

TREE FLORA of SABAH AND SARAWAK

Volume Two

edited by
E. Soepadmo, K.M. Wong and L.G. Saw



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TREE FLORA
of
SABAH AND SARAWAK

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INTERNATIONAL TROPICAL TIMBER ORGANIZATION



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E. Soepadmo, K.M. Wong and L.G. Saw

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CONTENTS

	<i>Page</i>
Foreword	vii
Acknowledgements	ix
FAMILIES	
1. Anacardiaceae (<i>K.M Kochummen</i>)	1
2. Boraginaceae (<i>A.L. Dayang Awa</i>)	93
3. Caprifoliaceae (<i>Noorma Wati Haron</i>)	107
4. Casuarinaceae (<i>Runi S. Pungga</i>)	119
5. Chloranthaceae (<i>John B. Sugau</i>)	129
6. Crypteroniaceae (<i>J.T. Pereira</i>)	135
7. Ctenolophonaceae (<i>Runi S. Pungga</i>)	151
8. Daphniphyllaceae (<i>Balu Perumal</i>)	155
9. Epacridaceae (<i>S.P. Lim</i>)	159
10. Erythroxylaceae (<i>R.C.K. Chung</i>)	167
11. Ixonanthaceae (<i>Runi S. Pungga</i>)	175
12. Leeaceae (<i>A. Latiff</i>)	181
13. Loganiaceae (<i>K.M. Wong & John B. Sugau</i>)	189
14. Lythraceae (<i>P.C. Yii</i>)	225
15. Malvaceae (<i>Balu Perumal</i>)	233
16. Myricaceae (<i>A. Noorsiha</i>)	245
17. Nyctaginaceae (<i>A. Latiff</i>)	251
18. Santalaceae (<i>L.S.L. Chua</i>)	257
19. Sapindaceae (<i>F. Adema, P.W. Leenhouts & P.C. van Welzen</i>)	263
20. Scyphostegiaceae (<i>E.J.F. Campbell-Gasis</i>)	375
21. Tetrameristaceae (<i>John B. Sugau</i>)	379
22. Ulmaceae (<i>E. Soepadmo & Z. Edi Hamli</i>)	383
23. Winteraceae (<i>K.M. Wong</i>)	403
Abbreviations of Frequently Cited References	409
Commonly Used Abbreviations for Localities	411
Index to Scientific Names	413
Index to Vernacular Names	435

ERYTHROXYLACEAE

R.C.K. Chung

Forest Research Institute Malaysia,
Kepong, Malaysia

King, J. As. Soc. Beng. 62, 4 (1893) 190 (as Order Lineae, in part); Koorders, Exk. Fl. Java (1912) 415; Merrill, EB (1921) 313; Ridley, FMP 1 (1922) 324 (as Order Lineae, in part); Masamune, EPB (1942) 357; Payens, FM 1, 5 (1958) 543; Backer & Bakhuizen *f.*, FJ 1 (1963) 440; Hutchinson, Fam. Fl. Pl. 1 (1959) 263, Gen. Fl. Pl. 2 (1967) 605; Cockburn, TFM 1 (1972) 194, TS 1 (1976) 82; Keng, OFMSP (1978) 175; Anderson, CLTS (1980) 171; Ashton, MNDTS 2 (1988) 238; Corner, WSTM 3rd ed. 1 (1988) 254; Whitmore, Tantra & Sutisna, CLK 1 (1989) 108.

Shrubs or trees. *Stipules intrapetiolar, rarely extrapetiolar, completely fused or rarely bifid, often caducous. Leaves alternate (distichous) or rarely opposite (Aneulophus), simple, entire. Flowers axillary, solitary or in clusters, bisexual, heterostylous (with short- and long-styled forms), 5-merous, radially symmetrical; calyx campanulate, lobes 5, imbricate or valvate, persistent; petals 5, free, caducous, imbricate or involute in bud, usually with a ligular appendage near the base on the inner side; stamens 10, in two whorls of 5, filaments connate at least at the base, anthers basifixed, 2-locular, dehiscent longitudinally; disc absent; ovary superior, mostly 3-carpellate, 3-locular with 2 of the locules usually sterile, fertile locule 1- or 2-ovulate; styles 3, erect, free or partly connate, stigmas capitate (often oblique) or clavate; ovules pendulous, anatropous. Fruit a drupe; endocarp hard. Seeds with or seldom without endosperm; embryo straight.*

Distribution. Four genera with about 270 species; *Aneulophus* (2 species), *Nectaropetalum* (6 species) and *Pinacopodium* (2 species) are restricted to Africa, while *Erythroxylum* (c. 250 species) is a genus centered mainly in the Andes and the Amazon basin in tropical and subtropical S America. In Sabah and Sarawak, 4 species of *Erythroxylum* are known.

