

***Calandrinia holtumii* (Portulacaceae), a new and unusual species from arid Western Australia**

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Abstract

Obbens, F.J., Hancock, L.P., Edwards, E. & Thiele, K.R. *Calandrinia holtumii* (Portulacaceae), a new and unusual species from arid Western Australia. *Nuytsia* 28: 217–223 (2017). A new species of *Calandrinia* Kunth., *C. holtumii* Obbens & L.P.Hancock, from arid Western Australia is described and mapped. At this stage, the sectional placement for *C. holtumii* is uncertain. It has several anomalous morphological characters not previously recorded within the genus and has recently been shown to exhibit a stronger form of Crassulacean Acid Metabolism (CAM) than any other Australian species of *Calandrinia*.

Introduction

This paper is the latest in a series of papers (e.g. Obbens 2011, 2012) describing endemic species of *Calandrinia* Kunth. in Western Australia. *Calandrinia holtumii* Obbens & L.P.Hancock *sp. nov.*, described here, has several anomalous morphological characters (see *Diagnostic features*) and exhibits a stronger form of Crassulacean Acid Metabolism (CAM) than any other Australian species of *Calandrinia*. It is widespread within the Eremaean Botanical Province of Western Australia.

Methods

Methods used are as described in Obbens (2011). In *C. holtumii* it is impossible to discern between stems and scapes, as also seen in *C. umbelliformis* Obbens in which the length of the stem and scape was measured as one unit referred to as the stem/scape shoot (Obbens 2012). In this paper, the length of the stem, scape and inflorescence axis are measured as one unit along the main axis of the shoot and referred to as the flowering shoot.

The bioregions referred to in describing species distributions and indicated on the map are from the *Interim Biogeographical Regionalisation for Australia (IBRA) Version 7.0* (Department of the Environment 2013).

Taxonomy

Calandrinia holtumii Obbens & L.P.Hancock, *sp. nov.*

Type: Mulla Mulla Flat, Coolcalalaya Road, Shire of Mullewa, along the road from Coolcalalaya Homestead to Yallalong Homestead, c. 17.7 km west-south-west of the New Forest Yallalong Road junction, Western Australia, 6 October 2004, *F. Hort, J. Hort & J. Shanks* 2349 (*holo:* PERTH 06873928; *iso:* AD, CANB, MEL).

Calandrinia sp. Black angular seeds (A.A. Mitchell PRP 1661), Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed June 2016].

Prostrate to ± decumbent *annual herbs*, 5–30 mm tall, 40–230 mm wide, glabrous, the root system comprising a weak taproot with several lateral roots. *Basal leaves* succulent, narrowly spatulate to spatulate, 7.7–16.5 mm long, 1.9–5.2 mm wide at widest point, usually somewhat withered upon flowering and more so by fruiting. *Flowering shoots* usually 5–11, 27–210 mm long, radiating from base, the proximal 5–48 mm leafless, thereafter leafy and branched several times with secondary branching relatively common, each branch terminating in an inflorescence. *Stem leaves* succulent, broadly elliptic to orbicular in outline (3D-shape resembling kidney or jellybeans and also small spheres), occasionally obovate in outline, 2.5–10.3 mm long, 1.4–6.1 mm wide, sessile, alternate, somewhat stem-clasping, terete or semi-terete in T.S., rarely somewhat flattened, mucronate at apex, mostly green becoming reddish brown with age, but some scattered leaves are colourless, translucent, swollen and vesicular; upper leaves on adult plants grading into inflorescence bracts, occasionally with leaf vesicles as above. *Inflorescences* 3–7-flowered; axis 10–90 mm long; bracts 1.4–7.2 mm long, 1.3–4.8 mm wide, succulent, the lower ones broadly semi-orbicular to reniform, auriculate to stem-clasping, often with a mucro at apex, the upper ones broadly triangular, with up to 3 adjoining triangular lobes wrapping around a stem, somewhat scarious when young, but becoming broader, more succulent and leaf-like as the axis continues to grow. *Pedicels* 2.5–10 mm long (to 15 mm long in fruit), erect. *Flowers* 5–8.5 mm diam. *Sepals* thick, broadly ovate to orbicular, 2.1–3.6 mm long, 2.1–3.4 mm wide, free to base, apex obtuse and somewhat cucullate, venation not prominent. *Petals* 5, creamy white tinged with pink or fully mid-pink, broadly elliptic to broadly ovate, rarely broadly obovate, 2.2–4.8 mm long, 1.5–3.4 mm wide, free to base. *Stamens* 10, in one row, alternating short and long; filaments free, 0.6–2.3 mm long, attached to the top of a relatively wide basal ring beneath ovary; lower portion of filament not papillose, but top of basal ring with several rows of transparent, non-glandular, clavate hairs; anthers purple to pink before anthesis, broadly oblong to occasionally elliptic in outline, 0.6–1.8 mm long, 0.4–0.8 mm wide, versatile, extrorse, dehiscing longitudinally. *Ovary* broadly obovoid, 1.1–1.9 mm diam., brown. *Stigmas* 3, becoming narrowly triangular to linear upon maturity, 0.9–1.9 mm long, free to base, with a dense covering of moderately long stigma trichomes. *Capsule* ovoid to broadly ovoid, 2.1–3.2 mm long, 1.3–2.8 mm wide, usually protruding beyond the sepals at maturity; apex obtuse; valves 3, splitting at the summit at first, extending to 2/3 the length of the capsule with age. *Seeds* 55–134 per capsule, black, glossy, globular or ‘tear-drop’ shaped with a relatively flattened base, trigonous in section, often angular and faceted when not fully developed, surface nearly smooth (although obscurely colliculate at high magnification), 0.3–0.4 mm long, 0.25–0.35 mm wide, 0.2–0.3 mm thick. (Figures 1, 2)

