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# *Tephrosia oxalidea* (Fabaceae: Millettieae), a new species from the Pilbara and Gascoyne bioregions of Western Australia

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## Abstract

Butcher, R. & Hurter, P.J.H. *Tephrosia oxalidea* (Fabaceae: Millettieae), a new species from the Pilbara and Gascoyne bioregions of Western Australia. *Nuytsia* 22(6): 341–349 (2012). The Australian species of *Tephrosia* Pers. (Fabaceae: Millettieae) have not been revised in full since Bentham's *Flora Australiensis*, although considerable work towards this goal has been performed at the herbaria of the Northern Territory (DNA) and Queensland (BRI) to date. Taxonomic work is now underway on the *Tephrosia* of Western Australia, with Western Australia's plant census currently recording 23 informally named taxa in this State. One of these, *Tephrosia* sp. Cathedral Gorge (F.H. Mollemans 2420), is a distinctive species and is described herein as *T. oxalidea* R.Butcher & P.J.H.Hurter. Images and a distribution map for this species are included, as is a discussion of its affinities.

## Introduction

*Tephrosia* Pers. is a pantropically distributed genus of pea-flowered legumes comprising *c.* 350 to over 400 species worldwide (Cowie 2004; Lewis *et al.* 2005). Centres of species diversity include Africa–Madagascar (*c.* 170 spp.), Australia (*c.* 90 spp.) and Central and tropical North America (*c.* 45 spp.) (Lewis *et al.* 2005). Sixty-two *Tephrosia* taxa are currently recognised as occurring in Western Australia (WA), 23 of which are informally named (Western Australian Herbarium 1998–). Nearly three-quarters of the informally named taxa lack any descriptive information or tools for their identification, hindering our understanding of their circumscription and distribution. It is also apparent that five undescribed taxa occurring in both WA and the Northern Territory (NT) are known by different phrase names on either side of the State line, thereby confounding accurate communication about the taxa and leading to increased taxonomic confusion. These names are currently being harmonised under the *Australian Plant Census* project.

*Tephrosia* is well recognised for its taxonomic complexity (Lewis *et al.* 2005) and it is clear that the Australian taxa are in need of comprehensive revision (Pedley 1977). The most recent published treatment in Australia is that of Bentham (1864). Wheeler *et al.* (1992) and Cowie (2004) provide descriptions and illustrations for the majority of formally and informally named taxa from the Northern Botanical Province of WA, but little recent information beyond Maconochie (1980, 1981) is available for the species occurring in the Eremaean Botanical Province. The first author has recently commenced


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revisionary work on the Western Australian taxa in collaboration with *Tephrosia* specialists Ian Cowie (DNA) and Les Pedley (BRI). This paper is the second in a series dealing with informally named and poorly circumscribed taxa in WA (see Butcher 2012).

*Tephrosia oxalidea* was first recognised as distinct in 1994 from material collected from north-west of Newman in 1987. The name *T.* sp. Cathedral Gorge (F.H. Mollemans 2420) was subsequently erected on Western Australia's plant census in 1995 with a Priority One conservation listing; this was downgraded to Priority Three in 1999. In 2003 the phrase name *T.* sp. Pilbara Ranges (S. van Leeuwen 4246) was erected on the census to apply to specimens collected from the Hamersley and Barlee Ranges which had previously been identified as '*T.* sp. West Angelas (M.E. Trudgen 16533)'. This latter informal name was never erected on the census as it was considered too geographically restrictive, given the known distribution of the taxon, and because the voucher specimen (*M.E. Trudgen* 16533) was never submitted to the Western Australian Herbarium (PERTH) (S. van Leeuwen 29/04/2003, *in litt.*). No diagnostic differences between these putative taxa were provided at this time. *Tephrosia* sp. Pilbara Ranges was listed as a Priority Three conservation taxon in 2008. Detailed study by the second author in 2009 determined that these two phrase names applied to the same taxon and *T.* sp. Pilbara Ranges was synonymised under *T.* sp. Cathedral Gorge in 2010. As the number of known populations of *T.* sp. Cathedral Gorge increased so too did its known area of occupancy and the taxon was removed from the *Declared Rare and Priority Flora list for Western Australia* in the same year (Smith 2010).