Ecology. In primary and secondary forests, to c. 1600 m, especially on slopes of low hills.

Taxonomy. In the past the genus *Erythroxylum* has been incorporated in different families, viz. the Malpighiaceae (de Jussieu, Gen. Pl. (1789) 281), Linaceae (Bentham & Hooker, Gen. Pl. 1 (1862) 244, and Ridley *l.c.* 323), and Erythroxylaceae (Payens *l.c.*, Hutchinson *l.c.*, Keng *l.c.*, and others). In recent classifications, it is widely accepted that the Erythroxylaceae differ from the Malpighiaceae in their fruits which are not winged and at maturity do not split into 3 nut-like parts, and from the Linaceae in their ligulate petals and 3-locular ovary with only one locule fully developing.

ERYTHROXYLUM P. Browne(Greek, *erythros* = red, *xylon* = wood)

Civ. Nat. Hist. Jam. 1 (1756) 278; Linnaeus, Syst. Nat. ed. 10, 2 (1759) 1035 (*Erythroxylo*); King, J. As. Soc. Beng. 62, 4 (1893) 190; O. E. Schulz, Pflanzenr. 29 (1907); Koorders, Exk. Fl. Jav. (1912) 416; Merrill, EB (1921) 313; Ridley, FMP 1 (1922) 324; Masamune, EPB (1942) 357; Payens, FM 1, 5 (1958) 543; Backer & Bakhuizen *f.*, FJ 1 (1963) 441; Burkill, EPMP (1966) 966; Plowman, Taxon 25 (1976) 141; Ashton, MNDTS 2 (1988) 238; Corner, WSTM 3rd ed. 1 (1988) 254; Whitmore, Tantra & Sutisna, CLK 1 (1989) 108; Ng, MFFSS 1 (1991) 66; Chung, Sandakania 7 (1996) 67.

Shrubs or trees. *Young twigs flattened*, usually becoming terete when older; small distichous bracts (ramenta) often found at the base of lateral twigs and between the leaves. *Stipules* small, *entire*, rarely two-lobed, often 2-keeled below, sometimes emarginate or 2-dentate at apex, *caducous and leaving a distinct scar*. **Leaves** *alternate (distichous)*, involute in bud, *pinnately veined*; midrib often sunken above, prominent below, *lateral veins* numerous, fine, *joining and forming marginal loops and anastomosing irregularly with the intermediate lateral, intercostal, and intramarginal veins to form a distinctive reticulate venation*; petioles articulate at the base. **Flowers** appearing as the leaves mature, subtended by bracts; pedicels thickened under the calyx, mostly angular, with 2 bracteoles at the base; *calyx lobes imbricate in bud, persistent*; *petals* alternating with the calyx lobes, *with a 3-lobed, ligule-like appendage inserted on the apex of the claw*; stamens 10, arranged in 2 whorls of 5, persistent, *filaments connate into a persistent staminal tube at base*, outermost alternate with the petals, arising directly from the staminal tube, innermost sometimes ventral to the obtuse or dentate rim of the staminal tube, anthers ellipsoid, basifixed, cordate at the base; ovary (1–)3-locular, only one locule fertile, with 1 ovule; styles 3, erect, free or partly connate, stigmas capitate (often oblique) or clavate, rounded or rarely acute. **Fruit** *a drupe*, 3-locular, with one containing a seed, the other two empty but enlarged; mesocarp pulpy; endocarp hard and connate into a 3-locular pyrene. **Seeds** flattened; with or without endosperm; testa thin-coriaceous; embryo oblong, straight, erect, cotyledons flat to plano-convex, radicle distinct, pointing towards the fruit apex.

Distribution. A pantropical genus with about 250 species, with the centre of distribution in S America; 6 species are known in the Malesian region, of which 4 are documented in Sabah and Sarawak.

Ecology. Primary and secondary forests, from sea level to 500 m, especially on slopes of low hills.

Uses. The family includes the important cocaine-producing plants, *Erythroxylo* *coca* (Bolivian coca) and *E. novogranatense* (Peruvian coca), whose leaves yield the important alkaloid cocaine, a narcotic widely used in modern medicine. In the past, *E. novogranatense* was cultivated in Sri Lanka, Java and Thailand to produce cocaine, used as a local anaesthetic and in the prescription of some medicines. The timber of some species is hard, strong, and durable and used locally in tropical America and Africa for construction purposes. In SE Asia, however, due to its small size, the timber is of minor importance.

