

A taxonomic revision of *Ixora* L. (Rubiaceae: *Ixoroideae*) in Australia

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Summary

Reynolds, S.T. & Forster, P.I. (2006). A taxonomic revision of *Ixora* L. (Rubiaceae: *Ixoroideae*) in Australia. *Austrobaileya* 7(2): 253–278. The genus *Ixora* L. has seven species in Australia. Five species are endemic – *Ixora baileyana* Bridson & L.G.Adams, *I. beckleri* Benth., *I. biflora* Fosberg, *I. oreogena* S.T.Reyn. & P.I.Forst. sp. nov. and *I. queenslandica* Fosberg, and one species *I. timorensis* Decne., occurs elsewhere in Malesia. *Ixora coccinea* L. occurs as a semi-naturalised adventive at a small number of localities in Queensland and Western Australia. All species are described, native species illustrated and a key to native and naturalised species and a key to Australian cultivated species are provided.

Key Words: Rubiaceae, *Ixoroideae*, *Ixora baileyana*, *Ixora beckleri*, *Ixora biflora*, *Ixora coccinea*, *Ixora oreogena*, *Ixora queenslandica*, *Ixora timorensis*, *Ixora triflora*, new species, Australian flora, Queensland flora, taxonomy, identification keys

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Introduction

The genus *Ixora* was named by Linnaeus in 1753; although historically it has been often combined with the genus *Pavetta* L. which was described at the same time (e.g. Lamarck 1789). Some early authors including Blume (1826) treated *Ixora* as a section under *Pavetta*, whereas other authors such as Bentham (1867) combined *Pavetta* under *Ixora* and recognised the former as one of the sections under the latter. De Candolle (1830) disagreed with Lamarck and his followers, and considered that the characteristics of the stigma and style, together with flower colour were sufficient to distinguish *Ixora* and *Pavetta*. This view was later accepted by Bentham (1873) and Schumann (1897). The latter author further distinguished the two genera on the form of the bracts at the base of the inflorescence. These two genera have since been recognised as distinct by various authors including Bailey (1900), Valetton (1911), Bremekamp (1934, 1937), Bridson (1988), Risdale (1988), Robbrecht (1988), Smith & Darwin (1988), Husain & Paul (1989), De Block (1998) and Andreasen & Bremer (2000).

In its present circumscription *Ixora* is a pantropical genus of trees and shrubs with up to 400 species (Ridsdale 1988; Robbrecht 1988; De Block 1998). Recognition of *Ixora* as a genus is largely unequivocal, due especially to the articulate nature of the leaf petiole, the inflorescences that are terminal or terminal on side branches or short side shoots, and the stipules with apices that are apiculate or cuspidate (De Block 1998). On the basis of morphology *Ixora* was included in Rubiaceae, subfamily *Ixoroideae* Raf., tribe *Pavetteae* A.Rich. ex Dum. by Robbrecht (1988, 1993) together with *Captaincookia* Hallé, *Cladoceras* Bremek., *Coleactina* Hallé, *Dictyandra* Welw. ex Hook.f., *Doricera* Verdc., *Dupperrea* Pierre ex Pit., *Hitoea* Nad., *Leptactina* Hook.f., *Myonima* Comm. ex Juss., *Nichallea* Bridson, *Pachystylus* Schumann, *Pavetta*, *Rutidea* DC., *Tarenna* Gaertn., *Tennantia* Verdc. and *Versteegia* Valetton.

An initial molecular (*rbcl*) study by Andreasen & Bremer (1996) found that *Pavetteae sensu* Robbrecht (1988, 1993) was paraphyletic with *Ixora* included. Subsequent studies using nuclear (Ribosomal rDNA) and chloroplast regions (*rbcl*) indicate that *Ixora* is most closely related to the genera *Myonima* and *Versteegia* (Andreasen & Bremer 2000) or when sequences from the plastid region

trnL-F were studied, to *Aleisanthia* Ridley, *Aleisanthiopsis* C.Tange and *Greenea* Wight & Arn. forming a clade that is sister to the *Vanguerieae* clade (Rova *et al.* 2002). Andreasen & Bremer (2000) formally placed *Ixora* in Rubiaceae, subfamily *Ixoroideae* Raf., tribe *Ixoreae* A.Gray and provided an updated morphological description of the tribe. Robbrecht & Manen (2006) reduced the number of subfamilies in Rubiaceae to two, with *Ixora* placed in subfamily *Cinchonoideae* Raf., supertribe *Ixoridinae* Robbr. & Manen, alliance *Vanguerieae*, tribe *Ixoreae*, together with *Aleisanthia*, *Aleisanthiopsis*, *Greenea*, *Myonima*, *Scyphiphora* and *Versteegia*.

The first reference to *Ixora* with respect to the native Australian flora was by Mueller (1865) when he described *I. klanderiana* F.Muell. (now a synonym of *I. timorensis* Decne.). Mueller (1861) had previously described *I. thozetiana* F.Muell.; however, this is now considered a synonym of *Aidia racemosa* (Cav.) Triveng. Benth. (1867) recognised seven species of *Ixora* L. under three sections for the Australian species *viz.* (1) sect. *Pavetta* with two species. *I. pavetta sensu* Benth. and *I. tomentosa sensu* Benth. (flowers 4-merous, stigma lobes coherent). (2) sect. *Ixora* with four species *I. beckleri* Benth., *I. coccinea* L., *I. timorensis* and *I. triflora* R.Br. ex Benth. (flowers 4-merous, stigma with 2 recurved lobes). (3) sect. *Pentadium* with one species *I. pentamera* Benth. (Flowers 5-merous, stigma undivided). Three of these species have been transferred to other genera, *viz.* *I. pavetta* and *I. tomentosa* to *Pavetta* (*P. australiensis* Bremek. and *P. brownii* Bremek. respectively) (Reynolds 1993), *I. pentamera* Benth. to *Tarenna* (as *T. pentamera* (Benth.) S.T.Reynolds) (Reynolds & Forster 2005), whereas one species *viz.* *I. triflora* R.Br. ex Benth. is a *nom. illeg.*, being predated by *I. triflora* (G.Forst.) Seem. Moreover the type elements (description and syntypes) of *I. triflora* R.Br. ex Benth. consist of several distinct species, one is an *Ixora* (subsequently renamed as *I. queenslandica* Fosberg), whereas the other is not an *Ixora* and referable to *Diplospora ixoroides* F.Muell. (now *Triflorensia ixoroides* (F.Muell.) S.T.Reynolds (Reynolds & Forster

2005)). Bailey (1900) dispensed with an all encompassing concept of *Ixora*, recognising both this genus and *Pavetta*, the former with the species *I. beckleri*, *I. timorensis* and *I. pentamera*.

Four species *Ixora orophila* C.T.White, *I. biflora* Fosberg, *I. queenslandica* Fosberg and *I. baileyana* Bridson & Adams have since been added to this genus. *Ixora biflora* was based on new material and is still recognised. *Ixora orophila* was transferred to *Psydrax* with a new name as *P. montigena* S.T.Reynolds & R.J.F.Hend. (Reynolds & Henderson 2004). *Ixora queenslandica* was a new species based in part on elements applicable to the invalidly named *I. triflora* R.Br. ex Benth. (Fosberg 1938a). *Ixora baileyana* was a new name for the plant previously known as *Lasianthus graciliflorus* F.M.Bailey (Adams *et al.* 1987). These descriptions and transfers resulted in five, named native species being recognised for Australia (Forster & Halford 2002). A sixth native species, *I. oreogena* S.T.Reynolds & P.I.Forst. is described in the current paper.

Materials and methods

The initial draft of this revision was undertaken by the first author prior to 1999. It has been updated in 2005 and 2006 by the second author, particularly in terms of introductory information about recent generic phylogenies, the typification and application of some names (especially the *Ixora queenslandica* – *I. triflora* conundrum) and new data pertaining to species distribution, habitat and conservation status.

The revision is based on morphological characters derived from herbarium specimens (dried sheets, spirit material) at BRI, CANB, DNA, K, NSW and QRS examined by the first author, with supplementary observations and measurements by the second author of specimens accessioned at BRI since 1995. All taxa have been examined and collected in the field by the second author. Measurements encompass the main range of variation, with aberrant or unusual data indicated in brackets, e.g. (8–)12–15.

Common abbreviations in the specimen citations are L.A. (= Logging Area), N.P. (=

National Park), S.F. (= State Forest), S.F.R. (= State Forest Reserve) and T.R. (= Timber Reserve). Two species keys are presented, the first to the native and naturalised species that occur in Australia, and the second to commonly cultivated species in Australian horticulture.

The species concepts used in this revision have been discussed previously (Forster 2005; Reynolds & Forster 2005).

Taxonomy

Ixora L., *Sp. Pl.* 110 (1753). *Pavetta* section *Ixora* (L.) Blume, *Bijdr. Fl. Ned. Ind.* 1: 949 (1826). **Type:** *I. coccinea* L. [lecto, *vide* Hitchcock & Green (1929: 124)].

Derivation of name: Portuguese form of the Sanskrit word *içvara* (Lord), for the Hindu God Çiwa.

Shrubs or small trees, erect. Stipules interpetiolar, with a truncate or triangular limb connate for most of its length, bearing a cuspidate or aristate apical awn, glabrous or variously hairy, especially near base inside. Leaves opposite, rarely ternate (not in Australia), entire, domatia absent, petiolate or ± sessile; petioles markedly articulate at base. Inflorescences terminal, pedunculate or sessile above the last pair of leaves, or occasionally terminal on very short axillary branchlets, the flowers arranged in 1–3-flowered cymes enclosed in a pair of broad foliaceous bracts, or in many-flowered compact cymes, corymbs or open trichotomously branched panicles with patent, opposite or alternate, often articulate branches; bracts showy or small; bracteoles small, usually paired. Flowers 4 (or rarely 5) -merous, usually showy and fragrant; sessile or pedicellate. Calyx tube ovoid, limb as wide as the tube, with small or well developed lobes at apex; lobes imbricate. Corolla white, yellow, orange, pink or red; tube cylindrical, straight, erect, slender, only slightly wider at mouth, glabrous outside, glabrous or hairy inside; corolla lobes as long as or shorter than the tube, contorted in bud, lanceolate, ovate or oblong, patent, reflexed or revolute in flower. Stamens attached near the mouth of the corolla tube, exerted, spreading and erect; filaments very short, anthers dorsifixed, submedifixed,

narrowly ovate or ovate, base usually sagittate, apex with an apiculate and aristate connective, spreading or erect, hanging down in open flowers. Disc annular, fleshy. Ovary 2–4 (–6) locular, ovule solitary in each locule, immersed in the fleshy placenta attached to the septum; style filiform, exerted or included in corolla tube; stigmatic lobes 2–4 (–6 in *I. biflora*), divaricate, recurved. Fruits drupaceous, globose to subglobose and flattened at both ends, red or black, containing 1–4 (–7 in *I. biflora*), subglobose, thin-walled pyrenes that are solitary in each cell of the fruit; seeds ± same shape as pyrenes, plano-convex, brown, with a deep round excavation on the ventral side.

Distribution: Pantropical, about 400 species (De Block 1998); seven species in Australia (six native, five endemic).

Diagnostic characters: The genus *Ixora* is characterised by the articulate base of the leaf petiole, the inflorescences that are terminal or terminal on side branches or short side shoots, the stipules with apices that are apiculate or cuspidate, inflorescences and cymes enclosed in a pair of large foliaceous bracts, flowers that are 4 (rarely 5) -merous with stigmatic lobes that are divergent and recurved. *Ixora* may be readily distinguished from the allied genera *Tarenna* Gaertn. and *Pavetta* by the above characters.

Sectional Classification: Bremekamp (1937) recognised subgenera, sections and series under *Ixora*, whereas other authors including Fosberg (1942) and Smith & Darwin (1988) recognised the major species groups of *Ixora* as sections only. The latter authors are followed here.

Species from five sections are present in Australia; however, since each of these sections are represented by one or two species only, the species are keyed out together in a combined species key, rather than under each section. In the species account, native taxa are arranged alphabetically, followed by the naturalised species. Their sectional affinity is indicated in the following conspectus of the sections.

Conspectus of *Ixora* sections represented in Australia

1. *Ixora* sect. *Ixora* ('*Ixorastrum*') Bremek., *Bull. Jard. Bot. Buitenzorg* ser. 3, 14: 208 (1937). **Type: *I. coccinea* L.**

Inflorescence branches opposite, articulate in axil of bracts; inflorescence corymbiform, much branched and densely flowered; bracteoles shorter than ovary; flowers red, pink, orange or yellow; calyx with minute lobes.

One species in Australia (*I. coccinea*) that is widely cultivated and occasionally naturalised as a localised adventive since European settlement.

2. *Ixora* sect. *Phylleilema* A.Gray, *Proc. Amer. Acad. Arts Sci.* 4: 40 (1858). **Type: not designated.**

Inflorescences with 1–3 flowered subumbellate cymes enclosed in a pair of large ovate cuspidate bracts; flowers sessile.

Two species in Australia, both endemic (*I. biflora* and *I. queenslandica*).

3. *Ixora* sect. *Vitixora* Fosberg, *Sargentia* 1: 124 (1942). **Type: not designated.**

Inflorescence small, comprising head-like cymes with many-flowers that are borne at the apices of short axillary branchlets; flowers surrounded by linear bracts; calyx lobes well developed, lanceolate or elliptic-ovate, elongate in fruit.

One endemic species in Australia (*I. baileyana*).

Note: This section was previously thought to be endemic to Fiji where it is represented by four species (Fosberg 1942; Smith & Darwin 1988).

