Nuytsia The journal of the Western Australian Herbarium

30: 237–245 Published online 15 October 2019

Calandrinia monosperma and *C. uncinella* (Montiaceae), two new indehiscent species from Western Australia

Frank J. Obbens

c/o Western Australian Herbarium, Department of Biodiversity, Conservation and Attractions,
Locked Bag 104, Bentley Delivery Centre, Western Australia 6983
Corresponding author, email: frank.obbens@aapt.net.au

Abstract

Obbens, F.J. *Calandrinia monosperma* and *C. uncinella* (Montiaceae), two new indehiscent species from Western Australia. *Nuytsia* 30: 237–245 (2019). Two unique indehiscent species of *Calandrinia* Kunth. from Western Australia are described and mapped and their affinities are discussed with regards to a recent phylogeny for Australian *Calandrinia*.

Introduction

This paper describes two new annual species of *Calandrinia* Kunth. from Western Australia, both having capsules that are indehiscent and deciduous. The newly described *C. monosperma* Syeda ex Obbens is a prostrate, small to medium-sized species with a widespread distribution in the IBRA Eremaean bioregion, while *C. uncinella* Obbens is a decumbent, usually smaller-sized species of patchy distribution within the IBRA Southwest bioregion. The distinctive capsules of both these species make them readily identifiable when in fruit, however, their seeds are also quite distinctive. This is somewhat unusual, as seed shape and pattern are generally considered important diagnostic characters within the genus. Hancock *et al.*'s (2018) recent molecular phylogeny for Australian *Calandrinia*, based on a targeted gene enrichment approach, placed *C. monosperma* (as *C.* sp. The Pink Hills (F. Obbens FO 19/06)) within their clade 3 and *C. uncinella* (as *C.* sp. Piawaning (A.C. Beauglehole 12257)) within their clade 5. Two other indehiscent species, *C. disperma* J.M. Black and *Rumicastrum chamaecladum* (Diels) Ulbr. were also placed in clade 3. Both these species also have unusual and distinctive fruits; however their fruits and seeds are quite different to the above, allowing for all four indehiscent species to be quite easily recognised.

Methods

Methods used are the same as those described in Obbens (2011). In both *C. monosperma* and *C. uncinella* it is impossible to distinguish between stems and scapes. Therefore, in this paper, the term 'flowering shoot' is used to refer to the length of the stem, scape and inflorescence axis measured as one unit along the main axis of the shoot. The length of the inflorescence axis is also recorded separately.

The bioregions referred to in describing species distributions and indicated on the map are from *Australia's bioregions (IBRA)* (Department of the Environment 2013).

https://florabase.dpaw.wa.gov.au/nuytsia/
ISSN 2200-2790 (Online)
ISSN 0085-4417 (Print)

Taxonomy

Calandrinia monosperma Syeda ex Obbens, *sp. nov.*

Type: Site is *c.* 3.8 km E along Talawana Track from the turnoff into Balfour Downs homestead, Pilbara region, Western Australia, 1 June 2004, *F. Obbens* & *B. Bromilow* FO 32/04 (*holo*: PERTH 06609740; *iso*: CANB).

Calandrinia sp. The Pink Hills (F. Obbens FO 19/06), Western Australian Herbarium, in *FloraBase*, https://florabase.dpaw.wa.gov.au/ [accessed June 2019].

