

Taxonomic revision of the tribe Hymenodictyeae (Rubiaceae, Cinchonoideae)

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The palaeotropical tribe Hymenodictyeae Razafim. & B. Bremer, belonging to the otherwise predominantly Neotropical subfamily Cinchonoideae s.s. (coffee family or Rubiaceae), is revised here. The tribe as presently circumscribed contains two genera, *Hymenodictyon* Wall. and *Paracorynanthe* Capuron ex J.-F. Leroy, and is distinct from the other Cinchonoideae tribes with capsular fruits in having stipules bearing large, deciduous colleters on the margins, valvate corolla aestivation, and lenticellate capsular fruits that contain elongate, bilaterally flattened, and accrescent placentae. We recognize 22 *Hymenodictyon* species, including four new species (*H. antakaranensis* sp. nov., *H. epiphyticum* sp. nov., *H. madagascariense* sp. nov., and *H. tsingy* sp. nov.), and the two described species of *Paracorynanthe*. *Hymenodictyon* is distinguished from its sister genus, *Paracorynanthe*, by simple or compound spicate, racemose or thyrsoid inflorescences and corolla lobes without any appendages, rather than compound umbelliform inflorescences and corolla lobes prolonged by ciliate appendages. A full taxonomic treatment, keys, and distribution maps of all recognized *Hymenodictyon* and *Paracorynanthe* species are provided. Five lectotypes and one neotype are designated. Finally, six *Hymenodictyon* species are illustrated for the first time. © 2006 The Linnean Society of London, *Botanical Journal of the Linnean Society*, 2006, 152, 331–386.

ADDITIONAL KEYWORDS: Africa – Asia – *Hymenodictyon* – Madagascar – *Paracorynanthe* – systematics – taxonomy.

INTRODUCTION

The tribe Hymenodictyeae Razafim. & B. Bremer, correctly spelled by Bridson & Verdcourt (2003: 385 & 423) as Hymenodictyeae, was described by Razafimandimbison & Bremer (2001) to accommodate the two palaeotropical genera, *Hymenodictyon* Wall. and *Paracorynanthe* Capuron. Andersson & Persson (1991) placed these genera in the tribe Coptosapelteae, which was demonstrated by Razafimandimbison & Bremer (2001) to be highly polyphyletic. Hymenodictyeae belongs to the subfamily Cinchonoideae s.s. (Bremer *et al.*, 1999) of the coffee family (Rubiaceae) and has been shown to be sister to the mostly palaeotropical tribe Naucleaeae s.l. (Razafimandimbison & Bremer,

2002). In Andersson & Antonelli (2005) the Hymenodictyeae–Naucleaeae clade was resolved as sister to a predominantly Neotropical clade, which contains Chiococceae *sensu* Bremer (1992), Cinchoneae *sensu* Andersson & Antonelli (2005), Guettardeae, Hamellieae, Hillieae, Isertieae *sensu* Bremer & Thulin (1998), and Rondeletieae. In Razafimandimbison & Bremer (2001: 526), *Paracorynanthe*, represented by *P. antakaranana* Capuron ex J.-F. Leroy, and *Hymenodictyon*, represented by four *Hymenodictyon* species [*H. decaryi* Homolle, *H. flaccidum* Wall., *H. floribundum* (Hochst. & Steud.) B.L. Rob., and *H. parvifolium* Oliv.] formed a strongly supported monophyletic group (bootstrap support value = 100%). The phylogenetic relationships within this *Hymenodictyon*–*Paracorynanthe* clade (= Hymenodictyeae) were unresolved. On the other hand, an unpublished phylogenetic analysis based on external transcribed spacers sequence data (S. Razafimandimbison and B.

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Bremer, unpubl. data) supports the distinction of two monophyletic genera, *Hymenodictyon* and *Paracorynanthe*, consistent with morphological data (Capuron & Leroy, 1978). The members of Hymenodictyeae can be recognized easily by their stipules bearing large, deciduous colleters on the margins (e.g. Figs 10B, 13A), valvate corolla aestivation, and lenticellate, capsular fruits (e.g. Figs 6D, 13D, 17K), which contain elongate, bilaterally flattened, and accrescent placentae (e.g. Figs 2D, 6E). The presence of the colleters, which are absent in *H. decaryi*, is a reliable field character for recognizing sterile collections of the other Hymenodictyeae species. Within Cinchonoideae s.s., valvate corolla aestivation is only known in Hymenodictyeae and four of the 26 genera of Naucleaeae *sensu* Razafimandimbison & Bremer (2002), *Corynanthe* Welw., *Mitragyna* Korth., *Pausinystalia* Pierre ex Dupouy & Beille, and *Uncaria* Schreb. The combination of the stipule, floral, and fruit characters together distinguishes Hymenodictyeae from the other tribes of Cinchonoideae with capsular fruits.

Wallich (Roxburgh, 1824) originally described the genus *Hymenodictyon* based on the Indian *Cinchona excelsa* Roxb. (Roxburgh, 1799). The generic name is derived from the Greek word 'hymena', meaning a membrane, and 'dictyon', meaning a net, referring to the membranaceous wings around the seeds. The author made the new combination of *H. excelsum* (Roxb.) Wall. However, Mabberley (1982) correctly pointed out that Wallich overlooked *C. orixensis* Roxb. (Roxburgh, 1793), which is conspecific to *C. excelsa*. Consequently, Mabberley made the new combination of *H. orixense* (Roxb.) Mabb. *Paracorynanthe* was originally described by Capuron (Capuron & Leroy, 1978) as an endemic Malagasy genus. The name is derived from the African genus *Corynanthe* (Welwitsch, 1869), which also has well-developed corolla lobe appendages. *Hymenodictyon* can be diagnosed by its thick and nonplated bark, elongate inflorescences (e.g. Figs 4A, 6A, 8A, 10A), erect corolla lobes that are never prolonged by any appendages (Capuron & Leroy, 1978; Razafimandimbison & Bremer, 2001), and elliptic, capsular fruits that contain fusiform, bilaterally flattened, and accrescent placentae. *Paracorynanthe*, on

the other hand, is distinct from *Hymenodictyon* in its thin and plated bark, compound umbelliform inflorescences, wine-glass shaped and densely pubescent corollas, corolla lobes with filiform and densely bristled appendages topped by single globose and glabrous clubs (Figs 18B, 20E, F), and slightly bilaterally flattened fruits containing angular, oblanceolate, and accrescent placentae. Below we present keys that can be used for keying out the two sister tribes and the two Hymenodictyeae genera.

Before our present revision, *Hymenodictyon* and *Paracorynanthe* contained, respectively, 21 (Miquel, 1856; Baillon, 1880; Hutchinson & Dalziel, 1931; Cavaco, 1964c, 1968; Mabberley, 1982; Almeida & Almeida, 1987; Bridson & Verdcourt, 1988, 2003; Deb, 1989; Table 1) and two (Capuron & Leroy, 1978) species, all of which are regional endemics. *Paracorynanthe* and 11 of the 21 *Hymenodictyon* species are restricted to Madagascar (Homolle, 1939; Cavaco, 1964a, b, c, 1968; Capuron & Leroy, 1978; Table 1). One of the 11 Malagasy *Hymenodictyon* species, *H. madagascariensis* Baill., appeared never to have been described by Baillon (1880: 472). In our present revision, we recognize the two *Paracorynanthe* species, *P. antankarana* and *P. uropetala* Capuron (Capuron & Leroy, 1978), and nine of the 11 *Hymenodictyon* species (Table 1) and describe for the first time *H. madagascariensis* Baill. ex Razafim. & B. Bremer and two further new species, *H. antakaranensis* Razafim. & B. Bremer and *H. tsingy* Razafim. & B. Bremer. *H. occidentale* Homolle ssp. *glabrum* Cavaco is recognized at species level [*H. glabrum* (Cavaco) Razafim. & B. Bremer], whereas both *H. louhavate* Homolle var. *longicalyx* Cavaco and *H. maevatananense* Cavaco are merged in *H. berivotrense* Cavaco.

Prior to this revision, four *Hymenodictyon* species from tropical Africa (*H. biafranum* Hiern, *H. floribundum*, *H. pachyantha* K. Krausse, and *H. parvifolium*) were accepted (see Table 1) and treated in various 'Floras': West Africa (Hutchinson & Dalziel, 1931), Gabon (Hallé, 1966), East Africa (Bridson & Verdcourt, 1988), southern Africa (Retief & Leistner, 2000), and Zambesiaca (Bridson & Verdcourt, 2003). We recognize the four African species and describe one new

KEYS TO NAUCLEAEAE S.L. AND HYMENODICTYEAEE AND THE TWO GENERA OF HYMENODICTYEAEE

- 1a. Inflorescences globose; disks inconspicuous, embedded in hypanthia and ovaries; individual fruits not lenticellate Naucleaeae s.l. (26 genera)
 1b. Inflorescences elongate, rarely globose; disks conspicuous, not embedded in hypanthia and ovaries; individual fruits lenticellate Hymenodictyeae (2 genera) 2
 2a. Bark thin and plated; corolla lobes prolonged by filiform, densely bristled appendages terminating with globose clubs; fruits slightly, bilaterally flattened; placentae oblanceolate and angular *Paracorynanthe* (2 species)
 2b. Bark thick and nonplated; corolla lobes without any appendages; fruits ellipsoid; placentae fusiform and bilaterally flattened *Hymenodictyon* (22 species)

Table 1. List of *Hymenodictyon* species recognized in earlier treatments and in our study, and their geographical distributions

Earlier circumscriptions	Razafimandimbison & Bremer (this study)	Geographic distribution
<i>berivotrense</i> ¹² <i>biafranum</i> ⁵	<i>berivotrense</i> <i>biafranum</i>	Madagascar Tropical Africa
<i>decaryi</i> ^{11,12} <i>embergeri</i> ^{11,12} <i>flaccidum</i> ^{1,16}	<i>decaryi</i> <i>embergeri</i> <i>flaccidum</i>	Madagascar Madagascar Continental Asia
<i>floribundum</i> ^{8,10,13,17}	<i>floribundum</i>	Tropical Africa
<i>horsfieldii</i> ⁴	<i>horsfieldii</i>	South-east Asia
<i>leandrii</i> ^{11,12} <i>louhavate</i> ^{11,12} <i>madagascarium</i> ^{6,12} <i>maevatananense</i> ¹² <i>obovatum</i> ^{1,16}	<i>leandrii</i> <i>louhavate</i> <i>madagascarium</i> * <i>berivotrense</i> <i>obovatum</i>	Madagascar Madagascar Madagascar Madagascar Continental Asia
<i>occidentale</i> ^{11,12} <i>orixense</i> ^{1,14} <i>pachyantha</i> ^{9,10}	<i>occidentale</i> <i>orixense</i> <i>pachyantha</i>	Madagascar Tropical Asia Tropical Africa
<i>parvifolium</i> ^{7,17}	<i>parvifolium</i>	Tropical Africa
<i>perrieri</i> ^{11,12} <i>heedii</i> ¹⁵ <i>septentrionale</i> ^{11,12} <i>seyrigii</i> ^{11,12} <i>timoranum</i> ^{2,4}	<i>perrieri</i> <i>orixense</i> <i>septentrionale</i> <i>seyrigii</i> not treated	Madagascar Tropical Asia Madagascar Madagascar South-east Asia
	<i>antakaranensis</i> * <i>epiphyticum</i> *	Madagascar Tropical Africa
	<i>glabrum</i> * <i>tsingy</i> *	Madagascar Madagascar

¹Roxburgh (1824); ²Spanoghe (1836); ³Walpers (1846); ⁴Miquel (1856); ⁵Hiern (1877); ⁶Baillon (1880); ⁷Hooker (1885); ⁸Robinson (1910); ⁹Krause, 1920; ¹⁰Hutchinson & Dalziel (1931); ¹¹Homolle (1939), ¹²Cavaco (1964c, 1968); ¹³Hallé (1966); ¹⁴Mabberley (1982); ¹⁵Almeida & Almeida (1987); ¹⁶Deb (1989); ¹⁷Bridson & Verdcourt (1988; 2003); *new species described here.

epiphytic species, *H. epiphyticum* Razafim. & B. Bremer, known from Cameroon, Gabon, and Guinea. Similarly, we accept Verdcourt's (1976) two subspecies of *H. parvifolium*, *H. parvifolium* Oliv. ssp. *parvifolium* Verdc. and *H. parvifolium* Oliv. ssp. *scabrum* (Stapf) Verdc., but disregard his varietal concept for the latter subspecies.

Five *Hymenodictyon* species are confined to tropical Asia (e.g. Koorders & Valetton, 1902; Backer & Bakhuizen van den Brink, 1965; Almeida & Almeida, 1987; Deb, 1989; Table 1). Three of the described Asian species from India [*H. flaccidum* Wall., *H. obovatum* Wall., and *H. orixense* (Roxb.) Mabb.] (Table 1) were revised by Deb (1989). However, Deb's revision overlooked the new combination of *H. rheedei* (Rome. & Schult.) M.R. Almeida & S.M. Almeida (accepted name = *H. orixense*) made by Almeida & Almeida (1987). Four Asian species [*H. excelsum* (Roxb.) Wall. (accepted name = *H. orixense*), *H. horsfieldii* Miq., *H. koordersii* K. Schum. (accepted name = *H. horsfieldii*), and *H. timoranum* (Span.) Miq. (Miquel, 1856: 153), spelled *H. timoriense* Klotzsch ex Walp. by Walpers (1846)] (Table 1) have been reported in South-east Asia. *H. koordersii* is a nomen nudum based on a label manuscript of K. Schumann (July 1902) deposited at the Bogor herbarium, Java, Indonesia (Koorders, 1904). Spanoghe (1836) described *C. timorana* Span., but neither Spanoghe nor Walpers (1846), who correctly transferred *C. timorana* to *Hymenodictyon*, gave any further details on the type specimen of the species. Miquel (1856) recognized *H. timoranum* as a distinct species because of its velutinous corollas that make it distinct from the other four Asian *Hymenodictyon* species. On the other hand, we have not been able to trace the type specimen of *H. timoranum* and none of the studied Asian specimens quite matched the protologue. As a result, we do not treat this species in this revision, as we are unable to evaluate its status.

All previous species circumscriptions of and keys to *Hymenodictyon* species (e.g. Hutchinson & Dalziel, 1931; Homolle, 1939; Cavaco, 1964a, b, c, 1968; Hallé, 1966; Bridson & Verdcourt, 1988, 2003; Deb, 1989) were based on a combination of vegetative and reproductive characters. In our revision, we also use a combination of vegetative (e.g. leaf blade indumentums and shape, petiole length) and reproductive characters (e.g. corolla length, indumentums, and shape, inflorescence type, length, and indumentums, and the presence or absence of the long-etiolate leafy bracts) for species recognition. We accept the present species delimitation of *Paracorynanthe* (Capuron & Leroy, 1978) based on the following characters: the number of secondary veins of the leaf blades, and the presence or absence of the long-petiolate and leafy bracts.

Our study is the first worldwide taxonomic revision of *Hymenodictyon*, which provides new keys to all species. We recognize a total of 22 *Hymenodictyon* species (Table 1), of which four (*H. antakaranensis*, *H. epiphyticum*, *H. madagascarium*, and *H. tsingy*) are described herein. Our criterion for recognizing species was the presence of one or more apparently fixed or nonoverlapping morphological differences

between putative species. Morphologically distinct groups of specimens were then delimited by the discontinuous or fixed diagnostic differences. This revision is based on the examination of over 700 herbarium specimens (by S.G.R.) and on field observations of 11 of the 22 *Hymenodictyon* species. Lists of exsiccatae and an alphabetical checklist of all published *Hymenodictyon* and *Paracorynanthe* names, respectively, are presented in Appendices 1, 2 and 3. Specimens from the following herbaria (abbreviated according to Holmgren, Holmgren & Barnett (1990)) were examined and annotated during this study: BR, K, L, MO, PRE, S, TAN, TEF, UPS, and WAG. Habitat and ecology, vernacular names, and economic uses were taken from herbarium labels and literature. All measurements, colours, and other details included in the descriptions were based on herbarium specimens and/or data derived from field notes. Fieldwork was carried out by S.G.R. in Madagascar in December 2001, January 2002, November–December 2003, and January–February 2006 to collect herbarium specimens and spirit material, as well as to gather ecogeographical data. The spirit material was preserved in FAA (formalin/acetic acid/ethanol, Radford *et al.*, 1973), allowing detailed studies of inflorescences and flowers. Finally, all species distribution maps were made with help of the computer program ArcView GIS version 3.2 (ESRI).

MORPHOLOGICAL AND OTHER IMPORTANT CHARACTERISTICS OF *HYMENODICTYON* AND *PARACORYNANTHE*

This section presents a detailed overview of the characteristics of *Hymenodictyon* and *Paracorynanthe* species and discusses their potential taxonomic significance.

HABIT

The plants of *Hymenodictyon* are generally medium-sized to emergent trees up to 35 m tall, while the two *Paracorynanthe* species are medium-sized trees up to 15 m tall. *H. epiphyticum* is an obligate epiphyte up to 3 m tall, whereas both *H. biafranum* and *H. flaccidum* are facultative epiphytes, which occasionally grow on rocky substrates and become tall trees (up to 15 m).

LEAVES

The leaves of *Hymenodictyon* are simple, opposite, decussate, subcoriaceous or coriaceous, and sometimes membranaceous. There is great variation in the length of petioles and the size of leaf blades. The shortest petioles are found in *H. epiphyticum* and the longest ones in *H. embergeri* Cavaco and *H. occidentale*

Homolle. Most *Hymenodictyon* species have small- to medium-sized leaves, but the West African *H. pachyantha* has the largest leaf blades, 8–31 × 5–11 cm. The leaf blades are mostly glabrous but can be scabrous (e.g. *H. parvifolium* ssp. *scabrum* and all studied collections of *H. occidentale* from the Ankazoabo District, Toliara Province, Madagascar received from P herbarium), puberulous or pubescent (e.g. *H. berivotrense*, *H. louhavate*, *H. septentrionale* Cavaco), or even tomentose (some individuals of *H. perrieri* Drake and *H. floribundum*). Therefore, leaf indumentum is useful for species recognition in *Hymenodictyon*. In general, the secondary and tertiary veins of the leaf blades are adaxially prominent but abaxially prominent. Domatia, cavities located in the axils of the secondary veins on the abaxial sides of leaf blades (*sensu* Jacobs, 1966), are absent in most *Hymenodictyon* species. Some species of *Hymenodictyon*, for example, *H. antakaranensis* (Fig. 2B), *H. madagascariensis* (Fig. 8A), and *H. perrieri*, have tuft-type domatia (covered by dense hairs). Finally, the stipules of *Hymenodictyon* are interpetiolar, typically narrowly triangular to broadly oblong, sometimes foliaceous (e.g. *H. leandrii* Cavaco), and typically deciduous, rarely persistent (e.g. *H. leandrii*) or semipersistent (e.g. *H. perrieri*). Therefore, the persistence of the stipules can be used for species delimitation. Their margins are typically ornamented by large, deciduous black glands (colleters) (e.g. Fig. 10B). These colleters are absent on the stipules of the Malagasy *H. decaryi*.

The leaves of *Paracorynanthe* are simple, opposite, decussate, membranaceous, and puberulous. The petioles are also adaxially prominent but abaxially prominent, puberulous, and with lengths ranging from 15 to 35 mm. The midribs and both secondary and tertiary veins are densely pubescent. Domatia are absent. The stipules of *Paracorynanthe* are interpetiolar, triangular, membranaceous, and deciduous. Their margins also bear large and deciduous colleters.

INFLORESCENCES

The inflorescences of *Hymenodictyon* species are typically terminal and pedunculate. Some species (e.g. *H. biafranum*, *H. decaryi*), however, have both terminal and axillary inflorescences from the uppermost leaf pair. They vary from simple spicate or racemose to compound spicate, racemose, or thyrsoid, but tend to be more spherical in *H. parvifolium*. In the species with compound inflorescences, the peduncles of the primary inflorescence units are branched bilaterally, either at the base only (e.g. *H. horsfieldii*), at the apex only (e.g. *H. pachyantha*, *H. seyrigii* Cavaco), or at both (e.g. *H. orixense*), or between and at both ends (*H. embergeri* and *H. occidentale*). Lateral inflores-

cence units are typically unbranched, but are branched in *H. occidentale*. Each inflorescence unit is composed mostly of an elongate peduncle, a single or pair of long-petiolate, leafy, scarious bracts, an elongate, densely pubescent rhachis, sessile bracts and bracteoles, and numerous solitary flowers and/or two- to 18-flowered cymules. The peduncles are typically terete, slender, and puberulous or pubescent. However, they are coarse in *H. occidentale*. The long-petiolate bract separates the peduncle and the rhachis. These long-petiolate bracts are, however, absent in some species (e.g. *H. decaryi*, *H. pachyantha*, *H. parvifolium*, *H. septentrionale*). In *H. orixense*, two pairs of the long-petiolate bracts are present at the base and apex of the peduncles of the primary inflorescence units, whereas none are found on the lateral inflorescence units. In *H. antakaransis*, only the lateral inflorescence units are subtended by single long-petiolate bracts (Fig. 2A). Therefore, the presence or absence and the position of the long-petiolate bracts are useful for species recognition in combination with other characters. The rhachis of *Hymenodictyon* is terete and pubescent or puberulous, and bears numerous large, sessile bracts, and solitary flowers or cymules. Each cymule is borne in the axil of the small, subulate, sessile, and deciduous bract. Each individual flower bears a minute, linear, sessile, and deciduous bracteole (e.g. Fig. 4C). The shape and size of the sessile bracts and bracteoles vary among species, making them useful for species recognition. However, they were only seen in specimens with young inflorescences because they fall very early.

The inflorescences of *Paracorynanthe* are both terminal and axillary from the uppermost leaf pair, compound umbelliform, and unsubtended (*P. uropetala*, Fig. 20A) or subtended (*P. antakarana*, Fig. 18A) by a pair of long-petiolate, leafy, scarious bracts. Each inflorescence unit is composed of a slender and pubescent peduncle and rhachis, large and sessile bracts and bracteoles, and numerous two- to five-flowered cymules.

FLOWERS

The flowers in *Hymenodictyon* are hermaphroditic, protandrous, typically pedicellate, rarely nonpedicellate (e.g. *H. decaryi*, *H. obovatum*), and typically five-merous, rarely six- or seven-merous. Calyx tubes are absent, but the calyx lobes are well developed and show great variation in indumentum (Figs 8C, 10B, 11B), length, shape, and size, useful for species recognition. Corollas of most *Hymenodictyon* species are narrowly tubular up to the midpoint and abruptly open out into cups (Figs 6B, C, 8B, C). In *H. tsingy*, the widened parts of the corollas are elliptic (Fig. 10C). Corollas are, however, progressively widened

(infundibuliform) in *H. biafranum* and *H. epiphyticum* (Figs 11B, C, 13B, C) and napiform in *H. pachyantha*. The corolla lobes of *Hymenodictyon* are valvate in bud and typically erect. The corollas are glabrous inside and mostly glabrous outside, but glaucous in *H. flaccidum*, *H. orixense*, and *H. perrieri*, and densely pubescent in *H. pachyantha*. Filaments of *Hymenodictyon* species are mostly sessile and inserted at the base of the widened parts of the corolla tubes (e.g. Fig. 6C). Both *H. biafranum* and *H. epiphyticum*, however, have distinct filaments ranging from 1 to 4 mm in length (Figs 11C, 13C). The anthers are bicupid at the base (e.g. Fig. 17E), basifixed, and introrse, dehiscing along longitudinal slits. Ovaries are bicarpellate, and typically obovoid, but rounded in *H. epiphyticum* (Fig. 13B) and elongate in *H. pachyantha*. They are typically pubescent or puberulous (e.g. Figs 4C, 8C, 13B), but glabrous in *H. glabrum* (Fig. 6B). Placentae are fusiform and bilaterally flattened and are attached to the septa (axile placentation). The ovules are attached imbricately ascendent to the dorsal sides of the placentae (e.g. Fig. 2D). Most *Hymenodictyon* species have two to 14 ovules per locule, but three species, *H. biafranum*, *H. epiphyticum*, and *H. orixense*, have 20–40 ovules per locule. Stigmas are typically globose to clavate and function as pollen presenters. The receptive areas of the stigmas cover the entire surfaces and the styles are terete and exerted beyond the corolla lobes.

The flowers of *Paracorynanthe* share some similarities with those of *Hymenodictyon* (e.g. hermaphroditic, protandrous, valvate corolla aestivation, clavate to globose stigmas, exerted styles). However, the flowers of the former have wine-glass shaped corolla tubes and corolla lobes prolonged by filiform and densely bristled appendages, which in turn are topped by glabrous and globose clubs (Figs 18E, F, 20B). Placentae are oblanceolate, angular, and pendant, and are attached to the apices of the septa. Ovaries are also bicarpellate but contain only two or one ovules per locule, which are attached to the lower extremity of the placentae.

FRUITS

The fruits in *Hymenodictyon* species are broadly (Figs 2C, 6D) to narrowly (Fig. 13D) elliptic, lenticellate, grey-brown-tinged, and typically pedicellate. The pedicels, absent in *H. obovatum*, are woody, typically coarse (Fig. 2C), and lenticellate (e.g. Fig. 6D), but rather slender and nonlenticellate in both *H. biafranum* and *H. epiphyticum* (e.g. Fig. 13D). The lenticels on the fruits can be elongate or spherical and are typically not elevated, except in *H. perrieri*. Both the pedicels and placentae continue to grow during the fructification time. When the fruits reach maturity,

the two locular capsules dehisce loculicidally along the inserting point of the placentae and release the accrescent placentae and seeds at the same time.

The fruits of *Paracorynanthe* are relatively similar to those of *Hymenodictyon*, except they are grey-redtinged and slightly bilaterally flattened, and contain two or one seeds per locule (Figs 18G, 20H). The pedicels are also woody but slender.

SEEDS

The seeds of *Hymenodictyon* are reticulate, bilaterally flattened, mostly broadly winged all around, and deeply bifid at the base (Figs 1A–F, 2E, 6F). In *H. biafranum* and *H. epiphyticum*, they are broadly winged at both ends but narrowly winged along both lateral sides (Fig. 13E). The shape and size of the wings vary among the species and thus can be useful for species recognition. The smallest seeds are found in *H. biafranum* and *H. epiphyticum* (Fig. 13E) and the largest seeds in some of the Malagasy species (e.g. *H. louvahate*, *H. occidentale*).

The seeds of *Paracorynanthe* species are also reticulate, bilaterally flattened but narrowly winged along

the lateral sides and the lower part of the seeds, and broadly winged in the upper part (e.g. Fig. 20K).

CHROMOSOME NUMBER

The basic chromosome number of *Hymenodictyon* is $n = 11$, but the ploidy level varies from diploid to hexaploid (Kiehn, 1986). The chromosome number in *Paracorynanthe* is currently unknown.

ECOLOGY

Sixteen of the 22 *Hymenodictyon* species and the two *Paracorynanthe* species are restricted exclusively to dry, deciduous forests. In contrast, two African species, *H. biafranum* and *H. epiphyticum*, grow in evergreen rainforests, and two Malagasy species, *H. embergeri* and *H. perrieri*, are confined, respectively, to the sub-humid forests of the Andohahela and Sambirano regions, and the Marojejy and Sambirano regions. All collections of *H. horsfieldii* from the Island of Morotai (northern Moluccas), south Sumatra (the Palembang Reserve), the Philippines, and western Java were from evergreen rainforests. Finally, *H. orixense* occurs in

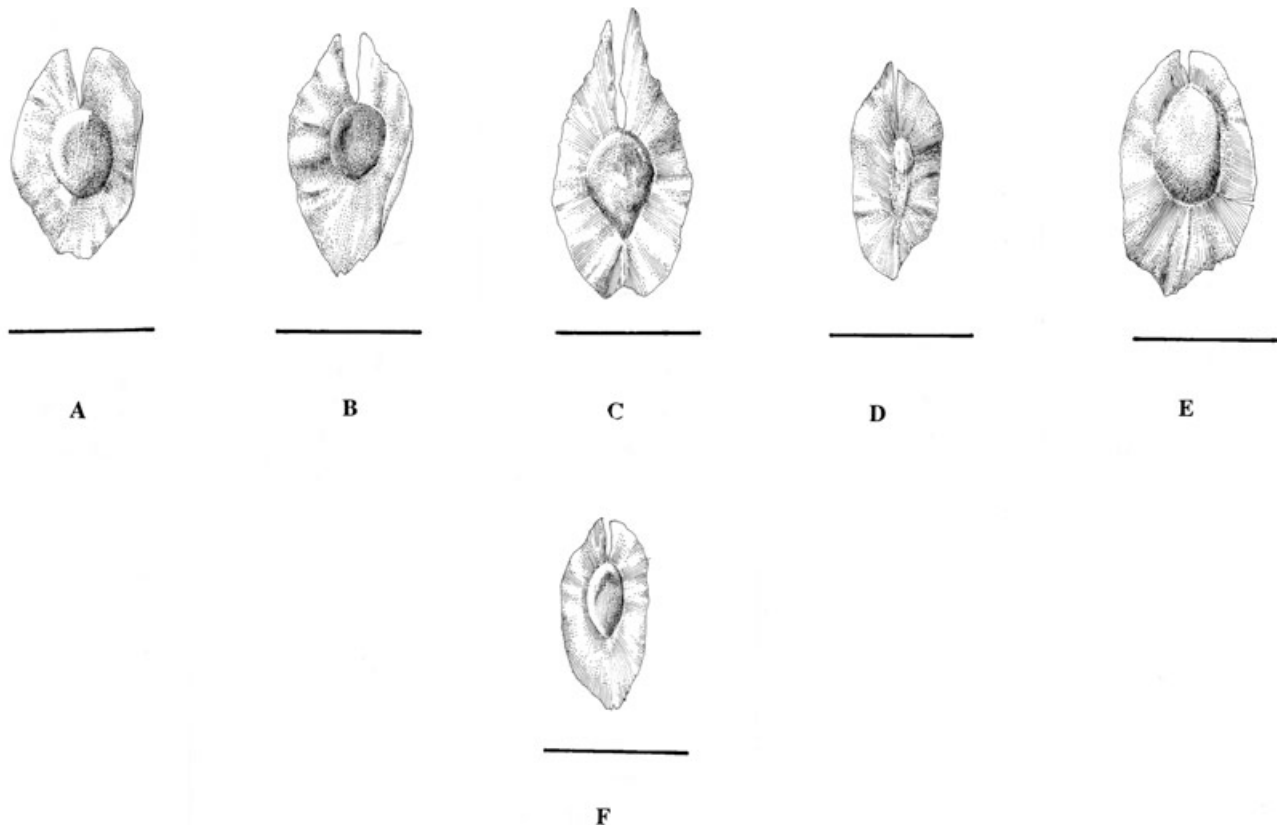


Figure 1. Seeds (dorsal sides) of some *Hymenodictyon* species. A, *H. decaryi* (from 4038-SF, P). B, *H. horsfieldii* (from Schmutz, 1815, L). C, *H. occidentale* (from 11443-SF, P). D, *H. madagascariensis* (from Humbert 18591, P). E, *H. tsingy* (from Kârehed *et al.* 249a, UPS). F, *H. perrieri* (from Perrier de la Bâthie 431, P). Scale bars, 6 mm.

seasonal, subhumid, and evergreen forests with deciduous elements. The above pattern seems to indicate that *Hymenodictyon* prefers seasonal climates (Backer & Bakhuizen van den Brink, 1965). On the other hand, van Steenis (1972) argued that the rarity of *Hymenodictyon* species in wet habitats was probably caused by its reproduction and ecology approaching those of nomad plants, which can only settle temporarily in dense rainforests and need open space for their germination and upgrowth of seedlings and saplings. Based on the ecogeographical data that we gathered, most *Hymenodictyon* species grow on exposed and rocky substrates and open habitats (e.g. grasslands, woodlands, and secondary forests).

ECONOMIC USES

Hymenodictyon species have various local uses. For example, the leaves of *H. obovatum* and *H. orixense* are used for dye, the bark as febrifuge, and the inner bark and roots for treating fever in India. The bark of *H. parvifolium* is used in Kenyan folk medicine as a remedy for skin diseases, venereal diseases, and dysentery (Mathias, 1982). In Tanzania, an infusion from the plant in combination with other plants is commonly used for treatment of insanity when the patient is noisy, abusive, and suicidal (Mathias, 1982). According to Purkayastha (1996: 407–408), both *H. excelsum* (accepted name = *H. orixense*) and *H. obovatum* produce indistinguishable, high-quality woods that are used mainly for making tea chests, various types of brush backs, pencil slats, toys, drums, and matches. Kariba (2002) revealed that the extracts from *H. parvifolium* had antifungal and antibacterial properties. Furthermore, hymexelsin (also called xeroboside), which is a glycoside derivative of scopoletin and β -sitosterol, has been found in both *H. floribundum* (Mitaine-Offer *et al.*, 2003) and *H. orixense* (Rao *et al.*, 1988). In contrast, no local uses of any Malagasy *Hymenodictyon* and *Paracorynanthe* species have been recorded in Madagascar.

TAXONOMIC TREATMENT

HYMENODICTYON WALL., IN ROXB., FL. IND. 2: 148. 1824, NOM. CONS.

TYPE: *Cinchona orixense* Roxb. [accepted name = *Hymenodictyon orixense* (Roxb.) Mabb.].

Benteka Adans. in Rheede Hort. Mal. 4: 63, pl. 30. 1683. TYPE: *Benteka rheedei* Roem. & Schult. [accepted name = *Hymenodictyon orixense* (Roxb.) Mabb.].

Kurria Hochst. & Steud., Flora 25: 234. 1842. TYPE: *Kurria floribunda* Hochst. & Steud. [accepted name = *Hymenodictyon floribundum* (Hochst. & Steud.) B. L. Rob.].

Description: TREES or SHRUBS, rarely woody EPIPHYTES. BARK grey, smooth, thick, nonplated. STIPULES interpetiolar, typically deciduous, rarely persistent or semipersistent, typically bearing large colleters on the margins, rarely without colleters. LEAVES simple, opposite, decussate, petiolate, typically deciduous, rarely persistent; petioles adaxially canaliculate, puberulous to pubescent, rarely glabrous; margins glabrous, sometimes ciliate; secondary veins conspicuous or inconspicuous, puberulous to pubescent, sometimes glabrous; mostly without domatia, sometimes tuft-type domatia present in the axils of secondary veins. INFLORESCENCES typically terminal, rarely terminal and axillary from uppermost leaf pair, simple (unbranched) spicate to racemose or thyrsoid to compound (branched) spicate, racemose or thyrsoid, mostly erect, sometimes deflexed or pendulous, pedunculate; main peduncles elongate, terete, pubescent to puberulous, often bearing a pair of long-petiolate, leafy bracts at the base and/or at the apex or at the midpoint. Each inflorescence unit composed of an elongate, terete peduncle, an elongate, terete, lenticellate, pubescent to puberulous rhachis, numerous two- to 18-flowered cymules and/or numerous solitary flowers borne in the axils of minute to medium-sized, sessile, deciduous bracts, minute, sessile, deciduous bracteoles borne at midpoint of pedicels of individual flowers, unsubtended or subtended by single or pairs of long-petiolate, leafy bracts at the base and/or at the apex and/or between both ends of the peduncles of the primary inflorescence units; lateral inflorescence units unsubtended or subtended by single or pairs of petiolate bracts at the apex of the peduncles; petiolate bracts elliptic to ovate, scarious, glabrous to puberulous, persistent. FLOWERS hermaphroditic, typically five-merous, rarely six- or seven-merous, mostly pedicellate, sometimes sessile or subsessile; calyx tubes absent, calyx lobes typically five, rarely six, linear to subulate, deciduous, typically pubescent to puberulous, rarely glabrous; corollas typically narrowly tubular up to midpoint and abruptly opening out into cups, sometimes infundibuliform, rarely napiform, mostly glabrous, sometimes glaucous or pubescent outside, lobes valvate in bud, five or six, short, erect; stamens typically five, rarely four, inserted at the base of the broadened part of the tubes, anthers basifixed, two-locous, filaments flattened; disc roll-shaped, epigynous; ovaries bicarpellate, placentation axile, typically obovoid, rarely rounded or elongate, pubescent to puberulous; styles terete, glabrous, exerted; stigmas clavate to globose, rarely capitate, all pollen presenters; ovules two to 40 per locule, ascendingly imbricate, apically attached to elongate, fusiform, bilaterally flattened placentae. FRUITS capsular, broadly to narrowly elliptic, typically ornated by elongate to spherical, typically with nonelevated lenticels, rarely with elevated

lenticels, dehiscing loculicidally into valves, glossy inside, brown- to grey-tinged outside, typically pedicellate, rarely sessile; pedicels woody, typically coarse, rarely slender; seeds two to 40 per locule, broadly to narrowly winged, deeply bifid at the base, reticulate, bilaterally flattened, containing abundant endosperm, with margins shallowly to entirely fringed.

