Nuytsia The journal of the Western Australian Herbarium

32: 39–50 Published online 24 June 2021

Two new, orange-flowered *Tephrosia* (Fabaceae: Millettieae) species from the Kimberley region, in Western Australia's monsoon tropics

Ryonen Butcher

Western Australian Herbarium, Biodiversity and Conservation Science,
Department of Biodiversity, Conservation and Attractions,
Locked Bag 104, Bentley Delivery Centre, Western Australia 6983
Email: Ryonen.Butcher@dbca.wa.gov.au

Abstract

Butcher, R. Two new, orange-flowered *Tephrosia* (Fabaceae: Millettieae) species from the Kimberley region, in Western Australia's monsoon tropics. *Nuytsia* 32: 39–50 (2021). Ongoing taxonomic revision of *Tephrosia* Pers. in Australia is continuing to identify new taxa from study of existing herbarium collections as well as new material gathered from remote and under-collected areas. The Kimberley region of Western Australia is recognised for its biodiversity and endemism, but the recognition of new species is hampered by its inaccessibility, especially to areas of relief with complex microhabitats and refugia. It is from these areas that many recently described species, from across the Western Australian flora, have been collected. This paper describes and illustrates two new, poorly known, orange-flowered species of *Tephrosia* from the Kimberley region: *T. cowiei* R.Butcher, a close ally of the Northern Territory's *T. bifacialis* Cowie, and *T. funicularis* R.Butcher, a distinctive new species from sandstone habitats.

Introduction

Tephrosia Pers. (Fabaceae: Millettieae) is a pantropically distributed, species-rich genus of pea-flowered legumes, comprising 77[1] named and 57 unnamed native taxa in Australia, based on the *Australian Plant Census* and Butcher (2018a, 2018b, 2020, this publication). This is considered an underestimate of its true diversity in Australia, with many more putatively new taxa recognised informally within the Herbarium collections of Queensland (BRI), Western Australia (PERTH) and the Northern Territory (DNA) as a result of recent and ongoing taxonomic revisions.

Since Les Pedley (dec.) commenced his revision of *Tephrosia* in Australia in the 1970s, 11 new taxa have been formally described from Western Australia (Pedley 1977; Maconochie 1980; Cowie 2004; Butcher & Hurter 2012; Butcher 2018a, 2018b, 2020). Of these, four extend across the Australian Monsoon Tropics (AMT) (*sensu* Bowman *et al.* 2010) from the Kimberley region (i.e. Kimberley Plateau phytogeographic sub-region *sensu* Ebach *et al.* (2013), of the Northern phytogeographic region *sensu* González-Orozco *et al.* (2014) and Ebach *et al.* (2015)) and beyond (WA+NT: *T. procera* Cowie, *T. spechtii* Pedley, *T. valleculata* Cowie; WA+NT+Qld: *T. virens* Pedley). The remaining seven are known only from Western Australia, with six occurring in the Northern Desert or Eremaean phytogeographic regions (*sensu* González-Orozco *et al.* (2014) and Ebach *et al.* (2015)) (*T. andrewii* Cowie, *T. arenicola* Maconochie, *T. densa* (Benth.) Pedley ex R.Butcher, *T. gardneri* Pedley ex

[1]Counting the species name and the autonym (and its rank variations, e.g. in *T. filipes*) as one taxon where infrataxa are listed.

© Department of Biodiversity, Conservation and Attractions 2021
https://florabase.dpaw.wa.gov.au/nuytsia/
ISSN 2200-2790 (Online)
ISSN 0085-4417 (Print)

R.Butcher, *T. oxalidea* R.Butcher & P.J.H.Hurter and *T. pedleyi* R.Butcher) and one (*T. cardiophylla* R.Butcher) apparently restricted to the Kimberley.

With a geomorphologically and physiographically diverse land area of 424,500 km^2, dominated by tropical savanna woodland punctuated with rainforest remnants, Western Australia's Kimberley region has a high level of richness and endemism for flora, fauna and fungi (e.g. Ladiges *et al.* 2011; Pepper & Keogh 2014; Barrett 2016). The region has a monsoonal climate, with average rainfall varying from 1,500 mm in the north-west coastal areas to under 350 mm in the south. Its varied terrain has evolved over 250 million years, supports a flora and fauna distinct from the remainder of Western Australia, and is a unique bioregion within the AMT (Pepper & Keogh 2014); it contains more than 2,000 plant species (Western Australian Herbarium 1998–) and is an area of endemism for many groups (e.g. species of *Eucalyptus* and *Corymbia*; Ladiges *et al.* 2011).

Thirty-eight (76%) of the 50 new species described in the collected papers of *Nuytsia* vol. 26, a special issue celebrating 50 years of the Botanic Gardens at Kings Park, are Kimberley taxa. The richest areas for new species discoveries have been highly seasonal sandstone pavements, mostly in the higher rainfall north-west Kimberley, as well as the peaks, plateaux, cliff-faces and gorges associated with dissected sandstone ranges, and outcrops (Barrett 2015). These environments provide microhabitats, and refugia from fire in surrounding savannas, with shallow soils undergoing complex wet-dry cycles supporting diverse communities of annual plants (Barrett 2015).

There are presently 151 informally named taxa on the Western Australian plant census (Western Australian Herbarium 1998–) that occur in the Kimberley region, a number that reflects only those collections that have sufficient material for taxonomic assessment, have been critically studied, and have been processed. Of these, 75 have conservation listing in Western Australia (T=1; P1=45; P2=12; P3=15), indicating their poorly known status[2]. There are undoubtedly many other putatively new Kimberley taxa among the specimens at PERTH that have not yet been identified as such or processed into the collection.

