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An annotated checklist of Haemodoraceae, including new taxa and new combinations

Stephen D. Hopper[1,2,3], Rhian J. Smith[2] and Ellen J. Hickman[1]

[1]University of Western Australia, Albany Centre and School of Biological Sciences, Albany,
Western Australia 6330, Australia
[2]Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AB, UK
[3]Corresponding author, e-mail: steve.hopper@uwa.edu.au

Abstract

Hopper, S.D., Smith, R.J. & Hickman, E.J. An annotated checklist of Haemodoraceae, including new taxa and new combinations. *Nuytsia* 36: 141–238 (2025). In order to provide an up-to-date checklist of Haemodoraceae informed by published and forthcoming molecular phylogenetics, we describe the following new taxa and make new combinations as follows: *Haemodorum* subg. *Gemina* Hopper & R.J.Sm., *H.* subg. *Antiqua* Hopper & R.J.Sm., *H. sandifordiae* Hopper & E.J.Hickman, *H. clarksonii* Hopper & E.J.Hickman, *H. ghungalorum* Hopper, *Paradilatris* (Hopper ex J.C.Manning) Hopper, *Paradilatris viscosa* (L.f.) Hopper, *Wachendorfia laxa* W.F.Barker ex Hopper, *Conostylis* subg. *Appendicula* (Geer.) Hopper, *C.* subg. *Divaricata* (Hopper) Hopper, *C.* sect. *Terraflora* Hopper, *C. glabra* Hopper, *C. magna* Hopper, *C. bungalbin* Hopper, *C. aculeata* R.Br. subsp. *bolghinup* Hopper, *C. robusta* Diels subsp. *hickmaniae* Hopper, *C. dasys* (Hopper) Hopper, *Anigozanthos decrescens* (Hopper) Hopper & R.J.Sm., *A. condingupensis* Hopper & R.J.Sm., *A. knappiorum* Hopper, *A. yorlining* Hopper, *A. humilis* Lindl. subsp. *grandis* Hopper, *A. viridis* subsp. *sophrosyne* Hopper, and *A. viridis* Endl. subsp. *metallicus* Hopper. We also reinstate Haemodoraceae tribe Wachendorfieae, *Haemodorum subvirens* F.Muell., *H. leptostachyum* Benth. and *H. flaviflorum* W.Fitzg., and make adjustments in the circumscription of subgeneric taxa in *Conostylis* R.Br. and *Anigozanthos* Labill. Notes on variation in need of further taxonomic research are provided in the checklist. With these changes Haemodoraceae is a family of two subfamilies, four tribes, 16 genera and 132 species as follows: Haemodoraceae subfamily Haemodoroideae (10 genera/51 species) comprising tribe Haemodoreae Dumort. (4/38) and tribe Wachendorfieae Dumort. (6/13), and subfamily Conostylidoideae T.Macfarlane & Hopper (6/81) comprising tribe Conostyleae Benth. (5/69) and tribe Tribonantheae T.Macfarlane & Hopper (1/12). We do not support the recent recognition of Haemodoraceae tribe Anigozantheae Z.H.Feng.

Introduction

Haemodoraceae is a small family of 132 species of herbaceous monocots of global horticultural interest and placed in the Commelinales (APG IV 2016; Zuntini *et al.* 2021). They are distributed across Australia + Papua New Guinea, the Americas and South Africa, mainly on old climatically-buffered infertile landscapes (OCBILs – Hopper 2009, 2018, 2023; Hopper *et al.* 2016, 2021; Silveira *et al.* 2021), and have been the subject of a complicated taxonomic history until the advent of modern studies. Today, two subfamilies are recognised (Macfarlane *et al.* 1987; Hopper *et al.* 2009): the Haemodoroideae, comprising herein ten genera and 51 species distributed across the global range of the family, and the Conostylidoideae T.Macfarlane & Hopper, endemic to the Southwest Australian Floristic Region (SWAFR, *sensu* Hopper & Gioia 2004; Gioia & Hopper 2017; Figure 1) with six genera and 81 species.

