

Four new species of *Boronia* (Rutaceae) from the Kimberley region of Western Australia

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Abstract

Barrett, R.L., Barrett, M.D. & Duretto, M.F. Four new species of *Boronia* (Rutaceae) from the Kimberley region of Western Australia. *Nuytsia* 26: 89–109 (2015). Four new species of *Boronia* Sm. are described from the North Kimberley region of Western Australia: *B. cremnophila* R.L.Barrett, M.D.Barrett & Duretto, *B. interrex* R.L.Barrett, M.D.Barrett & Duretto, *B. marcoana* R.L.Barrett & M.D.Barrett and *B. thedae* R.L.Barrett, M.D.Barrett & Duretto. All of these species have very restricted distributions and are of conservation concern. All new species are illustrated. A revised key to *Boronia* species in the Kimberley region is provided.

Introduction

The Kimberley region is a minor centre of diversity for the genus *Boronia* Sm. with nine species recognised in the region by Duretto *et al.* (2013). With the addition of the four species named here, nine species are considered to be endemic to the Kimberley, with four species shared with the Northern Territory, and one of these extending to Queensland. Endemic species include the unusual *B. anomala* Duretto, still only known from the type collection (Duretto 1999). Duretto (2006) indicated that further studies should be undertaken on poorly known species, particularly in the *B. pauciflora* W.Fitzg. species complex. Most Kimberley species occur on rough, broken sandstone, though the widespread species *B. wilsonii* (F.Muell. ex Benth.) Duretto also occurs in open woodland on sandstone and laterite. In the Northern Territory, a number of species are known from cliff faces, and significant time has been spent searching similar habitats in the Kimberley region. A cliff-dwelling species was finally located in the Kimberley region in 2010, named here as *B. cremnophila* R.L.Barrett, M.D.Barrett & Duretto.

As a genus with many highly localised species, details of micromorphology are critical to the accurate recognition of taxa. Duretto (1997, 1999) has provided a detailed discussion of the key characteristics for defining taxa in *Boronia* ser. *Lanuginosae* Duretto and included numerous Scanning Electron Microscope (SEM) images to aid character recognition and interpretation. We have undertaken similar imaging work for each of the species described here. While Duretto (1997, 1999) did not assess pollen morphology, there are some apparent differences between species in the *B. kalumburuensis* Duretto

species group. *Boronia interrex* R.L.Barrett, M.D.Barrett & Duretto shows particular differences to its putative closest relatives (*B. kalumburuensis*, *B. marcoana* R.L.Barrett & M.D.Barrett and *B. thedae* R.L.Barrett, M.D.Barrett & Duretto; Figure 5). Pollen of *B. interrex* is sub-globular and consistently has a raised dome in the centre of each colpus. Smaller domes may occasionally be present in the other species in this complex. The remaining species have pollen that is typical of many Australian Rutaceae. Further studies of pollen morphology in *Boronia* may identify characters that are useful for infrageneric classification.

Boronia kalumburuensis was recognised by Duretto (1997) based on a small number of collections from around Kalumburu and Theda Station. It is placed in *Boronia* subser. *Filicifoliae* Duretto (ser. *Lanuginosae*) which currently contains four other described species, viz. *B. barrettiorum* Duretto, *B. filicifolia* A.Cunn. ex Benth., *B. minutipinna* Duretto and *B. pauciflora* (Duretto 1999; Duretto *et al.* 2013). Other Kimberley species from ser. *Lanuginosae* are *B. jucunda* Duretto (subser. *Jucundae* Duretto), *B. lanuginosa* Endl. and *B. wilsonii* (subser. *Lanuginosae*). Further fieldwork in the region has provided additional collections of *B. kalumburuensis* *s. lat.* from known locations, as well as new populations from the King Edward River to Lawley River and Prince Regent River. These additional populations each have their own unique characteristics, requiring a reassessment of species boundaries in *B. kalumburuensis* and *B. wilsonii*. Careful study of these populations has concluded that three taxa should be recognised at species rank from *B. kalumburuensis* *s. lat.* and we describe *B. interrex* R.L.Barrett, M.D.Barrett & Duretto, *B. marcoana* R.L.Barrett & M.D.Barrett and *B. thedae* R.L.Barrett, M.D.Barrett & Duretto as new. These three species all have mottled seeds and are placed in *Boronia* subser. *Filicifoliae*. Further field study of *B. wilsonii* has shown that populations in the Drysdale River area are unusual and may require taxonomic recognition in the future. The new species described here may blur the division between subser. *Lanuginosae* and subser. *Filicifoliae*.

Another new species related to *B. pauciflora* and *B. barrettiorum* has been discovered on sandstone cliffs to the north-west of Mount Elizabeth Station and this is described here as *B. cremnophila* R.L.Barrett, M.D.Barrett & Duretto. Detailed studies of *B. pauciflora* are still required to determine the appropriate rank for geographic variants currently included in that species (see also discussion in Duretto 2006).

Methods

All measurements are based on dried herbarium material. All taxa newly described here have been examined in the field by the first two authors of this paper and colour descriptions are based on observations of fresh specimens or from photographs taken in the field. Descriptions are based on the format of Duretto (1997). Features of micromorphology, including indumentum and seed surface patterns, are particularly important in *Boronia* taxonomy and detailed illustrations are provided for comparative purposes. Dry leaves, stems and seeds were mounted on stubs using double-sided carbon tape with conductive carbon paint, coated with gold using an EMITECH K550X Sputter Coater and imaged at high vacuum and high voltage (15 KV) using a Jeol JCM 6000 NeoScope bench-top SEM at Kings Park and Botanic Garden.

Key to *Boronia* species in the Kimberley region of Western Australia

This key has been revised from Duretto (2006) to include the new species described here.

1. Plants glabrous (apart from petals and stamens); leaves 3–5-foliolate; leaflets linear, < 1 mm wide; sepals *c.* 1.25 mm long, < 1/2 the length of the petals **B. anomala**
- 1: Plants glabrescent or with a sparse to dense indumentum; leaves 1–55-foliolate;

- leaflet shape various, mostly >1 mm wide; sepals 3.5–15 mm long, usually >1/2 length of petals..... 2
2. Leaves simple or ternate (rachis absent)..... 3
- 2: Leaves 5–55-pinnate (rachis present) 6
3. Leaflets linear; younger branches glandular tuberculate (also NT)..... **B. jucunda**
- 3: Leaves or leaflets lanceolate to ovate to elliptic; branches not obviously glandular..... 4
4. Plant cliff-dwelling, base of stem thick and corky; terminal leaflets 6–18 mm long, 1.5–3 mm wide **B. cremnophila**
- 4: Plant on broken sandstone, base of stem slender, lacking any corky bark; terminal leaflets 10–80 mm long, 2–12 mm wide..... 5
5. Leaves glabrescent, 12–80 mm long..... **B. pauciflora**
- 5: Leaves with a moderately dense indumentum (sometimes not clearly visible to the naked eye, though particularly noticeable on new foliage, at least on dry specimens, making them appear white), 8–30 mm long **B. barrettiorum**
6. Leaves with a moderately dense (epidermis visible) to dense (epidermis not visible) stellate indumentum; sepals (4–)5–15 mm long, larger than petals, abaxial surface with a dense indumentum; petals 3–10 mm long; anthopodium (pedicel) 3–6(–10) mm long 7
- 6: Leaves glabrescent or with a sparse to moderately dense stellate indumentum; sepals 3.5–6 mm long, smaller to larger than petals, abaxial surface glabrous, glabrescent or with a sparse indumentum; petals 2.5–4.5 mm long; anthopodium 1–24 mm long..... 8
7. Leaflets linear to narrowly elliptic, so revolute that abaxial surface not usually visible; sepals 5–14 mm long (E of Ord R.; also NT & Qld)..... **B. lanuginosa**
- 7: Leaflets elliptic to lanceolate, abaxial surface visible; sepals 5–9 mm long (W of Ord R.; also NT)..... **B. wilsonii**
8. Terminal leaflets 1–2 mm long, lateral leaflets 0.5–1.5 mm long; anthopodium 1–6 mm long **B. minutipinna**
- 8: Terminal leaflets (1.5–)3–11 mm long, lateral leaflets 0.5–8 mm long; anthopodium (2–)6–21 mm long 9
9. At least some leaves with >30 leaflets present, (7–)30–75 mm long; leaflets elliptic to rhombic to circular; petiole 0–2 mm long; sepals 2–3.5 mm long, shorter to longer than petals (also NT)..... **B. filicifolia**
- 9: Leaves with <30 leaflets (if >30 leaflets then some petioles >3 mm long), 8–40(–56) mm long; leaflets linear to elliptic; petiole 0.2–7 mm long; sepals 3.5–6 mm long, as long or longer than petals..... 10
10. Petiole 2.8–6.9 mm long; rachis segments widest across the middle; anthopodium with a dense stellate indumentum; petals slender, 0.7–0.8 mm wide **B. interrex**
- 10: Petiole 0.2–1.0 mm long; rachis segments widest at distal end; anthopodium with a sparse to moderately dense stellate indumentum; petals broad, 1.0–1.5 mm wide 11
11. Mature plants erect to spreading, leaves and younger stems remaining green; stem indumentum of short stellate hairs to 0.5 mm long and long simple hairs to 1.8 mm long; petals 1/2 to 2/3 as long as sepals..... **B. marcoana**
- 11: Mature plants erect at first, then spreading or quickly becoming decumbent, leaves and younger stems turning reddish in sun; stem indumentum of mixed short