We find it more practical to have separate keys for the Malagasy, African, and Asian species, rather than a single key for all 22 species, because Madagascar, mainland Africa, and tropical Asia do not share any *Hymenodictyon* species.

1. *HYMENODICTYON ANTAKARANENSIS* RAZAFIM. & B. BREMER SP. NOV. (FIG. 2A–E)

Type: MADAGASCAR. [Antsiranana Province], Ankarana, 20.ii.1953 (fr.), 6693-SF (HOLOTYPE: TEF!; ISOTYPES: BR!, P!).

Diagnosis: Haec species ab omnibus congeneris foliorum laminis orbicularibus-obovatis, bracteis

longepetiolatis ad inflorescentiae primarum monadium basim atque seminibus cordiformibus distinguitur.

Description: Medium-sized to large TREES, 7–20 m tall. BARK grey. STIPULES not seen. LEAVES deciduous; petioles 2–4 (6–9) mm long, red-tinged, glabrous to puberulous; blades orbicular to obovate, 7.5–8.5 × 5.7–6 cm, drying black-red-tinged above, light brown beneath, glabrous, coriaceous, apex apiculate, base attenuate; margins glabrous; midribs yellow-tinged, puberulous; secondary veins five or six pairs per side, prominulous above, conspicuous beneath; domatia tuft-type in the axils of the secondary veins. INFLORESCENCES not seen. FLOWERS not seen. Infructescences terminal, erect, trichotomous, bilaterally branched at the base and apex of the peduncles of the primary infructescence units; primary infructescence units unsubtended by long-petiolate bracts; each lateral inflorescence unit subtended by a single long-petiolate bract at the apex of the peduncle; petiolate bracts obovate, glabrous. FRUITS 11–12 mm long, grey, ornated

KEY TO THE MALAGASY *HYMENODICTYON* SPECIES

- | | |
|--|------------------------------|
| 1a. Inflorescences unbranched..... | 2 |
| 2a. Leaf blades puberulous above and puberulous to pubescent or tomentose beneath; inflorescences 15–40 cm long and mostly unsubtended, rarely subtended by pairs of long-petiolate bracts; fruits ornated by elevated lenticels | 10. <i>H. perrieri</i> |
| 2b. Leaf blades glabrous on both surfaces; inflorescences 16–18 cm long and subtended by a pair of long-petiolate bracts; fruits not ornated by elevated lenticels | 8. <i>H. madagascaricum</i> |
| 1b. Inflorescences branched | 3 |
| 3a. Stipules persistent; calyx lobes 3–4 mm long; corollas infundibuliform, corolla lobes recurved | 6. <i>H. leandrii</i> |
| 3b. Stipules deciduous; calyx lobes 0.5–2 mm long, corollas narrowly tubular up to the midpoint and abruptly widened above, corolla lobes erect | 4 |
| 4a. Peduncles of primary inflorescence units bearing only one pair of lateral inflorescence units | 5 |
| 5a. Inflorescence units unsubtended by long-petiolate bracts | 6 |
| 6a. Leaf blades narrowly lanceolate, not wavy, glabrous; stipules without colleters on the margins | 3. <i>H. decaryi</i> |
| 6b. Leaf blades broadly lanceolate to ovate, sparsely puberulous above and densely pubescent above; stipules with colleters on the margins | 11. <i>H. septentrionale</i> |
| 5b. Inflorescence units unsubtended or rarely subtended by a pair of or single long-petiolate bracts | 7 |
| 7a. Leaves clustered at the apex, wavy; inflorescence units rarely subtended by long-petiolate bracts | 13. <i>H. tsingyi</i> |
| 7b. Leaves not clustered at the apex, not wavy; inflorescence units subtended by a pair of or single long-petiolate bracts..... | 8 |
| 8a. Only lateral inflorescence units subtended by single long-petiolate bracts | 1. <i>H. antakaranensis</i> |
| 8b. Each inflorescence unit subtended by a pair of or single long-petiolate bracts | 9 |
| 9a. Leaf blades puberulous to pubescent on both surfaces; inflorescences units subtended by single long-petiolate bracts..... | 2. <i>H. berivotrense</i> |
| 9b. Leaf blades glabrous on both surfaces; inflorescences units subtended by pairs of long-petiolate bracts..... | 10 |
| 10a. Inflorescences lax; ovaries glabrous | 5. <i>H. glabrum</i> |
| 10b. Inflorescences compact; ovaries puberulous or pubescent | 12. <i>H. seyrigii</i> |
| 4b. Peduncles of the primary inflorescence units bearing two to five pairs of lateral inflorescence units | 11 |
| 11a. Peduncles of the primary inflorescence units coarse; lateral inflorescence units branched..... | 9. <i>H. occidentale</i> |
| 11b. Peduncles of the primary inflorescence units slender; lateral inflorescence units unbranched | 12 |
| 12a. Inflorescences 7.5–8 cm long, inflorescence units spicate | 7. <i>H. louhavate</i> |
| 12b. Inflorescences 10–12 cm long, inflorescence units racemose..... | 4. <i>H. embergeri</i> |

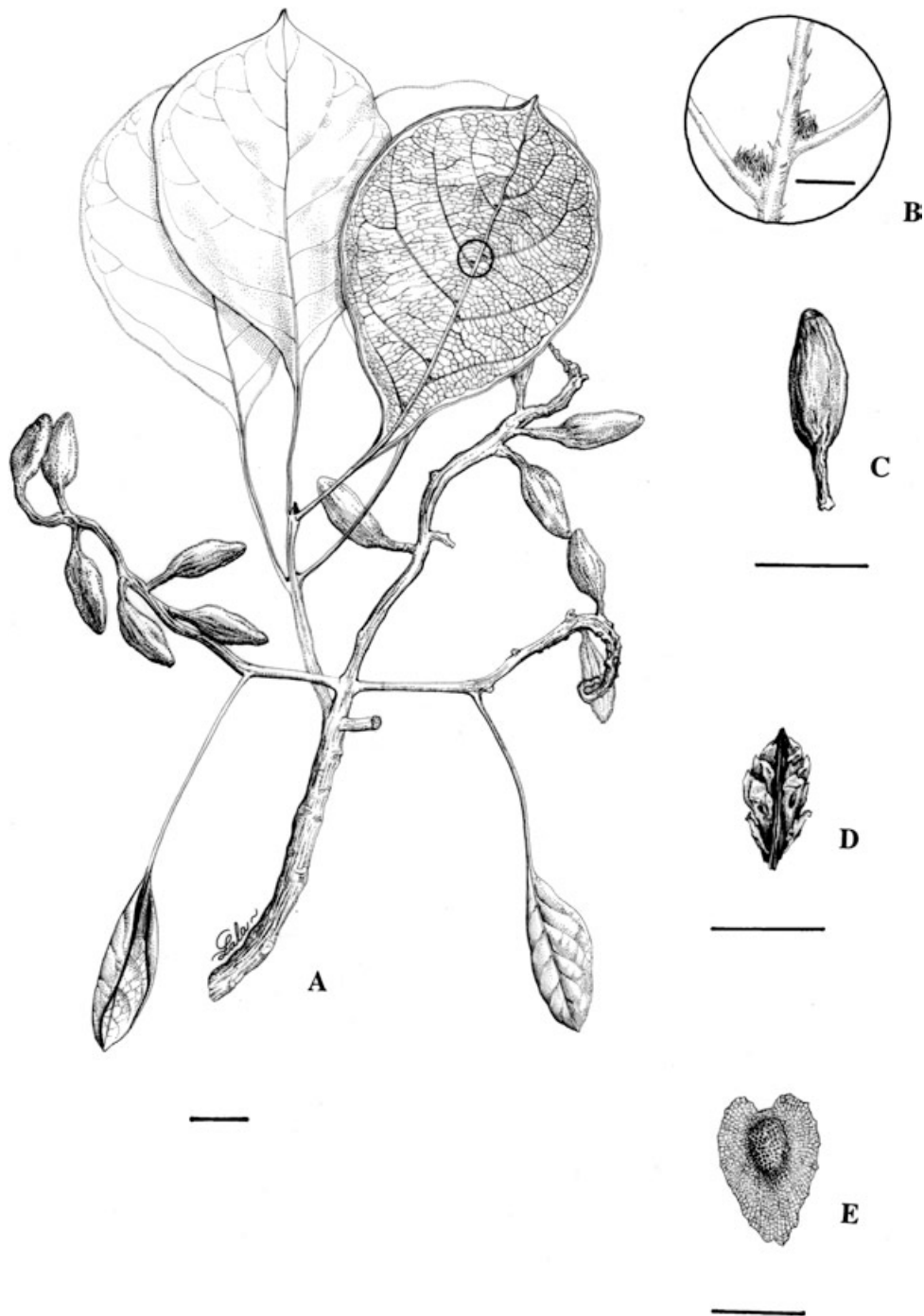


Figure 2. *Hymenodictyon antakaranensis* Razafim. & B. Bremer. A, fertile branch with immature infructescences. B, tuft-type domatia. C, immature fruit. D, winged seeds attached imbricately ascendant on the dorsal sides of the accrescent placenta. E, mature seed. A–E, from 18458-SF, P, TEF. Scale bars: A, C, D, 1 cm; B, 1 mm; E, 4 mm.

by inconspicuous spherical, nonelevated lenticels; pedicels 6–9 mm long, lenticellate; seeds six or seven per locule, heart-shaped, 10–11 × c. 5 mm (wings included), broadly winged, shallowly fringed.

Phenology: Flowering time unknown; fruiting November to April.

Common names. Unknown.

Habitat: Dry, deciduous forests; 82–200 m.

Distribution: Only known from the Ankarana Special Reserve, Ambilobe District, Antsiranana Province (Fig. 3).

Discussion: *H. antakaranensis* can be distinguished easily from the other *Hymenodictyon* species by its orbicular to obovate leaves, the presence of a single long-petiolate bract only at the base of each lateral inflorescence unit, and its heart-shaped seeds. This species is restricted to the Ankarana Special Reserve and appears to be rare there. The epithet '*antakaranensis*' refers to the native tribe Antakarana that occupies most of the Ankarana regions.

Additional specimens examined: MADAGASCAR: Antsiranana Province: Distr. Ambilobe, Ankara, 27.xi.1952 (fr.), 6166-SF (P, TEF). Distr. Antsiranana II, Canton Anivorano Nord, Village de Marovato-Anketraka, Forêt de Misoromahalana, sur les calcaires de l'Ankarana, 200 m, 25.i.1960 (young fr.), Cours 5468 (P); 30–350 m, 24.i–29.ii.1960 (fr.), *Humbert* 32569 (P); 23.iv.1953 (fr.), 7283-SF (BR, P, TEF); W of Ambondromifehy, 5.iii.1951 (fr.), 3032-SF (P, TEF). Forêt de Marovato, sur roche basaltique, 30.i.1960 (young fr.), *Humbert* 32406 (P).

2. *HYMENODICTYON BERIVOTRENSE* CAVACO, SOC.
BOT. FRANCE 111: 179. 1964a

TYPE: [MADAGASCAR]. [Mahajanga Province], [Mahajanga II Distr.], restes de forêts dans les vallons du Plateau de Berivotra, au SE de Majunga, c. 150 m, 23.xi.1957 (fl.), 18458-SF (HOLOTYPE: P!; ISOTYPE: TEF!).

Hymenodictyon louhavate Homolle var. *longicalyx* Cavaco, Soc. Bot. France 111: 178. 1964a. Synon. nov. TYPE: MADAGASCAR. [Mahajanga Province], Mahavavy (Ambongo), affluent à gauche du Betsiboka, xi.1914 (fl.), *Perrier de la Bâthie* 1765 (HOLOTYPE: P!).

Hymenodictyon maevatananense Cavaco, Soc. Bot. France 111: 276. 1964b. Synon. nov. TYPE: [MADAGASCAR]. [Mahajanga Province], Kandrehô Distr., Forêt de Katsijy, 13.xi.1953 (fr.), 8077-SF (HOLOTYPE: P!; ISOTYPES: BR!, TEF!).

Description: Medium-sized TREES, 8–10 m tall. BARK dark grey. STIPULES deltoid, 4–7 mm long, apex rounded to acute, glabrous, deciduous. LEAVES deciduous; petioles 1–1.5 mm long, puberulous; blades narrowly obovate, 5–7.5 × 3–4.2 cm, pale green above, light green beneath, puberulous to pubescent, membranaceous, apex acuminate, base attenuate; margins glabrous to ciliolate; midribs drying yellow-tinged, puberulous; secondary veins five or six pairs per side,

inconspicuous; domatia tuft-type. INFLORESCENCES axillary and terminal from uppermost leaf pair, 7.3–8.5 cm long, erect, trichotomous, bilaterally branched at the base of the peduncles of the primary inflorescence units. Each inflorescence unit spicate, compact, composed of a pubescent peduncle, a densely pubescent rhachis, numerous two- to five-flowered cymules, subtended by a single long-petiolate bract at the apex of the peduncle; petiolate bracts ovate to broadly lanceolate, colour unknown, pubescent. FLOWERS five-merous; sessile; calyx lobes narrowly oblong to linear, c. 0.8 mm long, green, pubescent; corolla tubes narrowly tubular up to the midpoint and abruptly opening out into cups, 2.5–3 mm long, light green, glabrous outside, corolla lobes triangular, 1–1.5 mm long, ciliate; anthers 1.25–1.5 mm long, filaments 0.3–0.5 mm long; ovaries obovoid, c. 1 mm long, puberulous; styles 7–8 mm long; stigmas clavate to capitate; ovules two or three per locule. FRUITS 17–20 mm long, grey-brown-tinged, ornated by spherical, nonelevated lentils; pedicels 10–12 mm long, lenticellate; seeds two or three per locule, broadly elliptic, 10–12 × 4–5 mm (wings included), winged, margins entire.

Phenology: Flowering in November; fruiting January to March.

Common names: Beholitse, Kalavelo, Kitata, Revojaky.

Habitat: Dry, deciduous forests; 0–700 m.

Distribution: Antsalova, Maevatanana, Mahajanga II (Berivotra Plateau) Districts (Mahajanga Province), Ranohira (Fianarantsoa Province), Sakaraha, and Toliara II District (Toliara Province) (Fig. 3).

Discussion: *H. berivotrense* can be distinguished from the other Malagasy species with inflorescences subtended by a pair of long-petiolate bracts by its pubescent leaves with ciliolate margins. Both *H. louhavate* var. *longicalyx* (Cavaco, 1964a) and *H. maevatananense* Cavaco (Cavaco, 1964b) are here merged in *H. berivotrense* based on these diagnostic features.

Additional specimens examined: MADAGASCAR: Antsiranana Province: Distr. Antsiranana II, near Vovo Village, 12 19°05'S 49 23°07'E, *Harder et al.* 1691 (MO, P, TAN, WAG); Road Diego-Suarez to Ramena, rocky hills overlooking sea, c. 0 m, *Gentry* 11936 (MO, TAN). Fianarantsoa Province: Distr. Ihosy, Zazafotsy, pk. 573, route du Sud, *Bosser* 15789 (P). Distr. Ivohibe, Canton Antombohobe, Ravaro, 8.xii.1957 (young fr.), 9566-RN (P, TEF). Mahajanga Province: Distr. Antsalova, Antsingy, 27.x.1954 (young fl.), 12013-SF (P, TEF). Distr. Maevatanana, *Perrier de la Bâthie* 14661 (P). Distr. Marovoay, Canton Ampi-

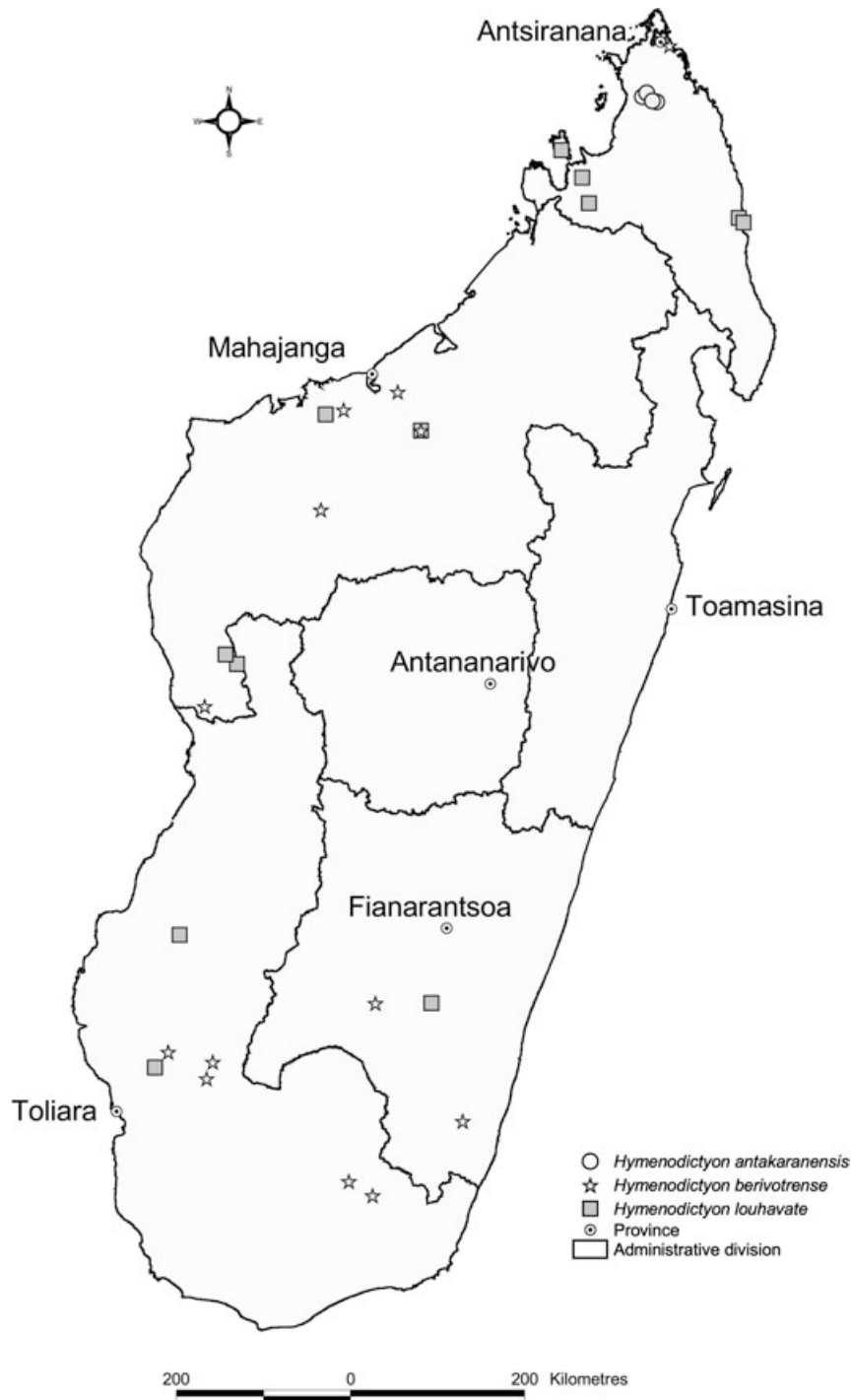


Figure 3. Distribution of *Hymenodictyon antakaranensis*, *H. berivotrense* and *H. louhavate*.

joroa, 25.v.1955 (fr.), 16841-SF (P, TEF). Toliara Province: Distr. Amboasary-Sud, piste Amboasary à Tsvivory, près du radier de Mahaly (Mandrare), *Keraudren* 1092 (P); Vallée moyenne du Mandrare, près d'Anababolava, 200–250 m, *Humbert* 12449 (P). Distr. Bekily, Andamilamy, 20.iii.1955 (fr.), 14376-SF (P,

TEF). Distr. Betroka, Canton Ranohira, Isalo, Sahanafo, Bevato, 700 m, 31.i.1955 (young fr.), *Cours* 5087 (P). Distr. Sakaraha, Vallée de l'Hazoroa (Bassin de l'Onilahy), au S de Sakaraha, 500–600 m, 30.iii.1955 (fr.), *Humbert* 29694 (BR, P); Hazoroa, 20.ii.1952 (fr.), 4985-SF (P, TEF); Zombitse National Park, à l'E de

Sakaraha, iii.1955 (fr.), 11937-*SF* (BR, P, TEF); 4.xii.2003 (fl.), *Razafimandimbison & Bremer* 502 (MO, TAN, UPS); Canton Lambonakondro, sur sables, 3.iii.1943 (fr.), *Decary* 18911 (P). Distr. Toliara II, Canton Andranovory, 21.iii.1951 (fr.), 3407-*SF* (P, TEF); Canton Analavelona, 15572-*SF* (P, TEF). Unknown localities, *Cours* 1971 (P), *unknown collector* 62 (P).

3. *HYMENODICTYON DECARYI* HOMOLLE, NOT. SYST. 8: 27. 1939 (FIGS 1A, 4A–C)

TYPE: MADAGASCAR. [Toliara Province], Bassin du Mandrare, Vallée de la Manambolo, aux environs d'Isomony, 400–900 m, xii.1933 (fl.), *Humbert* 12958 (LECTOTYPE here designated: P!; ISOLECTOTYPE: BR!). Chosen from syntypes: *Decary* 3138 (P!), *Decary* 3771 (P!), *Decary* 9001 (P!), *Humbert* 12958 (P!).

Description: Medium-sized TREES, 6–10 m tall. BARK grey. STIPULES oblong, c. 2 mm long, apex acuminate, glabrous, deciduous, without colleters on the margins. LEAVES deciduous; petioles 1–3 cm long, green-tinged, glabrous to puberulous; blades narrowly lanceolate, 5–10 × 1–3.5 cm, colour unknown, glabrous, membranaceous, apex acuminate, base attenuate; margins glabrous; midribs drying yellow-tinged, glabrous; secondary veins four to eight pairs per side, yellow-tinged, inconspicuous; without domatia. INFLORESCENCES terminal, sometimes terminal and axillary, 3–4 cm long, erect, trichotomous, bilaterally branched at the base of the peduncles of the primary inflorescence units. Each inflorescence unit spicate, compact, composed of a pubescent peduncle, a densely pubescent rhachis, numerous solitary flowers, unsubtended by long-petiolate bracts. FLOWERS five-merous; sessile;

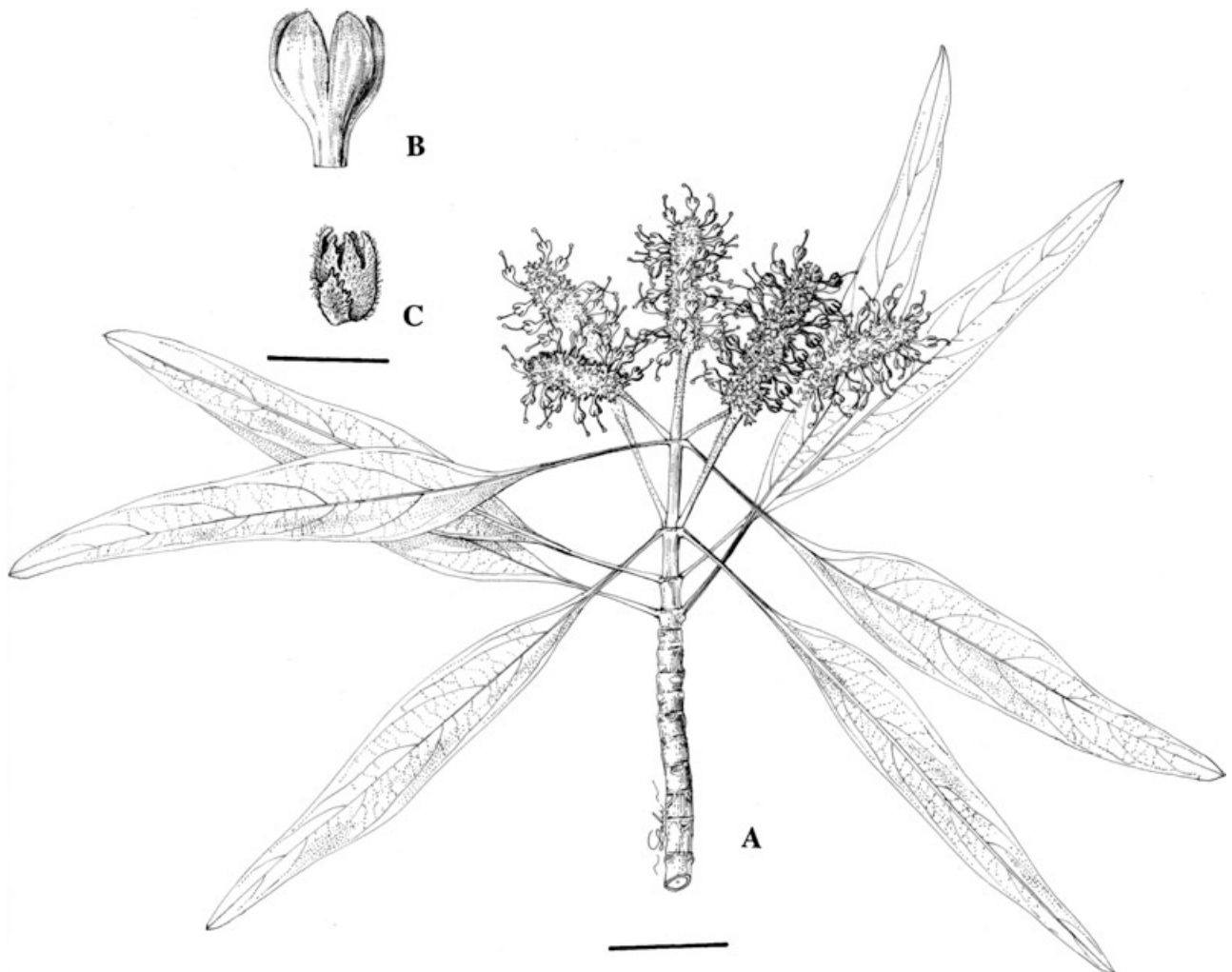


Figure 4. *Hymenodictyon decaryi* Homolle. A, fertile branch. B, mature corolla. C, calyx and ovary with one nonpetiolate bracteole. A–C, from *Razafimandimbison* 285b, UPS. Scale bars: A, 1 cm; B, C, 2 mm.

calyx lobes narrowly triangular, *c.* 0.8 mm long, densely pubescent; corolla tubes narrowly tubular up to the midpoint and abruptly opening out into cups, 2.5–3 mm long, pink-green-tinged, puberulous outside, corolla lobes ovate, 1–1.5 mm long, puberulous, ciliate; anthers 1–1.5 mm long, filaments *c.* 0.5 mm long; ovaries obovoid, *c.* 1 mm long, densely pubescent; styles pale yellow-green-tinged; stigmas clavate to globose; ovules two or three per locule. FRUITS 15–20 mm long, brown-tinged, ornated by elongate, nonelevated lenticels; pedicels *c.* 6 mm long, lenticellate; seeds two or three per locule, broadly elliptic, 9–10 × *c.* 5 mm, winged all around, margins entire.

Phenology: Flowering November to February; fruiting December to March.

Common names: Beholitse, Beholitra, Fatora, Kapaioty, Mafay.

Habitat: Xerophyllous thicket and grassland; 100–300 m.

Distribution: Amboasary-Sud, Ambovombe, Ampanihy, Beloha, Betioky, and Toliara I Districts (Toliara Province) (Fig. 5).

Discussion: *H. decaryi* is distinct from the other *Hymenodictyon* species by its narrowly lanceolate leaves and stipules without colleters on the margins.

Additional specimens examined: MADAGASCAR: Toliara Province: Distr. Amboasary-Sud, Réserve Naturelle # 11, Andohahela, Parcelle # 2, NE d'Amboasary, near Hazofotsy, 24 50'S 46 32'E, 100 m, 1991 (young fl.), *Malcomber* 1112 (G, K, MO, P, TAN); 23.i.1971 (sterile), *Richard* 075 (K); 26.i.1971 (sterile), *Richard* 093 (K); bush à l'E d'Amboasary (rive gauche du bas Mandrare), ii.1955 (fr.), 11751-SF. Vallée de Mandrare, ix.1905 (fl.), *Alleizette* 3020 (L). Distr. Ambovombe, Canton Behara, *Decary* 3138 (P); Canton Antanimora, 22.viii.1951 (fr.), 4038-SF (P); 13.v.1925 (fr.), *Decary* 3771 (P); *c.* 54 km NW d'Ambovombe, 15.iii.1985 (fr.), *Dorr et al.* 3965 (K, MO, P, TAN). Distr. Beloha, forêt entre Tsimilofo et Beloha, Androy, 10.xii.1953 (young fl.), 8029-SF (P, TAN); au NE d'Ambovombe, vi.1931 (fr.), *Decary* 9001 (G, P). Distr. Ampanihy, Belitsaka, 22.xi.1954 (fr.), 12841-SF (P, TAN). Distr. Betioky, 7 km E of Betioky, near Besely, 23 42'S 44 27'E, 300 m, 4.i.1988 (fl.), *Phillipson* 2778 (K, MO, P, S, TAN, WAG); 40 km NE of Betioky, near Analafaly, 23 39'S 44 38'E, 1.vi.1987 (fr.), *Sussman* 155 (MO, TAN, WAG). Distr. Toliara I, Arboretum d'Antsokay, 12 km from Toliara town, 20.i.1998 (fl.), *Razafimandimbison* 285b (UPS). Anadabolava, Moyen Mandrare, ii.1962 (fr.), *Bosser* 15746 (P); de

Tsivory à Anadabolava, 300–400 m, xii.1933 (young fl.), *Humbert* 12328 (P); bush entre Imonty et Ankaba (Bassin de la Mananara, affluent du Mandrare), 20.i.1963 (fl.), 22423-SF (P, TAN); Massif du Bezavona (entre Fanambana et Manambery), 20.iii.1967 (fr.), 27543-SF (BR, P, TAN). Unknown locality, *Homolle* 1700 (P).

4. *HYMENODICTYON EMBERGERI* CAVACO, BULL. MUS. NATL. HIST. NAT. II, 36: 699. 1964C; PUBL. 1965

TYPE: MADAGASCAR. [Antsiranana Province], Ambanja Distr., fond de vallée entaillant le Flanc Nord du Mt Ambatomenavavy, lieu dit Andolomihamy, ancienne route Ambanja-Benavony, 30 m, 10.i.1948 (fl.), 17.v.1948 (fr.), *Saboureau* 1292 (HOLOTYPE: P!; ISOTYPE: BR!).

Description: TREES, 10–18 m tall. BARK grey. STIPULES not seen. LEAVES deciduous; petioles (20–)40–90 mm long, red-tinged, glabrous; blades broadly elliptic to obovate, 9–15 × 5–7.2 cm, colour unknown, glabrous, subcoriaceous, apex acuminate, base attenuate; margins glabrous; midribs yellow-tinged, glabrous; secondary veins five to nine pairs per side, drying yellow-tinged, conspicuous, glabrous; without domatia. INFLORESCENCES terminal, 10–12 cm long, erect, bearing three to five pairs of lateral inflorescence units at the base and apex and between both ends of the peduncles of the primary inflorescence units. Each inflorescence unit racemose, lax, composed of a pubescent to puberulous rhachis, numerous two- to five-flowered cymules, unsubtended by long-petiolate bracts, rarely subtended by a pair of long-petiolate bracts. FLOWERS five-merous; pedicels 0.5–1 mm long, puberulous; calyx lobes linear, *c.* 1.5 mm long, pubescent to puberulous, ciliate; corolla tubes narrowly tubular up to the midpoint and abruptly opening out into cups, *c.* 5 mm long, colour unknown, glabrous outside, corolla lobes obtuse, *c.* 0.5 mm long, ciliate; anthers *c.* 2 mm long, filaments *c.* 1 mm; ovaries obovoid, *c.* 1.5 mm long, puberulous; styles 10–10.5 mm long; stigmas capitate to clavate, green; ovules four to six per locule. FRUITS 18–20 mm long, grey-tinged, ornated by elongate, nonelevated lenticels; pedicels 1–2 mm long, lenticellate; seeds four or five per locule, broadly elliptic, 7–9 × 1–1.5 mm (wings included), broadly winged all around, margins entire.

Phenology: Flowering February to March; fruiting March to May.

Common names: Lohavato lahy (Ambanja District, Antsiranana Province).

Habitat: Subhumid and humid forests; 200–700 m.



Figure 5. Distribution of *Hymenodictyon decaryi*, *H. embergeri*, *H. leandrii* and *H. tsingy*.

Distribution: Sambirano Domain, Ambanja District, the Parcelle # 1 of Andohahela Natural Reserve, Fort-Dauphin Distr., Toliara Province (Fig. 5).

Discussion: This species has a disjunct distribution (Fig. 5) but is only known from five specimens. *H. embergeri* and *H. occidentale* can be difficult to separate when in fruit because they both have leaves with

Table 2. Morphologically distinctive characters distinguishing *Hymenodictyon embergeri* and *H. occidentale*

Character	<i>H. embergeri</i>	<i>H. occidentale</i>
Inflorescence type	Compound racemose with three to five lateral branches	Compound thyrsoid with up to three lateral branches
Inflorescence unit type	Racemose, lax	Thyrsoid, compact
Inflorescence peduncles	Slender	Coarse
Long-petiolate bracts	Absent, rarely present	Present
Length of style (mm)	10–10.5	c. 6

very long petioles. However, they are distinct in many aspects (Table 2).

Additional specimens examined: MADAGASCAR: Antsiranana Province: Distr. Ambanja, Canton Ankaramibe, Réserve Spéciale de Manongarivo, crête entre les deux bras de l'Ambahatra, 13 59'S 48 26'E, 780 m, 6.iii.1999 (fl.), *Gautier et al.* 3493 (G, TAN); Canton Benavony, 22.iii.1954 (fr.), 9285-SF (P, TEF). Distr. Antalaha, Table basaltique d'Ambanitzana, 11.iv.1967 (sterile), 27738-SF (BR, P, TEF). Toliara Province: Distr. Fort-Dauphin, Réserve Naturelle Intégrale d'Andohahela (# 11), Parcelle # 1, vicinity of Eminiminy, 24 40'S 46 48'E, 200–700 m, 4–24.v.1993 (fr.), *Randriamampionona* 308 (BR, K, MO, P, PRE, TAN, WAG).

5. HYMENODICTYON GLABRUM (CAVACO) RAZAFIM. & B. BREMER, STAT. NOV. (FIG. 6A–F)

Hymenodictyon occidentale Homolle var. *glabrum* Cavaco, Bull. Soc. Bot. France 111: 277. 1964b. TYPE: MADAGASCAR. [Mahajanga Province], Antsalova Distr., Forêt subcotière à l'Ouest de Besara, 25.xii.1952 (young fl.), 6870-SF (HOLOTYPE: TEF!; ISOTYPE: P!).

Description: Medium-sized to large TREES, 8–20 m tall. BARK grey. STIPULES broadly elliptic, c. 2 mm long, apex rounded, ciliate, deciduous. LEAVES clustered at the apices, deciduous; petioles 30–55 mm long, red-tinged, glabrous; blades orbicular, 9–15 × 5–7.2 cm, pale green above, light green beneath, glabrous, membranaceous, thin, reticulate, apex acuminate, base attenuate; margins glabrous; midribs light green, drying red-tinged, glabrous; secondary veins three to five pairs per side, conspicuous, glabrous; without domatia. INFLORESCENCES terminal, 6–8 cm long, erect, trichotomous, bilaterally branched at the base of the peduncles of the primary inflorescence units. Each inflorescence unit racemose, lax, composed of a puberulous peduncle, a puberulous rhachis, numerous solitary flowers and two- to five-flowered cymes, subtended by a single long-petiolate bract at

the apex of the peduncle; petiolate bracts ovate, green-tinged, glabrous. FLOWERS five-merous; pedicels c. 1 mm long, glabrous; calyx lobes linear, c. 1 mm long, glabrous, ciliate; corolla tubes narrowly tubular, c. 4 mm long, light green up to midpoint and abruptly opening out into cups, red above, glabrous outside, sometimes with sparse long hairs, corolla lobes triangular, c. 0.5 mm long, dark red, glabrous; anthers c. 2 mm long, filaments 0.25–0.5 mm long; ovaries obovoid, c. 1.5 mm long, glabrous, styles c. 7 mm long; stigmas clavate to globose, green; ovules four to seven per locule. FRUITS 17–20 mm long, black-grey-tinged, ornated by elongate, nonelevated lenticels; pedicels 6–7 mm long, lenticellate; seeds six or seven per locule, ovoid, c. 10 × 4–5 mm, broadly winged all around, margins shallowly fringed.

