



Updated nomenclature and an identification key for *Hibbertia* subg. *Pachynema* (Dilleniaceae), and description of a new species from the Northern Territory

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Abstract: The eleven species and three morphological species groups of *Hibbertia* subg. *Pachynema* (R.Br. ex DC.) J.W.Horn are discussed, and an identification key and the first formal synonymy for the subgenus are given. Additionally, the phrase name *Hibbertia* sp. Marrawal (K.G. Brennan 3194) from the Northern Territory is assessed, found to be distinct from all other species of *Hibbertia*, and formally described as *Hibbertia triquetra* T.Hammer.

Keywords: Dilleniaceae, *Hibbertia*, Northern Territory, *Pachynema*, taxonomy

Introduction

Hibbertia Andrews is the largest genus in Dilleniaceae, with over 300 species currently accepted on the Australian Plant Census (APC 2022), 24 species in New Caledonia (one also in Fiji) and one species in Madagascar. A preliminary phylogeny by Horn (2009) resolved *Hibbertia* to be polyphyletic with respect to the genera *Adrastaea* DC. and *Pachynema* R.Br. ex DC. As a result, these two genera were synonymised under *Hibbertia*, and the four clades erected as the subgenera *Hibbertia* subg. *Adrastaea* (DC.) J.W.Horn, *Hibbertia* subg. *Hemistemma* (Juss. ex Thouars) J.W.Horn, *Hibbertia* subg. *Hibbertia* and *Hibbertia* subg. *Pachynema* (R.Br. ex DC.) J.W.Horn.

Hibbertia subg. *Pachynema* is a small group of species found in the Australian monsoonal tropics (i.e., in N.T. and W.A.) that are vegetatively distinct from the other subgenera. Mature plants of *H.* subg. *Pachynema* lack conspicuous leaves, having instead scale-like leaves along the stem that are similar in morphology to the floral bracts, leading some authors (e.g. Craven & Dunlop 1992; Horn 2009) to conclude that the entire flowering aerial shoot systems in *Pachynema* are inflorescences. Seedlings and resprouting plants have broad, basal leaves, but these are not persistent to maturity and are rarely found on herbarium specimens. Stems in *Pachynema* are cladodes, being the primary photosynthesizing organ; in some species the stems are distinctly flattened (e.g. *H. dilatata* (Benth.) J.W.Horn), while in others they are terete (e.g. *H. juncea* (Benth.) J.W.Horn).

Craven & Dunlop (1992) revised *Pachynema* and included seven species, three of which were newly described. They excluded *H. conspicua* (J.Drumm. ex Harv.) Gilg and *H. goyderi* F.Muell. from their concept of the genus, despite these species having the *Pachynema* vegetative morphology; they differ from *Pachynema* species mainly by having flowers with yellow petals (*vs.* white, pink or red) and stamens with more or less strap-like staminal filaments and elongate anthers (*vs.* short and bulbous filaments with minute anthers). The floral morphology of *H. conspicua* and *H. goyderi* is broadly similar to the leafy *Hibbertia* species, especially the eastern Australian *H. salicifolia* (DC.) F.Muell. (previously treated as the monotypic genus *Adrastaea* DC.). *Hibbertia goyderi* was placed from its inception within *Hibbertia*, while *H. conspicua* was originally described in a monotypic genus *Huttia* J.Drumm. ex Harv. before being transferred to *Pachynema* sect. *Huttia* (J.Drumm. ex Harv.) Benth. & Hook.f. as the sole species, and then subsequently to *Hibbertia* sect. *Huttia* (J.Drumm. ex Harv.) F.Muell.

A partial phylogeny of *Hibbertia* and its close relatives by Horn (2009), based on chloroplast sequences, included three *Pachynema* species (*P. dilatatum* Benth., *P. junceum* Benth. and *P. sphenandrum* F.Muell. & Tate) and resolved these as a clade with *H. conspicua* and *H. goyderi*. Horn (2009) formally combined *Pachynema* under *Hibbertia* by making the new combination *H.* subg. *Pachynema*, expanding the subgenus to include *H. conspicua* and *H. goyderi*. While the texts of his paper (Horn 2009) and PhD thesis (Horn 2005) make it clear that he intended to include *H. conspicua* and *H. goyderi* within *H.* subg. *Pachynema*, the treatment

Table 1. Morphological species groups of *Hibbertia* subg. *Pachynema* and their members.