Diagnostic features. *Calandrinia holtumii* may be uniquely diagnosed within the genus by the unusual swollen, translucent, vesicular, modified leaves scattered amongst normal photosynthetic ones, by the succulent, auriculate to stem-clasping inflorescence bracts, and by the smooth staminal filaments and basal androecial ring surmounted by rows of clavate hairs.

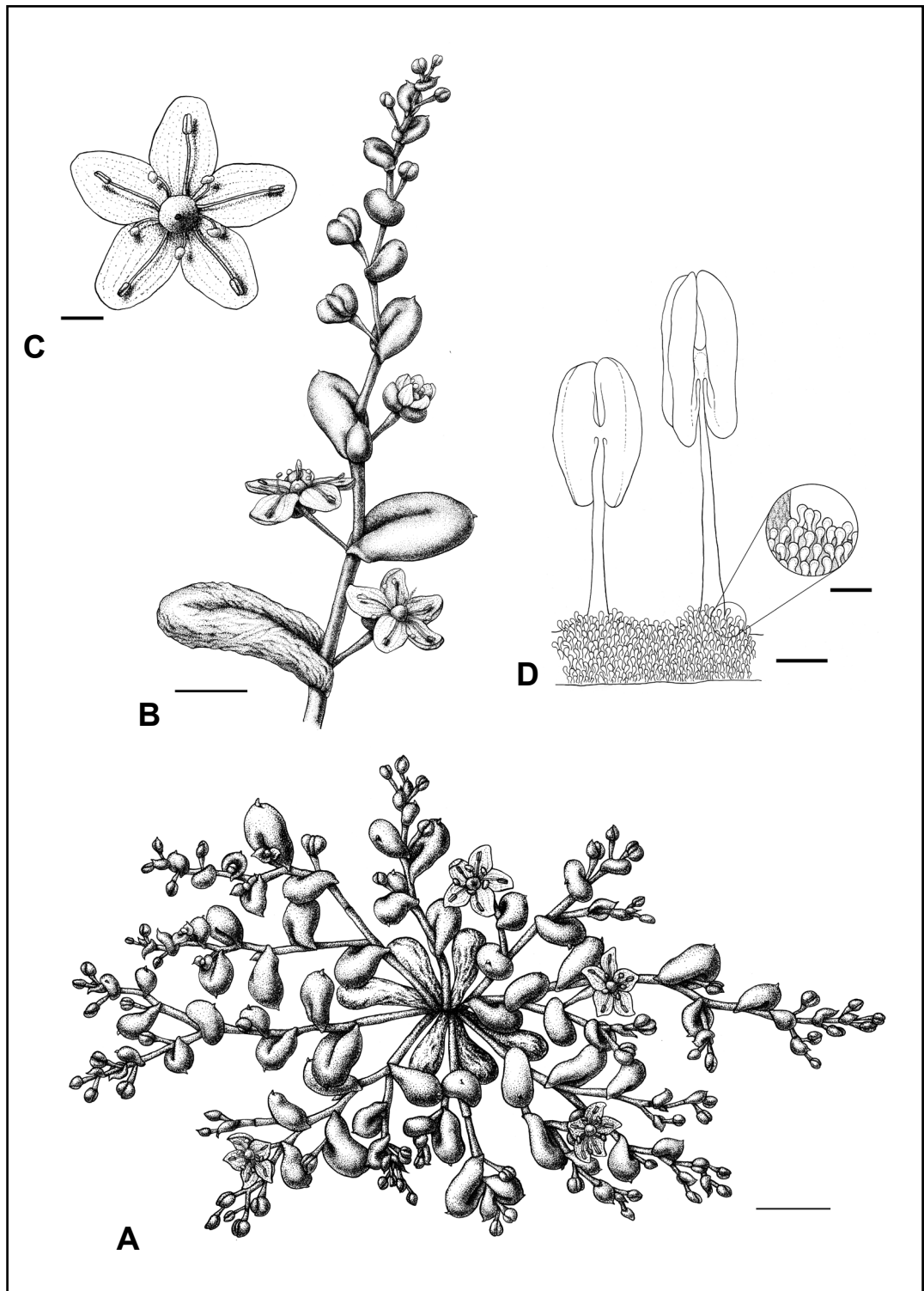


Figure 1. *Calandrinia holtumii*. A – habit; B – branchlet; C – flower; D – stamens, the magnified portion showing the unusual clavate hairs on the androecial ring. Scale bars = 1 cm (A); 5 mm (B); 1 mm (C); 400 μ m (D); 100 μ m (D inset). Illustration by Elissa Johnson.