Phenology: Flowering in December; fruiting March to April.

Common names: Lohavato, Kapaipoty, and Mafay.

Habitat: Dry, deciduous forests; 5–50 m.

Distribution: Ambato-Boeni and Marovoay Districts, both Mahajanga Province; Morombe, Sakaraha, Toliara II Districts, all Toliara Province (Fig. 7).

Discussion: *H. glabrum* was originally described as *H. occidentale* var. *glabrum* by Cavaco (1964b). Our study showed that this taxon is very distinct from *H. occidentale* and the other Malagasy *Hymenodictyon* species in its leaves with reticulate venation, and very lax inflorescences.

Additional specimens examined: MADAGASCAR: Mahajanga Province: Distr. Ambato Boeni, Canton Tsaramandroso, Ankarafantsika, Bevazaha, 150–200 m, iii.1933 (fr.), *unknown collector* 143 (P, TEF). Distr. Marovoay, Canton Ampijoroa, 17.xii.1953 (young fl.), 8107-SF (BR, P, TEF); 14.iii.1954 (fr.), 9613-SF (P, TEF). Forêt cotières près de Besaraha, 5–20 m, 25.xii.1952 (fl.), 2246-SF (BR, P, TEF). Toliara

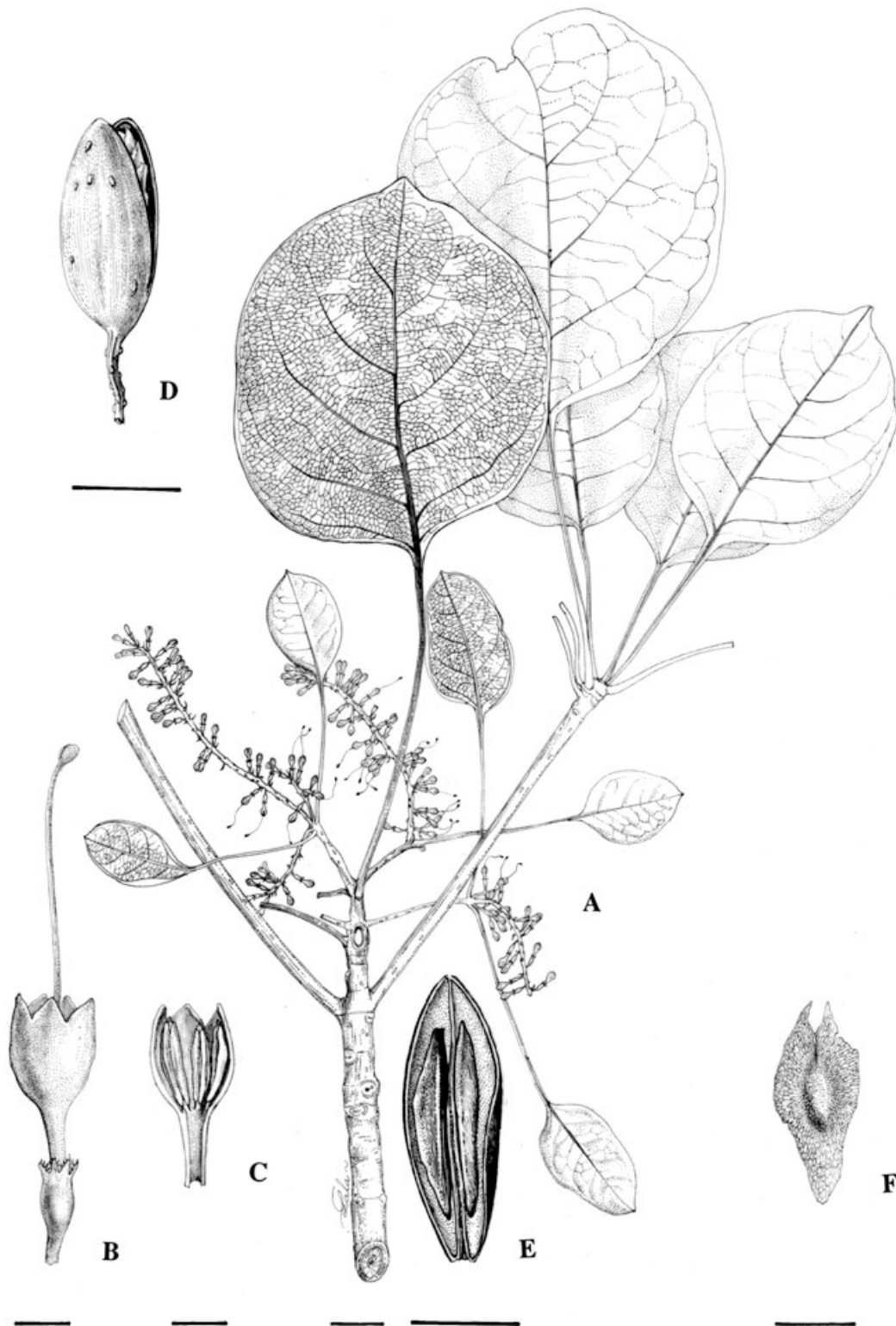


Figure 6. *Hymenodictyon glabrum* (Cavaco) Razafim. & B. Bremer. A, fertile branch with partly mature inflorescences subtended by a pair of or a single long-petiolate, leafy bracts. B, mature flower. C, dissected corolla showing the insertion of the filaments at the base of the widened part of the corolla tube. D, mature fruit ornated by few elongate lenticels. E, two accrescent placentae attached along the septa. F, mature seed. A–F, from 9613-SF, P, TEF. Scale bars: A, D, E, 1 cm; B, C, 1 mm; F, 5 mm.



Figure 7. Distribution of *Hymenodictyon glabrum*, *H. madagascarium*, *H. septentrionale* and *H. seyrigii*.

Province: Distr. Morombe, Analatelo, 8.iv.1953 (fr.), 7219-SF (BR, P, TEF). Distr. Sakaraha, Forêt de Zombitsy, E de Sakaraha, 27–28.xii.1961 (young fl.), 20582-SF (BR, P, TEF); 50 m, 3.xii.2003 (fl.), *Razafi-*

mandimbison & Bremer 490 (UPS), *Razafimandimbison & Bremer* 500 (MO, TAN, UPS). Distr. Toliara II, Antseva, Forêt d’Ambainjafy, 24.xii.1956 (young fl.), 12379-SF (BR, P, TEF).

6. *HYMENODICTYON LEANDRII* CAVACO, ADANSONIA 8: 69. 1968 ('PLANCHE 1' MADE FROM HOLOTYPE)

TYPE: MADAGASCAR. [Mahajanga Province], Antsalova Distr., Réserve Naturelle Intergrale de Bemaraha, 1932–33 (young fr.), *Leandri* 1003 (HOLOTYPE: P!).

Hymenodictyon homolleae Capuron in sched. (P!), nom. nud.; Bull. Mus. Natl. Hist. Nat. II, 36: 701. 1964c; publ. 1965, nom. nud.

Description: SHRUBS, 2–6 m tall. BARK grey. STIPULES broadly elliptic, c. 20 mm, apex rounded, glabrous, persistent, ciliolate. LEAVES clustered at the apex, deciduous; petioles 20–70 mm long, colour unknown, pubescent to glabrous; blades broadly oval to orbicular, 9–16.5 × 7–12 cm, colour unknown, pubescent, membranaceous, apex acuminate, base attenuate; margins glabrous; midribs drying green-yellow-tinged, glabrous; secondary veins eight to ten pairs per side, yellow-tinged, less conspicuous above, conspicuous beneath, pubescent; tertiary veins inconspicuous above, conspicuous beneath, pubescent; without domatia. INFLORESCENCES terminal, erect, trichotomous, bilaterally branched at the base of the peduncles of the primary inflorescence units. Each inflorescence unit spicate, compact, composed of a pubescent peduncle, a densely pubescent rhachis, numerous two- to three-flowered cymules, subtended by a pair of long-petiolate bracts at the apex of the peduncle; petiolate bracts elliptic, green-tinged, glabrous. FLOWERS five-merous; pedicels c. 0.5 mm long, puberulous; calyx lobes spathulate, 3–4 mm long, green, pubescent; corolla tubes infundibuliform, 5–7 mm long, colour unknown, glabrous outside, corolla lobes triangular, 0.5–1 mm long, recurved, glabrous, ciliolate; anthers 1.5–2 mm long, filaments c. 0.5 mm long; ovaries obovoid, 1.5 mm long, pubescent; styles 9–10 mm long; stigmas capitate to clavate, sometimes clavate to capitate; ovules four to six per locule. Young FRUITS c. 8 mm long, black-grey-tinged, ornated by spherical, nonelevated lenticels; pedicels of young fruits c. 4 mm long, lenticellate; seeds not seen.

Phenology: Flowering in January; fruiting March to April.

Common names: Felakoaky and Talifotsy.

Habitat: Dry, deciduous forests; 100–150 m.

Distribution: Antsalova District, Mahajanga Province (Fig. 5).

Discussion: *H. leandrii* is distinct from the other Malagasy *Hymenodictyon* species in its persistent and

foliolate stipules, long, spathulate calyx lobes, infundibuliform corolla tubes, and recurved corolla lobes. In his keys for the Malagasy *Hymenodictyon* species, Cavaco (1964c: 701) erroneously used an unpublished name, *H. homolleae*, which was written by R. Capuron on the label of *Leandri* 1003 (P!). However, neither Capuron nor Cavaco (1964c) formally described *H. homolleae*, and therefore it is a nomen nudum. Cavaco (1968) described his *H. leandrii* based on *Leandri* 1003. Three specimens (original paratypes), 8778-RN (P!, TEF!), *Léandri* 2676 (P!, UPS!), and *Perrier de la Bâthie* 1350 (P!), were seen by Cavaco (1968). He transferred the latter specimen from *H. occidentale* to *H. leandrii*. However, we agree with Homolle (1939) that *Perrier de la Bâthie* 1350 belongs to *H. occidentale* because it has relatively long petioles and deciduous stipules.

Additional specimens examined: MADAGASCAR: Mahajanga Province: Distr. Antsalova, forêt à feuilles caduques sur calcaires de l'Antsingy, vers Ambodiriana (E d'Antsalova), 100–150 m, 21–27.i.1960 (fl.), *Leandri* 2676 (P, UPS); c. 14 km E d'Antsalova, 17.iii.1993 (young fr.), *Villiers et al.* 4798 (MO, P, S, TAN). Distr. Soalala, Canton Andranomavo, 20.iii.1957 (young fr.), 8778-RN (P, TEF); rochers calcaires et lisières de Namoroka, i.1904 (young fl.), *Perrier de la Bâthie* 1694 (P). Unknown locality, 17.i.1954 (sterile), 6237-RN (P, TEF).

7. *HYMENODICTYON LOUHAVATE* HOMOLLE, NOT.
SYST. 8: 27. 1939

TYPE: MADAGASCAR. [Mahajanga Province], [Soalala Distr.], Bedanga, entre le Lac Kinkony et Andranomavo, xii.1926 (fl.), *Perrier de la Bâthie* 17844 [LECTOTYPE: designated by Cavaco (1964a): (178), P!; ISOLECTOTYPE: BR!].

Description: SHRUBS to TREES, 3–30 m tall. BARK grey. STIPULES broadly triangular, 3–5 mm long, apex acuminate, glabrous, deciduous. LEAVES deciduous; petioles 20–50 mm long, colour unknown, puberulous to glabrous; blades obovate to oblong, 10–12 × 6–7 cm, pale green above, light green beneath, glabrous above, densely pubescent beneath, coriaceous, apex acuminate, base shortly attenuate; margins glabrous; midribs brown-tinged, glabrous above, puberulous beneath; secondary veins six to eight pairs per side, red-tinged above, brown-tinged beneath, inconspicuous, glabrous above, puberulous beneath; domatia tuft-type. INFLORESCENCES terminal, 7.5–8 cm long, erect, bearing two or three pairs of lateral inflorescence units at the base, apex, and/or between both ends of the peduncles of the primary inflorescence units. Each inflorescence unit spicate, compact, com-

posed of a pubescent peduncle, a densely pubescent rhachis, numerous solitary flowers, subtended by a pair of or single long-petiolate bracts at the apex of the peduncle; petiolate bracts elliptic, colour unknown, glabrous. FLOWERS five-merous, solitary; pedicels c. 0.25 mm long, pubescent; calyx lobes triangular, c. 1 mm long, green, glabrous, ciliolate; corolla tubes narrowly tubular up to the midpoint and abruptly opening out into cups, 3.75–4 mm long, dark red-tinged, glabrous outside, corolla lobes triangular, c. 0.5 mm long, ciliolate; anthers c. 1 mm long, filaments c. 0.5 mm long; ovaries obovoid, 1–1.25 mm long, densely pubescent; styles 10–11 mm long; stigmas clavate to globose, green; ovules five to six per locule. FRUITS 15–30 mm long, grey-tinged, ornated with elongate, nonelevated lenticels; pedicels 1–5(–8) mm long, lenticellate; seeds four to six per locule, broadly elliptic, 10–12 × 5–6 mm (wings included), broadly winged all around, margins entire.

Phenology: Flowering in December; fruiting January to April.

Common names: Kalavelo (Mahajanga Province) and Lohavato (Antsiranana Province).

Habitat: Dry, deciduous forests; up to 600 m.

Distribution: Ambanja and Nossibe Districts, both Antsiranana Province; Antsalova District, Mahajanga Province; Manja District, Toliara Province (Fig. 3).

Discussion: We transferred *H. louhavate* var. *longicalyx* (Cavaco, 1964b) to *H. berivotrense* (Cavaco, 1964a) because of its pubescent leaves.

Additional specimens examined: MADAGASCAR: Antsiranana Province: Distr. Ambanja, Canton Marovato, 1.iii.1956 (fr.), 8237-RN (P, TEF). Haut Bemarivo, *Perrier de la Bâthie* 3961 (P). Distr. Nossibe, Berambao, 26.iv.1957 (fr.), 9231-RN (BR, P, TEF); Canton Hellville, Berambao, 16.iv.1957 (fr.), 9454-RN (BR, P, TEF). Andampy, entre Antsirabe Nord et Nosiravina, 28.iii.1967 (fr.), 27620-SF (BR, P, TEF). Mahajanga Province: Distr. Antsalova, Tsingy du Bemaraha, Tsiandro, rochers calcaires, 10–12.ii.1933 (fr.), *Leandri* 862 (P); sur calcaires de l'Antsingy, vers Bevary (E d'Antsalova), 400–600 m, 27.i.–5.ii.1960 (fr.), *Leandri* 2852 (BR, P); 27.ii.1960 (fr.), 11097-RN (P, TEF). Toliara Province: Distr. Manja, Fôret de Troboampamaky, Beharona, 14.iii.1954 (fr.), 9823-SF (P, TEF); Ankiranja, 30–35 km du Manja, sur la Route de Bevoay, 3–4.xii.1969 (fl.), 28949-SF (BR, P, TEF); Ankorasatra, 20 km du Manja, sur la Route de Bevoay, 30.xi.1969 (fl.), 28929-SF (BR, P, TEF).

8. *HYMENODICTYON MADAGASCARICUM* BAILL. EX RAZAFIM. & B. BREMER, SP. NOV. (FIGS 1D, 8A–C)

TYPE: MADAGASCAR. [Antsiranana Province], Ambilobe Distr., Collines et Plateaux calcaires de l'Ankarana, près d'Ambondromifehy, xii.1937–i.1938 (fl.), *Humbert* 18951 (HOLOTYPE: P!).

Hymenodictyon madagascariense Baill. in Baill., Hist. Pl. 7: 482. 1880, nom. nud.; *H. madagascariense* Baill., Bull. Mus. Natl. Hist. Nat., II, 36: 701. 1964c; publ. 1965, orth. var.

Diagnosis: A congeneris *Madagascarensibus* differt propter inflorescentias racemosas atque foliorum laminas glabras et minutas solummodo usque ad 9.5 cm longitudine et 5 cm latitudine attingentes.

Description: SHRUBS, 2.5–5 m tall. BARK grey. STIPULES triangular, 5.5–6 mm long, apex rounded or sometimes shallowly bifid, puberulous, deciduous. LEAVES deciduous; petioles 1–2.5 mm long, green, pubescent to glabrous; blades obovate to elliptic, 6–9.5 × 3.4–5 cm, pale green above, light green beneath, glabrous above, glabrous beneath, membranaceous, apex acuminate to apiculate, base strongly attenuate; margins glabrous, ciliolate; midribs pubescent, secondary veins five to seven pairs per side, red-tinged, inconspicuous above, conspicuous beneath, pubescent; tertiary veins, pubescent; domatia tuft-type. INFLORESCENCES terminal, 16–18 cm long, pendulous, solitary, lax, simple racemose, composed of a pubescent peduncle, a densely pubescent rhachis, numerous solitary flowers and two- or three-flowered cymules, subtended by a pair of long-petiolate bracts at the apex of peduncle; petiolate bracts elliptic to oblanceolate, light green. FLOWERS five-merous; pedicels c. 0.5 mm long, densely pubescent; calyx lobes oblong, 1–1.5 mm long, green-tinged, glabrous, ciliolate; corolla tubes narrowly tubular up to the midpoint and abruptly opening out into cups, c. 4 mm long, green, glabrous outside, corolla lobes broadly oblong, c. 0.5 mm long, glabrous; anthers c. 1 mm long, filaments 1–1.5 mm long; ovaries obovoid, 1–1.5 mm long, sparsely covered by long hairs; styles 10–11 mm long; stigmas clavate; ovules four or five per locule. FRUITS 11–17 mm long, grey-tinged, ornated by spherical, nonelevated lenticels; pedicels 1–3 mm long, lenticellate; seeds three to five per locule, broadly elliptic, 10–11 × c. 4 mm, broadly winged all around, margins entire.

Phenology: Flowering December to January; fruiting February to April.

Common name: Minandolo.

Habitat: Dry, deciduous forests; 50–80 m.

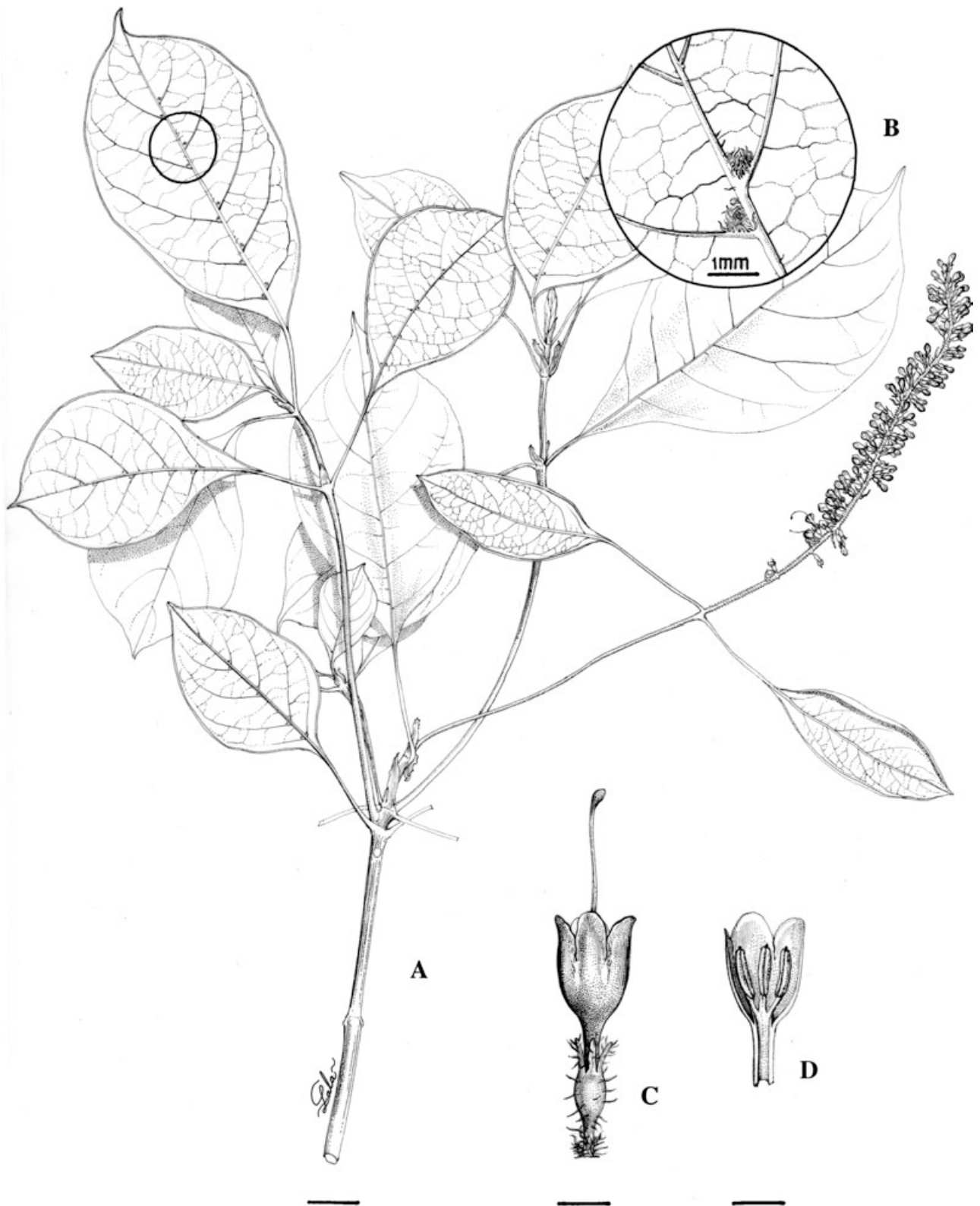


Figure 8. *Hymenodictyon madagascarium* Baill. ex Razafim. & B. Bremer. A, fertile branch with immature inflorescence. B, tuft-type domatia. C, mature flower. D, dissected corolla showing the insertion of the filaments at the base of the widened part of the tube. A–D, from Razafimandimbison & Andrianatoanina 445, BR, K, MO, TAN, UPS. Scale bars: A, 1 cm; B, C, 1 mm.

Distribution: Only known from the Ankarana Special Reserve, Ambilobe District, and Daraina region, Vohémar District, both Antsiranana Province (Fig. 7).

Discussion: *H. madagascariensis* was mentioned by Baillon (1880: 482) as the first species of *Hymenodictyon* from Madagascar. However, Baillon (1880) provided no description or diagnosis for his species. Cavaco (1964c: 701) spelled the name differently (*H. madagascariensis*) in his determination key to the Malagasy *Hymenodictyon* species but provided no descriptions for it. The characters he used in the keys matched our newly described *H. madagascariensis*. Baillon identified four old herbarium specimens of Bernier (at P) as *H. madagascariensis* and Cavaco determined two specimens of Humbert (at P) as *H. madagascariensis*. We selected *Humbert 18951* (P) as the holotype because this specimen is in a better condition than are the above collections of Bernier. *H. madagascariensis* and *H. perrieri* are the only Malagasy species with unbranched inflorescences. The former species can be distinguished easily by its smaller inflorescences (16–18 cm long) and glabrous leaves rather than the larger inflorescences (15–40 cm long) and puberulous to pubescent or tomentose leaves of the latter.

Paratypes: MADAGASCAR: Antsiranana Province: Distr. Ambilobe, Collines et Plateaux calcaires de l'Ankarana, près d'Ambondromifehy, 30–350 m, 29.ii.1960 (young fr.), *Humbert 32435* (P); c. 2 km from Mahamasina, c. 200 m W of the unfinished ANGAP house, 18.i.2002 (fl.), *Razafimandimbison & Andrianatoanina 440* (BR, K, MO, TAN, UPS), *Razafimandimbison & Andrianatoanina 445* (BR, K, MO, TAN, UPS), *Razafimandimbison & Andrianatoanina 446* (BR, K, MO, TAN, UPS); c. 2 km from and NE of Mahamasina, outside of the Réserve Spéciale de l'Ankarana, only 15–20 m from a new field rice, 19.i.2002 (fl.), *Razafimandimbison & Andrianatoanina 461* (BR, K, MO, TAN, UPS); 18.xii.2003 (fl.), *Kârehed et al. 245* (MO, TAN, UPS); path from the Campement des Anglais towards the Lac Vert and Grande Tsingy, 12 50'47"S 49 06'18"E, 82 m, 14.i.2002 (fl.), *De Block et al. 1210* (BR, MO, TAN, UPS), *De Block et al. 1216* (BR, MO, TAN, UPS). Unknown localities, *Boivin 2446* (P), *Bernier s.n.* (K), *Bernier 109* (G), *Bernier s.n.* (P), *Bernier s.n.* (P); iv.1989 (P), *Vaucoulon 390* (K), *Vaucoulon 416* (K). Distr. Antsiranana II, Canton Anivorano, Ambalavao, 12 48'S 49 14'E, 350 m, 11.iii.1988 (fr.), *Cheek 1437* (BR, MO, TAN). Distr. Vohémar, Commune Daraina, Forêt d'Ambohitsitondroina, 13 07'87"S 49 27'09"E, 170 m, 20.iii.2004 (young fr.), *Gautier et al. LG 4653* (G, S), Forêt de Solaniamilana-Maroadabo, 13 05'51"S

49 34'66"E, 100 m, 09.iii.2004 (fr.), *Gautier et al. LG 4523* (G, S).

9. *HYMENODICTYON OCCIDENTALE* HOMOLLE, NOT.

SYST. 8: 27. 1939 (FIG. 1C)

TYPE: MADAGASCAR. [Mahajanga Province], Marovoay Distr., ii.1910 (fl.), *Perrier de la Bâthie 3880* (LECTOTYPE here designated: P!). Chosen from syntypes: 143-SF (P, not seen), *Perrier de la Bâthie 1350* (P!), *Perrier de la Bâthie 1694* (P!), *Perrier de la Bâthie 3841* (P!), *Perrier de la Bâthie 3879* (P!), *Perrier de la Bâthie 3880* (P!), *Perrier de la Bâthie 15460* (P!).

Description: TREES (9)15–25 m tall. BARK grey. STIPULES triangular, c. 6 mm long, apex acuminate, glabrous, deciduous. LEAVES deciduous; petioles 50–80 mm long, red-tinged, puberulous to glabrous; blades broadly obovate, 11–20 × 7–14(–17) cm, pale green above, light green beneath, pubescent to glabrous, rarely scabrous, subcoriaceous, apex acuminate to apiculate, base rounded to attenuate; margins glabrous; midribs drying yellow-tinged, glabrous; secondary veins six to eight pairs per side, drying yellow-tinged, conspicuous, glabrous; without domatia. INFLORESCENCES terminal, 13–18 cm long, erect, each composed of a robust primary peduncle, a primary inflorescence unit, three or four pairs of lateral inflorescence units at the base and between both ends of the primary peduncle. Each primary and lateral inflorescence unit bearing three inflorescence units borne at the apex of each secondary peduncle, all subtended by a single or rarely a pair of long-petiolate bracts. Each inflorescence unit thyrsoid, compact, composed of a pubescent peduncle, a pubescent rhachis, numerous solitary flowers and two- to four-flowered cymules; petiolate bracts narrowly ovate, colour unknown, puberulous to glabrous. FLOWERS five-merous; pedicels c. 5 mm long, puberulous; calyx lobes oblong, 1–1.5 mm long, green, puberulous; corolla tubes narrowly tubular up to the midpoint and abruptly opening out into cups, 3–3.5 mm long, colour unknown, glabrous outside, corolla lobes obtuse, c. 1 mm long, colour unknown, puberulous; anthers c. 1.5 mm long, filaments 0.5–1 mm long; ovaries obovoid, c. 10 mm long, pubescent to puberulous; styles c. 6 mm long; stigmas clavate to globose, green; ovules four to six per locule. FRUITS 18–23 mm long, grey-tinged, ornated by elongate, nonelevated lenticels; pedicels 4–5 mm long, lenticellate; seeds four or five per locule, broadly elliptic, 10–15 × 6–8 mm (wings included), broadly winged all around, margins entire.

Phenology: Flowering December to February; fruiting February to August.

Common names: Beholitse (Toliara Province), Fatoraberavina (Ikongo District, Fianarantsoa Province), and Lohavato (Antsiranana Province) (Fig. 9).

Habitat: Dry, deciduous forests; 70–600 m.

Distribution: Ambanja and Ambilobe Districts, both Antsiranana Province; Ikongo (former Fort-Carnot) District, Fianarantsoa Province; Ambato-Boeni, Marovoay, and Soalala Districts, all Mahajanga Province; Ankazoabo, Mahabo, Morondava, Sakaraha, and Toliara II Districts, all Toliara Province.

Discussion: *H. occidentale* Homolle var. *glabrum* Cavaco was recognized at species level (*H. glabrum*) because it is very distinct from *H. occidentale* in many aspects (Table 3). Cavaco (1968) erroneously transferred *Perrier de la Bâthie* 1350 to *H. leandrii*, but we agree with Homolle (1939) that this specimen belongs to *H. occidentale*. *H. occidentale* can be distinguished easily from the other Malagasy *Hymenodictyon* species with long petioles by the coarse primary peduncles and branched lateral inflorescences units.

Additional specimens examined: MADAGASCAR: Antsiranana Province: Distr. Ambanja, endroit rocaillieux, Vallée du Sambirano, *Perrier de la Bâthie* 3841 (P), *Perrier de la Bâthie* 3842 (P). Alluvion du Sambirano, *Perrier de la Bâthie* 15460 (P). Distr. Ambilobe, Ankara, 8.viii.1952 (fr.), 5437-SF (P, TEF); Ankarana, iv.1963 (fl.), 22690-SF (BR, P, TEF); butte calcaire, près d'Andrakaka, W of Diego-Suarez, 27.ii.1964 (fl.), 23277-SF (BR, P, TEF); 16–28.i.1969 (young fl.), 28707-SF (BR, P, TEF), 28721-SF (BR, P, TEF). Road from the Lac Vert to Campement des Anglais, 12 50'47"S 49 06'18"E, 82 m, 14.i.2002 (sterile), *De Block et al.* 1225 (BR, TAN). Fianarantsoa Province: Distr. Ikongo, Ankararaka, 23.vi.1953 (fr.), 9673-SF (P, TEF). Mahajanga Province: Distr. Ambato-Boeni, Canton Tsaramandroso, Bevazaha, 10.ii.1955

(fl.), 13037-SF (BR, P, TEF). Distr. Marovoay, Canton Ampijoroa, *Perrier de la Bâthie* 3879 (P); 26.iii.1954 (fr.), 9856-SF (BR, P, TEF); Ampijoroa Forestry Station, 16 19'S 46 49'E, 70–100 m, 7.iv.1988 (fr.), *Gentry & Schatz* 62052 (MO, TAN). Distr. Soalala, Canton Bekopaka, Manambolo River, c. 1 km E of Vazimba tombs, E of Bekopaka, 19 09'S 44 48'E, 70 m, 26.iii.1990 (fr.), *Du Puy et al.* 781 (MO, TAN). Mt Tsi-tondraina, xi.1901 (sterile), *Perrier de la Bâthie* 1350 (P). Toliara Province: Distr. Ankazoabo, Betaratra, 5.vii.1971 (fr.), 4042-SF (P, TEF); Forêt de Betsako, à l'E d'Ankazoabo, c. 600 m, 2.iv.1955 (young fr.), 11943-SF (BR, P, TEF); Betsako, 29.vii.1951 (fr.), 3670-SF (P); vésige de la Forêt de Betsako, à c. 20 km E d'Ankazoabo, 500–600 m, 2.iv.1955 (young fr.), *Humbert* 29709 (P!). Distr. Mahabo, Manamby, 18.iv.1953 (fr.), 7222-SF (BR, P, TEF). Distr. Morondava, Forêt d'Antanambao, 7.ii.1956 (fl.), 15550-SF (BR, P, TEF); Fôret de Manamby, 22.vi.1954 (fr.), 10515-SF (P, TEF). Distr. Sakaraha, Zombitsy National Park, 4.xii.2003 (fl.), *Razafimandimbison & Bremer* 501 (MO, TAN, UPS). Distr. Toliara II, Canton Hazoroa, 6.ii.1951 (young fr.), 2836-SF (P, TEF).

10. *HYMENODICTYON PERRIERI* DRAKE, BULL. MENS. SOC. LINN. PARIS, II, 1: 48. 1898 (FIG. 1F)

TYPE: MADAGASCAR. [Mahajanga Province], Firin-galava, xii.1897 (fl.), *Perrier de la Bâthie* 431 (HOLOTYPE: P!; ISOTYPES: P[2]!).

Description: SHRUBS, 1–2 m tall. BARK red-grey-tinged. STIPULES orbicular, 10–15 mm long, apex rounded, puberulous, semipersistent. LEAVES persistent; petioles 20–40(–75) mm long, red-tinged above, light green beneath, puberulous to pubescent; blades, broadly ovate to oblong, or broadly ovate to elliptic, 9–10(–11) × (3.4–)7–10.5 cm, red-tinged above, drying grey-tinged beneath, puberulous above, puberulous to pubescent or tomentose beneath, subcoriaceous, apex

Table 3. Morphological distinctive characters distinguishing *Hymenodictyon glabrum* and *H. occidentale*

Character	<i>H. glabrum</i>	<i>H. occidentale</i>
Leaf shape	Orbicular	Broadly obovate
Leaf blade size	9–15 × 5–7.2 cm	11–20 × 7–14(–17) cm
Number of secondary veins per side	3–5	6–8
Inflorescence type	Compound spicate, bilaterally branched at the base of the peduncle of the primary inflorescence unit	Compound thyrsoïd, the peduncle primary inflorescence unit bearing three pairs of lateral branches at the base, apex and between both ends
Inflorescence unit length (cm)	6–8	13–18
Inflorescence unit type	Spicate	Thyrsoïd

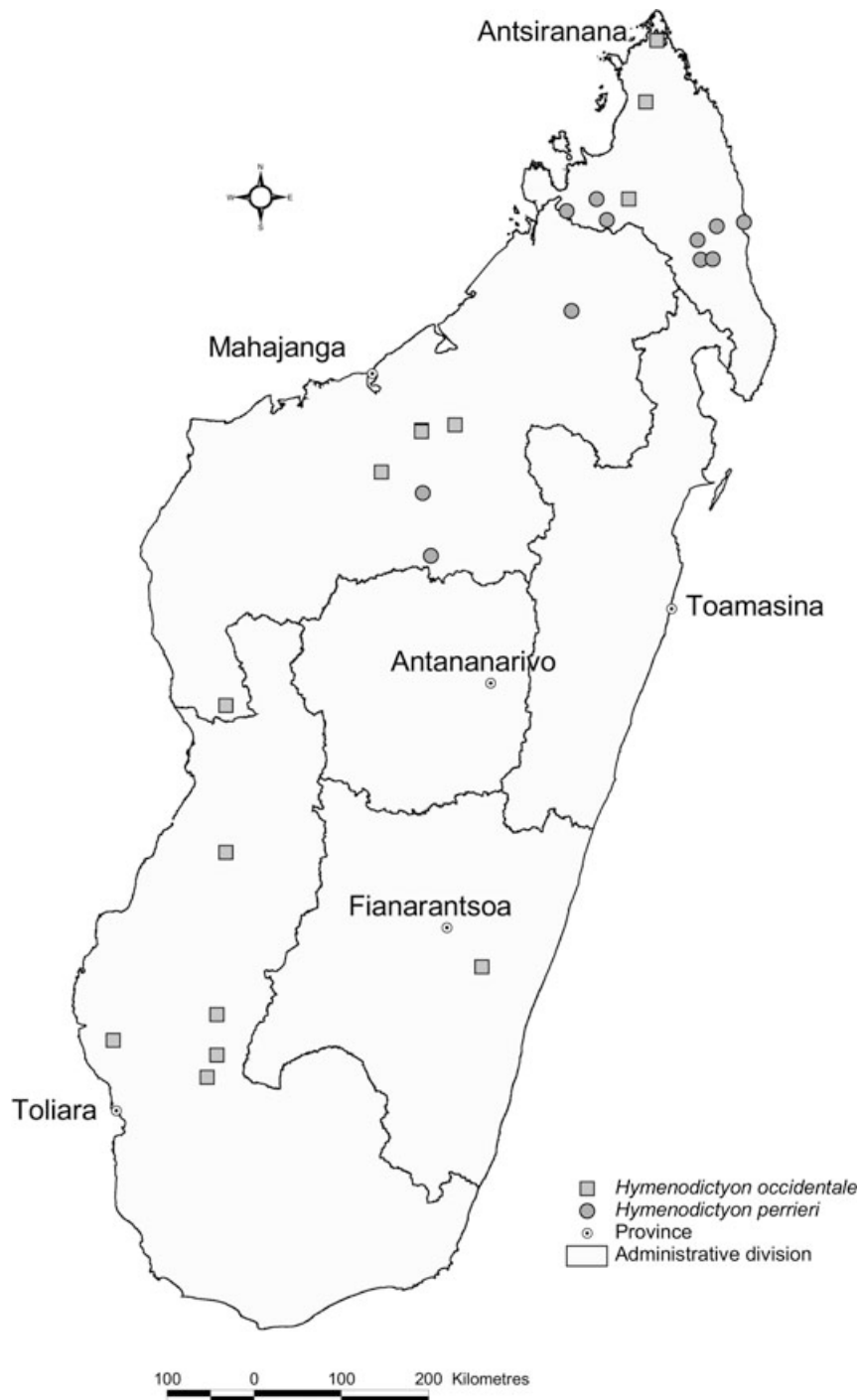


Figure 9. Distribution of *Hymenodictyon occidentale* and *H. perrieri*.

acuminate, base shortly attenuate to rounded; margins glabrous to ciliate; midribs drying yellow-tinged, pubescent; secondary veins seven to 12, rarely 14–15 pairs per side, red-tinged above, brown-tinged beneath, conspicuous, pubescent above, densely pubescent beneath; without domatia, sometimes domatia tuft-type present in the axils of secondary

and tertiary veins. INFLORESCENCES terminal, 15–40 cm long, pendulous, solitary, lax, simple thyrsoid, composed of a red, pubescent peduncle, a red, pubescent rhachis, numerous two- to five-flowered cymules, unsubtended by long-petiolate bracts. FLOWERS five-merous; pedicels 2–3 mm long, puberulous; calyx lobes linear, 0.8–1 mm long, red-tinged, pubescent, ciliate;

corolla tubes narrowly tubular up to the midpoint and abruptly opening into cups, 4–5 mm long, green, rarely green-red-tinged, glabrous outside, corolla lobes linear, *c.* 0.5 mm long, ciliate; anthers *c.* 1 mm long, filaments 0.5–1 mm long; ovaries obovoid, *c.* 2 mm long, puberulous; styles *c.* 7 mm long; stigmas clavate to globose, green; ovules four to nine per locule. FRUITS 10–23 mm long, black-tinged, ornated by spherical, elevated lenticels; pedicels 5–10 mm long, lenticellate; pedicels *c.* 10 mm long; seeds three to eight per locule, elliptic, 9–10 × *c.* 4 mm (wings included), broadly winged all around, margins entire.

