

A new species of *Calandrinia* (Montiaceae) from rocky pavements in eastern New South Wales and south-eastern Queensland

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Abstract

Calandrinia petrophila J.G.West & Albr. *sp. nov.* is described and illustrated, with notes on distribution, habitat, conservation status and features distinguishing it from similar species of *Calandrinia*.

Introduction

Since the mid-2000s more than 20 new Western Australian species of *Calandrinia* have been described, elevating the number of currently recognised named Australian *Calandrinia* species to 61 (Western Australian Herbarium 1998–; Northern Territory Herbarium 2015–; VicFlora 2016–; de Salas & Baker 2019; Thomas & Brown 2020; Flora SA 2021; PlantNET 2021). Collectively these references recognise a further 25 undescribed species with phrase names. New species have continued to be named in *Calandrinia* despite significant evidence (Carolin 1987; Hershkovitz 1998; Nyffeler & Eggli 2010; Thiele et al. 2018; Hancock et al. 2018) that Australian members of the genus are genetically distinct from those species in the Americas. Two alternative generic names, *Rumicastrum* Ulbr. (described in 1934) and *Parakeelya* Hershk. (described in 1999) have been proposed for the Australian species of *Calandrinia*, though neither has been adopted to date. Reasons in favour of adopting *Rumicastrum* were presented by Hershkovitz (2020), whilst those in favour of adopting *Parakeelya* were presented by Thiele et al. (2018). A proposal to conserve the name *Parakeelya* against *Rumicastrum* is awaiting consideration by the Nomenclature Committee for Vascular Plants (Thiele et al. 2018).

In this paper we describe a new species from eastern New South Wales and south-eastern Queensland that has been recognised as distinct for many years. It is named as a species of *Calandrinia* noting that the generic name will need to be changed in the future once the outcome of the proposal to conserve *Parakeelya* is voted on at the International Botanical Congress scheduled for 2024.

Methods

Measurements presented in the species description are based predominantly on rehydrated dried specimens and field collected live plants, with additional measurements from live cultivated material grown under favourable conditions at the Australian National Botanic Gardens (ANBG).

The flower-bearing shoots were measured in two parts. The proximal leafless portion was measured from the base to the insertion point of closest bract above (i.e. where the first pedicel of the inflorescence arises). The distal flowering portion (i.e. inflorescence axis sensu Obbens 2011) was measured as the distance from the lowermost bract to the apex of the distal-most bud or flower. Pedicel length was measured as the distance from its apex (at the junction with the sepals) to the insertion point of the closest bract below. For the purposes of consistency with descriptions of recently described species we here treat the two structures below the petals as sepals although it is acknowledged that they are considered to correspond to bracteoles or involucre bracts by some authors (see Nyffeler and Egli 2010 for discussion). These structures were detached and flattened to measure. Fruit measurements are based on unflattened mature fruits prior to dehiscence.

Taxonomy

Calandrinia petrophila J.G.West & Albr., *sp. nov.*

Type: New South Wales: Southern Tablelands: 16 km from Nerriga along road towards Nowra, c. 6km NW of Sassafras, 19 Feb. 1982, I.R.Telford 8677 (holo: CBG 8200581; iso: NSW, BRI).

Calandrinia sp. Nerriga (I.R.H.Telford 8677) NSW Herbarium

Calandrinia sp. A sensu Fl. NSW 1: 183 (1990)