Work towards the present checklist commenced with the senior author's PhD on speciation in *Anigozanthos* Labill. (Hopper 1978a) and papers therein (Hopper 1977a, 1978b, 1980; Hopper & Campbell 1977). Contributions to the treatment of Haemodoraceae in the *Flora of Australia* assembled what was then known

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about Australian members of the family, including descriptions of 17 new species in *Conostylis* R.Br. (Hopper 1987c), *Haemodorum* Sm. (Macfarlane 1987a) and *Tribonanthes* Endl. (Macfarlane 1987b) and a new subspecies in *Phlebocarya* R.Br. (Macfarlane 1987c). Simpson's (1990) PhD was the first attempt to erect a phylogeny of the family using morphological and anatomical characters, clarifying, in particular, the correct placement of *Phlebocarya* in subfamily Conostylidoideae rather than the Haemodoroideae in which it previously was placed. Specific morphological cladistic and molecular phylogenetic studies of *Anigozanthos* as then known were also published (Anderberg & Eldenaas 1991 and Le Roux *et al.* 2010 respectively). Hopper *et al.* (1999) were the first to investigate generic relationships through molecular phylogenetics research, commencing a program involving increasingly better taxon sampling thereafter (Hopper *et al.* 2009, in prep.; Zuntini *et al.* 2021).

Now that a revision of Neotropical species has been published (Pellegrini *et al.* 2020), and a revision of problematic genera such as *Tribonanthes* from the SWAFR and *Haemodorum* from the Kimberley of Western Australia is in hand (Barrett *et al.* 2015; Hickman & Hopper 2019), this paper updates the taxonomy of the family consistent with current molecular phylogenetic evidence through an annotated checklist, descriptions of new taxa, and new combinations. The paper also recognises the three new *Haemodorum* species described by Macfarlane and Barrett (2025).

Taxonomic concepts and methods

The checklist was compiled through review of historical literature. Clades are formally named if they are hypothesised to be monophyletic and usually diagnosable with apomorphies. The family Haemodoraceae itself is an exception to the latter criterion, having no apomorphies known other than from molecular sequences. Species-level molecular phylogenetic studies of *Conostylis* and *Tribonanthes* were previously published (Hopper *et al.* 2006; Hickman 2019). Similar studies on *Haemodorum* and *Anigozanthos* to inform taxonomic decisions are in preparation, although a start had been made previously in *Anigozanthos* by Le Roux *et al.* (2010). Based on that study, which only looked at three genera, Feng (2025) erected the tribe Anigozantheae with no comment. This is not supported in more comprehensive phylogenetic studies of Haemodoraceae (Hopper *et al*. 2009; Zuntini *et al*. 2021) and is not accepted here.

We have used standard herbarium and field collection approaches and molecular phylogenetics to test hypotheses as to the status of taxa. Our aim is to effect minimal change in nomenclature consistent with current scientific evidence, a fundamental principle articulated in the Preamble to the *International Code of Botanical Nomenclature* (Turland *et al.* 2018). There has been a long tradition in treatments of the Haemodoraceae of recognising monotypic taxa at generic level such as *Macropidia* J.Drumm. ex Harv., *Blancoa* Lindl., *Barberetta* Harv., *Cubanicula* Hopper, J.E.Gut., E.J.Hickman, M.Pell. & R.J.Sm. and *Lachnanthes* Elliott. While recognition of monotypic clades is often shunned (e.g. APG IV 2016; Zuntini *et al.* 2021; Feng 2025), we continue to recognise monotypic genera in Haemodoraceae to align our treatment with the principle of minimal nomenclatural change in the Preamble to the *Code*. Monotypic clades also can be justified on the basis that evolution occurs both cladistically (branching of clades through speciation) and anagenetically (divergence through time along the same evolutionary branch), and that extinction of close relatives can leave isolated and very distinct lineages that should not be merged with their nearest sister taxa. Depending on natural selection, diversification paths and rates of evolution and extinction, it is not unexpected that single species may diverge dramatically from their sister taxa and merit recognition at a higher taxonomic level to reflect this. Such recognition emphasises the differences and thereby conveys more information about the taxa concerned, which can be important in conservation.

