40 mm; C–M = 1 mm. Drawn by Jane Browning, reproduced with permission from the artist, originally published in Browning et al. (2020).

a thick corky beak, surface smooth to wrinkled. Embryo small and poorly developed, broadly obovate in outline, with a basal, poorly developed root cap and without a leaf primordium.

Distribution and ecology. *Cladium* is a cosmopolitan genus (POWO 2022). It grows in estuaries, freshwater wetlands, and lake margins up to 1500 m in elevation. In Madagascar, it is only known from the north where a single taxon, i.e. *Cladium mariscus* subsp. *jamaicense* (Fig. 5), has been recorded in the Sava region of Antsiranana province.

Tribe Bisboeckelereae

Diplacrum R.Br. (Brown 1810: 241)

Type species. *Diplacrum caricinum* R.Br.

Description of the genus. Small to medium-sized annuals or tufted, rarely stoloniferous perennials. Culms

Figure 4. A. *Coleochloa setifera*. **B**. *Costularia itremoensis*. **C.** *Eleocharis acutangula*. All photos taken in the Itremo Massif Protected Area by Fitiavana Rasaminirina.

scapose or leafy, often short. Leaves eligulate; blade linear or lanceolate, alternate, simple, often reddish purple abaxially. Primary bracts leaf-like, sheathing. Inflorescence paniculate or capitate; partial inflorescences anthelate or capitately contracted. Spikelets many, lateral spikelets usually male, terminal spikelets usually female. Glumes male spikelets with few distichous, persistent glumes, each subtending a male floret; female spikelet with 2 distichous, persistent glumes, sometimes deciduous with the fruit, surrounding a pseudo-terminal female floret. Florets unisexual. Bristles absent. Stamens 1; anthers sightly oblongs. Pistil seated on a basal trilobed disc, lobes opposite the 3 main ribs; style 3-fid ; base not distinct, not thickened, deciduous. Nutlets subglobose to ovoid, inconspicuously 3-ribbed, beak short, surface smooth, ribbed, or reticulate.

Distribution and ecology. *Diplacrum* is widely distributed in the tropics and tubtropics (POWO 2022). It grows in damp soils and freshwater wetlands including rice fields, usually near sea level. A single species of *Diplacrum*, i.e. *Diplacrum africanum* (Benth.) C.B.Clarke (Fig. 6), is known from northwestern and east central Madagascar, and from the southeast along the mountain range.

Tribe Sclerieae

Scleria P.J.Bergius (Bergius 1765: 142)

Type species. *Scleria flagellum-nigrorum* P.J.Bergius

Description of the genus. Habit variable, from tiny annuals with fibrous roots to perennial climbers more than 10 meters tall; stoloniferous rhizome or tubers; aerial adventitious roots at stem nodes (adaptation to flooded habitats). Culms trigonous or triquetrous, noded bearing leaves often without ligules, sometimes with a contraligule. Leaves alternate, tristichously arranged, often persistent at the base, and finely serrate at least along the distal third of the margins, rarely smooth: sometimes abruptly narrowed down or pseudopraemorse; sheaths sometimes winged, usually topped by a contraligule, opposite to the blade. Inflorescence bracts leaf-like and sheathing, setaceous, or glume-like; spikelet bract usually setaceous, rarely glume-like. Inflorescence variable, usually paniculate, but often with contracted partial inflorescences. Spikelets bearing flowers of one or both sexes, the bisexual ones with one basal female and one to few male flowers above; female spikelet similar but upper part reduced to 1–2 empty scales or wanting; male spikelet lacking basal female flower and with more male flowers. Glumes in androgynous or bisexual spikelets the lower part is female with distichously arranged glumes (a few may be empty), upper part male with few to many spirally arranged glumes. Florets always unisexual, enclosed by at least three glumes. Bristles absent. Stamens 1–3, anthers often linear, more or less apiculate. Style 3-fid; ovary surrounded at the base by a variously shaped (sometimes reduced) lobed hypogynium, which is shed with the fruit. Nutlets globose to ovoid, variously sculptured and ornamented, usually white, sometimes beaked, subtended by a cupule, frequently surrounded by a hypogynium.

Distribution and ecology. *Scleria* is widely distributed in the tropics and subtropics up to North America (POWO 2022). It grows in seasonally damp or permanently wet habitats, woodland, forests stream sides, and grasslands (Browning and Goetghebeur 2017). *Scleria* occurs throughout Madagascar. The 25 previously known species, including e.g. *Scleria bulbifera* Hochst. ex A.Rich. (Fig. 7) and *Scleria distans* Poir. (Fig. 8A), were recently monographed (Díaz et al. 2019), and a new species has been recently discovered from northern Madagascar (Larridon et al. unpubl. data).

Tribe Carpheae

Carpha Banks & Sol. ex R.Br. (Brown 1810: 230)

Type species. *Carpha alpina* R.Br.

Description of the genus. Perennials, small to medium-sized (rarely tall), tufted, mat-forming; rhizomatous or rarely stoloniferous. Culms erected, trigonous to more or less cylindrical, scapose or with a few nodes. Leaves basal and cauline, eligulate. Lower primary bracts more or less leaf-like, sheathing. Inflorescence open to condensed paniculate with (sub)capitate partial; inflorescences with few to many spikelets. Spikelets with 3–6 distichous, persistent glumes of increasing length. Lower glumes empty, larger 1–2(–3) glume(s) each subtending a floret, enclosed by the wings of the next glume. Floret bisexual, sometimes upper or lower floret male. Bristles 6, ciliate to partly fimbriate or plumose, shorter than to much longer than the fruit, deciduous with the fruit. Stamens 2–3, anthers conspicuously greenish yellow. Style 3-fid, base not distinct, slightly thickened, persistent, often scabrid. Nutlets narrowly (ob)ovoid to oblong, trigonous, often with a long beak, surface smooth or finely reticulate.

Distribution and ecology. *Carpha* occurs from Uganda to South Africa, Western Indian Ocean, South Japan, New Guinea to New Zealand and South America. It grows along streams, on marshy ground, and on rocks, from 1800 to 2500 m in elevation. In Madagascar, a single species of *Carpha*, i.e. *Carpha perrieri* Cherm., is known from Fianarantsoa province Matsiatra Ambony region and Toliara provinces Anosy region.

Tribe Schoeneae

1. *Subtribe Oreobolinae*

Costularia C.B.Clarke (Clarke 1898: 274)

Type species. *Costularia natalensis* C.B.Clarke

Description of the genus. Perennials, small to tall, tufted or more rarely shortly rhizomatous, caudex sometimes present. Culms scapose or with few nodes. Leaves usually basal and cauline; basal leaves with poorly defined sheaths; cauline leaves enveloping up to 1/2 internode length;

spirodistichous, eligulate; blade sometimes deciduous, margins scabrid. Involucral bracts more or less leaf-like, sheathing. Inflorescence terminal, contracted paniculate. Spikelets few to numerous. Glumes several, distichous, deciduous, of increasing length, the upper (1–)2 glumes each subtending a floret, enclosed by the wings of the next

Figure 5. *Cladium mariscus* subsp. *jamaicense*. **A**. Habit. **B**. Inflorescence. **C**. Plant base, longitudinal section. **D**. Detail of leaf. **E**. Nutlet and upper unisexual floret with 2 filaments and rudimentary gynoecium. **F**. Spikelet. All from *Ward 9082*. Scale bars: A = 25 cm; B, C = 5 cm; D = 1 cm; E, F = 2 mm. Drawn by Jane Browning, reproduced with permission from the artist, originally published in Gordon-Gray (1995).