For Beard's (1980) Northern Botanical Province of Western Australia[3], an analysis of the PERTH specimen collection by former curator Kevin Thiele found that over the period 1980–2010, on average one new taxon was discovered for every 30 specimens collected (Government of Western Australia 2011). This average rose to one new taxon for every eight specimens collected when only wet season collections were analysed; most Kimberley specimens (>80%) have been collected during the dry season, when the region can be more easily accessed. Thiele's Kimberley analyses indicate that (1) the return (new taxa) on investment (specimens collected) is very high (particularly for wet season collections; see also Barrett 2015), and (2) our state of knowledge of the flora is a long way from complete and the rate of discovery is very high.

Species discovery in the Kimberley is hampered by the scale and remoteness of the region, as well as complex land tenures. Consequently, field work is logistically challenging and expensive, with accessibility issues (e.g. road closures etc.) significantly exacerbated in the wet season, when most species are fertile and collections are of greatest value. For much of the Kimberley we are data deficient and lack the collections needed to properly assess species boundaries in poorly known taxa (or to describe them in full) and the field experience necessary to develop our taxonomies meaningfully through *in situ* observations of morphological variation across different habitats. Both of these constraints apply to

[2]For definitions see: https://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/Listings/conservation_code_definitions.pdf

[3]Comprising the IBRA regions Dampierland, North Kimberley, Central Kimberley, and those areas of the Ord-Victoria Plains and Victoria Bonaparte west of the Northern Territory border.

Tephrosia in the Kimberley and across the AMT: many interesting singleton or incomplete specimens languish, unvalidated, in the collection, and many seemingly variable and widespread, putatively new taxa have fuzzy boundaries with one another across their range. Comparatively, the highest number of *Tephrosia* phrase names erected and resolved since commencement of recent study has been in the Pilbara bioregion, which reflects comprehensive survey effort there (Pilbara Region Biodiversity Survey; McKenzie *et al.* 2009), often facilitated by improved access and increased collecting activity associated with the mining industry, and subsequent taxonomic investigations (Butcher *et al.* 2017).

In this paper, two new, orange-flowered species of *Tephrosia* from Western Australia are described, both known only from the Kimberley region. The first belongs in a group of reticulate-nerved species treated by Cowie (2004), with sterile material recognised as being different from the closely allied species *T. bifacialis* Cowie in that publication and in his specimen determinations from 2011 (*T.* sp. aff. *bifacialis* and *T.* aff. *reticulata* Benth.). Now that flowering and fruiting material has been seen, it is named here in his honour as *T. cowiei* R.Butcher. The second, *T. funicularis* R.Butcher, was recognised as new during revisionary curation of the PERTH *Tephrosia* collection, with two specimens located under *T. remotiflora* Benth. and one under *T. supina* Domin. It is readily distinguishable from both, however, and its affinities lie closer to *T. crocea* Benth. That the first known collection of *T. funicularis* was made in 2001 serves to highlight how poorly collected many taxa are in this mostly inaccessible region and is yet another example of ongoing taxonomic discovery in the Kimberley.

Material and methods

All *Tephrosia* specimens housed at PERTH were critically studied, as were the collections housed at AD, BRI, CANB, DNA, MEL, NSW and NT, and Australian material on loan from K. Types of all Australian species have been viewed on loan, through *Global Plants* (https://plants.jstor.org) or as images (e.g. from PR). Bioregions and sub-bioregions referred to in the text and displayed on distribution maps follow *Interim Biogeographic Regionalisation for Australia* (IBRA) v. 7 (Department of the Environment 2013).

Leaf venation terminology follows Ellis *et al.* (2009). The inflorescence is interpreted as a pseudoraceme following Tucker (1987, 2003), where the elongate rachis has fascicles of flowers in the axils of first-order bracts (here termed 'inflorescence bract'), each flower subtended by a second-order bract (here termed 'floral bract'); paired bracteoles on the pedicel can be present or absent in the genus. Fascicles comprise one or more 3-flowered units, with the first two flowers opening in relatively close succession and the third flower in each unit often delayed developmentally, with anthesis commonly occurring once the first two flowers have developed into fruits. Seed length is measured from the hilar side (point of attachment) to the opposite side, with width measured at 90° to this; terminology surrounding the hilum and rim aril follows Butcher (2020) and references therein.

Taxonomy

Tephrosia cowiei R.Butcher, *sp. nov.*

Type: Durack Station, east of Durack River crossing on Gibb River Road, Western Australia [precise locality withheld for conservation reasons], 4 May 2018, *R. Butcher, E.M. Joyce & K. Thiele* RB 2186 (*holo*: PERTH 09316221; *iso*: BRI, CANB, DNA).

Tephrosia sp. Durack River (C.A. Gardner 9938), Western Australian Herbarium, in *FloraBase*, https://florabase.dpaw.wa.gov.au/ [accessed 7 February 2020].

