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## ***Calostemma abdicatum* (Amaryllidaceae), a new species of Garland Lily endemic to the Everard Ranges, and a comparison of the three species within *Calostemma* R.Br.**

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### **Abstract**

A new rare arid zone species, *Calostemma abdicatum*, is described from central Australia. It has hitherto been treated as a north-western outlier of either of its two congeners, *C. purpureum* and *C. luteum*. Morphological measurements support the retention of these as separate species and demonstrate the distinctiveness of the new species. Despite the absence of a staminal corona, *C. abdicatum* is placed in *Calostemma* and the description of the genus is amended. Notes on habitat, ecology and conservation status are included.

### **Introduction**

*Calostemma* R.Br. is a genus of bulbous, seasonally nacreous and renascent, perennial geophytes, endemic in southern and eastern Australia. The genus was established by Robert Brown (1810) based on his Australian collections and comprised two species: *Calostemma album* R.Br. from Australia's north coast, and *C. purpureum* R.Br. from the south coast. The former species is now regarded as belonging in the allied genus *Proiphys* Herb., distributed from Southeast Asia to north-eastern Australia.

A similar plant with yellow flowers was described by Sims (1819) from cultivated material as a third species, *Calostemma luteum* Sims. Bentham (1873) in his *Flora Australiensis* treatment recognised all three species but suggested that *C. luteum* might only be a variety of *C. purpureum* and also noted the affinity of *Calostemma album* with the tropical genus *Euryclies* Salisb. ex Schult. & Schult.f., describing it as “a remarkable species with flowers of *Calostemma* and the [petiolate] leaves of *Euryclies*” (Bentham 1873, p. 458). Eventually Mueller (1889) transferred the latter species to *Euryclies*. More recently it was published as the new combination *Proiphys alba* (R.Br.) Mabb. by Mabberley (1980), based on priority of the generic name *Proiphys* over *Euryclies*.

*Calostemma* has mostly been recognised as comprising the two species, *C. purpureum* R.Br. and *C. luteum* Sims, although some botanists have regarded the latter as taxonomically indistinct and treated it as a synonym of the former (e.g., Cunningham et al. 1992). Intermediate forms with a variety of colour combinations are well known (Clark & Parsons 1994, Gibson 2002), especially in populations along the River Murray. Telford (1987, p. 383) accepted both species, but noted

that “variation in the genus requires investigation” and that *C. luteum* was “possibly only a colour variant of *C. purpureum*, though mostly larger in its parts”.

One area where assigning material to either species seemed particularly unworkable was the Everard Ranges in northern South Australia, an outlying occurrence at the western limit for the genus. The two herbarium collections from this area, the first made in 1950 (J.B. Cleland s.n., AD968051052), the second in 1983 (R. Bates 2920), had been variously determined. Jessop (1978, p. 363) referred to a specimen from the Everard Ranges that shared characters of both species and noted that it “would be a unique collection for *C. purpureum* which is not otherwise known from within 600 km of this locality.” For the *Flora of Central Australia*, Jessop (1981) recorded *C. purpureum* as uncertain for the Northwestern Region presumably based on the single collection by Cleland. In the *Flora of South Australia*, Jessop (1986, p. 1778) was more equivocal, omitting the Northwestern Region listing altogether and noting under *C. purpureum* that “two specimens from the NW resemble this species in colour, but in size and shape of the flower resemble *C. luteum*”. Subsequently, in the South Australian plant census Jessop (1993) gave a definite NW listing for *C. purpureum*. In 2000, both collections at AD were redetermined by H. Vonow as *C. luteum*, and this has been the view projected by Australia's Virtual Herbarium (CHAH 2004).

The Everard Ranges *Calostemma* was collected in May 2000 during the Biological Survey of the Anangu Pitjantjatjara Yankunytjatjara (APY) Lands and its significance as a probable new and distinct taxon was described in the survey report (Lang et al. 2003, pp. 82–83, 442). This paper presents the results of further investigation of the Everard Range plants and their relationship to existing species.



Fig. 1. Comparison of inflorescence of *Calostemma abdicatum* (left; P.J.Lang BSOP-762) and *C. purpureum* (right; P.J.Lang BSOP-755). Note erect bilobed spathe bract on *C. abdicatum*.

## Methods

A field trip to the Everard Ranges was undertaken in March 2004 to augment the small sample provided by existing herbarium specimens and to make field observations of populations. Additional material of the new species was obtained from plants cultivated ex situ from wild-collected bulbs.

Comparative measurements of morphological characters were made using a ruler, callipers and a binocular microscope graticule and included both fresh and dried pressed material for each of the three *Calostemma* species. All herbarium material examined is deposited at AD. Measurements were made for all collections cited in the taxonomic section but the characters that could be scored (and the resultant sample size) varied according to which organs were present in a suitable condition. Being soft and succulent, *Calostemma* specimens press poorly and they also fragment readily when dry, and as a result much material was unsuitable. Measurements for each collection were averaged and used to generate scatterplots for character pairs of interest using Microsoft Excel.

## Taxonomy

### *Calostemma* R.Br.

Prodr. 297 (1810). — **Type:** *Calostemma purpureum* R.Br. was designated as the type species of *Calostemma* in the Flora of Australia treatment by Telford (1987). The type material is constrained by Brown's citation of a

single collection for *C. purpureum* in the protologue – a reference to his 1802 gathering of a purple-flowered lily originally labelled as *Pancratium purpureum* from near Mount Brown in the southern Flinders Ranges, South Australia (Barker 2007)<sup>1</sup>.