## Methods

This study is based on examination of herbarium specimens at PERTH and field observations. Vegetative, fruit and indumentum characters were scored from dried material. Floral characters were scored from three rehydrated flowers from *J. Bull s.n.* (PERTH 07981643), *N. Casson & E.M. Mattiske* MCPL 1014 and *F.H. Mollemans* 2420, the only flowering specimens available besides the type, which was not destructively studied.

The taxonomic description format approximates Cowie (2004), with some additional information, to facilitate comparison between recently described species. The leaves of *Tephrosia* species vary from unifoliolate to trifoliolate to palmate to imparipinnate (multijugate), with many species having more than one type of leaf on a plant, depending on its growth stage. To account for this variation, the vegetative terminology adopted follows both Cowie (2004) and Bosman and de Haas (1983). *Petiole* refers to the leaf stalk (including the pulvinus) occurring below the petiolule of a solitary leaflet or the lowermost pair of leaflets; *rachis* refers to the mid-rib of a multijugate compound leaf between the lowermost leaflet pair and the petiolule of the terminal leaflet; *interjugal rachis* refers to the part between two adjacent leaflet pairs; *ultrajugal rachis* refers to that part (where present) between the uppermost leaflet pair and the petiolule of the terminal leaflet (Figure 1). Leaf venation terminology follows Ellis *et al.* (2009). 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 Environment, Water, Heritage and the Arts 2008).

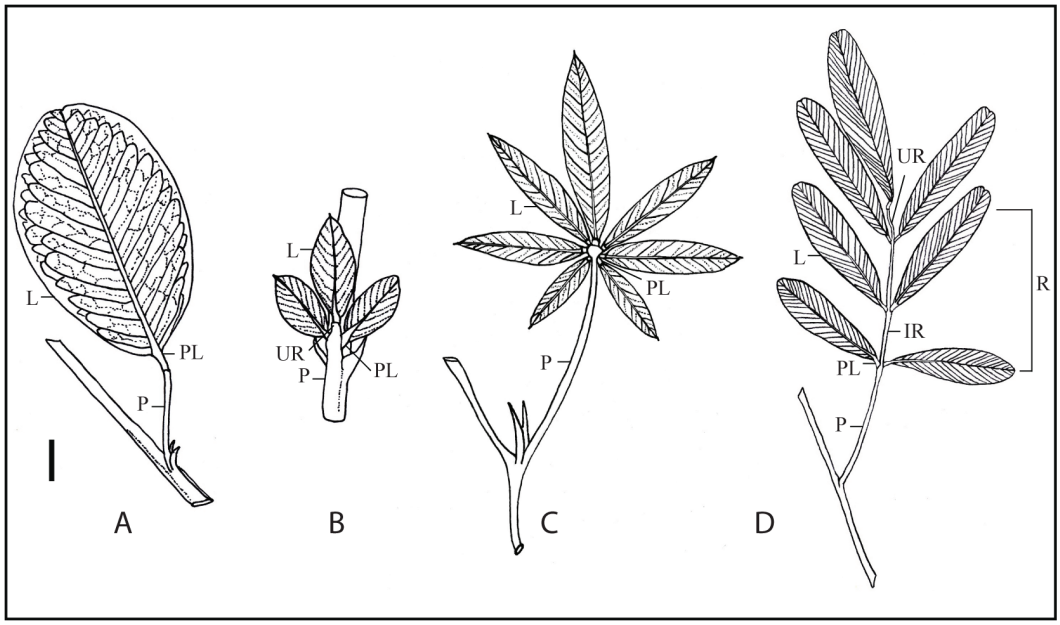


Figure 1. Examples of different leaf forms and their parts in *Tephrosia*. A – unifoliolate leaf (*T. coriacea*; *A.L. Chapman* 1); B – trifoliolate leaf (*T. lasiochlaena*; *G.W. Carr & A.C. Beauglehole* C 3592 B 47370); C – palmate leaf (*T. clementii*; *S. van Leeuwen et al.* PBS 0260); D – multijugate imparipinnate leaf (*T. rosea*; *K.F. Kenneally* 6032). P = petiole; R = rachis; IR = interjugal rachis; UR = ultrajugal rachis; PL = petiolule; L = leaflet; lower surface of all leaves shown; indumentum not shown. Scale bar = 10 mm (A, B, D); 5 mm (C).