4. *Ixora* sect. *Pavettopsis* Bremek., *Bull. Jard. Bot. Buitenzorg* ser. 3, 14: 210 (1937). **Type: *I. blumei* Zoll. & Mor.**

Stipules showy, with a long aristate awn; inflorescences paniculiform, few branched, lower branches opposite and articulate at base, the ultimate branches terminated by 2 or 3-flowered cymules, one flower always sessile and articulate at base, the others stalked; pedicels articulate at base; corolla glabrous at throat.

Two endemic species in Australia (*I. beckleri* and *I. oreogena*).

5. *Ixora* sect. *Pogonanthus* Bremek., *Bull. Jard. Bot. Buitenzorg* ser. 3, 14: 210 (1937). **Type: *I. timorensis* Decne.**

Stipules small, shortly cuspidate; inflorescences pedunculate or subsessile, paniculiform, many-flowered, laxly branched with patent opposite, subopposite or alternate branches; ultimate cymules 2–5-flowered; bracts subtending the inflorescence branches showy or small; corolla throat hairy.

One non-endemic species in Australia (*I. timorensis*).

Key to the species of *Ixora* present (native and naturalised) in Australia

- | | | |
|---|--|-----------------------------------|
| 1 | Inflorescences 1–3-flowered, enclosed in a pair of large bracts. | 2 |
| | Inflorescences usually more than 3-flowered, never enclosed in a pair of large bracts | 3 |
| 2 | Leaves broadly elliptic; inflorescences sessile; fruits broadly ellipsoid, up to 7-seeded, red; stigma 2–6-lobed, style hardly exceeding the corolla tube; anthers ovoid | 3. <i>I. biflora</i> |
| | Leaves narrowly elliptic; inflorescences pedunculate; fruits globose, 2-seeded, black; stigma 2-lobed, style long exerted from the corolla tube; anthers elongate, narrowly ovoid or lanceolate. | 5. <i>I. queenslandica</i> |

- 3 Inflorescences borne at apex of short axillary branchlets, subcapitate; bracts linear, hairy **1. I. baileyana**
 Inflorescences terminal on the main branchlet, open paniculiform or comprised of corymbs and subumbels; bracts ovate or subulate, glabrous 4
- 4 Corolla red, orange or yellow, tube 20–45 mm long; inflorescences compact, corymbiform or umbelliform, much branched with opposite articulate branches; bracts and bracteoles foliaceous and well developed **7. I. coccinea**
 Corolla white or cream, corolla tube 2–8 (–10) mm long; inflorescences open, loosely branched, paniculiform, with only the lower branches usually opposite and articulate; bracts subtending the inflorescences showy or small, others minute; bracteoles minute or absent. 5
- 5 Stipules shortly cuspidate; leaves (115–) 157–230 × (45–) 65–90 mm, base subcordate, obtuse or subacute; bracts subtending the three inflorescence branches showy or small; corolla tube densely hairy at mouth; style hairy in the middle; calyx and pedicels hairy or glabrous **6. I. timorensis**
 Stipules cuspidate with a long aristate awn; leaves 65–135 × 21–55 (–70) mm, base acute or obtuse; bracts subtending the inflorescence branches stipule-like; corolla tube glabrous inside; style, calyx and pedicels glabrous 6
- 6 Leaf lamina 95–135 × 35–70 cm; petioles 10–14 mm long; inflorescences shortly pedunculate (primary peduncle 5–7 (–12) mm long), ultimate cymules 3-flowered, middle flower sessile, lateral ones shortly pedicellate (pedicels 0.5–1.5 mm long); corolla tube 2–4.5 mm long, lobes obtuse **2. I. beckleri**
 Leaf lamina 65–95 × 21–31 cm; petioles 5–10 mm long; inflorescences sessile, ultimate cymules 2 or 3-flowered, one flower sessile, the others pedicellate (pedicels 2.5–3 mm long); corolla tube 7–8 mm long, lobes acuminate **4. I. oreogena**

A. Native Australian species of *Ixora*

1. *Ixora baileyana* Bridson & L.G.Adams, *Kew Bull.* 42: 214 (1987).

Lasianthus graciliflorus F.M.Bailey, *Queensland Dept. Agric. Bull.* 18:18 (1892); non *Ixora graciliflora* Benth., *Linnaea* 7: 448 (1850). **Type:** Queensland. COOK DISTRICT: Tringilburra (Behana) Creek, Bellenden Ker, in 1889, *F.M. Bailey s.n.* (holo: BRI [AQ318077]; iso: K).

Illustrations: Hyland *et al.* (1999, 2003).

Subshrubs with erect to decumbent slender stems to 1.5 m high; indumentum of erect to spreading, short (<0.5 mm long), simple trichomes; branchlets terete to somewhat angular, cream-grey, indumentum scattered to

sparse. Stipules 4–9 mm long, with sparse to dense indumentum externally and internally, colletors at base internally; shortly connate for up to 2 mm, limbs ovate-triangular and up to 2 mm long, keeled towards apex and aristate (awn 1.8–7 mm long). Leaves thinly coriaceous, subsessile to shortly petiolate; petioles 2–4 mm long; lamina elliptic-ovate, lanceolate, oblanceolate, occasionally wider above the middle, 100–210 × 25–65 mm; apex acute or abruptly acuminate, narrowing towards base; base subcordate or obtuse at base; upper surface dark glossy-green when live, drying dark brown with reddish nerves, glabrous; lower surface with scattered indumentum especially on the midrib and nerves; lateral nerves 9–14 pairs, ± patent and looping near margins, interlateral venation

reticulate and prominent on the lower surface. Inflorescences in small dense clusters at branchlet apices, \pm sessile or shortly pedunculate; bracts small, *c.* 2 mm long, ciliate. Flowers usually bisexual (unisexual in one collection), 4-merous, sessile, scented. Calyx *c.* 1 mm long, lobes lanceolate, $<$ 0.2 mm long, fimbriate and with sparse to dense indumentum. Corolla white; tube 8–10 mm long, with dense indumentum inside; lobes acuminate, 4–4.5 \times 1–1.3 mm, ciliate. Stamens at mouth of tube (only the anther tips exerted), anthers lanceolate-ovoid, 0.8–1 mm, filaments 7–8 mm long. Ovary 4-locular; style and stigma 10–12 mm long, shortly exceeding corolla tube, style glabrous, stigmatic arms 4, linear and spreading, 1–1.2 mm long. Fruits subglobose, depressed on top and bottom and obscurely 4-lobed, *c.* 10 mm long and wide, red, with persistent sparse indumentum, crowned by persistent calyx, pyrenes 1 or 2; seeds subglobose, *c.* 4 mm long and 4 mm wide. **Fig. 1.**

Additional selected specimens examined: Queensland.

COOK DISTRICT: N.P.R. 133, Daintree, above tributary of McKenzie Creek, WNW of Mt Hutchinson, 16°11'S, 145°24'E, Nov 2002, *Ford AF3677 & Holmes* (BRI); Baileys Creek, N of Daintree, 1962, *Webb & Tracey 6529* (BRI); S.F. 310 Goldsborough, 12 km along Goldsborough Valley road, 17°12'S, 145°45'E, Oct 2001, *Forster PIF27675 et al.* (A, BRI, K, L, MEL, NSW); S.F. 310 Goldsborough, 13.5 km along Goldsborough road, 17°13'S, 145°45'E, Jul 2000, *Forster PIF25891 et al.* (BRI, MEL); base of Bellenden Ker Cable Car installation, N of Babinda, 17°16'S, 145°54'E, Aug 1989, *Bostock 954 & Guymer* (BRI); S of junction of E and W Mulgrave Rivers, S.F.R. 310, Goldfield L.A., 20 km SSE of Little Mulgrave township, 17°18'S, 145°47'E, Nov 1988, *Jessup GJM1624 et al.* (BRI); Fishery falls, between Gordonvale & Babinda, 1962, *Webb & Tracey 7477* (BRI); W of lower Kraft Creek, Wooroonooran N.P., 17°18'S, 145°47'E, Jul 1995, *Hunter JH3368* (BRI); Kraft Creek, Wooroonooran N.P., 17°19'S, 145°48'E, Jul 1995, *Hunter JH4719* (BRI); Mulgrave River, Wooroonooran N.P., 17°21'S, 145°46'E, Apr 1995, *Hunter JH3266* (BRI); S.F.R. 755, Bartle Frere, Gosschalk L.A., 17°24'S, 145°47'E, Nov 1991, *Hyland 14335* (BRI, QRS); Barong L.A., S.F.R. 755, 17°30'S, 145°50'E, Oct 1976, *Umwinn GU87* (BRI, QRS); Cooroo Lands, Canal L.A., 17°30'S, 145°55'E, Nov 1974, *Dansie 20102* (BRI, QRS); 1.4 km SE of Cooroo Peak at head of Culla Creek, 17°31'S, 145°53'E, Oct 1988, *Jessup GJM2515 et al.* (BRI); Gregory Falls, lower Palmerston via Innisfail, 1962, *Webb & Tracey 6588* (BRI); Miriwinni near Mt Bartle Frere, 1962, *Webb & Tracey 6714A* (BRI); Boobaa Creek, Basilisk Range, 2 km SW of Moresby, 17°38'S, 146°00'E, Oct 1997, *Forster PIF21791 et al.* (BRI);

S.F.R. 756, West McNamee L.A., 17°41'S, 146°52'E, Nov 1977, *Gray 797* (BRI, QRS). NORTH KENNEDY DISTRICT: Mission Beach, 17°52'S, 146°07'E, Oct 1965, *Altena 4055* (BRI).

Distribution and habitat: *Ixora baileyana* is endemic to the Wet Tropics bioregion of north-eastern Queensland (**Map 1**). It grows as an understorey subshrub in lowland rainforests (semi-deciduous, complex notophyll to mesophyll vineforests) on substrates (often alluvial) derived from granite or metamorphic rocks.

Notes: *Ixora baileyana* is distinguishable from the other Australian species by its hairy lanceolate or ovate-elliptic, subsessile leaves, inflorescences that are borne on short axillary (or supra-axillary) branchlets, linear bracts surrounding the flowers, style with four stigmatic arms and 4-locular fruits.

This species is referable to *Ixora* sect. *Vitixora* Fosberg, previously thought to be endemic to Fiji. *Ixora baileyana* is putatively androdioecious (Adams *et al.* 1987) whereas all other species in the genus are thought to be hermaphroditic (De Block 1998).

Conservation status: *Ixora baileyana* is infrequent, although reasonably widespread throughout its known range. It is not considered threatened. Present in various National Parks, e.g. Daintree and Wooroonooran.

Etymology: The specific epithet honours Frederick M. Bailey (1827–1915), Queensland Colonial Botanist, who originally described this species as *Lasianthus graciliflorus*.

2. *Ixora beckleri* Benth., *Fl. Austral.* 3: 416 (1867) (as '*becklerii*'). **Type:** New South Wales. Richmond River & Clarence River, *Beckler s.n.* (holo: K)

Illustrations: Floyd (1989: 311); Hauser & Blok (1998: 292); Logan River Branch SGAP (QLD Region) Inc. (2005: 290).

Shrubs or small trees to 5 m high with stiff branches; indumentum largely absent, where present of erect, short ($<$ 0.5 mm long), simple trichomes; branchlets terete to somewhat flattened and angular, glabrous, cream-grey. Stipules 3.5–8 mm long, glabrous, internally with dense collectors near base;

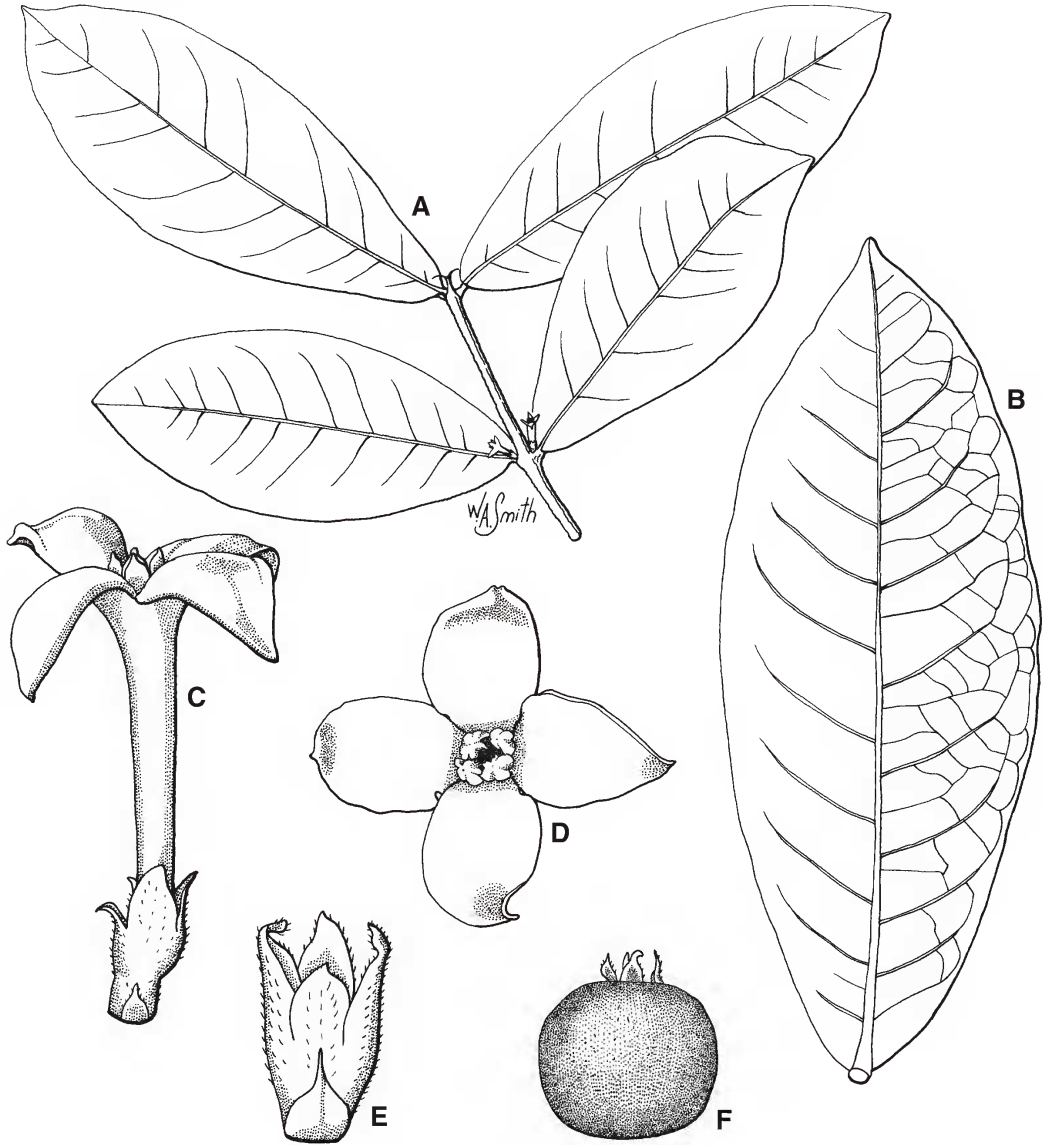


Fig. 1. *Ixora baileyana*. A. habit of flowering stem $\times 0.5$. B. leaf viewed from below showing detail of venation $\times 0.8$. C. lateral view of flower on peduncle showing bracts $\times 6$. D. face view of flower $\times 6$. E. peduncle with bracts $\times 8$. F. lateral view of fruit $\times 4$. A–E from Forster PIF27675 (BRI); F from Webb & Tracey 6714a (BRI). Del. W. Smith.

