

# New and little-known *Psychotria* (Rubiaceae) from West Africa, and notes on litter-gathering angiosperms

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**Background** – Five new species of *Psychotria* (Rubiaceae) from West Africa are described and illustrated, in the framework of a regional revision of the genus.

**Methods** – Normal practices of herbarium taxonomy have been applied.

**Key results** – Three of the new species, *Psychotria baldwinii*, *P. tetragonopus* and *P. voorhoevei*, are endemic to Liberia, while the other two, *P. blydeniae* and *P. rubriceps*, also occur in adjacent southwestern Côte d'Ivoire. The Ivorian endemic *Psychotria copeensis*, previously included in the synonymy of *P. subobliqua*, is separated as a distinct species. *Psychotria blydeniae* and *P. tetragonopus* are litterbin plants; we discuss this remarkable adaptation and its occurrence in various Angiosperm families in the African rainforests.

**Key words** – Rubiaceae, *Psychotria*, West Africa, taxonomy, litterbin plants.

## INTRODUCTION

The genus *Psychotria* L. is widespread and very diverse throughout the tropics. In subsaharan Africa, Petit's (1964, 1966, 1972) revision lists 161 species. However, this is a gross underestimation, first because section *Involucratae* E.M.A.Petit & Verdc. was not revised, and second because Cameroon and Gabon were poorly explored at the time and many species in these countries still await description. The West African species are better known, but nevertheless, our recent work, both in the field (by C. Jongkind) and in the herbarium, has resulted in several discoveries. In the present paper five new species are described and illustrated: *P. baldwinii* O.Lachenaud, *P. blydeniae* O.Lachenaud & Jongkind, *P. rubriceps* O.Lachenaud & Jongkind, *P. tetragonopus* O.Lachenaud & Jongkind and *P. voorhoevei* O.Lachenaud. In addition, *P. copeensis* De Wild., a Côte d'Ivoire endemic, previously sunk into synonymy of *P. subobliqua* Hiern, is resurrected. All these species occur in the very wet evergreen forests (> 2000 mm of annual rainfall) of Liberia and southwestern Côte d'Ivoire, which form a well-known centre of endemism (e.g. Guillaumet 1967).

Two of the novelties are litterbin plants; we discuss this remarkable adaptation and its occurrence in various Angiosperm families in the African rainforests.

Petit (1964, 1966) divided the African species of *Psychotria* in two subgenera, subg. *Tetramerae* (Hiern) E.M.A.Petit

for species with bacterial nodules in their leaves, and subg. *Psychotria*, further divided in six sections, for species lacking nodules. Subg. *Tetramerae* is restricted to Africa, Madagascar and the Comoros, while subg. *Psychotria* is pantropical. Our five new species all lack bacterial nodules and therefore belong to subg. *Psychotria* in Petit's sense. In this paper we will not extensively discuss the infrageneric classification, since this is the subject of an ongoing molecular study by the first author. It is evident however, from morphology and preliminar molecular results, that Petit's infrageneric classification is in need of revision.

## TAXONOMIC TREATMENT

*Psychotria baldwinii* O.Lachenaud, **sp. nov.**

Inflorescentia paniculata, bracteis lanceolatis, stipulisque bifidis basi carinatis *P. schweinfurthii* Hiern et *P. latistipula* Benth. valde affinis, sed inflorescentia ramis 4-verticillatis dispositi, foliisque coriaceis nervis lateralibus valde ascendentibus differt. – Type: Liberia, Gola National Forest, NE of Bomi Hills, fl., 27 Apr. 1966, *Bos* 1909 (holo-: WAG; iso-: BR, K, WAG).

**Shrub** 1.5 m high; twigs glabrous, 2.5–4 mm thick. **Stipules** 20–30 × 10–15 mm, obovate, bifid with acute triangular lobes, keeled at base, densely and shortly pubescent on both sides, caducous. **Leaves** with petiole 1–2 cm long, gla-

brous; lamina 18–30 × 5.5–10 cm, narrowly elliptic, acute at base, narrowly acuminate at apex, coriaceous, glabrous except the nerves minutely puberulous below, drying olive green to olive brown; midrib impressed above; lateral nerves 16–19 pairs, strongly ascending, arching 2–4 mm before margin; tertiary veins densely and prominently reticulate below; domatia absent. **Inflorescences** paniculate, hemispherical to shortly pyramidal, many-flowered, 3.5–11 cm long, very shortly and sparsely puberulous; peduncle 2–7 cm long; flowering part 1.5–4.5 cm long, 1.7–4 cm wide, with ramifications verticillate (4 per node); pedicels 0.5–1 mm, glabrous; bracts lanceolate, entire, acute, the lower ones 7–8 × 1–2 mm, minutely ciliate. **Flowers** 5-merous, heterostylous. **Calyx** cupuliform with very short teeth, 0.75 mm, glabrous to minutely ciliate. **Corolla** white, with narrow tube 4–4.5 × 1 mm and lobes 1.5–2 mm long, glabrous outside except puberulous apex of lobes, hairy inside in upper half of tube; flower buds conspicuously corniculate at apex. **Stamens** half-included in longistylous form, or exserted with the filaments exceeding throat by c. 1.5 mm in brevistylous form, anthers 1.5 × 0.3 mm. **Style** exserted, exceeding throat by 3 mm in longistylous form, or with just the stigmas exserted in brevistylous form. **Fruits** unknown. Fig. 1.

**Distribution** – Fig. 2A. Endemic to Liberia and apparently very rare, known only from two localities.

**Ecology** – Lowland high forest on riverbank.

**Conservation: Endangered EN B2ab(iii)** – The estimated area of occupancy (AOO) of *P. baldwinii* is 19.72 km<sup>2</sup>, within the threshold for Endangered under criterion B2; the extent of occurrence (EOO) is not calculable, since there are only two localities. Under criterion B2a, the species also qualifies for Endangered since it is known from two subpopulations representing two different locations. Both locations are unprotected, and a decline in habitat extent and quality is expected, due to farming and forest exploitation. The species is evidently rare, having been collected only twice before 1968. It has not been found during recent inventories, e.g. in Sapo N.P.

**Etymology** – Named after J.T. Baldwin, first collector of the species, and of many other Liberian plants in the 1940s.

**Affinities** – *P. baldwinii* clearly belongs to sect. *Bracteateae* Hiern but is separated from all other species in that section by the arrangement of the inflorescence branches, which are verticillate instead of opposite. It appears to be closest to *P. latistipula* Benth. and *P. schweinfurthii* Hiern, which also have entire lanceolate bracts, but, in addition to inflorescence structure it also differs from them in having coriaceous leaves and more ascending lateral nerves. Furthermore, both *P. schweinfurthii* and *P. latistipula* have more eastern ranges (*P. schweinfurthii*: Côte d'Ivoire to Uganda; *P. latistipula*: Nigeria to Gabon).

The earliest collection of *P. baldwinii* (Baldwin 11357) was cited by Petit (1972: 358) as *P. multinervis* De Wild., now a synonym of *P. maliensis* Schnell. However, that species, restricted to the Fouta Djallon highlands in Guinea, differs in having the inflorescence branches paired (not verticillate), the bracts smaller and usually dentate, and the leaves with lateral nerves less ascending and arching closer to the margin. The type specimen (Bos 1909) was initially identi-

fied as *P. bidentata* (Thunb. ex Roem. & Schult.) Hiern, which is also quite different in having broader, usually lobed bracts and inflorescences with 1–3 (rarely 5) large glomerules of flowers.

Due to a certain overall similarity, *P. baldwinii* may also be confused with *P. voorhoevei* described below; for the differences, see that species.

**Additional material studied** – **Liberia**: Sinoe Co.: Duo, fl., 11 Mar. 1948, Baldwin 11357 (K).

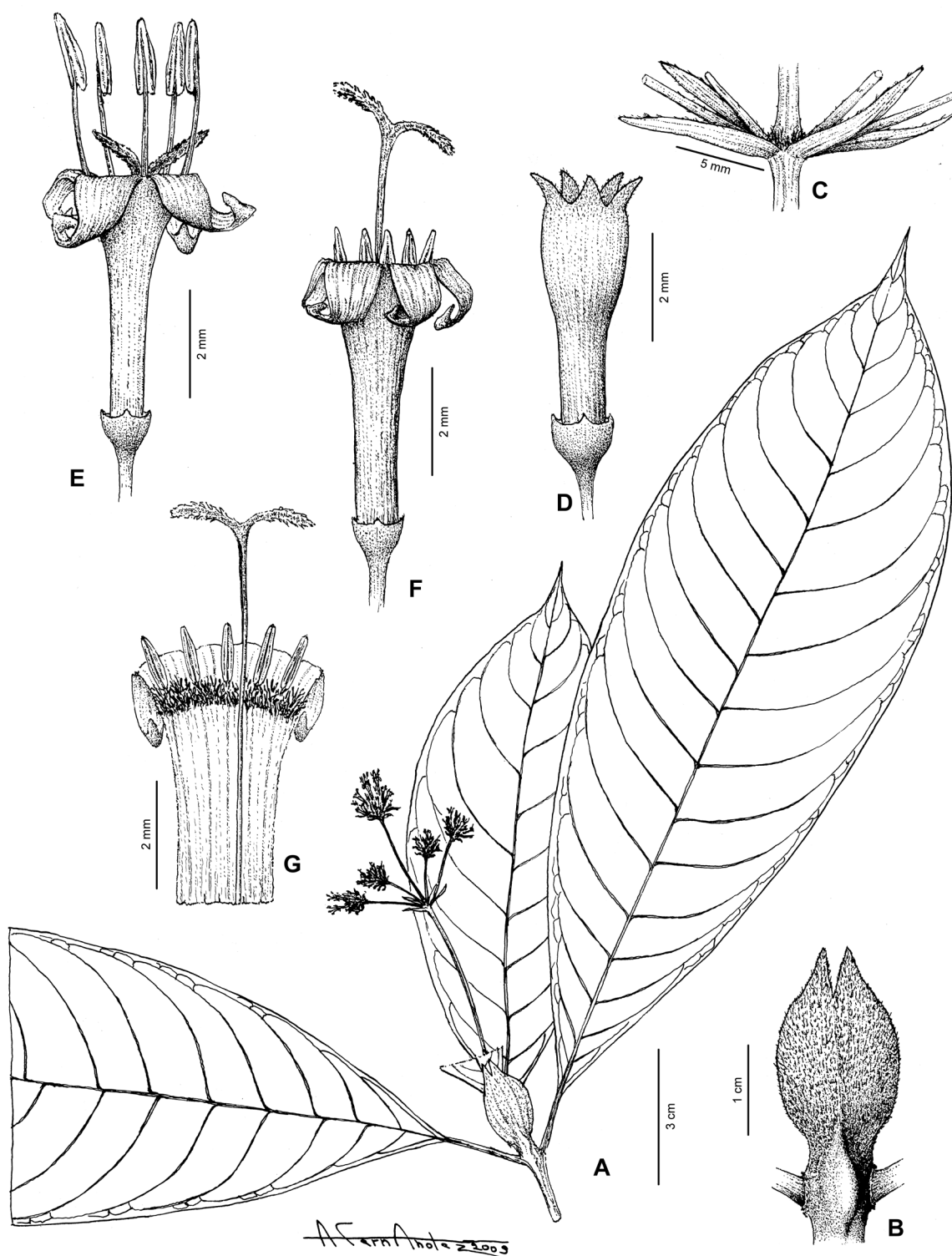
### *Psychotria blydeniae* O.Lachenaud & Jongkind, sp. nov.