## Taxonomy

**Tephrosia oxalidea** R.Butcher & P.J.H.Hurter, *sp. nov.*

*Typus*: Packsaddle Range (east of Great Northern Highway), 130 km north-west of Newman, Pilbara, Western Australia, March 2002, *K. McCreery s.n.* (*holo*: PERTH 06167365; *iso*: DNA).

*Tephrosia* sp. Cathedral Gorge (F.H. Mollemans 2420), Western Australian Herbarium, in *FloraBase*, http://florabase.dec.wa.gov.au [accessed 13 February 2012].

*Tephrosia* sp. Pilbara Ranges (S. van Leeuwen 4246), Western Australian Herbarium, in *FloraBase*, http://florabase.dec.wa.gov.au [accessed 13 February 2012].

*Tephrosia* sp. West Angelas (M.E. Trudgen 16533), *in sched.*

Woody *herb*, prostrate to erect, single- to few-stemmed, perennial, 0.02–0.25 m tall; rootstock slender, uniformly thickened, corky. *Branchlets*, *leaf and inflorescence rachises* moderately to densely hairy, the hairs loosely appressed to inclined, hyaline, white and stramineous, yellow-brown on young organs. *Leaves* simple at base of plant, usually trifoliolate above, up to *c.* 75 mm long including petiole; *stipules* persistent, antrorse, narrow-attenuate to narrowly lanceolate, 4.3–11.5 mm long, green or green and purple, becoming yellow-, red- or dark brown with age, 1–3-nerved, hirsute to hispid; *petiole* 3–30 mm long; *ultrajugal rachis* to 3.7 mm long; *stipellae* usually absent, if present then narrow-attenuate, 0.7–1.9 mm long; *petiolules* 0.5–1.6 mm long; *leaflets* 1–3, ovate to oblanceolate, through narrowly to

broadly elliptic, sub-orbicular and broadly to narrowly obovate, flat to very broadly V-shaped in T.S.; base cuneate to rounded; apex acute to obtuse, occasionally rounded, emarginate or retuse, frequently deflexed with a minute mucro *c.* 0.2–0.9 mm long; *lateral leaflets* 6.5–24 mm long, 3.9–13.5 mm wide, length 1.2–3.4 × width; *terminal leaflet* 1.2–3.3 × the length of laterals, 12–42 mm long, 5.7–18 mm wide, length 1.4–3.2 × width; lamina discolorous to strongly discolorous, the upper surface frequently purple or purple-brown, usually maculate with dark pigmentation; secondary veins in 6–12 pairs, brochidodromous, the intersecondary veins parallel at base then dichotomising and anastomosing submarginally, usually obscured by indumentum on lower leaflet surface; upper surface sparsely to moderately hairy on some very young leaves, otherwise glabrous, the hairs appressed to inclined, hyaline; lower surface with raised veins, moderately to densely hairy, the hairs appressed to inclined, hyaline, white and stramineous to yellow-brown, usually visible from above as a prominently hairy margin. *Inflorescence* racemose or fasciculate, leaf-opposed or terminal, 1.5–130 mm long, fascicles crowded to well-spaced, 1–3(–5)-flowered; *bracts* tardily caducous, antrorse, subulate to lanceolate, attenuate, 2.5–7.4 mm long; *pedicels* 1.5–9.2 mm long; *bracteoles* usually absent on pedicels, if present then ovate, *c.* 1.2 mm long. *Calyx* 3.6–6.8 mm long, moderately to densely hairy, the hairs loosely appressed to inclined, white, stramineous and yellow-brown; tube 1.1–2.3 mm long, 1/3–2/3 × the length of lateral lobes; lobes attenuate or lanceolate; vexillary lobes united higher than lower three, free for 1.7–3.5 mm; lowest lobe 2.5–5.5 mm long, slightly longer to longer than lateral lobes. *Corolla* orange, with a cream-yellow eye at throat; *standard* 4–5.5 mm long, 4–5.9 mm wide, the claw 0.8–1.5 mm long, the blade broadly obovate to suborbicular, slightly callused at base with an emarginate apex; *wings* 4–5.2 mm long, 1.6–2.3 mm wide, just clasping keel apex, the claw 1–1.5 mm long, the blade narrowly elliptic to narrowly obovate, gently incurved on upper edge, with an oblique apex; *keel* 4–5.2 mm long, 1.7–2.3 mm wide, the claw 1.1–1.8 mm long, glabrous, the blade ±semicircular, sometimes gently incurved on upper edge, obtusely angled at apex with a very small, acute beak. *Staminal tube* 2–4 mm long, glabrous near fenestrae, which are callused on margins towards the base; free upper filament straight in lower half and callused near base, glabrous; anthers broadly ovate, 0.4–0.5 mm long, 0.4–0.5 mm wide. *Ovary* linear, tomentose; ovules 8–11. *Style* flattened, uniform, mostly glabrous but with hairs on vexillary side to *c.* 1/3 length; stigma penicillate at base, linear. *Pod* usually linear, occasionally narrowly oblong, straight, ±turgid, (23–)29–41 mm long, 3.5–4.8 mm wide, with loose, spongy tissue between seeds, yellow- to pale brown, moderately hairy, the hairs patent, white, stramineous and yellow-brown; beak in line with upper suture to eccentric, straight or deflexed. *Seeds* (3)7–11 per pod, 2.6–4 mm between centres, subglobose to transversely ellipsoid, slightly flattened, 2.2–2.8 mm long, 2.3–3.3 mm wide, irregularly rugulose, ±uniformly coloured, brown to red-brown, darker in rugae; hilum central or nearly so; caruncle absent. (Figure 2)

