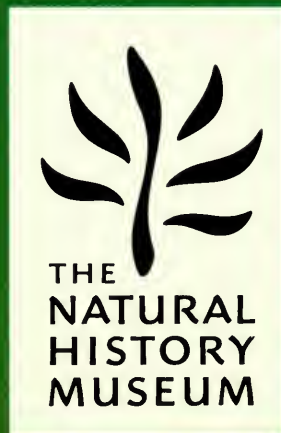


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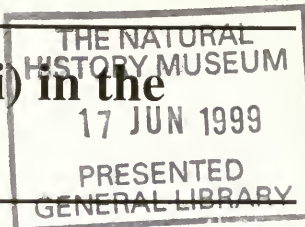
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The moss family Calymperaceae (Musci) in the Philippines

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SYNOPSIS. A taxonomic account is presented of the nonleucobryoid genera in the moss family Calymperaceae occurring in the Philippines. Four genera are recognized: *Calymperes* (18 species), *Chameleion* (1 species), *Mitthyridium* (8 species) and *Syrrophodon* (19 species). Keys to taxa are provided. Species newly recorded for the Philippines include *Calymperes mangalorensis* Dixon & P. de la Varde, *C. motleyi* Mitt. ex Dozy & Molk., and *C. subintegrum* Broth. *Mitthyridium fasciculatum* var. *cardotii* (M. Fleisch.) A. Eddy is raised to the rank of subspecies (*M. fasciculatum* subsp. *cardotii* (M. Fleisch.) B.C. Tan & L.T. Ellis).

INTRODUCTION

The family Calymperaceae is a group of tropical mosses mainly confined to lowland and coastal forest communities. Its diversity and distribution worldwide have recently been reviewed and mapped by Reese (1987b). Regional monographs of this family are available for southern India (Ellis, 1989), Malaysia (Reese & Mohamed, 1985; Reese, Mohamed & Mohamed, 1986; Mohamed & Reese, 1985), Borneo (Menzel & Schultze-Motel, 1990), Papua New Guinea (Reese, Koponen & Norris, 1986) and Australia (Reese & Stone, 1987, 1995). It is in the light of these new publications that a revision of the family was conducted for the Philippine archipelago based on the large collections made by the second author in recent years.

There have been attempts to redefine the family Calymperaceae by the inclusion of several genera, such as *Leucophanes* and *Exodictyon*, in which the species possess leucobryoid leaves (see review in Reese, Koponen & Norris, 1986). Although the arguments presented are not agreeable to many, these new treatments of the family have much merit. However, in the present work we have chosen to include only the four genera with species that possess nonleucobryoid leaves, namely *Calymperes*, *Syrrophodon*, *Mitthyridium* and *Chameleion*. The last one is a segregate genus of *Syrrophodon* (Eddy, 1990).

An early account of the Calymperaceae occurring in the Philippines can be found in Bartram (1939), who reported a total of three genera and 33 species. Iwatsuki & Tan (1979), in their checklist of Philippine mosses, report four genera and 35 species. This study recognizes four genera with 45 species. Three species are new records for the Philippine flora, namely, *Calymperes mangalorensis*, *C. motleyi* and *C. subintegrum*. Except for *C. mangalorensis*, which

was known only from a few localities in India and Myanmar (Burma) before its discovery in the Philippines, these are widespread species in tropical Asia. Their presence in the Philippines is therefore not surprising. On the other hand, there are four taxa whose alleged presence in the country cannot be confirmed by the present study (see excluded taxa). The increase in the number of species from 33 to 45, and the data from the new collections made by the second author, represent a great improvement in our knowledge of the high diversity of the family Calymperaceae in the Philippines.

Phytogeographically, the species of Philippine Calymperaceae can be grouped into the following six categories:

1. Pantropical – 8 species (c. 17%), *Calymperes afzelii*, *C. erosum*, *C. lonchophyllum*, *Syrrophodon gardneri* and *S. parasiticus*.
2. Palaeotropical to Oceania – 7 species (c. 15%), *Calymperes serratum*, *C. taitense*, *Syrrophodon armatus*, *S. involutus*, *S. spiculosus*, *S. trachyphyllus* and *S. tristichus*.
3. Indo-Pacific – 21 species (c. 46%), *Calymperes aeruginosum*, *C. moluccense*, *C. motleyi*, *C. porrectum*, *Mitthyridium constrictum*, *M. flavum*, *M. repens*, *Syrrophodon albobaginatatus*, *S. confertus*, *S. croceus*, *S. japonicus* and *S. muelleri*.
4. Malesian-Pacific – one species (c. 2%), *Mitthyridium subluteum*.
5. South India, Indochina, SW China and Central Malesia disjunct – 4 species (c. 9%), *Calymperes mangalorensis*, *Chameleion peguense*, *Syrrophodon flammeonervis* and *S. tajibodensis*.
6. Malesia – 4 species (c. 9%), *Calymperes robinsonii*, *C. subserratum*, *Mitthyridium wallisii* and *Syrrophodon rufescens*.
7. Philippine endemic – one species (c. 2%), *Mitthyridium iwatsukianum*.

From the above analysis it is evident that the majority (c. 46%) of

Philippine Calymperaceae are widely distributed from tropical Asia to Oceania. About 17% are pantropical and 15% are palaeotropical in distribution. Only 9% (four species) are restricted to Malesia, one species is Malesia and the western Pacific, and one species, *Mitthyridium iwatsukianum*, is locally endemic to Luzon island. This overall distribution well reflects the predominantly coastal distribution and preference for an epiphytic lifestyle in lowland habitats among members of this family. Species of Calymperaceae must be efficiently wind dispersed to achieve such a broad range. Evidence is seen in the frequent production of gemmae at the tips of leaves; in many species some leaves become strongly modified for the production of gemmae (see also Reese, 1987b). However, a few species, such as *Calymperes mangalorensis*, *Chameleion peguense* and *Syrrhopodon tjibodensis*, notwithstanding their gemma-producing capabilities, appear to have failed to disperse very far. They have some limitation that has resulted in their present-day disjunctive range in India, Indochina, SW China and a few island groups in central Malesia, where seasonally dry lowland rainforest predominates.

SYSTEMATIC ACCOUNT

Calymperaceae Kindb., *Gen. Eur. N.-Amer. Bryin.*: 11 (1897). Type genus: *Calymperes* Sw. ex F. Web.

Shoots erect or creeping, forming cushions, tufts or mats on trees, rock and soil. Leaves mostly linear, lingulate or lanceolate. Costa strong, ending just below apex or excurrent, smooth, toothed, spinose or ciliate; in nonleucobryoid genera usually composed of dorsal and ventral bands of stereids separated by 1–2 or more layers of guide cells (in leucobryoid genera largely composed of large, empty hyaline cells supporting networks or layers of small chlorophyllose cells), superficial cells often differentiated. Lamina in basal region of leaf composed of large, empty, thin-walled, porose hyaline cells; above basal region composed of small, thick-walled chlorophyllose cells (sometimes incorporating hyaline cells), smooth, toothed, spinose or papillose. Leaf margin often with a marginal or intramarginal rib, entire, toothed, papillose, spinose or ciliate. Clavate to fusiform, multicellular, mostly uniseriate gemmae often produced from a definite region of the costa (usually the apex), sometimes on specialized leaves. Dioecious. Sporophytes terminal; seta smooth; capsule usually cylindrical. Peristome haplolepidous (sometimes absent or reduced) and calyptra fugacious (*Syrrhopodon*, *Chameleion* and *Mitthyridium*), or peristome absent and calyptra persistent (*Calymperes*).

Key to genera and species

Note: This key includes four taxa which are highly likely to occur in the Philippines, *Calymperes crassinerve* (Mitt.) Jaeg., *Mitthyridium junquilianum* (Mitt.) H. Rob., *Syrrhopodon prolifer* var. *albidus* (Thwaites & Mitt.) S. Orbán & W.D. Reese, and *S. prolifer* var. *toesaensis* (Cardot) S. Orbán & W.D. Reese. However, as the authors are presently unaware of collections of these taxa from the study area they are not featured in the detailed descriptions of taxa in this paper.

- 1 Plants with erect shoots, branched or simple; leaf margins various Key 1: **Calymperes**, **Syrrhopodon**, **Chameleion**
- Plants with creeping main shoots and ascending branches; leaf margins largely formed (extending from leaf base to near apex) by a flattened, mostly unistratose* band of stereids Key 2: **Mitthyridium**

Key 1. *Calymperes*, *Syrrhopodon* and *Chameleion*

- 1 Leaves linear, costa and marginal ribs covered with irregular nodules of small chlorophyllose cells in more or less transverse rows (Fig. 9b, c, f, g) **Calymperes strictifolium**
- Leaves linear or not, lacking irregular nodules of small chlorophyllose cells 2
- 2 Leaves linear above hyaline base; cells immediately above hyaline lamina in leaf base shortly subrectangular, smooth, red, with thick, pitted walls, distinctly larger than the cells of the chlorophyllose lamina above (Fig. 18e) **Syrrhopodon croceus**
- Leaves linear or not; cells above hyaline lamina not differentiated as described above 3
- 3 Leaves soft, lingulate to spatulate, with long, remote cilia on costa and leaf margin; dorsal and ventral surfaces of chlorophyllose lamina smooth and flat (Fig. 16g–i) **Syrrhopodon ciliatus**
- Leaves variously shaped, lacking cilia, or if cilia present, then cells of chlorophyllose lamina protuberant and/or papillose 4
- 4 Hyaline lamina often occupying two thirds or more of leaf blade and/or hyaline cells continuing distally from hyaline lamina to near leaf apex, underlying the chlorophyllose lamina in 1 or 2 rows adjacent to costa (Fig. 18m, o) 5
- Hyaline lamina occupying less than two thirds of leaf blade; chlorophyllose lamina without underlying rows of hyaline cells adjacent to costa 7
- 5 Leaves 1.5–3.5 mm long with a short, but distinct chlorophyllose limb; margins denticulate from shoulders to apex **Syrrhopodon confertus**
- Leaves 1–1.5 mm long, lacking a distinct chlorophyllose limb; margins largely entire (small teeth sometimes evident near leaf apex) 6
- 6 Leaves suberect to erecto-patent; peristome teeth papillose **Syrrhopodon involutus**
- Leaves suberect to patent-recurved; peristome teeth finely striate **Syrrhopodon rufescens**
- 7 Distal extent of hyaline lamina poorly defined (showing a gradual transition from large hyaline cells in the base to small chlorophyllose cells in the distal leaf) (Fig. 8f); shoots usually acaulescent; leaves linear 8
- Hyaline lamina sharply defined with large, thin-walled hyaline cells abutting small, thick-walled chlorophyllose cells (Fig. 10g); shoots acaulescent or not; leaves linear or not 10
- 8 Leaves erect, bristle-like (wet or dry); margins above leaf base polystratose and largely entire **Syrrhopodon aristifolius**
- Leaves variously incurled when dry, strap-like; margins above leaf base unistratose and entire or, polystratose with well-developed, uni- to multicellular, often double teeth 9
- 9 Leaves <10–20 mm long; margins above leaf base polystratose, toothed **Calymperes serratum**
- Leaves c. 5 mm long; margins above leaf base unistratose, entire **Calymperes subserratum**
- 10 Leaves lingulate, less than 3 mm long; lamina on either side of hyaline region in leaf base formed by a broad band of rounded-quadrate/shortly subrectangular cells with thickened angles (Fig. 5k) 11
- Leaves various; hyaline region in leaf base bordered on either side by narrow marginal (Fig. 24d) or intramarginal (Fig. 1i) rib of thick-walled linear cells 12

*Polystratose in the Indonesian species *Mitthyridium retusum* (Besch.) W.D. Reese.

- 11 Cells of chlorophyllose lamina rounded, collenchymatous, mostly 8–20 × 7.5–15 µm; costa ending below leaf apex; gemmae produced from ventral surface of costal apex **Calymperes motleyi**
Cells of chlorophyllose lamina polygonal, not collenchymatous, mostly 7–12(–14) × 5–10(–12.5) µm; costa usually excurrent with gemmae produced from all around the tip **Calymperes tenerum**
- 12 Hyaline leaf base with intramarginal band of thick-walled, linear cells (Figs 1i, 3b, h) 13
Hyaline leaf base with marginal rib of thick-walled linear cells (Figs 20m, 24d) 28
- 13 Costa in cross-section with 2 or more layers of guide cells (Fig. 1f) 14
Costa in cross-section with a single layer of guide cells (Fig. 2e) .. 17
- 14 Leaves broadly linear, at apex abruptly narrowing into a linear proboscis (Fig. 10e) **Calymperes taitense**
Leaves narrowly linear or strap-like, at apex tapering to a blunt to acute tip 15
- 15 Leaves strap-like, <9–>15 mm long 16
Leaves bristle-like, up to 7.5 mm long **Calymperes aeruginosum**
- 16 Lamina abruptly narrowing into costa for a short distance above the hyaline base, giving leaf a petiolate appearance **Calymperes robinsonii**
Lamina not narrowing into costa above hyaline base **Calymperes lonchophyllum**
- 17 Lumina in cells of chlorophyllose lamina not or hardly protruding dorsally or ventrally (walls papillose or not), subrectangular in cross-section (Fig. 3e) 18
Lumina in cells of chlorophyllose lamina protruding ventrally, thumb-nail- or shield-shaped in cross-section (Fig. 3l) 20
- 18 Leaves dimorphic, with erect, bristle-like gemmiferous leaves and recurved, lingulate nongemmiferous leaves **Calymperes porrectum**
Leaves not dimorphic, all linear-lanceolate, lanceolate or strap-like 19
- 19 Leaves strap-like, <9–>15 mm long; shoots usually acaulescent **Calymperes lonchophyllum**
Leaves lanceolate to linear-lanceolate, 5–7.5 mm long; shoots with well-developed stems **Calymperes fasciculatum**
- 20 Costa excurrent; leaves hardly dimorphic, gemmae (when present) produced from all around the costal apex 21
Costa ending just below leaf apex; leaves dimorphic (gemmiferous and nongemmiferous); gemmae produced from the ventral surface of a modified costal apex 22
- 21 Rib bordering lamina in distal leaf intramarginal (bordered by 2–4 rows of chlorophyllose cells); cells of chlorophyllose lamina with one or two simple papillae on the ventral surface; distal-most cells of hyaline lamina acutely exserted, from above appearing to overlap adjacent cells of the chlorophyllose lamina **Calymperes erosum**
Rib bordering lamina in distal leaf marginal; cells of chlorophyllose lamina with a single acute summit projecting from the ventral leaf surface; distal-most cells of hyaline lamina usually with flat ventral surfaces **Calymperes mangalorensis**
- 22 Gemmiferous leaves lanceolate to lingulate (when moist); blades of chlorophyllose lamina usually broader than costa, often abruptly narrowing into apical proboscis and becoming recurved below apex (Fig. 1h) 23
Gemmiferous leaves linear, bristle-like; blades of chlorophyllose lamina often narrower than costa, tapering to just below apex (usually broadening at apex) (Fig. 9i) 27
- 23 Marginal lamina bordering intramarginal rib in hyaline leaf base composed of 2–>5 rows of small, subquadrate hyaline cells; proboscis in gemmiferous leaves narrow with lamina narrowly recurved, becoming plane but not, or barely, broadening out at apex; leaves commonly more than 4 mm long **Calymperes afzeli**
Marginal lamina bordering intramarginal rib in hyaline leaf base composed of 1–2(–3) rows of small, subquadrate to shortly subrectangular hyaline cells; proboscis in gemmiferous leaves with lamina broadening somewhat around the apex; leaves rarely more than 4 mm long 24
- 24 Nongemmiferous leaves up to 2 mm long; gemmiferous leaves strongly infolded when dry, with a cowl-like apex ... **Calymperes crassinerve**
Nongemmiferous leaves usually more than 2 mm long; apex of hyaline lamina various in shape but rarely strictly truncate; gemmiferous leaves straight to curled when dry but not infolded, apices cowl-like or not 25
- 25 Costa in gemmiferous and nongemmiferous leaves thick (with an inflated appearance), lacking stereids; leaf margins unistratose throughout **Calymperes boulayi**
At least in nongemmiferous leaves costa lacking inflated appearance and incorporating stereids; leaf margins above hyaline base usually formed by a polystratose rib 26
- 26 Cells of chlorophyllose lamina 5–12(–14)µm wide, thick-walled (thick walls particularly evident around shoulders of hyaline base where the cells are polygonal but possess rounded lumina), protruding acutely from the ventral leaf surface, often with thick, pleuripapillose summits; lamina at apices of gemmiferous leaves forming a broad, oval-concave ‘collar’ **Calymperes moluccense**
Cells of chlorophyllose lamina 4–7.5 µm wide, protruding roundly to subacutely from the ventral leaf surface, not pleuripapillose or notably thickened; lamina at apices of gemmiferous leaves forming narrow, spoon-shaped ‘collar’ **Calymperes graeffeanum**
- 27 Superficial walls of cells in hyaline lamina of even thickness; in gemmiferous leaves lamina forming a narrow (often obscure) collar above the costal apex; in nongemmiferous leaves cells of chlorophyllose lamina subacutely to acutely protuberant from the ventral leaf surface (shield-shaped in cross-section); costa and margins without lamellae **Calymperes subintegrum**
Superficial walls of cells in hyaline lamina with horizontal bands of thickening; in gemmiferous leaves lamina forming a funnel-shaped leaf apex; in nongemmiferous leaves cells of chlorophyllose lamina roundly protuberant from the ventral leaf surface (fingernail-shaped in cross-section); short lamellae (1–3 cells high) often apparent on ventral surface of costa and dorsal surfaces of marginal ribs **Chameleion peguense**
- 28 Leaf margin adjacent to apex of hyaline lamina entire 29
Leaf margin adjacent to apex of hyaline lamina with teeth, spines or cilia 35
- 29 Cells forming surface of marginal rib differentiated, in cross-section subquadrate to subrectangular or rounded 30
Cells forming surface of marginal rib not differentiated, composed of stereids 31
- 30 Leaves mostly patent to recurved with apices finely drawn out; leaf margins above mid-chlorophyllose limb strongly toothed **Syrhropodon tristichus**
Leaves erect to erecto-patent with blunt apices; leaf margins entire (sometimes weakly toothed near apex) **Syrhropodon muelleri**
- 31 Leaves lingulate or elongate triangular; often with filamentous gemmae produced just above the hyaline base from lateral cells in the ventral

- surface of the costa (Fig. 22g) 32
 Leaves narrowly lanceolate or linear; gemmae not produced as described above 33
- 32 Cells of chlorophyllose lamina acutely protuberant from the ventral leaf surface, dorsally unipapillose (Fig. 22k); apex of hyaline lamina acute (Fig. 22g) **Syrrhopodon parasiticus**
 Cells of chlorophyllose lamina with compound papillae on dorsal and ventral surfaces (Fig. 24n); apex of hyaline lamina rounded-truncate (Fig. 24k) **Syrrhopodon tjibodensis**
- 33 Chlorophyllose lamina with acute, distally-pointing teeth arranged in transverse rows occurring at regular intervals (Fig. 16c, e)
 **Syrrhopodon albovaginatus**
 Chlorophyllose lamina lacking teeth arranged in distinct transverse rows 34
- 34 Leaf abruptly narrowing at apex of hyaline lamina, forming distinct 'shoulders' (Fig. 19c) **Syrrhopodon flammeonervis**
 Leaf gradually narrowing at apex of hyaline lamina, hardly forming 'shoulders' **Syrrhopodon prolifer** var. **albidus**
- 35 Marginal rib around mid-chlorophyllose limb with subquadrate to subrectangular or rounded superficial cells, some cells forming double or single, unicellular to multicellular teeth at regular intervals 36
 Marginal rib around mid-chlorophyllose limb with linear superficial cells, entire or with each cell forming a distally pointing tooth 38
- 36 Cells of chlorophyllose lamina protruding acutely from the ventral leaf surface, often papillose dorsally and ventrally (Fig. 20t)
 **Syrrhopodon gardneri**
 Cells of chlorophyllose lamina flat to slightly roundly protuberant, smooth 37
- 37 Marginal rib lacking stereids; chlorophyllose lamina hardly constricted above hyaline leaf base; leaves less than 9 mm long; shoots with well-defined stem **Syrrhopodon japonicus**
 Marginal rib incorporating stereids; chlorophyllose lamina strongly constricted for a short distance above the hyaline leaf base; leaves 6–>30 mm long; shoots acaulescent **Syrrhopodon loreus**
- 38 Surface of costa largely formed by stereids, entire (except sometimes near leaf apex) (Fig. 24h) 39
 Ventral and/or dorsal surfaces of costa composed of subquadrate to subrectangular or rounded cells (surface view), some cells often giving rise to teeth, spines or papillae (Fig. 23h, j) 40
- 39 Leaves with spinose teeth at apex
 **Syrrhopodon prolifer** var. **tosaensis**
 Leaves lacking spinose teeth at apex **Syrrhopodon trachyphyllus**
- 40 Superficial cells of marginal rib around mid-chlorophyllose limb each forming an acute, distally pointing tooth
 **Syrrhopodon hispidissimus**
 Marginal rib around mid-chlorophyllose limb entire, or only a few superficial cells forming teeth or spines 41*
- 41 Leaves abruptly narrowing from subrectangular-elliptical hyaline leaf base into a linear chlorophyllose limb; margins spinose at 'shoulders', regularly toothed in distal chlorophyllose limb, from base of chlorophyllose limb to above mid-limb entire **Syrrhopodon spiculosus**
 Leaves ligulate, slightly tapering around apex of hyaline lamina; margins often spinose or ciliate from above mid-hyaline base to beyond mid leaf, not regularly toothed towards leaf apex
 **Syrrhopodon armatus**

NB. Most of the genera in the family Calymperaceae that possess leucobryoid leaves are unlikely to be confused with the nonleucobryoid genera. An exception is *Exostratum* L.T. Ellis. *Exostratum blumei* and *E. sullivantii* are known to occur in the Philippines. These species have a similar aspect to *Syrrhopodon spiculosus* and *S. hispidissimus*. However, unlike the latter, the leaves in *Exostratum* have a rather stiff appearance when wet or dry, in the costa there is a complete lack of stereids and the position occupied by guide cells in *Syrrhopodon* is occupied by chlorophyllose cells.

Key 2. *Mitthyridium*

- 1 Leaves 1–3.5 mm long 2
 Leaves mostly 3.5–>5 mm long 9
- 2 Apices of leaves modified with lamina inrolled to form a cup or tube (proboscis) (Fig. 15b) 3
 Apices of leaves plane, acute to rounded 5
- 3 Leaves up to 2.5 mm long, marginal band of thick-walled linear cells less than 50 µm wide at its broadest point; lamina at leaf apex loosely inrolled to form a tube, tube often flaring distally to form a narrow funnel **Mitthyridium wallisii**
 Leaf length various; marginal band of more than 100 µm wide at broadest point; modified leaf apices cup-shaped 4
- 4 Leaves tristichous, strictly ranked; cells of lamina smooth with evenly thickened walls, lumina seldom substellate; dorsal surface of costa near apex smooth **Mitthyridium iwatsukianum**
 Leaves seldom strictly ranked; cells of lamina papillose with incrassate, unevenly thickened walls enclosing substellate lumina (Fig. 12b); dorsal surface of costa near apex with spinose teeth **Mitthyridium constrictum**
- 5 Leaves tapering from base of chlorophyllose limb towards apex 6
 Leaves with parallel sides, chlorophyllose limb not tapering until close to apex 8
- 6 Leaves mostly narrowly lanceolate with acute apices 7
 Leaves with broadly flared shoulders, tapering to an obtuse apex
 **Mitthyridium fasciculatum** subsp. **cardotii**
- 7 Leaves 3–3.5 mm long; hyaline lamina occupying about a seventh of the leaf length **Mitthyridium subluteum**
 Leaves seldom more than 2 mm long; hyaline lamina occupying up to about a quarter of the leaf length **Mitthyridium junquilianum**
- 8 Leaves 1.5–2 mm long; apices acute or acuminate (Fig. 12d)
 **Mitthyridium flavum**
 Leaves 1–1.5 mm long; apices rounded-apiculate (Fig. 14b)
 **Mitthyridium repens**
- 9 Apices of leaves rounded-obtuse with marginal rows of lamina cells incrassate and smooth; apex of hyaline lamina truncate
 **Mitthyridium fasciculatum** subsp. **obtusifolium**
 Apices of leaves acute or acuminate with marginal rows of laminal cells similar to those below; apex of hyaline lamina broadly acute 10
- 10 Leaves with broad, pronounced shoulders, tapering sharply to leaf apex; marginal band of linear, thick-walled cells usually extending from base to near apex of leaf; cells of chlorophyllose lamina (in surface view) formed by 2–4 rounded lobes, papillose with papillae easily seen in surface view **Mitthyridium fasciculatum** subsp. **fasciculatum**
 Leaves with barely defined shoulders (sometimes lacking), sides of chlorophyllose limb tapering gently towards leaf apex, or parallel and

* An apparently undescribed variety of *Syrrhopodon prolifer* Schwägr., represented by a single Philippine collection, keys out here. See under excluded taxa.

tapering abruptly near apex; marginal band of linear thick-walled cells extending from base to over two thirds the length of the chlorophyllose limb; cells of chlorophyllose lamina polygonal in surface view (not usually lobed), obscurely papillose, seen easily only in cross-section

..... *Mitthridium papuanum*

Descriptions and illustrations of taxa

Calymperes Sw. ex F. Web., *Tab. Calyptr. operc.* (1813). Type species: *Calymperes lonchophyllum* Schwägr.

Shoots erect, simple or branched, forming mats or tufts. Leaves often dimorphic (gemmiferous and nongemmiferous), narrowly to broadly lingulate, lanceolate or linear, consisting of a hyaline, semi-sheathing base that narrows slightly, sometimes abruptly, into a chlorophyllose limb, apices various. Costa ending below apex to excurrent. Cells of chlorophyllose lamina small, mostly isodiametric, smooth, papillose, and/or protuberant. Cells of hyaline lamina large, empty, mostly smooth, with round to irregular pores in superficial and transverse walls; border between hyaline and chlorophyllose lamina usually sharply defined. Marginal and/or intramarginal ribs frequently present, usually intramarginal in hyaline base. Gemmae produced in a radial group, often from the modified apices of specialized leaves, fusiform to clavate, sometimes filamentous and branched, multicellular, uniseriate, smooth or papillose. Dioecious. Perichaetia terminal (innovations often fertile). Seta normally exerted. Capsule cylindrical with a conical operculum, enclosed in a persistent calyptra. Peristome absent.

Calymperes is most closely related to *Syrrhopodon*. The most important distinguishing feature is the presence in *Calymperes* of a persistent calyptra. It has been suggested that the calyptra in *Calymperes* plays a peristome-like role in the dispersal of spores (Edwards, 1980). In *Syrrhopodon* the calyptra is fugacious, falling from the capsule prior to spore dispersal. The differentiated leaf margin that occurs in many species in the Calymperaceae is often helpful in distinguishing between *Calymperes* and *Syrrhopodon*. In most species of *Calymperes* the hyaline lamina forming the leaf base possesses an intramarginal rib (in some species obscure or absent). In *Syrrhopodon* the hyaline lamina is often bordered by a marginal rib (in some species obscure or absent, rarely intramarginal).

Calymperes occupies a broad range across the wet regions in tropical and subtropical belts (Reese, 1987a). Species are mostly corticolous and lowland in distribution (mostly below 800 m in the Philippine archipelago). Many are confined to tree trunks along the margin of humid forests, especially in coastal areas of small islands.

There are about 24 species of *Calymperes* known from the Malesian region, of which 18 are reported here for the Philippines. A phytogeographical and floristic summary of the Philippine taxa is presented above in the introduction.

Calymperes aeruginosum Hampe ex Sande Lac. in *Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk.* 13(2): 7 (1872). Type: Philippines, Basilan Island, near Maridano, 5 January 1860, *Semper* s.n. (BM!-isotype).

Fig. 1a–f.

Calymperes mammosum Besch. in *Ann. Sci. Nat. Bot. sér. 8*, 1: 291 (1895). Type: Philippines, *Cuming* 2214 (BM!-holotype; BM!-isotype).

Shoots reaching 1–1.5 cm high, usually dark green. Leaves mostly straight and bristle-like (Fig. 1a, b) (sometimes incurled when dry), erect to patent, up to c. 6 mm long, linear with a constriction in the lamina for a short distance above the hyaline base, broadening

distally then narrowing gradually to a blunt, dentate apex. Costa strong, often occupying >25–>90 % of the width of the leaf, ending just below apex in a bluntly pointed or slightly expanded truncate tip, largely smooth, in upper leaf sometimes with a few blunt, multicellular teeth; internally with 2 layers of guide cells sandwiched between dorsal, median and ventral bands of stereids (Fig. 1f). Chlorophyllose lamina sometimes hardly apparent along constriction in leaf; cells mostly isodiametric to slightly longer than broad, with 4–6 sides or rounded, 6–12.5(–15) × 6–10(–12) µm, ventrally roundly to subacutely protuberant, dorsally flat. Hyaline lamina poorly to sharply defined. Leaf margin from around constriction in leaf to near apex plane to erect, formed by a thick polystratose rib, lacking stereids (Fig. 1f), superficial cells in surface view similar to those of the chlorophyllose lamina (slightly smaller) and some occasionally forming distant, blunt, (often multicellular) teeth; from constriction in leaf to below shoulders of leaf becoming unistratose, consisting of chlorophyllose lamina, denticulate; below shoulders of leaf to base often with an intramarginal band of long rectangular to linear, thick-walled cells, about 1–3 cells wide (Fig. 1d) (frequently obscure), laminal margin denticulate, composed of shortly subrectangular, thin-walled, hyaline cells in 1(–3) rows. Long, filamentous paraphyses produced in the axils of some leaves. Many leaves bearing gemmae on the ventral surface of the costal tip.

HABITAT. On trunks and exposed roots of trees, and on basic rock, in damp, shady lowland rainforest. The specimen cited below was growing on soil on limestone.

DISTRIBUTION. An Indo-Pacific species. Uncommon in the Philippines, but known also from Luzon and Mindanao.

SPECIMEN EXAMINED. Palawan, St Paul Bay, St Paul Subterranean National Park, 25 May 1989, *Tan* 89–1413b (FH).

Eddy (1990) notes plants of this species to be 'dark, blue-green to almost black'. However, this feature does not appear to be universal, as the recent collection cited above is green. Although yellowed by time, there is no remnant of dark colouration in the type of *Calymperes mammosum* Besch. (*Cumming* 2214, BM).

Calymperes afzelii Sw. in *Jahrb. Gewachsk.* 1: 3 (1818). Type: Africa, *Afzelius* s.n. (BM!-isotype). Fig. 1g–m.

Calymperes vriesii Besch. in *Ann. Sci. Nat. Bot. sér. 8*, 1: 307 (1895). Type: Sulawesi, Menahaye van Menado, *de Vriese* s.n. (Hb. Leyden, no. 4) (BM!-holotype).

Shoots reaching >3.5 cm high, in yellowish green tufts or mats. Leaves up to 5.5 mm long, dimorphic: nongemmiferous leaves lingulate; apex obtuse, broadly pointed, sometimes apiculate (Fig. 1g). Costa ending just below apex; above hyaline lamina rough with small, acute projections. Cells of chlorophyllose lamina mostly isodiametric with 4–6 sides, (3–)4–10(–12.5) × (3–)4–7.5 µm (Fig. 1k), roundly to acutely protuberant from the ventral leaf surface, sometimes with a simple papilla at the summit (Fig. 1m). Hyaline lamina sharply defined; cells in distal region often isodiametric, arranged in somewhat regular rows. Leaf margin from above hyaline base to near apex consisting of a polystratose marginal rib (usually strong), superficial cells subquadrate to shortly subrectangular, often forming small (unicellular) teeth, internally lacking stereids; in hyaline base with a narrow intramarginal band of linear, thick-walled cells (continuous with marginal rib in distal leaf), marginal lamina entire, composed of 2–>5 rows of thin-walled, subquadrate to shortly subrectangular hyaline cells (Fig. 1i). Gemmiferous

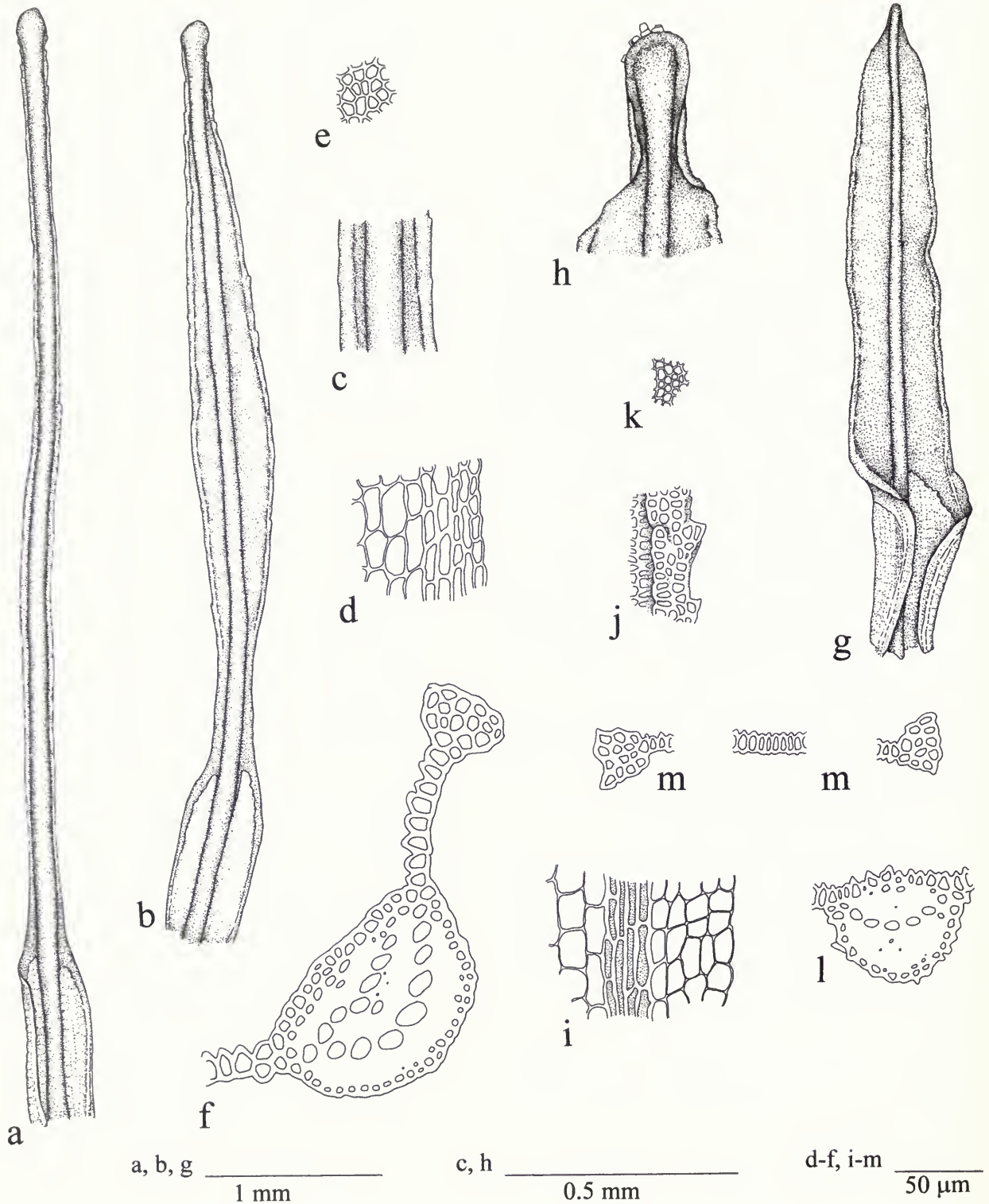


Fig. 1 a–f. *Calymperes aeruginosum* Hampe ex Sande Lac. a–c: leaves (a, b: in ventral view, with c: detail of mid-leaf; d, e: cells of leaf in surface view (d: at margin in hyaline base, e: in chlorophyllose lamina; f: cross-section of chlorophyllose limb. g–m. *Calymperes afzelii* Sw. g: leaf in ventral view; h: apex of gemmiferous leaf (dorsal view); i–k: cells of leaf in surface view (i: at margin of mid-hyaline base, j: at margin in chlorophyllose limb, k: of chlorophyllose lamina); l, m: cross-sections of leaf (l: costa, m: chlorophyllose lamina and marginal rib. a, c, d Drawn from Sarawak, *Jermy* 13734 (BM). b, e, f Drawn from *Tan* 89–1413b (FH). g–m Drawn from *Tan* 91–286 (BM).

leaves similar to above but possessing a linear apical proboscis (Fig. 1h). Costa extending into proboscis. Lamina abruptly narrowing into proboscis and becoming tightly recurved, at leaf apex becoming plane and forming a narrow, denticulate margin around the costal tip. Gemmae produced from the ventral surface of the costal apex.

HABITAT. On shaded trunks, exposed roots, decaying stumps and logs, sometimes on rock (the material cited below occurred on shale); occurring mostly in lowland areas.

DISTRIBUTION. A pantropical species. A previous report of this species from the Philippines (Menzel & Schultze-Motel, 1990) does not cite a collection or specific locality.

SPECIMENS EXAMINED. **Balabac Island**, Sitio Indalawan near Indalawan Village, 28 April 1993, *Tan* 93–228 (BM). **Palawan**, Puerto Princesa, Barangay San Rafael, Batac Village, 1 May 1991, *Tan* 91–286 (BM).

The leaves in *Calymperes afzelii* closely resemble smaller versions of those occurring in *Calymperes taitense* (Sull.) Mitt. However, the leaves of the latter always possess a narrow apical proboscis (potentially gemmiferous) and two rows of guide cells in the costa (a median layer and a smaller layer below the ventral surface). In *C. afzelii* at least some leaves have unmodified, flat apices, and there is a single (median) layer of guide cells in the costa (Fig. 11).

Calymperes boulayi Besch. in *Ann. Sci. Nat. Bot. sér. 8, 1: 278* (1895). Type: Borneo, *Korthals* s.n. (BM!-lectotype (fide Ellis, 1988); L!, NY!-isotypes?).

Fig. 2i–n.

Calymperes dozyanum Mitt. sensu M. Fleisch., *Musc. Fl. Buitenzorg* **1: 266** (1904).

Shoots reaching 2(–3) cm high, forming yellowish green mats or tufts. Leaves dimorphic: nongemmiferous leaves up to 3.5 mm long, lingulate to broadly lingulate (Fig. 2i), with apices obtusely pointed. Costa ending below apex, with an inflated appearance, above hyaline base rough with small, acute projections, internally virtually lacking stereids. Chlorophyllose lamina often with laxly incurved margins, cells isodiametric to slightly longer than broad, mostly irregularly quadrate to hexagonal, 5–10(–13) × (3–)5–7.5 μm, ventrally bluntly to acutely protuberant, dorsally flat, smooth or unipapillose. Hyaline lamina sharply defined. Leaf margin from around apex of hyaline lamina to leaf apex unistratose, entire or notched, rarely faintly denticulate toward leaf apex (Fig. 2l); below apex of hyaline lamina to leaf base with a narrow, unistratose intramarginal band of thick-walled linear cells (sometimes weakly developed), marginal lamina consisting of a row of thin-walled, subrectangular hyaline cells, entire to faintly denticulate (Fig. 2k). Gemmiferous leaves reaching 4 mm long, linear to broadly lingulate with an apical gemma-bearing proboscis (Fig. 2j). Costa as in nongemmiferous leaves but thicker. Lamina narrowing into proboscis, usually becoming recurved, distally becoming plane and broadening into a concave, oval collar around the costal tip. Gemmae produced from ventral surface of costal apex.

HABITAT. On trunks of trees, logs and stumps, sometimes on rock, rarely on humus at the base of trees; mostly occurring in lowland areas.

DISTRIBUTION. An Indo-Pacific species. As yet there are no records from Luzon.

SPECIMENS EXAMINED. **Mindanao**, Zamboanga, 1913, *Binstead* 142 (BM). **Palawan**, Port Barton, 30 April 1991, *Tan* 92–312 (FH).

The costa in both gemmiferous and nongemmiferous leaves of *Calymperes boulayi* has a rather inflated appearance and lacks stereids; marginal or intramarginal ribs are absent in the upper leaf, and at the apices of gemmiferous leaves a broad 'collar' of chlorophyllose lamina cups the gemmae (Fig. 2j). Together, these features distinguish this species from all others.

Calymperes erosum Müll. Hal. in *Linnaea* **21: 182** (1848). Type: Surinam, near Paramaribo, Hb. *Kegel* 539 (PC!-isotype).

Fig. 2a–h.

Calymperes hampei Dozy & Molck., *Bryol. jav. 1: 48* (1856). Type: Java, *Teysmann* s.n. (BM!-isotype?).

Calymperes sandeanum Besch. in *Ann. Sci. Nat. Bot. sér. 8, 1: 303* (1895). Type: Borneo, near Pontianak, *van Oorschot* s.n. (in Hb. Lacoste) (BM!-holotype).

Shoots <1–5 cm high, in yellowish green tufts and mats. Leaves up to 5 mm long, weakly dimorphic, consisting of a suberect, subelliptical hyaline base extending into an erect to patent (when moist), narrowly lingulate to lanceolate chlorophyllose limb (Fig. 2a); distal lamina sometimes involute; leaf apex acute or apiculate, denticulate. Costa ending in apex to excurrent, above hyaline base rough with small, acute projections. Cells of chlorophyllose lamina mostly isodiametric with 4–6 sides or rounded, 5–15(–17.5) × (4–)5–8(–9) μm (Fig. 2d), drawn out ventrally into acute projections each with 1–2 simple papillae forming the summit, dorsally flat or unipapillose (sometimes bipapillose). Cells (chlorophyllose and hyaline) in rows at apex of hyaline lamina drawn out ventrally into acute, distally- or laterally-leaning projections (in surface view appearing to overlap the cells adjacent them) (Fig. 2c). Continuous, narrow intramarginal rib of thick-walled linear cells extending from leaf base to shortly below apex; in hyaline base unistratose (Fig. 2b), beyond hyaline base becoming polystratose and sometimes incorporating stereids (Fig. 2d, g). Leaf margin unistratose; beyond hyaline base gradually narrowing towards apex, denticulate, consisting of 2–5(–>8) rows of small, subquadrate, thick-walled, chlorophyllose cells; in hyaline base entire below, notched to denticulate distally; composed of 1(–3) rows of narrowly rectangular, thin-walled, hyaline cells (Fig. 2b). Gemmiferous leaves with an excurrent costa; gemmae produced from all around the costal tip.

HABITAT. On trunks, branches and exposed roots of trees, tree stumps, not infrequently on rock, sometimes on soil; mainly occurring in lowland areas.

DISTRIBUTION. A nearly pantropical species.

SPECIMENS EXAMINED. **Balabac Island**, Sitio Melville, 28 April 1993, *Tan* 93–232 (FH). **Culion Island**, Barangay Culion, 6–7 May 1992, *Tan* 92–328 (BM); *Tan* 92–381 (BM); Sitio Ugnisan, Leyson Rancho, 7 May 1992, *Tan* 92–377 (BM). **Mindoro Island**, between Bongabon and Pinamalayan, February–April 1941, *Maliwanag* 136 (BM, FH).

For a comparison of *Calymperes erosum* with *C. mangalorensis* Dixon & P. de la Varde see under account of the latter.

Calymperes fasciculatum Dozy & Molck., *Bryol. jav. 1: 50* (1856). Type: Java, *Teysmann* s.n. (L!-holotype; BM!-isotype).

Fig. 3a–e.

Calymperes johannis-winkleri Broth. in *Mitt. Inst. Allg. Bot. Hamburg* **7(2): 122** (1928). Type: West Borneo, Bukit Raja, 1250 m, 9 December 1924, *Winkler* 3169 (BM!-isotype).

Syrhropodon hasagawae Tak. & Iwats. in *J. Hattori Bot. Lab.* **21: 240** (1959). Type: Japan, Kagoshima Pref., Isl. Yaku, Odakumi, 14

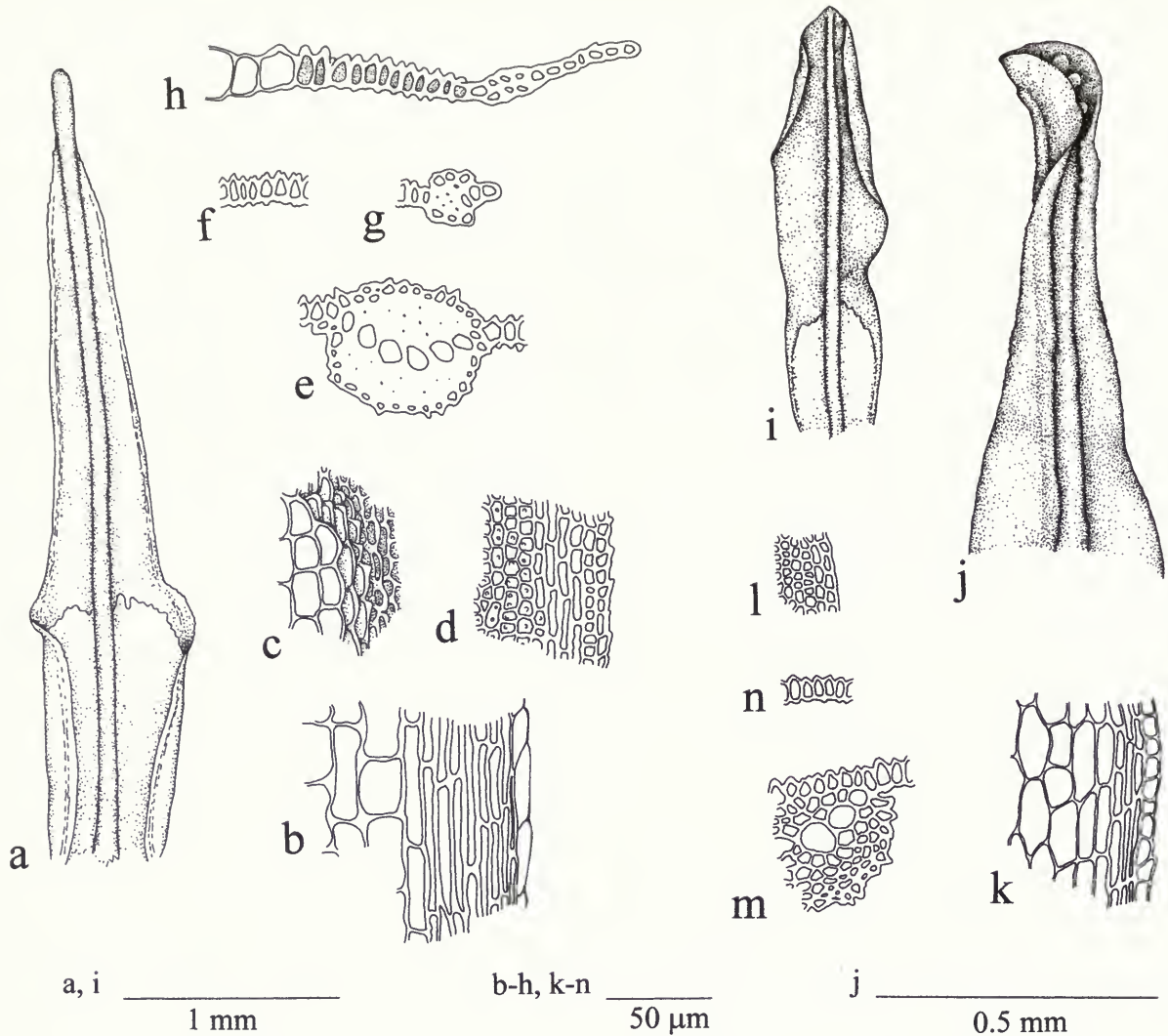


Fig. 2 a–h. *Calymperes erosum* Müll. Hal. a: leaf (ventral view); b–d: cells of leaf in surface view (b: at margin of hyaline base, c: around apex of hyaline lamina, d: in chlorophyllose lamina and at margin); e–h: cross-sections of leaf (e: costa, f: chlorophyllose lamina, g: margin in chlorophyllose limb, h: lamina and margin near apex of hyaline lamina). i–n. *Calymperes boulayi* Besch. i: nongemiferous leaf (ventral view); j: apex of gemmiferous leaf (ventral view); k, l: cells of leaf in surface view (k: at margin of hyaline base, l: at margin of chlorophyllose limb); m, n: cross-sections of leaf (m: costa, n: chlorophyllose lamina). a–h Drawn from *Tan* 92–328 (BM). i–n Drawn from *Tan* 92–312 (FH).

April 1950, *Hasagawa, Fukuhara & Fukui* 42757 (NICH-holotype).

Calymperes hasagawae (Tak. & Iwats.) Iwats. in *J. Hattori Bot. Lab.* **28**: 220 (1965).

Calymperes johannis-winkleri var. *hasagawae* (Tak. & Iwats.) Iwats. in *J. Jap. Bot.* **43**: 476 (1968).

Shoots reaching >5 cm high, in green tufts. Leaves erect to spreading (moist), mostly 5–7.5 mm long, lanceolate to linear-lanceolate, often narrowing abruptly a short distance above hyaline lamina (forming shoulders), apex narrowly acute, denticulate (Fig. 3a). Costa ending immediately below leaf apex in a blunt, toothed tip, mostly smooth. Cells of chlorophyllose lamina thick-walled, transversely to longitudinally elongate, with 4–6 sides, often rounded-elliptical, in distal leaf (8–)10–17.5 × 10–15(–22.5) µm, smooth (Fig. 3d, e). Hyaline lamina extending from leaf base to about half way to shoulders, usually sharply defined. Leaf margins

from leaf shoulders to near apex formed by a polystratose rib, i.e. a strand of stereid/substereid cells within a superficial layer of isodiametric cells similar to those of the lamina, some forming multicellular teeth (distant below, becoming more closely set towards leaf apex) (Fig. 3c); from shoulders to distal hyaline lamina undifferentiated, entire to notched; adjacent to hyaline lamina with an intramarginal band of thick-walled, linear cells in about 7 rows, marginal lamina entire to uneven, composed of thin-walled, shortly rectangular hyaline cells in a single row (Fig. 3b). Some leaves bearing gemmae on dorsal and ventral sides of costal apex; gemmae sometimes branched, sparsely papillose.

HABITAT. On tree trunks, decaying wood and rock.

DISTRIBUTION. An Indo-Pacific species. In the Philippines known previously only from Luzon.

SPECIMEN EXAMINED. **Panay Island**, Antique, Mt Madyaas, 15–16 January 1987, *Price* s.n. (FH).

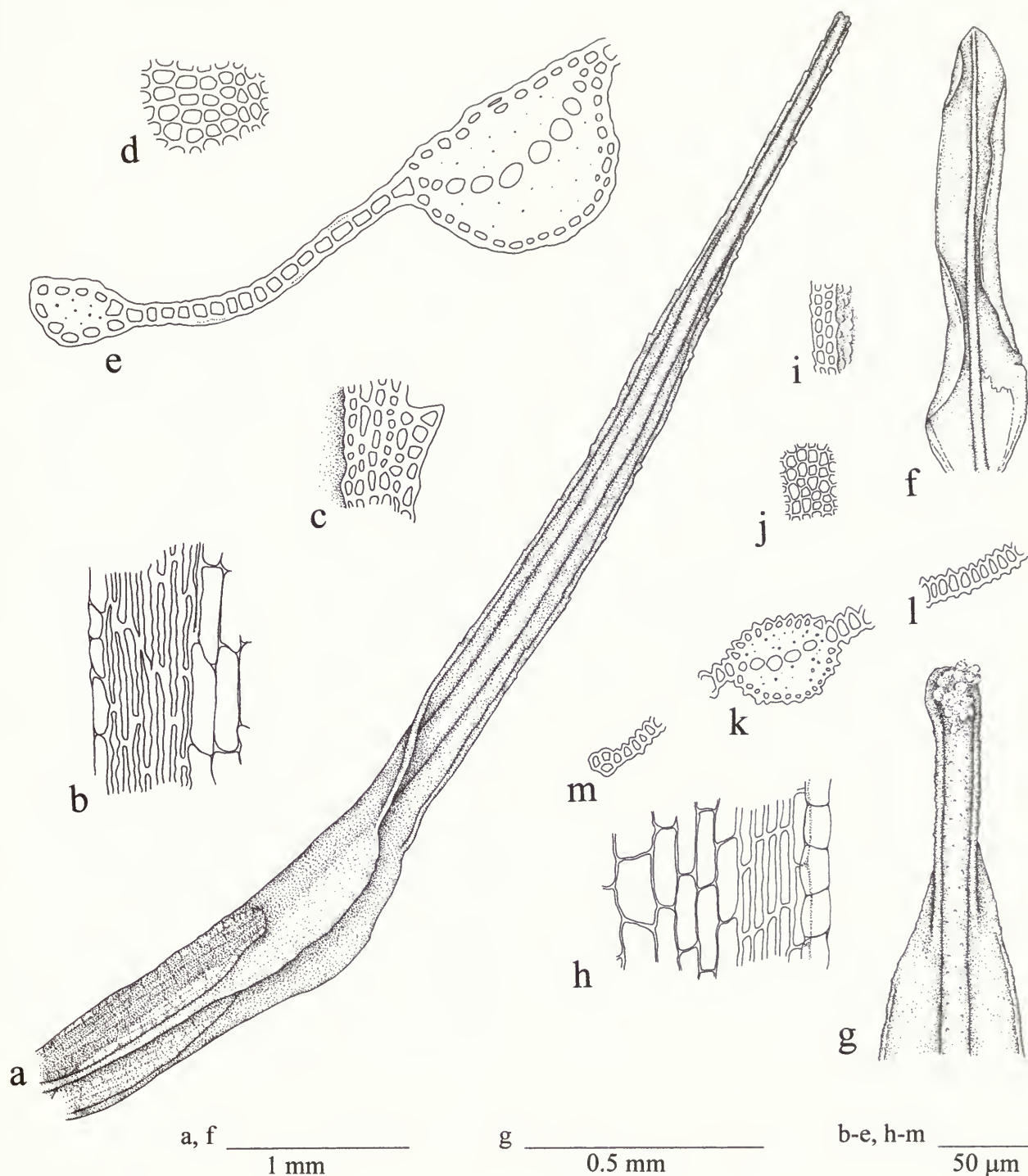


Fig. 3 a-e. *Calymperes fasciculatum* Dozy & Molk. a: leaf in ventral view; b-d: cells of leaf in surface view (b: at margin in hyaline base, c: at margin in chlorophyllose limb, d: in chlorophyllose lamina); e: cross-section of chlorophyllose limb. f-m. *Calymperes graeffeanum* Müll. Hal. f: leaf in ventral view; g: apex of gemmiferous leaf; h-j: cells of leaf in surface view (h: at margin in hyaline base, i: cells at margin in chlorophyllose limb, j: in chlorophyllose lamina); k-m: cross-sections of leaf (k: costa, l: chlorophyllose lamina, m: marginal rib). a, d, e Drawn from Price s.n. (FH). b, c, e Drawn from Sarawak, Bell 2055 (BM). f-m Drawn from Tan 93-297 (FH).

Calymperes graeffeanum Müll. Hal. in *J. Mus. Godeffroy* 3(6): 64 (1874). Type: Western Samoa, Upolu, *Graeffe* s.n. (BM!-isotype). Fig. 3f–m.

Calymperes semperi Hampe in Besch. in *Ann. Sci. nat. Bot. sér.* 8, 1: 302 (1895). Type: Philippine Islands, *Semper* s.n. (BM!-holotype; L!-isotype?).

Calymperes hyophilaceum Müll. Hal. ex Besch. in *Ann. Sci. Nat. Bot. sér.* 8, 1: 265, 287 (1895). Type: Philippine Islands, Calumpit, *Llanos* s.n. (BM?, not found; B?, destroyed 1943?).

Calymperes hyophilaceum var. *robustum* M. Fleisch., *Musc. Fl. Buitenzorg* 1: 265 (1904). Type: West Java, Rezidenz Krawang Bei Tjikao, 1899, *Fleischer (Musci Frond. Arch. Ind.* no. 263) (BM!, L!-isotypes).

Shoots reaching 1(–2) cm high, yellowish green. Leaves mostly 1.5–3.5 mm long, dimorphic: nongemiferous leaves lingulate to narrowly lingulate, leaf apex obtuse to subacute (Fig. 3f). Costa ending below apex, above hyaline base rough with small, acute projections. Chlorophyllose lamina plane, erect or laxly incurved, cells drawn out ventrally as subacute to acute projections, dorsally flat or unipapillose, mostly 5–10 × 4–7.5 µm, mostly isodiametric with 4–6 sides (Fig. 3j, l). Hyaline lamina sharply defined. Leaf margin from above apex of hyaline lamina to near leaf apex usually formed by a narrow, irregularly subdenticulate to denticulate polystratose rib (sometimes weak or absent), in surface view appearing as 2–3 rows of subquadrate chlorophyllose cells, sometimes incorporating stereids (Fig. 3i, m); adjacent to apex of hyaline lamina unistratose, entire to denticulate; from leaf base to below apex of hyaline lamina with a narrow, unistratose, intramarginal band of linear, thick-walled cells, marginal lamina unistratose, notched to denticulate, composed of 1–2 rows of shortly rectangular, thin-walled hyaline cells (Fig. 3h). Gemmiferous leaves lanceolate to narrowly lingulate with an apical gemma-bearing proboscis, apex rounded or truncate (Fig. 3g). Costa thick, often with a slightly inflated appearance, ending below apex of proboscis, internally incorporating many wide-lumened substereid cells, normal stereids few. Chlorophyllose lamina narrowing gradually to abruptly into proboscis and becoming tightly recurved, broadening distally and becoming plane to form narrow margin around the costal tip. Gemmae produced from the ventral surface of the costal tip.

HABITAT. On tree trunks and sometimes on rock, in lowland forest.

DISTRIBUTION. An Indo-Pacific species. Widespread in the Philippines.

SPECIMENS EXAMINED. **Luzon**, Mt Makiling, 27 August 1931, *Herklots* P30c (BM); Bataan Province, Lomas River, *Williams* 815 (NY); Isabela, Palanan Wilderness, 19 May 1992, *Tan* 92–207 (BM); 21 May 1992, *Tan* 92–181 (FH); **Palawan**: near Sitio Daan, Aborlan, 26 April 1992, *Tan* 92–259 (BM); St Paul Bay, St Paul Subterranean National Park, 25 May 1989, *Tan* 89–1417 (BM); Sabang Municipality, St Paul Underground River Subterranean Park, 3 May 1993, *Tan* 93–297 (FH); Iwahig, Balsahan, 4 April 1993, *Tan* 93–188 pro parte (FH); Barangay Puerto Princesa, Sitio Kalabayog, near Batac Village, 23–25 April 1993, *Tan* 93–222 (FH).

Calymperes lonchophyllum Schwägr., *Sp. musc. frond. suppl.* 1(2): 333 (1816). Type: Central America, 'Guyanne', *Richard* s.n. (PC!-isotype).

Fig. 4a–e.

Shoots reaching <1.0–>2.5 cm high, forming dense mats. Stems short to almost lacking. Leaves <9 >15 mm long, composed of a short, semi-sheathing, subelliptical hyaline base narrowing into a long-linear chlorophyllose limb (curled and contorted when dry, laxly suberect when moist); apex obtuse to acute, normally denticu-

late (Fig. 4a). Costa ending in leaf apex to shortly excurrent, smooth; internally with 1–2(–3) layers of guide cells (Fig. 4e). Chlorophyllose lamina occasionally transversely undulate, mostly unistratose, occasionally with bistratose streaks and patches, cells in surface view rounded, irregularly polygonal or quadrate to shortly subrectangular, mostly wider than long, <5–10(–12.5) × 7–15(–20) µm, thick-walled, flat, smooth or pleuripapillose (Fig. 4d, e). Hyaline lamina usually sharply defined. Leaf margin in base (adjacent to hyaline lamina) with an intramarginal rib of thick-walled, linear cells (c. 3–6 cells wide), marginal cells in 1–3(–6) rows, hyaline, thin-walled, irregular-elliptical, some in outermost row flask-shaped forming a bluntly denticulate margin (Fig. 4b); immediately above hyaline base formed by chlorophyllose lamina, unistratose, entire to denticulate; from a short distance above hyaline base to near leaf apex consisting of a robust polystratose rib, in section usually triangular, composed of small chlorophyllose cells and often incorporating a central strand of stereids; entire below; above usually with one to two rows of distant teeth (arising from angles of rib, often paired) (Fig. 4c), becoming closer set and more pronounced toward the leaf apex, each composed of a short, single row of cells ending distally as an acute projection. Long axillary hairs sometimes present, median and distal cells about 4 times longer than wide. Gemmae sometimes produced from the ventral surface of the costal apex (occasionally also from well below the apex), yellowish brown with simple papillae.

HABITAT. On tree trunks, sometimes on rock, in shaded rainforest.

DISTRIBUTION. A widespread pantropical species.

SPECIMENS EXAMINED. **Luzon**, Quezon National Park, Atimonan, 9 March 1986, *Tan & Lipaygo* s.n. (FH). **Palawan**, St Paul Bay, St Paul Subterranean National Park, 25 May 1989, *Tan* 89–1416 (BM); Puerto Princesa, Barangay Irawan, Mt Malinao, 4 May 1993, *Tan* 93–324 (FH); Barangay Apurawan, Sitio Daan, vicinity of Mt Tinik-basan, 27 April 1992, *Tan* 92–266 (BM).

Calymperes serratum A. Braun ex Müll. Hal. and *C. lonchophyllum* are superficially very similar but may be separated by two key features. Firstly, in *C. lonchophyllum* the hyaline lamina (in most leaves) is very sharply defined, with the relatively large, thin-walled, empty cells at its apex abutting the small, thick-walled, green cells forming the base of the chlorophyllose lamina. In *C. serratum* the distal cells of the hyaline lamina intergrade gradually with those of the chlorophyllose lamina. The second key distinguishing feature was recognized by Akiyama & Reese (1993) and Reese & Stone (1995). Long axillary hairs occur in both species (particularly commonly in *C. serratum*). In *C. lonchophyllum* the median and distal cells of these hairs are about four times as long as broad; those in *C. serratum* are seldom more than twice as long as broad. Additionally, the chlorophyllose lamina in *C. serratum* is consistently smooth and unistratose, and the intramarginal rib in the hyaline leaf base is often weak to the point of absence. In *C. lonchophyllum* the chlorophyllose lamina is often papillose with bistratose patches, and the intramarginal rib in the hyaline leaf base is well-developed.

Calymperes mangalorese Dixon & P. de laVarde in *Arch. Bot. (Paris)* 1(8–9): 164 (1927). Type: Southern India, Mangalore, Kananady, November 1925, *Foreau* 22 (BM!-holotype; PC!-isotype).

Fig. 4f–k.