The generic description of Telford (1987) is amended as follows (additional characters emphasised in bold):

Perennial herbs with subglobose tunicated bulbs. Leaves radical, linear, annual, elongating after flowering; venation parallel. Flowers bisexual, actinomorphic, pedicellate, usually **purple**, pink, yellow, rarely white, fragrant, in scapose umbels; spathes **1 to 3**, narrowly ovate. Perianth funnel-shaped; segments connate at base; lobes 6, obovate, mucronate, slightly spreading. Stamens 6, inserted into throat of perianth tube, the lower parts of filaments expanded and united into a corona, **or free**; corona, **when present**, truncate or lobed between the free parts of filaments; anthers versatile, dehiscing longitudinally, introrse. Ovary inferior, globose, 1-locular; placentation parietal; ovules 2; style 1; stigma small. Fruit subglobose, 1-'seeded', rupturing irregularly as 'seed' enlarges. 'Seeds' large, globose to ovoid, **firm, succulent**, smooth, green, **non-dormant**.

<sup>1</sup> Until Telford's designation as "Type" in 1987, no lectotype species had been chosen from Brown's two syntype species (*International Code of Biological Nomenclature*, Art. 7.11). Telford's choice of *Calostemma purpureum* over *C. album* (now *Proiphys alba*) is in accordance with the *Code's* Recommendation 9A.5 and preserves current usage of the genus *Calostemma*.



Fig. 2. *Calostemma abdicatum*. Bulbs. J.Bice, N.Dodd & A.Robin s.n., 9.iv.2003.



Fig. 3. *C. abdicatum*. Fruit (the uppermost partially peeled away to reveal the pseudoseed). P.J.Lang & P.D.Canty BSOP-904.

#### Key to species

1. Staminal corona absent; spathe bract usually solitary .... 1. ***Calostemma abdicatum***
- 1: Staminal corona present; spathe bracts two or more ... 2
2. Perianth 18–31 mm long, with yellow coloration; spathe bracts two ..... 2. ***C. luteum***
- 2: Perianth 11–19 mm long, without yellow coloration; spathe bracts three ..... 3. ***C. purpureum***

#### 1. *Calostemma abdicatum* P.J.Lang, sp. nov.

*Ab Calostemmate purpureo R.Br. et Calostemmate luteo Sims differt imprimis absentia coronae stamineae, umbella secunda e 7–17 (–25) floribus pendulis constata, bractea involucrali spathiformi plerumque sola erecta persistenti et bases pedicellorum vaginanti, perianthii tubo grandiore et ad oroficium 3–9 mm lato dilatato, filamentisque liberis, 4–10 mm longis, ad apicem perianthii tubi exorientibus.*

**Typus:** P.J. Lang & P.D. Canty BSOP-908, 18 Mar. 2004, SE footslope of Mt Illbillie, Everard Ranges, South Australia (holo.: AD200209; iso.: CANB, MEL, K).

*Calostemma* sp. Everard Ranges (P.J.Lang BS23-30021)  
P.J.Lang in Barker et al. (2005).

*Calostemma purpureum* auct. non R. Br.: Telford (1987)  
partly, as to Everard Ra. occurrence; J.P.Jessop (1981)  
partly, doubtfully, (as "NW?"); J.P.Jessop (1983) partly.



Fig. 4. *C. abdicatum*. Vegetative plants showing remains of sheathing leaf bases between the bulb and bases of laminae which emerge at the ground surface. J.Bice et al. s.n., 9.iv.2003.

Herbaceous perennial geophyte renascent from a spheroidal bulb. *Leaves* several per bulb, produced after flowers, seasonally senescent, withering to ground level, radical with sheathing bases, non-petiolate, erect, linear, 0.3–0.7 m long and 7–18 mm wide, flat to gently channelled, fleshy, slightly glaucous and mid-green (137 C<sup>2</sup>) to strongly glaucous and pale grey-green (138 C) sometimes with a purplish tinge, often reddish near base. *Inflorescence* a scapose 7–17 (–25)-flowered, one-sided umbel; *scape* 1–2 (–3) produced successively from each bulb, erect, subterete and weakly (2–) 3-angled to compressed, 3–10 mm wide, succulent, turgid, 0.14–0.75 m tall in flower, elongating up to 1 m and becoming procumbent in mature fruit; *spathe (involucral bracts* 1 (–2), narrowly triangular to lanceolate and boat-shaped to cucullate, 20–80 mm long, often acutely 2 (–3) lobed distally for 5–60% of its length, membranous, pink to almost white, completely or partially sheathing the base of pedicels and buds during flowering, persistent, erect and usually remaining so after flowering, aging to brown and scarious. *Flowers* pendulous, with a faint sweet carnation-like fragrance on opening; *pedicels* 15–50 mm

<sup>2</sup> Royal Horticultural Society (2001) colour code.