| <i>H. complanata</i> group | <i>H. sphenandra</i> group | <i>H. conspicua</i> group | Uncertain placement |
|----------------------------|----------------------------|---------------------------|----------------------|
| <i>H. complanata</i> | <i>H. haplostemona</i> | <i>H. conspicua</i> | <i>H. paranthera</i> |
| <i>H. cravenii</i> | <i>H. praestans</i> | <i>H. goyderi</i> | |
| <i>H. dilatata</i> | <i>H. sphenandra</i> | <i>H. triquetra</i> | |
| <i>H. juncea</i> | | | |

of Horn (2009) included no list of species included in each subgenus, nor did he formally assign previous genera and infrageneric taxa as synonyms (see also Kellermann *et al.* 2022).

A specimen of an unknown *Hibbertia* was collected by K.G. Brennan from the Marrawal Plateau, N.T., in 1996 and subsequently given the phrase name *H. sp. Marrawal* (K.G. Brennan 3194) in the Northern Territory (Cowie & Albrecht 2005). It was recognised to be similar to, but different from, *H. goyderi*, placing it within the current concept of *H. subg. Pachynema*. As part of a treatment of all species of *Hibbertia* being prepared for the *Flora of Australia*, I here critically evaluate the status of *H. sp. Marrawal* (K.G. Brennan 3194) (subsequently referred to as *H. sp. Marrawal*), compare it to all other species in the subgenus, and describe it as new. An identification key and formal list of synonyms for *H. subg. Pachynema* are provided.

Methods

This study was conducted by examining herbarium specimens and spirit material at AD and on loan from DNA.

Discussion

Affinities within subg. *Pachynema*

There are three main species morpho-groups within *Hibbertia* subg. *Pachynema* that can be readily segregated based on floral morphology (Table 1). These are the *H. complanata* (R.Br. ex DC.) J.W.Horn group, the *H. sphenandra* (F.Muell. & Tate) J.W.Horn group, and the *H. conspicua* group. Species in the *H. complanata* group (*H. complanata* (R.Br. ex DC.) J.W.Horn, *H. juncea*, *H. dilatata* and *H. cravenii* J.W.Horn) have white to pink, caducous petals; they differ from each other mainly by the presence and position of staminodes, stem shape in cross-section (flat or terete), and whether or not the stems are dimorphic. Species in the *H. sphenandra* group (*H. sphenandra*, *H. praestans* (Craven & Dunlop) J.W.Horn and *H. haplostemona* J.W.Horn) have dark red petals that are more or less persistent to the fruiting stage. Petals in *H. sphenandra* may be caducous, but this species can be otherwise discriminated by having an irregularly lobed, membranous sheath that encircles the androecium, referred to by previous authors as a 'corona' (e.g. Craven & Dunlop 1992); it is the only known *Hibbertia* species with such a structure and requires more study