shortly connate for up to 2 mm long, limbs broadly ovate-triangular to truncate, 1–2 mm long, keeled towards apex and aristate (awn 1.5–6 mm long). Leaves coriaceous, petiolate, glabrous; petioles slender, 7–8 mm long; lamina elliptic, ovate-elliptic or subovate, (50–) 110–165 \times (25–) 40–58 mm; apex acute, abruptly shortly acuminate or obtuse; base acute or obtuse; upper surface

glossy, dark-green when live, drying dark brown; lower surface matt, pale-green; lateral nerves 6–12 pairs, patent or suboblique and looping near margins, interlateral venation reticulate and prominent on lower surface. Inflorescences shortly pedunculate, glabrous or with scattered indumentum; peduncle 7–10 mm long, terminated by 3 branches each carrying cymes at their apex; branches

(secondary peduncles) 16–22 mm long, lateral ones patent, the central one sometimes with one internode; bracts at top of the peduncle foliaceous, or small, broadly ovate, aristate with fine points, bracts at apex of the branches (those subtending the cymes), broadly ovate, obtuse, finely aristate or represented by lateral, narrowly ovate subulate lobes. Flowers bisexual, 4-merous, sessile, scented. Calyx 1.5–2 mm long, shortly 4-toothed with the lobes truncate-ovate and up to 0.2 mm long. Corolla white; tube 3–5 mm long; lobes ovate, acute or acuminate, 2.5–3 mm long. Stamens near mouth of tube, anthers linear-oblong, 1.5–1.8 mm long, filaments 3–5 mm long. Ovary 2-locular; style and stigma 4–6 mm long, style shortly exceeding the corolla tube, glabrous, stigmatic lobes 2, ± erect, linear, 1–1.2 mm long. Fruits obovoid or subglobose, 8–12 × 8–12 mm, crowned by persistent calyx, black, glabrous, pyrenes 1 or 2; seeds subglobose, 5–8 × 5–6.5 mm. **Fig. 2.**

Additional selected specimens examined: Queensland. PORT CURTIS DISTRICT: Keppel Bay, in 1872, *Eaves s.n.* (MEL); S.F. 585 Wietalaba, 32 km S of Calliope, 24°17'S, 151°12'E, May 1993, *Gibson TO11309* (BRI); Wietalaba S.F., c. 31 km S of Calliope, 24°17'S, 151°12'E, Nov 1997, *Halford Q3444* (BRI); Bulburin S.F. 67, Scott Road, c. 3 km ENE of Forest Station, Apr 1980, *McDonald 3184 et al.* (BRI). BURNETT DISTRICT: Pine Mountain Creek, N of Monto, 24°36'S, 151°09'E, Jul 1995, *Bean 8772* (BRI, MEL); S.F. 695, Kalpowar, Mt Fort William, 24°38'S, 151°20'E, Mar 2000, *Forster PIF25438 & Booth* (A, BRI, MEL, QRS); T.R. 533, Mungore L.A., Pine Creek headwaters, 25°37'S, 152°00'E, Dec 1989, *Forster PIF6155* (BRI, L, MEL, MO, QRS). WIDE BAY DISTRICT: Upper reaches of Broken Creek, SE of Builyan, 24°39'S, 151°29'E, Nov 1995, *Bean 9166 & Turpin* (BRI); Mudlow Gap, T.R. 26, 8 km N of Kilkivan, 26°01'S, 152°13'E, Nov 1990, *Forster PIF7629* (BRI, K, MEL, QRS); Imbil, Aug 1935, *White 1411* (BRI, CANB). MORETON DISTRICT: Pedwell Road, edge of Wamuran Basin, Mt Mee, Delany Creek S.F., 27°02'S, 152°48'E, Dec 1993, *Grimshaw G231 & Franks* (BRI); Waterfall Gully No. 2, Somerset Dam, c. 20 km SW of Kilcoy, 27°06'S, 152°33'E, Apr 1989, *Sharpe 4855 & Forster* (BRI); Sankeys scrub, Dec 1887, *Simmonds 227* (BRI); Brisbane, Coomera, Logan River, in 1887, *Scortechini 52* (MEL). **New South Wales.** Lismore, Apr 1891, *Bauerlen* (NSW); Tumbulgum, Apr 1898, *Bauerlen* (NSW); Booyong Recreation Reserve, May 1982, *Floyd 1872* (NSW); Clarence River, *s.dat.*, *Moore 223* (MEL1537266); Turnstall, Lismore, Dec 1910, *Tanner 35* (NSW).

Distribution and habitat: *Ixora beckleri* is endemic to eastern Australia where it is found from central Queensland south to northern

New South Wales (**Map 1**), in dry rainforests (araucarian microphyll to notophyll vineforests).

Notes: *Ixora beckleri* is distinguishable by its glossy green elliptic leaves, shortly pedunculate, trichotomously-branched inflorescences, each branch ending in a small cyme, and by its short corolla tube with short, acute lobes (which are usually as long as the tube).

Conservation status: *Ixora beckleri* is common and widespread and is present in numerous State Forests and National Parks, viz. Main Range, Mt Bauple, Mt Pinbarren, Noosa, Mapleton Falls, Kondalilla, Moogerah Peaks, Burleigh Head, Nicoll Scrub (Forster *et al.* 1991).

Etymology: The specific epithet honours Hermann Beckler (1828–1914), medical doctor, botanist and plant collector.

3. *Ixora biflora* Fosberg, *J. Bot.* 76: 235 (1938); *I. biflora* var. *biflora* (as var. 'typica'), Fosberg, *loc. cit.* 76: 276 (1938). **Type:** Queensland. COOK DISTRICT: Slopes of Mt Demi, W of Daintree, 6 February 1932, *L.J.Brass 2050* (holo: BRI).

Ixora biflora var. *fleckeri* Fosberg, *J. Bot.* 76: 277 (1938). **Type:** Queensland. COOK DISTRICT: Intake, Mossman Gorge, 20 June 1937, *H.Flecker 3521* (holo: BRI; iso: QRS).

Illustrations: Jones (1986: 90); Hyland *et al.* (1999, 2003); Cooper & Cooper (2004: 443).

Small shrubs to 2 m high; indumentum of erect, short (<0.2 mm long), simple trichomes; branchlets terete, brown, glabrous. Stipules 2–8 mm long; shortly connate for up to 3 mm long, limbs broadly ovate to truncate, keeled towards apex and aristate (awn 0.5–5 mm long), glabrous. Leaves thinly coriaceous, petiolate, glabrous; petioles 3–8 mm long; lamina elliptic, elliptic-oblong or narrowly elliptic, (56–) 74–116 (–160) × (18–) 22–44 mm; apex subacute, abruptly shortly acuminate or obtuse; base acute or obtuse; upper surface dark glossy-green, paler on lower surface; lateral nerves 8–13 pairs, patent or suboblique, looping at margins, faint above, prominent below (drying reddish

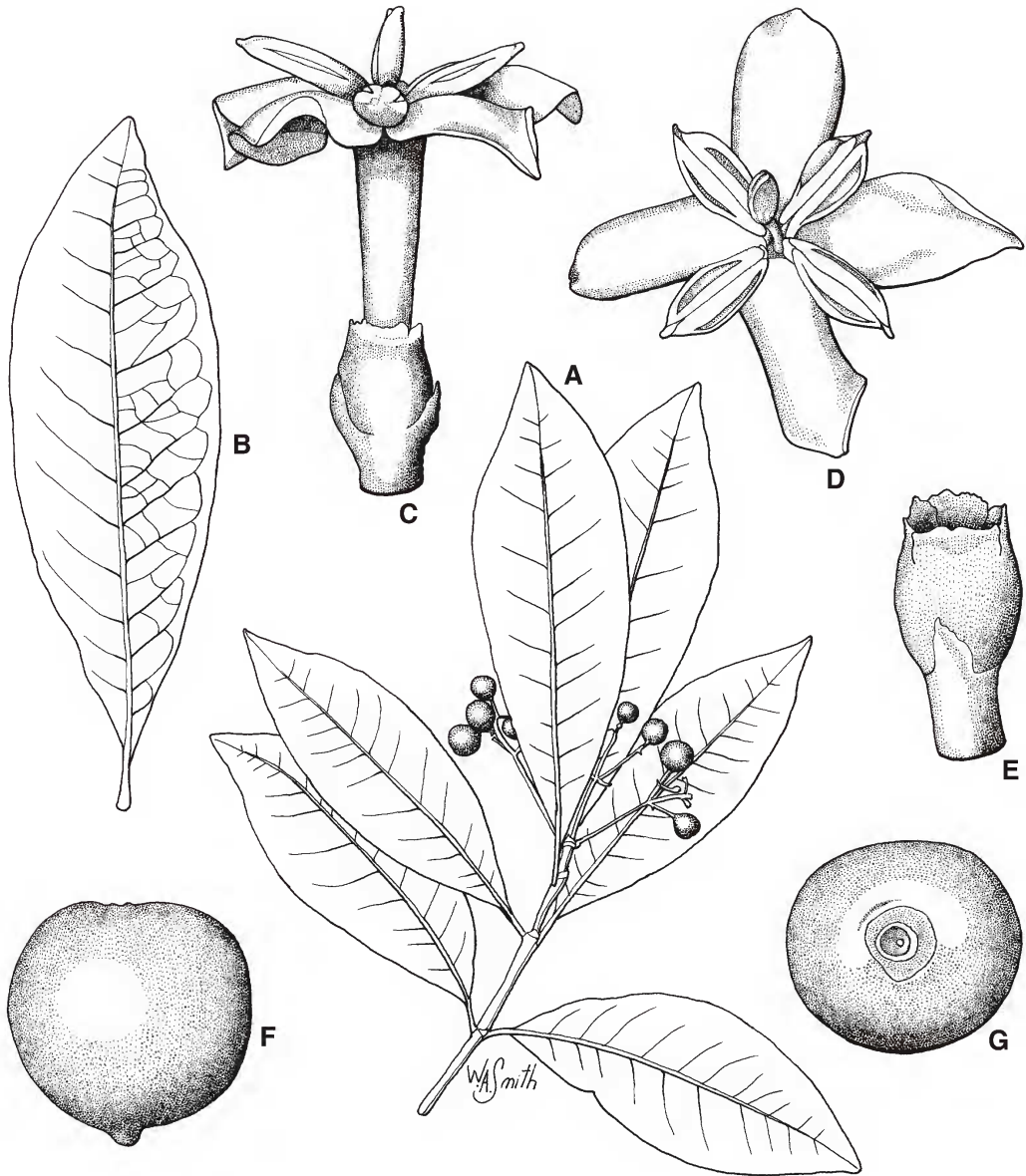


Fig. 2. *Ixora beckeri*. A. habit of fruiting stem $\times 0.5$. B. leaf viewed from below showing detail of venation $\times 0.8$. C. lateral view of flower on peduncle showing bracts $\times 8$. D. face view of flower $\times 8$. E. peduncle with bracts $\times 12$. F. lateral view of fruit $\times 3$. G. apical view of fruit $\times 3$. A & B from Forster PIF25438 & Booth (BRI); C–E from Forster PIF7597 (BRI); F & G from Sharpe 4885 (BRI). Del. W. Smith.

brown), interlateral venation reticulate and largely obscure. Inflorescences sessile at branchlet apices, 2 or 3-flowered, subtended by a pair of elliptic and apiculate bracts; bracts conspicuous, (8–) 12–20 \times 5–12 mm, elliptic-ovate, shortly aristate at apex, obtuse or subcordate at base, prominently nerved

with 11–15 pairs of fine patent lateral nerves, colletors occasionally present inside. Flowers bisexual, 4-merous, sessile, scented. Calyx *c.* 4 \times 2.5 mm, with sparse indumentum; lobes broadly ovate or \pm rounded, 0.7–1 \times 0.2–0.6 mm, thin. Corolla small and inconspicuous, white to pale pink, glabrous; tube slender, 10–

