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Three new species allied to the '*Mirbelia viminalis* group' (Fabaceae: Mirbelieae), from Western Australia

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Abstract

Butcher, R. Three new species allied to the '*Mirbelia viminalis* group' (Fabaceae: Mirbelieae), from Western Australia. *Nuytsia* 22(2): 75–92 (2012). *Mirbelia balsiformis* R.Butcher, *M. corallina* R.Butcher and *M. ferricola* R.Butcher are described herein as new species allied to the '*M. viminalis* group'. Of the newly described species, *M. balsiformis* is widely distributed between Kalbarri and Shark Bay, and is not conservation-listed, while *M. corallina* and *M. ferricola* are listed as Priority Three conservation taxa in Western Australia. *Mirbelia corallina* is restricted to sandplains in the Kalbarri area, with most collections from Kalbarri National Park. *Mirbelia ferricola* is restricted to Banded Iron Formation ranges between the Koolanooka Hills, east of Morawa, and the Bremer Range, west of Norseman. Although this species has a wide area of occupancy, the biodiverse ranges on which it occurs are small, disjunct islands in an otherwise subdued landscape, and are highly prospective for mining. The putative taxon *M.* sp. Carnarvon (J.S. Beard 6008), previously poorly defined, appears to be a recognisable variant within the variable *M. ramulosa* (Benth.) C.A.Gardner. The name is retained on Western Australia's plant census, however, until its status can be clarified by a comprehensive study of variation in *M. ramulosa* across its range. This paper describes, illustrates and provides distribution maps for *M. balsiformis*, *M. corallina* and *M. ferricola*, and distinguishes them from similar, scale-leaved *Mirbelia* Sm. species in Western Australia. A key to species of the '*M. viminalis* group' is also provided.

Introduction

The genus *Mirbelia* Sm. was described by Smith in 1805, diagnosed by having incomplete septa that divide the pod longitudinally. In most species the septa intrude from both the adaxial and abaxial sutures to varying degrees; however, *M. ovata* Meisn., *M. seorsifolia* (F.Muell.) C.A.Gardner and *M. viminalis* (Cunn. ex Benth.) C.A.Gardner lack an abaxial septum and *M. oxylobioides* F.Muell. lacks an adaxial septum (Crisp & Cook 2003a).

Cladistic analyses of morphological (Crisp & Weston 1987) and molecular (Crisp & Cook 2003a, 2003b; Orthia *et al.* 2005a, 2005b) data question the monophyly of *Mirbelia*. It has been proposed to subsume all the genera in the *Mirbelia* group (19 genera) under *Pultenaea* Sm. (Crisp & Cook 2003a, 2003b; Orthia *et al.* 2005a, 2005b). Despite the taxonomic uncertainty surrounding *Mirbelia* and allied genera, there is still a pressing need to formally describe new taxa across this group, especially

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conservation-listed taxa. The species described herein are described as *Mirbelia* species, with due care given to selecting epithets not previously used elsewhere in *Pultenaea s. lat.*

There are currently 12 informally-named species of *Mirbelia* in Western Australia (Western Australian Herbarium 1998–) awaiting research into their status, and appropriate naming. Four of these are conservation-listed and thus are of higher priority for taxonomic resolution. This paper deals with those undescribed taxa allied to the '*M. viminalis* group' of Crisp and Taylor (1987). As currently recognised, the '*M. viminalis* group' is composed of taxa with spinescent branchlets and all leaves reduced to scales (Crisp & Taylor 1987: 134), and comprises *M. ramulosa* (Benth.) C.A.Gardner, *M. stipitata* Crisp & J.M.Taylor and *M. viminalis*. The following phrase-named putative taxa have characters which indicate membership of this group: *M.* sp. Helena & Aurora (B.J. Lepschi 2003), *M.* sp. Kalbarri (M.D. Crisp 6261), *M.* sp. Denham (W.E. Blackall 556) and *M.* sp. Carnarvon (J.S. Beard 6008). Of these, the first two have Priority Three conservation status, whereas the latter two are not conservation-listed. The purpose of this study was to review the taxonomy of the '*M. viminalis* group' with the express aim of evaluating the status of these phrase-named entities and naming those found to warrant formal description.

Methods

All scale-leaved *Mirbelia* specimens at PERTH were examined as well as material on loan from AD, selected during a visit to that Herbarium. Live plants were also examined in the field between 2008 and 2011. Vegetative, fruit and seed characters were measured from herbarium specimens and floral characters were measured from rehydrated and ethanol-preserved material.

Among the specimens studied, two different trichome types were observed. In some taxa, hairs were obviously peltate with the point of attachment *c.* one-quarter to half-way along the hair, usually appearing as a golden region on each translucent-white to stramineous hair, such that the indumentum was frequently bi-coloured white and golden. In the remaining taxa, the point of attachment was just above the base of the hair, such that each hair superficially appeared basifixed. Indumentum comprised of these hairs was usually translucent-white throughout. Similarly attached trichomes occur in the Indigofereae (Schrire 1995; see Plate 2, Figure D and Plate 3, Figure C for peltate hairs, and Plate 3, Figure E for ±basifixed hairs), and are referred to as 'equally biramous' and 'unequally biramous', respectively. Use of the term peltate here follows Crisp and Weston (1987; Table 3, Character 2), and is preferred as the point of attachment is usually off-centre and can vary considerably between organs on the same plant.

The format of the taxonomic description follows Crisp and Taylor (1987), with additions. Locality information has been withheld for selected specimens of conservation-listed species. Herbarium acronyms follow Thiers (continuously updated).

The distribution map was prepared from PERTH specimen data and shows *Interim Biogeographical Regionalisation for Australia (IBRA) Version 6.1* boundaries (Department of the Environment, Water, Heritage and the Arts 2008).

Results

Taxonomic investigation of the phrase-named putative taxa allied to the '*M. viminalis* group' supports the recognition of *M.* sp. Denham, *M.* sp. Kalbarri and *M.* sp. Helena & Aurora as new species, and

these are described herein as *M. balsiformis* R.Butcher, *M. corallina* R.Butcher and *M. ferricola* R.Butcher, respectively. *Mirbelia* sp. Carnarvon is not supported as a distinct taxon at this stage (see discussion following Taxonomy).

With the recognition of these three new species, two subgroups are now evident within the '*M. viminalis* group'. The '*M. viminalis* subgroup' comprises *M. viminalis*, *M. balsiformis* and *M. corallina*, united by acute to acuminate buds, the calyx tube shorter than to just longer than the lobes, the upper calyx lobes scarcely or shortly fused at the base and an indumentum of appressed, peltate, golden-hued hairs. The '*M. ramulosa* subgroup' comprises *M. ramulosa*, *M. stipitata* and *M. ferricola*, united by obtuse, oblique buds with a small to prominent apiculus, the calyx tube much longer than the lobes, the upper calyx lobes fused into a distinct lip and an indumentum of appressed, more or less basifixed, translucent-white hairs. These subgroups are not based on a formal phylogenetic analysis and taxon relationships within the '*M. viminalis* group' and beyond are undoubtedly more complex than these convenient groupings imply. For example, the characters originally used to define the '*M. viminalis* group' are no longer completely diagnostic, as *M. ferricola* lacks spinescent branchlets and *M. corallina* has true leaves grading into scale leaves. Similarly, some characters are shared across subgroups; for example, *M. viminalis* and *M. stipitata* both have pods with thickened sutures which persist as an ellipse, bearing the style, after each half of the longitudinally divided pod falls away.

Taxonomy

Mirbelia balsiformis R.Butcher, *sp. nov.*

Typus: 22.7 km west along Useless Loop Road (north side) from Denham–Hamelin Road (Site: na5), Western Australia, 23 August 1994, *G.J. Keighery & N. Gibson* 1263 (*holo*: PERTH 04993683!; *iso*: CANB *n.v.*, MEL!).

Mirbelia sp. Denham (W.E. Blackall 556), Western Australian Herbarium, in *FloraBase*. http://florabase.dec.wa.gov.au [accessed 13 October 2011].

Erect to sprawling, dense *shrub* 0.7–1.7 m tall and 1–1.2 m wide; *branchlets* not forked, alternate, ascending, subtly striate to striate with raised, narrow, longitudinal ridges, almost smooth, sometimes minutely papillose, drying olive-green to yellowish green, usually with sparse to moderately dense, appressed, white, peltate hairs on young stems and flowering branchlets, glabrescent, the apices senescent into silvery grey, usually sharp points, occasionally spinescent. *Leaves* alternate, reduced to triangular, acuminate scales 1.3–2 mm long, 0.6–1 mm wide, persistent with apices falling away over time; abaxial surface densely appressed-pubescent towards margins, glabrescent along midline, with appressed, white and gold, peltate hairs; adaxial surface densely pubescent; stipules absent. *Flowers* ±horizontal to declined in ascending, lateral racemes; buds acute to obtuse, the calyx lobes shortly imbricate. *Pedicels* with dense, appressed, white and golden, peltate hairs, 0.8–3.2 mm long; *bracts* ovate to broadly ovate, obtuse to rounded, 0.65–1 mm long, 0.55–1.2 mm wide, persistent, light brown to reddish brown, with moderately dense to dense, appressed, white and golden, peltate hairs concentrated towards margins, sparse along midline; *bracteoles* attached towards the apex of the pedicel, lanceolate to broadly ovate, acute, 0.6–1.2 mm long, 0.4–0.7 mm wide, persistent, light brown to red-brown, with dense, appressed, white and golden, peltate hairs concentrated towards margins, sparse to glabrous along midline. *Calyx* broadly conical to campanulate at base, 4.5–5.4 mm long, appressed-puberulous with moderately dense to dense, flattened, peltate, golden hairs, woolly just inside lobe margins and at tips; lobes a little shorter than to equalling the tube (0.7–1 × tube length);