We have conducted extensive herbarium and field studies of Haemodoraceae and base the following taxonomy on evidence gained from both dried and fresh material. Herbarium collections examined by our team, including the companion paper on Neotropical Haemodoraceae (Pellegrini *et al.* 2020), included specimens at AD, ALCB, B, BA, BHCB, BHZB, BM, BOTU, BRIT, C, CAL, CANB, CBG, CEPEC, CESJ, CGE, CGMS, CNMT, COL, COR, CORD, CVRD, EAC, ESA, F, FCAB, FCQ, FLOR, FURB, GUA, HAMAB, HAS, HB, HBR, HDCF, HRB, HRCB, HSTM, HUCS, HUEFS, HUFSJ,

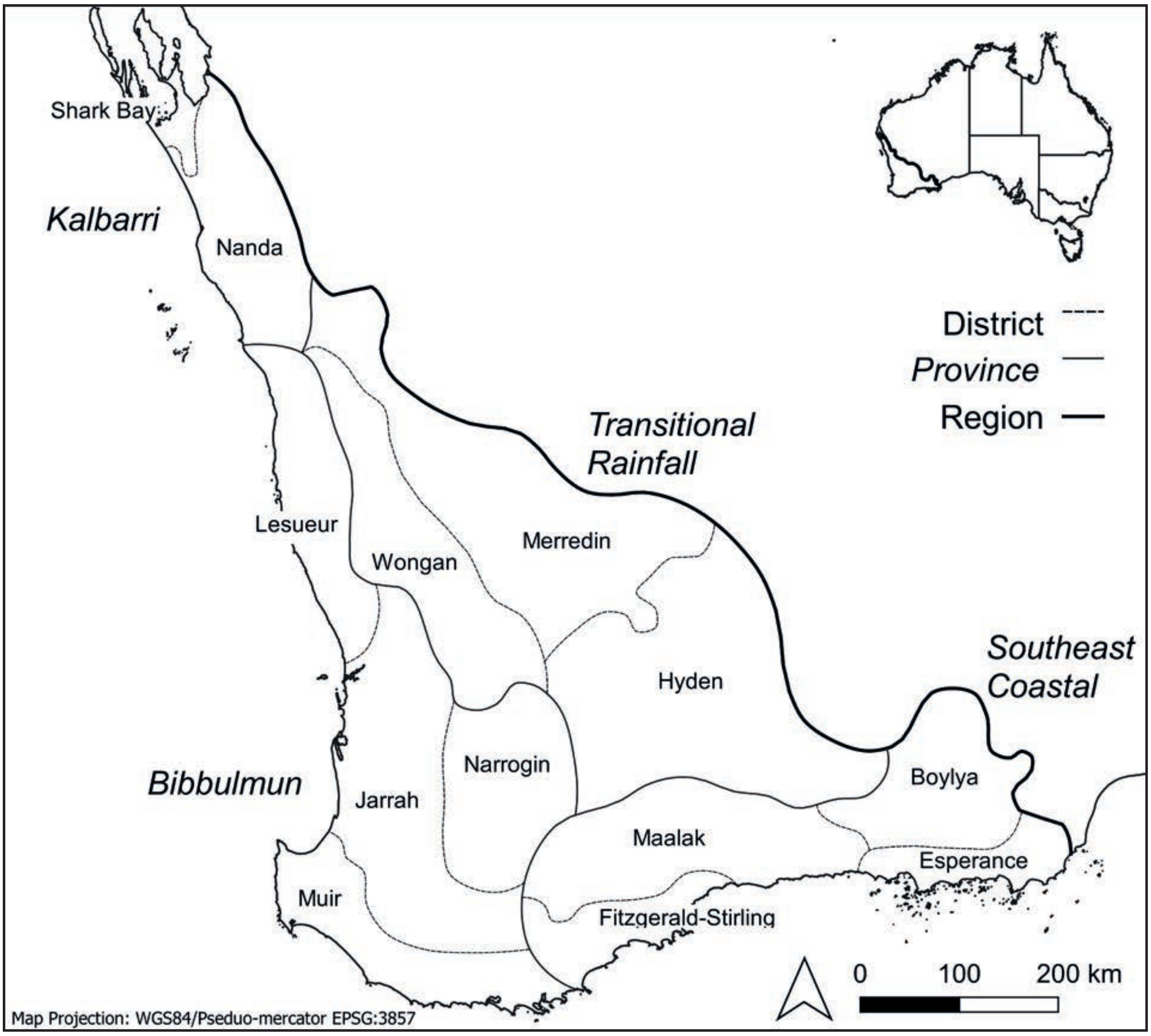

Figure 1. The Southwest Australian Floristic Region *sensu* Gioia and Hopper (2017), illustrating Provinces and Districts resulting from a multivariate analysis of locations on specimens in the Western Australian Herbarium.

HURB, IAC, ICN, INPA, JOI, K, L, MBM, MBML, MEL, MG, MO, MY, NBG, NSW, NY, P, PACA, PERTH, PMSP, R, RB, RFA, RFFP, SCP, SP, SPF, SPSF, U, UEC, UFRN, UPCB, US, USF, W, WAG, and WU. Distribution maps were compiled from herbarium specimen locations listed in the Atlas of Living Australia, the Australian Virtual Herbarium and in the Western Australian Herbarium's *Florabase*, https://florabase.dbca.wa.gov.au/ [accessed 22 May 2025]. For taxa of the SWAFR, nomenclature of Provinces and Districts is given in Figure 1.

The species concept applied is both morphological and biological, following that articulated by Hopper and Brown (2001), and first used by Darwin (1868). New species are recognised if they grow in populations (i.e. are not aberrant individuals within populations displaying normal variation), if they have traits or a combination of traits not seen in any previously named species, and especially if they grow with previously named species and produce few or no natural hybrids, the latter exhibiting evidence of partial or full sterility. Ecological data, including habitats occupied, were also determined through field survey and summary of the information provided from examining herbarium specimens. In *Anigozanthos*, experimental tests of reproductive interactions of putative species were undertaken (Hopper 1980). Where this was not possible, as an independent test of reproductive isolation, we sequenced DNA from populations of putative taxa and their sisters to search for genetic divergence or uniformity, as well as to explore molecular phylogenetics (Hopper *et al.* 1999, 2006, 2009, in prep.).