Prostrate, sometimes slightly decumbent *annual herbs*, 10–110 mm tall, 60–385 mm wide, glabrous, the root system comprising a small taproot (occasionally larger) with several fibrous roots. *Basal leaves* succulent, narrowly linear, sometimes slightly curved inwards, 7.5–80 mm long, 1.2–3.8 mm wide, terete to subterete in mid cross-section, green to brownish-green, often turning blackish when aging. *Flowering shoots* usually 4–11(–20), 25–270 mm long, radiating from base, the proximal 10–48 mm leafless, thereafter very leafy including proximal portions of inflorescence axes, branched several times with secondary branching relatively common, each branch terminating in either a singular or branched inflorescence. *Stem leaves* fleshy, narrowly linear to narrowly elliptic, 2.5–15 mm long, 1.2–3.2 mm wide, shortly mucronate, alternate to somewhat scattered, ascending, often curved inwards, usually terete to compressed in mid cross-section, colour as above. *Inflorescences* 4–12 flowered; axis 8–140 mm long, generally forming a loose cyme or panicle, the inflorescence tip unfurling with maturity, bare except for several ± scarious bracts. *Inflorescence axis bracts* appressed, narrowly triangular, occasionally broader, 0.75–1.1 mm long, 0.4–0.55 mm wide, apex acuminate, scattered, but often located near bases of individual flower pedicels, withering when flowers reach mature fruit stage. *Pedicels* 0.1–0.2 mm long and erect, to 0.4 mm long in fruit. *Flowers* 1.5–3.0 mm diam. *Sepals* thick, broadly ovate to orbicular, 0.9–1.3 mm long, 1–1.2 mm wide, fused over a short distance to the apex of the pedicel, with a moderately prominent midvein and two lateral veins and extensive reticulation, upper edge distinctly hyaline. *Petals* 5, usually pale pink or white, narrowly elliptic to ovate, occasionally broader, 1.1–1.6 mm long, 0.6–1 mm wide, free to base. *Stamens* 3–5 in one series; filaments flattened, very broad at the base, 0.4–0.6 mm long, shortly adnate to the base of adjoining petals and attached to the top of basal ring beneath ovary; anthers orbicular to broadly elliptic in outline, 0.25–0.35 mm long, 0.25–0.35 mm wide, versatile, extrorse, dehiscing longitudinally. *Ovary* obovoid, 0.55–0.7 mm diam., brown. Stigmas 3, squat, linear to narrowly triangular, lengthening and spreading with maturity, 0.15–0.3 mm long, free to base, with a dense covering of stigma trichomes. *Capsule* ellipsoid to globular, coriaceous to crustose, surface distinctly verrucose-colliculate, 1.3–1.7 mm long, 1.1–1.3 mm wide, the apex relatively obtuse, usually much longer than the sepals, capsules indehiscent and when mature also deciduous with sepals attached; valves 3, sometimes very shortly split at the apex, probably splitting fully with age. Seeds one per capsule, greyish to black, obovoid to globular with a relatively large strophiole, 1–1.05 mm long, 0.8–0.9 mm wide, 0.65–0.7 mm thick, surface minutely and parallelly rugose. (Figures 1, 2).

Diagnostic features. *Calandrinia monosperma* may be uniquely diagnosed within the genus by its distinctive hard, one-seeded, indehiscent capsules with a verrucate-colliculate surface that are unlike those of any other species of *Calandrinia*.

Other specimens examined. WESTERN AUSTRALIA: Mine Flats, Paraburdoo, 23 Sep. 1979, *K.J. Atkins* 584 (PERTH); Fish holes, 36.5 km from Doolgunna Homestead on the northern boundary of the station, 9 Aug. 2006, *G. Byrne* 2308 (PERTH); Site LMS 18, 17 km SW of Lake Mason Homestead, 21 Sep.