Phenology: Flowering September to January; fruiting November to April.

Common names: Lohavato (Mahajanga Province).

Habitat: Growing exclusively on exposed rocky substrates in subhumid forests; 300–1000 m.

Distribution: Réserve Spéciale de Manongarivo, Ambanja District, Antsiranana Province; Réserve Naturelle Intégrale de Marojejy, Andapa District, Antsiranana Province; Massif d'Andavakaka, Befandriana-Nord District and Maevatanana District, both Mahajanga Province (Fig. 9).

Discussion: *Hymenodictyon perrieri* is distinct from the other Malagasy species in its very long, unbranched inflorescences and fruits with elevated lenticels.

Additional specimens examined: MADAGASCAR: Antsiranana Province: Distr. Ambanja, Plateau du Beankany, 12.xii.1963 (young fl.), *Rakotozafy* 321 (P); E of Ankaramibe, Réserve Spéciale de Manongarivo, Massif du Bekolosy, 14 02'S 48 19'E, 800–1000 m, 7–12.xii.1992 (fl.), *Malcomber et al.* 1949 (K, MO, P, TAN). Bassin supérieur du Sambirano, xi-xii.1937 (young fl.), *Humbert* 18515 (BR, P). Distr. Ambilobe, Région du Sambirano, dalles greseuses, à la base SW du Mt Ambohipizaka, 9.iii.1964 (fr.), 23396-SF (BR, P, TEF). Distr. Andapa, Réserve Naturelle Intégrale de Marojejy, Canton Ambalanomby, near the Antsahaberoka River, 14 20'S 49 40'E, 820 m, 10–19.xii.1994 (young fl.), *Rasoavimbahoaka* 439 (MO, P, TAN), *Razafimandimbison & Ravelonarivo* 663 (MO, S, TAN); Forêt d'Ambatosoratra, 1000 m, 8.i.1949 (fr.), *Cours* 3372 (BR, P); Vallée de la Lokoho, près d'Ambalavoniho, rocher de Manenombasy, 300 m, 9–10.i.1949 (fl., fr.), *Humbert & Cours* 22975 (BR, G, P). Distr. unknown, Bemarivo, 8.iii.1928 (fl., fr.), *Perrier de la Bâthie* 4551 (P); rocailles d'Androranga, 500 m, ix.1912 (young fl.), *Perrier de la Bâthie* 3663 (P); vallée inférieure de l'Androranga, affluent de la Bemarivo

(NE) aux environs d'Antongondriha, Massif de Betsomanga, 850 m, 17–20.xi.1950 (fr.), *Humbert & Capuron* 24310 (BR, P). Mahajanga Province: Distr. Befandriana-Nord, Massif d'Andavakaka, 600 m, 22.xii.1942 (fl.), *collector unknown* 5607 (P). Distr. Maevatanana, rocher humid au soleil, 27.iv.1943 (fr.), *Decary* 19255 (BR, P).

11. *HYMENODICTYON SEPTENTRIONALE* CAVACO, SOC. BOT. FRANCE 111: 276. 1964B

TYPE: MADAGASCAR. [Antsiranana Province], [Antsiranana I Distr.], Montagne de Français, 24.xi.1958 (fl.), 20087-SF (HOLOTYPE: P!; ISOTYPES: BR!, TEF!).

Description: SHRUBS 2–4 m, tall. BARK grey. STIPULES narrowly elliptic, 7–12 mm long, apex obtuse to rounded, puberulous, deciduous. LEAVES deciduous; petioles 7–15 mm long, red-tinged, densely pubescent; blades broadly lanceolate to ovate, 5.5–7 × 2.4–3.4 cm, pale green above, light green beneath, wavy, sparsely puberulous above, densely pubescent beneath, subcoriaceous, apex acuminate, base attenuate; margins glabrous to ciliate; midribs red-tinged, densely pubescent; secondary veins four to six pairs per side, drying red-tinged, conspicuous, pubescent; domatia tuft-type. INFLORESCENCES terminal, 7–8 cm long, erect, trichotomous, bilaterally branched near the base of the peduncles of the primary inflorescence units. Each inflorescence unit spicate, compact, composed of a pubescent peduncle, a densely pubescent rhachis, numerous two- to five-flowered cymules, unsubtended by a pair of long-petiolate bracts. FLOWERS five-merous, subsessile; pedicels *c.* 0.25 mm long, puberulous to pubescent; calyx lobes oblong, *c.* 1.5 mm long, green, sparsely pubescent, ciliate; corolla tubes narrowly tubular up to the midpoint and abruptly opening into cups, 3.5–4.5 mm long, green, glabrous outside, corolla lobes triangular, *c.* 0.25 mm long, apex glabrous, ciliate; anthers 1.5–2 mm long, filaments *c.* 0.5 mm long; ovaries obovoid, *c.* 1 mm long, sparsely pubescent; styles 7.5–8 mm long; stigmas clavate to globose, green; ovules three to five per locule. FRUITS 20–25 mm long, grey-tinged, ornated by spherical, nonelevated lenticels; pedicels (2–)7–10 mm long, lenticellate; seeds two to four per locule, elliptic, 10–11 × 4–5 mm (wings included), broadly winged, margins entire.

Phenology: Flowering November to January; fruiting January to February.

Common name: Unknown.

Habitat: Dry, deciduous forests; 40–42 m.

Distribution: Baie de Sakalava, Montagne de Français, and Analamerana Special Reserve, all Antsiranana II District, Antsiranana Province (Fig. 7).

Discussion: *Hymenodictyon septentrionale* was originally described by Cavaco (1964c) based on only the type specimen collected from the Montagne de Français (Antsiranana Province). Since then, many collections have been made from the Baie de Sakalava, east of Ankorikakely, the Antongombato Canton, and more recently within the Analamerana Special Reserve. This species can be distinguished easily from the other species by its pubescent to puberulous leaves and inflorescences without long-petiolate bracts.

Additional specimens examined: MADAGASCAR: Antsiranana Province: Distr. Antsiranana II, Betahitra, Montagne de Français, 12 19°32'S 49 20'11"E, 310 m, 25.xi.1996 (fl.), *Labat et al.* 2821 (K, MO, P, TAN, WAG); Baie de Sakalava, 12 15'S 49 20'E, 19.i.2002 (fr.), *De Block et al.* 1295 (BR, K, MO, TAN, UPS); Réserve Spéciale d'Analamerana, *De Block et al.* 1078 (BR, K, MO, P, TAN, UPS), *De Block et al.* 1087 (BR, K, MO, P, TAN, UPS); 12 40'25"S 49 32'40"E, 41 m, 7.i.2002 (fl.), *De Block et al.* 1102 (BR, K, MO, P, TAN, UPS), 20.i.2002 (fr.), *Razafiman-dimbison et al.* 404 (BR, K, MO, TAN, UPS), *Razafiman-dimbison et al.* 406 (BR, K, MO, TAN, UPS). Dune E d'Ankorikakely, S d'Orangea, 24.iv.1966 (fr.), 24680-SF (BR, P, TEF). Butte calcaire au pk. 8 Route Diego-Suarez-Orangea, 12.xii.1963 (fl.), 22944-SF (BR, P, TEF). Canton Antongombato, 12 21'S 49 12'E, 14.iii.1988 (fr.), *Cheek* 1499 (BR, K, MO, TAN).

12. *HYMENODICTYON SEYRIGII* CAVACO, BULL. MUS. NAT. HIST. NAT., II, 36: 700. 1964C

TYPE: [MADAGASCAR]. [Toliara Province, Distr. Bekily], environs d'Ampanrandava (entre Bekily et Tsivory), xi.1942 (fl.), *Seyrig* 334 (HOLOTYPE: P!; ISOTYPE: TAN!).

Description: SHRUBS, 2–3 m tall. BARK black-red-tinged. STIPULES ovate to oblong, c. 4 mm long, apex acuminate, glabrous, deciduous. LEAVES deciduous; petioles 8–10 mm long, glabrous; blades broadly elliptic, 5–11.5 × 2.5–5.5 cm, above dark red-tinged, drying black-brown-tinged, drying light-brown-tinged, glabrous, subcoriaceous, apex acuminate, base shortly attenuate; margins glabrous; secondary veins five or six pairs per side, red-tinged, inconspicuous above, conspicuous beneath, glabrous; tertiary veins inconspicuous above, conspicuous beneath; without domatia, rarely domatia tuft-type present in the axils of the secondary veins. INFLORESCENCES terminal, 6–6.5 cm

long, erect, trichotomous, bilaterally branched at the top of peduncles of primary inflorescence units. Each inflorescence unit spicate, compact, composed of a pubescent peduncle, a densely pubescent rhachis, numerous two- or three-flowered cymules, subtended by a single long-petiolate bract at the apex of peduncle; petiolate bracts broadly elliptic, glabrous. FLOWERS five-merous, subsessile; pedicels c. 0.25 mm long, pubescent; calyx lobes linear, c. 0.5 mm long, densely pubescent; corolla tubes narrowly tubular up to the midpoint and abruptly opening out into cups, c. 3 mm long, dark red, glabrous outside, corolla lobes obtuse, c. 1 mm long, ciliate; anthers c. 1.5 mm long, filaments c. 0.5 mm long; ovaries obovoid, 1–1.5 mm long, densely pubescent; styles c. 7 mm long; stigmas clavate to globose, green; ovules two or three per locule. FRUITS not seen.

Phenology: Flowering in November; fruiting time unknown.

Common name: Unknown.

Habitat: This species is a shrub growing on rocky terrains according to label of the type specimen [*Seyrig* 334 (P!), Cavaco 1964].

Distribution: Ampandrandava region, Bekily District, Toliara Province (Fig. 7).

Discussion: *Hymenodictyon seyrigii* was described by Cavaco (1964c) based on the single specimen *Seyrig* 334 (P). Since then, no additional collections have been made; we therefore consider it to be an endangered species.

13. *HYMENODICTYON TSINGY* RAZAFIM. & B. BREMER SP. NOV. (FIGS 1E, 10A–C)

TYPE: MADAGASCAR. Antsiranana Province, Ambilobe Distr., Canton Mahamasina, 21.xi.2003 (fl.), *Kârehed et al.* 249a (HOLOTYPE: UPS!; ISOTYPES: MO!, TAN!).

Diagnosis: *A congeneris praeclare differt propter folia in ramorum apibus congesta; praeterea stipulis imbricatis atque lamninarum venis secundariis et intersecundariis subtus aurantiacis luteisve facile distinguitur.*

Description: SHRUBS, 3–4 m tall. BARK dark grey-tinged. STIPULES broadly obovate, 1–1.5 mm long, apex acuminate, imbricate, glabrous, deciduous. LEAVES clustered apically, deciduous; petioles 12–19 mm long, red-tinged, glabrous to puberulous; blades broadly elliptic to obovate, pale green above,

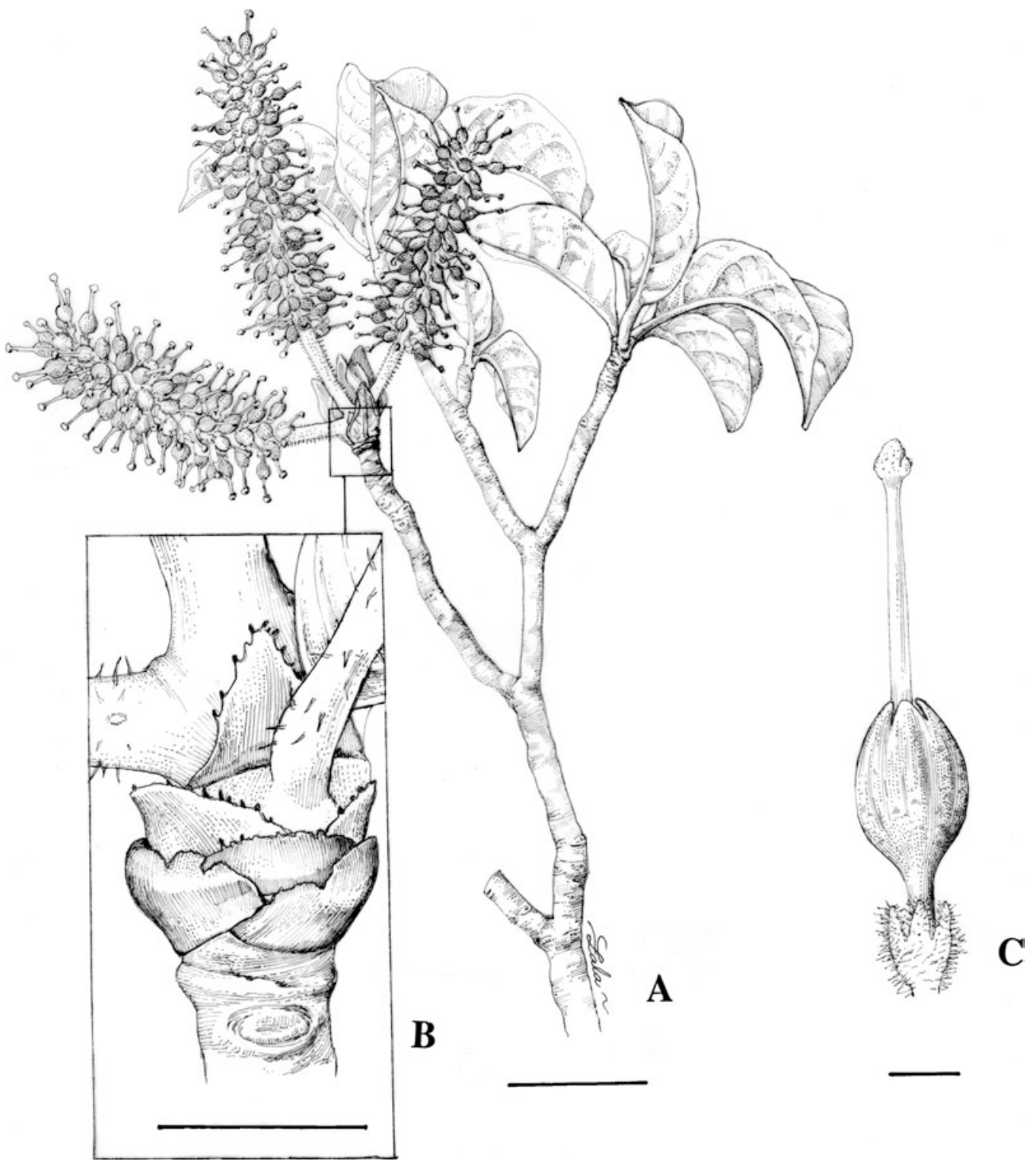


Figure 10. *Hymenodictyon tsingy* Razafim. & B. Bremer. A, fertile branch with mature inflorescences. B, mature flower. C, portion of a young stem showing imbricate stipules. A–C, from Kårehed *et al.* 249a, UPS. Scale bars: A, 3 cm; B, 7 mm; C, 2 mm.

3.5–7.5 × 2.4–5.2 cm, light green beneath, wavy, glabrous, subcoriaceous, apex apiculate, base attenuate; margins glabrous; secondary veins six to eight pairs per side, orange- to yellow-tinged, less conspicuous above, conspicuous beneath, glabrous; tertiary veins orange to yellow-tinged, inconspicuous above, conspicuous beneath. INFLORESCENCES terminal, 3.5–6 cm long, erect, trichotomous, bilaterally branched at the apex of the peduncles of the primary inflorescence units. Each inflorescence unit spicate, compact, composed of a pubescent peduncle, a pubescent rhachis, numerous two- to four-flowered cymules, unsubtended by long-petiolate bracts, rarely subtended by a single long-petiolate bract at the apex of the peduncle; petiolate bracts elliptic, green, glabrous. FLOWERS five-merous, subsessile; pedicels c. 0.25 mm long, puberulous; calyx lobes narrowly triangular, c. 1 mm long, light green, densely pubescent; corolla tubes narrowly tubular up to the midpoint and broadly elliptic above, 3–4 mm long, red-brown-tinged, glabrous outside, corolla lobes oblong, c. 0.25 mm long, apex glabrous, ciliate; anthers 1.5–1.8 mm long, filaments c. 1 mm long; ovaries obovoid, c. 1 mm long, densely pubescent; styles 7–8 mm long; stigmas clavate to globose, light green; ovules three to six per locule. FRUITS 15–20 mm long, grey-tinged, ornated by spherical, non-elevated lenticels; pedicels 6–10 mm long, lenticellate; seeds two to four per locule, broadly elliptic, 8–10 × c. 5 mm (wings included), winged all around, margins entire.

Phenology: Flowering November to February; fruiting March to July.

Common name: Soaravina (Morondava).

Habitat: Exclusively growing on limestone substrates; 10–250 m.

Distribution: Ankarana Special Reserve, Ambilobe District, Antsiranana Province; Forêt de Tanambao, Morondava District, Toliara Province (Fig. 5).

Discussion: This species is distinct from the other Malagasy *Hymenodictyon* species in its leaves clustered at the apex, imbricate stipules, and conspicuous and orange- to yellow-tinged secondary and tertiary veins at the lower leaf surfaces. *H. tsingy* specimens release a light-coloured and sticky liquid during the drying process. The same liquid was not observed in the other species we collected (*H. berivotrense*, *H. decaryi*, *H. madagascariensis*, *H. louhavate*, *H. occidentale*, and *H. septentrionale*). The epithet 'tsingy' is a Malagasy name for limestone.

Paratypes: MADAGASCAR: Antsiranana Province: Distr. Ambilobe, collines et plateaux calcaires de l'Ankarana, 10–250 m, xii.1937–i.1938 (fr.), *Humbert* 18849 (P); 21.xi.2003 (young fl., fr.), *Kârehed et al.* 249b (MO, TAN); 24.iv.1990 (fr.), *Vaucoulon* 1616 (K, P). Toliara Province: Distr. Morondava, Forêt de Tanambao, 13.xii.1954 (fr.), 12266-SF (P, TEF). Unknown province and locality, *Homolle* 273 (P).

14. *HYMENODICTYON BIAFRANUM* HIERN HIERN IN OLIV., FL. TROP. AFR. 3: 42–43. 1877 (FIG. 11A–C)
TYPE: CAMEROON. Prince Islands, on rocky islets, 4500 ft, 1857–59 (fl, fr.), Barter 1999 (HOLOTYPE: K!; ISOTYPES: K!, P[2]!, SI).

Hymenodictyon bracteatum K. Schum., Bot. Jahrb. Syst. 23: 424. 1896. TYPE: CAMEROON. [without exact locality], 1896 (fl.), *Staudt* 367 (HOLOTYPE: P!; ISOTYPE: G!).

Hymenodictyon oreophyton Hoyle, J. Bot. 75: 168. 1937. TYPE: CAMEROON. Ebang, 5000 ft, v.1932 (fl.), *Johnstone* J320/32 (HOLOTYPE: K!).

KEY TO THE AFRICAN *HYMENODICTYON* SPECIES

- | | |
|---|---------------------------|
| 1a. Inflorescences unbranched | 2 |
| 2a. Woody epiphytes; inflorescences < 10 cm long; number of ovules and seeds 30–40 per locule | 15. <i>H. epiphyticum</i> |
| 2b. Terrestrial shrubs; inflorescences >22 cm long; number of ovules and seeds five to 12 per locule | 16. <i>H. floribundum</i> |
| 1b. Inflorescences branched | 3 |
| 3a. Inflorescences subtended by long-petiolate, leafy bracts; number of ovules and seeds 25–40 per locule; filament 3–4 mm long | 14. <i>H. biafranum</i> |
| 3b. Inflorescences unsubtended by long-petiolate bracts; number of ovules and seeds < 10 per locule; filament up to 1 mm long | 4 |
| 4a. Leaf blades 8–31 × 5–11 cm; inflorescences elongate, 10–32 cm long; calyx lobes 4.5–7 mm long, recurved and longer than the mature corollas; corollas napiform, densely pubescent outside; ovaries elongate | 17. <i>H. pachyantha</i> |
| 4b. Leaf blades 1–9 × 0.4–5.9 cm; inflorescences globose, 1–8 cm long; calyx lobes 0.5–2.5 mm long, not recurved and shorter than the mature corollas; corollas narrowly tubular up to the midpoint and abruptly opening into cups, glabrous outside; ovaries obovoid | 18. <i>H. parvifolium</i> |



Figure 11. *Hymenodictyon biafranum* Oliv. A, fertile branch with immature and mature inflorescences. B, mature flower. C, dissected corolla showing the insertion of the filaments near the base of the tube. A–C, from *van der Burgt* 90, WAG. Scale bars: A, 1 cm; B, C, 3mm.

Hymenodictyon reflexum Hoyle, J. Bot. 75: 169. 1937. TYPE: NIGERIA. Oban, [without collection date] (fl.), Talbot 213 (HOLOTYPE: K!; ISOTYPE: BM!).

[*Hymenodictyon epidendron* Mildbr.], in unpubl. *manuscriptum*, nom. nud.; *H. epidendron* Mildbr. ex Hutch. & Dalziel in Hutch. & Dalziel, Fl. W. Trop. Afr. 2: 69–70. 1931. TYPE: EQUATORIAL GUINEA. Bioko Island, HOLOTYPE: not designated.

Description: SHRUBS or medium-sized TREES, 4–15 m tall, rarely woody epiphytes. BARK drying black to black-grey-tinged. STIPULES broadly triangular, 3–7 mm long, apex acuminate to rounded, glabrous, deciduous. LEAVES deciduous; petioles 8–24 mm long, red-tinged, glabrous; blades broadly elliptic to obovate, 4–16 × 1.5–6 cm, drying dark-red-tinged above, much paler green and drying light-brown-tinged beneath, glabrous, coriaceous, apex acuminate, base shortly attenuate; margins glabrous; midribs red-tinged, glabrous; secondary veins five to seven pairs per side, red-tinged, inconspicuous, glabrous; without domatia. INFLORESCENCES terminal, sometimes terminal and axillary from uppermost leaf pair, 8–18 cm long, erect, trichotomous, bilaterally branched at the base of the peduncles of the primary inflorescence units. Each inflorescence unit racemose, compact, composed of a pubescent peduncle, a pubescent rachis, numerous two- to five-flowered cymules, subtended by a pair of petiolate bracts at the apex of the peduncle of each inflorescence unit; petiolate bracts elliptic, white-pink-tinged, glabrous. FLOWERS five-merous; pedicels 3–5 mm long, pubescent to puberulous; calyx lobes oblong, 3–4 mm long, green-tinged,

puberulous, ciliate; corolla tubes infundibuliform, c. 6 mm long, red-tinged, glaucous outside, corolla lobes triangular, c. 1 mm long, glaucous, ciliate; anthers 1.5–2 mm long, filaments 3–4 mm long; ovaries narrowly obovoid to ellipsoid, 1–2 mm long, puberulous; styles 11–13 mm long; stigmas clavate to globose, yellow-green-tinged; ovules 25–40 per locule. FRUITS 10–18 mm long, grey-black-tinged, ornated by spherical, nonelevated lenticels; pedicels 7–10 mm long, nonlenticellate; seeds 25–40 per locule, narrowly elliptic, 9–11 × c. 6 mm (wings included), broadly winged only at both ends, margins shallowly fringed.

Phenology: Flowering December to June; fruiting January to December.

Common name: Unknown.

Habitat: Evergreen rainforests and submontane humid forests; up to 1750 m.

Distribution: Cameroon, Congo, Democratic Republic of Congo, Gabon, Nigeria, and São Tomé & Príncipe (Fig. 12).

Discussion: *Hymenodictyon biafranum* is probably closely related to *H. epiphyticum* because they both have a high number of ovules (25–40 ovules per locule) and more slender fruits and seeds (Fig. 13E) when compared with the other *Hymenodictyon* species. However, *H. biafranum* can be distinguished easily from *H. epiphyticum* by its longer petioles, larger inflorescences, calyx lobes and corollas (Table 4).

Table 4. Morphologically distinctive characters distinguishing *Hymenodictyon biafranum*, *H. epiphyticum*, and *H. floribundum*

Character	<i>H. biafranum</i>	<i>H. epiphyticum</i>	<i>H. floribundum</i>
Habit	Terrestrial shrubs and trees, rarely epiphytes	Small epiphytes	Terrestrial shrubs
Leaf blade indumentum	Glabrous	Glabrous	Glabrous above but puberulous to densely pubescent or tomentose beneath
Petiole length (mm)	8–24	4–6	4–40(–70)
Inflorescence type	Trichotomous, bilaterally branched at the base of the peduncle of the primary inflorescence unit	Simple racemose	Simple racemose
Inflorescence unit length (cm)	8–18	5.5–9.5	22–26
Inflorescence unit type	Racemose, compact	Racemose, lax	Racemose, compact
Corollas	Infundibuliform	Infundibuliform	Narrowly tubular up to the midpoint and abruptly widened above
Number of ovules per locule	25–40	15–40	< 10



Figure 12. Distribution of *Hymenodictyon biafranum* and *H. pachyantha*.

H. epidendron Mildbr. is a nomen nudum based on an unpublished manuscript written by Mildbraed (Hutchinson & Dalziel, 1931). However, the name was published validly by Hutchinson & Dalziel (1931: 70). According to Hutchinson & Dalziel (1931: 70), the type specimen, which they did not cite and we have not been able to trace, was originally collected on the Island of Bioko (former Fernando Po), Equatorial Guinea. The short descriptions given by Hutchinson & Dalziel (1931), probably taken from the manuscript of Mildbraed, matched *H. biafranum* as circumscribed here.

Additional specimens examined: CAMEROON: South-west Province. Ekona, shrub vegetation on the 1922 Lava flow at Bibundi (idenao) c. 100 m from the main road, 04 11'N 09 01'E, 50 m, 2.vi.1987 (young fl.),

Thomas & Zogning 7057 (MO, WAG); c. 3 km E of road to Yabassi-Douala, 50–100 m, 17.viii.1965 (fr.), *Leeuwenberg* 6404 (MO, WAG[2]). Bibundi Lava flow, W of the foot of Cameroon Mt, 50–100 ft, *Box* 3635 (BM). Path from Fabe-Mundemba, road to Makeke Camp, 08 55'E 05 00'N, 50 m, 29.viii.1986 (fr.), *Manning* 99 (MO, WAG); 08 55'N 08 54'E, 80 m, 1987 (young fl.), *Thomas et al.* 7111 (MO, WAG). Vicinity of Mundemba, Ndian Division, forest remnants, c. 24 km NE of Douala, along the road to Edea, 50 m, *Leeuwenberg* 6335 (PRE, WAG); secondary growth and roadside, 04 57'N 08 54'E, 80 m, 25–30.iii.1987 (fr.), *Thomas* 6774 A (MO). Gepka, 5 km N of Nkambe, forêt submontagnarde à *Anthonotha* sp., sur pente à pic, 1600 m, 13.i.1974 (fr.), *Letouzey* 13220 (P, WAG). Bibundi, c. 30 km NW of Victoria, 23.vi.1976 (young fl.), *Letouzey* 14952 (P, WAG). Massif du

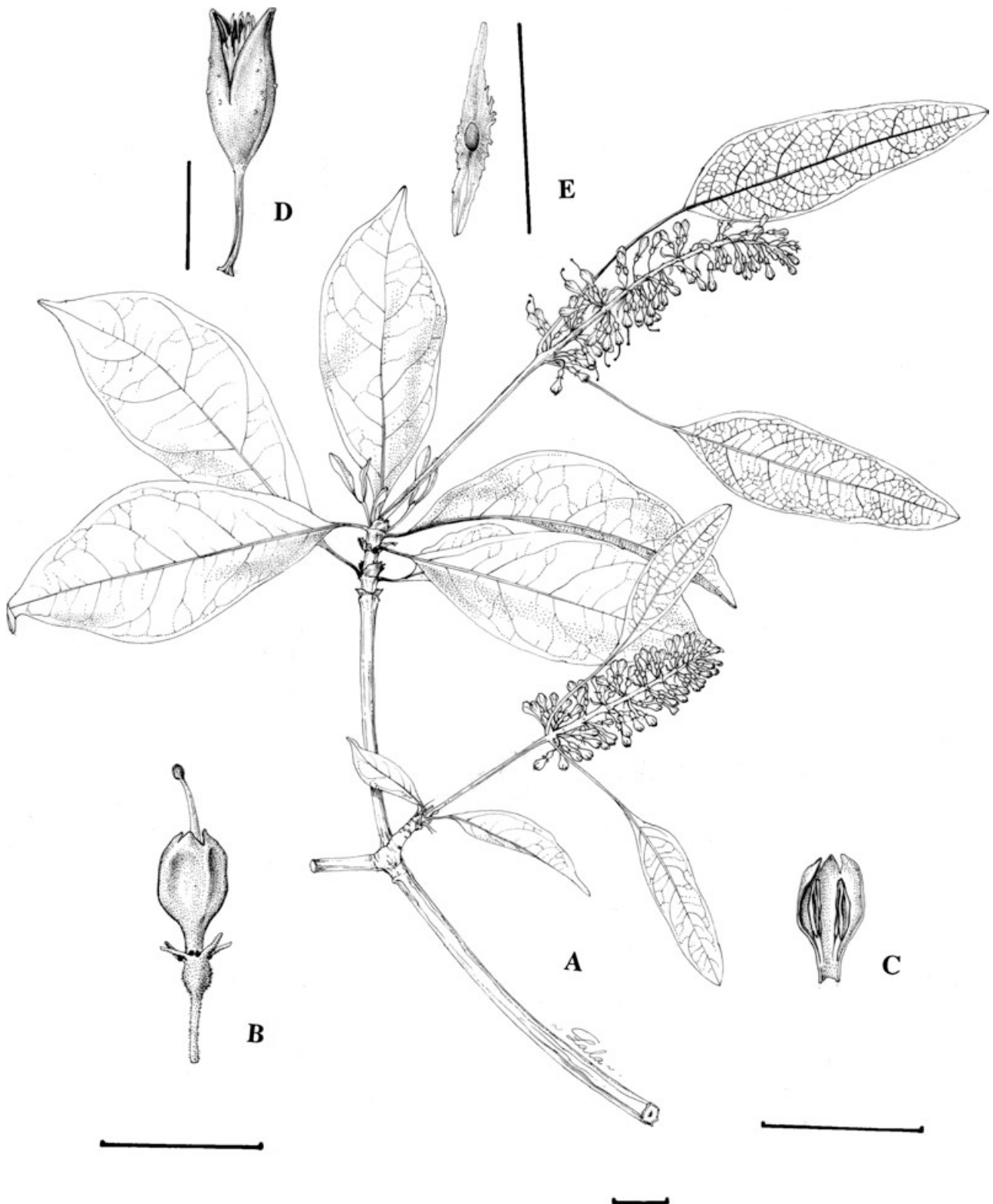


Figure 13. *Hymenodictyon epiphyticum* Razafim. & B. Bremer. A, fertile branch with immature and mature inflorescences. B, mature flower showing colleters in sinuses of calyx lobes. C, dissected corolla showing the insertion of the filaments near the base of the tube. D, mature fruit. E, mature seed. A–C, from *Leeuwenberg* 9748 (WAG); D, E, from *Letouzey* 14152 (P). Scale bars: A, D, E, 1 cm; B, C, 5 mm.

Nkokom, entre Ndom et Ndambok, à 40 km au S de Ndikinimeki, 13.xii.1971 (fr.), *Letouzey* 10782 (P). Victoria Division & the 1922 Lava flow, c. 0 m, 8.vi.1937 (young fl.), *Rosevea* 68/37 (K); 17.i.1951 (fr.), *Keay* 28652 (P). Mt Oundiougoun, c. 6 km au SW de Ndiki, 8.xi.1983 (fr.), *Nkongmebeck* 531 (P). Mt Rumpi, près de Dikome Balue, 35 km NNW of Kumba, 26.iii.1976 (fr.), *Letouzey* 14582 (P). Path NW of Elumseh-Mejelet, Bakossi, Bangem, 09 44'E 05 04'N, 1750 m, 6.x.1986 (fr.), *Etuge & Thomas* 333 (MO, WAG). Unknown locality, *Staudt* 367 (S). CONGO: Massif du Thailu, Bowal de Mamfoufou, près de Moudounga, vi.1981 (young fr.), *Sita* 4623 (P). DEMOCRATIC REPUBLIC OF CONGO: Kivu Province. Walikale, Kitshanga, 1400 m, *Léonard* 2797 (MO), *Léonard* 2801 (MO). GABON: Estuaire, Tchimbélé, rive gauche, 23.ii.1988 (fl.), *Louis* 2296 (BR, K). Ogooué-Ivindo, M'passa Field Station, near Makokou, 480 m, *Gentry* 33187 (MO). Haut-Ogooué, *Testu* 8955 (BM); 28.vii.1933 (fr.), *Testu* 9200 (BM, MO, P). Région de Lastourville, 15.iv.1930 (fl.), *Testu* 8024 (BM, P). Ogooué-Maritime, Rabi-Kounga, near Rabi 78, 01 55'S 09 50'E, 30 m, 2.ii.1994 (fl.), *van der Burgt* 11 (WAG); 31.iii.1994 (young fr.), *van der Burgt* 90 (WAG). Mt Cristal, entre Nkam et Méla, 30.i.1968 (fl.), *Hallé & Villiers* 4740 (P); 20.ii.1968 (sterile), *Hallé & Villiers* 5412 (P); au bord de la rivière Balakabo, *Hallé & Villiers* 541 (P). Mt Mvélakéné, c. 5 km, W de Méla, 12.ii.1968 (fr.), *Hallé & Villiers* 5200 (P). Rivière de Malimba, bords de Mangrove, 26.iii.1969 (fr.), *Villiers* 41 (P). Rocher Fané, 5.ii.1968 (fl., fr.), *Hallé & Villiers* 4958 (P). c. 24 km SE of Medouneu, 0 51'N 10 56'E, 5.ii.1986 (fl.), *Reitsma & Louis* 1887 (MO, WAG). Mangrove forest, c. 6 km, NE of Malibé, 0 35'N 09 26'E, 20.xii.1986 (fl.), *Reistma* 2743 (MO, WAG). NIGERIA: S of Nigeria, Oban, 1911 (young fl.), *Talbot* 256 (BM). SÃO TOMÉ AND PRINCIPE: W of Barriga Brauce, c. 3 km, SSW of Maria Correia, 150–300 m, 5.ii.1980 (young fr.), *de Wilde et al.* 379[2] (WAG). UNKNOWN COUNTRY: *Kallreyer* 183 (BM). Colline de Nkoltsia, 10 16'30"N 03 10'30"E, 23 km NW de Bipindi, 24.iv.1974 (young fl.), *Villiers* 868 (P).