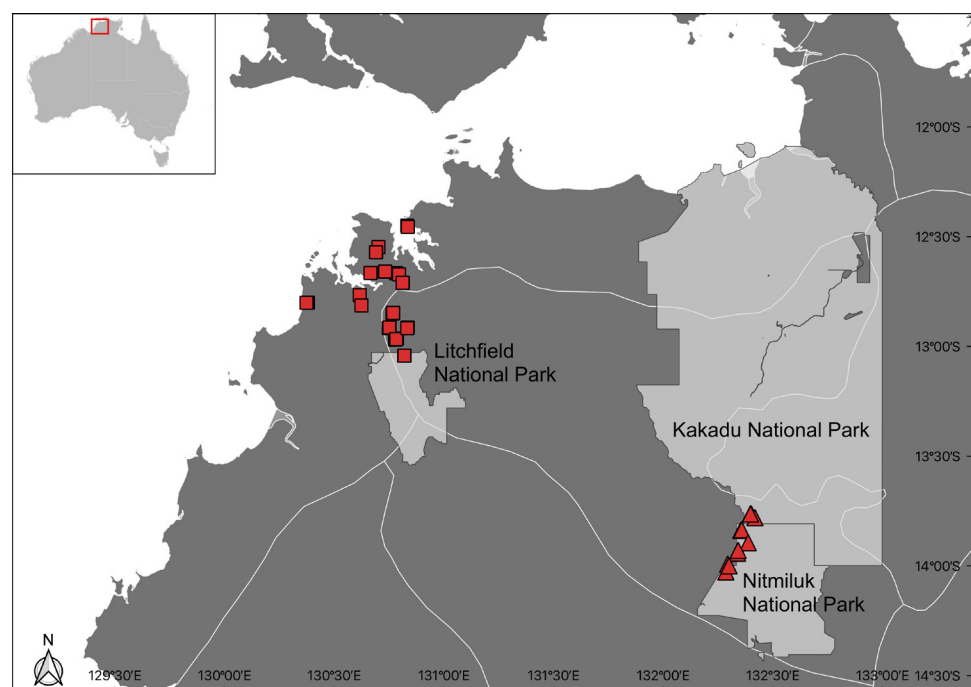


Fig. 1. Map of occurrences of *H. triquetra* (red triangles) and *H. goyderi* (red squares). Light grey shaded regions are national parks. White boundaries are IBRA 7.0 regions (DAWE 2022).

as to its origin. The *H. conspicua* group (*H. conspicua*, *H. goyderi*, *H. sp. Marrawal*) have yellow, caducous petals, flattened staminal filaments, elongate anthers, and staminodes (when present) in a whorl outside the two fertile staminal whorls.

The unusual species *Hibbertia paranthera* K.R.Thiele (Thiele 2015) has a combination of morphological characters that makes it difficult to place within any one of these traditional groups. The species has pink, caducous petals that are similar to those of the *H. complanata* group, but one whorl of two stamens that have flattened filaments and anthers 2–2.5 mm long. The androecium in the *H. complanata* group has two whorls of stamens (an outer of 7–10 stamens, and an inner of 2 stamens or staminodes) that have rounded, bulbous filaments and anthers usually 0.3–0.5 mm long. A forthcoming molecular phylogeny of the genus by T. Hammer *et al.* (in prep.) may resolve the relationships of this interesting species.

Hibbertia sp. Marrawal

Hibbertia sp. Marrawal is considered here to be a member of *H.* subgen. *Pachynema* based on its morphological similarity to *H. goyderi* and *H. conspicua*. It is only known from the Marrawal Plateau in Arnhem Land and is geographically widely disjunct from *H. goyderi*, which occurs from the vicinity of Darwin to Litchfield National Park (N.P.) and west to near Dundee Beach (Fig. 1).

Hibbertia goyderi shares with *H. sp. Marrawal* the unusual morphology of triquetrous (three-angled) stems. The stems of *H. sp. Marrawal* are more noticeably triquetrous due to the three sides of stems being typically smoother and less wrinkled or striated than those of *H. goyderi*, at least in dried specimens. The only other species with a distinctly triquetrous stem is the Western Australian *H. paranthera* K.R.Thiele, but this species can be readily differentiated from *H. sp. Marrawal* and *H. goyderi* by having flowers with pink petals, two stamens and lacking staminodes. *Hibbertia*

Key to *Hibbertia* subg. *Pachynema*

1. Petals white, pink or red; staminodes, if present, 2, internal to the fertile stamens
 2. Petals white to pink, caducous; corona absent
 3. Stems triquetrous; androecium comprising 1 whorl of 2 stamens; Kimberley, W.A. *Hibbertia paranthera*
 - 3: Stems terete to flattened; androecium comprising 2 whorls, the outer whorl with 7–10 stamens, the inner whorl with 2 stamens or staminodes; N.T. (*H. complanata* group)
 4. Stamens of inner whorl fertile; staminal filaments smooth to sub-papillate; anthers (0.8–) 1–1.8 mm long *Hibbertia cravenii*
 - 4: Stamens of inner whorl infertile (staminodes); staminal filaments papillate; anthers 0.3–0.5 (–0.7) mm long
 5. All branchlets terete to slightly compressed *Hibbertia juncea*
 - 5: All branchlets distinctly broad and flattened, or branchlets dimorphic with shorter stems flattened and branchlets of taller stems terete to flattened
 6. Stems dimorphic, the shorter stems with branchlets 3–10 (–15) mm wide and the taller stems with terete to flattened branchlets distinctly narrower than those of the shorter stems *Hibbertia complanata*
 - 6: Stems not dimorphic, the branchlets 5–20 (–35) mm wide *Hibbertia dilatata*
 - 2: Petals red, persistent, or if caducous then corona present (*H. sphenandra* group)
 7. Corona around androecium present; stamens 7 or 9, in two whorls; N.T., W.A. *Hibbertia sphenandra*
 - 7: Corona around androecium absent; stamens 4 or 5, in one whorl; N.T.
 8. Prostrate to decumbent shrubs to 0.3 m high; branchlets ± straight; stamens 5, the filaments gibbous *Hibbertia haplostemona*
 - 8: Shrubs 1.5–2 m high; branchlets ± drooping; stamens 4 (5), the filaments ± flattened *Hibbertia praestans*
- 1: Petals yellow; staminodes, if present, several in a whorl outside the fertile stamens (*H. conspicua* group)
 9. Stems ± terete; sepals pubescent (the outer ones rarely glabrous) with straight and hooked simple hairs; staminodes absent or c. 0.8 mm long; south-west W.A. *Hibbertia conspicua*
 - 9: Stems triquetrous; sepals glabrous; stamens surrounded by a whorl of staminodes 1.5–2 mm long; N.T.
 10. Flowers solitary on stems, terminal, sessile or indistinctly pedicellate; inner sepals acute to acuminate. *Hibbertia goyderi*
 - 10: Flowers few to several per stem, axillary, distinctly pedicellate; inner sepals obtuse to rounded *Hibbertia triquetra*