*Diagnostic features.* Distinguished from all other Western Australian species of *Tephrosia* by the following combination of characters: plants small, tufted; leaves usually trifoliolate, discolorous; upper leaflet surface usually green-purple to purple-brown, usually glabrous; stipules long; persistent; flowers orange; fruit usually linear, 23–41 mm long, 3.5–4.8 mm wide, with patent hairs; seeds compressed-subglobose, red-brown, rugulose.

*Other specimens examined.* WESTERN AUSTRALIA: Jinayri mining tenement M244SA, 53 km NW of Newman, 6 Mar. 2008, *J. Bull s.n.* (PERTH 07981643); Karijini National Park, *c.* 62.5 km NE along Karijini Drive from Paraburdoo–Tom Price Rd, *c.* 16 km SW of Ranger's Station turn-off, PBS plot TCMBE01, S side of road, 22 May 2011, *R. Butcher & S. Dillon* RB 1494 (PERTH); *c.* 6.5 km E of Yandicoogina mine, *c.* 4.1 km NNW of the confluence of Weeli Wolli Creek and Yandicoogina Creek, *c.* 82 km NW of Newman, 17 Apr. 2011, *N. Cadd & N. Krawczyk* Astron *s.n.* (PERTH); eastern Hamersley Range, 6 Sep. 1995, *N.E. Casson & E.M. Mattiske* MCPL 1014 (PERTH); 3.5 km ESE of Cathedral Gorge and 10.5 km along Newman–Packsaddle road turnoff NNE of railway crossing,