Glabrous perennial herb to c. 5 cm high with branching tuberous roots; finer roots arising from tuberous roots. *Leaves* all basal, mostly spreading, sometimes flat on substrate surface, succulent, dull green, paler at very base, progressively becoming suffused with yellow or orange with age or desiccation, linear, linear-oblongate or linear-elliptic, 20–60 mm long (–120 mm in cultivation), 1.0–3.0 mm wide (–5.8 mm in cultivation), dorsiventrally compressed, 1.0–2.5 mm thick, flat to slightly convex adaxially with or without a slightly depressed medial longitudinal area, flat to slightly convex abaxially or broader leaves with a slightly raised broad midrib and sometimes also with a slightly raised broad marginal rim; base attenuate; margins rounded in x-section for most of leaf length but becoming more angular proximally; apex narrowly rounded to acute. *Flower-bearing shoots* arising from leaf axils, sometimes prostrate on substrate surface, not or rarely slightly exceeding the length of the longest leaves; proximal leafless portion 8–30 mm long; distal flowering portion 15–65 mm long, flowers arranged in (1–)2–5(–7)-flowered monochasial cymes or dichasial cymes with monochasial branches, pedicels 1.5–7 mm long, distinctly broader distally, not obviously elongating in fruit; bracts opposite at each node, appressed or ascending, triangular, deeply concave, the bract adjacent to the pedicel often the smaller of the pair, 0.5–4.5 mm long (–7 mm in cultivation), the bract adjacent to the inflorescence axis 1.7–5 mm long (–12 mm in cultivation), herbaceous with hyaline margins becoming broader towards the base, acute. *Flowers* 6–12 mm diameter. *Sepals* ovate to broadly ovate, (3.0–)3.5–5.0(–6) mm long, 2–4.2 mm wide, persistent, free to base, venation not evident; margins narrow, hyaline, to c. 0.3 mm wide; apex broadly acute to obtuse. *Petals* 4–5, white, broadly lanceolate to ovate or elliptic, (2.2–)3–6.5 mm long, 1.2–3 mm wide, free or virtually so, apex broadly acute to obtuse. *Stamens* 4–5(–6); filaments white, linear, appearing free but attached to the top of a basal ring subtending ovary, 2–3 mm long, smooth; anthers cream, versatile, 2-celled, each cell oblong in outline, 0.2–0.7 mm long, 0.15–0.25 mm wide, latrorse, dehiscing longitudinally. *Ovary* pale green, ovoid, 1.5–3 mm long, 0.7–2.2 mm diameter. *Stigmata* 4, white, linear, 0.5–1 mm long, free to the base. *Capsule* ovoid to conical-ovoid, 4.0–5.2 mm long, 1.8–2.3 mm wide, exceeding the sepals, apex truncate; valves 4, persistent, firm-textured, when dry the external surface with numerous slightly raised short longitudinal lines, not splitting more than halfway to the base. *Seeds* numerous, obovoid, mid to dark brown, unevenly shiny due to surface pattern, (0.4–)0.45–0.6 mm long, 0.35–0.5 mm wide, colliculate, with a rudimentary strophiole. (Fig. 1).

Diagnostic characters: A distinctive species distinguished from other *Calandrinia* spp. by the combination of the following characters: leaves strictly basal, narrow and dorsiventrally compressed; flower-bearing shoots not or rarely slightly exceeding the length of the longest leaves; bracts opposite; petals white, 4 or 5; stamens 4–6; stigmas 4; capsules with 4 persistent, firm-textured and truncate valves with a distinctive surface pattern; and seeds colliculate.