- stellate hairs to 0.25 mm long and long simple hairs 0.6–0.9 mm long or short to long stellate hairs 0.1–0.7 mm long; petals 2/3 to as long as sepals..... 12
12. Mature plants semi-erect to spreading; indumentum of moderately dense, fine to robust, mixed short to long stellate hairs 0.1–0.7 mm long on stems (long simple hairs apparently absent); cocci occasionally glabrous but usually with evenly scattered, very short stellate hairs **B. kalumburuensis**
- 12: Mature plants quickly becoming decumbent; indumentum of sparse to moderately dense, fine, mixed short stellate hairs up to 0.25 mm long and long simple hairs 0.6–0.9 mm long on stems; cocci occasionally glabrous but usually with scattered, short stellate hairs, denser towards the margins..... **B. thedae**

Taxonomy

Boronia cremnophila R.L.Barrett, M.D.Barrett & Duretto, *sp. nov.*

Type: [north-west of Mount Elizabeth Station homestead,] Western Australia [precise locality withheld for conservation reasons], 28 March 2010, *R.L. Barrett & M.D. Barrett* RLB 6770 (*holo:* PERTH 08614644; *iso:* BM, BRI, CANB, CNS, DNA, K, MEL, NSW).

Erect or spreading, open *shrub* to 80 cm high and 1 m wide, occasionally some *branches* pendulous on large shrubs, mature growth dark green; usually glabrous throughout, apart from flowers. Multiangular stellate *hairs* found rarely on very new growth in the interpetiolar region and on the pedicels, when present hairs few, small, sessile, with up to 8 (occasionally more) rays; rays unicellular, unfused, firm, straight, not appressed, glossy, smooth, white, to 0.2 mm long. *Branches* ±terete, decurrent leaf bases absent, not glandular, glabrous, base of primary stem with 2–8 cm of distinctly fissured, somewhat corky bark. *Leaves* opposite-decussate, 1- or 3-foliolate, usually both types present on a given branch, mostly 3-foliolate, 7–20 mm long, 7–15 mm wide; lamina slightly discoloured, paler beneath, weakly dorsiventral, obviously glandular; margins entire, flat to slightly revolute; midrib not impressed adaxially, raised abaxially; pinnae with petiolules to 2.7 mm long, lanceolate to narrowly elliptic, tip acute, attenuate; unifoliolate and terminal pinnae longer than laterals, 6–18 mm long, 1.5–3 mm wide, midvein straight; lateral pinnae opposite, 4–9 mm long, 1.1–2.6 mm wide; petioles not winged. *Inflorescence* cymose, 1(2)-flowered; peduncle *c.* 1 mm long; prophylls minute; metaxyphylls absent or possibly minute; anthopodium (pedicel) ±glabrous (rarely a few stellate hairs present), 3.3–4.8 mm long. *Sepals* distinctly larger than petals, white with pale green apices, narrowly triangular to narrowly-deltate, acute, 3.5–4.4 mm long, 1.2–1.3 mm wide, not obviously enlarging with fruit; adaxial surface with a moderately dense to dense stellate indumentum, becoming glabrous towards base; abaxial surface glabrous except margins. *Petals* white, grading to pale pink at the base, 3.0–3.3 mm long, 0.7–0.9 mm wide, not elongating significantly with mature fruit; adaxial surface with a dense stellate indumentum, becoming glabrous towards base; abaxial surface with a moderately dense stellate indumentum, particularly at the apex and margins. *Stamens* with filaments bearing stiff simple and bifid hairs abaxially and on margins below glandular tip; antesealous filaments clavate, prominently glandular, suddenly narrowing to anther connective, 0.9–1.1 mm long; antepetalous filaments prominently glandular, warty, 1.4–1.6 mm long; anthers with abaxial surface not frosty, antepetalous ones much larger than antesealous; anthers shortly apiculate, glabrous; pollen not examined. *Ovary* glabrous; style pilose; stigma rounded, not or scarcely wider than style. *Cocci* glabrous, 4.9–5.5 mm long, 2.0–2.7 mm wide. *Seeds* with a prominent ridge on adaxial side, shiny, pale brown to grey when young, black but mottled when mature, 3.5–3.8 mm long, 1.5–1.7 mm wide; surface at magnification irregular, sub-tuberculate; tubercles smooth, unfused, anticlinal walls ±visible, 20–40 µm across; elaiosome white, to 1.9 mm long. (Figures 1, 2)



Figure 1. *Boronia cremnophila*. A – habitat on sparsely vegetated sandstone cliffs; B – habit of plants growing in fissures on cliff faces; C – corky bark at base of stem and orange stem below bark; D – flowering branchlet; E – paired flowers from above; F – close-up of petals and stamens showing detail of indumentum. Images from R.L. Barrett & M.D. Barrett RLB 6770. Photographs by R.L. Barrett.

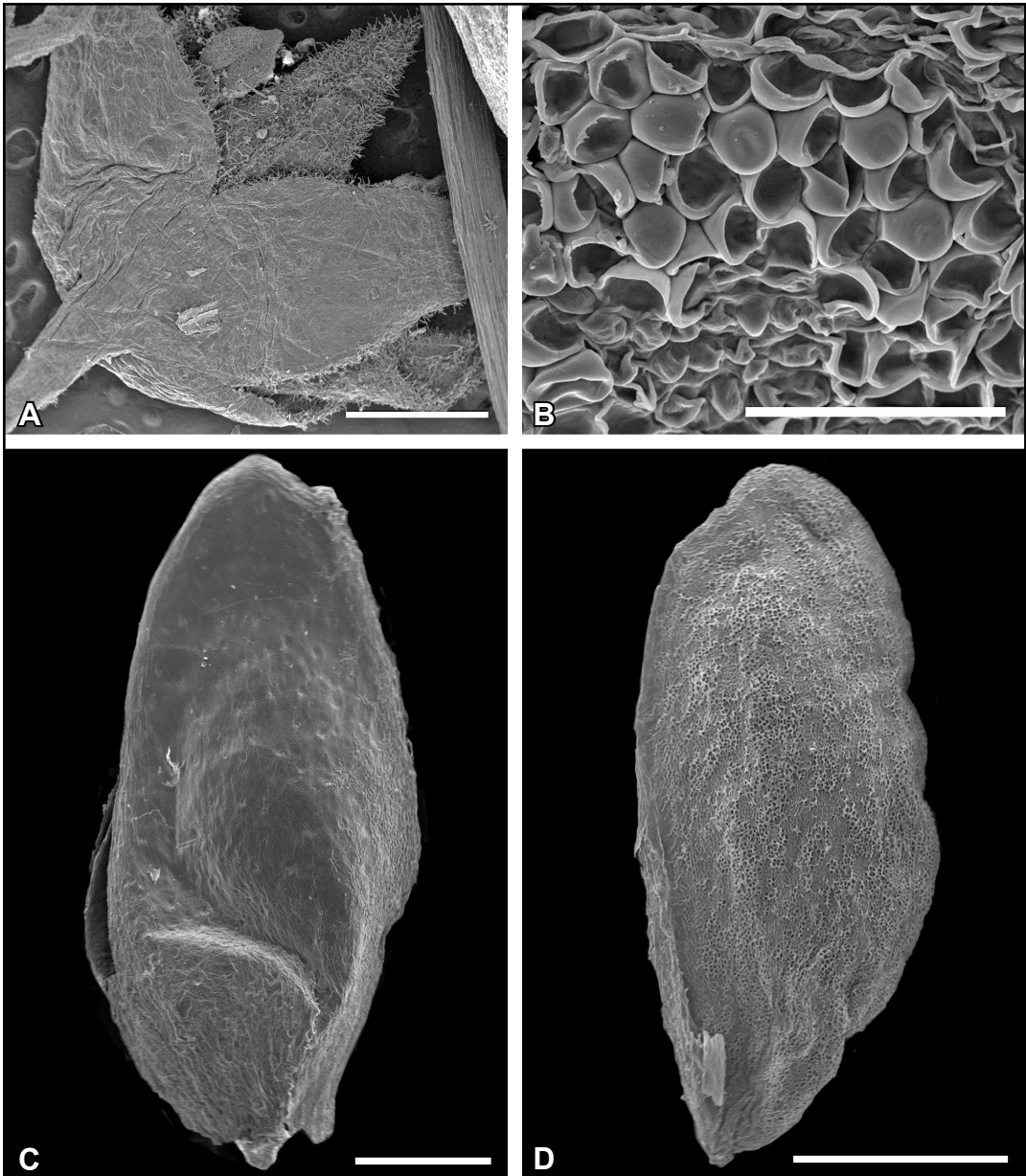


Figure 2. SEM images of *Boronia cremnophila*. A – flower showing abaxial surface of sepals and petals; B – immature seed surface from centre of seed; C – single coccus (lateral view); D – immature seed with elaiosome removed (lateral view). Scale bars = 1 mm (A, C); 100 μ m (B); 500 μ m (D). Images from R.L. Barrett & M.D. Barrett RLB 6770. Images by R.L. Barrett.