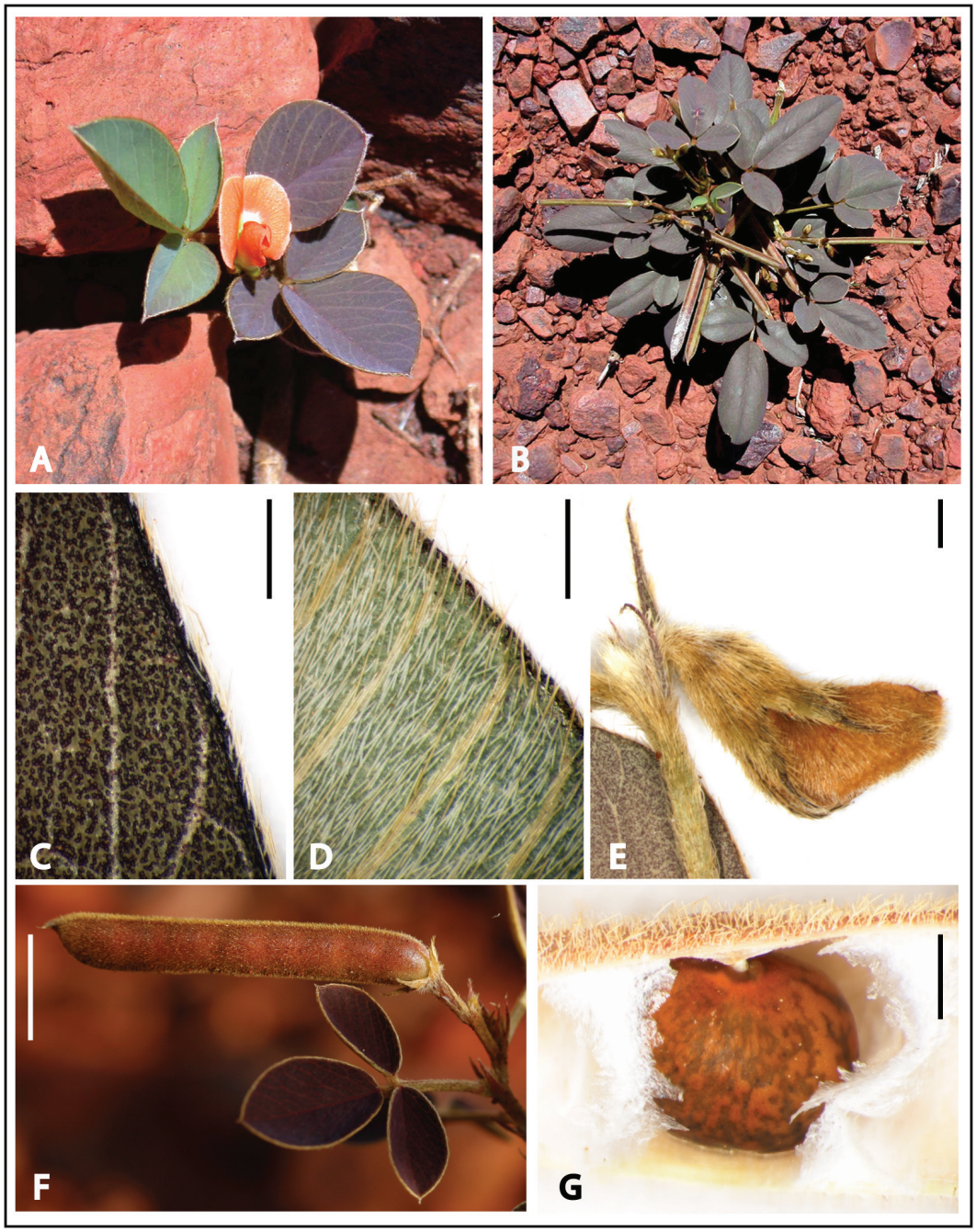


Figure 2. Images of *Tephrosia oxalidea*. A – flowering plant *in situ* showing small stature, trifoliolate leaves, purple-brown upper leaflets, leaflet colour variation and orange flower; B – fruiting plant *in situ* showing pods, buds and leaflet shape variation; C – glabrous upper leaflet surface showing dark pigmentation and hairy margin; D – appressed-hairy lower leaflet surface showing mixture of white and stramineous hairs; E – pressed flower showing calyx lobes longer than the tube and narrow, attenuate bracts; F – detail of fruiting plant showing linear, straight pod with patent, golden hairs and erect, narrowly triangular stipules at the base of a purple-brown leaf with a distinctly hairy leaflet margins; G – detail of open pod showing spongy tissue flanking a rugulose seed. Scale bars = 10 mm (A, B, F); 1 mm (C–E, G). Images from *S. van Leeuwen* 5075 (A, B; photographs S. van Leeuwen); *K. McCreery s.n.* (PERTH 06167365) (C–E); *R. Butcher & S. Dillon* RB 1494 (F; photograph R. Butcher); *W.A. Thompson & C. Wilson* Astron WAT 3001 (G).

2 Mar. 1987, *F.H. Mollemans* 2420 (PERTH); *c.* 6 km ENE of Yandicoogina mine, *c.* 5.4 km NNW of the confluence of Weeli Wolli Creek and Yandicoogina Creek, *c.* 82 km NW of Newman, 14 Apr. 2011, *W.A. Thompson & N. Krawczyk* WAT 3000 (PERTH); *c.* 6.2 km E of Yandicoogina mine, *c.* 3.5 km NNW of the confluence of Weeli Wolli Creek and Yandicoogina Creek, *c.* 82 km NW of Newman, 18 Apr. 2011, *W.A. Thompson & C. Wilson* Astron WAT 3001 (PERTH); Barlee Range Nature Reserve, 12.9 km W of Wongajerra Well, 22 June 1994, *S. van Leeuwen* 1820 (PERTH); 21.4 km E of West Angela Hill, Karijini National Park, Hamersley Range, 29 Sep. 1998, *S. van Leeuwen* 4123 (CANB, DNA, PERTH); 31.5 km W of Mt Ella, Turee Creek Station, Hamersley Range, 29 Sep. 1998, *S. van Leeuwen* 4136 (BRI, DNA, PERTH); 20.8 km E of Giles Point, Ophthalmia Range, eastern end of the Hamersley Range, 1 Oct. 1998, *S. van Leeuwen* 4246 (DNA, NSW, PERTH); Barlee Range Nature Reserve, 1.5 km SSW of Kohbling Pool, 27 July 2002, *S. van Leeuwen* 5075 (BRI, DNA, PERTH); S side of Karijini Drive, 15.9 km W of turnoff to Karijini Ranger's Station, Karijini National Park, 16 Sep. 2006, *S. van Leeuwen et al.* PBS 0317 (PERTH); *c.* 8 km NE of Newman, 9 Aug. 2004, *B. Vincent s.n.* (PERTH 07682972).