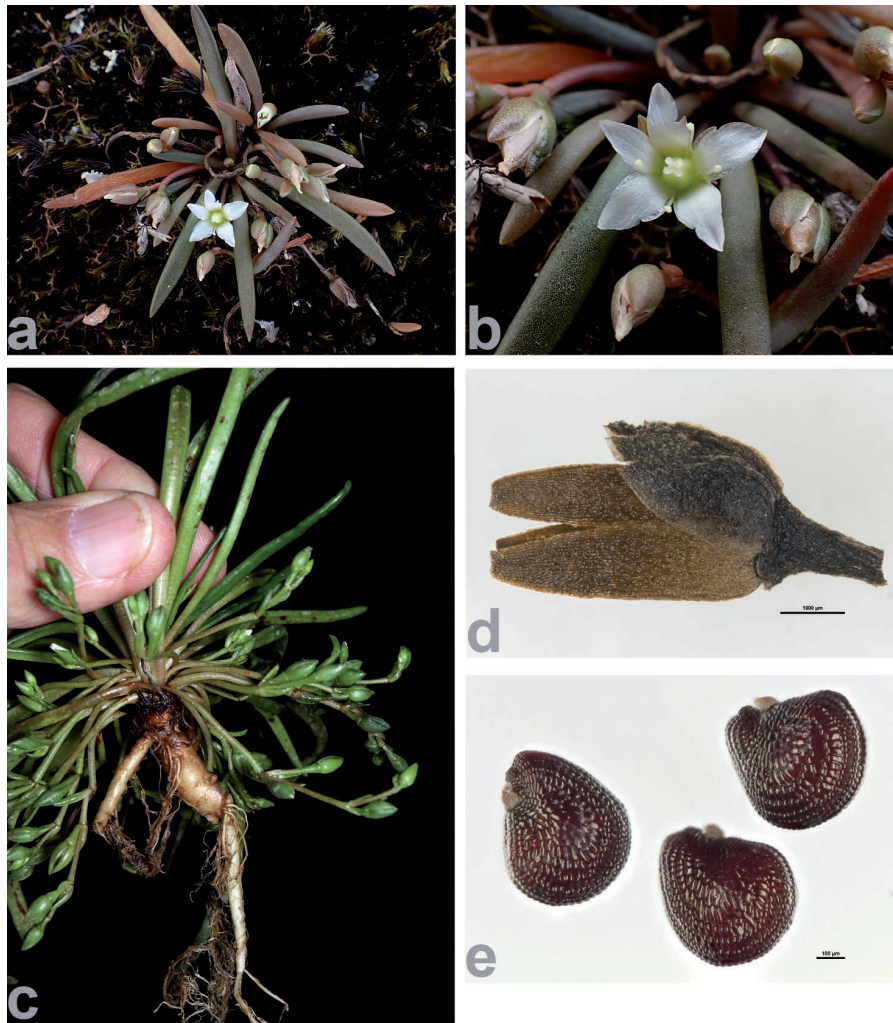


Fig. 1. *Calandrinia petrophila*: **a.** habit; **b.** flower; **c.** whole plant showing root system; **d.** dehiscing capsule showing external surface texture, one subtending sepal removed; **e.** seeds. Scale bars: a & c = 10 mm; b = 2.5 mm. Images a & b = T.Collins (*Albrecht 16362*); c = M.Fagg (cultivated ex *Albrecht 16362*); d = J.FitzGerald (*West 4642*); e = J.FitzGerald (*West 5554*).

Specimens examined: QUEENSLAND: Darling Downs: Burncluth Road to Barakula State Forest, Jan 1980, *M.G.Lithgow 672* (BRI); Chinchilla area, Oct 1978, *M.G.Lithgow s.n.* (BRI); Rosedale, c. 18km south west of Chinchilla, 9 Dec 2010, *C.Eddie CPE1740 & R. Aisthorpe* (BRI); 9km E of Condamine, 2 Dec 2013, *C.Todd s.n. & S.Leicester* (BRI); Headwaters of Pariagara Creek, 7km W of Bringalily Forestry Lookout Fire Tower (abandoned), 26 Sept 1982, *P.I.Forster 11653 & P.Machin* (BRI); Three Mile Station, Stanthorpe, 15 April 1961, *W.G.Trappnell 10* (BRI).