Shoots reaching 2 cm high, forming yellowish green tufts or mats. Leaves up to 3.5(–4) mm long, hardly dimorphic; narrowly to broadly lingulate, distal chlorophyllose lamina sometimes involute; leaf apex acute to obtuse, occasionally apiculate (Fig. 4f). Costa ending in apex to shortly excurrent, above hyaline base usually

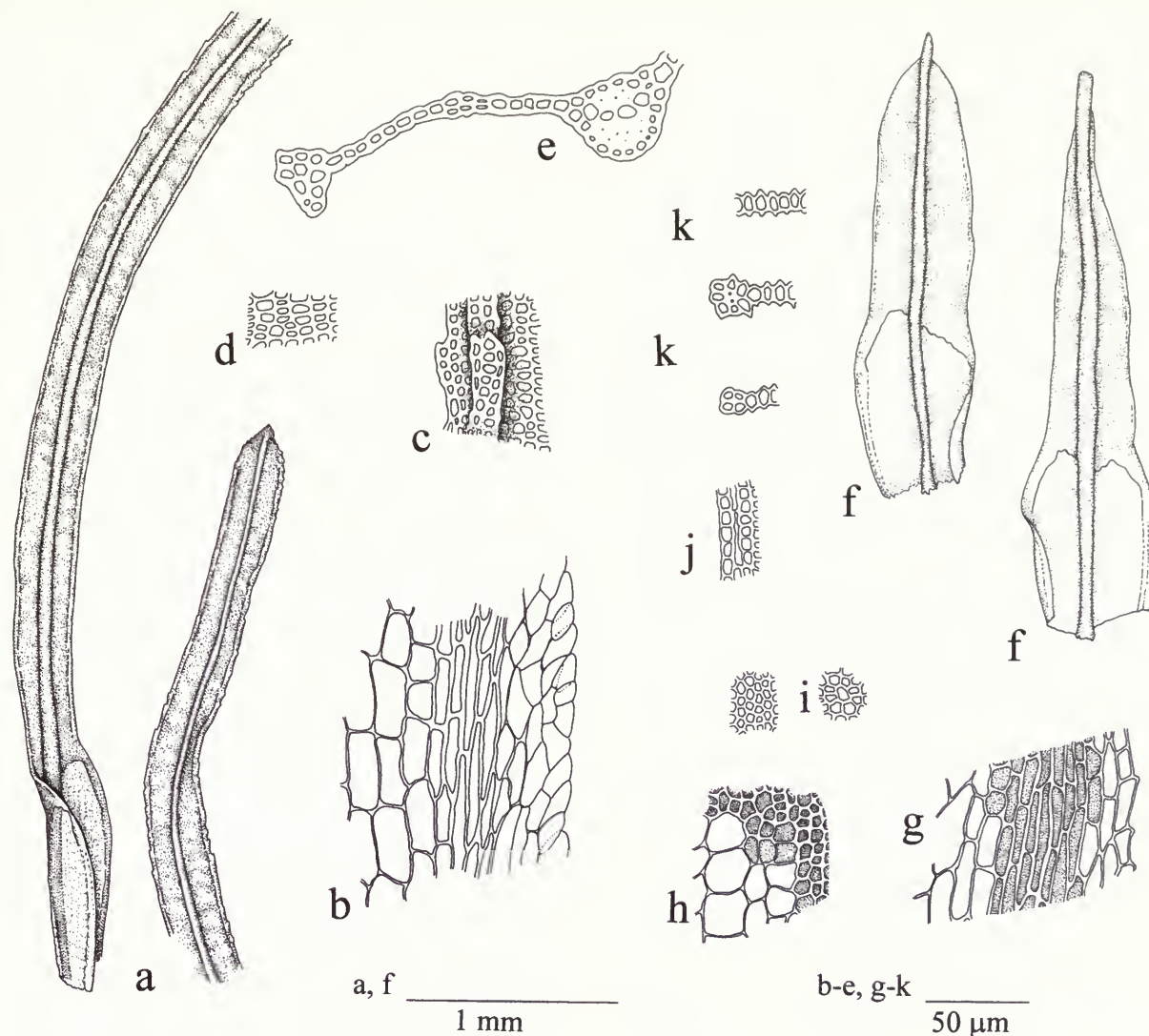


Fig. 4 a–e. *Calymperes lonchophyllum* Schwagr. a: leaf; b–d: cells of leaf in surface view (b: at margin in distal hyaline base, c: in marginal rib in chlorophyllose limb, d: in chlorophyllose lamina); e: cross-section of chlorophyllose limb. f–k. *Calymperes mangalorese* Dixon & P. de la Varde f: leaves; g–j: cells of leaf in surface view (g: at margin of distal hyaline base, h: around apex of hyaline lamina, i: in chlorophyllose lamina, j: at margin in chlorophyllose limb); k: cross-section of chlorophyllose lamina and marginal rib. a–e Drawn from *Tan* 89–1416 (BM). f–k Drawn from *Tan* s.n. (FH).

rough with small, acute projections. Cells of chlorophyllose lamina subsodiametric with 4–7 sides, $<5-11(-12.5) \times 5-10 \mu\text{m}$ (Fig. 4i), drawn out ventrally into rounded to acute projections, dorsally flat to unipapillose (Fig. 4k). Hyaline lamina sharply defined. Leaf margin beyond apex of hyaline lamina to near leaf apex, entire to uneven, formed by a polystratose rib of subquadrate to shortly subrectangular chlorophyllose cells (stereids sometimes present) (Fig. 4j, k), sometimes becoming intramarginal around apex of hyaline lamina; from around distal hyaline lamina to leaf base with an intramarginal unistratose band of long rectangular to linear thick-walled cells (often continuous with marginal rib in upper leaf, sometimes poorly developed), marginal lamina composed of 1–3 rows of thin-walled, subrectangular hyaline cells, entire to denticulate (Fig. 4g). Gemmiferous leaves with excurrent costa, gemmae produced from all around the costal tip.

HABITAT. The specimen cited below occurred on the bark of a tree in an open karst forest.

DISTRIBUTION. Formerly known only from India and Burma.

SPECIMEN EXAMINED. **Coron Reef Island** (Palawan Province), Coron Town, Lake Kayangan, off coast of Coron Municipality of Basuanga Island, 8 May 1992, *Tan* s.n. (FH) (new record).

This species has been confused with *Calymperes erosum*. In the leaves of the latter there is an intramarginal rib in the limb; the distal rows of cells in the hyaline lamina protrude acutely from the ventral surface of the leaf, overlapping the cells immediately distal to them; and (in most specimens) at least a few of the ventrally protuberant cells forming the chlorophyllose lamina have bipapillose summits. The leaves of *C. mangalorese* have a marginal rib in the limb (Fig. 4k), lack protuberant hyaline cells (Fig. 4h), and the ventrally protuberant cells forming the chlorophyllose lamina all possess unipapillose summits.

Calymperes mangalorese closely resembles *Calymperes graefeanum* in all features apart from the possession of leaves with an excurrent costa.

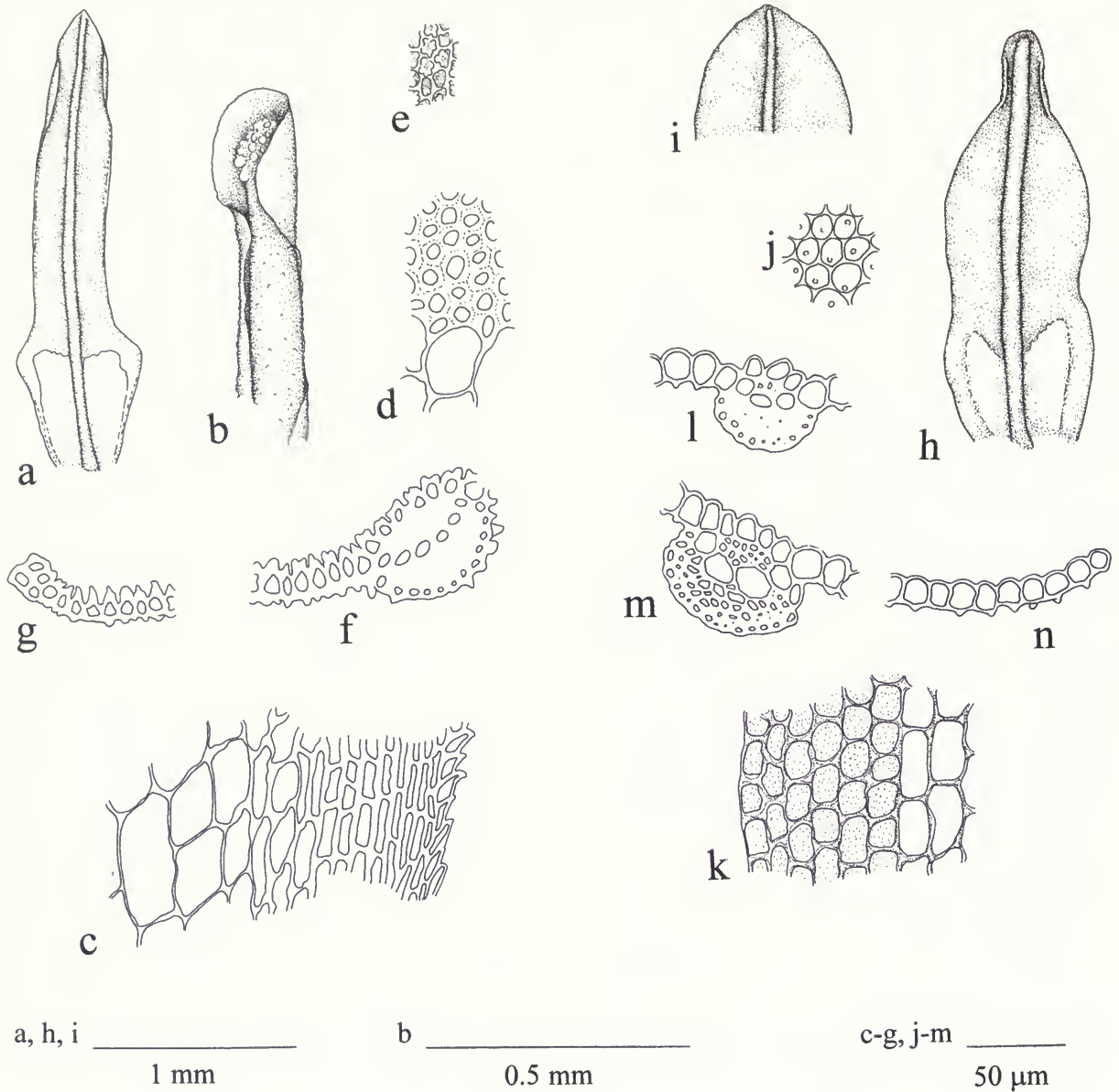


Fig. 5 a–g. *Calymperes moluccense* Schwägr. a: nongemmiferous leaf (ventral view); b: apex of gemmiferous leaf (ventral view); c–e: cells of leaf in surface view (c: at margin of hyaline base, d: around apex of hyaline lamina, e: in chlorophyllose lamina); f, g: cross-sections of leaf (f: costa and chlorophyllose lamina, g: marginal rib and chlorophyllose lamina). h–n. *Calymperes motleyi* Mitt. ex Dozy & Molk. h: gemmiferous leaf (dorsal view); i: apex of nongemmiferous leaf; j, k: cells of leaf in surface view in (j: chlorophyllose lamina, k: margin of hyaline base); l–n: cross-sections of leaves (l: costa (nongemmiferous), m: costa (gemmiferous), n: chlorophyllose lamina). a–g Drawn from *Tan* 92–186 (FH). h–n Drawn from *Tan* 93–240 (FH).

Calymperes moluccense Schwägr. *Sp. musc. frond. suppl.* 2(1): 99 (1824). Type: Moluccas, Rawak, *Gaudichaud* 29 (15) (BM!-isotypes).

Fig. 5a–g.

Calymperes palisotii subsp. *moluccense* (Schwägr.) M. Menzel in M. Menzel & Schultze-Motel in *Willdenowia* 19: 489 (1990).

Shoots reaching 2(–3) cm high, green above, often dark brown below, forming tufts or mats. Leaves 2.5–3.5 mm long, dimorphic: nongemmiferous leaves consisting of a narrowly lingulate chlorophyllose limb, extending (spreading when moist) from the slightly flared shoulders of a suberect hyaline base, distal

chlorophyllose lamina often involute, leaf apex obtuse, sometimes apiculate (Fig. 5a). Costa ending below apex, above hyaline base rough with coronate-papillose projections. Cells of chlorophyllose lamina drawn out ventrally into acute, often coronate-papillose projections, dorsally smooth or unipapillose (Fig. 5f, g), thick-walled (especially in region adjacent to hyaline lamina (Fig. 5d)), mostly 5–13 × 5–12 µm, isodiametric with 4–6 sides or rounded. Hyaline lamina sharply defined, often differentiated: cells in rows nearer the margin narrow with unevenly thickened walls (Fig. 5c), in rows adjacent to the costa broad and evenly thin-walled. Leaf margin from above shoulders to near apex formed by a narrow, irregularly subdenticulate, polystratose rib, in surface view appearing as 2–3

rows of subquadrate chlorophyllose cells, rarely incorporating stereids; at shoulders unistratose and denticulate, formed by small, thick-walled chlorophyllose cells; below shoulders with an intramarginal band of linear, thick-walled cells (sometimes continuous with marginal rib of upper leaf), marginal lamina unistratose, entire to denticulate, formed by 1–2 rows of subrectangular, thin-walled, hyaline cells (Fig. 5c). Gemmiferous leaves narrowly lingulate to lanceolate with an apical, gemma-bearing proboscis (Fig. 5b). Costa stout. Lamina abruptly narrowed into proboscis and becoming tightly recurved; at apex, broadening and becoming plane to form a collar around the costal tip. Gemmae produced from ventral surface of costal tip.

HABITAT. On the trunks and branches of trees, stumps and logs, sometimes on rock; occurring in lowland areas.

DISTRIBUTION. Widespread in the Indo-Pacific. In the Philippines, in addition to the localities cited below, also known from Bohol and Mindanao.

SPECIMENS EXAMINED. **Culion Island** (Palawan Province), near Sitio Ugnisan, 7 May 1992, *Tan* 92–382 (BM). **Luzon**, Isabela Province, Palanan Wilderness, 20 May 1992, *Tan* 92–212 (FH); 21 May 1992, *Tan* 92–186 (FH); Bicobian Bay, 22 May 1992, *Tan* 92–177 (FH). **Palawan** (Palawan Province), Barangay Napsan, Sitio Tagkulit, Salakot Waterfall vicinity, 2 May 1993, *Tan* 93–265 (FH).

Calymperes palisotii Schwägr. has been regarded by some authorities as a variety of *C. moluccense*. However, *C. palisotii* appears to be as distinct a species as any other in the genus (Ellis, 1987) and occurs mainly in the New World tropics, Africa and western SE Asia; it is extremely rare in Malesia and absent from Oceania. *Calymperes moluccense* has an Indo-Pacific distribution. In *C. moluccense* the leaves often have flared 'shoulders' where the hyaline lamina broadens before abruptly narrowing into the chlorophyllose limb; at the apices of gemmiferous leaves the chlorophyllose lamina forms a broad 'collar' around the gemmae (Fig. 5b); most cells in the chlorophyllose lamina and superficial cells in the costa protrude acutely and are often multipapillose on the protruding surface (Fig. 5f, g), those laminal cells adjacent to the distal hyaline lamina are usually strongly incrassate with a visible middle lamella (Fig. 5d); the cells of the hyaline lamina forming the rows adjacent to the intramarginal rib are often differentiated from those nearer the costa, being strikingly narrower with walls more unevenly thickened. In *C. palisotii* the leaves usually possess less pronounced shoulders (sometimes not evident); the lamina at the apices of gemmiferous leaves forms a narrow band around the costal apex; the cells of the chlorophyllose lamina and the superficial cells in the costa are roundly protuberant and lack papillae on the protruding surface, those laminal cells adjacent to the distal hyaline lamina are not unusually thick-walled; and the cells of the hyaline lamina are evenly thin-walled and not differentiated, with a gradual decrease in cell size across the lamina from the costa to the intramarginal rib.

Calymperes motleyi Mitt. ex Dozy & Molk., *Bryol. jav.* 1: 48 (1856). Type: Borneo, Labuan Island, Tanjong, *Motley* s.n. (BM!-isotype).

Fig. 5h–n.

Shoots reaching 1.5 cm high, forming yellowish green tufts or mats. Leaves about 2 mm long (erect to patent when moist), dimorphic: nongemmiferous leaves obovate to lingulate, distal chlorophyllose lamina sometimes involute, leaf apex obtuse to obtuse-apiculate. Costa ending below apex; in distal leaf ventral superficial cells protruding roundly, some dorsal superficial cells drawn out as blunt

projections; internally incorporating some substereid cells. Cells of chlorophyllose lamina collenchymatous, rounded to subhexagonal, 8–20 × 7.5–15 μm (Fig. 5j), protruding roundly from the ventral leaf surface, dorsally flat to slightly convex and/or unipapillose (Fig. 5n). Hyaline lamina sharply defined and enclosed on either side by broad marginal bands of small quadrate to shortly rectangular cells with differentially thickened transverse walls and/or angles (Fig. 5k). Leaf margins unistratose, entire, slightly irregular. Gemmiferous leaves lingulate with an apical, gemma-bearing, shortly suboblong proboscis (Fig. 5h). Costa often thicker than in nongemmiferous leaves, often incorporating substereid cells, extending into proboscis. Lamina abruptly narrowing into proboscis and becoming recurved, distally becoming plane to form a narrow, rounded margin around the costal tip. Gemmae arising from the ventral surface of the costal apex.

HABITAT. On trees in lowland areas. The specimen cited below occurred in an open, windy mangrove forest of *Avicenna*.

DISTRIBUTION. A widespread Indo-Pacific species.

SPECIMEN EXAMINED. **Balabac Island** (Palawan Province), Sitio Melville, 28 April 1993, *Tan* 93–240 (FH) (new record).

Calymperes motleyi and *C. tenerum* Müll. Hal. are similar in size, possess leaves with almost identical hyaline bases, and have sometimes been confused with each other. Under the microscope they are immediately distinguishable. In *C. motleyi*, the large (8–20 × 7.5–15 μm), unipapillose, collenchymatous cells that form the chlorophyllose lamina (Fig. 5j) contrast strongly with the small (7–12.5 × 7–10(–12.5) μm) polygonal cells of the chlorophyllose lamina in *C. tenerum* (Fig. 10o). Apart from the key features, these species are also distinguishable by the attitude of the leaves on the stem when dry. The apices in *C. motleyi* tend to roll inwards; in *C. tenerum* the leaves when dry often twist spirally around the shoot, or curl variously.

Calymperes porrectum Mitt. in *J. Linn. Soc. Bot.* 10: 172 (1868).

Type: Samoa, Tutuila, *Powell* 10 (BM!-isotype).

Fig. 6.

Calymperes salakense Besch. in *Ann. Sci. Nat. Bot. sér.* 8, 1: 271, 302 (1895). Type: Java, Mont Salak, near Buitenzorg, 400 m, *Kurz* 154 (BM!-holotype).

Calymperes scalare Besch. in *Ann. Sci. Nat. Bot. sér.* 8, 1: 303 (1895). Type: Philippines, Basilan Island, *Semper* s.n. (BM!-holotype).

Shoots robust, reaching >6 cm high, in yellowish green tufts or mats. Leaves mostly 5–7 mm long, strongly dimorphic: nongemmiferous leaves consisting of a recurved (moist or dry), narrowly to broadly lanceolate limb extending from the (usually distinct) shoulders of a suberect hyaline base; leaf apex narrowly to broadly acute (Fig. 6b). Costa ending immediately below apex to shortly excurrent, above hyaline base superficial cells smooth or drawn out into small, acute projections. Cells of chlorophyllose lamina mostly isodiametric, subquadrate to rounded, <5–10(–12.5) × <5–10(–12.5) μm, smooth, flat or ventrally slightly protuberant (Fig. 6h, j). Hyaline lamina sharply defined. Leaf margin with an intramarginal rib extending from leaf base to near apex; from shortly above apex of hyaline lamina polystratose, a strand of stereid-like cells with superficial cells similar to those of the lamina (Fig. 6k); from above apex of hyaline lamina to leaf base becoming a band of linear, thick-walled cells in 4–5 rows. Marginal lamina unistratose, narrowing from shortly below apex of hyaline base towards leaf apex, from about midleaf apparent only as a series of single, large, multicellular teeth; below midleaf to mid-hyaline lamina uneven to dentate, composed of several rows of cells similar to those of the chlorophyllose lamina

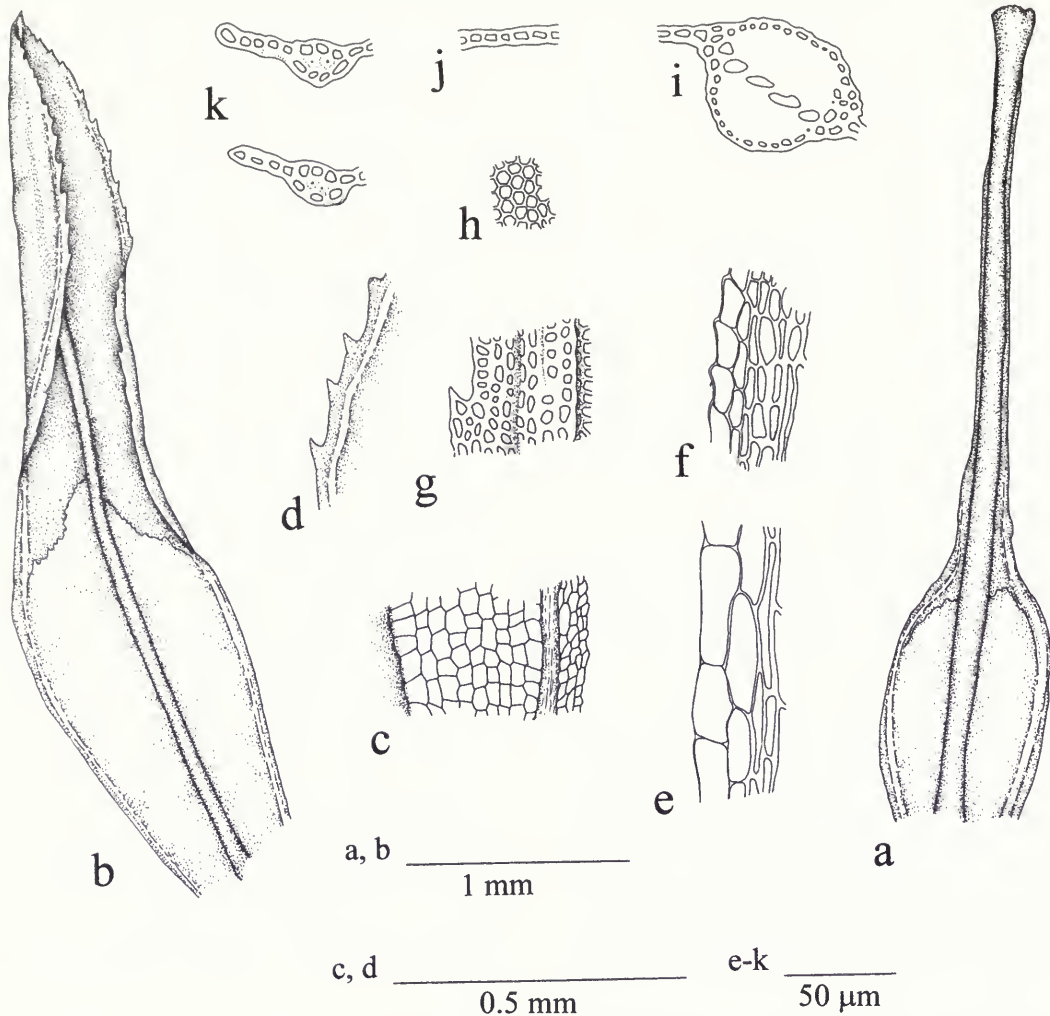


Fig. 6 a–k. *Calymperes porrectum* Mitt. a, b: leaves (a: gemmiferous leaf, b: nongemmiferous leaf); c, d: details of leaf (c: proximal hyaline base, and d: margin of chlorophyllose limb); e–h: cells of leaf in surface view (e: at margin in proximal hyaline base, f: at margin in distal hyaline base, g: at margin in chlorophyllose limb, h: in chlorophyllose lamina); i–k: cross-sections of leaf (i: costa, j: chlorophyllose lamina, k: margin in chlorophyllose limb. a–d Drawn from *Semper* s.n. (BM). e, f Drawn from North Borneo, *Wood* 1625 (BM). g–k Drawn from Papua New Guinea, *Cheesman* s.n. (BM).

(Fig. 6g); from around mid-hyaline lamina to leaf base entire to denticulate, consisting of 1–3 rows of shortly rectangular to slightly irregular thin-walled hyaline cells (Fig. 6e). Gemmiferous leaves suberect, a linear chlorophyllose limb abruptly narrowing from a subelliptical hyaline base (Fig. 6a); leaf apex rounded to truncate, denticulate. Costa thick, occupying more than two thirds of the width of the chlorophyllose limb for most of its length, shortly excurrent and broadening slightly at apex; beyond hyaline base rough with subacute to acute projections. Chlorophyllose lamina narrowing gradually from above hyaline base to just short of leaf apex. Gemmae produced from all around costal tip.

HABITAT. On tree trunks, rarely on soil, in moist, shaded forest; occurring from near sea level to around 900 m.

DISTRIBUTION. An Indo-Pacific species.

No local collections examined, apart from the type of *Calymperes scalare* Besch.

Calymperes robinsonii B.C. Tan & W.D. Reese in W.D. Reese & B.C. Tan in *Bull. Natl. Sci. Mus., Tokyo, Series B*, **9**: 30 (1983).
Type: Philippines, Palawan Island, Mt Apis, *Ebalo & Conklin* 82803 (PNH-holotype).

Fig. 7.

Shoots acaulescent. Leaves <9–>17 mm long, composed of a short, semi-sheathing, subelliptical hyaline base with a long-linear chlorophyllose limb (stiffly suberect when moist) (Fig. 7a); leaf blade immediately above hyaline base narrowing abruptly into costa, absent distally for a short distance (1–<2 mm) then re-emerging gradually into the chlorophyllose limb (i.e. forming a petiole) (Fig. 7c); apex subacute to obtuse, denticulate. Costa usually ending in apex, smooth; internally mostly with 2–4 layers of guide cells (costa in region of petiole especially thick and with guide cells in several layers) (Fig. 7f). Chlorophyllose lamina sometimes undulate, mostly unistratose, sometimes with small bistratose patches, cells in surface view rounded, irregularly polygonal or

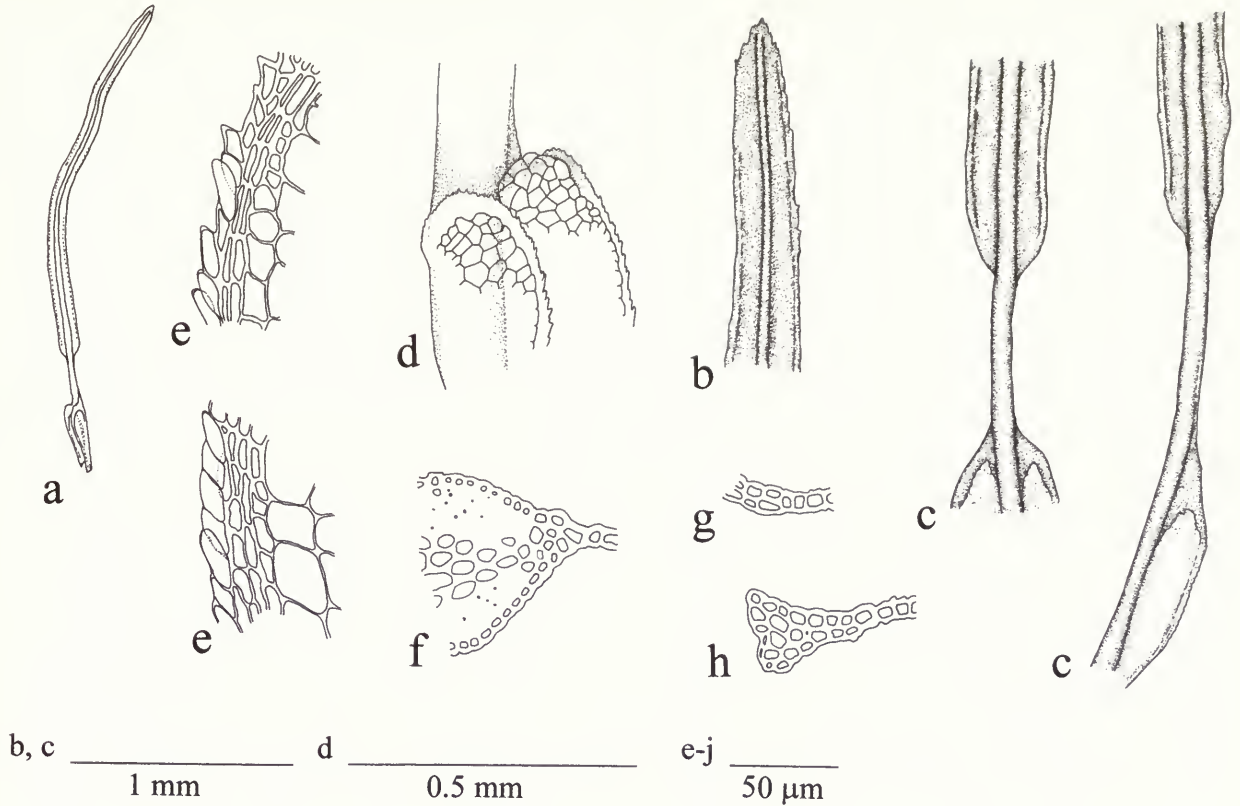


Fig. 7 a–h. *Calymperes robinsonii* B.C. Tan & W.D. Reese a–d: leaf (a: semidiagram and details of b: apex, c: ‘petiolate’ region above hyaline base, d: distal hyaline base; e: cells at margin in leaf base; f–h: cross-sections of leaf (f: costa in distal chlorophyllose limb, g: chlorophyllose lamina, h: marginal rib in chlorophyllose limb). b, c Drawn from *Tan* 89–1426 (BM). d, f, g, h Drawn from *Tan* 93–224 (FH). e Drawn from *Tan* 89–1422 (BM).

quadrate to shortly subrectangular, mostly wider than long, $<5\text{--}10 \times <5\text{--}12.5\ \mu\text{m}$, thick-walled, flat, smooth to obscurely pleuripapillose. Hyaline lamina sharply defined, often bulging ventrally at distal extremity. Leaf margin from insertion to beyond mid-hyaline base similar to that in *C. lonchophyllum* with an intramarginal rib of thick-walled linear cells within a narrow marginal band of thin-walled hyaline cells (Fig. 7e); from distal hyaline base to petiole formed by a narrow band of chlorophyllose lamina, unistratose, denticulate; in petiole entire; from above petiole to near leaf apex consisting of a polystratose rib largely composed of small chlorophyllose cells, in cross-section triangular, lacking a central strand of stereids, distant multicellular teeth arising from angles of rib, (Fig. 7h). Groups of long, filamentous axillary hairs produced in some leaves. Gemmae sometimes produced from the leaf apex.

HABITAT. On shaded tree trunks and occasionally on limestone outcrops.

DISTRIBUTION. A western Malesian species.

SPECIMENS EXAMINED. Luzon, Mt Arayat, 1896, *Loher* 1057 (BM). Palawan, St Paul Bay, St Paul Subterranean National Park, 25 May 1989, *Tan* 89–1422 (BM); *Tan* 1426 (BM); Barangay Puerto Princesa, Sitio Kalabayog, near the Batac Village, ‘23, 25’ April 1993, *Tan* 93–224 (FH).

The abrupt and complete disappearance of the lamina just above the hyaline base and its equally abrupt reappearance shortly above will distinguish leaves of this species from those of any other of the long-leaved species of Calymperaceae occurring in the Philippines. A less extreme constriction of the lamina occurs in the leaves of

Syrhropodon loreus (Sande Lac.) W.D. Reese. However, in this species, the margins of the distal hyaline leaf base are replete with acute, thick-walled teeth (Fig. 21t), and the costa possesses a single layer of guide cells (Fig. 21u). In *C. robinsonii* the hyaline base has an intramarginal rib, with a margin incorporating thin-walled hyaline cells (Fig. 7e); the costa includes 2–4 layers of guide cells (Fig. 7f).

Calymperes aeruginosum also possesses linear leaves with a constricted lamina. This species has short leaves (c. 6 mm long) as compared to those in *C. robinsonii* (mostly 9–17 mm long). In the latter, the cells of the chlorophyllose lamina are flat ventrally, those of *C. aeruginosum* are ventrally protuberant.

Calymperes serratum A. Braun ex Müll. Hal., *Syn. musc. frond.* 1: 527 (1849). Type: Java, *Junghuhn* s.n. (BM!, L!-isotypes). Fig. 8.

Shoots reaching > 2 cm high, in dense green mats or tufts; stems very short, barely apparent. Leaves 10–20 mm long, linear, laxly erect to suberect (moist), with a subelliptical hyaline base; above hyaline base narrowing for a short distance then broadening slightly and gradually towards mid leaf; near apex narrowing to form an acute, dentate tip (Fig. 8a–d). Costa ending in apex to shortly excurrent, smooth; internally with 2(–3) layers of guide cells. Chlorophyllose lamina sometimes transversely undulate, cells transversely to longitudinally elongate, rounded-elliptical or with 4–6 sides, $5\text{--}10\text{--}(12.5) \times 8\text{--}12.5\ \mu\text{m}$, smooth, flat to slightly protuberant (Fig. 8g, h, k). Hyaline lamina poorly defined, distal hyaline cells merging gradually

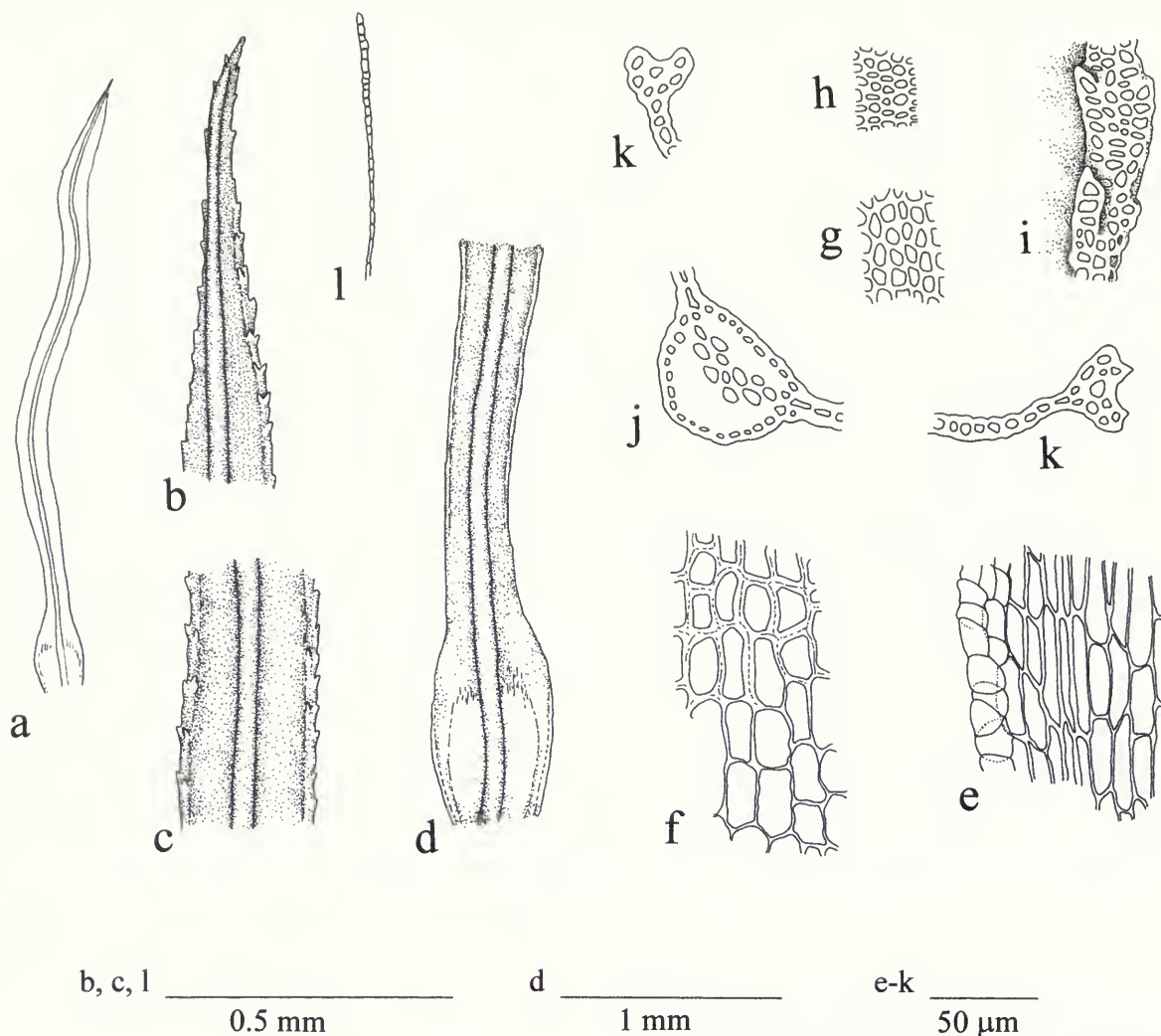


Fig. 8 a–k. *Calymperes serratum* A. Braun ex Müll. Hal. a–d: leaf (a: semidiagram (ventral view), and details of b: apex, c: mid-leaf, d: lower leaf); e–i: cells of leaf in surface view (e: at margin of distal hyaline base, f: around apex of hyaline base, g: in proximal chlorophyllose lamina, h: in distal chlorophyllose lamina, i: at margin of chlorophyllose limb); j, k: cross-sections of leaf (j: costa, k: chlorophyllose lamina and marginal rib); l: axillary hair. b–i Drawn from *Herklots* P14 (BM). j–l Drawn from *Elmer* 10387 (BM).

into chlorophyllose lamina above (Fig. 8f). Leaf margin a short distance beyond hyaline base formed by a polystratose rib, internally sometimes incorporating a strand of stereids, superficial cells in surface view similar to those of lamina, many forming multicellular, often distant, paired teeth (Fig. 8i, k); from proximal limit of marginal rib to below apex of hyaline lamina composed of chlorophyllose lamina, unistratose, entire to serrulate; from above mid-hyaline lamina to leaf base sometimes with a weak intramarginal band of linear thick-walled cells in about 3–4 rows, marginal lamina uneven to notched, consisting of 3–4 rows of subquadrate to shortly rectangular, thin-walled hyaline cells (Fig. 8e). Groups of long axillary hairs occur frequently, median and distal cells of hairs seldom more than twice as long as broad (Fig. 8l). Gemmae produced from dorsal and ventral sides of the costa at and near the leaf apex; gemmae sometimes branched, sparsely papillose.

HABITAT. On tree trunks, mostly in lowland forest, but reaching over 1000 m.

DISTRIBUTION. A palaeotropical species. In addition to localities

in the Philippines cited below, also known from Mindanao.

SPECIMENS EXAMINED. **Luzon**, Cordillera, *Semper* s.n. (BM); Mt Makiling: 16 August 1931, *Herklots* P14 (BM, BM-K); 21 March 1982, *Tan & Aguila* 82–03 (BM); 6–9 December 1912, *Robinson* 17121 (BM-K). **Negros**, Oriental Province: mountains in southern part of province, 1 May 1958, *Brown* 2859 (BM, BM-K); Cuernos Mountains, Dumaguete, June 1908, *Elmer* 10387 (BM, BM-K).

The following combination of features should separate *Calymperes serratum* from other long-leaved species in the family, such as *Calymperes lonchophyllum*, *C. robinsonii*, *Syrrhopodon aristifolius* Mitt. and *S. loreus* (Sande Lac.) W.D. Reese: a) leaves curled when dry; b) hyaline lamina (in all leaves) poorly defined (i.e. with the cells of the hyaline lamina gradually merging into those of the chlorophyllose lamina); c) leaves with toothed, polystratose margins above the hyaline base; d) chlorophyllose lamina unistratose throughout; e) costa with 2(–3) layers of guide cells.

The distinguishing features separating *C. serratum* from *C. lonchophyllum* are discussed in the account of the latter.

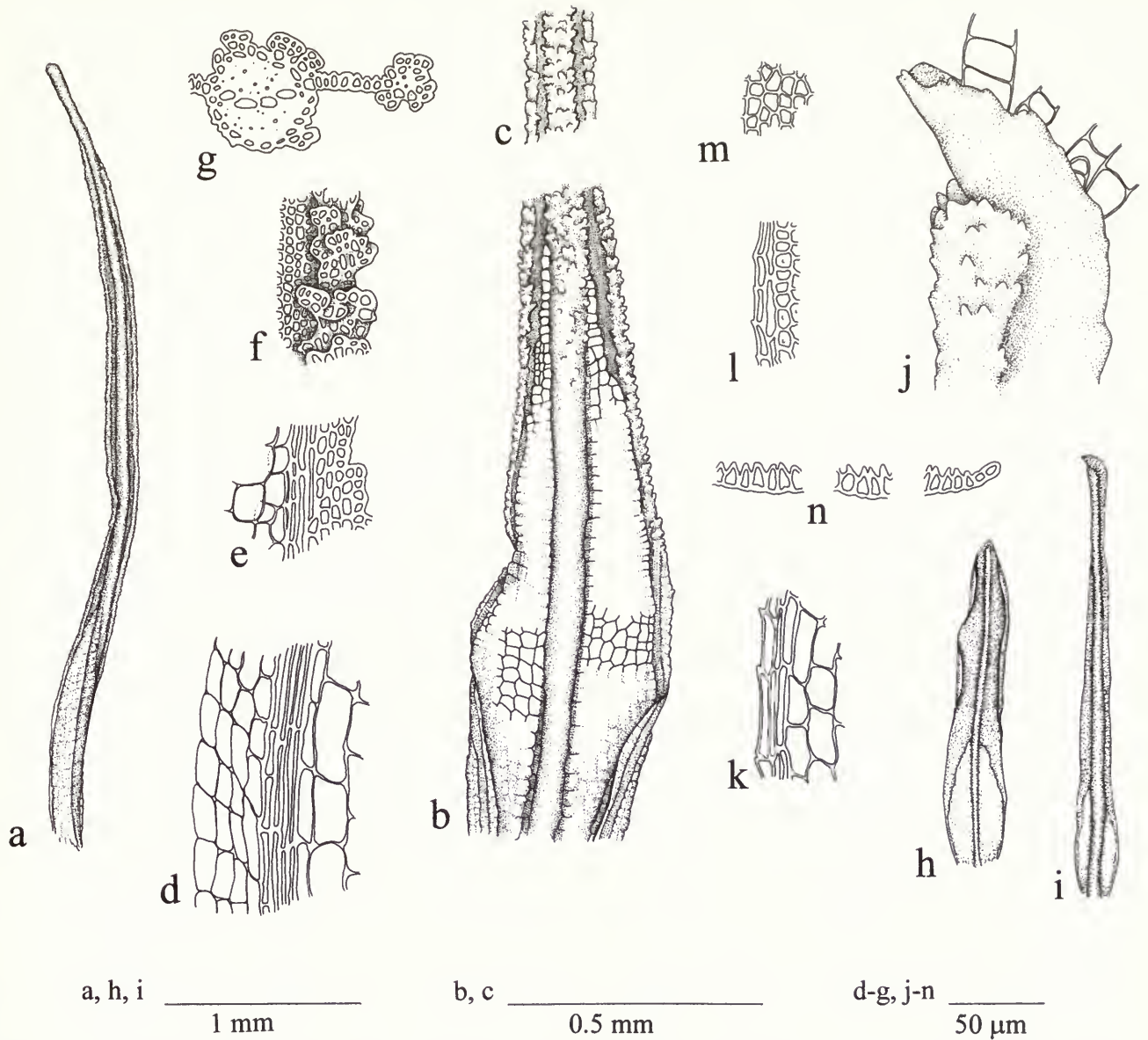


Fig. 9 a–g. *Calymperes strictifolium* (Mitt.) G. Roth a–c: leaf (a: in dorsal view, with details of b: distal region of hyaline base, c: chlorophyllose limb (dorsal view)); d–f: cells of leaf in surface view (d: at margin near leaf base, e: at margin above mid-hyaline base, f: at margin in chlorophyllose limb); g: cross-section of chlorophyllose limb. h–n *Calymperes subintegrum* Broth. h–j: leaves (h: nongemmiferous leaf in ventral view, i: gemmiferous leaf in dorsal view, with detail of j: gemmiferous apex in dorsi-lateral view); k–m: cells of leaf in surface view (k: at margin in hyaline base, l: at margin in proximal chlorophyllose limb, m: in chlorophyllose lamina); n: cross-section of chlorophyllose lamina and margin. a–g Drawn from New Guinea, Eddy 6527 (BM). h–n Drawn from Alvarez Jr 0-781138 (BM).

Calymperes strictifolium (Mitt.) G. Roth in *Hedwigia* 51: 127 (1911).

Fig. 9a–g.

Syrrhopodon strictifolius Mitt. in Seem., *Fl. vit.*: 388 (1873). Type: Samoa, Tutuila, Powell s.n. (BM!-isotype).

Syrrhopodon tuberculatus Thér. & Dixon in Dixon in *J. Linn. Soc. Bot.* 43: 303 (1916). Type: Borneo, Sekong, 22 April 1913, C.H. Binstead 84 (BM!-holotype).

Calymperes tuberculatum (Thér. & Dixon) Broth., *Nat. Pflanzenfam.* 2nd ed., 10: 240 (1924).

Shoots reaching 1.5–<2 cm high, in dark green mats. Leaves up to 5 mm long, obscurely dimorphic, linear-lanceolate, erect to erecto-

patent (Fig. 9a). Costa usually ending immediately below leaf apex, above hyaline base often occupying over a third of the width of the leaf; from distal region of the hyaline base to leaf tip covered (ventrally and dorsally) in irregular, knob-like, multicellular nodules arranged in closely set transverse rows. Blades of lamina gradually narrowing towards leaf apex; at leaf apex forming an extremely narrow band around the costal tip (often eroded away); cells of chlorophyllose lamina isodiametric to about twice as long as broad, with 4–6 sides or rounded, 5–10(–12.5) × 5–7.5 µm; ventrally bluntly to acutely protuberant, sometimes crowned with papillae, dorsally flat or slightly convex. Hyaline lamina sharply defined. Leaf margin from around distal region of hyaline base to near leaf apex consisting of a thick polystratose rib with similar ornamenta-

tion to that of the costa, sometimes incorporating stereids (Fig. 9f, g); in hyaline base similar to that in *C. afzelii*, i.e. entire; possessing a narrow, unistratose intramarginal band of linear, thick-walled cells (continuous with marginal rib in distal leaf), marginal lamina composed of hyaline, thin-walled, shortly subrectangular cells arranged in about 2–5 rows (Fig. 9d). Some leaves producing gemmae from the ventral surface of the costal apex; narrow band of chlorophyllose lamina at the leaf apex tending to be pushed backwards as the gemmae develop forming a minute concave collar around the costal tip.

HABITAT. On trunks and buttresses of trees, sometimes on logs or rocks; in damp, shady lowland rainforest.

DISTRIBUTION. An Indo-Pacific species. In the Philippines reported from Batan, Luzon and Mindanao (see Tan & Iwatsuki, 1991).

SPECIMEN EXAMINED. 'Philippine Islands', *Cuming* 2214b (BM, BM-K).

Within the Calymperaceae, multicellular nodules (Fig. 9f) are unique to the leaves of *Calymperes strictifolium*.

Calymperes subintegrum Broth. in J. Schmidt in *Bot. Tidsskr.* **24**: 119 (1901). Type: Thailand, Koh Chang, near Klong Majum, [6 January 1900], *Schmidt* [14] (H!-holotype; BM!-isotype). Fig. 9h–n.

Shoots reaching 1 cm high, forming yellowish green tufts. Leaves strongly dimorphic: nongemiferous leaves lingulate to lanceolate, upper lamina plane to involute, apex roundly subacute, 2–3(–4) mm long (Fig. 9h). Costa ending just below leaf apex; above hyaline base rough with simple, acute projections (more so on the ventral surface). Cells of chlorophyllose lamina isodiametric to slightly longer than broad with 4–6 sides, 7.5–15(–20) × 5–10(–12.5) μm (Fig. 9m), drawn out ventrally as acute, often unipapillose protuberances, dorsally smooth (Fig. 9n). Hyaline lamina sharply defined. Leaf margin above hyaline base consisting of a row of small, thick-walled, shortly rectangular cells, some projecting distally to form small teeth (Fig. 9l); in hyaline base with a narrow, unistratose (rarely bistratose), intramarginal band of linear, thick-walled cells, 1–3 cells wide (sometimes poorly developed or absent), marginal lamina composed of a single row of shortly rectangular hyaline, thin-walled cells, some projecting distally to form notches or small teeth (Fig. 9k). Gemmiferous leaves erect, linear, 3–5(–8) mm long (Fig. 9i), costa incrassate, a little less than twice the thickness of that in nongemiferous leaves. Blades of lamina from shortly beyond the hyaline base to the leaf apex narrower than costa, meeting above the costal tip to form a narrow, uneven to denticulate 'collar' (Fig. 9j). Gemmae produced from the ventral surface of the costal apex.

HABITAT. On decaying wood and boulders in moist, shady forest.

DISTRIBUTION. An Indo-Pacific species. Within the Philippines, in addition to the specimen from Luzon, cited below, this species has also been recorded from Palawan by Tan (1996).

SPECIMEN EXAMINED. **Luzon**, Quezon National Park, Atimonan, 16 September 1978, *Alvarez Jr* 0–781138 (BM) (new record).

The binomial, *Calymperes subintegrum*, was placed in synonymy with *Calymperes schmidtii* Broth. by Reese & Mohamed (1985). Ellis (1991) demonstrated that the holotype of the latter (Thailand, *Schmidt* 14, H) possesses features that are not shared with the type specimen of *C. subintegrum*, or those of any of its other proposed synonyms. The features of *C. schmidtii* are very similar to those of

Calymperes tenerum Müll. Hal. *Calymperes subintegrum* is the earliest name for the species described above.

Calymperes subintegrum is easily distinguished from other species with strongly dimorphic leaves occurring in the region. For example, *Calymperes porrectum* usually has recurved nongemiferous leaves with a strongly developed intramarginal rib and large multicellular teeth along the margin. In *C. subintegrum* the leaves are not recurved, and the leaf margins above the hyaline base are weakly differentiated and possess small irregularly occurring, unicellular teeth. *Chameleion peguense* (Besch.) L.T. Ellis & A. Eddy possesses leaves in which the cells of the hyaline lamina have transverse bands of thickening, and the gemmiferous leaves possess a broad, cowl-like apex (Fig. 11c). In contrast, *C. subintegrum* possesses leaves in which the cells of the hyaline lamina lack bands of transverse thickening, the gemmiferous leaves have a narrow, blunt apex, and the lamina forming the leaf apex is often obscure (Fig. 9i, j).

Calymperes subserratum M. Fleisch., *Musc. Fl. Buitenzorg* **1**: 245 (1904). Type: Java, Tjamea, 300 m, *Fleischer* s.n. (FH!-holotype). Fig. 10a–d.

Calymperes clemensiae Broth. in *Philipp. J. Sci. C. Bot.* **8**: 69 (1913). Type: Philippines, Mindanao, Camp Keithley, Lake Lamao, June 1907, *Clemens* 'T' (FH!-isotype).

Shoots <8 mm high, somewhat flattened into one plane, almost fan-like, forming mats. Stems very short, densely leaved, and often dense with rhizoids below. Leaves up to 5 mm long, not dimorphic, broadly linear, suberect to recurved, upper lamina often incurved to involute; leaf apex acute or apiculate, entire to denticulate (Fig. 10a). Costa ending immediately below, or in apex; superficial cells above hyaline base bluntly to subacutely protuberant (protuberances often more strongly pronounced towards leaf apex); internally with a single row of guide cells. Cells of chlorophyllose lamina thick-walled, mostly isodiametric, with 4–6 sides or rounded, <5–10(–12.5) × <5–7.5 μm (Fig. 10b); dorsally subacutely to bluntly protuberant; ventrally flat to convex, smooth to unipapillose (Fig. 10d). Hyaline lamina poorly defined, hyaline cells gradually merging with chlorophyllose lamina. Leaf margin unistratose; in chlorophyllose lamina often erect to incurved, entire to subdenticulate (sometimes denticulate towards the leaf apex); in hyaline lamina unistratose, entire. Long, filamentous, uniseriate, hyaline paraphyses produced in axils of some leaves.

HABITAT. On tree trunks, recorded at 300 m and 520 m (Reese & Streimann, 1994).

DISTRIBUTION. Java, New Britain and Mindanao.

No other local specimens examined.

This species, maintained as distinct by Reese *et al.* (1986), was placed in synonymy with *Calymperes serratum* A. Braun ex Müll. Hal. by Eddy (1990) and Menzel & Schultze-Motel (1990). However, Reese, Koponen & Norris (1986) and Reese & Streimann (1994) demonstrated that *Calymperes subserratum* is indeed a distinct species. Its short leaves (up to 5 mm long), with unistratose margins (Fig. 10d) are easily distinguished from those of *C. serratum*, which are mostly 10–20 mm long, with polystratose marginal ribs above the leaf base.

Calymperes taitense (Sull.) Mitt. in *J. Linn. Soc. Bot.* **10**: 172 (1868). Fig. 10e–l.

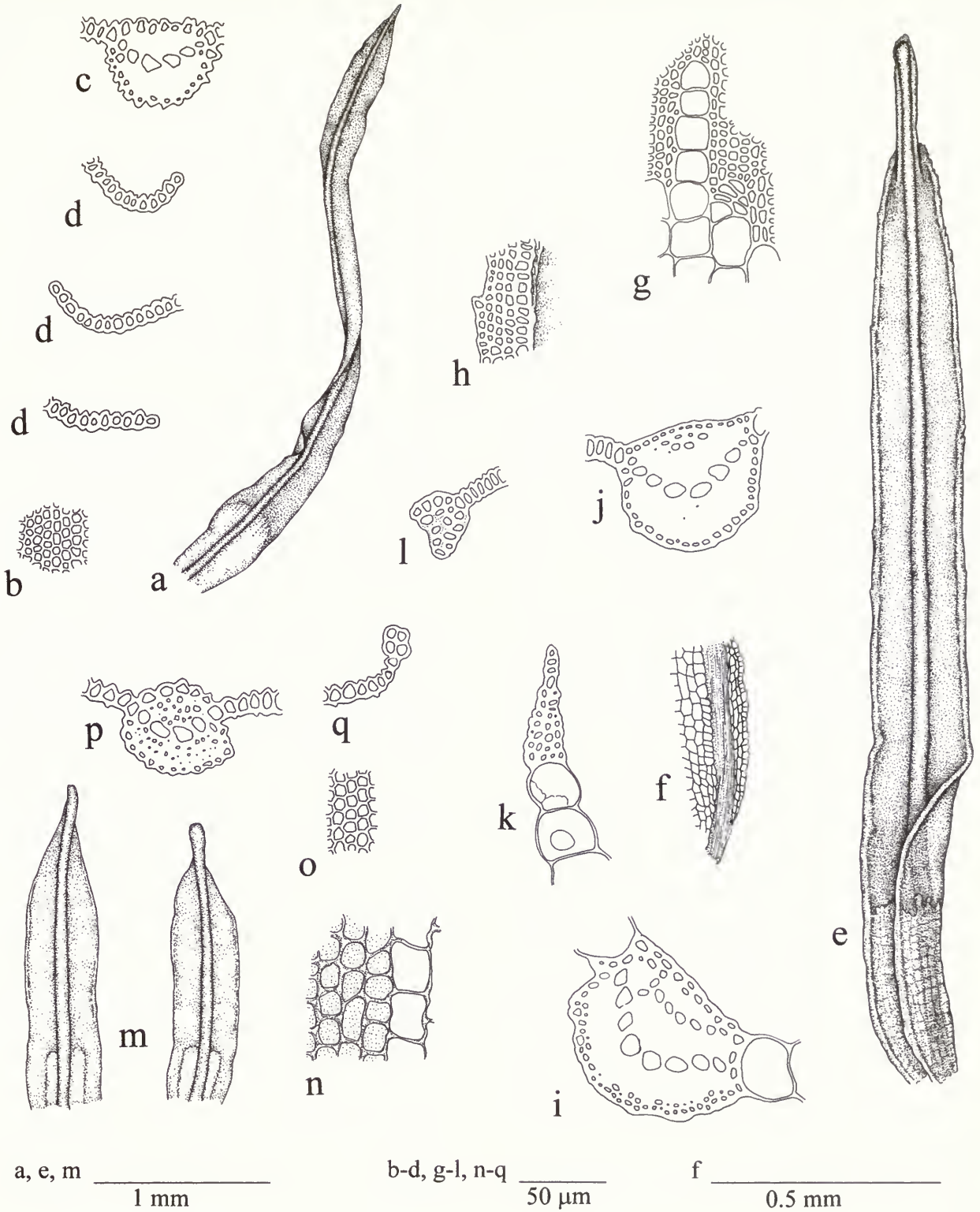


Fig. 10 a–d. *Calymperes subserratum* M. Fleisch. a: leaf; b: cells of chlorophyllose lamina (dorsal surface); c, d: cross-sections of leaf (a: costa, b: chlorophyllose lamina and margin). e–l. *Calymperes taitense* (Sull.) Mitt. e, f: leaf (e: in ventral view, f: detail of margin in proximal hyaline lamina); g–h: cells of leaf in surface view (g: around apex of hyaline lamina, h: at margin of chlorophyllose limb (ventral view)); i–l: cross-sections of leaf (i: costa in mid-hyaline base and j: in chlorophyllose limb, k: margin in hyaline base and l: in chlorophyllose limb). m–q. *Calymperes tenerum* Müll. Hal. m: leaves; n, o: cells of leaf in surface view (n: near margin in hyaline base, o: in chlorophyllose lamina); p, q: cross-sections of leaf (p: costa, q: chlorophyllose lamina and marginal rib). a–d Drawn from Java, *Fleischer* s.n. (FH). e–l Drawn from *Tan* 91–268 (BM). m–q Drawn from *Tan* 92–354 (FH).

Syrrhopodon taitense Sull., *U. S. Exploring Expedition*. Musci: 6 (1860 [1859]). Type: Society Islands, Tahiti, 1838–1842, *Wilkes Expedition* s.n. (BM!-isotypes).

Calymperes orientale Mitt. ex Besch. in *Ann. Sci. Nat. Bot.* sér. 8, 1: 272, 296 (1895). Type: Borneo, Labuan, *Motley* s.n. (BM?, NY? – not found)

Calymperes orientale var. *polytrichoides* M. Fleisch., *Musc. Fl. Buitenzorg* 1: 249 (1904). Type: Salak, bei Succamandri, 500 m, *Fleischer* s.n. (L [?] – holotype, fide Reese & Mohamed, 1985).

Shoots reaching 2–>6 cm high, dull green, forming tufts. Leaves mostly 6–7.5(–9) mm long, not dimorphic, a suberect, broadly subelliptical hyaline base with an erect to spreading (moist), linear-lingulate chlorophyllose limb ending in a linear proboscis (Fig. 10e). Costa extending into proboscis, ending immediately below apex, smooth; internally with two rows of guide cells (Fig. 10j). Chlorophyllose lamina abruptly narrowing into proboscis and becoming narrowly recurved, distally becoming plane to form a blunt, dentate leaf apex (sometimes eroded away); cells mostly isodiametric, sometimes wider than long, with 4–6 sides or rounded, 5–12 × 5–7.5 µm (Fig. 10g), ventrally roundly to subacutely protuberant, dorsally smooth (Fig. 10l). Hyaline lamina sharply defined. Leaf margin from above hyaline base to near base of proboscis consisting of a thick polystratose rib (internally lacking stereids) with regular, often paired, multicellular teeth; in surface view cells isodiametric, subquadrate to irregularly rounded (Fig. 10h, i); from proximal limit of marginal rib to leaf base with a narrow unistratose to polystratose intramarginal band of linear, thick-walled cells (continuous with marginal rib of upper leaf); marginal lamina shortly below apex of hyaline lamina unistratose, denticulate, consisting of small, thick-walled, chlorophyllose cells in about 8–14 rows; in mid to proximal hyaline base entire, unistratose, consisting of 2–5 rows of subquadrate to shortly subrectangular hyaline cells (Fig. 10f). Gemmae produced from the ventral surface of the costal tip.

HABITAT. On trunks and exposed roots of trees and on rock; common in damp, shaded situations in lowland forest.

DISTRIBUTION. A palaeotropical species reaching the Pacific island groups. Widespread in the Philippines.

SPECIMENS EXAMINED. **Leyte Island**, Baybay, Mt Pangasugan, near VISCA campus, 21–22 May 1984, *Tan, Navarez & Raras* 84–216 (BM). **Luzon**, Laguna, Mt Banahao, 5–7 March 1910, *Robinson* 9805 (BM); Oriental Mindoro, Sumagit Town, Bo. Magod, vicinity of Mt Wood along River Sapadao, 11–13 July 1983, *Tan* 83–123 (FH). **Mindanao**, Seno de Davao, 15 May 1890, *Micholitz* 5 (BM, BM-K). **Palawan**, western border of St Paul Subterranean National Park, 26 May 1989, *Tan* 89–1507 (BM); Puerto Princesa, Sitio Kalabayog, near Batac Village, 23–25 April 1993, *Tan* 93–220 (FH); Barangay San Rafael, trail to Batac Village, 1 May 1991, *Tan* 91–268 (BM); Barangay Apurawan, Sitio Daan, vicinity of Mt Tinik-basan, 27 April 1992, *Tan* 92–239 (BM); *Tan* 92–243 (BM); Aborlan, Sitio Daan, Barangay Apurawan, 27 April 1992, *Tan* 92–268 (FH). **Panay Island**, Capiz province, Libacao, May–June 1919, *Martelino & Edano* 35781 (BM). **Polillo Island**, August 1909, *Robinson* 9281 (BM).

All well-developed leaves in specimens of *Calymperes taitense* possess a linear, apical proboscis (formed by the costa with narrow, recurved wings of chlorophyllose lamina). Other species of *Calymperes* and *Syrrhopodon* in the Philippines either possess dimorphic leaves (in which only some produce a special, gemma-bearing apex), or leaves without apical modification of this kind.

Calymperes tenerum Müll. Hal. in *Linnaea* 37: 174 (1872). Type: India, Bengal, Calcutta, *Kurz* s.n. (BM!-isotype). Fig. 10m–q.

Shoots reaching 1 cm high, forming green mats. Leaves often homomallously curled when dry, up to 3 mm long, hardly dimorphic, obovate to lingulate with distal chlorophyllose lamina sometimes involute, leaf apex broadly acute (Fig. 10m). Costa usually excurrent, sometimes ending in apex, in distal leaf superficial cells often forming rounded to acute projections. Cells of chlorophyllose lamina mostly 7–12.5 × 7–10(–12.5) µm, isodiametric with 4 to 6 sides or rounded (Fig. 10o), ventrally drawn out as acute projections, dorsally flat or unipapillose (Fig. 10q). Hyaline lamina usually sharply defined, enclosed on either side by broad, unistratose, marginal bands of small quadrate to shortly rectangular cells with differentially thickened walls and/or angles (Fig. 10n). Leaf margins entire, beyond hyaline lamina sometimes unistratose but usually formed by a narrow polystratose rib of small isodiametric chlorophyllose cells, lacking stereids (Fig. 10q). Gemmiferous leaves with excurrent costa; gemmae produced from all around the costal tip.

HABITAT. On living and fallen trees and exposed tree roots, sometimes on rock; occurring in lowland areas.

DISTRIBUTION. A pantropical species. Widespread in the Philippines.

SPECIMENS EXAMINED. **Lubacan Island**, October 1906, *Elmer* 5279 (BM). **Luzon**, Laguna, UPLB campus, 20 July 1985, *Tan* s.n. (FH). **Palawan**, Barangay Apurawan, Sitio Daan, vicinity of Mt Tinikbasan, 27 April 1992, *Tan* 92–258 (FH); El Nido, 5 January 1992, *Tan* 92–354 (FH); Port Barton, 1992, *Tan* 92–315 (FH). Iwahig, Balsahan, 23 April 1993, *Tan* 93–188 pro parte (FH). **Culion Island**, Culion, Sister Convent Garden, 8 May 1992, *Tan* 92–347 (BM). **Ursula Island**, Barangay Rio Tuba, 29 April 1993, *Tan* 93–257 (FH).

The hyaline base in the leaves of *Calymperes tenerum* and *C. motleyi* are almost identical. For a comparison of these species see under description of the latter.

Chameleion L.T. Ellis & A. Eddy in A. Eddy, *Handbook of Malesian Mosses* 2: 250 (1990). Type species: *Chameleion cryptocarpos* (Dozy & Molke.) L.T. Ellis & A. Eddy.

Syrrhopodon section *Heliconema* Mitt. in *J. Linn. Soc. Bot.* 12: 112 (1869).

Heliconema (Mitt.) L.T. Ellis & A. Eddy in L.T. Ellis in *J. Bryol.* 15: 728 (1989), *hom. illeg.*

Shoots erect, simple or branched, often matted with rhizoids, forming mats or tufts. Leaves sometimes dimorphic (gemmaiferous and nongemmaiferous leaves), mostly lingulate, ligulate to oblong-lanceolate, consisting of hyaline, or partly hyaline base that usually narrows slightly into a chlorophyllose limb, apices truncate or rounded to broadly subacute, sometimes apiculate. Costa ending below apex, sometimes with short lamellae on ventral surface. Cells of chlorophyllose lamina small, mostly isodiametric, usually ventrally protuberant, smooth or papillose. Cells of hyaline lamina large, empty, smooth, porose, walls often with transverse bands of thickening; border between hyaline and chlorophyllose lamina often poorly defined. Marginal and/or intramarginal ribs frequently present, marginal ribs in chlorophyllose limb sometimes with short lamellae. Gemmae produced, often in radial groups, sometimes from the apices of modified leaves. Perichaetia terminal. Seta very short. Capsule urn-shaped, immersed among the upper leaves of the shoot. Peristome syrrhopodontoid or absent.

The name, *Chameleion*, was proposed by Ellis & Eddy in Eddy (1990) who also presented a short history of this segregate genus. As

a genus, the group resembles many small species of *Calymperes* in features of the gametophyte and *Syrrhopodon* in details of the sporophyte.

There are three species recognized in this small tropical genus, only one of which, *Chameleion peguense*, has been recorded in the Philippines. This species is probably now extinct here as it has not been refound since its original collection from Mt Lumutan, Rizal Province in 1917. The mountain vegetation has subsequently become largely secondary forest, and grassland of *Imperata cylindrica* (L.) Rausch.

The status of the genus *Chameleion* requires further research. The species included within the genus (*C. cryptocarpus* (Dozy & Molk) L.T. Ellis & A. Eddy, *C. peguense* and *C. xanthophyllus* (Mitt.) L.T. Ellis & A. Eddy) are united by the possession of capsules on very short setae that remain immersed among the leaves of the gametophyte. *Chameleion xanthophyllus* and *C. cryptocarpus* occur in tropical America and *C. peguense* has an Indo-Malesian distribution.

The leaves in the species of *Chameleion* are similar in form, but those of *C. xanthophyllus* lack some features shared by the leaves of *C. peguense* and *C. cryptocarpus*. For example, leaves in the latter two species possess hyaline cells in the basal lamina with unevenly thickened walls and series of large, subrectangular, transversely elongate, superficial pores; some cells on the ventral surface of the costa and those of the marginal rib in the chlorophyllose limb form short lamellae (only evident in well-developed specimens of *C. peguense*). These features are absent from the leaves of *C. xanthophyllus*.

Reese (1993) points out similarities between the leaves of *C. xanthophyllus* and *Syrrhopodon rigidus* Hook. & Grev. and some allied species (a group with exserted capsules, well accepted as belonging to the genus *Syrrhopodon*). He suggests that immersed capsules may have arisen more than once within the Calymperaceae and, therefore, undermines one of the principal justifications for recognizing the genus *Chameleion*. Similarities in the leaves of the species of *Chameleion* are said to be superficial. However, which features of these species of *Syrrhopodon* and *Chameleion* reflect their interrelationships requires greater clarification; a detailed cladistic analysis may help to resolve the problem. Presently, *Chameleion* appears to be worthy of retention.

