

## *Solanum zoeae* (Solanaceae), a new species of bush tomato from the North Kimberley, Western Australia

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### Abstract

Barrett, R.L. *Solanum zoeae* (Solanaceae), a new species of bush tomato from the North Kimberley, Western Australia. *Nuytsia* 23: 5–21 (2013). Recent surveys in the North Kimberley have brought numerous new species to light. Studies have revealed considerable taxonomic complexity in the genus *Solanum* L. in the Kimberley region that requires the recognition of a number of new taxa. *Solanum zoeae* R.L. Barrett is described here following collection of the first fertile material on a remote sandstone outcrop on Doongan Station. Notes are provided on all phrase-named *Solanum* taxa currently recognised in the Kimberley region and a revised key to *Solanum* species in the Kimberley region is provided.

### Introduction

The genus *Solanum* L. is a large, cosmopolitan genus of over 1,250 species (Mabberley 2008). Numerous new species have been recognised in Australia since the treatments of Symon (1981) and Purdie *et al.* (1982), particularly in Queensland and central Australia (e.g. Bean 2001, 2004, 2011, 2012; Symon 2001; Brennan *et al.* 2006; Bean & Albrecht 2008). Six new species have been recognised by phrase names in Western Australia (four from the Kimberley region and two from the Pilbara region), with additional species groups from the Kimberley region requiring further study. One Pilbara taxon has recently been named (Davis & Hurter 2012). When naturalised taxa are included there are about 185 species currently recognised in Australia (Barker 2010). Recent phylogenetic studies of *Solanum* in northern Australia by Martine *et al.* (2009) have also recommended the recognition of additional taxa in this region.

*Solanum zoeae* R.L. Barrett was first collected in 2008 by the author while on a field trip for a conservation organisation. The author was flown in by helicopter to join the conservation group at a remote sandstone escarpment. A brief opportunity was available to examine the flora in the area and the first known collection of this taxon was made. At the time, little fertile material could be located with only one plant holding one, old flower. The leaf shape and very fine indumentum suggested that it might represent a distinct taxon related to *S. leopoldense* Symon. Heavy wet season rains associated

with Cyclone Lua in March 2012 extended the flowering season of many species in the region and a return visit to the original location in search of fertile material at the beginning of June 2012 was successful in locating numerous fruiting plants and a small number of flowering plants. Comparison of this material to *S. leopoldense* and *S. petraeum* Symon has confirmed that it differs from both species in a number of characters. This material is used to formally describe the new species.

### Methods

This description is based on measurements from fresh specimens and pressed material now at PERTH. Terminology and the layout of the description follows Symon (1981). Illustrations are based on photographs of live plants and from herbarium material. Seeds and indumentum characters were imaged using a Jeol JCM 5000 NeoScope bench top scanning electron microscope (SEM) at Kings Park and Botanic Garden.

### Taxonomy

***Solanum zocae*** R.L.Barrett, *sp. nov.*

*Type:* Doongan Station, Western Australia, 6 June 2012, R.L. Barrett RLB 7700 (bisexual plant) (*holo:* PERTH 08386048; *iso:* AD, BRI, CANB, DNA, K, MEL).

Intricate, many-branched, erect to spreading, dioecious *shrub* 0.7–1.5(–1.9) m high, 0.5–1 m wide; stems to 3 cm diam. at base; bark with pale ‘warts’ (lenticels or tubercles at base of spines); young stems greenish, finely stellate-hairy, spiny; prickles 2–7 mm long, abundant (on stems up to 1 cm diam., upper and lower leaf surfaces, peduncles, pedicels and calyx), straight or slightly recurved, slender, pale coloured; leaves with minute, stellate hairs (subsessile porrect-stellate, central ray shortly peaked or absent), with minute, simple, stalked glandular hairs also present on margins and veins, usually only on young growth, general colour dark green. *Leaves* dark green, slightly discolourous (paler below), very finely stellate-hairy and with stalked glandular hairs on the margins and veins of young growth, (2.5–)4.9–8.9(–15.5) × 1.5–3.2(–5.0) cm, lanceolate, with (5–)7–14(–19) triangular lobes ± evenly spaced along margin; sinuses of lobes rounded to sub-acute, cut 1/2–3/4 of the way to midrib; lobe and leaf apex acute or acuminate; base cuneate, equal or oblique; petiole to 6.5 mm long. *Inflorescences* consisting of solitary female flowers and cymes of male flowers on separate plants. *Male flowers* not seen (one immature cyme seen). *Female flower:* pedicel 6–13 mm long; *calyx* tube 5–6 mm long; lobes 5–10 mm long, long-triangular including the linear apex with prominent midvein, all parts extremely prickly. *Corolla* 1.8–2.8 cm diam., purple to lavender, broadly stellate-rotate, sinuses cut to about 1/3–3/5 of petal length, the apices sub-acute to sub-emarginate, densely minutely pubescent along the mid-portion; acumen 0.6–1.2 mm, distinct. *Filaments* 3.3 mm long, glabrous; anthers dark yellow, 4.8 mm long, tapering, closely erect. *Ovary* glabrous; style 11.7 mm long; stigma entire, projecting 2.8 mm beyond anther tips, erect or recurved. *Berry* 0.9–2.0 cm diam., depressed-globular, green when mature, finally pale brown, usually drying on bush to hard bony texture, wholly enclosed (apex visible from below) in prickly, accrescent, truncate calyx tube which has prickly, linear, lobe tips 0.8–1.5 cm long, the calyx eventually splitting irregularly to release entire, dry berry. *Seeds* 1.6–2.0 mm long, distinctly, minutely reticulate (reticulae 50–80 µm across), dark brown, 65–377 (4 fruits examined). (Figures 1, 2)



Figure 1. *Solanum zoeae*. A – the author with typical plant of *S. zoeae*; B – branched, woody stem base; C – broken sandstone habitat; D – sectioned fruit; E – fully open flower; F – seeds (R.L. Barrett RLB 7700). Scale bars D = 1 cm; F = 2 mm. Image A by David Taggart.