Prostrate *subshrub*, few- to multi-stemmed, apparently perennial with annual above-ground parts, to 0.2 m tall including inflorescences, to 1.5 m wide; rootstock an undifferentiated taproot. *Branchlets, leaf and inflorescence rachides* moderately hairy, the hairs patent to spreading (in both directions) on the same plant, 0.3–1 mm long, straight to slightly wavy, white, hyaline. *Leaves* trifoliolate to pinnate, up to 90 mm long including petiole; *stipules* usually persistent, antrorse, reflexed with age, attenuate to ovate, 2–4.5 mm long, green ageing to yellow-brown, 3- or 5-nerved, sparsely to densely hairy; *petiole* 2–7 mm long; *ultrajugal rachis* 3.4–11 mm long; *stipellae* absent; *petiolules* 0.9–1.8 mm long; *leaflets* 3–7, elliptic to broadly oblong to obovate, flat in T.S. but depressed along midvein, at least some attached in the basal half of the leaf; base rounded; apex rounded to truncate, retuse, straight, not to scarcely mucronate, mucro 0.2–0.3 mm long on young leaves, otherwise vestigial; lateral leaflets 11–34 mm long, 8–24 mm wide, length 1.24–2.17 × width; terminal leaflet 1.05–1.32 × the length of adjacent laterals, 16–53.5 mm long, 10–31 mm wide, length 1.22–2.13 × width; lamina strongly discolorous, the upper surface mid- to dark green; upper surface glabrous, somewhat glaucous; lower surface indumentum moderately dense to dense, the hairs appressed, hyaline-white to silvery, sometimes visible from above as a hairy margin; secondary veins brochidodromous, in 8–13 pairs, the intersecondary veins reticulate, sometimes parallel at base before divaricating, veins raised on lower surface. *Inflorescence* pseudoracemose, terminal, to 325 mm long, fascicles well-spaced, 3–6(–9)-flowered; *inflorescence bracts* caducous (not seen); *floral bracts* antrorse, attenuate to deltoid, 0.6–1.5 mm long, caducous; *bracteoles* usually absent, if present then not on all flowers in inflorescence and spathulate, *c.* 0.2 mm long (excluding indumentum), caducous; *pedicels* 0.9–4.5 mm long. *Calyx* 2.2–3.6 mm long, indumentum moderately dense, the hairs ascending, hyaline-white, slightly wavy; tube 1.5–2.4 mm long, 1.1–1.6 × the length of lateral lobes; lower and lateral lobes narrowly deltoid to deltoid; vexillary lobes united higher than lower three, free for 0.2–0.6 mm; lowest lobe 1.1–1.8 mm long, ±equal to lateral lobes. *Flowers* pale orange, 5.5–7.5 mm long; standard 4.4–5.5 mm long, 5.5–7.4 mm wide, the claw 1–1.9 mm long, the blade depressed-ovate to transversely reniform, slightly callused at base with a shallowly emarginate apex; wings 4.6–5.8 mm long (incl. 1–2.3 mm long claw), 2.3–2.75 mm wide, longer than keel, the blade broadly oblong to obovate, with a broadly rounded apex; keel 3.9–5.6 mm long (incl. 0.7–2.2 mm long claw), 1.9–2.4 mm wide, the blade semi-circular, glabrous. *Staminal* tube glabrous, fenestrae a little thickened on margins towards the base; vexillary filament straight in lower half and not callused near base, glabrous; anthers 0.5–0.7 mm long, 0.4–0.6 mm wide, with a small apiculus between the cells. *Ovary* densely hairy; ovules 3 or 4, positioned in mid-region of ovary with notable voids at the proximal and distal ends (or just the proximal end). *Style* flattened, tapering to apex, some hairs at base on vexillary side; stigma ciliate, linear. *Pod* linear, straight, 30–40 mm long, 4–5.2 mm wide, tapering outwards from base to near apex because of ovule/seed position, stramineous (greyish pale brown by the following season), indumentum moderately dense, ascending to patent, white, the hairs straight to slightly wavy; beak excentric to central, deflexed; white tissue present between seeds and where seeds are absent. *Seeds* 1–4 per pod, 5.8–7 mm between centres of adjacent seeds, ±ellipsoid, slightly oblique at one end, very thick in the middle, 2.7–3.2 mm long, 4.4–4.7 mm wide, uniformly golden brown or flecked with gold and dark brown, yellow-gold around hilum, testa smooth; hilum slightly excentric, with an indistinct, golden, horse-collar shaped rim aril. (Figure 1)

Diagnostic features. Distinguished from all other Australian *Tephrosia* species by the following combination of characters: closely prostrate plants with 3–7, strongly discolorous, elliptic to obovate leaflets 11–53.5 × 8–31 mm; terminal pseudoracemes of pale orange flowers 5.5–7.5 mm long, with the calyx tube = to or longer than the lateral lobes, which are *c.* = in length to the lower lobe; glabrous staminal tube and vexillary filament; 3 or 4 ovules, which are positioned only in the mid-region of the ovary or centrally and distally; linear pod with an excentric to central, deflexed beak; and smooth, thick, obliquely ellipsoid, golden brown (often flecked) seeds 2.7–3.2 × 4.4–4.7 mm.

Figure 1. *Tephrosia cowiei*. A – small plant showing prostrate habit, 3–7 elliptic to obovate leaflets per leaf and spent, terminal infructescence (pods fallen); B – terminal pseudoraceme of pale orange flowers, showing the calyx tube longer than the deltoid lobes. Images from the type population (A) and the type, *R. Butcher, E.M. Joyce & K. Thiele* RB 2186 (B). Photographs by R. Butcher.

Specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 4 June 2012, *R.L. Barrett* RLB 7625 (DNA, NSW, PERTH); 4 May 2018, *R. Butcher, E.M. Joyce & K. Thiele* RB 2187 (PERTH); 20 May 1993, *I. Cowie* 4173 (BRI, CANB, DNA, MEL, PERTH); 15 May 2006, *I.D. Cowie* 11185 *& D. Dixon* (BRI, DNA, MEL, PERTH); 19 Oct. 2001, *A. Craig*

KNR_Ag0036 (PERTH); 30 Jan. 1951, *C.A. Gardner* 9938 (PERTH, 2 sheets); *s. dat.*, *B. Morgan s.n.* (PERTH 09316248).

Distribution. Currently known only from Durack River, Gibb River, and Doongan Stations, in the Central Kimberley and Northern Kimberley bioregions (Figure 2).