Key to *Erythroxylum* species

1. Shrub or treelet to 1.5 m tall. Flowers solitary; pedicels 16–19 mm long.....
- E. iwahigense** forma **callicola** R.C.K. Chung Fig. 2H–J.
l.c. 74. Type: *Paul Chai S. 39898*, Borneo, Sarawak, 4th Div., Mt. Mulu National Park, Mt. Buda (holotype SAR; isotypes K, KEP, L, MO, SAN).
 Leaves *thick-coriaceous*; elliptic or obovate, (1.6–)2.4–4(–4.3) × (1.1–)1.3–1.8(–2) cm; base cuneate, apex acute with rounded or emarginate tip, rarely obtuse with rounded tip; *lateral veins (12–)14–20 pairs, 1–2(–2.5) mm apart*, intercostal veins distinct, prominent to faint on both surfaces. *Flowers solitary, pedicels 16–19 mm long.*
 Endemic to Sarawak. Very uncommon, known only from the type collection. Limestone hills to 1000 m. The typical form, *E. iwahigense* forma *iwahigense* from Palawan Is., differs from the present form by its thin-coriaceous leaves and broader spacing between lateral veins, (3–)4–8(–10) mm.
- Treelet or tree, 5–40 m tall. Flowers in clusters of 2–8, or rarely solitary but never exclusively so; pedicels 3–10 mm long.....2
2. Staminal tube longer than calyx lobes.....**1. E. cuneatum**
 Staminal tube shorter than or at most as long as calyx lobes.....3
3. Leaves thin-coriaceous or chartaceous, apex acute with rounded or pointed tip, or cuspidate, or rarely obtuse with rounded or emarginate tip. Calyx lobes 1–1.2 mm long. Fruits broadly ellipsoid, 4.5–8 mm diameter.....**2. E. latifolium**
 Leaves thick-coriaceous, apex obtuse-emarginate. Calyx lobes 1.4–1.8 mm long. Fruits ellipsoid, to 4 mm diameter.....**3. E. sarawakanum**

1. **Erythroxylum cuneatum** (Miq.) Kurz

Fig. 1A–G.

(Latin, *cuneatus* = wedge-shaped; the leaf base)

J. As. Soc. Beng. 43, 2 (1847) 135; O.E. Schulz *l.c.* 146; Payens *l.c.* 548; Merrill, Philip. J. Sci. Bot. (1908) 232, EPP (1923) 325; Cockburn *l.c.* (1976) 84; Anderson *l.c.* 171; Ashton *l.c.* 238; Corner *l.c.* 255; Whitmore, Tantra & Sutisna *l.c.* 108; Chung *l.c.* 69. **Basionyms:** *Ficus cuneata* Wall., Cat. (1828) no. 4534, *nom. nud.*; *Urostigma ?cuneatum* Miq. in Hooker, Lond. J. Bot. 6 (1847) 585. **Type:** *Wallich, Cat. no. 4534, "India Orientalis"* (holotype K).

Shrub or small to large tree to 40 m tall, 65 cm diameter. **Bark** grey to reddish brown, smooth to finely fissured and sometimes scaly, lenticellate, brittle; inner bark orange-brown to reddish brown. **Sapwood** pale yellow; heartwood dark reddish brown. Twigs drying brown to black. *Stipules triangular to lanceolate*, as long as petiole. **Leaves** chartaceous to thin-coriaceous, glabrous; elliptic to elliptic-lanceolate or obovate, 1.9–12 × 0.9–5.8 cm; base cuneate, acute to obtuse, apex obtuse to acute, with emarginate, rounded or rarely pointed tip; midrib sunken above, lateral veins 8–15 pairs, 2–13 mm apart, intercostal veins slightly raised to faint on both surfaces; *petioles 2–9 mm long, 0.5–1 mm thick, glabrous*. **Flowers** in clusters of 2–6(–8), or rarely solitary but never exclusively so; *pedicels 3–10 mm long, 0.2–0.7 mm thick, glabrous*; calyx lobes 0.5–1.2 mm high, triangular to lanceolate; petals white, greenish white to light