*P. libericae* Hepper et *P. kupensi* Cheek affinis, sed a primo differt ramis glabris, foliis maioribus oblanceolatis (nec ellipticis), pedunculoque longiore; a secundo corolla extus velutina (nec glabra), calyci lobis triangularibus (nec semicircularibus) et extus velutinis, pedunculis et stipulis dense velutinis distinguitur. – Type: Côte d'Ivoire, F.C. de la Haute Dodo, 4°57'N 7°18'W, fl., buds, 7 May 1999, Jongkind 4566 (holo-: WAG).

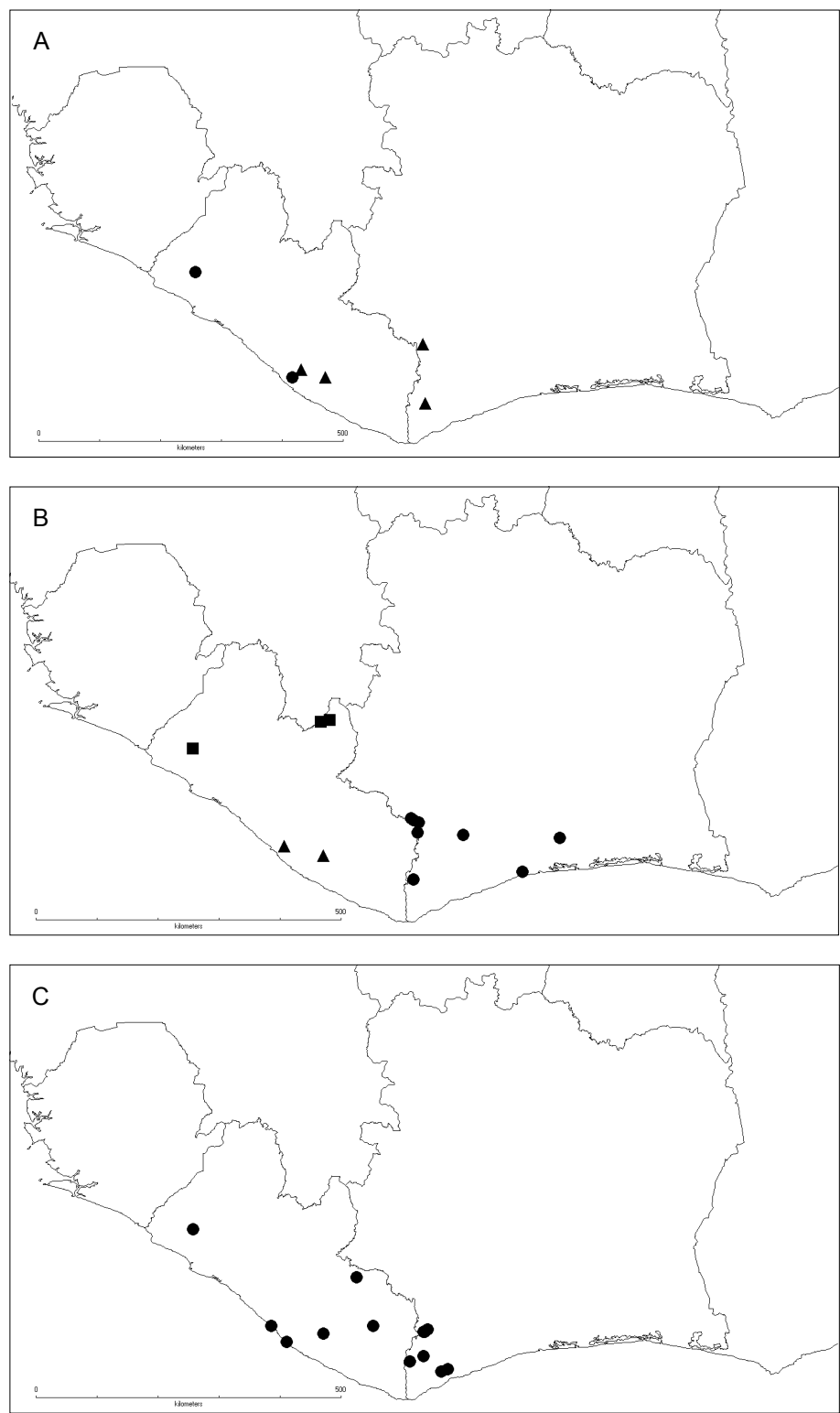
**Litter-collecting undershrub**, 30–50 cm tall, not or scarcely branched, with leaves often crowded near top of stem, the latter occasionally bearing adventitious roots; stem glabrous, 2–4 mm thick. **Stipules** 7–12 × 3–11 mm, +/- obovate, deeply (4–5 mm) divided into two triangular lobes varying from acute to long-acuminate at apex, densely velutinous, caducous to subpersistent. **Leaves** with petiole short and robust, 0.1–1.5 cm, puberulous; lamina (10–)11.5–22 × 3.4–7.5 cm, narrowly spatulate, rounded to obtuse at base, acuminate at apex, papyraceous, glabrous except midrib minutely puberulous below, medium green above, very pale green below, drying olive-green with lower side paler; lateral nerves 15–21 pairs, ascending to varying angles, conspicuously joining 2.5–5 mm before margin; tertiary veins lax and inconspicuous; domatia absent. **Inflorescence** a highly condensed, globose to ovoid panicle (sometimes appearing subcapitate), 5–9 cm long, densely velutinous; peduncle 4–7 cm long, erect, rounded; flowering part 0.5–2 cm long, 1.4–1.8 cm wide, with branches very short, 0.2–0.5 cm; bracts very reduced, < 1 mm long, triangular to irregularly divided, velutinous. **Flowers** subsessile, 5-merous. **Calyx** with tube c. 0.5 mm long and elliptic-triangular lobes 1.5 × 0.6–0.8 mm, entirely appressed-tomentose outside, glabrous inside. **Corolla** white on both sides, with tube narrowly funnel-shaped c. 3 × 1.5 mm and lobes c. 1.2 mm long, densely velutinous outside except for the glabrous base of tube, hairy inside the tube near the insertion of stamens; flower buds rounded. **Stamens** sub-included with tips just reaching throat, anthers c. 1 × 0.3 mm. **Style** exceeding corolla throat by c. 1 mm. **Fruits** cherry red, shiny, ellipsoid crowned with persistent calyx, c. 8 × 6 mm when dry, sparsely puberulous at first, soon glabrescent, subsessile; undeveloped ovaries persistent in the infructescence. **Pyrenes** narrowly ellipsoid, 6 × 4 mm, dorsally smooth. **Seeds** with a very shallow ventral groove, otherwise entire. Figs 3 & 4A.