Figure 2. *Solanum zoeae*. A – flower with corolla torn to show staminal filaments; B – open flower demonstrating shape of fused corolla; C – Partially closed flower and spinescent calyx; D – young fruit enclosed in calyx with elongated calyx lobes; E – primary leaf spine; F – leaf lobing; G – near mature fruit (less enclosed by calyx than usual); H – fruiting calyx and mature dry fruit; I – woody stem with spines (A, B, D, E, G, H from *R.L. Barrett* RLB 7700; C, F, I from *R.L. Barrett* RLB 7575).

**Diagnostic characters.** Closely related to *S. leopoldense*, distinguished by the larger, erect habit and thick, woody stem bases. The leaves of *S. zoeae* are more deeply lobed with a very fine but very dense stellate indumentum. The segments (rays) of the individual stellate hairs are clearly demarcated (constricted at the base). The glandular hairs on the leaf margins and veins are stalked. The seeds are more finely reticulate (reticulatae 60–110  $\mu\text{m}$  across in *S. leopoldense*).

**Specimens examined.** WESTERN AUSTRALIA: [all in the vicinity of the type location] 23 May 2009, *R.L. Barrett* RLB 5720 (male plant) (AD, DNA, PERTH); 1 June 2012, *R.L. Barrett* RLB 7575 (female plant) (AD, BM, BRI, CANB, HO, MEL, NSW, PERTH (2 sheets)); 1 June 2012, *R.L. Barrett* RLB 7575 B (male plant) (PERTH); 2 June 2012, *R.L. Barrett* RLB 7601 (PERTH).

**Distribution and habitat.** Known only from the type location north of Doongan Station homestead in the north Kimberley. Grows on rough sandstone ridges in fire-excluding sites in association with *Acacia*

*deltoidea*, *A. delibrata*, *A. tumida*, *Breynia cernua*, *Buchanania oblongifolia*, *Calytrix exstipulata*, *Capparis umbonata*, *Corymbia disjuncta*, *Cymbopogon ambiguus*, *Denhamia obscura*, *Erythrophleum chlorostachys*, *Eucalyptus miniata*, *E. tetradonta*, *Gardenia megasperma*, *Hibiscus fryxellii*, *H. leptocladus*, *Hypoestes floribunda*, *Lithomyrtus retusa*, *Maytenus cunninghamii*, *Panicum trichoides*, *Planchonella arnhemica*, *Santalum lanceolatum*, *Setaria apiculata*, *Smilax australis*, *Spermacoce* sp. *Saxitilis* (R.K. Harwood 1538), *Stemodia lythrifolia*, *Stenocarpus acacioides*, *S. cunninghamii*, *Terminalia hadleyana*, *Triodia claytonii*, *T. sp.* King Edward River (K.F. Kenneally 7021) and *Triumfetta monstrosa*, or occasionally at the base of the sandstone on sand with *Heteropogon contortus* (Figure 3).

**Phenology.** Flowering and fruiting probably occurs mainly late in the wet season; finished by May in 2008. In early June 2012, about half the population was retaining fruit with only five plants bearing flowers.

**Conservation status.** To be listed as Priority One under Department of Environment and Conservation (DEC) Conservation Codes for Western Australian Flora (M. Smith pers. comm.). This species is only known from the vicinity of the type collection over a range of about 1 km. About 200 plants have been observed in this area. The surrounding habitat in most directions is unsuitable for this species, but there is potentially suitable habitat to the north of the known population. There are no access tracks to the north, making further surveys difficult.

**Etymology.** The epithet honours Zoe Emily Davies who was one of the coordinators of the field trip on which this species was first found. This species was discovered the same day and in the same place that

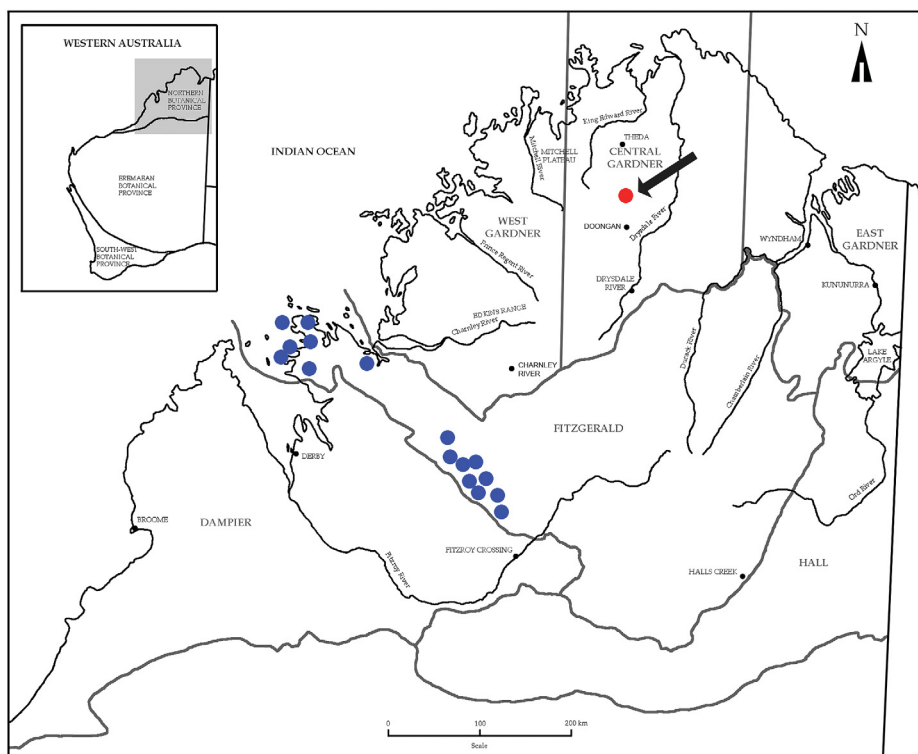


Figure 3. Distribution of *Solanum zoeae* (red dot with arrow) and *S. leopoldense* (blue dots). Map showing floristic provinces of Beard (1990).