Habitat. Grows in sandy or gravelly, sometimes seasonally wet/waterlogged, soils over sandstone, in *Eucalyptus obconica* or *E. tectifera-Melaleuca sericea* woodland over *Aristida hygrometrica* and *Sorghum* sp.

Phenology. Flowering and fruiting periods are not properly known. Only three specimens have flowers, and these were collected in late January, May and August (many flowers); dehiscing pods with seed were collected in early May.

Conservation status. Listed as Priority One (Poorly Known Flora) under Conservation Codes for Western Australian Flora as *T.* sp. Durack River (C.A. Gardner 9938) (Smith & Jones 2018). This is equivalent to the IUCN rank Data Deficient. This species is very poorly known and has been collected only six times since 1951, over an area of *c.* 60 km, and mostly along the Gibb River Road. Access

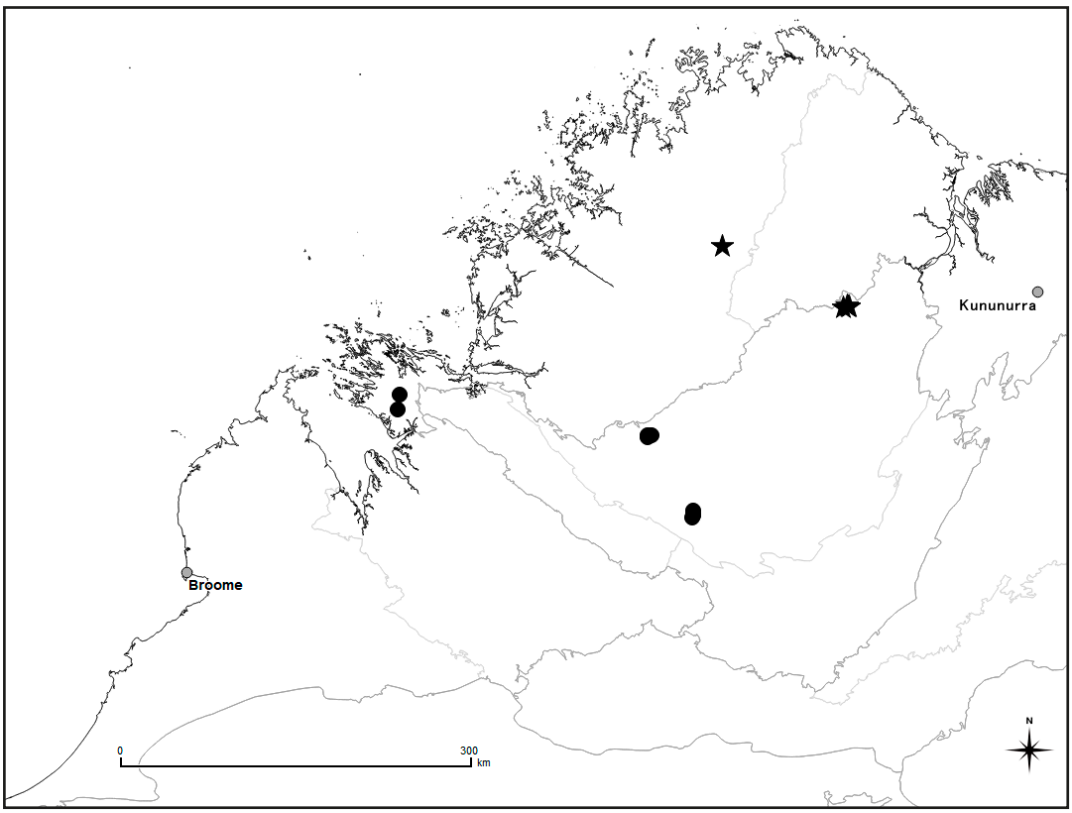

Figure 2. Distribution of *Tephrosia cowiei* (★) and *T. funicularis* (●) in the Kimberley region of northern Western Australia, where both species are known from the Central Kimberley and Northern Kimberley bioregions. *Interim Biogeographic Regionalisation for Australia* (IBRA) v 7 bioregions are shown in dark grey with subregions shown in light grey (Department of the Environment 2013).

issues in the Kimberley, combined with the unassuming, prostrate habit of this species, suggest that it may be more widespread than current collections indicate; however, this has yet to be determined.

Etymology. Named for *Tephrosia* specialist Ian Donald Cowie (1956–), Chief Botanist at the Northern Territory Herbarium, who was the first to recognise this species as distinct, during his revision of the reticulate-nerved taxa in northern Western Australia and the Northern Territory (see Cowie 2004).

Affinities and notes. *Tephrosia cowiei* is closely allied to the Northern Territory species *T. bifacialis*, which occurs *c.* 400 km to the north-east, between Daly River and Kakadu National Park, northward to Melville Island. Both species are prostrate with scarcely to shortly petiolate, ground-appressed leaves with strongly discolorous leaflets (upper surface green, glabrous; lower surface silver-white through dense indumentum), and pale orange flowers. *Tephrosia cowiei* differs notably, however, in having 3–7 leaflets that are 11–53.5 mm long and 8–31 mm wide (*vs* 3, rarely 1; 24–97 × 16–64 mm) with appressed indumentum on the lower leaflet surface (*vs* ascending, ±lanose), smaller flowers (5.5–7.5 mm long *vs* 7–14 mm long) and calyx (2.2–3.6 mm *vs* 4–9 mm), wings broadly oblong to obovate (*vs* elliptic), keel 3.9–5.6 mm long and straight on upper margin (*vs* 5–12 mm long, incurved on upper margin), staminal tube and vexillary filament glabrous (*vs* both significantly hairy) and three or four ovules positioned in the mid-region of the ovary (*vs* 6–12 ovules along the length of the placenta).