Chameleion peguense (Besch.) L.T. Ellis & A. Eddy in A. Eddy, *Handbook of Malesian Mosses* 2: 250 (1990).
Fig. 11.

Calymperes peguense Besch. in *Ann. Sci. Nat. Bot.* ser. 8, 1: 269, 299 (1895). Type: Burma, Pegu, Yomah, Kurz 2928b (BM!-holotype).

Calymperes ramosii Broth. in *Philipp. J. Sci.* 31: 281 (1926). Type: Philippines, Luzon, Province of Rizal, Mt Lumutan, July 1917, Ramos & Edano 29825 (BM!-isotypes).

Heliconema peguense L.T. Ellis & A. Eddy in *J. Bryol.* 15: 730 (1989), *hom. illeg.*

Syrrhopodon peguense (Besch.) W.D. Reese in *J. Hattori Bot. Lab.* 82: 243 (1997).

Shoots 0.5–1.5 cm high, densely matted with rhizoids below, forming mats or tufts. Leaves strongly dimorphic: nongemmiferous leaves erect to patent (sometimes recurved), mostly 3–4 mm long, narrowly to broadly lingulate, distal lamina often incurved; apex broadly obtuse to rounded or rounded-truncate, entire (Fig. 11a). Costa ending just below apex; on the ventral surface near costal apex sometimes with one or two low lamellae (2–3 cells high); ventral superficial cells above the hyaline base subquadrate to shortly rectangular, smooth to roundly or subacutely protuberant, dorsal

superficial cells similar but mostly longer relative to width and often with a shallow, simple papilla near end walls; internally with a single row of guide cells. Cells of chlorophyllose lamina isodiametric to slightly longer than broad, with 4–6 sides or rounded-elliptical, 5–12.5(–15) × 5–10 µm (Fig. 11f); ventrally roundly protuberant, dorsally flat to slightly convex or unipapillose (Fig. 11h). Hyaline lamina often poorly defined, adjacent to costa sometimes incorporating thick-walled, brownish yellow cells; largely composed of fragile hyaline cells, superficial walls with transverse bands of thickening (areas between thickened bands sometimes becoming pores) (Fig. 11e). Leaf margins above hyaline base entire to irregularly and distantly toothed (teeth blunt), sometimes unistratose but usually incorporating an intramarginal polystratose rib with superficial cells in surface view subquadrate to shortly subrectangular and often with an internal strand of stereids, dorsal surface of rib sometimes with one or two entire or distantly and bluntly toothed lamellae (1–3 cells high), marginal cells similar to laminal cells, forming a unistratose band 2–3 cells wide; in region around distal limit of hyaline lamina unistratose, entire to denticulate; in hyaline base incorporating an intramarginal, unistratose band of long rectangular to linear thick-walled cells (up to about 7 cells wide); marginal cells hyaline, shortly subrectangular, forming a single row (entire below, distally entire to denticulate).

Gemmiferous leaves linear with a funnel-shaped apex, stiffly erect (curved when dry), exserted well above nongemmiferous leaves, c. 5 mm long (Fig. 11b, c). Costa strong (occupying over a third of the leaf width), ending below apex, distally rough with many superficial cells drawn out as acute projections; internally with 1–3 layers of guide cells between dorsal and ventral bands of substereids (Fig. 11f). Chlorophyllose lamina usually involute, at apex forming a lax funnel-shaped collar above the tip of the costa; cells subquadrate to long subrectangular; dorsally and ventrally convex or drawn out as acute projections. Hyaline lamina narrow with cells similar to those in nongemmiferous leaves. Leaf margins above hyaline base similar to those in nongemmiferous leaves but lacking lamellae (some superficial cells of intramarginal polystratose rib acutely drawn out); in hyaline base intramarginal band of linear cells often obscure or absent. Gemmae produced in a radial mass from the ventral surface of the costal apex (within the ‘laminal collar’). Perichaetia terminal. Seta >0.5 mm long. Capsule urn-shaped, >1 mm long. Peristome syrrhopodontoid with 16 papillose teeth.

HABITAT. On trunks, branches and exposed roots of trees; occurring from near sea level to over 600 m.

DISTRIBUTION. Disjunct from India, Indochina and Luzon Island in the Philippines.

No other local material examined.

Plants of this species are similar to those of some small species of *Calymperes* with dimorphic leaves (e.g. *C. boulayi*, *C. subintegrum*), but the leaves possess lamellae on the costa and leaf margins (in well-developed specimens), and the cells of the hyaline lamina have transverse bands of thickening. Sporophytes are very rare.

Mitthyridium H. Rob. in *Phytologia* 32: 432 (1975). Type species: *Mitthyridium fasciculatum* (Hook. & Grev.) H. Rob.

Thyridium Mitt. in *J. Linn. Soc. Bot.* 10: 188 (1869), *hom. illeg.*

Plants forming mats, primary shoots creeping, often with short ascending secondary branches. Leaves when dry variously curled, when moist mostly spreading; consisting of a suberect, often

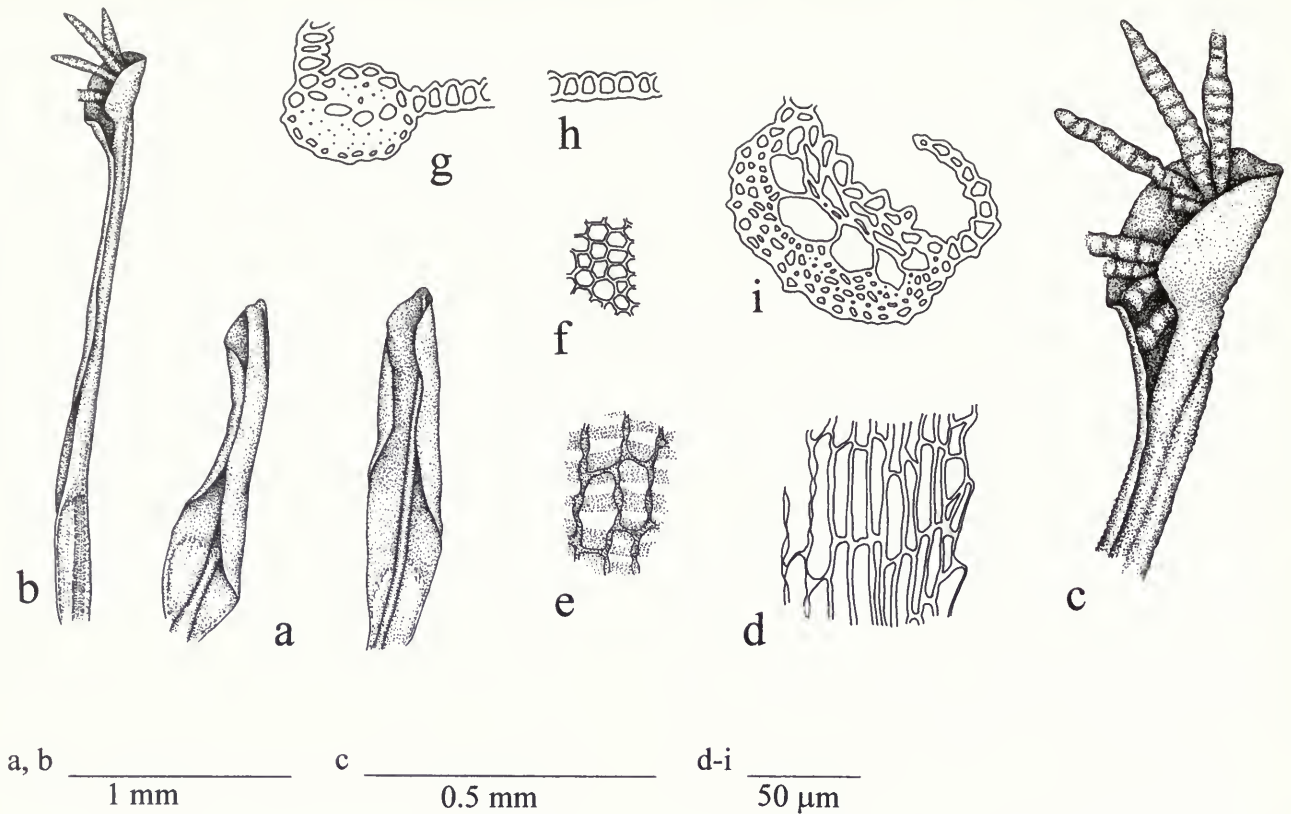


Fig. 11 a–h. *Chameleion peguense* (Besch.) L.T. Ellis & A. Eddy a: nongemmiferous leaves in ventral view; b, c: gemmiferous leaf (b: in lateral view, with c: detail of gemmiferous apex); d–f: cells of leaf in surface view (d: at margin in hyaline base, e: in hyaline lamina, f: in chlorophyllose lamina); g–h: cross-sections of nongemmiferous leaf (g: costa, h: chlorophyllose lamina); i: cross-section of gemmiferous leaf through chlorophyllose limb. a–i Drawn from Ramos & Edano 29825 (BM).

semiclasping hyaline base narrowing (sometimes abruptly) into a lingulate or lanceolate to triangular-lanceolate chlorophyllose limb. Costa ending below apex, usually smooth, sometimes with small, sparse teeth; internally composed of dorsal and ventral bands of stereids with a single, median layer of guide cells, superficial cells sometimes differentiated. Cells of chlorophyllose lamina small, thick-walled, mostly isodiametric, polygonal to rounded or substellate, not usually protuberant, often multipapillose. Hyaline lamina well defined. Leaf margin mostly with a unistratose marginal rib of linear thick-walled cells extending from the base into the upper leaf. Calypteroid gemmae produced near and/or at apices of leaves (apices strongly modified in some species). Sporophytes terminal; seta smooth; capsule exserted, erect, cylindrical. Calyptra rostrate, fugacious. Peristome syrrhopodontoid.

Mitthyridium is a small genus most closely related to *Syrrhopodon*, and is easily recognized by its creeping primary stems and broad leaf borders (in most species the leaf border is unistratose, an exception is the Indonesian species *Mitthyridium retusum* (Besch.) W.D. Reese in which the marginal rib is polystratose). The distribution of *Mitthyridium* is almost exclusively palaeotropical with only a single historical collection of a wide-ranging species recorded from South America (Reese, Mohamed & Mohamed, 1986). *Mitthyridium* occurs exclusively at low altitudes.

The species of *Mitthyridium* are highly variable and consequently have been differently interpreted by various authors. In this treatment, we have accepted a number of infraspecific taxa which reflect the morphological variations observed in specimens from the Philippines.

There are 12–13 species of *Mitthyridium* reported from Malesia. Eight are described below for the Philippine archipelago, of which one, *M. iwatsukianum* B.C. Tan is a local endemic.

Mitthyridium constrictum (Sull.) H. Rob. in *Phytologia* 32: 432 (1975).

Fig. 12a–c.

Calymperes constrictum Sull., *U. S. Exploring Expedition*. Musci: 6 (1860 [‘1859’]). Type: Hawaii [‘Sandwich Island’] *Wilkes Expedition* s.n. (FH-lectotype).

Shoots reaching *c.* 6 cm long, sparsely branched, densely leaved, forming stringy tufts and mats. Leaves sometimes in lax ranks, mostly 2.5–<3.0 mm long, subobovate with upper lamina involute, lower leaf suberect and clasping, upper leaf curled when dry, erect to spreading when moist; apex modified as a loosely tubular to funnel-shaped proboscis (tip mostly truncate) (Fig. 12a). Costa ending below leaf apex; dorsal surface near leaf apex scabrid with spinose teeth, otherwise smooth, composed of stereids/linear cells. Cells of chlorophyllose lamina 10–15(–17.5) × 7.5–>12.5 μm, with very thick walls (abutting cell walls sometimes as broad as lumina), longer than broad to broader than long, irregularly polygonal to substellate, multipapillose below (papillae mostly thick and simple, rarely obscure) (Fig. 12b); towards leaf apex on dorsal leaf surface usually becoming unipapillose (papillae prominent, sometimes branched). Hyaline lamina sharply defined, occupying just less than a third of the leaf length. Leaf margins irregularly notched to

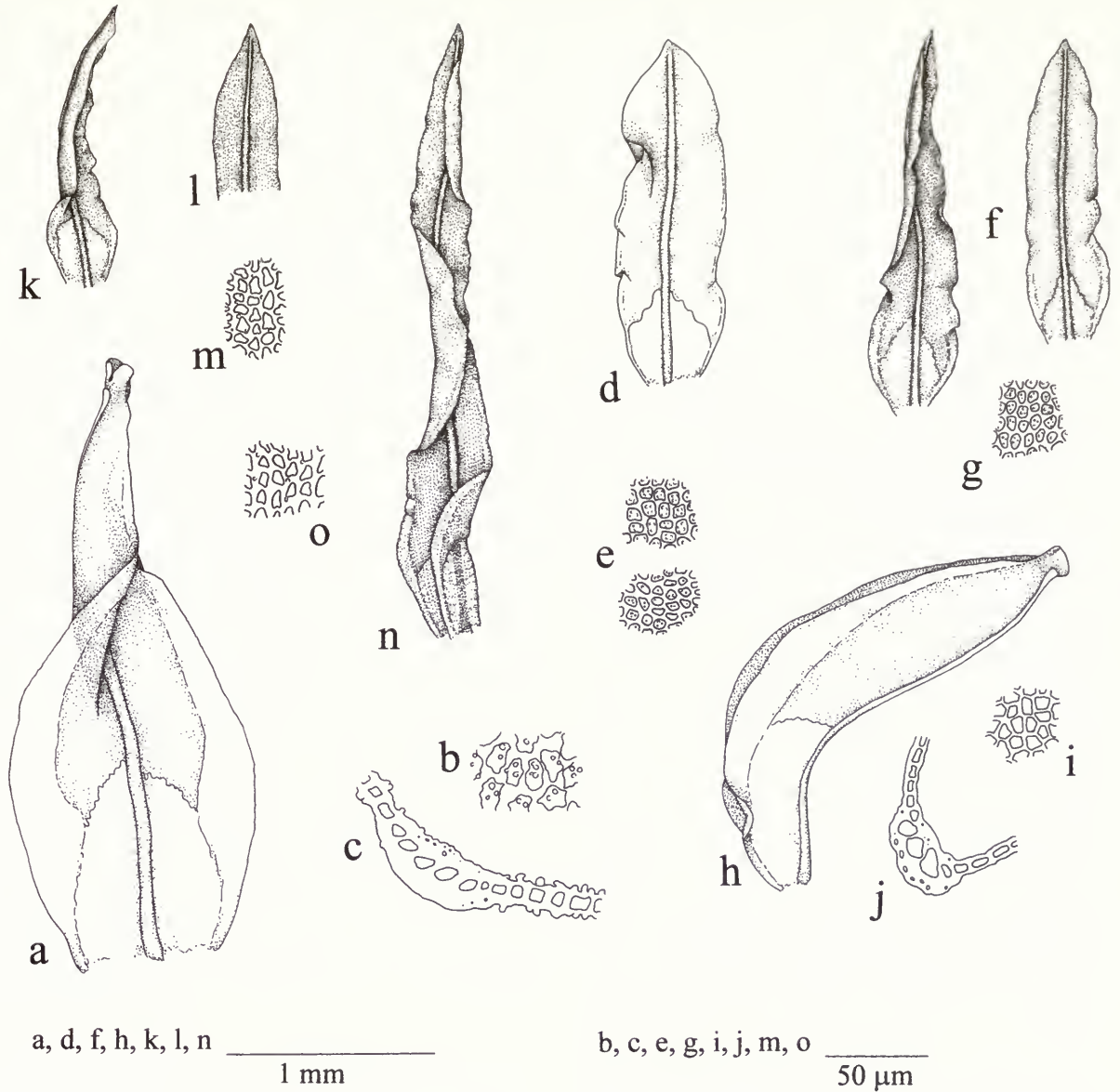


Fig. 12 a–c. *Mitthyridium constrictum* (Sull.) H. Rob. a: leaf; b: cells of chlorophyllose lamina; c: cross-section of costa and chlorophyllose lamina. d, e. *Mitthyridium flavum* (Müll. Hal.) H. Rob. d: leaf; e: cells of chlorophyllose lamina. f, g. *Mitthyridium* cf. *flavum*? f: leaves; g: chlorophyllose lamina. h–j. *Mitthyridium iwatsukianum* B.C. Tan h: leaf in lateral view; i: cells of chlorophyllose lamina; j: cross-section of costa and chlorophyllose lamina. k–m. *Mitthyridium junquilianum* (Mitt.) H. Rob. k: leaf in ventral view, with l: detail of distal chlorophyllose limb; m: cells of chlorophyllose lamina. n, o. *Mitthyridium subluteum* (Müll. Hal.) H. Novak n: leaf in ventral view; o: cells of chlorophyllose lamina. a Drawn from Tahiti, Whittier 2351 (BM). b, c Drawn from Louisades, Micholitz s.n. (BM). d, e Drawn from Tan 87–20 (FH). f, g Drawn from Sabah, Ellis 95–289 (BM). h–j Drawn from Tan & Tandang 82–371 (BM). k–m Drawn from Borneo, Motley s.n. (BM). n, o Drawn from Tan & Hernaez 87–449 (BM).

denticulate from a short distance above leaf base to near apex; marginal rib very broad, 100–250(–400) µm wide at broadest point (adjacent to or slightly above distal hyaline lamina). Gemmae produced from ventral surface of costal apex (enfolded in incurled lamina of proboscis).

HABITAT. On tree trunks and branches in lowland forest.

DISTRIBUTION. An Indo-Pacific species. Uncommon in the Philippines.

SPECIMEN EXAMINED. Luzon, Tayabas, Mt Binaung, May 1917, Ramos &

Edano 28941 (FH) (duplicate in BM is *M. fasciculatum*).

Mitthyridium constrictum is superficially very similar to *M. iwatsukianum* B.C. Tan. In *M. iwatsukianum* the leaves lie in three very neat ranks along the stem and the cells of the chlorophyllose lamina are subquadrate to irregularly polygonal, smooth, with narrow, evenly thickened walls. *M. constrictum* possesses leaves that lie in lax, untidy ranks and the cells of the chlorophyllose lamina are papillose with uneven walls which are often almost as broad as the lamina they define.

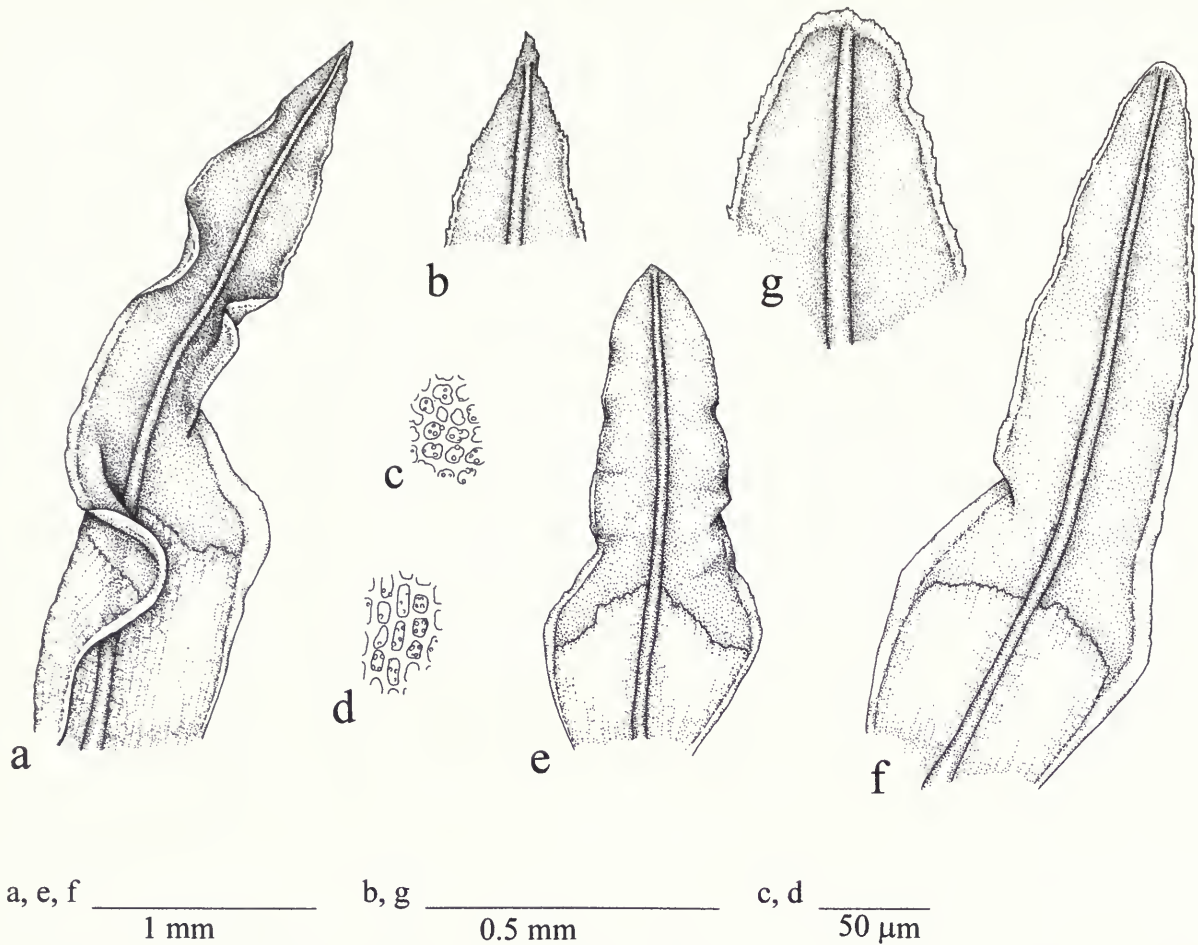


Fig. 13 a–d. *Mithyridium fasciculatum* (Hook. & Grev.) H. Rob. a, b: leaf (a: in ventral view, with b: detail of apex); c, d: cells of leaf in surface view (c: in chlorophyllose lamina, d: in ventral surface of costa). e. *M. fasciculatum* subsp. *cardotii* (M. Fleisch.) B.C. Tan & L.T. Ellis e: leaf. f, g. *M. fasciculatum* subsp. *obtusifolium* (Lindb.) M. Menzel f, g: leaf (f: in ventral view, with g: detail of apex). a–d Drawn from Java, *Eddy* s.n. (BM). e Drawn from Tan, Navarez & Raros 84–218 (FH). f, g Drawn from Tahiti, *Whittier* 2172 (BM).

Mithyridium fasciculatum (Hook. & Grev.) H. Rob. in *Phytologia* 32: 43 (1975).

Mithyridium fasciculatum (Hook. & Grev.) H. Rob. subsp. ***fasciculatum***
Fig. 13a–d.

Syrhropodon fasciculatus Hook. & Grev. in *Edinburgh J. Sci.* 3: 225 (1825). Type: Ternate Island, [C. Smith] s.n. (Hb. Dickson) (BM!-lectotype, fide Menzel & Schultze-Motel (1990)).

Thyridium fasciculatum (Hook. & Grev.) Mitt. in *J. Linn. Soc. Bot.* 10: 189 (1868).

Syrhropodon leucoloma Müll. Hal. in *Bot. Jahresber (Just.)* 5: 86 (1883). Type: New Guinea, September 1875, Naumann s.n. (BM!-isotype).

Syrhropodon codonoblepharoides Müll. Hal. ex M. Fleisch., *Musc. Fl. Buitenzorg* 1: 228 (1904), *nom. nud.* Original material ? : Philippines, *Cuming* 2199 (in Hb. Hampe, BM!).

Mithyridium leucoloma (Müll. Hal.) H. Rob. in *Phytologia* 32: 433 (1975).

Primary shoots reaching >8 cm, occasional ascending branches reaching >3 cm long, forming coarse stringy tufts and mats, densely

leaved. Leaves 3.5–5 mm long, consisting of a subobovate, semisheathing hyaline base narrowing abruptly into a broadly lanceolate to lingulate chlorophyllose limb (curled when dry, spreading when moist); leaf apex subacute to acute (Fig. 13a, b). Costa ending below leaf apex; dorsal surface composed of long rectangular to linear cells (some projecting distally); ventral surface above hyaline base composed of a (sometimes broken) layer of subquadrate to shortly subrectangular multipapillose cells, in hyaline base cells becoming slightly larger, smooth, thin-walled and hyaline. Chlorophyllose lamina strongly undulate; cells in surface view <5–12 × <5–10 µm, isodiametric, subquadrate to irregularly polygonal or appearing to consist of 2–4 rounded lobes, multipapillose (papillae appearing to overlie lumina) (Fig. 13c). Hyaline lamina sharply defined with a broadly-pointed, almost truncate apex. Leaf margins irregularly denticulate (and papillose) from above mid-hyaline base to leaf apex; marginal rib extending from leaf base to near apex, broadest adjacent to distal hyaline lamina (c. 15–>20 cells wide). Gemmae produced from near and at apex of costa.

HABITAT. Generally a lowland species. In the Philippines *Mithyridium fasciculatum* has been collected from tree trunks and logs between 400 m and 800 m.

DISTRIBUTION. A palaeotropical species with doubtful reports from tropical America. Widespread in the Philippines.

SPECIMENS EXAMINED. **Philippines**, *Cuming* s.n. (BM). **Luzon**, Mountain Province: June 1952, *Mack* 1395 (FH); Benguet, Mt Data, 26 March 1938, *Santos* 961 (BM, FH); Quezon Province, Atimonan: Quezon National Park, 9 March 1986, *Tan & Lipaygo* s.n. (FH); Malinao, 26 October 1937, *Santos* 857 (FH); Tayabas: Alabat, Mt Camagong, 22 October 1937, *Santos* 806 (FH); Mt Binuang, May 1917, *Ramos & Edano* 28941 (BM) (duplicate in FH is *M. constrictum*). **Mindanao**, Lanao, Dansalan, 29 September 1938, *Zwickey* 225b (FH). **Mindoro Island**, Lake Naujan, 15 April 1935, *Bartlett* 13561 (FH). **Palawan**, Puerto Princesa, Barangay Irawan, Mt Malinao, 4 May 1993, *Tan* 93–302 (FH); Barangay Napsan, Sitio Tagkuit, Salakot waterfall vicinity, 2 May 1993, *Tan* 93–264 (FH).

Nowak (1980), Eddy (1990), and Reese & Stone (1995) recognized *Mitthyridium leucoloma* as a distinct species. Menzel & Schultze-Motel (1990) placed *M. leucoloma* in synonymy with *M. fasciculatum* while Reese, Koponen & Norris (1986) placed it in synonymy with *M. obtusifolium* (Lindb.) M. Menzel. Reese & Stone (1995) distinguish *M. leucoloma* from *M. fasciculatum*, and other taxa, by the possession of leaves with entire margins (sometimes weakly denticulate) and with the upper lamina more or less involute; there is a 'lack of flaring at the leaf shoulders', and the cells at the apex of the hyaline lamina 'interfinger' with the proximal cells of the chlorophyllose lamina. In *M. fasciculatum* the leaves possess denticulate margins, an upper lamina not notably involute, flaring shoulders, and cells in the apex of the hyaline lamina not notably interfingering with the proximal cells of the chlorophyllose lamina. However, these apparently contrasting features may represent extremes in a range of variation. In the isotype specimen of *M. leucoloma* (Naumann s.n., BM) there are many leaves with well-developed denticulate margins, an upper lamina not notably involute, and with somewhat flaring shoulders. A range of specimens, including the type of *M. leucoloma*, differ to varying degrees from the typical form of *M. fasciculatum* in the features outlined above. Whether these form a group distinct at the level of species remains equivocal.

Nowak (1980) identifies two collections from the Philippines (one from Mindanao, the other unlocalized) as *Mitthyridium leucoloma*.

Mitthyridium fasciculatum* subsp. *cardotii (M. Fleisch.) B.C. Tan & L.T. Ellis, **stat. nov.**
Fig. 13e.

Thyridium cardotii M. Fleisch., *Musc. Fl. Buitenzorg* 1: 228 (1904).
Type: Java, Buitenzorg Botanical Garden, January 1899, *Fleischer* (*Musc. Frond. Archip. Indici* Ser. II, exs. no. 73 (BM!-isotypes)).
Mitthyridium cardotii (M. Fleisch.) H. Rob. in *Phytologia* 32: 432 (1975).

Mitthyridium fasciculatum var. *cardotii* (M. Fleisch.) A. Eddy, *Handbook of Malesian Mosses* 2: 135 (1990).

Differs from the type subspecies in having smaller shoots (<4 cm long), branches (<1 cm long) and leaves (up to c. 2.5 mm long) with obtuse apices (Fig. 13e).

HABITAT. On trunks of trees in lowland forest.

DISTRIBUTION. Largely an Indo-Malesian subspecies, but apparently occurring as far west as the Seychelles. In addition to the localities in the Philippines cited below, this subspecies has also been reported from Leyte and Negros by Iwatsuki & Tan (1980).

SPECIMENS EXAMINED. **Leyte Island**, Baybay, Mt Pangasugan, near VISCA campus, 21–22 May 1984, *Tan, Navarez & Raros* 84–218 (FH). **Luzon**,

Isabela, San Mariano, Barrio Disulap, Sierra Madre range, Dimahahabong Creek, 14 April 1991, *Tan* 91–119 (BM).

Reese, Koponen & Norris (1986) and Menzel & Schultze-Motel (1990) regard subspecies *cardotii* as a mere form of the type subspecies. However, Eddy (1990) proposed subspecies *cardotii* as a formal variety of *Mitthyridium fasciculatum*. The research of G. Jakab (pers. comm.) indicates that subspecies *cardotii* is not confined to Indo-Malesia, but also occurs in the Seychelles, where, hitherto, it has been treated as a distinct species, *Mitthyridium micro-undulatum* (Dixon) H. Rob.

Mitthyridium fasciculatum* subsp. *obtusifolium (Lindb.) M. Menzel in M. Menzel & W. Schultze-Motel in *Willdenowia* 19(2): 502 (1990).

Fig. 13f, g.

Syrrhopodon obtusifolium Lindb. in *Öfvers. Förh. Kongl. Vetensk.-Acad.* 21: 605 (1865) ['1864']. Type: Tahiti, September 1852, *Pontén* s.n. (BM!-lectotype, BM!-isotype (fide Nowak (1980))).

Thyridium obtusifolium (Lindb.) M. Fleisch., *Musc. Fl. Buitenzorg* 1: 228 (1904).

Mitthyridium obtusifolium (Lindb.) H. Rob. in *Phytologia* 32: 434 (1975).

Specimens of subsp. *obtusifolium* differ from those of the type subspecies in the possession of leaves with an obtuse apex (Fig. 13f, g), the rows of laminal cells forming the apical margin smooth and thicker walled than those below; the apex of the hyaline lamina tending to be truncate (rather than broadly acute) and the marginal rib generally broader. A collection from Luzon, *Tan & Lipaygo* s.n. (cited above under subsp. *fasciculatum*), possesses leaves with somewhat obtuse apices that approach halfway the characteristic form found in subsp. *obtusifolium*. In all other features, the leaves of this specimen are identical to those of subsp. *fasciculatum*. Unequivocal evidence for the presence of this subspecies in the Philippines has yet to be discovered.

Mitthyridium flavum (Müll. Hal.) H. Rob. in *Phytologia* 32: 433 (1975).

Fig. 12d–g.

Syrrhopodon flavus Müll. Hal. in *Bot. Zeitung (Berlin)* 13: 763 (1855). Type: Java, s.n. (B?-holotype, presumably destroyed 1943; isotypes not found).

Thyridium flavum (Müll. Hal.) M. Fleisch., *Musc. Fl. Buitenzorg* 1: 232 (1904).

Syrrhopodon luzonensis R.S. Williams in *Bull. New York Bot. Gard.* 8: 338 (1914). Type: Philippines, Luzon, Lamao River, 90 m, March 1904, *Williams* 824 (FH!-isosynotype).

Thyridium luzonensis (R.S. Williams) Broth., *Nat. Pflanzenfam.* 2nd ed., 10: 236 (1924).

Primary shoots prostrate, sometimes dense with rhizoids, <0.5–>2.0 cm long, unbranched to dense with very short ascending branches. Leaves mostly 1.5–>2 mm long, erect to spreading from a semi-sheathing hyaline base, lingulate, usually parallel-sided and abruptly narrowing at the apex to form a shortly pointed tip (Fig. 12d), sometimes gradually narrowing from hyaline base. Costa ending below apex, surface composed largely of stereids, some occasionally projecting at their distal ends to form minute teeth; lateral superficial cells sometimes shortly rectangular (at leaf apex sometimes producing gemmae). Cells of chlorophyllose lamina in surface view 5–10 × 5–12.5 µm, slightly longer than broad to slightly

broader than long, irregularly polygonal or rounded, each with 1–4 simple papillae on the dorsal and ventral surfaces (papillae sometimes obscure) (Fig. 12e). Hyaline lamina sharply defined, often with an acute apex. Leaf margins plane to undulate, with a narrow, unistratose rib of linear cells extending from the leaf base to distal leaf limb, 2–8 cells wide (broadest adjacent to distal hyaline lamina), sinuose to denticulate, rarely entire; margins toward leaf apex formed by cells of chlorophyllose lamina, entire to denticulate.

HABITAT. On shaded tree trunks in forest.

DISTRIBUTION. An Indo-Pacific species. Widespread in the Philippines.

SPECIMENS EXAMINED. **Leyte Island**, Baybay, Mt Pangasugan near VISCAMPAN, 21–22 May 1984, *Tan, Navarez & Raros* 84–217 (FH). **Luzon**, Bataan, Olongapo Naval Reservation, 25 May 1935, *Bartlett* 14114 (FH); Cagayan, hills at Sitio Babayuan, 30 October 1935, *Bartlett* 14926 (FH); *Bartlett* 14931 (FH); Isabela, Palanan Wilderness, 19 May 1992, *Tan* 92–205 (BM); Zambales, Candelaria, Bo. Tapaso, Mt Lanat, 15–16 March 1987, *Tan* 87–20 (FH). **Mindoro Island**, Mt Bulalacao, November 1939, *Ebalo* 231 (FH). **Palawan**, Mt Mantalingahan, between Nalpuan and Sandurapi, 26 April 1991, *Tan* 91–186 (BM); Aborlan, Barangay Apurawan, trail to Sitio Daan, 28 April 1992, *Tan* 92–297 (FH); Taytay, Lake Manguao (Lk Danao), 1 May 1992, *Tan* 92–311 (BM); Puerto Princesa, Barangay Irawan, Mt Malinao, 4 May 1993, *Tan* 93–316 (FH); Puerto Princesa, Sitio Kalabayog, near Batac Village, 23, 25 April 1993, *Tan* 93–221 (FH). **Sibuyan Island**, Magdiwang, Bo Tampayan, Mt Giting-Giting, 21 May 1987, *Tan & Hernaez* 87–455 (FH).

The holotype of *Mitthyridium flavum* was presumably destroyed along with the major part of Müller's herbarium (B) in 1943. Should the apparent absence of isotype material be real the species may require neotypification. Müller (1856), in his review of Dozy and Molkenboer's *Bryologia Javanica*, provides a strong indication of his concept of *M. flavum*. Referring to the illustrations of *Syrhropodon tenellum* Dozy & Molk. he proposes that the latter species is conspecific with his earlier described *Syrhropodon flavus*. These illustrations, and relevant material derived from Dozy and Molkenboer's herbarium (now in Hb. Hampe (BM) and Hb. Schimper (BM-K)), show features that agree with the concept of *M. flavum* as presently understood (Eddy, 1990; Menzel & Schultze-Motel, 1990; Reese, Koponen & Norris, 1986).

Most specimens can be identified as *Mitthyridium flavum* by their short leaves (>2 mm long) with parallel sides. The leaves in *M. repens* (Harv.) H. Rob. also have parallel sides, but are usually much smaller (1–1.5 mm long) and possess rounded-apiculate apices, not evident in the leaves of *M. flavum* (Fig. 14b).

Mitthyridium iwatsukianum B.C. Tan in *Mem. New York Bot. Gard.* **45**: 453 (1987). Type: Philippines, Laguna, Cavinti Town, Bo. Lumot, near Sitio Ubali, 500–800 m, 24 October 1982, *Tan & Tandang* 82–371 (BM!-isotype).

Fig. 12h–j.

Shoots reaching >4 cm long, with sparse branches up to about 1 cm long (shoots and branches with a flattened appearance). Leaves strictly aligned in three ranks, mostly 2.5–3 mm long, subobovate, subrecurved from a clasping base, folded along costa; apex modified as a loosely tubular to funnel-shaped proboscis (Fig. 12h). Costa ending below leaf apex, smooth (dorsal surface of the costal apex lacking spinose teeth). Chlorophyllose lamina smooth; cells small, mostly 5–12.5(–15) × 5–12.5(–15) µm, subquadrate to irregularly polygonal (never substellate), broader than long to longer than broad, with relatively narrow and evenly thickened walls (Fig. 12i). Hyaline lamina sharply defined, occupying just less than one third of the leaf length. Leaf margins irregularly notched to minutely den-

tulate from a short distance above the leaf base to near apex; marginal rib very broad, reaching 300–350 µm wide at its broadest point (near apex of hyaline lamina). Gemmae produced from ventral surface of costal apex (enfolded in incurled lamina of proboscis).

HABITAT. On leaf sheath of *Pinanga* palm in lowland rainforest.

DISTRIBUTION. Philippine endemic.

Known only from the type collection. Eddy (1990) draws attention to the strong similarities between *Mitthyridium iwatsukianum* and *M. constrictum*. However, their differences, most strikingly those of the chlorophyllose lamina (Fig. 12b, i), presently justify the recognition of *Mitthyridium iwatsukianum* as a species. Similar diverse forms of chlorophyllose lamina occur as extremes of a range of variation in *Mitthyridium wallisii*; intermediates between the forms of lamina in *M. iwatsukianum* and *M. constrictum* have yet to be found.

Mitthyridium papuanum (Broth.) H. Rob. in *Phytologia* **32**: 434 (1975).

Fig. 14i–o.

Syrhropodon papuanus Broth. in *Oefvers. Förh. finska Vetensk.-Soc.* **37**: 156 (1895). Type: New Ireland, October 1893, *Micholitz* [94] (BM!-isolectotypes, fide Nowak (1980)).

Thyridium papuanum (Broth.) M. Fleisch., *Musc. Fl. Buitenzorg* **1**: 232 (1904).

Primary shoots reaching >4 cm long, with sparse ascending branches <1–>3 cm long. Leaves 2–4 mm long, broadly lanceolate (gradually tapering from distal hyaline base to an acute apex) to lingulate (with parallel sides from base to near apex, at apex rapidly contracted into a subapiculate to apiculate, sometimes acuminate, point) (Fig. 14i, j); curved when dry, spreading when moist. Costa ending in apex; ventral and dorsal surfaces above midleaf largely formed by stereids, below midleaf formed by rectangular, thick-walled cells; on dorsal surface towards apex occasionally some cells giving rise to a small tooth from their distal ends. Chlorophyllose lamina undulate; cells mostly 5–12.5 × 5–10 µm, quadrate to irregularly polygonal, or rounded, usually with evenly thickened walls, on dorsal and ventral surfaces with 1 or more simple papillae (papillae often obscure) (Fig. 14k). Leaf margin from shortly above leaf base to apex minutely and irregularly denticulate; marginal rib extending from leaf base, broadest adjacent to hyaline lamina, tapering to beyond midleaf (Fig. 14l). Gemmae produced at leaf apex from shortly rectangular, lateral cells of costa.

HABITAT. On tree trunks, mostly in lowland forest.

DISTRIBUTION. A widespread Indo-Pacific species.

SPECIMENS EXAMINED. **Dalupiri Island**, 31 October–5 November 1935, *Bartlett* 15843 (FH). **Luzon**, Mt Makiling, 27 August 1931, *Herklots* P28 (BM, FH); Isabela, Palanan Wilderness, 19 May 1992, *Tan* 91–222 (BM); 20 May 1992, *Tan* 92–213 (FH); Tayabas, Alabat, Mt Camagong, 21 October 1937, *Santos* 810 (FH).

Reese, Koponen & Norris (1986) placed *Mitthyridium papuanum* in synonymy with *M. luteum* (Mitt.) H. Rob. and identified material from the Philippines as that species. Reese (1994) and Reese & Stone (1995) reinstated *M. papuanum* as a distinct species.

The lectotype of *Mitthyridium luteum*, from Fiji (*Milne* 363, BM), is like a form of *M. fasciculatum* with relatively narrow, tapering leaves. The chlorophyllose lamina is composed of strongly papillose cells with incrassate walls. Many of the leaves in the type, and other specimens of *M. papuanum*, are parallel-sided and resemble giant forms of those occurring in *Mitthyridium flavum*. In *M. papuanum*,

the cells of the chlorophyllose lamina are relatively thin-walled and possess low papillae that, even in cross-section, are barely visible. Evidence from material presently available does not justify including *M. papuanum* in synonymy with *M. luteum*, and specimens from the Philippines, previously identified as *M. luteum*, are referable to *M. papuanum*. *Mitthyridium luteum* remains a good species based on Milne 363.

Mitthyridium repens (Harv.) H. Rob. in *Phytologia* **32**: 434 (1975). Fig. 14a–h.

Syrhropodon repens Harv. in Hook., *Icon. Pl.* **1**: t. 22, fig. 4 (1836); Harv. in Harv. & Hook. in *J. Bot. (Hooker)* **2**: 7 (1840). Type: Peninsular Malaysia, Pinang ['Penang'], Wallich [H.1204] (BM-K!-holotype?).

Thyridium repens (Harv.) Mitt. in *J. Linn. Soc. Bot.* **10**: 188 (1868).

Primary shoots prostrate, forming mats, obscured by densely crowded, short, simple or innovating, ascending branches. Ascending branches 1–7 mm high, densely leaved, sometimes densely matted with rhizoids below. Leaves <1–1.5 mm long, consisting of an erect, subrectangular hyaline base (slightly and gradually widening from base to apex) narrowing slightly and gradually into an erect to spreading (moist), lingulate chlorophyllose limb (tightly incurled when dry); leaf apex abruptly narrowing, broadly rounded or broadly rounded and subapiculate to apiculate, entire (Fig. 14a, b). Costa ending below leaf apex; surface near costal apex often composed of subrectangular cells (surface view), surface below apical region composed of stereids. Cells of chlorophyllose lamina in surface view 5–12.5(–15) × 5–12.5 µm, longer than broad to broader than long, irregularly rounded to elliptical or appearing to consist of 2–4 (or more) rounded lobes; on dorsal and ventral surfaces each with several simple papillae (Fig. 14e, d). Hyaline lamina sharply defined with a somewhat truncate apex. Leaf margins plain to undulate (intermittently incurved); from below leaf apex to base consisting of a flattened band of stereids; from below leaf apex to around apex of hyaline lamina gradually broadening to c. 40–65 µm wide, regularly and sharply denticulate (Fig. 14c); below apex of hyaline lamina to leaf base slightly narrowing, entire to uneven. Gemmae produced towards and at leaf apex from ventral surface of costa.

HABITAT. On trunks and buttresses of trees in lowland areas.

DISTRIBUTION. An Indo-Pacific species. Philippine records are all from Luzon.

SPECIMENS EXAMINED. Luzon, Quezon, Real, National Botanic Garden, 4 August 1985, Tan & Wijangco s.n. pro parte (BM); Bataan Province, Mt Mariveles, July 1904, Leiberg 1215 (FH).

Mitthyridium repens has the smallest shoots of any species of *Mitthyridium* occurring in the Philippines. It often forms thin, dense mats resembling those of some diminutive species of *Macromitrium* and *Schlotheimia* in the family Orthotrichaceae.

Mitthyridium subluteum (Müll. Hal.) H. Nowak in *Bryophyt. Biblioth.* **20**: 144 (1980). Type: Samoa, Upolu, Graeffe s.n. (BM!-isolectotype).

Fig. 12n–o.

Codonoblepharum subluteum Müll. Hal. in *J. Mus. Godeffroy* **3**(6): 67 (1874).

Primary shoots prostrate, up to 2 cm long with sparse short branches. Leaves 3–3.5 mm long, lanceolate to linear-lanceolate with undulate margins (mostly 5–7 times longer than broad, slightly broadening from base to around distal extent of the short hyaline lamina, then

tapering to an acute to narrowly acuminate apex) (Fig. 12n). Costa ending immediately below leaf apex; surface largely smooth (a few sparse teeth sometimes evident near leaf apex), above leaf base formed by stereids, in ventral leaf base formed by rectangular cells with mostly thin, porose walls. Chlorophyllose lamina occupying about six sevenths of leaf length, sometimes incurved above; cells 7.5–15 × 7.5–12.5 µm, irregularly polygonal, subelliptical or appearing to consist of 2–4 rounded lobes; with walls unevenly thickened and several simple papillae (sometimes obscure) (Fig. 12o). Leaf margin denticulate from shortly above base to apex; marginal rib extending from base to near apex, often only 1–2 cells wide distally. Gemmae produced at leaf apex and from some dorsilateral cells of the costa for some distance below the leaf apex.

HABITAT. In the Philippines collected from tree trunks up to 1100 m.

DISTRIBUTION. A Malesian species. Previously reported, but with no specimen citation, as occurring in Mindanao (Reese, Mohamed & Mohamed, 1986; Menzel & Schultze-Motel, 1990).

SPECIMEN EXAMINED. Sibuyan Island, Magdiwang, Barangay Tampayan, Mt Giting-Giting, 21 May 1987, Tan & Hernaez 87–449 (BM).

The features of the collection from Sibuyan (Fig. 12n, o), cited above, accord especially well with those of the type of *Mitthyridium subluteum*. The latter has been widely accepted as representing a long-leaved (3–3.5 mm) form of *M. junquilianum* (Mitt.) H. Rob. in which the hyaline lamina often occupies a relatively small proportion (about one seventh) of the leaf length (Eddy, 1990; Menzel & Schultze-Motel, 1990; Reese, Koponen & Norris, 1986). Mohamed & Reese (1992) convincingly argue that *M. junquilianum* and *M. subluteum* are separate species. The present authors have not seen material from the Philippines that can safely be identified as *M. junquilianum*. The leaves of the isotype of *M. junquilianum* (Borneo, Motley s.n., BM) are relatively short (c. 2 mm) with the hyaline lamina often occupying about a quarter of the leaf length (Fig. 12k). Material recently collected in Sabah (e.g. Ellis 89–289, BM, UMS) possesses leaves that are not constant in form; some taper from around the apex of the hyaline base and closely resemble the leaves in the isotype of *M. junquilianum* (BM), whilst others (from the same shoot) are nearly parallel-sided and resemble the leaves of *M. flavum* (Fig. 12f). Consequently, this specimen is difficult to identify with certainty. The relationship between *M. junquilianum* and *M. flavum* requires further investigation.

Mitthyridium wallisii (Müll. Hal.) H. Rob. in *Phytologia* **32**: 435 (1975).

Fig. 15.

Syrhropodon wallisii Müll. Hal. in *Linnaea* **38**: 555 (1874). Type: Philippines, Luzon, Mahahai, 200 ft, 1870, Wallis s.n. (BM!-isotype; FH!-isotype).

Shoots prostrate to ascending, in densely packed mats, with dense, ascending branches, mostly <0.5–1 cm long, densely leaved. Leaves mostly 1.5–2.5 mm long, consisting of a semisheathing hyaline base narrowing into a lingulate to narrowly triangular chlorophyllose limb (spreading when moist, incurled and crisped when dry), apex modified as a loosely tubular to narrowly funnel-shaped proboscis (often apiculate, sometimes emarginate) (Fig. 15a, b). Costa ending below apex (occasionally slightly excurrent as a mucro), surface formed by stereids, smooth (Fig. 15f). Cells of chlorophyllose lamina mostly 5–12.5 × 5–12.5 µm; longer than broad to broader than long, with irregularly polygonal to substellate lumina; thick-walled, smooth or papillose (papillae appearing to overlie cell walls)

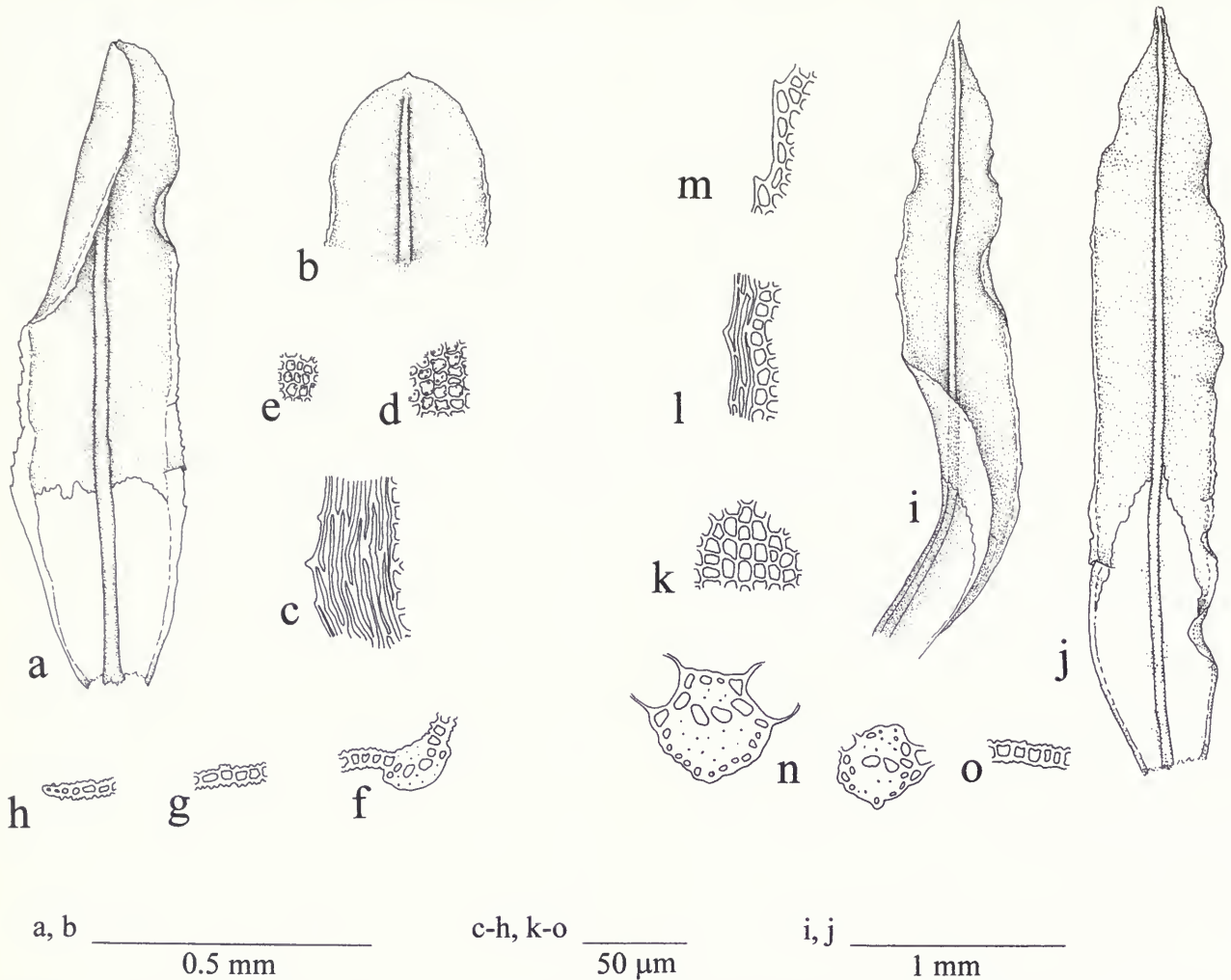


Fig. 14 a–h. *Mitthyridium repens* (Harv.) H. Rob. a, b: leaf (a: in ventral view, with b: detail of apex); c–e: cells of leaf in surface view (c: at margin above apex of hyaline lamina, d: of chlorophyllose lamina above apex of hyaline lamina, e: of distal chlorophyllose lamina); f–h: cross-sections of leaf (f: costa, g: chlorophyllose lamina, h: margin in chlorophyllose limb. i–o. *Mitthyridium papuanum* (Broth.) H. Rob. i, j: leaves (ventral view); k–m: cells of leaf in surface view (k: in chlorophyllose lamina, l: of margin near leaf apex, m: of margin at mid-leaf, n, o: cross-sections of leaf (n: costa, o: chlorophyllose lamina). a–h Drawn from Tan & Wijangco s.n. pro parte (BM). i Drawn from Micholitz 94 (BM). j–o Drawn from Tan 91–222 (BM).

(Fig. 15d, e). Leaf margin in hyaline base mainly entire; from distal hyaline base to near apex minutely and irregularly denticulate, in apical region entire to irregularly crenulate-denticulate; marginal rib extending from base of leaf to beyond midleaf, broadest adjacent to distal extent of hyaline lamina (c. 7–10 cells wide, <50 µm). Gemmae produced from ventral surface of costa at leaf apex (enfolded within incurled lamina of proboscis).

HABITAT. On logs and tree trunks.

DISTRIBUTION. A Malesian species, common in the Philippines.

SPECIMENS EXAMINED. Luzon, Laguna, Cavinti Town, Sitio Calminoe, 25–26 February 1984, Tan & Trenbatt 84–50 (BM, FH); Quezon: Atimonan, 13 December 1980, Cadiz Fe Misa 12 (FH); Real, National Botanic Garden, 4 August 1985, Tan & Wijangco s.n. (FH); Tayabas, 17 September 1935, Pastrana 53 (FH); Guinayangan, February 1929, Doldulao 84421 (FH). Negros Island, Gimagon River, 6 January 1904, Copeland 73 (BM, FH); Dumaguete, November 1935, Chapman 41 (FH); May 1906, Whitford 1572 (BM). Panay Island, Capiz, October–November 1925, Edano 46254 (FH).

Sibuyan Island, Magdiwang, Barangay Tampayan, Mt Giting-Giting, 21 May 1987, Tan & Hernaez 87–442 (BM).

The cells of the chlorophyllose lamina in *Mitthyridium wallisii* vary widely in the thickness of their walls. At one extreme these cells possess relatively broad lumina and walls with unevenly thickened angles and sides (Fig. 15e); at the other extreme the walls appear broader than the lumina (Fig. 15d).

All material of *Mitthyridium wallisii* from the Philippines, examined for this study, is referable to the type variety. *Mitthyridium wallisii* var. *crassum* (Broth.) M. Menzel, with a largely Malesian distribution, possesses leaves reaching c. 4 mm long (approaching twice the length of most leaves seen in the type variety), which entirely lack the funnel-shaped apex present in some leaves in var. *wallisii*.

Syrrophodon Schwägr., *Sp. musc. frond. suppl.* 2: 110 (1824). Type species: *Syrrophodon gardneri* (Hook.) Schwägr.

Plants in tufts or mats, shoots erect, simple or branched, often

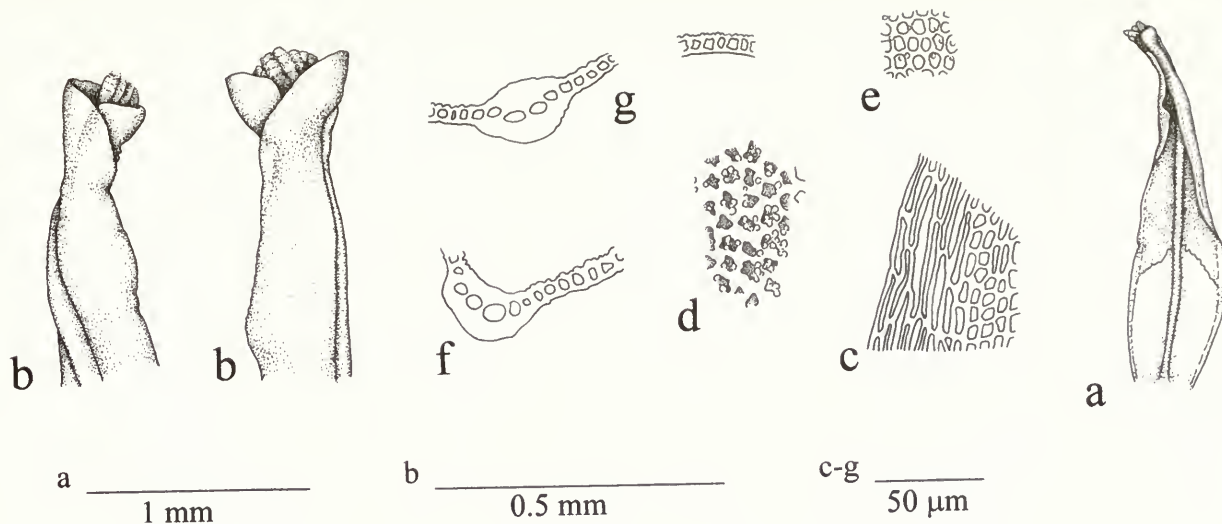


Fig. 15 a–g. *Mithridium wallisii* (Müll. Hal.) H. Rob. a, b: leaf (a: in ventral view, with b: detail of gemmiferous apex; c–e: cells of leaf in surface view (c: at margin adjacent to apex of hyaline lamina, d, e: of chlorophyllose lamina); f, g: cross-sections of costa and chlorophyllose lamina. a–d, f Drawn from *Wallis* s.n. (BM). e, g Drawn from *Tan & Wijangco* s.n. (FH).

densely matted with rhizoids below. Leaves when dry variously curled and twisted, when moist mostly erect to spreading or recurved; consisting of an erect to suberect, largely hyaline, semisheathing base extending (usually abruptly narrowing) into a ligulate, lingulate or linear chlorophyllose limb. Costa ending just below apex to shortly excurrent, superficial cells linear to subrectangular, smooth or giving rise to teeth, spines, cilia or coronate papillose projections; internally composed of 1(–2) layers of guide cells between dorsal and ventral bands of stereids. Cells of chlorophyllose lamina quadrate, shortly rectangular, irregularly polygonal or rounded, broader than long to longer than broad, smooth and flat, or producing spines, teeth or papillose projections from dorsal and/or ventral surfaces of the leaf. Leaf margin often differentiated (nearly always so in the hyaline base); in proximal hyaline base usually consisting of a flattened rib of thick-walled linear cells, most often unistratose and entire; in distal leaf base often with spines, teeth or cilia; interrupted by chlorophyllose lamina, or continuing into upper leaf; in chlorophyllose limb obscure to strong, or absent, consisting of stereids and/or subrectangular, irregularly polygonal cells in 1–several layers; entire, denticulate, dentate, spinulose, or ciliate. In many species gemmae produced from the costa, most often from the costal apex (in a few species produced on specialized leaves). Sporophytes terminal; seta smooth; capsule exserted, erect, cylindrical. Peristome haplolepidous (lacking in some species), with 16 teeth (usually ridged and/or papillose); hyaline properistome often evident. Operculum rostrate; calyptra cucullate, fugacious.

Syrrhopodon is the largest genus in the Calymperaceae and has the broadest latitudinal and altitudinal ranges. Several species have reached the temperate regions of Asia and North America (Reese, 1987b). In the Philippines, the genus is primarily a corticolous moss of lowland rainforest, although several species occur on humid boulders. A few have successfully penetrated the montane or cloud forests above 1000 m.

Syrrhopodon lacks autapomorphic characters, and consequently, has been thought to represent the ancestral or primitive form in the family Calymperaceae (Reese, 1987b). Yet, the genus also has the largest number of endemics or locally derived species. There are about 30 Malesian species of *Syrrhopodon*, of which 19 are reported below for the Philippine archipelago.

Syrrhopodon alboginatus Schwägr., *Sp. musc. frond. suppl.* 2(1): 131 (1824). Type: Moluccas, Rauwack Island, *Gaudichaud* [14A (H. 1230)] (BM!-isotype).

Fig. 16a–f.

Syrrhopodon micholitzii Müll. Hal. in Paris, *Index Bryol.*: 1253 (1898), *nom. nud.* Original specimen: Philippines, Mindanao, Surigao, Jaganan, March 1896, *Micholitz* 171 (FH).

Shoots slender, <1–>3.5 cm high, in tufts or mats, with a scolopendroid appearance, sometimes dense with rhizoids below. Leaves close-set, mostly 3–3.5(>4.0) mm long; each consisting of an erect, semisheathing, narrowly elliptical hyaline base extending into a spreading to recurved, linear (slightly twisted) chlorophyllose limb with an acute to subacute dentate apex (Fig. 16a–d). Costa ending in apex, superficial cells shortly to long rectangular, above hyaline base some giving rise to subtransverse rows of acute teeth; internally with a single row of guide cells between dorsal and ventral layers of stereids. Cells of chlorophyllose lamina mostly isodiametric, rounded, quadrate, shortly rectangular or irregularly polygonal, smooth, mostly 7–12.5 × 5–10 µm, at short regular intervals along the leaf limb (on both dorsal and ventral surfaces) forming largely unbroken, oblique to transverse rows of acute, distally leaning teeth (Fig. 16e). Marginal rib continuous from leaf base to near apex, entire, above proximal hyaline base polystratose, composed of stereid cells, obscured in distal leaf where the margins of the chlorophyllose lamina become tightly incurved and apparently form a denticulate leaf margin. Sporophytes occasional, seta 5–7 mm long, capsule c. 1.5 mm long, erect, narrowly cylindrical; peristome teeth papillose; operculum with a long, erect, narrow, subulate beak.

HABITAT. On decaying logs and tree stumps in lowland forest.

DISTRIBUTION. A widespread Indo-Pacific species. Very common in the Philippines.

SPECIMENS EXAMINED. Luzon, Laguna Province, Los Banos, Mt Makiling, June–July 1917, *Elmer* 18457 (BM); Mt Makiling, 17 August 1931, *Herklots* P22 (BM); Siniloan, U.P. Quezon Land Grant, 3 January 1882, *Baldovino* 001 (BM); San Antonio, September–October 1912, *Ramos* 16670 (BM); Sierra Madre Range, 16 December 1985, *Tan* s.n. (FH); Aurora Province,

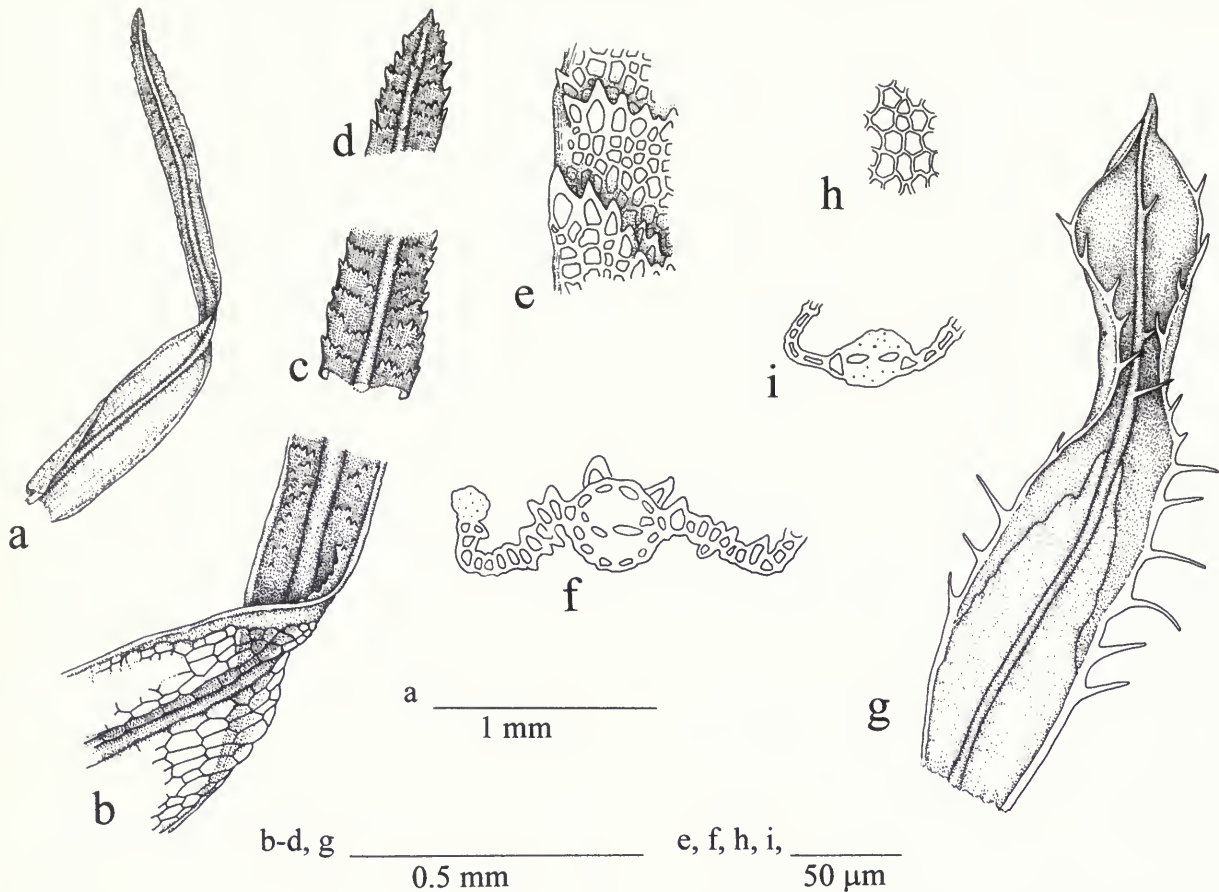


Fig. 16 a–f. *Syrrhopodon albovaginatius* Schwägr. a–d: leaf (a: dorsal aspect, with details of b: apex of hyaline lamina, c: mid-chlorophyllose limb, d: apex); e: cells of chlorophyllose lamina in surface view; f: cross-section of chlorophyllose limb. g–i. *Syrrhopodon ciliatus* (Hook.) Schwägr. g: leaf in ventral view; h: cells of chlorophyllose lamina in surface view; i: cross-section of costa and chlorophyllose lamina. a–d Drawn from *Tan* 92–210 (BM). f Drawn from *Tan* 93–320 (FH). g–i Drawn from *Micholitz* 165 (BM).