15 mm long; lobes elliptic, obtuse, 4–7 × 2–3.2 mm, recurved; stamens much shorter than lobes, anthers squat, ovoid, 0.8–1.5 × 0.5–1 mm; filaments c. 0.5 mm long; ovary 2-many locular; style and stigma 13–14 mm long, the style not exceeding the corolla tube, glabrous, stigmatic lobes 5 or 6, erect, ellipsoid, 0.8–1 mm long. Fruits subglobose, 7–14 × 12–18 mm, squat and flattened at both ends, red, glabrous, pyrenes 1–7; seeds rounded on top, angular on side, c. 7 × 5 mm. **Fig. 3.**

Additional selected specimens examined: Queensland. COOK DISTRICT: Mt Finnigan, west slopes, Sep 1948, *Brass* 20042 (BRI); Gap Creek, c. 38 km S by E of Cooktown, 15°43'S, 145°14'E, Aug 1959, *Smith* 10735 (BRI); 1 mile [0.6 km] NW of Stuckies' Gap, Bloomfield River area, 15°50'S, 145°19'E, May 1969, *Webb & Tracey* 8419 (BRI, QRS); Mt Misery, 15°52'S, 145°13'E, Jun 1992, *Forster PIF10756 et al.* (BRI, L, MEL, QRS); Daintree N.P., Mt Sorrow track, 2.5 km W of Cape Tribulation, 16°04'S, 145°27'E, Dec 1997, *Forster PIF21973 et al.* (BRI, MEL, QRS); Oliver Creek, a tributary of Noah Creek, 16°06'S, 145°27'E, May 1972, *Webb & Tracey* 11211 (BRI, CANB, QRS); Entrance to Coconut Village, Cape Tribulation, 16°07'S, 145°27'E, Aug 1993, *Cooper WWC597 & Cooper* (QRS); Daintree N.P., Noah Creek, 16°08'S, 145°26'E, May 2000, *Forster PIF25755 & Booth* (A, BRI, K, L, MEL); 1 km N of Cyanide Creek – Cape Tribulation Road, 16°08'S, 145°27'E, Sep 1976, *Williams* 76062 (BRI); Baileys Creek, 16°13'S, 145°25'E, Oct 1962, *Smith* 11531 (BRI); Pinnacle Rock track, 2 km W of Karnak, 16°23'S, 145°18'E, Jun 1992, *Forster PIF10684 et al.* (BRI); Creek behind Karnak, Daintree River N.P., tributary of Whyanbeel Creek, 16°24'S, 145°19'E, Nov 1996, *Jago* 4155 (BRI); Saltwater Creek, 4 km NW of Mossman, 16°25'S, 145°20'E, Nov 2001, *Forster PIF27797 & Booth* (BRI, MEL); Rex Range, c. 2.8 km from Mossman – Julatten road intersection, c. 9 km NE of Julatten, 16°32'S, 145°22'E, Dec 1988, *Jessup GJM5201 et al.* (BRI, DNA); Rex Range, NE of Julatten, 16°34'S, 145°23'E, Jan 1993, *Bean* 5681 & *Forster* (BRI); Devil Devil Creek, c. 9.6 km S of Mossman, Sep 1948, *Smith* 3951 (BRI).

Distribution and habitat: *Ixora biflora* is endemic to north-eastern Queensland in the Wet Tropics bioregion from a northern limit at Mt Finnigan, south to Rex Range (**Map 2**). The species occurs in lowland (<850 m altitude), wet rainforest (evergreen, complex notophyll to mesophyll vineforest) on ridges, sides of gorges or along permanent streams or in sand behind beach, on substrates derived from metamorphics or stabilised sand-dunes.

Notes: *Ixora biflora* is characterised by its elliptic or narrowly elliptic leaves with fine parallel nerves; large red subglobose

squat fruits, and sessile 2 or 3-flowered inflorescences enclosed in finely nerved large bracts. It resembles *I. queenslandica* in its 2 or 3-flowered inflorescences enclosed in large bracts but that species differs by its pedunculate inflorescences, and small ellipsoid, black fruits.

This species has no close relative in Australia. It differs from all the Australian *Ixora* species by its many-lobed stigmas and many-celled large fruits. The leaves are variable, ranging from broad, elliptic or elliptic-oblong (typical of the type collection) to narrow-elliptic (as in the type of *I. biflora* var. *fleckeri*). Fosberg (1938b) recognised two varieties in this species on the basis of leaf size; however, they are not recognised here because the leaves can vary on the same branchlet.

Conservation status: *Ixora biflora* is widespread and common throughout its range. It is not considered threatened. Present in Cedar Bay and Daintree National Parks.

Etymology: The specific epithet is derived from the Latin *bi-* (two) and *flos* (flower) and refers to the floral arrangement as viewed by Fosberg (1938a).

4. *Ixora oreogena* S.T.Reynolds & P.I.Forst., species nov. *I. beckleri* Benth. valde simile autem inflorescentiis et foliis parvioribus, floribus fructibusque majoribus, corollae lobis acuminatis differt. **Typus:** Queensland. COOK DISTRICT: State Forest 194, Mt Baldy, Herberton Range, 17°18'S, 145°24'E, 24 January 2001, *P.I.Forster PIF26596 & R.Booth* (holo: BRI [1 sheet + spirit]; iso: MEL).

Ixora sp. (North Mary LA *B.P.Hyland* 8618) (Forster & Halford 2002).

Ixora sp. (N. Mary L.A. *B.Hyland* 8618) (Hyland *et al.* 2003).

Illustrations: Hyland *et al.* (1999, 2003).

Shrubs or small trees 4–18 m high; indumentum of spreading, short (<0.2 mm long), simple trichomes; branchlets terete, pale cream or reddish brown, glabrous. Stipules 3–7 mm long, externally glabrous, internally with dense trichomes and collectors at base; shortly connate for up to 1.2 mm, limbs broadly ovate,

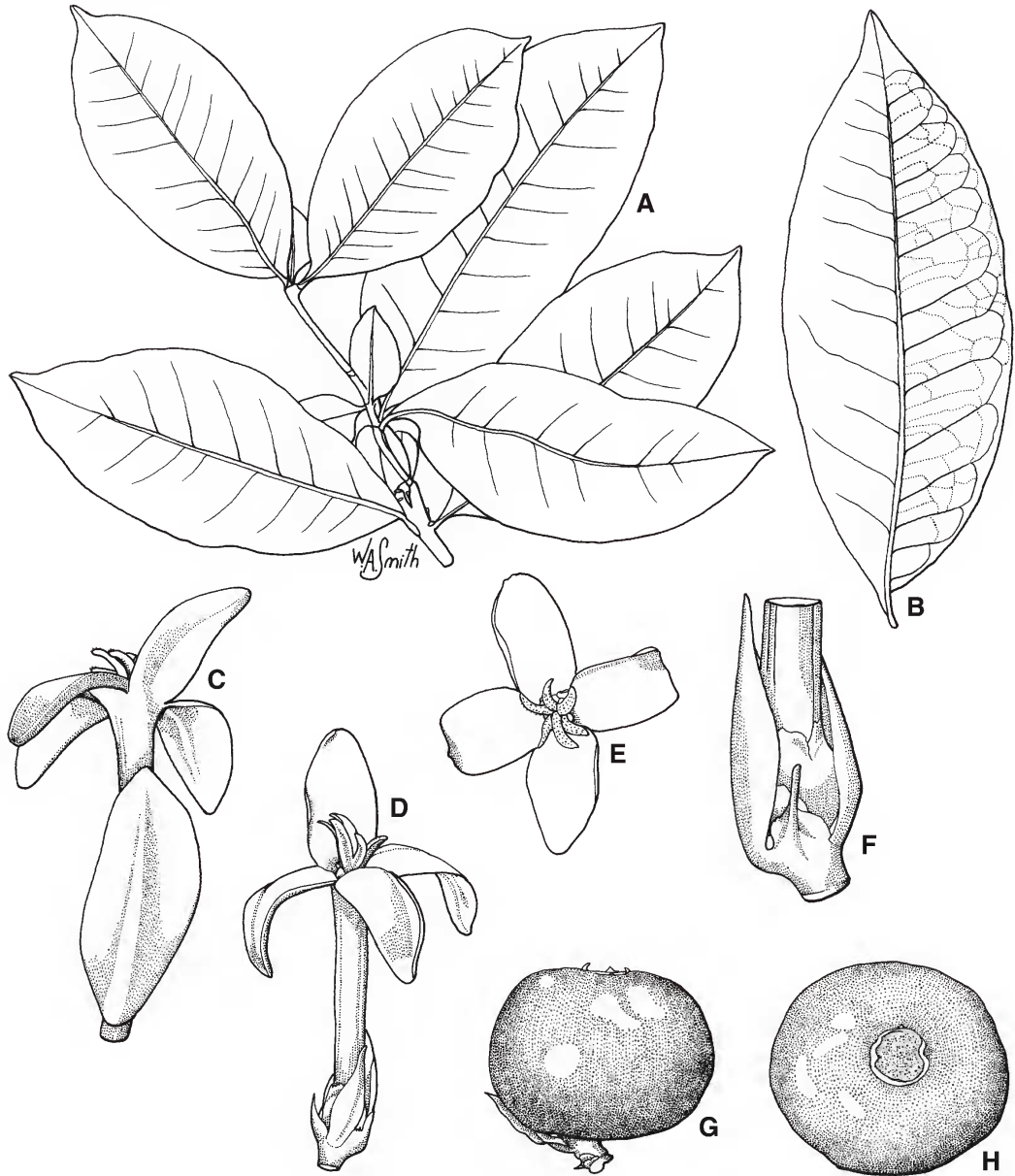


Fig. 3. *Ixora biflora*. A. habit of flowering stem $\times 0.6$. B. leaf viewed from below showing detail of venation $\times 0.8$. C. lateral view of flower on peduncle showing large bract $\times 3$. D. lateral view of flower $\times 3$. E. face view of flower $\times 3$. F. peduncle with bracts $\times 6$. G. lateral view of fruit $\times 2$. H. apical view of fruit $\times 2$. A, C–H from *Bean 5681* (BRI); B from *Smith 11531* (BRI). Del. W. Smith.

keeled towards apex and aristate (awn 1–5 mm long). Leaves coriaceous, petiolate, glabrous; petioles 5–10 mm long; lamina narrowly elliptic, 65–95 (–112) \times 21–31 (–42) mm; apex acute, or shortly acuminate and apiculate; base acute to obtuse; upper surface dark glossy-

green, drying \pm glossy; lower surface matt pale-green; lateral nerves indistinct, 8–10 pairs, patent or arcuate, interlateral venation reticulate, visible on lower surface only in dried specimens. Inflorescences glabrous, the three branches sessile at apex of reduced

leaves or shortly pedunculate (peduncle 2–4 mm long); each of the three branches articulate at base, trichotomously branched, and sometimes each of these branches are branched again (internodes 2–7 mm long); ultimate cymules or cymes 2–6-flowered, one flower oldest (usually the central flower of the cymule) sessile or subsessile, flanked by stalked 2 or 3-flowered cymules; bracts subtending the main inflorescence branches foliaceous, ovate-elliptic, to 16 × 5 mm, obscurely nerved, those subtending the cymes at apex of the three branches shortly connate, fimbriate at apex, and often with lateral ovate lobes; those subtending 5-flowered cymes with erose margin, whereas those subtending the 2 or 3-flowered ultimate cymules small, ovate. Flowers bisexual, 4-merous, sessile to subsessile (the oldest flower sessile or subsessile (pedicels to 1.5 mm long); the pedicellate flowers on slender pedicels (2.5–3 mm long), scented; pedicel bracteoles paired, ovate, 0.5–0.75 mm long and wide. Calyx 2–3 × 1.5–2 mm, glabrous; lobes broadly ovate or ± hemispherical, 0.5–1 × c. 1 mm, slightly fimbriate. Corolla white; tube slender, slightly dilated near apex, 7–8 mm long, glabrous inside; lobes elliptic-ovate, acuminate, 4–5 × c. 2 mm, ciliolate, reflexed. Stamens slightly shorter than corolla lobes, anthers ovoid, acuminate, c. 2 mm long, filaments 0.2–0.3 mm long. Ovary 2–3-locular; style and stigma 5–6 mm long, style barely exceeding tube, glabrous, stigmatic lobes 2, erect, linear, 1.8–2 mm. Fruits globose to subglobose, 8–18 × 8–22 mm, black, glabrous, pyrenes 2 or 3; seeds obovoid to subglobose, 5–8 mm long, 5–6 mm diameter. **Fig. 4.**

Additional specimens examined (*tentative identification on sterile collection): **Queensland.** COOK DISTRICT: S.F.R. 143, Kanawarra, Carbine L.A., 16°29'S, 145°16'E, Nov 1987, *Hyland 25244RFK* (BRI, QRS); Daintree N.P., near end of Mt Lewis road, 12 km SW of Mossman, 16°29'S, 145°16'E, Nov 1988, *Jessup GJM116 et al.** (BRI); North Mary L.A., S.F.R. 143 Mt Lewis, 16°30'S, 145°16'E, Sep 1973, *Sanderson 368* 430* (QRS); S.F.R. 143, North Mary L.A., 16°32'S, 145°15'E, Feb 1976, *Hyland 8618* (QRS); Mt Lewis road, South Mary L.A., 16 km NNW of Mt Molloy, 16°32'S, 145°17'E, Nov 1988, *Jessup GJM1581 et al.** (BRI); S.F.R. 143, Carbine L.A., 16°33'S, 145°15'E, Dec 1974, *Hyland 3157* (BRI, QRS); S.F.R. 143, Carbine L.A., 16°33'S, 145°15'E, Feb 1988, *Gray 4729* (BRI, QRS); T.R. 66, Mt Lewis, 16°34'S, 145°17'E, Sep 1978, *Moriarty 2456* (QRS);

Kaarru L.A., SW corner, 14.5 km SSE of Millaa Millaa, 17°37'S, 145°40'E, Oct 1988, *Jessup GJM5035 et al.** (BRI); Davies Creek, 1962, *Webb & Tracey 8016** (BRI); Forestry track, Mt Formartine, 16°44'S, 145°37'E, Nov 1988, *Jessup 922 et al.** (BRI); Peeramon, *s.dat.*, *Bick s.n.* (BRI [AQ124623]); Mt Misch, Herberton Range, tributary of Rocky Creek, 17°14'S, 145°25'E, Dec 1996, *Ford 1838* (BRI, QRS); S.F.R. 194, 17°15'S, 145°17'E, Aug 1968, *Hyland 1749* (QRS); E fall of Bellenden Ker, Wooroonooran N.P., 17°16'S, 145°52'E, Jan 1995, *Hunter JH929** (BRI); Palmerston Track ridge, Wooroonooran N.P., 17°24'S, 145°45'E, Jun 1995, *Hunter JH3828** (BRI); Tick Camp, Bellenden Ker, Aug 1959, *Webb & Tracey 3736* (BRI).