**Distribution** – Fig. 2A. Southeastern Liberia and adjacent southwestern Côte d'Ivoire.

**Ecology** – Lowland wet evergreen forest, c. 100–150 m in altitude.



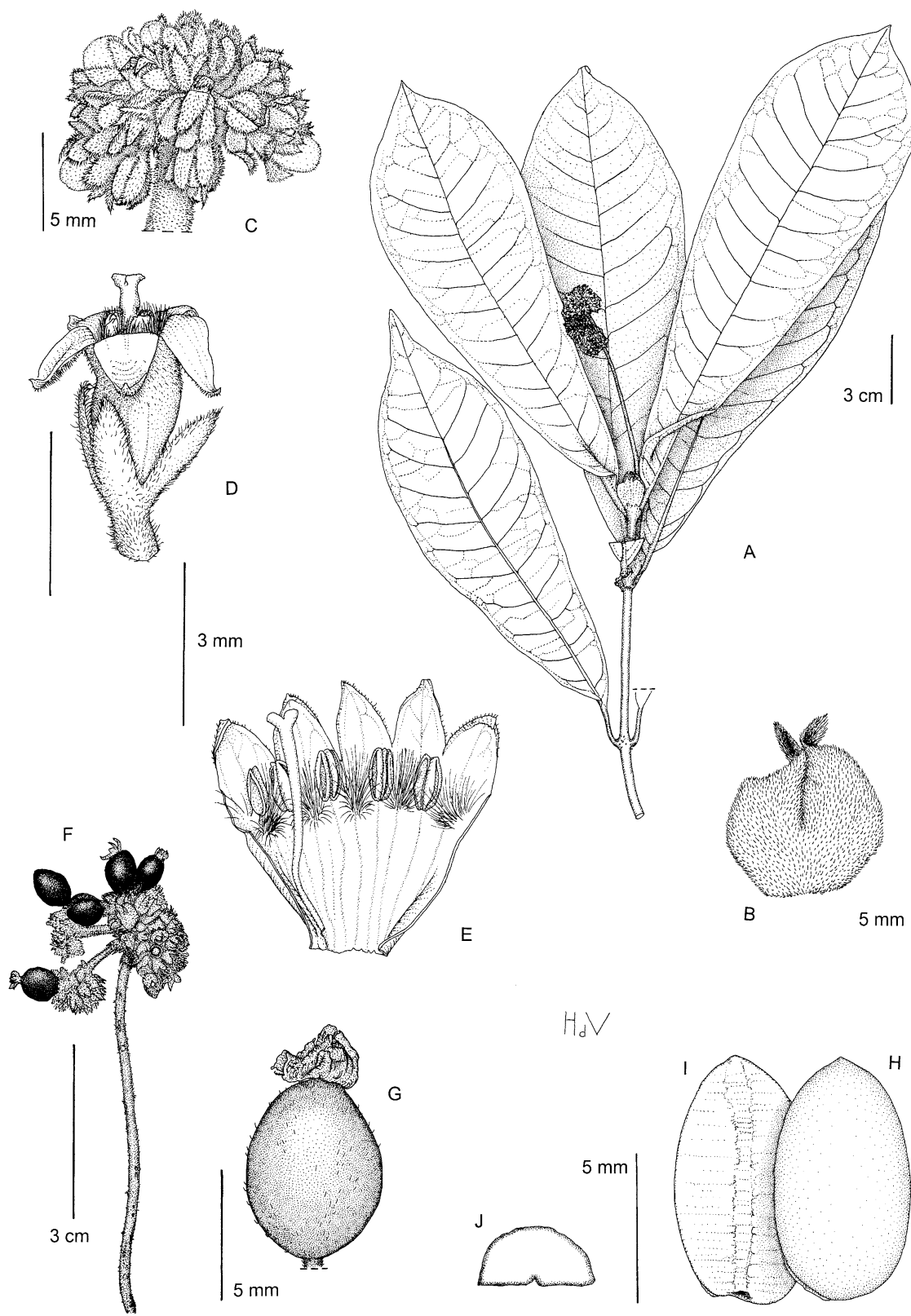
**Figure 1** – *Psychotria baldwinii* O.Lachenaud: A, flowering twig; B, stipule; C, bracts; D, flower bud; E, short-styled flower; F, long-styled flower; G, long-styled flower, corolla laid open. From Bos 1909 (A–E) and Baldwin 11357 (F–G). Drawing by Antonio Fernandez.



**Figure 2** – A, distribution of *Psychotria baldwinii* (circles) and *Psychotria blydeniae* (triangles); B, distribution of *Psychotria copeensis* (circles), *P. tetragonopus* (triangles) and *P. voorhoevei* (squares); C, distribution of *Psychotria rubriceps*. Scale bars = 500 km.

**Conservation: Endangered EN B2ab(i, ii, iii)** – The estimated area of occupancy (AOO) of *P. blydeniae* is 39.44 km<sup>2</sup>, below the upper limit for Endangered under criterion B2, while the estimated extent of occurrence (EOO) is 10303.10 km<sup>2</sup>, within the threshold for Vulnerable under cri-

terion B1. The species is known from four subpopulations representing four different locations, and qualifies for Endangered under criterion B2a. The habitat extent and quality, probably also the area of occupancy and extent of occurrence, are declining due to forest clearance for farming. One of the



**Figure 3** – *Psychotria blydeniae* O.Lachenaud & Jongkind: A, habit; B, stipule; C, part of inflorescence; D, flower; E, corolla with stamens from the inside; F, infructescence; G, fruit; H, pyrene, dorsal view; I, pyrene, ventral view; J, seed, cross section. From *Jongkind 4566* (A–C), *Jongkind & Blyden 5597* (D–E), *Aké Assi 6076* (F–G) and *Jongkind & Blyden 5602* (H–J). Drawing by Hans de Vries.

**Table 1 – Differences between five litter-collecting species of *Psychotria*.**

	<i>P. foliosa</i>	<i>P. tetragonopus</i>	<i>P. micheliana</i>	<i>P. blydeniae</i>	<i>P. kupensis</i>
Tertiary nerves	densely reticulate	lax and inconspicuous	densely reticulate	lax and inconspicuous	lax but clearly visible
Stipules	bifid, glabrous	bifid, glabrous	entire, puberulous	bifid, hairy	entire to variously bifid, hairy to glabrous
Inflorescence	lax, pyramidal	lax, pyramidal	lax, hemispherical	condensed, subglobose	condensed, subglobose
Peduncle	4-angled, glabrous	4-angled, glabrous	rounded, puberulous	rounded, <b>long-hairy conspicuous triangular lobes</b> (persistent on fruit)	rounded, puberulous <b>conspicuous rounded lobes</b> (persistent on fruit)
Calyx	subtruncate	subtruncate	subtruncate		
Corolla	<b>4-merous</b>	5-merous	5-merous	5-merous	5-merous
Corolla outside	glabrous	glabrous	glabrous	<b>hairy</b>	glabrous
Corolla tube	+/- cylindrical	broadly funnel-shaped	funnel-shaped	+/- cylindrical	+/- cylindrical
Pyrenes	ellipsoid, strongly grooved	hemispherical, slightly costate	hemispherical to ellipsoid, grooved	ovoid, smooth	ovoid, smooth
Seeds (cross-section)	two confluent ventral grooves forming a V	<b>entire</b>	deep T-shaped ventral groove	nearly entire (very shallow ventral groove)	deep T-shaped ventral groove
Range	Central Africa (Nigeria to Gabon)	West Africa (Liberia)	West Africa (Liberia, Côte d'Ivoire)	West Africa (Liberia, Côte d'Ivoire)	Central Africa (Cameroon)

locations, Haute-Dodo F.C., is possibly lost, having been largely cleared in the last ten years (G. Koffi pers. comm.). The species occurs in at least one national park (Sapo N.P.); it is not clear whether the collection from “Forêt de Taï” was made within the current boundaries of Taï N.P.

**Etymology** – Named after Prof. Florence Blyden from the University of Liberia, with whom the second author discovered the species.

**Affinities** – In flower and inflorescence characters *P. blydeniae* most resembles *P. liberica* of sect. *Confertiflorae* Hiern, which is also West African, and probably its closest relative. However, the two species are very dissimilar in habit. *P. liberica* is a usually ramose shrub, not litter-collecting, with hairy twigs and leaves, the latter elliptic and smaller than in *P. blydeniae*; it also has shorter peduncles. The earliest collection of *P. blydeniae* (Aké Assi 6076) was already recognised by Hepper (1963) as being closely related to, but distinct from *P. liberica*.

In general habit *P. blydeniae* closely resembles *P. kupensis* Cheek, from Cameroon, which is also a litterbin shrub. *P. kupensis*, however, has rounded calyx-lobes, a corolla glabrous outside, shortly puberulous inflorescences, and seeds with a deep T-shaped ventral groove (table 1).

In Hawthorne & Jongkind (2006), *P. blydeniae* was erroneously named *P. micheliana* J.G. Adam, largely because no material of this rare species was then available to the authors for comparison. It is now clear that *P. micheliana* is an unrelated species, only superficially resembling *P. blydeniae* in habit. *P. micheliana* differs in particular in having a truncate calyx, the corolla glabrous outside, the pyrenes dorsally grooved, leaves with densely reticulate tertiary nerves, and the inflorescence shortly puberulous (not conspicuously hairy as in *P. blydeniae*). The illustration of *P. micheliana* in Hawthorne & Jongkind (2006: 653) represents *P. blydeniae*;

for a (not very complete) illustration of *P. micheliana* see Adam (1975: 1298).

**Notes** – Only two flowering specimens have been seen, both with the style exerted. Due to the paucity of collections it is not known whether the species is heterostylous.

**Additional material studied** – **Liberia**: Sapo N.P., just E of Sinoe river, 5°20'N 8°48'W, fl., 2 Dec. 2002, *Jongkind & Blyden* 5597 (WAG); *ibid.*, fr., 2 Dec. 2002, *Jongkind & Blyden* 5602 (WAG); Close after Sinoe River crossing from Jalay's Town into Sapo N.P., fr., 4 Mar. 2009, *Jongkind et al.* 8801 (WAG); South of Sayon Town, fr., 1 Dec. 2010, *Jongkind et al.* 9968 (WAG).

**Côte d'Ivoire**: Forêt de Taï, fr., Oct. 1960, *Aké Assi* 6076 (K).

***Psychotria copeensis*** De Wild. (De Wildeman 1924: 353).

Type – Côte d'Ivoire, collines basaltiques du Mont Kopé, fl., 30–31 Jul. 1907, *Chevalier* 19677 (holo-: P; iso-: BR, K).

*Psychotria yabaensis* De Wild. (De Wildeman 1924: 440), **syn. nov.** – Type: Côte d'Ivoire, Moyen-Cavally, pays des Yaba, village de Tébo [=Sakré] et environs, fl., 10–12 Jul. 1907, *Chevalier* 19412 (holo-: P).