While the inflorescence and floral bracts of *T. bifacialis* are predominantly persistent and it has obvious bracteoles at either the junction of the pedicel and calyx tube or halfway down the pedicel (these caducous after flowering to persistent into fruit), the bracts of *T. cowiei* are caducous and the bracteoles are absent or rarely present (and caducous) on only a few flowers in the inflorescence.

When describing *T. bifacialis*, Cowie (2004: 172) noted that two incomplete, 5-foliolate collections from the central Kimberley (e.g. *I. Cowie* 4173) were allied to this but different, and he tentatively placed them with *T. reticulata*. Like *T. cowiei*, *T. reticulata* has more than three leaflets per leaf and a glabrous staminal tube and vexillary filament. This latter species is not known from Western Australia and differs in its: distinctly petiolate leaves with 7–13, very narrowly ovate to oblong leaflets that are (usually) not strongly discolorous and have prominently reticulate, raised venation on the upper surface of leaflets; persistent, lanceolate to ovate, leaf-like inflorescence and floral bracts; prominent, persistent bracteoles on the slender pedicel; longer calyx lobes relative to the calyx tube; and broader pods (6–7 mm wide). The two species can be distinguished even when sterile by their stipules (2–4.5 mm long, usually antrorse and attenuate to ovate in *T. cowiei vs* 4.8–10 mm long, prominently reflexed and narrowly ovate to ovate in *T. reticulata*) and visibility of the reticulating intersecondary venation on the lower leaflet surface (very obvious in *T. reticulata*).

Another very similar species is the Northern Territory taxon *T. humifusa* Cowie, which is vegetatively almost identical to *T. bifacialis* but can be readily distinguished by its purple flowers on longer pedicels in prostrate inflorescences, its shorter, broader, flatter pods, and fewer, larger, elongate-lenticular seeds with the hilum excentric. The secondary and intersecondary venation on the lower leaflet surface is also somewhat reddish (on specimens seen) in this species compared with *T. bifacialis*, a phenomenon common among pink/purple-flowered taxa across *Tephrosia*.

Highlighting again the remarkable convergence in vegetative morphologies in *Tephrosia*, *T. cowiei* shares its prostrate habit, and leaflet number, shape, size and colour with the North American species *T. chrysophylla* Pursh. They differ significantly in the colour and morphology of their flowers, however, with notable differences in the indumentum and apex shape of their pods, also.

Tephrosia funicularis R.Butcher, *sp. nov.*

Type: Mornington [Sanctuary], Western Australia [precise locality withheld for conservation reasons], *H. Dauncey* H 529, 3 March 2011 (*holo*: PERTH 08364133!; *iso*: CANB!, PERTH 08417393!).

Tephrosia sp. Yampi (A.N. Start per R.L. Barrett RLB 2291), Western Australian Herbarium, in *FloraBase*, https://florabase.dpaw.wa.gov.au/ [accessed 18 February 2020].

Sprawling, few-stemmed, perennial *subshrub*, 0.1–0.7 m tall, 0.2–0.7 m wide, with a slender taproot. *Branchlets, leaf and inflorescence rachides* with moderately dense, stiff, straight, patent to ascending, white indumentum, to 1.2 mm long. *Leaves* pinnate, 25–77 mm long including petiole, occasional unifoliolate leaves on flowering branchlets; *stipules* persistent, antrorse just at first then strongly reflexed with the apices frequently upturned (like a handlebar moustache), leaf-like, lanceolate to narrowly ovate, 3.5–6.5 mm long, green, 1- to 5-nerved, with only the central nerve extending to the apex; *petiole* 5–24 mm long; *ultrajugal rachis* 1.2–8.2 mm long; *stipellae* absent; *petiolules* 0.6–1.2 mm long; *leaflets* (3–)5–9(–11), almost oblong to elliptic to obovate, flat in T.S., at least some attached in the basal half of the leaf; bases rounded; apices rounded, straight, minutely mucronate with mucro 0.4–0.5 mm long; lateral leaflets 5.2–20 mm long, 2.5–8.7 mm wide, length 1.54–2.67 × width, gradually increasing in size from base to apex of rachis; terminal leaflet 1.15–1.45 × the length of adjacent laterals, 7–30 mm long, 3.9–11.7 mm wide, length 2.25–2.76 × width; lamina discolorous; upper surface appearing glabrous but with a moderately dense indumentum of short, gently ascending to patent, very fine, straight, silvery hyaline hairs; lower surface indumentum moderately dense, hairs ascending, straight, much longer than on upper, white; secondary veins brochidodromous, in 6–11 pairs, intersecondary veins obscure on lower surface, parallel at base, diffuse towards margin (seen on upper surface). *Inflorescence* pseudoracemose, leaf-opposed, often with a cluster of flowers in the leaf axil, or axillary only, pseudoraceme 9–153 mm long, fascicles well-spaced, 3–9-flowered; *inflorescence bracts* caducous to tardily so, ovate, acuminate, 1.6–2.1 mm long; *floral bracts* 0.4–1 mm long, attenuate to lanceolate and acuminate, caducous; *pedicels* 1.8–4.3 mm long; *bracteoles* absent. *Calyx* 3–4.6 mm long, moderately to densely hairy, the hairs loosely appressed to ascending, straight, white; tube 1.8–2.5 mm long, 0.9–1.25 × the length of lateral lobes; lower and lateral lobes lanceolate to narrowly deltoid, acuminate; vexillary lobes united higher than lower three, free for 0.6–1.2 mm (upper lip divided to 27–40% length); lowest lobe 2–2.7 mm, a little longer than lateral lobes. *Flowers* orange, 4–6.5 mm long; standard 4.5–5.7 mm long, 5.2–7 mm wide, the claw 1.5–1.65 mm long, the blade suborbicular to reniform, not callused at base, apex rounded, entire to shortly and broadly emarginate; wings 4.6–6 mm long (incl. 1.4–2.1 mm claw), 2.2–2.8 mm wide, a little longer than keel, the blade elliptic to obovate with rounded apex; keel 4.1–4.6 mm long (incl. 2–2.1 mm claw), 2.1–2.4 mm wide, the blade ±semi-circular, incurved just in front of spur, with a few hairs along lower margin near apex. *Staminal* tube glabrous, not callused; vexillary filament straight in lower half, glabrous, not callused; anthers 0.3–0.4 mm long, 0.2–0.4 mm wide. *Ovary* densely hairy; ovules 7 or 8. *Style* flattened, tapering to apex, glabrous, with hairs at base on vexillary side; stigma penicillate, linear. *Pods* linear, upturned at apex, 25–40 mm long, 3.8–5 mm wide, laterally compressed and indented between seeds, the lower margin slightly sinuate, the sutures somewhat thickened, pale to mid-brown at maturity; indumentum of moderately dense, patent, white to pale stramineous, hyaline hairs over numerous minute, shortly stalked glands; beak in line with the upper suture, straight to distinctly down-curved; white tissue present between seeds. *Seeds* 2–8 per pod on prominent funicles 0.6–1 mm long, with 3.5–5 mm between centres of adjacent seeds, lenticular but oblique on lower edge, 2.2–3 mm long, 2.2–3.7 mm wide, finely and darkly mottled, orange- to chocolate brown with tan-grey-brown and purplish grey-brown and black streaks, testa smooth; hilum ±central to excentric, containing a minute to distinct, annular, opaque rim aril (with tongue). (Figure 3)