Distribution and habitat: *Ixora oreogena* is endemic to the Wet Tropics bioregion of north-east Queensland (**Map 3**) where it occurs in montane rainforests (complex notophyll vineforests) between 600 and 1100 m on substrates derived from basalt or granite.

Notes: *Ixora oreogena* is characterised by its elliptic leaf lamina, inflorescences that are small and open paniculiform, flowers with slender long corolla tubes, fruits that are subglobose or globose and black. It resembles *I. beckleri* Benth. in its leaves and inflorescences, but that species differs by its larger inflorescences, smaller fruits and flowers with shorter corollas.

Conservation status: The species is widespread, although never locally common, in the Wet Tropics. No conservation status listing is necessary. It occurs in various Forest Reserves and National Parks (Daintree and Wooroonooran).

Etymology: The specific epithet alludes to the mountainous habitat for the species and is derived from the Greek *oreogenus* (mountain-born).

5. *Ixora queenslandica* Fosberg, *J. Bot.* 76: 234 (1938). **Type:** [Queensland. PORT CURTIS DISTRICT:] Bay of Inlets, May 1770, *Banks & Solander s.n.* (holo: BM; iso: BRI).

Ixora triflora R.Br. ex Benth. *pro parte*, non (G.Forst.) Seem.; *Fl. Austral.* 3: 416 (Jan 1867), *nom. illeg.*

Diplospora ixoroides auct. non F.Muell.: Britten (1901); Bailey (1912).

Illustration: Britten (1901: t. 141 [as *Diplospora ixoroides*])

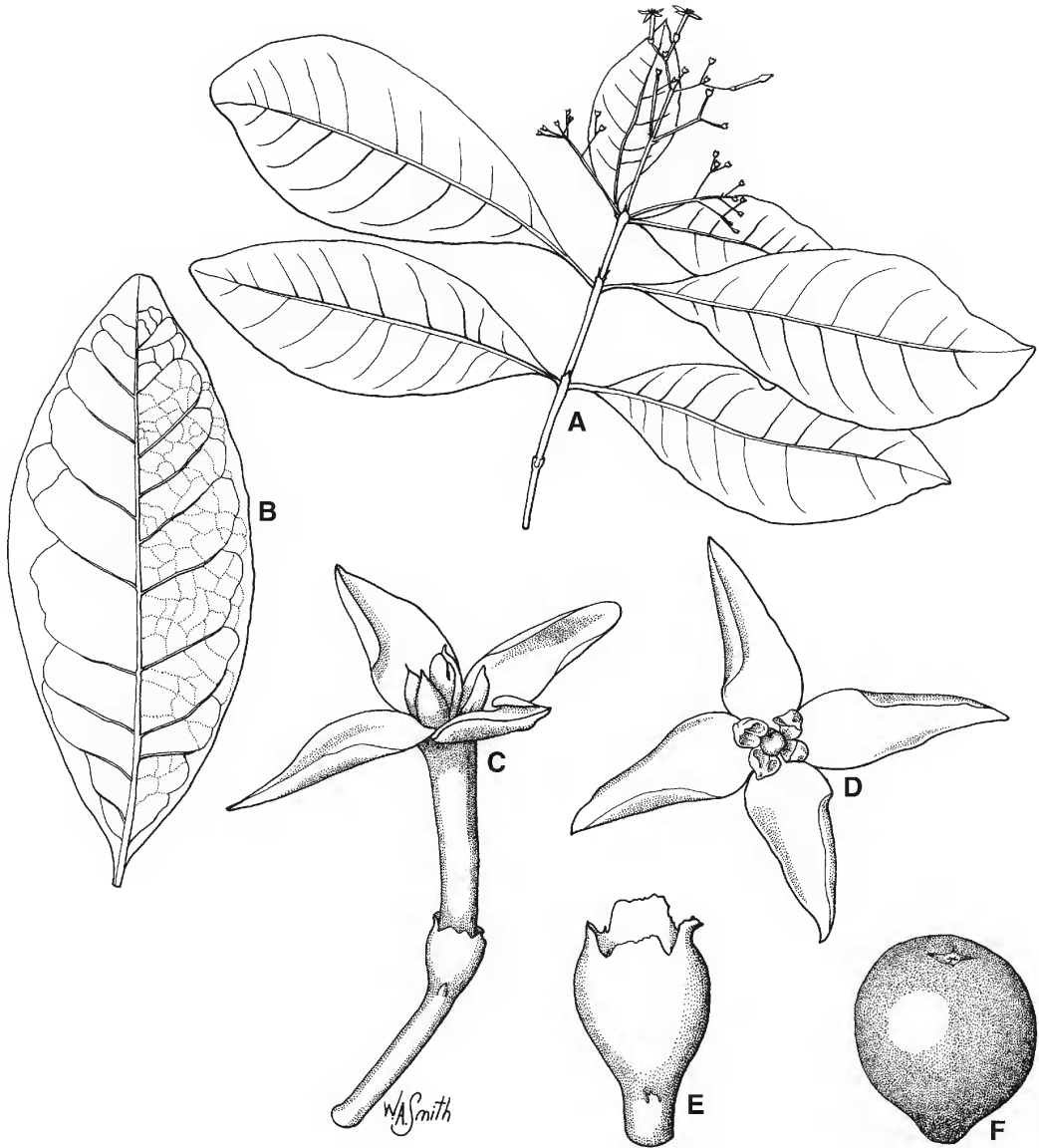


Fig. 4. *Ixora oreogena*. A. habit of flowering stem $\times 0.5$. B. leaf viewed from below showing detail of venation $\times 0.8$. C. lateral view of flower $\times 5$. D. face view of flower $\times 5$. E. peduncle with bract $\times 12$. F. lateral view of fruit $\times 3$. A–E from Forster PIF26596 & Booth (BRI); F from Hyland 25244RFK (BRI). Del. W. Smith.

Shrubs or small trees to 4 m high; indumentum of spreading, short (<0.5 mm long), simple trichomes; branchlets terete to somewhat angular and flattened, brown grey to light brown blotched, glabrous. Stipules 2.5–4.5 mm long, externally glabrous or with scattered to sparse indumentum near base, internally with sparse indumentum and dense colletors at base; shortly connate for *c.* 0.5

mm, limbs ovate to lanceolate-ovate and up to 2 mm long, keeled towards apex and aristate (awn 1.7–3.5 mm long). Leaves coriaceous, petiolate, glabrous; petioles 5–7 mm long; lamina elliptic, obovate or suborbicular (the suborbicular leaves often subtending branchlets carrying normal elliptic leaves or inflorescences), 47–108 \times 25–45 mm; apex obtuse to rounded; base obtuse to subacute;

upper surface glossy dark green; lower surface pale green; lateral nerves 7–9 pairs, suboblique, interlateral venation reticulate, indistinct. Inflorescences pedunculate; peduncles 20–35 mm long, side branches to 6 mm long with 3-flowered cymes that are terminated by a pair of large bracts enclosing the 3 sessile flowers; bracts ovate, acute or cuspidate at apex, obtuse or subcordate at base, 15–28 × 11–22 mm, faintly nerved (nerves 5 or 6 pairs, patent). Flowers bisexual, 4-merous, sessile, scented. Calyx *c.* 2.5 × 1–1.5 mm, glabrous; limb subtire or broadly and indistinctly 4-lobed with acute lobes <0.2 mm long, ciliate. Corolla white; tube slender, 4–17 mm long, 1–1.5 mm diameter at throat; lobes elliptic, acute, 4.5–10 × 1.5–2.5 mm, patent or recurved. Stamens slightly shorter than the corolla lobes to shortly exerted, anthers oblanceolate to narrowly ovoid, apiculate, 2.5–5 × 0.8–1 mm; filaments 1–1.5 mm long. Ovary 2-locular; style and stigma *c.* 19 mm long, style slender, hardly exceeding the corolla tube, glabrous; stigmatic arms 2, linear, recurved, 1.8–2 mm long. Fruits ellipsoid, 9–12 × 8–8.5 mm, dark brown or blackish, glabrous, pyrenes single; seeds ellipsoid, 6.5–8 × 4.5–5 mm. **Fig. 5.**

Additional selected specimens examined: Queensland. SOUTH KENNEDY DISTRICT: Port Mackay, May 1869, *Dietrich 2450* (MEL); Keswick Island, Singapore Bay, 20°54'S, 149°23'E, Sep 1996, *Batianoff 960929* (BRI); Prudhoe Island N.P., 53 km SE of Mackay, 21°19'S, 149°41'E, Nov 1992, *Batianoff 92113K & Robins* (BRI); Irving Island, SE of Sarina, 21°27'S, 149°28'E, Dec 1989, *Thompson 168* (AD, BRI). PORT CURTIS DISTRICT: coast just S of Bluewater Creek, *c.* 12.5 km SE of Carmila, 21°59'S, 149°29'E, Jul 1994, *McDonald 6039 et al.* (BRI); S of Stanage Bay, NW end of Shoalwater Bay, Apr 1945, *Blake 15678 & Webb* (BRI, CANB); Clairview Beach, 25 km N of St Lawrence, 22°06'S, 149°32'E, Apr 1985, *Rodd 4414 & Hardie* (BRI, NSW); Shoalwater Bay Training Area, Reef Point, 22°19'S, 150°34'E, Sep 1993, *McDonald 5776 & Tweedie* (BRI); Wedge Island, 23°17'S, 150°53'E, Nov 1987, *Batianoff 9814 & Dillewaard* (BRI, NSW); Pine Island, Percy Islands, Mar 1906, *Tryon s.n.* (BRI [AQ124688]); Bluff at northern end of Keppel Sand Beach, 23°19'S, 150°47'E, Apr 1986, *Anderson 4139* (BRI); Keppel Sands, 8 km S of Emu Park, 23°20'S, 150°48'E, Jul 1977, *Batianoff 207 & McDonald* (BRI); S.F. 150, 12 km SW of Gladstone, 23°57'S, 151°11'E, Feb 1995, *Worthington 1482* (BRI); Eurimbula Holding between Eurimbula & Middle Creeks, 24°10'S, 151°50'E, Dec 1970, *Tracey 14561* (BRI); *c.* 1.8 km WSW of Eurimbula Beach, 24°11'S, 151°50'E, May 1981, *Guymer 1536 & Jessup* (BRI,

CANB); Deepwater Creek N.P., on track to Deepwater Creek, 24°21'S, 151°58'E, Sep 1992, *Sharpe 5175* (BRI); Rules Beach near Baffle Creek, NW of Bundaberg, 24°29'S, 152°02'E, Oct 1996, *Bean 11068* (BRI). WIDE BAY DISTRICT: Sloping Hummock, 3 km SW of Bargara, 24°50'S, 152°25'E, Feb 1997, *Forster PIF20210 et al.* (BRI); Coonarr Creek, 24°59'S, 152°29'E, Jul 1983, *Young 654* (BRI); Coonarr Creek, adjoining Kinkuna N.P., 25°01'S, 152°26'E, Sep 2001, *Schmitt s.n.* (BRI [AQ551495]).

Distribution and habitat: *Ixora queenslandica* occurs in coastal and subcoastal central and south-eastern Queensland, from a northern limit at Keswick Island, south to Kinkuna National Park (**Map 2**). Plants occur in coastal or subcoastal locations and offshore islands where they grow in dry rainforests (araucarian microphyll vineforest, littoral microphyll vineforest) on stabilised sand-dunes and rocky headlands.

Notes: *Ixora queenslandica* is distinguishable by its long pedunculate, 3-flowered inflorescences, and sessile flowers enclosed in showy ovate-cuspidate bracts. It resembles *Ixora biflora* in its 3-flowered cymes, but that species differs by its sessile inflorescences, greater number of nerves on its bracts and larger, subglobose, red fruits that are depressed at both ends.

There is considerable variation in leaf size and shape depending on the degree of exposure to radiation, wind sheer and salt spray. Material from exposed situations tends to have small, thickened foliage, often with more orbicular leaf laminas, whereas that from within the canopy or understorey tends to be thinner and with more elliptic or obovate leaf laminas. Material from either extreme may appear markedly dissimilar; however, this is typical of other plants that occur in similar situations. In some instances both extremes may be found on the same plant (e.g. *McDonald et al. 6039*; *Sharpe 5175* [both BRI]).