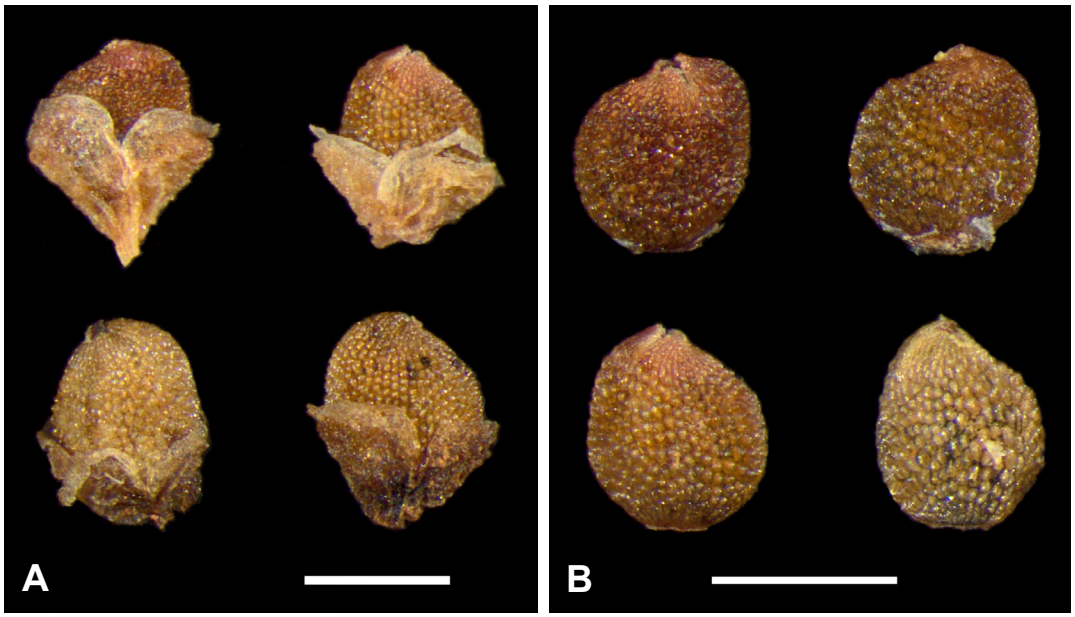

Figure 1. *Calandrinia monosperma* capsules with sepals and portion of pedicel attached (i.e. dispersal unit) (A) and capsules with sepals removed (B). Scale bars = 1 mm. Voucher: *F. Obbens & B. Bromilow* FO 32/04.

2004, *D.J. Edinger & G. Marsh* DJE 4989 (PERTH); Mount Narryer, SW of main peak, 10 Aug. 1997, *A.S. George* 17374b (PERTH); Booylgoo Range, survey site BOOY07, on Booylgoo Spring Station approximately 4.1 km SE of Number 1 Bore and 2.8 km north of Phils Bore. Approximately 62.6 km east north-east of Sandstone, 3 Sep. 2006, *A. Markey & S. Dillon* 4778 (PERTH); Jack Hills, survey site JACK35, located at the end of the main range approximately 3 km S of spot-height 482 m, and approximately 30 km from the junction of Berringarra - Cue Rd and the main track running adjacent and parallel N of the Jack Hills Range, 29 Aug. 2005, *R. Meissner & Y. Caruso* 705 (PERTH); Mt Nairn, Milly Milly Station, survey site MTNN04, *c.* 2.7 km NE of spot-height 371 m and 4.1 km E of Tardy Well, 15 Aug. 2007, *R. Meissner & G. Owen* 1690 (PERTH); Mount Barloweerie survey site MTBW04, located on Mount Barloweerie (BIA Aboriginal Reserve), *c.* 3.8 km SE of Burra Burra Well and 7.5 km SW of Pia Well. Located *c.* 134 km NNW of Yalgoo, 25 Aug. 2008, *R. Meissner & J. Wright* 2416 (PERTH); Site 702, Weld Range, 19 July 2006, *J. Naaykens* JN 702 07 (PERTH); Area *c.* 6 to 7 km E of Channar East Mine (ESE of Paraburdoo) and *c.* 0.5 km downslope from Pilbara Biological Survey site TCMBC05, 7 June 2006, *F. Obbens* FO 19/06 (PERTH); Area along track *c.* 50 km directly ESE of Paraburdoo and *c.* 4 km S of Turee Creek East Branch. Also located nearby Pilbara Biological Survey site TCMBC12, 8 June 2006, *F. Obbens* FO 22/06 (PERTH); 5.3 km N along the Cobra-Dairy Creek Rd from junction with the Carnarvon - Mullewa Rd (W side), 9 Aug. 2015, *F. Obbens* 18/15 (PERTH); 6.4 km S along Carnarvon - Mullewa Rd from junction with the Byro - Beringarra Rd. On W side of road *c.* 250 to 300 m away, 10 Aug. 2015, *F. Obbens* 19/15 (PERTH); *c.* 40-45 km N of Murchison settlement on Carnarvon - Mullewa Rd (before Curbur Homestead turnoff), 30 Aug. 2018, *F. Obbens* FO 01/18 (PERTH); Site number: 648, 6.8 km NW of Mount Hilditch, Hamersley Ranges, Fortescue Botanical District, 2 June 1997, *M.E. Trudgen* 18309 (PERTH); Foot of The Pink Hills, 17 Aug. 1973, *E. Wittwer* W 1050 (PERTH).