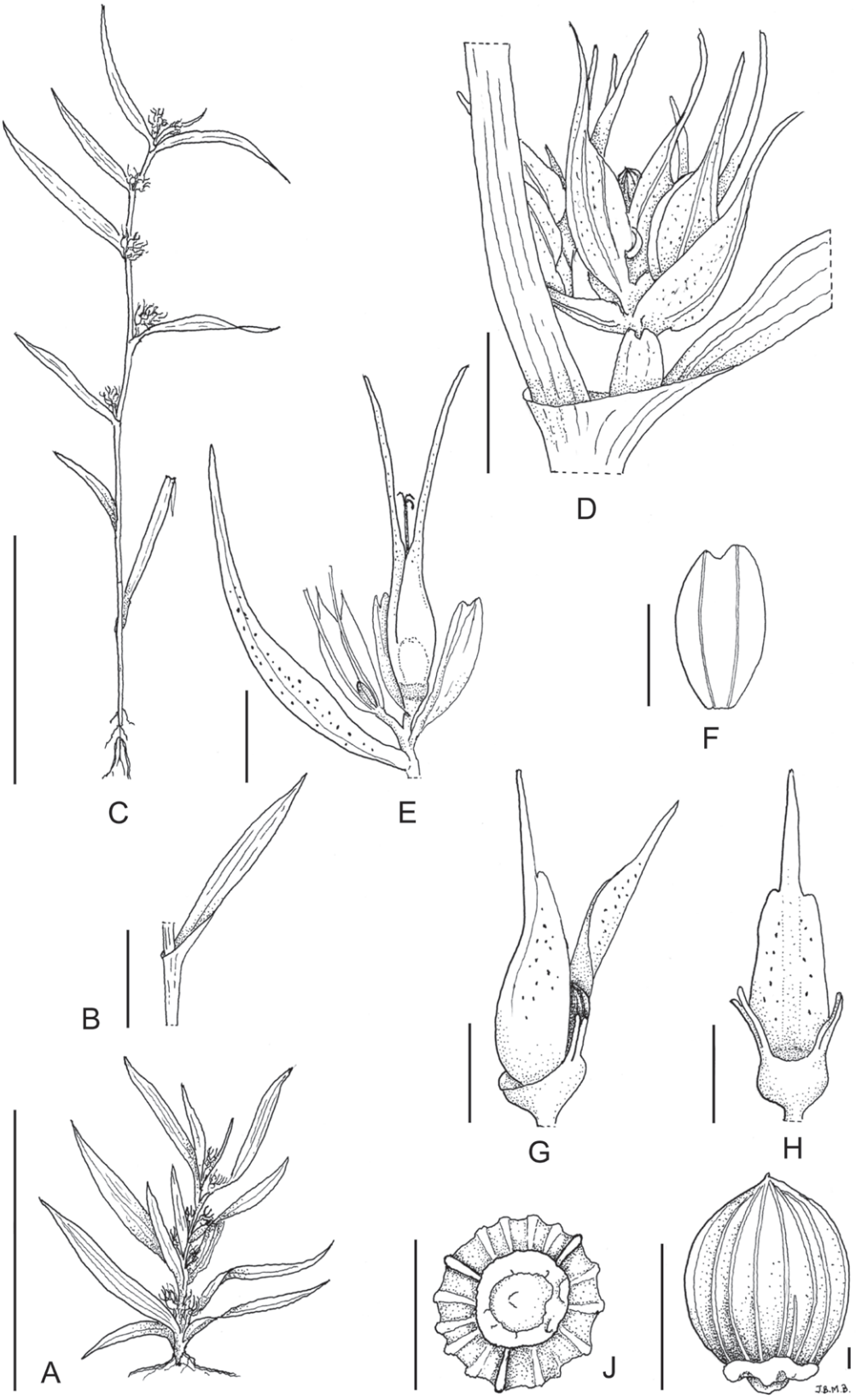

Figure 6. *Diplacrum africanum*. **A**, **C**. Habit. **B** Leaf. **D**. Inflorescence. **E**. Spikelets, male and female with bract and prophyll. **F**. Prophyll. **G**–**H**. Female spikelet, with and without nutlet. **I**–**J**. Nutlet, lateral and basal view. B–D, G–J from *Robinson 2851*; A, E, F from *Bidgood et al. 3967*. Scale bars: A, B = 25 mm; C = 10 mm; D–H = 1 mm; I, J = 0.5 mm. Drawn by Jane Browning, reproduced with permission from the artist, originally published in Browning et al. (2020).

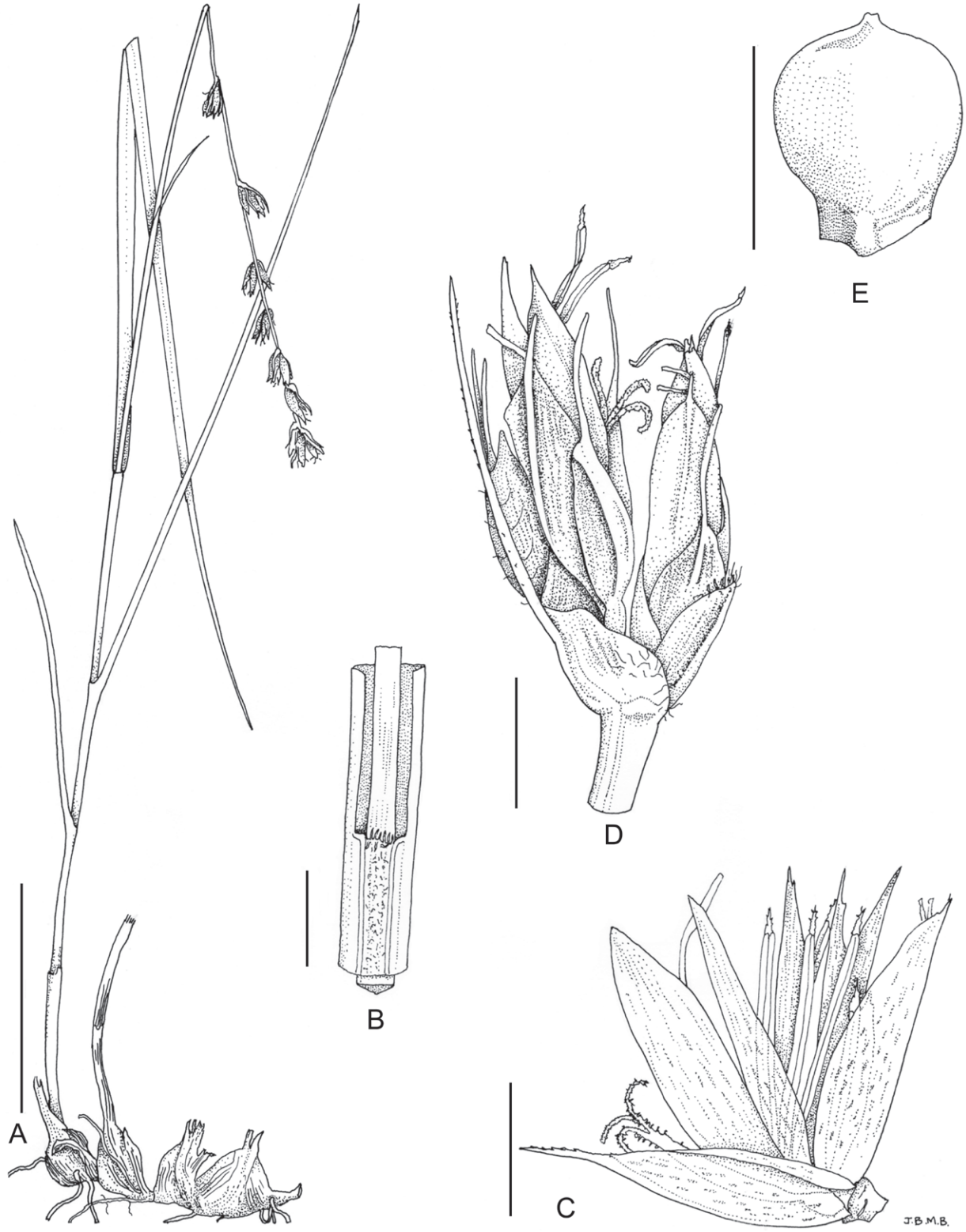

Figure 7. *Scleria bulbifera*. **A**. Habit showing rhizome. **B**. Junction of lamina and sheath. **C**. Androgynous spikelet with lower prophyll and one glume removed; remainder displaced to show lower female floret and upper male florets. **D**. Glomerule of three spikelets. **E**. Nutlet. A–D from *Hilliard & Burtt 13394*; E from *Hilliard & Burtt 18036*. Scale bars: A = 40 mm; B–E = 2 mm. Drawn by Jane Browning, reproduced with permission from the artist, originally published in Gordon-Gray (1995).

glume. Lower floret functionally male rarely bisexual or absent, upper floret bisexual or functionally female rarely functionally male. Bristles 6, fimbriate to ciliate, mostly longer than the nutlet and deciduous with it. Stamens 3; anthers long linear, briefly apiculate or not. Style 3-fid; base often distinct (at anthesis), thickened, persistent, often scabrid. Nutlets ovoid or oblong, rounded trigonous, often 3-ribbed, more or less stipitate, beaked, surface smooth or rugulose.

Distribution and ecology. *Costularia* occurs in southeastern Africa, Madagascar, the Mascarenes, and Seychelles. It grows on rocky ground in forest, grassland, or ericoid vegetation, sometimes along streams or in swamps, usually at higher elevations. In Madagascar, *Costularia* is known from north to south along the mountain ridge and high elevation areas, including the Central Highlands. The genus was recently monographed (Larridon et al. 2019), and 11 species are native to Madagascar, including e.g.

Figure 8. A. *Scleria distans*. **B**. *Bulbostylis itremoensis*. **C**. *Fuirena pubescens* (pale green) and *Schoenoplectiella corymbosa* (dark green). All photos by Fitiavana Rasaminirina.

Figure 9. *Costularia pantopoda* var. *pantopoda*. **A**. Habit. **B**. Inflorescence matching the habit. **C**. Spikelet. **D**. Lowest glumes of spikelets. **E**. Rest of glumes lower to upper, abaxial view. **F**. Bisexual flower. **G**. Male flower. **H**. Nutlet. Scale bars: A–B = 3 cm, C–H = 3 mm. All from *Larridon et al. 2010-0144*. Drawn by Juliet Beentje, reproduced with permission from the artist, originally published in Larridon et al. (2019).

Costularia itremoensis Larridon (Fig. 4B) and *Costularia pantopoda* C.B.Clarke (Fig. 9).

