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# *Gossypium anapoides* (Malvaceae), a New Species from Western Australia

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**ABSTRACT.** *Gossypium anapoides* J. M. Stewart, Craven, Brubaker & Wendel (Malvaceae), a new species of *Gossypium* L. endemic to the north Kimberley region of Western Australia, is described. The species is erect, with multiple, unbranched stems arising from the crown of a woody lignotuber. This trait, along with the presence of an elaiosome on each seed and the results of molecular analyses, places it with the species of *Gossypium* sect. *Grandicalyx* (Fryxell) Fryxell and makes it phylogenetically sister to the geographically disjunct species *G. cunninghamii* Tod. The species is named for the unique raised venation on the adaxial leaf surface that imparts the appearance of an abaxial surface.

**Key words:** Australia, *Gossypium*, *Gossypium* sect. *Grandicalyx*, IUCN Red List, Malvaceae.

The monsoonal north Kimberley region of Australia is climatically distinct within the Australian continent, being characterized by wet and dry climatic cycles. During the wet cycle that usually begins in late November monsoonal rains are frequent, often occurring daily. However, when the rains cease, usually in March, little to no rain falls

until the next wet season. As a result, the lush vegetation, which is rich in grasses that grow during the wet period, becomes dry and prone to burning. Consequently, all vegetation in the region either possesses adaptation to fire or grows in niches that escape fire (e.g., rock outcrops). This unique habitat hosts a distinctive and diverse flora that is high in endemics. Several taxa of note form a diverse and morphologically distinctive group of cotton relatives (*Gossypium* L. spp.) that are endemic to the Kimberley Plateau and nearby region.

The *Gossypium* species occurring in this region, all of which are included within subgenus *Sturtia* (R. Br.) Tod., section *Grandicalyx* (Fryxell) Fryxell, are clearly adapted to this climatic regime with a number of morphological elaborations unique to the genus: (1) an herbaceous perennial growth habit in which the stems grow from the crown of a woody lignotuber, (2) a capsule whose peduncle becomes recurved shortly after anthesis such that the capsule is pendent and upon opening drops the seeds to the ground, and (3) development of an elaiosome from the seed rachis so that ants disperse the seed to underground nests when they fall to the ground,

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<sup>1</sup> This paper is dedicated to James McD. “Mac” Stewart (1941–2012) and Lyn A. Craven (1945–2014), both of whom passed away prior to its completion. Both Mac and Lyn made major contributions to our understanding of *Gossypium* diversity and taxonomy.

where they may escape fire or possibly predation by birds. The stems of the plants most frequently die during the dry cycle and resprout from the crown of the lignotuber at the onset of the wet cycle or following a fire. In the absence of fire, the stems of some of the more robust species may survive the dry period and regrow from lateral buds.

Based on the short branch lengths obtained in molecular analyses (Seelanan et al., 1999), speciation in *Gossypium* sect. *Grandicalyx* appears to have been rapid. Evidence to date suggests two evolutionary lineages within the section. One lineage consists mostly of the prostrate to decumbent species, whereas the second lineage contains the more upright species (Seelanan et al., 1999; fig. 6; Liu et al., 2001).

During 1981–1985, explorations for germplasm related to cotton (*Gossypium hirsutum* L.) resulted in numerous collections that led to a revision of *Gossypium* sect. *Grandicalyx* and recognition of six new species (Fryxell et al., 1992). In 1993, Wendel, Brubaker, Craven, and Fryxell undertook another expedition to areas of the Kimberley region of Western Australia not visited during previous expeditions. During this 1993 collecting expedition, a new *Gossypium* morphotype that was clearly attributable to section *Grandicalyx*, but that could not be ascribed to any of the known species, was collected from several populations.

The new morphotype possesses the diagnostic features of the *Gossypium* sect. *Grandicalyx* species: large, nearly naked seeds carrying a prominent elaiosome, white flowers with deep maroon petal spots, recurved fruit pedicels, and an underground lignotuber. Subsequent phylogenetic analyses also support its inclusion within the section (Seelanan et al., 1999; Liu et al., 2001). Unlike other species in section *Grandicalyx*, the new species possesses a distinctive raised venation on the adaxial leaf surface that imparts the appearance of an abaxial surface.