Diagnostic characters. Distinctive in its cliff-dwelling *habitat*. *Stems* glabrous. *Bark* corky at the base of the stem. *Leaves* 1- or 3-foliolate, glabrous, terminal pinnae small, 6–18 mm long, 1.5–3 mm wide.

Other specimens examined. Only known from the type collection.

Phenology. Flowering and fruiting recorded for March, but probably from January to May.

Distribution and habitat. Only known from a small number of locations north-west of Mount Elizabeth Station homestead in the north-west Kimberley where it grows on small, vertical, sandstone cliff faces. Plants grow in vertical rock fissures with *Ficus* and *Triodia*.

Conservation status. *Boronia cremnophila* is to be listed as Priority One under Department of Parks and Wildlife Conservation Codes for Western Australian Flora (A. Jones pers. comm.). Four populations are known over a range of about 5 km, with a total of around 500 plants known. Only one population was accessible on the ground, the other three populations being identified and surveyed from a helicopter. There are only a limited number of cliffs in the vicinity of the known locations and this species is likely to be highly localised and rare.

Etymology. The epithet is from the Latin *cremnos* (cliff) and *-philus* (loving), in reference to the cliff-dwelling habitat of this species.

Notes. *Boronia cremnophila* is most closely related to *B. barrettiorum* and *B. pauciflora* which are also endemic to the western Kimberley region (Duretto 1997, 2006). *Boronia cremnophila* is readily distinguished from *B. pauciflora* s. lat. by its cliff-dwelling habitat, corky bark at the base of the stem and small terminal leaflets, 6–18 mm long, 1.5–3 mm wide.

There are a number of cliff-specialising *Boronia* species in the Northern Territory along the Kakadu escarpment. Two, *B. viridiflora* Duretto and *B. suberosa* Duretto, are in the same subsection (*Grandisepalae*) as *B. cremnophila* but in different series, while *B. rupicola* Duretto is in its own series of subsect. *Valvatae* (see Duretto & Ladiges 1997; Duretto 1997, 1999; Duretto *et al.* 2013). *Boronia cremnophila* and *B. suberosa* are the only species in *Boronia* that have massive cork development. They are also the two cliff specialists that are semi-erect to erect; *B. rupicola* is pendulous and *B. viridiflora* grows perpendicular to the cliff face. It would appear that cliff specialisation has independently evolved four times in *Boronia*, and massive cork development twice, all in the north-west of Australia, on sandstone plateaux in relatively high rainfall zones.

This species was discovered by R.L. and M.D. Barrett on a targeted collecting trip funded by the Botanic Gardens and Parks Authority in March 2010.

The vernacular name of Kimberley Cliff *Boronia* is suggested.

Boronia interrex R.L.Barrett, M.D.Barrett & Duretto, *sp. nov.*

Type: Prince Regent Nature Reserve [National Park] [precise locality withheld for conservation reasons], Western Australia, 16 January 2010, R.L. Barrett, M.D. Barrett & M. Maier RLB 6110 (*holo:* PERTH 08614679; *iso:* BM, BRI, CANB, CNS, DNA, K, MEL, NSW, PERTH 08642745).

Spreading to erect or decumbent, much branched *shrub* to 80 cm high and 150 cm across, branches sometimes supported by surrounding vegetation, mature growth becoming red-green to purple-red in appearance in sun-exposed positions; *indumentum* of both stellate and simple hairs, moderately dense on young growth, but becoming sparse when mature. Multiangular *stellate hairs* sessile, with 5–8 rays; rays unicellular, unfused, firm, straight, not appressed, glossy, smooth, white, 0.2–0.4 mm long. *Simple hairs* erect, 1–1.3 mm long. *Branches* terete, decurrencies absent, not obviously glandular, hair distribution even, becoming glabrous with age, little or no cork development. *Leaves* opposite-decussate, imparipinnate, (3–)5–11(–13) pinnae, not becoming unifoliolate with age, 10–37 mm long, 8–16 mm wide; lamina discolorous, paler beneath, dorsiventral, *indumentum* moderately dense (slightly denser

beneath), not obviously glandular; margins entire, usually planar, occasionally recurved; midribs of leaflets and rachis segments slightly impressed adaxially, prominently raised abaxially; pinnae sessile to very shortly petiolate with petiolule up to 0.6 mm long, elliptic to ovate, tip obtuse; terminal pinnae 6.4–11.5 mm long, 3.3–4.7 mm wide, longer than laterals, midvein straight; lateral pinnae opposite or rarely subopposite, 3.5–7.8 mm long, 2.0–3.6 mm wide; rachis segments winged, oblanceolate to narrowly rhombic, middle widest, 2.2–5.3 mm long, 0.8–1.6 mm wide; petiole not winged, 2.8–6.9 mm long; some juvenile leaves persisting, larger than mature leaves, indumentum similar. *Inflorescence* cymose, 1-flowered; peduncle to 5.5 mm long; prophylls to 0.9 mm long, persistent; metaxyphylls absent or minute and persistent; anthopodium with a dense stellate indumentum, 7.5–15.0 mm long. *Sepals* longer and wider than petals, cream to pale pink, narrowly ovate-deltoid, acuminate, 3.6–5.6 mm long, 1.1–1.4 mm wide, enlarging to 5.9 mm long and 2.3 mm wide with fruit; adaxial surface with a dense stellate and simple indumentum near margins becoming a moderately dense simple indumentum towards centre and base; abaxial surface with a sparse stellate indumentum. *Petals* pale pink, darker at the base, 2.6–3.7 mm long, 0.7–0.8 mm wide, elongating to 4.2 mm long with mature fruit, abaxial midrib not or slightly raised at base; adaxial surface with a dense simple and few-branched stellate indumentum, becoming a moderately dense simple indumentum towards centre and very dense towards base; abaxial surface with a dense simple and few-branched stellate indumentum. *Stamens* with filaments bearing stiff simple hairs abaxially and on margins; antesealous filaments clavate, suddenly narrowing to anther connective, 1.2–1.4 mm long, distal 0.6–0.7 mm prominently glandular; antepetalous filaments warty, 0.9–1.0 mm long; anthers with abaxial surface not frosty, antepetalous ones much larger than antesealous; anther apiculum minute, glabrous; pollen sub-globular, *c.* 20 µm long, with a raised dome in the centre of each colpus. *Ovary* glabrous; style glabrous; stigma rounded, not or scarcely wider than style. *Cocci* with a sparse simple and stellate indumentum, 3.2–5.4 mm long, 2.0–2.9 mm wide. *Seeds* with prominent ridge on adaxial side, shiny, black and mottled brown, 3.7–3.9 mm long, 1.8–2.1 mm wide, surface at magnification tuberculate to colliculate; tubercles and collicles smooth, unfused, anticlinal walls ±visible, 15–40 µm across; elaiosome yellow-white, to 2.3 mm long. (Figures 3; 4A, B; 5A; 6A; 7A, B; 8A, B; 9A)

Diagnostic characters. Spreading to erect or decumbent *shrub*, mature growth becoming red-green to purple-red in appearance. *Indumentum* sparse on mature plants; stellate hairs 0.2–0.4 mm long. *Leaves* with (3–)5–11(–13) pinnae; pinnae elliptic to ovate, tip obtuse. *Anthopodium* 7.5–15.0 mm long, with a dense stellate indumentum. *Petals* 2.6–3.7 mm long in flower, 0.7–0.8 mm wide, adaxial surface with a dense simple and few-branched stellate indumentum, becoming a moderately dense simple indumentum towards centre and very dense towards base; abaxial surface with a dense simple and few-branched stellate indumentum. *Cocci* with a sparse stellate indumentum, 3.2–5.4 mm long, 2.0–2.9 mm wide.

Other specimen examined. WESTERN AUSTRALIA: [locality withheld for conservation reasons] 10 Jan. 2001, *R.L. Barrett & M.D. Barrett* RLB 1663 (PERTH).

Phenology. Flowering and fruiting collections made in January.

Distribution and habitat. Known only from the summit of a single sandstone mesa just outside Prince Regent National Park. Small step-sandstone pavement with skeletal sands. Grows with low shrubs, including *Acacia adenogonia*, *A. latifolia*, *A. retinervis*, *Grevillea latifolia*, *Jacksonia rupestris* and *Triodia* sp., and scattered *Eucalyptus ?herbertiana* on pavement margins.