2. *Subtribe Lepidospermatinae*

Machaerina Vahl (Vahl 1805: 238)

Type species. *Schoenus restioides* Sw. [= *Machaerina restioides* Vahl]
Description of the genus. Medium-sized to tall creeping rhizomatous or stoloniferous perennials. Culms scapose or with few nodes, flattened, angular, compressed or (sub)terete, sometimes septate. Leaves distichous, eligulate, blade ensiform to (sub)terete, sometimes septate, rarely reduced to a sheath. Primary bracts often leaf-like, sheathing. Inflorescence sometimes more or less pseudolateral, paniculate, main axis often sinuous, partial inflorescences sometimes capitately contracted. Spikelets many. Glumes 2–10 distichous, long-persistent, of increasing length, with (1–)2–4(–5) florets subtended by the larger glumes and enclosed by the wings of the next glume. Lower 1–2 floret(s) usually bisexual, upper floret(s) usually functionally male. Bristles absent or poorly developed, or up to 6, delicate, shorter than, to as long as the fruit, deciduous with the fruit. Stamens 3; filaments sometimes conspicuously elongated after anthesis. Style 3-fid, base not distinct, thickened, persistent, sometimes scabrid. Nutlets ovoid to oblong, terete to triquetrous, more or less 3-ribbed to winged, stipitate or sessile, beaked, smooth to rugose.
Distribution and ecology. *Machaerina* occurs in Tanzania, Western Indian Ocean to Pacific, Tropical America (POWO 2022). It grows in forest, shrubland, or grassland, along streams, in marshy areas or on rocks. *Machaerina* occurs in northern, northeastern, and southeastern Madagascar; four species are known including e.g. *Machaerina flexuosa* (Boeckeler) J.Kern (Fig. 10).

Tribe Rhynchosporeae

Rhynchospora Vahl (Vahl 1805: 229), nom. cons.

Type species. *Rhynchospora alba* (L.) Vahl
Description of the genus. Usually small to medium-sized perennials, rarely annuals; rhizomatous or with a poorly developed root system. Culms scapose or with 1-many nodes, rounded to trigonous. Leaves radical or radical and cauline; sheaths closed, ligule minute or absent. Involucral bracts leaf-like or reduced. Inflorescence very variable, paniculate, corymbose, anthelate or capitate, rarely pseudolateral. Glumes spirally arranged (rarely distichous), of increasing length to subequal, larger (1–)2-few glume(s) subtending a floret, enclosed by the wings of the next glume. Florets bisexual, the lowest few sterile and/or upper staminate (variable with species). Perianth bristles usually 3–6, or absent. Stamens (1–2–)3, inconspicuous. Style 2-fid, with base persistent (tubercle). Nutlets usually lenticular to globose. Embryo top-shaped in frontal view, root cap developed in a (sub)basal position, and first leaf primordium developed in a lateral position (*Carex*-type embryo).
Distribution and ecology. *Rhynchospora* is a cosmopolitan genus (POWO 2022). It grows in seasonally wet to permanently flooded grassland, laterite outcrops, lake shores, stream sides, swamps, rice fields (Browning and Goetghebeur 2017). *Rhynchospora* occurs throughout Madagascar; ten species are known including e.g. *Rhynchospora holoschoenoides* (Rich.) Herter (Fig. 11) and *Rhynchospora angolensis* Turrill (Fig. 12A).

Tribe Cariceae

Carex L. (Linnaeus 1753: 972)

Schoenoxiphium Nees (Nees von Esenbeck 1832: 531)

Type species. *Carex hirta* L.
Description of the genus. Generally perennials, rarely annuals, caespitose or rhizomatous, sometimes forming a compact tussock. Culms central or lateral, mostly scapose, rarely with nodes, simple, smooth or scabrid. Leaves generally present, glabrous or rarely hairy, sheath often surrounding culm, ligule or sometimes contraligule present at the junction of the sheath and the blade. Primary bracts leaf-like or not, sheathing or not. Partial inflorescences spike-like, unisexual or bisexual, with few to many spirally arranged bracts (or glumes), either subtending a female spikelet or a male floret. Inflorescence terminal, rarely pseudolateral, paniculate, often partly or completely contracted, rarely corymbose or anthelate with few to numerous spikes, less frequently reduced to a single spike, cladoprophylls sometimes swollen at the base, utriculiform and subtending a female floret; inflorescence mostly bisexual, rarely unisexual or florets dioecious. Spikes male, female, or bisexual, and then mostly male florets apically, rarely basally, or intermingled; female spikelet reduced to the rachilla and a utriculiform, flower-bearing prophyll, completely enclosing the rachilla. Glumes 0 or 1. Floret unisexual; staminate flowers without scales; pistillate flowers with 1 scale with fused margins (perigynium) enclosing flower, open only at apex. Bristles absent. Stamens 1–3, filaments distinct, anthers linear. Style 2–3-fid, exserted, base not distinct, rarely thickened, persistent. Nutlets often obovoid, trigonous, or dorsiventrally compressed, sometimes remarkably malformed.
Distribution and ecology. *Carex* is a cosmopolitan genus (POWO 2022). It grows in humid forest, wet grassland, in freshwater wetlands, on sand or rocks, usually at higher elevation. *Carex* (Fig. 12B) occurs throughout Madagascar; 30 species are known.

Figure 10. *Machaerina flexuosa*. **A**. Habit (× 2/3). **B**. Spikes from top of inflorescence (× 3). **C**–**D**. Glume, abaxial and side view (× 10). **E**. Flower (× 10). **F**. Young flower (× 8). **G**. Anther (× 16). **H**. Nutlet (× 16). A from *Andriamahay & Rakotoarison 1969*; B–G from *Nusbaumer et al. 1103*; H from *Ranirison 642*. Drawn by Juliet Beentje, reproduced with permission from the artist, originally published in Hoenselaar et al. (2010).

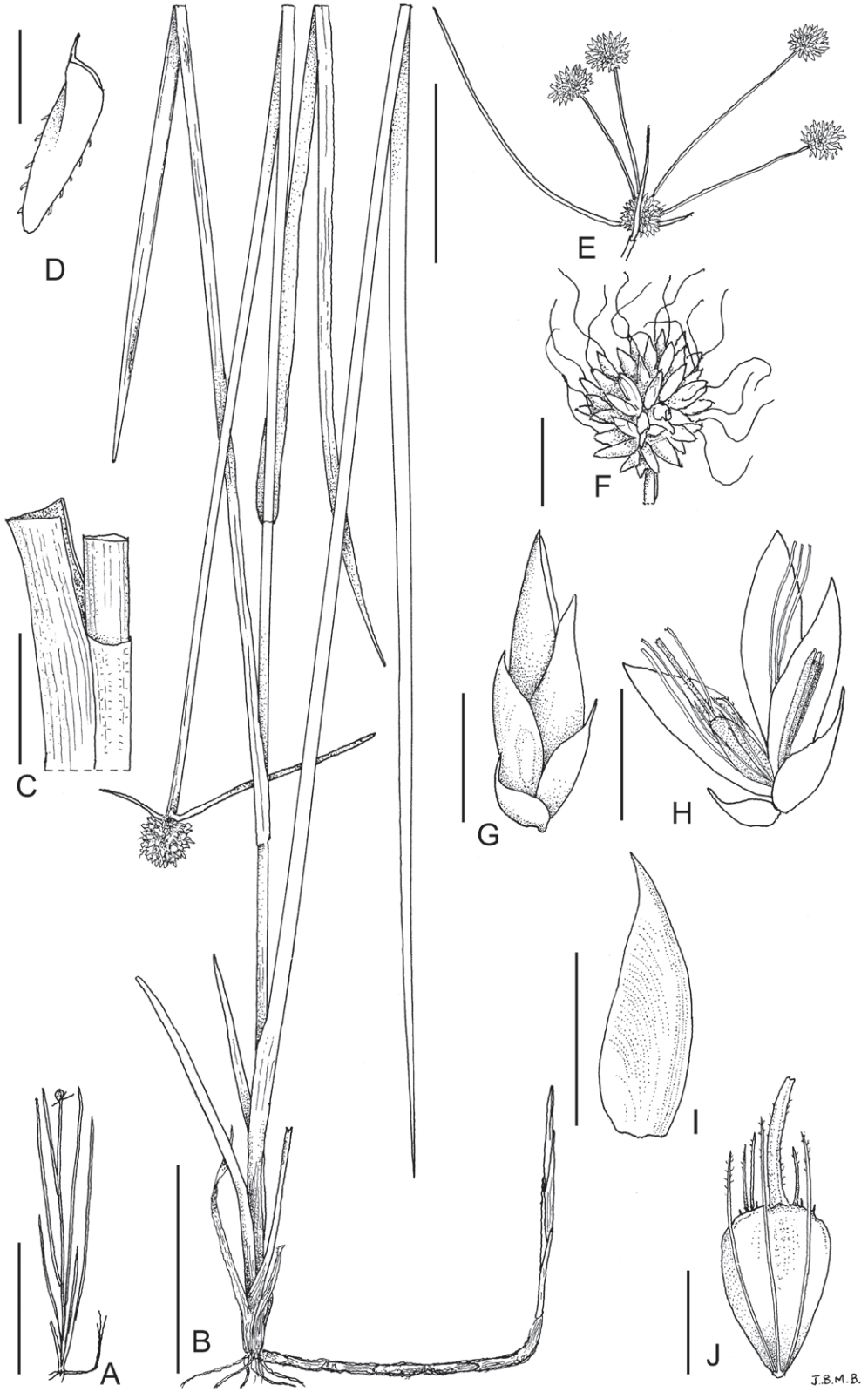

Figure 11. *Rhynchospora holoschoenoides*. **A**–**B**. Habit. **C**. Leaf sheath. **D**. Leaf apex. **E**. Inflorescence. **F**. Head of spikelets. **G**–**H**. Spikelet, complete and opened to show florets. **I**. Glume, lateral view. **J**. Nutlet. A–D from *Robinson 6123*; E, G, I from *Robinson 1048*; F from *Robinson 1456*; J from *Renvoize 5598*. Scale bars: A = 250 mm; B, E = 40 mm; C, F = 5 mm; G–I = 2 mm; D, J = 1 mm. Drawn by Jane Browning, reproduced with permission from the artist, originally published in Browning et al. (2020).