We have also applied multivariate morphometrics informally or formally (as Canonical Variate Analysis described in Hopper & Campbell 1977) to test for significant shape and size variation where univariate analysis is not decisive. In one case (*Anigozanthos bicolor* Endl. and *A. decrescens* (Hopper) Hopper & R.J.Sm.), extensive population sampling for multivariate morphometrics was combined with experimental hybridization (Hopper 1980) and molecular phylogenetics (Hopper *et al.*, unpublished) to accurately map the ranges of parental taxa and their narrow hybrid zone identified first by Hopper and Campbell (1977). For the multivariate morphometrics study, stepwise elimination of 16 poor discriminatory floral characters among the 31 originally used (Hopper & Campbell 1977) to distinguish *A. bicolor* from *A. decrescens* left 15 perianth characters then measured on the extensively sampled population set (see further discussion under *A. decrescens*).

Subspecies are recognised if they form geographical or ecological races with minor morphological differences. These may hybridise and intergrade extensively where their geographical ranges overlap. Our species and subspecies concepts are thus morphological and biological, springing from approaches lucidly summarised by Grant (1971).

Hybrids are recognised with a standard formula if they are intermediate in morphology between putative parental taxa (e.g. Hopper 1977a, 1977b, 1978b). Evidence of reproductive impairments such as reduced seed set or reduced pollen fertility were also assessed where needed.

Aboriginal names, where known, are from literature or through extensive oral history interviews by SDH and colleagues with Noongar elders in the SWAFR (e.g. Meagher 1974; von Brandenstein 1988; Bindon & Chadwick 1992; Bindon 1996; Knapp 2011; Lullfitz *et al.* 2022; Knapp *et al.* 2024, and references therein).

The only unusual characters highlighted herein are in *Haemodorum* seeds, a few of which routinely exude a pale pinkish maroon pigment onto paper under sticky tape.