Conservation status. *Boronia interrex* is to be listed as Priority Two under Department of Parks and Wildlife Conservation Codes for Western Australian Flora (A. Jones pers. comm.).



Figure 3. *Boronia interrex*. A – sprawling habit on sandstone; B – flowering branchlet; C – petiolate mature leaf, showing rachis segments widest across the middle; D – flowering branchlet from shaded habitat; E – lateral view of inflorescence in leaf axils; F – close-up of petals and stamens. Images from R.L. Barrett, M.D. Barrett & M. Maier RLB 6110. Photographs by R.L. Barrett.

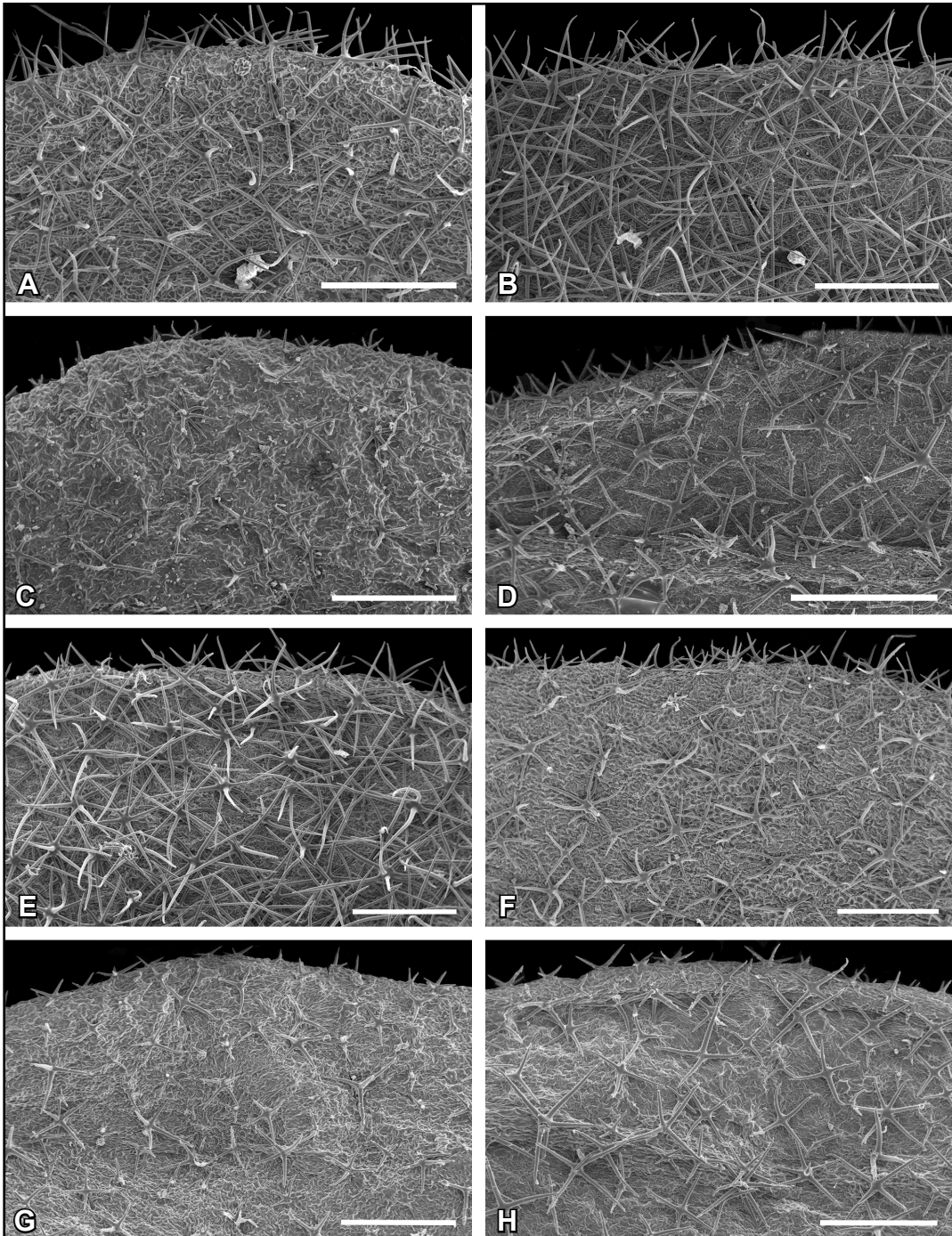


Figure 4. SEM images of mature leaves showing adaxial surface (A, C, E, G) and abaxial surface (B, D, F, H). A, B – *Boronia interrex* (indumentum moderately dense); C, D – *B. kalumburuensis* (indumentum sparse above, moderately dense below); E, F – *B. marcoana* (indumentum moderately dense above, sparse below); G, H – *B. thedae* (indumentum sparse). Scale bars = 500 μ m. Images from R.L. Barrett & M.D. Barrett RLB 1663 (A, B), M.D. Barrett & R.L. Barrett MDB 3119 (C, D), R.L. Barrett & M.D. Barrett RLB 6830 (E, F) and R.L. Barrett RLB 8868 (G, H). Images by R.L. Barrett.

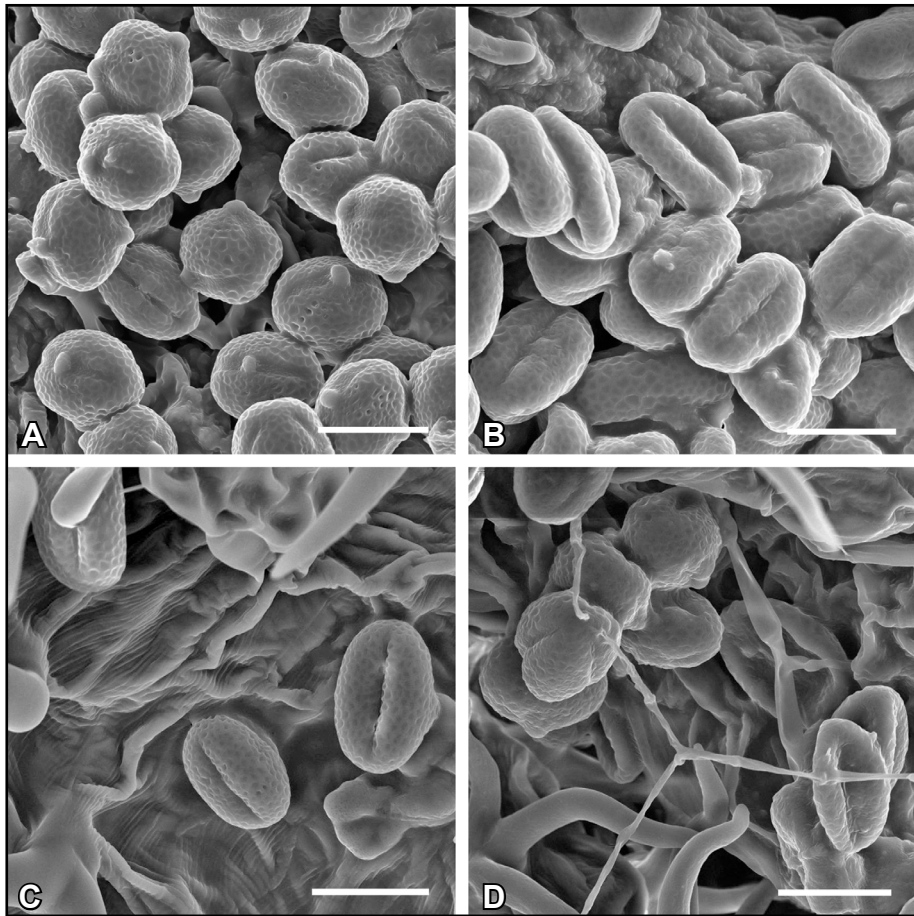


Figure 5. SEM images of pollen. A – *Boronia interrex* (note raised dome in the centre of each colpus); B – *B. kalumburuensis*; C – *B. marcoana*; D – *B. thedae*. Scale bars = 20 μm . Images from R.L. Barrett & M.D. Barrett RLB 1663 (A), M.D. Barrett & R.L. Barrett MDB 3119 (B), R.L. Barrett & M.D. Barrett RLB 6830 (C) and R.L. Barrett RLB 8868 (D). Images by R.L. Barrett.

Etymology. The epithet is from the Latin *interrex* (a regent, temporary king), in reference to the location of this species in Prince Regent National Park.

Notes. *Boronia interrex* is superficially similar to *B. wilsonii* which occurs nearby, but differs in the fewer, broader leaflets, sparse indumentum and longer anthopodium, features which clearly relate it to *B. kalumburuensis*. It can be readily distinguished from *B. kalumburuensis* by the long petioles 2.8–6.9 mm long (similar to *B. wilsonii*), the rachis segments being widest in the middle, the anthopodium with a dense stellate indumentum and the slender petals 0.7–0.8 mm wide.