Tribe Eleocharideae

Eleocharis R.Br. (Brown 1810: 224)

Websteria S.H.Wright (Wright 1887: 135)

Type species. *Scirpus palustris* L. [= *Eleocharis palustris* (L.) Roem. & Schult.]

Description of the genus. Very small to medium-sized tufted annuals or large rhizomatous, stoloniferous perennials; rhizome often strong, horizontal, often producing stolons. Culms scapose, 3–4 angular, ridged or terete, occasionally septate, ancipitous or bulbously thickened at base. Leaves reduced to inconspicuous basal sheaths, rarely with a short blade, eligulate. Primary bracts absent, rarely proximal scale of spikelet resembling short bract. Inflorescence solitary terminal spikelet, usually quite short and ebracteate. Spikelets with 2–many spirally arranged, rarely subdistichous, deciduous imbricate glumes, each subtending a floret. Lowermost glume often empty or with a vegetative bud, rarely flower-bearing. Floret bisexual. Bristles barbellate, (0–)3–6(–10), or reduced to a narrow rim underlying nutlet, shorter or longer than nutlet and shed with it. Stamens 1–3; anthers linear. Style 2–3-fid, upper portion deciduous, base enlarged persistent as a conical or flattened appendage on nutlet. Nutlets obovoid, lenticular or trigonous, beaked smooth or variously ornamented with pits in longitudinal rows.

Distribution and ecology. *Eleocharis* is a cosmopolitan genus (POWO 2022). It grows in forest, wet grasslands, freshwater wetlands, along rivers, lake margins, and rice fields, and in rocky areas. *Eleocharis* occurs throughout Madagascar; 12 species are known including e.g. *Eleocharis acutangula* (Roxb.) Schult. (Fig. 4C) and *Eleocharis dulcis* (Burm.f.) Trin. ex Hensch. (Fig. 13).

Tribe Abildgaardieae

1. *Bulbostylis* Kunth (Kunth 1837: 205), nom. cons.

Type species. *Scirpus capillaris* L. [= *Bulbostylis capillaris* (L.) Kunth ex C.B.Clarke]

Description of the genus. Small to medium-sized annuals or tufted perennials, rarely with an elongated rhizome, rarely forming a caudex; rhizome woody, variable, usually compact with swollen confluent shoot bases, occasionally elongate in uniseriate or multiseriate rows, less often of uniform thickness throughout. Culms scapose, terete, ridged and furrowed, glabrous to pilose or densely velutinous apically. Leaves eligulate (rarely ligulate), but with two lateral tufts of long white hairs at the sheath mouth, rarely reduced to a sheath. Primary bracts short, not sheathing, rarely the lowermost bract leaf-like and erect. Inflorescence terminal, rarely pseudolateral, anthelate or capitate. Spikelets few to many, or reduced to a single spikelet, often with many densely

Figure 12. A. *Rhynchospora angolensis*; photo taken in the Itremo Massif Protected Area by Fitiavana. Rasaminirina. **B**. *Carex* sp.; photo taken in the Mantadia National Park by Vida. Svahnstrom.

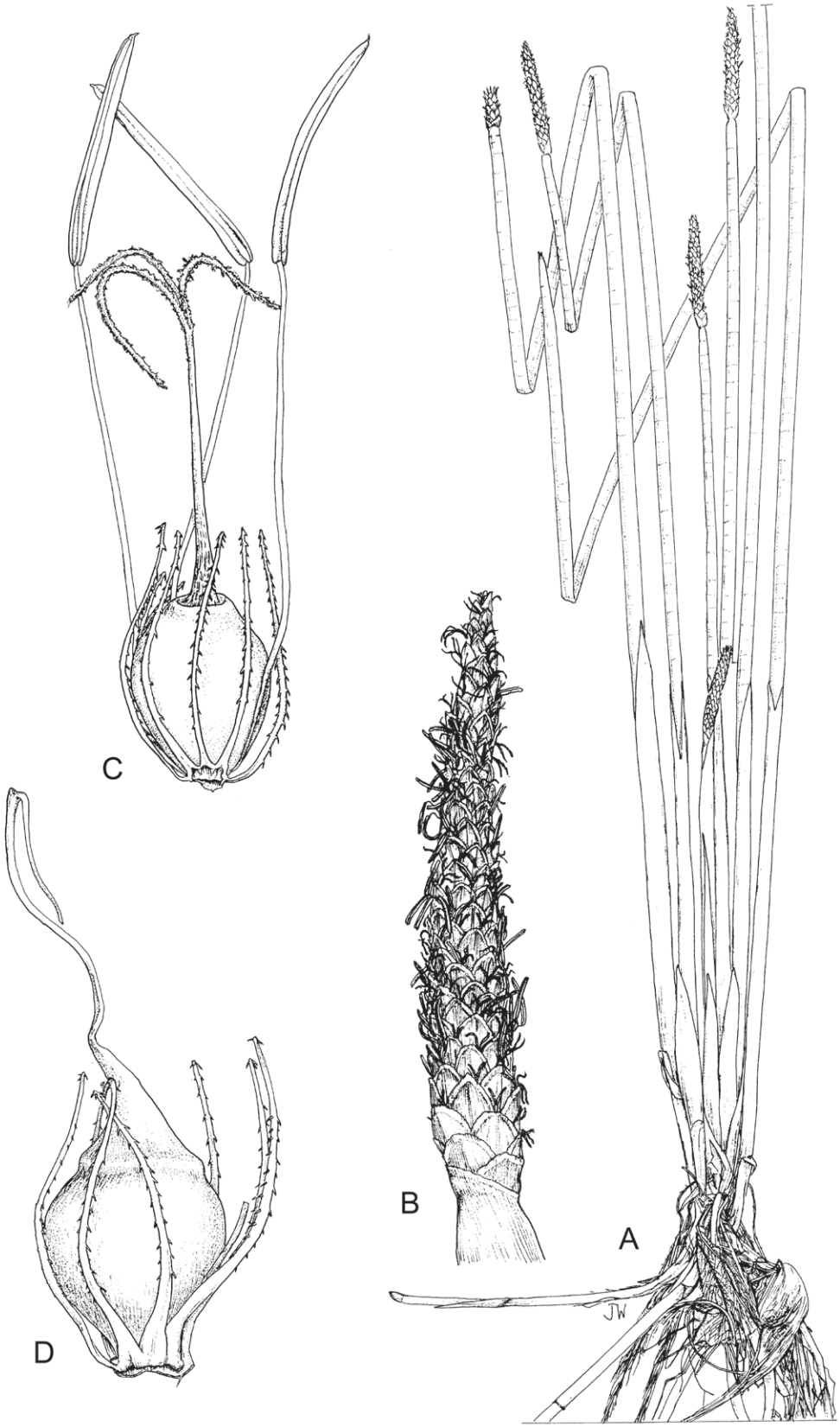

Figure 13. *Eleocharis dulcis*. **A**. Habit (× 1/3). **B**. Inflorescence (× 1.5). **C**. Floret (× 10). **D**. Nutlet (× 12). A from *Kirika et al. NMK 778*; B from *Vesey-Filtzgerald 401*; C from *Milne-Redhead & Taylor 9164*; D from *Faden et al. 96/468*. Drawn by Juliet Beentje, reproduced with permission from the artist, originally published in Hoenselaar et al. (2010).

spirally arranged (rarely distichous), deciduous glumes, each subtending a floret. Florets bisexual. Perianth bristles absent. Stamens 1–3, anthers generally oblongs or linear, often acute, rarely setiferous. Style (2–)3-fid, base distinct, thickened, persistent, rarely only slightly thickened or deciduous. Nutlets obovoid to obpyriform, rounded trigonous, rarely dorsiventrally lenticular, surface with various ornamentations, rarely smooth.

Distribution and ecology. *Bulbostylis* is widely distributed in the tropics and subtropics to Central Asia (POWO 2022). It grows in grasslands and woodlands, along roadsides and among rocks. In Madagascar, *Bulbostylis* is known from the northwest, the Central Highlands, and the southwest. This genus is currently being monographed (Rasaminirina et al. unpubl. data), and ca 25 species are currently known to occur in Madagascar including e.g. *Bulbostylis itremoensis* Lye ex Rasam. (Fig. 8B) and *Bulbostylis hispidula* (Vahl) R.W.Haines (Fig. 14).

2. *Trichoschoenus* J.Raynal (Raynal 1968: 223)

Type species. *Trichoschoenus bosseri* J.Raynal

Description of the genus. Small to medium-sized tufted perennials; thick roots. Culms scapose, densely hairy, flattened, tufted. Leaves reduced to a sheath, leaf sheath of increasing length, blade sometime present as a short mucro, eligulate. Primary bracts mostly as long as or shorter than spikelet, not sheathing. Inflorescence capitate. Spikelets many. Glumes 3, distichous, deciduous, of increasing length, the second subtending a floret, enclosed by the wings of the next. Florets bisexual. Perianth bristles absent. Stamens 3. Style deeply 3-fid, base more or less distinct, thickened, persistent. Nutlets obovoid, trigonous, with a thick short beak, surface minutely reticulate.