Conservation codes are as originally published in Hopper *et al.* (1990) and updated by the Department of Biodiversity, Conservation and Attractions today (State of Western Australia 2025; https://www.dbca.wa.gov.au/management/threatened-species-and-communities/nominations-listing).

Taxonomy

As field work, herbarium studies and DNA sequencing has progressed on Haemodoraceae over the past half-century, a sizable number of new taxa have been discovered. Progressively, these have been described, especially in the *Flora of Australia* treatment of the family (Macfarlane *et al.* 1987), and in subsequent anatomical studies and revisionary work including molecular phylogenetic investigations (Helme & Linder 1992; Hopper 1993; Maas & Maas 1993; Hopper *et al.* 1999, 2006, 2009; Le Roux et al. 2010; Barrett *et al.* 2015; Aerne-Hains & Simpson 2017; Manning & Goldblatt 2017; Hickman & Hopper 2019; Pelligrini *et al.* 2020; Macfarlane & Barrett 2025). Here the genus *Paradilatris* (Hopper ex J.C.Manning) Hopper and a range of additional new taxa and combinations in the genera *Haemodorum*, *Conostylis*, *Anigozanthos* and *Wachendorfia* Burm. are described to enable an updated annotated checklist of the family as a whole. It is noteworthy that the vast majority of new taxa are narrow endemics confined to OCBILs (Hopper 2009, 2023; Hopper *et al.* 2016, 2021; Silveira *et al.* 2021), highlighting the need for ongoing field surveys and collections in upland sandplains and hilltops in case there remain further undetected and undescribed narrow endemics in the family. We deal with taxonomic additions below alphabetically at generic rank and below, commencing with subfamily Haemodoroideae followed by subfamily Conostylidoideae.

Haemodorum

The genus *Haemodorum* consists of 36 species, including three here described as new plus three others by Macfarlane and Barrett (2025), occurring in all States of Australia except South Australia and Victoria, with one species (*H. coccineum* R.Br.) extending into Papua New Guinea. *Haemodorum* was last revised by Macfarlane (1987a). Some of the south-western Australian bulbous species were the most important underground storage organs used as food by Noongar Aboriginal people (Lullfitz *et al.* 2022). Tropical species furnish a dye used for basket-making (e.g. Liddy *et al*. 2006; Djorrk *et al*. 2015), and the leaves of *H. coccineum*. are used to make baskets (West 1999). Toy spears are made from flowering stems of some tropical species (Karadada *et al.* 2011).

Many *Haemodorum* species are often described as having brownish black flowers but when the plants are dissected they have a kaleidoscope of colour variation. Evident colour divergence from the usual brownish black is displayed in species from the tropical north of Australia and the remarkable *H. distichophyllum* Hook. from Tasmania (Figures 2, 3).

With colleagues, we are currently writing up a molecular phylogenetic study of *Haemodorum* (see also Zuntini *et al.* 2021). This study has identified three clades that can be recognised in a subgeneric classification. Two are new and are described below. Figures 2 and 3 provide a matrix of illustrations of the various flower, fruit and vegetative parts of nine *Haemodorum* species representing each of the three subgenera (see below) to demonstrate some of this colour and morpho/anatomical variation.

Haemodorum is a relatively young genus in the family, its ancestor separating from its north-central American sister *Lachnanthes* about 35 million years ago (Hopper *et al.* 2009). Although key taxa, including *H. sandifordiae* and *H.* subg. *Gemina*, were not sampled by Hopper *et al.* (2009), the remainder of the genus *Haemodorum* began diverging about 15 million years ago.

Haemodorum subg. **Antiqua** Hopper & R.J.Sm., *subg. nov.*

Type: *Haemodorum distichophyllum* Hook.