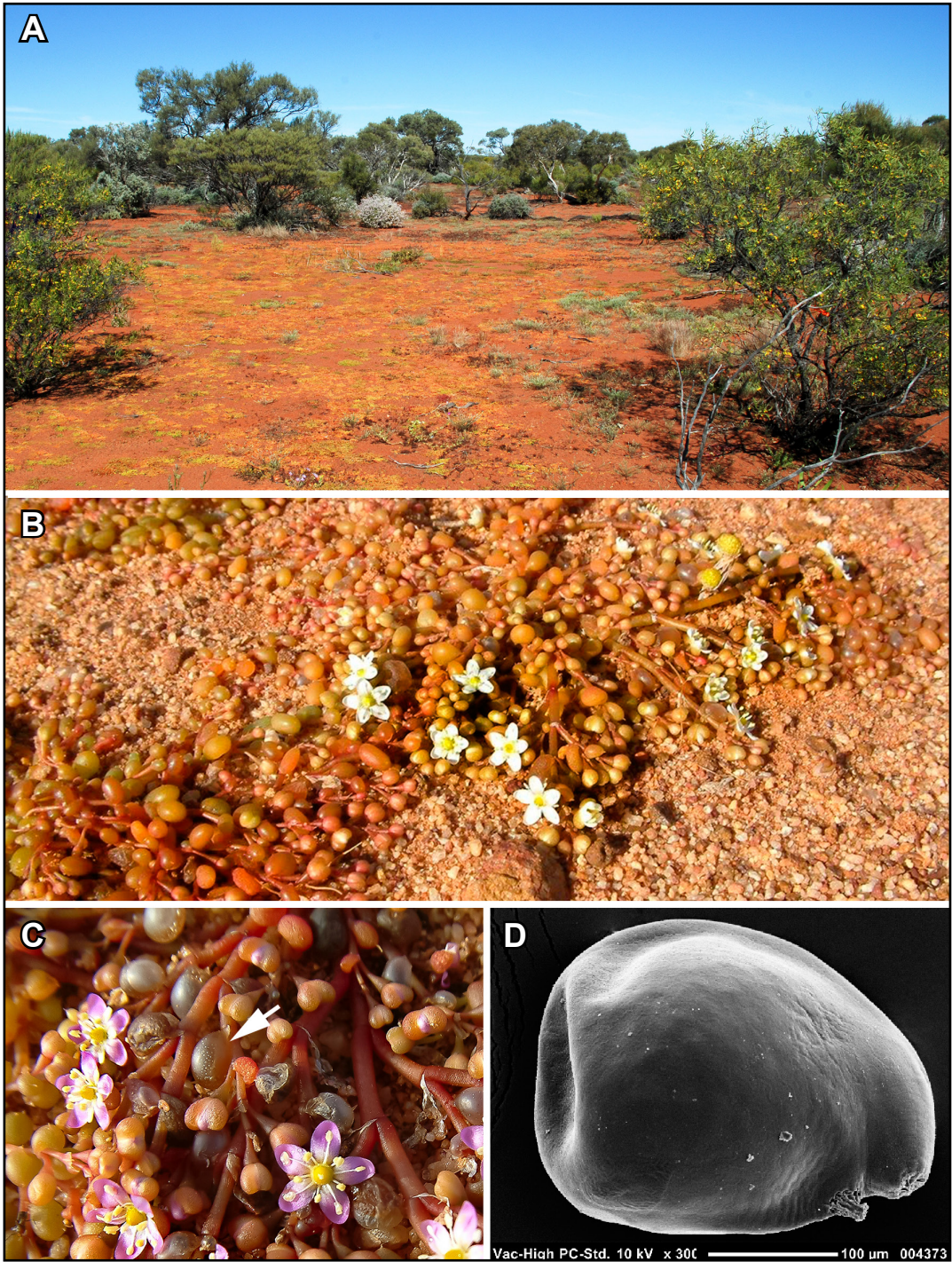


Figure 2. *Calandrinia holtumii*. A – habitat; B – habit, with translucent vesicular leaves indicated by an arrow; C – plan view of a well-developed seed. Photographs © Jean Hort (A–C), and Frank Obbens and Russell Barrett (D). Image voucher populations F. Obbens, F. Hort & J. Hort FO 10/08 (A); F. Hort, J. Hort & J. Shanks 2346 (B & C); F. Hort, J. Hort & J. Shanks 2349 (D).

Other specimens examined. WESTERNAUSTRALIA: mine flats, Paraburdoo, 29 Sep. 1979, *K. Atkins* 598 (PERTH); 2.4 km N of Salt Bore on Lake Way station, 12.8 km NW of homestead, 34.2 km SSE of Wiluna, 23 Sep. 2005, *P. Armstrong* PA 05/508 (PERTH); Mulla Mulla Flat, Coolcalalaya Rd, Mullewa, along road from Coolcalalaya Homestead to Yallalong Homestead, c. 20.4 km WSW of New Forest Yallalong Rd or c. 18.6 km ENE of Natural Gas Pipeline, 6 Oct. 2004, *F. Hort, J. Hort & J. Shanks* 2346 (PERTH); on Waldburg Station, upper Gascoyne River area, c. 65 km SE of Mount Augustus Station homestead, 17 Oct. 2004, *M. Lee & M. Strelein s.n.