I first met Zoe, who is now my wife. It was a chance meeting as we had both been asked to attend the field trip at short notice. When I first saw Zoe she was lying underneath a rock at the sandstone outcrop admiring some of the Indigenous rock paintings. The *Solanum* was discovered only 20 m from the spot where I met Zoe. I felt it was highly appropriate that this species be named in her honour following that wonderful chance meeting in the remote Kimberley.

*Notes.* *Solanum zoeae* belongs to subg. *Leptostemonum* sect. *Melongena* and is a member of the *S. dioicum* W.Fitzg. complex identified by Martine *et al.* (2009), a clade of entirely dioecious species.

*Solanum leopoldense* can develop thin woody stems, up to 0.6 cm thick, while *S. zoeae* is far more robust, commonly developing stems 2–3 cm thick at the base. Plants of *S. zoeae* are also more erect in habit, and much taller than *S. leopoldense*. The degree of leaf lobing is a rather variable characteristic in a number of *Solanum* species. Leaves of *S. zoeae* are consistently lobed at least halfway to the midrib and often two thirds of the way. Leaves of *S. leopoldense* are usually only lobed about a third of the way to the midrib, although one specimen from the Robinson River (*A.N. Start per R.L. Barrett RLB 2066*) has unusually large leaves which are lobed two thirds of the way to the midrib. The fine, dense indumentum on the mature leaves distinguishes most specimens of *S. zoeae* from *S. leopoldense*; however, juvenile leaves on *S. leopoldense* have a dense indumentum similar to *S. zoeae*. When imaged with an SEM, the stellate hairs differ in form; the ‘arms’ (rays) of the stellate hairs on *S. zoeae* (Figure 4A, B) consistently

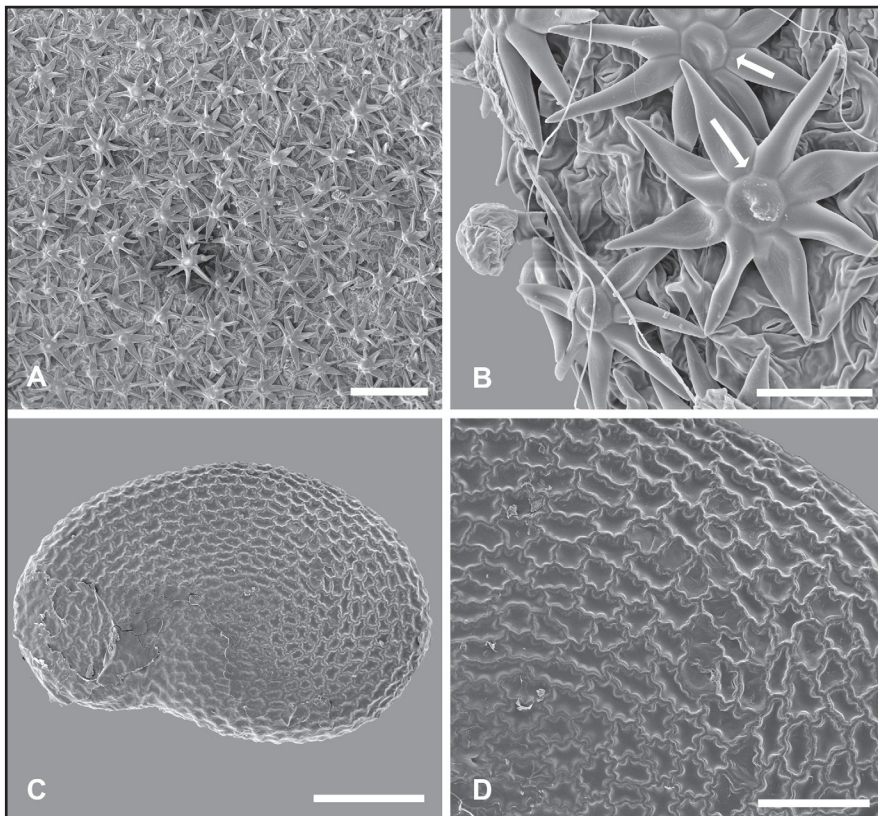


Figure 4. *Solanum zoeae*. Scanning electron micrographs. A – leaf indumentum; B – leaf margin with stalked glandular hair (centre left) and stellate hairs (lacking grooves between ‘arms’ as indicated by arrows); C – seed; D – seed reticulation (*R.L.Barrett RLB 7700*). Scale bars: A = 200  $\mu$ m; B = 50  $\mu$ m; C = 500  $\mu$ m; D = 200  $\mu$ m.



having distinct constriction grooves between the ‘arms’ and the centre (smooth, not constricted in *S. leopoldense*; Figure 5A, B). This character can be difficult to see under a light microscope but was very consistent when viewed with an SEM. The glandular hairs on the leaf margins (and occasionally on the veins) are stalked on *S. zoeae* (Figure 4B) and sessile on *S. leopoldense* (Figure 5B). The glandular hairs can often only be found on young leaves in both species. Seed reticulation of *S. zoeae* (Figure 4C, D) is finer and generally less rounded than in *S. leopoldense* (Figure 5C, D). There is a disjunction of 240 km in distribution between *S. leopoldense* and *S. zoeae*.

*Solanum zoeae* keys to Group VII of Symon (1981). It keys to couplet 31 where the deeply lobed leaves then leads to couplet 32 rather than to 34 with *S. leopoldense*. This species does not sit comfortably in couplet 32 as it has many triangular lobes on the leaves. *Solanum zoeae* keys to *S. leopoldense* in Wheeler (1992). A revised key is presented below based on Purdie *et al.* (1982) and later treatments.

Whether or not this species can be considered edible is unknown. It does not belong to the clade of true bush tomatoes identified by Martine *et al.* (2006).

Field observations showed that about 20% of fallen fruit had been predated by the larvae of an unidentified insect.

