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***Calandrinia mirabilis* (Portulacaceae), a spectacular new species from Western Australia with notes on its ecology, seed germination and horticultural potential**

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Abstract

A striking new species, *Calandrinia mirabilis* Chinnock & J.G.West, is described and illustrated and placed in section *Basales* Poelln. It is a little known species from the western part of the Eremaean Province of Western Australia and restricted to the IBRA Gascoyne Bioregion. It is unique among Australian species of the genus possessing large multi-coloured flowers with red-violet petals that abruptly change in the lower third to an irregular white band, then an orange red band then yellow to the base. This species has considerable horticultural potential and notes on its ecology, phenology and seed germination are provided.

Keywords: new species, taxonomy, horticulture, *Calandrinia*, Portulacaceae, Western Australia.

Introduction

This paper describes a new species of *Calandrinia* from Western Australia: *C. mirabilis*. The taxon came to our attention when discovered by one of us (RJC) and recognised as a new species in 1990. Later, a collection made in 1973, held in the State Herbarium of South Australia, was recognised as the same species. Subsequently, several attempts to relocate populations failed until recently, partly due to a number of low rainfall years when ephemeral species would not be present.

The spectacular, large, multicoloured flowers of *C. mirabilis* readily distinguish it from other Australian species. It falls within section *Basales* Poelln. in having 4 stigmas and a 4-valved capsule, but its relationships to other species is not clear. Obbens (2011) compared it with *Calandrinia pentavalvis* Obbens and *C. strophiolata* (F.Muell.) Ewart, B.Rees & B.Wood in sharing a similar petal number ranging from 8–12, but otherwise appeared unrelated. *Calandrinia mirabilis*, like *C. schistorhiza* Morrison, has a basal rosette of flattened, appressed leaves, dilated distally, but the two are not considered closely related. The latter species belongs to sect. *Tuberosae* Poelln., has flowers with 5 petals and thin, wiry, flowering branches with a small, scale-like, papery bract subtending each flower.

The taxonomy and phylogeny of the genus are under investigation by the first author, and it is hoped this work will clarify the placement of *Calandrinia mirabilis*. In recent years, a number of new species have been described from Western Australia (e.g. Obbens 2006, 2011, 2012) and it was considered that the description of

this species was important so that knowledge of it could be disseminated, especially because of its horticultural merit and the current activity being undertaken on the species by various researchers.

Calandrinia mirabilis has great horticultural potential and has attracted a considerable amount of research. Regulation of flowering in *Calandrinia mirabilis* (as *Calandrinia* sp. Mt Clere) has been undertaken by Wahyuni et al. (2010), who looked at day length and growth regulators in the control of vegetative growth and flowering. A series of papers have also been published relating to vernalization and other factors with the aim of manipulating flowering, see Cave & Johnston (2010), Cave et al. (2011), Cave et al. (2013).

***Calandrinia mirabilis* Chinnock & J.G.West, sp. nov.**

Type: Western Australia, Ashburton Botanical District, North of Landor Homestead, 28.viii.2011, R.J.Chinnock 10289 (holo: AD249700; iso: AD249699, AD249701, CANB, MEL, PERTH).

Calandrinia sp. Mt Clere (R.J.Dadd 5). FloraBase, florabase.dpaw.wa.gov.au [accessed: 18.x.2012].

Diagnostic characters: Differs from all other species of Australian *Calandrinia* in having large red violet flowers with white, orange-red and yellow bands in the basal third, and 8–12 petals.

Annual plants, ranging from small flowering individuals 1–3 cm diam. to very large robust plants to 1.2 m diam., initially with a basal rosette (40–) 50–80 (–240) mm diam., of appressed or slightly ascending leaves, which may dry off as flowering branches develop, one or a number of flowering branches radiating from the



Fig. 1. Large population of *Calandrinia mirabilis*, extending to the horizon and growing in mixed *Acacia* shrubland north of Landor (Aug. 2011).

basal rosette, glabrous. *Leaves* alternate, oblanceolate-spathulate, tapering towards base, obtuse, mucronate, fleshy to succulent, basal leaves (20–) 40–90 (–120) mm long, (5–) 10–20 (–25) mm wide, 1.5–2.5 mm thick, margins entire, midrib prominent on undersurface, surfaces similar or lower one slightly paler green. *Inflorescence* a monochasium. *Flowering branches* with green leaf-like oblanceolate bracts 10–80 mm long near base, gradually reducing along branch and becoming linear-acuminate, those subtending pedicels scale-like, translucent, papery, buff-coloured; **smaller plants**: flowering branches spreading to erect consisting of 3–15 flowers; **large plants**: primary flowering branches prostrate to decumbent with secondary inflorescences developing in leafy axils along branch (Fig. 3 & 4), these ascending to erect, 5–7-flowered. *Pedicels* erect to spreading, 15–40 mm long, decreasing in length towards distal end of inflorescence; bracts opposite, lanceolate, acuminate, 4–4.5 mm long with a medial green herbaceous linear band and scarious margins, drying buff-coloured, papery. *Flowers* (20–) 40–70 mm diam., faintly scented, protandrous. *Sepals* ovate, acute, (5.5–) 7–10 (–12) mm long, (4–) 5–8 (–10) mm wide, green, fleshy and with a narrow membranous margin, outside