Sierra Madre Range, 23 October 1980, *Alvarez* 0–801367 (BM); Isabela Province, Palanan Wilderness, 20 May 1992, *Tan* 92–210 (FH). **Mindanao**, Sunlug, Seno de Davao, 12 May 1890, *Micholitz* 4 (BM); March 1896, *Micholitz* 171 (BM); Zamboanga Province, Basilan City, Lamitan, 4 May 1948, *Santos* 4075 (BM); 25 May 1949, *Santos* 4301 (BM). **Mindoro**, between Bongabon and Pinamalayan, February–April 1941, *Maliwanag* 312 (FH). **Palawan**, Puerto Princesa, Barangay Irawan, Mt Malinao, 4 May 1993, *Tan* 93–320 (FH); between Roxas and Port Barton, 1992, *Tan* 92–374B (FH). **Panay**, Capiz Province: Libacao, May–June 1919, *Martelino & Edano* 35768 (BM); April–May 1918, *Ramos & Edano* 30840 (BM).

This species is unique in the possession of leaves with successive transverse rows of teeth projecting from the chlorophyllose lamina.

Syrrhopodon aristifolius Mitt. in *J. Linn. Soc. Bot.* **10**: 176 (1868).

Type: Samoa, Upolu, 1000–2000 ft, May 1867, *Powell* 89 (BM!-isotype).

Fig. 17.

Syrrhopodon subulatus Sande Lac. in *Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk.* **13**(2): 5 (1872). Type: Sulawesi ['Celebes'], ex Hb. *Sande Lac.* s.n. (BM!-isotypes?).

Syrrhopodon fallax Sande Lac. in *Verh. Kon. Ned. Akad. Wetensch. Amst., Afd. Natuurk.* **13**(2): 5 (1872). Type: Banca, *Kurz* s.n. (L-syntype); Borneo, *Korthals* s.n. (L-syntype).

Shoots mostly 1–2 cm high, in bristly tufts. Stems short, often matted with rhizoids. Leaves long, flexuous, hair-like, mostly (<5–) 7–20 mm long, erect to patent or subfalcate to variously flexed from a broadly subelliptical base with long sloping shoulders; apex aristate (Fig. 17a–d). Costa strong, above leaf shoulders occupying most of the leaf; gradually narrowing distally into an often long excurrent, fine, entire arista; superficial cells above leaf base quadrate to shortly rectangular, smooth and flat; internally with 1–2(–3) layers of guide cells between dorsal and ventral layers of stereids (Fig. 17h). Chlorophyllose lamina occupying leaf shoulders, merging proximally with the hyaline lamina; above leaf shoulders continuing linearly (seldom more than 5–6 cells wide on either side of the costa); beyond midleaf towards apex tapering into costa; unistratose but sometimes with bistratose patches; cells long to shortly rectangular or elliptical, isodiametric to longer than broad, smooth, sometimes slightly convex ventrally, mostly 10–20 × 7.5–12.5 µm (often more elongated in leaf shoulders, some reaching >30 µm long) (Fig. 17g). Hyaline lamina merging into chlorophyllose lamina below shoulders of leaf, not usually sharply defined (Fig. 17f). Leaf margins from above leaf shoulders towards apex formed by a polystratose rib (in some leaves continuing beyond distal limit of chlorophyllose lamina and becoming continuous with the costa), lacking stereids, superficial cells in surface view quadrate to shortly rectangular, smooth, some forming distant, often multicellular teeth;

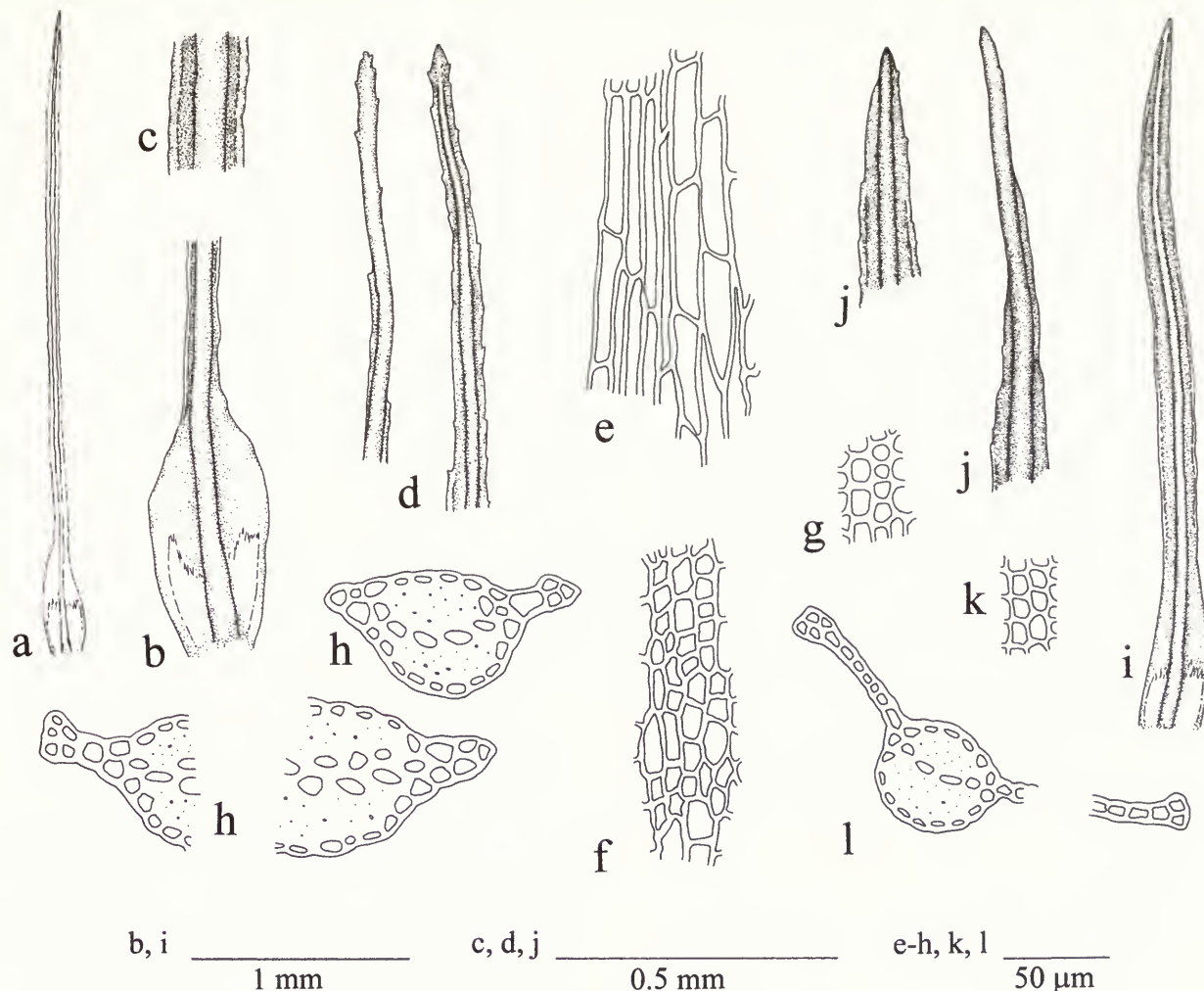


Fig. 17 a–h. *Syrrhodon aristifolius* Mitt. (typical form) a–d: leaf (a: semidiagrammatic representation, with details of b: hyaline base, c: mid-leaf, d: apices); e–g: cells of leaf in surface view (e: at margin of hyaline base, f: around apex of hyaline lamina, g: in chlorophyllose lamina); h: cross-section of leaf in chlorophyllose limb. i–l. *S. aristifolius* (short-leaved form) i, j: leaf (i: in ventral view, with j: detail of apices); k: chlorophyllose lamina in surface view, l: chlorophyllose limb in cross-section. a–h Drawn from Solomon Islands, *Lee* 803 (BM). i–l Drawn from Peninsular Malaysia, *Ellis* s.n. (BM).

around leaf shoulders unistratose, usually entire, rarely subdenticulate; in proximal leaf base unistratose, entire, composed of small hyaline cells, sometimes with walls thicker than those of adjacent hyaline cells (marginal band of linear thick-walled cells rarely apparent) (Fig. 17e). Seta c. 11 mm long; capsule c. 1.5 mm long; operculum with a long subulate beak.

HABITAT. On tree trunks in lowland rainforest.

DISTRIBUTION. An Indo-Pacific species. Bartram (1939) cites three Philippine collections (as *Syrrhodon fallax* Sande Lac. and *S. subulatum* Sande Lac.) from Mindoro and Mindanao.

No other local specimens examined.

As with most species in the Calymperaceae, plants of *Syrrhodon aristifolius* are highly plastic. An atypical, under-developed form, with leaves consistently <5–7 mm long (Fig. 17i), occurs in lowland tropical rainforest. This form is all but absent from herbaria, yet extensive populations have been sampled in Sabah and the Malayan Peninsula. It remains to be detected in the Philippines.

Superficially this form has some resemblance to *Calymperes subserratum*, but leaves in the latter possess unistratose margins and

much smaller cells in the chlorophyllose lamina (<5–10(–12.5) × 5–7.5 µm) which are ventrally protuberant. The leaves in *S. aristifolius* have polystratose margins and larger, mostly flat cells in the chlorophyllose lamina (10–20 × 7.5–12.5 µm).

***Syrrhodon armatus* Mitt.** in *J. Linn. Soc. Bot.* 7: 151 (1863).

Type: West Africa, Bagroo River, 1861, *Mann* s.n. (NY-syntype; BM!-isotype); West Africa, banks of the Nun, September 1860, *Mann* [549] (NY-syntype; BM!-isotype).

Fig. 19h–n.

Syrrhodon fimbriatus Müll. Hal. in *Linnaea* 37: 151 (1872), *hom. illeg.*

Syrrhodon fimbriatulus Müll. Hal. in *J. Mus. Godeffroy* 3(6): 52 (1874). Type: Australia, Brisbane River, 1864, *Dietrich* s.n. (B-holotype, presumably destroyed; isotypes not found, fide Reese & Bartlett (1982)).

Syrrhodon larminatii Broth. & Paris in *Rev. Bryol. Lichénol.* 28: 125 (1901). Type: Vietnam, Hanoi, Lao Cai, *Larminat* s.n. (H-BR-holotype).

Syrrhodon tsushimae Cardot in *Bull. Herb. Boissier* ser. 2, 7: 716

(1907). Type: Japan, *Faurie* 1637 (PC?-holotype).

Syrrhopodon philippinensis E.B. Bartram in *Philipp. J. Sci.* **68**: 83 (1939). Type: Philippines, Luzon, Zambales Prov., hills between San Marcelino and Mount Pinatubo, *Bartlett* 14219 (FH!-holotype).

Shoots 0.4–1 cm high, densely leaved, matted with rhizoids below, forming dense, yellowish green mats. Leaves 1–2(–3) mm long, linear, erect to patent (incurled-cripsed when dry), consisting of a narrowly elliptical hyaline base tapering gradually into a chlorophyllose limb; leaf apex broadly obtuse to almost truncate, cuspidate (cusp sometimes dorsally inclined) (Fig. 19h, i). Costa (prominent dorsally) ending below apex in a blunt, dentate point; dorsally (usually from mid-hyaline base to apex) and ventrally (usually from above hyaline base to apex) with short to long, erect to distally-curving, acute spines. Chlorophyllose lamina laxly incurved, rarely slightly undulate; cells longer than broad to broader than long, with 4–6 sides or rounded-elliptical, 5–15 × 5–10 µm (Fig. 19j), ventrally and dorsally drawn out as single, often tall, sometimes curving, subacute projections (Fig. 19n). Hyaline lamina sharply defined. Leaf margins from proximal chlorophyllose limb to beyond midleaf (occasionally to near apex) usually consisting of a thin, largely entire strand of stereids (sometimes weak, intermittent or absent) (Fig. 19k); in hyaline base composed of a narrow, flattened strand of linear, thick-walled cells (<3–5 cells wide, usually continuous with marginal strand in distal leaf); adjacent to and beyond distal region of hyaline lamina giving rise to a row of acute spines and/or cilia (Fig. 19j). Gemmae sometimes produced from ventral surface of costal apex. Sporophytes rare. Seta c. 5–6 mm long; capsule cylindrical, c. 1 mm long; peristome teeth strongly papillose.

HABITAT. Corticolous

DISTRIBUTION. A Palaeotropical species. In the Philippines confined to Luzon Island.

Asian and Australasian plants of this species were previously referred to *Syrrhopodon fimbriatulus* Müll. Hal. Reese & Stone (1995) recognized this taxon to be conspecific with *Syrrhopodon armatus*, earlier described from Africa.

Syrrhopodon armatus is very similar to *Syrrhopodon trachyphyllus* Mont. The latter has slightly more robust shoots and leaves than *S. armatus* but the main distinguishing feature is the form of the chlorophyllose lamina. In *S. trachyphyllus* the cells of the chlorophyllose lamina are 10–15(–17.5) × 8–12.5 µm, each with a crown of papillae projecting from the dorsal and ventral surfaces (Fig. 24i). Those in *S. armatus* are 5–15 × 5–10 µm, with a single papilla projecting from the dorsal and ventral surfaces (Fig. 19n).

Syrrhopodon ciliatus (Hook.) Schwägr., *Sp. musc. frond. suppl.* **2**(1): 114, 130 (1824).

Fig. 16g–i.

Weissia ciliata Hook., *Musci Exot.* **2**: 7, 171 (1820). Type: Ternate Island, Hb. Dickson (BM!-holotype?; BM!-isotype).

Shoots mostly <0.5–1(–4) cm high, soft, pale green, often densely covered with red rhizoids below. Leaves delicate, suberect to reflexed, <1–2.5(–3) mm, lingulate, ending in an obtuse, apiculate apex, hyaline lamina often exceeding half of the total leaf length (Fig. 16g). Costa thin, ending in the apiculus, superficially smooth apart from occasional long cilia projecting from the ventral surface, internally a single row of guide cells between dorsal and ventral rows of stereids. Chlorophyllose lamina in distal leaf often laxly infolded, sometimes slightly undulate; cells 8–12.5 × 8–17.5(–20) µm, with smooth, flat surfaces (Fig. 16h). Leaf margin in hyaline

base formed by a flattened band of long, narrow thick-walled cells; distally, slightly narrowing but continuing to near the leaf apex; above mid-hyaline lamina giving rise at distant intervals to long cilia (sometimes exceeding 200 µm in length).

Modified gemmiferous leaves occasionally present, usually 1–2 per shoot; linear and tubular, sometimes exceeding 4 mm long. Costa thick, occupying most of leaf; at apex expanding slightly to form a broad, blunt tip from which the gemmae are produced. Lamina present but very narrow throughout, involute. Marginal rib bearing short cilia. Sporophytes not uncommon. Seta red, c. 4–5 mm long; capsule reddish light brown, shortly cylindrical, c. 0.75–1 mm long; operculum with a long, subulate beak; peristome teeth red, papillose.

HABITAT. On trees at low altitudes.

DISTRIBUTION. An Indo-Pacific species, uncommon in the Philippines.

SPECIMEN EXAMINED. **Mindanao**, March 1896, *Micholitz* 165 (BM, BM-K).

Syrrhopodon confertus Sande Lac. in *Verh. Kon. Ned. Akad. Wetensch. Afd. Natuurk* **13**: 4 (1872). Type: Banca, Kurz s.n. (L-lectotype).

Fig. 18k–p.

Syrrhopodon amoenus Broth. in *Oefvers. Förh. Finska Vetensk.-Soc.* **42**: 94 (1900). Type: New Guinea, 1897, *Musgrave* s.n. (BM!-isotypes).

Shoots <0.5–>2.5 cm, densely leaved, forming pale, dense mats and cushions. Leaves erect to patent, lanceolate, 1.5–3 mm long, consisting of a short, linear-lanceolate chlorophyllose limb extending from a narrowly suboblong hyaline base (usually occupying over half the leaf length); leaf apex usually drawn out into a fine, denticulate, acute point (Fig. 18k, l). Costa narrow (especially in leaf base), ending in apex to excurrent; superficial cells long and narrow, ventral surface smooth, dorsal surface above hyaline base smooth to spinose (spines most frequently arising from cells adjacent to lamina); internally (above base) consisting of a layer of guide cells (2–3 cells wide) separating dorsal and ventral bands of stereids. Lamina at leaf shoulders often recurved. Cells of chlorophyllose lamina obscured on ventral and dorsal surfaces of leaf by tall projections crowned with compound papillae. Hyaline lamina often occupying up to two thirds of leaf length, sharply defined but narrowly tapering into the chlorophyllose limb between the costa and the narrow wings of the proximal chlorophyllose lamina (Fig. 18m). Leaf margins from shoulders to near leaf apex composed of stereids or substereids in a thin, polystratose rib, at shoulders notched to denticulate, above denticulate with single or double teeth; from below shoulders to leaf base entire, consisting of a flattened, narrow band of thick-walled, linear cells. Sporophytes rare, not seen in Philippine material.

HABITAT. On tree trunks in lowland rainforest.

DISTRIBUTION. An Indo-Pacific species. Bartram (1939) cites Philippine specimens from Luzon, Negros and Panay (as *Syrrhopodon amoenus* Broth.).

SPECIMEN EXAMINED. **Luzon**, Isabela Province, San Mariano, Barrio Disulap, Dimahahabong Creek, 14 April 1991, *Tan* 91–140 pro parte (FH).

The leaves of *Syrrhopodon confertus* are distinguishable from those of related species, such as *S. involutus* Schwägr. and *S. rufescens* Hook. & Grev., by the possession of a short but well-defined chlorophyllose limb. In the latter two species, the chlorophyllose

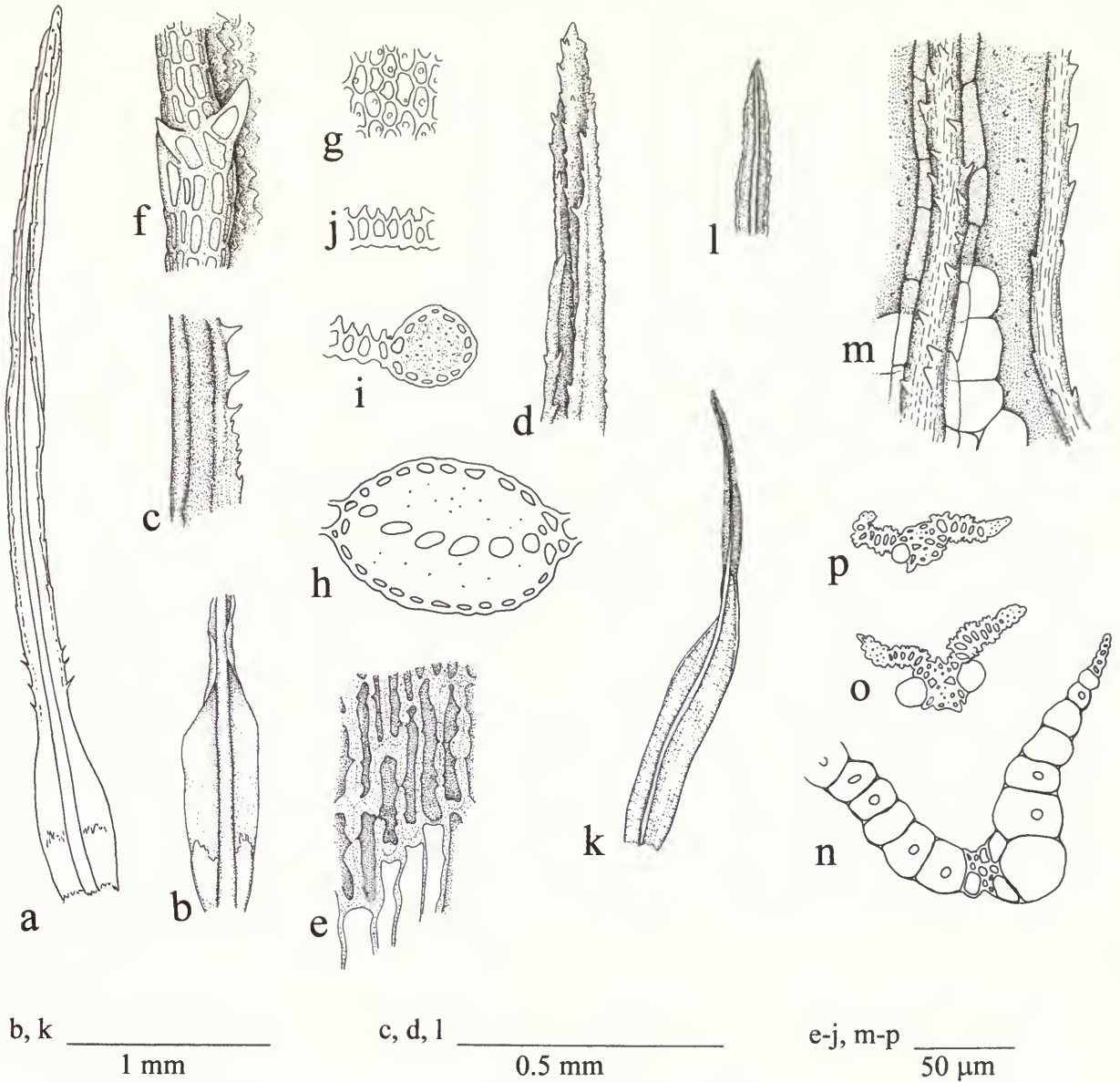


Fig. 18 a–j. *Syrrhopodon croceus* Mitt. a–d leaf (a: diagram of whole leaf, with details of b: base, c: region above base, d: apex); e–g: cells of leaf in surface view (e: above hyaline lamina, f: at margin in chlorophyllose limb, g: in chlorophyllose lamina); h–j cross-sections of leaf (h: costa, i: marginal rib in chlorophyllose limb, j: chlorophyllose lamina). k–p. *Syrrhopodon confertus* Sande Lac. k–l: leaf (k: in dorsal view, with details of l: apex in ventral view, m: apex of hyaline lamina in dorsal view); n–p: cross-sections of leaf (n: near base, o: above mid-leaf, p: near apex). a–j Drawn from *Tan* 92–173 (BM). k, m Drawn from Peninsular Malaysia, *Burkill* 2112 (BM). l, n–p Drawn from Sabah, *Ellis* 143–366 (BM).

lamina is confined to the apex of shortly pointed leaves, otherwise composed of hyaline cells.

Syrrhopodon croceus Mitt. in *J. Linn. Soc. Bot. Suppl.* **1**: 41 (1859).

Fig. 18a–j.

Calymperidium croceum (Mitt.) M. Fleisch., *Musc. Fl. Buitenzorg* **1**: 219 (1904). Type: Singapore, *Wallich* s.n. [3640] (BM!-isotype).

Shoots in dark green to reddish brown tufts, 2–5 cm high, often densely matted with rhizoids below. Leaves <5–10 mm long, stiff, straight or slightly curving, with an erect, elliptical semisheathing

base narrowing gradually into an erect to patent, linear-ligulate chlorophyllose limb, ending in a blunt, denticulate apex (Fig. 18a, b, d). Costa ending just below leaf apex to excurrent (tip dentate and often, especially in gemmiferous leaves, slightly expanded), in distal leaf-limb scabrid on both dorsal and ventral surfaces, proximally becoming smooth. Hyaline lamina clearly defined, usually confined to the lowermost third to half of leaf base, hyalocysts often yellow tinged; distal leaf base occupied by bright orange-red, incrassate, long rectangular to linear, porose cells (Fig. 18e); distally these becoming smaller and paler, gradually merging into the chlorophyllose lamina of the lower leaf-limb. Chlorophyllose lamina often incurved to near leaf apex, composed of shortly subrectangular to subelliptical cells with walls sometimes thickened at the angles,

mostly 10–20 × 7.5–10 mm, each projecting acutely from the ventral leaf surface (usually terminating in a sharp papilla), dorsally unipapillose (Fig. 18g, j). Margins of leaf base entire, adjacent to hyaline lamina formed by a broad, flat, orange-red band of incrassate, porose, linear cells (sometimes cells in outermost row of band shortly rectangular, thin-walled and hyaline); distally becoming indistinct, merging with the upper basal lamina; around and shortly above shoulders of leaf becoming clearly defined once more, composed of shortly to long subrectangular, incrassate cells in 5–8 rows, some in marginal row giving rise to long, acute teeth (Fig. 18c); from above shoulders to near leaf apex becoming a thick, polystratose rib composed of stereids with a broken superficial layer of shortly rectangular cells, some forming distant, large, single or double (sometimes triple) teeth (Fig. 18f, i). Gemmae sometimes produced from the ventral surface of the costal apex. Seta 12–17.5 mm long; capsule cylindrical, 1.5–<2 mm long.

HABITAT. On logs, tree trunks, and limestone rock in shade.

DISTRIBUTION. An Indo-Pacific species, very common in the Philippines.

SPECIMENS EXAMINED. **Basilan**, *Semper* s.n. (in Hb. Hampe, BM). **Leyte**, Baybay, Mt Pangasugan, 21–22 May 1984, *Tan, Navarez & Raros* 84–235 (BM). **Luzon**, Isabel Province, San Mariano, Sierra Madre Range, Barrio Disulap, Dimahabong Creek, 14 April 1991, *Tan* 91–140 pro parte (FH); *ibid*, Sitio Digoyo, 17 April 1991, *Tan* 91–170 (BM); Palanan Wilderness, 21 May 1992, *Tan* 92–173 (BM); Laguna Province, Cavinti, Bo. Lumot, Ubali River, near Sitio Ubali, 24 October 1982, *Tan & Tandang* 82–376 (FH); Quezon Province, Real, National Botanical Garden, 24 December 1981, *Tan* 81–446 (Musc. Philipp. Fasc. 2 no. 29) (BM). **Palawan**, Puerto Princesa, Barangay Irawan, Mt Malinao, 4 May 1993, *Tan* 93–308 (FH). **Sibuyan**, Magdiwang, Barangay Tampayan, Mt Giting-Giting, 1 May 1987, *Tan & Hernaez* 87–473 (BM); *ibid*, 21 May 1987, *Tan & Hernaez* 87–445 (BM).

This species is highly variable. There are many atypical forms in which the leaves may be very short and in which distinctive features, such as the orange-red cells in the distal leaf base or the teeth along the margin of the lower leaf limb, may be obscure or completely missing.

Syrrhopodon flammeonervis Müll. Hal. in *Linnaea* 38: 557 (1874).

Type: Philippines, Luzon, 1871, *Wallis* s.n. (FH!, H-isotypes). Fig. 19a–g.

Syrrhopodon flammeonervis var. *robustus* Dixon in *J. Linn. Soc. Bot.* 50: 81 (1935). Type: Sarawak, Ulu Tinjar, Sungei Balapau, G. Laiun, c. 1100 m, 2 November 1932, *Oxford Expedition [Richards]* 2381 (BM!-holotype).

Shoots 2–>6 cm high, in pale to dull green tufts. Leaves 3–>6 mm long, consisting of an erect, clasping, narrowly oblong hyaline base abruptly narrowing into an erect to spreading, linear chlorophyllose limb that is 'v'-shaped in cross-section (loosely and irregularly curved and twisted when dry); apex blunt, dentate (Fig. 19a, b). Costa ending immediately below apex; towards and at apex dorsal surface with large, acute teeth, proximally cells in rows adjacent to the lamina sometimes forming acute to spinose teeth, otherwise smooth (dorsal and ventral surfaces largely composed of stereids). Chlorophyllose lamina at leaf apex forming a narrow, spinose margin around the costal apex, ultimate cell often in the form of a large, dorsally slanting, spinose tooth (Fig. 19b); below apex cells isodiametric to longer than broad, with 4–6 sides or irregularly rounded-elliptical, 8–17(–25) × 7.5–10(–12.5) µm (Fig. 19e), dorsally and ventrally drawn out into coronate-papillose projections (towards leaf apex projections sometimes becoming more spinose) (Fig. 19f). Hyaline lamina sharply defined. Leaf margin sometimes

incurved above and/or recurved at leaf shoulders; from around apex of leaf shoulders to near leaf apex formed by a thick strand of stereids (Fig. 19g), largely entire but near apex some superficial cells forming teeth; from shoulders to leaf base composed of a flattened band (continuous with rib in upper leaf) of thick-walled, linear cells in about 3–7 rows (sometimes cells of outermost row with thin walls) (Fig. 19d); in shoulders uneven to denticulate, below shoulders entire. Sporophytes not seen.

HABITAT. Eddy (1990) reports this species as occurring 'on bark and acidic rocks in moist rainforest between 1000 and 2000 m alt.'

DISTRIBUTION. SW China, Indochina, Philippines, Borneo. In the Philippines known from the islands of Luzon, Palawan and Negros.

SPECIMENS EXAMINED. **Luzon**, Mt Makiling, 16 August 1931, *Herklots* P18b (BM). **Palawan**, Mt Manalsal, May 1929, *Edano* 80869 (BM).

Syrrhopodon gardneri (Hook.) Schwägr., *Sp. musc. frond. suppl.* 2(1): 110 (1824).

Fig. 20i–u.

Calymperes gardneri Hook., *Musci Exot.* 2:146 (1819). Type: Nepal, *Gardner* [1205] (BM!-holotype, BM!-isotype).

Syrrhopodon curranii Broth. in *Philipp. J. Sci. C.* 5: 142 (1910). Type: Philippines, Luzon Island, Benguet Province, December 1908, *H.M. Curran* 15636 (BM!-isotype).

Shoots 0.5–>5 cm high. *Leaves* mostly 3–5 mm long, erect to patent, narrowly to broadly linear-ligulate from an erect, elliptical hyaline base; ending in an obtusely pointed, denticulate apex (Fig. 20i–k). Costa ending just short of leaf apex in a dentate tip; in upper leaf many superficial cells forming acute, forward-pointing teeth, often with one or two small papillae; especially towards leaf apex distant, subtransverse rows of relatively larger teeth sometimes occur (Fig. 20q). Chlorophyllose lamina often broadly incurved to below leaf apex; cells quadrate to shortly rectangular or subelliptical (mostly isodiametric or longer than broad), 7–17.5(–20) × 7–10 µm (Fig. 20p), projecting acutely from the ventral leaf surface, each projection bearing one or more small papillae, dorsally uni- or pleuri-papillose (Fig. 20t, u). Hyaline lamina well-defined (Fig. 20l). Marginal ribs in proximal leaf base entire to dentate, flat, composed of long, narrow, thick-walled cells (Fig. 20m); in distal leaf base vanishing into chlorophyllose lamina; from around mid-hyaline base to above shoulders rib lacking, margin denticulate to subciliate (Fig. 20n); above shoulders polystratose, erect or incurved, composed of quadrate to shortly rectangular cells (stereids absent), double or single teeth occurring at intervals along the margin (Fig. 20o). Gemmae sometimes produced from the ventral surface of the costal apex. Seta dull orange, 4–5 mm long; capsule cylindrical, 1–1.3 mm long.

HABITAT. On tree trunks in rainforest. Most frequent at 1000–2000 m, occurring at higher altitudes than many taxa in the Calymperaceae.

DISTRIBUTION. A nearly pantropical species. In the Philippines confined to Luzon.

SPECIMEN EXAMINED. **Luzon**, Benguet Province, Buguias, Lake Tabayog, 25 October 1985, *Tan & Hernaez* 85–127 (BM, FH).

The leaves of *Syrrhopodon gardneri* are superficially similar to those of *S. japonicus* (Besch.) Broth. but are usually shorter. In most specimens of *S. gardneri* the leaves seldom exceed 5 mm long, the cells of the chlorophyllose lamina project acutely from the ventral leaf surface and dorsally and ventrally are usually papillose

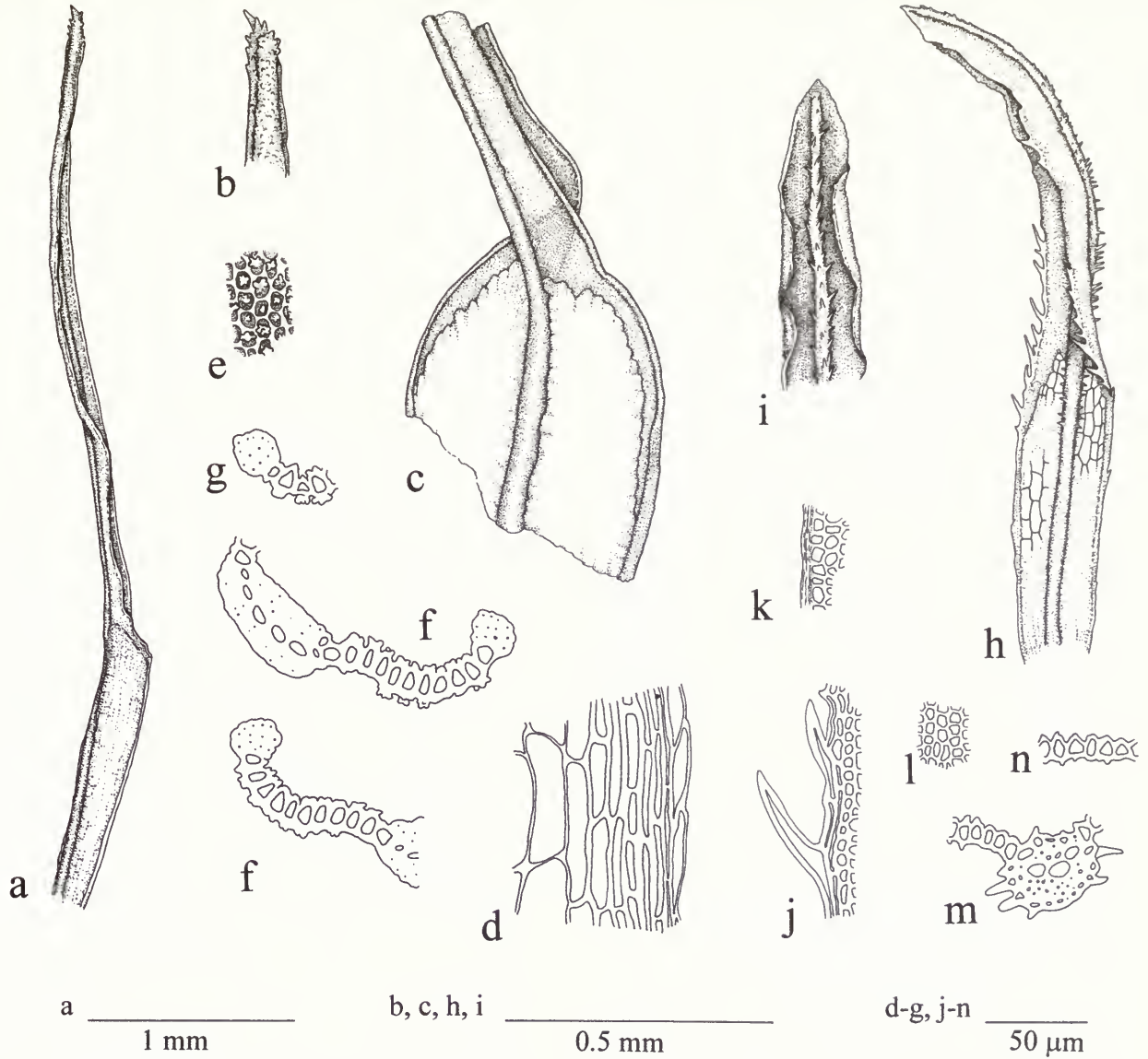


Fig. 19 a–g. *Syrrhopodon flammeonervis* Müll. Hal. a–c leaf (a: lateral view, with details of b: apex, and c: distal hyaline base); d, e: cells of leaf in surface view (d: at margin in mid-hyaline base, e: in chlorophyllose lamina); f–g: cross-sections of leaf (f: chlorophyllose limb, g: margin of chlorophyllose limb). h–n. *Syrrhopodon armatus* Mitt. h, i: leaf (h: ventral view, with detail of i: distal chlorophyllose limb in ventral view); j–l: cells of leaf in surface view (j at margin in distal hyaline base, k: at margin in mid-chlorophyllose limb, l: in chlorophyllose lamina (dorsal view)); m, n: cross-sections of leaf (m: costa, n: chlorophyllose lamina). a–g Drawn from *Edano* 80869 (BM). h–n Drawn from North Borneo, *Binstead* 35 (BM).

(Fig. 20t, u). In most specimens of *S. japonicus* the leaves are up to 7–8 mm long, the cells of the chlorophyllose lamina lack papillae and are more roundly protuberant (Fig. 21n), often with the greater protuberance from the ventral leaf surface.

Syrrhopodon hispidissimus Dixon in *J. Malayan Branch Roy. Asiat. Soc.* 6: 23 (1928). Type: Sumatra, Siberoet Island, September 1924, *Boden Kloss* 10581b (BM!-holotype).

Fig. 20a–g.

Syrrhopodon perarmatus E.B. Bartram in *Farlowia* 1: 42 (1943), *hom. illeg.* (non *S. perarmatus* Broth.).

Syrrhopodon hispido-ciliatus E.B. Bartram in *Farlowia* 1: 504

(1944). Type: Papua New Guinea, Palmer River, 2 miles below junction, Black River, July 1936, *Brass* 7161a (FH!-holotype).

Shoots delicate, <0.3–1.5 cm high, forming pale green, soft mats or tufts. Leaves consisting of a linear, erect to patent chlorophyllose limb narrowing from a suberect, subelliptical hyaline base, <1.5–3 mm long; apex subacute to acute, dentate (Fig. 20a–c). Costa ending below apex; dorsal and ventral surfaces above hyaline base with close-set, transverse-oblique rows of long, acute, distally leaning, unicellular spines (may exceed 35 µm long) (Fig. 20g); internally with a single row of guide cells. Chlorophyllose lamina <5–c.10 cells wide on either side of costa; cells mostly isodiametric to slightly longer than broad, 5–12.5 × 5–7 µm; each with a thick, often

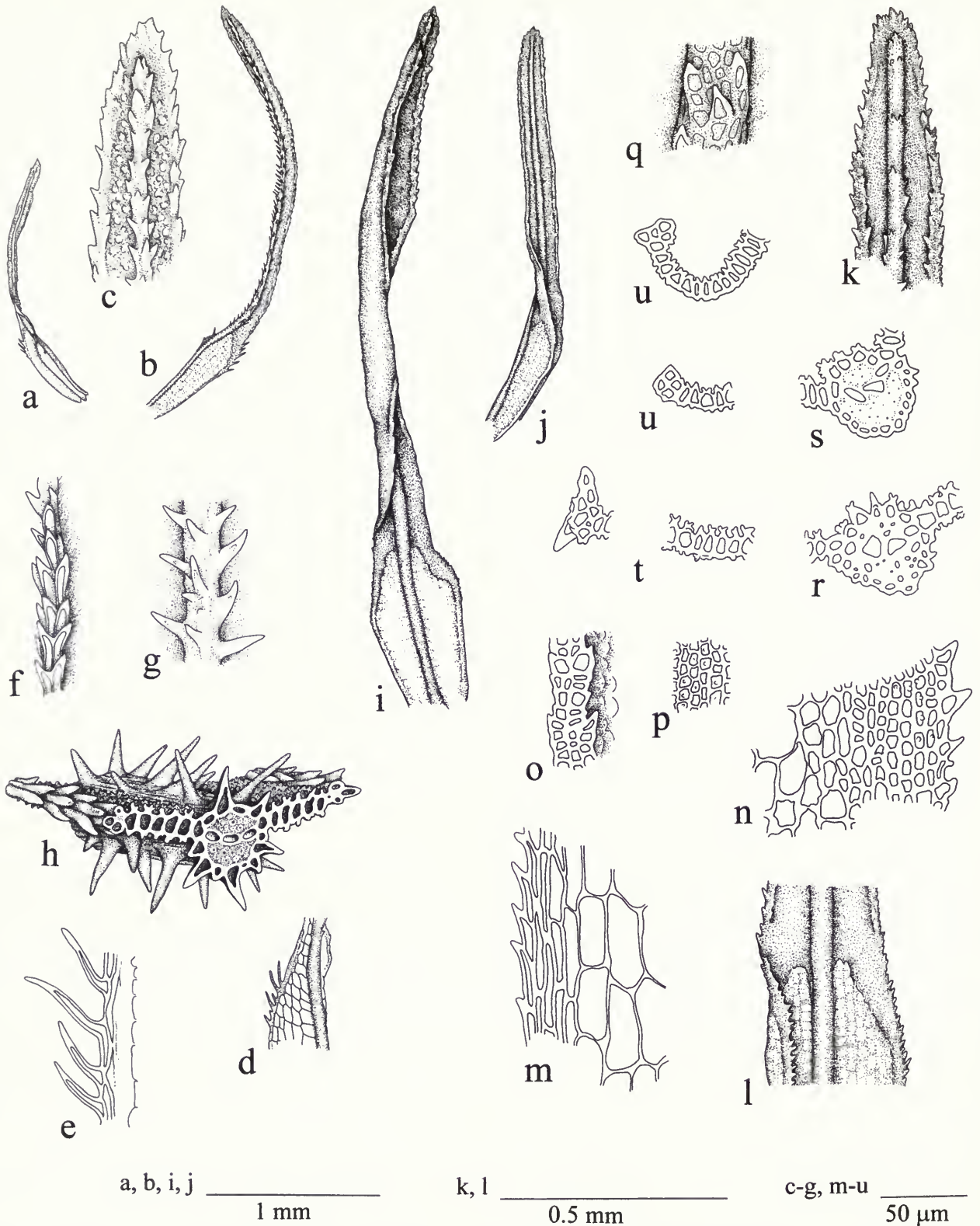


Fig. 20 a–h. *Syrrhopodon hispidissimus* Dixon a, b leaves, with details of c: apex, and d: region around apex of hyaline lamina; e–g: cells of leaf in surface view (e: at margin of distal hyaline base, f: at margin of chlorophyllose limb, and g: in costa); h: diagrammatic cross-section of leaf through chlorophyllose limb. i–l. *Syrrhopodon gardneri* (Hook.) Schwägr. i–l: leaves (i, j in ventral view, with details of k: apex (ventral view), and l: distal region of hyaline lamina); m–q: cells of leaf in surface view (m: at margin of hyaline lamina, n: at margin adjacent to apex of hyaline lamina, o: at margin in chlorophyllose limb (ventral view), p: of chlorophyllose lamina, q: of costa (ventral view)); r–u: cross-sections of leaf (r, s: costa, t, u: chlorophyllose lamina). a, c, d Drawn from *Ebalo 737* (FH). b Drawn from Sumatra, *Boden Kloss 10581b* (BM). e, f, g Drawn from Papua New Guinea, *Brass 7161a* (FH). i, k, m, r, t Drawn from *Tan & Hernaez 85–127* (BM). j, l, n–q, s, u Drawn from *Curran 15636* (BM).

tall crown of papillae protruding from the dorsal and ventral surfaces (in surface view papillae obscuring the shape of the underlying cells). Leaf margins from above shoulders of leaf to near apex formed by a thin polystratose rib of transversely aligned, long, narrow cells that are drawn out distally as acute, forward pointing teeth (in transverse ranks of 2–4) (Fig. 20f); from shoulders to leaf base consisting of a flattened band of long, narrow, thick-walled cells (continuous with rib of upper leaf), at shoulders producing a row of cilia (cilia often exceeding 80 μm long) (Fig. 20e), entire below. Sporophyte unknown.

HABITAT. On exposed roots, tree trunks and buttresses in shaded situations.

DISTRIBUTION. An uncommon Indo-Pacific species. In the Philippines the species has been found in Mindanao and probably also occurs in Luzon.

SPECIMEN EXAMINED. **Mindanao**, Zamboanga Province, Muralong Mountain near Kabasalan, 27 November 1940, *Eballo* 737 (FH).

Syrrhopodon hispidissimus is sometimes confused with *S. spiculosus*. In the latter, the margin of the leaf above the hyaline base is formed (except near the leaf apex) by a rib of stereids which is smooth and entire (Fig. 23h); in *S. hispidissimus* most cells at the surface of the marginal rib give rise to sharp, distally-pointing teeth (Fig. 20f).

Syrrhopodon involutus Schwägr., *Sp. musc. frond. suppl.* 2(1): 117 (1824). Type: Moluccas, Rawak Island, *Gaudichaud* 11 (26) (BM!-isotype).

Fig. 21a–g.

Syrrhopodon revolutus Dozy & Molk. in *Ann. Sci. Nat. Bot. sér.* 3, 2: 315 (1844). Type: Java and Borneo, *Korthals* s.n. (L-holotype; BM!-isotype).

Trachymitrium borneense Hampe in *Nuovo Giorn. Bot. Ital.* 4: 280 (1872). Type: Borneo, Sarawak, *Beccari* 46 (BM!-holotype).

Syrrhopodon borneensis (Hampe) A. Jaeger, *Gen. Sp. musc.* 1: 316 (1873).

Leucophanella borneense (Hampe) M. Fleisch., *Musc. Fl. Buitenzorg* 1: 197 (1904).

Leucophanella revoluta (Dozy & Molk.) M. Fleisch., *Musc. Fl. Buitenzorg* 1: 198 (1904).

Shoots 1–2(–>3) cm high, freely branched, densely leaved, in densely packed, pale green cushions, often loosely matted with red rhizoids below. Leaves 1–1.5 mm long, erect to erecto-patent, lanceolate, above often involute or 'v'-shaped in cross-section; leaf apex obtuse to shortly pointed, entire to denticulate; largely composed of hyaline lamina (Fig. 21a, b). Costa thin, ending in or just below apex; dorsal surface smooth below, nearing leaf apex often scabrid, teeth mostly formed by cells in rows adjacent to the lamina; ventral surface smooth, rarely toothed near apex; internal structure similar to that in *Syrrhopodon confertus*, consisting of a layer of guide cells (2–3 cells wide) separating dorsal and ventral bands of stereids (ventral band sometimes poorly developed) (Fig. 21d–f). Chlorophyllose lamina occupying leaf apex, proximally narrowly tapering down either side of the hyaline lamina, ceasing prior to midleaf; cells mostly quadrate to shortly rectangular, or irregularly rounded-elliptical, mostly 5–>15 \times 5–>10 μm (Fig. 21c); dorsally and/or ventrally flat or protruding subacutely, smooth or unipapillose (Fig. 21e, g). Hyaline lamina occupying about two thirds to more than four fifths of the leaf length, sharply defined; cells large, thin-walled, shortly subrectangular, seldom in more than about 5–6 rows on either side of the costa. Leaf margins often recurved above; from

leaf base to near apex entire, consisting of a narrow, smooth, unistratose to bistratose strand of stereids (Fig. 21c, d, e). Seta red, smooth, <6–>10 mm long; capsule erect, shortly cylindrical, <1 mm long, yellowish brown with a red rim, lid long rostrate, reddish brown; peristome teeth <100–>150 μm long, papillose.

HABITAT. On trunks and exposed roots of trees and decaying logs.

DISTRIBUTION. A palaeotropical species. Common in the Philippines.

SPECIMENS EXAMINED. **Catanduanes**, 14 November–1 December 1917, *Ramos* 30610 (BM, BM-K); **Luzon**, *Loher* 1056 (BM-K); Baguio, 1910, *Sanchez* 6 (BM); Benguet, *Micholitz* 153 (BM-K); Laguna, San Antonio, *Ramos* 16672 (BM). **Mindanao**, March 1896, *Micholitz* 179 (BM, BM-K); Agusan Norte, Cabadbaran, Mt Hilog-Hilog, 31 May–2 June 1984, *Tan & Navarez* 84–492 (FH). **Mindoro**, between Bongabon and Pinamalayan, 5 February–5 April 1941, *Maliwanag* 313 (FH).

Syrrhopodon japonicus (Besch.) Broth., *Nat. Pflanzenfam.* 2nd ed., 10: 233 (1924).

Fig. 21h–o.

Calymperes japonicus Besch. in *J. Bot. (Morot)* 12: 296 (1898).

Type: Japan, Nagasaki, March 1895, *Faurie* 15454 (BM!-holotype).

Calymperes datense E.B. Bartram in *Philipp. J. Sci.* 68: 98 (1939).

Type: Philippines, Luzon, Benguet subprovince, Mount Data, 8000 ft, *Hadden* 116 (FH!-lectotype, fide Mohamed & Reese, 1985).

Shoots <2–5(–6) cm high, often matted with red rhizoids below. Leaves 7–8(–9) mm long, linear-lanceolate, bristle-like, patent to recurved from an erect, narrowly elliptical hyaline base (shoulders of leaf often not very pronounced), at apex tapering to an acute, dentate tip (Fig. 21h, i). Costa strong, excurrent, sometimes long-excurrent; superficial cells mostly flat and smooth but often forming teeth near costal apex; internally with a single row of guide cells between dorsal and ventral bands of stereids (Fig. 21m). Cells of chlorophyllose lamina quadrate to subrectangular, mostly 1–3 times longer than broad, 6–12.5(–15) \times 5–8 μm (Fig. 21l), projecting roundly to subacutely from the ventral leaf surface, dorsally flat to slightly protuberant, smooth (Fig. 21n); around leaf shoulders usually grading gradually into areas of larger, subquadrate to subrectangular incrassate cells (often with transverse walls and corners preferentially thickened) that grade proximally into the large, thinner walled cells of the hyaline lamina in the leaf base (sometimes hyaline cells thick-walled to base of leaf) (Fig. 21j). Margins from above shoulders to near leaf apex formed by a polystratose rib (sometimes weak), superficial cells subquadrate to rounded, double (sometimes triple) teeth occurring at short intervals, lacking stereids (Fig. 21k, o); in shoulders and upper leaf base unistratose and undifferentiated, denticulate; in proximal leaf base usually entire, formed by a flattened rib composed of long, narrow thick-walled cells (cells in marginal row often with slightly thinner walls than those in inner rows), vanishing distally. Sporophytes apparently rare, not seen in Philippine material. Seta *c.* 15 mm long; capsule 1.5–2 mm long.

HABITAT. In montane rainforest; on tree trunks, buttresses, moist humus and logs, usually in shade.

DISTRIBUTION. Japan, China, Indo-China, Malesia. Widespread in the Philippines.

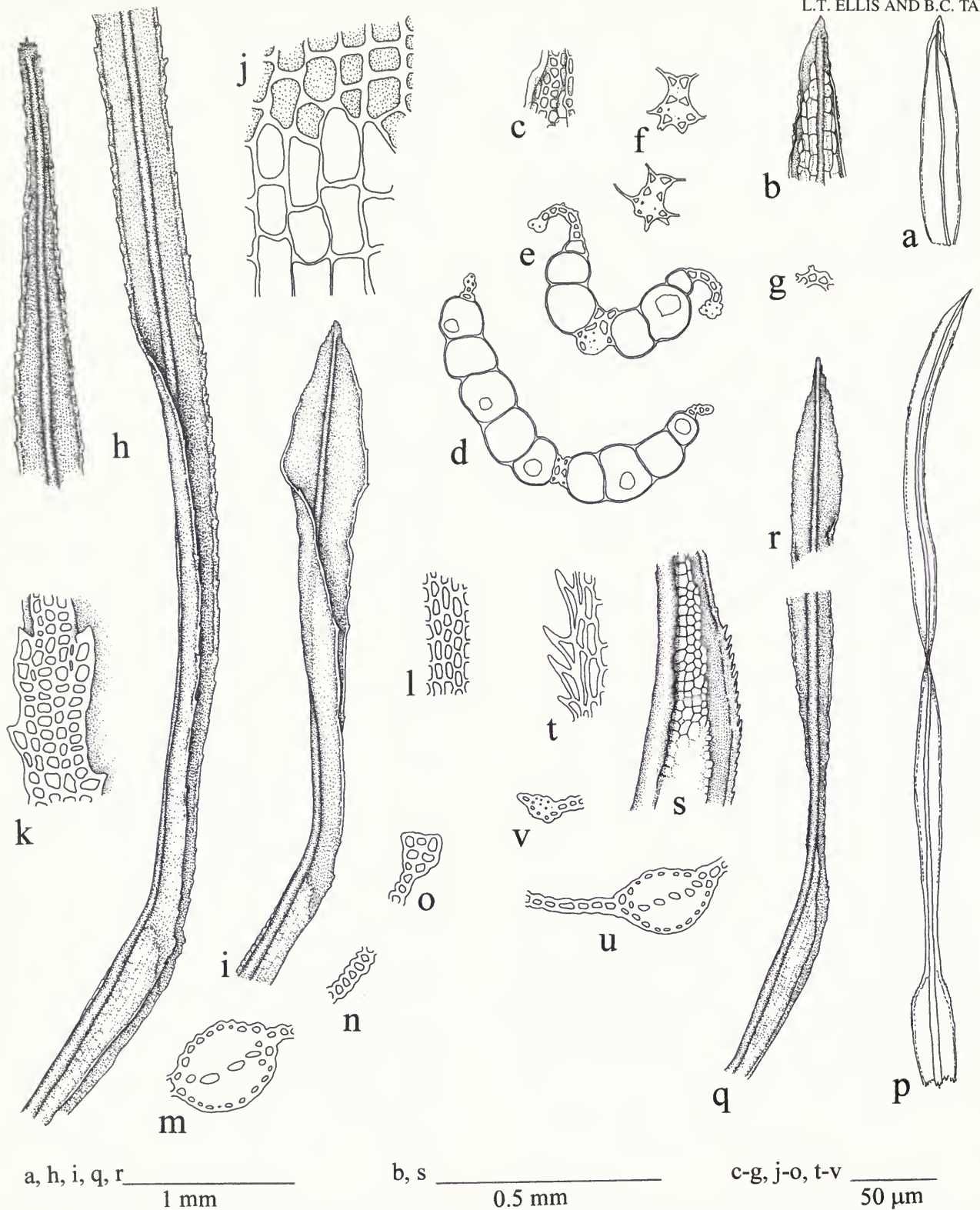


Fig. 21 a–g. *Syrrhopodon involutus* Schwägr. a: leaf, with b: detail of apex in ventral view; c: cells of chlorophyllose lamina above hyaline lamina; d–g: cross-sections of leaf (d: near base of leaf, e: above mid-leaf, f: costa near apex, g: chlorophyllose lamina). h–o. *Syrrhopodon japonicus* (Besch.) Broth. h, i: leaves; j–l: cells of leaf in surface view (j: around apex of hyaline lamina, k: at margin in mid-leaf, l: in chlorophyllose lamina); m–o: cross-sections of leaf (m: costa, n: chlorophyllose lamina, o: marginal rib in chlorophyllose limb). p–v. *Syrrhopodon loreus* (Sande Lac.) W.D. Reese p–s: leaf (p: diagram of whole leaf, with details of q; hyaline base and proximal chlorophyllose limb, r: apex, and s: distal hyaline base); t: cells at margin of leaf adjacent to apex of hyaline lamina; u, v: cross-sections of leaf (u: costa and chlorophyllose lamina, v: marginal rib in chlorophyllose limb). a–g Drawn from Tan & Navarez 84–492 (FH). h Drawn from Tan, Navarez & Amoroso 84–365 (BM). i, m–o Drawn from Gruezo 5798 (FH). j–l Drawn from Hadden s.n. (FH). p–t Drawn from Tan 91–108 pro parte (FH). u, v Drawn from Tan & Wijengco 85–105 pro parte (BM).

SPECIMENS EXAMINED. **Mindanao**, Bukidnon Province, trail to summit of Mt Kitanglad, 25–27 May 1984, *Tan, Navarez & Amoroso* 84–365 (BM, FH). **Negros**, Cuerno de Negros, 28 January 1937, *Magdamo* 1 (FH); *Magdamo* 12 (FH). **Palawan**, Mt Mantalingahan Range, Padparan, trail to Mt Inang Baboy Peak, 27 April 1979, *Gruezo* 5798 (FH).

Syrrhodon loreus (Sande Lac.) W.D. Reese in *Phytologia* **56**: 306 (1984).

Fig. 21p–v.

Calymperes loreum Sande Lac. in *Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk.* **13**(2): 7 (1873). Type: Borneo, Labuan, *Motley* s.n. (L-holotype).

Calymperes setifolium Hampe in *Besch. in Ann. Sci. Nat. Bot.* sér. 8, **1**: 304 (1895). Type: Philippines, Basilan, *Semper* s.n. (BM!-holotype).

Calymperes ebaloi E.B. Bartram in *Farlowia* **1**: 505 (1944). Type: Philippines, Zamboanga Prov., Mindanao, Lilimbrog Mountain, near Kabasalan, *Ebaloi* 664 (FH!-holotype).

Shoots 3–5 cm high, with a short, obscure stem. Leaves 6–>30(–>40) mm long, hair-like, erect, falcate or variously curving from a narrowly elliptical hyaline base; chlorophyllose limb notably constricted for a short distance above hyaline base; towards apex tapering to a long, fine, denticulate tip (Fig. 21p–s). Costa strong, excurrent or ending in leaf apex, largely smooth but often sparsely toothed near apex, superficial cells shortly rectangular, internally guide cells forming a single row between dorsal and ventral bands of stereids (Fig. 21u). Chlorophyllose lamina narrow, often undulate; from shoulders of leaf tapering proximally into the leaf base along either side of the hyaline lamina and gradually merging into the broad marginal ribs in the lower part of the leaf base; around shoulders of leaf cells towards margins slightly elongated, with the marginal row forming teeth or short spines (Fig. 21s, t); distally, from shoulders of leaf tapering or abruptly narrowing, virtually disappearing into costa, then broadening gradually above into long, linear limb (constricted region of lamina sometimes exceeding twice the length of the leaf base); towards apex tapering into the long, fine leaf tip; cells subquadrate to shortly rectangular (mostly longer than broad) or rounded, 5–15(–17) × 5–10(–12.5) μm, dorsally flat and smooth, ventrally flat to roundly protuberant (Fig. 21u). Hyaline lamina usually well-defined. Marginal ribs in proximal leaf base broad and flat, entire, composed of long, narrow, thick-walled cells, vanishing distally into chlorophyllose lamina; absent around leaf shoulders and below region of constricted lamina; above constriction narrow, polystratose, composed largely of a band of stereids adjacent to longitudinal rows of shortly to long rectangular chlorophyllose cells (sometimes forming a partial layer around the band of stereids) (Fig. 21g); some chlorophyllose cells forming large distant teeth, towards the leaf apex teeth becoming more closely set and sometimes double. Sporophytes reddish brown; seta 12–13 mm long; capsule 1.5–<2 mm long.

HABITAT. Mostly occurring on tree trunks in lowland rainforest.

DISTRIBUTION. An Indo-Pacific species. In the Philippines known from Luzon and Mindanao.

SPECIMENS EXAMINED. **Luzon**, Isabela Province, Sitio Digoyo, 17 April 1991, *Tan* 91–108 pro parte (FH); Quezon Province, Real, National Botanical Garden, 4 August 1985, *Tan & Wijangco* 85–105 pro parte (BM).

Syrrhodon loreus is distinguishable from other species in the Calymperaceae with long leaves by the possession (in combination) of the following features: a) a sharply defined hyaline lamina (Fig.

21s); b) acute, thick-walled marginal teeth adjacent to the distal hyaline lamina (Fig. 21s, t); c) the constriction of the chlorophyllose lamina just above the hyaline base (Fig. 21q); and d) a single row of guide cells in the costa (Fig. 21u).

Syrrhodon muelleri (Dozy & Molk.) Sande Lac., *Bryol. jav.* **2**: 224 (1870).

Fig. 22a–f.

Calymperidium muelleri Dozy & Molk., *Bryol. jav.* **1**: 51 (1856). Type: Java, *Holle* s.n. (BM!-isotypes?).

Shoots up to >1.5 cm high, forming stiffly bristled tufts and mats. Stems very short, obscure. Leaves stiffly erect to erecto-patent, 6–>12 mm long, consisting of a linear chlorophyllose limb arising from a narrowly subelliptical hyaline base (limb sometimes spirally twisted when dry); apex obtuse (rarely acute), entire or with one or two small teeth (Fig. 22a, b). Costa ending in apex, usually smooth above hyaline base sometimes some superficial cells projecting from their distal ends; internally with a single layer of guide cells (Fig. 22e); in upper leaf subtriangular in cross-section. Cells of chlorophyllose lamina quadrate to shortly rectangular or rounded-elliptical, 5–12.5 × 5–10 μm, obscured by a crown of low papillae or smooth, not protuberant (Fig. 22d, f). Leaf margin from base to near apex formed by a thick, entire, polystratose rib; above leaf shoulders terete in cross-section, consisting of a strand of stereids largely enclosed by a superficial layer of chlorophyllose cells (subrectangular in surface view) (Fig. 22d, f); below shoulders becoming flattened, superficial cells linear or undifferentiated. Gemmae sometimes produced from the ventral surface of the costal apex. Seta 11–14 mm long; capsules 1–1.4 mm long, reddish brown.

HABITAT. On tree trunks in lowland to mid-montane (c. 800 m) rainforest.

DISTRIBUTION. An Indo-Pacific species.

SPECIMENS EXAMINED. **Catanduanes**, 14 November 1917, *Ramos* 30609 (BM); **Luzon**, Isabela Province, Sitio Digoyo, 17 April 1991, *Tan* 91–108 pro parte (FH); Quezon Province, Real, National Botanical Garden, 4 August 1985, *Tan & Wijangco* 85–105 pro parte (FH); Quezon Province (Tayabas), Tagcauayan, *Foxworthy & Ramos* 13097 (BM); **Mindanao**, 1880, *Montano* s.n. (BM); *Montano* 192 (BM); **Palawan**, Mt Mantalingahan, between Nalpuan and Sandurapei, 26 April 1991, *Tan* 91–225 (BM); Palawan Province, Puerto Princesa, Barangay Irawan, Mt Malinao, 4 May 1993, *Tan* 93–336 (FH). **Sibuyan**, Magdiwang, Bo. Tampayan, Mt Giting-Giting, 21 May 1987, *Tan & Hernaez* 87–456 (FH).

Syrrhodon muelleri is distinguished from all other Malesian species by its erect, linear, largely entire leaves, with thick, subcylindrical marginal ribs composed of superficial chlorophyllose cells enclosing a core of stereids.

Syrrhodon parasiticus (Brid.) Besch. in *Ann. Sci. Nat. Bot.* sér. 8, **1**: 298 (1895).

Fig. 22g–k.

Bryum parasiticum Brid., *Muscol. recent.* **2**(3): 54 (1803). Type: Jamaica, *Swartz* s.n. (BM!-isotypes).

Syrrhodon wiemansii M. Fleisch., *Musc. Fl. Buitenzorg* **1**: 204, 210 (1904). Type: Java, Tjipannas, *Fleischer* s.n. (FH, H-isotypes?).

Calymperopsis wiemansii (M. Fleisch.) M. Fleisch. in *Biblioth. Bot.* **80**: 5 (1913).

Calymperopsis parasitica (Brid.) Broth., *Nat. Pflanzenfam.* 2nd ed., **10**: 235 (1924).

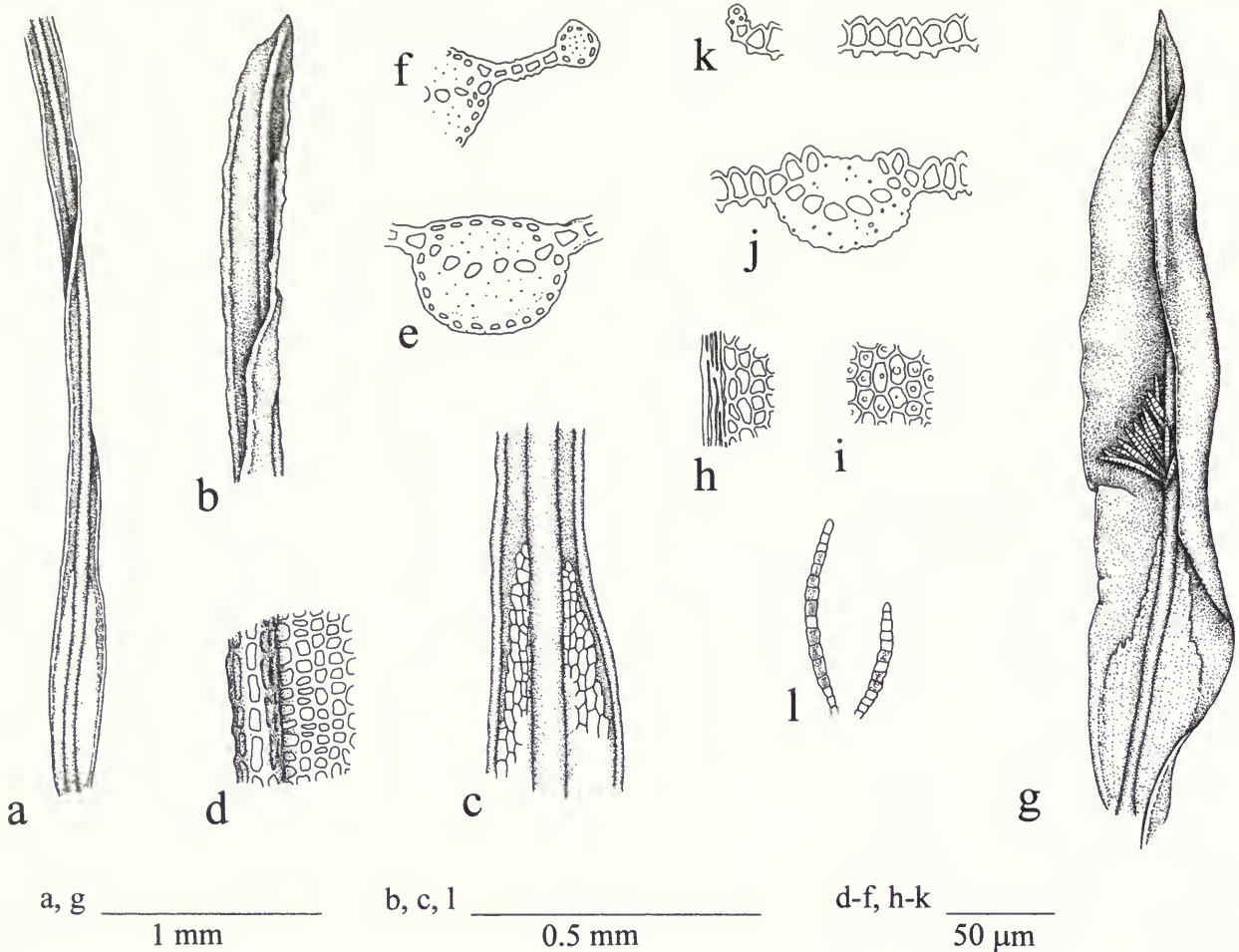


Fig. 22 a–f. *Syrrhopodon muelleri* (Dozy & Molck.) Sande Lac. a–c: leaf (detail a: from base to above mid-leaf, b: apex, c: distal hyaline base; d: cells of chlorophyllose lamina with marginal rib in surface view; e, f: cross-sections of leaf (e: costa, f: chlorophyllose lamina with marginal rib). g–k. *Syrrhopodon parasiticus* Brid. g: leaf in ventral view with gemmae; h, i: cells of leaf in surface view (h: at margin in mid-leaf, i: in chlorophyllose lamina (dorsal view)); j, k: cross-sections of leaf (j: costa, k: chlorophyllose lamina and marginal rib. a–f Drawn from Tan 91–225 (BM). g–k Drawn from Sumatra, Jacobson 11393b (BM).