green, 3–4 x 1.5–2 mm, claw distinctly narrowing towards the base, about a third as long as the petal; filaments in short-styled form *c.* 2–3.5 mm long (for equal stamens) and *c.* 1.5–4.5 mm long (for unequal stamens), in long-styled form *c.* 2–4 mm long (for equal stamens) and 0.5–1.5 mm long (for unequal stamens), *staminal tube longer than calyx lobes*, 1.5–2 mm high, anthers 0.3–0.5 mm across; ovary ellipsoid or ovoid, longer than staminal tube, 3-locular, styles in short-styled form 1–2 mm long, shortly connate at base, in long-styled form 2–5 mm long, connate to a third to a half of their length, stigma in short-styled form oblong-ovoid or clavate, in long-styled form capitate, in both forms broader than the style. **Fruits** ripening bright red, ellipsoid, 8–12 x 2.5–4.5 mm, *curved*, glabrous, apex acute, triangular with curved sides in cross section; locules arranged in a triangular position, with the fertile one nearly of the same size as the 2 sterile locules. **Seeds** 6–10 x 1.5–3 mm; endosperm present.

Vernacular name. Sabah—*perepat burong* (Malay).

Key to forms

Leaf apex obtuse with rounded or emarginated tip.....

forma **cuneatum**

Fig. 1A–F.

Synonyms: *E. burmanicum* Griff., Posth. Papers, Not. Pl. As. 4 (1854) 468, *t.* 581, fig. 3; *E. longistipulatum* Burck, Ann. Jard. Bot. Btzig. 11 (1893) 193; *E. bancanum* Burck *l.c.* 192, *t.* 16; *E. cuneatum* (Miq.) Kurz var. *bancanum* (Burck) O.E. Schulz. *l.c.* 148; *E. platyphyllum* Merr. *l.c.* (1908) 232.

Shrub or small tree to 5 m tall, 5 cm diameter. *Stipules lanceolate*, (2.5–)4–6(–7.5) mm long. Leaves obovate or elliptic to elliptic-lanceolate, (1.9–)3.5–9.5(–12) x (0.9–)1.9–4.5(–5.8) cm; *base cuneate*, *apex obtuse with emarginate or rounded tip*; lateral veins 8–12 pairs, (2–)3–9(–13) mm apart; petioles (2–)3–7(–9) mm long. Calyx lobes 0.5–1(–1.2) mm high, triangular. Fruits 8–10 x 2.5–4.5 mm. Seeds 6–8 x 1.5–3 mm.

Myanmar, Thailand, Indo-China, Sumatra (Banka and Riouw Islands), Peninsular Malaysia, Singapore, Anambas and Natuna Islands, Java (western part, Kangean), Borneo (Sabah only), Philippines, Lesser Sunda Islands (Sumbawa) and Maluku. Seasonal monsoon forest, lowland mixed dipterocarp forest, beaches; also (rarely) on mountain peaks and limestone. In Sabah, uncommon, found along beaches and on islands. No record from Sarawak, Brunei and Kalimantan.

Leaf apex acute with rounded or emarginate or rarely pointed tip.....

forma **sumatranum** (Miq.) R.C.K. Chung

Fig. 1G.

l.c. 71. Basionym: *E. sumatranum* Miq., Fl. Ned. Ind., Suppl. (1862) 200, 512. Type: *Teijsmann, s.n.* (= *L. sheet no.* 908.125–2056), Sumatra, Palembang, Ogan Ulu (holotype L; isotype BO). Synonyms: *E. densinerve* O.E. Schulz *l.c.* 142, Merrill *l.c.* (1921) 313, Masamune *l.c.* 357; *E. borneense* Merr., PEB (1929) 112, Masamune *l.c.* 357.

Trees to 40 m tall, 65 cm diameter. *Stipules triangular*, (2–)2.5–4(–5) mm long. Leaves elliptic to narrowly elliptic, lanceolate or rarely obovate, (2.8–)4.2–7.7(–10.2) x (0.9–)1.7–2.8(–3.2) cm; *base acute to obtuse*, *apex acute with rounded or emarginate or rarely acute tip*; lateral veins 8–15 pairs, (2–)3–7(–9) mm apart; petioles (2–)3–5(–7) mm long. Calyx lobes 0.5–1.2 mm high, triangular to lanceolate. Fruits 9–12 x 2.5–4 mm. Seeds 8–10 x 1.5–2.5 mm.

Sumatra, Borneo and the Philippines. In Borneo, found in mixed dipterocarp forest to

150 m; rather common in Sabah, but uncommon in Sarawak; also known in Kalimantan.

2. *Erythroxylum latifolium* Burck

Fig. 1H.