Discovered in 2001 by R.L. and M.D. Barrett, this collection was noted to differ from *B. wilsonii*, but was not immediately associated with *B. kalumburuensis*, and with only a single known collection was not described at the time. A second population was found nearby in 2010, verifying the consistency of this taxon and allowing its real relationships to be determined.

The vernacular name of Prince Regent River *Boronia* is suggested.

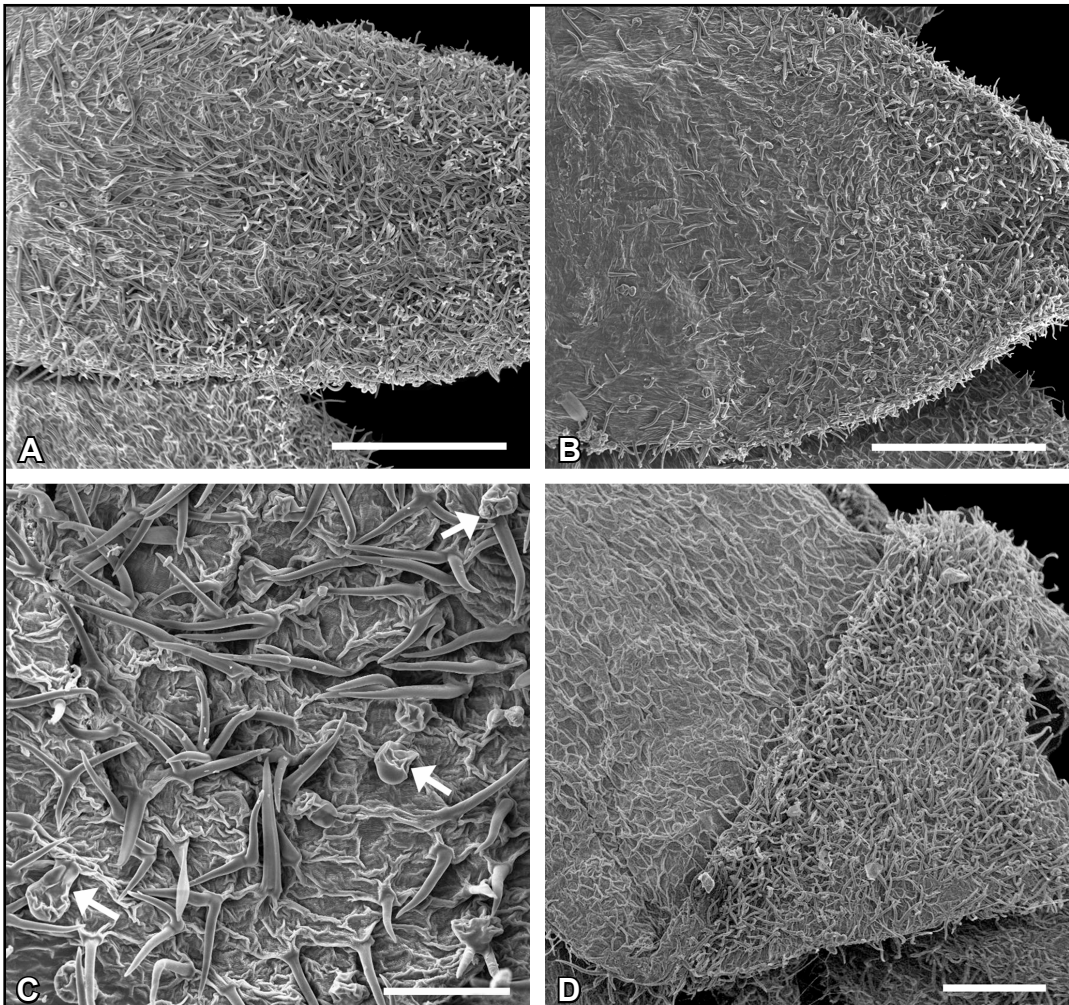


Figure 6. SEM images of petal indumentum on adaxial surface. A – *Boronia interrex* (dense stellate and simple indumentum near margins, becoming a moderately dense simple indumentum towards centre and base; few stalked glands also visible); B – *B. kalumburuensis* (moderately dense stellate and simple indumentum near margins, becoming a sparse simple indumentum towards centre and base); C – *B. marcoana*, (showing unusual stalked glands (arrowed) at higher magnification); D – *B. thedae* (moderately dense to dense simple and stellate indumentum as well as scattered, stalked glandular hairs, extending to the base). Scale bars = 500 μ m (A, B, D); 100 μ m (C). Images from R.L. Barrett & M.D. Barrett RLB 1663 (A), M.D. Barrett & R.L. Barrett MDB 3119 (B), R.L. Barrett & M.D. Barrett RLB 6830 (C) and R.L. Barrett RLB 8868 (D). Images by R.L. Barrett.

Boronia marcoana R.L.Barrett & M.D.Barrett, *sp. nov.*

Type: near Lawley River [precise locality withheld for conservation reasons], Western Australia, 29 March 2010, R.L. Barrett & M.D. Barrett RLB 6830 (*holo:* PERTH 08614725; *iso:* BM, BRI, CANB, CNS, DNA, HO, K, MEL, NSW).

Illustration. A.J.G. Wilson (ed.) *Fl. Austral.* 26: pl. 34 (2013), as *B. kalumburuensis*.

Erect to spreading, few- or many-branched *shrub* to 100 cm high and 120 cm wide, leaves and younger stems remaining pale to dark green in sun-exposed positions; with a sparse to moderately dense stellate

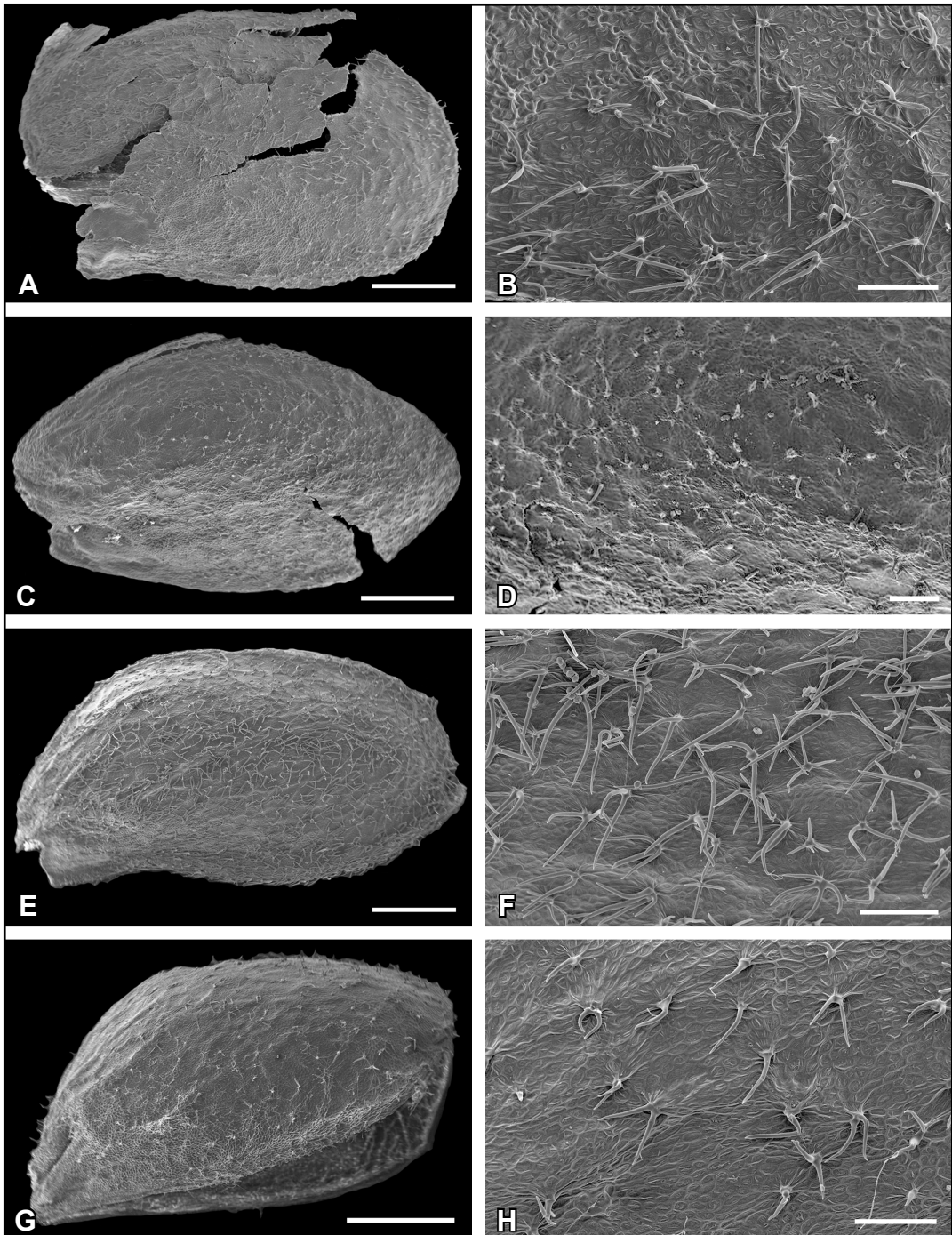


Figure 7. SEM images of a single valve of coccos from capsule (A, C, E, G) and coccos indumentum (B, D, F, H). A, B – *Boronia interrex* (sparse, simple and stellate hairs); C, D – *B. kalumburuensis* (old coccos valve with many ray branches broken off near the base); E, F – *B. marcoana* (sparse to moderately dense, stellate or rarely simple hairs); G, H – *B. thedae* (scattered simple and stellate hairs on surface with longer simple hairs on the inner and apical margins of the valves). Scale bars = 500 μm (A, C, E, G); 200 μm (B, D, F, H). Images from R.L. Barrett & M.D. Barrett RLB 1663 (A, B), M.D. Barrett & R.L. Barrett MDB 3119 (C, D), R.L. Barrett & M.D. Barrett RLB 6830 (E, F) and R.L. Barrett RLB 8868 (G, H). Images by R.L. Barrett.