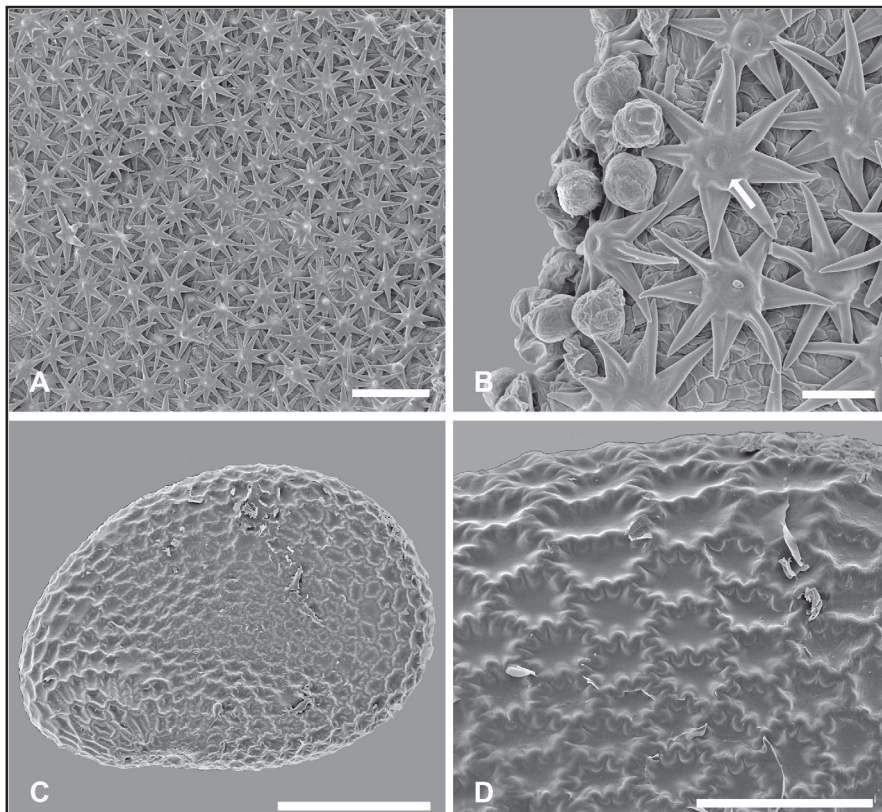


Figure 5. *Solanum leopoldense*. Scanning electron micrographs. A – leaf indumentum; B – leaf margin with sessile glandular hair (centre left) and stellate hairs (arrow indicates grooves between ‘arms’); C – seed; D – seed reticulation (*D.E.Symon* 10147). Scale bars: A = 200  $\mu\text{m}$ ; B = 50  $\mu\text{m}$ ; C = 500  $\mu\text{m}$ ; D = 200  $\mu\text{m}$ .

### Notes on phrase-named *Solanum* taxa in the Kimberley

A number of *Solanum* taxa have been listed on Western Australia's plant census in recent years (Western Australian Herbarium 1998–) under phrase names and these are discussed below. Currently, the amount of material available is insufficient to formally describe these taxa. Notes and brief descriptions are provided here to aid their identification and encourage further collections so that they can be formally described. Additional taxa should undoubtedly be recognised in the region, but are currently included in species complexes. In particular, the current concept of *S. dioicum* is particularly morphologically variable. The Kimberley collections referred to *S. carduiforme* F.Muell. by Wheeler (1992) probably represent an undescribed species and are keyed out below as *S. aff. carduiforme*.

#### ***Solanum* sp. Bachsten Creek (R.L. Barrett & M.D. Barrett RLB 3813)**

*Subshrub*, 50–80 cm tall, dioecious. Indumentum of glandular stellate hairs, each hair stalked, with a ring of short non-glandular branches, and terminating in a very long, erect glandular branch arising from the centre of the whorl. *Leaves* entire, narrowly elliptic, ± concolourous, softly hairy with rusty grey-green, slightly ferruginous hairs; blade 15–40 mm long, 7–12 mm wide. *Female flowers* solitary, purple. *Fruit* small, *c.* 12 mm diam., almost entirely enclosed in expanded calyx tube that is covered in dense spines.

*Specimen examined.* WESTERNAUSTRALIA: ridgeline between Gwens Gorge south arm and Bachsten Falls (south) on E side of falls, NE of Bachsten Creek Bush Camp, southern boundary of Prince Regent Nature Reserve, 24 Jan. 2007, *R.L. Barrett & M.D. Barrett* RLB 3813 (PERTH 08130310).

*Conservation status.* Recently listed as Priority Two under the DEC Conservation Codes for Western Australian Flora (Western Australian Herbarium 1998–).

*Notes.* This taxon is only known from a single collection. Within the *S. dioicum* group, this species differs from all described species by the unique, elongated, gland-tipped stellate hairs. It is further distinguished from all except *S. dioicum s. lat.* and *S. vansittartense* C.A.Gardner by the entire, ± concolourous leaves. It differs from *S. dioicum* and *S. vansittartense* by the smaller fruits.

#### ***Solanum* sp. Boomerang Bay (K.F. Kenneally 10021)**

*Plant* prostrate, to 15 cm tall, dioecious. *Leaves* entire, ± linear, involute, lacking spines, covered in fine, golden, stellate hairs; blade 10–20 mm long, 2–3 mm wide. There are no flowers on the single known collection, a female plant. *Fruit* small, solitary, *c.* 5 mm diam., completely enclosed in the calyx at maturity; calyx densely covered in long spines; sepals extending beyond the fruit, being about half the length of the calyx.

*Specimen examined.* WESTERNAUSTRALIA: Boomerang Bay on W side of Bigge Island, Bonaparte Archipelago, W. Kimberley coast, 28 May 1987, *K.F. Kenneally* 10021 (*AD n.v.*, PERTH 037000593).

*Conservation status.* Listed as Priority One under the DEC Conservation Codes for Western Australian Flora (Smith 2012).