Aerial stems 3–80 cm long. *Inflorescence* a single dense umbel-like cluster of many flowers not in pairs, 3–10 cm long, or paniculate with widely divergent dichotomous branches to 80 cm tall, with flowers solitary or in loose clusters of 2–5 concentrated at tip of branches. *Flowers* on equal pedicels. *Petals* multicoloured differing inside and out or uniformly green. *Stamens* short; anthers red or bright orange. *Style* extending well above the length of the short petals; stigma simple unbranched globular. *Seed* uniformly black. (Figures 2E, F; 3E, F)

Etymology. From the Latin adjective *antiquus, -a, -um* = ancient, in reference to the early origin of the subgenus in *Haemodorum* and the ancient divergence of its two constituent species which sit on long branches in molecular phylogenies.

Affinities and notes. This subgenus consists of two morphologically disparate species – *H. distichophyllum* from Tasmania and *H. tenuifolium* Cunn. ex Benth. from the central east coast of Australia (Figures 2, 3).

Haemodorum subg. **Gemina** Hopper & R.J.Sm., *subg. nov.*

Type: *Haemodorum spicatum* R.Br.

Aerial stems 8–230 cm long. *Inflorescence* a slender few- to many-flowered spike. *Flowers* paired, each pair on equal or unequal pedicels and spaced up to 8.5 cm apart. *Petals* uniformly black or bicoloured dark brown and black, the same colour inside and out, or multicoloured differing inside and out. *Stamens* elongate, anthers purple, white, sometimes greenish or orange. *Style* either approaching the length of the petals or much shorter (to half the length of the petals); stigma simple or trifid. *Seed* uniformly black or maroon. (Figures 2–7)

Etymology. From the Latin adjective *geminus, -a, -um* = paired, twin, alluding to the paired flowers in the inflorescence, which are found only in this subgenus.