* (PERTH); 15.1 km from Red Hill Station near Onslow, on bearing of 240 deg., Site 1424, 16 Sep. 1996, *A.A. Mitchell* PRP 1661 (PERTH); 80.2 km NE along the Dooley Downs–Pingandy Rd from Mt Augustus Homestead, 20 Sep. 2013, *F. Obbens & R. Davis* FO 7/13 (PERTH); 48.9 km along the Dalgety Downs–Landor Rd from junction with the Landor–Mt Augustus Rd, 22 Sep. 2013, *F. Obbens & R. Davis* FO 11/13 (PERTH); along Butchers Track 25.7 km E of where gas pipeline crosses track and also c. 93 km E of the North West Coastal Hwy, 19 Aug. 2008, *F. Obbens, F. Hort & J. Hort* FO 10/08 (PERTH); 29.2 km N of Murchison Settlement on the Carnarvon–Mullewa Rd (W side of road), 19 Aug. 2008, *F. Obbens, F. Hort & J. Hort* FO 16/08 (PERTH); 54.5 km W along the Byro–Woodleigh Rd from the junction with the Carnarvon–Mullewa Rd, just past the turnoff to Ballythunna Homestead, 12 Oct. 2011, *F. Obbens & G. Marsh* FO 13/11 (PERTH).