surface with small rounded papillae, persistent. *Petals* 8–11, oblanceolate-elliptic, broadly acute to obtuse, erose-dentate towards apex, apiculate, 25–35 mm long, 8–11 mm wide, distal 2/3–3/4 red-violet (between RHS 74A and 80A, drying purple-violet RHS 82A), abruptly changing to an irregular white band, then an orange-red band (RHS 45A) then proximally yellow (RHS 6B) to base. *Stamens* more than 50 in 4–5 whorls, extrorse, outer filaments with papillose bases. *Ovary* ovoid, 3–4 mm long; stigmata 4, very rarely 3, 3–5 mm long, free to base; ovules numerous, reniform. *Capsule* ovoid, 4–10 mm long, slightly 4-angled, 4-valved, very rarely 3, dehiscing by an apical pore, pale brown. *Seeds* reniform, 0.6–0.7 mm diam., red-brown, shiny, colliculate, cells laterally elongated. **Plate 1, Fig. 1–3, 5, 6.**

Distribution and Ecology. *Calandrinia mirabilis* extends from the Erong Station east to at least Mt Clere Station in the Pilbara region of Western Australia (Fig. 4). At all sites observed it occurs on red sandy soils on sand plain, but it has also been recorded on dunal rises on gibber plain (R.J.Dadd 5). It occurs in mulga (*Acacia aneura*) low woodlands or in mixed *Acacia* shrublands over mixed annual and perennial grassland where, in a good season, it is abundant and dominates the open



Fig. 2. Plants of *C. mirabilis* were common on road edges along the Landor–Mt Clere road between the Landor turnoff and Waldburg road (Aug. 2011).

areas among grasses. It grows with other species of *Calandrinia*, like *C. creethiae* Morrison and *C. papillata* Syeda, as well as *Eremophila* spp., especially *E. forrestii* F.Muell., *Senna* spp. and *Goodenia* spp. It has also been recorded growing with *Solanum lasiophyllum* Poir. and *Grevillea ?berryana* Ewart & Jean White near Erong.

Like many ephemeral species, the occurrence and size of populations of *Calandrinia mirabilis* are dependent on good rainfall events at the appropriate time of year. When the species was encountered in 1990 by one of us (RJC) it was a relatively dry year and only one small population was discovered on the Waldburg road a few kilometres north of the junction with the Landor–Mt Clere road. The largest plants in this population were about 30 cm diameter although most were 15 cm diameter or less. Flowering stems were all ascending with up to 15 flowers.

In 2009 the area was revisited by one of us (RJC) to search for the species, travelling from Mt Augustus south to Landor and then east along the Landor–Mt Clere road to the turnoff to Waldburg and then north via Waldburg back to Mt Augustus. The area was in drought and no plants of *C. mirabilis* were located. Other species of *Calandrinia* also known to be in the area, as well as

ephemeral genera like *Rhodanthe*, *Waitzia*, *Ptilotus*, *Sal-sola*, *Goodenia* or ephemeral grasses, were also absent.

During autumn–winter 2011, substantial rainfall was experienced throughout the area mentioned above and *Calandrinia mirabilis* was found to be abundant from about 20 km north of Landor Homestead (Fig. 1) south to the Mt Clere turnoff and then almost with a continuous extension east to the Waldburg turnoff. It extended north on the Waldburg road for about 5 km and abruptly vanished where the sandy loams are replaced by stony soils and gibbers. The species was later found on the Meekatharra–Landor road, south of the Dalgety Downs turnoff, and then westwards along the Dalgety Downs road to near the turnoff to Erong.

The species was so abundant that it could be seen at most sites extending to the horizon and it was also very common along the roadsides where some of the largest plants were observed, these obviously benefiting for the additional water run-off (Fig. 2 & 3).

Phenology and Flower development. From the known collections and field observations, the main flowering period probably extends from June to October. The large mature plants found in late August 2011 would certainly have been in flower during July, if not June.



Fig. 3. Large plant of *C. mirabilis*, c. 1 metre diameter, showing primary and secondary branching.