Phenology. The main flowering and fruiting period for *C. monosperma* is from early June through to late September. This extensive period relates to the species' wide distribution, hence flowering and fruiting occurs first in northern populations and later at more southern locations.

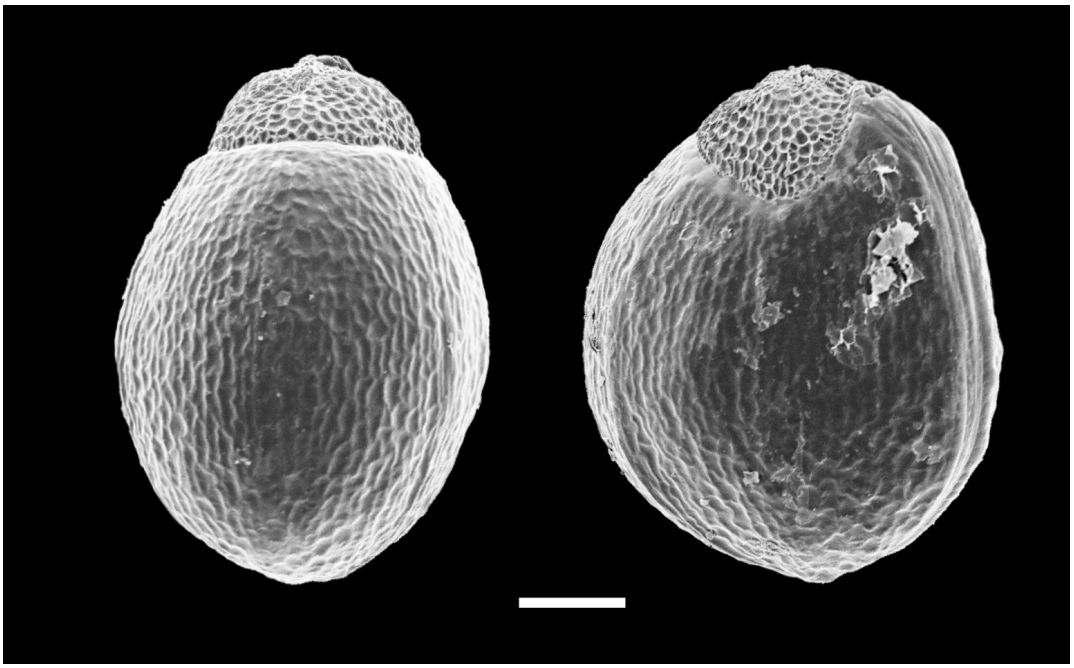

Figure 2. *Calandrinia monosperma* seeds with dorsal and plan views. Scale bar = 0.2 mm. Voucher: *F. Obbens & B. Bromilow* FO 32/04.

Distribution and habitat. *Calandrinia monosperma* occurs over a relatively wide area, from southern parts of the *IBRA* Pilbara subregion to the Murchison subregion, and from Gascoyne Junction-Murchison settlement areas in the west and eastwards to Wiluna-Leonora areas (Figure 3). This species is found growing in soils described as mainly red to orange-brown, clayey or sandy loams, often pebbly or rocky and frequently ironstone on various landforms that include gibber or rocky plains, moderate hill slopes and ridgelines. It is even found growing in rocky cracks above breakaways. There are a few different vegetation communities where *C. monosperma* grows, but by far, it is most often associated with open shrublands dominated by species of *Acacia* such as *A. aneura s. lat.*, *A. ramulosa*, *A. rhodiophloia*, *A. tetragonophylla* and *A. sibirica* and other taller shrubs including *Eremophila phyllopoda*, *E. flaccida*, *E. macmilliana*, *Hakea recurva* subsp. *arida*, *Senna artemisioides* subsp. *helmsii* and *Indigofera monophyla*, with a lower storey of subshrubs, grasses and annuals such as *Ptilotus obovatus*, *P. helipteroides*, *Calytrix desolata*, *Aristida contorta*, *Eriachne pulchella*, *Goodenia prostrata* and *Helipterum craspedioides* to name a few.