**Distribution** – Fig. 2B. Endemic to south-western Côte d'Ivoire; but can be expected in neighbouring Liberia as well.

**Ecology** – Lowland wet evergreen forest, c. 50–300 m in altitude.

**Conservation: Endangered EN B2ab(i, ii, iii)** – The area of occupancy (AOO) of *P. copeensis* is estimated at 78.88 km<sup>2</sup>, below the upper limit for Endangered status under criterion B2, while the extent of occurrence (EOO) is estimated at 17158.00 km<sup>2</sup>, within the threshold for Vulnerable under criterion B1. The species is known from five subpopulations that represent five different locations, just within the limit for Endangered under criterion B2a. There is an obvious decline

**Table 2 – Differences between *Psychotria copeensis*, *P. brieyi* and *P. subobliqua*.**

	<i>P. copeensis</i>	<i>P. brieyi</i>	<i>P. subobliqua</i>
Indumentum	glabrous	<b>puberulous</b> at least on inflorescence (usually on twigs also)	glabrous (rarely with puberulous peduncle)
Twigs	soon covered with pale grey bark	soon covered with pale grey bark	<b>remaining green</b> (only the lower stems woody)
Lower leaf surface (when dry)	<b>microverrucose</b> and slightly scabrid to touch	smooth	smooth
Inflorescence	<b>patent or reflexed</b> , umbellate to very shortly branched	erect, usually with distinct branches (rarely umbellate)	erect or half-erect, umbellate
Calyx-lobes	<b>narrowly lanceolate</b> or rarely triangular, <b>(0.7–)1–2.5 mm</b>	triangular, < 1 mm	rounded to very shortly triangular, 0.3–1.5 mm
Distribution	SW Côte d'Ivoire	S Cameroon to D.R.Congo	SE Côte d'Ivoire to D.R.Congo

in habitat extent and quality, probably also in area of occupancy and extent of occurrence, since the southwest of Côte d'Ivoire has experienced massive deforestation for agriculture in recent decades. Some locations, e.g. Mt Kopé, may be already lost; only one of them (Taï N.P.) is protected.

**Affinities** – This species was included by Petit (1964) in the synonymy of *P. subobliqua* Hiern but shows significant differences in the twigs, inflorescence and calyx, and also the leaves which are microverrucose below in the dry state (table 2). Furthermore, the ranges of the two species are separate: *P. copeensis* is endemic to southwestern Côte d'Ivoire, while *P. subobliqua* occurs from Abidjan eastwards (to D.R.Congo). While *P. copeensis* is no doubt related to *P. subobliqua*, possibly an even closer relative would be *P. brieyi* De Wild., which resembles *P. copeensis* in having a pale grey bark (see table 2 for differences between the three species). *P. liberica* is also closely related but readily separable by its conspicuously hairy stems and leaves.

**Notes** – Among the two names of same date, *P. copeensis* and *P. yabaensis*, we gave priority to the former because its type has several duplicates. *Psychotria copeensis* De Wild. is not to be confused with *P. copensis* Dwyer (now a synonym of *Palicourea seemannii* Standl.), a Neotropical species.

**Additional material studied** – Côte d'Ivoire: 10 km ESE Taï, fl., 6 Sep. 1975, *Beentje* 874 (WAG); 8 km N Guitry, fl., 3 Nov. 1975, *Beentje* 1348 (WAG); 36 km NE Sassandra, fr. imm., 29 Nov. 1968, *Breteler* 6112 (BR, K, WAG); Ponan, fl. (fallen), 26 Sep. 1986, *de Rouw* 223 (WAG); c. 6 km SSW Nigbi II (Nigbi II situated 11 km SSW Soubré), fr., 20 Nov. 1961, *J.J. de Wilde* 3272 (BR, K, P, WAG); Forêt de Bakoué Soubré, st., 20 Nov. 1961, *Guillaumet* 964 (BR); Mont Kopé, 17 Aug. 1975, *Hall & Abbiw* GC 45494 (K); Mont Kopé, 17 Aug. 1975, *Hall & Abbiw* GC 45514 (K); rivière Davo, 1960, *F. Hallé* 36 (P); Taï, 4 Aug. 1954, *Schnell* 6059 (P).

### *Psychotria rubriceps* O.Lachenaud & Jongkind, **sp. nov.**

Capitulis hemisphaericis involucri integro cinctis, floribus pro genere maioribus, calyce longe tubuloso, fructibusque caeruleis *P. spathaceae* (Hiern) Verdc. valde affinis, sed involucri rubro (nec albo), stipulis puberulis (nec basi excepta glabris), pedunculo glabro (nec puberulo) et distributione differt. – Type: Liberia, Chiehn, along the Tapeta road, fl., 17 Jan. 1967, *Bos* 2852 (holo-: WAG; iso-: K, WAG).

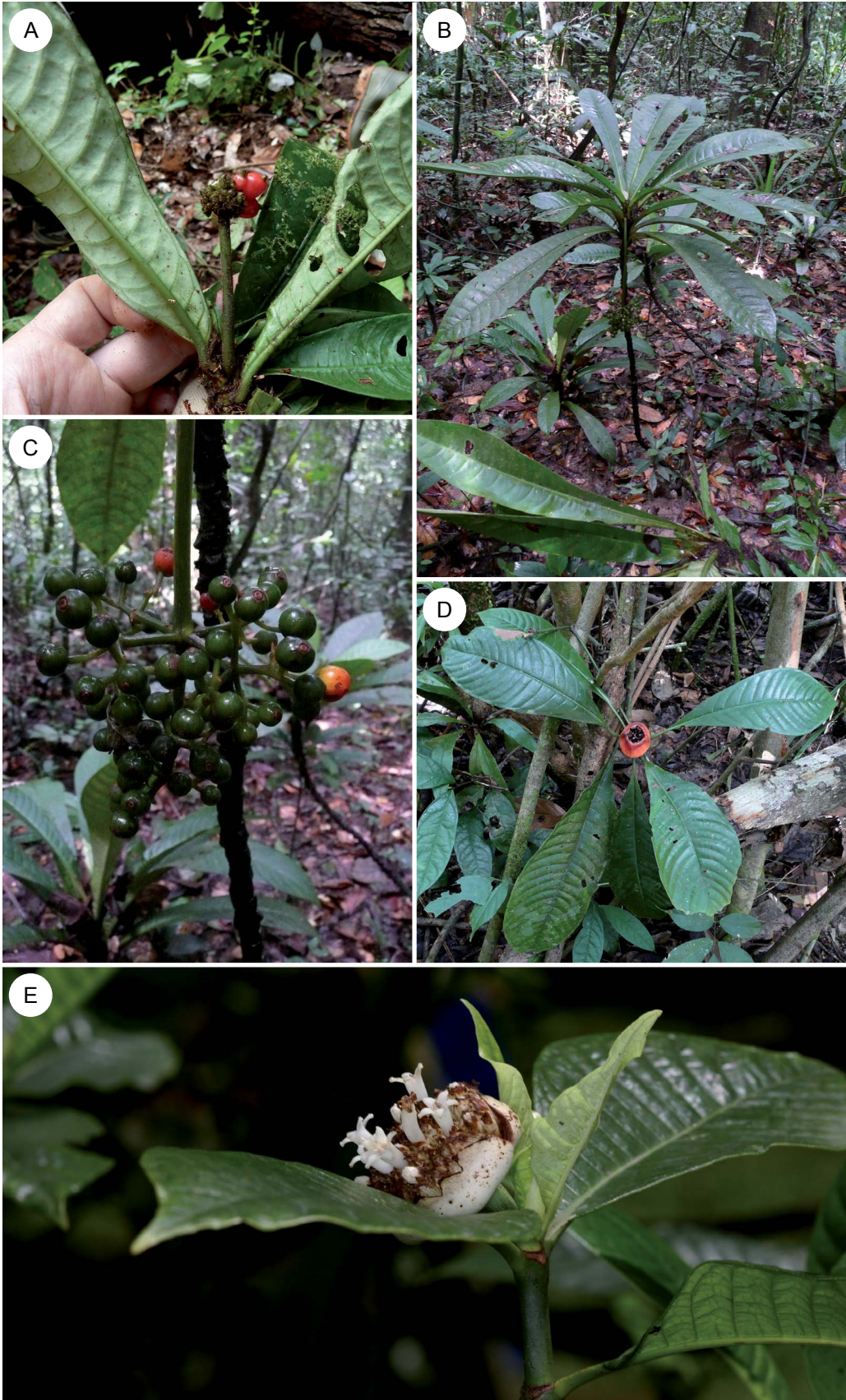
**Shrub** 1–3 m high; stems glabrous, 3.5–6 mm thick. **Stipules** 15–35 × 5–23 mm, ovate or obovate, shortly bifid with

broadly triangular lobes, dorsally keeled at base, minutely and densely puberulous, soon caducous. **Leaves** with petiole 1.5–8 cm long, glabrous to puberulous; lamina 20–34 × 7.5–15 cm, elliptic to slightly obovate, acute at base, acuminate at apex, coriaceous, glabrous or sometimes minutely puberulous on underside of nerves, drying brown; midrib prominent above; lateral nerves 17–24 pairs; tertiary veins densely reticulate beneath; domatia absent. **Inflorescences** capitate and involucriate, erect even in fruit, 2.5–4.3 cm in diameter at anthesis, 3.8–6 cm in fruit; peduncle 0–1.5 cm, glabrous; involucre bright red, broadly hemispherical, entire (the bracts completely fused) or irregularly broken in fruit, glabrous. **Flowers** 5-merous, heterostylous. **Calyx** brownish, with a long tube c. 6 mm long and short, +/- unequal triangular teeth < 1 mm long, densely ciliate, otherwise glabrous. **Corolla** white with pale green lobes, with tube very narrowly infundibuliform 14–20 × 1.5–3.5 mm and lobes 2–3.5 mm, glabrous outside, hairy inside in upper half of tube; flower buds rounded. **Stamens** included in longistylous form, or two thirds exserted in brevistylous form, anthers 3.5 × 0.4 mm. **Style** exceeding throat by 4–5 mm in longistylous form, or included in brevistylous form. **Fruits** blue, ellipsoid with the calyx soon caducous, glabrous, 7.5–9 × 4–5 mm when dry, on white fleshy pedicels 3–10 mm long. **Pyrenes** narrowly ellipsoid, 8–9 × 4–4.5 mm, with 6 acute ridges (4 dorsal and 2 lateral). **Seeds** ruminate, with several grooves on both sides. Figs 4D & 5.