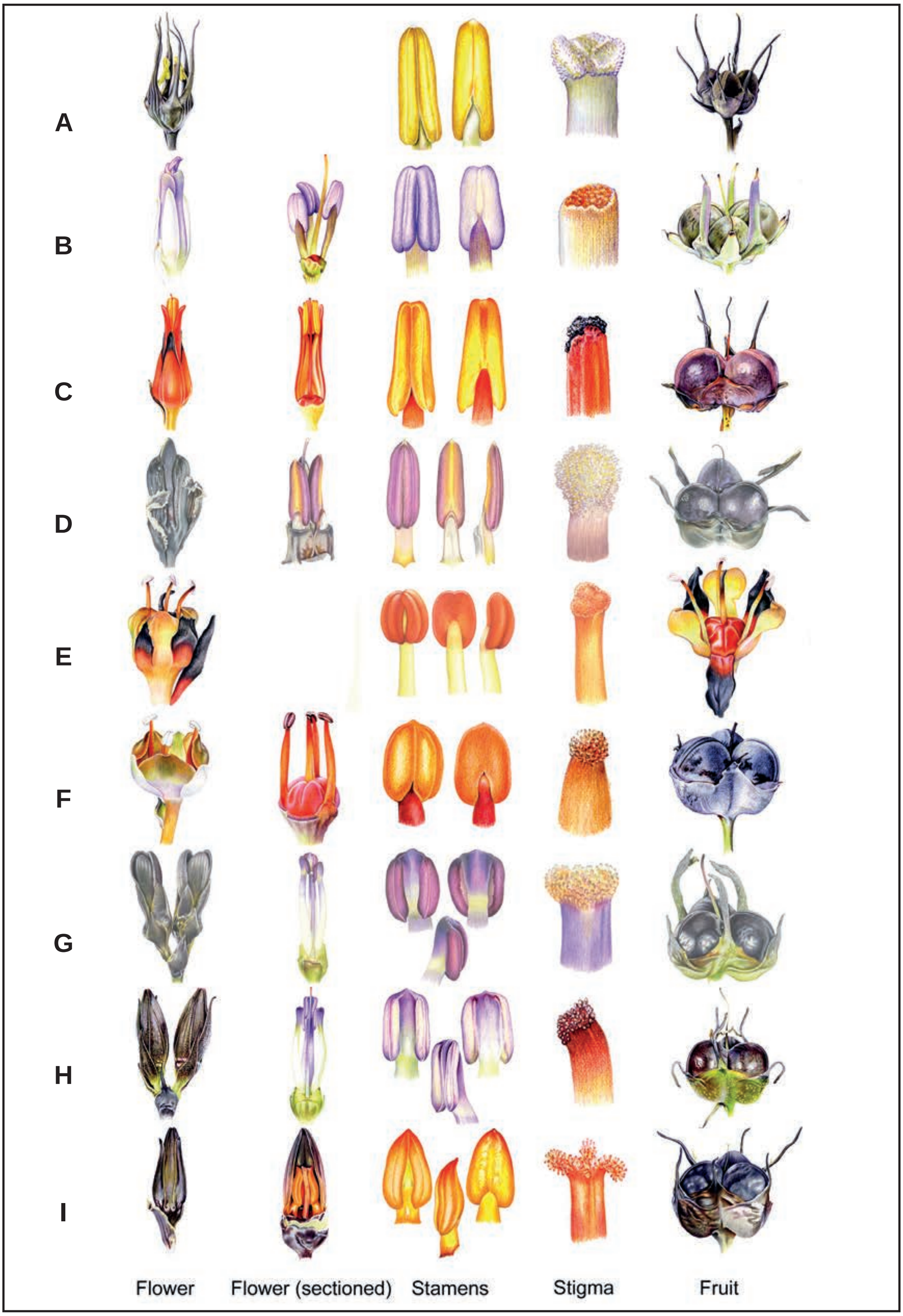

Figure 2. Flowers and fruits of *Haemodorum* species highlighting distinctive features of the three subgenera and of *H. clarksonii* and *H. sandifordiae*. A – *H. austroqueenslandicum* [subg. *Haemodorum*] Glasshouse Mountains, Qld 26°55’16.17” S 152°57’55.63” E; B – *H. clarksonii* [subg. *Haemodorum*] Cape York Peninsula, Qld 15°00’43.38” S 143°30’46.38” E; C – *H. coccineum* [subg. *Haemodorum*] Watsonville, Qld 17°22’35.89” S 145°18’30.02” E; D – *H. discolor* [subg. *Haemodorum*] Lake Camm, WA 32°52’18.20” S 119°49’20.77” E; E – *H. distichophyllum* [subg. *Antiqua*] Lake Pedder, Tas 43°02’13.64” S 146°16’38.57” E; F – *H. tenuifolium* [subg. *Antiqua*] Currimundi Lake, Qld 26°45’45.82” S 153°07’51.37” E; G – *H. brevisepalum* [subg. *Gemina*] Stirling Range, WA 34°22’45.82” S 118°00’20.33” E; H – *H. spicatum* [subg. *Gemina*] Narrikup, WA 34°46’18.11” S 117°41’47.07” E; I – *H. sandifordiae* [subg. *Gemina*] Shannon, WA 34°43’04.36” S 116°26’10.72” E. Illustrations, not to scale, by E.J. Hickman.