Conservation status. There are currently 27 collections of *C. monosperma* held at PERTH. It is certainly under-collected in many areas over its relatively broad range. It does not appear, at this stage, to be in need of any special conservation management even though numerous mining tenements occur throughout this region.

Etymology. The epithet for this species is derived from the Greek *mono–* (one–) and *–sperma* (–seeded) in reference to its one-seeded capsules.

Notes. *Calandrinia monosperma* was described by Syeda (1979) in her unpublished MSc thesis and thus was only known as a manuscript name for many years. Under the new 2005 CHAH protocols manuscript names were allocated phrase-names and so *C.* sp. The Pink Hills (F. Obbens FO 19/06) was raised, with a voucher from the location of an earlier collection near The Pink Hills (*E. Wittwer*

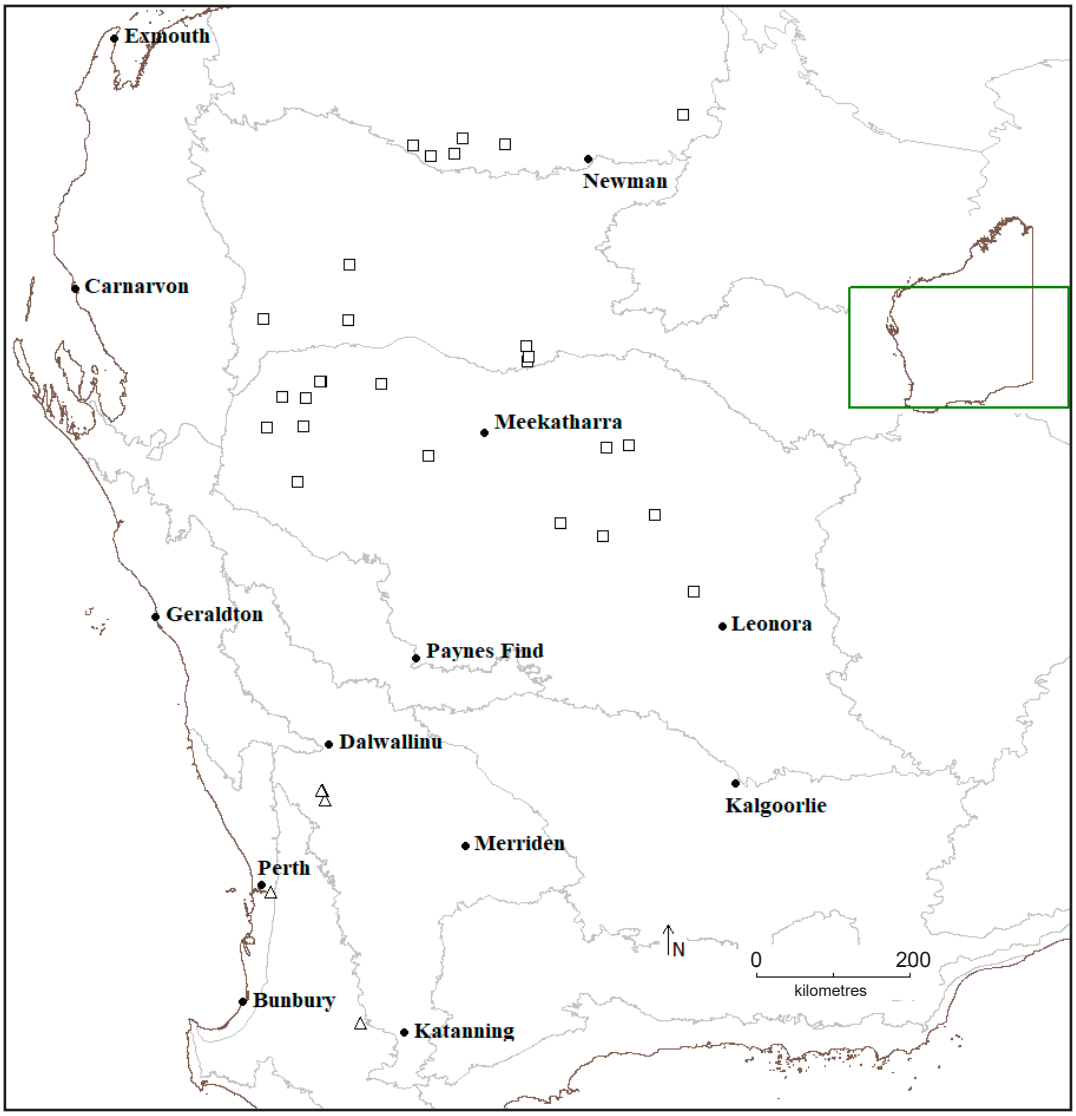

Figure 3. Distribution of *Calandrinia monosperma* (□) and *C. uncinella* (Δ) in Western Australia.

W 1050). However, Syeda's unpublished protologue in her MSc thesis cited two Western Australian specimens being Mt. Harris, 32 miles north of Agnew on road to Wiluna (*T.E.H. Aplin* 2379) and 2 miles north of Mt. Fouracre, Leonora (*B. Severne* 635395 GA). Both these collections are currently on loan to CANB, but their locations are still included on Figure 3. Most importantly, the Scanning Electron Microscope images of the diagnostic capsules of *C. monosperma* that were included in Syeda's thesis have confirmed the distinctiveness of this taxon and facilitated the accurate identification of further collections.

Apart from the unusual indehiscent capsules, *C. monosperma* has other unique characteristics. For instance, the proximal end of the filaments and the top of basal rings are not papillose, a nectary feature common to almost every *Calandrinia* species. The lack of these nectaries could indicate that self-pollination is occurring, but further study is required to confirm this.