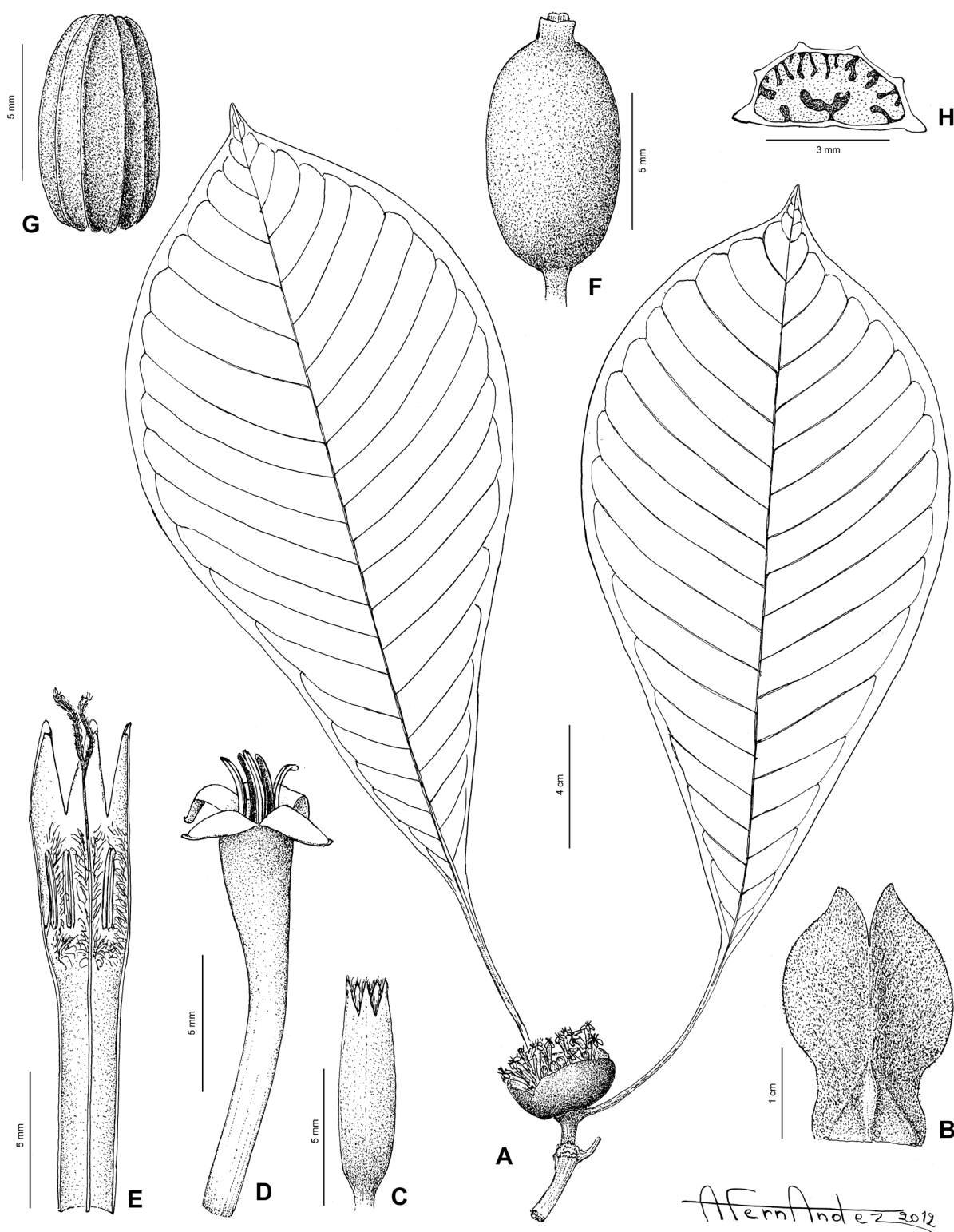
**Distribution** – Fig. 2C. Liberia and southwestern Côte d'Ivoire (Cavally basin).

**Ecology** – Marshy bottomlands in lowland wet evergreen forest.

**Conservation: Vulnerable VU B2a(i, ii, iii)** – The estimated extent of occurrence (EOO) of *P. rubriceps* is 39909.00 km<sup>2</sup> and exceeds the upper limit for Vulnerable status under criterion B1. However, the estimated area of occupancy (AOO) is 118.32 km<sup>2</sup>, within the threshold for Endangered under criterion B2. The species is known from ten subpopulations representing ten locations, i.e. just within the limit for Vulnerable under criterion B2a. There is evidence of a decline in habitat extent and quality, probably also in area of occupation and extent of occurrence, since the area where the species occurs is experiencing continuing forest clearance for farming. The southwestern part of Côte d'Ivoire, in particular, has experienced dramatic deforestation in recent decades, and some lo-



**Figure 4** – *Psychotria* spp.: A, *P. blydeniae*, fruiting stem; B, *P. tetragonopus*, habit; C, *P. tetragonopus*, fruits; D, *P. rubriceps*, flowering stem; E, *P. spathacea*, inflorescence. Photographs by C. Jongkind (A–D) and T. Stévant (E).



**Figure 5** – *Psychotria rubriceps* O.Lachenaud & Jongkind: A, flowering twig; B, stipule; C, calyx; D, short-styled flower; E, long-styled flower (longitudinal section); F, fruit; G, pyrene, dorsal view; H, pyrene, cross section. From *Bos* 2852 (A & C–D), *Jangoux* 519 (B & E) and *Cremers* 1209 (F–H). Drawing by Antonio Fernandez.

cations may no longer exist, e.g. Haute-Dodo F.C. (G. Koffi, pers. comm.). Only two locations (Sapo N.P. in Liberia and Taï N.P. in Côte d'Ivoire) are effectively protected.

**Etymology** – The name *rubriceps* refers to the red flower heads, a colour which is unique among West African species.

**Affinities** – *P. rubriceps* belongs to sect. *Involucratae* E.M.A.Petit & Verdc. So far it has always been included in *P. spathacea* (Hiern) Verdc., but on a closer examination we concluded the latter is a Sao Tomé endemic. The two species are very similar in leaf, flower and inflorescence morphology, in particular the bracts which are completely fused, and they are certainly each other's closest relative. However, *P. spathacea* differs in having a white, not red, involucre (see fig. 4E), in having puberulous, not glabrous peduncles, and in the stipules which are pubescent at the base only. Because of this striking difference in the colour of the involucre, and also of their widely separate ranges, it seems appropriate to treat the two taxa as species.

**Additional material studied** – **Liberia**: across Cess River from River Cess, fl. (fallen), 9 Mar. 1948, *Baldwin* 11299 (K); Sinoe Co.: Sangwin, fr., 9 Mar. 1948, *Baldwin* 11307 (K); new road Chiehn – Cape Palmas, c. 6 km S Kanweake, fr., 30 Mar. 1962, *J.J.F.E.de Wilde* 3715 (BR, K, P, WAG); near Bomi Hills, fr., 11 Feb. 1969, *Jansen* 1455 (BR, K, P, WAG); 18 miles N Bomi Hills, fr., 27 Jul. 1971, *Jansen* 2579 (K, WAG); Sapo N.P., buffer zone, around Safari camp, 5°20'N 8°48'W, 22 Nov. 2002, *Jongkind & Blyden* 5307 (BR); Bomi Hills NF, 5 Feb. 1962, *Voorhoeve* 818 (WAG).

**Côte d'Ivoire**: Rives de la Hana entre Fort Binger [=Djiroutou] et le Mont Niénokoué, Jul. 1907, *Chevalier* 19506 (P); Grabo, s.d., *Chevalier* s.n. (P); 28 km NW Béréby, 5 km W Oueollo, fr., 10 May 1970, *Cremers* 1209 (BR); Hana river near crossing with road Taï – Tabou, 12 Mar. 1962, *J.J.F.E.de Wilde* 3619 (BR, K, P, WAG); no locality or date, *Guillaumet* 834 (BR); entre Bahi et Nérobrousse, st., 20 Jun. 1961, *Guillaumet* 1143 (P); Niébi (=Patokla), bac sur la Hana sur la route Taï – Tabou, fl., 16 Aug. 1962, *Jangoux* 519 (BR, BRLU); F.C. de la Haute Dodo, close to Kouadjokro, fr., 2 May 1999, *Jongkind* 4436 (FHO, MO, WAG); Djiroutou, 23 Mar. 1999, *Téré* 2899 (WAG).

***Psychotria tetragonopus* O.Lachenaud & Jongkind, sp. nov.**

Habitu monocaule et radicifero, foliis magnis oblanceolatis in rosula terminali dispositis, paniculisque pyramidalibus pedunculis quadrangularibus *P. foliosae* Hiern valde similis, sed corolla 5-mera tubo lato (nec 4-mera tubo angusto), seminibus integris (nec fissura mediana V-formi munitis), venulis laxissimis et inconspicuis (nec densis et subtus prominentibus), distributioneque differt. – Type: Liberia, Cestos-Sanguin area, logging concession of the Cooper's, 5°29'N 9°23'W, fl., fr., 6 Dec. 2002, *Jongkind & Blyden* 5643 (holo.: WAG).