Typification: The correct application of the earliest, legitimate validly published name of this taxon has been beset with difficulty and complications that have not been helped with long term misidentifications and misapplications of names by several authors. Since 1938 this taxon has been known in

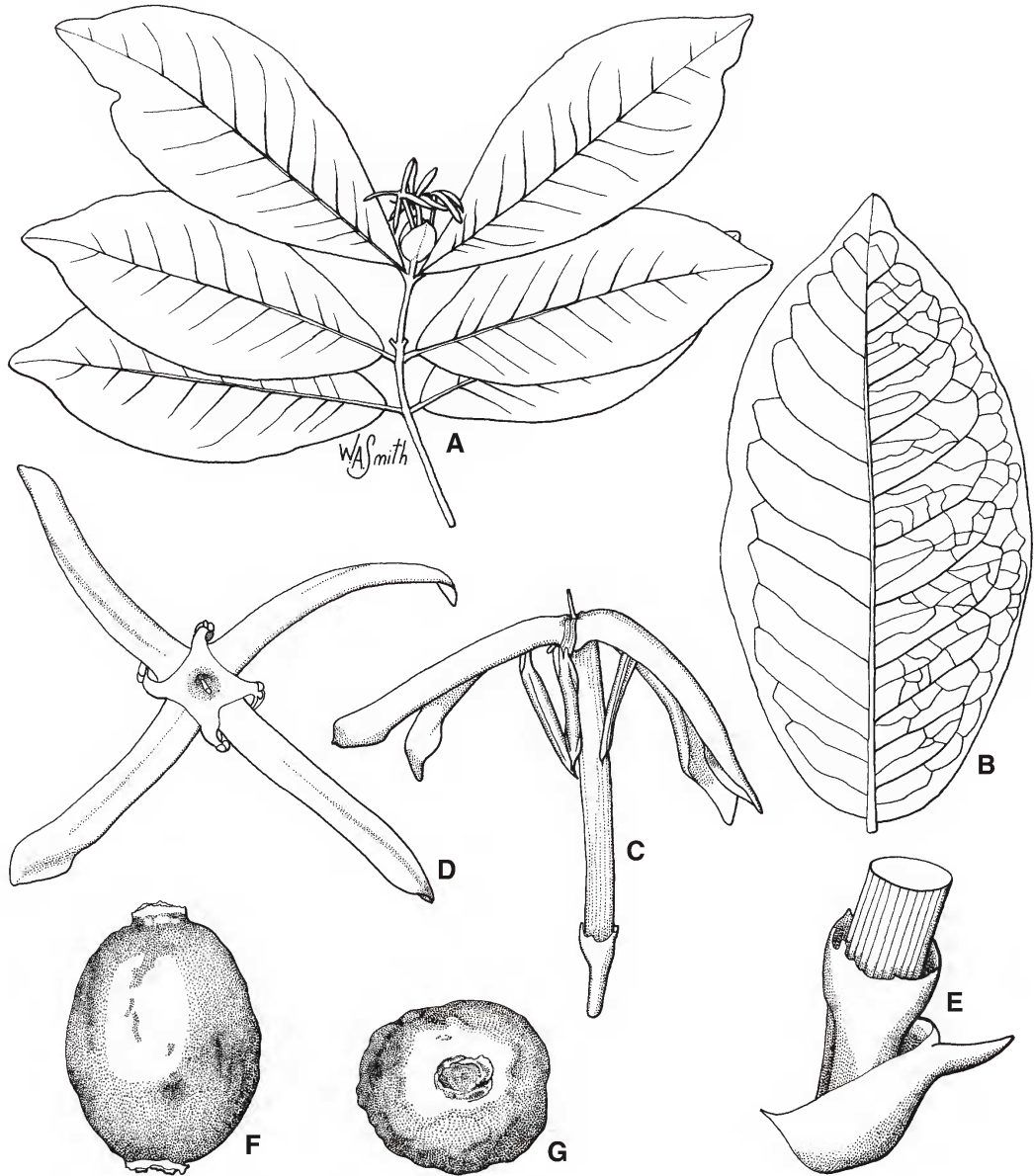


Fig. 5. *Ixora queenslandica*. A. habit of flowering stem $\times 0.6$. B. leaf viewed from below showing detail of venation $\times 0.8$. C. side view of flower $\times 4$. D. face view of flower $\times 4$. E. peduncle with bract $\times 12$. F. lateral view of fruit $\times 4$. G. apical view of fruit $\times 4$. A from *Gibson 549* (BRI); B from *Forster PIF20210* (BRI); C–G from *Champion 1083c* (BRI). Del. W. Smith.

Australia as *Ixora queenslandica* Fosberg (McGillivray 1972; Reynolds 1997; Forster & Halford 2002). Prior to this it was known as *Ixora triflora* R.Br. ex Benth. (Bentham 1867) based on material collected on the east coast of Australia; however, this name is invalid as it is predated by *I. triflora* (G.Forst.)

Seem. that is based on material collected in Polynesia. Forster (1787) originally named his Polynesian collection (made jointly with his father) as *Coffea triflora*.

In respect to *Ixora triflora* R.Br. ex Benth., the following sequence of events is worth repeating. Both Daniel Solander and

Robert Brown left manuscript names on many specimens that they collected whilst in Australia. As outlined by McGillivray (1972) Banks and Solander collected flowering material at Thirsty Sound that they labelled *Pavetta triflora* and Solander prepared a manuscript description of it. Robert Brown revisited the general locality in 1802 and collected fruiting material of what he thought was the same taxon, labelling the material as *Ixora triflora*, directly taking up Solander's specific epithet, but in another genus. Solander's name was never published and Bentham (1867) subsequently validated Brown's manuscript name (itself based on the Solander ms.); however, Bentham (*op. cit.*) cited several different collections at the time, including the Brown collection from 1802 that is a mixture of two species (Reynolds & Forster 2005). Bentham's (1867) "species" description reflects this, being an amalgam of data from species in two genera. Both Moore (1926) and Fosberg (1938a) correctly concluded that *Ixora triflora* R.Br. ex Benth. was based on several elements; however, Moore (1926) was unaware of the earlier name *I. triflora* (G.Forst.) Seem.

After exclusion of the Brown material (flowering) that was referable to *Diplospora ixoroides* F.Muell. (Reynolds & Forster 2005), Fosberg (1938a) considered that the remaining elements cited by Bentham (1867) under *Ixora triflora* R.Br. ex Benth. were indeed referable to *Ixora* and in need of a new name (as a *nom. nov.*) – *I. queenslandica*. Fosberg (1938a) did not provide a Latin diagnosis for *I. queenslandica*, nor did he clearly indicate a type in the traditional sense, citing specimens collected by Tryon (A, BRI) that he had examined and referring to the material seen by Moore (1926). McGillivray (1972) pointed out that "Fosberg refers to S. Moore's paper [Moore 1926]...as a source of information of the colour of the flowers and shape of the fruit, but in so doing gives "a reference to a previously and effectively published Latin description..." (I.C.N.B. Article 36) viz., Moore's citation on p. 215 of that portion of Brown's description which Brown transposed, in a slightly modified form, from Solander's manuscript... All the requirements of valid publication are fulfilled

provided that one is prepared to accept the name as a "sp. nov." instead of a "nom. nov.". The name *Ixora queenslandica* Fosberg is typified by the specimen:– Bay of Inlets, Banks and Solander, May 1770 (BM, holotype)." McGillivray (1972) made this conclusion on the basis of the flowering material that Moore (1926) was referring to, namely the collection at BM made by Banks and Solander and from which the Latin diagnosis was derived. Lectotypification of this name is not considered necessary, as the application appears to be tied to the single collection of Banks and Solander in BM. A duplicate of this specimen is present in BRI and is considered an isotype.

Conservation status: *Ixora queenslandica* is widespread and common. No conservation status listing is necessary. It occurs in National Parks such as Deepwater, Eurimbula, Keppel Bay Islands, Prudhoe Island and South Cumberland Islands.

Etymology: The specific epithet is for the occurrence of this plant within Queensland.

6. *Ixora timorensis* Decne., *Nouv. Ann. Mus. Hist. Nat.* 3: 418 (1834).

Pavetta timorensis (Decne.) Miq., *Fl. Ind. Bat.* 2: 278 (1857). **Type:** Timor, [*Decaisne s.n.*] (holo: ?S *n.v.*, *fide* Bremekamp (1937: 338); iso: L908217977).

Ixora klanderiana F.Muell., *Fragm.* 5: 18 (1865). **Type:** Queensland. NORTH KENNEDY DISTRICT: Seaview Range, 4 November 1864, *Dallachy* (lecto [here designated]: MEL 1537416-7).

Ixora kochii Bremek., *Bull. Jard. Bot. Buitenz.*, ser. 3, 14: 340 (1937). **Type:** Indonesia. PAPUA PROVINCE: Merauke, 1904, *J.W.R. Koch 566* (holo: BO *n.v.*, *fide* Bremekamp (1937: 340); iso: L908217929).

Illustrations: Brock (2001) [as *Ixora klanderana* (sic)]; Hyland *et al.* (1999, 2003) [as *I. klanderiana*]; Nicholson & Nicholson (2004: 45).

Slender shrubs or small trees 2–8 m high; indumentum of spreading, short (<0.5 mm long), simple trichomes; bark smooth or scaly, brown, grey brown; branchlets terete to somewhat flattened, glabrous. Stipules

4–6 mm long, externally glabrous, internally with dense indumentum and colletors at base; shortly connate for 1–2 mm, limbs ovate-triangular, 2–3 mm long, keeled towards apex and aristate (awn 1.5–4 mm long). Leaves coriaceous, petiolate, glabrous; petioles 6–15 mm long, thickened; lamina elliptic, elliptic-lanceolate, broadly elliptic-oblong or ovate-elliptic, (102–) 120–230 (–260) × (30–) 45–90 (–110) mm; apex acuminate, abruptly shortly acuminate or obtuse; base broad truncate, subcordate (usually with the opposite sides of lamina folded inwards), or obtuse, subacute, oblique and sometimes shortly decurrent into the petiole; upper surface olive green, drying pale or dark brown, paler below; lateral nerves distinct, 10–14 (–18) pairs, subpatent or arcuate; interlateral nerves reticulate. Inflorescences loosely branched, paniculiform, the three branches clustered on a short or long peduncle (this 0.6–6.8 cm long), subtended by a pair of large or small bracts; the central branch with 1 or 2 internodes (these 2–11 mm long) ultimately 10–80-flowered; branches (lateral) patent 52–85 mm long, trichotomously branched, occasionally with one internode, ultimate branches 5–16 mm long terminated by trichotomously branched cymes (these 6–42-flowered), the ultimate cymes 2 or 3-flowered, one flower (the oldest) on a shorter pedicel; bracts subtending the inflorescence branches either large (then ovate or broadly elliptic-ovate (sometimes represented by reduced leaves), apiculate at apex, obtuse or subcordate at base), or small, then stipule-like, 10–50 (–95) × 12–24 (–45) mm; bracts higher on the inflorescence branch (usually at junction of the branches) smaller, ovate, often represented by lateral subulate lobes only. Flowers 4 or occasionally 5-merous, pedicellate; pedicels slender, (2–) 4–10 mm long, glabrous or with sparse indumentum. Calyx ellipsoid, lobes minute, ovate, (<0.2 mm long), finely puberulous or glabrous. Corolla small and inconspicuous, cream, sometimes with pinkish tinge, sweetly scented; tube (3–) 6–10 mm long, slightly dilated at mouth (to 1.5 mm wide at mouth), finely hairy at throat; lobes twisted to the left in bud, elliptic, subacute or obtuse, 5–7 × 1.5–2.5 mm, spreading or reflexed. Stamens inserted at mouth of corolla tube, anthers linear-ovate,

apiculate, 4.5–7 × 0.5 mm, filaments 1.5–2.5 mm long. Ovary 2-locular; style and stigma 10–17 mm long, shortly exerted from tube, the style usually sparsely hairy from below lobes, stigmatic lobes 2, glabrous, 1.8–2.2 mm long, linear, recurved or suberect. Fruit subglobose, 6–9 × 6–10 mm, black when ripe, glabrous, pyrenes single; seeds subglobose, rounded on top, 4.5–5 × 4.5–5 mm. **Fig. 6.**

Additional selected specimens examined: Northern Territory. Melville Island, Snake Bay, Sep 1986, *Fensham 287** (DNA); Croker Island, Minjilang, 11°09'S, 132°34'E, Oct 1986, *Wightman 3220 & Smith** (DNA); 8 km W of Three Ways, Melville Island, 11°40'S, 130°38'E, Apr 1987, *Russell-Smith 2127 & Lucas* (DNA); Ganpura turnoff, Elcho Island, 11°53'S, 135°48'E, Jun 2002, *Mitchell 7298* (BRI, DNA); Inverell Bay, 6 km W of Nhulunbuy, 12°12'S, 136°43'E, Nov 1989, *Forster PIF5956* (BRI, DNA); 1.5 km NW of Yirrkala, 12°15'S, 136°52'E, Nov 1989, *Forster PIF5972* (BRI, DNA); Koolatong River, near road crossing, 13°06'S, 135°44'E, Oct 1996, *Cowie 7383* (BRI, DNA); Angurugu, Groote Eylandt, 13°59'S, 136°27'E, Jul 1973, *Levitt 319** (DNA). **Queensland.** COOK DISTRICT: Dauan Island, Torres Strait, 9°25'S, 142°30'E, Jul 1975, *Cameron 2324** (QRS); Yorke Island, 9°45'S, 143°24'E, Oct 1981, *Clarkson 3976* (BRI, QRS); Lockerbie, Cape York road, 10°48'S, 142°28'E, Sep 1985, *Williams 85190* (BRI); Bolt Head, Temple Bay, 12°15'S, 143°05'E, Jun 1996, *Forster PIF19380* (BRI, MEL); Lake Patricia, Weipa, 12°39'S, 141°49'E, Jun 1994, *Forster PIF15267* (BRI); Rocky River, 13°55'S, 143°30'E, Sep 1971, *Hyland 5483** (QRS); Fishtail Hill, McIlwraith Range, Silver Plains, 13°41'S, 143°26'E, Jul 1997, *Forster PIF21399 et al.* (BRI, MEL, QRS); Bonanza Creek, Peach River, Aug 1948, *Brass 19824* (BRI, CANB); Kowanyama Aboriginal Reserve, South Mitchell River, c. 6 km from the river mouth, 15°24'S, 141°33'E, Aug 1980, *Clarkson 3384* (BRI); Craiglie, c. 5 km S of Port Douglas, 16°31'S, 145°28'E, Sep 2002, *Halford Q7388* (BRI, DNA). NORTH KENNEDY DISTRICT: Conway Beach, 20°28'S, 148°44'E, Nov 1985, *Sharpe 4087* (BRI, CANB). SOUTH KENNEDY DISTRICT: Cathu S.F. 658 Macartney, 20°45'S, 148°34'E, Nov 1989, *McDonald 4423 et al.* (BRI, QRS); St Helen's Gap, Eungella N.P., 20°55'S, 148°30'E, Mar 1995, *Pearson SP586* (BRI).