Phenology. Flowers and fruits from mid-August to mid-October.

Distribution and habitat. *Calandrinia holtumii* is widespread in the Yalgoo, Murchison, Gascoyne and Pilbara bioregions (Figure 3). It is probably under-collected and is likely to occur in adjacent parts of the Carnarvon and Little Sandy Desert bioregions. It occurs mostly on plains sometimes adjacent to drainage lines and claypans, rarely on gibber flats and lower scree slopes of mesas, on red-brown sandy loams or sandy clay loams sometimes with surface stones and quartz. Most sites are open shrublands or herbfields with one site described as low open shrubs with samphire. Associated species across its wide range include: *Acacia aneura*, *A. acuaria*, *A. ?citrinoviridis*, *A. grasbyi*, *Aristida contorta*, *Angianthus* sp., *Atriplex holocarpa*, *Brachyscome* sp., *Calandrinia remota*, *Eragrostis dielsii*, *Eremaea crenulata*, *E. phylloda*, *Goodenia tenuiloba*, *Gunniopsis rodwayii*, *Maireana carnosa*, *M. georgei*, *Ptilotus polakii*, *Senna glutinosa* subsp. *glutinosa*, *Sida calyxhymentia*, *Triodia longiceps* and *T. wiseana*.

Conservation status. *Calandrinia holtumii* is represented at PERTH by 11 collections distributed over a range of approximately 650 × 550 km. Only one collection is from a conservation reserve, with most occurring on either pastoral or mining leases or Unallocated Crown Land. Although poorly collected, *C. holtumii* is not considered to be under threat.

Etymology. The epithet honours Prof. Joseph Holtum of James Cook University, Townsville, Australia, who has pioneered research on CAM photosynthesis including work within the Australian flora (e.g. Holtum & Winter 1999; Winter & Holtum 2014).

Affinities. The affinities of *C. holtumii* are uncertain, although it shows similarities in habit to a few other species. Both *C. holtumii* and *C. umbelliformis* have a prostrate habit comprising several radiating stems, each stem with the proximal part bare, but thereafter much-branched and with numerous broadly elliptic to orbicular leaves somewhat reminiscent of jellybeans and small spheres in 3D-shape. *Calandrinia creethiae* Morrison is also prostrate and has similar (although often longer) leaves, but it differs in having four-valved rather than three-valved capsules. All three species co-occur on flats at Coolcalalaya Station. *Calandrinia holtumii* and *C. umbelliformis* have similar-sized, five-merous flowers, while *C. creethiae* has slightly larger flowers with six or seven petals. *Calandrinia holtumii* consistently has ten stamens while *C. umbelliformis* has 25–35.