Unbranched, litter-collecting undershrub 1.2–1.5 m high, with leaves crowded near top of stem, the latter with adventitious roots; stem glabrous, 4–7 mm thick. Stipules 5–8 × 4–5 mm, oval, shortly (1–2 mm) bifid, glabrous, very caducous. Leaves with petiole short and robust, 0.2–1.5 cm long, glabrous; lamina 26.5–42 × 5.4–12.6 cm, narrowly spatulate, rounded to acute at base, acute to shortly acuminate at apex, slightly succulent in the fresh state, glabrous on both sides, drying olive green to olive brown with lower side paler; lateral nerves 13–22 pairs, ascending to varying angles; tertiary nerves slightly apparent below, very lax; domatia absent.

Inflorescence paniculate, many-flowered, ovoid to pyramidal, initially erect, 8–9.5 cm long in flower, then drooping, 15.5–22.5 cm in fruit, glabrous, with axes 4-angled; peduncle 5–5.5 cm in flower, 10–17 cm in fruit; flowering part 3–4 × 2.5–4 cm in flower, 3.5–7 × 4.8–7 cm in fruit, the ramifications verticillate, (3–)4(–5) per node; bracts very reduced, almost invisible. Flowers on 0.5–1 mm long pedicels, 5-merous. Calyx shortly cupuliform, truncate or minutely denticulate, c. 0.4 mm long, glabrous. Corolla green (in bud) to reddish-brown, with tube broadly funnel-shaped c. 2 × 1.5 mm and lobes 1.5 mm long, glabrous outside, hairy inside the tube near the insertion of stamens. Stamens mostly included, anthers c. 0.8 × 0.4 mm. Style exceeding throat by 0.75 mm. Fruits red, subglobose (or occasionally ellipsoid if 1-seeded), 6–7 × 6–7 mm when dry, glabrous, on slightly accrescent, 3–4 mm long pedicels. Pyrenes nearly hemispherical, c. 7 × 6.5 mm, weakly 3-costate dorsally. Seeds entire. Figs 4B–C & 6.

**Distribution** – Fig. 2B. Endemic to southeastern Liberia (Sino and Grand Bassa counties); most collections are from Sapo National park.

**Ecology** – Lowland wet evergreen forest, 60–110 m in altitude.

**Conservation: Endangered EN B2ab(iii)** – The estimated area of occupancy (AOO) of *P. tetragonopus* is 19.72 km<sup>2</sup>, well under the 500 km<sup>2</sup> limit for Endangered under criterion B2, while the estimated extent of occurrence (EOO) of 13.58 km<sup>2</sup> would even suggest a Critically endangered status under criterion B1. The species is known from two subpopulations representing two different locations, and qualifies for Endangered status under criterion B2a. One of the locations (Sapo N.P.) is protected, the other is in a logging concession, where a decline in habitat extent and quality is expected due to forest exploitation.

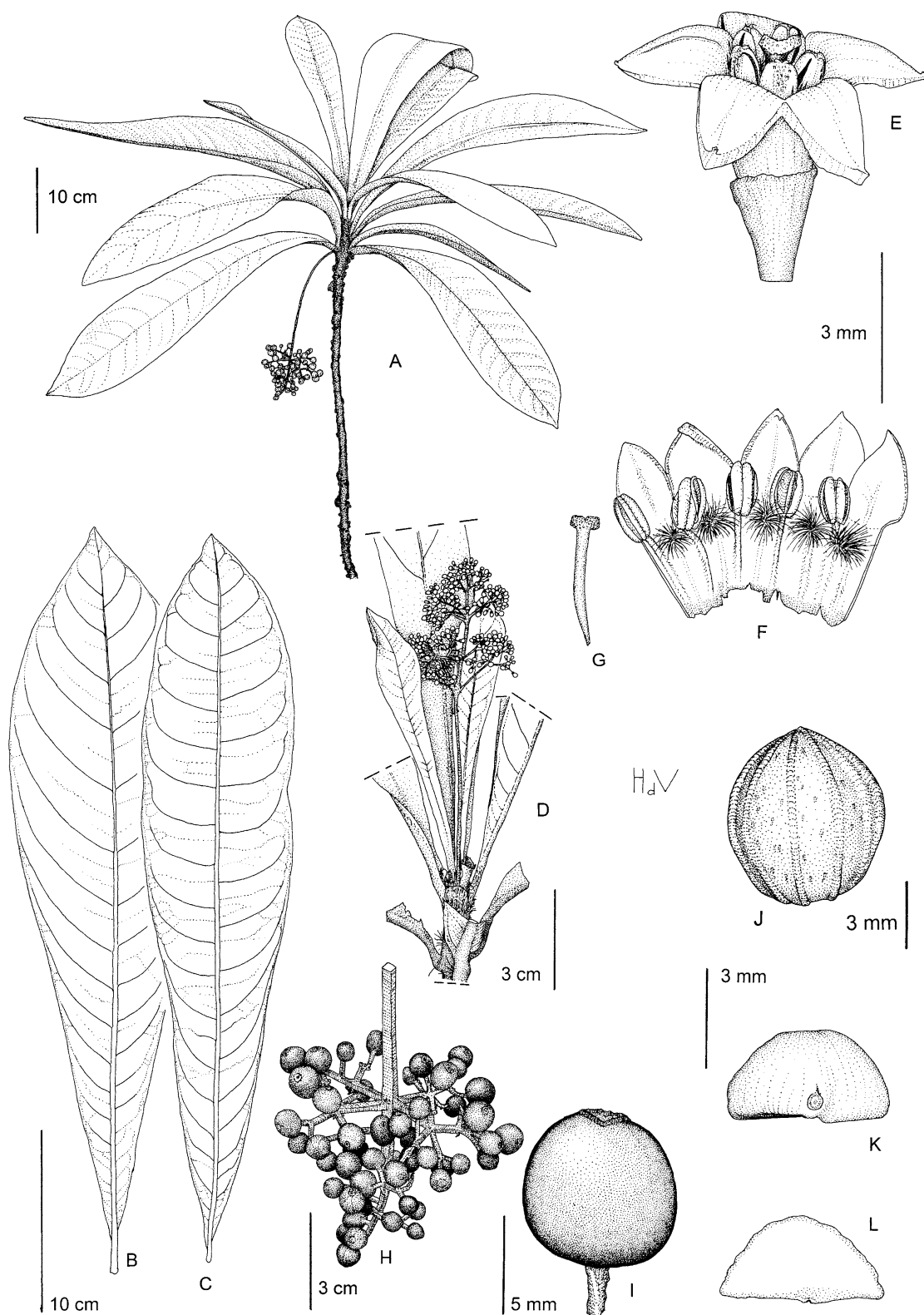
**Etymology** – The name *tetragonopus* refers to the 4-angled peduncles of this species, a very unusual character in the genus, although shared with *P. foliosa* Hiern (see below).

**Affinities** – *P. tetragonopus* most closely resembles *P. foliosa* Hiern, a Central African species occurring from Nigeria to Gabon. They share the same monocauleous litter-collecting habit with large oblanceolate leaves, and pyramidal inflorescences with square peduncles. However, *P. foliosa* has different flowers, fruits and seeds, as well as densely reticulate tertiary nerves (table 1).

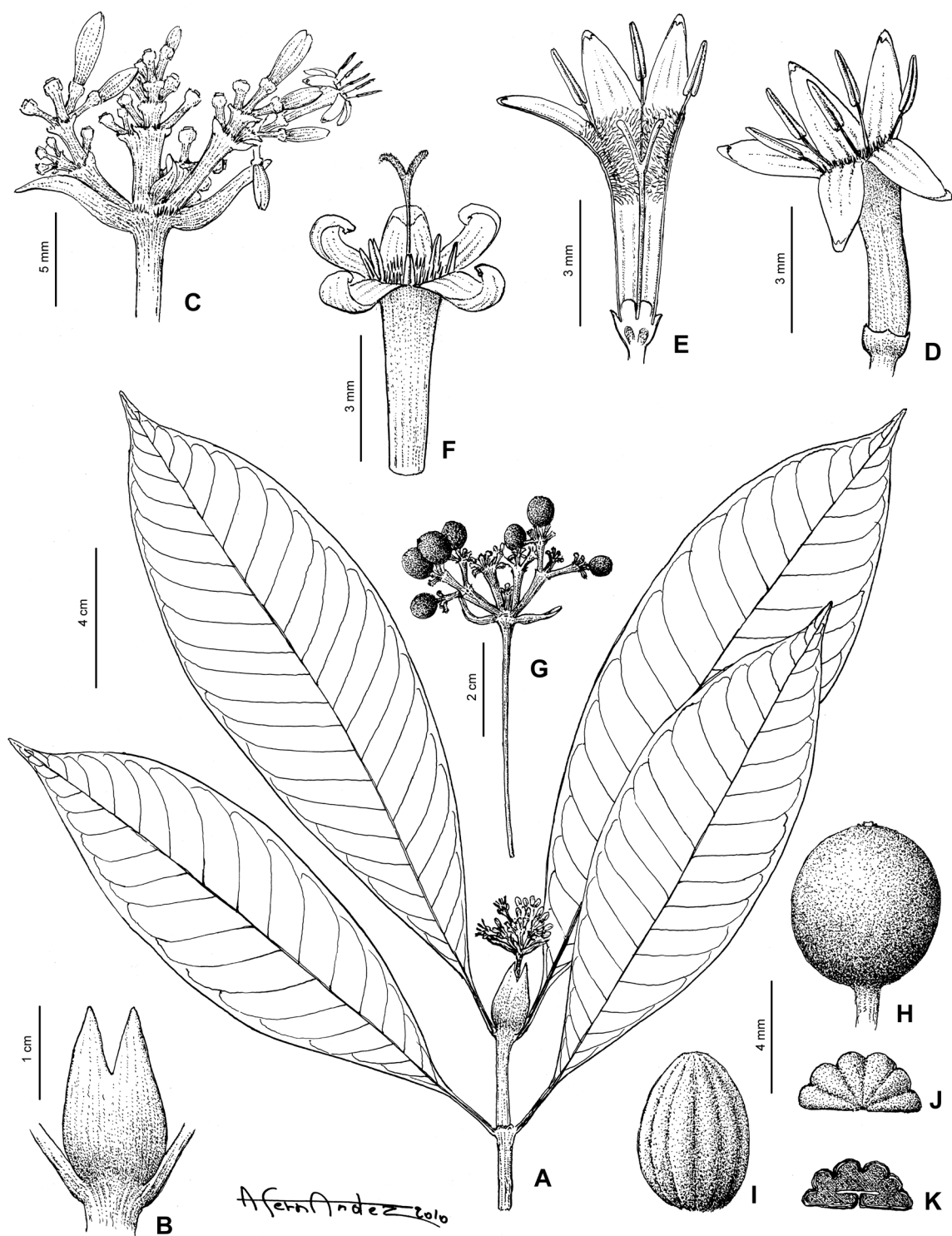
In the field, confusion is also possible with *P. blydeniae* and *P. micheliana*, which may grow alongside *P. tetragonopus* and have a similar habit; however, the resemblance is superficial and based on vegetative characters only (see table 1 for differences).