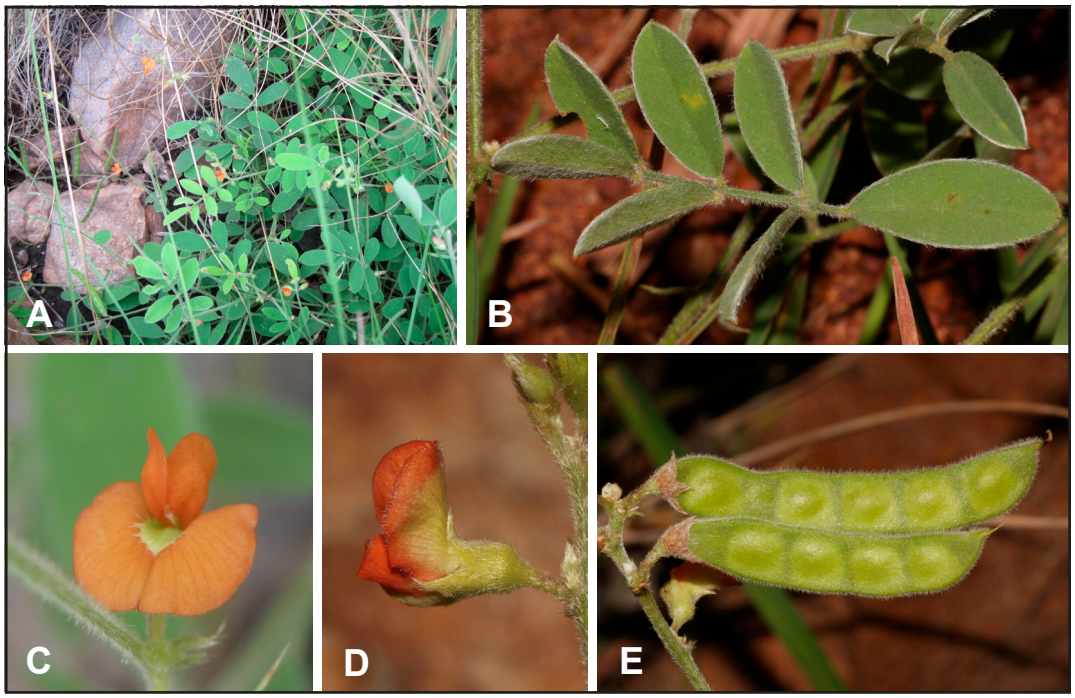

Figure 3. *Tephrosia funicularis*. A – plant sprawling among sandstone rocks; B – leaf showing elliptic leaflets with margin of hairs from lower surface; C – resupinate flower from front; D – flower from side showing calyx morphology and indumentum; E – immature pods. Images from the type *H. Dauncey* H 529 (A, C) and *A.N. Start per R.L. Barrett* RLB 2291 (B, D, E). Photographs © H. Dauncey (A, C) & © R. Barrett (B, D, E), used with permission.

Diagnostic features. *Tephrosia funicularis* is a distinctive species readily recognised by the following combination of characters: strongly deflexed stipules, which resemble a handlebar moustache; usually 5–9, elliptic leaflets that appear glabrous on the upper surface (actually very finely hairy) and have a distinct border of white hairs (formed from hairs that protrude beyond the margin from the appressed-hairy lower surface); pseudoracemes of orange flowers with the calyx tube *c.* = in length to the lobes; linear, ±straight, laterally compressed pods, which are flattened between the seeds; and seeds that are mottled purplish dark brown and have an elongate funicle 0.6–1 mm long.

Specimens examined. WESTERN AUSTRALIA. [localities withheld for conservation reasons] 13 Apr. 2013, *R.L. Barrett, M.D. Barrett & B. Anderson* RLB 8074 (CANB, DNA, PERTH); 11 Mar. 2001, *R.L. Barrett & T. Handasyde* RLB 1984 (PERTH); 15 May 2018, *R. Butcher, E.M. Joyce & K. Thiele* RB 2251 (PERTH, UWC); 16 May 2018, *R. Butcher, E.M. Joyce & K. Thiele* RB 2254 (PERTH); 13 May 2006, *I.D. Cowie* 11163 (BRI, DNA, MEL, PERTH); 14 Aug. 2011, *H. Dauncey* H 849 (K, PERTH); 13 Mar. 2001, *A.N. Start per R.L. Barrett* RLB 2291 (BRI, PERTH); 12 Mar. 2006, *S. Legge* 842 *& S. Murphy* (CANB).