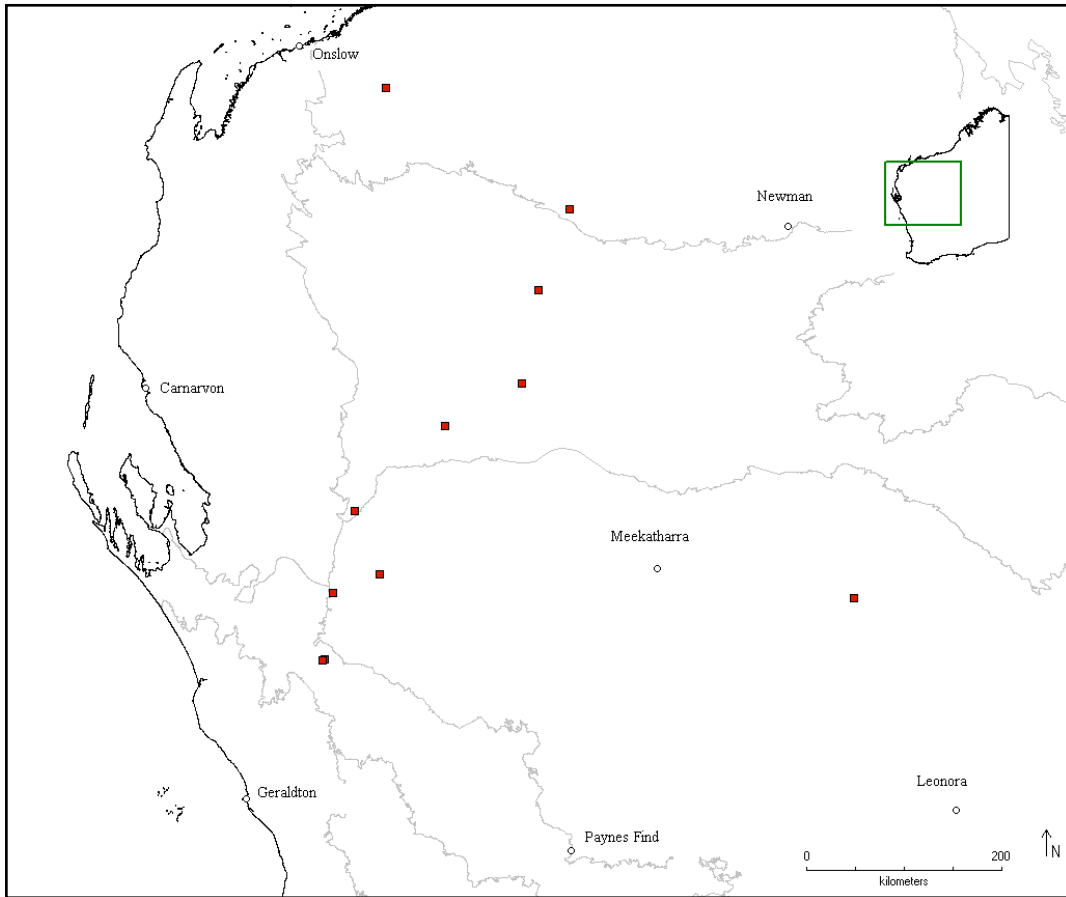


Figure 3. Distribution of *Calandrinia holtumii* in Western Australia.

Notes. The two earliest PERTH collections of *C. holtumii* came from the Pilbara region and are relatively poor specimens with limited immature seed; thus, they were labelled as indeterminant. In 2004 better-developed specimens of *C. holtumii* were collected by Fred and Jean Hort and Jim Shanks, from Coolcalalaya Station in the Murchison region. These collections were confirmed as being the same as those from the Pilbara and the phrase-name *C. sp. Black angular seeds* (A.A. Mitchell PRP 1661) was erected on the vascular plant census. Pilbara collections of *C. holtumii* have larger flowers and more elliptical anthers than those from further south, but in all other respects are typical of this taxon.

Calandrinia holtumii exhibits the strongest CAM photosynthetic cycle among Australian *Calandrinia* species investigated for CAM activity thus far (L.P. Hancock pers. comm.). CAM photosynthesis improves water use and photosynthetic efficiency in conditions such as drought and high soil salinity (Luttge 1987). It is a complex trait that requires numerous biochemical, anatomical and physiological changes, yet has evolved from the more common C_3 photosynthetic pathway, likely dozens of times (Smith & Winter 1996). While full, constitutive CAM plants utilise CAM most of the time, there are many C_3 -CAM intermediate phenotypes (Cushman 2001; Winter *et al.* 2015), including in *Calandrinia* (Winter & Holtum 2011, 2014; Holtum *et al.* 2017). Recent molecular analyses of *C. holtumii* (L.P. Hancock pers. comm.) indicates that it has a key CAM-specific amino-acid substitution that is lacking in all other tested *Calandrinia* species. This substitution may make its CAM cycle more efficient (L.P. Hancock pers. comm.) and it is possible that *C. holtumii* may represent an incipient origin of ‘full’ constitutive CAM.

Acknowledgements

We thank Mike Hislop for reviewing an earlier draft of this paper. Our thanks to Elissa Johnson who produced the excellent illustrations for Figure 1. Fred and Jean Hort provided excellent collections and field observations and also provided the images for Figure 2. Rob Davis provided welcome field assistance. Thanks to Russell Barrett, previously at the Botanic Gardens and Parks Authority, Western Australia, for help with the SEM seed images. Many staff, colleagues and volunteers at the Western Australian Herbarium (Department of Parks and Wildlife) helped in some way with this project, including provision of access to facilities at that institution. LPH was supported in part by NSF IGERT grant DGE 0966060.

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