With the species described here, *Gossypium* sect. *Grandicalyx* comprises 12 species (Fryxell et al., 1992), all but one of which are endemic to the north Kimberley region of Western Australia. The geographically exceptional species is *G. cunninghamii* Tod., which occurs on the Cobourg Peninsula of the Northern Territory of Australia, approximately 500 km disjunct from other section *Grandicalyx* species. The morphology of *G. cunninghamii* is noteworthy in the context of the present article in that phylogenetic analyses (Seelanan et al., 1999; Liu et al., 2001) suggest that the closest relatives of the new species *G. anapoides* J. M. Stewart, Craven, Brubaker & Wendel are *G. cunninghamii* and *G. londonderriense*

Fryxell, Craven & J. M. Stewart. Within this clade, *G. cunninghamii* and *G. anapoides* are probably sister taxa, as they share morphological features that are otherwise unique within section *Grandicalyx*, namely pinnate venation and short (up to 14 mm) petioles.

The possibility of shared ancestry between the lineage leading to modern *Gossypium anapoides* and *G. cunninghamii* is noteworthy. The latter species possesses the morphological features typical of the section, but it is unique in having sessile leaves and a cytoplasmic genome more similar to that of *G. sturtianum* J. H. Willis (subgenus *Sturtia*, section *Sturtia* (R. Br.) Tod.) than to the other species of section *Grandicalyx* (Wendel & Albert, 1992). The species described here has very short petioles but a cytoplasmic genome similar to that of the other section *Grandicalyx* species (Wendel & Albert, 1992; Seelanan et al., 1999).

***Gossypium anapoides*** J. M. Stewart, Craven, Brubaker & Wendel, sp. nov. TYPE: Australia. Western Australia: near Cape Talbot, ca. 90 km N of Kalumburu, 13°48'S, 126°45'E, 24 May 1993, L. A. Craven, J. M. Stewart & J. F. Wendel 9192 (holotype, CANB; isotypes, A, DNA, K, L, MEL, MO, NA, P, PERTH, WIR). Figure 1.

Haec species a speciebus omnibus ceteris *Gossypii* sect. *Grandicalycis* (Fryxell) Fryxell foliorum venis majoribus adaxialiter abaxialiterque aequaliter prominentibus atque petiolo brevi (usque ad 14 mm longo) distinguitur.

Shrubs erect, multistemmed to 1.5 m, persisting in absence of fire and regenerating from a basal crown following fire or severe drought; stems appearing glabrous but with scattered, minute stellate hairs, denser around leaf attachments and on apical buds; black punctae (lysigenous cavities, or “gossypol glands”) abundant, more apparent in younger stems than in older stems due to bark pigmentation. Leaves alternate and in vivo often ascending and partially encircling stem, leaf size typically decreasing in size toward apex of each stem, coriaceous; stipules 1–2 mm, caducous. Lamina ovate to orbicular, as broad as long (< 7 cm) especially in proximal leaves; adaxial surface with abundant minute stellate hairs, abaxial surface and margin nearly glabrous; apex variously obtuse, apiculate, cuspidate, or acuminate with base mostly cuneate or sometimes rounded to attenuate; margin entire with an occasional minute stellate hair; black punctae numerous throughout; trichomes minute, pigmented, globose, claviform, or linear, common, more so adaxially, especially near base of lamina; nectary 8–12 mm, linear, positioned abaxially on



Figure 1. Sheet 1 of the holotype of *Gossypium anapoides* J. M. Stewart, Craven, Brubaker & Wendel from L. A. Craven, J. M. Stewart & J. F. Wendel 9192 (CANB).

midvein approximately 5 mm from base of leaf; major veins equally raised abaxially and adaxially; petioles ca. 10 mm (5–14 mm), 1/10 to 1/5 the length of lamina in older leaves; sepals basally connate into a cup, 4–7

mm in length, lobes acuminate to linear, equal to or slightly longer (4–8 mm) than cup, sinuses between lobes broadly rounded, trichomes numerous on the adaxial (inner) surface of lobes, black punctae