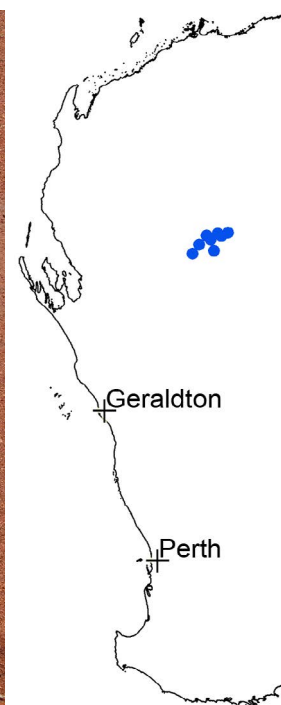


Fig. 4. Distribution map

The species is very uniform in the colour of the flower over its distribution range, although in one population a single individual was discovered with white petals but with the normal colour banding in the basal part of the petal (Fig. 6).

Floral development is protandrous like many of the medium to large flowered *Calandrinia* species. The flower opens late morning day 1. The first anthers have dehisced and at this stage the styles are short, c. 1 mm long, smooth, erect and appressed together. By day 3–4 all anthers have dehisced and usually by day 5 the styles have separated and stigmatic hairs are well developed and receptive. On day 6 the styles have fully elongated to 3–5 mm, lie horizontally, and are covered with long receptive hairs except on the basal half of the abaxial surface (Plate 1D₁–D₃). If pollinated day 5, the flower will close on day 6, but if not pollinated the flower continues to open until day 8.

Conservation status. *Calandrinia mirabilis* (as *Calandrinia* sp. *Mt Clere*) was listed in the Western Australian vascular plant census in 2009 (Western Australian Herbarium 1998–), and subsequently classified by Smith (2010) as Priority 1 under the Department of Environment and Conservation's conservation codes for Western Australian flora. At that time only two collections were held at the Western Australian Herbarium so a Priority 1 classification was appropriate.

Observations by one of us (RJC) on this species in 2011 and 2013, and additional collections subsequently made, suggested that a re-examination of its conservation code was necessary. The conservation status of this species has now been re-evaluated by the Department (M. Smith, pers.comm.) and it is currently listed as

Priority 4 (Rare, near threatened and other taxa in need of monitoring).

Rainfall variation, seed germination and population size. *Calandrinia mirabilis* has a restricted distribution in the IBRA Gascoyne Bioregion, extending just over 100 km from east to west and 40 km from north to south. Many ephemeral species like *C. mirabilis* are reliant on a good rainfall before populations will develop. In this particular case, in a dry year the species may be restricted to small populations resulting from localised rain events or absent during very dry years, as was the case in 2009. In 2011 however, following good autumn/winter rainfall, *C. mirabilis* was found to be super-abundant over large areas of its known range while in 2013, an obviously drier year than 2011, populations were more scattered and plants very small.

Like many of the larger flowered arid species of *Calandrinia*, including *C. polyandra* Benth., *C. remota* J.M.Black and *C. reticulata* Syeda, *C. mirabilis* is difficult to germinate from seed. A period of weathering is probably required under in situ conditions and seed may lie dormant in the sandy surface soil layer, tolerating temperatures of 60° C or more over many months for one or a number of years until a rainfall event triggers germination. Temperatures of 64°–67° C have been recorded in Adelaide on a 40° C day at the soil interface with a dark brown (gibber) surface. One can expect similar or higher surface temperatures in the areas *C. mirabilis* occurs during the summer period. One of us (RJC) has managed to maintain this species since 1990, but germination has only followed exposure to sunlight over one or more summers and only very few plants developed. In excess of a thousand seeds were sown of



Fig. 5. Primary branch of *C. mirabilis* with developing (especially in lower part) and fully developed secondary branches with 3–5 flowers.

both the purple and white-flowered forms (*R.J.Chinnock 10294–10295*) in February 2012, but, no germinations had occurred by August 2013, while in an adjacent pan, which had plants sown in years prior to 2012, 13 plants germinated in June/July 2013.

Etymology. The name is taken from the Latin word, *mirabilis*, marvellous, wonderful; referring to the spectacular multi-coloured flowers, a unique feature within the Australian species.

Other specimens examined.