Distribution and habitat: *Ixora timorensis* has a wide distribution in Indonesia (Lesser Sunda Islands, Moluccas, Celebes, Papua), Papua New Guinea, East Timor and northern Australia in the Northern Territory and Queensland (**Map 4**). It occurs in coastal vine thickets on dunes, riparian rainforests, sometimes on sandstone in gorges, hillsides and gullies.

Notes: *Ixora timorensis* is readily recognisable from the other species here

by the shortly stalked elliptic-oblong or lanceolate, coriaceous leaves that are somewhat amplexicaule at the base and the large, many-flowered, loose-paniculiform inflorescences that are subtended by showy bracts.

Bentham (1867) considered *Ixora timorensis* and *I. klanderiana* to be conspecific and combined *I. klanderiana* under the earlier name. Use of the name *I. timorensis* was accepted by Bailey (1900), Ewart & Davies (1917) and Domin (1929). Bremekamp (1937) kept the species separate because the flowers of *I. klanderiana* were described as 5-merous (as compared to 4-merous in *I. timorensis*); however, he was not able to check the Australian specimens to confirm this distinction. Australian specimens in herbaria largely remained under the name *I. klanderiana* after Bremekamp's account. *Ixora klanderiana* is considered here to be a synonym of *I. timorensis* as the flowers are 4-merous in the majority of specimens seen in this study (including some of the syntypes of *I. klanderiana*) and the Australian specimens are hardly distinguishable from specimens of *I. timorensis* from Indonesia (especially Timor) and New Guinea in their aspect, leaves, inflorescence, bracts and corolla size and shape.

Ixora timorensis was recorded from New Guinea by Valetton (1911) who also recognised *I. timorensis* var. *pauciflora* Valetton from the same island. Bremekamp (1937) however, considered the New Guinea specimens to be distinct from *I. timorensis* and described two new species viz, *I. brachypogon* Bremek. (previously known as *I. timorensis* var. *pauciflora* Valetton) and *I. kochii* Bremek. and cited one or two specimens under each. His new species were distinguished from *I. timorensis* by their hairy inflorescences and from each other by their leaf shape (base), size of corolla and hairiness of calyx). Most specimens seen from New Guinea have glabrous inflorescences which are typical of *I. timorensis*. Both hairy and glabrous variants are present in the Australian specimens, and one of the specimens Bremekamp (1937) cited under *I. kochii* is hardly distinguishable from the Australian specimens under *I. timorensis*. Moreover, the other distinguishing characters

he used, namely the shape of leaves, size of flowers and hairiness are unreliable because they are all very variable in the specimens seen in this study. His two new species appear to be just local forms of the very variable *I. timorensis*.

As indicated above, pubescent (indicated * in list of specimens above) and glabrous variants are distinguishable in the Australian specimens available for study, but are not formally recognised here because with the exception of hairiness (of the inflorescences) the specimens have more or less the same leaves, inflorescences, bracts and corollas.

The variant with glabrous peduncles, pedicels and calyx is typical for the species. The majority of specimens from Queensland (including syntypes of *I. klanderiana*) are of this type. These possess a distinct (usually long) main peduncle which is terminated by a pair of large showy bracts (at the base of the trichotomous inflorescence branches). These specimens resemble collections from Timor and New Guinea in their inflorescence axes and calyx, shape and size of leaves and corolla (corolla tube 4–7 mm long), but the showy bracts which are usually present (at the base of the main inflorescence) in the Queensland specimens are sometimes absent on the specimens from those places; however, specimens seen from those regions are too few to be certain of this. The character of the bract is variable in the Australian collections, with the majority of specimens from the Northern Territory (and a few from far northern Queensland) having the small bracts as in specimens from the above islands.

The majority of collections from Northern Territory are of the pubescent variant. It resembles the above type in the shape and size of its leaves, inflorescences and flowers, but differs by its hairy inflorescence axes and hairy calyx, and a short, usually reduced main peduncle subtended by the uppermost pair of leaves or the main inflorescence subtended by stipule-like small bracts (the showy bracts typical of the glabrous variant only occasionally present), and also by its longer corollas (corolla tube 8–12 mm long). This variant appears to be the same as the plant described as *I. kochii* Bremek. from New Guinea (see above).

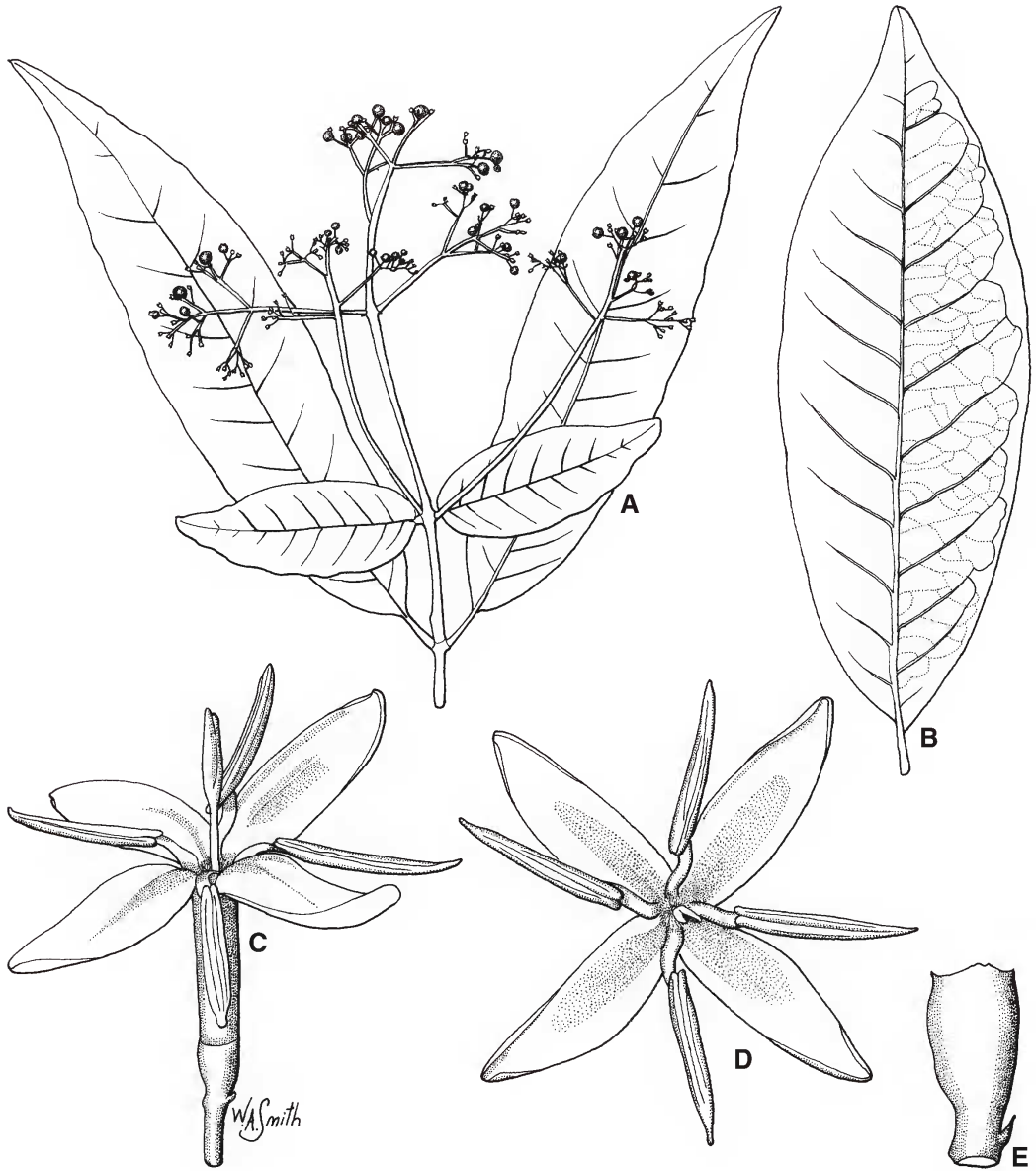


Fig. 6. *Ixora timorensis*. A. habit of fruiting branchlet $\times 0.5$. B. leaf viewed from below showing detail of venation $\times 0.6$. C. lateral view of flower $\times 4$. D. face view of flower $\times 4$. peduncle with bract $\times 8$. A from *Forster PIF19380* (BRI); B from *Forster PIF19349* (BRI); C–E from *Halford Q813* (BRI). Del. W. Smith.

Typification: Mueller cited three syntypes in the protologue for *Ixora klanderiana* (Herbert River, Dallachy; Mt Elliot, Dallachy; Seaview Range, Dallachy). All of these syntypes are represented by multiple sheets in MEL. The best specimen is the Seaview Range collection of 4 November 1864 by John Dallachy that is fully fertile with many flowers. This specimen

(MEL1537416-7) is selected as lectotype for the name.

Conservation status: The species is common and widespread.

Etymology: The specific epithet refers to the island of Timor from where the species was first described.

B. Exotic species of *Ixora* naturalised in Australia

A single species (*I. coccinea*) is sparingly naturalised as an adventive in Australia. It is commonly cultivated and likely to be confused with other cultivated species in the genus.

Key to commonly cultivated species of *Ixora* in Australia

- 1 Bracts and calyx lobes similar in shape; calyx lobes much longer than tube, lanceolate, veined, 4–5 mm long, drying paler than tube, persistent in fruit; flowers white, very fragrant ***I. finlaysoniana*** Wall. ex G. Don
- Bracts and calyx dissimilar in shape; calyx lobes much shorter than tube, ovate; flowers red, pink, yellow or orange, usually not fragrant 2
- 2 Inflorescences longer than leaves, open, paniculiform with few widely spaced opposite or alternate branches, terminated by densely-flowered cymes or corymbs; flowers very small (corolla tube 7–9 mm long, lobes *c.* 2 mm long); style usually hairy ***I. parviflora*** Vahl
- Inflorescences usually shorter than the leaves, corymbiform or subumbellate, compact with opposite branches, terminated by densely flowered corymbs or subumbels; flowers showy (corolla tube 20–35 mm long, lobes 5–10 mm long); style glabrous 3
- 3 Leaves obtuse or cordate and clasping the stem at base, very shortly petiolate; corolla red or sometimes yellow, lobes 9–10 mm long, lanceolate or rhomboidal, acute, acuminate or obtuse ***I. coccinea*** L.
- Leaves cuneate or subobtusate at base, usually distinctly petiolate; corolla reddish-pink or orange, lobes 5–7 mm long, obovate, rounded ***I. chinensis*** Lam.

7. *Ixora coccinea* L., *Sp. Pl.* 110 (1753). **Type:** Rheede, *Hot. Mal.* 2: 17, t. 13 (1679) (lecto [icono]: Fosberg & Sachet 1989b: 486).

Illustrations: Whistler (2000: 278).

Shrub or small tree 1–2 m high, usually much branched with stiff branches; indumentum of erect, short (<0.2 mm long), simple trichomes; branchlets flattened angular, with short, dense indumentum when young, green-grey, glabrescent. Stipules 2–6 mm long, externally glabrous, internally with sparse indumentum and colletors near base; shortly connate for up to 0.8 mm, limbs ovate-truncate, 1–3 mm long, keeled towards apex and aristate (awn 1.5–4 mm long). Leaves coriaceous, subsessile to shortly petiolate, glabrous; petioles 0–5 mm long; lamina elliptic, elliptic-oblong or obovate, 35–100 × 20–50 mm; apex acute or obtuse and shortly mucronate; base cuneate, obtuse or subcordate, sometimes slightly amplexicaul; lateral nerves 10–13 pairs, suboblique, interlateral venation reticulate. Inflorescences sessile, three branched, corymbiform, densely flowered, subtended

by leaf-like bracts; the three branches branched again (to about 5 times ramified), each terminated by dichasial cymes; ultimate cymules 3–5-flowered, the oldest (central flower) usually sessile, laterals pedicellate; bracts at base of inflorescence consist of reduced leaves, those on branches smaller, ovate-subulate, acuminate; bracteoles paired, ovate-acuminate, 1–10 mm long. Flowers bisexual, 4-merous, pedicellate, inodorous; pedicels 2–4 mm long. Calyx red; tube ± urceolate, 2–3 mm long, with short, sparse indumentum; lobes triangular, acute, 1.5–3.5 mm long. Corolla large and showy, red, orange or orange-red; tube slender, 10–45 mm long; lobes ovate-elliptic, acute, 7–15 × 3–5 mm. Stamens exserted, anthers linear-oblong, 2.5–3 mm long, filaments 0.7–2 mm long. Ovary 4-locular; style and stigma 10–50 mm long, exserted for 3–4 mm, stigmatic lobes 2, glabrous, 1.8–2 mm long. Fruits globose to subglobose, 5–6 × 5–6 mm, reddish black, glabrous, pyrenes 2–4; mature seeds not seen.