Shoots 0.5–1.5 cm high, often densely matted with rhizoids below, forming mats. Leaves 3–4 mm long, consisting of an erect suboblong hyaline base narrowing slightly into a suberect to patent-reflexed (moist), lingulate to lanceolate chlorophyllose limb; leaf apex broadly acute, entire to subdenticulate (Fig. 22g). Costa ending in apex; mostly smooth with a surface largely composed of stereids; dorsal surface from just above hyaline base to midleaf (or beyond) often composed of quadrate to shortly rectangular, subacutely protuberant cells (sometimes forming only one or two rows along either side of the ventral surface in this region) (Fig. 22j). Chlorophyllose lamina often incurved; cells isodiametric to slightly longer than broad, with 4–6 sides or rounded-elliptical, 5–12.5(–15) × 5–8(–10) μm (Fig. 22i); ventrally acutely to subacutely protuberant (often tipped with a small papilla), dorsally unipapillose (Fig. 22k). Hyaline lamina sharply defined, with a long acute apex penetrating the chlorophyllose lamina. Leaf margins entire to subdenticulate; above hyaline base consisting of a thin, intermittent to continuous strand of stereids or substereids (Fig. 22h, k); in hyaline base consisting of a broad rib of linear, thin- to thick-walled cells (not continuous with strand in chlorophyllose limb but merging distally into the chlorophyllose

lamina). Gemmae long, filamentous, uniseriate (Fig. 22l); produced from rows of cells on either side of the ventral surface of the costa from slightly above the hyaline base to well beyond midleaf (Fig. 22g). Sporophytes rare, not seen in Philippine material.

HABITAT. On trunks of trees.

DISTRIBUTION. A nearly pantropical species. Tixier (1967) cites a Philippine specimen from Baguio in Luzon (as *Calymperopsis wiemansii* (M. Fleisch.) M. Fleisch.).

No other local specimens examined.

***Syrrhopodon rufescens* Hook. & Grev.** in *Edinburgh J. Sci.* 3: 227 (1826). Type: Singapore, Wallich 2271 (BM!-holotype). Fig. 23a–e.

Leucophanella rufescens (Hook. & Grev.) M. Fleisch., *Musc. Fl. Buitenzorg* 1: 200 (1904).

Shoots 1–>2 cm high, densely leaved, forming pale green cushions, often loosely matted with red rhizoids below. Leaves 1.5–>2 mm long, suberect to patent-recurved, lanceolate, 'v'-shaped in cross-

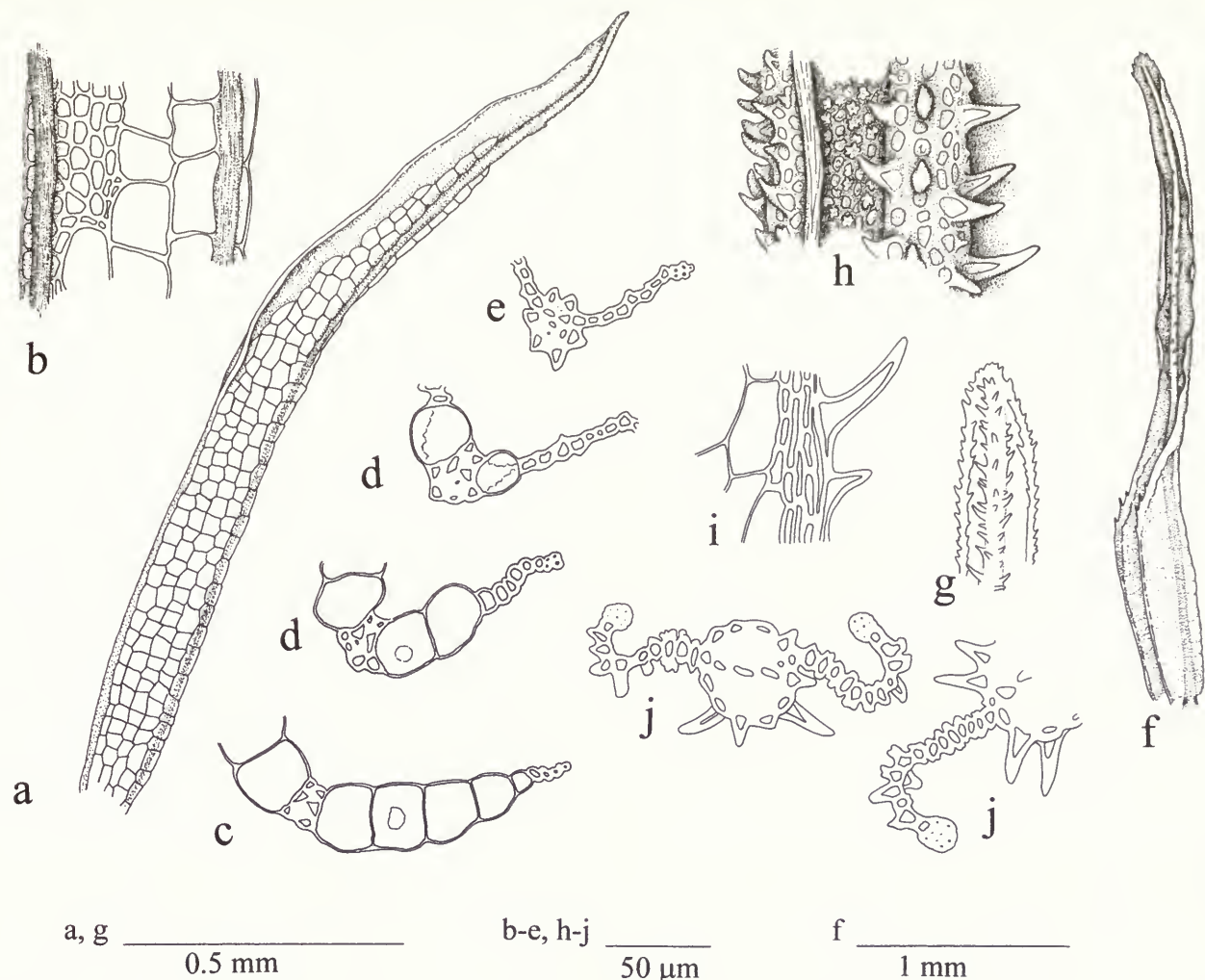


Fig. 23 a–e. *Syrrhopodon rufescens* Hook. & Grev. a, b: leaf (a: dorsal view, with b: detail of proximal chlorophyllose lamina); c–e: cross-sections of leaf in c: lower leaf, d: mid-leaf, and e: near apex. f–j *Syrrhopodon spiculosus* Hook. & Grev. f, g: leaf (f: ventral view, with g: detail of apex); h, i: cells of leaf (ventral surface) (h: in costa and blade of chlorophyllose limb, i: at margin of distal hyaline lamina); j: cross-section of chlorophyllose limb. a–e Drawn from *Elmer* 16843 (BM). f Drawn from Thailand, *Kerr* 456 (BM). g–j Drawn from Peninsular Malaysia, *Spare* 1726 (BM).

section, narrowing from above midleaf to an acute apex; largely composed of hyaline lamina (Fig. 23a). Costa thin, ending in apex, composed of a median layer of guide cells (about two cells wide) between dorsal and ventral bands of stereids, superficial cells differentiated (Fig. 23c–e), in distal leaf shortly subrectangular in surface view, many giving rise to teeth, toward leaf base elongated and smooth. Chlorophyllose lamina occupying less than one fifth of leaf length, narrowly to broadly tapering down either side of hyaline lamina, ceasing prior to midleaf, cells mostly quadrate to shortly rectangular, irregularly rounded-elliptical, mostly $6\text{--}12.5\text{--}(17.5) \times 6\text{--}10\ \mu\text{m}$ (Fig. 23b); dorsally and ventrally flat or protruding subacutely, often with an apical papilla. Hyaline lamina sharply defined, cells large, thin-walled, seldom more than about 5–6 rows on either side of the costa. Leaf margins often recurved for a short distance above midleaf; from leaf base to apex entire, consisting of a narrow, smooth unistratose or bistratose strand of stereids. Seta red, smooth, c. $6\text{--}8\ \text{mm}$ long; capsule erect, shortly cylindrical, c. $1\ \text{mm}$ long, yellowish brown with a red rim; operculum long-rostrate; peristome teeth c. $150\ \mu\text{m}$ long, usually with papillose longitudinal striations.

HABITAT. On trees in lowland forest.

DISTRIBUTION. A Malesian species.

SPECIMEN EXAMINED. Luzon, August 1916, *Elmer* 16843 (BM, BM-K).

Eddy (1990) points out the strong similarity between *Syrrhopodon rufescens* and *S. involutus*. At least one Philippine specimen (*Elmer* 16843) possesses the features apparently definitive of *S. rufescens* and is separable from the locally collected material of *S. involutus*. However, the relationship between these taxa needs further study using fresh material with peristomes in a good condition..

Syrrhopodon spiculosus Hook. & Grev. in *Edinburgh J. Sci.* 3: 226 (1825). Type: Singapore, *Wallich* [83 (H.1207)] (BM!-holotype; BM!-isotype).

Fig. 23f–j.

Shoots mostly 1–3(–4) cm high. Leaves 2–>4 mm long, consisting of an erect, narrowly elliptical, semisheathing hyaline base rapidly narrowing distally into a patent to spreading linear chlorophyllose limb with a blunt, dentate apex (Fig. 23f, g). Costa ending just below

apex; above hyaline leaf base on dorsal and ventral surfaces with long, distally pointing, acute spines (often in subtransverse rows) (Fig. 23h). Cells of chlorophyllose lamina isodiametric to longer than broad, with 4–6 sides or rounded-elliptical, mostly $5 \rightarrow 12 \times 5\text{--}8 \mu\text{m}$; drawn out dorsally and ventrally as erect, coronate-papillose projections (towards leaf apex often becoming more spinose and curving distally) (Fig. 23h, j). Hyaline lamina sharply defined. Leaf margins towards and at apex dentate; from above shoulders of leaf to a short distance below apex often incurved, consisting of an entire polystratose rib of stereids (Fig. 23h, j); from around shoulders of leaf to base composed of a flattened band of thick-walled, linear cells (continuous with rib in upper leaf), at shoulders giving rise to a row of long, acute spines (Fig. 23i), below shoulders entire. Sporophytes rare. Seta > 7 mm long; capsule cylindrical, *c.* 1–1.5 mm long.

HABITAT. On decaying logs, and trunks and twigs of trees in damp, shaded situations at low altitude.

DISTRIBUTION. A palaeotropical species with sporadic distribution. Reported for the Philippines by Bartram (1939), as a single collection from Panay.

No other local specimens examined.

Syrrhopodon tjibodensis M. Fleisch., *Musc. Fl. Buitenzorg* **1**: 209 (1904). Type: Java, Tjibodas, 1450 m, September 1899, *Fleischer (Musci Frond. Arch. Ind., ser. VI, exs. no. 261)* (BM!-isotype). Fig. 24j–n.

Syrrhopodon bartlettii E.B. Bartram in *Philipp. J. Sci.* **68**: 82 (1939). Type: Philippines, Luzon, Mountain Prov., Baguio, 25 March 1935, *Bartlett 13331* (FH!-holotype).

Calymperopsis tjibodensis (M. Fleisch.) M. Fleisch. in *Biblioth. Bot.* **80**: 5 (1913).

Shoots 0.5–1.5 cm high, densely leaved, forming dense mats. Leaves erect to spreading (moist), mostly 2–3.5 mm long, consisting of a shortly subrectangular hyaline base that narrows slightly distally into a broadly linear-lanceolate chlorophyllose limb (often curved (inner edge ventral) and/or longitudinally folded, i.e. 'v'-shaped in cross-section) (Fig. 24j); apex narrowly to broadly acute or apiculate, entire or with 1–2 small teeth. Costa ending in apex, smooth, dorsal and ventral surfaces formed by stereids (Fig. 24n). Cells of chlorophyllose lamina isodiametric to slightly longer than broad, with 4–6 sides or rounded-elliptical, mostly $7.5\text{--}15 \times 7.5\text{--}11 \mu\text{m}$; dorsally and ventrally slightly protuberant and strongly pleuripapillose (papillae often obscuring outlines of cells) (Fig. 24m, n). Hyaline lamina sharply defined with a somewhat truncate apex (Fig. 24k, l). Leaf margins entire, adjacent to apex of hyaline lamina often narrowly recurved (Fig. 24l); from below base of chlorophyllose limb to near apex consisting of a narrow rib of stereids (Fig. 24n); from between distal and mid-hyaline base to insertion composed of a flattened band of linear, thick-walled cells (about 3–5 cells wide, continuous with rib in upper leaf). Gemmae (fusiform-clavate) often produced from the ventral surface of the costa shortly above the apex of the hyaline lamina (Fig. 24k). Sporophytes apparently unknown.

HABITAT. On trunks of trees.

DISTRIBUTION. China, Indonesia (Java), Philippines. Bartram (1939) cites a specimen from Luzon (as *Syrrhopodon bartlettii*, see above).

SPECIMEN EXAMINED. Palawan, St Paul Bay, St. Paul Subterranean National Park, 25 May 1989, *Tan 89-1361* (FH).

Syrrhopodon tjibodensis is very similar to *S. parasiticus*, but is most easily distinguished by the possession of pleuripapillose cells forming the chlorophyllose lamina (Fig. 24m, n). In *S. parasiticus* these cells are ventrally protuberant (sometimes with a single papilla) and dorsally unipapillose (Fig. 22i, k).

Syrrhopodon trachyphyllus Mont., *Syll. Gen. Sp. Crypt.* **47** (1856).

Type: Singapore, *Gaudichaud*, Hb. Montagne (BM!-isotypes). Fig. 24a–i.

Syrrhopodon semperi Müll. Hal. in *Linnaea* **38**: 557 (1874). Type: Philippines, Luzon, 1861, *Semper s.n.* (BM!-isotype).

Shoots $< 0.5\text{--}1.5$ cm high, forming dense, low mats. Stems sometimes thickly matted with rhizoids towards base. Leaves about 2–3 mm long, consisting of a short, slightly tapering, broadly linear-rectangular, suberect to patent (when moist) chlorophyllose limb extending from a suberect, shortly oblong hyaline base; apex obtusely pointed to subcucullate (Fig. 24a–c). Costa ending just below or in apex, smooth; formed by dorsal and ventral strands of stereids separated by a unistratose layer of guide cells, superficial cells not differentiated (i.e. surface formed by stereids) (Fig. 24h). Cells of chlorophyllose lamina mostly isodiametric to slightly longer than broad, with 4–6 sides, $10\text{--}15\text{--}17.5 \times 8\text{--}12.5 \mu\text{m}$ (Fig. 24g); ventrally protruding subacutely and crowned with papillae; dorsally flat to slightly convex, with a crown of papillae (Fig. 24i). Hyaline lamina sharply defined. Leaf margins at leaf apex denticulate; above hyaline base to near leaf apex often erect to incurved, with a thin (often intermittent), usually entire polystratose rib composed of stereids (Fig. 24i); adjacent to apex of hyaline lamina becoming unistratose, often weak, sometimes giving rise to acute teeth or spines (Fig. 24e, f); in leaf base entire, formed by a flattened band of linear, thick-walled cells (Fig. 24d).

Sporophytes not seen.

HABITAT. Mostly on tree trunks, sometimes on rock.

DISTRIBUTION. A palaeotropical species. In the Philippines, apparently confined to Luzon.

No local specimens examined, apart from the type of *Syrrhopodon semperi*.

For a comparison of this species with *Syrrhopodon armatus* see under the description of the latter.

Eddy (1990) illustrates two specimens with different features as *Syrrhopodon trachyphyllus*. One has features which conform to the above description and match those of the type specimen, the second possesses costae with a superficial layer of papillose chlorophyllose cells and cells in the chlorophyllose lamina apparently narrower than those described above. The material on which the latter illustration is based may not represent *S. trachyphyllus* and plants with its features have yet to be recorded for the Philippines.

Syrrhopodon tristichus Nees ex Schwägr., *Sp. musc. frond. suppl.* **4**: 311b (1842). Type: Java, Hb. Nees (BM!-isotypes). Fig. 24o–t.

Syrrhopodon macrotristichus Broth. in *Leafl. Philipp. Bot.* **2**: 652 (1909). Type: Philippines, Luzon, Lucban, Tayabas Province, May 1907, *Elmer 7713* (BM!-isotype, NY-isotype).

Syrrhopodon victorianus E.B. Bartram in *Bernice P. Bishop Mus. Occ. Pap.* **19**(11): 222 (1948). Type: Fiji, Viti Levu, Mount Victoria, *Greenwood 1159* (FH-holotype).

Shoots 2–9 cm long, slender, occasionally branched, often matted

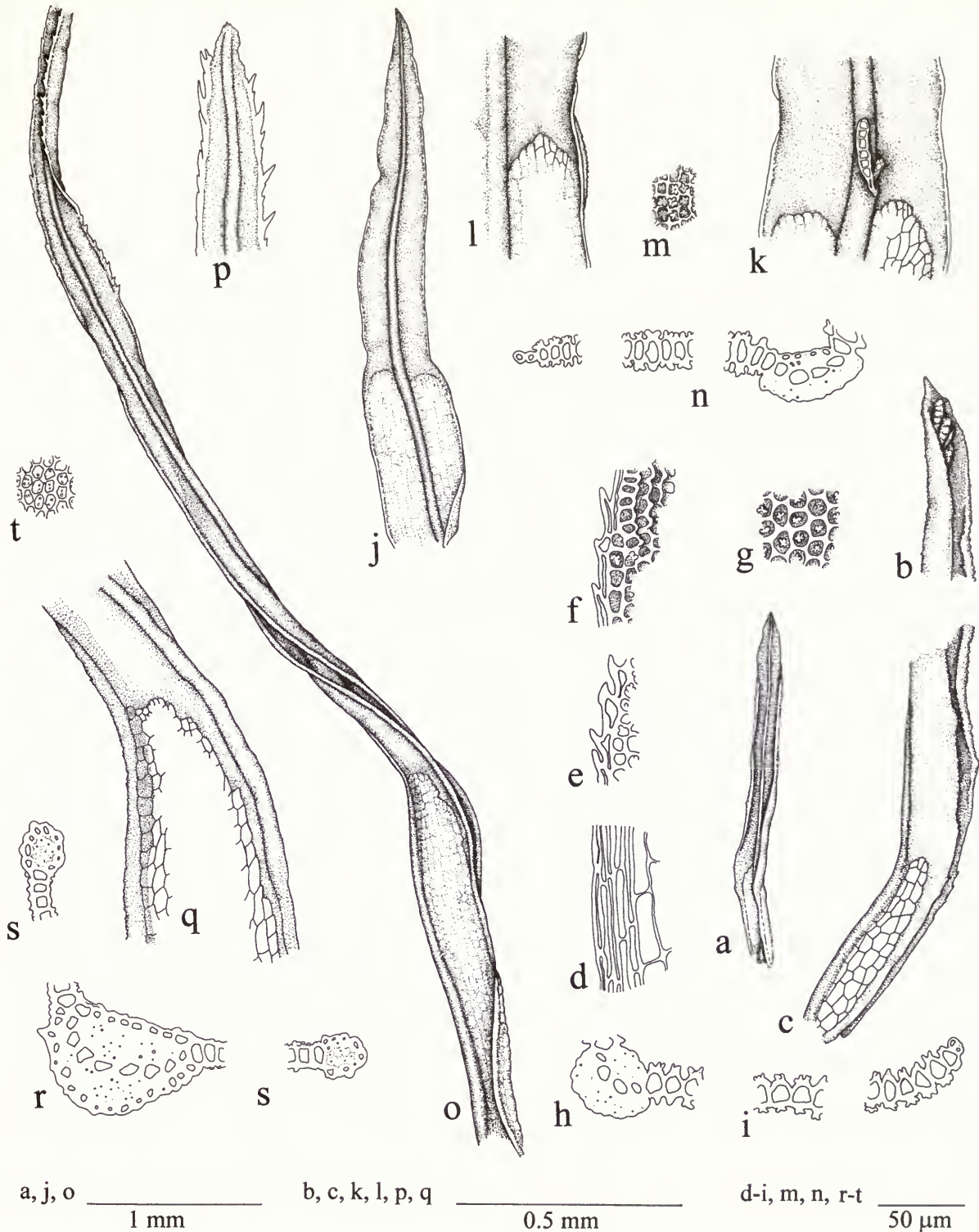


Fig. 24 a–i. *Syrrhopodon trachyphyllus* Mont. a–c: leaf (a: in ventral view, with details of b: apex in ventral view with gemmae, and c: of lower leaf); d–g: cells of leaf in surface view (d: at margin in proximal hyaline base, e, f: at margin adjacent to apex of hyaline lamina, g: in chlorophyllose lamina); h, i: cross-sections of leaf (h: costa, i: chlorophyllose lamina and marginal rib). j–n. *Syrrhopodon tjibodensis* M. Fleisch. j–l: leaf (j: in ventral view, with detail of region around apex of hyaline lamina k: in ventral view with gemmae, and l: in dorsal view showing recurved margin); m: cells of chlorophyllose lamina in surface view; n: cross-section of chlorophyllose limb. o–t. *Syrrhopodon tristichus* Nees ex Schwägr. o–q: leaf (o: in lateral view, with details of p: apex, q: distal hyaline base); r, s: cross-sections of leaf (r: costa, s: chlorophyllose lamina and marginal rib); t: cells of chlorophyllose lamina in surface view. a–d, f–i Drawn from Sarawak, *Bell* 2008 (BM). e Drawn from *Semper* s.n. (BM). j–n Drawn from *Tan* 89–1361 (FH). o–t Drawn from *Price* s.n. (FH).

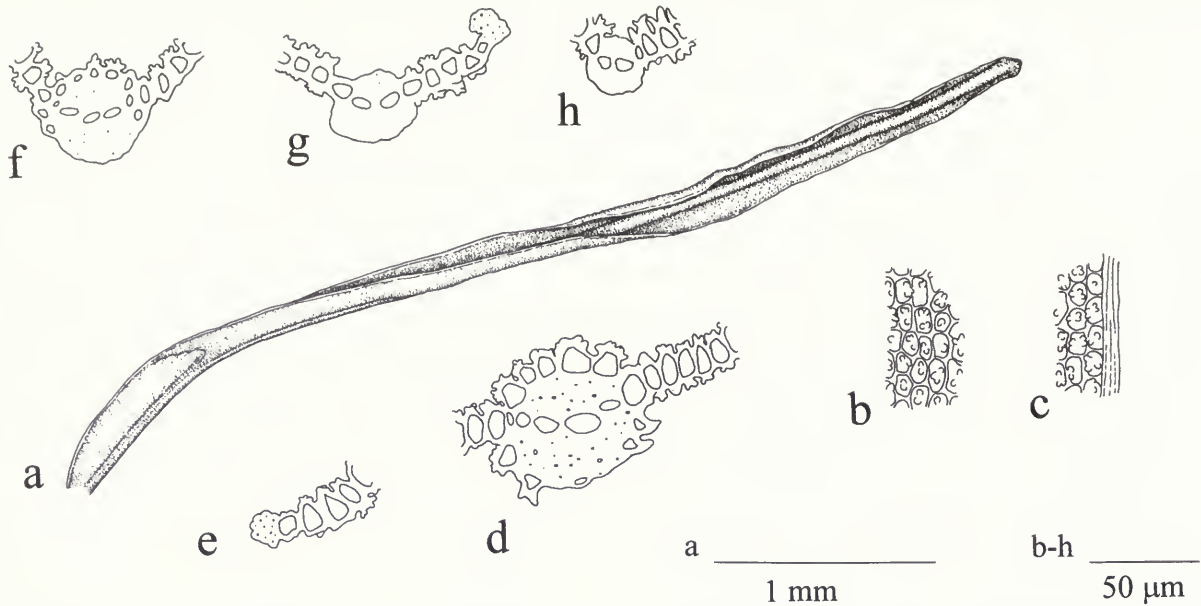


Fig. 25 a–e. *Syrrhopodon prolifer* var.? a: leaf; b, c: details of leaf surface (b: in chlorophyllose lamina, c: at margin of chlorophyllose lamina); d, e: cross-sections of chlorophyllose limb (d: costa, e: margin). f. *Syrrhopodon prolifer* var. *papillosum* (Müll. Hal.) W.D. Reese f: cross-section of costa in chlorophyllose limb. g. *Syrrhopodon prolifer* var. *albidus* (Thwait. & Mitt.) S. Orbán & W.D. Reese g: cross-section of chlorophyllose limb. h. *Syrrhopodon prolifer* var. *tosaensis* (Cardot) S. Orbán & W.D. Reese h: cross-section of costa in chlorophyllose limb. a–e Drawn from Tan & Hernaez 87–507 (BM). f Drawn from Venezuela, Funcke & Schlim 358 (BM). g Drawn from Sri Lanka, Thwaites 53 (BM). h Drawn from Japan, Iwatsuki, Sharp & Sharp 1044 (BM).

with rhizoids below. Leaves in three lax ranks (obscured by flexing of leaf limbs when dry), 4–11 mm long, bristle-like, mostly patent to recurved from an erect, long, narrowly oblong hyaline base; apex dentate, long and finely drawn out (Fig. 24o, p). Costa ending just short of leaf apex; superficial cells shortly to long rectangular, mostly smooth and flat, or with slightly projecting distal ends, sometimes forming teeth close to leaf apex; internally with a single row of guide cells between dorsal and ventral layers of stereids (Fig. 24r). Chlorophyllose lamina incurved to above mid-limb, forming a channel; composed of quadrate to subrectangular or irregularly rounded to elliptical, thick-walled cells, isodiametric or longer than broad, 8–17(–20) × 6–10 mm (Fig. 24t), each with a crown of low papillae on the dorsal and ventral surfaces (sometimes poorly developed) (Fig. 24s). Marginal ribs strong, continuous from leaf base to shortly below apex, a polystratose band of stereid or substereid cells; in proximal leaf base flattened and entire; around shoulders of leaf becoming thicker and more rounded in section (commonly reaching 30–38 mm wide); from above shoulders towards leaf apex gradually becoming thinner and more flattened (Fig. 24s); distally (from about mid-limb) giving rise to acute, forward pointing, often double teeth, towards leaf apex these are usually more closely set and more commonly single.

Sporophytes uncommon; seta 6–7 mm long; capsule 1.5–1.8 mm long.

HABITAT. Mostly occurring on tree trunks in rainforest.

DISTRIBUTION. A palaeotropical species.

SPECIMENS EXAMINED. **Basilan**, *Semper* s.n. (in Hb. Hampe, BM). **Luzon**, Rizal Province, April 1914, *Loher* 15164 (BM). **Mindanao**, Agusan Norte Province, Mt Hilong-Hilong, May–June 1984, *Tan & Navarez* 84–503 (BM). **Mindoro**, Baco, Mt Halcon, 17 April 1987, *Tan* 87–117 (BM); 18 April 1987, *Tan* 87–136 (BM). **Negros**, Negros Oriental Province, Dumaguete, Cuernos Mts, June 1908, *Elmer* 9768 (BM); May 1908, *Elmer* 9886 (BM). **Palawan**,

Motley s.n. (in Hb. Hooker, BM-K). **Panay**, Mt. Madyaas, 15–16 January 1987, *Price* s.n. (FH). **Sibuyan**, northern slope of Mt Giting Giting, near Mayo's Peak, 22 May 1987, *Tan & Hernaez* 87–509 (FH).

The leaves of *Syrrhopodon tristichus* have a superficial resemblance to those of *S. flammeonervis* Müll. Hal. In the latter the surface of the costa is undifferentiated, composed of stereids (Fig. 19f); in *S. tristichus* the costa possesses a superficial layer of rectangular chlorophyllose cells (surface view).

Excluded taxa

Mitthyridium luteum (Mitt.) H. Rob. – See under *M. papuanum*.

Mitthyridium undulatum (Dozy & Molke.) H. Rob. – There are no reliable records of *M. undulatum* from the Philippines. The specimens cited under this name by Bartram (1939) have subsequently been redetermined, mostly as *Mitthyridium fasciculatum*.

Three other taxa, *Calymperes crassinerve* (Mitt.) A. Jaeger*, *Mitthyridium junquilianum* (Mitt.) H. Rob.* and *Syrrhopodon prolifer* var. *albidus* (Thwait. & Mitt.) S. Orbán & W.D. Reese* have had the Philippines either mentioned in the discussion of a species range, or included in maps showing the geographical range of a species (Mohamed & Reese, 1985; Reese, 1987a, 1987b; Reese, Mohamed & Mohamed, 1986). There is no mention of a definitive Philippine specimen in these publications. Although the distribution pattern of these species suggests a high probability of their occurrence in the Philippines, we have opted to exclude them in this treatment owing to the lack of a voucher specimen documenting their presence in the country.

Syrrhopodon prolifer Schwägr. var. ? – *Syrrhopodon prolifer*, with its many varieties, was revised by Orbán & Reese (1990). A collection from Sibuyan Island, *Tan & Hernaez* 87–507 (BM), resembles a small form of the neotropical endemic *S. prolifer* var. *papillosum*

(Müll. Hal.) W.D. Reese. Shoots of *Tan & Hernaez* 87–507 have erect to recurved, green, linear leaves, about 3–5 mm long. The cells forming the ventral surface of the costa above the hyaline base are subquadrate to shortly subrectangular or rounded (in surface view) with compound papillae (Fig. 25d); cells in the chlorophyllose lamina (mostly 10–18(–22.5) × 10–12.5(–15) µm) are similarly crowned on their dorsal and ventral surfaces with compound papillae (Fig. 25b, e). The leaf margins adjacent to the apex of the hyaline lamina are entire to distantly denticulate. *Syrrhopodon prolifer* var. *papillosus* possesses erect to recurved, linear leaves, up to >7 mm long with a reddish brown costa. The cells forming the ventral surface of the costa above the hyaline base (Fig. 25f), and those forming the chlorophyllose lamina, are similar to those in *Tan & Hernaez* 87–507 (except the cells of the chlorophyllose lamina have slightly thicker walls). The leaf margins adjacent to the apex of the hyaline lamina are most often entire.

Syrrhopodon prolifer var. *albidus* (Thwait. & Mitt.) S. Orbán & W.D. Reese and *S. prolifer* var. *tosaensis* (Cardot) S. Orbán & W.D. Reese have an Asian distribution. In these varieties (and most others) the ventral surface of the costa is smooth (except at the leaf apex) and composed of stereids (Fig. 25g, h). Leaves of var. *tosaensis* are about 2–4 mm long, generally smaller than those in *Tan & Hernaez* 87–507, but possess similar laminal papillae. According to Orbán & Reese (1990), in var. *tosaensis*, the leaf margins adjacent to the apex of the hyaline lamina are consistently toothed. In var. *albidus* the leaves are 3–6 mm long, with entire leaf margins. The cells of the chlorophyllose lamina are similar in size and ornamentation to those of *Tan & Hernaez* 87–507, but are relatively thick-walled.

Tan & Hernaez 87–507 cannot be readily identified as any of the presently recognized varieties of *Syrrhopodon prolifer*. However, the authors are reluctant to describe a new variety on the basis of a single specimen.

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Accepted names are in roman and synonyms in *italic*; new names are in **bold**.

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Revision of *Hibiscus* section *Furcaria* (Malvaceae) in Africa and Asia

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SYNOPSIS. *Hibiscus* section *Furcaria* (Malvaceae) in Africa and Asia is revised. Three new species are described: *Hibiscus parvilobus* F.D. Wilson from Kenya, *Hibiscus reekmansii* F.D. Wilson from eastern Democratic Republic of Congo, Rwanda, Burundi, and western Tanzania, and *Hibiscus sineaculeatus* F.D. Wilson from Nigeria. Four taxa represent new combinations: *Hibiscus goossensii* (Hauman) F.D. Wilson, *Hibiscus partitus* (Hochr.) F.D. Wilson, *Hibiscus gillettii* subsp. *hiernianus* (Exell & Mendonça) F.D. Wilson and *Hibiscus gillettii* subsp. *lundaensis* (Baker f.) F.D. Wilson. *Hibiscus rostellatus* Guill. & Perr. and *Hibiscus persicifolius* Eckl. & Zeyh. are lectotypified.

INTRODUCTION

This treatment of *Hibiscus* section *Furcaria* DC. emend. Hochr. is intended to cover all of the known African taxa. The key also includes the Asian species which I have examined but does not include the two Indian species *H. hoshiarpurensis* T.K. Paul & M.P. Nayar and the (previously undescribed?) species of Bahadur *et al.* (1970) because herbarium material was not available for study.

Hibiscus section *Furcaria* is a natural group of over 100 known species, set apart from species in other sections of the large genus *Hibiscus* by having a calyx with a thickened, rigid midrib and two thickened marginal (or near-marginal) ribs (Wilson, 1994). The sectional name refers to the bifurcate apex of the involucellar bracteoles (epicalyx) of some species. Species are distributed mostly in tropical and subtropical areas of the world but a few penetrate also into the temperate zone (to c. 35°N in North America and 35°S in Australia). Species occur in subsaharan Africa and associated islands, on the Indian subcontinent, southeastern Asia, Australia, islands of the Pacific Basin (including New Zealand), the West Indies, and in North, Central and South America. They occur in a variety of habitats, from grasslands to savannas, forests, and marshes. Some are attuned to a wet-dry precipitation cycle, avoiding the dry cycle by either having an annual habit or going dormant. Others are adapted to a fire climax, in which new shoots arise from a protected crown after a fire. Still others are adapted to a more-or-less uniform rainfall regime; some prefer marshy environments (e.g. *H. diversifolius*). Most are frost-sensitive but at least one species, *H. aculeatus* Walter, is adapted to the warm-cold seasonal cycle of the Gulf and Atlantic coastal plains of the southeastern United States. Growth habits vary from small, herbaceous annuals to shrubs, vines, and trees.

Species have showy, delicate flowers which vary considerably in size; some have potential as ornamentals. Flower colours vary from pure white to various shades of cream, yellow, pink, red, lavender, and purple. Flowers of all species have a red to purple centre (basal petal spot), although mutants have been found which lack this feature. Flowers are adapted to a variety of pollinators; some have rotate, fully opened flowers, others have tubular, pendent flowers. Some have included stigmas and are obviously well adapted for self pollination. Others have exerted stigmas which require cross pollination. The red salverform flower of one Mexican species, *Hibiscus uncinellus* DC., presumably is adapted to hummingbird pollination.

The two most important species of commerce are *Hibiscus cannabinus*, 'kenaf', and *H. sabdariffa*, 'roselle' (Wilson & Menzel, 1964). Kenaf is a rapidly growing, tall annual fibre plant. The bast (bark) fibres are used mainly for cordage, including twine, rope, and burlap. The bast and woody fibres together are used for paper-pulp, and the woody fibres are used for poultry litter, packing materials, and mulch (Taylor, 1992). Other potential uses include animal bedding, an oil and water sorbent, a horticultural medium, an enhancer of bioremediation in breaking down pollutants, construction boards, textile fibres for blending with other fibres, a component of moldable fibre/resin composites, and as mats to protect forest seedlings (Goforth & Fuller, 1994; Werber, 1993). Young kenaf plants afford a nutritious livestock forage (Perry *et al.*, 1993).

Leaves, flowers, and seeds are used for food, the seed oil has various food uses and various parts of the plant are used in folk medicines (Dalziel, 1948; Duke & duCellier, 1993).

The commercial cultivars of roselle fall into one of two categories, edible or fibre. The edible cultivars are small, branched annuals which possess fleshy calyces used for making sauces and drinks and for a number of other food uses. Various parts of the plant are used in folk medicines. The fibre cultivars are tall, unbranched annuals from which the bast fibre is extracted for cordage (Crane, 1949; Dalziel, 1948; Duke & duCellier, 1993). A number of species other than kenaf and roselle are also used as fibre, food or medicines by native peoples. The leaves, particularly when young, have an agreeable acid taste (e.g. *Hibiscus acetosella*) and are used as salad or cooked as spinach (Dalziel, 1948).

MATERIALS AND METHODS

Herbarium specimens and living plants in nature, experimental gardens, and glasshouses formed the basis for this study. The late Margaret Y. Menzel and I, at various times, borrowed herbarium material or solicited assistance from the curators of the following herbaria (Holmgren *et al.*, 1990): ASU, B, BM, BOL, BR, BSD, CAL, EA, FSU, G, K, LISC, LISU, MEL, NA, NBG, P, PAL, PRE, S, SRGH, TCD, TEX. I studied living plants in their native habitats in Kenya and Tanzania (Wilson, 1978) and deposited vouchers of 63 accessions in one or more of the following herbaria: ASU, EA, NA. Plants grown from seeds were studied in experimental gardens and glasshouses at USDA-ARS Research Laboratories at Lake Worth, Palm Beach Co., Florida, and at Phoenix, Maricopa Co., Arizona and also at Florida State University, Tallahassee, Leon Co. Over 60 000 interspecific pollinations were made and more than 140 different interspecific hybrids were produced (Menzel, 1986).

Herbarium specimens examined are listed, insofar as possible, from west to east and from north to south under each taxon. Distribution maps were prepared for all of the African taxa except for those that are mainly cultivated (*Hibiscus acetosella*, *H. radiatus*, *H. sabdariffa*).

GENOME RELATIONSHIPS

The basic chromosome number for the section is $x = 18$. Diploid, tetraploid, hexaploid, octoploid, and decaploid species exist in nature (Menzel & Wilson, 1969; Wilson, 1994). All of the polyploid species studied thus far are allopolyploid. Thirteen genomes have been confirmed or postulated (A, B, C, D, E, G, H, J, P, R, V, X, Y), either through the study of chromosome pairing in interspecific hybrids or through electrophoresis (Menzel, 1986; Wilson, 1994).

The greatest genomic diversity is found in subsaharan Africa; nine of the 13 genomes are represented (A, B, C, D, E, G, H, X, Y) and nine of the 10 confirmed diploid species occur there (all except *Hibiscus costatus* A. Rich. from Mexico, Central America, and the Caribbean). Tetraploid and octoploid species occur also in Africa.

Diploid, tetraploid, and octoploid species occur in India and south-eastern Asia. The eight confirmed diploid species carry genomes designated as follows: 'A' (*H. asper*, *H. cannabinus*, and *H. greenwayi*); 'B' (*H. surattensis*); 'G' (*H. sudanensis*); 'X' (*H. gillettii* subsp. *hiernianus*, *H. mastersianus*); 'Y' (*H. mechowii*). The ninth diploid, *H. berberidifolius*, carries an unknown genome, presumably different from the other African diploid genomes. Analysed African tetraploids carry 'AB' (*H. acetosella*), 'AX' (*H. nigricaulis*), 'AY' (*H. sabdariffa*), and 'GH' (*H. rostellatus*). Analysed or partially analysed African octoploid species carry 'CDE' and a modified 'G' (*H. diversifolius*), or 'BG' and two unidentified genomes (*H. altissimus*). *Hibiscus surattensis*, the African 'B' genome diploid, is found also in India and southeastern Asia. *Hibiscus diversifolius*, the 'CDEG' octoploid, is found in some parts of southeastern Asia. The only two other analysed Indian species are the 'AB' tetraploid *H. radiatus* and the octoploid, *H. hispidissimus*, which carries 'BG' and two unidentified genomes.

The diploid African and Asian species display characteristic morphological patterns based upon the four major diagnostic characters used in the key and correlated with their genome structure. The four major diagnostic characters are as follows: 1) stems aculeate (+) or not aculeate (-); 2) peduncles articulating nearer the summit (+) or nearer the base (-); 3) involucellar bracteoles forked (bifurcate) (+) or simple (-); 4) nectary on the calyx midrib present (+) or absent (-). The patterns are: 'A': (+ -- +); 'B': (++ + -); 'G': (+ - + -); 'X': (- - + -); 'Y': (+ - - -). In *Hibiscus berberidifolius*, the African diploid with an unknown genome, the most common pattern is the same as that of the 'Y' genome *H. mechowii*, but some plants, having a calyx nectary, show the 'A' pattern.

NATURAL HYBRIDS AND INTROGRESSANT FORMS

I examined a number of sheets which I and/or others interpreted as natural hybrids or introgressant forms. This interpretation is of course subjective, but my extensive experience with experimental hybrids assisted me materially. The most common hybrid or introgressant forms involved the closely related species *Hibiscus asper* and *H. cannabinus* (both 'A' genome diploids), interpreted as follows:

H. asper × *cannabinus*: **Angola**, Welwitsch 5268 (BM); **Democratic Republic of Congo**, Symoens 7321 (BR), Vanderyst 1833 (BR); **Chad**, Fotius 1081 (K), Palayer 421 (P); **Senegal**, Berhaut 4551 (P).

H. asper introgressed with *H. cannabinus*: **Mali**, Chevalier 24919 (P); **Guinea**, Berhaut 4175 (P); **Niger**, Boudet 4980 (P); **Nigeria**, Latilo & Eimuenze FHI 6540 (K).

H. cannabinus introgressed with *H. asper*: **Tanzania**, Schlieben 2218 (BM); **Ethiopia**, Welby s.n. (P).

Other putative hybrids and introgressive types were interpreted as follows:

Hibiscus asper × *noideae*(?): **Democratic Republic of Congo**, DeLoose 203 (BM); **Cameroon**, deWilde & deWilde-Duyfjes 3751 (BR).

H. cannabinus × *nigricaulis*(?): **Mozambique**, Barbosa 1086 (BM, LISC); Garcia 490A (LISC). [NOTE. Barbosa 1086 at BR is *H. nigricaulis*]; [see Gonçalves, L.M. in *Mem. Junta Invest. Ultram.* 2nd ser., 41: 57–159 (1963)].

H. cannabinus × *acetosella*: **Central African Republic**, Chevalier 6914 (G, P); **Angola**, Welwitsch 5269 (BM); **Tanzania**, Wilson & Kissie 7562 (NA); **Uganda**, Jackson 462 (BR).

H. diversifolius × *nigricaulis*(?): **Democratic Republic of Congo**, Hauman 3 (BR).

H. diversifolius × *cannabinus*(?): **Democratic Republic of Congo**, Hulstaert 1472 (BR).

H. sabdariffa × ? : **Democratic Republic of Congo**, Dechamps 13088 (BR).

H. acetosella introgressed with *H. mechowii* or *H. sabdariffa* (?): **Zambia**, Mutimushi 1949 (K).

H. nigricaulis × ? : **South Africa**, Transvaal, Scheepers 327 (PRE).

H. sudanensis × ? : **Democratic Republic of Congo**, Becquet 108 (BM, BR).

THE INDIAN SPECIES OF *HIBISCUS* SECTION *FURCARIA*

Only one of the species which occur in India, *Hibiscus surattensis*, is native to both India and Africa. Two others, *H. cannabinus* and *H. sabdariffa*, are cultigens developed from wild African ancestors. One, *H. mastersianus* (including *H. beddomei*), is native to Africa and apparently adventive in India. *Hibiscus hispidissimus* is native to India and adventive or cultivated in South Africa. *Hibiscus radiatus* may have originated in India as a hybrid between *H. cannabinus* and *H. surattensis* but is now widely cultivated in the Old World and New World tropics (Wilson & Menzel, 1964; Menzel, 1986). *Hibiscus furcatus* Willd. occurs in India and Thailand. *Hibiscus hoshiarpurensis* and the (previously undescribed?) species called *H. furcatus* Roxb. (= *H. hispidissimus* Griff.) by Bahadur *et al.* (1970) are apparently indigenous in India.

Seven of the species which occur in India are included in the key, but *Hibiscus hoshiarpurensis* and the Bahadur *et al.* species are not because herbarium material was unavailable to me. The two introduced cultigens, *H. cannabinus* and the fibre form of *H. sabdariffa*, have aculeate stems, peduncles articulating nearer the base, unforked bracteoles, and calyx nectaries (the 'A' genome pattern). Four native species, *H. surattensis*, *H. hispidissimus*, *H. furcatus*, and *H. radiatus*, have aculeate stems, peduncles articulating nearer the epicalyx, forked bracteoles, and lack calyx nectaries (the 'B' pattern). The adventive *H. mastersianus* (including *H. beddomei*) and the native *H. hoshiarpurensis* have non-aculeate stems, peduncles articulating nearer the base, forked bracteoles, and lack calyx nectaries (the 'X' pattern). Finally, the species of Bahadur *et al.* (1970) has aculeate stems, peduncles articulating nearer the base, forked bracteoles, and lacks calyx nectaries (the 'G' pattern). Furthermore, this species occurs on the Upper Gangetic Plain (Dehra Dun and Tehri-Gharwal), whereas the true *H. hispidissimus* occurs in central and southern India and in Sri Lanka.

TAXONOMIC TREATMENT

Description of *Hibiscus* section *Furcaria*

Hibiscus section *Furcaria* DC., *Prodr.* 1: 449 (1824); emend Hochr. in *Annuaire Conserv. Jard. Bot. Genève* 4: 101 (1900). Lectotype

species: *Hibiscus surattensis* L. (Borssum Waalkes, 1966: 57). Fryxell (1988: 195) noted that Kearney had chosen *H. furcellatus* Desr. as lectotype but that this name was inadmissible.

Hibiscus section *Sabdariffa* DC., *Prodr.* 1: 453 (1824).
Furcaria Kostel., *Allg. Med. Pharm. Fl.* 5: 1856 (1836).
Sabdariffa Kostel., *Allg. Med. Pharm. Fl.* 5: 1856 (1836).
Hibiscus section *Furcaria* subsection *Furcaria simplicia* Hochr. in *Annuaire Conserv. Jard. Bot. Genève* 4: 41 (1900), pro parte.
Hibiscus section *Furcaria* subsection *Furcaria typica* Hochr. in *Annuaire Conserv. Jard. Bot. Genève* 4: 41 (1900), pro parte.
Hibiscus section *Furcaria* series *Friesia* Ulbr. in Engl., *Pflanzenw. Ost-Afrikas* 3(2): 402 (1921), pro parte.
Hibiscus section *Furcaria* series *Furcaria cannabina* Ulbr. in Engl., *Pflanzenw. Ost-Afrikas* 3(2): 400 (1921), pro parte.
Hibiscus section *Furcaria* series *Furcaria furcellata* Ulbr. in Engl., *Pflanzenw. Ost-Afrikas* 3(2): 400 (1921), pro parte.
Hibiscus section *Furcaria* series *Furcaria diversifolia* Ulbr. in Engl., *Pflanzenw. Ost-Afrikas* 3(2): 402 (1921), pro parte.
Hibiscus section *Furcaria* series *Furcaria sabdariffa* Ulbr. in Engl., *Pflanzenw. Ost-Afrikas* 3(2): 402 (1921), pro parte.
Hibiscus section *Furcaria* series *Saxicolae* Ulbr. in Engl., *Pflanzenw. Ost-Afrikas* 3(2): 403 (1921), pro parte.
Hibiscus [sect.] *Cannabini* Small, *Man. s.e. fl.*: 854 (1933).
Hibiscus [sect.] *Furcellati* Small, *Man. s.e. fl.*: 854 (1933).

Annual herbs, perennial *subshrubs*, *shrubs*, *trees*, or *vines*. Stems and other plant parts often aculeate. Stems, leaves, peduncles, and floral parts glabrous or variously pubescent. Leaves alternate, the basal leaves usually petiolate, apical ones sometimes sessile and reduced to linear bracts; leaf shape variable, from entire to variously palmately lobed, even on the same plant; often with conspicuous foliar nectaries borne basally on the adaxial surface of the midrib (and sometimes also on secondary ribs). Flowers axillary, solitary, borne in racemes by the reduction or abortion of upper leaves, in clusters at the tips of branches, or in few- to many-flowered sympodia. Peduncles articulated at or near the base, or above the base, often accrescent. Involucellar bracteoles 5–22, free or connate at the base, linear to subulate, simple, channelled, or variously bifurcate at the apex. Calyx gamosepalous, 5-lobed, persistent, leathery or woody in fruit (fleshy in edible forms of *H. sabdariffa*), glabrous or variously pubescent, each lobe with a more or less thickened midrib and two marginal (or near marginal) ribs, the midrib often with a conspicuous nectary. Corolla usually delicate, often large and showy; petals varying in colour from white to various shades of yellow, pink, red, lavender and purple, and usually with a reddish to purple petal spot at the base. Staminal column shorter or longer than the petals, variously coloured. Style exceeding the staminal column, 5-branched above, each branch surmounted by a capitate stigma. Capsule 5-celled, loculicidally dehiscent, glabrous to densely appressed-pubescent (some South American species have glandular hairs on the capsule). Seeds reniform to angular, often scaly or variously marked, but rarely pubescent. Basic chromosome number, $x = 18$.

Key to African and selected Asian taxa of *Hibiscus* section *Furcaria*

- 1 Stems aculeate 2
- Stems not aculeate 28
- 2 Involucellar bracteoles clearly or obscurely bifurcate 3
- Involucellar bracteoles not bifurcate 15

- 3 Calyx nectary absent 4
- Calyx nectary present 14
- 4 Stipules ovate, auriculate, amplexicaul 1. **H. surattensis**
- Stipules linear to subulate, not amplexicaul 5
- 5 Peduncle articulated closer to epicalyx than to base 6
- Peduncle articulated at base, near base, or apparently unjointed 11
- 6 Calyx lobes with reticulate venation and simple to 4-fid bristles on enlarged bases on ribs, otherwise almost glabrous ... 2. **H. altissimus**
- Calyx lobe venation not as above 7
- 7 Lower and mid-plant leaves entire or shallowly lobed 8
- Lower and mid-plant leaves deeply palmately lobed 9
- 8 Leaves with patches of lanate pubescence; stems stellate-pubescent .
..... 3. **H. furcellatoides**
- Leaves without lanate pubescence; stems hirsute with simple hairs to 3 mm long 4. **H. rostellatus**
- 9 Peduncles to 10(–13) cm long in fruit; stems with stout, retrorse aculei on large bases 5. **H. hispidissimus**
- Peduncles ≤ 5 cm long in fruit; stems more finely aculeate or aculeolate 10
- 10 Peduncles to 5 cm long, articulating 8 mm below epicalyx; ribs of adaxial leaf surface finely and coarsely stellate-pubescent
..... 6. **H. goossensii**
- Peduncles to 2 cm long, articulating ≤ 5 mm below epicalyx; ribs of adaxial leaf surface with mostly simple (some to 4-fid) hairs
..... 7. **H. furcatus**
- 11 Foliar nectary present 12
- Foliar nectary absent 13
- 12 Mid-plant leaves not lobed; peduncle articulating near base to 1/3 the distance from base to epicalyx 8. **H. sudanensis**
- Mid-plant leaves deeply 3-lobed, midlobe markedly longer than lateral lobes; peduncle articulating at base or appearing unjointed
..... 9. **H. flavo-roseus**
- 13 Stems above glabrate to finely aculeate; leaves glabrate
..... 10. **H. radiatus**
- Stems above with stout retrorse aculei and a line of stellate pubescence; leaves scabrous 11. **H. torrei**
- 14 Involucellar bracteoles clearly bifurcate, outer fork 3–6 mm long, not reflexed, inner fork 1–6 mm long, linear to subulate; peduncles articulating above the base, aculeolate and sparsely puberulent above the joint, densely fine-pubescent below the joint 12. **H. noldeae**
- Involucellar bracteoles obscurely bifurcate, outer fork 2 mm long, reflexed, inner fork vestigial or absent; peduncles articulating at base or appearing unjointed, aculeate and stellate-pubescent throughout
..... 13. **H. nigricaulis**
- 15 Calyx nectary absent 16
- Calyx nectary present 18
- 16 Upper 6–11 mm of involucellar bracteoles lanceolate; leaves throughout the plant deeply palmately 3–5-lobed 14. **H. mechowii**
- Upper part of involucellar bracteoles not lanceolate; leaves entire to shallowly lobed 17
- 17 Peduncle articulating midway between base and epicalyx; leaves densely stellate-pubescent throughout 15. **H. subdiversifolius**
- Peduncle articulating at base or apparently unjointed; leaves with

- simple and stellate hairs on veins, otherwise almost glabrous
 16. **H. berberidifolius**
- 18 Stems with large stout aculei 19
 Stems more finely aculeate or aculeolate 23
- 19 Aculei borne at the base of stem nodes singly, in pairs, or in threes;
 leaves to 2 × 4 cm, shed early 17. **H. sparseaculeatus**
 Aculei borne ± randomly on the stem; leaves larger, persistent 20
- 20 Calyx densely and finely stellate-pubescent, sparsely aculeate on ribs;
 midlobes and lateral lobes of lower leaves rotund to spatulate
 18. **H. greenwayi**
 Calyx with rigid bristles; leaf lobes not rotund or spatulate 21
- 21 Calyx aculeate or aculeolate on the ribs; lobes of lower leaves mani-
 festly secondarily lobed 19. **H. partitus**
 Calyx not aculeate or aculeolate on the ribs; leaf lobes not manifestly
 secondarily lobed 22
- 22 Stems usually with one or more longitudinal lines of pubescence;
 flowers yellow 20a. **H. diversifolius** subsp. **diversifolius**
 Stems more densely and uniformly hairy; flowers reddish to purple .
 20b. **H. diversifolius** subsp. **rivularis**
- 23 Some flowers subtended by a linear, flattened, sometimes bifid bract
 resembling the stipules; leaves deeply 5(–7)-lobed, midlobes and lateral
 lobes of lower leaves often secondarily lobed 21. **H. reekmansii**
 Flowers without a subtending bract; leaves variously lobed, but not
 secondarily lobed 24
- 24 Involucellar bracteoles subulate to triangular, length:base width ratio
 3:1 or less, upper 3–6 mm channelled on the inner (ventral) surface .
 22. **H. sabdariffa**
 Involucellar bracteoles generally narrower, length:base width ratio
 >3:1, inner surface not channelled 25
- 25 Vegetative branches in leaf axils well-developed, with up to 7 persistent
 leaves; newly opened leaves with a gland-like structure at apex of each
 leaf margin serration; leaves entire to shallowly 3-lobed
 16. **H. berberidifolius**
 Vegetative branches not as well-developed; gland-like structure not
 present; leaves variously lobed 26
- 26 Calyx with white, woolly tomentum basally, or more uniformly distrib-
 uted; capsule with long, dense appressed pubescence
 23. **H. cannabinus**
 Calyx without white woolly tomentum; capsule pubescence various .
 27
- 27 Calyx with bristly simple hairs on ribs, almost glabrous between ribs;
 capsule with long, dense appressed pubescence 24. **H. parvilobus**
 Calyx with antrorse aculei or pigmented short, coarse bristles on
 enlarged bases; capsule with short, sparse appressed pubescence
 25. **H. asper**
- 28 Involucellar bracteoles manifestly to obscurely bifurcate; calyx nectary
 absent or present 29
 Involucellar bracteoles not bifurcate; calyx nectary present 36
- 29 Calyx and foliar nectaries present; leaves glabrate, sometimes red ...
 26. **H. acetosella**
 Calyx nectary absent, foliar nectary absent or present; leaves glabrate to
 pubescent, green 30
- 30 Foliar nectary absent; leaves glabrate 10. **H. radiatus**
 Foliar nectary present; leaves pubescent 31
- 31 Inner fork of involucellar bracteoles ± twice as long as outer fork . 32
 Inner and outer forks of involucellar bracteoles ± of equal length . 34
- 32 Calyx lobes acute to slightly acuminate in fruit; length:width ratio of
 midlobe of mid-plant leaves 1:1 to 3:1 33
 Calyx lobes long-acuminate in fruit; length:width ratio of midlobe of
 mid-plant leaves c. 4:1 27c. **H. gillettii** subsp. **lundaensis**
- 33 Length:width ratio of midlobe c. 2:1 to 3:1; outer fork of involucellar
 bracteoles 2–4 mm long, inner fork 6–9 mm long
 27a. **H. gillettii** subsp. **gillettii**
 Length:width ratio of midlobe c. 1:1; outer fork of involucellar bracteoles
 1.5–3 mm long, inner fork 4–5 mm long
 27b. **H. gillettii** subsp. **hiernianus**
- 34 Stems lanate-pubescent, patchy below, continuous above; lower leaves
 deeply 3- to 5-lobed (ratio of base to apex: base to sinus c. 5:1)
 28. **H. mixicoensis**
 Stems not lanate-pubescent; lower leaves shallowly to moderately 3- to
 5-lobed (ratio of base to apex: base to sinus c. 1.3:1 to 2:1) 35
- 35 Stems finely stellate-pubescent and with coarse stellate hairs; lower
 leaves moderately 5-lobed (ratio of base to apex: base to sinus c. 2:1),
 without a foliar nectary 29. **H. cuanzensis**
 Stems with stiff, simple to 3-fid or stellate pigmented bristles on
 enlarged bases; lower leaves shallowly 3-lobed (ratio of base to apex:
 base to sinus c. 1.3:1), with a foliar nectary 30. **H. mastersianus**
- 36 Calyx fleshy in fruit; involucellar bracteoles broadly subulate to trian-
 gular, upper 3–6 mm channelled on the inner (ventral) surface
 22. **H. sabdariffa**
 Calyx not fleshy in fruit; bracteoles narrower, not channelled 37
- 37 Stipules divided into 2 or 3 filiform or linear segments; involucellar
 bracteoles filiform to narrowly linear; all leaves linear; foliar nectary
 absent 31. **H. elongatifolius**
 Stipules simple; involucellar bracteoles linear to subulate; at least lower
 leaves broader or palmately lobed; foliar nectary present 38
- 38 Involucellar bracteoles subulate, c. 2 mm wide at the base, apex pointed;
 calyx finely stellate-pubescent and with simple to stellate stiff bristles
 on enlarged red bases 32. **H. sineaculeatus**
 Involucellar bracteoles linear, c. 1 mm wide at the base, apex narrowly
 lanceolate; calyx densely and finely stellate-pubescent, not bristly
 33. **H. scotellii**
1. **Hibiscus surattensis** L., *Sp. pl.* 2: 696 (1753). Type: India, Surat,
Herb. Linn. 875.29 (LINN-holotype).
Furcaria surattensis Kostel., *Allg. Med. Pharm. Fl.* 5: 1856 (1836).
Hibiscus surattensis var. *genuinus* Hochr. in *Annuaire Conserv. Jard. Bot. Genève* 4: 111 (1900), nom. illeg. (Art. 26.2).
 Hochreutiner (1900) lists synonymy for *H. surattensis* sens. strict.
 (var. *genuinus*), which will not be repeated here.
Hibiscus surattensis var. *villosus* Hochr. in *Annuaire Conserv. Jard. Bot. Genève* 4: 112 (1900).
Hibiscus surattensis var. *villosus* Backer, *Fl. Batavia* 1: 128 (1907),
 non Hochr. (1900).
Hibiscus surattensis var. *villosus* forma *concolor* Backer, *Fl. Batavia*
 1: 129 (1907). Type: Indonesia, Java, Tandjungpriok, *Backer*
 32783 (BO-isotype).
Hibiscus furcatus Craib, *Fl. siam.* 1: 157 (1925), non Roxb. (1814),
 pro parte quoad specim. *Marcan* 1517.
Hibiscus surattensis forma *immaculata* Kurz ex Rakshit & Kundu in
Sci. & Cult. 27: 194 (1961). Type: Burma, Pegu Yomah, *Kurz*
 1248 (CAL-holotype).

Illustrations: Exell & Gonçalves, *Malvaceae* in *Fl. Moçamb.*: 25, fig. 8, 4 (1979); Gibson, *Wild fl. natal.*: pl. 64, fig. 6 (1975); Hochreutiner, *Fl. Madagasc.*, *Malvac.*: 37, fig. X, 1–3 (1955); Paul & Nayar, *Fasc. fl. India* 19: 154, fig. 32 (1988); Pradeep & Sivarajan, *Taxon* 40: 636, figs 7, 8 (1991); Icones Roxburghianae no. 1504 (K); Wight, *Icon. pl. Ind. orient.* 1: pl. 197 (1839).

Annual herb, up to 3 m high, prostrate or climbing on shrubs or trees; stems reddish green, with soft simple hairs to 2 mm long, sparsely to densely retrorse-aculeate, the aculei often red-tipped. *Stipules* up to 15 × 10 mm, ovate, auriculate, amplexicaul. *Leaves*: petioles up to 11 cm long, hairy and aculeate like the stems, the blades up to 10 × 10 cm, shallowly to densely palmately 3–5-lobed, abaxial surface aculeate and with simple hairs on main and secondary veins and sparsely stellate-pubescent on smaller veins, adaxial surface with mostly simple hairs, the base obtuse to subcordate, the margin serrate, the apex acute to acuminate, the nectary absent. *Flowers* axillary, solitary; peduncles up to 8 cm long, articulating c. 10 mm below the epicalyx, sparsely aculeate and hirsute below, and densely hispid above the articulation; involucellar bracteoles 8–9, up to 15 mm long, spreading, with simple hairs on margins, the apex bifurcate, the outer fork up to 5 × 4 mm, spatulate, the inner fork up to 10 mm long, linear, ascending; calyx up to 2.5 cm long, becoming scarious in fruit, the lobes acuminate, aculeate and setose on the ribs, the nectary absent; corolla bright yellow with red-purple centre and a pink stripe along the edge of each petal, the petals up to 6 × 4 cm, obovate, glabrous; staminal column up to 20 mm long, red, the filaments up to 3 mm long, purple; pollen yellow; style branches up to 5 mm long, cream. *Capsules* up to 15 × 12 mm, ovoid to globose, with dense appressed pubescence, the beak inconspicuous; seeds 3 × 2 mm, subreniform, faveolate and with minute pectinate scales. Chromosome number, $n = 18$.

Ruderal and wild, sea level to 1700 m, in cultivated and abandoned farm fields and plantations, waste ground near habitations, and in a wide variety of natural habitats, many in low-lying areas such as river beds and banks, swamps, and other damp situations, but also in savannas, in grassland and bushland, forest clearings and edges, as well as in coastal habitats such as coastal evergreen bushland and sand dunes.