**Notes** – Only one open flower, from the type, has been seen, and it is therefore not known if the species is heterostylous.

**Additional material studied** – **Liberia**: Sapo N.P., along Sinoe river, 25 Nov. 2002, *Jongkind & Blyden* 5422 (WAG); Sapo N.P., just E of Sinoe river, 5°20'N 8°48'W, fl., buds, 2 Dec. 2002, *Jongkind & Blyden* 5599 (WAG); Sapo N.P., close to Sinoe River crossing from Jalay's Town, 4 Mar. 2009, *Jongkind et al.* 8788 (WAG); Sapo N.P., fr. imm., 30 Jan. 2010, *Jongkind et al.* 9324 (WAG); Sapo N.P., fr. imm., 30 Jan. 2010, *Jongkind et al.* 9330 (WAG).



**Figure 6** – *Psychotria tetragonopus* O.Lachenaud & Jongkind: A, habit; B & C, leaves; D, inflorescence; E, flower; F, corolla with stamens from the inside; G, style; H, infructescence; I, fruit; J, pyrene; K, seed; L, seed, cross section. From Jongkind *et al.* 8788 (A & H), Jongkind *et al.* 9330 (B), Jongkind & Blyden 5599 (C & D) and Jongkind & Blyden 5643 (E–G & I–L). Drawing by Hans de Vries.



**Figure 7** – *Psychotria voorhoevei* O.Lachenaud: A, flowering twig; B, stipule; C, inflorescence; D, short-styled flower; E, same, longitudinal section; F, long-styled flower; G, infructescence; H, fruit; I, pyrene, dorsal view; J, pyrene, basal view; K, cross section of seed. From *De Wilde & Voorhoeve* 3819 (A & C–E), *Adam* 16618 (B), *Adam* 16602 (F) and *Jaeger* 9947 (G–K). Drawing by Antonio Fernandez.

**Table 3 – Differences between *Psychotria ombrophila* and *P. voorhoevei*.**

	<i>P. voorhoevei</i>	<i>P. ombrophila</i>
Habit	shrublet, c. 50 cm high	low creeping herb, 10–30 cm high
Leaf apex	acuminate	rounded to obtuse
Lateral nerves	obliquely ascending	nearly horizontal
Inflorescence	shortly branched in flower, becoming laxer in fruit, not involucre	initially capitate and involucre, becoming branched in fruit
Bracts	narrowly lanceolate	broadly elliptic
Fruiting pedicel	c. 3 mm, shorter than fruit	7–13 mm, at least equalling fruit length

***Psychotria voorhoevei* O.Lachenaud, sp. nov.**

Stipulis bidifis ecarinatis, inflorescentiis bracteatis primo congestis sed statu fructifero laxiores et carnosae, seminibus fissura mediana T-formi munitis *P. ombrophilae* (Schnell) Verdc. valde affinis, sed conspicue differt foliis acuminatis (nec obtusis), nervis lateralibus obliquis (nec horizontalibus), bracteis anguste lanceolatis (nec late ellipticis) involucre non efformantibus, fructibusque brevioribus pedicellatis. – Type: Liberia, Gola National Forest, c. 11 km NE of Bomi Hills, fl., 16 Apr. 1962, J.J. de Wilde & Voorhoeve 3819 (holo-: WAG; iso-: BR, WAG).

**Shrublet**, 50 cm high; stems glabrous, 4–5 mm thick. **Stipules** 13–25 × (6–)10–15 mm, ovate, bifid with obtusely triangular lobes, dorsally flat (not keeled), glabrous, caducous. **Leaves** with petiole 1–2.5 cm long, glabrous; lamina (9.5–)13.5–22 × (3.4–)4.3–7.5 cm, narrowly elliptic, acute at base, acuminate at apex, coriaceous, entirely glabrous, drying grey-green to olive brown or the lower side sometimes yellowish green; midrib prominent above; lateral nerves 16–24 pairs, ascending, arching close to margin; tertiary veins lax and inconspicuous; domatia absent. **Inflorescences** hemispherical, very shortly paniculate, 2–3.8 cm long in flower, becoming laxer, 6.7 cm long, and apparently fleshy in fruit, glabrous except short hairs at the nodes; peduncle 1–2.3 cm long in flower and then usually hidden by the stipules, 5 cm long and well-exserted from the stipules in fruit; flowering part 0.8–1.5 × 1.5–3 cm in flower, 1.7 × 4.5 cm in fruit, the ramifications short (< 1 cm) and verticillate, 3–4 per node; pedicels 0.5–1(–1.5) mm; bracts lanceolate, entire, acute, the lower ones 7–12 × 2–3 mm, glabrous. **Flowers** 5-merous, heterostylous. **Calyx** cupuliform, truncate or hardly denticulate, 0.5–0.75 mm, glabrous. **Corolla** white, with narrow tube c. 5 × 1 mm and lobes 2–3 mm long, glabrous outside, hairy inside in upper half of tube; flower buds rounded (not corniculate). **Stamens** sub-included in longistylous form, or exserted with filaments exceeding throat by c. 1 mm in brevistylous form, anthers 2 × 0.2 mm. **Style** exserted, exceeding throat by 2 mm in longistylous form, or included in brevistylous form. **Fruits** probably black (see notes), globose to slightly ellipsoid, glabrous, 5–6.5 × 4.5–5.5 mm when dry, on +/- fleshy pedicels 2–3 mm long. **Pyrenes** ovoid, 6.5 × 4.5 mm, with 6–7 rounded dorsal ridges. **Seeds** with deep T-shaped ventral groove in cross-section, and very shallow intrusions all around. Fig. 7.

**Distribution** – Fig. 2B. Endemic to Liberia (Gola forest and Mt Nimba area), although to be expected in Ivorian and Guinean parts of the Nimba range.

**Ecology** – The type specimen was collected in open exploited high forest.

**Conservation: Endangered EN B2ab(iii)** – The area of occupancy (AOO) of *P. voorhoevei* is estimated at 29.58 km<sup>2</sup>, well under the 500 km<sup>2</sup> limit for Endangered under criterion B2, while the estimated extent of occurrence (EOO) of 65.64 km<sup>2</sup> would even suggest a Critically endangered status under criterion B1. The species is known from two subpopulations representing two different locations, and qualifies for Endangered under criterion B2a. Both locations are unprotected, and a loss in habitat extent and quality is expected due to farming, forest exploitation, and possibly mining in Mt Nimba area.

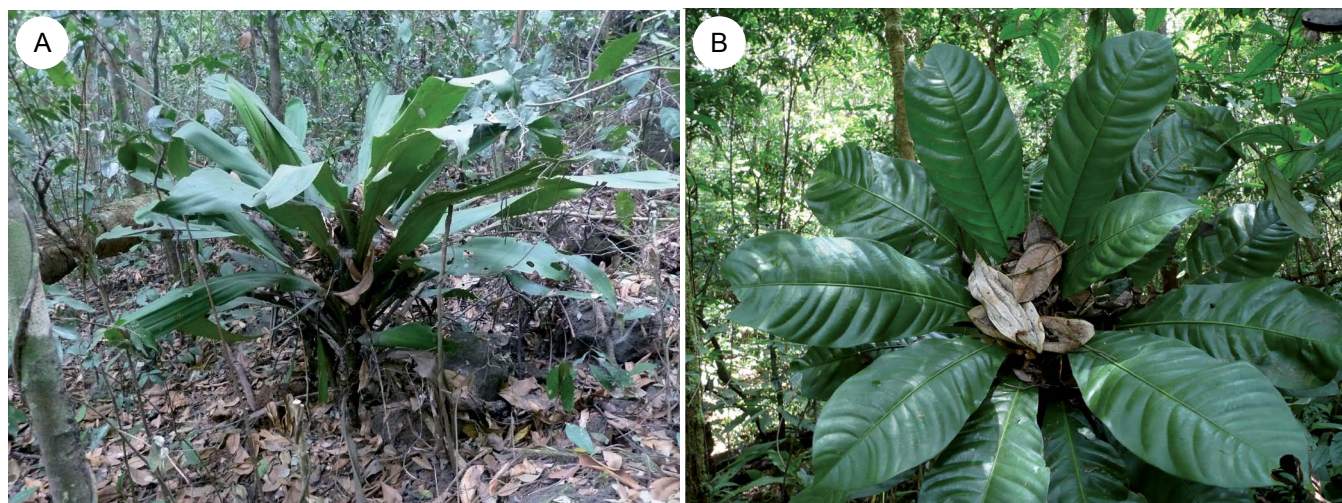
**Etymology** – Named after A.G.Voorhoeve, one of the collectors of the type, and author of *Liberian high forest trees* (1965).