upper two lobes shortly united at base, narrowly triangular to triangular, slightly falcate, acute to acuminate, the free parts 1–1.9 mm long; lower three lobes narrowly triangular to triangular, acute to acuminate, 1.5–2.6 mm long. *Corolla* yellow to orange and red: *standard* reniform to broadly reniform, occasionally broadly obovate, emarginate, egg-yolk yellow with a narrow, diffuse red region surrounding a broad, pale yellow, irregularly-margined, ±domed eye, the red region broader at base than apex, scarcely following veins, 6.5–7.8 mm long, 7.9–10 mm wide, including a 1.1–1.7 mm long claw; *wings* ±ovate to ±obovate, lower edge straight to gently curved, apex broadly to obliquely rounded, gently downcurved, incurved to clasp keel, auriculate, egg-yolk yellow at apex and base, red in mid-region, 4.8–5.7 mm long, 1.9–2.4 mm wide, including a 1.2–1.8 mm long claw; *keel* sub-orbicular to obovate with upper and lower edges inrolled, tapering obliquely to an obtusely angled apex, auriculate, very strongly pouched in front of adaxial spur, light yellow at base and apex, red in mid-region, 4.4–5.3 mm long, 1.6–2.3 mm wide, including a 1.2–2 mm long claw. *Stamens* 10, free; *anthers* with a sagittate, orange connective on dorsal surface. *Gynoecium* 3.9–4.7 mm long, including a 0.2–0.5 mm long stipe and 1.5–2.5 mm long, slightly compressed style, this straight to inclined from base then hooked below stigma; *ovary* lanceolate when viewed from above, mostly glabrous with a narrow band of long, white, peltate hairs along the abaxial suture distally, extending along lower edge of style to *c.* 3/4 length; *ovules* 11–16; *stigma* simple to slightly capitate. *Pod* not conspicuously stipitate (the stipe enclosed by the persistent calyx), inflated, cymbiform, very deeply concave and strongly grooved adaxially, deeply convex and imperceptibly to shallowly grooved abaxially, 7.2–11.7 mm long, 4.2–5.6 mm wide, including the 0.2–0.5 mm long stipe, mostly glabrous bar a few apical hairs on adaxial surface extending onto style, the veins raised; false septa developed along both sutures, the abaxial one more pronounced, *c.* 2–3 × longer than the adaxial one; *seed* transversely depressed-ellipsoid, slightly raised above hilum, light brown when immature, dark brown at maturity, 1–1.1 mm long, 1.5–1.7 mm wide, the testa smooth but with faint, broadly curved, parallel lines; hilum with an annular, aril-like structure of short, pink-tinged papillae, this broadly interrupted at micropyle. (Figure 1)

Specimens examined. WESTERN AUSTRALIA: Kirralee Farm, Brooke Rd, Ajana, 10 km E of North West Coastal Hwy, 27 Aug. 2001, *G. & P. Allan* 33 (PERTH); just N of Murchison sandplain, North West Coastal Hwy, 18 July 1971, *A.M. Ashby* 3868 (AD, PERTH); 30 miles S of Denham (Shark Bay), 27 Aug. 1931, *W.E. Blackall* 556 (PERTH); 144 km S of Hamelin Pool, between Carnarvon and Geraldton, 28 Aug. 1931, *W.E. Blackall* 572 (PERTH); VCL S of Coolcalalaya Stn, on E side of Coolcalalaya Rd, 4.5 km due E of Thompson's Claypan. (Site: 21), 31 Aug. 1990, *A.H. Burbidge* 4499 (PERTH); *c.* 70 km S of Billabong on North West Coastal Hwy, 16 Aug. 1999, *R. Davis* 8932 (AD, PERTH); Peron Peninsula, 21 Aug. 1931, *C.A. Gardner* 2556 (PERTH); 55 miles N of Murchison River, North West Coastal Hwy, 2 Sep. 1960, *A.S. George* 1492 (PERTH); 34 miles S of Denham, 26 Aug. 1969, *A.S. George* 9553 (PERTH); 41 miles S of Wannoo Roadhouse, N of Geraldton, Aug. 1967, *C.H. Gittins* 1555 (PERTH); W-10 Mile Buffer, 19 Aug. 2004, *K. Himbeck* KH 27/04 (PERTH); 13 km W of Cooloomia HS, 50 km WNW of Nerren Nerren HS, 18 Sep. 1979, *S.D. Hopper* 1365 (PERTH); 'Cooloomia' Nature Reserve, 25 km SW of Cooloomia HS, 18 Sep. 1979, *S.D. Hopper* 1370 (PERTH); 23 km SSW of Cooloomia HS, 50 km W of Nerren Nerren HS, 70 km N of Kalbarri, 23 Aug. 1983, *S.D. Hopper* 3311 (PERTH); Useless Loop Rd 8.4 km SW from T-junction with Denham Rd, 80 km SSE of Denham, 6 Aug. 1986, *S.D. Hopper* 5120 (CANB, PERTH); *c.* 30 km NW of New Tamala HS, 20 July 1988, *G.J. Keighery & J.J. Alford* 2017 (DNA, PERTH); 2.5 km W along Useless Loop Rd (N side) from Denham–Hamelin Rd (Site: na2), 23 Aug. 1994, *G.J. Keighery & N. Gibson* 1267 (PERTH); Toolonga Nature Reserve, 27.96 km E of NW Coastal Hwy on track from highway at grid immediately N of Nerren Nerren turn-off, 3 Aug. 1996, *G.J. Keighery & N. Gibson* 1828 (CANB, PERTH); 5 km ENE of Nanga Stn HS, E of Nanga bore and yards, S of track [Plot-nang01], 3 Oct. 1997, *A. Markey* 1903 (PERTH); Shark Bay, entre Tamala et Nilemah Station, 20 July 1988, *Ph. Morat* 8240 (P, PERTH); North West Coastal Hwy, 61.7 km N of Kalbarri Rd, 30 Oct. 1996, *R. Schuh &*

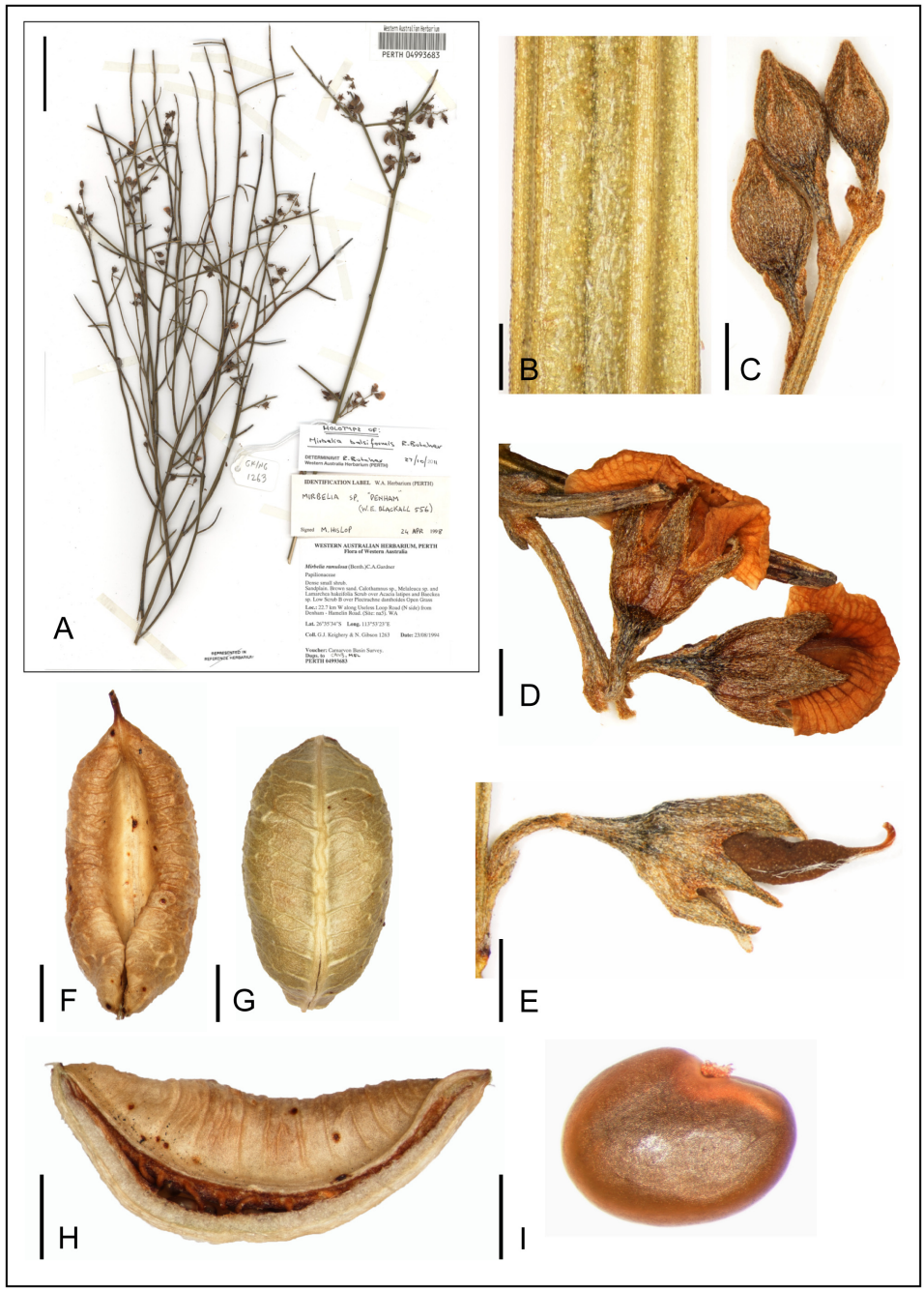

Figure 1. Images of *Mirbelia balsiformis*. A – holotype (*G.J. Keighery & N. Gibson* 1263; PERTH 04993683); B – stem detail; C – buds showing imbricate calyx lobes, bracts and bracteoles; D – pressed flowers showing calyx tube *c.* equal in length to lobes, upper lobes shortly fused at base, and persistent bracteoles; E – gynoecium *in situ* showing band of hairs along lower suture of ovary extending onto style; F – adaxial surface of ±sessile fruit showing concavity; G – abaxial surface of ±sessile fruit showing convexity; H – L.S. of fruit showing adaxial concavity and greater development of the abaxial suture; I – seed showing pink-tinged papillae within hilum. Images taken from *R. Butcher & R. Davis* 1271 (B); *C.H. Gittens* 1555 (C, D); *A.H. Burbidge* 4499 (E); *Schuh & Cassis* 96-40 (F–I). Scale bars = 5 cm (A); 0.5 mm (B, I); 2 mm (C–H).