numerous throughout and 2 to 3 times larger than the foliar punctae; petals pink to red where exposed in bud, white with basal burgundy spots when open, senescing to pink within 12 hours of anthesis, 45–65 mm, basal spots 10–15 mm, black punctae scattered throughout, stellate trichomes numerous, the longest on basal portions of petal margins; staminal column white, epunctate; filaments 1–1.5 mm; anthers occasionally with one to several black punctae, pollen cream-colored at anthesis and drying to yellow; style clavate, 15–22 mm, extending 6–8 mm beyond staminal column, with scattered black punctae; stigmata fused and decurrent on style; epicalyx lobes sharply reflexed in fruit, with 4–5 mm acute lobes, basally 1–1.5 mm wide, usually entire, rarely with 1 to 2 teeth, with numerous pigmented trichomes on the adaxial surface; epicalyx nectaries absent or insignificant and subtending lobes; capsules globose, apiculate, 8–10 mm diam., trilobulate, with 1(2) seeds per locule, capsule walls densely punctate, with individual punctae ca. twice as large as those of calyx; seeds brown, with a thin covering of short (< 1 mm) solitary trichomes, slightly longer than wide, elaiosome 1/2 to 3/4 of seed length.

For additional phylogenetic information on the new species described here, see *Gossypium* sp. A; Seelanan et al., *Syst. Bot.* 24: 184, 187 (1999); and *Gossypium species novum*; Liu et al., *Amer. J. Bot.* 88: 94 (2001).

*Distribution and habitat.* *Gossypium anapoides* apparently is restricted to a narrow coastal strip on the east side of Napier Broome Bay between ca. 30 and 90 km to the north of Kalumburu, Western Australia. The climate is one of a distinct monsoonal season followed by a prolonged dry period. Plants are generally associated with relatively deep sandy soils in coastal flats and adjacent broken sandstone catchments. Specific habitats where plants have been recorded by collectors include (1) open mixed woodland near the beach, growing on lateritic gray-brown sandy loam; (2) sandstone spinifex and margins thereof; (3) deeper sands (locally common) and also *Eucalyptus miniata* A. Cunn. ex Schauer woodland inland from sandstone spinifex; (4) eucalypt and *Sorghum* Moench savannah grassland on plain with black gravel strew, probably underlain with sandstone or laterite; and (5) rocky slopes ca. 50 m behind the beach in open eucalypt woodland with understory of coarse grass.

*IUCN Red List category.* The conservation status of *Gossypium anapoides* is assessed as Data Deficient,

or DD, according to IUCN Red List criteria (IUCN, 2001).

*Etymology.* The epithet is arbitrarily derived from the Greek combining forms *ana-* (back or bottom), *apo-* (front or top), and *-eidos* (resemblance) and refers to the leaves being of quite similar appearance on each surface; that is, they approach being isobilateral, being distinguishable only by a small nectary on the main vein of the abaxial side of the leaf. The leaves of all other species of section *Grandicalyx* are distinctly dorsiventral.

*Discussion.* The lengths of the inflorescence branches are related to the growth cycle. The peduncle plus pedicel may exceed 50 mm early in the cycle, but branches developing later in the reproductive season are shorter, generally ranging from 25 to 45 mm. The articulation between the peduncle and pedicel is ca. half of their combined length and is subtended by a small bract (to 3 mm in length), which in late-developing buds is further reduced or may be wanting. The elaiosome arises as an elaboration of the rachis and is fleshy and white on fresh seed, becoming shriveled and brownish when dried.

*Paratypes.* AUSTRALIA. **Western Australia:** E of Cape Talbot, ca. 90 km N of Kalumburu, 13°46'S, 126°49'E, 24 May 1993, *Craven, Stewart & Wendel 9193* (AD, CANB, DNA, NA, PERTH, WIR); near Curran Point, ca. 80 km N of Kalumburu, 13°54'S, 126°48'E, 24 May 1993, *Craven, Stewart & Wendel 9188* (A, BRI, CANB, DNA, L, MEL, NA, NSW, P, PERTH), *Craven, Stewart & Wendel 9191* (CANB, DNA, NA, PERTH); ca. 2 km S of Honeymoon Bay, ca. 35 km N of Kalumburu on track to Pago Pago, 14°07'02"S, 126°40'47"E, 5 June 1996, *Michell 4432* (CANB, PERTH not seen); Honeymoon Beach, betw. Bluff Point & Tate Point, ca. 30 km N of Kalumburu, 28 July 1995, *Fraser s.n.* (CANB).

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