*Notes.* This taxon is only known from a single collection. It is distinctive for its prostrate habit, fine, simple leaves and small fruit. It is probably most closely allied to *S. petraeum*, but may also have affinity with the prostrate species *S. cataphractum* Benth. Keyed out below based on bisexual plants only.



***Solanum* sp. Longini (C.T. Martine 807 et al.)**

*Plant* erect, 50–70 cm tall, stems with spines. *Leaves* entire, densely covered in large, thickly matted, greenish white, stellate hairs, lacking spines; 20–60 mm long, 15–30 mm wide, asymmetric at base, the surface hidden by hairs.

*Specimen examined.* WESTERN AUSTRALIA: Kalumburu area: Longini Landing, just E of road between Kalumburu and Longini Landing, 1 June 2004, C.T. Martine, B. Barker & J. Karadada CTM 807 (CONN *n.v.*, PERTH).

*Conservation status.* Listed as Priority One under DEC Conservation Codes for Western Australian Flora (Smith 2012).

*Notes.* Allied to *S. dioicum*. No fertile material of *S. sp. Longini* is known but the indumentum is unique and the taxon has been identified as a unique lineage based on ITS sequence data by Martine *et al.* (2009). This species is a member of the dioecious clade, so is most likely dioecious. All related species have the calyx surrounding the berry. A visit to the original location by M. and R. Barrett located only a single plant. An additional population of 100+ plants was found further south at the base of a rough sandstone hill. This species is probably fire sensitive.

***Solanum* sp. Prince Regent River (T. Handasyde CH 1925)**

*Plant* erect to spreading, 20–80 cm tall, dioecious. *Leaves* lobed about 1/2–2/3 of the way to the midrib, distinctly discolourous, covered in thick, matted, pale stellate hairs, with numerous spines; blade 30–80 mm long, 10–20 mm wide. *Male flowers* in a short cyme, small, only *c.* 8 mm diam., pale blue. *Female flowers* solitary, larger, to *c.* 15 mm diam. *Fruit* *c.* 10–20 mm diam., completely enclosed in the calyx at maturity; densely covered in long spines; sepals persistent, extending beyond the fruit, almost as long as the calyx.

*Specimens examined.* WESTERN AUSTRALIA: 10 km NE of Prince Regent River mouth, 27 May 1993, L.A. Craven, J. McD. Stewart & C.L. Brubaker 9215 (CANB *n.v.*, PERTH); summit of Mt Trafalgar, Prince Regent Nature Reserve, 20 Aug. 1974, A.S. George 12809 (PERTH); tributary to Prince Regent River, above Rainforest Patch 28/3, trapline 3, 24 May 2003, T. Handasyde TH 1925 (AD *n.v.*, PERTH); *c.* W5 Prince Regent River Reserve, 29 Aug. 1974, K.F. Kenneally 2175 (PERTH); Kings Cascade, 85.2 km from Kuri Bay settlement on a bearing of 97 degrees, 18 Mar. 2002, A.A. Mitchell 7102 (AD *n.v.*, PERTH).

*Conservation status.* Listed as Priority Three under DEC Conservation Codes for Western Australian Flora (Smith 2012).

*Notes.* Probably allied to the morphologically similar *S. petraeum* which has entire mature leaves and lobed juvenile leaves. The lobed leaves are similar in appearance to *S. leopoldense* and *S. zoeae*, but the indumentum is distinctly different with the stellate hairs being much more robust.

*Variants.* Two additional collections cited below are similar in having prominently lobed and strongly discolourous leaves, but a finer indumentum. One of these collections is in fruit, with the calyx not completely enclosing the fruit, distinguishing it from the specimens cited above.

*Specimens examined.* WESTERN AUSTRALIA: large gully, 10.8 km NE of junction of Youwanjela Creek and Prince Regent River, Prince Regent Nature Reserve, 20 Jan. 2007, *R.L. Barrett & M.D. Barrett* RLB 3665 (PERTH); small sandstone gully above Gwens Gorge south arm, NE of Bachsten Creek Bush Camp, southern boundary of Prince Regent Nature Reserve, 24 Jan. 2007, *R.L. Barrett & M.D. Barrett* RLB 3805 (PERTH).

Two additional collections cited below from the Edkins Range are similar to the above form in indumentum and discoloured leaves, but differ in having smaller, entire leaves.

*Specimens examined.* WESTERN AUSTRALIA: Bachsten Creek Bush Camp, Bachsten Creek South, Mt Elizabeth – Munja Road, 21 Jan. 2007, *R.L. Barrett & M.D. Barrett* RLB 3693 (PERTH); small sandstone gully above Gwens Gorge south arm, NE of Bachsten Creek Bush Camp, southern boundary of Prince Regent Nature Reserve, 24 Jan. 2007, *R.L. Barrett & M.D. Barrett* RLB 3806 (PERTH).

### Key to *Solanum* species in the Kimberley Region

The key below has been adapted from Purdie *et al.* (1982) including information from Symon (2001), Bean & Albrecht (2008), Bean (2012), and this paper. It includes a number of taxa that were not recorded at the time of Wheeler (1992) in the *Flora of the Kimberley Region: Solanum americanum* Mill., *S. chenopodium* F.Muell., *S. chippendalei* Symon, *S. eburneum* Symon, *S. fecundum* A.R.Bean, *S. ferocissimum* Lindl., *S. gilesii* Symon, *S. lasiophyllum* Poiret, (*S. lycopersicum* L. was included under the genus *Lycopersicon* Mill.), *S. oligandrum* Symon, *S. pseudocapsicum* L., *S. seaforthianum* Andrews, *S. succosum* A.R.Bean & Albr., *S. tumulicola* Symon, *S. zoeae*, *S. sp.* Bachsten Creek, *S. sp.* Boomerang Bay, *S. sp.* Longini and *S. sp.* Prince Regent River.

*Solanum sp.* Boomerang Bay and *S. sp.* Longini are still imperfectly known and may not key out properly in this key. They are only included in sections of the key where their character states are certain.