WESTERN AUSTRALIA: 34.4 km S of Waldburg, 3.5 km N of junction with the Landor-Mt Clere road, 18 Sep. 1990, *R.J.Chinnock 8043* (AD, CANB, PERTH); 36 km E on the Landor-Mt Clere road from Landor, 28 Aug. 2011, *R.J.Chinnock 10293* (AD, PERTH); 3.4 km N of turnoff on Landor-Mt Clere road towards Waldburg, 28 Aug. 2011, *R.J.Chinnock 10294* (AD, PERTH); 3.4 km N of turnoff on Landor-Mt Clere road towards Waldburg, 28 Aug. 2011, *R.J.Chinnock 10295* (AD); 26.2 km S of the turnoff to Dalgety Downs on the Meekatharra-Landor road, 13 Sep. 2011, *R.J.Chinnock 10319* (AD, PERTH); 16.7 km W of the turnoff on the Meekatharra-Landor road on the Dalgety Downs road, 13 Sep. 2011, *R.J.Chinnock 10320* (AD, PERTH); 10 km E on the Landor-Mt Clere road from Landor, 18.ix.2013, *R.J.Chinnock 10377* (AD, PERTH); 6 km along Landor-Mt Clere road from Waldburg turnoff towards Landor, 27 July 2006, *R.J.Dadd 5* (PERTH); 21.4 km N along Erong road from turnoff into Erong Springs Station and is also in the vicinity of Macadam Plains, 20 Aug. 2008, *F.Obbens FO22/08* (PERTH); Mountain Well, Mt Clere Station, 29 Sep. 1973, *T.L.Setter 394* (AD).

CULTIVATED: Material based on *R.J.Chinnock 8043* collection: *R.J.Chinnock 9161*, 25 Nov. 1996 (AD); *R.J.Chinnock 9171*, 7 Jan. 1997 (AD).



Fig. 6. *C. mirabilis*, normal flower colour (*R.J.Chinnock 10294*) and the extremely rare white form (*R.J.Chinnock 10295*).

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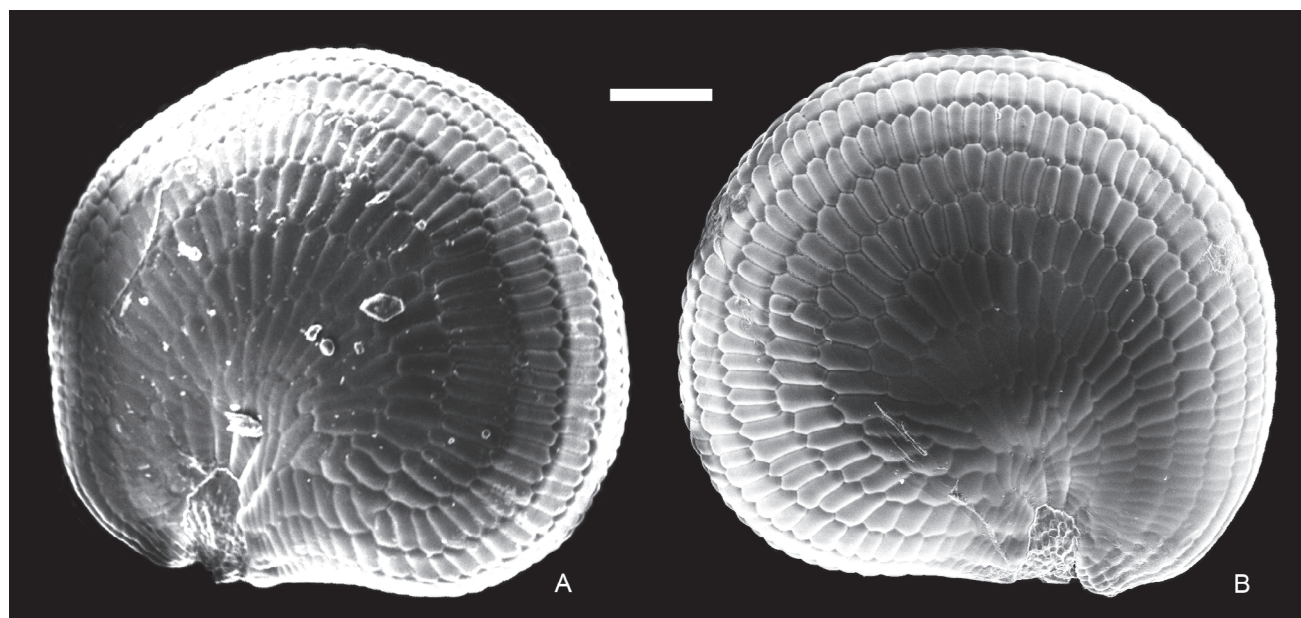


Fig. 6. Photomicrographs of seed from two populations of *Calandrinia mirabilis*. Scalebar: 100 μ m. — A R.J.Chinnock 10289; B R.J.Chinnock 10295. (Images taken with a Neoscope JCM 5000 SEM).

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Plate 1. *Calandrinia mirabilis*. Captions for colour plate (opposite page).

A plant habit; B flower: B₁ top view; B₂ side view; B₃ cross-section through flower; C petals showing variation in banding; D gynoecium: D₁–D₂ stigmas at anthesis stage appressed together and developing but non-receptive; D₃ mature receptive stigmas; E stamens; F mature capsule, side view; G capsule from above showing poral dehiscence; H side view of seed. — Illustration by Gilbert R.M. Dashorst, based on cultivated material derived from R.J.Chinnock 8043.