G. Cassis 96-40 (PERTH); Shark Bay, site 3, 16 Sep. 1989, *M.E. Trudgen* 7376 (PERTH).

Distribution. Mostly in the western Yalgoo IBRA region through the Shark Bay area, extending to the south-east of Kalbarri (Figure 2).

Habitat. Commonly occurs in flat to undulating sandplain or low sand dune country, in yellow, orange or red deep sands, occasionally in brown sand, clayey sands or sandy loams. Occurs in a variety of vegetation types including low woodland, dense thicket and scrub, over shrubland, heath, grassland and herbs. Associated species include *Acacia acuminata*, *A. ligulata*, *A. ramulosa*, *A. rostellifera*, *A. roycei*, *Allocasuarina acutivalvis*, *A. campestris*, *Banksia ashbyi*, *Brachychiton gregorii*, *Eremophila maitlandii*, *Eucalyptus eudesmioides*, *E. mannensis* subsp. *vespertina*, *Grevillea rogersoniana*, *G. stenobotrya*, *Hakea stenophylla* and *Lamarchea hakeifolia* in the upper to mid-storey, and *Acacia latipes*, *Baeckea* sp., *Lechenaultia linarioides*, *Olearia* sp., *Pimelea microcephala*, *Stylobasium spathulatum* and *Triodia danthonioides* in the lower storey.

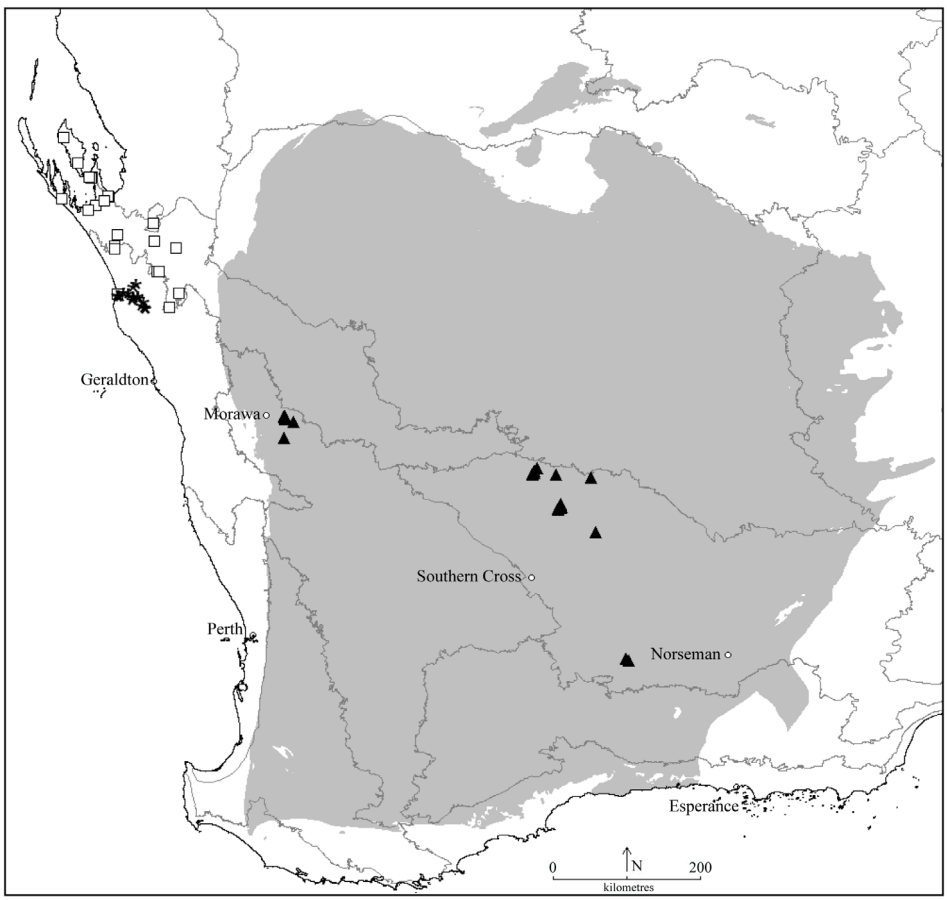

Figure 2. Distribution of *Mirbelia balsiformis* (□), *M. corallina* (*) and *M. ferricola* (▲) in south-west Western Australia. *Mirbelia balsiformis* is widely distributed across the western Yalgoo IBRA region with some extension into the Geraldton Sandplains and Carnarvon IBRA regions, while the conservation-listed taxa have their distributions restricted by habitat specificity. *Mirbelia corallina* is restricted to the sandplains around Kalbarri, in the Geraldton Sandplains IBRA region, while *M. ferricola* is restricted to the disjunct Banded Iron Formation ranges of the Yilgarn craton (light grey area) in the Avon Wheatbelt and Coolgardie IBRA regions.

Phenology. Flowers recorded from April to September and fruits from August to October, but probably persisting later.

Conservation status. This species does not require a conservation code.

Etymology. Named for its fruit, which resemble the woven totora (*Schoenoplectus californicus* subsp. *tatora*) reed boats constructed by pre-Columbian South American civilizations, such as those still living on Lake Titicaca. These boats are traditionally called 'balsa'.

Affinities. Affiliated with *M. viminalis* and *M. corallina* in the '*M. viminalis* subgroup' (see Results). Within this subgroup *M. balsiformis* is most similar to *M. viminalis* in its erect, dense habit and flower colour and shape, but most similar to *M. corallina* in fruit shape (only seen immature in *M. corallina*) and in consistently having long hairs at the apex of the ovary which extend onto the style.

Mirbelia balsiformis differs from *M. viminalis* in having branchlet apices that senesce into dull to moderately sharp points (*cf.* apices spinescent and pungent), red and yellow flowers (*cf*. uniformly yellow), a slender line of hairs consistently along the lower suture of the ovary and along the lower edge of the style (*cf.* glabrous or rarely with scattered hairs on style and ovary, more rarely with ovary densely hairy), fruit that are strongly convex on the abaxial edge and very strongly concave on the adaxial surface along the suture line (*cf.* obliquely ovoid-ellipsoid with a distinct groove along the adaxial suture), the abaxial septum more developed than the adaxial one (*cf.* abaxial septum absent and the adaxial one very well developed) and 11–16 (*cf.* 4) ovules. The differences from *M. corallina* are discussed under that species.

Notes. Three specimens of *M. balisiformis* at CANB (*S.J. Forbes* 1662, image viewed; *S.D. Hopper* 5120 ; *G.J. Keighery & N. Gibson* 1828, both duplicated at PERTH) have been determined as *M. rigida* (Benth.) Crisp ms by collections staff. This name is apparently based on *M. daviesioides* (Meisn.) Benth. var. *rigida* Benth.; however, the type of this variety ('Dirk Hartog Island, New Holland', *Milne s.n.*; K 000642608, image viewed) clearly belongs to *M. ramulosa* (*fide* M.D. Crisp 1987, *in sched.*) and these determinations are in error. The name *M. rigida* ms has been taken up in a number of web publications such as The Pea Key (Australian Pea-flowered Legume Research Group 2007–) and GBIF (Global Biodiversity Information Facility 2001–), based on CANB data; however, its nomenclatural status awaits a formal treatment of the *M. ramulosa* complex (see below).

Mirbelia corallina R.Butcher, *sp. nov.*

Typus: Kalbarri National Park, Western Australia [precise locality withheld for conservation reasons], 5 September 2008, *R. Butcher & R. Davis* RB 1274 (*holo*: PERTH 08023808!; *iso*: CANB!, K!, MEL!).

Mirbelia sp. Kalbarri (M.D. Crisp 6261), Western Australian Herbarium, in *FloraBase*. http://florabase.dec.wa.gov.au [accessed 13 October 2011].