- |    |                                                                                                                                                       |                            |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| 1. | Stellate hairs absent; prickles absent or rare (introduced species).....                                                                              | 2                          |
| 1: | Stellate hairs and/or prickles present (native species).....                                                                                          | 6                          |
| 2. | Leaves deeply pinnatisect; flowers yellow; fruit red, sub-globular.....                                                                               | * <b>S. lycopersicum</b>   |
| 2: | Leaves entire or lobed, not pinnatisect; flowers mauve, purple or rarely white;<br>fruit red, green, brown or black, globular.....                    | 3                          |
| 3. | Climbing or scrambling perennials; leaves deeply 3–9-lobed;<br>berry usually 10–12 mm diam.; seeds shaggy-haired .....                                | * <b>S. seaforthianum</b>  |
| 3: | Annuals or herbaceous perennials, not climbing; leaves entire, or some<br>with 1–5 basal lobes or leaflets; berry 5–10 mm diam.; seeds not hairy..... | 4                          |
| 4. | Leaves usually 1–2 cm wide, hairs (if present) forked;<br>berries bright orange-red, 1 or 2 per peduncle .....                                        | * <b>S. pseudocapsicum</b> |
| 4: | Leaves 1–8 cm wide, hairs not forked; berries not bright orange-red,<br>usually 2–10 per peduncle.....                                                | 5                          |
| 5. | Mature berry shiny; seeds usually more than 40 in each fruit.....                                                                                     | * <b>S. americanum</b>     |
| 5: | Mature berry dull; seeds usually 20–40 in each fruit .....                                                                                            | * <b>S. nigrum</b>         |
| 6. | Hairs predominantly simple or glandular .....                                                                                                         | 7                          |

- 6: Hairs predominantly stellate..... 9
- 7: Fruiting calyx largely enclosing berry..... **S. oedipus**
- 7: Fruiting calyx not enclosing berry..... 8
- 8: Leaves deeply and narrowly lobed; inflorescence reduced,  
with one bisexual flower below several male flowers; seeds discoid..... **#S. oligandrum**
- 8: Leaves with triangular lobes; inflorescence not reduced as above;  
seeds flat, distinctly winged..... **S. pugiunculiferum**
- 9: Indumentum of glandular stellate hairs, each hair stalked,  
with a ring of short non-glandular branches, and terminating in a very  
long, erect, glandular branch arising from the centre of the whorl ..... **S. sp. Bachsten Creek**
- 9: Indumentum of non-glandular stellate hairs..... 10
- 10: Prickles absent or rare ..... 11
- 10: Prickles present on stems, leaves, petioles and/or inflorescences ..... 23
- 11: Flowers all male ..... 12
- 11: At least the basal flower bisexual ..... 16
- 12: Leaves linear-lanceolate, sometimes lobed ..... **S. tudununggae**
- 12: Leaves lanceolate to elliptic or ovate, not lobed ..... 13
- 13: Leaves green..... **S. vansittartense**
- 13: Leaves silvery or rusty ..... 14
- 14: Leaves discolourous, lanceolate-elliptic, rusty, 1–2 cm wide ..... **S. cunninghamii**
- 14: Leaves concolourous, ovate-elliptic, rusty, silvery  
or greenish white, 1–5 cm wide..... 15
- 15: Indumentum silvery (type form) or rusty (W Kimberley form)..... **S. dioicum**
- 15: Indumentum greenish white ..... **S. sp. Longini**
- 16: Lowest flower of inflorescence bisexual, the others male,  
or flowers solitary and bisexual..... 17
- 16: Flowers all bisexual, rarely lower ones bisexual and upper ones male..... 19
- 17: Leaves lanceolate to elliptic or ovate, not lobed ..... 18
- 17: Leaves linear-lanceolate, sometimes lobed ..... **S. tudununggae**
- 18: Leaves 10–15 mm wide; fruit *c.* 20 mm diam..... **S. cunninghamii**
- 18: Leaves 2–3 mm wide; fruit *c.* 5 mm diam..... **S. sp. Boomerang Bay**
- 19: Leaves sparsely pubescent or glabrous on upper surface..... **#S. chenopodium**
- 19: Leaves densely to moderately pubescent on upper surface..... 20
- 20: Mature berry dry, brown or black..... 21
- 20: Mature berry mucilaginous, yellow, green or orange-brown ..... 22
- 21: Small sub-shrub to 0.5 m; calyx with few or no prickles  
(S Kimberley & arid Australia) ..... **S. centrale**
- 21: Erect shrub to 3 m; calyx with prominent prickles (far N Kimberley) ..... **S. vansittartense**