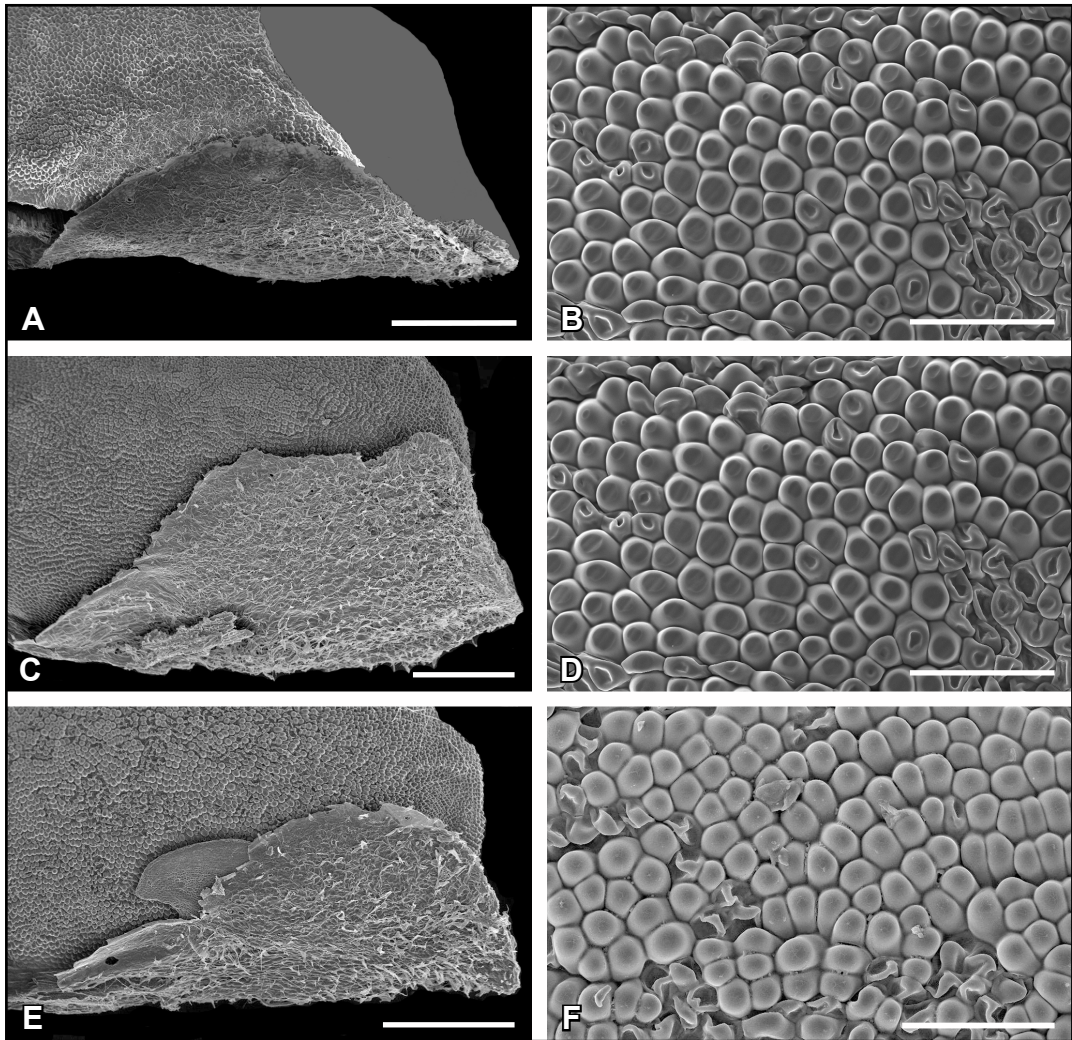


Figure 8. SEM images of elaiosome attached to seed (A, C, E) and seed surface from centre of seed (B, D, F). A, B – *Boronia interrex* (uniformly grey area in A represents broken portion of seed); C, D – *B. marcoana*; E, F – *B. thedae*. Scale bars = 500 μ m (A, C, E); 100 μ m (B, D, F). Images from R.L. Barrett & M.D. Barrett RLB 1663 (A, B), R.L. Barrett & M.D. Barrett RLB 6830 (C, D) and R.L. Barrett RLB 8868 (E, F). Images by R.L. Barrett.

indumentum, denser on young growth, and long, simple hairs. Multiangular *stellate hairs* sessile, with 4–10 rays; rays unicellular, unfused, firm, straight, not appressed, glossy, smooth, white, to 0.5 mm long. *Simple hairs* to 1.8 mm long. *Branches* terete, decurrencies absent, not obviously glandular, hairs distributed evenly, becoming glabrous with age, no cork development. *Leaves* opposite-decussate, imparipinnate with (1–)3–13 pinnae, not becoming unifoliolate with age, 7–27 mm long, 4–13 mm wide; lamina weakly discolorous, paler beneath, dorsiventral, indumentum moderately dense above, sparse beneath, denser when young, becoming sparsely hairy with age, not obviously glandular; margins entire, flat to slightly recurved; midribs of leaflets and rachis segments usually impressed adaxially, raised abaxially; pinnae sessile, tip obtuse to acute; terminal pinnae ovate to oblanceolate or obovate, longer than laterals, 4–10 mm long, 2.3–4.5 mm wide, midvein straight; lateral pinnae opposite, elliptic to ovate, 3–7.5 mm long, 2–4.5 mm wide; rachis segments winged, narrowly triangular, distal end wider, 2.3–3.7 mm long, 0.5–1.2 mm wide; petiole not winged, 0.2–0.4 mm long; juvenile