Slender, sprawling *sub-shrub* to 1 m tall and to 0.6 m wide; *branchlets* not forked, alternate or opposite, spreading, deeply striate, smooth, drying light green to yellowish green, usually with sparse to moderately dense, appressed, white and golden, peltate hairs on young stems and flowering branchlets, glabrescent, the apices senescing into silvery grey, dull to sharp points, sometimes spinescent. *Leaves* infrequent at base of branchlets, alternate, ascending, narrowly elliptic to narrowly obovate,

3.8–7.2 mm long, 0.7–1.8 mm wide, including the 0.3–0.7 mm long petiolar region, the apex obtuse to acuminate, straight or recurved, with a small apiculus, with appressed, flattened, translucent-white, peltate hairs on both surfaces, grading into triangular scale-leaves 0.8–1.6 mm long, 0.2–0.6 mm wide, persistent with apices falling away over time; stipules absent. *Flowers* horizontal to ascending, in ascending, terminal racemes; buds usually acuminate, sometimes acute, the apex downcurved, the calyx lobes valvate. *Pedicels* 2.5–3.5 mm long, with moderately dense, appressed, flattened, golden, peltate hairs; *bracts* ovate, acute, 1–1.3 mm long, 0.6–0.75 mm wide, persistent, light golden brown, with moderately dense to dense, appressed, flattened, golden, peltate hairs concentrated towards margins and at base, midline glabrescent; *bracteoles* attached between the middle and apex of the pedicel, triangular to ovate, acute, 0.8–1.65 mm long, 0.3–0.45 mm wide, persistent, green, drying light brown to red-brown, with sparse to moderately dense, appressed, flattened, golden, peltate hairs concentrated towards margins, the midline glabrescent. *Calyx* conical to turbinate at base, 6–9.6 mm long, with moderately dense to dense, flattened, golden, peltate hairs, woolly just inside lobe margins and at tips; lobes shorter than to longer than the tube (0.7–1.4 × tube length); upper two lobes scarcely united at base, narrowly triangular, slightly falcate, acuminate, the free parts 2.3–5.1 mm long; lower three lobes narrowly triangular, acuminate, 2.7–5.8 mm long. *Corolla* coral-pink to apricot-pink: *standard* broadly reniform, shallowly emarginate, coral-pink fading to apricot-pink with a diffuse, darker pink region surrounding a bright yellow, irregularly-margined, ±oblong eye, the darker pink region broader at base than apex, following veins for a short distance, reverse of standard diffusely dark pink, 9.5–13.4 mm long, 10.2–16.7 mm wide, including a 1.9–2.4 mm long, thickened claw; *wings* ±obovate, the apex rounded, downcurved, enveloping keel, auriculate, coral-pink fading to apricot-pink, darker pink to pink-red in proximal half, 7.2–8.7 mm long, 3.4–3.8 mm wide, including a 1.1–1.9 mm long claw; *keel* ±quadrate, the apex oblique, obtuse to beaked, shortly and broadly auriculate, very strongly pouched in front of adaxial spur, yellowish, 5–5.6 mm long, 2–2.8 mm wide, including a 1.4–1.6 mm long claw. *Stamens* 10, free; *anthers* with a linear, orange connective on dorsal surface. *Gynoecium* 5.2–6.2 mm long, including a 0.7–0.9 mm stipe and 1.9–3.8 mm long scarcely compressed style, this straight then geniculate just below stigma; *ovary* depressed-ellipsoid when viewed from above, prominently invaginated to broadly concave along upper suture, mostly glabrous in proximal half, with long, appressed, white, peltate hairs concentrated in the distal half on all surfaces, sometimes extending along abaxial suture onto the stipe, extending onto style to 3/4–7/8 of length and concentrated on the lower and lateral surfaces; *ovules* 6–10; *stigma* simple, oblique. *Immature pod* not conspicuously stipitate (the stipe enclosed by the persistent calyx), inflated, ovoid to ellipsoid, very deeply concave adaxially, convex and scarcely grooved abaxially, *c.* 6.8 mm long including the *c.* 1.4 mm stipe, with scattered, long, appressed, white, peltate hairs concentrated in the distal half on all surfaces, sometimes extending along abaxial suture onto stipe, extending onto style to 3/4–7/8 of its length and concentrated on the lower and lateral surfaces, the veins raised; false septa developed along both sutures, the abaxial one more pronounced, *c.* 2 × longer than adaxial one; *seed* not seen. (Figure 3)

Specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 9 Sep. 1980, *Bellairs* 1410 (PERTH); 5 Sep. 1988, *D. & B. Bellairs* 2205 (PERTH); 8 Oct. 1996, *D. & B. Bellairs* 4012 (CANB, PERTH); 16 Sep. 1999, *D. & B. Bellairs* 6044 (CANB, PERTH); 8 Sep. 1990, *A.H. Burbidge* 4498 (PERTH); 31 Aug. 1966, *A.C. Burns* 1023 (PERTH); 10 Oct. 1996, *M.G. Corrick & B.A. Fuhrer* MGC 11380 (MEL, PERTH); 30 Sep. 1979, *M.D. Crisp, J. Taylor & R. Jackson* MDC 6261 (CBG, PERTH); 24 Sep. 2000, *M.D. Crisp & L.G. Cook* MDC 9251 (CANB, PERTH); 23 Aug. 1983, *I.R. Dixon s.n.* (PERTH); 3 Sep. 1963, *A.R. Fairall* 1194 (PERTH); 29 Sep. 1985, *N. Hoyle* 567 (PERTH); Oct. 1961, *Mrs de la Hunty s.n.* (PERTH); 26 Sep. 1995, *S. Patrick* 2434 (PERTH); 27 Sep. 1995, *S. Patrick* 2441 (PERTH); 29 Sep. 1999, *D. Pember* 40 (PERTH), 65 (PERTH); 8 Oct. 1982, *K.H. Rechinger* 58384 (PERTH); 25 Sep. 1953, *N.H. Speck s.n.* (PERTH).

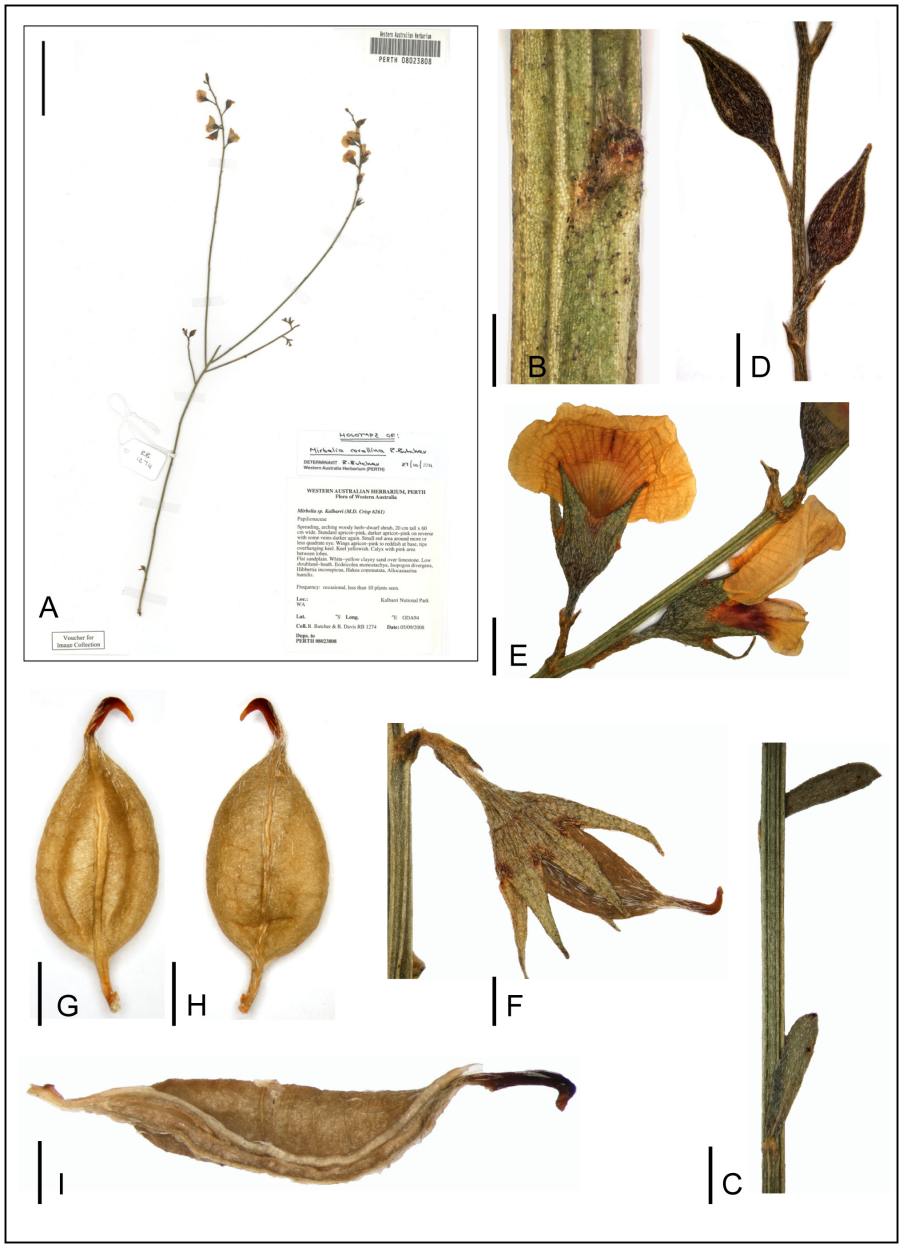

Figure 3. Images of *Mirbelia corallina*. A – holotype (*R. Butcher & R. Davis* RB 1274; PERTH 08023808); B – stem detail showing scale leaf remnant; C – young stem and leaves; D – buds showing valvate calyx lobes, bracts and bracteoles; E – pressed flowers showing persistent bracteoles, calyx tube *c.* equal to lobes in length, upper lobes fused just at the base, pink-orange patch between calyx lobes, and downcurved wing petal apex; F – gynoecium *in situ* showing calyx tube just shorter than lobes in length, orange-brown patch between calyx lobes, and hairs on lower surface and apex of ovary extending onto style; G – adaxial surface of immature fruit showing concavity and hairs on fruit apex extending onto style; H – abaxial surface of immature fruit showing convexity, hairs on fruit apex extending onto style and hairs along lower suture extending onto stipe; I – L.S. of immature fruit showing adaxial convexity and greater development of the abaxial septum. Images taken from *M.D. Crisp & L.G. Cook* 9251 (B); *S. Patrick* 2441 (C); *I.R. Dixon s.n.* PERTH 02887851 (D); *R. Butcher & R. Davis* 1274 (E); *D. & B. Bellairs* 401 (F–I). Scale bars = 5 cm (A); 0.5 mm (B); 2 mm (C–I).