long, initially flexuose and drooping, as flowers wither becoming patent to erect. *Perianth* funnel-shaped, (14–) 18–30 (–35) mm long, *tube* narrowly obconical, 9–17 (–22) mm long, 1.5–4 mm diameter at base expanding to 3–9 mm diameter at insertion of lobes, white to pale pink (62 D); *lobes* attached to broadened filament bases only by their margins towards the mouth of the tube and producing a narrow pocket 2–3 mm deep behind them, remaining imbricate, elliptic to obovate, 8–14 mm long and 3.5–9.5 mm wide, purplish-red to deep pink (59 B/C/D), grading to pink (63 B/C) externally at their centres and bases, the apices white-tipped with a dense patch of minute papillae. *Corona* absent. *Stamens* fused basally with inside of perianth tube, becoming free at insertion of tepal lobes; *filaments* terete, slightly tapered, 4–10 mm long in their free part, their basal part broadened by a wing or flange of tissue fused with the perianth tube; *anthers* subdorsifixed, versatile, 2.2–4 mm long, 0.8–2 mm wide; golden-yellow; *pollen* ellipsoidal. *Ovary* 1.5–5 mm diameter, with 2 ovules attached laterally near the base; *style* filiform 16–30 mm long, white, usually protruding 1–5 mm beyond corolla lobes, *stigma* inconspicuous, truncate. *Capsule* abscissing when mature, spheroidal to obloidal, 8.5–19 mm diam., membranous, enclosing 1 (–2) ‘seeds’, usually buoyant; ‘seeds’ extruding 1–2 cotyledons within 2–3 weeks of abscission. Fig. 2–8.

**Discovery.** After being collected in full flower from Everard Park [= Mimili] by J.B. Cleland in April 1950, the Everard Range *Calostemma* remained unrecognised as a new taxon for the next fifty years. In part this was probably because its most significant feature, the absence of a corona, was obscured in pressed herbarium specimens. A second factor appears to be the lack of subsequent field observations during the main flowering period which comes at the end of the hot summer season, a time generally not favoured for field work in Central Australia.

During the Field Naturalists Society expedition to the Everard Ranges in August–September 1968 *Calostemma* had been observed in abundance around the southern slopes of Mt Illbillie in a vegetative phase. A plant dug up on this trip and brought back to Adelaide survived in cultivation for many years but its identity was unresolved as it never flowered (D.N. Krahenbuehl, pers. comm., 2003). The second herbarium collection of the species, by R. Bates in May 1983, was made well past the main flowering period and had only a single inflorescence in a withered state. The third collection, made by the author in May 2000, sampled a similar phase: all the plants had fully-grown leaves and only a single clump of flowering stems was found. However, from casual observation of the fresh flowers the lack of a staminal corona was obvious (Fig. 8). Initially it was thought that

Table 1: Comparison of *Calostemma* species.

	<i>C. abdicatum</i>	<i>C. luteum</i>	<i>C. purpureum</i>
<b>leaves</b>	wide (7–18 mm) mid green to purplish grey, weakly to strongly glaucous	narrow (4–9 mm) bright/dark green, non-glaucous, often shiny	wide (10–19 mm) mid green, non-glaucous
<b>spathe bracts</b>	1 (–2) often bilobed, sometimes tri-lobed tending to remain erect and sheathing at base	2 usually one is bilobed divergent	3 usually entire readily divergent
<b>perianth</b>	(14–) 18–30 (–35) mm long bicoloured, predominantly purplish-red or deep pink, with tube white to pale pink	18–31 mm long predominantly golden to greenish yellow, sometimes suffused pink at base	11–19 mm long predominantly purplish-red, pink or white
<b>tube</b>	obconical, expanding 3–9 mm diam. at apex (mean: 5.5 mm) 8–17 (–22) mm long remaining entire	almost cylindrical to 1–3 mm diam. at apex (mean: 1.8 mm) 7–12 (–14) mm long readily splitting	almost cylindrical 1–3 mm diam. at apex (mean 1.9 mm) 4–9 mm long splitting with age
<b>lobes</b>	remaining imbricate during flowering	divergent during flowering	weakly imbricate at first, diverging as flowers wither
<b>filaments</b>	4–10 mm long	2–5 mm long	1–3 mm long
<b>corona</b>	absent	thin, often dilated distally 7–13 mm long, 4–8 mm wide often has pink or red blotches at base	fleshy, tubular 3–6.5 mm long, 1.5–4 mm wide no blotches at base
<b>scent</b>	faint, sweet and spicy, ‘carnation-like’	reported as spicy	strong, sharp, ‘fejioa-like’
<b>habitat</b>	creeks and gullies of granitic hills	riverine and floodplain areas	hilly terrain with grassland or woodland



Fig. 5. *Calostemma abdicatum*. Inflorescence. P.J.Lang BSOP-762.

