

## A new species of *Cochlospermum* (Bixaceae) from Arnhem Land, Northern Territory, Australia

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### Abstract

A new species of small tree, *Cochlospermum arafuricum* Cowie & R.A.Kerrigan *sp. nov.* from the wet-dry tropics of Australia is described and illustrated here. The species is distinctive in having the leaves divided for  $\frac{1}{3}$ – $\frac{1}{2}$  of their length with broadly triangular, aristate leaf lobes, conspicuously serrate margins, red outer staminal filaments and with most parts almost glabrous. It appears to be relatively common although not abundant and occurs in various woodland communities in foot slope situations over a wide area of central and eastern Arnhem Land. As there are no obvious threats or decline and the species is relatively widespread and common, it is assessed as Least Concern using IUCN criteria. A key to species of *Cochlospermum* in Australia is provided.

### Introduction

*Cochlospermum* Kunth is a genus of around 14 species found in the tropics of the Americas, Africa, Asia and Australia, with five endemic in Australia and New Guinea (CHAH 2012; George 1982; Mabberley 2008; Poppendieck 1980; Short *et al.* 2011). The type of the genus, *C. religiosum* (L.) Alston, a native of India and Myanmar, also cultivated in SE Asia and Africa, is the only Asian species, while *C. gillivraei* Benth. occurs in both southern Papua New Guinea and northern Australia (Poppendieck 1980; van Steenis 1949). In Australia, three described species are known from the Northern Territory (NT) and Queensland, with two from Western Australia. The Australian and New Guinea species generally grow in open savanna vegetation in regions with a monsoonal or wet-dry tropical climate, although the recently described *C. macnamarae* Hislop, K.R. Thiele & D. Brassington occurs in the semi-arid Pilbara region (Hislop *et al.* 2013; Kerrigan & Dixon 2011). An additional, putative new species was recognised in the NT in 1998 based on three leaf-bearing but sterile collections, with additional collections made since that time showing a high degree of stability in leaf characters, allowing description of floral and fruit characters and providing certainty in the distinctness of the taxon.

The taxonomy of species in the genus is largely based on the degree of division of the leaves and shape of the lobes, but anther size and shape of the anther pore, colour of staminal filaments, stipule and flower size and presence or absence of an indumentum provide important additional characters (Poppendieck 1980). While Poppendieck treated *C. gregorii* F.Muell. as a subspecies of *C. gillivraei*, George (1982) reinstated it to species level and this status has since been maintained (CHAH 2012). *Cochlospermum heteronemum* F.Muell.

was reduced to *C. fraseri* subsp. *heteronemum* (F.Muell.) Poppendieck by Poppendieck (1980), and this was followed by George (1982) and CHAH (2012).

## Materials and methods

This study was based on examination of dried and spirit-preserved herbarium specimens at DNA. Herbarium abbreviations follow Thiers (2010). Morphological descriptions follow George (1982). The distribution map was prepared based on specimen data at DNA.

## Taxonomy

***Cochlospermum arafuricum*** I.D.Cowie & R.A.Kerrigan *sp. nov.*

**Diagnosis:** Distinguished from all other species of *Cochlospermum* by the combination of leaf lobes deltate to widely deltate, usually  $\frac{1}{3}$ – $\frac{1}{2}$  of lamina length with aristate apices, coarsely serrate margins and cordate base usually with a wide sinus, seeds 5.5–7.5 mm long, 4.5–6 mm wide, outer staminal filaments red and the vegetative parts largely glabrous.

**Holotype:** Northern Territory: Darwin and Gulf Region: Arafura Swamp, Mirrnatja, 16 June 1999, I.D. Cowie 8345 (DNA, 2 sheets, plus spirit).