*Distribution*. *Tephrosia oxalidea* has mostly been collected from the Hamersley, Packsaddle and Ophthalmia Ranges in the Pilbara bioregion, with additional collections from the Barlee Range on the north-western edge of the Gascoyne bioregion (Figure 3).

*Habitat*. *Tephrosia oxalidea* has been collected from a range of habitats and substrates ranging from drainage valleys with pebbly, brown, loamy sand, to ironstone scree slopes with small to large rock fragments, to steep upper slopes and hill crests in skeletal soil over sandstone, siltstone or banded ironstone. Most commonly recorded from open, low woodland of *Eucalyptus leucophloia* subsp. *leucophloia*, sometimes also with *E. kingsmillii*, *E. gamophylla*, *Corymbia hamersleyana* and *C. deserticola*, over open, low scrub or shrubland dominated by acacias (e.g. *Acacia adoxa*, *A. arida*, *A. exilis*, *A. hilliana*, *A. maitlandii*, *A. retivenea*, *A. tenuissima* or *A. tetragonophylla*) over *Triodia* hummock grassland (e.g. *T. basedowii*, *T. pungens* or *T. wiseana*) with sedges and herbs. Associated species include *Bulbostylis barbata*, *Corchorus lasiocarpus*, *Dampiera candicans*, *Eriachne lanata*, *Eremophila jucunda*, *Gompholobium polyzygum*, *Indigofera monophylla*, *Paraneurachne muelleri*, *Ptilotus obovatus*, *P. rotundifolius*, *Rulingia luteiflora*, *Scaevola browniana*, *Senna glutinosa*, *Solanum horridum*, *S. lasiophyllum* and *Themeda* sp.

*Phenology*. Flowering and fruiting in *T. oxalidea* appears to be in response to local rainfall events. The only flowering specimens seen (*J. Bull s.n.* PERTH 07981643; *K. McCreery s.n.* PERTH 06167365; *F.H. Mollemans* 2420) were all collected in March, and fruit were also present on the plants. *W.A. Thompson & N. Krawczyk* WAT 3000, *S. van Leeuwen* 5075 and *N.E. Casson & E.M. Mattiske* MCPL 1014 collected in mid-April, late July and early September, respectively, bear early to late buds, with *S. van Leeuwen* 5075 and *N.E. Casson & E.M. Mattiske* MCPL 1014 also bearing fruit. The remaining specimens, collected from April–October, are sterile or in fruit.

*Conservation status*. This taxon does not require a conservation listing. Although *T. oxalidea* is found on some mining tenements, it also occurs in a number of DEC conservation reserves in the Pilbara and Gascoyne bioregions, and has an area of occupancy of *c.* 400 km$^2$.

*Etymology*. The epithet acknowledges the superficial resemblance of *T. oxalidea* to some members of the genus *Oxalis* L.