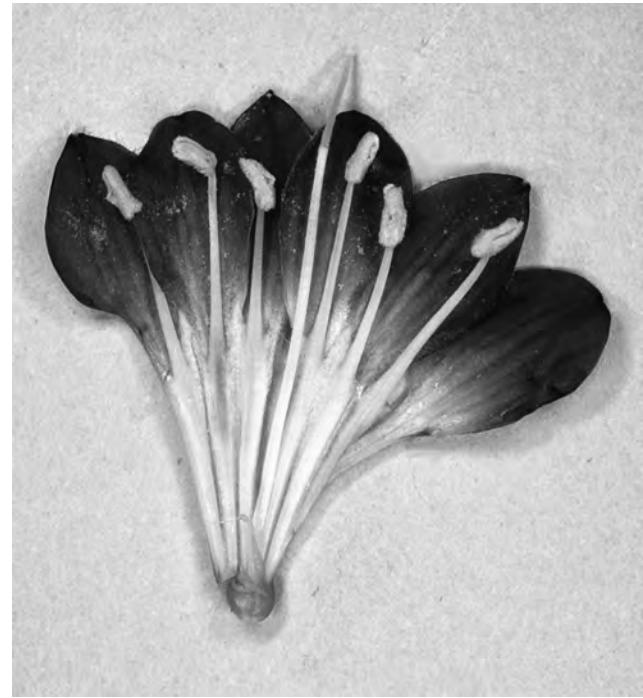


Fig. 6. *C. abdicatum*. Dissected flower. P.J.Lang BSOP-762.



Fig. 7. *C. abdicatum*. Inflorescence with protruding styles prominent. P.J.Lang BSOP-762.



Fig. 8. *C. abdicatum*. Front view of flower. P.J.Lang BS23-30021.

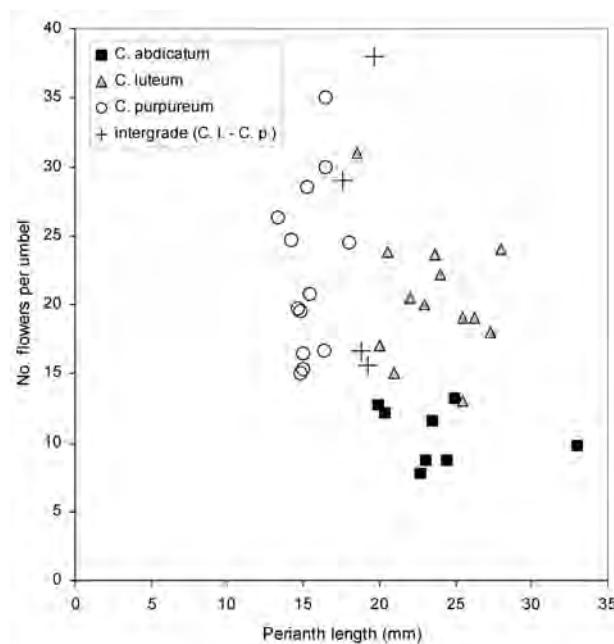


Fig. 9. Scatterplot of flower number per umbel vs. perianth length, based on averaged measurements for each collection. Flower number counts incorporated very small buds through to pedicels from which fruits had been shed.

this condition might be an aberration, perhaps related to development outside the normal flowering period, but this was discounted after dissection of flowers from both previous herbarium collections revealed the same structure. The lack of a corona proved to be consistent in the hundreds of flowering plants examined in the field across the two known populations.

**Distinguishing features.** *Calostemma abdicatum* shares with *C. purpureum* predominantly purplish-red to pink coloured flowers, elliptic-obovate perianth lobes that remain overlapping in flower, and a hillside or riparian rather than flood-plain habitat. It is similar to the mainly yellow-flowered *C. luteum* in its larger flowers and inflorescence, but not flower shape and structure, as *C. luteum* has almost spathulate perianth lobes that diverge and become widely separated at maturity. It also lacks the narrower, more intense green and often shiny leaves that characterise that species. Like *C. luteum* the major spathe bracts are reduced in number through fusion (from the three present in *C. purpureum*), but the degree of reduction is greater and usually results in a single bilobed or trilobed bract rather than two as in *C. luteum*.

*Calostemma abdicatum* is most clearly differentiated from both species by the absence of a corona, with stamens exserted freely from the base of the tepal lobes. It is also distinguished by its variably glaucous leaves, more pendulous funnel-shaped flowers, the strongly obconical perianth tube, the protruding style, the one-sided inflorescence with few flowers, and the way the major involucral bract continues to sheath the emerging flowers, usually remaining erect and coherent during flowering. The flowers on opening emit a very delicate,

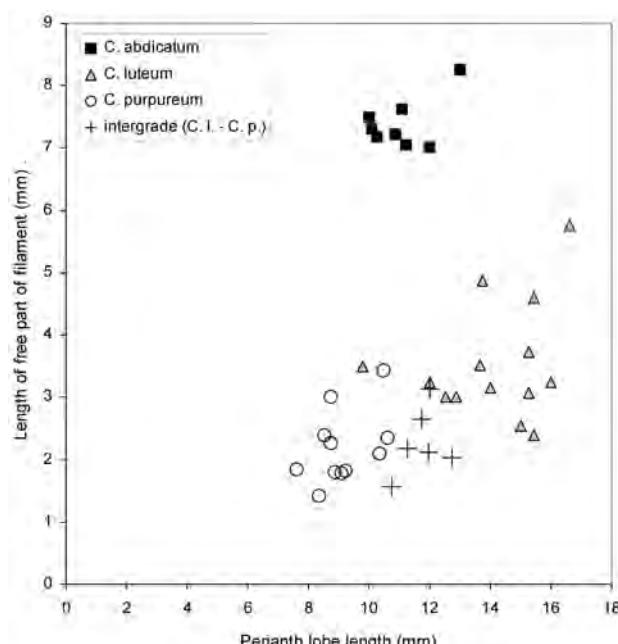


Fig. 10. Scatterplot of length of filament vs. perianth lobe, based on averaged measurements for each collection.

sweet, spicy, carnation-like fragrance quite different from the stronger, sharper, less-pleasant, fejioa-like scent of *C. purpureum* in the Mt Lofty Ranges.