(Latin, *latus* = broad, *folium* = leaf)

l.c. 192; Merrill *l.c.* (1921) 313; Masamune *l.c.* 357; Chung *l.c.* 77. **Type:** *Teijsmann, s.n.*, Sumatra, Lingga (holotype BO). **Synonyms:** *E. latifolium* Burck var. *angustatum* O.E. Schulz *l.c.* 144; *E. latifolium* Burck var. *longipetiolatum* Boerl. & Koord., *l.c.* Bog. 1 (1897) t. 6; *E. cuneatum* (non (Miq.) Kurz) Payens *l.c.* 549, *p.p.*, *quoad syn. E. latifolium*, incl. var. *angustatum* O.E. Schulz et var. *longipetiolatum* Boerl. & Koord.

Shrub or small tree to 6 m tall. Twigs brown to grey-brown. *Stipules triangular*, (2.5–)3–3.5(–4) mm long. **Leaves chartaceous or thin-coriaceous**; elliptic or rarely obovate, (5.5–)6.2–13(–17) x (2.5–)2.8–5.7(–6.4) cm; base cuneate to acute, *apex acute with rounded or pointed tip, sometimes cuspidate or rarely obtuse with rounded or emarginate tip*; midrib sunken above, lateral veins 9–14 pairs, (3–)5–13(–16) mm apart, intercostal veins distinct, slightly prominent below, faint above; *petioles (3–)4–8(–10) mm long*, 0.8–1.5 mm thick, glabrous. **Flowers in clusters of 2–4**; pedicels 5–6 mm long, 0.8–1 mm thick, glabrous; *calyx lobes 1–1.2 mm high*, triangular; petals 5; stamens 10, *staminal tube shorter than or at most as long as the calyx lobes*. **Fruits broadly obovoid**, 9–12 x 4.5–8 mm, *not curved*, glabrous, apex acute, triangular with curved sides in cross-section; locules arranged in a triangle, with the fertile one nearly of the same size as the 2 sterile locules. **Seeds** 7–9 x 3–5 mm; endosperm present.

Distribution. Sumatra (including Banka, Billiton, and Lingga), Anambas and Natuna Islands, and Borneo. In Sarawak, known from Baram, Marudi FR, Lambir Hills NP and Sg. Dalam FR in the 4th Div. and from the Lassa Protected Forest in the 6th Div. Not yet recorded from Sabah; also found in Brunei.

Ecology. Lowland mixed dipterocarp, *kerangas* and peat swamp forests, to 20 m.

3. *Erythroxylum sarawakanum* R.C.K. Chung

Fig. 2A–G.

(of Sarawak)

l.c. 78. **Type:** *Ilias S. 17894*, Borneo, Sarawak, Bako National Park (holotype SAR; isotypes A, BO, K, L, SAN, SING).

Shrub or treelet to *c.* 5 m tall, 4 cm diameter. Twigs grey-brown. *Stipules triangular*, 2–2.5 mm long. **Leaves thick-coriaceous**, drying brown and glabrous above, *pruinose below*; obovate or elliptic, (4.3–)5.5–9(–10.5) x (2.2–)2.8–5(–5.5) cm; base broadly cuneate to acute, *apex obtuse with emarginate tip*; midrib sunken above, lateral veins (6–)8–12 pairs, (4–)7–12(–13) mm apart, intercostal veins distinctly prominent above, faint below; *petioles (6–)7–10(–12) mm long*, 1–2 mm thick, glabrous. **Flowers in clusters of 2–4**; pedicels 4–5 mm long, *c.* 0.5 mm thick, glabrous; *calyx lobes 1.4–1.8 mm high*, triangular; petals 5; stamens 10, *staminal tube shorter than or at most as long as the calyx lobes*. **Fruits ellipsoid**, 9 x 3.5–4 mm, glabrous, with a rounded top, triangular with curved sides in cross-section; locules arranged in a triangle,