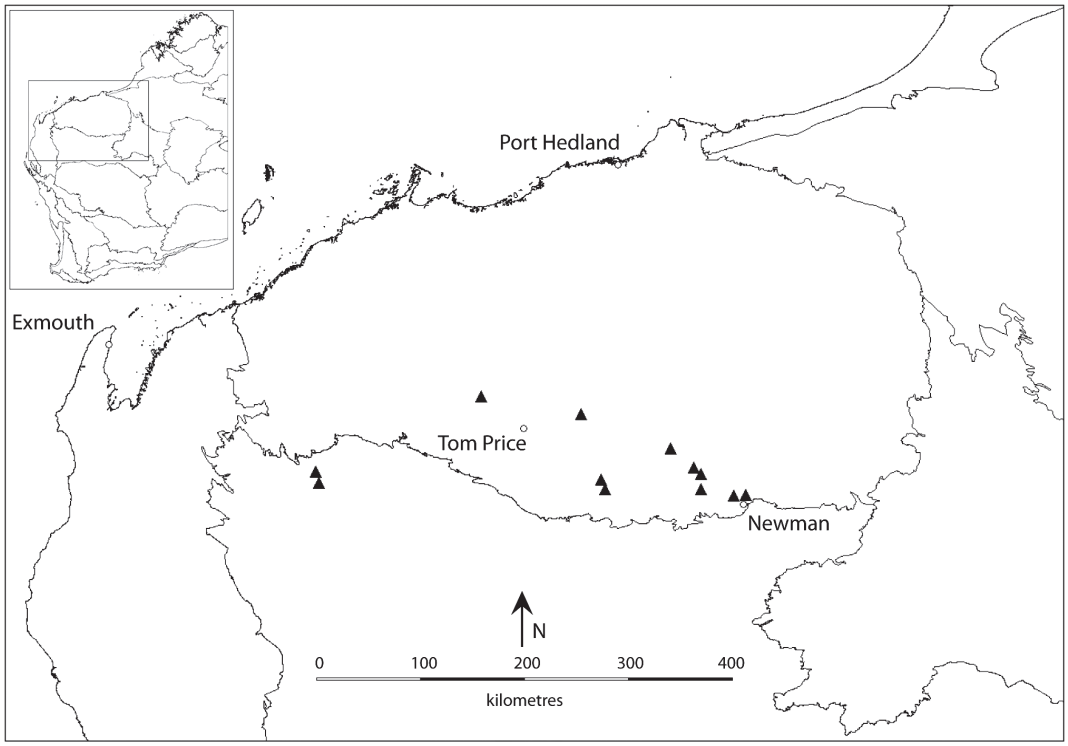


Figure 3. Distribution of *Tephrosia oxalidea* (▲) in the Pilbara and Gascoyne bioregions of Western Australia.

*Affinities*. *Tephrosia oxalidea* is similar to the Pilbara form of *T. supina* Domin *s. lat.* and to *T. clementii* Skan in having orange flowers, the calyx with long, slender lobes that are longer than the tube, persistent stipules which are often clustered on short stems at the base of the plant, and ±linear, turgid, straight pods with ±patent indumentum. *Tephrosia oxalidea* also has a similar pattern of leaflet venation to *T. supina s. lat.* (Pilbara form).

*Tephrosia supina s. lat.* is a widespread and variable species with a number of forms across its range. Ongoing taxonomic work has found that the application of this name is uncertain across Australia, and two broad groups corresponding to flower colour (orange v. pink-purple) have been identified, each containing a number of putatively distinct taxa. *Tephrosia supina s. lat.* (Pilbara form) can be readily distinguished from *T. oxalidea* by its (3–)5–7-foliolate leaves which have less-markedly discolorous leaflets (upper and lower surfaces different shades of green) with the upper leaflet surface usually patently hairy with slightly sunken secondary veins and the lower surface usually with prominently reticulating intersecondary veins, as well as a paler, patent to spreading indumentum on stems, petioles, leaflets and inflorescences. In the herbarium, precocious flowering individuals of *T. supina s. lat.* (Pilbara form) have been confused with *T. oxalidea* due to their trifoliolate leaves, but are recognisable by the orientation of hairs on the stems and petioles.

*Tephrosia clementii* and the recently segregated taxon *T.* sp. clay soils (S. van Leeuwen et al. PBS 0273) are similar to *T. oxalidea* in sometimes also having darker upper leaflet surfaces; however, these taxa are readily distinguished by their palmate, 5–9-foliolate leaves and white indumentum. *Tephrosia* sp. clay soils differs from *T. clementii*, *T. oxalidea* and *T. supina s. lat.* (Pilbara form) in

having pods with an upturned apex and appressed indumentum, as well as calyx lobes that are ±equal in length to the tube.