Fig. 2. Holotype of *Hibbertia triquetra* (DNA D0137319).



Fig. 3. Representative specimen of *Hibbertia goyderi* (AD169293).

sp. Marrawal and *H. goyderi* have yellow petals, a whorl of staminodes outside of the stamens, and 8 or 9, or 8–10 stamens, respectively.

Hibbertia sp. Marrawal and *H. goyderi* can be additionally differentiated by the shape of the sepal apex and the number and arrangement of flowers on the main stems (Figs. 2 & 3). *Hibbertia* sp. Marrawal has multiple (up to c. 12), seemingly axillary flowers per stem borne on pedicels that are thinner and much shorter than the stems and of a different shape, being \pm compressed-terete (often irregularly striate) and 0.3–0.5 mm wide, while the stems are c. 1–2.5 mm wide (Fig. 2, Fig. 4A). In contrast, flowers in *H. goyderi* are usually solitary, terminal and sessile on the triquetrous stems (Fig. 3), or are occasionally borne on short, triquetrous lateral stems, but lack distinct pedicels. *Hibbertia* sp. Marrawal can be additionally differentiated by having obtuse inner sepals (Fig. 4A, B), the inner and outer sepals of *H. goyderi* being distinctly acute to acuminate (Fig. 4C, D).

Hibbertia conspicua is the only species in *H.* subg. *Pachynema* that occurs outside of tropical Australia, being endemic in south-west Western Australia. Despite this geographic disjunction, it is morphologically quite similar to *H.* sp. Marrawal and *H. goyderi*. *Hibbertia conspicua* can be readily distinguished from these two species by having terete stems, pubescent young stems and leaves with mostly retrorse hooked hairs, and having pedicellate flowers well-separated in poorly defined inflorescences. Staminodes in *H. conspicua* are minute or lacking, in contrast to the long and distinct staminodes in *H. goyderi* and *H.* sp. Marrawal.

Hibbertia sp. Marrawal can be readily distinguished from all other members in the genus, and is formally described below as *Hibbertia triquetra* T.Hammer.

Taxonomy

Hibbertia subg. *Pachynema* (R.Br. ex DC.) J.W.Horn

Int. J. Pl. Sci. 170(6): 809 (2009). — *Pachynema* R.Br. ex DC., *Syst. Nat.* 1: 397, 411–412 (1817). — *Pachynema* R.Br. ex DC. sect. *Pachynema*: Benth. & Hook.f., *Gen. Pl.* 1(1): 15 (1862). — **Type:** *Pachynema complanatum* R.Br. ex DC. [= *Hibbertia complanata* (R.Br. ex DC.) J.W.Horn].

Pachynema sect. *Stemmatanthus* F.Muell. & Tate, *Trans. Proc. & Rep. Roy. Soc. South Australia* 5: 79 (1882). — *Pachynema* sect. *Stemmatanthus* Gilg & Werderm. in Engler & Prantl, *Nat. Pflanzenfam.* ed. 2, 21: 30 (1925), *orth. var.* — **Type:** *Pachynema sphenandrum* F.Muell. & Tate [= *Hibbertia sphenandra* (F.Muell. & Tate) J.W.Horn].