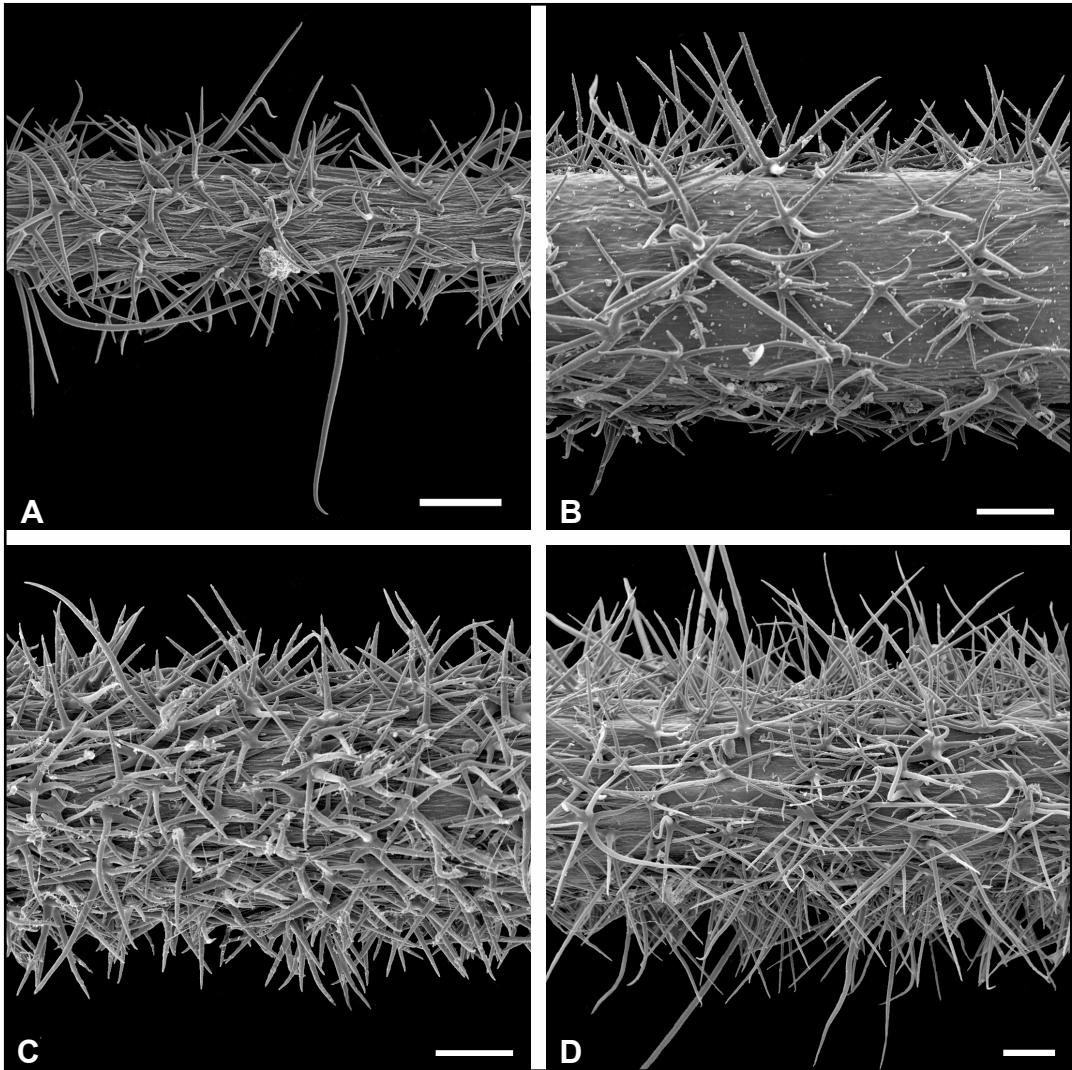


Figure 9. SEM images of indumentum on young stems. A – *Boronia interrex* (moderately dense indumentum of long simple and short stellate hairs); B – *B. kalumburuensis* (sparse to moderately dense indumentum of short stellate hairs); C – *B. marcoana* (dense indumentum of short stellate hairs); D – *B. thedae* (dense indumentum of moderately long simple and short stellate hairs). Scale bars = 200 μ m. Images from R.L. Barrett & M.D. Barrett RLB 1663 (A), M.D. Barrett & R.L. Barrett MDB 3119 (B), R.L. Barrett & M.D. Barrett RLB 6830 (C) and R.L. Barrett RLB 8868 (D). Images by R.L. Barrett (A); M.D. Barrett (B–D).

leaves larger than mature leaves, terminal leaflet up to 15 mm long, 11 mm wide. *Inflorescence* cymose, 1-flowered; peduncle absent; prophylls to 0.4 mm long, persistent; anthopodium with a moderate to dense stellate indumentum, 4.5–13 mm long. *Sepals* longer and wider than petals, white or cream to pale pink, narrowly triangular to ovate-deltoid, acute to acuminate, 3.3–4.9 mm long, 1.1–1.5 mm wide, enlarging to 5.5 mm long with fruit, width similar; adaxial surface with dense stellate indumentum; abaxial surface with a moderately dense stellate indumentum. *Petals* pale to dark pink, 2.1–3.8 mm long, 1.0–1.5 mm wide, not elongating significantly with mature fruit, abaxial midrib not raised at base; adaxial surface with a moderately dense to dense simple and stellate indumentum as well as scattered stalked glandular hairs, extending to the base; abaxial surface with a dense stellate indumentum. *Stamens* with filaments bearing simple hairs abaxially and on margins; antesealous filaments clavate, suddenly narrowing to anther connective, 1.8 mm long, distal 0.9 mm swollen and

prominently glandular; antepetalous filaments bearing simple hairs abaxially and on margins, warty, 1.1 mm long; anthers with abaxial surface not frosty, antepetalous ones much larger than antesepalous; anther apiculum absent or minute, glabrous; pollen ovoid, *c.* 25 µm long, colpi lacking a central dome. *Ovary* glabrous; style hirsute for full length; stigma rounded, not or scarcely wider than style. *Cocci* with a sparse to moderately dense stellate (rarely simple) indumentum, 5.0–5.5 mm long, 2.5–2.9 mm wide, regularly only one or two cocci developing. *Seeds* with prominent ridge on adaxial side, shiny, black but mottled, 4.3–4.5 mm long, 1.9–2.3 mm wide; surface at magnification tuberculate; tubercles smooth, unfused, anticlinal walls ± visible, 15–40 µm across; elaiosome yellow-white, to 1.8 mm long. (Figures 4E, F; 5C; 6C; 7E, F; 8C, D; 9C; 10)

Diagnostic characters. Erect to spreading *shrub*. *Indumentum* of moderately dense to dense, mixed short stellate and long simple hairs on young growth. *Leaves* with (1–)3–13 pinnae, with a sparse stellate indumentum when mature. *Anthopodium* 4.5–13 mm long. *Petals* moderately to densely stellate hairy, denser abaxially, mixed with simple hairs on adaxial surface. *Cocci* with a sparse to moderately dense stellate indumentum.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 3 May 2011, *M.D. Barrett* MDB 3432 (PERTH); 12 Mar. 2014, *R.L. Barrett* RLB 8985 (BRI, CANB, DNA, MEL, NSW, PERTH).

Phenology. Flowering and fruiting recorded for late March. Probably January to May.

Distribution and habitat. Only known from two locations, the first near the Lawley River, east of the Mitchell Plateau, and the second on the King Edward River, south of Kalumburu. Found in fire protected sites, growing among massive broken sandstone boulders, often under rock overhangs, with associated species including *Acacia kelleri*, *Caesia setifera*, *Calytrix exstipulata*, *Calytrix* sp., *Corymbia torta*, *Eriosema chinense*, *Eucalyptus herbertiana*, *Grevillea refracta*, *Hibbertia scopata*, *Ipomoea* sp., *Micraira spiciforma*, *Monodia stipoides*, *Planchonia rupestris*, *Solanum* spp., *Stemodia* spp., *Stylidium saintpaulioides*, *Trichosanthes cucumerina* and *Triodia microstachya*.

Conservation status. *Boronia marcoana* is to be listed as Priority One under Department of Parks and Wildlife Conservation Codes for Western Australian Flora (A. Jones pers. comm.). Only known from two locations. One population is known from just outside Lawley River National Park and contains a small number of plants. Further surveys may locate this species within the reserve. A second extensive population is known from the King Edward River, about 25 km south-east of the first population.

Etymology. The epithet recognises the extensive work of Marco F. Duretto in documenting the genus *Boronia*, particularly in northern Australia.

Notes. The relatively few leaflets of *Boronia marcoana* provide a possible morphological link between subser. *Filicifoliae* and subser. *Lanuginosae*. Closely related to *B. interrex*, which has distinctly petiolate leaves, and to *B. kalumburuensis* and *B. thedae*, *B. marcoana* differs in the mature plants being erect to spreading, remaining green, the stem indumentum having short stellate hairs to 0.5 mm long and long simple hairs to 1.8 mm long, and petals one-half to two-thirds as long as sepals.

The vernacular name of Duretto's *Boronia* is suggested.



Figure 10. *Boronia marcoana*. A – habit among sandstone boulders; B – flowering branchlet, showing rachis segments widest at the distal end; C – lateral view of inflorescences in leaf axils; D – flowers showing variation in colour and shape of sepals and petals relative to B and E; E – close-up of sepals, petals and stamens; F – fruit. Images from R.L. Barrett RLB 8985 (A, C, D, F) and R.L. Barrett & M.D. Barrett RLB 6830 (B, E). Photographs by R.L. Barrett.

Boronia thedae R.L.Barrett, M.D.Barrett & Duretto, *sp. nov.*

Type: Theda Station [precise locality withheld for conservation reasons], Western Australia, 9 March 2014, R.L. Barrett RLB 8868 (*holo:* PERTH 08614709; *iso:* AD, BM, BRI, CANB, DNA, HO, K, MEL, NSW, PERTH 08615039).