15. *HYMENODICTYON EPIPHYTICUM* RAZAFIM. & B. BREMER SP. NOV. (FIG. 13 A–E)

TYPE: CAMEROON. Mt Koupé, c. 5 km W of Kola, 04 50'N 09 44'E, 800 m, 26.iv.1972 (fl.), *Leeuwenberg* 9748 (HOLOTYPE: WAG!; ISOTYPES: BR!, P!).

Diagnosis: *Haec species epiphytica obligata a congeneris terrestribus vel epiphyticis facultativis distinguitur foliarum laminis membranaceis pertenuibus hebetibus, inflorescentiis laxis et solitariis, atque seminibus gracilibus 25–40 pro loculo.*

Description: Woody EPIPHYTES (0.3–)1–3 m tall. BARK grey. STIPULES broadly to narrowly triangular, 3–3.5 mm long, apex acuminate to rounded, glabrous, deciduous. LEAVES persistent, clustered apically; petioles 4–6 mm long, red-tinged, glabrous; blades elliptic to ovate, 5.5–16 × 1.6–4.5 cm, pale green above, light green beneath, glabrous, membranaceous, very thin, dull, apex acuminate, base shortly attenuate; margins glabrous; midribs red-tinged, glabrous; secondary veins three to six pairs per side, red-tinged, conspicuous, glabrous; without domatia. INFLORESCENCES terminal, 5.5–9.5 cm long, erect, solitary, lax, simple racemose, composed of a puberulous peduncle, a puberulous rhachis, numerous solitary flowers and two- to four-flowered cymules, subtended by a pair of long-petiolate bracts at the apex of peduncle; petiolate bracts lanceolate, red- to pink-tinged, glabrous. FLOWERS five-merous; pedicels 2.5–6 mm long, puberulous; calyx lobes linear, c. 1 mm long, green-tinged, excurved, with large colletes in sinuses, ciliate; corolla tubes infundibuliform, 4.5–5 mm long, red-purple-tinged, glabrous outside, corolla lobes triangular, c. 1 mm long, glabrous; anthers c. 2.5 mm long, filaments 1–1.5 mm long; ovaries globose, 1.5–2 mm long, puberulous; styles 9–9.5 mm long; stigmas clavate, light green; ovules 15–40 per locule. FRUITS 13–14 mm long, light-brown-tinged, ornated by spherical, nonelevated lenticels; pedicels 7–10 mm long, nonlenticellate; seeds 25–40 per locule, narrowly elliptic, 8–9 × 1–1.5 mm, broadly winged only at both ends, margins shallowly fringed.

Phenology: Flowering December to April; fruiting May to November.

Common name: Unknown.

Habitat: Evergreen rainforests; 130–700 m.

Distribution: Cameroon, Gabon, and Guinea (Fig. 14).

Discussion: Many of the herbarium specimens of *H. epiphyticum* we studied were identified as either *H. biafranum* or *H. floribundum*. These three species are all very distinct morphologically (Table 4). *H. epiphyticum* is the smallest species and probably closely related to *H. biafranum*, as they both have a higher number of ovules and rather slender seeds. Also, the former species is an obligate epiphyte, whereas the latter species is a facultative epiphyte. The epithet 'epiphyticum' refers to the habit of the species.

Paratypes: CAMEROON: South-west Province: Environ du village de Dékouma, Forêt de N'Dzigo, 19–28.vii.1917 (fr.), *Fleury* 33340 (P); forest near Mekom

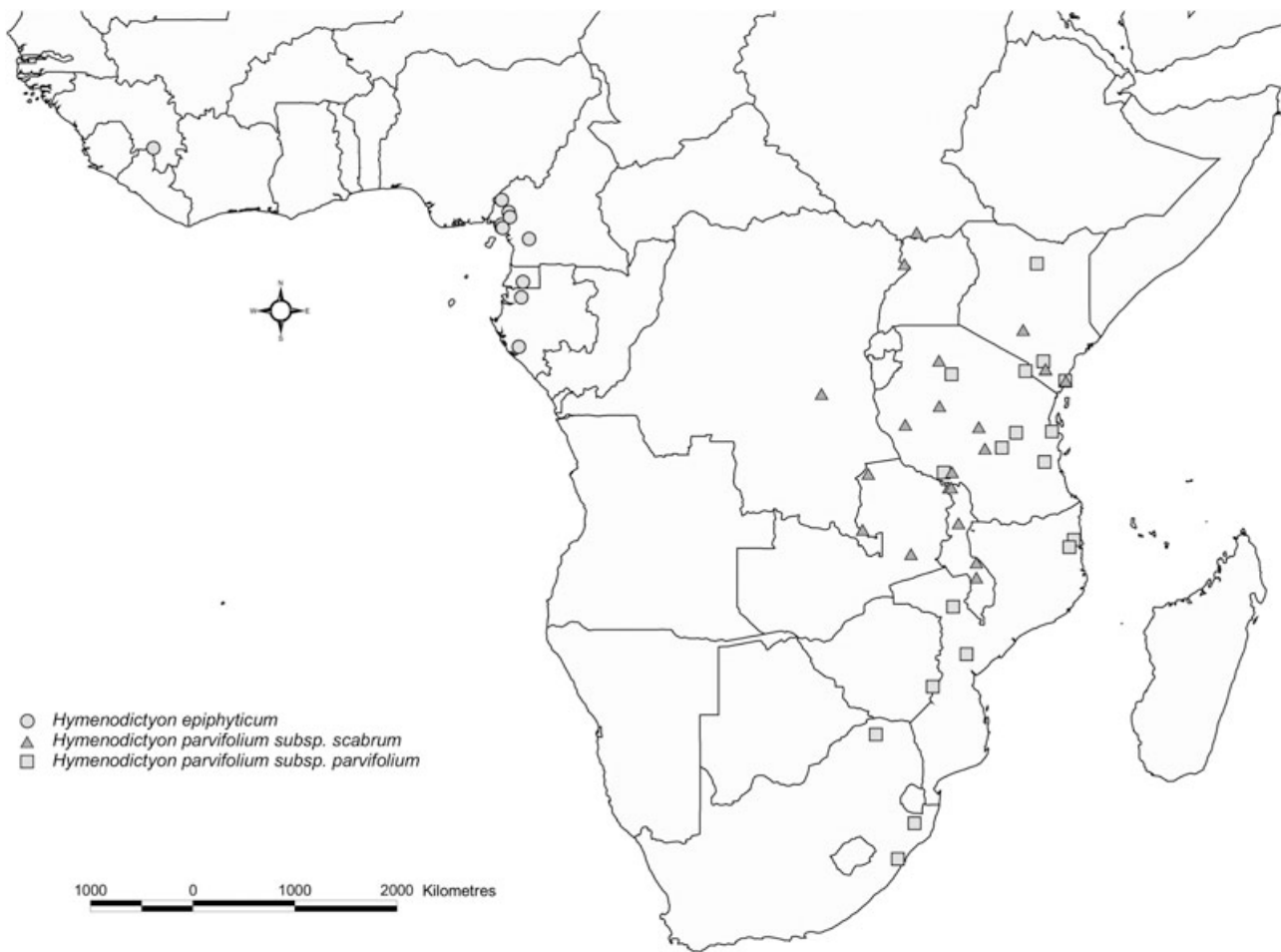


Figure 14. Distribution of *Hymenodictyon epiphyticum*, *H. parvifolium* ssp. *scabrum* and *H. parvifolium* ssp. *parvifolium*.

Bakossi, c. 8 km E of Kumba, Mamfe road, near Konye, 05°05'N 09°40'E, 350 m, 16.iv.1986 (fl.), *Nemba & Thomas* 19 (MO, WAG); Ekona, the 1959 Lava flow, 04°14'N 09°19'E, 600 m, 3.vi.1987 (young fr.), *Thomas & Zogning* 7042 (MO, WAG); 700 m, 12.vii.1990 (fr.), *Cheek et al.* 3030 (WAG); near the Plot # 1 from the base of Lava, 23.x.1995 (fr.), *Dawson* 58 (K); Mt Cameroon (Ekona), 1958 (fl.), *Upson* 160 (K). Distr. Bufi, c. 30 km d'Ene Akwaya, 20.vii.1975 (young fr.), *Letouzey* 14046 (P); Piste Akwaya-Mamfe, entre Nyang et Rivière Mabeme, NNE de Mampe, 31.vii.1975 (fr.), *Letouzey* 14152 (P). Distr. Muyuka, près de Munyenge, 20 km NW of Muyuka, 29.v.1976 (young fr.), *Letouzey* 15021 (BR, P); c. 50 km NW of Eseka, W of Yaoudé, 25.xi.1963 (fr.), *de Wilde* 1341 (MO, P, WAG). GABON: c. 61 km, along an exploitation track leading in NW of Doussala, 130 m, 02°12'S 10°12'E, 28.xi.1986 (fl.), *de Wilde et al.* 9021 (WAG). Ngounié, SW of Fougamou, Koumounabwali, 250 m, 01°18'S 10°25'E, 11.xii.1995 (fl.), *de Wilde et al.* 11547 (WAG). Route de Kinguelé, 18.i.1968 (sterile), *Hallé & Villiers* 4541 (P). GUINEA: Environ de Macenta,

8.viii.1936 (fr.), *Jacques-Félix* 1087 (P). UNKNOWN COUNTRY: *Gueckedou* s.n. (P).

16. *HYMENODICTYON FLORIBUNDUM* (HOCHST. & STEUD.) B.L. ROB., PROC. AMER. ACAD. ARTS 45: 404. 1910 (BRIDSON & VERDCOURT, 1988: 453, FIG. 66)

Kurria floribunda Hochst. & Steud., Flora 25: 234. 1842, nom. illegit. *H. kurria* Hochst., Flora 26: 71. 1843, nom. illegit. TYPE: Abyssinie [ETHIOPIA]. [without exact locality], 11.vi.1837 (fr.), *Schimper* 277 (HOLOTYPE: P!; ISOTYPES: BM!, G!, S!, UPS!).

Hymenodictyon kurria Hochst. var. *elongatum* Hiern Hiern in Oliv., Fl. Afr. Trop. 3: 42. 1877, nom. illegit. TYPE: ANGOLA. Niam-Niam, 28.v.1870 (young fr.), *Schweinfurth* s.n. (HOLOTYPE: K!; ISOTYPE: BM!).

Hymenodictyon kurria Hochst. var. *tomentellum* Welw. in Welw., Cat. Afr. Pl. 2: 436–437. 1898, nom. illegit. TYPE: ANGOLA. Huilla, xii.1859 (fl.) & iii.1960 (fr.), *Welwitsch* 3033 (HOLOTYPE: BM!; ISOTYPES: G!, P!).

Hymenodictyon kurria Hochst. var. *bequaertii* De Wild. in De Wild., Pl. Berquaert. 2: 201–202. 1923, nom. illegit. TYPE: DEMOCRATIC REPUBLIC OF CONGO: Angi, galerie forestière, bords de la rivière, 19.ix.1914 (fl.), *Bequaert* 5775 (HOLOTYPE: BR!; ISOTYPES: BR[2]!).

Hymenodictyon kurria Hochst. var. *claessensi* De Wild. in De Wild., Pl. Berquaert. 2: 202–203. 1923, nom. illegit. TYPE: DEMOCRATIC REPUBLIC OF CONGO. Takolu, vii.1921, *Claessens* 1123 (HOLOTYPE: BR!; ISOTYPE: BR!).

Description: SHRUBS to medium-sized TREES (1.5–)3–9 m tall, with rounded crown, spreading branches. BARK drying red-brown-tinged. STIPULES triangular to lanceolate or strap-shaped, 8–14(–21) mm long, apex acute to rounded, rarely truncate, bifid, glabrous, deciduous. LEAVES deciduous; petioles 4–40(–70) mm long, red-tinged, glabrous to pubescent; blades elliptic to obovate, 5–18 × 2–12 cm, pale green above, light green beneath, glabrous above, puberulous to densely pubescent or tomentose beneath, coriaceous, apex abruptly acuminate, base cuneate to attenuate; margins glabrous; midribs drying yellow-red-tinged, glabrous above, puberulous to pubescent, rarely glabrous beneath; secondary veins seven to nine pairs per side, yellow-red-tinged, conspicuous, glabrous above, puberulous to pubescent beneath; tertiary veins glabrous above, puberulous pubescent beneath; without domatia. INFLORESCENCES terminal (6)22–26 cm long, erect, solitary, compact, simple racemose, composed of a puberulous peduncle, a puberulous rhachis, numerous single flowers and two- to five-flowered cymules, subtended by a pair of long-petiolate bracts at the apex of peduncles; petiolate bracts narrowly elliptic to lanceolate, yellow-green- to red-tinged, puberulous to pubescent. FLOWERS five-merous; pedicels 0.30–0.75(–2) mm long, puberulous; calyx lobes narrowly ovate to linear, 0.25–1 mm long, green, glabrous to puberulous, ciliate; corolla tubes narrowly tubular up to the midpoint and abruptly opening out into cups, 3.5–7 mm long, red- to yellow-red-tinged or green-yellow-tinged, glabrous to puberulous outside, corolla lobes narrowly ovate or triangular, 0.8–1 mm long, glabrous; anthers 1.8–2 mm long, filaments 1–1.5 mm long; ovaries obovoid, 1.5–2 mm long, pubescent; styles 8–10 mm long, red-tinged; stigmas clavate to globose, light green; ovules (5)ten to 16 per locule. FRUITS 8–15 mm long, red-brown-tinged, ornated by spherical, nonelevated lenticels; pedicels 6–9 mm long, lenticellate; seeds (5)ten to 16 per locule, narrowly elliptic, 6–10 × 3–4 mm (wings included), broadly winged only at both ends, margins entire.

Phenology: Flowering January to December; fruiting January to December.

Common names: Dabka and/or Abalo (Ethiopia), Umwamtra (Rwanda).

Habitat: Growing on outcrops and granite domes, open woodlands (Bridson & Verdcourt, 2003); 1000–2200 m, occasionally found in evergreen rainforests and remnants by rivers (Bridson & Verdcourt, 2003) between 200 and 960 m.

Distribution: Angola, Burundi, Cameroon, Congo, Eritrea, Ethiopia, Gabon, Guinea, Ivory Coast, Kenya, Liberia, Malawi, Mozambique, Nigeria, Rwanda, Sierra Leone, Sudan, Tanzania, Togo, Uganda, and Zimbabwe (Fig. 15).

Discussion: Both *H. floribundum* and *H. epiphyticum* have simple racemose inflorescences, but the former is a terrestrial shrub to medium-sized tree with compact inflorescences and coarse rhachis compared with the latter, which is a small epiphytic up to 3 m tall with rather lax inflorescences and slender rhachis (Table 4). Four varieties of *H. floribundum* have been recognized based mainly on leaf indumentum and size. However, this varietal classification appears never to have gained acceptance. This revision showed continuous variation in leaf indumentum and size in *H. floribundum*.

Additional specimens examined: ANGOLA: Distr. Benguela, Lepi, 2000 ft, 3.viii.1940 (fr.), *Gossweileri* 12078 (BM); near Quipeio, 1500 m, 11.v.1937 (fr.), *Exell & Mendonça* 1902 (BM). Distr. Buila, Sanda Bandeira, Tunda Vala, *Teixeira & Soussa* 7869 (PRE); site de Tundavala, c. 6 km de Sa da Bandeira, 14 56'S 13 24'E, 2200 m, *Dechamps-Kurta & Silva* 1173 (WAG). Distr. Cuanza Sul, Amboim, Capir, *Gossweiler* 10026 (BM). Distr. de Malanje, près de Caculama, 1150 m, 13.iii.1974 (fr.), *Dechamps-Kurta & Silva* 1476 (WAG). Distr. Huambo, Mt Moco, *Huntley* 1215 CD (PRE). Quedas, Duque de Bragança, 16 01'E 09 04'S, 5.iii.1960 (fr.), *Barbosa* 8827 (BM, UPS); 1140 m, 23.iii.1973 (fr.), *Bamps et al.* 4262 (MO, UPS). Distr. Malange, R. Lucala, Duque de Bragança, Rianzondo Falls, 1050–1100 m, 28.iii.1937 (fr.), *Excell & Mendonça* 83 (BM). Pungo Andongo Province: 21.xii.1907 (fl., fr), *Kassner* 2178 (BM). Unknown locality, *Welwitsch* 3032 (BM, G, P), 1750 m, 2.ii.1907 (fr.), *Glossweiler* 2858 (BM), *Hochs* 3032 (G). BURUNDI: Bururi Province: Muyange, 2000 m, 26.ix.1971 (fl.), *Reekmans* 1024 (BR, MO). Bubanza Province: Mabaye, Lua frontière du Rwanda, 1650 m, 22.vi.1969 (fr.), *Lewalle* 3789 (BR, MO); Muyange, *Lewalle* 1071 (MO). Ruyigi Province: Gitwenge-Muzire, 03 13'S 30 43'E, 1900 m, 17.v.1978 (fr.), *Reekmans* 7052 (MO, WAG). Distr. Gitwenge, 30 13'S 30 42'E, 1800 m, 10.ii.1978 (fl.), *Reekmans* 7322 (MO,

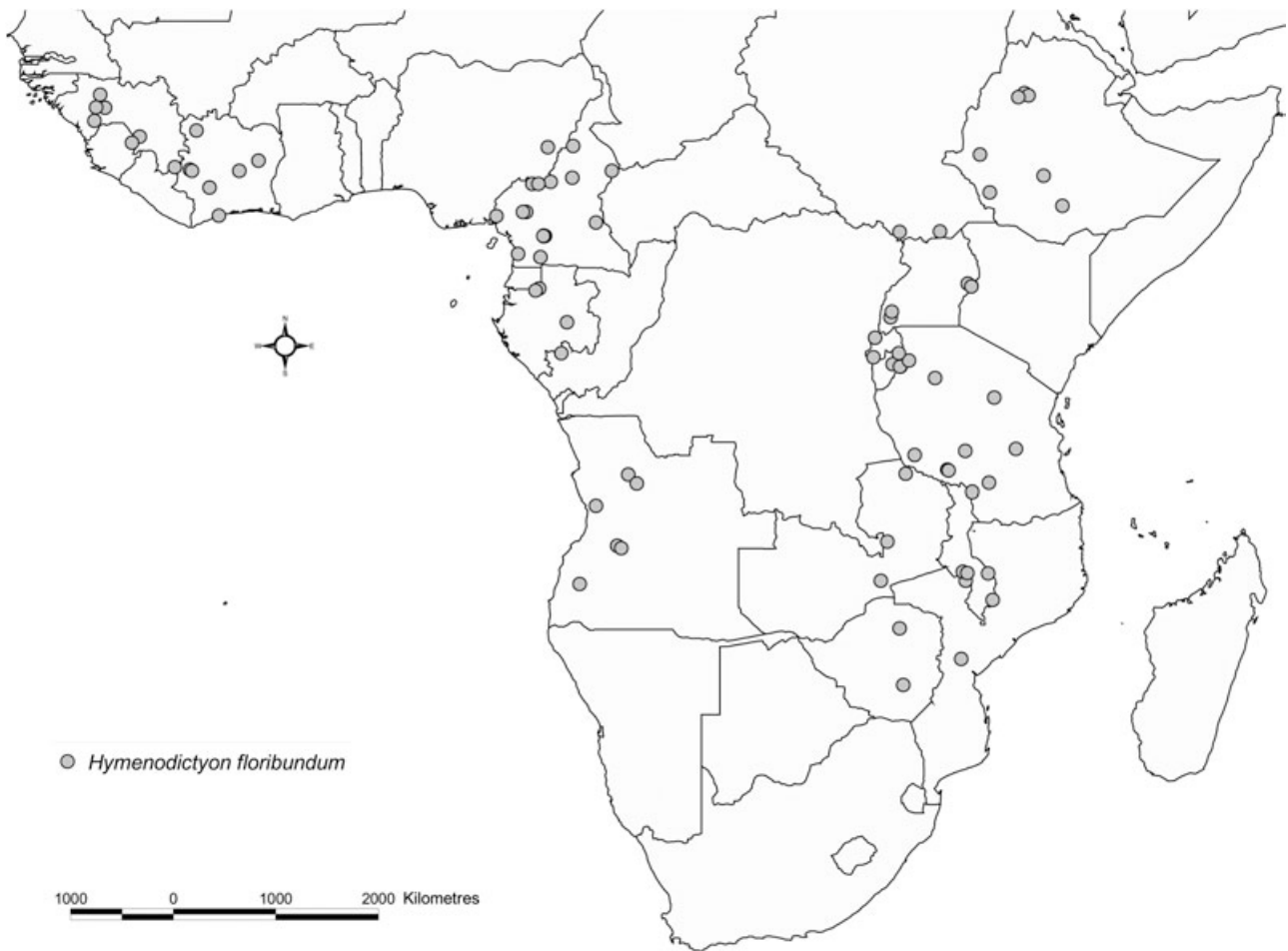


Figure 15. Distribution of *Hymenodictyon floribundum*.

WAG); Colline de Kukaremera, 03 12'S 30 42'E, 1700 m, 5.i.1979 (young fr.), *Reekmans* 7517 (MO, PRE, WAG); Colline de Gatunti, savane à *Combretum* et *Strychnos*, 1700 m, 2.v.1980 (fr.), *Reekmans* 9006 (MO). Distr. Mpinga, Gouffre des Allemands, 1900 m, 21.xi.1975 (fl.), *Reekmans* 4623 (MO, P, WAG). Distr. Murori, 1800 m, 1966 (fl.), *Lewalle* 1147 (BR). Kininga, 4.x.1951 (sterile), *Michel* 2480 (BR); Reserve Buyogona, sommet de colline, rocailleux, 4.x.1952 (fr.), *Michel* 4433 (BR). Rutaka Province Garuwa, 2000 m, 19.ii.1959 (fr.), *Michel* 6127 (BR). Direction Gankuzo, Colline de Muyaga, 03 13'S 30 34'E, 1800 m, 28.ii.1980 (fl.), *Ndabaneze* 1390 (BR). CAMEROON: Distr. Bangwa, c. 15 km NW of Banganté, 5.v.1964 (fl.), *de Wilde* 2475 (WAG). Distr. Dschang, bord de la route, 1300 m, *herbier CNAD* 1877 (P, WAG). Akoakas Rock, 24 km on the road from N'Koemvome to Akoakas, 02 43'N 11 16'E, 2.iv.1975 (fl.), *de Wilde* 8130 (MO, PRE, WAG); Nkolbison, c. 8 km W of Yaoundé, 650 m, 19.iv.1964 (fl.), *de Wilde* 1394 (PRE, WAG); 700 m, 6.xii.1963 (fl.), *de Wilde*

1394B (PRE, WAG), *de Wilde* 2287 (MO, WAG); Nkolbisson, c. 8 km from Yaoundé, N of Edea road, 03 52'N 11 26'E, 1000 m, 19.iv.1969 (young fr.), *Bos* 4355 (MO, WAG); NW of the Village de Nkolbisson, c. 7 km W of Yaoundé, 800 m, 26.ix.1961 (fr.), *Breteler* 1927 (WAG); 2.xii.1965 (fr.), *Leeuwenberg* 6036 (MO, WAG). Plateau of the Adamaoua, c. 6 km S of Ngoomoeuré, 16.x.1960 (fr.), *Breteler* 506 (WAG); Pandi Mt, 700–850 m, 14.iv.1962 (fl.), *Breteler* 2792 (WAG). Mgaoudéré, iii.1939 (fl.), *Jacques-Félix* 3465 (P). Mt Bana, 11.v.1959 (fl.), *Letouzey* 1322 (P). Massif de Djoumte, 34 km NW of Poli, 12.vii.1974 (fr.), *Forius* 2069 (P). Colline de Nkolkoue, 3 km de Yaoundé, 17 km E of Awae, 10.vi.1974 (young fl.), *Villiers* 912 (P). Ngaou, 1600 m, vi.1939 (fr.), *Jacques-Félix* 4052 (P). Région de M'Bamileke, 19.xii.1957 (fr.), *de Wit* 279 (WAG). Pente NW of Hoseré, Banyo, 1100–1400 m, 9.vi.1967 (fl.), *Letouzey* 8573 (G, WAG). Massif de Ngolé, versant E d'Yakounga, N de Banda, rochers gneissiques nus, 1000 m, 4.iv.1963 (fl.), *Raynal et al.* 10731 (P). Unknown localities, sommet de la fal-

aise rocheuse, 26.i.1974 (fr.), *Letouzey* 12788 (P, WAG). 1450 m, 2.viii.1955 (fr.), *Saxer* 259 (G, WAG). Central Province: near the top of Akondo Hill, NW of the handicapped centre, Etoug Ebe, Yaoudé, 03 50'N 11 28'E, 880 m, 15.ix.1986 (fr.), *Manning* 224 (MO); 03 51'N 11 28'E, 960 m, 3.vi.1987 (fr.), *Manning* 1908 (WAG). CONGO: Massif du Thailu, Bowal de Missanda, N Kouyi, xi.1982 (fl.), *Sita* 4728 (P). Forêt et lisière de la plaine de Missanda, 28.x.1975 (fl.), *Sita* 3959 (BR). Katerusi, on the 1912 volcano, 13.i.1931 (fr.), *Burt* 3273 (G). DEMOCRATIC REPUBLIC OF CONGO: *Hendricks* 4262 (PRE). Kivu Province, Kabare, Matale, forêt de basse Montagne, 1480 m, iv.1959 (fr.), *Léonard* 3670 (MO, UPS, WAG). Masisi, Karunda, Niabiondo, *Gutzwiller* 3262 (PRE). Unknown locality, 1460–1500 m, x.1953 (young fr.), *Humbert* s.n. (P). Distr. Kivu Nord, Virunga-Kette, Lavaebene, 16.ix.1954 (fl.), *Stauffer* 350 (K, UPS, WAG). Distr. Walikale, Lungoma, 1050 m, vi.1958 (fl.), *Gutzwiller* 3072 (MO). Mashamba, brousse enrochée, 1440 m, 16.i.1981 (fr.), *Malaisse* 11489 (WAG). Colline Awe Sources du Kibali, 21.ii.1956 (fl.), *Smeyers* 320 (MO). Plaines de laves entre les lacs Kivu et Edouard du Mikeno au Ninagongo, 2000 m, 1929 (fl.), *Humbert* 8178 (P). Kinibata, Lume, 1600 m, 13.viii.1952 (fr.), *Osmaston* 2018 (BM). R. Nezelube, N of Mwenda, 1300 m, 10.ix.1952 (fr.), *Osmaston* 2292 (BM). Unknown locality: iv.1937 (buds), *Ghesquière* 4326 (K). ERITREA: Unknown locality, 1891 (fr.), *Schweinfurth* 850 (G). ETHIOPIA: Kaffa Province: Gobe, NW of Maji, 06 13'N 35 33'E, 2200 m, 16.i.1970 (fl.), *de Wilde* 6182 (MO, PRE, WAG). Walema, c. 4 km from W of Dilla, growing along a river, 24.viii.1967 (fr.), *Ebba* 607 (WAG). About 25 km N of Lekemti, road to Angar-river, savanna, 14.iv.1966 (buds), *de Wilde* 10781 (WAG). Gojjam Province: in open woodland, c. 5 km S of Bahar Dar, 11 36'N 37 25'E, 5900 ft, 27.x.1964 (fr.), *Meyer* 8660 (P, WAG). Gondar Region Tissisat, at the path leading to the principal viewpoint of the falls, 11 28'N 37 38'E, 1800 m, 26.vii.1988 (fl, fr.), *Friis & Lawesson* 5413 (K). Shoa Region, N of the shore of Lake Awasa near Eondo Tika, 07 07'N 38 27'E, 1750 m, 7.v.1980 (fr.), *Thulin et al.* 3325 (UPS). c. 55 km on the Dangla-Bahar Dar road, c. 9 km beyond Marawi, 11 23'N 37 05'E, 2100 m, 31.v.1980 (fl.), *Thulin & Hunde* 4070 (UPS). Gore Awr. Gombela road, 15–20 km W of Gore, 08 16'N 35 01'E, 1120 m, 13.viii.1982 (fr.), *Puff & Kelbessa* 8208 (UPS). Bitata 20 km from on road to Kebre Menghinst (Adola), 05 29'N 39 28'E, 1450 m, 24.v.1983 (fl.), *Gilbert et al.* 7806 (UPS). Wondo Gennet near Swamp Lake, 1700 m, 15.viii.1970 (fr.), *Hovda* s.n. (UPS). Unknown localities, *Agosto* 281 (L), *Schimper* 148 (BM, S), *Schimper* 707 (P, WAG), *Chiré* s.n. (P). GABON: Bélinga, 975 m, 7.xi.1964 (fl., fr.), *Hallé* 3080 (P); Bélinga Mines de Fer, 3.vi.1966 (fr.), 1000 m, *Hallé* 3717 (P). Inselberg de Ntan (Bikougou), 01 01'N 11 13'E, 790 m, 22.i.2000 (fr.), *Parmenier & Nguema* 825 (WAG). Inselberg, c. 28 km of Medouneu, 0 55'N 11 01'E, 500 m, 3.ii.1986 (fr.), *Louis* 1806 (MO, WAG). Région de Lastoursville, 900–1000 m, 27.xii.1930 (fl.), *Testu* 8625 (BM, MO). Région entre Ogooué et Cameroun; 28.x.1932 (fl.), *Testu* 8953 (BM, P); 5.ii.1933 (fl.), *Testu* 9008 (BM, P). GUINEA: Béna, i-ii.1942 (young fl.), *Chillon* 3052 (P). Hort Dalaba, 3.vii.1912 (fl.), *Chillon & Maunoury* s.n. (P). Diagenssa, 1350 m, 17–18.iv.1905 (fr.), *Chevalier* 12919 (P). Distr. Kissidougou, Bambadou, 1944 (fl.), *Jacques-Georges* 126 (MO). Environ de Kindia, *Jacques-Félix* 319 (P). Environ de Pita, x.1937 (fr.), *Jacques-Félix* 1952 (P). Mt Nimba, 30.iii.1932 (fl.), *Tono* 1133 (P). Fouta-Djallon, entre la Cascade de Ditim et la Missidi de Dalaba, ix.19. 1907 (fr.), *Chevalier* 18543 (P). Unknown locality, v.1909 (fl.), *Pobeguins* 2081 (P). IVORY COAST: Basse Côte d'Ivoire, Boka d'Issia, *Roberty* 13850 (G). Mt Momi, 850–900 m, 29.iv.1909 (fl.), *Chevalier* 21392 (P). Mt Sassandra, pays Toura, entre Soucourala et Sanrou, 20.v.1909 (young fr.), *Chevalier* 21596 (P). Mt Tonkouï, secondary forest NW of Man, 1100 m, 1962 (young fl.), *Leeuwenberg* 3852 (L, MO, WAG); Serebou, 1958–59 (fr.), *Leeuwenberg* s.n. (WAG); rocher du sacrifice, 3.x.1961 (fr.), *Hallé* 356 (P); environ de Man, x.1936 (fr.), *Jacques-Félix* 1272 (P). Sederou, *Amshoff* s.n. (WAG); road to Odienne to Tieme, Massif de Tougoukoli, 22.x.1974 (fr.), *de Koning* 4354 (WAG). KENYA. Distr. Eldoret, *Williams* 246 (PRE). Elgon, Swan River, 7000 ft, v.1948 (fl.), *Adamson* 453 (G); Elgon Mt, 6500–7500 ft, *Jackson* 362 (BM). Nyanza Province: Distr. Trans-Nzoia, 6000 ft, 15–17.ii.1935 (fl., fr.), *Taylor* 3399 (BM, S). Unknown locality, xii.1955 (fl.), *Starzenski* 19 (BR). LIBERIA: Nimba Mt, iv.1942 (fl.), *Schnell* 1340 (P); 19.xii.1964 (fr.), *Adam* 20195 (P, UPS). MALAWI: Mzimba Province: Distr. Dedza, Vipha, Kangoli (Kanjoli) Hill, Chongeni Forest Reserve, 12.i.1967 (fl.), *Salubeni* 486 (K, UPS). Distr. Mulanje, Fort Lister Gap, foot of Mchese Mt, 16.iv.1970 (fr.), *Brummitt & Banda* 9912 (PRE, UPS), *Kathumba et al.* 38 (PRE). Distr. Vipya plateau, 38 miles SW of Mzuzu, Kamunga, 5500 ft, 3.ii.1974 (fr.), *Pawek* 8060 (MO, WAG); 23.ii.1975 (young fr.), *Pawek* 9087 (MO, PRE, WAG). Southern Province: Distr. Mangochi, Namwera Escarpment, Jalasi, 1120 m, 15.iii.1955 (fr.), *Exell et al.* 906 (BM). MOZAMBIQUE: Tete, Angónia, 14.xii.1980 (fl.), *Macuácuá* 1442 (MO, PRE, WAG). Distr. Manica E of Sofala, 2.iii.1948 (fr.), *Garcia* 472 (MO); Macanga, 1140–1265 m, 15.iii.1966 (fl.), *Pereira et al.* 1789 (BR). NIGERIA: State North-eastern, Distr. Mambilla, Mambilla plateau, 9.vii.1972 (fr.), *Chapman* 1969 (WAG); Gembu, behind dispensary, 06 40'N 11 10'E, 11.v.1972 (fl.), *Wit et al.* 2053 (MO, WAG). Orosun Mt, iv.1967 (fl.), *Guile* 2608 (MO). Division Muri, Distr. Mumuye, 5000 ft, on