NEW SOUTH WALES: North Coast: On a property known as “Archerfield” in the Mount Thorley - Warkworth area, c. 8 km N of the Golden Hwy and 1 km W of the Hunter River, 18 Oct 2011, *A.N. Rodd s.n.* (NSW). Central Tablelands: cultivated Fairfield [NSW] ex The Grandstand [The Lookout], Bindook Highlands, Blue Mountains National Park, 5 Nov 2005, *C.P.Gibson, R.T.Miller & G.W.Carr s.n.* (NSW). Southern Tablelands: c. 6.3 km due N of the intersection of Tolwong Road and Braidwood Rd (c. 11 km due NE of Nerriga), 18 Apr 2021, *D.E.Albrecht 16362 & T.Collins* (CANB); Near Bulee Gap, 5.5 km NE of Nerriga, 26 Nov 1981, *I.R.Telford 8668 & J.W.Wrigley* (CBG); Morton National Park, on Braidwood-Nowra Rd, 5.5 km NE of Nerriga, 5 Dec 1981, *J.G.West 4642* (CANB); 1.6 km east of Sassafras on road to Tomerong, 1 Nov 1984, *J.G.West 4952* (CANB); Middle Creek, 3.2 km S of Sassafras, 24 Mar 1974, *I.Olsen 1988* (NSW); 1 km S of Round Hill, Northern Budawang Range, 31 Jan 1977, *J.Pickard 3321* (NSW); 7.5km S of Sassafras, 8 Mar 1975, *J.G.Seur 198 & S.Jacobs* (NSW); Northern Budawang Range, Folly Point track, 3 km S of Newhaven Gap, 4 May 1991, *I.R.Telford 11003 & R.Rudd* (CBG, NSW). South Coast: Tullyangella Labyrinth, 7 km N of Bulee Hill, 27 Jan 1984, *I.R.Telford 9642* (CBG, NSW, BRI); E of Sassafras along Turpentine Road, (c. 200 m S of road), 6.5 km (direct) NE of Tianjara Falls, 8.3 km W (by road) of Tomerong turnoff, 16 Nov 2011, *J.G.West 5554* (CANB); Morton NP, NW of Milton, along Mt Bushwalker walking track, Little Forest Plateau, 9 Dec 2020, *J. Miles 21-09* (CANB).

Distribution: Based on specimens in Australian herbaria *Calandrinia petrophila* is currently known from four disjunct regions (Fig. 2). Most collections have been made from the southern part of its range in the Budawang Range of south-eastern New South Wales, with several collections made in the Queensland Darling Downs at the northern edge of its range. Only two collections have been made between the northern and southern clusters – one from the Bindook Highlands in the southern part of the Blue Mountains National Park and another from north-west of Singleton. It is probable that the species is under collected as several unvouchered records of it are on iNaturalist (currently as *C. eremaea* Ewart or *C. sp.*), including one from just north of Torrington, New South Wales, c. 75 km from an existing vouchered collection site (iNaturalist 2020).