Distribution and ecology. *Trichoschoenus* is the only endemic genus of Cyperaceae in Madagascar. Its only species *Trichoschoenus bosseri* (see Browning and Goetghebeur 2017: 85) has only been collected near Ihosy in the Central Highlands (Raynal 1968). It grows in dry sandy soil, in open woodland (Browning and Goetghebeur 2017) between 500 to 1000 m in elevation (Catalogue of the Vascular Plants of Madagascar 2023).

3. *Actinoschoenus* Benth. (Bentham 1881: 33)

Type species. *Actinoschoenus filiformis* (Thwaites) Benth. [= *Actinoschoenus aphyllus* (Vahl) Larridon]

Description of the genus. Small to medium-sized, tufted, shortly rhizomatous or stoloniferous perennials. Culms scapose, smooth, tufted, more or less 4-angular, bases covered by closed leaf sheaths. Leaves ligulate if present, blade very short, almost reduced to a sheath. Primary bracts small, not very conspicuous not sheathing. Inflorescence terminal, capitate. Spikelets 2 or many. Glumes 4–7 distichous, deciduous glumes, of increasing length; rachilla internodes short, somewhat elongated between the florets. Floret(s) 1(–2), subtended by the penultimate larger glume, enclosed by the wings of the next glume, bisexual. Perianth bristles absent. Stamens 3. Style deeply 3-fid, style base distinct, thickened, deciduous. Nutlets obovoid, trigonous, more or less 3-ribbed, surface smooth to slightly tuberculate.

Distribution and ecology. *Actinoschoenus* occurs from West-Central Tropical Africa to Zambia, Western Indian Ocean, Sri Lanka to southern China and Australia (POWO 2022). It grows in open woodland on dry sandy areas (Browning and Goetghebeur 2017), wetlands, swamps, sands and wet rocks, water's edge, forest, to 800 m elevation (Chermezon 1937). A single species of *Actinoschoenus*, i.e. *Actinoschoenus aphyllus* (Vahl) Larridon (Fig. 15), occurs throughout Madagascar.

4. *Abildgaardia* Vahl (Vahl 1805: 296)

Type species. *Cyperus monostachyos* L. [= *Abildgaardia ovata* (Burm.f.) Kral]

Description of the genus. Small to medium-sized annuals or tufted perennials; short woody rhizome. Culms scapose, rounded, generally glabrescent, rarely scabrid. Leaves eligulate, sometimes reduced to a sheath, basal polystichous, sheaths distally open, loose, ribbed; blades mostly filiform, compressed or lunate to semicircular in cross section, margins strongly involute. Primary bracts short, not sheathing, inconspicuous. Inflorescence terminal, depauperate anthelate or capitate. Spikelets few or reduced to one single spikelet. Glumes many densely (spiro) distichous, deciduous, each subtending a floret. Floret bisexual, protandrous. Perianth bristles absent. Stamens 2–3. Style deeply 3-fid, base distinct, thickened, deciduous. Nutlets mostly obovoid, stipitate, rounded trigonous, rarely winged, surface often tuberculate.

Distribution and ecology. *Abildgaardia* is widely distributed in the tropics and subtropics (POWO 2022). It grows in grasslands, woodlands, freshwater wetlands, and brackish marshes. *Abildgaardia* occurs throughout Madagascar; two species are known including e.g. *Abildgaardia triflora* (L.) Abeyw. (Fig. 16).

5. *Fimbristylis* Vahl (Vahl 1805: 285), nom. cons.

Type species. *Scirpus dichotomus* L. [= *Fimbristylis dichotoma* (L.) Vahl]

Description of the genus. Annuals tufted or perennials with rhizomes. Culms scapose or subscapose, terete or 3–4–5-angular or ancipitous, variously pubescent to glabrous. Leaves spirally or distichously arranged, or reduced to a sheath, ligulate or eligulate; blade linear, filiform, or rarely ensiform, usually dorsiventrally compressed and canaliculate, often adaxially cellular-reticulate. Primary bracts short, not sheathing. Inflorescence variable usually capitate or anthelate. Spikelets few to numerous, or reduced to a single spikelet, mostly cylindric. Glumes usually spirally arranged, rarely distichous, deciduous, each subtending a bisexual floret. Perianth bristles absent. Stamens 1–3. Style 2–3-fid, often

Figure 14. *Bulbostylis hispidula*. **A**. Habit. **B**. Glume. **C**. Nutlet. **D**. Spikelet. **E**. Mouth of leaf sheath. **F**. Young nutlet with style. All from *Ward 610*. Scale bars: A = 40 mm; B, C = 5 mm; D–F = 0.5 mm. Drawn by Jane Browning, reproduced with permission from the artist, originally published in Gordon-Gray (1995).

flattened with fimbriate margins when 2-fid; base distinct, thickened, deciduous. Nutlets obovoid, trigonous or biconvex and often variously ornamented, trigonous when style 3-fid, lenticular when style 2-fid, smooth, tuberculate or longitudinally ribbed, not transversely wrinkled.

Distribution and ecology. *Fimbristylis* is a cosmopolitan genus (POWO 2022). It grows on seasonally wet or damp sandy soils in grassland, woodland, riverbeds, and rice fields, also on rocks in shallow soil (Browning and Goetghebeur 2017). *Fimbristylis* occurs throughout Madagascar; 17 species are known including e.g. *Fimbristylis dichotoma* (Fig. 17).

Tribe Bolboschoeneae

Bolboschoenus (Asch.) Palla (Palla 1905: 2531)

Type species. *Bolboschoenus maritimus* (L.) Palla

Description of the genus. Perennials with long rhizomes often forming hard ovoid tubers at tips. Culms many-noded, sharply trigonous, thickened at base. Leaves basal and cauline, eligulate; blade often reduced in lower leaves. Involucral bracts leaf-like, patent, lowermost often suberect. Inflorescence terminal (in reduced inflorescences, bract may be erect, but clearly leaf-like), a (compound) corymb-like anthela or capitate with

Figure 15. *Actinoschoenus aphyllus*. All photos taken in Andrainjato, Taolagnaro District, Anosy Region by Andriambolantsoa Rasolohery (https://www.inaturalist.org/observations/145409565), reproduced with permission from the photographer.

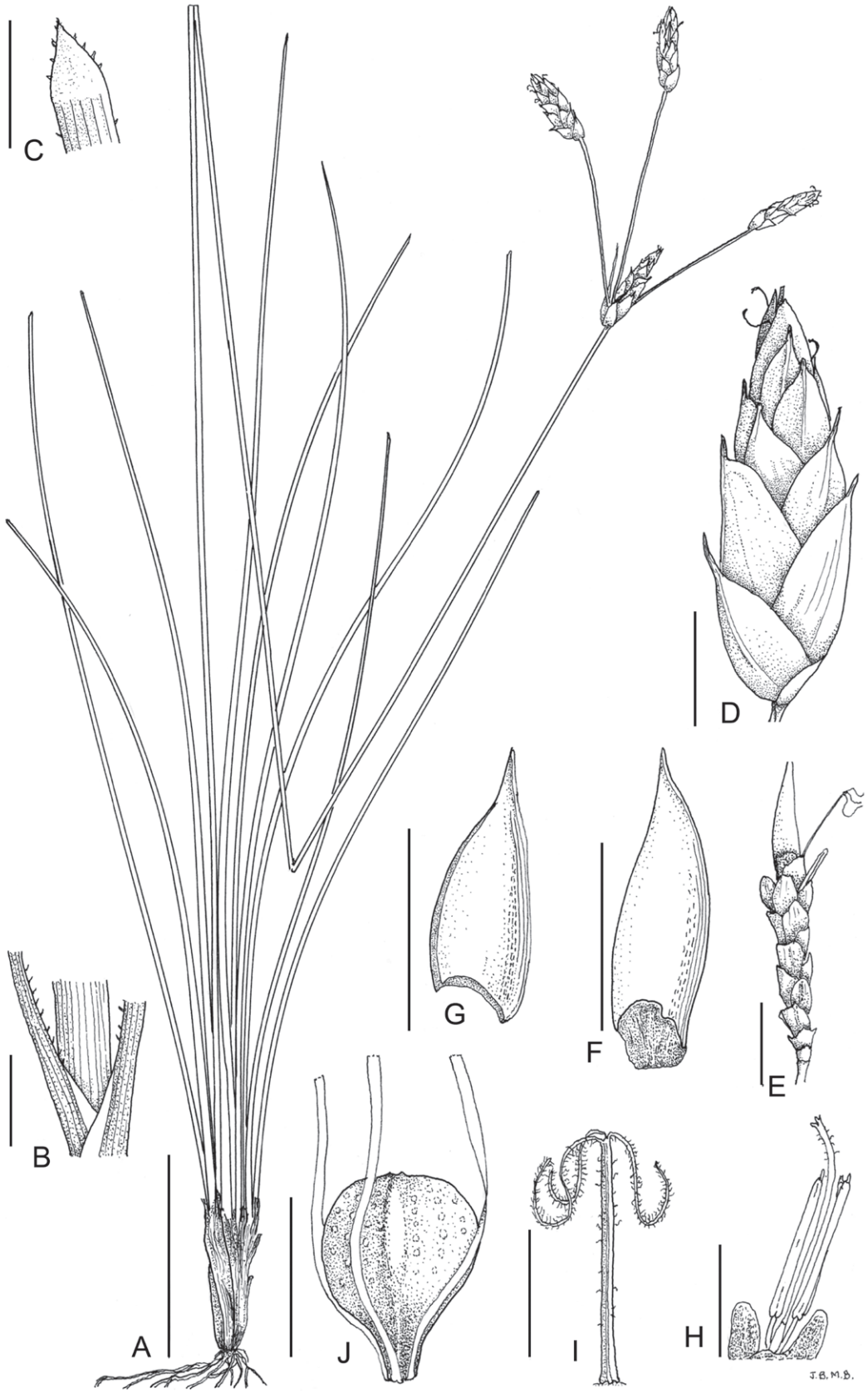

Figure 16. *Abildgaardia triflora*. **A**. Habit. **B**. Two leaf bases. **C**. Leaf apex. **D**. Spikelet. **E**. Rachilla. **F**, **G**. Glume, complete and upper abscised part. **H**. Young floret. **I**. Style and branches. **J**. Nutlet with filaments. All from *Robinson 2038*. Scale bars: A = 40 mm; B, C, H–J = 2 mm; D–G = 5 mm. Drawn by Jane Browning, reproduced with permission from the artist, originally published in Browning et al. (2020).