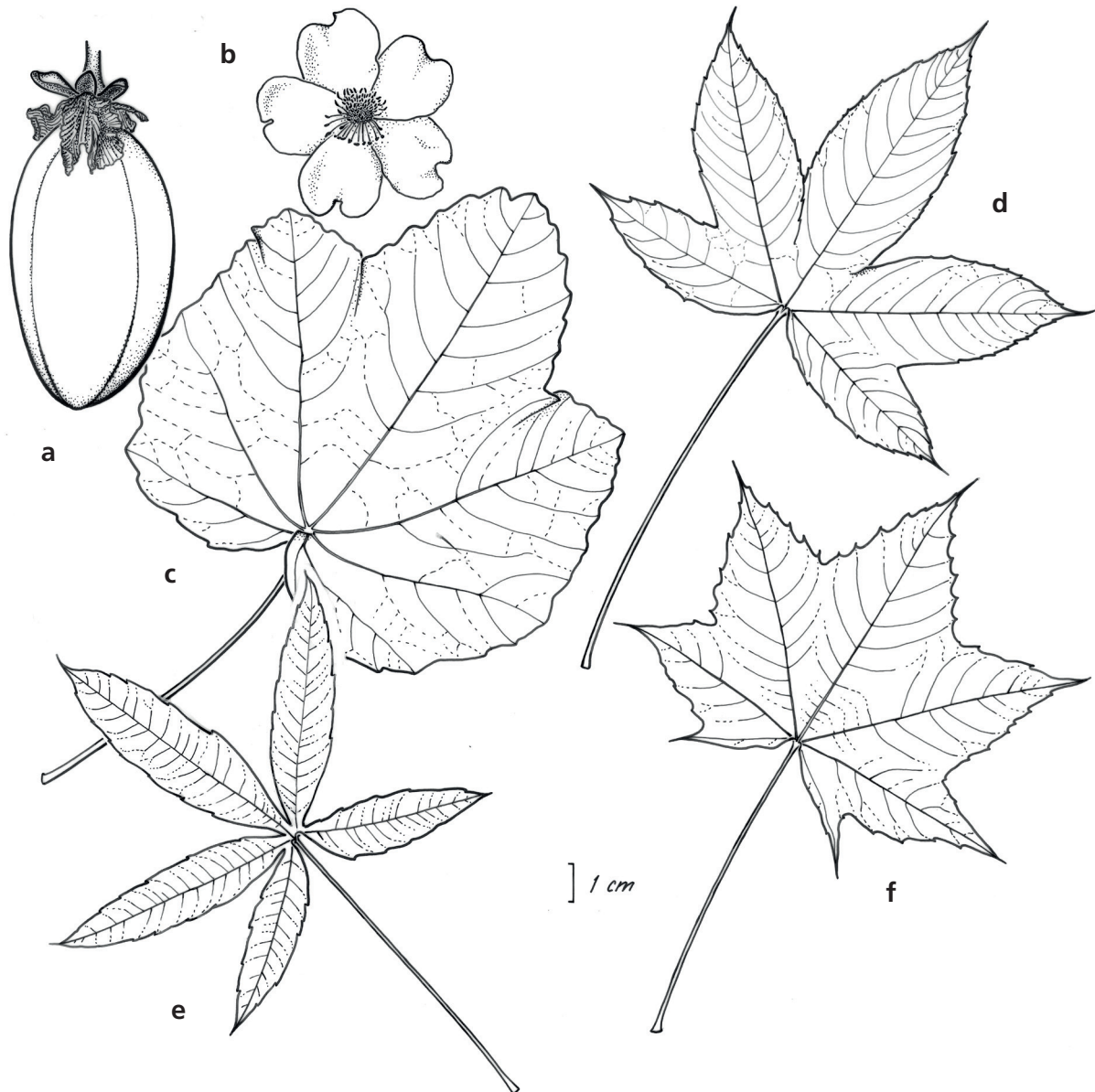
*Cochlospermum* sp. Arnhem Land (I.D.Cowie 5916) NT Herbarium, CHAH, Australian Plant Census (2005).

*Cochlospermum* sp. Arnhem Land (I.D.Cowie 5916) I.D.Cowie & C.P.Mangion, R.A.Kerrigan & D.J.Dixon, *Bixaceae*, in *Flora of the Darwin Region* (2011).