A recent molecular phylogeny of Australian *Calandrinia* (Hancock *et al.* 2018) has *C. monosperma* placed in clade 3, a group of small-flowered, mostly prostrate annuals with usually five petals and five stamens, although some species have fewer (as low as three). Most species are several-seeded, except *C. monosperma* and the other two indehiscent species in this group, that is, *C. disperma* and *Rumicastrum chamaecladum* which are one or two-seeded. As mentioned in the introduction, all the indehiscent species are readily recognised by their unusual fruits and seeds, but like most *Calandrinia* species, these indehiscent species could be difficult to recognise from flowering material only, although habit, habitat and distribution can be of some use for identification. Surprisingly, the three indehiscent species within clade 3 are not each other's closest relatives, however, the bootstrap support for the clade and at each branch is high. *Calandrinia disperma*, however, is sister to *C. liniflora* Fenzl., while the other two indehiscent species occur on separate branches. Other members in this clade include *C.* sp. Bungalbin (G.J. Keighery & N. Gibson 1656), *C. brevipedata* F.Muell., *C.* sp. Truncate capsules (A. Markey & S. Dillon 3474) and *C. corrigioloides* Benth.

Calandrinia uncinella Obbens, *sp. nov.*

Type: east of Piawaning, Western Australia [precise locality withheld for conservation reasons], 26 August 1965, *A.C. Beauglehole* 12257 (*holo*: PERTH 06189512; *iso*: CANB).

Calandrinia sp. Piawaning (A.C. Beauglehole 12257), Western Australian Herbarium, in *FloraBase*, https://florabase.dpaw.wa.gov.au/ [accessed June 2019].