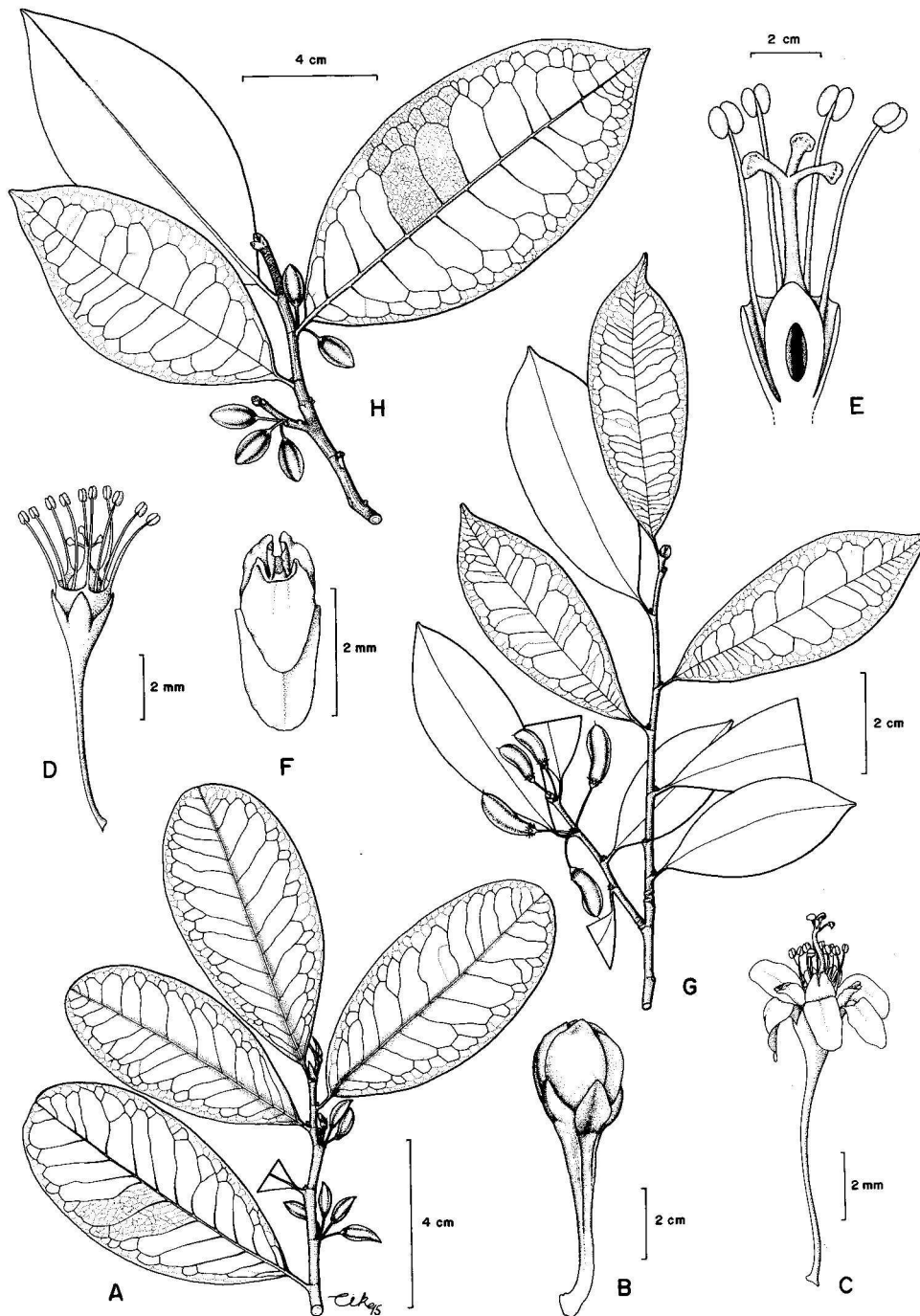


Fig. 1. *Erythroxylum cuneatum* forma *cuneatum* (A–C, F), forma *sumatranum* (D–E, G); *E. latifolium* (H). A, fructing leafy twig; B, flower bud; C, long-styled flower with equal stamens; D, short-styled flower with equal stamens, with petals removed; E, longitudinal section through flower, with petals removed; F, posterior clawed petal with 3-lobed ligule-like appendage; H, fructing leafy twig. (A from SAN 107458, B from S. 12753, C and F from KKSS 417, D–E and G from SAN 30377, H from S. 25076.)