Dry-season deciduous tree to 9 m tall; bark pale grey, almost smooth with shallow furrows. *Branchlets* terete, glabrous. *Stipules* caducous, 2–3 mm long, subulate, with margin sparsely ciliolate otherwise glabrous. *Petiole* 50–125 mm long, usually longer than blade, glabrous, often pink-red. *Lamina* obovate to widely depressed-obovate in outline, (3–)5–7-lobed (often 1 or 2 basal lobes reduced), 50–145 mm long, 60–180 mm wide, glabrous apart from a tuft of minute hyaline hairs at the junction of petiole and blade; venation palmate; lobes deltate to widely deltate, occasionally deltate-ovate, usually  $\frac{1}{3}$ – $\frac{1}{2}$  the lamina length, 13–50 mm long, length to width ratio 0.9–1.5:1; base shallowly cordate with a sinus 4–25 mm deep, the sinus lobes widely separated to occasionally overlapping; margin serrate to coarsely serrate, sparsely ciliolate when young; lobe apex usually aristate. *Inflorescence* terminal, paniculate, to 26 cm long, glabrous to sparsely puberulous; bracts caducous, deltate, 1.5–2.5 mm long, acute. *Pedicel* to 20–25 mm long, puberulous to sparsely puberulous. *Sepals* 5, sparsely puberulous, glabrescent or the indumentum sometimes persistent, red-streaked; margin ciliolate, apex rounded; outer sepals ovate to widely ovate or widely oblong, 9–16 mm long, 6.5–10 mm wide; inner sepals ovate to elliptic, 13–18 mm long, 9–15 mm wide. *Petals* 5, obovate or obovate-oblong, 33–40 mm long, 21–29 mm wide, glabrous, yellow, red-streaked; apex emarginate to obcordate. *Stamens* 9–16 mm long, glabrous; anthers 2.5–3.5 mm long, with deltate apical pores; outer stamens c. 20, with filaments red, 0.5–0.7 mm diam.; inner stamens c. 50, with filaments 0.2–0.3 mm diam., shorter than outer stamens, apparently yellow. Style 12–14 mm long, with apex recurved; ovary globular, glabrous. *Capsule* apparently pendulous, 5-valved, obovoid, 50–90 mm long, 45–60 mm diam., brown, glabrous, emarginate at apex. *Seeds* reniform, 5.5–7.5 mm long, 4.5–6 mm wide; exotesta falling with seed, brown, thin, crustaceous, densely villous with white to pale stramineous hairs to 25 mm long, the hairs easily removed; exotegmen woody, smooth, dark brown to black, dull. Fig. 1.

**Distribution:** Apparently endemic to the NT where it has been recorded from Arnhem Land, extending from near Murganella in the west to Inglis Island in the east and south to the Annie Creek area near Bulman. The species has also been seen (no vouchers) at Wongalara Wildlife Sanctuary to the south of Bulman (K. Brennan *pers. comm.*). Fig. 2.

The distribution of *C. arafuricum* is allopatric with *C. gillivraei*, which adjoins it to the east, while *C. gregorii* is slightly disjunct and occurs largely to the south or west (Fig. 2). *Cochlospermum fraseri* Planch. occurs to the west, but is apparently sympatric with *C. arafuricum* around Murganella and Maningrida. While three species occur in western Arnhem Land, this area is distinct from the distribution of *C. arafuricum*.



**Fig. 1.** Northern Territory species of *Cochlospermum*. **a–c.** *Cochlospermum fraseri*, **a**, fruit; **b**, flower; **c**, leaf; **d.** *C. gillivraei*, leaf; **e.** *C. gregorii*, leaf; **f.** *C. arafuricum*, leaf. **a, b**, from Cowie 10272 (DNA); **c**, from Leach 3351 (DNA); **d**, from Russell-Smith 2457 (DNA); **e**, from Thomson 3134 (DNA); **f**, from Cowie 8028 (DNA). Scale bar: 1 cm. Del. M. Osterkamp.

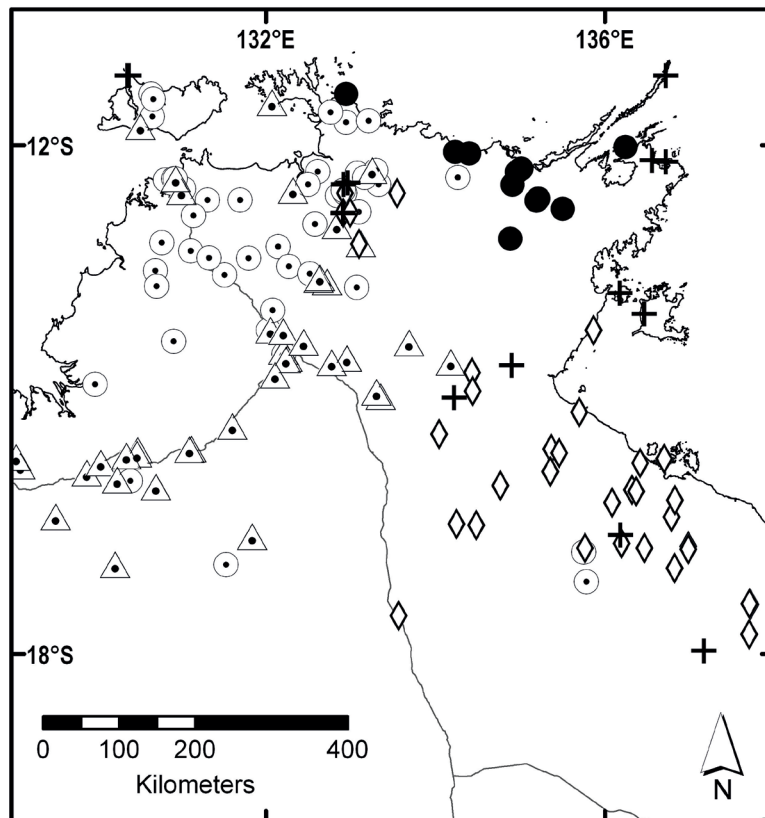
**Phenology:** Flowering: June–September; fruiting: September–December.