- Gamvriki Hill, 1.iii.1976 (fl.), *Chapman* 4272 (K). Gangoro Forest Reserve, 1969–70 (fl.), *van Meer* 1060 (WAG), *van Meer* 1813 (WAG); savanna, 4200 ft, 9.v.1980 (fl.), *Sharland* 1201 (K). University compound Ibadan, 22.ii.1968 (fl.), *Gledhill* 839 (P, WAG). RWANDA: Bugesera, xi.1970 (fl.), *Michelson* 1332 (WAG); 4–5 km from road to Niendezi, 17.vi.1975 (fr.), *Runyinya* 200 (WAG); Rusumo, chutes de l'Akagera, galerie forestière, 1300 m, 24.i.1980 (fr.), *Bridson* 275 (WAG). Ruanda Province: Distr. Biumba, région du Mutara, environ de Mimuli, 1400 m, 22.x.1957 (fl.), *Troupin* 5061 (BR); Réserve IRSAC, Colline de Bukire, 1450 m, 27.v.1957 (fr.), *Troupin* 3319 (K); 1400–1450 m, *Troupin* 11823 (MO); région du Mutara, Colline de Nteko, 12.iii.1958 (fr.), *Troupin* 6659 (BR), Région du Mutara, Colline de Gikandura, 9.x.1958 (sterile), *Troupin* 8513 (BR); Route Bukavu-Astrida, environ d'Uwinka, 1900 m, 2.ii.1959 (fl.), *Troupin* 9706 (BR) 1920 m, 26.x.1959 (fl.), *Troupin* 11239 (BR); environ d'Uwinka, 2200 m, 5.v.1960 (fr.), *Troupin* 12289 (BR); P.N. Akagera, mt. Nutumba, 1650 m, 9.xii.1974 (fl.), *Troupin* 15578 (BR). SIERRA LEONE: Tingi Hills on plateau near camp, 12.iv.1965 (fl.), *Morton & Gledhill* 1836 (WAG). SUDAN: South-west Equatorial Province: Distr. Yei, Mngwa Mt, Yei-Uganda road, 21.iii.1939 (fl.), *Hoyle* 491 (BM). Imatong Mt, 12.iii.1976 (fl. fr.), *Howard* 77 (K); v.1921 (fl.), *Legagneux* s.n. (L). TANZANIA: Distr. Iringa, Kidatu, 07 40'S 36 57'E, 28.i.1971 (fl.), *Mhoro* 281 (UPS); 3.iii.1971 (fl.), *Mhoro* 420 (UPS). Distr. Kondo, 10.i.1928 (fl.), *Burt* 973 (BM); 21.i.1928 (fl.), *Burt* 938 (BM). Distr. Kyimbila, *Stolz* 1596 (BM); Station Kyimbila, 1912 (young fr.), *Stolz* 1870 (BM), *Stolz* 1873 (G, L, S, WAG). Distr. Mahenge, 900–1000 m, 14.i.1932 (fl.), *Schlieben* 1623 (BM, G, P, S). Distr. Mbeya, Pungaluma Hills, 08 47'S 33 15'E, 1300–1400 m, 16.xi.1989 (young fl.), *Lovett & Kayombo* 3307 A (MO, PRE, UPS); 23.v.1990 (fr.), *Kayombo* 978 (MO, PRE); Mshewe village, 08 50'S 33 20'E, 1250 m, 10.iv.1990 (fr.), 23.xii.1989 (young fl.), *Lovett et al.* 3830 (PRE, UPS), *Lovett & Kayombo* 4486 (K, MO, PRE); Ruaha National Park, on the northern slopes of Magangwe Hill, 1600–1700 m, 20.xii.1972 (fr.), *Bjornstad AB* 2238 (UPS). Distr. Mkwani, Kahama, 25.v.1937 (fr.), *Burt* 6564 (BM). Distr. Mufindi, c. 1 km. E of Lulanda, Escarpment of Ifinga, Kipemba stream, rocky terrains, 925 m, 1.viii.1999 (fr.), *Kayombo & Kikoti* 2805 (MO). Distr. Njombe, Livingstone Mt, 09 59'S 34 36'E, 1920 m, 15.i.1991 (fl.), *Gereau & Kayombo* 3618 (MO, PRE). Distr. Ufipa, 2.ii.1960 (fl.), *Richards* 13629 (K). West Lake Province: Distr. Biharamulo, Lusahanga, 4500 ft, 15.x.1960, *Tanner* 5321 (WAG). Distr. Ngara, Mu Rgwanza, Bugufi, 5900 ft, 20.i.1961 (fr.), *Tanner* 5622 (WAG). Unknown localities, *Buchanan* 751 (BM), *Buchanan* 1062 (G), *Kaessner* 529a (BM), *Peter* 55731 (WAG). TOGO: Sokodé Bafilo, bei Péwa, 500 m, NE of Straßenabzweigung, 1.xi.1979 (fl. fr.), *Schiers* 235 (K, MO, P); Sokodé-Basari, *Kersting* 741 (BM). UGANDA: Agota, *Greenway & Hummel* 7317 (PRE). Distr. Mbale, Buginyanya Bugiashu, 6500 ft, 9.xii.1938 (fr.), *Thomas* 2588 (P); Tracey Falls, Mt Elgon, 5500 ft, 27.vii.1917 (fr.), *Snowden* 510 (BM); Mt Elgon, 5600 ft, 22.iii.1926 (fl.), *Snowden* 855 (BM). Distr. Bushenyi North, SW of Kashoha forest, 0 15'S 30 15'E, 1824 m, 21.ix.1987 (fl.), *Katende* 3193 (MO). Mabiva Mt, ii.1918 (young fl., fr.), *Dummer* 3907 (BM). Unknown localities, c. 6000 ft, 3.xii.1903 (fl.), *Bagshawe* s.n. (BM), *Bagshawe* 313 (BM). ZIMBABWE: Northern Province: Distr. Abercorn, 15.xi.1952 (buds), *Angus* 760 (WAG), Bock 24 (PRE), *White* 3646 (PRE, WAG). Distr. Goromonzi, Chinamora Reserve, 8 km N of Muwanga, 5000 ft, 5.i.1967 (fl.), *Simon* 968 (K, MO); on rocky slope, c. 1500 m, 29.xi.1981 (fl.), *Best* 1821 (MO); 5000 ft, v.1960 (fr.), *Miller* 7298 (MO). Distr. Gresham, 17 13'N 30 50'W, 3.iv.1998 (sterile), *Poilecot* 7901 (G). Distr. Makoni, Rurape, xi.1952 (fr.), *Dehn* 42366 (MO, P, PRE), *Venter et al.* 1832AC (PRE); Numba Mt, *Fennar* 4058 (PRE). Makoni, c. 8 km, 1.xii.1930 (fl.), *Fries et al.* 3400 (WAG). Distr. Inyanga, Zinbiti Reserve, 17.iv.1966 (fr.), *Biegel* 1105 (MO); 5900 ft, 27.iv.1967 (fr.), *Rushworth* 824 (MO); unknown locality, 1.xi.1930 (fl.), *Fries et al.* 2539 (BM). Distr. Mehetter, Welgelegen, 4000 ft, xi.1952 (young fl.), *Ball* 41972 (MO). Distr. Mpika, on crest of Muchinga escarpment about 30 miles from Shiwa Ngandu, 29.xi.1952 (fl.), *Angus* 881 (WAG). Distr. Sipolilo, Nyamunyeche Estate, near Homestead, growing on Kopje, granite sandy soil, 22.xi.1978 (young fl.), *Nyariri* 506 (MO). Distr. Umtali, Watsomba, Kukwaansa trug, Ruware, 4900 ft, 9.i.1967 (fl.), *Biegel* 1707 (MO); Murakwas Hill, on the cliff edge of Zimunya Reserve, 17.xii.1950 (fl.), *Chase* 3477 (G, MO), *Chase* 30930 (MO); growing on rocky substrate, ii.1947 (fl.), *Chase* 297 (BM), *Chase* 30056 (MO); Murakwas Hill, 3600 ft, 17.i.1950 (fl.), *Chase* 2905 (BM, MO). Vicinity of Umvukwe Mt, 23.iv.1948 (fl.), *Rodin* 4409 A (MO). Victoria, 1909–12 (fr.), *Monro* 1905 (BM). Unknown locality, 13.viii.1929 (fr.), *Rendle* s.n. (BM). UNKNOWN COUNTRY: *Roberty* 15967 (G), *Roberty* 17642 (G), *Roberty* 17753 (G), *Schweinfurth* 3866 (G, P). Africa centralis, in Mt Elgon, *Holm* 88 (S). Colline de Nkoltsia, près Gouap, 18 km NW of Bipundi, 5.xii.1974 (fr.), *Villiers* 851 (P). Plateau de l'Oubangui, région de la Quaka, 7.v.1925 (fl.), *Tisserant* 1893 (BM, K, P), *Tisserant* 2443 (BM, P).
17. *HYMENODICTYON PACHYANTHA* K. KRAUSE, BOT. JAHRB. SYST. 57: 26. 1920
- TYPE: CAMEROON. [without exact locality], iii.1911 (young fl. and fr.), *Mildbraed* 4623 (HOLOTYPE: B

destroyed). NEOTYPE: CAMEROON. *c.* 210 km NE of Jaunde, iii.1914 (fl.), *Mildbraed* 8497 (NEOTYPE here designated: K!).

Hymenodictyon gobiense Aubrév. & Pellegr., Bull. Soc. Bot. France 105: 34. 1958. TYPE: IVORY COAST. Près le village de Gobia, non loin du Fleuve Bandama, Nord-Est d' Oumé, 4.iii.1957 (fl.), *Aubreville* 4153 (HOLOTYPE: P!).

Description: TREES, up to 31 m tall, with medium-sized buttresses, pyramidal crowns. BARK grey. STIPULES broadly oblong, 6–8 mm long, apex rounded, glabrous, deciduous. LEAVES deciduous, clustered apically; petioles 35–50 mm long, glabrous; blades broadly obovate (8–)14–31 × 5–11 cm, drying red-brown-tinged above, light green-tinged beneath, glabrous, subcoriaceous, apex acute to rounded, base attenuate; margins glabrous; midribs drying red-tinged above, yellow-tinged beneath, glabrous; secondary veins eight to 12 pairs per side, drying yellow-tinged above, yellow-tinged beneath, less conspicuous above, conspicuous beneath, glabrous; without domatia. INFLORESCENCES terminal, sometimes terminal and axillary from uppermost leaf pair, 10–32 cm long, erect, trichotomous, bilaterally branched at the base of the peduncles of the primary inflorescence units. Each inflorescence unit racemose, compact, composed of a pubescent peduncle, a densely pubescent rhachis, numerous solitary flowers and two- to six-flowered cymules, unsubtended by long-petiolate leaf-like bracts. FLOWERS five- to six-merous; pedicels 2–3 mm long, densely pubescent; calyx lobes subulate, 4.5–7 mm long, green, recurved, puberulous; corolla tubes napiform, 1.3–1.5 mm long, densely pubescent, corolla lobes broadly triangular, *c.* 0.5–1 mm long, inflexed, densely pubescent; anthers 0.75–1 mm long, filaments *c.* 0.25–0.5 mm long; ovaries elongate, 1.5–2 mm long, pubescent; styles *c.* 6 mm long; stigmas green-tinged, globose; ovules eight or nine per locule. FRUITS 20–28 cm long, brown-tinged, ornated by elongate, nonelevated lenticels; pedicels 5–10 mm long, lenticellate; seeds eight or nine per locule, broadly elliptic, *c.* 12 × *c.* 5 mm long (wings included), broadly winged, margins entire.

Phenology: Unknown.

Common name: Obadan (Benin).

Habitat: Unknown.

Distribution: Benin, Cameroon, and Ivory Coast (Fig. 12).

Discussion: *Hymenodictyon pachyantha* is very distinct from the other *Hymenodictyon* species because of its recurved calyx lobes, which are longer than the

mature corollas, and its elongate ovaries. We were unable to trace the type specimen of this species (*Mildbraed* 4623). According to the Index herbarium (Vegeter, 1976: 538), the original, African collections of *Mildbraed* from the four German expeditions collected in 1907–08, 1910–11, 1913 and 1928 were all destroyed at the Berlin herbarium (Holmgren *et al.*, 1990). Consequently, we here designate a neotype, *Mildbraed* 8497(K), also collected by *Mildbraed* in Cameroon.

Additional specimens examined: BENIN: Unknown localities, 10.iv.1911 (fl.), *Tarquhar* 18 (K), *Tarquhar* 33 (K). CAMEROON: *c.* 3 km à E de Momjepom, km 22, Route Yokadouma-Moloundou, 6.vi.1963 (fr.), *Letouzey* 5204 (BR[3], P); entre Song et Gribe, à 65 km au SSW de Yokadouma, 2.iv.1973 (sterile), *Letouzey* 12238 (BR, P).

18. *HYMENODICTYON PARVIFOLIUM* OLIV. IN HOOK.,
IC. PL. 15: T. 1488. 1885.

TYPE: KENYA. Mombasa, [without collecting date] (fl.), *Wakefield* s.n. (HOLOTYPE: K!).

Description: SHRUBS or small TREES, sometimes scandent shrubs (1.2–)3.6–10 m tall. BARK light grey- or purple-grey-tinged. STIPULES deltoid or oblong-triangular, 2–7 mm long, bifid, bearing two partly fused, large colleters at the apex, glabrous or ciliolate, deciduous. LEAVES deciduous; petioles 0.3–5.5 mm long, often crimson, glabrous to pubescent; blades elliptic to lanceolate, 1–9 × (0.4–0.8)4.7–5.9 cm, pale green above, light green beneath, glabrous to scabrous, subcoriaceous, apex obtuse to subacuminate, base narrowly cuneate to attenuate, decurrent; margins glabrous, ciliolate; midribs yellow-tinged, glabrous to scabrous; secondary veins three to five pairs per side, yellow-tinged, inconspicuous above, conspicuous beneath, glabrous to scabrous; without domatia. INFLORESCENCES terminal, 1–8 cm long, pendulous, trichotomous, bilaterally branched at the apex of the peduncles of the primary inflorescence units. Each inflorescence unit racemose, compact, composed of a pubescent peduncle, a puberulous to densely pubescent rhachis, numerous two- to seven-flowered cymules, unsubtended by long-petiolate bracts. FLOWERS five- or six-merous; pedicels (0.5–)1–1.5 mm long, puberulous to pubescent; calyx lobes linear (0.5–)1–2.5 mm long, green, puberulous to pubescent, sometimes ciliate; corolla tubes narrowly tubular up to the midpoint and abruptly opening out into cups, 2.5–5 mm long, white to light green or light yellow, sometimes tinged red in buds, glabrous to puberulous outside, corolla lobes ovate, 0.5–1.5 mm long, glabrous, ciliate; anthers 1–2.5 mm long, filaments 0.3–1 mm long;

KEY TO SUBSPECIES OF *HYMENODICTYON PARVIFOLIUM*

- 1a. Leaves glabrous or rarely pubescent on nerves; stems mostly glabrescent.....ssp. *parvifolium*
 1b. Leaves with at least some scaly scabrid hairs on the midrib beneath, stems mostly scabrid-pubescent when young
 ssp. *scabrum*

ovaries obovoid, 1.25–2 mm long, puberulous to densely pubescent; styles c. 14 mm long, green-tinged; stigmas clavate to globose; ovules two or three per locule. FRUITS 10–25(–40) mm long, red-brown-tinged drying grey-brown-tinged, ornated by elongate, nonelevated lenticels; pedicels up to 2 mm long, lenticellate; seeds two or three per locule, broadly ovoid, 10–18 × 5–6 mm long (wings included), winged, margins shallowly fringed.

HYMENODICTYON PARVIFOLIUM OLIV. SSP.

PARVIFOLIUM VERDC., KEW BULL. 31: 182. 1976.

Phenology: Flowering November to March; fruiting March to June.

Common names: Mulinditi (Kenya), Mtumpho and Nherenhere (Mozambique).

Habitat: Grasslands and woodlands; 100–750 m.

Distribution: Kenya, Mozambique, South Africa (Transvaal), Tanzania, and Zimbabwe (Fig. 14).

Discussion: *Hymenodictyon parvifolium* ssp. *parvifolium* can be diagnosed easily by the very short and opposite lateral branches and the presence of two large colleters at the apex of its stipules. The collections from Mozambique that we studied all tend to have much larger leaves and more elongate inflorescences than do those from the other countries. *H. parvifolium* ssp. *parvifolium* is known to occur in Limpopo and Mpumalanga Provinces of South Africa (Bridson & Verdcourt, 2003: 427). However, none of the herbarium specimens that we received on loan from PRE were collected there.

Additional specimens examined: KENYA: Distr. Mombasa, vicinity of Changamwe, on the Uganda railway, 100 m, 21–30.xi.1909 (fr.), *Mearns* 2150 (BM). Distr. Nairobi, Kilaweri, xii.1975 (fl.), *Kokwaro* 3831 (BR). Distr. Ntito Andei, *Greenway* 9541 (PRE, S). Hill immediately across Athi River from Bushwackers Camp, 02 19'N 38 06'E, 19.xi.1978 (fl.), *Gilbert* 5323 A (K). Tsavo National Park, c. 7 km from Voi Gate campsite, 1600 ft, 7.xii.1966 (fl.), *Green & Kanuri* 12680 (K). Distr. Taita, 03 24'S 38 35'S, 520 m, 18.iii.1974

(fr.), *R.B. & Faden* 74/247 (BR, MO); Buchuma, between Voi and Mackinnon Road, 1560 ft, 16.ix.1961 (fr.), *Pohill & Paulo* 477 (BR). Unknown locality, *Dnapper* 1347 (PRE). MOZAMBIQUE: Distr. Cahora Bassa, Songo, 10.ii.1972 (fl.), *Macêdo & Esteves* 4830 (K, PRE), *Macerdo* 5050 (PRE). Distr. Gorongosa, Beira, Gorongosa National Park, *Tinkey* 2736 (PRE). Cabo-Belgado Province: Distr. Acube, Metoro, 1.ii.1984 (fl.), *de Koning & Groenendijk* 919 (MO, WAG); Mt Ancuabe, 550 m, 7.ii.1984 (fl.), *de Koning & Groenendijk* 9480 (WAG), *de Koning & Groenendijk* 9490 (WAG). TANZANIA: Lukosi River, at bottom of Kitonga gorge, c. 6 km W of the Mahenge Village, 07 38'S 36 14'E, 9.i.1989 (fr.), *Gereau et al.* 2798 (BR, MO). Distr. Mbeya, Ruaha National Park, 6 km N of Msembe, 880 m, 1.xii.1972 (fl.), *Bjornstad* 1979 (UPS). Distr. Kilosa, 2500 ft, i.1931 (fl.), *Haarer* 1963 (MO). Distr. Kilimanjaro, Moshi, Chekereni, 03 30'S 37 30'E, 750 m, 2.iii.1993 (fr.), *Abballah et al.* 385 (UPS). Distr. Lindi, 20.i.1935 (fl.), *Schlieben* 5894 (BM, BR, G, P, S); 500 m, 22.i.1935 (fl.), *Schlieben* 5900 (BM, BR, G, P, S). Selous Game Reserve, c. 7 km NNW of Kingupira, 08 24'S, 38 31'E, 125 m, 28.ii.1976 (fl.), *Vollesen* 3298 (WAG). Distr. Morogoro, 2000 ft, 20.iii.1932 (fl.), *Wallace* 391 (BR). Distr. Mpwapwa, 4.iii.1930 (fl.), *Homy* 194 (BM, PRE). Distr. Nyanamba, Nassanza, Musanga, 3000 ft, *Tanner* 538 (S). Distr. Rufiji, Matumbi Hills, Kiwengoma Forest Reserve, 08 19'S 38 58'E, 200–250 m, xi.26. 1999 (fr.), *Kibure* 588 (BR, MO). Distr. Shinyanga, 4000 ft, *Kemp* 30 (BM). Unknown localities *Buchanan* 17 (BM), *Buchanan* 527 (G), *Peter* 55735 (WAG). Distr. Tanga, Mgambo Forest Reserve, Bwitu Village, 04 44'57"S 38 49'06"E, 2.xi.1999 (fr.), *Kindeketa* 188 (BR, MO). Distr. Urazamo, Kibaha, behind cashew plantation, along brook, *Wingfield* 97d (S), *Wingfield* 202 (S). ZIMBABWE: Southern Province: Domboshawa granitic rocks, c. 20 km from Salisbury, *Rendle* 280 (BM). Distr. Chipinge, 640 m, 29.i.1975 (sterile), *Pope et al.* 1436 (BR, MO, PRE). Victoria Province: unknown locality, *Monro* 1805 (BM).

HYMENODICTYON PARVIFOLIUM OLIV. SSP. SCABRUM (STAPF) VERDC., KEW BULL. 31: 182. 1976

Hymenodictyon scabrum Stapf, J. Linn. Soc. 37: 519. 1906. *H. parvifolium* ssp. *scabrum* var. *scabrum* (Stapf) Verdc., Kew Bull. 31: 183. 1976. TYPE: SUDAN.

Bari, [without collecting date] (fl.), *Dawe* 885 (HOLOTYPE: K!).

Hymenodictyon fimbriolatum K. Schum. ex De Wild., Ann. Mus. Congo Belge, Bot., sér. 4, 1: 225–226. 1903. *H. parvifolium* ssp. *scabrum* var. *fimbriolatum* (K. Schum. ex De Wild.) Verdc., Kew Bull. 31. 183. 1976. TYPE: ZAIRE [DEMOCRATIC REPUBLIC OF CONGO]. Katanga, xii.1899 (fl.), *Verdick* 257 (HOLOTYPE: BR!).

Phenology: Flowering December to February; fruiting March to July.

Common names: Mchungusi and Mdimwamburi (Tanzania), Mulinditi (Kenya).

Habitat: Dry, deciduous forests and grasslands; 520–1200 m.

Distribution: Democratic Republic of Congo, Kenya, Malawi, Sudan, Tanzania, Uganda (Verdcourt, 1976: 182), Zambia, and Zimbabwe (Fig. 14).

Discussion: Verdcourt (1976: 182–183) recognized two varieties of *H. parvifolium* ssp. *scabrum* based on whether leaves are densely scabrid-pubescent all over (var. *scabrum*) or they have at least some scaly hairs on the main nerves (var. *fimbriolatum*). His varietal concept has been adopted in the Floras of East Africa (Verdcourt, 1976; Bridson & Verdcourt, 1988) and Zambesiaca (Bridson & Verdcourt, 2003). We studied many more collections of *H. parvifolium* [including most of those seen by Verdcourt (1976) and Bridson & Verdcourt (1988, 2003)]. Our revision shows that there is a range of intermediate variation between the two varieties, making it difficult to separate them as Verdcourt (1976) did. Accordingly, we abandon Verdcourt's (1976) varietal concept but accept his two subspecies of *H. parvifolium*: *H. parvifolium* ssp. *parvifolium* and *H. parvifolium* ssp. *scabrum*.

Additional specimens examined: DEMOCRATIC REPUBLIC OF CONGO: Province Kivu. Depression de la Kando, 1200 m, 22.ii.1978 (sterile), *Malaisse* 9521 (WAG). Gombela, Parc National de Kundelungu, 8.iii.1988 (fr.), *Pawels* 6982 (WAG). Mahagi, 700–1100 m, ix.1931 (fr.), *Lebrun* 3799 (MO, WAG). KENYA: Eastern Province: Distr. Machakos, Mbiuni, Mutula Village, 26.xi.1980 (fl.), *Fliervoet* s.n. (WAG). Distr. Mombasa, Maougou Mt, vii.1897 (fl., fr.), *Carleuman* 2298 (P). Distr. Taita, c. 1.5 km from junction with Nairobi-Mombasa Road, 03 24'S 38 35'E, 520 m, 18.iii.1974 (fr.), *Faden & Faden* 74/247 (UPS, WAG); *Polhill & Paulo* 477 (PRE). Distr. Teita, Voi, 2000 ft, xi.1987 (fl.), *Dale* 3761 (BM). MALAWI: Chitipa Province: Distr. Chitipa, c. 4 km, E of Kapoka, on Misuku

Road, 33 30'E 09 46'S, 23.v.1989 (fr.), *Smith et al.* 5930 (P, WAG); Kaseye Mission, 10 miles from Chitipa, 4200 ft, *Pawek* 7754 (MO); Kaseya Mission, E of Chitipa, 1270 m, 29.xii.1977 (fl.), *Pawek* 13438 (MO, PRE, WAG); c. 42 miles, W of Karonga, 10 miles, E of the crossroad at the Songa Stream, 1070 m, 16.iv.1976 (fr.), *Pawek* 11079 (MO, WAG); Kaseye Mission, E of Chitipa, 26.iv.1972 (fr.), *Pawek* 5265 (K, MO). Distr. Rumphu, 16 km from Livingstonia, Ng'onga, 3500 ft, 13.i.1976 (fl.), *Phillips* 953 A (K, MO), *Phillips* 955 (K, MO). SUDAN: Nih Province: Bari, 1600 ft, 24.iii.1907 (fl. fr.), *Bagshawe & Camb* 1646 (BM). TANZANIA: Iringa Province: Distr. Iringa, 07 40'S 35 20'E, 1100 m, 2.iii.1987 (fr.), *Lovett* 1648 (MO, PRE). Distr. Kondo, road to Dodoma, 23.iv.1940 (fr.), *Vaughan* 3120 (BM), *Vaughan* 3121 (BM). Distr. Kyimbila, N of Lake Nyasa, *Stolz* 2560 (BM, BR, PRE, UPS). Mbeya Province: Distr. Mbeya, hot spring limestone rocks near Songwe, 1200 m, 6.v.1991 (fr.), *Lovett & Kayombo* 172 (MO); 20.xi.1990 (fl.), *Lovett & Kayombo* 4964 (MO); Madibira-Ipogoro Road, 900 m, 8.xii.1962 (fl.), *Richards* 17348 (BR); Chimala-Mbeya Road., 1350 m, 6.xii.1963 (fl.), *Richards* 18583 (BR). Distr. Mpanda, Mpanda Road, 780 m, 13.ii.1971 (fl.), *Sanaro* 1538 (UPS). Distr. Mwanza, v.1922 (fr.), *Swynnerton* 701 (BM). Distr. Tabora, Kawewe's country, 05 22'S 32 52'E, 20.x.1928 (sterile), *Carnochan* 68 (BM); 3500–4000 ft, i.1935 (fr.), *Lindeman* 30 (BM). ZAMBIA: Katuta, i.1944 (fl.), *Bredo* 5878 (BR, WAG). Northern Province: Distr. Mporokoso, c. 16 miles N of Kafulwe, on road to Chiangi, 5.xi.1952 (sterile), *Angus* 721 (BM, WAG). Distr. Petauke, in woodland on Karroo stones, Luangwa Valley, near Ndefu, 19.iv.1952 (sterile), *White* 2420 (BR, WAG). ZIMBABWE: Northern Province: Distr. Abercorn, Kalambo Falls, path down to the Lake, 1200 m, 9.ii.1965 (fl.), *Richards* 19621 (BR). UNKNOWN COUNTRIES: *Bock* 264 (BM, PRE), *Elliot* 6245 (BM).

19. *HYMENODICTYON FLACCIDUM* WALL. IN ROXB., FL. IND. 2: 152. 1824

Cinchona flaccida Spreng., Syst. Veg. 4: 73. 1827; Wall., Cat. 6115a–c. 1832.

TYPE: NEPAL. [without exact locality], 1821 (fl.), *Wallich* s.n. (HOLOTYPE: K!; ISOTYPES: G[3]!, P!).

Hymenodictyon yunnanense Pit. in sched. (P!), nom. nud. TYPE: CHINA. Yunnan, 26.v.1909 (fl.), *Ducloux* 6767 (HOLOTYPE: P!).

Description: TREES or SHRUBS, rarely facultative EPiphytes, 3–17 m tall. BARK drying dark grey-tinged. STIPULES spatulate or oblong, 1–1.5 × 0.5–0.7 cm long, apex rounded, glabrous, deciduous. LEAVES deciduous; petioles 60–100 mm long, colour unknown, glabrous; blades broadly elliptic to broadly lanceolate,

KEY TO THE ASIAN *HYMENODICTYON* SPECIES

- 1a. Inflorescences unbranched and composed of two or three basally coherent simple racemose inflorescence units..... 19. *H. flaccidum*
 1b. Inflorescences branched and composed of at least two lateral racemose or thyrsoid inflorescence units.....2
 2a. Inflorescences erect; flowers sessile; capsules sessile, erect 21. *H. obovatum*
 2b. Inflorescences deflexed or pendulous; flowers pedicellate; capsules pedicellate, reflexed.....3
 3a. Inflorescences pendulous, only bilaterally branched at the base of the main peduncle; inflorescence units subtended by a single long-petiolate bract 20. *H. horsfieldii*
 3b. Inflorescences deflexed, bilaterally branched in the axils of each pair of the petiolate bracts; bearing a pair of long-petiolate bracts at the base and apex of the main peduncle 22. *H. orixense*

10–28 × 5–20 cm, pale green above, light green beneath, subcoriaceous, glabrous above, pubescent beneath, apex acuminate, base acute or cuneate; margins glabrous; midribs drying yellow-tinged, glabrous above, puberulous to pubescent beneath; secondary veins nine to 12 pairs per side, colour unknown, conspicuous above, less conspicuous beneath, glabrous above, puberulous beneath; without domatia. INFLORESCENCES terminal, 12–20 cm long, pendulous, spreading, three or two simple racemose, coherent at the base. Each inflorescence unit compact, composed of a puberulous rhachis, numerous two- to 12-flowered cymules, subtended by a single long-petiolate bract at the apex of the peduncle; petiolate bracts elliptic, colour unknown, glabrous. FLOWERS five- or six-merous; pedicels 1–1.5 mm long, puberulous; calyx lobes oblong, c. 1.5 mm long, yellow-green-tinged, puberulous; corolla tubes narrowly tubular up to the midpoint and abruptly opening out into cups, c. 2 mm long, light yellow, glaucous outside, corolla lobes acute or ovate to lanceolate, 3–3.5 mm long, glaucous outside; anthers 1.1–1.4 mm long, filaments 1–1.2 mm long; ovaries globose, c. 1 mm long, puberulous; styles 7–8 mm long; stigmas globose, slightly bilobed, green; ovules ten to 12 per locule. FRUITS 12–18 mm long, drying red-brown-tinged, ornated by spherical, non-elevated lenticels; pedicels 3–5 mm long, lenticellate; seeds nine to 12 per locule, narrowly lanceolate, 8–11 × c. 2 mm (wings included), narrowly winged at both ends only, shallowly fringed.

Phenology: Flowering May to July; fruiting August to January.

Common names: Mei Sirkan (Khasi, India).

Habitat: Dry, deciduous forests; 150–1680 m.

Distribution: Bangladesh, Bhutan, China (Yunnan), India (Andaman, West Bengal, Maghalaya, Nagaland, Uttar Pradesh, Sikkim; Deb, 1989), Nepal, and Thailand (Fig. 16).

Discussion: *Hymenodictyon flaccidum* is distinct from the other Asian *Hymenodictyon* species by its three to two simple racemose inflorescences, which are spreading and coherent at the base.

Additional specimens examined: BHUTAN: 5000 ft, 1.vii.1914 (fl.), *Cooper* 1030 (BM); Anganpnovana, 5000 ft, 16.ix.1915 (fr.), *Cooper* 4848 (BM). CHINA: SW of China, Yangpi Mt, 1913 (fr.), *Forrest* 11144 (BM, K), *Forrest* 15916 (K). Yunnan, Szemeo, 5000 ft, *Henry* 11922 (K). INDIA. Andaman Island, Port Monat, Jungle Hill, 16.i.1892 (fr.), *Dr King* s.n. (G) Bombay State, Saurashtra, *Srivastava* 16265 (S). Leoni, *Witt* 12374 (S). Mt Khasia, 4000–5000 ft, *Hooker & Thompson* s.n. (BM, G, K, L). Mt Sillet, *Wallich* s.n. (P). Sikkim, *Meebold* 160407 (S); *Dajeeling* 28013 (K). Uttar Pradesh, Gurhwal, *Falconer* s.n. (K). Saharanpur Botanical Garden, near Askot, 4000–5000 ft, 7.vii.1886 (sterile), *Kumaun* 5587 (BM). Eastern Himalaya, Birick, 2000 ft, 9.iii.1914 (fr.), *Cave* s.n. (G). NEPAL: Bhirungdi Khola, 3500 ft, 16.vi.1954 (sterile), *Sykes & Williams* 5813 (BM). Butwal, Ytainton, 500 ft, 7.x.1954 (fr.), *Sykes & Williams* 8828 (BM). Gurta, 5000 ft, 25.vi.1966 (fl.), *Shresltia* 5233 (BM). W of Steklazam, 26 51'N 87 34'E, 5500 ft, 24.v.1969 (fl.), *Williams* 165 (BM). Central Nepal, Bagmati Zone, 27 56'53"N 85 02'50"E –27 58'29"N 84 56'26"E, 970 m, 15.vii.1994 (fr.), *Suzuki et al.* 9455013 (BM); Bher, Valley Hurta, 28 56'N 8230'E, 4500 ft, 25.vi.1966 (fl.), *Stainton* 5461 (BM). Bhote Kosi, Charikot, 27 40'N 86 05'E, 3600 ft, 27.v.1967 (fl.), *Stainton* 5963 (BM). Gandaki Zone, Distr. Kaski, 29 20'N 83 40'E –29 15'N 83 45'E, 1080 m, 7.ix.1988 (fr.), *Suzuki et al.* 8861021 (BM). East Nepal, below Siling Tzokupa-Khebang, 22.xi.1963 (fr.), *Hara et al.* 6303861 (BM). THAILAND: Doi Angka, 1400 m, 18.iv.1939 (fl. fr.), *Garrett* 1113 (BM, L[2]). Chiang Mai Province: Distr. Sangampang, 500–675 m, 26.xii.1989 (fr.), *Maxwell* 89–1595 (K, L). UNKNOWN COUNTRIES: *Kailash Chandra* 22 (S), *Makay* 469 (S), *Pierre* 6215 (K), *Pierre* 6242 (K), *Pierre* 6245 (G), *Wallich* s.n. (G), *Wallich* s.n. (BM, G).

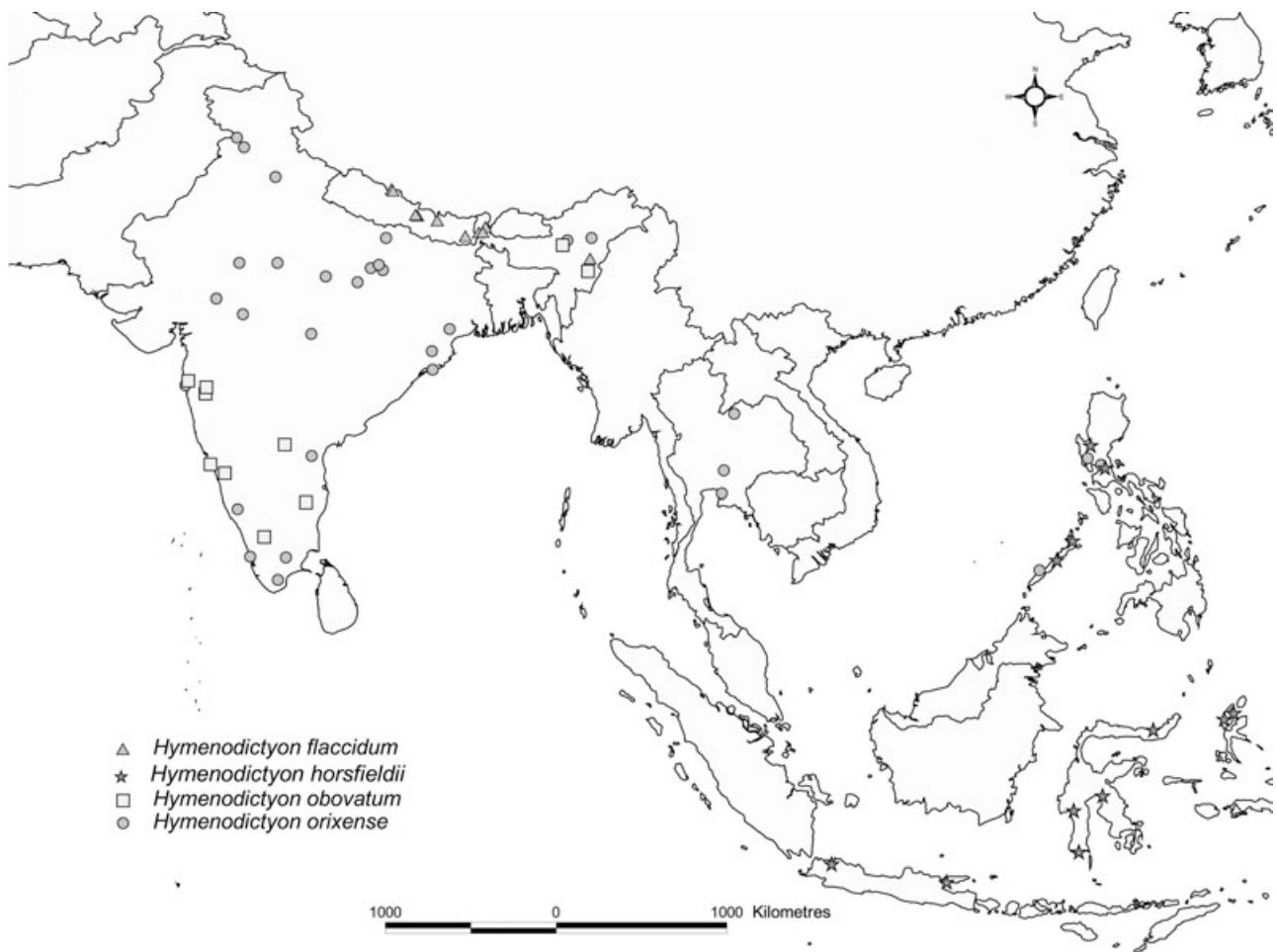


Figure 16. Distribution of *Hymenodictyon flaccidum*, *H. horsfieldii*, *H. obovatum*, and *H. orixense*.

20. *HYMENODICTYON HORSFIELDII* MIQ. IN MIQ., FL. NED. IND. 2: 154. 1856 (FIG. 1B)

TYPE: INDONESIA. Java, [without exact locality], [without collecting date], *Horsfield* s.n. (HOLOTYPE: K, photo!; ISOTYPES: BM[2]!).

[*Hymenodictyon koordersii* K.Schum.] in K. Schum., ms. label (July 1902) at Bogor Hort. herbarium, nom. nud.; Koord., *Natuurk. Tijdschr. Ned. Indië* 63: 78–79. 1904.