Distribution. Currently known from two areas flanking the Wunaamin-Miliwundi Ranges (formerly King Leopold Ranges), with infrequent collections from the Yampi Peninsula (Mitchell sub-bioregion, North Kimberley) eastward to the Phillips Range and south-eastward to Mornington Sanctuary (Pentecost sub-bioregion, Central Kimberley); it is likely to also occur in intervening areas (Figure 2).

Habitat. Mostly collected from shallow brown loamy sand or red-brown clayey sand among sandstone rocks, with one record stating ‘sand over quartzite’. Grows in open *Corymbia* (*C. collina*,

C. confertiflora) or mixed woodland (including *Brachychiton viscidulus*, *Buchanania oblongifolia*, *Celtis philippensis*, *Erythrophleum chlorostachys*, *Ficus aculeata*, *Hakea arborescens*, *Lophostemon grandiflorus* subsp. *riparius*, *Sersalisia sericea*, *Terminalia hadleyana*, *Wrightia saligna*) over shrubs (e.g. *Acacia stigmatophylla*, *A. tumida*, *Calytrix brownii*, *Grevillea pyramidalis*) and grasses (e.g. *Sorghum*, *Triodia*), or in hummock grassland at more exposed sites. Observed to grow with or adjacent to other *Tephrosia* taxa, including *T. coriacea* Benth., *T. filipes* Benth., *T. oblongata* Benth. *s. lat.*, and *T.* sp. Sparse pinnae (C.R. Michell 2202).

Phenology. Phenology is poorly known because very few collections have been made. Flowers and fruits recorded in March and August; mature pods bearing seed recorded in May and August. Many *Tephrosia* taxa occurring at Mornington Sanctuary flower over a long period in response to rain (H. Dauncey, pers. comm.): the collections *H. Dauncey* H 529 and H 849, made in March and August 2011 respectively, are at the same stage of flowering and fruiting despite being collected five months apart, with a significant dry season rain event occurring in July (H. Dauncey, pers. comm.).

Conservation status. Listed as Priority Three (Poorly Known Flora) under Conservation Codes for Western Australian Flora as *T.* sp. Yampi (A.N. Start per R.L. Barrett RLB 2291) (Smith & Jones 2018). This is equivalent to the IUCN rank Data Deficient.

Etymology. Named for the prominent funicles (from L. *funis*; rope, cord) attaching the ovules and seeds to the carpel's placenta.

Affinities and notes. *Tephrosia funicularis* is similar to *T. crocea*, which also has orange flowers and leaf-like, recurved stipules, but this latter species has (5–)15–51 narrowly elliptic to cuneate leaflets (*vs* 3–11 sub-oblong, elliptic or obovate leaflets) that reduce in size toward the apex of the leaf (*vs* gradually increase in size), with the terminal leaflet dissimilar in shape to the adjacent laterals (similar, but larger in *T. funicularis*), as well as bracteoles on the pedicel (*vs* bracteoles absent). It also differs in its pods and seeds, the pods having an ascending beak that is often long (*vs* shorter, straight to down-curved beak), and the seeds being ellipsoid, uniformly tan to mottled yellow-tan with dark flecks, *c.* 2.8–2.9 × 3.7–3.8 mm, and attached to the placenta by short funicles 0.2–0.3 mm long (*vs* obliquely lenticular, darkly mottled, 2.2–3 mm × 2.2–3.7 mm, with funicles 0.6–1 mm long).

Tephrosia funicularis has some similarity to the phrase-named taxon *T.* sp. Northern (K.F. Kenneally 11950) in the number and shape of its leaflets, but this can be distinguished from *T. funicularis* by its eucamptodromous to apically brochidodromous secondary venation (with indistinct intersecondary veins) (*vs* brochidodromous venation), antrorse to inclined stipules (*vs* strongly reflexed), larger flowers with calyx lobes to 7 mm long that are characteristically longer than the tube (*vs* 1.8–2.7 mm long, *c.* = to the tube), turgid pods (*vs* laterally compressed), and ellipsoid (*vs* obliquely lenticular) seeds.

Two of the specimens (*A.N. Start per R.L. Barrett* RLB 2291; *R.L. Barrett & T. Handasyde* RLB 1984) were originally identified as being a hairy form of *T. remotiflora*; this species is superficially similar to *T. funicularis* but has smaller, purple flowers, reddish venation on leaflets, and narrower fruits with fine, appressed or patent hairs.

The minute glands that are readily visible on pods were also observed in lower numbers on pedicels and inflorescence rachides of some specimens.

Acknowledgements

Thanks to Helen Dauncey and Russell Barrett for providing photographs of *T. funicularis*, taken during specimen collection, to Kevin Thiele for permission to publish the findings of his PERTH specimen collection analysis, to Annika Spiridis for redistributing type material from the reference herbarium collection at Mornington Sanctuary, and to Kevin Thiele and Lizzy Joyce for their assistance and companionship during Kimberley fieldwork in 2018. The curators and staff of the Queensland Herbarium (BRI) and the Northern Territory Herbarium (DNA) are thanked for the provision of facilities and assistance during visits between 2012–2019. Project supervisor Terry Macfarlane (PERTH) is thanked for taxonomic discussions, and comments towards the improvement of this manuscript, as are the reviewer, Charles Stirton, and editor, Kelly Shepherd. Taxonomic revision of *Tephrosia* in northern Western Australia has been funded by Rio Tinto Pty Ltd through a Mesa A Terrestrial Offset (2011–2014), with additional support from BHP, and the Australian Government's Australian Biological Resources Study National Taxonomy Research Grant Programme (2017–2020) for the project 'Towards an eFlora treatment of *Tephrosia* Pers. (Fabaceae) in Australia: taxonomic revision of the genus in Western Australia and the Northern Territory'.