The scatterplots (Figs. 9 to 12) show a higher level of differentiation of *C. abdicatum* than between the other two species. The new species conforms with *C. luteum* in flower size as measured by overall perianth length, but has fewer flowers per umbel (Fig. 9). The different flower shape and structure in *C. abdicatum* is evident from its perianth lobes being intermediate in length between *C. purpureum* and *C. luteum* and its much longer staminal filaments (Fig. 10). It also has a longer and more open perianth tube (Fig. 11) and larger anthers (Fig. 12) than both its congeners. Diagnostic characters for the three species are collated in Table 1.

**Taxonomic relationships.** *Calostemma* and its sister group *Proiphys* constitute the Australasian tribe *Calostemmateae* (Meerow et al. 1999) which has emerged as a well-defined clade based on plastid DNA sequences, nuclear rDNA sequences and morphological data (Meerow et al. 2000). The genera are united by two important synapomorphies: the unique pseudoseed bulbul formed by a precociously germinated embryo and the staminal corona which is present in the two existing species of *Calostemma* and all four species of *Proiphys*.

*Calostemma abdicatum* stands apart from its congeners as a distinct, morphologically consistent and geographically disjunct taxon. Although it could be argued that absence of the corona is a sufficient ground to erect a separate genus, the new species has been placed in *Calostemma*, rather than in the allied genus *Proiphys* or a new genus, because of the overall general similarity to the two existing *Calostemma* species. There is no

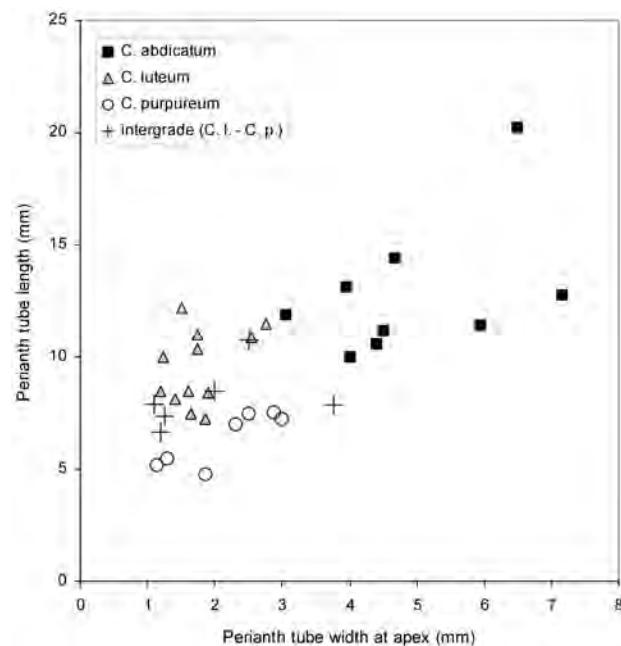


Fig. 11. Scatterplot of perianth tube length vs. width, based on averaged measurements for each collection.

sign of features that are diagnostic of *Proiphys* (petiolate leaves, consistently white flowers, strongly lobed corona). The new species retains the broadened filament bases fused with the corolla tube and apart from the lack of a projecting staminal corona it closely matches *Calostemma* in all aspects. The absence of a staminal corona in *C. abdicatum* is taken to be an autapomorphy, representing a derived rather than primitive condition.

Within the Amaryllidaceae, Meerow (1995) notes that modification of the staminal filaments, especially by basal fusion, is widespread and possibly homoplasious, and he suggests that floral morphology has been rapidly and readily modified by pollinator selection pressure. Within the Calostemmateae there is much plasticity in the structure of the corona. The four species of *Proiphys* have very diverse coronas. In *Calostemma*, the corona of *C. luteum* is a more highly developed and modified structure, while in *C. purpureum* it is less differentiated from its constituent stamens and there is variation in the degree of lobing of the flattened filament bases and their extent of fusion with each other. It is easy to envisage a breakdown and loss of this structure under natural selection for a different pollination strategy, particularly within a small isolated refugial population. The combination of a more open and accessible flower (the result of a larger and more expanded perianth tube as well as the lack of corona), usually protruding style, more pendulous flower and distinctive fragrance suggests that the new species has evolved in association with a different type of pollinator, and that larger insects, possibly moths, may be involved.