Distribution. Restricted to the Kalbarri area of Western Australia (Figure 2), with the majority of collections made from within Kalbarri National Park.

Habitat. Grows on sandplain and winter-wet flats, in kwongan heath and low shrubland. Associated taxa include *Acacia* spp., *Anigozanthos kalbarriensis*, *Banksia* spp., *Calytrix* sp., *Conospermum stoechadis*, *Ecdeiocolea monostachya*, *Eremaea* sp., *Geleznowia* sp., *Grevillea integrifolia*, *Hakea auriculata*, *Malleostemon* sp., *Melaleuca uncinata*, *Patersonia occidentalis*, *Scholtzia* sp., *Stenanthemum pomaderroides*, *Synaphea spinulosa*, *Verticordia picta* and *V. polytricha*.

Phenology. Flowering from August to October with immature fruit seen in early October.

Conservation status. Listed as Priority Three under Department of Environment and Conservation (DEC) Conservation Codes for Western Australian Flora (Smith 2012), as *Mirbelia* sp. Kalbarri (M.D. Crisp 6261).

Etymology. The specific epithet is derived from the Latin word *corallinus* (coral-coloured), and refers to the colour of the flowers, which readily distinguishes this species from its most-similar congeners, which have yellow, or yellow and red, flowers.

Affinities. Affiliated with *M. viminalis* and *M. balsiformis* in the '*M. viminalis* subgroup' (see Results). Within this subgroup *M. corallina* is most similar to *M. balsiformis* in fruit shape (inflated and deeply concave on the adaxial surface), in the indumentum of the ovary and style (hairs along abaxial edge, at apex and onto style), and in frequently having a pink patch between each calyx lobe, at the base.

Mirbelia corallina can be readily differentiated from both *M. viminalis* and *M. balsiformis* by its spreading to decumbent habit, its larger, coral-pink to apricot-pink flowers, which have the wing petals folded over the apex of the keel for a long distance, its longer, narrower calyx lobes, its gynoecium having hairs on the distal part of the ovary and the lower and lateral surfaces of the style, and its possession of 6–10 ovules (*cf.* 11–16 in *M. balsiformis*; 4 in *M. viminalis*).

Mirbelia ferricola R.Butcher, *sp. nov.*

Typus: Helena and Aurora Range, Western Australia [precise locality withheld for conservation reasons], 3 October 2008, *N. Gibson, K. Brown & B. Moyle* 4621 (*holo*: PERTH 07979835!; *iso*: AD!, BRI!, CANB!, DNA!, HO!, K!, MEL!, NY!, NSW!).

Mirbelia sp. Helena & Aurora (B.J. Lepschi 2003), Western Australian Herbarium, in *FloraBase*. http://florabase.dec.wa.gov.au [accessed 12 October 2011].

Erect *shrub* 1–3 m tall and 0.7–2 m wide; *branchlets* not forked, alternate, ascending, prominently striate, minutely papillose, drying dull pale green to yellow-green, with moderately dense, appressed, white to occasionally stramineous, ±basifixed hairs on young stems and flowering branchlets, glabrescent, the apices senescing to silvery grey, dull points, not spinescent. *Leaves* alternate, reduced to ovate to triangular, acuminate scales, 1–3.5 mm long, 0.6–1.7 mm wide, persistent with apices falling away over time; abaxial surface glabrous; adaxial surface densely silky from base; stipules absent. *Flowers* pendulous in ascending, terminal racemes; buds obtuse, oblique, with a pronounced apiculus, the calyx lobes imbricate. *Pedicels* 1.4–3 mm long, with moderately dense to dense, loosely appressed, white, ±basifixed hairs; *bracts* lanceolate, ovate, narrowly rhombic or triangular, acuminate, 1.9–3.1 mm

long, 0.7–1.5 mm wide, caducous before anthesis, green, drying red-brown, with sparse to moderately dense, loosely appressed, white, ±basifixed hairs covering or concentrated towards the apex and ciliate margins, glabrescent, especially along midline; *bracteoles* attached above the middle of the pedicel (usually towards the apex), linear-lanceolate to narrowly elliptic, acuminate, 1.7–3 mm long, 0.3–0.8 mm wide, caducous before anthesis, mid-green with pale yellow-green base and red-brown apex, with sparse to moderately dense, loosely appressed, white, ±basifixed hairs covering or concentrated towards the apex and ciliate margins. *Calyx* broadly conical to turbinate at the base, 4.2–6.1(7–7.4) mm long, with sparse to moderately dense, white, ±basifixed hairs, occasionally sub-glabrous, woolly just inside margins of calyx lobes; lobes shorter than the tube (0.47–0.69 × tube length); upper two lobes united into a lip, acute, or obtuse and apiculate at tips, the free parts 0.75–1.8 mm long; lower three lobes triangular, acute, 1.5–3.3 mm long. *Corolla* yellow and red: *standard* broadly reniform to flabelliform, emarginate, pale yellow to yellow with prominent red border to a darker yellow, stellate eye, the red border broader at base than apex, following veins for a short distance, more pronounced on reverse, 8.1–10.3 mm long, 11.8–16.5 mm wide, including a 1.9–2.6 mm long claw; *wings* narrowly to broadly obovate, oblique, the apex rounded to truncate, occasionally broadly 2-lobed, downcurved, enveloping keel, auriculate, pale yellow, the proximal half reddish, 7.6–9.3 mm long, 3.3–4.7 mm wide, including a 1.7–2.7 mm long claw; *keel* sub-orbicular to semicircular, obliquely angled on abaxial edge, broadly rounded at apex, auriculate, with a small pouch in front of adaxial spur, cream-yellow, reddish at apex and in adaxial half, 5.4–7.1 mm long, 2.5–3.6 mm wide, including a 1.9–2.6 mm long claw. *Stamens* 10, free; *anthers* without an orange connective on dorsal surface. *Gynoecium* 4.3–6 mm long, including a 0.8–1.5 mm long stipe and 1.7–2.5 mm long, slightly compressed, incurved style; *ovary* narrowly ellipsoid when viewed from above, mostly glabrous with some long, white, ±basifixed hairs along the abaxial suture in the distal 1/2 to 2/3, the hairs covering ovary apex and extending onto style to up to 3/4 length; *ovules* (12)14–16; *stigma* capitate. *Pod* not conspicuously stipitate (the stipe enclosed by the persistent calyx), inflated but dorsiventrally compressed, narrowly ovoid, narrowly ellipsoid or narrowly obovoid, tapering obliquely towards style on adaxial edge, not or shallowly grooved along abaxial suture, moderately to deeply grooved along adaxial suture, 6.8–13.5 mm long, 3.8–5 mm wide, including the 2.2–3.2 mm long stipe, mostly glabrous except for a few hairs towards the apex and within the lower suture extending onto style, the veins raised; false septa developed along both sutures, the abaxial one more pronounced, extending almost to adaxial suture; *seed* obliquely compressed-obloid to obliquely compressed-ellipsoid, prominently raised above hilum, orange- to mid-brown when immature, dark olive-green with black spots at maturity, 1.4–2 mm long, 1.3–1.9 mm wide, testa smooth; hilum with an annular, aril-like structure of minute, pink-tinged papillae, this interrupted at micropyle. (Figure 4)

Specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 2 Sep. 2008, *R. Butcher & R. Davis* RB 1266 (CANB, K, MEL, PERTH); 8 Oct. 2004, *V. Clarke* 504 (PERTH); 23 June 2005, *G.F. Craig* 6576 (PERTH); 15 Sep. 1988, *R.J. Cranfield* 7482 (AD, CBG, PERTH); 21 Sep. 2004, *R. Dillon & C. Yates* 1 (PERTH); 17 Nov. 2004, *R. Dillon & C. Yates* 3 (PERTH); 4 Oct. 2008, *N. Gibson, K. Brown & B. Moyle* 4627 (PERTH, DNA); 20 Sep. 1994, *N. Gibson & M. Lyons* 1881 (PERTH); 27 July 1995, *N. Gibson & M. Lyons* 2951 (PERTH); 3 Nov. 1995, *N. Gibson & B. Moyle* 3390 (PERTH); 25 Sep. 1995, *B.J. Lepschi* 2003 (CANB, PERTH); 8 Oct. 2005, *R. Meissner & Y. Caruso* 508 (PERTH); 9 Oct. 2005, *R. Meissner & Y. Caruso* 1434 (PERTH), 1435 (PERTH), 1437 (PERTH); 12 Oct. 2005, *R. Meissner & Y. Caruso* 1433 (PERTH); 13 Oct. 2005, *R. Meissner & Y. Caruso* 1436 (PERTH); Sep. 1981, *K.R. Newbey* 8949 (PERTH).