**Affinities** – The affinities of this species are clearly with *P. ombrophila* (Schnell) Verdc., also a West African endemic, but more widespread from Sierra Leone to southwestern Côte d'Ivoire. The two species have similar stipules, flowers, fruits and seeds, but the leaves and inflorescence are quite different (table 3). Due to their seed anatomy (seeds with one deep T-shaped ventral furrow, instead of two very shallow ones) and their stipules lacking a basal keel, *P. ombrophila* and *P. voorhoevei* appear to fit neither in sect. *Involucratae* E.M.A.Petit & Verdc., where the former was placed by Verdcourt (1975), nor in sect. *Bracteatae*. They probably should be transferred to a new section, which we refrain from doing now, waiting for the results of an ongoing molecular study.

*P. voorhoevei* may also be confused with *P. baldwinii*, due to a superficial similarity in general habit, especially leaf and bract shape. However, *P. baldwinii* has the stipules pubescent and keeled at base, the inflorescences shortly puberulous and already well-exserted from the stipules at anthesis, the tertiary nerves denser and more conspicuous, and the flower buds corniculate at apex (rounded in *P. voorhoevei*).

**Notes** – Although the only fruiting collection (Jaeger 9947) bears no field notes, the fruits' drying colour makes little doubt that they are black in life, as in *P. ombrophila*.

**Additional material studied** – **Liberia**: Kitoma, fl., Mar. 1959, Adam 16602 (P); ibid., fl., Mar. 1959, Adam 16618 (P); Sanichelli (=Sanniquellie), fr., 9 Jul. 1974, Jaeger 9947 (P).



**Figure 8** – Litterbin plants: A, *Dracaena adamii*; B, *Campylospermum duparquetianum*. Photographs by C. Jongkind.

## DISCUSSION

### Diversity of *Psychotria* in West Africa

Taking into account these records, 49 species of *Psychotria* are now recorded from West Africa (here defined as the area from Senegal to Togo), of which nearly one half (24 species) are endemic. Both features are probably underestimated since the taxonomy of some species (e.g. *P. peduncularis* (Salisb.) Steyerl.) needs further study, and in several cases the identification of West African material is tentative. Thus, West Africa is a significant diversity centre for the genus, although certainly not as rich as Atlantic Central Africa – compare e.g. Cameroon with an estimate of 130 species (Lachenaud & Séné 2010). The richest West African country is Côte d'Ivoire (forty species), followed by Liberia (32 species) and Ghana (29 species). However, Liberia has four endemics (*P. baldwinii*, *P. micheliae* (J.G. Adam) Jongkind & Hawthorne, *P. tetragonopus*, and *P. voorhoevei*), compared to one each for Côte d'Ivoire (*P. copeensis*) and Ghana (*P. ankasensis* J.B. Hall). The very wet evergreen forests of Liberia and adjacent western Côte d'Ivoire, and those near the Côte d'Ivoire/Ghana border, show the greatest diversity. This is consistent with general findings, these two areas being well-known centres of endemism, which are thought to have harboured forest refuges during the Pleistocene (Sosef 1994). The central part of Côte d'Ivoire, which has a less humid climate (< 2000 mm of annual rainfall) generally has fewer endemic species and in particular no endemic *Psychotria*.

### Litterbin plants

An interesting fact is that two of the new species here described are litter-collecting plants. This brings to four the number of litter-collecting *Psychotria* in West African rain forests: *P. blydeniae*, *P. micheliae*, *P. micheliana* and *P. tetragonopus*. These species are only found in the very wet evergreen forests of Liberia and southwestern Côte d'Ivoire. The drier central part of Côte d'Ivoire seems generally devoid of litter-collecting plants, but more surprisingly, the wet area further east around the Côte d'Ivoire/Ghana border,

where such plants are not uncommon, apparently has no litterbin species of *Psychotria*.

Litter-collecting species of *Psychotria* are also well-represented in Central Africa with *P. bukaensis* De Wild., *P. foliosa* Hiern, *P. konguensis* Hiern, *P. kupensis* Cheek, and c. ten new species currently under description. Therefore, *Psychotria* includes more litterbin species than any other genus in Africa. Litterbin *Psychotria* are also known from the Neotropics, e.g. *P. dressleri* (Dwyer) C.W. Ham.

These species all share a similar habit, with usually unbranched aerial stems (occasionally connected by rhizomes), bearing at apex a crown of narrowly spatulate leaves, which are held obliquely erect and function as a funnel collecting the debris falling from the canopy (Hawthorne & Jongkind 2006: 948). The petioles are always short, sometimes extremely so, and small adventitious roots develop on the stem at the nodes, which evidently have a role in absorbing the nutrients. Despite resembling each other vegetatively, these litterbin *Psychotria* species belong to several different sections of the genus, and often have non-litterbin relatives, e.g. *P. liberica* for *P. blydeniae* and *P. yapoensis* (Schnell) Verdc. for *P. micheliae*. It is clear that the litterbin habit evolved many times independently. The genus seems to have a predisposition for it, possibly related to its strong ability to develop adventitious roots (e.g. on fallen stems). There is no relation between the litterbin habit and the presence (e.g. *P. konguensis*) or absence (e.g. *P. foliosa*, *P. kupensis*) of bacterial nodules in the leaves. Domatia are always absent in litterbin species of *Psychotria*, but this may have no connection with their habit, since among African *Psychotria* they are mostly found in species from forest edges and are rare in the undergrowth. In some species (e.g. *P. konguensis*, *P. micheliana*), the litterbin habit is usual but not constant: possibly in relation with ecology, some specimens do not collect litter and have more elongate internodes.

Although litterbin plants are particularly common and conspicuous in some parts of Africa (e.g. Gabon and southern Cameroon), they have received very little attention from either ecologists or systematicians. Species descriptions based on herbarium collections tend to overlook this charac-

ter, which is of course much more conspicuous in the field. Litterbin species are known to occur in several angiosperm families: in Africa alone, examples are known in Apocynaceae (*Calocroter preussii* K.Schum.), Araceae (*Culcasia panduriformis* Engl. & K.Krause and some forms of *C. dinkelagei* Engl.), Arecaceae (*Sclerosperma* spp.: van Valkenburg et al. 2008), Asparagaceae (some *Dracaena* – fig. 8A), Cyperaceae (some species of *Mapania*), Euphorbiaceae (*Crotonogynopsis* spp. and several species of *Pycnocomia*), Flacourtiaceae (*Phyllobotryon* spp.), Moraceae (occasional in *Scyphosyce manniana* Baill.) Myrsinaceae (*Ardisia bracteata* Baker, *A. hallei* Taton, *A. mayumbensis* (Good) Taton), Loganiaceae (*Mostuea megaphylla* R.Good, usually treated as a synonym of *M. brunonis* Didr., but a distinct species according to the first author), Ochnaceae (several species of *Campylospermum* – fig. 8B), Rubiaceae (*Chassalia ischnophylla* (K.Schum.) Hepper; *Chazaliella letouzeyi* Robbr.; *Chazaliella viridicalyx* (Good) Verdc; *Coffea magnistipula* Stoffelen & Robbr.; *Ixora synactica* De Block; *Oxyanthus brevicaulis* K.Krause; several species of *Pavetta* and *Psychotria*), Sapindaceae (*Deinbollia mezilii* D.W.Thomas & D.J.Harris), Sterculiaceae (*Scaphopetalum mannii* Mast.) and Violaceae (several species of *Allexis* and *Rinorea*). The list of families and species grows quickly when plants that have a juvenile litterbin stage are included as well.

Most of these species resemble *Psychotria blydeniae* and *P. tetragonopus* in habit, with their stem bearing a crown of spatulate simple leaves. Figure 8 illustrates the convergence in habit between species of unrelated families. In *Deinbollia mezilii*, the leaves are unijugate and subsessile, and their leaflets remarkably mimic simple leaves. The case of *Sclerosperma* palms is particular, since they are usually acaulescent, with long-petiolate and usually divided leaves. Litterbin plants are always linked to very humid areas, and there is a very strong tendency for different litter-collecting species to grow together. For example *Psychotria blydeniae*, *P. micheliana* and *P. tetragonopus* were frequently encountered together in Liberia. Similarly in Akom II, Cameroon, five litterbin species of *Psychotria* (*P. foliosa*, *P. konguensis*, *P. kupensis*, the other two undescribed) were found growing together in abundance.

#### ACKNOWLEDGEMENTS

The first author is a research fellow of the F.R.S.-F.N.R.S. (Fonds National de la Recherche Scientifique, Belgium). His thesis also received funding from the Fonds David et Alice van Buuren. His visits to Kew and Wageningen were supported by the European Community SYNTHESYS project (<http://www.synthesys.info>) and by the Alberta Mennega Stichting, The Netherlands. The herbarium curators of Kew, Paris and Wageningen are thanked for sending specimens on loan. The second author wishes to thank Fauna & Flora In-

ternational (FFI) for their support. The expedition that led to the discovery of *Psychotria blydeniae* and *P. tetragonopus* was made possible by FFI. The illustrations were made by Hans de Vries and Antonio Fernandez, to whom we are most grateful. We also thank Tariq Stévar for permission to reproduce his photograph of *Psychotria spathacea*.

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Manuscript received 11 Jun. 2012; accepted in revised version 18 Apr. 2013.

Communicating Editor: Elmar Robbrecht.