DISTRIBUTION. Fig. 4. Widespread in subsaharan Africa, also in the Indian subcontinent and southeastern Asia, not in Australia, as reported by Masters (1868, 1872) and other subsequent authors. **Guinea-Bissau**, Susana, 1 December 1960, *Raimundo & Guerra* 274 (G-2 sheets); entre Nova Lamego e Canjufa, 29 October 1950, *Esperito Santo* 3545 (BR). **Sierra Leone**, Kenema (Nongova), 25 November 1952, *Deighton* 5888 (K). **Ivory Coast**, banks of Comoé River, opposite Grand Bassam, 15 July 1963, *de Wilde* 468 (BR); réserve de LAMTO, S/P de Tiassalé, 15 December 1987, *Gautier-Beguín* 728 (G-2 sheets). **Ghana**, Atwabo, 1931, *Fishlock* 21 (BR); Kumasi, September 1928, *Vigne* 1381 (BM, K-2 sheets). **Togo**, prope Lome, 1900/1902, *Warnecke* 243 (BM, BR, K). **Benin**, Ocoja Ouéré, 11 December 1901, *LeTestu* 188 (BM-2 sheets); Benin Div., Okomu Forest Reserve, 27 February 1948, *Brenan* 9166 (BM, K). **Nigeria**, Western Province, Massambolahun, 3 miles S. of Bolahun, 6 January 1953, *Konneh* 614 (BR); Ibadan, 1935, *Newberry* 131 (K). **Cameroon**, prés Djoum, 21 November 1966, *Letouzey* 8437 (BR); Bipinde, October 1913, *Zenker* 423 (G-2 sheets). **Central African Republic**, 5 km SW of Bambari on the Alindao road, 8 November 1981, *Fay* 1906 (K); Haute-Kotto, 31 October 1922, *LeTestu* 4271 (BM, BR). **Sudan**, Equatorial Prov., Zande Land, 24 November 1937, *Wyld* 332 (BM). **Príncipe**, Esperança, 27 December 1932, *Exell* 678 (BM, BR). **São Tomé**, Piedada, 1 July 1885, *deWildeman* 411 (BR). **Equatorial Guinea**, Biocora-Riaba, cerca de Baó Basuala, 12 February 1989, *Fernández Casas* 11511 (K). **Gabon**, Cap Esterias, 24 February 1968, *Halle & Villiers* 5507 (P). **Democratic Republic of Congo**, Leopoldville, 11 June 1915, *Bequaert* 7576 (BR); Yangambi, 22 September 1936, *Louis* 2642 (K); Kisangani, Zone Lubunga, km 4, route Ubundu, 9 January 1982, *Szafrański* 1032 (BR). **Uganda**,

Kipayo, September 1914, *Dümmer* 1059 (BM, BOL); W. Mengo Dist., Bat Valley, Kyadondo, 19 November 1985, *Rwaburindore* 2142 (BR). **Kenya**, K7, Kilifi Creek, 13 August 1975, *Greenway & Kanuri* 15556 (K); Kilifi Dist., Mida, Arabuku-Soko Forest Reserve, 15 miles S. of Malindi, 2 December 1961, *Polhill & Paulo* 881 (B, BR). **Burundi**, Bujumbara, 1 June 1967, *Lewalle* 1990 (BR); Bururi Prov., Kigwena, 4 June 1980, *Reekmans* 9253 (BR). **Tanzania**, Western Prov., Kigoma Dist., Lumbye River mouth, 30 July 1959, *Newbould & Jefford* 1158 (K); Tanga region, 21 km W. of Pongwa, Hway A14, 5 August 1975, *Wilson & Kissie* 75128 (ASU, EA, NA); Bezirk Mahenge, Umgebung der Station Mahenge, 30 June 1932, *Schlieben* 2148 (BM, G); Lutamba-See, 40 km W. Lindi, 2 September 1934, *Schlieben* 5219 (BR); Insel Zanzibar, September 1873, *Hildebrandt* 915 (BM). **Angola**, Cujenjo (?), July 1909, *Gossweiler* 4759 (BR); Pungo Adongo, May 1857, *Welwitsch* 5253, 5254 (BM); in palmatis ad R. Cuango, May 1856, *Welwitsch* 4921 (BM). **Zambia**, Luapula Prov., Fort Roseberry Dist., 23 August 1952, *Angua* 301 (BM); Central Province, Iolanda, Kafue, 4 June 1965, *Robinson* 6683 (BR); Victoria Falls, Long Island, April 1918, *Eyles* 1264 (G). **Malawi**, Southern Reg., Mulanje, Chisambo Forest Plantation, 1 August 1979, *Bandan, Salubeni & Masiya* 1538 (BR). **Mozambique**, Cabo Delgado, 53 km de Diaca para Mocimboa de Praia, 14 April 1964, *Torre & Paiva* 11904 (BR); Maringua, Sabi River, 19 June 1950, *Chase* 2560 (BM-2 sheets); Maputo (Lourenço Marques) Dist., Marracuene, 10 April 1946, *Gomes & Sousa* 3417 (K); Delagoa Bay, Inhaca Island, July 1934, *Weintraub* 20321 (BOL). **Comoros**, Grande Comore, N. O. T'Sidje-Moroni, 19 August 1981, *Doutrelepont* 1085 (BR). **Seychelles**, Mahé . . . road from Victoria to Exile, 18 July 1936, *Day* 73 (BM). **Zimbabwe**, Sebwingwe Dist., confluence of Sanyati and Zambesi Rivers, 1 September 1955, *Davies* 1510 (BR); Umtali Dist., on stream bank beyond Cross Hill, November 1948, *Chase* 1665 (BM-2 sheets). **Madagascar**, Majunga (Mahajanga) Prov., Station forestiere d' Ampijoroa, c. 30 km N. d'Andranofasika Fôret, 8 April 1984, *Dorr & Koenders* 2958 (K); Ambovomba, 2 June 1931, *Decary* 8963 (G). **South Africa**, Transvaal, Zoutpanasberg, 4 km NW of Punda Maria, 18 May 1949, *Codd & deWinter* 5552 (PRE); Transvaal, Lekgalameetse Nat. Res.: Cyprus, near last bridge over Wolfspruit, 3 May 1985, *Stalmans* 581 (PRE); Natal, 2.5 km from Arboretum turnoff on old Richardsbay road, 12 December 1985, *Pienaar* 828 (PRE); Natal, Alexandra Dist., Dumisa Station, Friedenau Farm, 26 March 1908, *Rudatis* 333 (G). **Swaziland**, Pigg's Peak Dist., Wyldesdale, 25 March 1959, *Compton* 28741 (NBG); Mankaiiana Dist., Ntondozi, 27 June 1963, *Compton* 31650 (NBG). **India**, Kerala, Trichur Dist., Chiklai, 29 September 1982, *Ramamurthy* (Bot. Surv. Ind. 74953) (CAL); Tamil Nadu, Kanniyakumari Dist., Kughithurai, 10 December 1980, *Swaminathan* (Bot. Surv. Ind. 70302) (CAL); Assam, Garo Hills, Rewar, 16 November 1930, *Parry* 891 (K). **Bangladesh**, Chittagong, 3 January 1851(?), *Hooker & Thompson* 353 (K). **China**, Hainan, K'üing-shan Dist., Kiung-chow City and vicinity, 30 July 1932, *Fung* 20256 (B, BM, K); ins. Hong Kong, Hoihan, 1877, *Bullock* 559 (BM). **Sri Lanka**, without specific locality or date, *Fraser* 68 (BM, BR). **Thailand**, Pak Chong, 29 December 1923, *Marcant* 1517 (BM); Phitsanulok Prov., Thoung Saleng Louang, 25 November 1965, *Vidal* 4559 (P). **Laos**, Vientiane Prov., env. de Ban Na Hai, 22 October 1965, *Vidal* 4121 (P). **Vietnam**, Tonkin, bords de la route conduisant de Tu-Phap aux roches de Notre-Dame, 20 December 1887, *Balansa* 3715 (P); Onnam, Courane, 18 February 1939, *Poilane* 28900 (P). **Philippines**, Luzon, Union Prov., Bauang, February 1904, *Elmer* 5666 (G); Culio Island, December 1927, *Ramos & Edamo* s.n. (BR); Occidental Mindoro Prov., Abra de Ilog, January 1951, *Sulit* s.n. (BR). **Singapore**, 1893, *Ridley* s.n. (BM). **Malaysia**, c. mile 1.2 from Kota Belud to Kabaiau, 11 March 1954, *Darnton* 509 (BM). **Indonesia**, Sumatra, Hoeta Pradang, Asahan, east coast, October–December 1932, *Krukoff* 4401 (BR); Java, sables maritimes, Batavia, 13–15 August 1878, *Savinierre* 1170 (BR); Moluccas, Ambon (Island of Amboyna), 3–15 September 1840, *Barclay* 4136 (BM); Timor, without date, *Forbes* 3817 (BM).

Hibiscus surattensis forma *immaculata* Kurz ex Rakshit & Kundu is a later name for *H. surattensis* var. *villosus* forma *concolor* Backer, a form with completely yellow flowers, lacking the basal petal spot. Hochreutiner (1900: 112–113) mistakenly lists synonyms for *H. surattensis* sens. lat., which apply to other taxa included in this paper (see *H. furcatus* Willd., *H. hispidissimus* Griff., *H. acetosella* Welw. ex Hiern, *H. mastersianus* Hiern, and *H. rostellatus* Guill. & Perr.).

Pradeep & Sivarajan (1991: 635) point out that several authors (Borssum Waalkes (1966), among them), wrongly listed *Narinam poulli* Rheede as a synonym of *H. surattensis*, while in fact it is synonymous with *H. hispidissimus* Griff.

I examined a number of variant forms of *Hibiscus surattensis*. The most common is one that has narrow stipules and involucellar bracteoles, occurring throughout much of the range of this species. It may be interpreted as a mutant or as an introgressant form. Examples are: **Liberia**, *Adam* 16511 (BM), 20527, 20702 (K); **Tanzania**, *Renvoize* 2010 (K); **Mozambique**, *Goodier* 1005 (BM); **India**, *Hamilton* s.n. (BM); **Thailand**, *Hosseus* 468 (BM); **Madagascar**, Herb. Martii 68 (*F.V. Thompson* s.n.) (BR); **Laos**, *Vidal* 4121 (P); **Vietnam**, *Pierre* s.n. (P). Other variant forms seen are as follows: narrow, acuminate calyx lobes, **China**, Hainan, *Henry* s.n. (G); an apparently purple-flowered form, **Madagascar**, *Hildebrandt* 2869 (G); atypical leaves, narrow stipules [possibly *H. surattensis* × *H. rostellatus* hybrid], 'French West Africa', *Roberty* 6401, 15860 (G); villous calyx, **Cameroon**, *Zenker* 423 (G), **Tanzania**, *Schlieben* 3690 (G); miniature but typical-shaped stipules, **Thailand**, *Marcant* 1517 (BM).

2. ***Hibiscus altissimus*** Hornby in *Proc. & Trans. Rhodesia Sci. Assoc.* **41**: 55 (1946). Type: Mozambique, Lusa River Valley, W. of Guruè, 7 May 1942, *Hornby* 4563 (K!-isotype).

Fig. 1D.

A woody *scrambler* over bushes; stems to 10 m long, retrorse-aculeate, otherwise almost glabrous or with a line of pubescence, or sometimes more densely pubescent above. *Stipules* 5–9 mm long, linear, almost glabrous. *Leaves*: petioles 0.2–10 cm long, retrorse-aculeolate plus a line of pubescence adaxially, the blades 3–11 × 2–13 cm, broadly lanceolate to ovate to 3(incipiently 5)-lobed, the midlobe broadly lanceolate to ovate, the lateral lobes lanceolate to triangular, sometimes unequal in length, the blades abaxially retrorse-aculeolate on the ribs and with sparse coarse 2-fid to stellate hairs on the veins, adaxially with simple to stellate sparse hairs on veins, the base cuneate, truncate, or cordate, the margin serrate or dentate, the apex acute, the nectary 1–4 mm long, slit-like. *Flowers* axillary, solitary or clustered near the ends of branches; peduncles 1–5 cm long in fruit, articulating 1–3 mm below the epicalyx, or sometimes the joint not evident, accrescent, retrorse-aculeolate and densely and finely stellate-pubescent; involucellar bracteoles 10–12, 9–12 mm long, linear below the apex, with coarse, mainly simple bristles on enlarged bases on the margins, the apex bifurcate, the outer fork 3 mm long, lanceolate, the inner fork 5–9 mm long, linear, ascending, the base free; calyx 2–3 cm long in fruit, the lobes lanceolate, acute to acuminate, with reticulate venation and simple to 4-fid bristles on enlarged bases on the ribs, otherwise almost glabrous or sparse, finely stellate-pubescent, the nectary absent; corolla yellow with a purple centre, the petals 3.5–5 × 2–3 cm, obovate, sparsely and finely stellate-pubescent dorsally, almost glabrous ventrally; staminal column 22–25 mm long, the filaments 1 mm long; style branches 4–5 mm long. *Capsules* 17–27 × 14–21 mm, densely appressed-pubescent, the beak 2 mm long, glabrous; seeds (according to Exell, 1961) 4 × 3 mm, subreniform, with whitish, irregularly discoid scales. Chromosome number, $n = 72$.

Undergrowth in forest glades and plantations and in seral montane scrub.

DISTRIBUTION. **Fig. 5.** Southeastern Africa. **Mozambique**, Manica e Sofola, Cheringoma, Durundi, 17 May 1948, *Barbosa* 1660 (BM); Cheringoma, Inhaminga, 24 May 1948, *Mendonça* 4363 (BM); Sul do Save, entre Bilene e Vila de João Belo, 1 May 1957, *de Carvalho* 131 (BM); Bilene, Praia de S. Martinho do Bilene, 14 May 1957, *de Carvalho* 213 (BM); Laureçon

Marques, Rikatla, April 1918, *Junod* 238 (BM, G). **South Africa**, Transvaal, 20 km along Witvlag Road from Louis Trichardt, 4 April 1971, *Oakes* 1585 (PRE); Louis Trichardt, Entabeni, 16 August 1989, *van Heerden* A33 (PRE); Letaba, Duiwelskloof Rosendal, 26 July 1958, *Scheepers* 438 (G); Natal, Hlabisa, Dukuduku forest glade, 29 January 1967, *Strey* 7365 (PRE).

Exell (1961) cites, as a synonym of *Hibiscus altissimus*, *H. furcatus* 'sensu Harv.' in Harv. & Sond., *Fl. Cap.* **1**: 176 (1860), but Harvey's succinct description and his reference to Drège's specimens labelled '*Hibiscus hamatus* E. Mey.' cast some doubt on this conclusion. I examined two of Drège's specimens, collected at Port Natal and labelled *H. hamatus* (Drège s.n., G; Drège 5289, P); both are referable to the native Indian species that has long been called *H. furcatus* Roxb. (= *H. hispidissimus* Griff.). These plants were possibly adventive or cultivated in Natal.

3. ***Hibiscus furcellatoides*** Hochr. in *Annuaire Conserv. Jard. Bot. Genève* **20**: 157–158 (1917). Type: Guinea, entre le Konkouré et Timbo, March 1905, *Chevalier* 12504 (P!-holotype).

Fig. 1A.

Hibiscus furcatus Hutch. & Dalziel, *Fl. W. trop. Afr.* **1**(2), 1st ed.: 267 (1928), non Roxb. (1814), pro parte quoad specim. *Chevalier* 12504.

Hibiscus rostellatus Keay, *Fl. W. trop. Afr.* **1**(2), 2nd ed.: 346 (1958), non Guill. & Perr. (1831), pro parte quoad specim. *Chevalier* 12504.

Habit unknown; stems with stout retrorse aculei on large bases, sparsely stellate-pubescent below, densely and finely stellate-pubescent above. *Stipules* 7 mm long, subulate, almost glabrous. *Leaves*: petioles 1.2–2.5 cm long, aculeolate and densely stellate-pubescent, the blades 4.5–6.5 × 4–6 cm, ovate-triangular, the blades of middle leaves and upper leaves entire (lower leaves not seen), abaxially and adaxially with lanate patches, otherwise finely stellate-pubescent, the base truncate, the margin finely serrate, the apex slightly acuminate, the nectary to 6 mm long, prominent, slit-like. *Flowers* axillary, solitary; peduncles 2–3.3 cm long in fruit, articulating 4–9 mm below the epicalyx, with a fine dense stellate tomentum, not aculeate; involucellar bracteoles 9–10, 7 mm long below the apex, linear, flattened, densely and finely stellate-pubescent, the apex bifurcate, the outer fork 3–5 mm long, lanceolate to sagittate, the inner fork 7–8 mm long, linear, ascending, the base free; calyx 1.3–1.8 cm long, the lobes up to 1 cm wide, ovate, acuminate, densely and finely stellate-pubescent, not aculeate, the nectary absent; corolla yellow(?) with a purple(?) centre, the petals up to 4.5 × 3.5 cm, obovate, sparsely stellate dorsally, glabrous ventrally; staminal column 20 mm long, purple near the summit, the filaments 1.5 mm long, anthers brown(?); style branches 5 mm long. *Capsules* 17 × 15 mm, densely appressed-pubescent, the beak 1.5 mm long, glabrous; seeds unknown.

DISTRIBUTION. **Fig. 5.** Guinea. Known to me only from the type collection.

Bahadur *et al.* (1970) wrongly placed *Hibiscus furcellatoides* in synonymy with the (previously undescribed?) Indian species which they called *H. furcatus* Roxb.

4. ***Hibiscus rostellatus*** Guill. & Perr. in Guill., Perr. & A. Rich., *Fl. Seneg. tent.* **1**: 55–56 (1831). Type: Apparently not designated. I examined three of Perrotet's specimens, one each from BM, G, and P. I designate the specimen from P as the lectotype because it is the most complete and well preserved of the three specimens. The label on the sheet from P reads as follows: 'Herbarium Richard [red ink] *Hibiscus rostellatus* Nob. afigurer [black ink]



Fig. 1 Leaves and fruits (or flowers) of species of *Hibiscus* section *Furcaria*. **A:** *H. furcellatoides*, Chevalier 12504 (P); **B:** *H. rostellatus*, leaf: Exell & Mendonça 3171 (BM), fruit: Scott Elliot 7244 (BM); **C:** *H. goossensii*, Goossens 1202 (BR); **D:** *H. altissimus*, Mendonça 4363 (BM); **E:** *H. nigricaulis*, Exell & Mendonça 1759 (BM); **F:** *H. flavo-roseus*, Young 646 (BM); **G:** *H. torrei*, Torre 435 (BM); **H:** *H. noldeae*, Leeuwenberg 10288 (BR).

Senegal, Perotter' [red ink]. The sheet from BM has two labels, as follows: 1) '*Hibiscus rostellatus* Nob., n. 88 [in pencil], ...du Cap Vert, Kounoun 13 Mars 1829, Perotter'; 2) 'Perotter, no. 53, 'B' [in pencil] Senegal'. The label on the sheet from G reads as follows: '*Hibiscus rostellatus*, fl. Seneg., Kounoun (Capvert), M. Perotter 1831'. The black ink entries on the BM and P sheets were made in the same hand, presumably Perotter's (especially since they say 'Nob. '), while the writing on the G label was in a different hand.

Fig. 1B.

Hibiscus surattensis var. *rostellatus* (Guill. & Perr.) Hochr. in *Annuaire Conserv. Jard. Bot. Genève* 4: 110 (1900).

Hibiscus furcatus Hutch. & Dalziel, *Fl. W. Trop. Afr.* 1(2): 267 (1928), non Roxb. (1814), excl. *Chevalier* 12504 (see Keay, 1958: 346).

Hibiscus furcatus Berhaut, *Fl. Seneg.*: 159 (1954), non Roxb. (1814).

Coarse prostrate or climbing perennial, much-branched vine up to 3 m tall; stems more or less hirsute (hairs to 3 mm long) [Zenker 4957 almost glabrous], with many conspicuous retrorse aculei on red bases. *Stipules* up to 11 mm long, filiform to subulate, with fine hairs on margins. *Leaves*: petioles 0.5–9 cm long, with pubescence like that of the stems, the blades 3–13 × 3–15 cm, cordate to very shallowly 3–5-lobed, suborbicular in outline, the lobes triangular, abaxially densely stellate-pubescent and retrorse-aculeolate and with coarse, 2-several-fid bristles on ribs, adaxially sometimes aculeolate on the ribs, usually less densely stellate-pubescent, the base truncate to shallowly or deeply cordate, the margin finely serrate to dentate, the apex acute to long-acuminate, the nectary to 4 mm long, slit-like, on the midrib and sometimes also on two lateral ribs. *Flowers* axillary, solitary, or sometimes clustered on short flowering branches to 8 cm long, or near the plant apex; peduncles 2–8 cm long, articulating 5–10 mm below the epicalyx, with long simple hairs and retrorse aculeoli below the articulation, dense long straight bristles above the articulation; involucellar bracteoles 8–12, 6 mm long below the apex, linear, bristly, the apex bifurcate, the outer fork 3–7 mm long, foliaceous, more or less enlarged, oval or elliptic, sometimes flattened or reflexed, the inner fork 4–10 mm long, subfiliform to subulate-acuminate, the base free; calyx 1.5–3.5 cm long, the lobes ovate-lanceolate, acute to long-acuminate, very finely stellate-tomentose and also with 2-fid to stellate bristles on the ribs, the nectary absent; corolla lemon yellow with a large red-purple centre, the petals 5–7.5 × 3–6.5 cm, showy, obovate, finely stellate-pubescent dorsally, glabrous ventrally; staminal column 22–30 mm long, white to dark pink, the filaments 2 mm long, light to dark pink, the anthers yellow or pink, the pollen orange; style branches 4–8 mm long, light to dark pink; stigmas pink to red-purple. *Capsules* 22–30 × 15–20 mm, ovoid, appressed-pubescent, the beak 2 mm long, glabrous; seeds 5 × 3 mm, subreniform, brown, with parallel striations and fine pectinate scales, the funiculus small, dark brown, glabrous. Chromosome number, $n = 36$.

Ruderal and wild, in farm clearings, plantations, fallow land, savannas, creek and river banks, temporary ponds, swamps, secondary scrub, gallery and rain forests; apparently never cultivated, but leaves are sometimes eaten [e.g. Democratic Republic of Congo, Staner 1482 (BR)].

DISTRIBUTION. Fig. 4. Western to eastern central Africa from Senegal to Sudan, Angola, Zambia, and Tanzania. **Senegal**, Laugalkaur, October 1950, Berhaut 678 (BR); Bidahay, 25 January 1931, Trochain 1307 (P). **Sierra Leone**, Savane Piedmont, est Loma, 16 November 1965, Jaeger 8150 (G); Kambia, Scarcies, 30 December (year?), Scott Elliott 4349 (BM). **Guinea**, Kindua (Kindia?), March 1905, Chevalier 13031 (P); Koba, 15 November 1956, Jacques-Felix 7262 (P). **Liberia**, Cape Mount, 18 November 1908,

Dinklage 2257 (B); Peàtah, 16 October 1926, Linder 1098 (K). **Mali**, Sikasso-Koutiala, 30 December 1950, Roberty 13337 (G); **Ivory Coast**, entre Fuènoula et Bouaflé, 28 December 1963, AkéAssi 7292 (G); Bingerville, 17–20 February 1907, Chevalier 17355 (P); near Tiassalé, right bank of Bandama R., 10 December 1958, Leeuwenberg 2150 (BR). **Ghana**, road to Amedzofe, 31 January 1971, Ents GC42474 (K). **Benin**, Cercle de Zagnanado, Pays de Hollis, Entre Abbo et Massé, 6 February 1910, Chevalier 22969 (P). **Nigeria**, Bende road, 4.5 miles from Umuahia, 9 November 1966, Ariwaodo 1436 (K); Western State, Egbado Dist., Alasinde, 14 November 1973, Eimunjze & Ekwuno FHI 67996 (K); North East State, Gombe Dist., Malam Sidi, 30 November 1971, Latilo FHI 646447 (K); Ilorin Prov., Omu-Aran Dist., on Ilorin-Kabba motor road, 16 November 1968, Latilo FHI 62279 (K); Ibadan Div., near Ibadan, 5 January 1950, Meikle 959 (BR); southern Nigeria, Eket Dist., main road from Aron to Eket, January 1913, Talbot s.n. (BM). **Cameroon**, 10 km S. of Ngaoundéré, Station Fouràgre de Wakwa, 1 November 1966, Leeuwenberg 7672 (BR); Bipinde, Urwaldgebiet, 1896, Zenker 1303 (G-2 sheets); same locality, 1913, Zenker 4957 (B, BM). **Chad**, Forêt galerie du Bakoua, 1 November 1968, Gaston 2481 (P). **Central African Republic**, 4 km SE of Bambari on the Alindao road, 27 January 1982, Fay 2138 (K); right bank of Mambéré R., 2 km S. of Carnot, 6 December 1965, Leeuwenberg 7230 (K); La Haute-Kotto, Oubangui-Chari, 5 October 1921, LeTestu 3325 (BR); **Sudan**, Mongalla Prov., Valley of R. Yei near source, 28 February 1934, Dandy 543 (BM); Equatorial Prov., Kagelu Stat., Yei, 2 October 1937, Myers 7824 (K). **Congo**, Impfondo, 24 September 1966, Bouguet 2049 (P). **Democratic Republic of Congo**, Leopoldville Prov., Thysville Terr., 22 April 1960, Compere 1979 (K); Parc Nat. de l'Upemba, June 1949, de Witte 6692 (BR, K); Eala, November 1930, Staner 1482 (BM); Lac Kivu, Ile Wahu, 15 March 1953, Vander Ben 208 (BR). **Uganda**, Kyagwe, Mukono U4, 1 km E. of Lugazi town, 25 September 1987, Rwaburindore 2546 (BR); without locality (Ruwendzori Expedition 1893–94), Scott Elliot 7244 (BM); Albert-Edward-Nyanza, 1893–94, Scott Elliot 8046 (BM). **Rwanda**, Kirambo, 6 June 1981, Troupin 16280 (BR). **Angola**, Cuanza Sul, between Gabela and Vil Nova de Seles, R. Cuvo, 12 July 1937, Exell & Mendonça 3171 (BM-2 sheets); Pungo Adongo, without date, Welwitsch 5243 (BM). **Zambia**, Solwezi, 14 May 1969, Mutimushi 3309 (K). **Tanzania**, Msimbazi stream, 82 km WSW Dar Es Salaam, 7 May 1972, Wingfield 1967 (EA); Mahali Mts, Kasoge, 21 November 1973, Uehara 192 (EA).

Bahadur *et al.* (1970) wrongly placed *Hibiscus rostellatus* in synonymy with the (previously undescribed?) Indian species which they called *H. furcatus* Roxb.

Variant forms of *Hibiscus rostellatus* were examined, as follows: short bracteole forks and leaves that resemble those of *H. goossensii*: **Tanzania**, Faulkner 3667 (BR); fine, short pilose indumentum: **Congo**, Descoings 5880 (P); reduced pubescence on plant parts: **Cameroon**, Letouzey 9518 (P).

5. *Hibiscus hispidissimus* Griff., *Not. pl. asiat.* 4: 521 (1854); Pradeep & Sivarajan in *Taxon* 40: 634–637 (1991). Type: India, Kerala, Thanneerpandal, near town of Badagara, Pradeep 5008 (K-neotype, Pradeep & Sivarajan, 1991; CALI-isoneotype).

Narinam poulli Rheede, *Hort. malab.* 6: 75, t. 44 (1686) (see Pradeep & Sivarajan, 1991: 635).

Hibiscus furcatus Roxb. [*Hort. beng.* 51 (1814), nom. nud., nom. illeg. (Art. 53.1)] ex DC., *Prodr.* 1: 448 (1824), non Willd. (1809) nec Moritz (1846) nec Mast. (1868) nec Bahadur, Dayal & Raturi (1970). Type: Icones Roxburghianae no. 1582 (K!-holotype).

Hibiscus aculeatus Roxb., *Fl. ind.* 3rd ed.: 206 (1832), non Walter (1788) nec Bahadur, Dayal & Raturi (1970), nom. illeg. (Art. 53.1). Type: Icones Roxburghianae no. 356 (K!-holotype).

Furcaria roxburghii Kostel. in *Allg. Med. Pharm. Fl.* 5: 1856 (1836). *Hibiscus aculeatus* T.K. Paul & M.P. Nayar, *Bull. Bot. Surv. India* 22: 195 (1980), non Walter (1788) nec Roxb. (1832).

Illustration: Pradeep & Sivarajan, *Taxon* 40: 636, figs 1–6 (1991).

A trailing or rambling shrub to 2 m tall; stems green tinged with

pink, with stout retrorse aculei on enlarged bases, otherwise variably hairy from almost glabrous to densely tomentose. *Stipules* 4–11(–15) mm long, linear to foliate, minutely ciliate to tomentose. *Leaves*: petioles 0.6–10 cm long, aculeate and pubescent like the stems, the blades 3–12 × 2.5–16 cm, blades on lower leaves deeply palmately 3–5(–7)-lobed, the midlobe lanceolate to ovate, the lateral lobes ovate to triangular, the outer lobes triangular, the blades on upper leaves lanceolate, entire or moderately 3-lobed, blades of all leaves abaxially retrorse-aculeolate on the ribs, simple to stellate-pubescent on the ribs and veins, adaxially sparsely pubescent, with mostly simple hairs on ribs and veins, or tomentose, the base truncate to shallowly cordate, the margin crenate to coarsely serrate, the apex acute to acuminate, the nectary 1–2 mm long, slit-like, on the midrib and sometimes also on two lateral ribs. *Flowers* axillary, solitary and sometimes clustered on the ends of flowering branches; peduncles 2–10(–13) cm long, articulating 5–14 mm below the epicalyx, below the articulation with retrorse aculeoli and sparse to very dense simple hairs, above the articulation with straight simple pigmented bristles, simple to stellate hairs, and sometimes with some retrorse aculeoli; involucellar bracteoles 8–12, 5–9 mm long below the apex, linear, with fine hairs or tomentose and with straight, coarse pigmented bristles, the apex bifurcate, the outer fork 2–4 mm long, lanceolate to ovate, sometimes reflexed, the inner fork 6–12 mm long, linear to subulate, ascending, the base free; calyx 1.4–2.2 cm long, the lobes triangular to lanceolate, acute to acuminate, almost glabrous or finely stellate-pubescent to stellate-tomentose and with coarse, mostly simple bristles on bases to 4 mm long on ribs, the nectary absent; corolla yellow with a purple centre, the petals 4–6.5 × 3–4.5 cm, obovate, glabrous; staminal column 18 mm long, dark pink, the filaments 2 mm long, the anthers dark pink, the pollen yellow to violet; style branches 6–12 mm long, the styles and stamens red-purple. *Capsules* up to 15–20 × 15–17 mm, ovoid, densely appressed-pubescent, the beak 2–4 mm long, glabrous; seeds 4 × 3 mm, subreniform, dark brown, faveolate and with parallel striations and minute pectinate scales, the funiculus light tan, glabrous. Chromosome number, $n = 72$.

In scrub and evergreen or semi-evergreen forest, often among rocks.

DISTRIBUTION. Central and southern India and Sri Lanka; possibly adventive in South Africa. **India**, Bombay Presidency, southern Marathra Country and North Canara, 23 March 1881, *Young* s.n. (BM); Goa, Colem, 9 May 1963, *Kanodia* 88497 (BM); Karnataka, Coorge Dist., Mercara Hill Tops, 30 January 1976, *Bannerjee* 11542 (CAL); Coorg Region, c. 50 miles from coast, 3 December 1979, *Pickett* (ASU); Karnataka, 19 km W. of Saklespur, 19 December 1977, *van der Maesen* 3037 (CAL); Canara, Mangalore, 1854, *Mez*: 1634 (P); Madras, 1885, *Beddome* 565, 566, 567, 568 (BM); Kerala, Idukki Dist., near Meenmutti, 18 February 1982, *Raju* 71251 (CAL); Madras, Coimbatore, Vellingiri Hills, 18 February 1937, *Sebastine* 2377 (CAL); Madras, Nilgin Dist., near Woodbriar Estate, 18 November 1958, *Sebastine* 7396 (CAL); Tamil Nadu, Kanyakumari Dist., 23 January 1978, *Henry* 53232 (CAL); **Sri Lanka**, Summo Wadinagala monte, 2 November 1975, *Bernardi* 15617 (G-2 sheets); Sri Lanka, without specific locality, 1863, *Thwaites* 727 (BM, P).

6. ***Hibiscus goossensii*** (Hauman) F.D. Wilson, **comb. & stat. nov.**

Type: Democratic Republic of Congo (Zaire), Dist. du Bas-Congo: without specific locality, 1920, *Goossens* 1202 (BR!-holotype).

Fig. 1C.

Hibiscus rostellatus var. *goossensii* Hauman in *Bull. Jard. Bot. État.* **31**: 88 (1961).

Shrub; stems retrorse-aculeolate, glabrous below, very sparsely hairy above. *Stipules* 5 mm long, linear, with simple long (≥ 1 mm)

hairs on margins. *Leaves*: petioles 2–7 cm long, retrorse-aculeolate plus a line of pubescence on the adaxial surface, the blades 4–10 × 4–10 cm, hastately 3-lobed or deeply palmately 5-lobed, the midlobe and lateral lobes lanceolate to narrowly lanceolate, the outer lobes triangular, the sinuses obtuse, the blades abaxially retrorse-aculeolate and finely stellate-pubescent on ribs, sparsely stellate-pubescent on veins, adaxially finely and coarsely stellate-pubescent on ribs, with simple to stellate pubescence on veins, the base truncate to cordate, the margin serrate, the apex acute to acuminate, the nectary 2 mm long, slit-like. *Flowers* axillary, solitary; peduncles 3–5 cm long in fruit, articulating c. 8 mm below the epicalyx, retrorse-aculeolate and finely and sparsely pubescent below the articulation, more densely and finely pubescent and with bristles to 2 mm long above the articulation; involucellar bracteoles 10, 8–10 mm long below the apex, linear, with fine bristles on margins, the apex bifurcate, the outer fork 3–4 mm long, lanceolate, reflexed, the inner fork 8–10 mm long, linear, ascending, the base free; calyx 2.2 cm long in fruit, the lobes broadly lanceolate, slightly acuminate, the ribs not conspicuous, with very fine stellate hairs plus a few simple to 3-fid bristles, the nectary absent; corolla yellow with a purple centre, the petals 3.5 × 2.5 cm, obovate, sparsely stellate-pubescent dorsally, glabrous ventrally. *Capsules* 15 × 14 mm, densely appressed-pubescent; seeds unknown.

DISTRIBUTION. Fig. 5. Democratic Republic of Congo. Known to me only from the type collection.

7. ***Hibiscus furcatus*** Willd., *Enum. pl.*: 736 (1809). Type: Southern India(?), (B-W no. 12880-holotype; ASU!-photograph).

Hibiscus surattensis var. *furcatus* (Willd.) Hochr. in *Annuaire Conserv. Jard. Bot. Genève* **4**: 112 (1900).

Hibiscus furcatus Craib, *Fl. siam. enum.* **1**: 157 (1925), non Roxb. (1814), pro parte quoad specims. *Kerr* 2768, *Marcan* 1078.

Herb or shrub to 1.5 m tall; stems with retrorse aculei plus sparse, simple to stellate pubescence below, more dense above. *Stipules* 7–10 mm long, linear to foliate, with fine hairs on margins. *Leaves*: petioles 3–5 cm long on leaves at mid-plant (lower leaves not seen), 0.6–5 cm long on upper leaves, retrorse-aculeate and with fine and dense simple hairs, the blades on leaves at mid-plant 5–7 × 6–7 cm, moderately to deeply palmately 3–5-lobed, the midlobe broadly lanceolate to ovate or obovate, the lateral lobes broadly lanceolate to triangular or ovate, the outer lobes vestigial to broadly lanceolate, the blades on upper leaves 2–6.5 × 2–5.2 cm, moderately to deeply 3-lobed, midlobe and lateral lobes ovate, blades of all leaves abaxially with or without retrorse aculei and with simple to stellate hairs on ribs and veins, adaxially with mostly simple hairs (some to 4-fid) on ribs and veins, the base cuneate to truncate, the margin finely serrate to dentate, the apex obtuse to acute or acuminate, the nectary 1–2 mm long, slit-like, inconspicuous. *Flowers* axillary, solitary, and sometimes clustered near the ends of flowering branches; peduncles 0.6–1 cm long in flower, up to 2 cm long in fruit, articulating 1–5 mm below the epicalyx, below the articulation almost glabrous, above the articulation retrorse-aculeolate and with a few, fine 1–2-fid hairs; involucellar bracteoles 8–10, 7–9 mm long below the apex, linear, 3-nerved, with fine, sparse simple to 3-fid hairs and coarse simple bristles borne on enlarged bases, the apex bifurcate, the outer fork 5–8 × 2–3 mm, lanceolate to ovate or foliate, 3-nerved, the inner fork 4–7 mm long, linear, flattened, the base free; calyx 1.2–1.5 cm long in flower, up to 2.1 cm long in fruit, the lobes lanceolate to ovate, acuminate, with or without aculei, and with sparse simple bristles on ribs, otherwise almost glabrous, the nectary absent; corolla yellow with a maroon(?) centre. *Capsules* 13–16 × 11–14 mm, densely

appressed-pubescent, the beak 2–5 mm long, conspicuous and glabrous, or inconspicuous and covered with appressed hairs; seeds unknown.

Open jungle and dense forest, locally abundant.

DISTRIBUTION. India and Thailand. **India**, without locality or date, *Dalzell* s.n. (K); without locality or date, *Hooker & Thomson* s.n. (BM); Waghai, forest, Daus, 22 October 1955, *Santapau* 19958 (BR). **Thailand**, Doi Sutēp, 27 October 1912, *Kerr* 2768 (BM); Bān Tākī, 10 November 1922, *Marcan* 1078 (BM).

Much confusion exists in the literature about the name *Hibiscus furcatus*. Willdenow published the name in 1809 for an Indian plant, as did Roxburgh in 1814. Many authors have presumed that these names refer to the same species. However, both Paul & Nayar (1980, 1988: 124) and Pradeep & Sivarajan (1991), after having examined a photograph of the original type material of *H. furcatus* Willd. (which I have done also), pointed out that the epithet refers to two different species and that the name *H. furcatus* Roxb. is an illegitimate later homonym of Willdenow's name. Paul & Nayar (1980) took up the name *H. aculeatus* Roxb. as the correct epithet for the Roxburgh plant. However, Pradeep & Sivarajan (1991) pointed out that *H. aculeatus* Roxb. is also an illegitimate later homonym of *H. aculeatus* Walter. Pradeep & Sivarajan (1991) took up the name *H. hispidissimus* Griff. as the correct epithet, and published an excellent illustration for the common Indian species that is usually called *H. furcatus* Roxb. The true *H. furcatus* Willd. is genuinely different from *H. hispidissimus*, but it seems to occur much less commonly.

8. ***Hibiscus sudanensis*** Hochr. in *Annuaire Conserv. Jard. Bot. Genève* 10: 18 (1906). Type: Central African Republic, territoire de l'Oubangi entre la porte de la Noaca et le fort Sibut, 10 December 1903, *Chevalier* 10757 (P!-holotype; G!-isotype).

Fig. 2E.

Hibiscus sudanensis var. *genuinus* Hochr. in *Annuaire Conserv. Jard. Bot. Genève* 10: 19 (1900), nom. illeg. (Art. 26.2).

Hibiscus sudanensis var. *glabrescens* Hochr. in *Annuaire Conserv. Jard. Bot. Genève* 10: 19 (1900).

Hibiscus sudanensis var. *glabrescens* forma *grandiflorus* Hochr. in *Annuaire Conserv. Jard. Bot. Genève* 10: 20 (1900). Type: 'Central Africa', collector and locality unknown, identified by 'XZ063' (P!-holotype).

Hibiscus sudanensis var. *glabrescens* forma *minoriflorus* Hochr. in *Annuaire Conserv. Jard. Bot. Genève* 10: 20 (1900). Type: Central African Republic, territoire du Chari: vallée du Boro, 2 January 1903, *Chevalier* 7104 (P!-holotype; G!-isotype).

Hibiscus rostellatus var. *congolanus* Hauman in *Bull. Jard. Bot. État* 31: 86–87 (1961). Type: Democratic Republic of Congo (Zaire), District Forestiere Centrale, Yangambi, December 1937, *Louis* 7032 (BR!-holotype & isotype).

Hibiscus rostellatus var. *sudanensis* Hauman, *Fl. Congo belge* 10: 119 (1963).

Various described as a *shrub*, *shrubby climber*, or a trailing woody *vine* with long internodes, scarcely branched; stems green tinged with pink, or pink, with sparse, fine retrorse aculei, and with or without a line of pubescence. *Stipules* 3–6(–9) mm long, filiform to linear, usually with fine hairs on margins. *Leaves*: petioles 2–9 cm long, with pubescence like that of the stems, the blades 6–10 × 3–8 cm, unlobed or incipiently 3-lobed, deltoid to lanceolate, ovate, or cordate, abaxially with or without retrorse aculeoli on the ribs, abaxially and adaxially with sparse, simple to stellate hairs on ribs and veins, or densely stellate-tomentose, the base truncate to cordate, the margin shallowly dentate (almost entire) or serrate, the

apex short- to long-acuminate, the nectary 1–5 mm long, slit-like. *Flowers* axillary, solitary or clustered near the ends of short flowering branches; peduncles 0.3–0.9(–1.5) cm long, articulating near the base to about one-third the distance from the base to the epicalyx, with or without retrorse aculeoli and simple to several-fid bristles; involucellar bracteoles 8–12, 9–11 mm long, linear, with fine simple or stellate hairs and with or without simple to 3-fid bristles on enlarged bases, the apex bifurcate, the outer fork 1.5–5 mm long, narrowly to broadly lanceolate, reflexed, the inner fork 2–9 mm long, linear to subulate, ascending; calyx 1.3–1.9 cm long, the lobes lanceolate to ovate, acute to acuminate, with simple to 4-fid bristles on the ribs, glabrous or finely stellate-pubescent between the ribs, the nectary absent; corolla lemon yellow with a large conspicuous purple centre, the petals 4–5 × 2–3 cm, obovate, finely stellate-pubescent dorsally, glabrous ventrally; staminal column 19 mm long, streaked dark pink and white, the filaments 3 mm long, the staminal column and filaments covered with very small red-purple clavate hairs, the anthers and pollen yellow; style branches 9 mm long, dark pink; stigmas dark red-purple. *Capsules* up to 17 × 15 mm, ovoid, densely appressed-pubescent, the beak 1–2 mm long (sometimes absent?), glabrous; seeds 4 × 3 mm, reniform, dark brown, faveolate and with pectinate scales, the funiculus light tan, glabrous. Chromosome number, $n = 18$.

Riverbanks, marshy prairies, swamps, swampy forests.

DISTRIBUTION. Fig. 5. Central Africa, Cameroon to Democratic Republic of Congo. **Cameroon**, sur la rivière Ziege près de Djemiong (50 km SW de Batouri), 18 April 1962, *Letouzey* 4794 (P). **Central African Republic**, Ruisseau près Riv. Eôwe, 40 km N. Alindao, 24 November 1927, *Tisserant* 2327 (BM-2 sheets; BR-2 sheets; P); Haut Oubangui, Région de Yalinga, 25 December 1922, *LeTestu* 4247 (BM, P). **Democratic Republic of Congo**, Leopoldville Prov., Inurbain, Kimuenza, 3 December 1956, *Carlier* 325 (BR, K); Uele, Station Domest. Elephants, 16 November 1942, *Offerman* 625 (BR); Ango, November 1945, *Germain* 4322 (BR); Gandajika, 29 April 1957, *Liben* 2813 (BR).

9. ***Hibiscus flavo-roseus*** Baker f. in *J. Bot.* 77: 20 (1939). Type: Angola, Lunda: Saurimo, without date, *Young* 646 (BM!-holotype).

Fig. 1F.

Shrub up to 1.2 m tall; stems retrorse-aculeolate, sparsely and finely stellate-pubescent below, more densely stellate-pubescent above. *Stipules* 2 mm long, linear, flattened, a few hairs on margins. *Leaves*: petioles 0.3–2 cm long, with pubescence like that of the stem, the blades of leaves at mid-plant and upper leaves (lower leaves not seen) 1–6.5 × 0.8–6.5 cm, the blades of leaves at mid-plant deeply 3–5-lobed, the midlobe longer (sometimes markedly so) than the lateral lobes, the blades of upper leaves narrowly ovate to 3-lobed, all blades densely and finely cinereo-stellate-pubescent abaxially, sparsely stellate-pubescent adaxially, the base truncate to cordate, the margin serrate, the apex obtuse to acute, the nectary up to 4 mm long, slit-like. *Flowers* clustered at the summit of long flowering branches or borne singly or in small clusters on short secondary branches; peduncles 0.3–0.6 cm long in flower, apparently articulating at the base, with pubescence like that of the stem; involucellar bracteoles 10, 6–7 mm long below the apex, linear, long-bristly above, the apex bifurcate, the outer fork 2 mm long, broadened, recurved, the inner fork 5 mm long, linear, ascending; calyx 1.4–1.6 cm long in flower, the lobes triangular, acute, with very fine, dense stellate pubescence and a few coarse 2-fid to stellate hairs on the marginal ribs, the nectary absent; corolla yellowish pink (according to the collector) with a purple centre, the petals *c.* 3 cm long. *Capsules* and seeds unknown.

DISTRIBUTION. Fig. 5. Angola. Known to me only from the type collection.

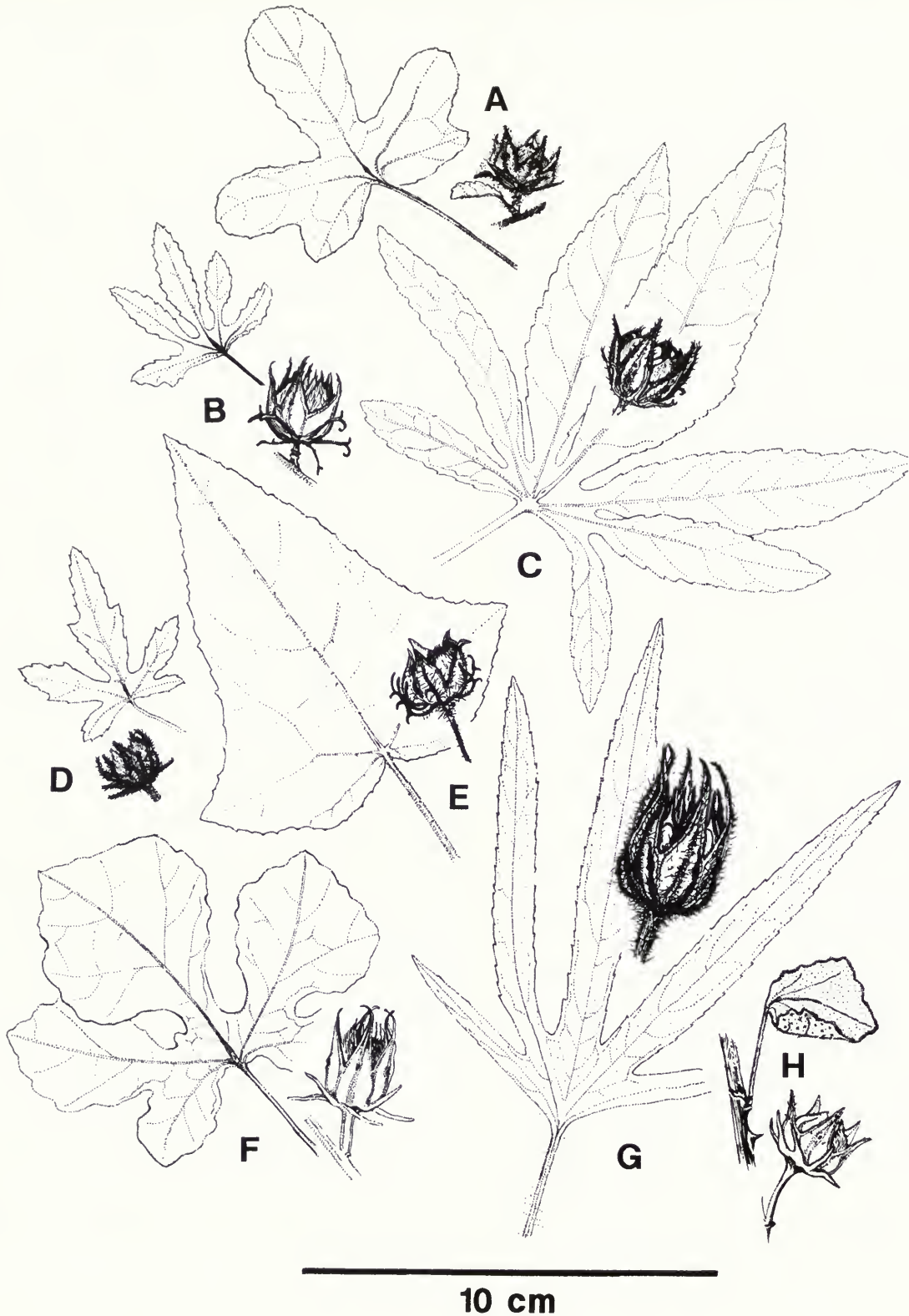


Fig. 2 Leaves and fruits of species of *Hibiscus* section *Furcaria*. A: *H. parvilobus*, Spjut & Ensor 3184 (ASU); B: *H. acetosella*, leaf: Gossweiler s.n. (BM), fruit: Welwitsch 5271 (BM); C: *H. asper*, leaf: Dalziel 426 (K), fruit: De Saeger 1038 (K); D: *H. reekmansii*, Troupin 16264 (BR); E: *H. sudanensis*, Tisserant 2327 (BM); F: *H. greenwayi*, leaf: Polhill & Paulo 835 (BR), fruit: Hooper & Townsend 1094 (K); G: *H. mechowii*, Exell & Mendonça 1538 (BM); H: *H. sparseaculeatus*, leaf: Gillett 13198 (K), fruit: Ash 2783 (K).

10. *Hibiscus radiatus* Cav., *Diss.* 3: 150, t. 54, f. 2 (1787). Type: Paris, cult. from seeds collected by Banks, *Cavanilles* s.n. (P-holotype).

Hibiscus unidens Lindl. in *Bot. Reg.* 9: t. 878 (1823). Type: *Bot. Reg.* 9: t. 878 (holotype).

Hibiscus lindleyi Wall., *Pl. asiat. rar.* 1: 4, t. 4 (1830). Type: Burma, Segaing on Mt. Taung Dong, *Wallich* 1895-1 (K-lectotype, according to Borssum-Waalkes, 1961; G!-isotype-2 sheets).

Hibiscus furcatus Moritz, *Syst. Verz.*: 29 (1846), non Roxb. (1814).

Hibiscus cannabinus Mast. in Oliver, *Fl. trop. Afr.* 1: 204 (1868), non L. (1759), pro parte quoad syn. *H. radiatus*.

Hibiscus radiatus var. *lindleyi* (Wall.) Kurz in *J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist.* 43: 110 (1874).

Hibiscus cannabinus Hochr. in *Annuaire Conserv. Jard. Bot. Genève* 4: 114 (1900), non L. (1759), pro parte syn. *H. radiatus*, *H. unidens*, *H. lindleyi*.

Hibiscus cannabinus var. *unidens* (Lindl.) Hochr. in *Annuaire Conserv. Jard. Bot. Genève* 4: 115 (1900).

Hibiscus cannabinus Merr. in *Philipp. J. Sci.* 3: 244 (1908), non L. (1759).

Hibiscus cannabinus var. *radiatus* (Cav.) Chiov. in *Atti Ist. Bot. Univ. Pavia* ser. 4, 7: 125-126 (1936).

Illustrations: Sims, *Bot. Mag.*: t. 5098 (1859); Paul & Nayar, *Fasc. Fl. India* 19: 145, fig. 30 (1988); Icones Roxburghianae no. 1584 (K).

Erect, branched *herb* or *subshrub* to 2 m tall; stems tinged red, glabrous or sometimes sparsely aculeate. *Stipules* 8-12 mm long, linear to lanceolate. *Leaves*: petioles 2-11(-15) cm long, sparsely aculeate or glabrous, the blades 2-12 × 1.5-12 cm, deeply palmately 3-5(-7)-lobed, glabrate, the base cuneate, truncate, or subcordate, the margin coarsely serrate, the apex acuminate, the nectary absent. *Flowers* axillary, solitary; peduncles 0.2-0.5(-1.3) cm long, articulating near the base to about halfway between the base and the epicalyx, glabrous to pubescent below the articulation, bristly above it; involuellar bracteoles 8-10, 10-15 mm long, spreading, linear, sparsely bristly, the apex bifurcate (or rarely entire or obscurely bifurcate), the outer fork 4-5 mm long, narrowly lanceolate, the inner fork usually shorter, linear, the base free; calyx 1.5-3 cm long, the lobes lanceolate, long-acuminate, sparse-bristly on the ribs, essentially glabrous otherwise, or minutely pubescent below, the nectary absent; corolla red-purple, or more rarely yellow, with a deep purple centre, the petals 6-7 × 3-4 cm, obovate, finely and sparsely pubescent dorsally, glabrous ventrally; staminal column 25-30 mm long, the filaments 2 mm long, the anthers purple, the pollen yellow-brown; style branches 2-3 mm long, red; stigmas red-purple. *Capsules* 20-25 × 15-22 mm, ovoid, densely appressed-pubescent, the beak 3 mm long, glabrous; seeds 4 × 3 mm, subreniform, dark brown, faveolate and beset with minute pectinate scales, the funiculus small, inconspicuous, glabrous. Chromosome number, $n = 36$.

DISTRIBUTION. Apparently Indian in origin (an amphidiploid species, possibly from hybridization of *Hibiscus cannabinus* with *H. surattensis*: Menzel, 1986: 452), but now widely cultivated. **Central African Republic**, Chari, 21 November 1902, *Chevalier* 6347 (G); Oubangi-Chari, 10 November 1924, *LeTestu* 1687 (BM). **India**, Assam, November 1890, *Dr King's Collector* s.n. (CAL); Coromandel, without date, *Mace* s.n. (P); India, without precise locality or date, *Roxburgh* s.n. (BM). **Burma**, Minlen, 1902, *Shaik Mokim* 548 (G); *Wallich* 1895c (BM). **Vietnam**, 'Cochinchine', without precise locality or date, *Pierre* 3735 (P-2 sheets). **Indonesia**, 'North Borneo', without precise locality, 1877-78, *Burbridge* s.n. (BM); Java, without precise locality or date, *Zollinger* 1248 (BM).

Widely cultivated in both the Old and New Worlds. Whether it ever appears as a truly wild plant is unknown. Saldanha (1985) described it as being 'frequent in deciduous forests' in Karnataka, India. Borssum Waalkes (1966) noted that it was both cultivated and ruderal in Malesia. Fryxell (1988, 1992) states that it is sometimes naturalized in Mexico and Ecuador.

11. *Hibiscus torrei* Baker f. in *J. Bot.* 75: 101 (1937). Type: Mozambique: Niassa, Vila Cabral, July 1934, *Torre* 435 (COI-holotype; BM!-isotype, 2 sheets; G!-photograph). Fig. 1G.

Shrub or much-branched perennial *herb*; stems with many stout retrorse aculei and lines of dense stellate pubescence and soft simple hairs. *Stipules* 4-5 mm long, subulate to lanceolate, with a few small fine hairs. *Leaves*: petioles 0.5-4.5 cm long, with pubescence like that of the stems, the blades 4.5-10 × 5.5-10 cm, palmately shallowly 3-5-lobed, scabrous, abaxially retrorse-aculeolate on the midrib and lateral ribs and veins, adaxially without the aculeoli, the base truncate to cordate, the margin coarsely dentate, the apex acute to obtuse, the nectary apparently absent. *Flowers* solitary, axillary or sometimes clustered near the apex of flowering branches; peduncles 0.4-0.8 cm long, articulating at the base, with long rigid hairs on enlarged bases and some finer simple or stellate hairs; involuellar bracteoles 8-10, 6-7 mm long below the apex, linear, flattened, finely stellate-pubescent and with a few longer hairs on bases, the apex bifurcate, the outer fork 3-4 mm long, broadly lanceolate to ovate, with a prominent midvein, the inner fork 4-6 mm long, linear to subulate, the base free; calyx 1.7-2.2 cm long, the lobes triangular, acute, finely stellate-pubescent on the ribs and with matted long hairs on enlarged bases and a few aculei on the margins, the nectary absent; corolla yellow with a purple centre, the petals 3-5 cm long, obovate, sparse, simple and stellate-pubescent dorsally, glabrous(?) ventrally. *Capsules* 19-20 × 15-17 mm, densely appressed-pubescent, the beak 1 mm long, glabrous; seeds subreniform, the surface faveolate (according to Exell, 1961).

Damp places (Exell, 1961).

DISTRIBUTION. Fig. 5. Southern Tanzania to northern Mozambique. **Mozambique**, (type collection). **Tanzania**, Iringa: Mufindi Dist., Uhafiwa, 3 August 1989, *Kayombo* 795A (TEX); Iringa: Mufindi Dist., Luhega forest near Uhafiwa, 10 June 1989, *Lovett et al.* 3287 (TEX).

12. *Hibiscus noldeae* Baker f. in *J. Bot.* 77: 20 (1939). Type: Angola, Malange, Quela, April 1938, *Nolde* 713 (BM!-holotype). Fig. 1H.

Hibiscus eetveldeanus var. *asperatus* de Wild. in *Bull. Jard. Bot. État* 3: 279 (1911). Type: Democratic Republic of Congo (Zaire), Kasai, Katola, April 1908, *Sapin* s.n. (BR!-holotype).

Hibiscus mechowii Exell & Mendonça, *Cons. fl. angol.* 1(2): 376 (1951), non Garcke (1881), pro parte quoad specim. *Milne-Redhead* 4100.

Hibiscus furcatus Mullend. in *Publ. Inst. Natl. Étude Agron. Congo Belge, Sér. Sci.* 61: 79 (1954), non Roxb. (1814).

Illustration: Maquet, *Fl. rwand.* 2: 383, fig. 121, 6A, 6B (1983).

Variably described as a *herb* to 1.5 m tall, a *shrub* to 3 m tall, or a *climber* with stems to 4 m long; stems retrorse-aculeate and with simple hairs or sometimes stellate-pubescent, more dense near the apex. *Stipules* 5-11 mm long, lanceolate to narrowly ovate, with fine short hairs on the margins. *Leaves*: petioles 1-11 cm long, retrorse-aculeolate and with long, mostly simple hairs, more dense on the adaxial surface, the blades 1-9 × 0.2-10 cm, on lower leaves deeply

palately 3–5-lobed, the midlobe and lateral lobes lanceolate or oblanceolate, the outer lobes vestigial to lanceolate or ovate, the blades on uppermost leaves bract-like, all blades abaxially retrorse-aculeolate and with simple to 4-fid hairs on ribs, mostly simple hairs on veins, adaxially with simple to 4-fid hairs on ribs and veins, the nectary 2 mm long, conspicuous. *Flowers* axillary, solitary; peduncles 0.2–1.2 cm long, articulating from near the base to c. halfway between the base and epicalyx, densely fine-pubescent below the articulation, aculeolate and sparsely puberulent above the articulation; involucellar bracteoles 8–10, 7 mm long below the apex, linear to subulate, with long simple hairs or bristles on enlarged bases, mostly on margins, the apex bifurcate, the outer fork 3–6 mm long, lanceolate, not reflexed, the inner fork 1–6 mm long, linear to subulate, the base free; calyx 1.5–2.5 cm long, the lobes triangular, long-acuminate, with simple hairs or bristles on purple enlarged bases plus finer simple to 2-fid hairs, mostly on ribs, more dense below, the nectary < 1 mm long, inconspicuous; corolla yellow with a dark red to purple centre, the petals 2.5–5 × 2–2.5 cm, obovate, sparsely stellate-pubescent dorsally, glabrous ventrally. *Capsules* 14–20 × 11–15 mm, densely appressed-pubescent, the beak 1–2 mm long, glabrous; seeds 3 × 2 mm, reniform, dark brown, faveolate and with pectinate scales, the funiculus small, inconspicuous, glabrous. Chromosome number, $n = 36$ (Kachecheba, 1972).

Ruderal and wild, in plantations and fallow land, in savannas, edges and clearings in forests, river banks and swamps; apparently sometimes cultivated for fibre and young leaves.

DISTRIBUTION. Fig. 4. Western to eastern central Africa, from Sierra Leone to Ethiopia and south to Angola and Zambia. **Sierra Leone**, c. 5 miles from Kamerea on Kurubonla road, 14 November 1965, *Morton* SL2486 (K). **Ivory Coast**, Mt. Nimba, 14 December 1967, *Geerling & Bokdam* 1713 (BR). **Nigeria**, NE State, Sardauna Prov., Mambilla Plateau, 9 October 1973, *Chapman* 3249 (K). **Cameroon**, cult., 6 km W. of Bandjoun, 26 August 1972, *Leeuwenberg* 10288 (BR); 36 km N. de Bafia, 22 November 1969, *Letouzey* 9600 (P); Bamenda, 2 February 1928, *Migeod* 463 (BM). **Central African Republic**, Oubangui, Région de la Waka, 10 November 1924, *Tisserant* 1687 (P). **Sudan**, Mongalla Prov., S. of Juba-Yei road between Libogo and Yei, 23 February 1934, *Dandy* 485 (BM). **Ethiopia**, c. 40 km N. of Lekemti, ...tributary of Angar River, 13 November 1965, *deWilde & deWilde-Duyffes* 8866 (B, BR, P). **Democratic Republic of Congo**, Nioka, 1932, *Jurion* 128 (BM-2 sheets); Kivu Prov., Kabare Terr., Birava, 30 April 1960, *Meurillon* 819 (BR); Kaniama-Haut Lomani, 10 June 1947, *Mullenders* 290 (BR). **Uganda**, SE of Kampala, N. of Nioka, 30 April 1952, *Sperry* 553 (BR). **Rwanda**, Butare pref., Gihindansuyagu, 8 June 1978, *Raynal* 20345 (P). **Burundi**, Ruyigi: Muzire, 2 May 1980, *Reekmans* 8981 (K). **Angola**, Moxico, E. of Lusavo Falls, 13 January 1938, *Milne-Redhead* 4100 (BM, BR). **Zambia**, Kawambwa Dist., Mbereshi River swamp, 20 April 1957, *Richards* 9371 (BR).

One collection from Cameroon, *Letouzey* 9600 (P), has unusually long involucellar bracteoles which equal the calyx in length at anthesis.

13. **Hibiscus nigricaulis** Baker f. in *J. Bot.* 77: 19–20 (1939). Type: Angola, Bié: between Coemba and R. Cuanza, 7 May 1937, *Exell & Mendonça* 1759 (BM!-holotype).

Fig. 1E.

Hibiscus cannabinus Ulbr. & R.E. Fries in R.E. Fries, *Wiss. Ergebn. Schwed. Rhod.-Kongo-Exped.* 1: 145 (1914), non L. (1759), pro parte quoad specim. *Fries* 954.

Hibiscus cf. *diversifolius* Verdoorn & Collett in *Farming South Africa* 34: 2, fig. 2 (1947), non Jacq. (1789).

Hibiscus sabdariffa Mendonça & Torre, *Contr. Conhec. Fl. Mocamb.*

1: 11 (1950), non L. (1753), pro parte quoad specim. *Mendonça* 332 (LISC).

Hibiscus meeusei Exell in *Bol. Soc. Brot.*, ser. 2, 33: 165 (1959).

Type: South Africa, Transvaal, Bronkhorstspuit Dist., Donkerhoek (Donkerpoort), between Pretoria and Bronkhorstspuit, 19 March 1959, *Meeuse* 10646 (BM!-holotype; G!, P!-isotypes).

Illustration: (as *Hibiscus* cf. *diversifolius*) Verdoorn & Collett, *Farming South Africa* 34: 2, fig. 2 (1947).

Annual (sometimes biennial?) herb to 1.5 m tall; stems aculeolate and stellate-pubescent. *Stipules* 4–10 mm long, filiform to narrowly subulate, with short, fine pubescence. *Leaves*: petioles 1–12 cm long, with pubescence like that of the stems, the blades 2–12 × 0.2–1.5 cm, those of lower leaves deeply palmately 3–7(–9)-lobed, the lobes oblanceolate, obovate, or triangular, sometimes secondarily lobed, the blades of upper leaves less deeply lobed or even bract-like at the apex, all blades with fine simple and stellate hairs abaxially and adaxially, the base cuneate, truncate, or very shallowly cordate, the margin regularly to irregularly serrate, the apex obtuse to acute, the nectary 1–4 mm long, slit-like. *Flowers* axillary, solitary, or clustered on short-to-long flowering branches, the short flowering branches with a subtending, bract-like leaf with a nectary borne above the axillary leaf; peduncles 0.4–0.7 cm long, articulating at the base, with pubescence like that of the stems; involucellar bracteoles 8–9(–12?), 8–10 mm long, linear, flattened, finely stellate-pubescent and with coarse bristles on enlarged bases mainly on the margins, the apex obscurely bifurcate, the outer fork 2 mm long, reflexed, the inner fork < 0.5 mm long, vestigial, or sometimes absent, the base free or slightly united; calyx 1.4–2.0 cm long, the lobes lanceolate to ovate, more or less acuminate, finely stellate-pubescent and with coarse bristles on bases, mostly on the ribs, the nectary 1 mm long, usually conspicuous; corolla cream to light yellow, with a pinkish red to dark red-purple centre, the petals 2–4 × 1.5–3 cm, obovate, glabrous to stellate-pubescent dorsally, glabrous ventrally; staminal column 10–14 mm long, pink or red, the filaments 0.5 mm long, the anthers pink or purple, the pollen yellow or tan; style branches included in staminal column or exerted up to 1 mm long; stigmas red-purple, usually not exerted beyond the anthers. *Capsules* 14–18 × 11–16 mm ovoid, densely appressed-pubescent, the beak 1–2 mm long, glabrous; seeds 3–4 × 2–3 mm, subreniform, dark brown, finely faveolate and with sparse pectinate scales, the funiculus small, dark brown, glabrous. Chromosome number, $n = 36$.

Ruderal and wild, in old cultivated lands and waste places, disturbed native vegetation, moist places and marshland.

DISTRIBUTION. Fig. 4. Southern Africa from Angola, Zambia, and Mozambique to South Africa. Hauman (1963) also cites several specimens (as *H. meeusei*) from southeastern Democratic Republic of Congo (Zaire), none of which I have seen. **Angola**, Huila, Humpata, 24 April 1964, *de Menzies* 1061 (BM); Okavongo Nat. Terr., Okavongo River at Dujona Camp, 2 miles E. of Nyangana Mission Station, 18 February 1956, *deWinter & Marais* 4757 (BM). **Zambia**, Kasama Dist., 80 km S. of Kasama, 29 April 1962, *Robinson* 5121 (B); NW Dist., near Kitwe Railway Station, 8 April 1961, *Linley* 133 (BM); Ndola [North], 20 March 1954, *Fanshawe* 979 (K); Lusaka Dist., April 1957, *Noak* 193 (BM); S. Prov., Kalomo Dist., 18 March 1962, *Astle* 1516 (K). **Mozambique**, Manica E Sofola, Chimoio, Garuso, 3 March 1948, *Barbosa* 1086 (BR). **Zimbabwe**, Lomagundi, Umboi Valley, 28 March 1950, *Colville* 108 (BM); Odzani Banks, March 1935, *Gilliland* 1721 (BM); Victoria Falls, May 1915, *Rogers* 13157 (BM). **Namibia**, Tsumeb, April 1934, *Dinter* 7588 (BM); Grootfontein Nord, zwischen Numkaub und Bumbi im Omuramba, 5 March 1958, *Merxmüller & Giess* 1827 (BM). **South Africa**, Transvaal, Waterberg, 4 km Kienaars River Station, 18 March 1947, *Codd* 2749 (BM, PRE); Transvaal, Kwandebele, farm Gembokfontein, 17

March 1981, *Hoepen* 1627 (PRE); Transvaal, Zoutpansberg Dist., c. 2 mi W. of Hangklip along road to Buckworth, 4 April 1957, *Meeuse* 10234 (BM); Natal, 14 July 1929, *Salter* 382/12 (BM); Natal, Port Shepstone, Izotaha ravine, 8 July 1967, *Strey* 7551 (PRE).