Distribution. *Mirbelia ferricola* occurs on a number of Banded Iron Formation (BIF) ranges in the semi-arid Yilgarn region of Western Australia, including the Koolanooka Hills and Perenjori Hills, on the border of the Avon Wheatbelt–Yalgoo IBRA regions, as well as Mt Finnerty, Mt Manning,

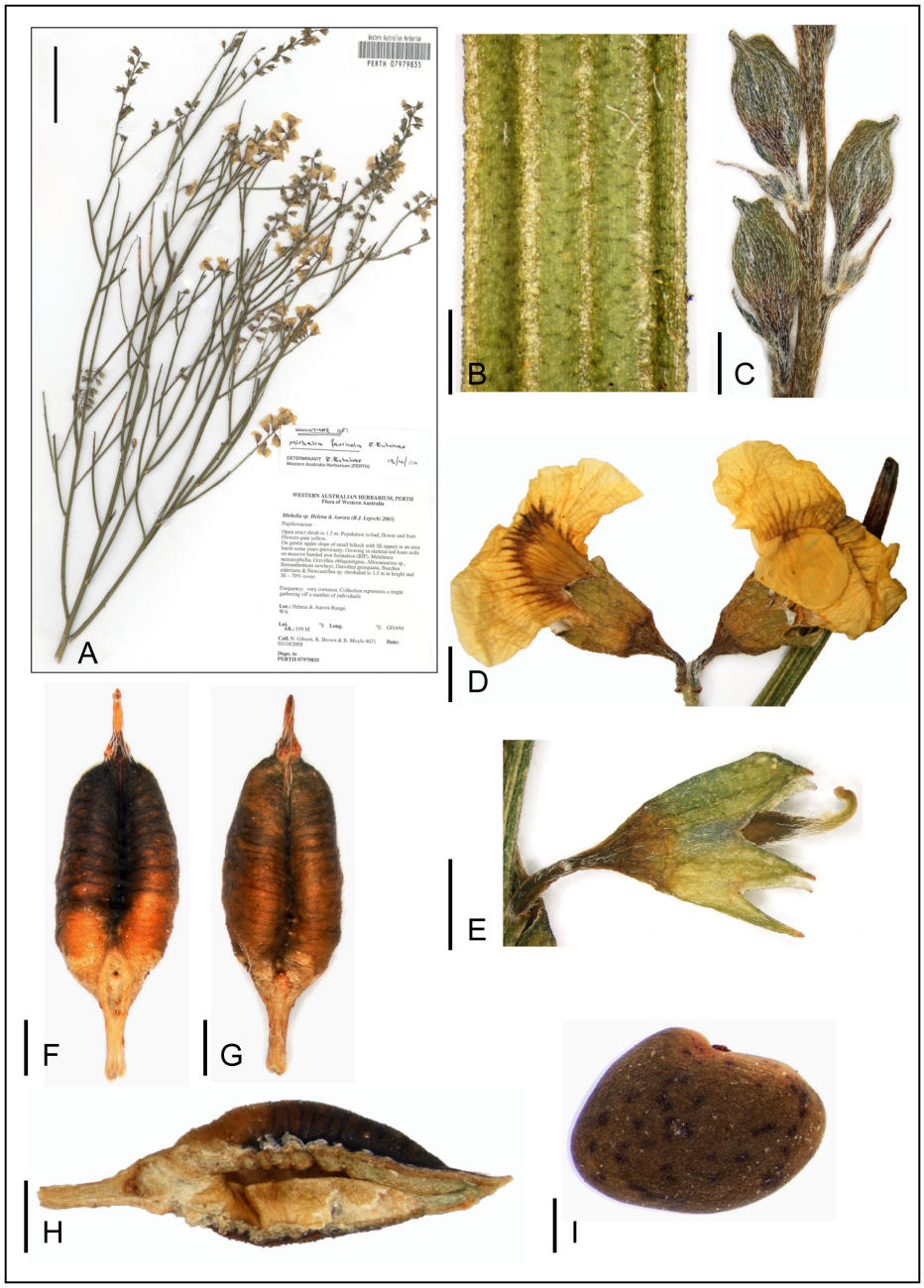

Figure 4. Images of *Mirbelia ferricola*. A – holotype (*N. Gibson, K. Brown & B. Moyle* 4621; PERTH 07979835); B – stem detail; C – buds showing oblique apex with apiculus and bracts and bracteoles with acuminate apices; D – pressed flowers showing calyx tube longer than the lobes, the upper lip fused for *c.* half its length, and scars where bracts and bracteoles have fallen; E – gynoecium *in situ* showing hairs at the apex of the ovary extending along the sutures and onto the style; F – adaxial surface of stipitate fruit showing deep groove and hairs at style base; G – abaxial surface of stipitate fruit showing groove and hairs along suture and at style base; H – L.S. of fruit showing well-developed septa and greater development of the abaxial septum; I – seed showing irregular dark spots and short, pink-tinged papillae within hilum. Images taken from *N. Gibson, K. Brown & B. Moyle* 4261 (B, D, E); *R. Butcher & R. Davis* RB 1267 (C); *B.J. Lepschi* 2003 (F–I). Scale bars = 5 cm (A); 0.5 mm (B, I); 2 mm (C–H).

the Helena and Aurora Range, the Die Hardy Range and the Bremer Range, in the Coolgardie IBRA region (Figure 2).

Habitat. *Mirbelia ferricola* is apparently restricted to the BIF habitat type. Plants grow in shallow and lateritic soils on lower to upper slopes and crests of BIF massifs and laterised banded ironstone with haematite, as well as on ledges and between rock-cracks on BIF cliffs. Occurs in open woodland and/or tall shrubland with a diverse low shrub understorey, over sparse forbs, ferns, grasses and sedges. Associated taxa include *Acacia quadrimarginea*, *Allocasuarina acutivalvis* subsp. *acutivalvis* and subsp. *prinsepiana*, *Eucalyptus ebbanoensis* subsp. *glauciramula*, *E. livida*, *Grevillea obliquistigma*, *Melaleuca atroviridis*, *M. cordata* and *M. nematophylla* in the upper storey, *Acacia acuminata*, *A. nigripilosa* subsp. *nigripilosa*, *Aluta appressa*, *A. aspera* subsp. *hesperia*, *Alyxia buxifolia*, *Baeckea elderiana*, *Banksia arborea*, *Calycopeplus paucifolius*, *Dodonaea scurra*, *Hibbertia arcuata*, *H. exasperata*, *Grevillea georgeana*, *G. paradoxa*, *Logania buxifolia*, *Mirbelia ramulosa*, *Olearia muelleri*, *Stenanthemum newbeyi*, *Tetratheca paynterae* subsp. *cremnobata* and *Westringia cephalantha* in the lower- to mid-storey, over *Aira* sp., *Chamaexeros macranthera*, *Cheilanthes adiantoides*, *Lepidosperma* sp., *Neurachne annularis*, *Trachymene ornata* and *Waitzia acuminata* var. *acuminata*.

Phenology. Flowering from late June to November, with fruit recorded from September to November.

Conservation status. Listed as Priority Three under DEC Conservation Codes for Western Australian Flora (Smith 2012), as *Mirbelia* sp. Helena & Aurora (B.J. Lepschi 2003).

Etymology. The specific epithet refers to the iron-rich substrate upon which this species is restricted (L. *ferrum*, iron; -*icola*, dweller).

Affinities. Affiliated to *M. ramulosa* and *M. stipitata* in the '*M. ramulosa* subgroup' (see Results). Within this subgroup *M. ferricola* is most similar to *M. ramulosa* in ovule number, fruit morphology and stipe length, whereas *M. stipitata* is easily distinguished from both by its possession of only two ovules, fruit with sunken veins in which the pseudo-septum is retained on the plant while the seed-holding halves of the pod fall away, and a long stipe (*c.* 3 mm long) which is exserted beyond the persistent calyx in fruit. While *M. ramulosa* usually has 3-forked, spinescent branchlets, a glabrous calyx, the bracts and bracteoles persistent at least until fruit-set and a glabrous ovary (but see below for variants), *M. ferricola* has simple, non-spinescent branchlets, an appressed-puberulous calyx, the bracts and bracteoles caducous before anthesis and hairs at the apex of the ovary which extend onto the style.

Variation in Mirbelia ramulosa and the status of M. sp. Carnarvon

The taxonomic status of *Mirbelia* sp. Carnarvon is less clear than for the other, previously phrase-named taxa in this group, and needs to be considered in the context of *M. ramulosa*, the most similar described species. Detailed examination of *M. ramulosa* specimens at PERTH and from AD has identified some interesting patterns of variation and these are summarised here so as to facilitate further study of the group.

Mirbelia ramulosa is a widespread taxon occurring across the drier parts of the South-west Botanical Province of Western Australia, extending into the Yalgoo, Murchison, Carnarvon, Gascoyne, Coolgardie and Central Ranges bioregions of the Eremaean Botanical Province and into the southern

Northern Territory (Western Australian Herbarium 1998–; Council of Heads of Australasian Herbaria 2009–). The species is typically characterised by the following combination of characters: prominently striate or sulcate stems with spinescent, usually three-forked lateral branchlets; terminal and/or axillary racemes; glabrous calyx with a well-formed, shallowly emarginate upper lip; calyx lobes much shorter than the tube; glabrous bracts and bracteoles with ciliate margins; bracteoles usually persistent beyond anthesis; glabrous ovary and style; 14–18 ovules; inflated pods which are ±straight on the abaxial edge and obliquely convex on the adaxial edge, with shallow to moderately deep grooves along both sutures; and abaxial septum most developed and extending almost to the adaxial suture in pods (Bentham 1864; Grieve 1998).