22. Leaves oblong, sometimes shallowly lobed; flowering pedicel 10–15 mm long; calyx lobes linear or narrow-triangular, 2–3 mm long..... **S. esuriale**
- 22: Leaves oblong, not lobed; flowering pedicel to 10 mm long; calyx lobes triangular, 1–1.5 mm long ..... #**S. tumulicola**
23. Flowers all male ..... **24**
- 23: At least basal flower bisexual; fruits, when present, one to several on each peduncle ..... **38**
24. Leaves entire..... **25**
- 24: Leaves lobed..... **31**
- 25: Leaves lanceolate to elliptic or ovate, 10–70 mm wide ..... **26**
25. Leaves linear-lanceolate or lanceolate, 8–15 mm wide..... **29**
26. Leaves green..... **S. vansittartense**
- 26: Leaves silvery or rusty ..... **27**
27. Leaves discolourous, lanceolate-elliptic, rusty, 1–2 cm wide ..... **S. cunninghamii**
- 27: Leaves concolourous, ovate-elliptic, rusty, silvery, or greenish white, 1–5 cm wide..... **28**
28. Indumentum silvery (type form) or rusty (W Kimberley form)..... **S. dioicum**
- 28: Indumentum greenish white ..... **S. sp. Longini**
29. Leaves silvery; corolla 30–45 mm diam., purple ..... **S. tudununggae**
- 29: Leaves grey-green; corolla 15–20 mm diam., pale lavender ..... **30**
30. Male flowers 15–25 mm diam., female flowers 20–30 mm diam..... **S. petraeum**
- 30: Male flowers *c.* 8 mm diam., female flowers *c.* 15 mm diam..... **S. sp. Prince Regent River** (entire leaf form)
31. Lobes cut no more than half way to midrib..... **32**
- 31: Lobes cut almost to midrib..... **35**
32. Leaves glabrous or nearly so; glandular hairs absent; lobes narrow-linear..... **S. cataphractum**
- 32: Leaves pubescent with minute stellate and glandular hairs; lobes triangular ..... **33**
33. Leaves strongly discolourous, dull olive green..... **S. sp. Prince Regent River** (lobed leaf form)
- 33: Leaves not or only weakly discolourous, dark green ..... **34**
34. Plants spreading, with thin woody stems up to 0.6 cm thick at the base; leaves densely stellate-hairy when young, sparsely so with age; glandular hairs sessile; seed reticulation fine, reticulae 60–110  $\mu\text{m}$  across, mostly  $\pm$  rounded..... **S. leopoldense**
- 34: Plants erect, with thick woody stems up to 2–3 cm thick at the base; leaves consistently densely stellate-hairy; glandular hairs stalked; seed reticulation very fine, reticulae 50–80  $\mu\text{m}$  across,  $\pm$  elongate ..... **S. zoeae**
35. Leaf lobes 3–5 or 7–14, oblong to broadly triangular ..... **36**
- 35: Leaf lobes 4–14, linear ..... **37**

36. Leaf lobes 3–5 ..... **S. aff. carduiforme**
- 36: Leaf lobes 7–14 ..... **S. zoeae**
37. Leaves 3–6 cm long, green, the lobes 2–20 mm long, 1–3 mm wide ..... **S. cataphractum**
- 37: Leaves 9–25 cm long, silvery, the lobes 10–170 mm long, 5–10 mm wide ..... **S. tudununggae**
38. Fruiting calyx surrounding or enclosing at least three-quarters of berry (sometimes split) ..... **39**
- 38: Fruiting calyx not enclosing berry ..... **67**
39. Berry mostly enclosed in or surrounded by lobes of persistent calyx ..... **40**
- 39: Berry mostly enclosed in enlarged calyx tube ..... **44**
40. Glandular hairs present on calyx of bisexual flower; berry 15–20 mm diam., slightly bilobed ..... **S. oedipus**
- 40: Glandular hairs usually absent; berry 20–40 mm diam., globular or ellipsoid ..... **41**
41. Fruiting calyx lobes triangular to broadly angular, 10–25 mm long ..... **S. beagleholei**
- 41: Fruiting calyx lobes narrowly triangular, linear, or triangular with a linear tip, 20–50 mm long ..... **42**
42. Bisexual flower 40–50 mm diam.; male flowers 30–40 mm diam.; fruiting pedicel to 25 mm long ..... **S. phlomoides**
- 42: Bisexual flower 30–35 mm diam.; male flowers 20–25 mm diam.; fruiting pedicel 25–45 mm long ..... **43**
43. Lower leaves shallowly lobed or entire; anthers basifixed, filaments 0.5–1.5 mm long; mature fruits globular, internal cavity dry ..... **S. chippendalei**
- 43: Lower leaves deeply lobed; anthers dorsifixed, filaments (1.6–)2.0–3.3 mm long; mature fruits mostly longer than broad, internal cavity liquid-filled ..... **#S. succosum**
44. Leaves lobed ..... **45**
- 44: Leaves entire or slightly undulate ..... **55**
45. Flowers solitary, rarely numerous with basal one bisexual and upper ones male ..... **46**
- 45: Flowers 1–15 on each peduncle but never regularly 1, usually all bisexual ..... **53**
46. Lobes cut almost to midrib ..... **47**
- 46: Lobes cut no more than half way to midrib ..... **50**
47. Leaf lobes 3–5 or 7–14, oblong to broadly triangular ..... **58**
- 47: Leaf lobes 4–14, linear ..... **49**
48. Leaf lobes 3–5 ..... **S. aff. carduiforme**
- 48: Leaf lobes 7–14 ..... **S. zoeae**
49. Leaves 3–6 cm long, green, the lobes 2–20 mm long, 1–3 mm wide ..... **S. cataphractum**
- 49: Leaves 9–25 cm long, silvery, the lobes 1–17 cm long, 5–10 mm wide ..... **S. tudununggae**
50. Leaves dull green or yellow-green, sometimes discolourous, the lobes broadly triangular ..... **S. heteropodium**
- 50: Leaves green, concolourous, the lobes tooth-like or narrowly triangular ..... **51**