14. *Hibiscus mechowii* Garcke in *Linnaea* 43: 121 (1881). Type: Angola, Cuanza Norte, without date, *Mechow* 105 (B-holotype; BM!-drawing).

Fig. 2G.

Hibiscus lancibracteatus de Wild. & T. Durand in *Bull. Soc. Roy. Bot. Belgique* 38(2): 25 (1899). Type: Democratic Republic of Congo (Zaire), Coquilhatville, 17 February 1896, *Dewèvre* 752 (BR!-holotype).

Hibiscus cannabinus Hochr. in *Annuaire Conserv. Jard. Bot. Genève* 4: 114 (1900), non L. (1759), pro parte quoad syn. *H. mechowii* (4: 115).

Illustration: (as *H. lancibracteatus*) de Wild. & T. Durand, *Ann. Mus. Congo*, sér. 1, Bot. 1: 147, t. 84 (1901).

Herb or *shrub* to 2 m tall; stems aculeolate and with long fine simple hairs and lines of pubescence. *Stipules* 10–20 mm long, filiform to linear, almost glabrous. *Leaves*: petioles 2–7 cm long, aculeolate and with long simple hairs, the blades 4–10 × 3–8 cm, very deeply palmately 3–5-lobed, the lobes linear, or rarely, shallowly lobed (e.g. *Nannan* 24) both surfaces covered with fine simple hairs plus a few stout hairs on enlarged bases on ribs, the base cuneate, the margin serrate or with minute antrorse barbs, the apex acute, the nectary 3 mm long, slit-like. *Flowers* axillary, solitary; peduncles 0.5–1.2 cm long, articulating at the base, with dense short woolly pubescence and long simple hairs; involucellar bracteoles 9–10, 11–22 mm long, with long simple hairs and pigmented stout bristles, linear below the apex, the upper 6–11 mm channelled on the ventral surface, several-nerved on the dorsal surface, becoming lance-shaped upon drying, the apex entire, pointed, the base united; calyx 2–3 cm long, the lobes broadly lanceolate, acuminate, with long simple matted hairs, mostly on the ribs, the nectary absent; corolla lemon yellow with a large red-brown centre, the petals 4–6 × 2–3.5 cm, obovate, glabrous dorsally and with a few simple hairs ventrally; staminal column 15 mm long, light pink, the filaments 1 mm long, the anthers purple, the pollen brownish red; style branches included in the staminal column or to 3 mm long; stigmas white to red. *Capsule* 20–26 × 15–18 mm, ovoid, densely appressed-pubescent, the beak 5 mm long, pubescent; seeds 4 × 3 mm, subreniform, with sparse fine matted hairs. Chromosome number, $n = 18$.

Ruderal and wild (rarely cultivated?), in abandoned plantations or cultivated fields, wooded steppes, savannas, sandy, shady river banks, swampy alluvial plains. In Central African Republic, the stem fibres are reportedly used for making fish nets and wrapping steamed manioc (*Fay* 5295 (K)).

DISTRIBUTION. Fig. 4. Central and southern Africa, Central African Republic to Namibia, Botswana, Zimbabwe, and Mozambique; apparently disjunct in extreme western Africa. **Guinea-Bissau**, Bissau, Quinhamel, 17 November 1960, *Raimundo & Guerra* 48 (K). **Senegal**, Region de Bignona, Tèndouk, 13 December 1963, *Berhaut* 6773 (P). **Central African Republic**, Territoire du Chari, 2 December 1902, *Chevalier* 6546 (P); Bossangoa, 10 October 1981, 600 m, *Fay* 5295 (K); Monova-Gounda-St. Floris Nat. Park, 1 November 1983, *Fay* 6102 (K); Haute-Kotto, Yalinga, 9 October 1921, *LeTestu* 3339 (BM); Oubangui, Region de Bambari, 10 October 1923, *Tisserant* 1246 (P). **Democratic Republic of Congo**, Kivu Prov., Uvira Terr., Uvira, 8 June 1956, *Kinet* 148 (BR); Terr. Popokabaka, Kinata, 25 April 1959, *Pauwels* 2661 (BR); cultivated, près village Bonananga, 22 October 1913, *Nannan* 24 (BR); Democratic Republic of Congo, without locality, August 1914, *Vanderyst* 3972 (BM). **Burundi**, Bubanze, Randa, 5 June 1980, *Reekmans* 9267 (K).

Tanzania, T4, Lukoma, Kigoma Dist., L. Tanganyika, 29 May 1975, Kahurananga, *Kibuwa & Mungai* 2688 (BR); Bezirk Lindi, 50 km W. Lindi, 24 April 1935, *Schlieben* 6485 (BM). **Angola**, Moxico, River Luena, near Vila Luso, 3 May 1937, *Exell & Mendonça* 1538 (BM); Pungo Adongo, April 1857, *Welwitsch* 5262 (BM). **Zambia**, Bulaya, June 1950, *Bullock* 2910 (BR); Abercorn Dist., Kawi Village, 19 May 1936, *Burt* 6147 (BM); Zambesi, Gonyé, 28 April 1925, *Pocock* 170 (BOL); Namwala Dist., 1934–35, *Read* 54 (BM); Abercorn Dist., Chilongowelo, 10 May 1952, *Richards* 1697 (K); Bulaya, NE of Mwerū-Wantipa, 11 August 1962, *Tyrer* 401 (BM). **Namibia**, Okavango Native Territory, 4 March 1956, *de Winter & Marais* 4973 (PRE); Groetfontein-Nord, Südlich Mavanze, im Omuramba, 5 March 1958, *Mertx Müller & Giess* 1871 (BM). **Zimbabwe**, Victoria Falls, May 1915, *Rogers* 13155 (BOL).

15. *Hibiscus subdiversifolius* Hochr. in *Annuaire Conserv. Jard. Bot. Genève* 20: 83–85 (1916). Type: Madagascar, loco collectore haud indicato, n. 22 (G!-holotype).

Hibiscus diversifolius var. *subdiversifolius* Hochr., *Fl. Madagasc., Malvac.*: 40–41 (1955).

Illustration: Hochreutiner, *Fl. Madagasc., Malvac.*: 39, fig. XI, 1–2 (1955).

Shrub 3–4 m tall; stems aculeate and very densely tomentose. *Stipules* 4 mm long, filiform, with dense, short pubescence. *Leaves*: petioles 0.5–10 cm long, very densely tomentose, the blades 1.5–12.5 × 0.5–14.5 cm, lanceolate to ovate or very shallowly 7-lobed, abaxially and adaxially densely stellate-pubescent, the base cuneate, truncate, or deeply cordate, the margin serrate or dentate, the apex acute to acuminate, the nectary 1.5 mm long, slit-like. *Flowers* apparently clustered near the apex of the stem; peduncles 0.6 cm long, articulating midway between the base and the epicalyx, densely short-tomentose below and above the articulation, and with long simple hairs above it; involucellar bracteoles 6(?), 10 mm long, linear, flattened, channelled on the ventral surface, densely tomentose, the apex entire, the base free; calyx 1.5–1.7 cm long, the lobes triangular, acuminate, densely and finely stellate-pubescent and with long, simple to stellate(?) hairs, mainly on the ribs, the nectary apparently absent; corolla colour unknown, but with dark-coloured centre, the petals 5.5 × 2 cm, obovate, finely stellate-pubescent dorsally, glabrous ventrally; staminal column tan, filaments 1 mm long, anthers purple. *Capsules* and seeds unknown.

Riverbanks and vicinity (Hochreutiner, 1955).

DISTRIBUTION. Fig. 5. **Madagascar.** I have seen only the type collection which cites Madagascar without specific locality, but Hochreutiner (1955) lists two *Perrier* collections (5343, 5464) from western Madagascar.

The specimen mounted on *Dale* 2479 (G!), collected at the Nairobi, Kenya arboretum in September 1930, is *Hibiscus subdiversifolius* even though the label states that the plant was collected originally near Embu, Kenya, and was identified as *Hibiscus* sp. near *H. panduriformis* Burm.; a later label identifies the plant as *Hibiscus diversifolius* Jacq.

16. *Hibiscus berberidifolius* A. Rich., *Tent. fl. abyss.* 1: 56 (1847). Type: Ethiopia (Abyssynia), *Quartin Dillon et Petit* s.n. (P!-lectotype, Wilson, 1983; BR!-isolectotype).

Hibiscus diversifolius var. *witteanus* Hochr. in Robyns, *Bull. Jard. Bot. État* 10: 276 (1947). Type: Democratic Republic of Congo (Zaire), Kilisti, route de Kibumba, forêt, 17 January 1934, *de Witte* 1320 (G!-holotype; BR!-isotype); Tshamugussa, 9 August 1934, *de Witte* 1817 (BR!, G!-paratypes).

Illustrations: Maquet, *Fl. rwand.* 2: 383, fig. 121, 2A, 2B (1983); Wilson, *Brittonia* 35: 176, fig. 1 (1983).

Robust, few to many-branched perennial *shrub*, 1–4 m tall; stems sparsely to moderately aculeate, lower and mid-stem with a longitudinal line of dense fine pubescence to 2 mm long, alternating position at each node, also with sparse, mostly simple hairs, upper stems densely and uniformly pubescent. *Stipules* 2–4 mm long, linear, inconspicuous, very finely pubescent, sometimes lacking (caducous?). *Leaves*: petioles 0.3–3.5 cm long, aculeate, villous, the blades 0.9–8.5 × 0.4–6 cm, the blades of lower leaves ovate or shallowly 3-lobed, the blades of upper leaves obovate, narrowly obovate or bract-like, vegetative branchlets in leaf axils well-developed, with up to 7 persistent leaves, the blades of leaves on vegetative branchlets ovate to obovate, blades of all leaves abaxially and adaxially with simple and stellate hairs on the veins, the base cuneate to truncate, the margin serrate to coarsely serrate (newly opened leaves exhibit a gland-like, thickened structure at the apex of each serration), the apex acute, the nectary present or absent. *Flowers* axillary, solitary, disposed in the upper 7–23 cm of the branch; peduncles 0.1–2 cm long, accrescent, articulating at the base or apparently unjointed, densely and finely stellate-pubescent and with dense, simple hairs to 2 mm long; involucellar bracteoles 6–7, 9–13 mm long, subulate, flattened, obscurely several-nerved, apex entire, with long simple hairs on margins; calyx 1.4–2.2 cm long, the lobes short- to long-acuminate, villous below, finely pubescent above, the nectary usually absent; corolla varying from white to several shades of off-white, yellow, and purple, with a small, purple centre, the petals 3–5.5 × 3–5.5 cm, obovate to broadly obovate, sparsely simple- or stellate-pubescent dorsally, glabrous ventrally; staminal column 20–40 mm long. *Capsule* 13–17 × 11–17 cm, broadly ovoid, densely appressed-pubescent, the beak absent or up to 1 mm long, glabrous; seeds 4 × 3 mm, subreniform, dark brown, faveolate and with short, white, many-branched hairs. Chromosome number, $2n = 36$.

Savanna and grassland, upper elevation forests, bamboo and *Hagenia* zones.

DISTRIBUTION. Mountains of East Africa (1300 to 2700 m) associated with the Rift Valley in Democratic Republic of Congo, Uganda, Rwanda, Tanzania, Kenya, and Ethiopia (distributional map and specimens cited in Wilson, 1983).

17. *Hibiscus sparseaculeatus* Baker f. in *J. Bot.* **76**: 22 (1938).

Type: Somalia, Sheik Pass, *Freemantle* s.n. (BM!-holotype). Fig. 2H.

Cienfuegosia sp. Cufod. in Chiovenda, *Miss. biol. borana* **4**: 345, fig. 117 (1939).

Hibiscus greenwayi Cufod. in *Bull. Jard. Bot. État.* **29**: Suppl.: 562 (1959), non Baker f. (1937), pro parte quoad specim. *Bally* 9128.

Hibiscus greenwayi var. *megensis* J.P. Lebrun in *Adansonia* **15**: 379 (1976). Type: Kenya, Nyiro, 4000–5000 ft, stony hills, *Haylett* 12 (K-holotype).

Illustration: Cheek, *Fl. pl. afric.* **52**: pl. 2058 (1992).

Rigid, woody *shrub* to 3 m tall; stems with conspicuous, long (to 6 mm), red to brown, stout aculei, borne singly, in pairs, or in threes at the base of each node, stems otherwise glabrous and sometimes glaucous below. *Stipules* not seen. *Leaves* apparently shed early (some flowering and fruiting specimens are leafless); petioles 0.5–3 cm long, densely stellate-pubescent, the blades 0.6–2 × 2–4 cm, oval or rotund, densely stellate-pubescent abaxially and adaxially, the base truncate to cordate, the margin and apex dentate, the nectary 0.2–0.5 mm long. *Flowers* semi-pendulous, axillary, solitary; peduncles 0.5–3 cm long, articulating at or near the base, densely stellate-pubescent and sometimes with antrorse aculeoli; involucellar

bracteoles 7–9, 5–11 mm long, narrowly subulate, densely stellate-pubescent, the apex entire, pointed; calyx 1.2–2.0 cm long, the lobes lanceolate, short- to long-acuminate, densely stellate-pubescent and sparsely aculeolate, the nectary small but conspicuous; corolla yellow with a crimson-purple centre, the petals 4–6 × 3–5 cm, obovate, simple to stellate-pubescent dorsally, glabrous ventrally; staminal column 25–37 mm long, crimson, the filaments 0.5 mm long, the anthers red-brown, the mature pollen purple(?); style branches 9–12 mm long, red-brown below, purple(?) above, the stigmas purple. *Capsules* 10–20 × 9–15 mm, long appressed-pubescent, the beak 1–2 mm long, glabrous; seeds 4 × 3 mm, with fine pectinate scales, the funiculus with a dense fringe of short hairs.

Sandy or red soils, gravelly or rocky slopes, dry bushland dominated by *Acacia-Commiphora* and *Sansevieria* (Cheek, 1992), 750–2000 m elevation.

DISTRIBUTION. Fig. 4. Eastern Africa, from southern Ethiopia and Somalia to northern Tanzania. **Ethiopia**, Sidamo Prov., 8 miles S. of Mega on International Hwy., 25 December 1974, *Ash* 2783 (K); Km 10 SE Mega, 4 February 1973, *Boudet* 8166 (P); Borama, October 1945, *LePelley* in *Bally* 4663 (K). **Kenya**, Northern Province, Dandu, 14 June 1952, *Gillett* 13198 (BR, K-2 sheets); Northern Province, Furroli Mt., 15 September 1952, *Gillett* 13874 (B); K1, N. side of Lolockwe Mt., 28 km NNW of Archers post, 20 April 1973, *Gillett* 20199 (K). **Tanzania**, Northern Prov., Mbulu Dist., N. end Lake Eyasi, 23 July 1957, *Bally* 11588 (BR, G-2 sheets).

18. *Hibiscus greenwayi* Baker f. in *J. Bot.* **75**: 99 (1937). Type: Tanzania, NW Usambara, Mnazi, 12 January 1930, *Greenway* 2034 (EA-holotype; BM!-isotype).

Fig. 2F.

Large, perennial, much-branched *shrub* to 3 m tall; stems almost glabrous below to densely and finely stellate-pubescent above and with few to many stout conical aculei. *Stipules* 4–6 mm long, filiform, with dense, fine, short hairs. *Leaves*: petioles 0.4–13 cm long, stellate-tomentose, the blades 2.5–8 × 0.9–1.1 cm, the blades of lower leaves palmately 5-lobed, the midlobe and lateral lobes rotund to spatulate, the outer lobes ovate to oval, the blades of upper leaves entire and oblanceolate or 3-lobed, all blades densely and finely stellate-pubescent abaxially and adaxially, the base cuneate, truncate, or cordate, the margin coarsely dentate or repand, the apex obtuse or acute, the nectary 0.5–1 mm long. *Flowers* pendulous, axillary, solitary and clustered near the apex; peduncles 0.3–0.9 cm long, articulating at the base, stellate-tomentose and sometimes with a few antrorse aculeoli; involucellar bracteoles 6–10, 8–14 mm long, subulate, sometimes slightly acuminate, with fine and dense simple hairs to stellate-tomentose, the apex entire, pointed, the base free; calyx 1.7–2.2 cm long, the lobes lanceolate, acuminate, densely and finely stellate-pubescent and with a few antrorse aculeoli on the ribs, nectary small but conspicuous; corolla funnelform, lemon yellow to primrose yellow, with a red-purple centre, the petals 4–8.5 × 3–6.5 cm, obovate to oval, sparsely and finely to coarsely stellate-pubescent dorsally, glabrous ventrally; staminal column 35–60 mm long, dark pink to red-purple, the filaments 0.5–1 mm long, the anthers red to purple, the pollen yellow, orange-tan, or purple; style branches included in the staminal column or up to 9 mm long, red or purple, the stigmas dark red-purple. *Capsules* 16–18 × 11–14 mm, densely appressed-pubescent, the beak 1–2 mm long, glabrous; seeds 5–6 × 3–4 mm, subreniform, dark brown, faveolate and with long (0.5 mm) simple, flattened tan/brown hairs, the funiculus densely covered with simple, flattened straw-coloured hairs. Chromosome number, $n = 18$.

Ditch banks with grasses and shrubs, dry savannas, dense *Acacia-Commiphora* thornbush, edge of *Brachystegia* woodlands.

DISTRIBUTION. **Fig. 4.** Uganda, Kenya, and Tanzania. **Uganda**, about the Griffen Falls (Mabira Forest), 18 February 1918, *Dümmer* 3908 (BM). **Kenya**, Kwale Dist., between Samburu and MacKinnon Road, 31 August 1953, *Drummond & Hemsley* 4078 (K); Taita Dist., Tsavo West, hill c. 4 km SE of Manda Hill, 24 July 1969, *Gilbert* 4073 (EA); K7, Kilifi Dist., outside Sala Gate, 59 km W. of Malindi, 28 February 1977, *Hooper & Townsend* 1094 (K-2 sheets); Voi Dist., foot of Taita Hills, Bura, 14 April 1969, *Jones* 69159 (NA); K4, Kitui Dist., Yakaseva, Voo location, 24 August 1968, *Kimani* 78 (EA); K4, Kitui Dist., Mutomo, 24 April 1969, *Napper & Kanuri* 2070 (B, EA); Kilifi Dist., Marafa, 25 miles NW of Malindi, 22 November 1961, *Polhill & Paulo* 835 (B, BR); Kwale Dist., MacKinnon Rd., c. 54 miles from Mombasa, 12 June 1964, *Verdcourt* 3904 (EA, K); Kwale Dist., 8 km E. of MacKinnon Rd on Nairobi-Mombasa Hwy (A-109), 12 August 1975, *Wilson* 75140 (ASU, EA, NA); Kwale Dist., 30 km W. of Mombasa on Nairobi-Mombasa Hwy (A-109), 13 August 1975, *Wilson* 75143 (ASU, EA, NA). **Tanzania**, Umba Steppe, plains at base of Usambara Mts, 3 February 1954, *Faulkner* 1339 (B, K); T3, N. of Mombo, 8 September 1972, *Flock* 431 (EA).

19. *Hibiscus partitus* (Hochr.) F.D. Wilson, **comb. et stat. nov.**

Hibiscus diversifolius var. *partitus* Hochr. in *Annuaire Conserv. Jard. Bot. Genève* 4: 120 (1900). Type: Madagascar, environ de Tananarive, *Goudot* s.n. (G).

Illustration: Hochreutiner, *Fl. Madagasc., Malvac.*: 37, fig. X, 9, 10 (1955).

Habit unknown; stems large, stout-aculeate and with lines of stellate pubescence below, more densely stellate-pubescent above. *Stipules* 4–5 mm long, filiform to linear, finely short-pubescent. *Leaves*: petioles 0.3–5 cm long, aculeolate abaxially and with a line of dense pubescence adaxially, the blades 1.3–5 × 0.2–6 cm, on lower leaves palmately 5-lobed and manifestly secondarily lobed, on upper leaves bract-like or 5-lobed and secondarily lobed, all blades abaxially aculeolate on the ribs, veins, and margins, plus some dense, fine simple to stellate hairs, adaxially with simple to stellate hairs, usually not as dense, the base cuneate to truncate, the margin entire, serrate, or coarsely serrate and secondarily lobed, the apex acute to acuminate, the nectary minute (< 0.5 mm long) but conspicuous. *Flowers* axillary, solitary; peduncles 0.3–0.9 cm long, articulating at the base, antrorse-aculeolate and finely stellate-tomentose; involucellar bracteoles 7–8, 7–11 mm long, linear to narrowly subulate, with 2-fid or stellate hairs or short bristles, the apex entire, the base free or scarcely united; calyx 1.2–2.1 cm long, the lobes lanceolate to narrowly ovate, slightly to long-acuminate, aculeolate on the ribs and with short, rigid bristles, more dense near the base, the nectary small (0.2 mm long) but conspicuous; corolla yellow(?), with a large purple(?) centre, the petals 4–5.5 × 2.5–3.5 cm, obovate, with sparse 2–4-fid hairs dorsally, glabrous(?) ventrally. *Capsules* 14–20 × 12–15 mm, densely appressed-pubescent, the beak 1 mm long, glabrous; seeds unknown.

Rocky habitats and dried-out ponds (Hochreutiner, 1955).

DISTRIBUTION. **Fig. 5.** Central and northern Madagascar. **Madagascar**, Central, without precise locality and date, *Baron* 542, 3286, 3945 (K); North-west, without precise locality and date, *Baron* 5347 (K). Hochreutiner (1955) cites several specimens from west-central Madagascar.

20. *Hibiscus diversifolius* Jacq., *Collectanea* 2: 307 (1789). Type: *Icon. pl. rar.*: t. 551 (1792) (neotype, Fryxell, 1988). This was recognized as the holotype by Borssum Waalkes (1966), but as Fryxell (1988) points out, the plate was published several years after the name was published.

Perennial *subshrub* or *shrub* to 3 m tall (or rarely a *tree* to 10 m tall), the stems below with many stout conical aculei and with one or more

lines of pubescence, or more densely stellate-pubescent, the stems above aculeolate, densely and finely simple- and stellate-pubescent. *Stipules* 3–7 mm long, linear, pubescent. *Leaves*: petioles 0.6–22 cm long, with pubescence like that of the upper stems, the blades 3–16 × 0.7–14 cm, the blades of lower leaves ovate to shallowly or very deeply palmately 3–7-lobed, the blades of uppermost leaves bract-like, linear or narrowly lanceolate, all blades abaxially with simple and stellate hairs on the ribs and veins and adaxially with simple and stellate hairs on the ribs, and simple and 2-fid hairs on the margins, the base cuneate, truncate, or cordate, the margin serrate, dentate, or crenate, the apex acute or obtuse, the nectary 1–2 mm long, conspicuous, on the midrib and sometimes on two lateral ribs. *Flowers* axillary, solitary, or with 1–3 flowers at each node, or borne in racemes formed by the reduction of the upper leaves and shortening of the internodes; peduncles 0.2–0.8 cm long, articulating at the base, densely stellate-pubescent and with or without long, simple bristles; involucellar bracteoles 5–10, 8–15 mm long, linear to subulate, slightly concave ventrally, bristly, the apex entire, the base free; calyx 2–3 cm long, the lobes lanceolate, acute to short-acuminate, covered with stiff bristles, the nectary conspicuous; corolla light yellow, reddish, or purple, with a dark red-purple centre, the petals 3–6 × 2–5 cm, obovate, sparsely simple- and stellate-pubescent dorsally, glabrous ventrally; staminal column 15–32 mm long, white, pink, red, or purple, the filaments 1–2 mm long, dark red-purple, the anthers light pink, red, or purple, the pollen orange; style branches included in the staminal column or to 7 mm long, dark pink to purple; stigmas dark red-purple. *Capsules* 20–24 × 15–19 mm, densely appressed-pubescent, the beak 2 mm long, glabrous; seeds 4 × 3 mm, subreniform, dark brown, glabrous, with parallel striations, the funiculus tan, conspicuous, glabrous. Chromosome number, $n = 72$.

A form from Uganda, *Syngé* S.1042 (BM), is closely allied to *Hibiscus diversifolius*, but has foliaceous involucellar bracteoles and may be an undescribed species.

20a. *Hibiscus diversifolius* Jacq. subsp. **diversifolius**

Hibiscus ficulneus Cav., *Diss.* 3: 148, t. 51, fig. 2 (1787), non L. (1753), nom. illeg. (Art. 53.1).

Hibiscus scaber Lam., *Encycl.* 3: 350 (1792). Type: Mauritius (Île de France), *Commerson* s.n. (P-LA-holotype).

?*Hibiscus biflorus* A. Spreng., *Tent. suppl.*: 19 (1828). Type: South Africa, *Zeyher* 241 (BM!-sketch of type).

Hibiscus macularis E. Mey. ex Harv. in Harv. & Sond., *Fl. cap.* 1: 171 (1860), nom. nud.

Hibiscus decaisneanus Schimp. ex Hochr. in *Annuaire Conserv. Jard. Bot. Genève* 4: 119 (1900), nom. nud. Type: Ethiopia, Tigrè v. Begemder, 10 November 1863, *Schimper* 1479 (BM!-isotype?).

Hibiscus diversifolius subsp. *genuinus* Hochr. in *Annuaire Conserv. Jard. Bot. Genève* 4: 119 (1900), nom. illeg. (Art. 26.2).

Hibiscus paludosus Merr. in *Philipp. J. Sci.* 3: 151 (1908). Type: The Philippines, Mindanao, Lake Lanao, *Clemens & Clemens* s.n. (BO, G, L-isotypes).

Hibiscus berberidifolius Cufod. in *Bull. Jard. Bot. État.* 29, *Suppl.*: 560 (1959), non A. Rich. (1847).

Hibiscus diversifolius var. *witteanus* Cufod. in *Bull. Jard. Bot. État.* 29, *Suppl.*: 560 (1959), non Hochr. (1947).

Hibiscus diversifolius var. *angustilobus* Hauman in *Bull. Jard. Bot. État.* 31: 86 (1961) excl. specims. *Laurent* 11, *de Witte* 2435. Type: Democratic Republic of Congo (Zaire), Haut-Katanga: Sakala, Marungu, April 1944, *Dubois* 1157 (BR!-holotype).

Illustrations: Maquet, *Fl. rwand.* 2: 383, fig. 121, 4 (1983); An-

draws, *Fl. pl. anglo-egypt. sud.* 2: 24, fig. 10 (1952); Hochreutiner, *Fl. Madagasc.*, *Malvac.*: 39, fig. X, 6–8 (1955).

Stems usually with one or more longitudinal lines of pubescence, flowers yellow (Exell, 1961).

In generally moist habitats, riverbeds, river banks, swamps, in papyrus and other vegetation at lake edges, bays; also reported as ruderal plants on road shoulders and in grass and bushland.

DISTRIBUTION. **Fig. 4.** Circumtropical. Widely distributed in subsaharan Africa from Cameroon and Ethiopia to Madagascar and South Africa, except in the *Flora Zambesiaca* area (Zambia, Malawi, Zimbabwe, Mozambique, Botswana), where it is replaced by subsp. *rivularis* (Exell, 1961). *Wilson & Kissie* 7531 (subsp. *rivularis*) and 7532 (subsp. *diversifolius*) were growing together in a papyrus-*Typha* swamp in the Musoma Region, Tanzania (Wilson, 1978); disjunct in Senegal? **Senegal**, Niombato, 1950–51, *Berhaut* 1061 (BR, P). **Cameroon**, près village de Pêcheurs de Mouhengué (=Malimba), 6 January 1974, *Letouzey* 12629 (P); Ndop Plain, 6 March 1962, *Brunt* 146 (K-2 sheets). **Ethiopia**, Shoa Prov., Lake Shala, 14 November 1971, *Ash* 1357 (K); Agaro, 24 January 1969, *Jones* 6908 (K). **Congo**, Region de Brazzaville, île M'Bamou, 13 October 1967, *Sita* 1818 (P); **Democratic Republic of Congo**, Plaine de la Ruzizi, lac Ranyinia, January 1950, *Germain* 5650 (G); Kivu Prov., Kabare Territ., Lulonge, 9 January 1967, *Vermeylen* 35 (BR). **Uganda**, Kyaka, Toro, 1914, *Snowden* 31 (BM, K). **Kenya**, 13 miles S. of Thika on Nairobi-Thika Road (Hwy A-2), 17 July 1975, *Wilson* 7511 (ASU, EA, NA); c. 9 km from Nairobi on road to Nakuru, 24 June 1977, *Gachathi* 287 (B); Nairobi Prov., Kiririchusa Ndogo Valley, 10 July 1944, *Bally* 3407 (G). **St. Helena**, above Lufkins, 23 February 1955, *Kerr* 108 (BM). **Rwanda**, 22 August 1958, *Michel* 5562 (BR). **Tanzania**, Musoma Region, 8 km N. of Nyakanga on Hwy B-6, 23 July 1975, *Wilson & Kissie* 7532 (ASU, EA, NA); Laliondo Dist., 6 July 1956, *Williams* 702 (BR); Kirumba, Ilemera, Mwanza, 24 June 1953, *Tanner* 1608 (K); Ndingo, Songea Dist., 29 September 1956, *Semsei* 2490 (K). **Malawi**, Station Kyimbila, 29 September 1910, *Stolz* 307 (G); N. Prov., Mzimba Dist., Vipya Plateau, 14 July 1975, *Pawek* 9887 (K). **Madagascar**, Nord Betsiléo, Linabé, August 1880, *Hildebrandt* 3567 (BM, G); central Madagascar, 1855, *Baron* 4169 (BM). **South Africa**, Natal, Alexandra Dist., Dumisa, 12 May 1908, *Rudatis* 380 (BM); Cape Peninsula, Retreat, April 1951, *Pillans* 10565 (G); Cape Prov., Voëklip camping area, 29 August 1985, *Williams* 1087 (PRE); Cape Prov., Humansdorp, November 1921, *Fourcade* 1781 (BOL); Cape Peninsula, Granger Kloof swamp below farm, 9 May 1897, *Wolley* 2496 (BM, BOL). **Mauritius**, Rivière Citron near Balaclava, 21 November 1961, *Duljeet* 10244 (BM).

Hulstaert 1472 (BR!), listed under *Hibiscus diversifolius* var. *angustilobus* by Hauman (1963) is probably a hybrid involving *H. diversifolius* (*H. cannabinus* × *diversifolius*?), as Hauman's annotation of the specimen indicated.

20b. ***Hibiscus diversifolius*** subsp. *rivularis* (Bremek. & Oberm.) Exell, *Fl. zambes.* 1: 444 (1961).

Hibiscus rivularis Bremek. & Oberm. in *Ann. Transvaal Mus.* 16(3): 424 (1935). Type: Botswana, Chobe R., Kabulabula, July 1930, *van Son* s.n., in Herb. Transv. Mus. 28936 (PRE-holotype; BM!-isotype).

Stems more densely and uniformly hairy, flowers reddish to purple (Exell, 1961).

Generally in habitats in or close to standing water, riverbanks, swamps, lake shores, forest edges.

DISTRIBUTION. **Fig. 4.** Eastern, southeastern and southwestern Africa from Uganda to Botswana. **Angola**, Cuanza Sul, banks of River Longo, Quissama Country, 7 June 1921, *Gosswailer* 8300 (BM, P) [Exell & Mendonça (1937) cite *Gosswailer* 8300 as subsp. *diversifolius* – note on BM specimen says 'flower a beautiful dusky purple']. **Democratic Republic of Congo**, Lac Mokoto, Terr. Masisi, 22 January 1959, *Leonard* 2657 (BR). **Rwanda**, Territ. Biumba, Reg. du Mutara, env. de Mimuli, 2 April 1957, *Troupin* 3079 (BR).

Burundi, Kigamba (préf. Ruyigi), 3 October 1974, *Auquier* 4367 (BR). **Uganda**, Koki, 9 August 1903, *Bagshawe* 380 (BM); Igara, Ankole, March 1939, *Purseglove* 612 (BR, K-2 sheets). **Tanzania**, West Lake Province, Keza, Bushubi, Ngara, 30 May 1960, *Tanner* 4950 (K); Bezirk Lindi, Lutamba-See, 40 km W. Lindi, 9 November 1934, *Schlieben* 5287 (BM, G); Musoma Reg., 8 km N. of Nyakanga on Hwy B-6, 23 July 1975, *Wilson & Kissie* 7531 (ASU, EA, NA); Zanzibar, June 1894, *Sacleux* 2148 (P). **Zambia**, Western Prov., Fort Rosebery Dist., 20 August 1952, *Angus* 353 (BM, BR); near Nabwalya's, Luangwa Valley, 16 August 1966, *Astle* 4932 (K). **Malawi**, Benga by Lake Nyasa, 28 August 1950, *Foster* 11 (K); Kota-Kota Dist., Benga, W. shore of Lake Nyasa, 2 September 1946, *Brass* 17480 (BR); Chipoka, Fort Johnston, 7 August 1954, *Banda* 41 (BM). **Mozambique**, Gaza, Bilene, Praia de S. Martinho, 7 November 1969, *Correia & Marques* 1450 (K); Sul do Save, Lourenço Marques, Catembe, 10 June 1957, *de Carvalho* 277 (BM); Delagoa Bay, Rikatla, 1890, *Junod* 38 (G-2 sheets); Lourenço Marques, Marracuene, 30 June 1971, *Marques* 2313 (NBG); Kurumadgi R. Jihu, 12 August 1906, *Swynnerton* 2109 (BM). **Botswana**, N. District, Linyanti R. at Shalie, 28 October 1972, *Gibbs Russell* 2413 (PRE); banks of Chobe R., 8 miles N. of Kachikau, 9 July 1937, *Erens* 366 (BR).

21. ***Hibiscus reekmansii*** F.D. Wilson, **sp. nov.** Type: Burundi, Muramwya Prov., bois sacré de Mptosa jachère bord route, 17 May 1979, *Reekmans* 7993 (BR!-holotype).

Fig. 2D.

Hibiscus diversifolius var. *angustilobus* Hauman in *Bull. Jard. Bot. État* 31: 86 (1961), pro parte quoad specims. *Laurent* 11, *deWitte* 2435.

Hibiscus diversifolius var. *angustilobus* P. Maquet in G. Troupin (Ed.), *Fl. rwanda* 2: 382 (1983), non Hauman (1961), pro parte quoad specims. *Auquier* 3937, *Troupin* 16264.

Caules aculeati; folia profunde 5–7 lobata; pedunculi fructificantes, <1 cm longi; bracteolae involucellorum non bifurcatae, apicibus auctis; calyces pilis argenteis vel cinereis vel stramineis, nectariis in quoque costa.

Shrub to 2 m tall; stems with antrorse to retrorse aculeoli and with lines of stellate pubescence below, densely stellate-pubescent above. *Stipules* 2–6 mm long, filiform or linear, with fine, short hairs. *Leaves*: petioles 0.4–5 cm long, with pubescence like that of the stem, the blades 0.6–6 × 0.2–7 cm, the blades of lower leaves deeply 5(–7)-lobed, the midlobe linear to ovate or obovate, the lateral lobes linear to ovate, the outer lobes lanceolate or triangular, the midlobe and lateral lobes often secondarily lobed, the blades of upper leaves bract-like or 3-lobed, all blades abaxially aculeolate and with simple and stellate hairs on the ribs, and simple to 4-fid hairs on the veins, adaxially with dense simple to stellate hairs on the ribs and fine, short, mostly stellate hairs on the veins, the base cuneate, truncate, or cordate, the margin serrate to irregularly serrate, the apex acute or acuminate, the nectary 0.2–0.5 mm long. *Flowers* axillary, solitary, or with 2–3 nodes clustered near the apex, some flowers with a subtending bract resembling the stipules, linear, flattened, pink, sometimes with a bifid apex; peduncles 0.2–0.6 cm long, articulating at the base, with simple, appressed grey-to straw-coloured, dense, fine hairs to 2 mm long; involuellar bracteoles 6–8, 6–10 mm long, linear, flattened, with short bristles or with hairs like those of the peduncles, the apex entire but slightly enlarged, the base free; calyx 1.0–1.5 cm long, the lobes triangular-acute to lanceolate-acuminate, with bristles to 3 mm long or with hairs as on the peduncles, the nectary small but conspicuous; corolla bright yellow to primrose yellow, with a small purple centre, the petals 3–4 × 2–2.5 cm, obovate, finely stellate-pubescent dorsally, glabrous ventrally; staminal column 16 mm long, yellow(?), the filaments 0.5 mm long, the anthers yellow-brown(?), the pollen yellow; style branches 5 mm long, yellow-brown(?). *Capsule* 12–15 × 10–13 mm, densely

appressed-pubescent, the beak 1–2 mm long, glabrous; seeds 3 × 2 mm, subreniform, dark brown, with a faveolate background and minute protuberances, the funiculus small, dark-brown, glabrous.

Mountainous habitats, 1800–2400 m elevation, in savannas, rock talus, fields, and pastures.

DISTRIBUTION. **Fig. 5.** Eastern Democratic Republic of Congo, Rwanda, Burundi, and western Tanzania. **Democratic Republic of Congo,** Kivu, environs de Kabare, 25 July 1942, *Laurent* 11 (BR); Parc Nat. de L'Upemba, Mukana, 24 March 1942, *de Witte* 2435 (BR). **Rwanda,** route Butare-Cyangugu, vers km 30, Préf. Gikongoro, 28 May 1981, *Troupin* 16264 (BR); Colline Gisego, village Rugera, au sud de lat Préf. Gikongoro, 6 September 1974, *Auquier* 3937 (BR). **Burundi,** Muramvya Prov., Teza, 19 June 1980, *Reekmans* 9395 (BR). **Tanzania,** Iringa Prov., Mbosi, May 1935, *Horsburgh-Porter* s.n. (BM).

22. *Hibiscus sabdariffa* L., *Sp. pl.* 2: 695 (1753). Type: resolved but not yet published (P.A. Fryxell, pers. comm., 1996).

Hibiscus cannabinus Hiern, *Cat. afr. pl.* 1: 72 (1896), non L. (1759), pro parte quoad specims. *Welwitsch* 5263 (BM!, LISU!), *Welwitsch* 5265 (BM!, LISU!).

Hibiscus masuianus de Wild. & T. Durand in *Bull. Soc. Roy. Bot. Belgique* 38(2): 20 (1899). Type: Democratic Republic of Congo (Zaire), Boma, 1 August 1895, *Dewèvre* 71 (BR!-holotype & isotype).

Hibiscus sabdariffa var. *albus* A. & G. Howard in *Mem. Dept. Agric. India, Bot. Ser.* 4: 32 (1911).

Hibiscus sabdariffa var. *intermedius* A. & G. Howard in *Mem. Dept. Agric. India, Bot. Ser.* 4: 32 (1911).

Hibiscus sabdariffa var. *ruber* A. & G. Howard in *Mem. Dept. Agric. India, Bot. Ser.* 4: 32 (1911).

Hibiscus sabdariffa var. *bhaghalpuriensis* A. & G. Howard in *Mem. Dept. Agric. India, Bot. Ser.* 4: 33 (1911).

Hibiscus sabdariffa var. *altissima* Wester in *Philipp. Agric. Rev.* 7: 266 (1914).

For additional synonymy, see Hochreutiner, 1900: 116, 117; Hauman, 1963: 114; Borssum Waalkes, 1966: 64; Fryxell, 1988: 225.

Illustrations: Andrews, *Fl. pl. anglo-egypt. sud.* 2: 24, fig. 12 (1952); Hochreutiner, *Fl. Madagasc., Malvac.*: 39, fig. XI, 3 (1955); Ochse, *Veg. Dutch E. Ind.*: 476, fig. 296 (1960).

Annual herb, branched or unbranched, up to 4.5 m tall; stems and foliage green, green-red, or red, glabrous to sparsely pubescent, sometimes sparsely aculeate. *Stipules* 5–13 mm long, linear to narrowly subulate. *Leaves:* petioles 0.3–1.2 cm long, pubescence like that of the stems, the blades 2–15 × 2–15 cm, blades on lower leaves almost entire to shallowly or deeply 3–5(–7)-lobed, on upper leaves almost entire to shallowly to deeply 3–5-lobed, the middle lobe longest, at the plant apex narrowly lanceolate to bract-like, all blades almost glabrous or abaxially and adaxially with mostly simple hairs, and abaxially with a few aculei on the ribs, the base cuneate to truncate, the margin finely to coarsely serrate, the apex obtuse to acute or acuminate, the nectary 1–3 mm long, slit-like. *Flowers* axillary, solitary; peduncles 0.6–2.0 cm long, articulating near the base to halfway between the base and the epicalyx, glabrous to finely pubescent below the articulation, and almost glabrous to bristly or sometimes aculeolate above the articulation; involuellar bracteoles 8–12, united at the base, the free part 6–18 mm long, the upper 3–6 mm channelled on the ventral surface, flattened, subulate to triangular, short-aculeolate, the apex entire, pointed; calyx 1.1–5(–5.5) cm long, green, green-red, or red, fleshy and edible, or leathery and inedible, the lobes triangular to ovate, acute to acuminate, glabrous, sparsely pubescent or bristly, the nectary inconspicuous; corolla

pale yellow, with or without a dark red-purple centre, the petals 2–5 × 1.2–3.5 cm, obovate, glabrous to simple or stellate-pubescent dorsally, glabrous ventrally; staminal column 10–20 mm long, pink, filaments 1 mm long, pollen tan; style branches included in the staminal column; stigmas dark red-purple. *Capsules* 13–22 × 11–20 mm, ovoid, nearly glabrous to sparsely or densely appressed-pubescent; seeds 3–5 × 2–4 mm, subreniform, dark brown, faveolate, with or without minute pectinate or stellate scales, the funiculus small, dark brown, glabrous. Chromosome number, $n = 36$.

Widely cultivated in tropical and subtropical areas of the world, including northern Africa; sometimes escapes from cultivation (e.g. Karnataka, India, Saldanha, 1985).

The most common form of *Hibiscus sabdariffa* in Africa is a culinary form with fleshy edible calyces (segregated as *H. sabdariffa* var. *sabdariffa* by Rakshit & Kundu, 1970: 163). The calyces have various uses, including drinks and jams. The leaves also are eaten sometimes as a vegetable (Exell, 1961; Ochse, 1960). On a collection from Darfur Province, Sudan, *Lynes* 538 (BM), it was noted that the plant was used to preserve and water-proof skins, but it did not specify which part of the plant was used, or how it was used. Several cultivars have been released (e.g. Abdallah *et al.*, 1976). In fact, the varieties of Howard & Howard (1911) and of Wester (1914) represent horticultural cultivars rather than botanical varieties. The culinary form is found mostly in cultivation but sometimes becomes naturalized. A short description follows: Branched, branches long, plant up to 1.5 m tall; stems almost glabrous; involuellar bracteoles up to 18 mm long; calyx 3(–5) cm long in fruit, fleshy and edible, glabrous or sparsely pubescent; petals up to 5 × 3 cm.

DISTRIBUTION (in subsaharan Africa and Asia). **Senegal,** Parc Nat. de lat Basse Casamance, 26 November 1984, *Bamps* 7785 (BR). **Mali,** Madina Diassa, 19 November 1974, *Audru* 5928 (P). **Upper Volta,** W. Dindéresso, 14 November 1980, *Lejoly* 80/129 (BR). **Sierra Leone,** Njala, 19 November 1930, *Deighton* 1849 (K). **Guinea-Bissau,** Bedanda-Cadique, 5 January 1962, *Pereira* 2613 (G-2 sheets). **Togo,** Lomi (Nord), 5 November 1985, *Schilter* 112 (G). **Nigeria,** North-east State, Gombe Dist., near Gombe Railway Station, 19 October 1971, *Latilo* FHI 63844 (K). **Central African Republic,** 6 km SE of Bambari on the Alindao road, 14 November 1981, *Fay* 1955 (K). **Cameroon,** Mogodé, Gomtemale Mt., 9 October 1972, *Leeuwenberg & v. Beek* 10474 (BR). **Sudan,** Tombouctou, 18 July 1899, *Chevalier* 1250 (BR). **Democratic Republic of Congo,** Leopoldville, 17 April 1915, *Bequaert* 7410 (BR). **Uganda,** without specific locality, June 1917, *Dümmer* 3194 (BM). **Burundi,** Bujumbura Prov., Katumba Commune, 15 April 1977, *Reekmans* 6021 (BR). **Tanzania,** West Lake Prov., Ruganzo, Bugufi, Ngara, 10 July 1960, *Tanner* 5033 (K). **Angola,** Lunda, 11 May 1903, *Gossweiler* 1477 (BM). **Zambia,** Balovale Dist., July 1933, *Trapnell* 1262 (K). **Malawi,** Rifu Village, 13 July 1936, *Burt* 6088 (BM). **Mozambique,** Montepuez, Aldeamento de Nairó, 27 August 1972, *Mafumo* 19 (BR). **Madagascar,** Vallée de la Betsiboka, 5–6 July 1928, *Humbert & Swingle* 4412 (B). **Namibia,** Okahamoja, September 1934, *Vedder* 7826 (B); Righini Terr., Lovanium, 7 April 1961, *Evrard* 6290 (BR). **India,** Tilaikani, Gangpur State, Orissa, 14 November 1947, *Mooney* 2970 (K); Gdukki Dist., 15 December 1982, *Mohanan* (Bot. Surv. Ind. 76099) (CAL). **Nepal,** East Nepal, Nissim-Dunham, 30 October 1963, *Hara et al.* (Univ. Tokyo 6300743) (BM). **Burma,** Taungdut, Chindwin River, 28 March 1935, *Kingdon-Ward* 11277 (BM). **Thailand,** Bangkok, 16 November 1924, *Marcant* 1899 (BM). **The Philippines,** Manila, 17 December 1903, *Merrill* 3801 (BM).

A short description follows of the fibre type of *Hibiscus sabdariffa* cv. 'altissima' (segregated as *H. sabdariffa* var. *altissima* Wester by Rakshit & Kundu, 1970): Unbranched or branches short, plant up to 4.5 m tall; stems aculeolate or pubescent; involuellar bracteoles up to 7 mm long; calyx up to 2.2 cm long in fruit, leathery, inedible, bristly; petals up to 3 × 2 cm.

This form is not found commonly in Africa. *Morton & Jarr* 3250 from Sierra Leone is a tall, erect and unbranched cultivated plant, but

it is not clear from the label whether it is cultivated for fibre (could be cultivated for leaves or seed). According to Dempsey (1975: 306) the fibre type is grown as a fibre crop on a large scale in the Central African Republic and in seven countries in south-central and south-eastern Asia.

DISTRIBUTION. **Sierra Leone**, Kain Kordu, near Lagbwema, Lono Dist., 12 December 1965, *Morton & Jarr* SL 3250 (K). **India**, Carnatic, 10 km from Ulundurpet on the Salem road, 13 December 1978, *Mathew & Perumal* RHT 20145 (CAL). **Indonesia** (Java), *Zollinger* 2998 (BM).

Forms occur in Africa that are neither the edible, culinary form nor the fibre form; they are usually branched and have bristly and/or aculeate plant parts. Some may be cultivated for seeds (Wilson & Menzel, 1964) but some appear to be truly wild or at least ruderal. For example, the seeds which gave rise to *Menzel & Wilson* HV220 (FSU) were collected originally in the wild near Maradi, Niger by D.W. Fishler. This plant is apparently truly wild because it is branched and woody, has aculeate stems, bristly calyces, and small seeds.

DISTRIBUTION. **Niger**, provenance Maradi, grown in cultivation in U.S.A., Florida, Palm Beach Co., Everglades Exp. Stn., 12 December 1964, *Menzel & Wilson* HV220 (FSU). **Ghana**, mile 73, Arebubi-Yeji road, grass savannah, 13 December 1955, *Afruah* (WACRI Herb. 5097) (K); Danongo, Gonja Dev. Corp. farm, ruderal, 30 September 1956, *Innes* GC 30194 (K); N. of Pong-Tamale, in cultivated land, 12 December 1953, *Morton* GC 9870 (K). **Nigeria**, Plateau Prov., Jemaa Emirate, about 8 miles E. of Jagindi, Madaki Dist., open savannah woodland just W. of Kurmin Damiss, 19 November 1946, *Keay & Onochie* (FHI 212724) (K); **Angola**, Golungo Alto, May 1855, *Welwitsch* 5263 (BM); Quicuxe(?), July 1854, *Welwitsch* 5265 (BM).

23. **Hibiscus cannabinus** L., *Syst. nat.* 10th ed.: 1149 (1759). Type: resolved but not yet published (P.A. Fryxell, pers. comm., 1996).

Hibiscus sabdariffa var. δ L., *Sp. pl.* 2: 695 (1753).

?*Hibiscus verrucosus* Guill. & Perr., *Fl. Seneg. tent.* 1: 57 (1831).

?*Hibiscus cannabinus* var. *verrucosus* (Guill. & Perr.) Garcke in *Linnaea* 43: 56 (1880).

Hibiscus cannabinus var. *genuinus* Hochr. in *Annuaire Conserv. Jard. Bot. Genève* 4: 115 (1900), nom illeg. (Art. 26.2).

Hibiscus cannabinus var. *simplex* A. & G. Howard in *Mem. Dept. Agric. India, Bot. Ser.* 4: 16 (1911).

Hibiscus cannabinus var. *purpureus* A. & G. Howard in *Mem. Dept. Agric. India, Bot. Ser.* 4: 17 (1911).

Hibiscus cannabinus var. *ruber* A. & G. Howard in *Mem. Dept. Agric. India, Bot. Ser.* 4: 17 (1911).

Hibiscus cannabinus var. *viridis* A. & G. Howard in *Mem. Dept. Agric. India, Bot. Ser.* 4: 17 (1911).

Hibiscus cannabinus var. *vulgaris* A. & G. Howard in *Mem. Dept. Agric. India, Bot. Ser.* 4: 17 (1911).

Hibiscus sabdariffa subsp. *cannabinus* (L.) G. Panigrahi & S.K. Murti, *Fl. Bilaspur dist.* 1: 127 (1989).

For additional synonymy, see Exell, 1961. Hochreutiner (1900: 114–115) lists an extensive synonymy for *Hibiscus cannabinus*, most of which I have not been able to check. Hochreutiner and other authors generally have treated *H. verrucosus* as a synonym of *H. cannabinus*, but it may well be synonymous with *H. asper* (in which case, the correct name for this entity is *H. verrucosus*). In the absence of an authentic type specimen of *H. verrucosus*, this question must go unanswered. Some of Hochreutiner's synonyms obviously refer to other species, as follows: *H. radiatus* Cav., *H. unidens* Lindl. (= *H. radiatus* Cav.), *H. lindleyi* Wall. (= *H. radiatus* Cav.), *H. asper* Hook. f., *H. mechowii* Garcke, *H. acetosella* Welw. ex Hiern.

Illustrations: *Icones Roxburghianae* no. 355 (K); Verdoorn & Collett, *Farming South Africa* 34: 1, fig. 1 (1947); Andrews, *Fl. pl. anglo-egypt. sud.* 2: 24, fig. 11 (1952); Hochreutiner, *Fl. Madagasc., Malvac.*: 37, fig. X, 4, 5 (1955); Gibson, *Wild fl. natal:* pl. 65, fig. 3 (1975).

Annual *herb* up to 2 m tall (up to 5 m tall in cultivars), stems pale green to pink or red-purple, sparsely aculeate, otherwise nearly glabrous. *Stipules* 4–7 mm long, filiform. *Leaves*: petioles 0.4–30 cm long, aculeate like the stems, the blades 1–19 × 0.1–20 cm, very shallowly to very deeply palmately 3–7-lobed below, sometimes unlobed above, or even bract-like near the apex, nearly glabrous, sparsely aculeolate on the ribs, the base cuneate to shallowly cordate, the margin serrate or dentate, the apex acute, the nectary 3 mm long, prominent. *Flowers* axillary, solitary, or sometimes clustered near the apex; peduncles 0.3–0.6 cm long, articulating at the base, aculeolate or bristly; involucellar bracteoles 7–8, 7–18 mm long, linear to subulate, aculeolate or bristly, the apex entire, the base free; calyx 1.1–2.5 cm long (up to 3.4 cm in cultivars), the lobes acuminate to subcaudate, aculeate, or sparsely to densely bristly, with a characteristic white, woolly tomentum, especially near the base and margins, the nectary conspicuous; corolla off-white, cream, or various shades of purple, from almost grey to deep purple, and with a deep purple centre, the petals 4–6 × 3–5 cm, obovate, sparsely stellate-pubescent dorsally, glabrous ventrally; staminal column 17–23 mm long, dark red, the filaments 1–2 mm long, the anthers tan, the pollen yellow; style branches 2–4 mm long, dark red; stigmas dark red. *Capsule* 12–20 × 11–15 mm, ovoid-acuminate, densely-appressed pubescent, the beak 1 mm long, glabrous; seeds 3–4 × 2–3 mm, subreniform, dark brown, faveolate, and sometimes with minute pectinate scales, the funiculus small, tan, glabrous. Chromosome number, $n = 18$.

Cultivated, ruderal, and wild, in cultivated land, old gardens, dikes between irrigated fields, ridge tops in shallow soil, rocky fissures, talus, open grassland plains, savannas, flood plains, seasonal swamps.

DISTRIBUTION. **Fig. 4.** Widely distributed as a cultivated fibre, food and medicinal plant and as a ruderal and native plant in subsarahafrica; grown by Makrakra Tribe in Sudan for game nets, *Cartwright* 2 (K); seeds eaten by natives in Sudan, *Imperial Institute* s.n. (K); used medicinally in Nigeria for stomach complaint, *Wickens* 3546 (K). It is cultivated as a fibre crop and sometimes naturalized in India (Saldhana, 1985), and cultivated as a fibre and paper-pulp plant in a number of other tropical and subtropical countries (Dempsey, 1975; Taylor, 1992). The following listing includes only collections from native habitats. **Senegal**, 1952, *Berhaut* 263 (P). **Mali**, near Kidal, 25 October 1968, *Popov* 11 (BM). **Ghana**, along Comtomenlō-Achimota Rd, Accra E. P., 18 August 1955, *Lovi* (WACRI Herb. 4200) (K). **Nigeria**, NE State, Kirinava, 9 December 1975, *Wickens* 3546 (K). **Cameroon**, Waza, 21 November 1969, *Hepper* 3957 (K); près Yafounou (50 km ENE de Meiganga), 17 October 1963, *Letouzey* 6200 (P); Mogodé, Gomtemale Mt., 9 October 1972, *Leeuwenberg* 10473 (BR). **Chad**, c. 8 km S. of Ft. Lamy, along road to Bongor, 3 January 1965, *deWilde & deWilde-Duyffes* 5175 (BR). **Central African Republic**, Manova-Gounda, St. Floris Nat. Park, 2 October 1982, *Fay* 3683 (K). **Sudan**, Equatorial Prov., 6 miles S. of Gogrial, without date, *Myers* 7692 (K); Yei River District, without date, *Cartwright* 2 (K); Equatorial Prov., Zande Land, 12 September 1940, *Wylde* 841 (BM). **Ethiopia**, 70 km SW of Jimma on Bonga Road, 25 January 1969, *Jones* 6913 (K); Kaffa Province, Ometch Village, 2 January 1962, *Meyer* 7887 (K); road from Soddo to Arba Mintch, 55 km from Sotto, 2 December 1967, *Westphal & Westphal-Stevels* 2927 (BR); **Democratic Republic of Congo**, Gimbi, July 1949, *Brynaert* 134 (BR); plaine du lac Edoard et de la rivière Rutshuru, 28 July 1937, *Louis* 4788 (BR-2 sheets); Ruzizi, 22 January 1950, *Germain* 5770 (G); Kivu Dist., Beni Prov., Kangali, 8 December 1954, *deWitte* 11387 (K). **Uganda**, elephant grassland, W. Kipayo, September–October 1914, *Dümmer* 1055 (BM); U4, 1 mile E. of Kakoge, Mengo, 14 December 1955, *Langdale-Brown* 1711 (K); U1, Mt. Debasien, 1936, *Eggeling* E2820 (K). **Kenya**, 70

miles from Isiolo, 23 May 1945, *Adamson* 79 (G); Kajiado Dist., Athi Plains 30 miles from Nairobi on the Namanga Road, 1 June 1963, *Verdcourt* 3647 (BR); K7, Lamu Dist., Kanwe-Mayi pool between Witu and Kipini, 4 March 1977, *Hooper & Townsend* 1182 (K); K1, Northern Frontier Prov., S. Turkana, c. 12 m NNE of Kangetet, 25 June 1970, *Matthew* 6383 (K); Kwale Dist., 38 km W. of Mombasa, 13 August 1975, *Wilson* 75141 (ASU, EA, NA). **Somalia**, Webi Schabeli, 1891, *Keller* 53 (K); Sheik husin, 25 September 1894, *Donaldson-Smith* 200 (BM). **Rwanda**, Territ. Buinda, Reg. du Mutaro, environ de Karukwangi, 15 April 1958, *Troupin* 7097 (BR); Rwabioga, Parc Nat. de la Kagera, January 1938, *Lebrun* 9806 (B). **Burundi**, Bujumbura, 12 May 1971, *Lewalle* 5719 (BR); route de Bugarama, km 10, territ. Bujumbura, 24 May 1966, *Lewalle* 844 (K). **Tanzania**, Bahi, on the Dodoma to Manyoni Rd, mile 38, 23 April 1962, *Polhill & Paulo* 2129 (BR); Shinyanga Reg., 5 km S. of Shinyanga on Hwy B-6, 28 July 1975, *Wilson & Kissie* 7579 (NA); Tabora Region, 12 km W. of Tabora on road to Urambo, 29 July 1975, *Wilson & Kissie* 7580 (EA, NA); T7, Njombe Dist., 19 m E. of Rujewa on road from Mbeya to Iringa, 6 April 1969, *Jones* 69130 (K); T6, Masada, 28 June 1973, *Greenway & Kanuri* 15280 (K); Kondoia Dist., Mapapu, Mbuga, 15 May 1929, *Burt* 2067 (BM); Tanga Prov., Handeni Dist., Handeni Town, 5 August 1989, *Mhoro* 6301 (TEX); Cheju Plain, Zanzibar, 6 August 1933, *Vaughan* 2158 (BM). **Angola**, Huila, Cassinga, Chamutete, 2 April 1960, *Barbosa & Correia* 8965 (BM); Mossamedes Dist., 1 August 1859, *Welwitsch* 4931 (BM); Huila, Quipungo, Handa, 1 May 1967, *Henriques* 1079 (BM); Pungo Adongo, April 1857, *Welwitsch* 5274 (BM); Huila, Chicungo, 9 May 1962, *Texeira & Almeida* 5625 (BR). **Zambia**, Mkushi Dist., Tiwila Congo Zambesi Basin, 1932, *Hewitt* 37 (BM); Marumba (Livingstone), June 1909, *Rogers* 7142 (BOL). **Zimbabwe**, Umtali, 22 February 1960, *Head* 22 (BM); Nartley Dist., Poole Farm, 15 April 1950, *Nornby* 3171 (BM); Manica Dist., Umtali Div., Odranis River Valley, 1914, *Teague* 130 (BOL). **Malawi**, Mafina Hills, Chisenga, 24 August 1962, *Tyrer* 535 (BM); S. Region, Thyolo Dist., Boumbure, 7 May 1983, *la Croix* 2272 (BM). **Mozambique**, Lourenço Marques Dist., Sul do Save, Costa do Sul, 3 March 1949, *Barbosa* 2637 (BM); Sul do Save, Guijá, 4 May 1957, *de Carvalho* 151 (BM); Sul do Save, estrada Chissano-Chibuto, 8 July 1948, *Myre* 46 (BM); Cabo Delgado, Macondes, 10 April 1964, *Torre & Paiva* 11849 (K); Maputo, Marracuene, ao km 34 da Estrada Nacional no. 1, 25 May 1977, *Nuvunga, Zunguze & Doane* 1 (NBG). **Namibia**, Grootfontein Dist., Farm Bergen, 25 April 1963, *Giess, Volk & Bleissner* 6453 (PRE); Tsumeb, 22 April 1934, *Dinter* 7549 (B-2 sheets). **Botswana**, floodplain grassland of the Sibuyu River, 12 April 1983, *Smith* 4250 (PRE); Savuti, Chobe Nat. Park, 25 March 1948, *Jacobsen* 3053 (PRE); Northern Dist., Thamalakane River, Maun, 24 March 1976, *Smith* 1666 (B). **South Africa**, Transvaal, Grobiersdal, Mossiesdal, 11 March 1958, *Meeuse* 10321 (PRE); Transvaal, Waterburg, 6 December 1931, *Galpin* 11569 (BOL); Transvaal, Shilouvane, 1904–1905, *Junod* 2265 (G); Natal, Uvongo Beach, April 1968, *Liebenberg* 8099 (PRE); Natal, sandy flat near Durban, 27 April 1893, *Wood* 4848 (BM); Natal, Port Shepstone, 3 April 1966, *Strez* 6540 (BR, G). **Swaziland**, Lubombo Dist., 7 km W. of Siteki, 31 March 1977, *Kemp* 825 (PRE). I also examined cultivated specimens from Afghanistan, Yemen, Eritrea, Saudi-Arabia, Mauritania, India, Vietnam, Pakistan, Egypt, Thailand, and Nepal.

A number of variants in the *Hibiscus cannabinus-asper* group occur in nature, some of them representing hybrids or introgressive types. Others possibly represent undescribed taxa, but material is insufficient to describe them adequately, as follows: a form with very long bristly bracteoles (longer than the calyx) and bristly calyces: **Ethiopia**, *Schimper* 1484 (BM, K); **Tanzania**(?), *Schweinfurth* 1626 (B, BM, BR, G), **Uganda**, *Wilson* s.n. (K); a form with dense, stiff bristles mainly on the calyx midrib and marginal ribs: **Zambia**, *Fanshawe* 8786 (BR).

The varieties of Howard and Howard represent horticultural cultivars rather than botanical varieties. The key characters used to differentiate their varieties are generally simply inherited and are found in various combinations in cultivars, land races, and in wild forms of *H. cannabinus*. Hauman (1963) recognized var. *simplex*, but it is merely an entire-leaved form of this polymorphic species (*deWitte* 10527, 10617 (BR!)).

24. **Hibiscus parvilobus** F.D. Wilson, *sp. nov.* Type: Kenya, Rift Valley Prov., Nakuru Dist., 35°39'E, 0°9'S, c. 9 km NE of Londiani, 2743 m, 8 February 1973, *Spjut & Ensor* 3184 (EA!-holotype; BR!, K!-isotypes; sheets are also lodged at ASU which were prepared from plants grown at Phoenix from seeds of the original collection).

Fig. 2A.

Hibiscus berberidifolius F.D. Wilson in *Brittonia* 35: 178 (1983), non A. Rich. (1847), pro parte quoad specim. *Spjut & Ensor* 3184.

Caules aculeati; folia 5-lobata, apicibus et sinibus obtusissimis; pedunculi fructificantes <1 cm longi; bracteolae involucellorum non bifurcatae, lineares, subulatae vel triangulares, apicibus auctis; calyces in costas pilis densis, glabrati inter costas, nectariis in quoque costa prominentibus.

Many-branched perennial *shrub*, 1–4 m tall; stems with antrorse aculei and with fine, simple hairs up to 1.5 mm long, aculei and hairs sparse below, more dense above, and with a line of crisped pubescence changing position at each node. *Stipules* 6 mm long, linear, with sparse, fine, simple hairs. *Leaves*: petioles 1.6–6.5 cm long, with dense, woolly pubescence adaxially, sparse simple hairs abaxially, the blades 3.4–5.5 × 1–9 cm, the blades of all leaves on vegetative branches moderately to deeply 5-lobed, not differing much in size from the base to the apex of the plant, abaxially and adaxially with simple antrorse hairs to 1 mm long on midrib and principal veins, less dense or lacking on smaller veins and absent from the lamina, the base cordate, the margin finely serrate, the apex and sinus obtuse; the blades of mid-plant leaves on flowering branches 3-lobed, otherwise similar to those on vegetative branches, blades of upper leaves on flowering branches obscurely 3-lobed to entire, the base truncate, the margin finely serrate, the apex acute; nectary present on all leaves, 2 mm long; vegetative branchlets in the leaf axils to 2.5 cm long, blades up to 3 × 3 cm, ovate, the base truncate to very slightly cordate, the margin finely serrate, the apex obtuse. *Flowers* borne singly in the leaf axils of flowering branches; peduncles 0.3–0.5 cm long, articulating at the base or joint not evident, with dense, simple bristly hairs 2–3 mm long, borne at right angles to the peduncle; involucellar bracteoles 6–8, 5–11 mm long × 1–3 mm wide at the base, linear to subulate or triangular, flattened, several nerved, below with pubescence like that of the peduncle, above almost glabrous, apex entire; calyx 1.2–1.4 cm × 0.6 cm wide at the base in flower, 1.5–1.8 cm × 0.7–0.8 cm wide at the base in fruit, the lobes slightly acuminate, with pubescence like that of the peduncle on the ribs below, sometimes sparsely aculeolate on the ribs above, almost glabrous between the ribs, the nectary prominent, enlarged, 2 mm long; corolla light yellow with a prominent deep red-purple centre, the petals 3.5 × 3.5 cm, obovate, finely and densely pubescent dorsally, glabrous or pubescent ventrally; staminal column on only flower seen 23 mm long, deep red-purple; filaments 1 mm long, anthers and pollen tan; style branches 8 mm long, deep red-purple; stigmas deep purple. *Capsule* 16–17 × 15–16 mm, ovoid, densely appressed-pubescent, the beak 3 mm long, glabrous; seeds 4 × 3 mm, subreniform to triangular, dark brown, with minute pectinate scales, funiculus very dark brown, with a fringe of colourless hairs on the large end.