The name *Mirbelia* sp. Carnarvon (J.S. Beard 6008) was erected on Western Australia's plant census in 2002 to accommodate a handful of fruiting specimens from between Shark Bay and Exmouth, allied to *M. ramulosa*. However, the taxonomic concept behind *M.* sp. Carnarvon and the means by which it might be distinguished from *M. ramulosa* are obscure, with no record of the reasons for its segregation and with considerable variation evident among the five specimens available for study. Four of these specimens bear specialist determinavits (all made at the time of erecting the name) and although they have similar morphology (i.e. leafless stems with numerous simple, non-spinescent apical branchlets; pods glabrous and obliquely convex on the adaxial edge), two of them (E of Carnarvon, *J.S. Beard* 6008; Cape Range, *A.S. George* 10286) have slender stems with subdued striae, bearing only non-spinescent, simple branchlets, and eight to ten ovules per pod, while the remaining two (Dirk Hartog Island, *R.I.T. Prince s.n.* PERTH 05188113; Shark Bay, *M.E. Trudgen* 7172) have prominently striate stems bearing a mixture of spinescent and non-spinescent, simple and forked branchlets, and *c*. 30 ovules per pod. Neither of these forms is a good match for more typical specimens of *M. ramulosa*. As *J.S. Beard* 6008 is the designated voucher for *M.* sp. Carnarvon, this name is only appropriately applied to the slender-stemmed form with fewer ovules, with the other specimens best assigned to a variable *M. ramulosa s. lat.* (see below).

Recent flowering and fruiting collections made from near the original collection site of *J.S. Beard* 6008 (*R. Butcher & S. Dillon* RB 1541, RB 1542; *G. Guerin & M.E. Trudgen* GG 1033) are morphologically comparable with that specimen and provide further information on habitat and habit for this putative taxon. Plants occur on red sand dunes and are generally large (to 1.5 m × 1.5 m), domed shrubs with slender, ascending, somewhat tangled branches. Stems have infrequent, three-forked lateral branchlets and are finely and shallowly striate, with a number often arising from a node. Flowers are comparable to *M. ramulosa*, although at the smaller end of the range, and have eight to ten ovules. Fruit are tall relative to their length, being strongly convex on the adaxial edge and steeply angled to the style, but fall within the range of variation observed in *M. ramulosa*. Other specimens matching this morphology have also been collected from sand hills in the Kennedy Range (e.g. *J.S. Beard* 4393; *R. Butcher & S. Dillon* RB 1540; *R. Butcher & R. Davis* RB 1548; *R.J. Cranfield* 1917; *K. Newbey* 11719), from sand hills east of Wooramel (*G.J. Keighery & N. Gibson* 1248), at Cape Range (*A.S. George* 10286) and on Burnerbinmah Station (*S. Patrick* 2930).

Although the specimens cited above form a relatively cohesive group and match the voucher for *M.* sp. Carnarvon, the boundary of this putative taxon is poorly defined from *M. ramulosa s. lat.*, which this study has found to be highly variable across its range. Among the PERTH and AD specimens of *M. ramulosa s. lat.* examined for this study, variation was observed in the thickness of stems, the prominence and spacing of stem ridges, the degree to which stems and calyces are glaucous, the relative occurrence of simple and three-forked lateral branchlets, the spacing between the lateral branchlets and the lengths of each fork, the relative occurrence of terminal and axillary racemes, whether pedicels were glabrous or appressed-pubescent, shapes and lengths of bracts and bracteoles, indumentum of

calyces and ovaries, the shape of fruit, and the number of ovules (4–30). There is some geographic pattern in the morphological variation of *M. ramulosa s. lat.*, although similar forms occur in widely disjunct areas, different forms occur together and various forms intergrade with each other and with *M.* sp. Carnarvon.

Many specimens of *M. ramulosa s. lat.* collected from the Eremaean Botanical Province have similar overall morphology to *M.* sp. Carnarvon, as well as *M. stipitata* (Wiluna–N of Laverton), in that their stems are slender and subtly striate to almost smooth and their lateral branchlets are frequently simple or have long forks. These specimens have a higher number of ovules (10–14) than *M. stipitata* (2) but overlap with *M.* sp. Carnarvon (8–10). Many of these specimens come from similar sand dune habitats to *M.* sp. Carnarvon, though others occur around granites. Two interesting specimens from the northern Gascoyne (Turee Creek dunefields, *S. Black s.n.* PERTH 06344046; Turee Creek Station, *D.J. Edinger & G. Marsh* DJE 3489) are also morphologically similar to *M.* sp. Carnarvon, but have only four or five ovules.

Similarly, many specimens of *M. ramulosa s. lat.* from the northern sandplains between Geraldton and Nerren Nerren also share a suite of characters, being tall shrubs (to 1.5 m high) with elongate terminal inflorescences (plus shorter axillary racemes) and infrequent to frequent 3-forked branchlets which tend to be longer than those observed on Wheatbelt collections. These are similar to Shark Bay specimens previously included in *M.* sp. Carnarvon (i.e. *M.E. Trudgen* 7172; *R.I.T. Prince s.n.*). Elongate terminal inflorescences and longer-forked branchlets also occur on specimens collected from other areas, however, including the Darling Scarp, from near York and from the Ravensthorpe–Hopetoun region. Specimens having numerous, short, 3-forked lateral branchlets with a higher number of short axillary racemes are also widespread and are common in the Wheatbelt. All of these specimens are more or less typical of *M. ramulosa* and have prominently striate stems, often with the ridges much narrower than the grooves.

Ovule number counts from a selection of *M. ramulosa s. lat.* specimens (83 of 165) from across its range reveal some interesting patterns that require further investigation (Figure 5). Specimens with 11–18 ovules are widely distributed across the south-west and also occur in Central Australia. There is a trend towards an increase in ovule number northwards from the Geraldton area to Shark Bay, where the highest number (30) was found. Interestingly, slender-stemmed specimens from areas inland of Carnarvon and between Turee Creek and Laverton have noticeably lower ovule numbers (4–12), overlapping *M.* sp. Carnarvon (8–10); however a specimen with a typically Wheatbelt morphology from north-east of Ongerup (*K.R. Newbey* 1467) also had ten ovules. Further sampling is required, however, to investigate these patterns, including the degree to which ovule number varies between flowers on a single plant, whether there are other robust morphological differences correlated to differences in ovule number, and whether these differences are correlated to substrate.

There may also be phenological differences between morphological variants in this complex: for example, two specimens collected in the Shark Bay area five days apart (*M.E. Trudgen* 7332, *M.E. Trudgen* 7172) are at very different phenological stages, the former in bud, flower and early fruit and the latter in late fruit. It is also noteworthy that *M.E. Trudgen* 7332 has 22 ovules while *M.E. Trudgen* 7172 has 30 ovules. These differences in phenology and ovule number undoubtedly contributed to the first collection being identified as *M. ramulosa* while the second was identified as '*Mirbelia* sp.(2)' and later assigned in error to *M.* sp. Carnarvon, along with *R.I.T. Prince s.n.* The specimens *M.E. Trudgen* 7172 and *R.I.T. Prince s.n.* are similar to the type of *M. daviesioides* var. *rigida*, also collected from the Shark Bay area (see *Notes* under *M. balsiformis*); however, a full revision of *M. ramulosa s. lat.* is needed to determine whether the name '*rigida*' should be used and at what rank.