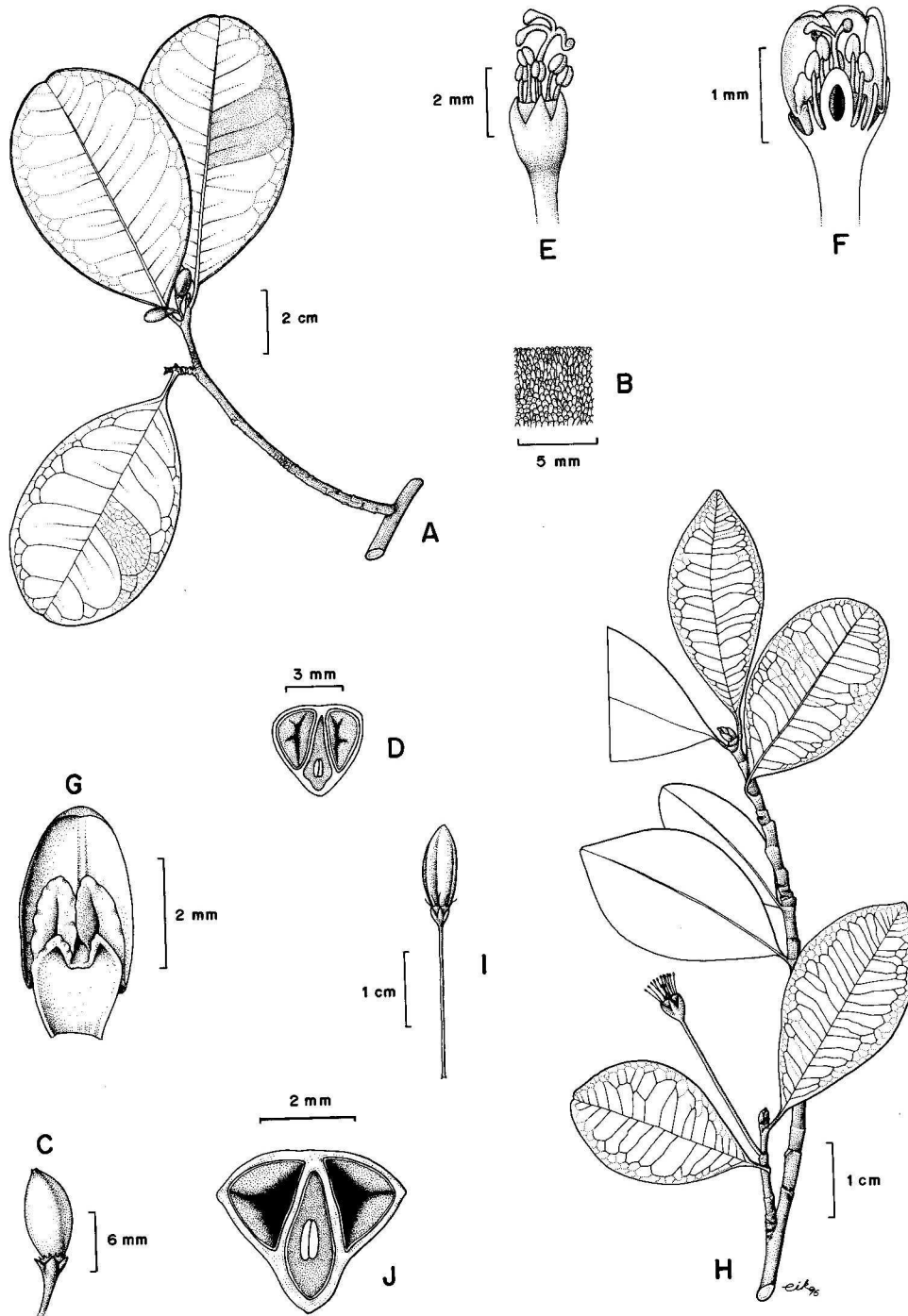


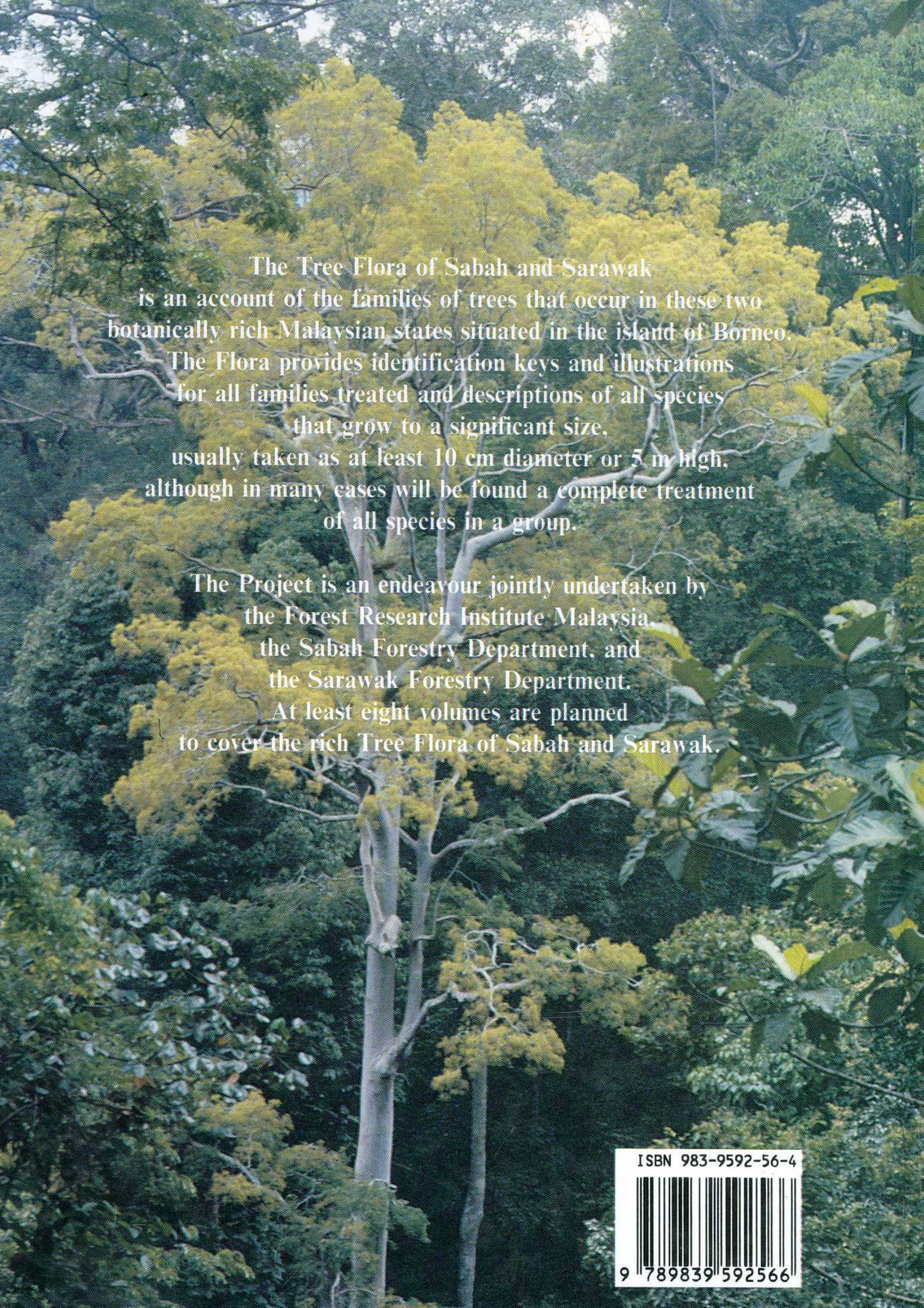
Fig. 2. *Erythroxylum sarawakanum* (A–G); *E. iwahigense* forma *calcicola* (H–J). A, fruiting leafy twig; B, detail of lower leaf surface; C, fruit; D, fruit in cross-section; E, mature flower bud with petals removed; F, flower bud in longitudinal section; G, posterior clawed petal with 3-lobed ligule-like appendage; H, flowering leafy twig; I, fruit; J, fruit in cross-section. (A–D from *S. 17894*, E–G from *S. 73603*, H–J from *S. 39898*.)

with 2 sterile ones as large as the fertile one, *seldom curved*. **Seeds** 6–8 \times 2.5–3 mm; endosperm present.

Distribution. Endemic to Sarawak. So far known only from a few collections from Bako National Park (*S. 17894, S. 10324, S. 73601*), Mt. Matang (*Clemens 22354*) and Mt. Santubong (*S. 37668* and *S. 73603*).

Ecology. Lowland to hill forest, to *c.* 700 m.

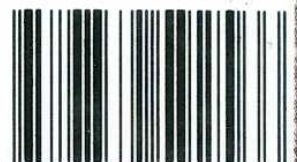
Notes. *E. sarawakanum* differs from *E. latifolium* in its thick-coriaceous leaves, which are obovate or elliptic, obtuse at the apex and with a emarginate tip; longer calyx lobes (1.4–1.8 mm long), and ellipsoid fruits (up to 4 mm wide).



The Tree Flora of Sabah and Sarawak
is an account of the families of trees that occur in these two
botanically rich Malaysian states situated in the island of Borneo.
The Flora provides identification keys and illustrations
for all families treated and descriptions of all species
that grow to a significant size,
usually taken as at least 10 cm diameter or 5 m high,
although in many cases will be found a complete treatment
of all species in a group.

The Project is an endeavour jointly undertaken by
the Forest Research Institute Malaysia,
the Sabah Forestry Department, and
the Sarawak Forestry Department.
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to cover the rich Tree Flora of Sabah and Sarawak.

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