Description: Medium-sized to emergent TREES, 10–37 m tall. BARK pale-red-tinged or pale-brown-tinged, drying grey-tinged. STIPULES broadly ovate to triangular, 5–9 mm long, apex acute, glabrous, deciduous. LEAVES deciduous; petioles 25–70(–110) mm long, colour unknown, puberulous; blades oblong to obovate or oblong to elliptic, 8–18 × 12–30 cm, pale green above, light green-tinged beneath, glabrous above, puberulous to densely pubescent beneath, coriaceous, apex shortly acuminate, base acute to attenuate; margins glabrous, ciliolate; midribs drying yellow-tinged,

puberulous, secondary veins eight to 12 pairs per side, drying yellow-tinged, inconspicuous above, conspicuous beneath, densely pubescent; without domatia. INFLORESCENCES terminal, or terminal and axillary from uppermost leaf pair, 14–24 cm long, erect, trichotomous, lax, bilaterally branched at the base of the peduncles of the primary inflorescence units. Each inflorescence unit thyrsoïd, compact, composed of a puberulous peduncle, a puberulous rhachis, numerous seven- to 14-flowered cymes, subtended by a single, rarely by a pair of long-petiolate bracts; petiolate bracts broadly ovate, colour unknown, pubescent. FLOWERS five-merous; pedicels 2–3 mm long, pubescent; calyx lobes, ovate to triangular, c. 1 mm long, puberulous to densely pubescent; corolla tubes narrowly tubular up to the midpoint and abruptly opening out into cups (3–)5–6 mm long, colour unknown, pubescent outside, corolla lobes acute or rounded, c. 1 mm long, villous outside; anthers 1.5–2 mm long, filaments c. 0.5 mm long; ovaries obovoid, 1–2 mm long, puberulous to pubescent; styles 11–12 mm long;

stigmas clavate, green-tinged; ovules ten to 12 per locule. FRUITS c. 15 mm long, drying grey-brown, ornated by spherical, nonelevated lenticels; pedicels 8–10 mm long, lenticellate; seeds nine to 11 per locule, elliptic, c. 10 × 4–5 mm (wings included), broadly winged, shallowly fringed.

Phenology: Flowering August to February (Indonesia); fruiting May to July (Philippines), February to June (Indonesia), January to April (Philippines).

Common names: Lepar (Malaysia), Wunis (Indonesia).

Habitat: Evergreen rainforests; up to 800 m.

Distribution: Indonesia (Java, Lesser Sunda Islands, the Moluccas, Sulawesi, and Timor Islands), Malaysia (Langkawi Islands), Philippines (Palawan, Pangasinan, and Rizal Provinces) (Fig. 16).

Discussion: Many specimens from Leiden that we identified as *H. horsfieldii* were determined as *H. koordersii* by Bakhuizen van den Brink. However, *H. koordersii* is a nomen nudum that K. Schumann (July 1902) used in his manuscript label, which was deposited at the Bogor herbarium, Indonesia (Koorders, 1904). According to Koorders (1904: 78–79), Schumann's description of *H. koordersii* was based on a cultivated tree in the Bogor Botanical Garden under the name '*Hymenodictyon spec. Menado*' and accession number Cult. Hort. Bog. 98 & 98a IX E. Koorders (1904) considered *H. koordersii* to be a nomen nudum, and we agree with him because he did not provide any descriptions or diagnosis for the species. The status of *H. horsfieldii* as a distinct species has been questioned. Hooker (1880) accepted it but Koorders & Valeton (1902) and Backer & Bakhuizen van den Brink (1965) treated it as nonspecific with *H. orixense*. Here, we recognize *H. horsfieldii* and *H. orixense* as two different species. We restricted *H. orixense* to include all Asian *Hymenodictyon* plants with compound inflorescences that are composed of long, articulate inflorescence peduncles, one apical inflorescence unit, two pairs of lateral units at the base and the apex of the peduncles, three pairs of long-petiolate and leafy bracts subtending the apical unit and the pairs of lateral units. The four lateral inflorescence units are not subtended by any long-petiolate bracts. *H. horsfieldii* is diagnosed by its trichotomous inflorescences, bilaterally branched at the base of the inflorescence peduncle; each inflorescence unit is subtended by a single long-petiolate bract.

Additional specimens examined: INDONESIA: Java: Bogor, Kebun Raya (cult.), 28.xii.1977 (fl.), *Nitta* 15247 (L). SW of Java, Peutjang Island, Ujung Kulon

Nature Reserve, 27.i.1964 (young fl.), *Wirawan* 408 (L). Soenda Exil. Flores, W of Nggoer-Tjereng, 16.xii.1966 (fl.), *Schmutz* 928 (L). W of Sumbawa, Mt Batulanteh, 500 m, 3.v.1961 (fr.), *Kostermans* 18659 (L). Unknown locality, *Kigala* 567 (L[7]). Lesser Sunda Islands: W of Manggarai, Mbelawang River, 25.xi.1971 (fl.), *Schmutz* 2843 (L). Unknown localities, *Verheijen* 3259 (L), *Verheijen* 3306 (L); 800 m, 25.ii.1972 (fr.), *Schmutz* 1815 (L). Molucas: Morotai, Tobelo, N of Totodokoe, 30 m, 5.v.1949 (fl.), *Tangkilisan* 109 (L); Tanimbar-eilanden, Ilgnei-Otimmer, 15.iii.1938 (sterile), *Neth.Ind.For.Service* bb. 24259 (L). Localities unknown, *De Vriese & Teijsmann* s.n. (L[4]). Sulawesi (Celebes): Malili, 250 m, 15.viii.1932 (young fl.), *Boschproefd cel/V-136* (L); Moens, Bone, 20 m, 8.xii.1936 (sterile), *Neth.Ind.For.Service* b.b. 21711 (L). Timor Island: unknown locality, 125 m, 27.ii.1939 (fr.), *Neth.Ind.For.Service* b.b. 27065 (L). MALAYSIA: Langkaw Islands, 17.xi.1992 (fr.), *Zainudin et al.* AZ 4350 (L). PHILIPPINES: Palawan Province: Taytay municipality, Lake Manguao (Danao), 50 m, 10.iv.1984 (fr.), *Smri* 395 (L). Unknown localities, v–vi.1906 (fl.), *Curram* 4514 (MO); v.1913 (fl.), *Merrill* 9413 (BM, K, L). Princesa City, Irawan, Impapai Hill, eastern lower slope of Mt Beaufort, 250 m, 16.vi.1992 (young fl.) *Soejarto & Fernando* 7636 (L). Bgy, Irawan, Pto. Princesa City, along the Irawan River, 11.i.1996 (fr.), *Madulid & Majaducon* 39 (L). Pangasinan Province: Bautista, vii.1903 (fl.), *Elmer* 2879 (BM). Rizal Province: Bosoboso, Luzon Island, vii.1903 (young fl.), *Elmer* 2814 (BM).

21. *HYMENODICTYON OBOVATUM* WALL. IN ROXB., FL. IND. 2: 153. 1824

Cinchona obovata Spreng., Syst. Suppl. 73. 1828; Wall., Cat. 6116. 1832. TYPE: INDIA. [without exact locality], [without collecting date], *Heyne* s.n. (HOLOTYPE: K-W, not seen; ISOTYPE: G!).

Hymenodictyon obovatum Wight in Wight, Ic. Pl. Ind. Orient. 3: t. 1159. 1846 (Fig. 17A–K, from Ic. Pl. Ind. Orient. 3: t. 1159. 1846), nom. illegit. TYPE: INDIA. Peninsula Indiae Orientalis, [without exact locality], [without collecting date], *Wight* 1303 (HOLOTYPE: K!; ISOTYPES: G!, K[2]!, S!).

Description: Medium-sized TREES, 6–8 m tall. BARK grey-brown-tinged. STIPULES ovate to oblong, c. 2 mm long, apex rounded, glabrous, deciduous. LEAVES deciduous; petioles 20–50 mm long, drying red-tinged, glabrous to puberulous; blades ovate to broadly obovate, 7–15 × 5–6 cm, pale green above, light-green-tinged beneath, glabrous, subcoriaceous, apex abruptly acuminate, base acute to cuneate; margins glabrous; midribs drying dark-red-tinged, glabrous, secondary veins seven or eight pairs per side, colour



Figure 17. *Hymenodictyon obovatum* Wall. A, fertile branch with mature inflorescences. B, portion of a mature spicate inflorescence unit. C, mature flower. D, dissected corolla showing the insertion of the filaments at the base of the widened part of the tube. E, stamens. F, longitudinal section of ovary and calyx. G, transversal section of an ovary. H, immature fruit with remnant of nectary disc. I, longitudinal section of immature fruit. J, transversal section of immature fruit. K, portion of mature infructescence unit. A–K, taken from Wight (1846), *Ic. Pl. Ind. Orient.* 3: t. 1159.

unknown, inconspicuous above, conspicuous beneath, glabrous above, puberulous beneath; without domatia. INFLORESCENCES terminal, rarely terminal and axillary from uppermost leaf pair, 10–15 cm long, erect, bilaterally branched at the base of the peduncles of the primary inflorescence units. Each inflorescence unit spicate, lax, composed of a pubescent peduncle, a densely pubescent rhachis, numerous, solitary flowers, subtended by a single long-petiolate bract at the apex of the peduncle, unilaterally branched in the axil of each petiolate bract; petiolate bracts elliptic, colour unknown, glabrous to puberulous. FLOWERS five- to seven-merous, sessile; calyx lobes, narrowly triangular, c. 0.5 mm long, puberulous; corolla tubes narrowly tubular up to midpoint and abruptly opening out into cups, 1.8–2 mm long, colour unknown, glabrous outside, corolla lobes triangular, c. 0.5 mm long, colour unknown, glabrous; anthers c. 1.5 mm long, filaments c. 0.5 mm long; ovaries obovoid, c. 1 mm long, puberulous to pubescent; styles 5–6 mm long; stigmas clavate to globose, green; ovules 12–16 per locule. FRUITS 10–12 mm long, drying red-brown-tinged, erect, ornated by spherical, nonelevated lenticels; sessile; seeds 12–14 per locule, lanceolate, 6–9 × 2–2.5 mm long (wings included), narrowly winged all around, shallowly fringed.

Phenology: Flowering August to September; fruiting September to December (Deb, 1989).

Common names: Dudippa, Kadamba, Kaduval, Kadavu, and Kadwa-arid (Deb, 1989).

Habitat: In slopes near streams in hilly forests; 150–400 m.

Distribution: Restricted to India: Maharashtra to Tamii Nadu, Andhra Pradesh, Orissa, Assam, Meghalaya (Fig. 16).

Discussion: *Hymenodictyon obovatum* is diagnosed by its sessile and erect fruits.

Additional specimens examined: INDIA: Malabar, Bababoodum Hills, Law s.n. (K); unknown locality, Law s.n. (L). Southern Maratha Country and North Canara, Young s.n. (BM), Young s.n. (BM). Unknown localities, Bebbome s.n. (BM), Gibson s.n. (L), Jacquemont 659 (P), Law s.n. (G, L), Law s.n. (G, L).

22. *HYMENODICTYON ORIXENSE* (ROXB.) MABB.,
TAXON 31: 66. 1982

Cinchona orixensis Roxb. in Roxb., Bot. Descr. Swietenia 21. 1793; Medical Facts Obs. 6: 152. 1795.

C. excelsa Roxb. in Roxb., Pl. Coast Corom. 2: 3. f. 106. 1799. *H. excelsum* (Roxb.) Wall. in Roxb., Fl. Ind. 2: 149. 1824. TYPE: INDIA. [without exact locality], [without collecting date], Roxburgh s.n. (HOLOTYPE: K not seen; ISOTYPE: BM!).

Cinchona thyrsoflora Roxb. in Roxb., Hort. Beng. 15. 1814. *H. thyrsoflorum* Wall. in Roxb., Fl. Ind. 2: 151. 1824; in Wall., Cat. 6114e. 1832. TYPE: INDIA. [without exact locality], [without collecting date], Wallich s.n. (HOLOTYPE: K!; ISOTYPES: G!, K!, P!).

Benteka rheedei Roem. & Schult., Syst. Veg. 4: 706–707. 1819. *H. rheedei* (Roem. & Schult.) M.R. Almeida & S.M. Almeida, J. Bombay Nat. Hist. Sci. 83: 223. 1987. TYPE: INDIA. [without exact locality], [without collecting date], Shenoy 3719 (HOLOTYPE: BLAT, not seen).

Hymenodictyon excelsum Wall. in Wight, Ic. Pl. Ind. Orient. 1: t. 79. 1834.

Hymenodictyon utile Wight in Wight, Ic. Pl. Ind. Orient. 1: t. 80. 1834.

Hymenodictyon excelsum (Roxb.) var. *subglabrum* Pierre ex Pit. Pit. in M.H. Lecomte, Fl. Indo-Chine 3: 56. 1922. TYPE: Colchinchine [VIETNAM]. Cho-Quan, 1862–1866 (young fr.), Thorel 675 (LECTOTYPE here designated: P!). Chosen from syntypes: *Chevalier* 36231 (P, not seen); iii.1870, *Pierre* 3230 (P, not seen); vii.1868, *Pierre* 3230 (P, not seen); iv.1867, *Pierre* 3232 (P, not seen); vi.1867, *Pierre* 3232 (P!); vi.1869, *Pierre* 3232 (P!); *Poilane* s.n. (P, not seen); *Poilane* 569 (P!); *Thorel* 675 (P!).

Hymenodictyon excelsum (Roxb.) var. *canescens* Pierre ex Pit. Pit. in M.H. Lecomte, Fl. Indo-Chine 3: 57. 1922. TYPE: Colchinchine [VIETNAM]. Baria Province, Mt Dinh, iv.1867 (fl.), *Pierre* 3231 (LECTOTYPE here designated: P!). Chosen from syntypes: v.1865, *Pierre* 3231 (P, not seen); iv.1866, *Pierre* 3231 (P, not seen); iv.1867, *Pierre* 3231 (P!); 3.xii.1867; *Pierre* 3231 (P, not seen); iv.1877, *Pierre* 3232 (P!).

Hymenodictyon excelsum (Roxb.) var. *velutinum* Pierre ex Pit. Pit. in M.H. Lecomte, Fl. Indo-Chine 3: 57. 1922. TYPE: Colchinchine [VIETNAM]. Tonkin, Tuhap, sur les collines incultes, viii.1887–ii.1888 (fl.), *Balansa* 2580 (LECTOTYPE here designated: P!). Chosen from syntypes: *Balansa* 2578 (P, not seen); *Balansa* 2579 (P, not seen); *Balansa* 2580 (P!).

Description: Medium-sized to emergent TREES, 10–30 m tall. BARK grey-brown-tinged. STIPULES linear to lanceolate or ovate to lanceolate, c. 15 mm long, apex acuminate, deciduous, pubescent. LEAVES deciduous; petioles 10–60 mm long, green-white-tinged, puberulous; blades ovate, elliptic to lanceolate or oblong to lanceolate, 20–30 × 9–20 cm, pale green above, light-green-tinged beneath, glabrous to puberulous above, pubescent to puberulous beneath, membranaceous, apex acuminate, base acute to cuneate; margins

glabrous, ciliate; midribs drying yellow-red-tinged, sometimes brown-black-tinged, puberulous above, puberulous to pubescent beneath; secondary veins seven to ten pairs per side, colour unknown, inconspicuous above, conspicuous beneath, glabrous; without domatia. INFLORESCENCES terminal, 20–30 cm long, deflexed, bilaterally branched in the axils of each pair of the long-petiolate bracts, bearing pairs of long-petiolate bracts at the base and apex of the peduncles of the primary inflorescence units; petiolate bracts broadly elliptic, colour unknown, puberulous to glabrous. Each lateral inflorescence unit thyrsoïd, compact, composed of a puberulous peduncle, a puberulous to densely pubescent rhachis, numerous two- to 18-flowered cymules, unsubtended by long-petiolate bracts. FLOWERS five- or six-merous; pedicels 1.5–2 mm long, densely pubescent; calyx lobes oblong, 1–1.5 mm long, pubescent; corolla tubes narrowly tubular up to the midpoint and abruptly opening out into cups, 2.5–3.5 mm long, colour unknown, pubescent outside, corolla lobes oblong, 2–2.5 mm long, colour unknown, pubescent outside; anthers 1–1.5 mm long, filaments *c.* 0.5 mm long; ovaries obovoid, *c.* 1 mm long, puberulous to pubescent; styles *c.* 9 mm long; stigmas globose, green-tinged; ovules 20–30 per locule. FRUITS 15–20 mm long, elliptic to oblong, drying grey-brown-tinged, ornated by spherical, nonelevated lenticels; pedicels 1–1.6 mm long, nonlenticellate; seeds 20–30 per locule, elliptic, 9–12 × 4–6 mm (wings included), broadly winged all around, shallowly fringed.

Phenology: Flowering July to September; fruiting September to June.

Common names: Abar, Aligango, Balangcori, Camatolong, Huliganga, Magtalisay, Malatabaco (Philippines), Bheulan, Bhuikan, Gitthlei, Mach, Dudipps, Kadav, Kadambu (India), Kuthan (Burma), and Lala (Thailand).

Habitat: Dry, deciduous forests; 20–840 m.

Distribution: Burma (Upper Burma), Cambodia (Cong Province), India (throughout India, except Jammu and Kashmir; Deb, 1989), Nepal, the Philippines (Bulacan, Palawan, Rizal, and Zambales Provinces), Thailand (Chonburi, Loei, and Saraburi Provinces), and Vietnam (Fig. 16).

Discussion: Here, we merged *H. rheedei* into *H. orixense* on the basis of leaf shape (broadly ovate, long-petiolate, acuminate at the apex and attenuate at the base), inflorescence orientation (deflexed), and

fruit shape (acute at apex). *H. orixense* can be diagnosed by its deflexed inflorescences, which bear two pairs of long-petiolate bracts at the base and apex of the main peduncle, sometimes with an additional pair subtending the apical inflorescence unit, and that are bilaterally branched in the axils of each pair of bracts.

Additional specimens examined: BURMA: Upper Burma, x.1890 (fl.), *Huk* s.n. (G). Rangoon, x.1937 (fr.), *Dickason* 6555 (L, P). CAMBODIA: Cong Province: Région de Kompong Thom, 28–30.xii.1917 (fr.), *Chevalier* 36231 (K, P). Unknown locality, 8.v.1929 (fr.), *Bèjeaud* s.n. (P). INDIA: Bihar Province: Ranka, 25.ix.1947 (sterile), *Koelz* 18952 (L). Assam, *Simons* s.n. (L), *Gaudichaud* 245 (G, P), *Jenkins* s.n. (G, L). Punjab Province: Gurdaspur, 600 m, 30.viii.1969 (fl.), *Bhattacharyya* 39432 (L). Peninsula Indiae Orientalis, *Campbell* s.n. (BM). Pulney Hills, *Beddome* 3504 (BM), *Beddome* 3505 (BM). West Bengal, Damalgin, Garo Hills, 16.ii.1886 (fr.), *Clarke* 43122 A (BM). Kangean-Arch Sabaenten, 5.ix.1919 (fr.), *Backer* 29869 (L). Distr. Almora, near Balwakot, Kali Valley, 840 m, 26.vii.1923 (fl.), *Parker* 2111 (G, K). Distr. Madura, Lower Pulneys, 3000–4000 ft, viii.1922 (fl.), *Anglade* 392 (G); 3500 ft; 26.viii.1913 (fl.), *Saulière* 207 (K). Distr. Saharanpur, i.1893 (fr.), *Gamble* 24050 (K); *Sriwastava* s.n. (P). Godavari, 14.ii.1956 (young fl.), *Wagh* 1400 (P); 20.iii.1956 (fl.), *Wagh* 2226 (K, MO). Siwalik and Jausar Divisions, Lachiwalla, *Mohan Ghosh* 63 (G), *Priya Nath* s.n. (G, K, P). Unknown localities, *Jacquemont* s.n. (K, P), *Dr King* 13 (BM). NEPAL: Chilwan, 500 m, vi.1994 (fr.), *Wesche* 51291 (BM). Tamur Valley, 26 55'N 87 22'E, 1000 ft, 4.viii.1967 (BM), *Williams & Stainton* 8364 (BM). Distr. Kalikot, Karnali Zone, 81 37'04"E 29 10'57"N –81 41'04"E 29 14' 51"N, 7.viii.1991 (fl.), *Suzuki et al.* 91 (BM). East Nepal, Sibganja-Mahara Bahara, 12.xii.1963 (fr.), *Murata et al.* 6303860 (BM). PHILIPPINES: Busuanga Island, *Malbato* 231 (K, P). Guimaras Island, xi.1903 (fr.), *Gammill* 111 (BM). Bulacan Province: Luzon Island, Angat, viii.1913 (fl, fr.), *Merrill* 643 (BM, L, MO, P). Palawan Province: Langen (Malapakan) Island, Malapakan Cove, 20 m, 15.iv.1984 (fr.), *Smri* 437 (L). Rizal Province: Luzon Island, xii.1912 (fr.), *Reillo* 19301 (BM, L, P); viii.1905 (fr.), *Aherns* 3287 (K). Zambales Province: Mt Pinatubo, vi-vii.1948 (fl.), *Fox* 4795 (L). THAILAND: Ampokaokao, Trang, 6.viii.1929 (fl.), *Rabil* 389 (BM, K). Chaung Ke N of Sawan, 28.xi.1928 (fr.), *Kerr* 2155 (BM). Chonburi Province: Distr. Siracha, Kow Kiao, 13 16'N 101 05'E, 150 m, 26.x.1976 (fr.), *Maxwell* 76–709 (L). Noir River Bassin, Brangkasi, 100–150 m, 6.vii.1946 (young infl.), *Kostermans* 1012 A (L). Chien-grai, 1500 ft, 8.iii.1912 (fr.), *Kerr* 2513 (BM). Unknown localities, *Collins* 36 (BM), *Pierre* 3231 (BM, L). Loei Province: along trail from Samhaek to Laegpae,

540 m, 29.viii.1988 (fr.), *Fukuoka*-63720 (L). Saraburi Province: Sahn Lahn, 25 m, 29.vi.1974 (young infl.), *Maxwell* 74–638 (L); 14 30'N 101 10'E, 100 m, 25.i.1975 (fr.), *Geesink & Maxwell* 8357 (L). VIETNAM: Baria Province: Mt Dinh, 500 m, vi.1869 (fl.), *Pierre* 3232 (P). Bien-hoa Province, rives du Fleuve Song-bé, vi.1867 (fl.), *Pierre* 3232 (P); Dac Lac Province: Hau Bôn, *Dournes* s.n. (P). Tonkin Province: unknown localities, viii.1887 (fl.), *Balansa* 13 (K, L), 1888–89 (fl.), *Balansa* 2580 (K). Unknown provinces, Cap St. Jacques, ix.17 1919 (fr.), *Poilane* 569 (G, P); Cho-quan, Cho-len, without collecting date (fl.), *Thorel* 675 (BM, P); v.1867 (fl.), *Pierre* 3231 (P); Gia-lau-mé, iv.1877 (fl.), *Pierre* 3232 (P); vii.1868 (fl.), *Pierre* 3230 (P). UNKNOWN COUNTRIES: Distr. Arcot, Kalrayans, 650 m, 25.ix.1978 (young fl.), *Venugopal & Manoharan* 17798 (L). Katraj Ghat-Poona, 3500 ft, viii.1920 (fl.), *Sedgwick & Bell* 7536 (K). Noord Soerabaja JA 617 (BM, WAG). *Wallich* s.n. (G), *Wallich* s.n. (G).

UNPLACED SPECIES

We could not trace the type specimen of *Hymenodityon timoranum* or place it using the author's description.

Hymenodictyon timoranum (Span.) Miq. in Miq., Fl. Ned. Ind. 2: 153. 1856

Cinchona timorana Span., Linnaea 14: 315. 1836. *C. timoriensis* Span. ex Walp., Repert. Bot. Syst. 2: 509. 1843, orth. var. *H. timoriense* Klotzsch ex Walp., Repert. Bot. Syst. 6: 63. 1846, orth. var. TYPE: untraced.

PARACORYNANTHE CAPURON, ADANSONIA 18: 159–166. 1978.

TYPE: *Paracorynanthe uropetala* Capuron.

Description: Small to medium-sized TREES. BARK grey-green-tinged, exfoliating in plates. STIPULES interpetiolar, triangular, shallowly to deeply bifid, bearing large colleters on the margins, entire or bifid, membranaceous, deciduous. LEAVES simple, opposite, decussate, deciduous; petioles adaxially canaliculate, pubescent; margins glabrous; secondary and tertiary veins inconspicuous above, conspicuous beneath, secondary veins pubescent; without domatia. INFLORESCENCES terminal and axillary from uppermost leaf pair, compound umbelliform, erect, pedunculate;

peduncles long, terete, pubescent to puberulous; primary inflorescence units unsubtended or subtended by pairs of long-petiolate, leafy bracts; petiolate bracts ovate, scarious, puberulous, persistent; each inflorescence unit elongate, composed of lenticellate, elongate, pubescent to puberulous rhachis, numerous two- to five-flowered cymules borne in the axils of large, sessile, membranaceous, deciduous bracts, large, sessile, membranaceous, deciduous bracteoles borne at the apex of the pedicel of each individual flower. FLOWERS hermaphroditic, typically five-merous, pedicellate; calyx tubes absent, lobes five, filiform, deciduous, glabrous, ciliate; corollas narrowly tubular up to two-thirds of the length of the tubes and abruptly widened above, densely pubescent outside, corolla lobes five, valvate in bud, triangular, erect, each prolonged by one filiform, densely bristled appendage topped by a glabrous, globose club; stamens typically five, inserted at the base of the broadened part of the tubes, anthers basifixed, dithecal, filaments flattened, short; disc roll-shaped, epigynous; ovaries bicarpellate, placentation axile, typically obovoid, rarely elongate, pubescent to puberulous; styles terete, glabrous, exserted; stigmas (pollen presenters) clavate to globose, rarely capitate; ovules two or one per locule, ascendingly imbricate, apically attached to elongate, fusiform, bilaterally flattened placentae. FRUITS capsular, broadly to narrowly elliptic, slightly, bilaterally flattened, ornated by elongate or spherical, nonelevated lenticels, dehiscent loculicidally into valves, glossy inside, brown- to grey-tinged outside, typically pedicellate, rarely sessile; pedicels woody, typically coarse, rarely slender; seeds two or one per locule, narrowly winged along the sides and in the lower part and broadly winged in the upper part, reticulate, bilaterally flattened, ascendingly imbricate, containing abundant endosperm; margins entire.

1. *PARACORYNANTHE* ANTANKARANA CAPURON EX J.-F. LEROY, ADANSONIA 18: 164. 1978 (FIG. 18A–G, FROM CAPURON & LEROY, 1978:165)

TYPE: MADAGASCAR. Ouest (Nord) [Antsiranana Province], [Ambilobe Distr.], lapiaz dans les calcaires du Mur de l'Ankarana, 16–28.i.1969 (fl.), 28718-SF (HOLOTYPE: P!; ISOTYPES: K!, L!, MO!, TEF!).

Description: Medium-sized to large TREES, 7–15 m tall. BARK dark green-tinged, lenticellate. STIPULES

KEY TO *PARACORYNANTHE* SPECIES

- 1a. Secondary veins nine to 12 per side; inflorescences subtended by a pair of long-petiolate bracts 1. *P. antankarana*
 1b. Secondary veins six to eight per side; inflorescences unsubtended by long-petiolate bracts 2. *P. uropetala*

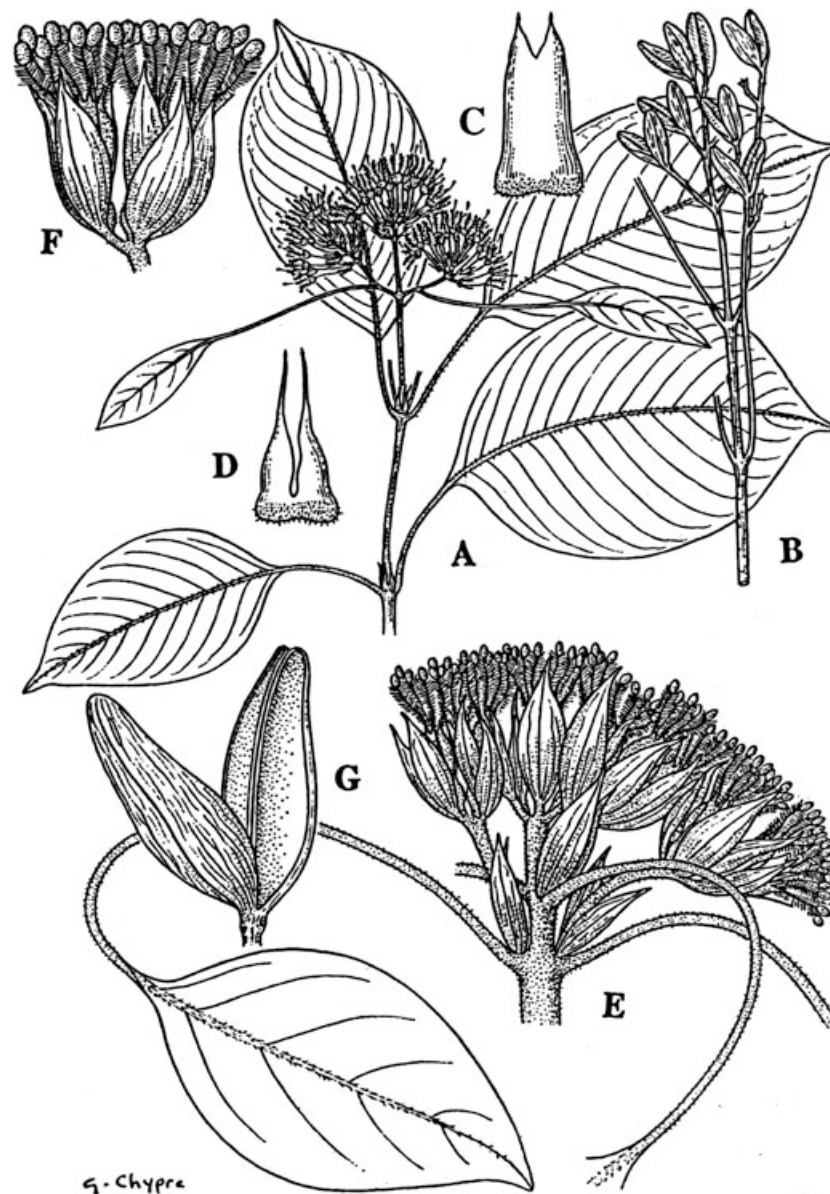


Figure 18. *Paracorynanthe antankarana* Capuron ex J.-F. Leroy. A, fertile branch with mature inflorescence with each lateral unit subtended by a single long-petiolate bract. B, mature infructescence. C, D, mature stipules. E, mature inflorescence with large and sessile bracts and bracteoles. F, part of mature inflorescence. G, mature fruit after dehiscence. (Publications Scientifiques du Muséum National d'Histoire Naturelle, Paris, Capuron & Leroy, 1978: 159–166).

triangular, 7–10 mm long, apex acuminate, puberulous. LEAVES deciduous; petioles 15–35 mm long, colour unknown, slender, puberulous; blades broadly obovate, 4.5–9 × 3.5–6.4 cm, pale green above, light green beneath, glabrous, membranaceous, apex acuminate, base attenuate; margins glabrous; midribs white-tinged, glabrous above, pubescent beneath; secondary veins nine to 12 pairs per side, white-tinged above, light-yellow-tinged beneath, inconspicuous above, conspicuous beneath, glabrous above, pubescent beneath; without domatia. INFLORESCENCES

terminal and axillary from uppermost leaf pair, 6.5–12.5 cm long, erect, bilaterally branched near the midpoint of the peduncles of the primary inflorescence units, each inflorescence unit compact, composed of an elongate, pubescent peduncle, a densely pubescent rhachis, numerous two- to four-flowered cymules clustered near the apices, each lateral inflorescence unit subtended by a pair of long-petiolate bracts; long-petiolate bracts elliptic to ovate, white-green-tinged, glabrous. FLOWERS five-merous; pedicels 2–3 mm long, pubescent; calyx lobes filiform, 2–2.5 mm long, green,

puberulous, ciliate; corolla tubes 5.5–7.5 mm long at the base, 1–1.5 mm long \times c. 2 mm diam. above, white, pubescent outside, corolla lobes triangular, c. 0.5 mm long; corolla appendages filiform, 3–4 mm long, densely pubescent with straight, long, white hairs; anthers c. 1 mm long, filaments c. 0.5 mm long; ovaries obovoid, 1–1.25 mm long, densely pubescent; styles 11–12.5 mm long; stigmas globose to capitate, green; ovules two or one per locule. FRUITS 10–12 mm long, dark red-tinged, ornated by elongate lenticels; pedicels 3–7 mm long, lenticellate; seeds two or one per locule, fusiform, 9–12 mm long (wings included), margins shallowly fringed above, entire below.

Phenology: Flowering in January; fruiting in April.

Common name: Hompa.

Habitat: Dry, deciduous forests; 80–110 m.

Distribution: Ambilobe District (Ankarana region) and Vohémar District (Daraina Commune and Forest of Analafiana) (Fig. 19).

Discussion: *Paracorynanthe antankarana* can be distinguished easily from *P. uropetala* by the presence of the persistent pairs of long-petiolate, leafy bracts that subtend the inflorescences. Moreover, these species do not grow sympatrically: the former is restricted to northern Madagascar (Ankarana and Daraina regions) and the latter is confined to western

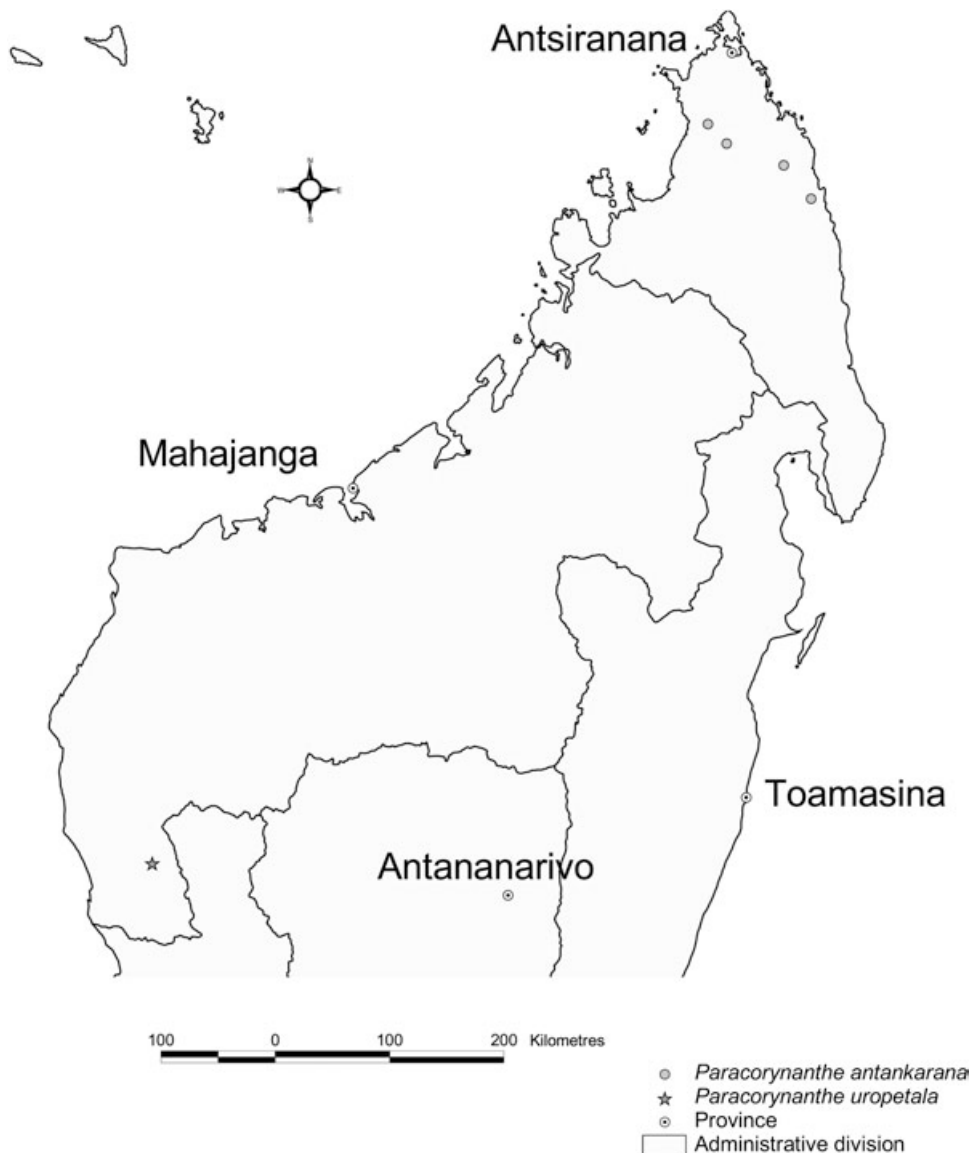


Figure 19. Distribution of *Paracorynanthe antankarana* and *P. uropetala*.