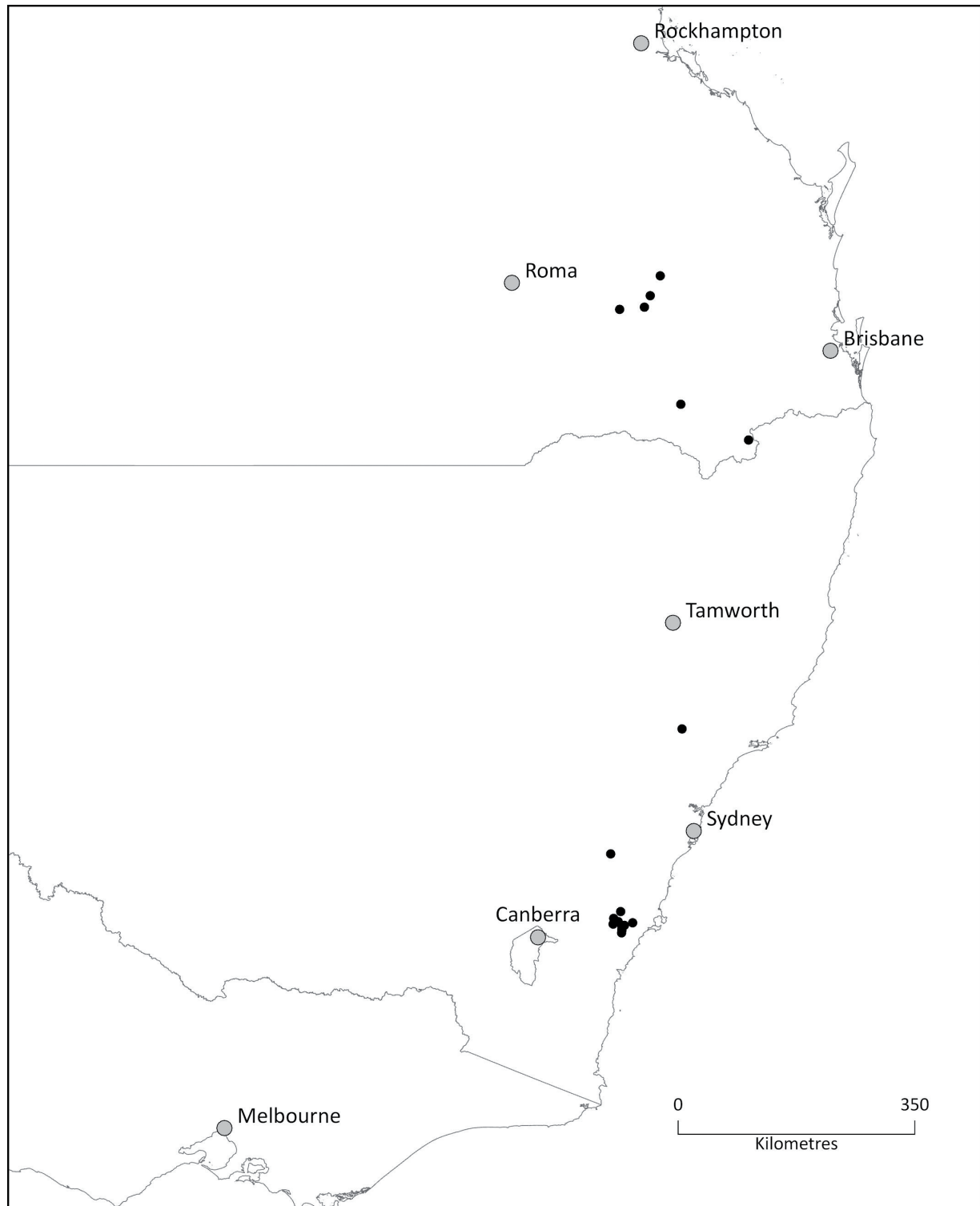


Fig. 2. Distribution of *Calandrinia petrophila* based on specimens lodged at CANB, NSW and BRI.

Conservation status: Although the species has been recorded from at least twenty sites little is known about the size of populations. Until further field assessments are undertaken a conservation code of *data deficient* would seem appropriate. Although plants were present at two sites in the Budawangs visited after the 2020 bushfires, the impact of these fires on populations is uncertain as no pre-fire population size data is available for comparison. Given that the species typically occurs on exposed sites with shallow soils over rock, drought may be a key risk. The southern populations occur within Morton National Park and the population from the Bindook Highlands occurs within the Blue Mountains National Park.

Habitat: Throughout its geographic range *Calandrinia petrophila* occurs principally on flat to gently sloping rock pavements in low open vegetation. Plants are frequently found growing in cryptogam mats on shallow soil over sandstone, or less frequently granite or conglomerate bedrock (Fig. 3). On sandstone sites in the southern part of its geographic range associated species include *Rytidosperma monticola*, *Centrolepis strigosa*, *Schoenus ericetorum*, *Lepidosperma viscidum*, *Crassula sieberiana*, *Platysace lanceolata*, *Goodenia bellidifolia* ssp. *bellidifolia* and seedlings of various shrub species from the surrounding heathland, shrubland or heathy forest/woodland vegetation. *Calandrinia eremaea* and *C. pickeringii* co-occur at some sites. Habitat notes on two collections from Queensland and one from the Hunter region in NSW suggest that the species also rarely occurs on non-rocky sites, though in some cases the information provided is not detailed enough to be certain. These apparently atypical habitats include grassland dominated by *Aristida caput-medusae* and *Eragrostis* sp. on a plain in brown clay loam (C.Eddie CPE1740 & R.Aisthorpe); cleared grassland, grazing land, shallow brown duplex soil (C.Todd s.n. & S.Leicester); and open areas in a stand of *Eucalyptus crebra* with *Melaleuca thymifolia*, *Murdannia graminea*, *Laxmannia gracilis*, *Cheilanthes sieberi* and *Aristida ramosa*, with some exotic species (A.N.Rodd s.n.). The latter site supports an unusual floristic assemblage that may align with the critically endangered Warkworth Sands woodland of the Hunter Valley (Department of the Environment 2021). This site also supports an unusual disjunct population of *Calandrinia balonensis* (Tony Rodd pers. comm.).