Figure 17. *Fimbristylis dichotoma*. **A**, **B**. Habit. **C**. Leaf sheath apex. **D**. Leaf apex. **E**. Spikelet. **F**, **G**. Glume, abaxial and lateral view. **H**. Floret. **I**. Nutlet. All from *Brummitt 9546*. Scale bars: A = 250 mm; B = 40 mm; C, E = 5 mm; D = 2 mm; F–I = 1 mm. Drawn by Jane Browning, reproduced with permission from the artist, originally published in Browning et al. (2020).

1-many spikelets. Spikelets with many spirally arranged, deciduous glumes, each subtending a flower. Glumes puberulent, the apex entire to emarginate or deeply 2-fid, awned or mucronate. Floret bisexual. Perianth present, formed by 3–6 parts, shorter to longer than the nutlet, bristle-like, deciduous with fruit. Stamens 3. Style 2–3-fid; base persistent, barely thickened. Nutlets obovate, dorsiventrally lenticular or trigonous. Pericarp with the three highly differentiated layers, exocarp cells often enlarged and hollow; surface smooth, epidermal cells roughly isodiametric. Embryo fungiform with three primordial leaves.

Distribution and ecology. *Bolboschoenus* is a cosmopolitan genus (POWO 2022). It grows in saline, brackish, or freshwater wetlands. In Madagascar, *Bolboschoenus* is known from the north and west, occurring in the Diana Region of Antsiranana province, Boeny region of Mahajanga province, and Atsimo Andrefana region of Toliara province. Only a single species occurs in Madagascar, i.e. *Bolboschoenus glaucus* (Lam.) S.G.Sm. (Fig. 18).

Tribe Fuireneae

Fuirena Rottb. (Rottbøll 1773: 70)

Type species. *Fuirena umbellata* Rottb.

Description of the genus. Annuals or rhizomatous perennials. Culms many-noded, rarely scapose, 3–5-sided, sometimes thickened at base. Leaves usually well developed, basal and cauline, ligule tubular, membranous, with blade often reduced in lower leaves (rarely all leaf blades reduced). Involucral bracts leaf-like, usually sheathing, lowermost bract sometimes erect. Inflorescence terminal (in reduced inflorescences, bract may be erect, but clearly leaf-like), paniculate to capitate with few to many spikelets. Glumes many, spirally arranged or rarely pentastichously arranged, deciduous, each subtending a flower, often pubescent, the apex entire and mucronate to awned. Floret bisexual. Perianth present, as long or shorter than nutlet, formed by 3 parts, or when 6 in 2 whorls, the inner parts scale-like, the outer parts bristle-like, rarely all parts reduced or absent or only 1 scale developed, deciduous with the fruit. Stamens 1–3. Style 3-fid, base persistent, barely thickened, if at all. Nutlets obovate, triquetrous to trigonous, frequently stipitate, smooth or variously ornamented. Embryo turbinate to weakly fungiform with a horizontally broadened scutellum, first leaf primordium not strongly outgrown, the second leaf primordium either absent or poorly developed.

Distribution and ecology. *Fuirena* is a cosmopolitan genus (POWO 2022). It grows in seasonally wet grasslands, freshwater wetlands, on sand or in rocky areas. *Fuirena* occurs throughout Madagascar; seven species are known including e.g. *Fuirena pubescens* (Poir.) Kunth (Figs 8C, 19).

Tribe Schoenoplectieae

Schoenoplectus (Rchb.) Palla (Palla 1888: 49), nom. cons.

Type species. *Schoenoplectus lacustris* (L.) Palla

Description of the genus. Perennials with long rhizomes sometimes ending in tubers at tips. Culms scapose, trigonous to terete, thickened at base. Leaves usually reduced to a sheath, sometimes developing a ligulate blade, but rarely well developed. Involucral bracts often large, erect, stem-like, rarely leaf-like, and patent to reflexed. Inflorescence pseudolateral, rarely clearly terminal, corymb-like anthela or capitate. Spikelet 1 or few. Glumes many, spirally arranged, deciduous, each subtending a flower; puberulent to glabrous, the margins often ciliate or laciniate distally, apex entire to emarginate or deeply 2-fid, awned or mucronate. Floret bisexual. Perianth present, formed by (5–)6 parts, smooth to retorsely scabrid, bristle-like or sometimes plumose, longer or shorter than nutlet, deciduous with fruit. Stamens 2–3. Style 2–3-fid, base not thickened, persistent. Nutlets smooth, obovate, trigonous, or dorsiventrally lenticular, yellow to dark brown when mature; fruit epidermal cells isodiametric to narrowly oblong. Embryo fungiform, scutellum turbinate to rhomboid in shape, root cap lateral, first well developed and second embryonic leaves basal.

Distribution and ecology. *Schoenoplectus* is a cosmopolitan genus (POWO 2022). It grows in freshwater wetlands, along stream banks, wet grasslands, and rocky areas. In Madagascar, only two species of *Schoenoplectus* occur including e.g. *Schoenoplectus subulatus* (Vahl) Lye (Haines and Lye 1983: 54).

Tribe Pseudoschoeneae

Schoenoplectiella Lye (Lye 2003: 20)

Type species. *Scirpus articulatus* L. [= *Schoenoplectiella articulata* (L.) Lye]

Description of the genus. Annuals or perennials, tufted or with firm, short to creeping rhizomes. Culms nodeless and scapose or 1(–3)-noded above the base, trigonous, terete or rarely 7-sided. Leaves reduced to a mucronate sheath, rarely with well-developed blades, ligulate or eligulate. Involucral bracts culm-like, erect, or patent while fruiting, rarely short, rigid, and sheathing, but then appearing as a continuation of the stem. Inflorescence pseudolateral, rarely appearing terminal, a corymb-like anthela or capitate with 1-many spikelets, rarely compound-paniculate with 1-many spikelets, with a conspicuously sinuous main axis. Glumes many, spirally arranged, deciduous or persistent, each subtending a flower; scale apex entire to apiculate. Floret bisexual, rarely polygamodoecious. Perianth bristles present or absent, formed by 0–10 parts, smooth or retrorsely scabrid, bristle-like, as long as or longer than the nutlet, deciduous with the fruit. Stamens 2–3, rarely vestigial in female flowers. Style 2–3-fid, base undifferentiated, rarely