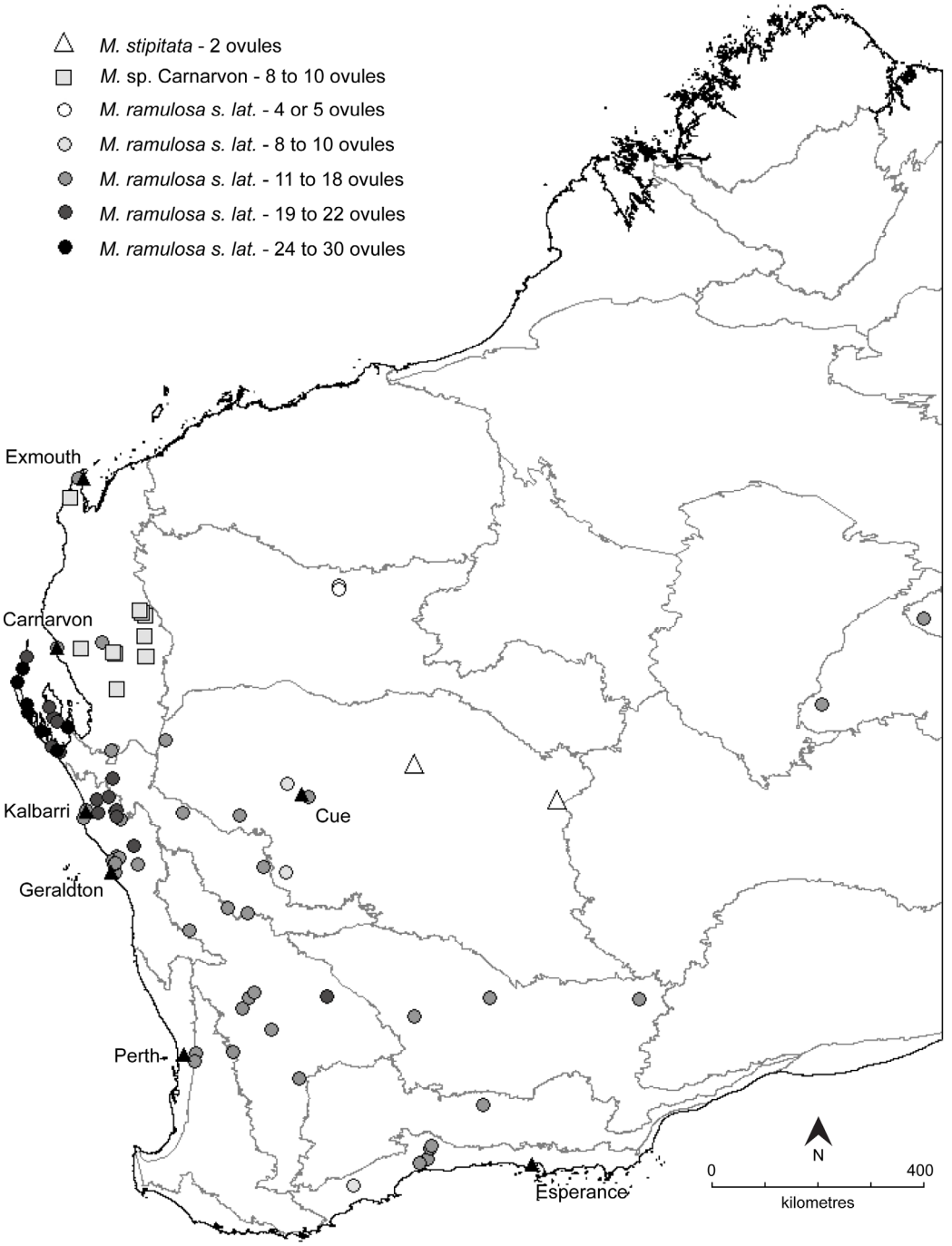

Figure 5. Geographic distribution of various ovule numbers in a selection of *Mirbelia ramulosa s. lat.*, *M.* sp. Carnarvon and *M. stipitata* specimens in Western Australia. *Mirbelia stipitata* is characterised by having only two ovules, while *M. ramulosa s. lat.* specimens have between four and 30 ovules, with the recognisable form *M.* sp. Carnarvon having between eight and ten ovules. While specimens of *M. ramulosa s. lat.* having 11–18 ovules are widespread across its range, two specimens from the upper Gascoyne are unusual in having only four or five ovules, specimens with ten ovules have been collected near Cue and near Ongerup, specimens with 19–22 ovules occur mostly north of Geraldton through to Shark Bay, and specimens with 24–30 ovules are restricted to the Shark Bay area.

Taxa that have already been segregated from *M. ramulosa* (*M. stipitata*, *M. ferricola*) have a number of robust characters supporting their recognition as discrete species. It is not yet possible, however, to identify similarly strong and consistent characters among specimens of *M.* sp. Carnarvon, despite them being a recognisable group. Although they cannot be adequately separated as a discrete taxon at this stage, and they have a nebulous relationship with other Eremaean collections of *M. ramulosa s. lat.*, the name *M.* sp. Carnarvon (J.S. Beard 6008) should be retained on Western Australia's plant census pending a comprehensive study of the patterns of morphological and molecular variation in *M. ramulosa s. lat.* across its range.

Key to scale-leaved *Mirbelia* in Western Australia

1. Indumentum, where present, comprising peltate, white and/or golden hairs; bud apices acuminate to acute, occasionally obtuse, not apiculate; upper calyx lobes fused only at base or to less than half their length

2. Spreading sub-shrubs with true leaves and scale leaves; calyx lobes in buds valvate; flowers coral-pink to apricot-pink (WA: Kalbarri area)..... **M. corallina**

2: Erect shrubs with scale leaves only; calyx lobes in buds imbricate; flowers yellow or yellow and red

3. Flowers yellow and red; ovules 11–16; pods cymbiform, deeply concave on adaxial edge, abaxial septum more developed than adaxial septum (WA: Shark Bay to E Kalbarri) ..... **M. balsiformis**

3: Flowers yellow; ovules 4; pods obliquely ovoid-ellipsoid, convex and deeply grooved on adaxial edge, abaxial septum absent, adaxial septum very well developed (WA: Eremaean and Northern Botanical Provinces; NT; Qld) ..... **M. viminalis**

1: Indumentum, where present, comprising ±basifixed, translucent to white hairs; bud apices obliquely rounded to obtuse with a small to prominent apiculus; upper calyx lobes fused for half their length or more into a lip

4. Ovules 2; stipe *c.* 3 mm long; pods deeply grooved along both sutures, veins sunken, stipe exserted beyond persistent calyx (WA: Meekatharra to Laverton) ..... **M. stipitata**

4: Ovules 4–30; stipe 0.4–1.5 mm long; pods not to shallowly grooved along abaxial suture, scarcely to moderately deeply grooved along adaxial suture, veins raised, stipe not exserted beyond persistent calyx

5. Branchlets not spinescent, not 3-forked; bracts and bracteoles acuminate, 1.7–3.1 mm long, caducous before anthesis; ovary with long hairs along the abaxial suture, covering the apex and extending along the style (WA: Yilgarn BIF ranges) ..... **M. ferricola**

5: Branchlets usually spinescent, infrequently to frequently 3-forked; bracts and bracteoles obtuse to acute, 0.4–2 mm long, usually persistent beyond anthesis; ovary and style usually glabrous

6. Plants large, tangled shrubs with slender, subtly striate, infrequently 3-forked stems; ovules 8–10 (WA: sand dunes E Carnarvon) ..... **M. sp. Carnarvon**

6: Plants variable in height, stems slender to robust, subtly striate to prominently sulcate, infrequently to frequently 3-forked; ovules 2–30 (WA: South-west and Eremaean Botanical Provinces; NT)..... **M. ramulosa s. lat.**

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References

Australian Pea-flowered Legume Research Group (2007–). *The Pea Key*. http://www.anbg.gov.au/cpbr/cd-keys/peakey/key/The%20Pea%20Key/Media/Html/index.html [accessed 10 May 2012].

Bentham, G. (1864). *Flora Australiensis*. Vol. 2. pp. 32–38. (Reeve & Co.: London.)

Centre for Australian National Biodiversity Research (1999–). *Australian Plant Name Index*. http://www.anbg.gov.au/cgi-bin/apni [accessed 3 May 2012].

Council of Heads of Australasian Herbaria (2009–). *Australia's Virtual Herbarium (AVH)*. http://www.chah.gov.au/avh/ [accessed 17 November 2011].

Crisp, M.D. & Cook, L.G. (2003a). Molecular evidence for definition of genera in the *Oxylobium* group (Fabaceae: Mirbelieae). *Systematic Botany* 28(4): 705–713.

Crisp, M.D. & Cook, L.G. (2003b). Phylogeny and embryo sac evolution in the endemic Australasian papilionoid tribes Mirbelieae and Bossiaeeae. *In*: Klitgaard, B.B. & Bruneau A. (eds) *Advances in legume systematics Part 10: higher level systematics*. pp. 253–268. (Royal Botanic Gardens, Kew: London.)

Crisp, M.D. & Taylor, J.M. (1987). Notes on *Leptosema* and *Mirbelia* (Leguminosae – Papilionoideae) in Central Australia. *Journal of the Adelaide Botanic Gardens*. 10(1): 131–143.

Crisp, M.D. & Weston, P.H. (1987). Cladistics and legume systematics, with an analysis of the Bossiaeeae, Brongniartieae and Mirbelieae. *In*: Stirton, C.H. (ed.) *Advances in legume systematics Part 3*. pp. 65–130. (Royal Botanic Gardens, Kew: London.)

Department of the Environment, Water, Heritage and the Arts (2008). *Interim Biogeographic Regionalisation for Australia (IBRA) Version 6.1*. http://www.environment.gov.au/parks/nrs/science/bioregion-framework/ibra/index.html [accessed 25 August 2011].

Global Biodiversity Information Facility (2001–). *Mirbelia rigida ms*. http://es.mirror.gbif.org/species/16134559/ [accessed 10 May 2012].

Grieve, B.J. (1998). *How to know Western Australian wildflowers Part 2: Dicotyledons (Amaranthaceae to Lythraceae)*. 2nd Edn. (University of Western Australia Press & the Wildflower Society of Western Australia (Inc.): Nedlands.)

Orthia, L.A., Cook, L.G. & Crisp, M.D. (2005a). Generic delimitation and phylogenetic uncertainty: an example from a group that has undergone an explosive radiation. *Australian Systematic Botany* 18: 41–47.

Orthia, L.A., Crisp, M.D., Cook, L.G. & de Kok, R.P.J. (2005b). Bush peas: a rapid radiation with no support for the monophyly of *Pultenaea* (Fabaceae: Mirbelieae). *Australian Systematic Botany* 18: 133–147.

Schrire, B.D. (1995). Evolution of the tribe Indigofereae (Leguminosae – Papilionoideae). *In*: Crisp, M.D. & Doyle, J.J. (eds) *Advances in legume systematics Part 7: phylogeny.* pp. 161–244. (Royal Botanic Gardens, Kew: London.)

Smith, J.E. (1805). *Mirbelia. In*: Koenig, C. & Sims, J. *Annals of botany*. p. 115. (R. Taylor: London.)

Smith, M. (2012). *Declared Rare and Priority Flora list for Western Australia*. (Department of Environment and Conservation: Kensington.)

Thiers, B. (continuously updated). *Index Herbariorum: a global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium*. http://sweetgumnybg.org/ih/ [accessed 12 October 2011].

Western Australian Herbarium (1998–). *FloraBase—the Western Australian Flora*. Department of Environment and Conservation. http://www.florabase.dec.wa.gov.au/ [accessed 17 November 2011].