Fig. 3. Typical habitat of *Calandrinia petrophila* = M.Fagg (West 5554) ©M. Fagg, 2011.

Phenology: Flowering specimens have been collected in the field between September and April, and fruiting specimens between October and May. Adequate soil moisture, light and sufficiently high ambient temperatures appear to be important for flowers to develop and open.

Etymology: The specific epithet is derived from the Ancient Greek *pétros* meaning “rock” and *phíleo* meaning “to love” in reference to the rocky habitat where most records of the species have been made.

Affinities: On occasions, *Calandrinia petrophila* has been confused with *C. pickeringii* and *C. pleiopetala*, but the relationship between these species and *C. petrophila* is probably not particularly close. *Calandrinia pickeringii* is readily separated from *C. petrophila* by having cauline leaves on at least the lower stems, smaller sepals (2.5–3(–3.5) mm long), pink petals, smaller capsules (2.5–4 mm long) with a subacute to somewhat nipple-like apex and 3 non-persistent thinner-textured valves that separate from base upward, and larger seeds (0.6–0.8 mm long) with a papillate-punctate surface pattern. *Calandrinia pleiopetala* differs most noticeably from *C. petrophila* in having 8–10 larger pink petals, and numerous (>20) stamens.

Dried herbarium specimens of *Calandrinia petrophila* are superficially similar to an undescribed species from northern Australian estuaries known variously as *C. sp.* Berry Springs (M.O.Parker 855) or *C. sp.* Olive River (J.R.Clarkson 10012). However, that species differs from *C. petrophila* in a range of features including having alternate bracts, fruiting pedicels 4–23 mm long, non-persistent sepals, 6–7(–8) pale pink or rarely white petals to 3.5(–4) mm long, smaller (2–3.2 mm long) obtuse to subacute capsules that split into 5–7 non-persistent valves, and smaller paler brown seeds mostly 0.35 mm long and 0.25 mm wide, that are more evenly shiny and very faintly patterned. *Calandrinia pumila* also has a similar habit to *C. petrophila* and has opposite bracts, however *C. pumila* has spatulate to narrowly obovate leaves, smaller sepals (1.5–3 mm long), generally smaller (1.8–4 mm long) pink or rarely white petals, 3 stigmata, smaller (2–3.5 mm long) thinner-textured basally circumscissile broadly ovoid to globose fruits that lack strong surface patterning, and usually paler brown to red-brown seeds that are more evenly shiny and appear smooth though they are very weakly patterned.

Notes: *Calandrinia petrophila* was not included in the subgeneric classification of von Poellnitz (1934) nor in the morphological and molecular phylogenies presented by Tahir and Ashton (1989) and Hancock et al. (2018) respectively. Based on the brief morphological notes provided for each of the six clades within Australian *Calandrinia* recovered in the Hancock et al. (2018) study, the placement of *Calandrinia petrophila* is equivocal. The 4-valved capsules would suggest its membership of clade 6, which aligns with section *Basales* but species in that group have six or more petals and usually numerous stamens. Molecular sampling may help to resolve its placement.

Limited observations suggest that the capsule, subtending sepals and pedicel often fall as a unit, sometimes with seeds still within the capsule.

Acknowledgements

We thank staff of ANBG nursery for cultivating plants, Jeremy Bruhl for undertaking anatomical investigations to determine the nature of the tuberous underground organs and N. Prakash for providing confirmation of Jeremy’s findings, Tim Collins for assistance with field work and providing images, Murray Fagg and John FitzGerald for providing images, Kirsten Cowley for technical support, Donna Lewis for checking fruit measurements at DNA, Col Gibson and Tony Rodd for providing additional habitat information for their collections, Sally Mumford for preparing Fig. 1, Margarita Goumas for preparing the map, and the directors of NSW and BRI for loans and access to specimens.