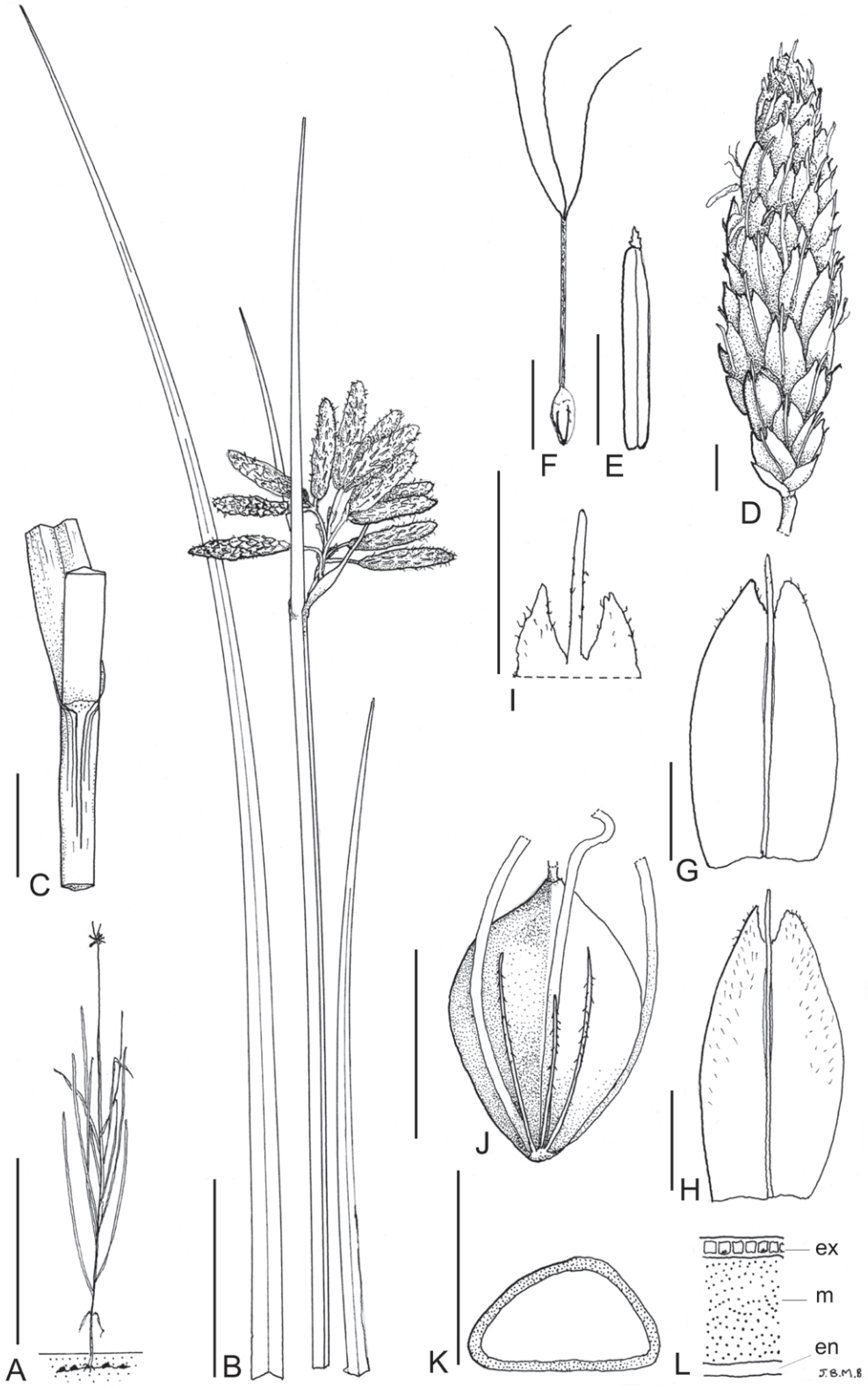

Figure 18. *Bolboschoenus glaucus*. **A**. Habit. **B**. Inflorescence and leaves. **C**. Leaf sheath apex. **D**. Spikelet. **E**. Anther. **F**. Ovary, style and branches. **G**, **H**. Glume, adaxial and abaxial surface. **I**. Glume apex. **J**. Nutlet, abaxial view. **K**, **L**. nutlet sections. All from van *Rensburg 2404*. Scale bars: A = 250 mm; B = 10 mm; C = 40 mm; D–K = 2 mm. Abbreviations: ex = exocarp, m = mesocarp, en = endocarp. Drawn by Jane Browning, reproduced with permission from the artist, originally published in Browning et al. (2020).

Figure 19. *Fuirena pubescens*. **A**. Nutlet. **B**. Habit. **C**. Leaf sheath apex. **D**. Inflorescence. **E**. Glume lateral view. **F**. Floret. A–C from *Taylor 36*; D–F from *Browning 165*. Scale bars: A = 40 mm; B, C = 5 mm; D–F = 1 mm. Drawn by Jane Browning, reproduced with permission from the artist, originally published in Gordon-Gray (1995).

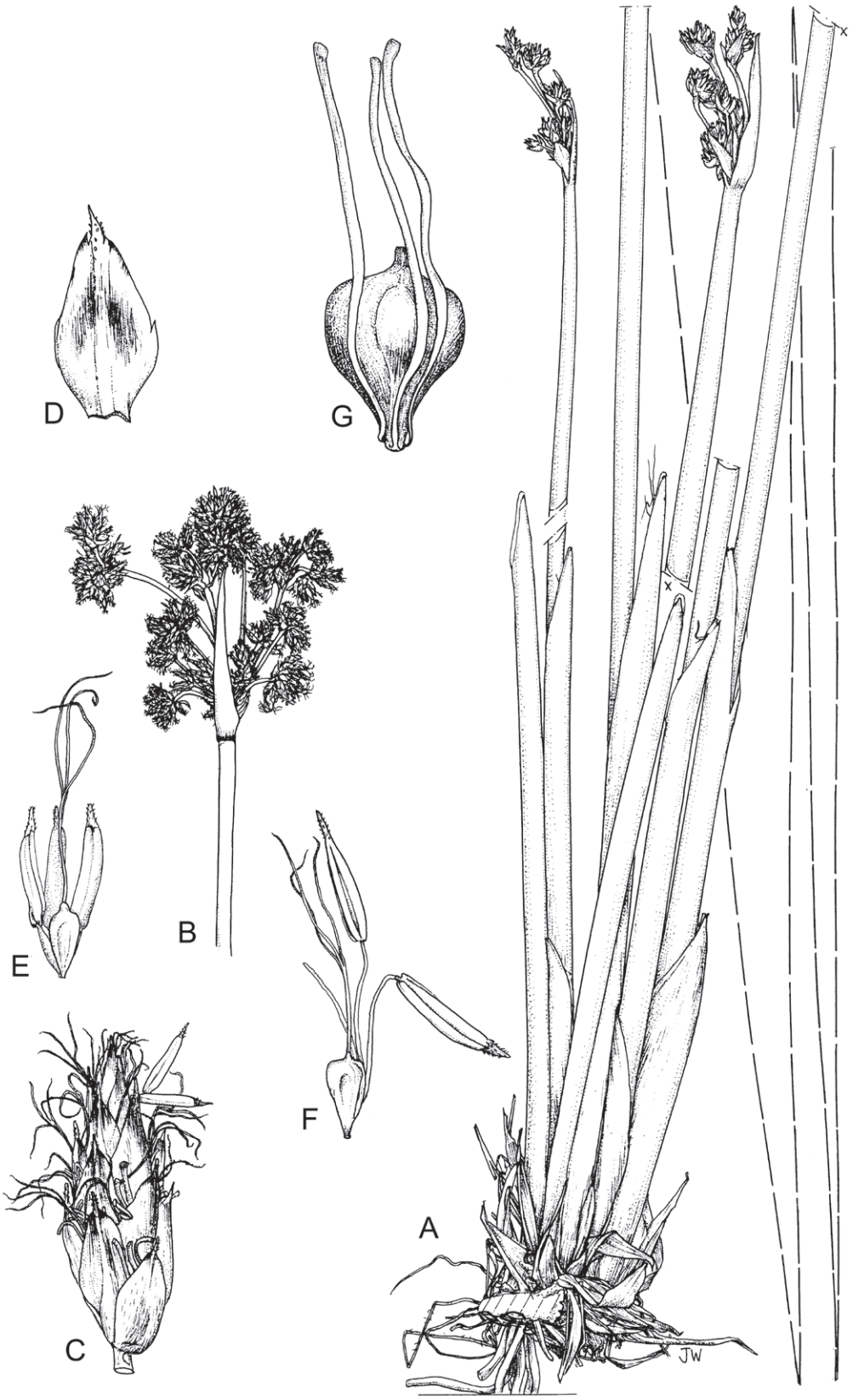

Figure 20. *Schoenoplectiella corymbosa*. **A**. Partial habit (× 2/3). **B**. Inflorescence (× 2/3). **C**. Spikelet (× 6). **D**. Glume (× 10). **E**. Young floret (× 10). **F**. Floret (× 10). **G**. Nutlet (× 20). A from *Richards 6616*; B, G from *Greenway & Kanuri 12546*; C–F from *Grimshaw 93*. Drawn by Juliet Beentje, reproduced with permission from the artist, originally published in Hoenselaar et al. (2010).