**Distribution.** *Calostemma abdicatum* appears to be endemic to the Everard Ranges and is currently known from only two major populations: the larger in the

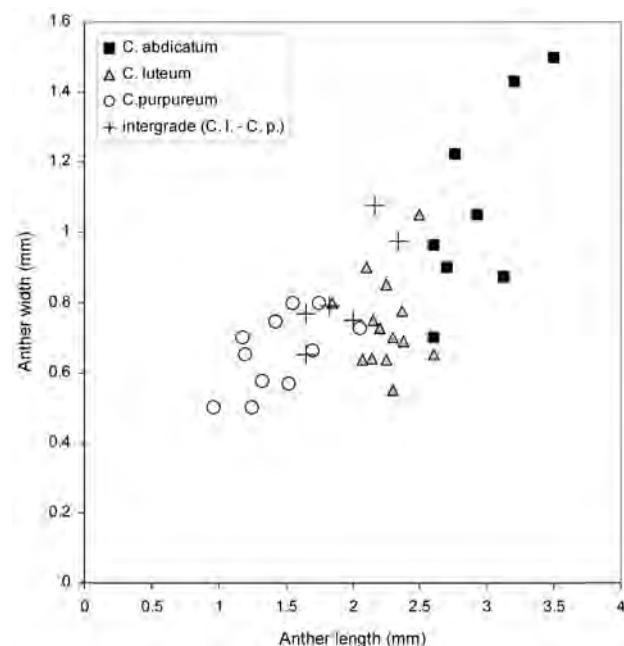


Fig. 12. Scatterplot of anther width vs. length, based on averaged measurements for each collection.

Victory Well-Mt Illbiliee area on the south side of the main range, the other on the north-eastern outskirts of Mimili in foothills south of Artoonanna Hill (Fig. 13). These are separated by a distance of 21 km. Within the main population the occurrences are very patchy and discontinuous over a distance of 2.5 km. Areas of potential habitat with similar topography and aspect occur further south in the Everard Range complex, but could not be investigated for aboriginal cultural reasons.

Significantly, *C. abdicatum* has not been recorded from Sentinel Hill or Mt Lindsay, two large outlying inselbergs that share a similar geology and some specialised plant species with the Everard Ranges. It is unlikely that *Calostemma* would have been overlooked in these areas which were the focus of separate Biological survey trips (Robinson et al. 2003).

**Ecology.** *Calostemma abdicatum* grows in deep alluvial soils of creek beds, in rocky gullies and on steep south-facing slopes of hills and gorges where pockets of soil accumulate. The habitat is characterised by substantial shade, water accumulation, and well-drained fertile soil. These are critical features in an arid environment and ultimately derive from properties of the porphyritic granite which forms the Everard Ranges (Krieg 1973). This rock type erodes to produce large domes with steep slopes and deep gorges that provide protection and shade; the extensive bare exfoliating surfaces shed large volumes of run-off water and so concentrate available moisture and sustain a shady overstorey, and the granites weather to produce a coarse gritty substrate with nutrient-rich clays.

The plant formation varies from *Eucalyptus camaldulensis* Dehnh. (River Red Gum) or *Eucalyptus*

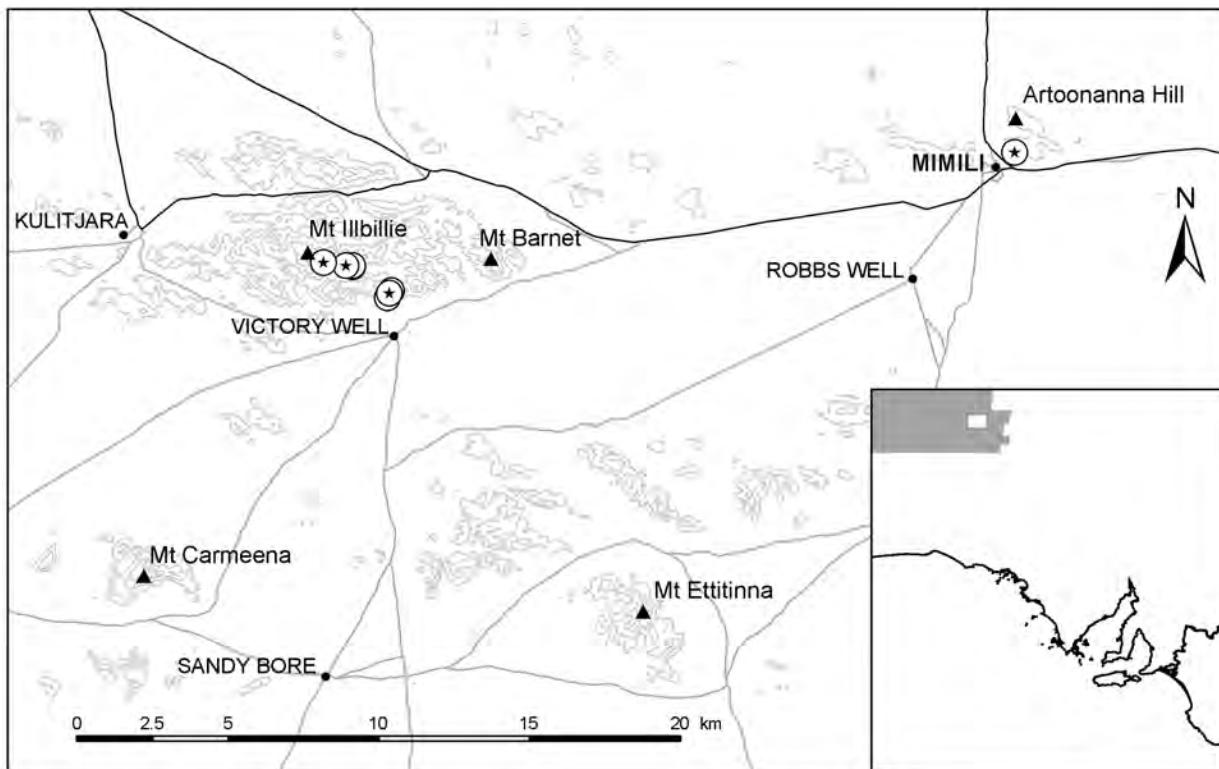


Fig. 11. Known distribution of *Calostemma abdicatum* (★). Contour lines indicate areas of exposed rock that form the Everard Ranges. Inset of South Australia shows the map area extent (white) within the APY Lands (shaded).