References

- Carolin R (1987) A review of the family Portulacaceae. *Australian Journal of Botany* 35: 383–412. <https://doi.org/10.1071/BT9870383>
- Department of the Environment (2021) *Warkworth Sands Woodland of the Hunter Valley* in Community and Species Profile and Threats Database, Department of the Environment, Canberra. <http://www.environment.gov.au/sprat> (Accessed 1 July 2021)
- de Salas, MF, Baker ML (2019) *A census of the vascular plants of Tasmania, including Macquarie Island*. Tasmanian Herbarium, Tasmanian Museum and Art Gallery, Hobart <https://flora.tmag.tas.gov.au/resources/census/> (Accessed 30 June 2021)
- Flora SA (2021) *Census of South Australian Plants, Algae and Fungi*. State Herbarium of South Australia, Adelaide <http://www.flora.sa.gov.au/census.shtml> (Accessed 30 June 2021)

- Hancock LP, Obbens F, Moore AJ, Thiele K, de Vos JM, West J, Holtum JAM, Edwards EJ (2018) Phylogeny, evolution, and biogeographic history of *Calandrinia* (Montiaceae). *American Journal of Botany* 105: 1021–1034. <https://doi.org/10.1002/ajb2.1110>
- HersHKovitz MA (1998) *Parakeelya*: a new genus segregated from *Calandrinia* (Portulacaceae). *Phytologia* 84: 98–106. <https://www.biodiversitylibrary.org/item/47142#page/40/mode/1up>
- HersHKovitz MA (2020) *Rumicastrum* Ulbrich (Montiaceae): a beautiful name for the Australian calandrinias. *Phytologia* 102: 116–123. https://www.phytologia.org/uploads/2/3/4/2/23422706/102_3_116-123hersHKovitzrumicasterum9-9-20final.pdf
- iNaturalist (2020) <https://www.inaturalist.org/observations/41284658> (Accessed 14 June 2022)
- Northern Territory Herbarium (2015–) *FloraNT Northern Territory Flora Online*, Department of Land Resource Management, Darwin <http://eflora.nt.gov.au> (Accessed 30 June 2021)
- Nyffeler R, Eggli U (2010) Disintegrating Portulacaceae: A new familial classification of the suborder Portulacineae (Caryophyllales) based on molecular and morphological data. *Taxon* 59: 227–240. <https://doi.org/10.1002/tax.591021>
- Obbens FJ (2011) Five new species of *Calandrinia* (Portulacaceae) from Western Australia with additional information on morphological observations. *Nuytsia* 21: 1–23. <https://florabase.dpaw.wa.gov.au/science/nuytsia/592.pdf>
- PlantNET (2021) *The NSW Plant Information Network System*. Royal Botanic Gardens and Domain Trust, Sydney. <https://plantnet.rbg Syd.nsw.gov.au> (Accessed 30 June 2021)
- Tahir SS, Ashton PS (1989) A cladistic analysis of *Calandrinia* (Portulacaceae). *Pakistan Journal of Botany* 21: 158–169. [http://www.pakbs.org/pjbot/PDFs/21\(1\)/19.pdf](http://www.pakbs.org/pjbot/PDFs/21(1)/19.pdf)
- Thiele KR, Obbens F, Hancock L, Edwards E, West JG (2018) (2587) Proposal to conserve the name *Parakeelya* against *Rumicastrum* (Montiaceae). *Taxon* 67: 214–215. <https://doi.org/10.12705/671.25>
- Thomas MB, Brown GK (2020) Portulacaceae. In Brown GK & Bostock PD. 2020. *Census of the Queensland Flora 2020*. Queensland Department of Environment and Science, Queensland Government. www.data.qld.gov.au/dataset/census-of-the-queenslandflora-2020 (Accessed 30 June 2021)
- VicFlora (2016–) *Flora of Victoria*. Royal Botanic Gardens Victoria, <https://vicflora.rbg.vic.gov.au> (Accessed 30 June 2021)
- Von Poellnitz K (1934) Die *Calandrinia* — Arten Australiens. *Feddes Repertorium* 35: 161–173.
- Western Australian Herbarium (1998–). *Florabase—the Western Australian Flora*. Department of Biodiversity, Conservation and Attractions. <https://florabase.dpaw.wa.gov.au/> (Accessed 30 June 2021)

Received 6 July 2022, accepted 6 October 2022