Decumbent to semi-erect *annual herbs*, 35–110 mm tall, 30–230 mm wide, glabrous, the root system comprising a weak taproot with numerous fibrous roots. *Basal leaves* succulent, narrowly linear, often slightly curved inwards, 4–27 mm long, 1.4–2.3 mm wide, sometimes slightly mucronate, terete to sub-terete in cross-section, green to brownish-green. *Flowering shoots* usually 2–5(–15), 24–135 mm long, radiating from base, the lower third to half usually with 2 to 4 scattered stem leaves. *Stem leaves* fleshy, narrowly linear, 2.7–18.5 mm long, 0.6–1.8 mm wide, ascending, often slightly curved inwards, terete to sub-terete in cross-section, colour as above. *Inflorescences* 2–3 flowered; axis 6–27 mm long, generally a loose cyme, bare except for 3 to several ± scarious bracts. *Inflorescence axis bracts* appressed to ± spreading, narrowly triangular, occasionally broader, 0.7–2.2 mm long, 0.3–1.1 mm wide, apex acuminate. *Pedicels* 2.7–4.8 mm long and erect, to 8 mm long in fruit and strongly reflexed. *Flowers* 3.5–5 mm diam. *Sepals* thick, ovate to broadly ovate, 1.7–2.4 mm long, 1.4–2.4 mm wide, free to base, mucronate, with an indistinct midvein and several parallel lateral veins with some reticulation. *Petals* 5, occasionally 6 or 7, creamy white, rarely light pink, narrowly obovate to obovate, sometimes broader, shallowly mucronate at apex, 2.3–3.1 mm long, 0.9–2.1 mm wide, free to base. *Stamens* 5, in one row, alternating short and long, not equally spaced; filaments free, 1.2–2 mm long, attached to the top of basal ring beneath ovary; anthers broadly elliptic to orbicular in outline, 0.3–0.55 mm long, 0.3–0.5 mm wide, versatile, extrorse, sometimes facultatively antrorse when the longest filaments fold inwards towards stigmas, dehiscing longitudinally. *Ovary* ovoid, surface bumps often noticeable, 1.1–1.25 mm diam., brown. *Stigmas* 3, squat-triangular, lengthening and spreading modestly with maturity, 0.3–0.55 mm long, on a short style 0.2–0.25 mm long, with a dense covering of short stigma trichomes. *Capsule* roughly ovoid to somewhat pyramidical, coriaceous to woody, with many upright hooked appendages protruding from the surface, 4.5–6.5 mm long, 3.5–4.5 mm wide, the apex acuminate, much longer than the sepals although the sepals usually deciduous when capsule matures, capsule indehiscent and eventually deciduous (possibly epizoochory) with pedicel attached; valves 3, probably splitting with age. Seeds 2–5 per capsule, red-brown, elongated and 'pear-shaped', sometimes compressed with a long thin strophiole, 1–2.2 mm long, 0.5–1.3 mm wide, 0.3–0.8 mm thick, surface appears smooth (but, very lightly colliculate and wrinkled at higher magnification), somewhat glossy. (Figures 4)

Figure 4. *Calandrinia uncinella* capsule (A) and seeds showing variation in shape and size (RH seed partially squashed within the capsule) (B). Scale bars = 1 mm. Voucher: *A.C. Beauglehole* 12257.

Diagnostic features. *Calandrinia uncinella* may be readily diagnosed within the genus by its unusual and uniquely indehiscent capsules that have numerous upright hooked appendages protruding from the surface; a feature that is not evident in any other species.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 16 Sep. 2013, *K.L. Brown & G. Paczkowska* KLB 1191 (PERTH); 14 Oct. 1983, *A.S. George* 16292

(PERTH); 2 Oct. 2002, *F. Obbens* 33/02 (PERTH); 16 Sep. 2003, *F. Obbens* FO 25/03 (PERTH); 1 Oct. 2014, *F. Obbens & L. Hancock* FO 01/14 (PERTH); 3 Sep. 2011, *K. Thiele* 4217 (PERTH).

Phenology. The main flowering and fruiting period for *C. uncinella* is from late August to mid-October.