Huttia J.Drumm. ex Harv. in Hooker, *Hooker's J. Bot. Kew Gard. Misc.* 7: 51 (1855). — *Pachynema* sect. *Huttia* (J.Drumm. ex Harv.) Benth. & Hook.f., *Gen. Pl.* 1(1): 15 (1862). — *Hibbertia* sect. *Huttia* (J.Drumm. ex Harv.) F.Muell., *Fragm.* 7(56): 123

(1871). — **Type:** *Huttia conspicua* J.Drumm. ex Harv. [= *Hibbertia conspicua* (J.Drumm. ex Harv.) Gilg].

Hibbertia triquetra T.Hammer, *sp. nov.*

Holotypus: 4 km SW [of] Bloomfield Springs, Kakadu National Park, Northern Territory, 5 Jan. 1995, *J. Russell-Smith & D. Lucas 9109* (DNA D0137319!). **Isotypi:** CANB, BRI; both *n.v.*

Hibbertia sp. Marrawal (*K.G. Brennan 3194*) Northern Territory Herbarium, R.A.Kerrigan & Albr., *Checkl. N. Terr. Vasc. Pl. Sp.* [not paginated] (2007).

Erect or rounded *shrubs* 0.3–1.2 m high, multi-stemmed, resprouting from a woody rootstock. *Stems* triquetrous, the sides \pm smooth except for minute papillae, often slightly glossy, green (becoming glaucous with age), glabrous; older stems becoming woody and more rounded towards the base. *Cauline leaves* scale-like, narrowly triangular, 2–3 mm long, caducous with usually the tip or all but the very base falling away, glabrous; apex acute to attenuate. *Seedling and resprout leaves* not seen. *Flowers* single, along stems at inconspicuous nodes, each subtended by a scale-like leaf, pedicellate; pedicel 1–2.5 mm long, 0.3–0.5 mm wide, distinctly narrower than the stems, \pm compressed-terete, glabrous; bracts 2–4, subtending or recaulescent on the pedicel, 1–1.5 mm long, similar to but usually smaller than the subtending scale-like leaf, glabrous. *Sepals* unequal, glabrous; outer sepals 2, ovate to elliptic, 4–5 mm long, narrowly scarious-margined, the apex acute to obtuse and apiculate; inner sepals 3, elliptic to broadly elliptic, 6–7 mm long, broadly scarious-margined, the apex obtuse to rounded and entire to emarginate. *Petals* 5, yellow, broadly obovate to spatulate, 5–7 mm long, emarginate. *Stamens* 8 or 9, arranged in two tight whorls in a cone-like structure around the gynoecium at anthesis (later diverging), the outer whorl with 6 or 7 stamens, the inner whorl with 2 stamens that are tucked between the carpels; filaments \pm flattened, connate basally, 1–1.2 mm long (fused plus free portion); anthers lanceolate, 2–2.5 mm long, dehiscent by introrse, longitudinal slits; staminodes 8–16, \pm linear, 1.5–2 mm long, outside the stamens, erect to radiating outward. *Carpels* 2; ovaries compressed-ovoid to -globular, \pm smooth, glabrous, 2-ovulate; styles robust, subulate, 3–3.5 mm long, erect and enclosed by the anthers (at anthesis) with the stigmas placed above them. *Seeds* \pm globular, 3.2–3.8 mm long, brown, shiny, reticulate; aril \pm membranous, slightly fleshy basally, covering basal one-third to one-half of seed. **Figs 2, 4A, B.**

Diagnostic features. *Hibbertia triquetra* can be readily distinguished from all other species of *Hibbertia* by the combination of its stems being triquetrous and having the cauline leaves very reduced and narrowly triangular to 3 mm long, multiple flowers along the stems that are distinctly pedicellate, obtuse inner sepals, yellow petals, 8–16 linear staminodes arranged around the fertile stamens, and 8 or 9 fertile stamens arranged around two glabrous, \pm smooth carpels.