Madagascar (Bemaraha and Marovoay regions). *P. antankarana* has its centre of distribution in the Ankarana region (District Ambilobe). Only two herbarium specimens of *P. antankarana*, *Gautier et al.* 4379 (G, UPS, TEF) and 27507-SF (K, L, P) collected within the Daraina Commune (District Vohémar), are so far known outside the Ankarana region.

Additional specimens examined: MADAGASCAR: Antsiranana Province: Distr. Ambilobe, Massif calcaire de l'Ankarana, 28.xi.1951 (old fr.), 4352-SF (P); près d'Ambondromifehy, 17.ii.1962 (fr.), 22028-SF (B, BR, G, K, L, MO, NY, PRE, US, WAG); Plateau calcaire de l'Ankarana, à l'ouest de Mahamasina (Antanitsimanaja), 23.iv.1963 (fr.), 22675-SF (P, TEF); road from the Campement des Anglais towards the Lac vert and Grande Tsingy, 12 50'47S 49 06'18'E, 82 m, 14.i.2002 (fl.), *De Block et al.* 1215 (BR, G, K, MO, P, TAN, UPS, WAG), *De Block et al.* 1219 (BR, G, K, MO, P, TAN, UPS, WAG). Unknown locality, unknown date (fl.), *Debray* 10960 (P). Distr. Vohémar, Commune Daraina, Forêt de Bekaraoka, partie Sud, en aval d'Andranotsimaty, 13 10'09'S 49 42'03'E, 110 m, 15.iii.2003 (fr.), *Gautier et al.* 4379 (G, UPS, TEF); Forêt d'Analafiana, N de la basse de Manambery, 11.iii.1967 (fr.), 27507-SF (K, L, MO, P).

2. *PARACORYNANTHE UROPETALA* CAPURON,
ADANSONIA 18: 162. 1978 (FIG. 20A–L, FROM
CAPURON & LEROY, 1978: 161)

TYPE: MADAGASCAR. [Mahajanga Province], [Antsalova Distr.], Forêt de l'Antsingy, près de la clairière d'Ambodiriana (Piste Antsalova-Tsiandro), 9.xii.1952 (fl.), 6798-SF (HOLOTYPE: P!; ISOTYPES: BR!, K!, L!, MO!, TEF!, WAG!).

Description: TREES, 10–15 m tall. BARK grey. STIPULES triangular, 7–10 mm long, shallowly to deeply bifid, acuminate at the apex, puberulous. LEAVES deciduous; petioles 15–25 mm long, colour red-tinged, slender, pubescent; blades ovate to elliptic, 4.5–9 × 2.7–4.5 cm, pale green above, light green beneath, glabrous to puberulous above, pubescent, covered by straight hairs beneath, membranaceous, apex acuminate, base rounded to attenuate, glabrous above; margins ciliate; midribs red-tinged, glabrous above, pubescent to puberulous beneath; secondary veins six to eight pairs per side, red-tinged, inconspicuous, glabrous above, puberulous beneath; without domatia. INFLORESCENCES terminal and axillary from uppermost leaf pair, 6.5–12.5 cm long, erect, unbranched, compact, simple thyrsoid, composed of an elongate, pubescent peduncle, a densely pubescent rhachis, ten- to 14-flowered cymules, unsubtended by one pair of or a single

long-petiolate bract. FLOWERS five-merous; pedicels c. 2 mm long, pubescent; calyx lobes c. 4 mm long, green, filiform, glabrous, ciliate; corolla tubes c. 5 mm long at the base, 1 mm long × c. 2 mm diam. above, dark red-tinged, pubescent outside, corolla lobes triangular, c. 0.25 mm long, corolla appendages c. 3 mm long, erect; anthers c. 1 mm long, filaments c. 0.25 mm long; ovaries obovoid, c. 1 mm long, densely pubescent; styles c. 10 cm long; stigmas clavate to globose, green; ovules two or one per locule. FRUITS 11–13 mm long, grey-red-tinged, ornated with elongate to fusiform lenticels; pedicels 2–3 mm long, lenticellate; seeds two or one per locule, c. 8 mm long (wings included), margins shallowly fringed above, entire below.

Phenology: Flowering from December to January; fruiting from March to April.

Common name: Vatoa.

Habitat: Dry, deciduous forests; 100–150 m.

Distribution: Bemaraha regions, Antsalova District (Mahajanga Province) (Fig. 19).

Discussion: *Paracorynanthe uropetala* can be distinguished easily from *P. antankarana* by its inflorescences unsubtended by long-petiolate, leafy bracts. The former is restricted to western Madagascar (Bemaraha, Antsalova District), whereas the latter is restricted to northern Madagascar (Ankarana and Daraina regions). *P. uropetala* is also known to occur in Marovoay regions and Namoroka National Park (Soalala District). However, we did not see any specimens collected from these regions.

Additional specimens examined: MADAGASCAR: Mahajanga Province: Distr. Antsalova, sur calcaire de l'Antsingy, vers Ambodiriana (E Antsalova), 100–150 m, 7.xii.1952 (fl.), *Leandri et al.* 2069 (BR, K, L, MO, NY, P, WAG), 4669-RN (P, TEF); 21–27.i.1960 (fr.), *Leandri & Saboureau* 2729 (B, BR, K, L, MA, MO, NY, P, WAG); 1.xi.1953 (fr.), 8437-SF (P, TEF).

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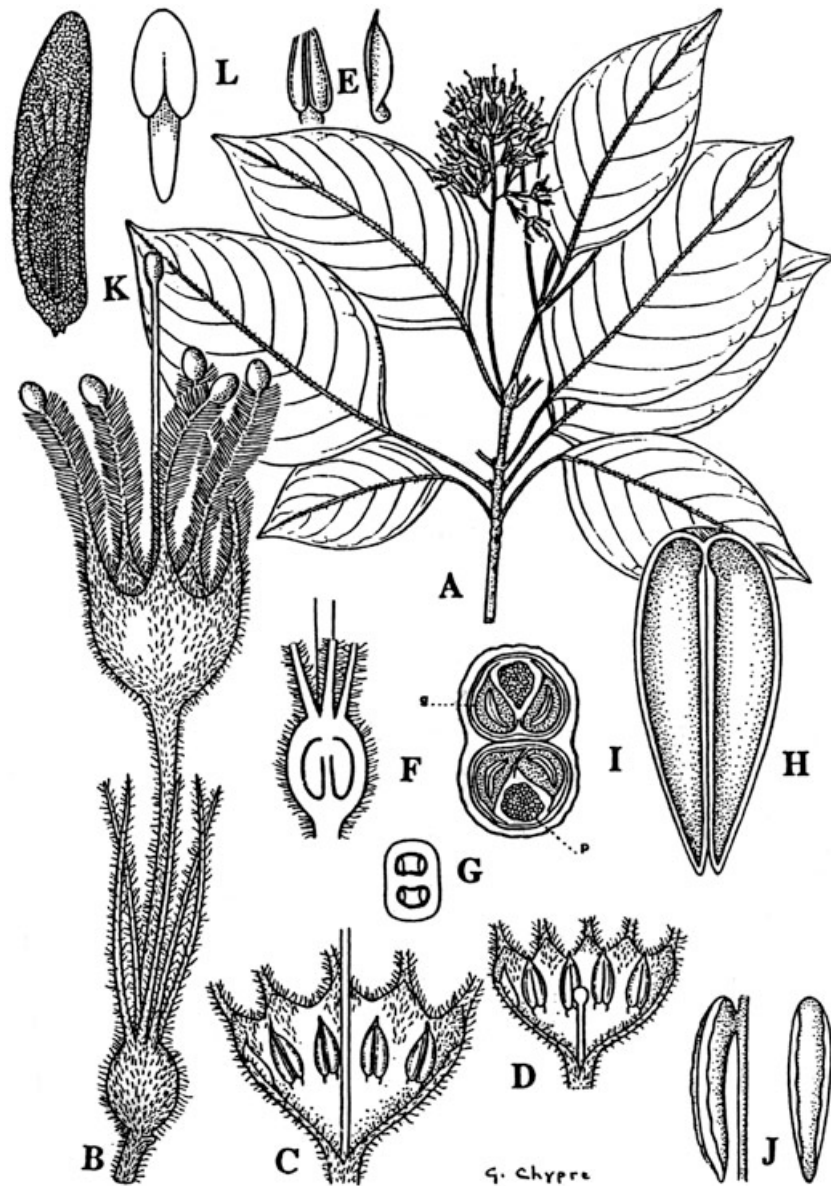


Figure 20. *Paracorynanthe uropetala* Capuron. A, fertile branch with mature inflorescence. B, mature flower. C, partially dissected mature corolla showing the insertion of the filaments on the corolla tube. D, partially dissected immature corolla showing the insertion of the filaments on the corolla tube. E, ventral and dorsal views of anthers. F, longitudinal section of an ovary. G, transversal section of an ovary showing the lateral position of the seeds. H, half of a capsular fruit after loculicidal dehiscence. I, cross-section of a mature fruit before dehiscence showing four seeds (g) and two placentae (p). J, one immature seed attached to a placenta; dorsal side of an immature seed. K, mature seed. L, embryo. (Publications Scientifiques du Muséum National d'Histoire Naturelle, Paris, Capuron & Leroy, 1978: 159–166).

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APPENDIX 1

LIST OF THE SPECIMENS OF *HYMENODICTYON*
SPECIES EXAMINED

Species abbreviations of *Hymenodictyon* species: an, *H. antakaranensis*; be, *H. berivotrense*; bi, *H. biafranum*; de, *H. decaryi*; em, *H. embergeri*; ep, *H. epiphyticum*; fla, *H. flaccidum*; flo, *H. floribundum*; gl, *H. glabrum*; ho, *H. horsfieldii*; le, *H. leandrii*; lo, *H. louhavate*; ma, *H. madagascariense*; ob, *H. obovatum*; oc, *H. occidentale*; or, *H. orixense*; pa, *H. pachyantha*; pa ssp. pa, *H. parvifolium* ssp. *parvifolium*; pa ssp. sc, *H. parvifolium* ssp. *scabrum*; pe, *H. perrieri*; sep, *H. septentrionalis*; sey, *H. seyrigii*; ts, *H. tsingy*.

Notes: The 'RN' stands for 'Reserve Naturelle' and 'SF' for 'Service Forestier'.

6237-RN le; 8237-RN lo; 8778-RN le; 9231-RN lo; 9454-RN lo; 9566-RN be; 11097-RN lo.

2246-SF gl; 2836-SF oc; 3032-SF an; 3407-SF be; 3670-SF oc; 4038-SF de; 4042-SF oc; 4985-SF be; 5437-SF oc; 6166-SF an; 6693-SF (type) an; 6870-SF (type) gl; 7219-SF gl; 7222-SF oc; 7283-SF an; 8029-SF de; 8077-SF be; 8107-SF gl; 9285-SF em; 9613-SF gl; 9673-SF oc; 9823-SF lo; 9856-SF oc; 10515-SF oc; 11751-SF de; 11937-SF be; 11943-SF, oc; 12013-SF be; 12266-SF ts; 12379-SF gl; 12841-SF de; 13037-SF oc; 14376-SF be; 15550-SF oc; 15572-SF be; 16841-SF be; 18458-SF (type) be; 20087-SF (type) sep; 20582-SF gl; 22423-SF de; 22690-SF oc; 22944-SF sep; 23277-SF oc; 23396-SF pe; 24680-SF sep; 27543-SF de; 27620-SF lo;

27738-SF em; 28707-SF oc; 28721-SF oc; 28929-SF lo; 28949-SF lo; 29709-SF oc.

Abballah *et al.* 385 pa ssp. pa; Adam 20195 flo; Adamson 453 flo; Agosto 281 flo; Aherns 3287 or; Alleizette 3020 de; Amshoff s.n. flo; Anglade 392 or; Angus 721 pa ssp. sc; Angus 760 flo; Angus 881 flo; Aubreville 4153 pa.

Backer 29869 or; Bagshawe 313 flo; Bagshawe s.n. flo; Bagshawe & Camb 1646 pa ssp. sc; Balansa 13 or; Balansa 2580 or (lectotype); Ball 41972 flo; Bamps *et al.* 4262 flo; Barbosa 8827 flo; Barter 1999 (type) bi; Beddome 3504 or; Beddome 3505 or; Bebbome s.n. ob; Bejeaud s.n. or; Bequaert 5775 flo; Bernier 109 ma; Bernier s.n. ma; Bernier s.n. ma; Bernier s.n. ma; Best 1821 flo; Bhattacharyya 39432 or; Biegel 1105 flo; Biegel 1707 flo; Bjornstad 1979 pa ssp. pa; Bjornstad AB 2238 flo; Bock 24 flo; Bock 264 pa ssp. sc; Boivin 2446 ma; Bos 4355 flo; Boschproefdcel/V-136 ho; Bosser 15746 de; Bosser 15789 be; Box 3635 bi; Bredo 5878 pa ssp. sc; Breteler 506 flo; Breteler 1927 flo; Breteler 2792 flo; Bridson 275 flo; Brummitt & Banda 9912 flo; Buchanan 17 pa ssp. pa; Buchanan 527 pa ssp. pa; Buchanan 751 flo; Buchanan 1062 flo; Burtt 938 flo; Burtt 973 flo; Burtt 3273 flo; Burtt 6564 flo.

Campbell s.n. or; Carleuman 2298 pa ssp. sc; Carnochan 68 pa ssp. sc; Cave s.n. fla; Chapman 1969 flo; Chapman 4272 flo; Chase 297 flo; Chase 2905 flo; Chase 3477 flo; Chase 30056 flo; Chase 30930 flo; Cheek 1437 ma; Cheek 1499 sep; Cheek *et al.* 3030 ep; Chevalier 12919 flo; Chevalier 18543 flo; Chevalier 21392 flo; Chevalier 21596 flo; Chevalier 36231 or; Chillon 3052 flo; Chillon & Maunoury s.n. flo; Chiré s.n. flo; Clarke 43122 A or; Claessens 1123 flo; Collins 36 or; Cooper 1030 fla; Cooper 4848 fla; Cours 1971 be; Cours 3372 pe; Cours 5087 be; Cours 5468 an; Curram 4514 ho.

Dajeeling 28013 fla; Dale 3761 pa ssp. sc; Dawson 58 ep; Dawe 885 pa ssp. sc; De Block *et al.* 1210 ma; De Block *et al.* 1216 ma; De Block *et al.* 1225 an; de Koning 4354 flo; de Koning & Groenendijk 919 pa ssp. pa; de Koning & Groenendijk 9480 pa ssp. pa; de Koning & Groenendijk 9490 pa ssp. pa; De Vriese & Teijmann s.n. ho; de Wilde 10781 flo; de Wilde 1341 ep; de Wilde 1394 flo; de Wilde 1394B flo; de Wilde 2287 flo; de Wilde 2475 flo; de Wilde 6182 flo; de Wilde 8130 flo; de Wilde *et al.* 11547 ep; de Wilde *et al.* 379 bi; de Wilde *et al.* 9021 ep; de Wit 279 flo; Decary 3138 de; Decary 3771 de; Decary 9001 de; Decary 18911 be; Decary 19255 pe; Dechamps-Kurta & Silva 1173 flo; Dechamps-Kurta & Silva 1476 flo; Dehn 42366 flo; Dickason 6555 or; Dnapper 1347 pa ssp. pa; Dorr *et al.* 3965 de; Dournes s.n. or; Dr King 13 or; Dr King s.n. or; Ducloux 6767 fl; Dummer 3907 flo; Du Puy *et al.* 781 oc.

Ebba 607 flo; Elliot 6245 pa ssp. sc; Elmer 2814 ho; Elmer 2879 ho; Etuge & Thomas 333 bi; Excell & Men-

donça 83 flo; Exell & Mendonça 1902 flo; Exell *et al.* 906 flo.

Faden & Faden 74/247 pa ssp. sc; Falconer s.n. fla; Fennar 4058 flo; Fleury 33340 ep; Fliervoet s.n. ssp. fi; Forius 2069 flo; Forrest 11144 fla; Forrest 15916 fla; Fox 4795 or; Fries *et al.* 2539 flo; Fries *et al.* 3400 flo; Friis & Lawesson 5413 flo; Fukuoka T-63720 or.

Gamble 24050 or; Gammill 111 or; Garcia 472 flo; Garrett 1113 fla; Gaudichaud 245 or; Gautier *et al.* 3493 em; Gautier *et al.* 4523 ma; Gautier *et al.* 4653 ma; Geesink & Maxwell 8357 or; Gentry 11936 be; Gentry 33187 bi; Gentry & Schatz 62052 oc; Gereau & Kayombo 3618 flo; Gereau *et al.* 2798 pa ssp. pa; Ghesquière 4326 flo; Gibson s.n. ob; Gilbert 5323 A pa ssp. pa; Gilbert *et al.* 7806 flo; Gledhill 839 flo; Glossweiler 2858 flo; Gossweiler 10026 flo; Gossweiler 12078 flo; Green & Kanuri 12680 pa ssp. pa; Greenway 9541 pa ssp. pa; Greenway & Hummel 7317 flo; Gueckedou s.n. ep; Guile 2608 flo; Gutswiller 3072 flo; Gutzwiller 3262 flo.

Haarer 1963 pa ssp. pa; Hallé 356 flo; Hallé 3080 flo; Hallé 3717 flo; Hallé & Villiers 541 bi; Hallé & Villiers 4541 ep; Hallé & Villiers 4740 bi; Hallé & Villiers 4958 bi; Hallé & Villiers 5200 bi; Hallé & Villiers 5412 bi; Hara *et al.* 6303861 fla; Harder *et al.* 1691 be; Hendricks 4262 flo; Henry 11922 fla; Herbar CNAD 1877 flo; Heyne s.n. (type) ob; Hochs 3032 flo; Holm 88 flo; Homby 194 pa ssp. pa; Homolle 273 ts; Homolle 1700 de; Hooker & Thompson s.n. fla; Horsfield s.n. (type) ho; Hovda s.n. flo; Hoyle 491 flo; Howard 77 flo; Huk s.n. or; Humbert 8178 flo; Humbert 12328 de; Humbert 12449 be; Humbert 12958 (lectotype) de; Humbert 18515 pe; Humbert 18849 ts; Humbert 18951 (type) ma; Humbert 29694 be; Humbert 29709 oc; Humbert 32406 an; Humbert 32435 ma; Humbert 32569 an; Humbert s.n. flo; Humbert & Capuron 24310 pe; Humbert & Cours 22975 pe; Huntley 1215 CD flo.

Jackson 362 flo; Jacquemont 659 ob; Jacquemont s.n. or; Jacques-Félix 319 flo; Jacques-Félix 1087 ep; Jacques-Félix 1272 flo; Jacques-Félix 1952 flo; Jacques-Félix 3465 flo; Jacques-Félix 4052 flo; Jacques-Georges 126 flo; Jenkins s.n. or; Johnstone J320/32 bi.

Kaessner 529a flo; Kailash Chandra 22 fla; Kallreyer 183 bi; Kallreyer 183 bi; Kårehed *et al.* 249a (type) ts; Kårehed *et al.* 249b ts; Kassner 2178 flo; Katende 3193 flo; Kathumba *et al.* 38 flo; Kayombo 978 flo; Kayombo & Kikoti 2805 flo; Keay 28652 bi; Kemp 30 pa ssp. pa; Keraudren 1092 be; Kerr 2155 or; Kerr 2513 or; Kersting 741 flo; Kibure 588 pa ssp. pa; Kigala 567 ho; Kindeketa 188 pa ssp. pa; Koelz 18952 or; Kokwaro 3831 pa ssp. pa; Kostermans 1012 A or; Kostermans 18659 ho; Kumaun 5587 fla.

Labat *et al.* 2821 sep; Law s.n. ob; Law s.n. ob; Law s.n. ob; Law s.n. ob; Leandri 862 lo; Leandri 1003 (type) le; Leandri *et al.* 2069 ur; Leandri 2676 le; Leandri 2852 lo; Leandri & Saboureaux 2729 ur; Leeuwen-

berg 3852 flo; Leeuwenberg 6036 flo; Leeuwenberg 6335 bi; Leeuwenberg 6404 bi; Leeuwenberg 9748 (type) ep; Leeuwenberg s.n. flo; Legagneux s.n. flo; Léonard 2797 flo; Léonard 2801 bi; Léonard 3670 flo; Letouzey 1322 flo; Letouzey 5204 pa; Letouzey 8573 flo; Letouzey 10782 bi; Letouzey 12238 pa; Letouzey 12788 flo; Letouzey 13220 bi; Letouzey 14046 ep; Letouzey 14152 ep; Letouzey 14582 bi; Letouzey 14952 bi; Letouzey 15021 ep; Lewalle 1071 flo; Lewalle 1147 flo; Lewalle 3789 flo; Lindeman 30 pa ssp. sc; Louis 1806 flo; Louis 2296 bi; Lovett 1648 pa ssp. sc; Lovett & Kayombo 172 pa ssp. sc; Lovett & Kayombo 3307 A flo; Lovett & Kayombo 4486 flo; Lovett & Kayombo 4964 pa ssp. sc; Lovett *et al.* 3830 flo; Lebrun 3799 pa ssp. sc.

Macêdo & Esteves 4830 pa ssp. pa; Macerdo 5050 pa ssp. pa; Macuácuá 1442 flo; Madulid & Majaducon 39 ho; Makay 469 fla; Malaisse 9521 pa ssp. sc; Malaisse 11489 flo; Malbato 231 or; Malcomber 1112 de; Malcomber *et al.* 1949 pe; Manning 99 bi; Manning 224 flo; Manning 1908 flo; Maxwell 74–638 or; Maxwell 76–709 or; Maxwell 89–1595 fla; Mearns 2150 pa ssp. pa; Meebold 160407 fla; Merrill 643 or; Merrill 9413 ho; Meyer 8660 flo; Mhoro 281 flo; Mhoro 420 flo; Michel 2480 flo; Michel 4433 flo; Michel 6127 flo; Michelson 1332 flo; Mildbraed 8497 (neotype) pa; Miller 7298 flo; Mohan Ghosh 63 or; Monro 1805 pa ssp. pa; Monro 1905 flo; Morton & Gledhill 1836 WAG; Murata *et al.* 6303860 or.

Ndabaneze 1390 flo; Nemba & Thomas 19 ep; Neth. Ind. For. Service b.b. 24259 ho; Neth. Ind. For. Service b.b. 21711 ho; Neth. Ind. For. Service b.b. 27065 ho; Nitta 15247 ho; Nkongmebeck 531 bi; Noord Soerabaja JA 617 or; Nyariri 506 flo. Osmaston 2018 flo; Osmaston 2292 flo.

Parker 2111 or; Parmentier & Nguema 825 flo; Pawek 5265 pa ssp. sc; Pawek 7754 pa ssp. sc; Pawek 8060 flo; Pawek 9087 flo; Pawek 11079 pa ssp. sc; Pawek 13438 pa ssp. sc; Pawels 6982 pa ssp. sc; Pereira *et al.* 1789 flo; Perrier de la Bâthie 431 (type) pe; Perrier de la Bâthie 1350 oc; Perrier de la Bâthie 1694 oc; Perrier de la Bâthie 1765 be; Perrier de la Bâthie 3663 pe; Perrier de la Bâthie 3841 oc; Perrier de la Bâthie 3842 oc; Perrier de la Bâthie 3879 oc; Perrier de la Bâthie 3880 (type) oc; Perrier de la Bâthie 3961 lo; Perrier de la Bâthie 4551 pe; Perrier de la Bâthie 14661 be; Perrier de la Bâthie 15460 oc; Perrier de la Bâthie 17844 (type) lo; Peter 55731 flo; Peter 55735 pa ssp. pa; Phillips 953 A pa ssp. sc; Phillips 955 pa ssp. sc; Phillipson 2778 de; Pierre 3230 or; Pierre 3231 or (lectotype): Pierre 3231 or [2]; Pierre 3232 or [3]; Pierre 6215 fla; Pierre 6242 fla; Pierre 6245 fla; Pobeguins 2081 flo; Poilane 569 or; Poilecot 7901 flo; Polhill & Paulo 477 pa ssp. sc; Polhill & Paulo 477 pa ssp. pa; Pope *et al.* 1436 pa ssp. pa; Priya Nath s.n. or; Puff & Kelbessa 8208 flo.

R.B & Faden 74/247 pa ssp. pa; Rabil 389 or; Rakotozafy 321 pe; Randriamampionona 308 em; Rasoavimbahoaka 439 pe; Raynal *et al.* 10731 flo; Razafimandimbison 285b de; Razafimandimbison & Andrianatoanina 440 ma; Razafimandimbison & Andrianatoanina 445 ma; Razafimandimbison & Andrianatoanina 446 ma; Razafimandimbison & Andrianatoanina 461 ma; Razafimandimbison & Bremer 490 gL; Razafimandimbison & Bremer 500 gL; Razafimandimbison & Bremer 501 oc; Razafimandimbison & Bremer 502 be; Razafimandimbison & Ravelonarivo 663 pe; Razafimandimbison *et al.* 404 sep; Razafimandimbison *et al.* 406 sep; Reekmans 1024 flo; Reekmans 4623 flo; Reekmans 7052 flo; Reekmans 7322 flo; Reekmans 7517 flo; Reekmans 9006 flo; Reillo 19301 or; Reistma 2743 bi; Reitsma & Louis 1887 bi; Rendle 280 pa ssp. pa; Rendle s.n. flo; Richard 075 de; Richard 093 de; Richards 13629 flo; Richards 17348 pa ssp. sc; Richards 18583 pa ssp. sc; Richards 19621 pa ssp. sc; Roberty 13850 flo; Roberty 15967 flo; Roberty 17642 flo; Roberty 17753 flo; Rodin 4409 A flo; Rosevea 68/37 bi; Roxburgh s.n. or; Runyinya 200 flo; Rushworth 824 flo.

Saboureau 1292 (type) em; Salubeni 486 flo; Sanaro 1538 pa ssp. sc; Saulière 207 or; Saxer 259 flo; Schweinfurth 850 flo; Schweinfurth 3866 flo; Schweinfurth s.n. flo; Schiers 235 flo; Schimper 148 flo; Schimper 277 (type) flo; Schimper 707 flo; Schlieben 1623 flo; Schlieben 5894 pa ssp. pa; Schlieben 5900 pa ssp. pa; Schmutz (1815) ho; Schmutz 2843 ho; Schmutz 928 ho; Schnell 1340 flo; Sedgwick & Bell 7536 or; Seyrig 334 (type) sey; Sharland 1201 flo; Shenoy 3719 or; Shresltia 5233 fla; Simon 968 flo; Simons s.n. or; Sita 3959 flo; Sita 4623 bi; Sita 4728 flo; Smeyers 320 flo; Smith *et al.* 5930 pa ssp. sc; Smri 395 ho; Smri 437 or; Snowden 510 flo; Snowden 855 flo; Soejarto & Fernando 7636 ho; Sriwastava s.n. or; Starzenski 19 flo; Stainton 5461 fla; Stainton 5963 fla; Staudt 367 bi; Stauffer 350 flo; Stolz 1596 flo; Stolz 1870 flo; Stolz 1873 flo; Stolz 2560 pa ssp. sc; Sussman 155 de; Suzuki *et al.* 8861021 fla; Suzuki *et al.* 91 or; Suzuki *et al.* 9455013 fla; Svivastava 16265 fla; Swynerton 701 pa ssp. sc; Sykes & Williams 5813 fla; Sykes & Williams 8828 fla.

Talbot 213 bi; Talbot 256 bi; Tangkilisan 109 ho; Tanner 538 pa ssp. pa; Tanner 5321 flo; Tanner 5622 flo; Tarquhar 18 pa; Tarquhar 33 pa; Taylor 3399 flo; Teixeira & Soussa 7869 flo; Testu 8024 bi; Testu 8625 flo; Testu 8953 flo; Testu 8955 bi; Testu 9008 flo; Testu 9200 bi; Thomas 2588 flo; Thomas 6774 A bi; Thomas

& Zogning 7042 ep; Thomas & Zogning 7057 bi; Thomas *et al.* 7111 bi; Thorel 675 or (lectotype); Thulin & Hunde 4070 flo; Thulin *et al.* 3325 flo; Tinkey 2736 pa ssp. pa; Tisserant 1893 flo; Tisserant 2443 flo; Tono 1133 flo; Troupin 3319 flo; Troupin 5061 flo; Troupin 6659 flo; Troupin 8513 flo; Troupin 9706 flo; Troupin 11239 flo; Troupin 11823 flo; Troupin 12289 flo; Troupin 15578 flo.

Unknown collector 62 be; unknown collector 143 gL; unknown collector 5607 pe; Upson 160 ep.

van der Burgt 11 bi; van der Burgt 90 bi; van Meer 1060 flo; van Meer 1813 flo; Vaucoulon 390 ma; Vaucoulon 416 ma; Vaucoulon 1616 ts; Vaughan 3120 pa ssp. sc; Vaughan 3121 pa ssp. sc; Venter *et al.* 1832AC flo; Venugopal & Manoharan 17798 or; Verdick 257 (type) pa ssp. sc; Verheijen 3259 ho; Verheijen 3306 ho; Villiers 41 bi; Villiers 851 flo; Villiers 868 bi; Villiers 912 flo; Villiers *et al.* 4798 le; Vollesen 3298 pa ssp. pa.

Wagh 1400 or; Wagh 2226 or; Wakefield s.n. (type) pa ssp. pa; Wallace 391 pa ssp. pa; Wallich s.n. (type) fla; Wallich s.n. ob; Wallich s.n. fla; Wallich s.n. fla; Wallich s.n. or; Wallich s.n. or; Wallich s.n. or; Wallich s.n. or; Welwitsch 3032 flo; Welwitsch 3033 flo; Wesche 51291 or; White 2420 pa ssp. sc; White 3646 flo; Wight 1302 fla; Wight 1303 ob; Williams 165 fla; Williams 246 flo; Williams & Stainton 8364 or; Wingfield 202 pa ssp. pa; Wingfield 97d pa ssp. pa; Wirawan 408 ho; Wit *et al.* 2053 flo; Witt 12374 fla.

Young s.n. ob; Young s.n. ob.

Zainudin *et al.* AZ 4350 ho.

APPENDIX 2

LIST OF THE SPECIMENS OF *PARACORYNANTHE* SPECIES EXAMINED

Species abbreviations of *Paracorynanthe* species: ant, *P. antankarana*; ur, *P. uropetala*.

Notes: The 'RN' stands for 'Reserve Naturelle' and 'SF' for 'Service Forestier'.

4669-RN ur.

4352-SF ant; 6798-SF (type) ur; 8437-SF ur; 22028-SF ant; 22675-SF ant; 27507-SF ant; 28718-SF ant (type).

De Block *et al.* 1215 ant; De Block *et al.* 1219 ant; Debray 10960 ant.

Gautier *et al.* 4379 ant.

Leandri *et al.* 2069 ur; Leandri & Saboureau 2729 ur.

APPENDIX 3

ALPHABETICAL CHECKLIST OF ALL PUBLISHED *HYMENODICTYON* AND *PARACORYNANTHE* NAMES

Published names	Accepted names
* <i>Hymenodictyon antakaranensis</i> Razafim. & B. Bremer	
* <i>Hymenodictyon berivotrense</i> Cavaco	
* <i>Hymenodictyon biafranum</i> Hiern	
<i>Hymenodictyon bracteatum</i> K. Schum.	* <i>Hymenodictyon biafranum</i> Hiern
* <i>Hymenodictyon decaryi</i> Homolle	
* <i>Hymenodictyon embergeri</i> Cavaco	
<i>Hymenodictyon epidendron</i> Mildbr. ex Hutch & Dalziel	* <i>Hymenodictyon biafranum</i> Hiern
* <i>Hymenodictyon epiphyticum</i> Razafim. & B. Bremer	
<i>Hymenodictyon exselsum</i> (Roxb.) Wall.	* <i>Hymenodictyon orixense</i> (Roxb.) Mabb.
var. <i>canescens</i> Pierre ex Pit.	* <i>Hymenodictyon orixense</i> (Roxb.) Mabb.
var. <i>subglabrum</i> Pierre ex Pit.	* <i>Hymenodictyon orixense</i> (Roxb.) Mabb.
var. <i>velutinum</i> Pierre ex Pit.	* <i>Hymenodictyon orixense</i> (Roxb.) Mabb.
<i>Hymenodictyon fimbriolatum</i> K. Schum. ex De Wild.	* <i>Hymenodictyon parvifolium</i> Oliv. ssp. <i>scabrum</i> (Stapf) Verdc.
* <i>Hymenodictyon flaccidum</i> Wall.	
* <i>Hymenodictyon floribundum</i> (Hochst. & Steud.) B. L. Rob.	
* <i>Hymenodictyon glabrum</i> (Cavaco) Razafim. & B. Bremer	
<i>Hymenodictyon gobiense</i> Aubrév.	* <i>Hymenodictyon pachyantha</i> K. Krause
<i>Hymenodictyon homolleae</i> Capuron ex Cavaco	* <i>Hymenodictyon leandrii</i> Cavaco
* <i>Hymenodictyon horsfieldii</i> Miq.	
<i>Hymenodictyon koordersii</i> K. Schum. ex Koord.	* <i>Hymenodictyon horsfieldii</i> Miq.
<i>Hymenodictyon kurria</i> Hochst.	* <i>Hymenodictyon floribundum</i> (Hochst. & Steud.) B. L. Rob.
var. <i>bequaertii</i> De Wild.	* <i>Hymenodictyon floribundum</i> (Hochst. & Steud.) B. L. Rob.
var. <i>claessensi</i> De Wild.	* <i>Hymenodictyon floribundum</i> (Hochst. & Steud.) B. L. Rob.
var. <i>elongatum</i> Hiern	* <i>Hymenodictyon floribundum</i> (Hochst. & Steud.) B. L. Rob.
var. <i>tomentellum</i> Welw.	* <i>Hymenodictyon floribundum</i> (Hochst. & Steud.) B. L. Rob.
* <i>Hymenodictyon leandrii</i> Cavaco	
* <i>Hymenodictyon louhavate</i> Homolle	
* <i>Hymenodictyon madagascariicum</i> Baill. ex Razafim. & B. Bremer	
<i>Hymenodictyon maevatananense</i> Cavaco	* <i>Hymenodictyon berivotrense</i> Cavaco
* <i>Hymenodictyon obovatum</i> Wall.	
<i>Hymenodictyon obovatum</i> Wight	* <i>Hymenodictyon obovatum</i> Wall.
* <i>Hymenodictyon occidentale</i> Homolle	
<i>Hymenodictyon oreophyton</i> Hoyle	* <i>Hymenodictyon biafranum</i> Hiern
* <i>Hymenodictyon orixense</i> (Roxb.) Mabb.	
* <i>Hymenodictyon pachyantha</i> K. Krause	
* <i>Hymenodictyon parvifolium</i> Oliv. ssp. <i>parvifolium</i> Verdc. ssp. <i>scabrum</i> (Stapf) Verdc. var. <i>fimbriolatum</i> (K. Schum. ex De Wild.) Verdc. var. <i>scabrum</i> (Stapf) Verdc.	* <i>Hymenodictyon parvifolium</i> Oliv. ssp. <i>scabrum</i> (Stapf) Verdc. * <i>Hymenodictyon parvifolium</i> Oliv. ssp. <i>scabrum</i> (Stapf) Verdc.
* <i>Hymenodictyon perrieri</i> Drake	
<i>Hymenodictyon reflexum</i> Hoyle	* <i>Hymenodictyon biafranum</i> Hiern
<i>Hymenodictyon rheedei</i> (Roem. & Schult.) M. R. Almeida & S. M. Almeida	* <i>Hymenodictyon orixense</i> (Roxb.) Mabb.
<i>Hymenodictyon scabrum</i> Stapf	* <i>Hymenodictyon parvifolium</i> Oliv. ssp. <i>scabrum</i> (Stapf) Verdc.
* <i>Hymenodictyon septentrionale</i> Cavaco	
* <i>Hymenodictyon seyrigii</i> Cavaco	
<i>Hymenodictyon thyrsoflorum</i> Wall.	* <i>Hymenodictyon orixense</i> (Roxb.) Mabb.
<i>Hymenodictyon timoranum</i> (Span.) Miq.	
* <i>Hymenodictyon tsingy</i> Razafim. & B. Bremer	
<i>Hymenodictyon utile</i> Wight	* <i>Hymenodictyon orixense</i> (Roxb.) Mabb.
* <i>Paracorynanthe antankarana</i> Capuron ex J.-F. Leroy	
* <i>Paracorynanthe uropetala</i> Capuron	

*Accepted names in our revision.