References

Barrett, M. (2016). Fungi of the Kimberley region. Poster presented at: *The natural world of the Kimberley*. Kimberley Society Seminar, University of Western Australia, 15th October 2016. DOI: 10.13140/RG.2.2.28174.36168

Barrett, R.L. (2015). Fifty new species of vascular plants from Western Australia—celebrating fifty years of the Western Australian Botanical Garden at Kings Park. *Nuytsia* 26: 3–20.

Beard, J.S. (1980). A new phytogeographic map of Western Australia. *Western Australian Herbarium Research Notes* 3: 37–58.

Bowman, D.M.J.S., Brown, G.K., Braby, M.F., Brown, J.R., Cook, L.G., Crisp, M.D., Ford, F., Haberle, S., Hughes, J., Isagi, Y., Joseph, L., McBride, J., Nelson, G. & Ladiges, P.Y. (2010). Biogeography of the Australian monsoon tropics. *Journal of Biogeography* 37: 201–216.

Butcher, R. (2018a). *Tephrosia pedleyi* (Fabaceae: Millettieae), a new species from the west Kimberley of Western Australia. *Nuytsia* 29: 69–73.

Butcher, R. (2018b). Making it official—formal description of two orange-flowered *Tephrosia* (Fabaceae: Millettieae) species from north-west Western Australia. *Nuytsia* 29: 265–281.

Butcher, R. (2020). *Tephrosia cardiophylla* (Fabaceae: Millettieae), a distinctive, new, conservation-listed species from Western Australia's Kimberley sandstones. *Nuytsia* 31: 47–51.

Butcher, R. & Hurter, P.J.H. (2012). *Tephrosia oxalidea* (Fabaceae: Millettieae), a new species from the Pilbara and Gascoyne bioregions of Western Australia. *Nuytsia* 22(6): 341–349.

Butcher, R., van Leeuwen, S. & Thiele, K. (2017). *Taxonomic studies in* Tephrosia *Pers. (Fabaceae) in northern Western Australia*. Final report for Rio Tinto Pty Ltd – MesaA Terrestrial Offset Project, 8th May 2017. (Western Australian Herbarium, Department of Parks and Wildlife: Kensington, Western Australia).

Cowie, I.D. (2004). New species and lectotypifications of some reticulate-nerved *Tephrosia* (Fabaceae) from north-west Australia and the genus *Paratephrosia* re-evaluated. *Nuytsia* 15(2): 163–186.

Department of the Environment (2013). *Australia's bioregions (IBRA)*. IBRA7, Commonwealth of Australia. http://www.environment.gov.au/land/nrs/science/ibra#ibra [accessed 4 July 2018].

Ebach, M.C., Murphy, D.J., González-Orozco, C.E. & Miller, J.T. (2015). A revised area taxonomy of phytogeographical regions within the Australian Bioregionalisation Atlas. *Phytotaxa* 208(4): 261–277.

Ellis, B., Daly, D.C., Hickey, L.J., Johnson, K.R., Mitchell, J.D., Wilf, P. & Wing, S.L. (2009). *Manual of leaf architecture*. (Cornell University Press/The New York Botanical Garden Press: New York.)

González-Orozco, C.E., Ebach, M.C., Laffan, S., Thornhill, A.H., Knerr, N.J., Schmidt-Lebuhn, A.N., Cargill, C.C., Clements, M., Nagalingum, N.S., Mishler, B.D. & Miller, J.T. (2014). Quantifying phytogeographical regions of Australia using geospatial turnover in species composition. *PLoS One* 9(3): e92558.

Government of Western Australia (2011). *Kimberley science and conservation strategy*. 50 pp. Available at: https://www.dpaw.wa.gov.au/images/documents/conservation-management/kimberley/kimberley_science_conservation_strategy.pdf [accessed 4 July 2018].

Maconochie, J.R. (1980). Three new species of Fabaceae for the Flora of Central Australia. *Journal of the Adelaide Botanical Gardens* 2(4): 323–328.

McKenzie, N.L., van Leeuwen, S. & Pinder, A.M. (2009). Introduction to the Pilbara Biodiversity Survey, 2002–2007. *Records of the Western Australian Museum, Supplement* 78: 3–89.

Pedley, L. (1977). Notes on Leguminosae. I. *Austrobaileya* 1(1): 25–42.

Pepper, M., Keogh, S.J. (2014). Biogeography of the Kimberley, Western Australia: a review of landscape evolution and biotic response in an ancient refugium. *Journal of Biogeography* 41: 1443–1455.

Smith, M.G. & Jones, A. (2018). *Threatened and Priority Flora list 05 December 2018*. Department of Biodiversity, Conservation and Attractions. https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-plants [accessed 18 February 2020].

Tucker, S.C. (1987). Pseudoracemes in papilionoid legumes: their nature, development, and variation. *Botanical Journal of the Linnean Society* 95: 181–206.

Tucker, S.C. (2003). Floral development in legumes. *Plant Physiology* 131: 911–926.

Western Australian Herbarium (1998–). *FloraBase—the Western Australian Flora*. Department of Biodiversity, Conservation and Attractions. https://florabase.dpaw.wa.gov.au/ [accessed 16 March 2021].