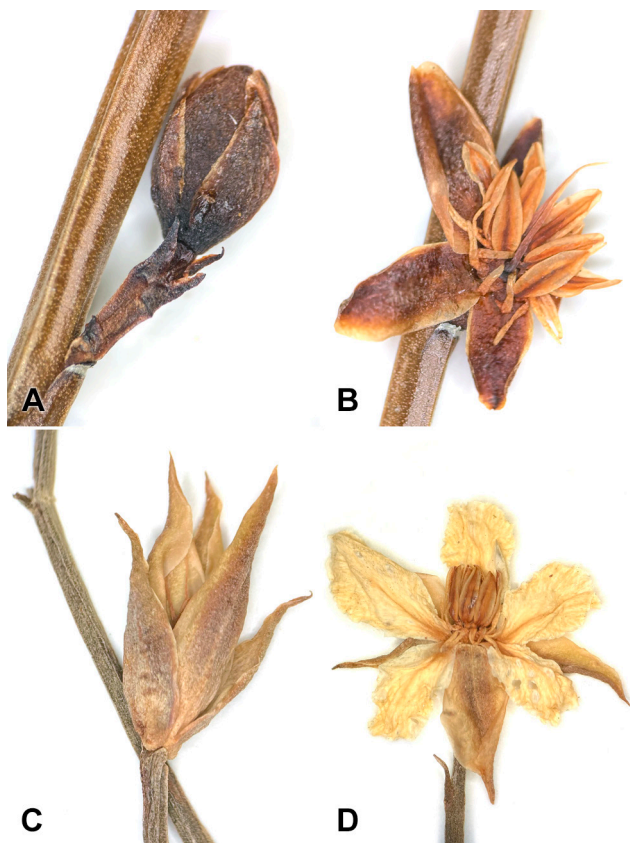


Fig. 4. *Hibbertia triquetra*: **A** flower bud and pedicel; **B** open flower (corolla). *Hibbertia goyderi*: **C** closed flower; **D** open flower. — **A, B** DNA D0137319; **C, D** AD169293.

Phenology. Recorded as flowering January–May and fruiting March–May.

Distribution. Occurs from the Marrawal Plateau (*K. Brennan 7495*) in the southwestern corner of Kakadu N.P. to upper Fergusson River area (*I.D. Cowie & A. Gibbons 9527*) in western Nitmiluk N.P., apparently restricted to the Pine Creek IBRA region (Fig. 1).

Habitat. Occurs on plateaus, ridges, slopes or near creeks in open *Corymbia dichromophloia* woodlands or on the edge of *Allosyncarpia* forests, on laterite, quartzite or sandstone.

Conservation status. Not conservation listed. Conserved in Kakadu and Nitmiluk national parks.

Etymology. From the Latin *triquetrus* (triangular, having three corners), referring to the shape of the stem in cross section.

Notes. Other members of *H.* subg. *Pachynema* that overlap with or occur near *H. triquetra* can be readily differentiated. *Hibbertia juncea* (Benth.) J.W.Horn is recorded from the Marrawal Plateau and nearby areas in Kakadu and Nitmiluk national parks. It has \pm terete stems, white or pinkish petals, and two androecial whorls, the outer comprising fertile stamens with round and papillate staminal filaments and very

reduced anthers, and the inner whorl comprising two staminodes. *Hibbertia dilatata* and *H. complanata* have white to pink petals and at least some stems distinctly flattened. *Hibbertia triquetra* can be differentiated from these species by having triquetrous stems, yellow petals, and an androecium of two whorls of fertile stamens, usually tightly appressed in a conical structure, with the anthers approximately twice the size of the flattened filaments and with a whorl of thread-like staminodes surrounding the fertile stamens.

Hibbertia sphenandra is not recorded at the same localities as *H. triquetra*, but there are records nearby in Kakadu N.P., Nitmiluk N.P. and near Pine Creek. It differs in having \pm terete stems (*vs.* triquetrous stems) and red flowers with usually persistent petals (*vs.* yellow, caducous petals), a persistent membranous corona around the androecium (*vs.* lacking such a structure), and stamens with thickened and angular staminal filaments (*vs.* filaments \pm flattened).

Additional specimens examined.

NORTHERN TERRITORY. Marrawal Plateau, S of Bloomfield Springs, 6 Feb. 1996, *K. Brennan 3194* (DNA); Marrawal Plateau, Kakadu N.P., 15 Mar. 2008, *K.G. Brennan 7495* (DNA); Nitmiluk N.P., upper Fergusson River area, 25 Mar. 2002, *I.D. Cowie & A.K. Gibbons 9527* (AD; DNA, *n.v.*); 20 km N Edith Falls, Nitmiluk N.P., 25 Mar. 2002, *C.R. Michell 3926* (DNA; MO, *n.v.*); N Edith Falls, Nitmiluk N.P., 25 Mar. 2002, *C.R. Michell 3927* (DNA); Site 608, Nitmiluk N.P., 22 May 2001, *J.A. Risler & B. Deichmann 1545* (DNA).

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