*intertexta* R.T.Baker Open Woodland along creek beds, to *Acacia olgana* Maconochie (Mt Olga Wattle) or *A. symonii* Whibley (Symon's Wattle) Tall Open Shrubland in the more rocky sites. In favorable sites *Calostemma abdicatum* forms a dense mono-specific carpet. Soil sampled at two sites was a sandy loam notable for its acidity (pH 5.5 and 6).

Like its congeners, *C. abdicatum* has round, mostly buoyant fruits (c. 70% floated in water) that can disperse by rolling down slope or being transported on water.

**Phenology.** The new species has been collected in full flower in March and April, and twice found in leaf with rare flowers in May. Cultivated plants in Adelaide have flowered in three successive years, twice from mid March to mid April, and once, following early rains, from mid January to mid February.

**Aboriginal usage.** Anangu from Everard and Musgrave Ranges communities familiar with the *Calostemma* referred to it as 'apita' and distinguished it from *Typha domingensis* Pers. which they called 'tjuna'. Goddard (1992) recorded the Pitjantjatjara name 'apita' as being applied to *Calostemma*, but also as a more generic term for reeds and similar plants near water. Conran (1994) stated that the bulbs of *C. purpureum* were an important food source for Koories in Victoria. However, there are no records of Anangu usage for the Everard Range *Calostemma*, and local Anangu considered the plants to be poisonous.

**Conservation status.** This species is assessed as Rare (RA) based on extent of occurrence and area of

occupancy using the South Australian criteria adapted from IUCN categories by the National Parks and Wildlife Council (2003). There is no indication that populations have suffered significant decline in historical times and no threats are apparent.

**Etymology.** The epithet is derived from the Latin *abdicō* to disown, renounce or resign, and alludes to the absence of the corona or 'crown'. This is in apposition to the generic name *Calostemma*, from the Greek *calos* beautiful and *stemma* garland or crown, which refers to the conspicuous golden staminal corona of the type species.

#### Specimens examined (all deposited at AD)

SOUTH AUSTRALIA: North-Western: J.B. Cleland s.n., 12 Apr. 1950, Everard Park [=Mimili]; R.J.Bates 2920, 17 May 1983, c. 30 km W of Mimili; P.J.Lang BS23-30021, 23 May 2000, valley above Victory Well, Everard Ranges, Anangu Pitjantjatjara Lands; J.Bice, N.Dodd & A.Robin s.n., 9 Apr. 2003, loc. ibid; P.J.Lang BSOP-762, 10 Mar. 2004, and P.J.Lang BSOP-762, 4 Feb. 2005, [both cultivated from bulbs of previous collection]; P.J.Lang & P.D.Canty BSOP-904, 17 Mar. 2004, gully in foothills NE of Mimili football oval; P.J.Lang & P.D.Canty BSOP-905, [...] -906, -907, -908], 18 Mar. 2004, Victory Well Creek, main rockhole [...] [to] lower SE slopes of Mt Illbillie].

#### 2. *Calostemma luteum* Sims

In the protologue Sims (1819) commented "however readily this plant and the preceding [*C. purpureum*] are distinguished by the colour of the flowers, it is not easy to find specific distinguishing characters". Nevertheless, he proceeded to detail differences in size, shape and structure of floral features, with the caveat that "we have

not examined a sufficient number of flowers to be certain that this distinction will always hold good". Compared to *C. purpureum*, Sims noted that *C. luteum* had a larger and "less connivent" corolla (i.e. more divergent lobes) through which the darker patches on the corona could be seen, and its corona had a more entire margin with the stamen filaments arising from sinuses in its outline rather than the apices of recognisable staminal lobes.

Examination of a range of pressed and fresh material for this study indicated that these distinctive morphological features are maintained where the population comprises only yellow-flowered plants. The typical yellow form of *C. luteum* has pink to red blotches at the base of the corona, and sometimes some diffuse pink coloration at the base of the perianth lobes, but pink or purplish-red areas elsewhere on the perianth indicates intergradation with *C. purpureum* and is associated with a breakdown in the size and shape differences. Clark & Parsons (1994) explain the distribution of colour forms and intergrades along the Murray River by suggesting that *C. purpureum*-dominated forms enter the Murray largely by the Murrumbidgee River and *C. luteum* by the Darling River. Typical forms of *C. luteum* are widespread in the drainage systems of the Darling River and Lake Eyre Basin in Southern Queensland, western New South Wales and northeastern South Australia. *C. luteum* is maintained here as a separate species because of the general consistency in a suite of characters that correlate with its flood plain habitat, a pattern that predominates over the instances of intergradation with *C. purpureum*.

A solitary record of *C. luteum* in the Northern Territory, *J.M. Stuart s.n.* 1861 (MEL), reported in the Australian Virtual Herbarium (CHAH 2004), indicated a disjunct population from Mt Margaret, NE of Harts Range. Photographs of this collection were obtained to see whether it might be a misidentification of *C. abdicatum* which seemed to better fit the distribution and likely habitat. Its identity as *C. luteum* was confirmed but the location was corrected to Mt Margaret in the Lake Eyre basin of South Australia based on details of John McDouall Stuart's expedition in Hardman (1865, pp. 98-99, 477-78, 506, & map inside back cover).