Additional selected specimens examined (naturalised): Western Australia. Black Madonna Retreat near Gregory's Well, c. 10 km N of Lombadina Mission, 16°28'S, 122°54'E, Jul 1997, Mitchell 4813 (BRI). Queensland. North Kennedy District: Daydream Island, Whitsunday Region, 20°15'S, 148°53'E, Mar 1990, Batianoff 900349 (BRI); Sinclair Bay, Cape Gloucester, 20°07'S, 148°27'E, Sep 1992, Batianoff 9209198 (BRI); Sinclair Bay, 20°05'S, 148°26'E, Mar 1994, Batianoff 9403257 (BRI). South Kennedy District: Netherdale, E of Eungella, Nov 1981, McConnell & McConnell s.n. (NSW193804).

Distribution and habitat: *Ixora coccinea* is a native of India and widely cultivated in the tropics, especially in south-east Asia, Africa, Malesia, Pacific Islands and northern Australia, as an ornamental shrub or hedge plant (Whistler 2000). It is undoubtedly the most widely cultivated species of this genus in the tropics and is now naturalised in many countries, albeit as a localised adventive. *Ixora coccinea* was reported as occurring in Australia from very early times (Hooker 1859: 44); however, it is unclear as to the application of the name by Hooker. Bentham (1867) stated "this may have been one of the exotic shrubs planted during the time that Port Essington was colonised". It has never become fully naturalised and at the most should be regarded as a persistent adventive. Despite Ewart & Davies (1917) reporting it as naturalised in the Northern Territory, and subsequent widespread cultivation in gardens until the present day, it has not persisted as a weed and is not currently regarded as naturalised there (I. Cowie, pers. comm. August 2005). The

species has been collected as a naturalised adventive on a handful of occasions in central coastal Queensland (Map 2).

Notes: *Ixora coccinea* is readily recognisable by its densely flowered corymbiform inflorescences, with clusters of red or orange-red flowers, long slender corolla tube, broad acute corolla lobes, thick leaves that are sessile or shortly stalked, and usually subcordate and slightly amplexicaule at their base. It may be distinguished from the other cultivated species of *Ixora* in Australia (*I. chinensis* Lam., *I. finlaysoniana* Wall. ex G. Don and *I. parviflora* Vahl) by the above key. A single record of 'naturalised' *I. finlaysoniana* from Cooktown in 1980 (Scarth-Johnson 1167A – BRI) has not been corroborated in recent times (B. Waterhouse, pers. comm. 2006) and is discounted.

Ixora coccinea is reported to be very variable by Smith & Darwin (1988), Fosberg & Sachet (1989a) and Rajaseger *et al.* (1999). The penultimate authors recognised four varieties and two forms in Micronesia. At least two of these are present in Australia, namely var. *coccinea* and var. *bandhuca*, as well as a number of cultivars with Spencer (2002) listing over thirty. They are not further treated here.

Etymology: The specific epithet is from the Latin *coccineus* (deep red, crimson) and refers to the corolla colour.

Excluded species and misapplications

Ixora dallachiana (F. Muell.) F. Muell., *Census Austral. pl.*, 1: 75 (1882) = **Tarenna dallachiana** (F. Muell. ex Benth.) S. Moore

Ixora expandens (F. Muell.) F. Muell., *Census Austral. pl.* 1: 75 (1882) = **Tarenna dallachiana** subsp. **expandens** (F. Muell.) S. T. Reynolds & P. I. Forst.

Ixora indica Kuntze, *Rev. Gen. Pl.* 1: 286 (1891) = **Pavetta australiensis** Bremek.

Ixora orophila C. T. White, *Proc. Roy. Soc. Queensland* 53: 220 (1942); non Bremek. = **Psydrax montigena** S. T. Reynolds & R. J. F. Hend.

Ixora pavetta sensu Benth., *Fl. Austral.* 3: 414 (1867) = **Pavetta australiensis** Bremek.

Ixora pentamera Benth., *Fl. Austral.* 3: 416 (1867) = **Tarenna pentamera** (Benth.) S. T. Reynolds

Ixora thozetiana F. Muell., *Fragm.* 2: 132 (1861) = **Aidia racemosa** (Cav.) Triveng.

Ixora tomentosa sensu Benth., *Fl. Austral.* 3: 414 (1867); Ewart & Davies, *Fl. Northern Territory* 258 (1917) = **Pavetta brownii** Bremek.

Ixora triflora R.Br. ex Benth., *Fl. Austral.* 3: 416 (1867) *p. p.* = **Triflorensia ixoroides** (F.Muell.) S.T.Reynolds (see also under **Ixora foetida** (L.f.) Fosberg)

Ixora vinosa F.Muell. ex Rchbf. (1866), *nomen* = **Pavetta australiensis** Bremek.

Acknowledgements

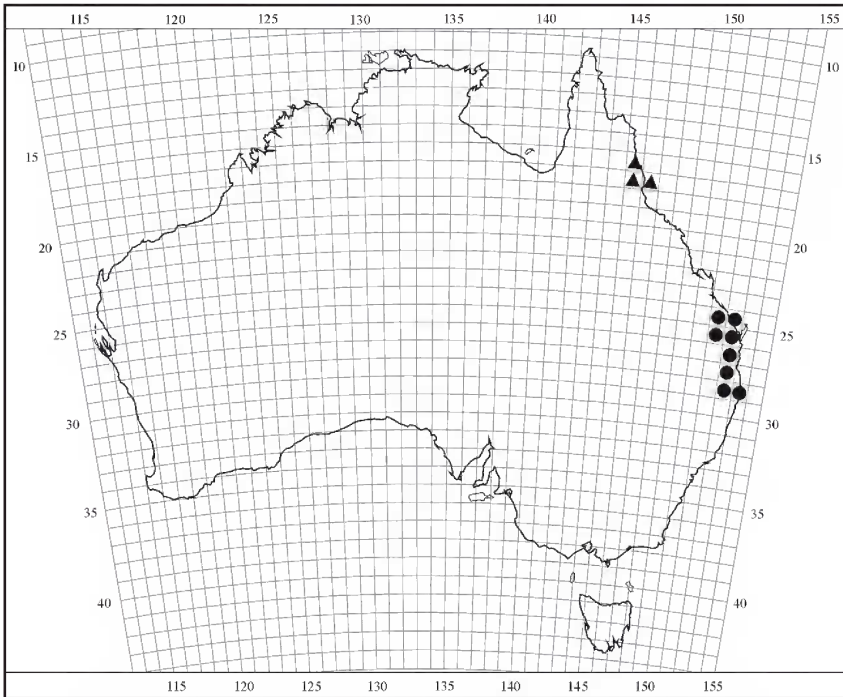
The authors are grateful to Les Pedley for the Latin diagnosis, Rod Henderson for his advice on nomenclature and for checking specimens from Timor at Kew, Gordon Guymer and Juliet Wege for checking and photographing types during their terms as ABLO at Kew, Val Stajsic for images of *Ixora klanderiana* syntype material at MEL, Aaron Davis (Kew) for helping resolve aspects of the application of *I. triflora* and for his constructive criticism of the manuscript, Will Smith for the illustrations and maps, the Australian Biological Resources Study for funding support for this revision, and the curators of the following herbaria AD, BM, CANB, DNA, K, L, MEL, NSW, PERTH and QRS for the loan of specimens including types, or for access to specimens at their institutions.

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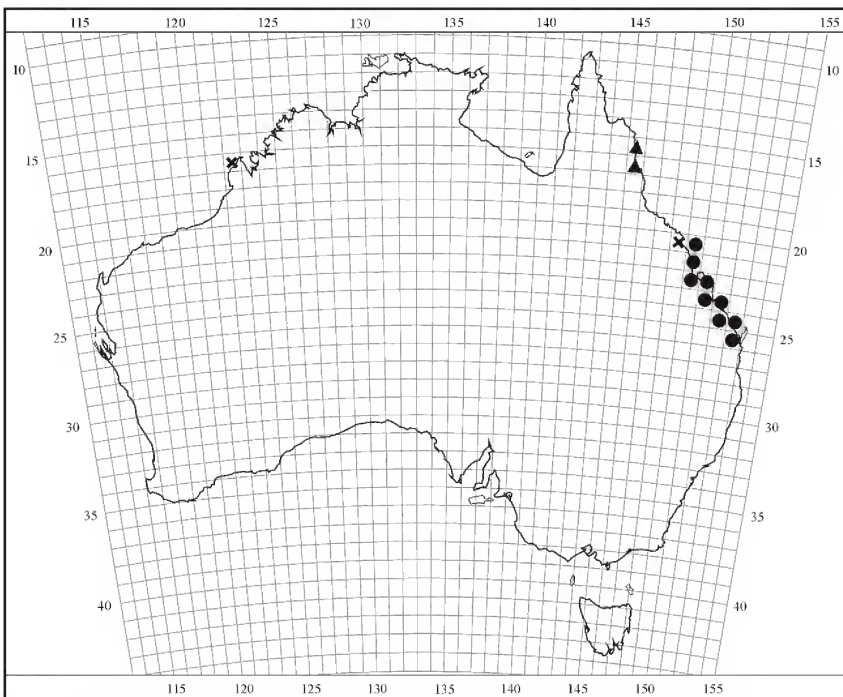
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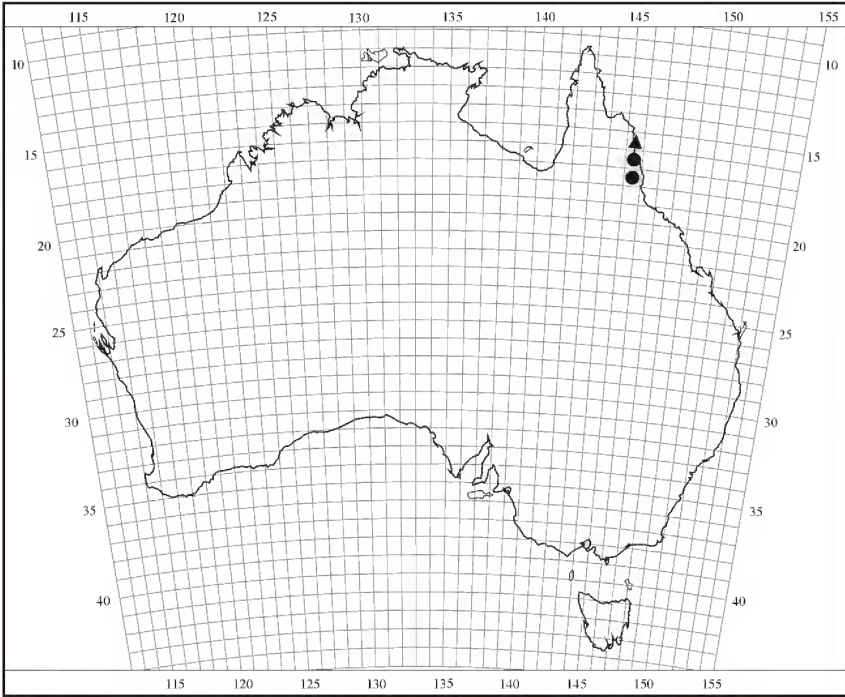
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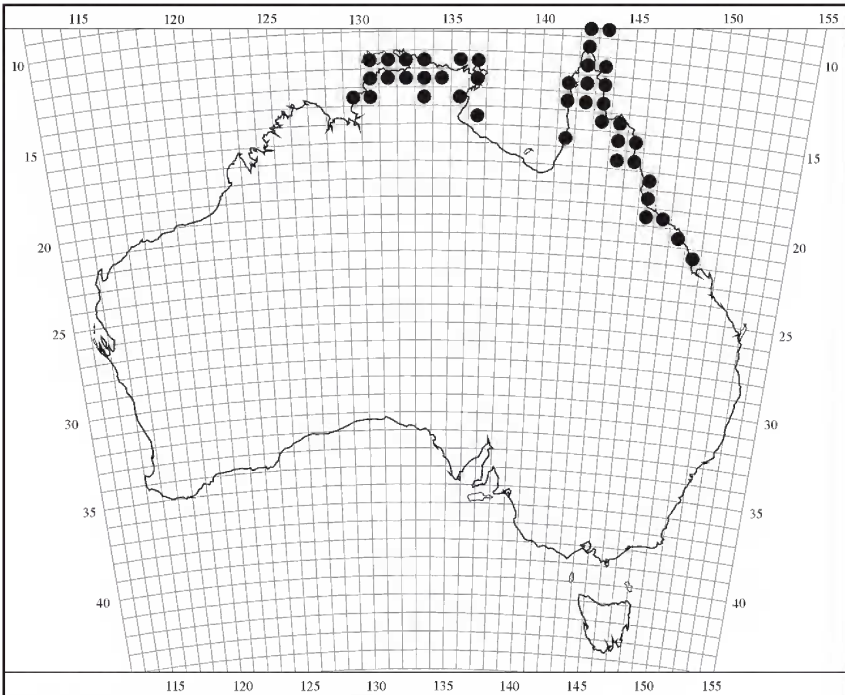
Map 1. Distribution in 1° grids in Australia for *Ixora baileyana* ▲ and *Ixora beckleri* ● .



Map 2. Distribution in 1° grids in Australia for *Ixora biflora* ▲ , *Ixora coccinea* × , *Ixora queenslandica* ● .



Map 3. Distribution in 1° grids in Australia for *Ixora finlaysoniana* ▲ and *Ixora oreogena* ● .



Map 4. Distribution in 1° grids in Australia for *Ixora timorensis* ● .