Collected in a more or less dry, scrubby forest with *Tarchonanthus camporatus* L., *Trichocladus ellipticus* Eckl. & Zeyh., *Euclea divinorum* Hiern, *Rhus natalensis* Bernh. ex Krauss, *R. vulgaris* Meikle, *Maytenus heterophylla* (Eckl. & Zeyh.) N. Robson, and *Scutia myrtina* Kurz.

DISTRIBUTION. Known to me only from the type collection.

25. *Hibiscus asper* Hook. f., *Niger fl.*: 228 (1849). Type: Sierra Leone, *Miss Turner* s.n. (K-holotype).

Fig. 2C.

Hibiscus verrucosus var. *punctatus* A. Rich., *Tent. fl. abyss.* 1: 59 (1847). Type: Ethiopia, crescit in provincia Chiré, *Petit* s.n.

Hibiscus cordofanus Turcz. in *Bull. Soc. Nat. Mosc.* 31: 193 (1858).

Type: Ethiopia, Cordofan, 1837–1838, *Kotschy* 65 (KW-holotype).

Hibiscus cannabinus Mast. in *Oliver, Fl. trop. Afr.* 1: 204 (1868), non L. (1759), pro parte quoad syn. *H. asper*.

Hibiscus cannabinus Hochr. in *Annuaire Conserv. Jard. Bot. Genève* 4: 115 (1900), non L. (1759), pro parte quoad syn. *H. asper*.

Hibiscus cannabinus var. *chevalieri* Hochr. in *Annuaire Conserv. Jard. Bot. Genève* 5: 125 (1901). Type: Hochreutiner (1901) did not designate a holotype for *H. cannabinus* var. *chevalieri* but lists two syntype specimens (neither of which I have seen), as follows: Mali, Koulikoro, moyen Niger, 6–14 October 1899, *Chevalier* s.n.; Mali, Sindou, terres cultivées parmi les plantations de cotonniers, 10 May 1899, *Chevalier* 856. *Chevalier* (1920) cites these two and a later collection from Guinea, *Chevalier* 14909 (G!, P!) under *H. cannabinus* var. *chevalieri*. Hochreutiner annotated a sheet at G as a '2nd form of *Hibiscus cannabinus* var. *chevalieri*, leg. *Chevalier*, Sindou et Niger moyen ex Herb. *Chevalier*' which is referable to *Hibiscus scotellii* Baker f.

Hibiscus vanderystii de Wild. in *Bull. Jard. Bot. État.* 5: 35 (1915).

Type: Angola, Kwango, July 1913, *Vanderyst* 1377 (BR!).

Hibiscus cannabinus var. *punctatus* (A. Rich.) Hochr. in *Annuaire Conserv. Jard. Bot. Genève* 20: 82 (1916).

Hibiscus malangensis Baker f. in *J. Bot.* 77: 22 (1939). Type: Angola, Malange, River Cuango, near Xa-Sengue, c. 1075 m, 5 April 1937, *Exell & Mendonça* 274 (BM!).

Hibiscus asper var. *punctatus* (A. Rich.) *Berhaut, Fl. Sénégal*: 160 (1954).

Herb to 2 m tall; stems with antrorse aculeoli (aculeoli sometimes 2-fid) and with fine, simple to stellate hairs, and sometimes with a line of pubescence changing at each node. *Stipules* 3–6 mm long, filiform, with short, fine pubescence. *Leaves*: petioles 0.3–18 cm long, with pubescence like that of the stems or sometimes less or more pubescent, the blades extremely variable in size and shape, the blades of lower leaves 4–18 × 1.5–14 cm, strap-like, lanceolate, ovate, oval, or shallowly to deeply palmately 3–5(–7)-lobed (some blades even 2- or 4-lobed), the lobes sometimes secondarily lobed, the blades of upper leaves 2–7 × 0.2–6.5 cm, bract-like, lanceolate, oblanceolate, ovate, or 3-lobed, the blades of all leaves with 2-fid to stellate hairs on ribs and veins, more sparse on the adaxial surface, the base cuneate, truncate, or cordate, the margin regularly or irregularly finely to coarsely serrate or repand, the apex acute, the nectary 0.5–2 mm long, slit-like. *Flowers* axillary, solitary, or often with more than one flower at the same node; peduncles 0.2–0.8 cm long, articulating at or near the base, with or without antrorse aculeoli and straight bristles and with finer, simple to stellate hairs; involucellar bracteoles 6–7, 9–18 mm long, subulate to narrowly lanceolate-acuminate, with or without antrorse aculeoli or short, coarse pigmented bristles on enlarged bases plus some finer simple to stellate hairs, the apex entire, pointed, the base free or scarcely united; calyx 0.8–2.6 cm long, the lobes lanceolate to broadly lanceolate, short- to long-acuminate, with antrorse aculei or pigmented short, coarse bristles on enlarged red bases on the ribs, otherwise almost glabrous or with some fine hairs, the nectary small but conspicuous; corolla light yellow with a red-purple centre, the petals 2.8–4.5 × 2–3 cm, obovate, glabrous to sparsely stellate-

pubescent dorsally, glabrous ventrally; staminal column 10–12 mm long, dark pink, the filaments 0.5–1 mm long, the anthers tan-orange or red-purple, the pollen yellow; style branches included in the staminal column; stigmas red-purple. *Capsule* 12–19 × 12–16 mm, sparsely and finely short appressed-pubescent, the beak 1–2 mm long, pubescent, inconspicuous; seeds 3–4 × 2–3 mm, subreniform, dark brown, with parallel striations and minute protuberances, the funiculus with simple, coarse flattened hairs. Chromosome number, $n = 18$.

Ruderal and wild, in abandoned farm fields, savannas, grassland, river alluvium, moist rock basins, and edges of gallery forest.

DISTRIBUTION. Fig. 4. Widely distributed in subsaharan Africa, from Senegal to Ethiopia, Angola, Zambia, Mozambique, and Madagascar (Sprague, 1913). **Senegal**, Parc Nat. de la Basse Casamance, 26 November 1984, *Bamps* 7773 (BR). **Guinea-Bissau**, Bafatá, entre Cambasse et Geba, 19 October 1952, *Esperito-Santo* 3102 (BR). **Guinea**, Kouria et environs, 20 October 1905, *Chevalier* 14909 (G, P). **Upper Volta**, Duarkoye Station, 30 October 1973, *Audru* 5443 (P). **Sierra Leone**, Waterloo, 1 December 1936, *Deighton* 3346 (K). **Ivory Coast**, Bouaké, 6 February 1981, *Ake Assi* 15791 (BR); réserve de LAMTO, 11 November 1986, *Gautier-Béguin* 438 (G). **Ghana**, Northern, Mole Nat. Park, 25 km N. of Damango, 27 November 1995, *Schmidt, Amponsah & Welsing* 1790 (TEX); Dukwesein, N. of Agogo, Ashanti, 23 December 1913, *Clupp* 599 (K); Weijaa, near Accra, October 1961, *Irvine* 4807 (K). **Mali**, Domaine soudanien vallée Si Kasso-Koutiala, 1 January 1951, *Roberty* 13324 (G). **Niger**, Parc Nat. du W, du Niger, près de la Mékrou, 2 December 1986, *Robbrecht & Leman* 3460 (BR). **Nigeria**, Zunjeru, 10 October 1905, *Dalziel* 128 (K); Sokoto, October 1910, *Dalziel* 426 (K-2 sheets); near Toupé on grassy plain along Comoé R., 28 November 1967, *Geerling & Bokdam* 1521 (K). **Chad**, Sarh Station, 7 November 1974, *Palayer* 420 (P). **Cameroon**, Waza, 21 November 1969, *Hepper* 3956 (B, K). **Central African Republic**, Bambari Reg., 6 km SE of Bambari on the Alindao Road, 29 November 1984, *Fay* 1947 (K). **Sudan**, Sugura, Gedaref Dist., 28 September 1951, *Babiku Beshir* 145 (K). **Ethiopia**, in montibus prope Dscheladscheranne, 3 November 1839, *Schimper* 717 (G). **Congo**, bords du Congo, 14 April 1966, *Farron* 5100 (P). **Democratic Republic of Congo**, Orientale, Parc Nat. de la Garamba, 5 March 1951, *De Saeger* 1038 (BR, K). **Uganda**, Namaraprure(?), June 1915, *Dümmer* 2565 (BM). **Tanzania**, Mbeya Dist., base of Punguluma Hills, Parinari woodland, 21 April 1990, *Lovett & Kayombo* 4562 (TEX); Iringa Region, Mufindi Dist., Ngwazi, 15 April 1989, *Kayombo* 441 (TEX); 50 km W. of Lindi, 24 April 1935, *Schlieben* 6486 (BM). **Angola**, Dist. Ambaca, inter Mandiocae plantations prope Ngombe, October 1856, *Welwitsch* 5267 (BM, LISU); Dist. Cuanza Norte, Cassualala, Cuanza, 10 July 1923, *Gossweiler* 8927 (BM). **Zambia**, Kapiri Mposhi, 13 July 1932, *Young* 38 (BM). **Malawi**, Central Prov., Dowa Dist., 31 July 1951, *Chase* 3911 (BM); without precise locality, 24 May 1937, *Lawrence* 411 (BR). **Mozambique**, Nemagoa, Dist. Mocuba, November 1947, *Faulkner* 159 (K); Montepuez, proximidades do aldeamento de Nairó, 11 August 1972, *Mafumo* 12 (NBG). **Madagascar**, Beravi Interior, Gebinge, July 1879, *Hildebrandt* 3086 (BM).

Berhaut (1954) lists four collections of his *H. asper* var. *punctatus* (none of which are involved in the typification of *H. asper*): Senegal, *Berhaut* 1800, 4175, 4453, 4551; I have seen *Berhaut* 4175 (P), which I regard as an *H. asper* × *cannabinus* hybrid, and *Berhaut* 4551 (P), which perhaps also is a hybrid derivative but closer to the true *H. asper*.

26. *Hibiscus acetosella* Welw. [ex Ficalho in *Bol. Soc. Geogr. Lisbon*, sér. 2: 608 (1881), nom. nud.] ex Hiern, *Cat. Afric. Pl.* 1: 73 (1896). Type: Angola, Cuanza Norte, Golungo Alto, December 1854, *Welwitsch* 5271 (BM!-holotype; LISU!-isotype). *Exell & Mendonça* (1937) listed the specimen at LISU as 'tipo' (presumably the holotype), but it is more appropriate to list the BM specimen as holotype because the best set of *Welwitsch*'s specimens were retained at BM (Hiern, 1896).

Fig. 2B.

Hibiscus eetveldeanus de Wild. & T. Durand in *Bull. Soc. Bot. Belgique* 38(2): 24 (1899). Type: Democratic Republic of Congo (Zaire): Monbanga, *Dewèvre* s.n. (BR-holotype).

Hibiscus surattensis var. *furcatus* (Willd.) Hochr. in *Annuaire Conserv. Jard. Bot. Genève* 4: 112 (1900), pro parte quoad syn. *H. eetveldeanus*.

Hibiscus cannabinus Hochr. in *Annuaire Conserv. Jard. Bot. Genève* 4: 114 (1900), non L. (1759), pro parte quoad syn. *H. acetosella*.

Hibiscus surattensis var. *eetveldeanus* (de Wild. & T. Durand) Hochr. in *Annuaire Conserv. Jard. Bot. Genève* 6: 49–51 (1902).

Illustration: Ochse, *Veg. Dutch E. Ind.*: 474, fig. 295 (1960).

Annual or perennial *subshrub* to 2 m tall; stems and leaves green or red; stems glabrous to sparsely pubescent, not aculeate. *Stipules* 12–15 mm long, linear to very narrowly lanceolate, with a few simple hairs on the margins. *Leaves*: petioles 3–11 cm long, glabrous or finely pubescent, the blades 2–10 × 2–10 cm, shallowly to moderately 3–5-lobed below, sometimes entire above, glabrous or sparsely pubescent, the base cuneate, truncate, or subcordate, the margin crenate, the apex obtuse, the nectary 2 mm long, slit-like. *Flowers* axillary, solitary; peduncles 0.4–1.0 cm long, articulating near the base, glabrous to hirsute; involucellar bracteoles 8–10, 7–12 mm long below the apex, linear, with simple hairs on margins, the apex bifurcate, the outer fork 3 mm long, lanceolate, ascending or recurved, the inner fork 3 mm long, linear, ascending; calyx 1.5–2.5 mm long, the lobes ovate to ovate-lanceolate, acute to acuminate, nearly glabrous or sometimes with long simple hairs on the ribs, particularly near the base, the nectary present; corolla dusky pink (red-foliaged plants) or lemon yellow (green-foliaged plants), with a red-purple centre, the petals 2–5.5 × 1.5–3.5 cm, obovate, glabrous; staminal column 10–20 mm long, the filaments 1–2 mm long, the anthers purple, the pollen orange or tan; style branches included in the staminal column or up to 5 mm long; stigmas pink to red-purple. *Capsule* 19–25 × 12–18 mm, ovoid, almost glabrous to appressed-pubescent, the beak 1–2 mm long, glabrous; seeds 3 × 2.5 mm, subreniform, dark brown, the surface finely faveolate and with pectinate scales, the funiculus small, dark brown, glabrous. Chromosome number, $n = 36$.

Cultivated, ruderal, and naturalized; abandoned plantations, marshy habitats, forest clearings.

DISTRIBUTION. Probably African in origin (an amphidiploid species, possibly from hybridization of *Hibiscus asper* with *H. surattensis*: Menzel, 1986: 451). Now widely distributed in tropical and subtropical areas of both hemispheres as a cultigen used for ornamental and food purposes. *Westphal & Westphal-Stevens* 8978 (PRE) noted that the leaves are used for making tea in Cameroon. **Ivory Coast**, Adiopodonné, December 1963, *Ake Assi* 7376 (G). **Cameroon**, Ipono, near Ntem River, 3 December 1975, *Westphal & Westphal-Stevens* 8978 (PRE). **Sudan**, Kagelu, 1938, *Myers* 11897 (K). **Congo**, Kinsuka, 6 April 1967, *Pauwels* 4987 (BR). **Democratic Republic of Congo**, Bambesa, 23 October 1961, *Gerard* 5041 (BR); Yangambi, 13 January 1953, *Germain* 1880 (G). **Uganda**, Entebbe Region, 13 May 1925, *Maitland* s.n. (K). **Tanzania**, Mwanza Region, Sengerema, 26 July 1975, *Wilson & Kissie* 7561 (NA); Tanga Region, Muheza, 5 August 1975, *Wilson & Kissie* 75129 (ASU, EA, NA). **Príncipe**, S. Antonio, 31 August 1956, *Khonua* 12187 (BM). **São Tomé**, S. Vicente, 7 January 1949, *Espírito Santo* 77 (BR). **Angola**, Cuanza Norte, Golungo Alto, without date, *Welwitsch* 5270 (BM, LISU). Lunda, Dala, 29 June 1937, *Exell & Mendonça* 1456 (BM); Bié, Chitembo, 2 November 1966, *Teixeira* 10911 (BR); Moxico, Vila Cuzo-Cuchipoque(?), without date, *Gossweiler* s.n. (BM). **Zambia**, Mivini Lunga, 11 June 1963, *Edwards* 739 (BR). **Zimbabwe**, Harare (Salisbury), 23 June 1953, *Bertram* 43476 (BM, SRGH). **Mozambique**, Niassa, Vila Cabral, 1 March 1964, *Torre & Paiva* 10932 (BOL). **Mauritius**, garden at Phoenix, 19 April 1963, *Vaughan* 10752 (BM).

27. *Hibiscus gillettii* de Wild. in *Ann. Mus. Congo, Sér. Bot.* 5(1): 166 (1904). Type: Democratic Republic of Congo (Zaire), Bas-Congo, Kimuenze, March 1901, *Gillet* 2057 (BR!-holotype).

Annual (or sometimes perennial?) *herb*, stems branching near the base, sparsely fine stellate-pubescent, with or without coarse stellate hairs on enlarged bases below, coarse stellate hairs becoming more dense above. *Stipules* 2–6 mm long, filiform to linear, with fine, short pubescence. *Leaves*: petioles 0.2–7 cm long, with pubescence like that of the stems, the blades 1–5 × 0.1–5 cm, the blades of lower leaves shallowly to deeply palmately 3–5-lobed, midlobe lanceolate, ovate, obovate, or rhombic, length-width ratio from 1:1 to 4:1, the blades of upper leaves from bract-like near the apex to deeply 3-lobed, all blades finely stellate-pubescent and sometimes with a few coarse stellate hairs on bases on the veins abaxially and adaxially, the base cuneate, truncate, or cordate, the margin serrate to repand, the apex acute or obtuse, the nectary 1–3 mm long, prominent, slit-like. *Flowers* clustered at the apex of flowering branches, the branches up to 54 cm long; peduncles 0.2–0.8 cm long, articulating at the base, densely and finely stellate-pubescent and with or without coarse stellate hairs; involucellar bracteoles 10–14, 5–8 mm long below the apex, filiform to linear, densely and finely stellate-pubescent throughout and long-bristly on the margins, the apex bifurcate, the outer fork 1.5–4 mm long, linear, reflexed, the inner fork 4–9 mm long, filiform, ascending, the base free; calyx 1.0–1.6 cm long, the lobes lanceolate, acute to long-acuminate, finely stellate-pubescent with coarse, 2-fid to stellate hairs on the ribs, the ribs conspicuous, the nectary absent; corolla yellow with a red or reddish brown centre, the petals up to 3.5 cm long; staminal column 12 mm long, filaments 0.5 mm long; style branches 2 mm long. *Capsule* up to 12 × 11 mm, ovoid, densely appressed-pubescent, the beak inconspicuous; seeds 3 × 2 mm, subreniform, brownish, with parallel striations and a few pectinate scales.

27a. *Hibiscus gillettii* subsp. *gillettii*

Fig. 3C.

Hibiscus gillettii de Wild. in *Ann. Mus. Congo, Sér. Bot.* 5(1): 166 (1904).

Hibiscus poggei Gürke ex Engl. in Engl., *Pflanzenw. Ost-Afrikas* 3(2): 400 (1921). Type: Angola, 'Lunda-Kasai Bezirk', *Pogge* s.n. (B).

Stems finely stellate-pubescent and with sparsely and coarsely stellate hairs throughout; leaves at mid-plant usually 5-lobed, length-width ratio of midlobe *c.* 2:1 to 3:1; outer fork of involucellar bracteole 2–4 mm long, the inner fork 6–9 mm long; calyx lobes acute to slightly acuminate in fruit.

Ruderal and wild, abandoned cultivated fields, savannas, and gallery forests.

DISTRIBUTION. Fig. 5. Democratic Republic of Congo, Angola and Zambia. **Democratic Republic of Congo**, Kisai Occidentale, Dibaya, 26 March 1957, *Liben* 2725 (BR); Miao, 4 June 1913, *Sparano* 18 (BR); Difuma (Kinshe), 9 March 1934, *Rossignol* 99 (BR); Katanga, Kafubu, 28 March 1927, *Quarré* 186 (BR-2 sheets); Wombali, without date, *Vanderyst* 1297 (BM); Nioki, Dist. du Lac Leopold, *Goossens* 6070 (BR). **Angola**, Lunda, Xa-Sangue, 4 April 1937, *Exell & Mendonça* 251 (BM); Lunda, near Vila Henrique de Carvalho, 15 April 1937, *Exell & Mendonça* 618 (BM); Moxico, Teixeira de Sousa, 4 July 1940, *Gossweiler* 12510 (BM); Nordeste da Lunda, Luachimo, 8 November 1946, *Gossweiler* 13.82K (BM). **Zambia**, Kabompo Dist., 6 km W. of Kabompo, 24 March 1961, *Drummond & Rutherford-Smith* 7267 (K).

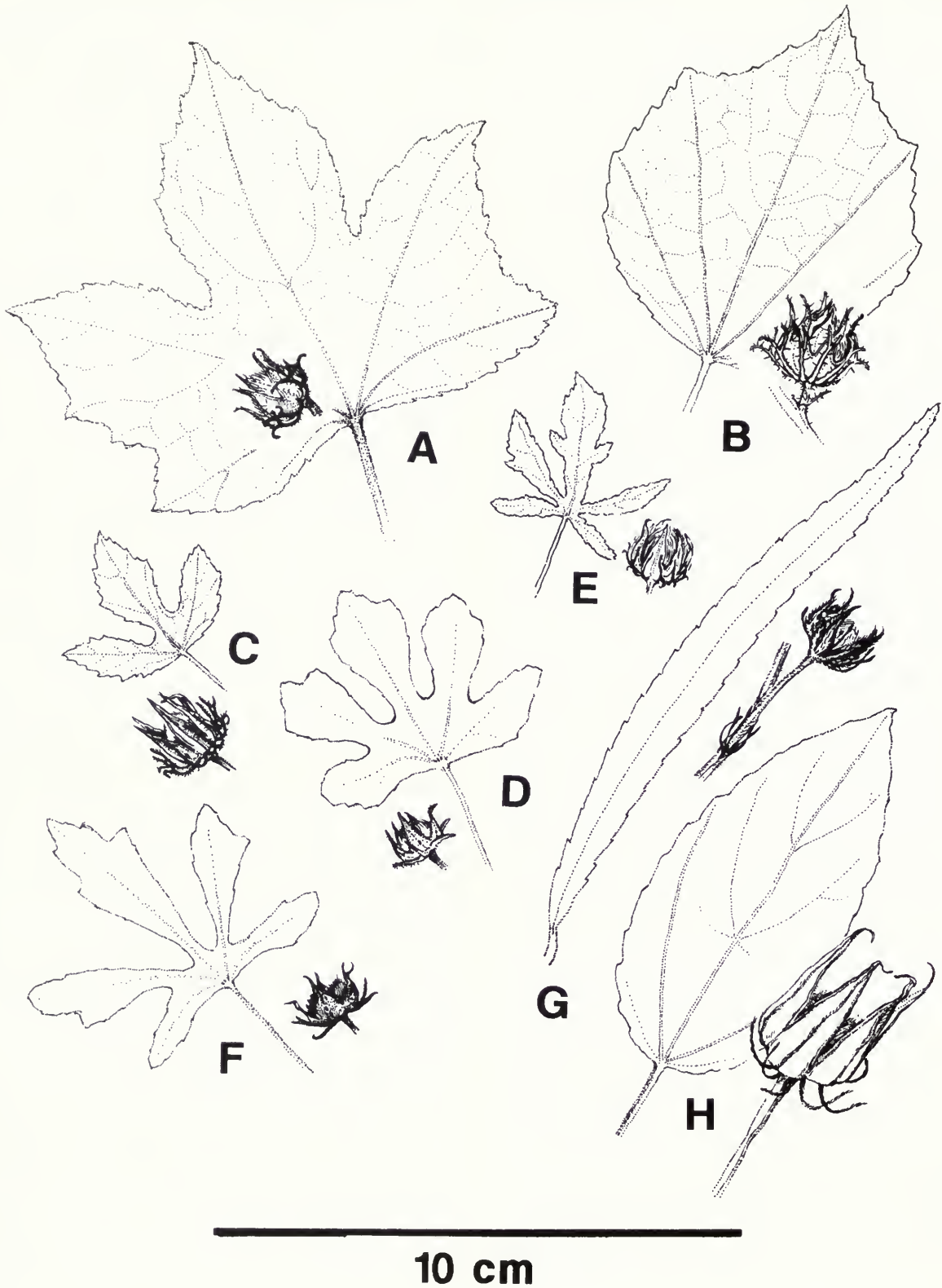


Fig. 3 Leaves and fruits of taxa of *Hibiscus* section *Furcaria* and *H. trichospermoides*. **A:** *H. cuanzensis*, Welwitsch 5241 (BM); **B:** *H. mastersianus*, leaf: Exell, Mendonça & Wild 1458 (BM), fruit: Beddome 581 (BM); **C:** *H. gillettii* subsp. *gillettii*, Quarré 186 (BR); **D:** *H. sineaculeatus*, leaf: Olorunfeni FHI 24354 (K), fruit: Keay FHI 22587 (K); **E:** *H. moxicoensis*, Exell & Mendonça 1599 (BM); **F:** *H. scotellii*, Glanville 111 (K); **G:** *H. elongatifolius*, Zenker 1440 (P); **H:** *H. trichospermoides*, Humbert & Capuron 19291 (G).

E. Morith at B wrote to E.G. Baker, 5 December 1938. Morith had compared *Exell & Mendonça* 618 with the type of *Hibiscus poggei* at B and said that they were the same species. *Exell & Mendonça* 618 (BM!) is *H. gillettii* subsp. *gillettii*.

27b. *Hibiscus gillettii* subsp. *hiernianus* (Exell & Mendonça) F.D. Wilson, **comb. et stat. nov.**

Hibiscus mastersianus Hiern, *Cat. Afric. Pl.* 1: 71 (1896), pro parte quoad specims. *Welwitsch* 4927 et 4928.

H. surattensis var. *mastersianus* (Hiern) Hochr. in *Annuaire Conserv. Jard. Bot. Genève* 4: 112 (1900), pro parte quoad specims. *Welwitsch* 4927 et 4928.

Hibiscus hiernianus Exell & Mendonça in *J. Bot.* 74: 136–137 (1936). Type: Angola, Huila, January 1860, *Welwitsch* 4927 (BM!-holotype).

Stems finely stellate-pubescent and with occasional coarse stellate hairs below, increasing in density above; leaves at mid-plant mainly 3-lobed, the midlobe often conspicuously obovate or rhombic, the length-width ratio approaching 1:1; outer fork of involuellar bracteole 1.5–3 mm long, the inner fork 4–5 mm long; calyx lobes acute to slightly acuminate in fruit. Chromosome number, $n = 18$.
River banks, river marshes, grasslands, and woodlands.

DISTRIBUTION. **Fig. 5.** Angola and Zambia. **Angola**, River Tiengo Cuito, 5 March 1906, *Gossweiler* 3665 (BM) [See Exell & Mendonça, 1951]; Huambo, 22 February 1927, *Lynes* s.n. (BM); Huila, May 1860, *Welwitsch* 4928 (BM); S. Angola, without date, *Pearson* 2102 (BOL). **Zambia**, Kasama Dist., Chibutubutu, 24 February 1960, *Richards* 12562 (K); Mwinilunga, 16 June 1963, *Edwards* 796 (K).

27c. *Hibiscus gillettii* subsp. *lundaensis* (Baker f.) F.D. Wilson, **comb. et stat. nov.**

Hibiscus lundaensis Baker f. in *J. Bot.* 77: 21 (1939). Type: Angola, Lunda: Cacolo, River Cuilo, 11 April 1937, *Gossweiler* 11821 (BM!-holotype).

Stems finely and coarsely stellate-pubescent throughout; leaves at mid-plant deeply 5-lobed, length-width ratio of the midlobe *c.* 4:1; outer fork of involuellar bracteole *c.* 3 mm long, the inner fork 7–8 mm long; calyx lobes long-acuminate in fruit.

Annual herb among grasses.

DISTRIBUTION. **Fig. 5.** Angola. Known to me only from the type collection.

28. *Hibiscus moxicoensis* Baker f. in *J. Bot.* 77: 21 (1939). Type: Angola, Moxico: River Luena, near Vila Luzo, *c.* 1240 m, 4 May 1937, *Exell & Mendonça* 1599 (BM!-holotype).

Fig. 3E.

Perennial (annual?), prostrate *herb*; stems patchily lanate-pubescent below, continuous above; petioles, leaf blades, peduncles, involuellar bracteoles, and calyx also lanate or patchily lanate-pubescent (individual hairs stellate), interspersed with fine to coarse, simple to stellate hairs. *Stipules* 6 mm long, filiform, with short, fine hairs. *Leaves*: petioles 0.4–2.0 cm long, the blades 1–3.5 × 0.3–3.8 cm, deeply 3- to 5-lobed below to bract-like at the apex, the midlobe of lower leaves oblanceolate, the lateral lobes narrowly lanceolate, the outer lobes lanceolate, the midlobe and lateral lobes also secondarily lobed, the base cuneate, truncate, or subcordate, the margin regularly to irregularly serrate, the apex acute, the nectary 2 mm long, slit-like. *Flowers* sometimes axillary, solitary but mostly clustered at the apex of the main shoot or on flowering branches up to 8.5 cm long; peduncles 0.4 cm long in fruit, articulating at the base;

involuellar bracteoles 10–12, 4 mm long below the apex, filiform to linear, the apex bifurcate, the outer fork 3 mm long, linear, reflexed, the inner fork 4 mm long, linear, ascending, the base free; calyx 1.1–1.4 cm long in fruit, the lobes lanceolate, slightly acuminate, the ribs conspicuous, the nectary absent; corolla yellow with a red-brown centre. *Capsules* 11 × 10 mm, ovoid, densely appressed-pubescent, the beak 1.5 mm long, glabrous; seeds 2 × 2 mm, subreniform, very dark brown, with parallel striations, the funiculus inconspicuous, glabrous.

Habitat unknown.

DISTRIBUTION. **Fig. 5.** Angola. Known to me only from the type collection.

29. *Hibiscus cuanzensis* Exell & Mendonça in *J. Bot.* 77: 136 (1936). Type: Angola, Cuanza Norte, Pungo Adongo, April 1857, *Welwitsch* 5241 (BM!-holotype; G!, LISU!, P!-isotypes).

Fig. 3A.

Hibiscus furcatus Garcke in *Linnaea* 43: 121 (1881), non Roxb. (1814).

Hibiscus mastersianus Hiern, *Cat. Afr. Pl.* 1: 71 (1896), pro parte quoad specim. *Welwitsch* 5241.

Perennial *herb* to 1.5 m tall; the stems finely stellate-pubescent and with coarse stellate hairs, increasing in density towards the apex, not aculeate. *Stipules* 5–7 mm long, linear, densely and finely pubescent. *Leaves*: petioles 0.5–7 cm long, densely and finely stellate-pubescent, the blades 2–7.5 × 0.6–9 cm, the blades on lower leaves moderately 5-lobed, the midlobe and lateral lobes ovate, the outer lobes triangular, the blades of upper leaves lanceolate, ovate, or shallowly 3-lobed, the blades of all leaves densely stellate-pubescent and with a few short simple hairs abaxially, densely stellate-pubescent and with a few longer (to 2 mm) simple hairs adaxially, the base cuneate to truncate, the margin finely serrate to irregularly dentate, the apex acute, the nectary 2 mm long, slit-like, on upper leaves and on mid-plant leaves, apparently absent on lower leaves. *Flowers* axillary, solitary, or sometimes with more than one flower at a node or on a short flowering branch; peduncles 0.3–0.6 cm long, articulating at the base, densely and finely stellate-pubescent; involuellar bracteoles 9–10, 5–6 mm long below the apex, linear, finely pubescent and with longer bristles, the apex bifurcate, the outer fork 4 mm long, reflexed, the inner fork 5 mm long, ascending, the base free; calyx 1.4–1.6 cm long, the lobes triangular, acute to slightly acuminate, purple-punctate, densely and finely stellate-pubescent and with a few coarse 2-fid to stellate hairs on bases, the nectary absent; corolla yellow. *Capsules* 14 × 10 mm, ovoid, densely appressed-pubescent, the beak < 1 mm long, obscure; seeds unknown.

‘Ad dumetria junta lafera rivulorum’, etc. (*Welwitsch* 5241); ‘erva vivaz do mato xerófilo’ (Exell & Mendonça, 1937: 167).

DISTRIBUTION. **Fig. 5.** Angola. Narrow endemic, collected only from ‘Cuanza Norte, Pungo Adongo’. Exell & Mendonça (1937) cite, besides the type specimen, *Mechow* 103 (B), from the same general location.

Exell (1936) and Exell & Mendonça (1937) also cited *Welwitsch* 5242 under *Hibiscus cuanzensis*, but it is in fact *H. mastersianus* Hiern.

30. *Hibiscus mastersianus* Hiern, *Cat. Afric. Pl.* 1: 71 (1896) emend. excl. specim. angol. *Welwitsch* 4927, 4928, 5241. Type: Mozambique, Lupata, *Kirk* s.n. (K-lectotype, designated by Milne-Redhead, *Bull. Misc. Inform.* 1935: 273 (1935)).

Fig. 3B.

Hibiscus furcatus Mast. in Oliver, *Fl. Trop. Afr.* 1: 201 (1868), non Roxb. (1814), pro parte excl. specim. ex Gambia.

Hibiscus surattensis var. *mastersianus* (Hiern) Hochr. in *Annuaire Conserv. Jard. Bot. Genève* 4: 112 (1900), excl. specims. *Welwitsch* 4927, 4928.

Hibiscus pachmarhicus Haines in *Bull. Misc. Inform.* 1914: 24 (1914). Type: India, Central Provinces; common in the middle Gondwana sandstones about Pachmarhi in the Satpura range, 900 m, October 1911, Haines 197P (K-holotype).

?*Hibiscus beddomei* Rakshit & Kundu in *Sci. & Cult.* 27: 192 (1961). Type: India, South India, without precise locality, *Beddome* 91 & 92 (CAL-holotype).

Illustrations: Haines, *Bull. Misc. Inform.* 1914: 25, figs 1–7 (1914) (as *H. pachmarhicus*); Rakshit & Kundu, *Sci. & Cult.* 27: 192, fig. 1 (1961) (as *H. beddomei*).

Annual erect herb to 2 m tall; stems with sparse to dense, stiff simple to 3-fid or stellate pigmented bristles on enlarged bases and one or more lines of dense pubescence, not aculeate. *Stipules* 5–8 mm long, filiform. *Leaves*: petioles <1–18 cm long, hairy like the stems, the blades 2–16 × 0.3–15 cm, very shallowly palmately 3-lobed below to entire above, or bract-like near the apex, sparsely to densely stellate-pubescent on both surfaces, the base cuneate to truncate or cordate, the margin serrate to dentate, the apex acute to slightly acuminate, the nectary 1–3 mm long, slit-like, near base of midrib, and sometimes on the two adjacent ribs. *Flowers* axillary, solitary; peduncles 0.4–0.8 cm long, articulating at the base, hispid and with a few long bristles; involucellar bracteoles 9–10, 9–11 mm long, linear, ascending, hispid and with 1–2-fid bristles on the margins, the apex bifurcate, the outer fork 3–4 mm long, lanceolate, the inner fork 2–5 mm long, linear, the base free; calyx 1.1–2.0 cm long, the lobes lanceolate, slightly to long-acuminate, bristly mainly on the ribs, the nectary absent; corolla yellow with a purple centre, the petals 3–5 × 2–3 cm, obovate, sparsely stellate-pubescent dorsally, glabrous ventrally; staminal column 15 mm long, the filaments 1 mm long; style branches 1 mm long. *Capsules* 12–15 × 9–11 mm, ovoid-acuminate, densely appressed-pubescent, beak 2 mm long, glabrous; seeds 4 × 3 mm, angular to subreniform, faveolate, beset with numerous pectinate scales. Chromosome number, $n = 18$.

Ruderal and wild, in old cultivation, in open and mixed grassland, savannas, dense bush and woodland.

DISTRIBUTION. Fig. 5. Eastern, southern and southwestern Africa, Tanzania to South Africa; possibly adventive in India. An anonymous reviewer reported it as having been recorded from Mutomo Hill, Kitui Dist., Kenya, but I saw no specimens from Kenya. **Tanzania**, Kondoia Dist., Sambala, 28 March 1929, *Burt* 2152 (BM); Iramga Plateau, April 1959, *Hammond* 263 (K); Nbulu Island, Lake Tanganyika, 1 April 1955, *Richards* 5389 (BR); Western Province, Tabora-Itigi, 27 April 1962, *Tallantire* T628 (K); Mpulungu...Pier L'île de Niamkolo, 27 March 1947, *Van Meel* 1352 (BR); Mwanza Region, 27 km E. of Geita on Hwy B-163, 26 July 1975, *Wilson & Kissie* 7559 (ASU, EA, NA). **Angola**, Pungo Adongo, 1 May 1857, *Welwitsch* 5242 (BM); Okavongo Native Territory, 25 February 1956, *deWinter & Marais* 4865 (BM). **Zambia**, Wankie Dist., Victoria Falls Village, 14 March 1974, *Gonde* 69/74 (K); Livingstone, 10 April 1930, *Jenkins* 44 (BM); 1 mile S. of Kafue on road to Livingstone, 2 April 1969, *Jones* 69126 (NA); Livingstone and common all along the line, April 1909, *Rogers* 7007 (BOL, K). **Mozambique**, Tete, Cabora Bassa, 19 April 1972, *Pereira & Correia* 2143 (BM). **Namibia**, Tsumeb, 20 March 1934, *Dinter* 7462 (BM); Grootfontein-Nord, zwischen Karakowisa und Numkaub im Omuramba, 5 March 1958, *Merxmüller & Giess* 1819 (BM); **Botswana**, Northern Div., Chobe-Zambesi confluence, 11 April 1955, *Exell, Mendonca & Wild* 1458 (BM); Savuti, Chobe Nat. Park, 25 March 1984, *Jacobsen* 3030 (PRE); Northern Div., 51 km S. of Shakawe on Sepopa Rd, 16 March 1965, *Wild & Drummond* 7102 (BR). **Zimbabwe**, Harley Dist., 13 January 1952, *Hornsby* 3256 (BM); Victoria Falls, 11 April 1925, *Pocock* 9 (BOL). **South Africa**, Transvaal, 14 January 1894, *Schlechter* 4160 (BOL). **India**, Madras, Jubbulpore, 1885, *Beddome* 581 (BM).

Hiern (1896) cited *Welwitsch* 4927, 4928, 5241, and 5242 from Angola as specimens of *Hibiscus mastersianus*. *Welwitsch* 4927 (BM!) and *Welwitsch* 4928 (BM!, LISU!) are referable to *H. gillettii* subsp. *hiernianus*; *Welwitsch* 5241 (BM!, G!, LISU!, P!) is referable to *H. cuanzensis*; *Welwitsch* 5242 (BM!, G!, LISU!) is typical *H. mastersianus*, not a form of *H. cuanzensis*, as Exell & Mendonca (1937) surmised. *Sacleux* 2141 (P-2 sheets, one collected July 1894, the other collected February 1898), from Kenya, is near *H. mastersianus*, but may be an undescribed species; it has very distinctive deeply 7-lobed leaves; the lobes are obovate and are themselves secondarily lobed.

31. ***Hibiscus elongatifolius*** Hochr. in *Annuaire Conserv. Jard. Bot. Genève* 4: 117 (1900). Type: Cameroon, Sanaga, Urwaldgebiet, 1897, *Zenker* 1440 (P!-holotype; BM!, G! [2 sheets]-isotypes). Fig. 3G.

Habit unknown; stems pilose, with matted grey hairs. *Stipules* 8–11 mm long, filiform or linear, each stipule divided into 2 or 3 filiform or linear segments, finely appressed-pubescent. *Leaves*: petioles 0.3–0.8 cm long, with pubescence like that of the stem, the blades 2.5–12.5 × 0.3–0.8 cm, linear, abaxially densely grey stellate-pubescent, adaxially with less dense, simple to 3-fid grey hairs, the base cuneate, the margin serrate, the apex acute, the nectary absent. *Flowers* borne on a leafless shoot, at first clustered near the apex, later axillary, solitary, as the shoot elongates; peduncles 1.7–2.2 cm long, articulating at the base, with pubescence like that of the stem; involucellar bracteoles 11–13, 9–12 mm long, filiform-linear, ascending, with dense, soft, appressed pubescence, the apex entire, the base free; calyx 1.4–1.5 cm long, the lobes lanceolate, acuminate, densely and softly appressed-pilose, the nectary 1 mm long, slit-like; corolla orange-red(?), petals 2 cm long, glabrous(?), the petal spot not seen. *Capsules* 10 × 10 mm, oval, densely appressed-pubescent, the beak inconspicuous; seeds unknown.

DISTRIBUTION. Fig. 5. Cameroon. Known to me only from the type collection.

32. ***Hibiscus sineaculeatus*** F.D. Wilson, *sp. nov.* Type: Nigeria, Zaria Province, Kan Gimi Veg. mapping area, Dutsen Gwagwa, 20 October 1947, *Keay* FHI 20117 (K!-holotype). Fig. 3D.

Hibiscus scotellii Keay, *Fl. W. trop. Afr.* 2nd ed. 1(2): 347 (1958), non Baker f. (1894), pro parte quoad specims. *Keay* FHI 20017, *Lely* 609, P686.

Caulis non aculeati; folia ovata ad 3-lobata; pedunculi fructificantes ≤1 cm longi; bracteolae involucellorum 2 mm latae ad basim, non bifurcatae, subulatae, apicibus acutis; calyces pilis stellatis tenuis atque setis rigidis ad basim rubris, nectariis in quoquo costa.

Erect shrubby herb to 2 m tall; stems, petioles, leaf blades, peduncles, and involucellar bracteoles densely and finely stellate-pubescent and sometimes with some coarse stellate hairs, not aculeate. *Stipules* 2–4 mm long, filiform to linear, with short, fine hairs. *Leaves*: petioles 0.8–6 cm long, the blades 2–8 × 0.7–5 cm, on lower leaves ovate to palmately shallowly or deeply 3-lobed, on upper leaves bract-like to narrowly lanceolate, the base cuneate, truncate, or cordate, the margin serrate, dentate or repand, the apex acute to obtuse, the nectary 0.5–1.5 mm long, slit-like. *Flowers* axillary, solitary, or with an additional smaller flower on a short branch; peduncles 0.2–1.0 cm long, articulating at the base; involucellar bracteoles 6–7, 6–10 mm long, 2 mm wide at the base, subulate, several nerved, the apex entire, pointed, the base free; calyx 1.1–1.8 cm long, the lobes triangular to broadly lanceolate, short-

long-acuminate, finely stellate-pubescent and with simple to stellate stiff bristles on enlarged red bases on the ribs, the nectary small but conspicuous; corolla pale yellow to yellow with a deep crimson to purple centre, the petals 3–4 × 1–2 cm, obovate, with sparse simple to stellate pubescence dorsally, glabrous(?) ventrally. *Capsules* 10–14 × 12–14 mm, with long, dense appressed pubescence, the beak 1–1.5 mm long, glabrous; seeds unknown.

Ruderal and wild, in farm fields, in rocks in grasslands and in open savanna woodlands.

DISTRIBUTION. **Fig. 5.** Nigeria. **Nigeria**, Panshanu, N. Nigeria, 20 September 1921, *Lely* 609 (K); N. Nigeria, without precise locality, September 1930, *Lely* P686 (K); Zari Prov., Zari Dist., Anara F. R., Kangimi, 23 September 1948, *Olorunfeni* FHI 24354 (K); Oyo Prov., Oyo Dist., about 3 miles to Oke-iho on the Iseyin road, 17 October 1959, *Onochie* FHI 40873 (K); Ondo Prov., Idanre Hills, Carter Peak, 24 October 1948, *Keay* FHI 22587 (K).

33. *Hibiscus scotellii* Baker f. in *J. Linn. Soc., Bot.* **30**: 74–75 (1894). Type: Sierra Leone, on gneissose rocks by Scarcies River, 2 miles N. of Sasseni, January, *Scott-Elliott* 4535 (K-holotype; BM!-isotype).

Fig. 3F.

Hibiscus cannabinus var. *chevalieri* Hochr. (1901), pro parte quoad specim. *Chevalier* s.n. (G!).

Erect, little-branched *herb* to 2 m tall; stems, stipules, petioles, leaf blades, peduncles, bracteoles, and calyx densely covered with very fine stellate pubescence. *Stipules* 2–4 mm long, linear to subulate. *Leaves*: petioles 0.2–5 cm long, the blades 1–7 × 0.3–7 cm, the blades of lower leaves shallowly to deeply 3–5–(7)-lobed, the lobes usually oblanceolate to secondarily lobed, the blades of upper leaves strap-like or bract-like, the base cuneate, the margin distantly and finely serrate, the apex acute or obtuse, the nectary 0.5 mm long, usually on the midrib and two lateral ribs. *Flowers* axillary, solitary or sometimes clustered on short branches; peduncles 0.2–1 cm long, articulating at the base; involucellar bracteoles 6–7, 4–10 mm long, 1 mm wide at the base, linear, flattened, several-nerved, the apex entire, slightly broadened to lanceolate, the base free; calyx 0.7–1.4 cm long, the lobes triangular to broadly lanceolate and acuminate, the nectary present but sometimes inconspicuous; corolla yellow to primrose yellow, with a dark red to purple centre. *Capsules* 6–11 × 6–10 mm, ovoid, densely appressed-pubescent, the beak <1 mm long, inconspicuous; seeds 3 × 2 mm, subreniform, shiny, dark brown, sparsely covered with minute, 2-fid to stellate hairs, the funiculus small, with very fine hairs.

In open, sunny locations in grasslands and among rocks.

DISTRIBUTION. **Fig. 5.** Sierra Leone, Ivory Coast, and Mali. **Sierra Leone**, Tisana, Bonthe Island 14 November 1931, *Deighton* 2318 (K); Lungi, 28 November 1928, *Glanville* 111 (K-2 sheets); E. of York on road, 2 April 1958, *Melville & Hooker* 381 (K); Falaba Rest House, 26 November 1965, *Morton* SL 2852 (K); Sugarloaf, 1892, *Scott Elliott* 4031 (BM). **Mali**, Sindou et Niger moyen, *Chevalier* s.n. (G). **Ivory Coast**, near Brafoudi, 75 km NW of Abidjan, 30 December 1958, *Leeuwenberg* 2293 (B).

POORLY KNOWN AND EXCLUDED SPECIES

Hibiscus baumanii Ulbr. in *Notizbl. Bot. Gart. Mus. Berlin-Dahlem* **8**: 167 (1922). Type: Togo, tree prairies and savannahs N. to 7° N, *Baumann* 400 (B-holotype).

Ulbrich stated that this taxon is related to *Hibiscus elongatifolius* Hochr. and placed it in his series *Furcaria cannabina*. No specimen was found at B. Hutchinson & Dalziel (1928) treated *H. baumannii*

as a synonym of *H. congestiflorus* Hochr. (section *Ketmia*) [*Annuaire. Conserv. Jard. Bot. Genève* **10**: 21 (1906)] and cited *Baumann* 400 under this species.

Hibiscus beddomei Rakshit & Kundu in *Sci. & Cult.* **27**: 192 (1961). Type: India, South India without precise locality, *Beddome* 91 & 92 (CAL-holotype).

This plant is probably conspecific with *Hibiscus mastersianus* Hiern. Both have stiff stem pubescence, ovate, shallowly 3–5-lobed hairy leaves with cordate bases, 9–10 stiffly pubescent involucellar bracteoles, acuminate calyx lobes with pubescence on the ribs (otherwise almost glabrous), and beaked, densely pubescent capsules. The plant in the photograph accompanying the description of *H. beddomei* (Rakshit & Kundu, 1961), even though poorly presented, strongly resembles *H. mastersianus*. Unfortunately, I have been unable to examine any authentic specimens of *H. beddomei*.

Hibiscus campanulifolius Ulbr. in *Notizbl. Bot. Gart. Mus. Berlin-Dahlem* **8**: 166 (1922). Type: Namibia, Tsumeb, *Dinter* 1692 (B-holotype).

Ulbrich places this species in series *Furcaria cannabina* but pencilled notes on two sheets at BM of sketches of the type specimens of *Hibiscus campanulifolius* suggest that it is referable to *H. lunarifolius* Willd. or *H. dongolensis* Del., in section *Ketmia*.

Hibiscus comoensis A. Chev., *Expl. bot. Afrique occ. franc.* **1**: 65 (1920), nom. nud. Hutch. & Dalziel, *Fl. W. trop. Afr.* **1**: 265, in clavi, 267 (1928); Hutch. & Dalziel, *Kew Bull.* **1928**: 298 (1928) descr. Type: Ivory Coast, Middle Comoe: between Akabossué and Ebrinahoné, 19 December 1909, *Chevalier* 22613 (P!-holotype; BR!, P!-isotypes).

Hibiscus comoensis, a plant of southeastern Ivory Coast (*Chevalier* 22613) and southwestern Ghana [between Kwapon and River Tano, c. 90 km W. of Kumasi, 23 December 1963, *Oldeman* 807 (BR)] (Figs 5, 6), was associated with other species of *Hibiscus* section *Furcaria* by Hutchinson & Dalziel (1928) in their key because the involucellar bracteole has a foliaceous appendage. This species does not fit into any of the currently recognized sections of *Hibiscus* because of its umbellate inflorescence, much reduced calyx lobes (0.4–0.5 cm long) with poorly developed ribs, and alternating involucellar bracteoles that are linear below and ovate above and much longer than the calyx lobes (6–7 mm long below and 3–6 mm long and 2–4 mm wide in the ovate portion).

Hibiscus friesii Ulbr. in *Feddes Repert.* **13**: 521 (1915). Type: Zambia, Chiruktu bei Broken Hill, *Fries* 239 (UPS-holotype).

Ulbrich placed this species in section *Furcaria* in his series *Friesia*. I did not see a specimen from B. Baker (1937) moved series (subsection) *Friesia* to the genus *Kosteletskyia*. Exell (1961) placed *Hibiscus friesii* in synonymy with *Hibiscus panduriformis* Burm.f., but suggested the possibility that it is a separate taxon. At any rate, *H. friesii* does not belong in section *Furcaria*.

Hibiscus furcatus Bahadur, Dayal & Raturi in *J. Bombay Nat. Hist. Soc.* **70**: 495–496, pl. II (1970), non Roxb. (1814).

This plant, collected in northwestern India, is certainly not conspecific with *Hibiscus furcatus* Roxb. (*H. hispidissimus* Griff.). In fact, it may be a previously undescribed species of *Hibiscus* section *Furcaria*.

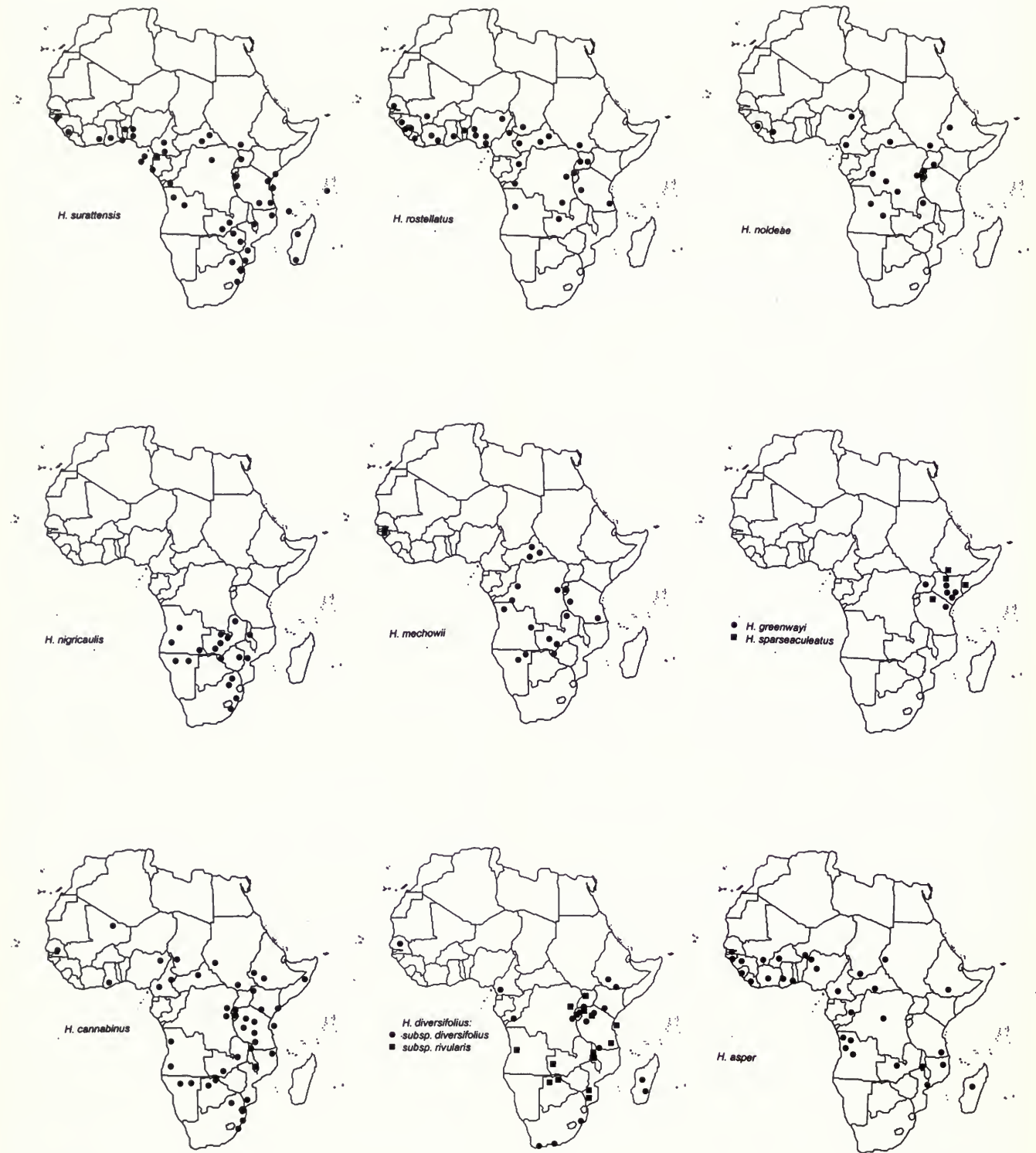


Fig. 4 African distributions of taxa of *Hibiscus* section *Furcaria*.

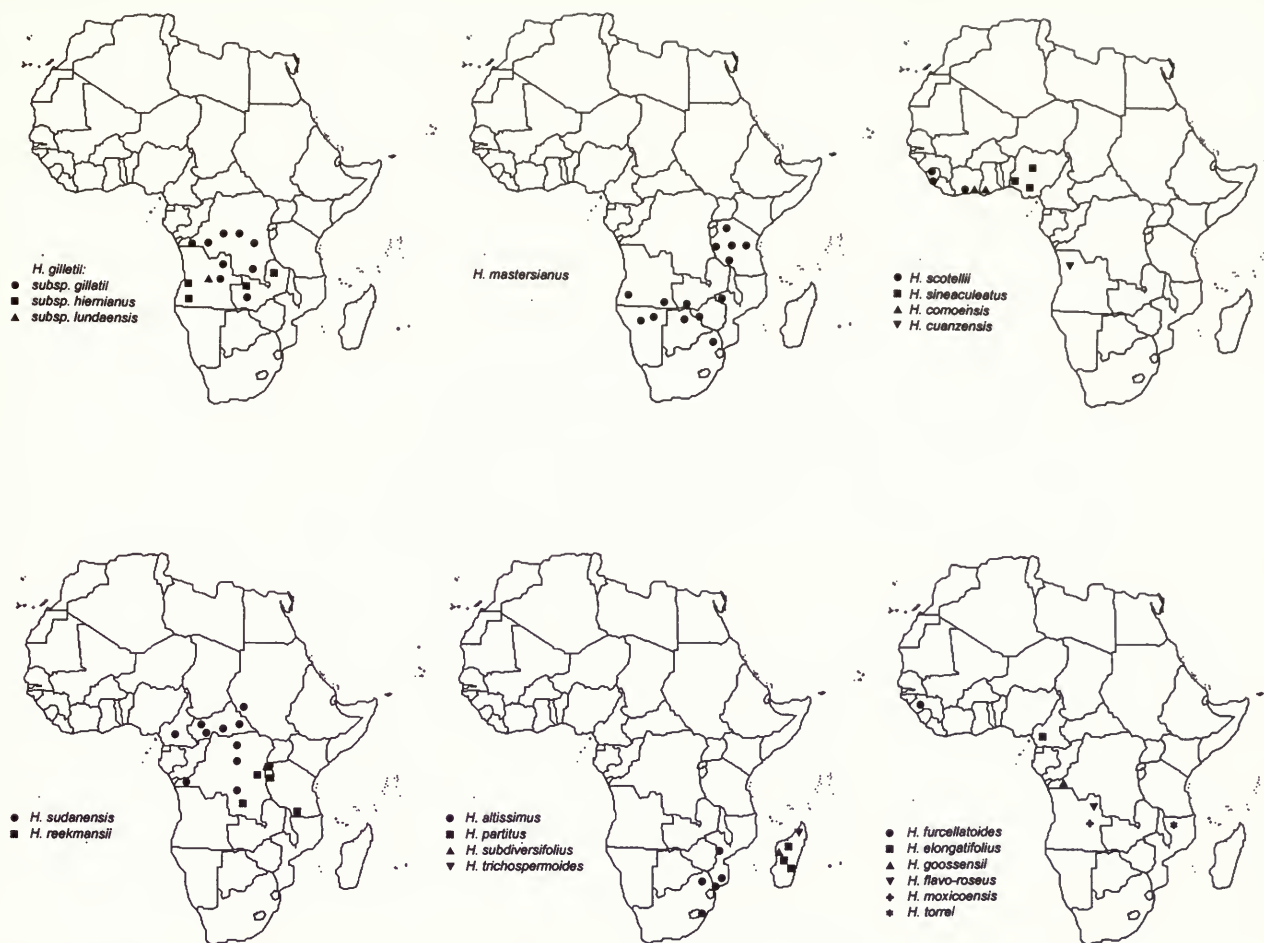


Fig. 5 African distributions of taxa of *Hibiscus* section *Furcaria*.

Bahadur *et al.* (1970) wrongly placed the following taxa in synonymy with the species that they called *H. furcatus* Roxb.: *H. aculeatus* Roxb., *H. furcellatoides* Hochr., *H. hispidissimus* Griff., and *H. rostellatus* Guill. & Perr.

Hibiscus furcatus* var. *microcarpus Mattei in *Boll. Reale Orto Bot. Giardino Colon. Palermo* 7: 103 (1908). Type: Somalia, Giumbo in reg. Goscia, *Macaluso* 55 (PAL-holotype).

Mattei differentiates this taxon from the Indian species *Hibiscus furcatus* [referring to *H. furcatus* Roxb., not to *H. furcatus* Willd.] by its short peduncles, small, deep yellow corolla, included capsule, and very short calyx. He also states that it has an affinity with *H. surattensis*. No specimen was found at PAL.

Hibiscus hispidissimus A. Chev., *Rev. Bot. Appliq.* 20: 326 (1940), non Griff. (1854), nom. illeg. (Art. 53.1) [based on *Hibiscus abelmoschus* var. *hispidissimus* A. Chev., *Explor. Bot. l'Afrique occ. franc.* 1: 63 (1920), nom. nud.] = *Abelmoschus esculentus* (L.) Moench (see Keay, 1958: 348). Type: Ivory Coast, Cercle du Baoule-Nord Vallée du Nzi moyen; entre Korakissikro et Manikro Casût, 1909, *Chevalier* 22307 (P!).

My opinion is that *Chevalier* 22307 is a typical specimen of *Abelmoschus esculentus*.

Hibiscus hoshiarpurensis T.K. Paul & M.P. Nayar in *Bull. Bot. Surv. India* 25: 188–189, figs 1–6 (1983). Type: India, Punjab, Dholbah, Hoshiarpur Dist., 22 September 1970, *Misra* 41888 (BSD-holotype).

This plant is closely related to *Hibiscus mastersianus* (including *H. beddomei*) but seems to be a genuine species, according to the description and accompanying illustration. It has lanceolate, unlobed leaves, and shorter petioles and longer calyx lobes in relation to the capsule than does *H. mastersianus*. It occurs in extreme northwestern India (Punjab), whereas *H. mastersianus* has a more southerly distribution in India.

Hibiscus imerinensis Ulbr. in *Notizbl. Bot. Gart. Mus. Berlin-Dahlem* 8: 168 (1922). Type: Madagascar, Imerina, near Tananarive, *Hildebrandt* 4033 (BM!, G!-isotypes).

Hochreutiner [*Fl. Madagasc., Malvac.*: 46 (1955)] lists *Hibiscus imerinensis* as a synonym of *H. stenophyllus* var. *solandroketmia* (Hochr.) Hochr. [section *Solandra*]. At any rate, it does not belong in section *Furcaria*.

Hibiscus keilii Ulbr. in *Notizbl. Bot. Gart. Mus. Berlin-Dahlem* 8: 681 (1924). Type: Tanzania (Ostafrika), Usumbura, Luwironsa-Ufer bei Mugera, 4 August 1905, *Keil* 183 (B-holotype).



Fig. 6 *Hibiscus comoensis*, Oldeman 807 (BR).

Ulbrich placed this species in series *Furcaria furcellata* and noted that it is closely related to *Hibiscus rostellatus*.

Hibiscus paolii Mattei in Chiovenda, *Result. Sci. Somalia ital.* **1**: 32 (1916). Type: Somalia, Bur-Meldac, Paoli 699 (PAL-holotype).

A sheet at BM (012890) has a poor sketch of this species. An abbreviated description on this sheet shows that this species belongs to section *Furcaria* and suggests a close affinity with *Hibiscus rostellatus* (rhomboid leaves and bifurcate involucellar bracteoles).

Hibiscus persicifolius Eckl. & Zeyh., *Enum. pl. afric. austral.*: 38 (1835); Harvey & Sonder, *Fl. Cap.* **1**: 171–172 (1860). Type: South Africa, in the Great Karroo, between Graaf Reynet and Uitenhage, Ecklon & Zeyher 305 (Herb. Sond.).

I made inquiries at six herbaria (BM, K, MEL, NBG, S, and TCD) known to have Sonder specimens. A fragmentary sterile specimen of Ecklon & Zeyher 305 was found at NBG (photocopy seen), and two fragmentary specimens, one sterile and one flowering, were found at S (not seen). I designate the flowering specimen of Ecklon & Zeyher 305 at S as lectotype and the other specimens of this same collection as isocotypes. In addition, a fragmentary sterile specimen of apparently the same species (Ecklon & Zeyher s.n.) was found at MEL (photocopy seen). No specimens were found at the other three herbaria. The appearance of the plant fragments and the sketchy description of *Hibiscus persicifolius* suggests strongly that this is the Australian species, *H. heterophyllus* Vent. (In particular, the peduncles and calyx clothed with golden-yellow echinate tubercles). If so, the specimen must have been collected from a cultivated plant or one that had escaped cultivation. Ecklon & Zeyher's description of the flower as purplish is a little disturbing because *H. heterophyllus* has white or yellow flowers. However, the corollas of the white-flowered form are pink-tinged, particularly on the dorsal surface, and dry to a dark pink color.

Hibiscus procerus Roxb. ex Wall., *Cat. no.* 2692.

Roxburgh's illustration [Icons Roxburghianae 1506 (K!)] is of the white-flowered form of *Hibiscus heterophyllus* from Australia. Masters in Hooker, *Fl. Brit. India* **1**: 339 (1872) gives as type: Burma, Wallich. If this plant was collected in Burma, it was obviously cultivated, not native there.

Hibiscus saxicola Ulbr. in *Notizbl. Bot. Gart. Mus. Berlin-Dahlem* **7**: 179–180 (1917). Type: Cameroon, Ebolowa region, Mildbraed 5515 (B-holotype).

In his original description, Ulbrich placed this species in section *Azanza*, but later erected series *Saxicolae* under section *Furcaria* to accommodate it.

Hibiscus trichospermoides Hochr. in *Annuaire Conserv. Jard. Bot. Genève* **20**: 82 (1916). Type: Madagascar, Grés liasiques, bois secs, Mt Ampohipirika (Herbier Perrier de la Bathie n. 62) (G!-holotype).

Fig. 3H.

Hibiscus bernieri var. *trichospermoides* (Hochr.) Hochr., *Fl. Madagas., Malvac.*: 65, fig. 17 (1955).

Illustration: Hochreutiner, *Fl. Madagasc., Malvac.*: fig. XII, 3–6 (1955).

The sectional placement of *Hibiscus trichospermoides* is in doubt. My opinion is that it does not belong in section *Furcaria*. The calyx

nerivation resembles more closely other species of section *Solandra* rather than section *Furcaria*, but the capsule and seed characteristics are not like other species of either of these sections. No other African or Asian species of section *Furcaria* shows the same combination of diagnostic characters: stem not aculeate, peduncles long, articulating above the base, involucellar bracteoles not bifurcate, calyx nectary absent. Furthermore, the capsule has a dense stellate, unappressed tomentum, and the seed surface is covered with silky hairs to 3 mm long, characters that appear in no other species of *Furcaria* with which I am familiar. Hochreutiner, in his description of *H. trichospermoides*, thought that its closest affinity was with *H. heterophyllus* and related Australian species of section *Furcaria*, but later regarded it merely as a variety of *H. bernieri* Baill., which he inexplicably placed in section *Lilibiscus*.

I have seen no authentic specimens of *Hibiscus bernieri* var. *bernieri* but Hochreutiner's illustration and description suggest that these two entities, both endemic in Madagascar, are indeed closely related.

Figure 3H is Basse Mahahavy du Nord, au Sud d'Ambilobé, April 1951, Humbert & Capuron 19291 (G).

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