Distribution and habitat. While poorly known and categorised as a species of conservation concern, *C. uncinella* occurs over a relatively wide area of the south-west of Western Australia. Most of the known collections are from within the IBRA Avon Wheatbelt subregion or closely adjacent with specimens from around the type location near Piawaning and one from south of Arthur River. Three other collections are from outer metro Perth and within the IBRA Swan Coastal Plains subregion, seemingly a strange disjunction from the wheatbelt populations (Figure 3). So far, all populations have been found in seasonally wet swamps or on saline river flats on ground or embankments just above water, growing in soils described as grey-brown sandy or silty loams or white to creamy sands over clays usually with poor drainage. Associated vegetation communities are generally low heath to shrubland with abundant herbfield understories or open spaces that occasionally include samphires. Other associated shrub species include *Melaleuca hamata*, *M. brevifolia*, *Acacia lasiocarpa*, *Hypocalymma angustifolium*, *Callitris pyramidalis*, while the herbfields include grasses, sedges and annuals such as *Eragrostis dielsii*, *Austrostipa* sp., *Gahnia trifida*, *Chaetanthus aristatus*, *Hyalochlamys globifera*, *Pogonolepis stricta*, *Gnephosis* sp., *Tribonanthes* sp., *Atriplex* sp., and some samphires such as *Tecticornia lepidosperma.*

Conservation status. *Calandrinia uncinella* is listed as a Priority One under the Conservation Codes for Western Australia Flora (Smith & Jones 2018), under *Calandrinia* sp. Piawaning (A.C. Beauglehole 12257). Presently, there are only seven collections at PERTH of this species, although its distribution could be more widespread. Sporadic searches of potential habitat have not yet succeeded in finding more populations. The existing populations are being impacted by increasing salinity and possibly a lack of vectors for spreading its indehiscent capsules (i.e. seeds). More dedicated surveys are required to determine whether the species needs increased protection.

Etymology. The epithet is derived from the Latin *uncinus* (hook, barb) and *–ellus* (diminutive) in reference to the small hooks on the capsule appendages (see Figure 4A).

Notes. *Calandrinia uncinella* falls within clade 5 of the molecular phylogeny published by Hancock *et al*. (2018), which includes a group of small-flowered, mostly decumbent annuals with five or more petals (up to seven) and generally five stamens. Most species have capsules with several to many seeds, except *C. uncinella*, which is generally two or three-seeded. Thus far, *C. uncinella* is the only indehiscent species in the group with other members including *C.* sp. Needilup (K.R. Newbey 4892), *C. holtumii* Obbens & L.P. Hancock, *C. polypetala* Fenzl, *C.* sp. Warriedar (F. Obbens 04/09), *C. granulifera* Benth. and *C.* sp. Kenwick (G.J. Keighery 10905). Also *C. uncinella*, like *C. monosperma*, lacks nectaries at the base of the filaments and on the basal rings, but this does not necessarily confirm that self-pollination is occurring. Interestingly, however, is the fact that indehiscence has evolved multiple times and independently in two different Australian *Calandrinia* clades.

Acknowledgements

My thanks to the many who assisted me with fieldwork on this project. They include: Fred and Jean Hort, Lillian Hancock, Kevin Thiele and Rob Davis. Steve Dillon produced the excellent images for Figures 1, 2 and 4, for which I am very grateful. My appreciation to the Western Australian Herbarium, Department of Biodiversity, Conservation and Attractions, for use of their facilities.

References

Department of the Environment (2013). *Australia's bioregions (IBRA)*. Commonwealth of Australia. http://www.environment.gov.au/topics/land/national-reserve-system/science-maps-and-data/australias-bioregions-ibra#ibra [accessed June 2019].

Hancock, L.P., Obbens, F., Moore, A.J., Thiele, K., de Vos, J.M., West, J., Holtum, J.A.M. & Edwards, E. (2018). Phylogeny, evolution, and biogeographic history of *Calandrinia* (Montiaceae). *American Journal of Botany* 105: 1021–1034.

Obbens, F. (2011). Five new species of *Calandrinia* (Portulacaceae) from Western Australia with additional information on morphological observations. *Nuytsia* 21: 1–23.

Smith, M.G. & Jones, A. (2018). *Threatened and Priority Flora list December 2018*. Department of Biodiversity, Conservation and Attractions. https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-plants [accessed June 2019].

Syeda, S. T. (1979). The genus *Calandrinia* H.B. et K. in Australia. Msc Thesis, University of Sydney.