Preliminary investigation of suitable specimens indicates that seed morphology may also be useful for distinguishing taxa. *Tephrosia oxalidea* has slightly depressed, subglobose seeds that are only slightly wider than long, are irregularly rugulose and red-brown, with darker coloration in the rugae. *Tephrosia clementii* has obovoid seeds that are slightly longer than wide, smooth to gently dimpled and mottled in combinations of light brown, dark brown and black. *Tephrosia* sp. clay soils has large, transversely obloid to transversely ellipsoid seeds that are wider than long, minutely pitted and rugulose, and mottled brown and black. *Tephrosia supina s. lat.* has considerable variation in seed morphology, in keeping with its gross morphological variation, and seeds of the various orange-flowered forms range from subglobose to obovoid to transversely depressed-ellipsoid in shape, from smooth to rugulose in texture and from subtly to boldly mottled in cream, light brown, dark brown and black (Figure 4). It must be noted that there is some variation within, and intergradation between, forms of *T. supina s. lat.* in terms of their seed morphology, and the taxonomy of this group is currently under investigation.

*Notes*. Field observations (RB) in May 2011 indicate that the intensity of the dark purple-brown coloration of the leaflet upper surface is variable within a population and may be affected by a plant's position in the landscape. At the location for *R. Butcher & S. Dillon* RB 1494, sheltered plants tended to have darker leaflets than plants in exposed situations, where leaflets bordered on purple-green. Similar variation in upper leaflet surface colour from green to purple-green was also observed in *T. clementii*, *T.* sp. clay soils and *T. sphaerospora* F.Muell., in the field.

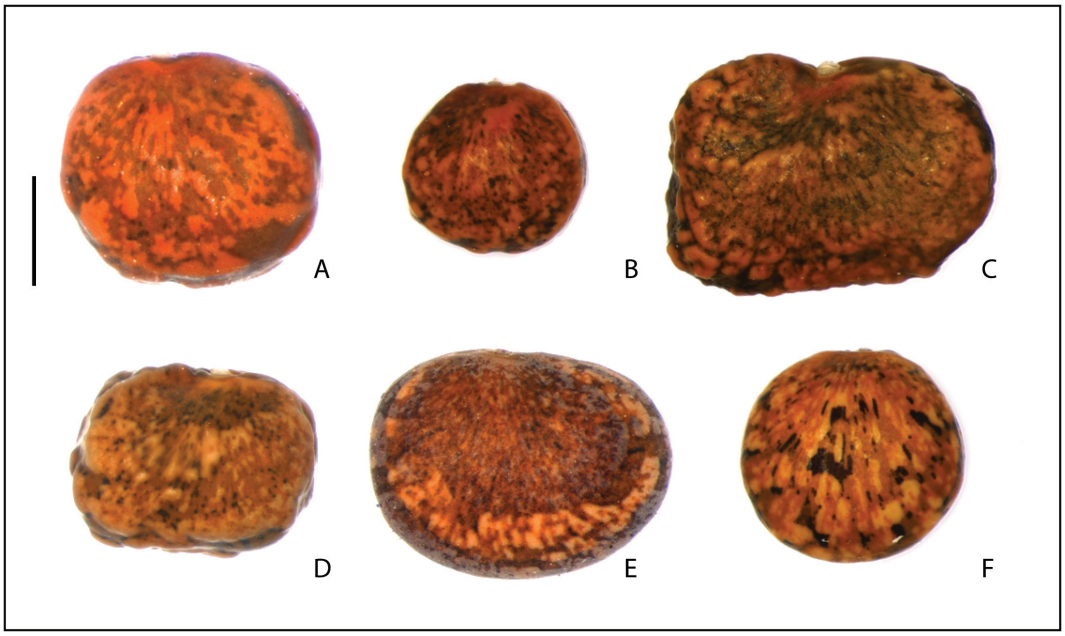


Figure 4. Examples of variation in seed morphology among *Tephrosia oxalidea* and allied orange-flowered taxa. A – *T. oxalidea* (*W.A. Thompson & C. Wilson* Astron WAT 3001); B – *T. clementii* (*M.E. Trudgen* 2672); C – *T.* sp. clay soils (S. van Leeuwen et al. PBS 0273) (*S. van Leeuwen et al.* PBS 0265); D – *T. supina s. lat.* (Pilbara form) (*A.A. Mitchell* 4728); E – *T. supina s. lat.* (Kimberley form) (*A.S. George* 15380); F – *T. supina s. lat.* (central form) (*P.K. Latz* 17037). Scale bar = 1 mm.

## Acknowledgements

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