#### **Selection of specimens examined and measured:**

SOUTH AUSTRALIA: **Lake Eyre:** *C.O'Malley* 284, 6 Feb. 1987, Cuttapisirie Corner Waterhole; *L.D.Williams* 7691, 18 Feb. 1976, Cordillo Downs, near HS airstrip; *D.E.Symon* 6102, leg. 18 Aug. 1968, cultivated 19 Mar. 1969 & 10 Mar. 1970, ex 22 mi N of Moolawatana Stn, cult. WARI, [Urrbrae]. **Flinders Ranges:** *D.E.Symon* 6083, 24 Aug. 1968 & cult. 28 Mar. 1969, lower hill slopes below Paralana Springs & cult. WARI, [Urrbrae]. **Murray:** *R.Bates* 31688, 15 Mar. 1993, Katarapko; *P.J.Lang* 2435, 16 Feb. 1994, Katarapko section, Murray River National Park, Camp 36, W side Katarapko Ck; *D.N.Krahenbuehl* 1141, 25 Apr. 1964, Blanchetown; *H.J.Eichler* 12358, 11 Apr. 1956, River Murray S of Berri.

NEW SOUTH WALES: *S.Dixon* s.n., Apr. 1885, Darling [River]; *D.E.Murfei* 4598, 8 Feb. 2004, 11 km W Weilmoringle; *D.E.Murfei*, 4605, 8 Feb. 2004, 6 km E Weilmoringle; *D.E.Murfei* 4651, 4 Apr. 2004, 5 km N Mt Oxley, 30 km E of Bourke; *D.E.Murfei* 4644, 25 Mar. 2004, 10 km SW Louth towards Tilpa; *[S.B.J.Rosier]* 255, Feb. 1984, Hay Plain.

### **3. *Calostemma purpureum* R.Br.**

#### **Selection of specimens examined and measured**

SOUTH AUSTRALIA: **Flinders Ranges:** *D.E.Symon* s.n., 9 Sep. 1961, cultivated 12 Mar. 1962, ex Wilpena, cult. WARI [Urrbrae]; *B.J.Blaylock* 1384, 30 Mar. 1970, Warren Gorge. EASTERN: *R.Bates* 46316, 17 Feb. 1997, Oodlawirra Hills in valley NE of town. **Eyre Peninsula:** [southern Flinders Ranges.] *R.Bates* 46208, 16 Feb. 1997, Mount Brown Conservation Park. **Northern Lofty:** *B.Copley* 122, 6 Mar. 1966, c. 8 km from Snowtown. **Yorke Peninsula:** *J.G.O.Tepper* s.n., Mar. 1880, Ardrossan; *K.Ridley* s.n., 8 Mar. 1967, near Pt Vincent. **Southern Lofty:** *R.L.Taplin* 979, 31 Mar. 2004, Grenfell Road Reserve, Fairview Park; *R.L.Taplin* 978, 31 Mar. 2004, Abercrombie Reserve, St Agnes; *R.L.Taplin* 981, 31 Mar. 2004, Doxiadus Reserve, St Agnes; *R.L.Taplin* 980, 31 Mar. 2004, Kaplan Reserve, St Agnes; *P.J.Lang BSOP-582*, 16 Mar. 2003, Waite Conservation Reserve, Urrbrae; *P.J.Lang BSOP-758*, 12 Apr. 2004, loc. ibid; *P.J.Lang BSOP-581*, 2 Mar. 2003, Belair National Park; *P.J.Lang BSOP-755*, 29 Feb. 2004, loc. ibid.

NEW SOUTH WALES: *B.G.Briggs* 8025, 17 Apr. 1987, Weddin Mountains Natl P., c. 16 km SSW Grenfell.

### **4. Intergrades *Calostemma purpureum* – *C. luteum***

During the course of this study one population considered to be intermediate between *Calostemma purpureum* and *C. luteum* was examined in the field. This population extended for several kilometres along the base of an old consolidated red dune abutting the River Murray floodplain at Murtho Forest, north of Renmark, South Australia. The uniformity of flower colour and floral morphology across this population suggests that it was only reproducing apomictically. This is supported by the widespread occurrence of abnormalities involving partial development of ovaries on staminal tissue.

This situation differs from other populations reported where characters of the two parent species appear to have been recombined to produce a variety of different coloured forms.

#### **Specimens examined and measured**

SOUTH AUSTRALIA: **Murray:** *R.Bates* 18464, 15 May 1989 Murtho State Forest; *R.Bates* 36177, 20 Jan. 1994, Murtho Forest; *A.G.Spooner* 11487 13 May 1989, Murtho Forest Reserve; *P.J.Lang BSOP-775*, 17 May 2006, Murtho Forest, 1.4 km WSW of Murtho Landing, 11.3 km direct N of Renmark; *D.E.Phelps* s.n., s.dat., Loxton, near the river front below the town, AD98421103.

VICTORIA: *G.C.Cornwall* 327, 20 Mar. 1979, Kulkyne State Forest, adjacent to River Murray.

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