**Habitat:** Recorded as growing in tall open forest or woodland dominated by *Corymbia*, *Eucalyptus*, *Grevillea*, *Lophostemon*, *Xanthostemon* or mixed species, typically in foot-slope situations such as adjoining creek flats, floodplain margins and on creek banks in hilly country but occasionally also on coastal chenier-derived dunes and lower slopes of stony hills; usually on sandy or silty soils.

**Etymology:** The epithet *arafuricum* is a reference to Arafura Swamp in central Arnhem Land, around which the distribution of the species is centred, and the Arafura Sea which is immediately to the north. At over 700 km<sup>2</sup> in area with important biodiversity values, Arafura Swamp is one of the largest seasonally inundated freshwater swamps in the NT, is listed as a wetland of national significance in the *Directory of Important Wetlands in Australia* and is also of international significance (Brennan *et al.* 2003; Brennan undated; Environment Australia 2001).

**Affinities:** *Cochlospermum arafuricum* appears to have its closest affinities with *C. gillivraei*, from which it can be differentiated by the shape of the main lamina lobes (deltate with a length to width ratio of 0.9–1.5:1 in *C. arafuricum*, lanceolate to elliptic, rarely ovate and with a length to width ratio of (1.6–) 2–3.4 (–3.9):1 in *C. gillivraei*), the conspicuously serrate margins and the wider seeds (4.5–6 mm compared to 3–4.5 mm wide in *C. gillivraei*). The Pilbara endemic species *Cochlospermum macnamarae* has leaves divided for 3/4–7/8 of their length with long narrow leaf-lobes with a length to width ratio of 5.2–8:1, the margins entire or with one or two coarse teeth and smaller flowers (Hislop *et al.* 2013).

In the division and lobing of the leaves, *C. arafuricum* is apparently similar to *C. religiosum* (Poppendieck 1980). However, that species has obscurely crenate or obscurely serrate leaf margins, cordate leaf bases with the lobes laterally imbricate (usually widely separated in *C. arafuricum*) as well as hairy abaxial leaf surfaces and capsule. In addition, *C. religiosa* has distinctly longer stipules, outer and inner sepals and anthers, yellow staminal filaments and can grow to a substantially larger tree.



**Fig. 2.** Map of distribution of *Cochlospermum* taxa in the Northern Territory, Australia. *Cochlospermum arafuricum* (solid circles), *C. fraseri* subsp. *fraseri* (open circles), *C. fraseri* subsp. *heteronemum* (open triangles); *C. gregorii* (diamonds) and *C. gillivraei* (crosses).

**Notes:** As plants are frequently leafless when bearing flowers or fruit, this material can be difficult to identify. However, the red filaments on at least the outer stamens and short, deltate floral bracts 1.5–3 mm long help to differentiate *C. arafuricum* from *C. fraseri* which has yellow staminal filaments and deltate to widely ovate floral bracts 1.5–8 mm long, with the apex acute to obtuse. In the field, fallen leaves may frequently be found beneath the plants and these can be rehydrated to aid identification.

A number of specimens included within the variable *C. fraseri* (e.g. *N. Byrnes* 2337; *H. Streimann* 8285; *A.J.M. Hopkins* 337) from the north and west Kimberley have more deeply lobed leaves with obtuse or broadly acute to abruptly acuminate apices, in some cases reminiscent of *C. vitifolium* (Willd.) Spreng. from Central and South America; these may represent a distinct taxon. Collections of putative hybrids from NT showing intermediate characters between *C. fraseri* and *C. gillivraei* or *C. gregorii* (e.g. *I.D. Cowie* 12721, *J. Egan* 2511 and *G.M. Wightman* 1348) may be difficult to identify.