51. Leaves glabrous or nearly so; glandular hairs absent; lobes narrow-linear ..... **S. cataphractum**
- 51: Leaves pubescent with minute stellate and glandular hairs; lobes triangular ..... **52**
52. Plants spreading, with thin woody stems up to 0.6 cm thick at the base; leaves densely stellate-hairy when young, sparsely so with age; glandular hairs sessile; seed reticulation fine,  $\pm$  rounded ..... **S. leopoldense**
- 52: Plants erect, with thick woody stems up to 2–3 cm thick at the base; leaves consistently densely stellate-hairy; glandular hairs stalked; seed reticulation very fine,  $\pm$  elongate ..... **S. zoeae**
53. Indumentum on stems, calyx and young shoots rusty red or orange-brown ..... **#S. gilesii**
- 53: Indumentum on all parts grey-green, yellow-green or purple-green ..... **54**
54. Stems erect or almost so ..... **S. lasiophyllum**
- 54: Stems prostrate or sprawling ..... **S. lucani**
55. Flowers always solitary ..... **56**
- 55: Flowers 2–15 on each peduncle ..... **61**
56. Leaves usually 1–1.5 cm wide ..... **57**
- 56: Leaves usually 2–7 cm wide ..... **59**
57. Leaves concolourous, silvery green, 15–20 cm long; calyx with scattered prickles ..... **S. tudununggae**
- 57: Leaves discolourous, mostly 3–7 cm long; calyx densely prickly ..... **58**
58. Leaves usually with rusty hairs over a green blade, lanceolate-elliptic; berry *c.* 20 mm diam. .... **S. cunninghamii**
- 58: Leaves never as above, lanceolate; berry 15–20 mm diam. .... **S. petraeum**
59. Fruiting pedicel to 15 mm long, erect; fruit splitting around circumference to form a loose cap ..... **S. vansittartense**
- 59: Fruiting pedicel 15–30 mm long, deflexed or nodding; fruit not splitting around circumference ..... **60**
60. Indumentum silvery (type form) or rusty (W Kimberley form) ..... **S. dioicum**
60. Indumentum greenish white ..... **S. sp. Longini**
61. Stems prostrate or sprawling ..... **62**
- 61: Stems erect or almost so ..... **64**
62. Stellate hairs 0.3–0.6 mm diam. on branchlets and petioles, the central ray 0.3–1.2  $\times$  length of lateral rays; all stellate hairs on fruiting calyx with stalks <0.5 mm long; proto-prickles absent ..... **S. fecundum**
- 62: Stellate hairs 0.6–1.1 mm diam. on branchlets and petioles, the central ray 1–1.8  $\times$  length of lateral rays; some stellate hairs on fruiting calyx with stalks >0.8 mm long, proto-prickles sometimes present ..... **63**
63. Leaves slightly discolourous; petioles 25–55% of lamina length; average of 10–66 prickles per cm on branchlets; leaf margins often repand (wavy); calyx lobes 2.5–6 mm long at anthesis ..... **S. echinatum**
- 63: Leaves distinctly discolourous; petioles 55–115% of lamina length; average of 0.3–8 prickles per cm on branchlets; leaf margins entire; calyx lobes 1–2.5 mm long at anthesis ..... **S. lucani**



64. Indumentum bright rusty or orange-brown ..... 65
- 64: Indumentum grey-green, yellow-green or white ..... 66
65. Inflorescence 2–5-flowered; peduncle to 4 cm long; berry depressed-globular, squarish in outline ..... **S. echinatum**
- 65: Inflorescence 1- or 2-flowered; peduncle to 0.5 cm long; berry globular, circular in outline ..... #**S. gilesii**
66. Leaves concolourous; berry globular or ovoid, rarely conical or ellipsoid, yellow ..... **S. lasiophyllum**
- 66: Leaves discolourous; berry depressed-globular, squarish in outline, pale green ..... **S. echinatum**
67. Berry red, orange-red or blackish red ..... 68
- 67: Berry green, yellow or purple, often drying to brown or black ..... 69
68. Leaves linear or nearly so, 2–14 mm wide ..... **S. ferocissimum**
- 68: Leaves lanceolate, elliptic or ovate, 10–140 mm wide ..... #**S. chenopodium**
69. Inflorescence forked ..... **S. beagleholei**
- 69: Inflorescence simple ..... 76
70. Berry 30–40 mm wide, yellow ..... **S. phlomoides**
- 70: Berry up to 30 mm wide, green, yellow or brown ..... 71
71. Lowest flower of inflorescence bisexual, the others male; berry 15–30 mm diam., always solitary; seeds black ..... 72
- 71: Flowers all bisexual, rarely lower ones bisexual, upper ones male; berry usually less than 15 mm diam.; seeds not black ..... 78
72. Leaves entire or shallowly lobed with several basal lobes ..... 73
- 72: Leaves deeply lobed, cut more than half way to midrib ..... 76
73. Fruiting calyx lobes triangular to broadly angular, 10–25 mm long ..... **S. beagleholei**
- 73: Fruiting calyx lobes narrowly triangular, linear, or triangular with a linear tip, 20–50 mm long ..... 74
74. Bisexual flower 40–50 mm diam.; male flowers 30–40 mm diam.; fruiting pedicel to 25 mm long ..... **S. phlomoides**
- 74: Bisexual flower 30–35 mm diam.; male flowers 20–25 mm diam.; fruiting pedicel 25–45 mm long ..... 75
75. Lower leaves shallowly lobed or entire; anthers basifixed, filaments 0.5–1.5 mm long; mature fruits globular, internal cavity dry ..... **S. chippendalei**
- 75: Lower leaves deeply lobed; anthers dorsifixed, filaments (1.6–)2.0–3.3 mm long; mature fruits mostly longer than broad, internal cavity liquid-filled ..... #**S. succosum**
76. Fruiting calyx lobes broadly triangular, appressed ..... **S. diversiflorum**
- 76: Fruiting calyx lobes narrow, triangular to elliptic, not appressed ..... 77
77. Lower leaf lobes often cut 2–3 mm from midrib; flowering calyx to 10 mm long; fruiting calyx lobes 1–1.5 cm long ..... **S. eburneum**

- 77: Lower leaf lobes rarely cut 2–3 mm from midrib;  
flowering calyx 10–30 mm long; fruiting calyx lobes 2–2.5 cm long ..... **S. chippendalei**
78. Leaves shallowly lobed ..... **S. esuriale**
- 78: Leaves entire or slightly undulate ..... **79**
79. Berry dry, yellow, finally brown or black..... **S. centrale**
- 79: Berry bony or mucilaginous, yellow, green, purple or orange-brown ..... **80**
80. Berry hard and bony, the lower half enclosed by the calyx ..... **S. quadriloculatum**
- 80: Berry succulent, the lower half not enclosed by the calyx..... **81**
81. Calyx 2–3 mm long; stellate hairs on the foliage minute..... **#S. tumulicola**
- 81: Calyx 4–8 mm long; stellate hairs not minute..... **S. esuriale**

\*Naturalised in the Kimberley region.

#Not yet recorded in the Kimberley region, but probably present and included here to facilitate identification.

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