Erect when young or supported by vegetation, branches decumbent to prostrate with age, many-branched *shrub* to 50(–100) cm high and 150 cm wide, mature growth red-green to purple-red in appearance in sun-exposed positions; with an *indumentum* of long, simple hairs and sparse to moderately dense stellate hairs, which are dense on young growth, becoming very sparse on mature leaflets. Multiangular *stellate hairs* sessile, with 2–6 rays; rays unicellular, unfused, firm, straight, not appressed, glossy, smooth, white, to 0.25 mm long. *Simple hairs* 0.6–0.9 mm long. *Branches* terete, decurrencies absent, not obviously glandular, hairs distributed evenly, becoming almost glabrous with age, no cork development. *Leaves* opposite decussate, imparipinnate with 5–15(–27) pinnae, not becoming unifoliolate with age, 12–29(–39) mm long, 7–12(–16) mm wide; lamina weakly discolourous, paler beneath, dorsiventral, indumentum usually sparse (densely hairy on immature leaves, soon moderately hairy, becoming very sparsely hairy with age), not obviously glandular; margins entire, flat to slightly recurved; midribs of leaflets and rachis segments usually impressed adaxially, raised abaxially; pinnae subsessile, tip obtuse to sub-acute; terminal pinnae oblanceolate to obdeltoid, longer than laterals, 4–9 mm long, 1.3–3.0 mm wide, midvein straight; lateral pinnae opposite or rarely sub-opposite, lanceolate to elliptic, 3–7 mm long, 1.2–2.7 mm wide; rachis segments winged, narrowly triangular, distal end wider, 2.0–3.8 mm long, 0.6–1.2 mm wide; petiole not winged, 0.5–0.9 mm long; juvenile leaves larger than mature leaves, terminal leaflet up to 17 mm long, 3.8 mm wide, moderately hairy. *Inflorescence* cymose, 1(2)-flowered; peduncle absent; prophylls to 0.9 mm long, persistent; anthopodium with a very sparse stellate and simple indumentum, 4.7–21.3 mm long, distally flared. *Sepals* longer and wider than petals, white or cream to pale pink, narrowly triangular to ovate-deltoid, acute to acuminate, 4.3–4.7 mm long, 1.0–1.5 mm wide, enlarging to 5.8 mm long with fruit, width similar; adaxial surface with dense stellate indumentum; abaxial surface with a moderately dense to sparse stellate indumentum. *Petals* creamy white to pale pink, usually dark pink at the base, 2.9–3.5 mm long, 1.2–1.5 mm wide, elongating to 4.8 mm long with mature fruit, abaxial midrib not raised at base; adaxial surface with a moderately dense to dense simple and stellate indumentum as well as scattered, stalked glandular hairs, extending to the base; abaxial surface with a sparse to moderately dense stellate indumentum. *Stamens* with filaments bearing simple hairs abaxially and on margins; antesealous filaments clavate, suddenly narrowing to anther connective, 1.3 mm long, distal 0.7 mm swollen and prominently glandular; antepetalous filaments bearing simple hairs abaxially and on margins, warty, 1.1 mm long; anthers with abaxial surface not frosty, antepetalous ones much larger than antesealous; anther apiculum small, glabrous; pollen ovoid, *c.* 25 µm long, colpi lacking a central dome. *Ovary* glabrous; style sparsely hirsute for full length; stigma rounded, not or scarcely wider than style. *Cocci* with scattered simple and stellate hairs on surface with longer simple hairs on the inner and apical margins of the valves, occasionally glabrous, 4.5–5.9 mm long, 2.3–2.6 mm wide, regularly only 1 or 2 cocci developing. *Seeds* with prominent ridge on adaxial side, shiny, black but mottled, 3.7–4.1 mm long, 1.6–1.8 mm wide; surface at magnification tuberculate; tubercles smooth, unfused, anticlinal walls ±visible, 10–40 µm across; elaiosome white, large, to 2.1 mm long. (Figures 4G, H; 5D; 6D; 7G, H; 8E, F; 9D; 11)

Diagnostic characters. Erect to decumbent to prostrate *shrub*, mature growth red-green to purple-red in appearance. *Indumentum* of sparse to moderately dense, mixed short stellate and long simple hairs. *Leaves* with 5–15(–27) pinnae, with a very sparse stellate indumentum. *Lateral pinnae* lanceolate to elliptic, 3–7 mm long, 1.2–2.7 mm wide. *Anthopodium* with a very sparse stellate and simple indumentum,

4.7–21.3 mm long. *Petals* moderately to densely stellate hairy above, sparsely to moderately densely stellate hairy below. *Cocci* glabrous except with a few scattered hairs on the inner and apical margins of the valves, occasionally glabrous.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 28 Apr. 2008, *M.D. Barrett & R.L. Barrett* MDB 2168 (PERTH); 28 Apr. 2008, *M.D. Barrett & R.L. Barrett* MDB 2177 (PERTH); 22 May 2009, *R.L. Barrett* RLB 5706 (PERTH); 11 Mar. 2014, *R.L. Barrett* RLB 8936 (CANB, DNA, MEL, NSW, PERTH); 24 July 1984, *S.J. Forbes* 2722 (MEL); 18 June 1985, *P.A. Fryxell, L.A. Craven & J. McD. Stewart* 4858 (CANB, MEL, PERTH).

Phenology. Flowering and fruiting recorded for April to July.

Distribution and habitat. Only collected from near Theda Station homestead over a range of about 5 km, but known to extend south-east for a distance of about 20 km to near the border of (but not within) Drysdale River National Park, to the north-west of Worriga Gorge, with semi-continuous populations observed from a helicopter over this range. While this area is still poorly collected, sufficient surveys have been undertaken by the authors to suggest that the known locations are an accurate reflection of the range of the species. It grows among massive broken boulders on sandstone ridges with *Acacia dacrydioides*, *A. kelleri*, *A. plectocarpa*, *Calytrix exstipulata*, *Corymbia torta*, *Eucalyptus herbertiana*, *E. rupestris*, *Grevillea microcarpa*, *Hibbertia* sp., *Ipomoea* sp., *Planchonia rupestris*, *Ptilotus giganteus*, *Solanum lasiophyllum*, *Stemodia lythrifolia*, *Stylidium saintpaulioides*, *Triodia* aff. *burbidgeana*, *T. claytonii* and *Triumfetta monstrosa*.

Conservation status. *Boronia thedae* is to be listed as Priority One under Department of Parks and Wildlife Conservation Codes for Western Australian Flora (A. Jones pers. comm.).

Etymology. The epithet is derived from Theda Station, on the Kalumburu Road, where this species is found. Theda Station was apparently named for Theda, the wife of the founder of the station lease, so while the epithet recognises the station, this species is given a feminine epithet to reflect the history of its name.

Notes. Duretto (1997) and Duretto *et al.* (2013) included a few collections of *B. thedae* under *B. kalumburuensis*, including the first collection of this taxon made by S.J. Forbes in 1984.

Very closely related to *B. kalumburuensis*, *B. thedae* is most readily distinguished by the mature plants quickly becoming decumbent, and an indumentum of relatively dense, fine, mixed short stellate hairs up to 0.25 mm long and long simple hairs 0.6–0.9 mm long on stems. The density of hairs on the cocci varies in both species and both can occasionally be glabrous, but when hairy *B. kalumburuensis* has a denser, shorter indumentum than *B. thedae*. Comparison SEM images of *B. kalumburuensis* are provided in Figures 4–7 and 9. *Boronia kalumburuensis* remains poorly collected and better fertile collections are required to assess variation in coccus and seed features.

The vernacular name of Theda *Boronia* is suggested.



Figure 11. *Boronia thedae*. A – decumbent habit on sandstone; B – erect seedlings; C – flowering branchlet showing long anthopodium; D – leaf, showing sub-opposite pinnae (uncommon); E – flower; F – close-up of petals and stamens. Images from R.L. Barrett RLB 8868. Photographs by R.L. Barrett.

Acknowledgements

Preparation of this paper was funded by the Botanic Gardens and Parks Authority as part of the 50th anniversary celebrations of the Western Australian Botanic Garden at Kings Park. Butch and Robyn Maher are thanked for their company and sharing local knowledge on field trips over the past 15 years. Paul Doughty and the Western Australian Museum are thanked for allowing us to participate in biological surveys in the Prince Regent River Reserve in 2007 and 2010. Michi Maier (Biota), Peter Kendrick (DPaW) and Butch and Josh Maher (Fitzroy Helicopters) are thanked for assistance with collecting species in the North Kimberley. Peter and Pat Lacy are thanked for their generous hospitality at Mount Elizabeth Station. Traditional owners from the Kalumburu area are thanked for their assistance with fieldwork and for permission to access their traditional lands. Rick and Ann Jane and Bushtrack Safaris provided valuable logistical support for many research trips into the Prince Regent River area. Juliet Wege, Kelly Shepherd, Ryonen Butcher, Kevin Thiele and curation staff at the Western Australian Herbarium are thanked for their support. Terry Macfarlane and an anonymous referee are thanked for comments on the manuscript. Directors and staff at CANB, DNA, MEL, NSW and PERTH are thanked for allowing access to their collections. Some of the fieldwork associated with the discovery of this species was supported by a grant to the Western Australian Museum by Alcoa of Australia for the Alcoa Frog Watch programme and a personal donation from Harry Butler. The Botanic Gardens and Parks Authority, Mark Webb and Kingsley Dixon are thanked for funding fieldwork in March 2010 and March 2014. Australian Biological Resources Study is thanked for funding to RLB for fieldwork in March 2014 on *Cleome* that provided additional opportunities to collect *Boronia*. Cecelia Myers and Dunkeld Pastoral supported fieldwork on Theda Station between 2005 and 2012. Additional support came from the 2010 JobsFund grant to Zoos South Australia. The Australian Heritage Commission supported preliminary research on a number of the species named here through the Kimberley National Heritage assessment project in 2009.

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