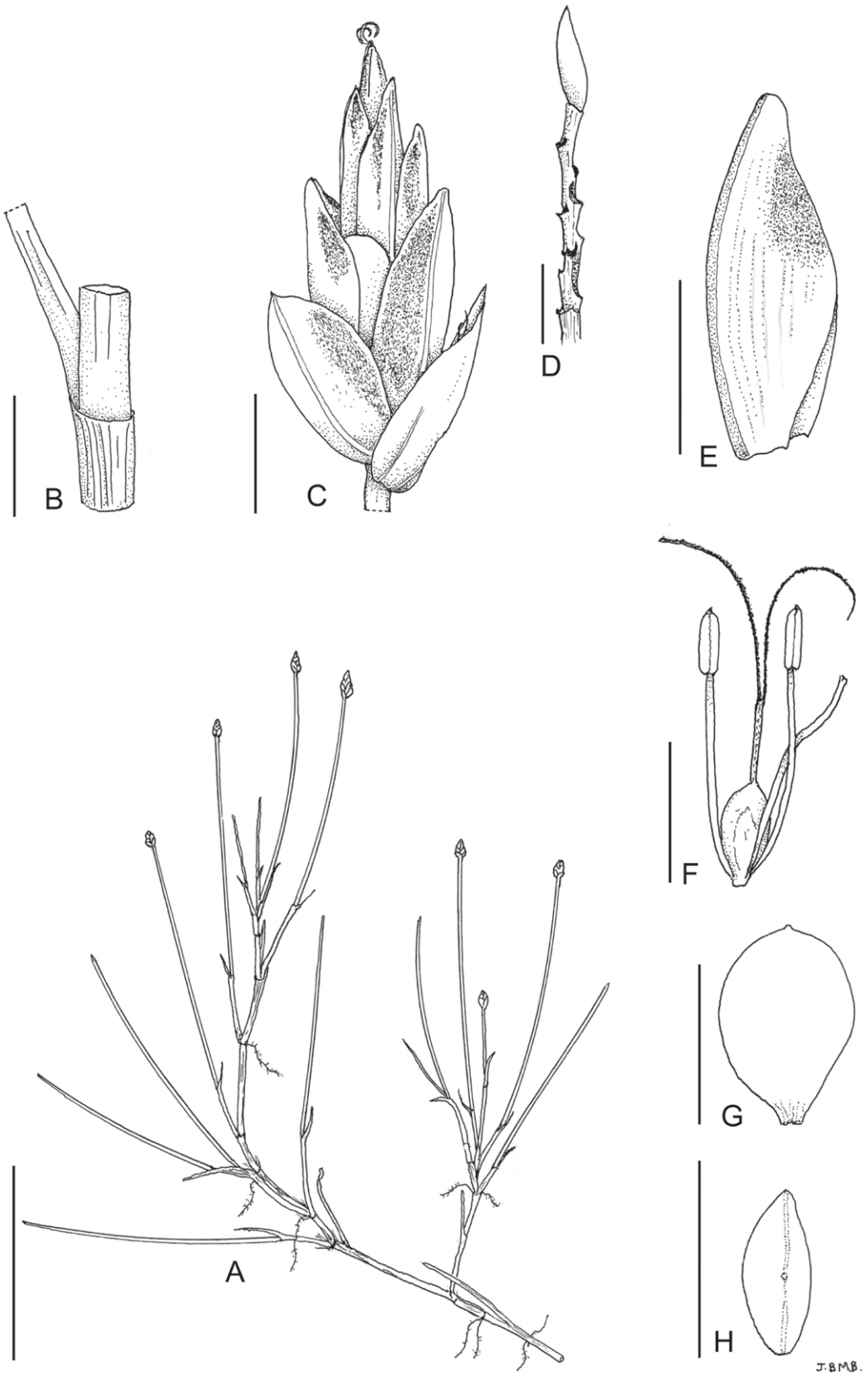

Figure 21. *Isolepis fluitans*. **A**. Habit. **B**. Leaf sheath. **C**. Spikelet. **D**. Rachilla, apical glume attached. **E**. Glume, lateral view. **F**. Floret. **G**, **H**. Nutlet, abaxial and apical view. All from *Iversen & Martinsson 89195*. Scale bars: A = 40 mm; B–H = 1 mm. Drawn by Jane Browning, reproduced with permission from the artist, originally published in Browning et al. (2020).

distinct and somewhat thickened, persistent. Nutlets smooth or transversely rugose to distinctly ridged, obovate, trigonous to planoconvex or biconvex, dark nearing black when mature, sometimes brown.

Distribution and ecology. *Schoenoplectiella* is a cosmopolitan genus (POWO 2022). It grows in freshwater wetlands, along stream banks, wet grasslands, and rocky areas. *Schoenoplectiella* is known from all parts of Madagascar; 13 species are known including e.g. *Schoenoplectiella corymbosa* (Roth ex Roem. & Schult.) J.R.Starr & Jim.Mejías (Figs 8C, 20).

Tribe Cypereae

1. *Subtribe Ficiniinae*

1. *Isolepis* R.Br. (Brown 1810: 221)

Type species. *Scirpus setaceus* L. [= *Isolepis setacea* (L.) R.Br.]

Description of the genus. Small to more rarely medium-sized tufted annuals or mat-forming perennials; rhizome more rarely creeping, rhizomatous or stoloniferous. Culms scapose or with few to many nodes. Leaves eligulate, of a minute lobe or elongated to form a linear blade often much reduced. Primary bracts leaf-like or short, not sheathing, lowermost bract often erect. Inflorescence often pseudolateral, capitate, rarely anthelate. Spikelets few to many or reduced to a single spikelet. Glumes with few to many usually spirally arranged (rarely distichous), mostly deciduous glumes, each subtending a floret. Floret bisexual. Perianth bristles absent. Stamens 1–3; filament ribbon-like, anther crested with minute spikes. Style deeply 2–3-fid; base not distinct, not or slightly thickened, persistent. Nutlets mostly obovoid, thick lenticular to (rounded) trigonous, often 3-ribbed, beaked, surface with various ornamentations.

Distribution and ecology. *Isolepis* is a cosmopolitan genus (POWO 2022). It grows in temporary and permanently wet areas. In Madagascar, *Isolepis* is known from the north and the Central Highlands; four species are known including e.g. *Isolepis fluitans* (L.) R.Br. (Fig. 21).

2. *Ficinia* Schrad. (Schrader 1832: 143)

Type species. *Schoenus filiformis* Lam. [= *Ficinia filiformis* (Lam.) Schrad.]

Description of the genus. Small to medium-sized tufted perennials; frequently with a short or elongated creeping rhizome, stoloniferous, or decumbent. Culms scapose, more rarely with few to many nodes or branched, rarely thickened at the base, leafy only at the base or in all their length. Leaves often conspicuously ligulate (rarely eligulate), blade sometimes with scarious margins, or leaf reduced to a sheath. Primary bracts leaf-like (rarely bright yellow) or short, not sheathing, lowermost bract sometimes erect. Inflorescence rarely pseudolateral, mostly capitate, more rarely compacted, paniculate, spicate, or spikelets scattered along a profusely branched stem. Spikelets 1–many. Glumes with few to many spirally arranged or more rarely distichous, usually long-persistent glumes, each with a floret, or a few lower glumes empty. Floret bisexual. Perianth bristles absent. Stamens 3; anthers linear, often apiculate or setiferous. Style deeply 3-fid, sometimes 2-fid, rarely almost undivided; base not distinct, not thickened, deciduous. Nutlets mostly obovoid, rounded trigonous, rarely biconvex, base mostly surrounded by a tightly enveloping cupular to 3-lobed disc (gynophore), surface usually smooth.

Distribution and ecology. *Ficinia* is a cosmopolitan genus (POWO 2022). It grows in wet or dry mountain grasslands (Browning and Goetghebeur 2017). In Madagascar, *Ficinia* is known from the Analamanga region of Antananarivo province. Only a single endemic species is known from Madagascar, i.e. *Ficinia ciliata* Boeckeler. No illustration is available of this species and the type material has not been located.

2. Subtribe Cyperinae

Cyperus L. (Linnaeus 1753: 44)

Kyllinga Rottb. (Rottbøll 1773: 12), nom. cons.

Remirea Aubl. (Aublet 1775: 44)

Mariscus Vahl (Vahl 1805: 372), nom. cons.

Pycreus P.Beauv. (Palisot de Beauvois 1807 publ. 1816: 48)

Lipocarpha R.Br. (Brown 1818: 459)

Torulinium Desv. ex Ham. (Hamilton 1825: 15)

Oxycaryum Nees (Nees von Esenbeck 1842: 90)

Ascolepis Nees (Nees von Esenbeck 1855: 105)

Queenslandiella Domin (Domin 1915: 415)

Courtoisina Soják (Soják 1979 publ. 1980: 193)

Type species. *Cyperus esculentus* L.

Description of the genus. Small to large annuals, or tufted, rhizomatous, stoloniferous or bulbiferous perennials. Culms mostly scapose, triangular to subterete, rarely winged, compressed or septate. Leaves eligulate (more rarely ligulate), sometimes reduced to a sheath; sheaths sometimes semisucculent; blade linear or rarely oblong or pseudopetiolate. Primary bracts often large and leaf-like, not sheathing, lowermost bract rarely erect. Inflorescence of few to many spikelets, in clusters called spikes, terminal, rarely pseudolateral, anthelate to capitate, rarely spicate or reduced to a single spikelet; partial inflorescences spike-like with spicately or digitately-arranged spikelets, or densely capitate. Spikelets with few to many, 2-ranked (very rarely spirally arranged) glumes, spikelet bract and prophyll more or less glume-like, each glume subtending a floret. Glumes deciduous or persistent; rachilla internodes elongated. Floret bisexual, very rarely unisexual or even dioecious. Bristles absent, lacking a gynophore. Stamens 1–3. Style (2–)3-fid, more rarely (sub)entire; base mostly not distinct, not thickened, persistent or deciduous. Nutlets most often 3-sided, with

Figure 22. *Cyperus pectinatus*. **A**. Habit (× 2/3). **B**. Inflorescence (× 1.5). **C**. Spikelet (× 3). **D**. Glume (× 10). **E**. Flower (× 10). **F**. Nutlet (×10). A from *Peter 8794*; B–D, F from *Greenway & Kanuri 12298;* E from *Richards 24601*. Drawn by Juliet Beentje, reproduced with permission from the artist, originally published in Hoenselaar et al. (2010).

Figure 23. Diversity in the genus *Cyperus*. **A**. *Cyperus* cf. *cyperoides*. **B**. *Cyperus obtusiflorus*. **C**. *Cyperus assimilis*. All photos taken in the Itremo Massif Protected Area by Fitiavana Rasaminirina.

the flat side pressed against the spikelet rachilla, often obovoid or ellipsoid, rarely dorsiventrally compressed, rarely stipitate, beaked or not, surface smooth or with various ornamentations, rarely thickened, corky.

Distribution and ecology. *Cyperus* is a cosmopolitan genus who can be found everywhere. *Cyperus* occurs throughout Madagascar; ca 145 species are known including e.g. *Cyperus pectinatus* Vahl (Figs 22, 23).

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