*Cochlospermum arafuricum* appears to have a high degree of fire tolerance. Established plants are able to resprout from underground parts following dry season fires. Seeds appear to be ‘hard’ with a relatively thick, woody exotegumen. Seeds from *I.D. Cowie* 8066, collected in December 1998, germinated following scarification almost 15 years later.

**Conservation status:** *Cochlospermum arafuricum* is currently listed (as *C. sp.* Arnhem Land (*I.D. Cowie 5916*) under the *Territory Parks and Wildlife Conservation Act 2000* as ‘Data Deficient’ using International Union for the Conservation of Nature (IUCN) categories (IUCN 2012). However, it is now clear that it is relatively common although not abundant in woodland and open forest vegetation over an extensive area of central to eastern Arnhem Land, with no immediate threats. In the long term, invasion of savanna vegetation by gamba grass (*Andropogon gayanus* Kunth) and consequent changes in fire and soil nutrient regimes may be a threat. This grass is currently rare or absent in the range of *C. arafuricum*. Both in cultivation and in situ, living *Cochlospermum* plants including this species appear to be more susceptible to attack by the termite *Mastotermes darwiniensis* Froggatt than are many other native species (G. Wightmann *pers. comm.*; I. Cowie *unpubl.*). This apparent predation may serve to limit abundance and distribution. Following IUCN guidelines and criteria it has been assessed as ‘Least Concern’ (IUCN 2012; IUCN Standards and Petitions Subcommittee 2014).

**Other specimens examined: AUSTRALIA: Northern Territory: Darwin and Gulf District:** Murgengella, road to Sand Dunes, *C. Brock 215*, 6 Nov 2000 (DNA); Mitchell Ranges area, near Central Arnhem Road, *C. Brock s.n.*, 15 May 2013 (DNA); Arnhem Land, Maningrida, *I.D. Cowie 5916*, 22 Aug 1995 (DNA); Inglis Island; Nth side, *I.D. Cowie 6837*, 30 Apr 1996 (DNA); Arafura swamp, near Ramingining, Garanydjirr area, *I.D. Cowie 7956* & *C.P. Mangion*, 18 Sept 1998 (DNA); Near Ramingining, Gulmirrin area, *I.D. Cowie 8028* & *R.K. Harwood*, 4 Dec 1998 (DNA); Near Arafura Swamp, approx. 5 km west of Merwangi H.S., *I.D. Cowie 8066* & *R.K. Harwood*, 6 Dec 1998 (DNA); Central Arnhem Land, Annie Creek area, *I.D. Cowie 8448* & *C.R. Dunlop*, 20 Sept 1999 (DNA); Mirrynatja, Arnhem Land, *N. Scarlett 299*, 20 Aug 1986 (DNA); Arnhem Land, Maningrida, *G.M. Wightman 4922*, 15 Mar 1990 (DNA).

### Key to *Cochlospermum* in Australia

1. Apex of major leaf lobes rounded, rarely obtusely angled or emarginate, the blades mostly less than  $\frac{1}{3}$  divided; outer staminal filaments yellow ..... 2
1. Apex of major leaf lobes acute to aristate, the blades  $\frac{1}{3}$  or more divided; at least the outer staminal filaments red ..... 3
2. Leaf blades and young branchlets glabrous; floral bracts 1.5–3.5 mm long ..... *C. fraseri* subsp. *fraseri*
2. Leaf blades pubescent at least on margins; young branchlets pubescent; floral bracts 4.5–8 mm long ..... *C. fraseri* subsp. *heteronemum*
3. Leaf blades divided to base or lobes connate at base for less than 5 mm ..... *C. gregorii*
3. Leaf blades divided for  $\frac{1}{3}$ – $\frac{7}{8}$  of their length, lobes connate at base for more than 5 mm ..... 4
4. Leaf blades divided for  $\frac{1}{3}$ – $\frac{1}{2}$  of their length; lobes deltate, length to width ratio 0.9–1.5:1 ..... *C. arafuricum*
4. Leaf blades typically divided for  $\frac{2}{3}$  of their length or more; lobes narrowly ovate to linear or oblanceolate, length to width ratio 1.6–8:1 ..... 5
5. Leaf lobes 14 mm or more in width, narrowly ovate to lanceolate or oblanceolate, length to width ratio (1.6–) 2–3.4 (–3.9):1 (NT, Queensland) ..... *C. gillivraei*
5. Leaf lobes 10 mm or less in width, linear, very narrowly ovate or very narrowly elliptic, length to width ratio 5.2–8:1 (Pilbara, Western Australia) ..... *C. macnamarae*

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