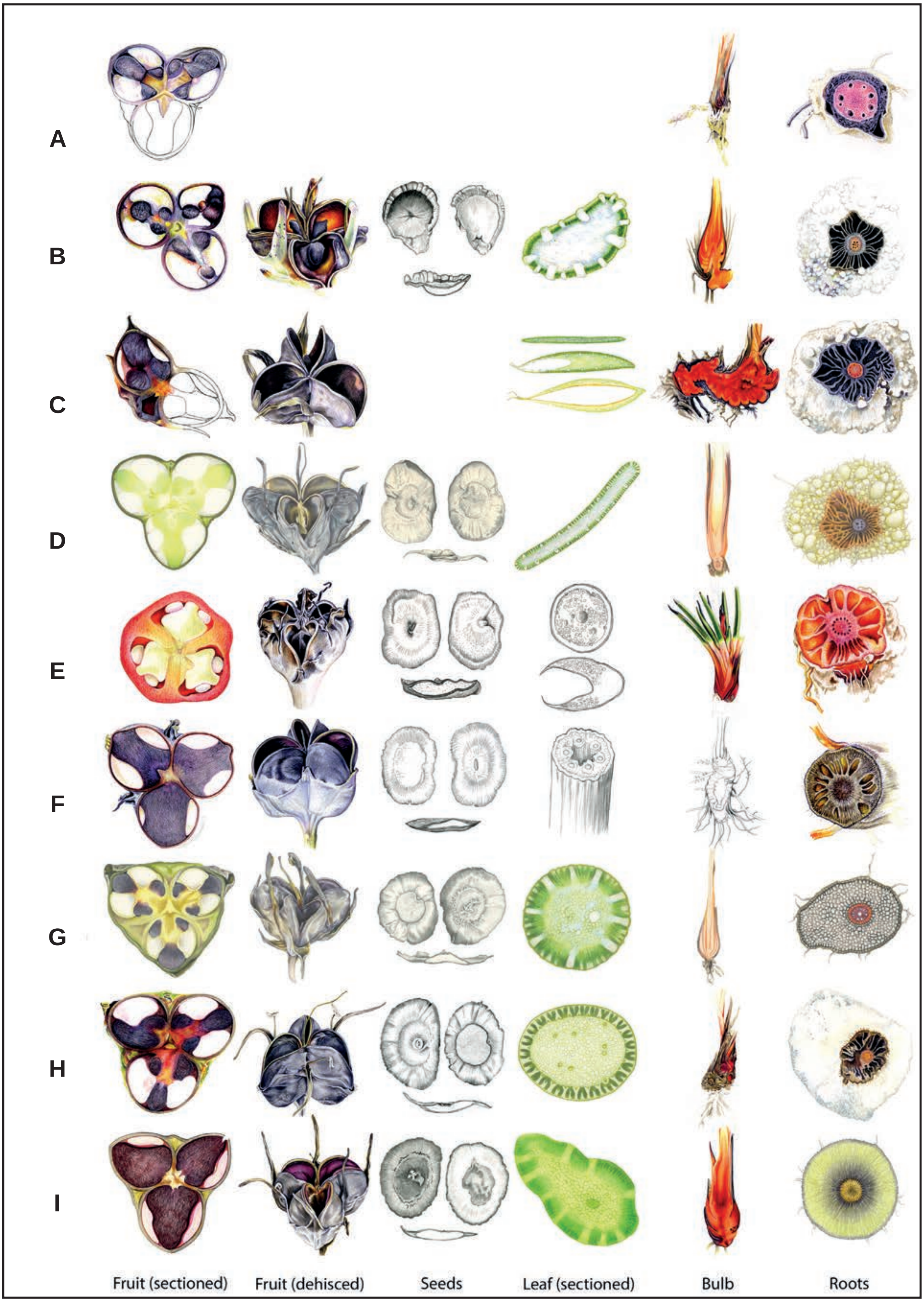

Figure 3. Colour illustrations of parts of nine *Haemodorum* species to highlight the distinctive features of the three subgenera and of *H. clarksonii* and *H. sandifordiae*. A – *H. austroqueenslandicum* [subg. *Haemodorum*]; B – *H. clarksonii* [subg. *Haemodorum*]; C – *H. coccineum* [subg. *Haemodorum*]; D – *H. discolor* [subg. *Haemodorum*]; E – *H. distichophyllum* [subg. *Antiqua*]; F – *H. tenuifolium* [subg. *Antiqua*]; G – *H.* *spicatum* [subg. *Gemina*]; H – *H. brevisepalum* [subg. *Gemina*]; I – *H. sandifordiae* [subg. *Gemina*]. Collection locations as in Figure 2. Illustrations, not to scale, by E.J. Hickman.

Figure 4. *Haemodorum* subg. *Gemina*. Dissected flowers exposing the purple and white/cream stamens of selected populations of *Haemodorum spicatum*. A – Mt Lindesay; B – Mt Clarence Albany, near anther shrivelled from herbivore damage; C – John Forrest National Park Perth; D – Two Peoples Bay, immature stamens not yet elongated, from a bud. Note that the south coast populations of *H. spicatum* (Mt Lindesay, Mt Clarence, Two Peoples Bay) often have the purple coloration confined to the summit of the filament adherent to the anther, and sometimes lack it altogether (see Figure 5). Photographs by S.D. Hopper.

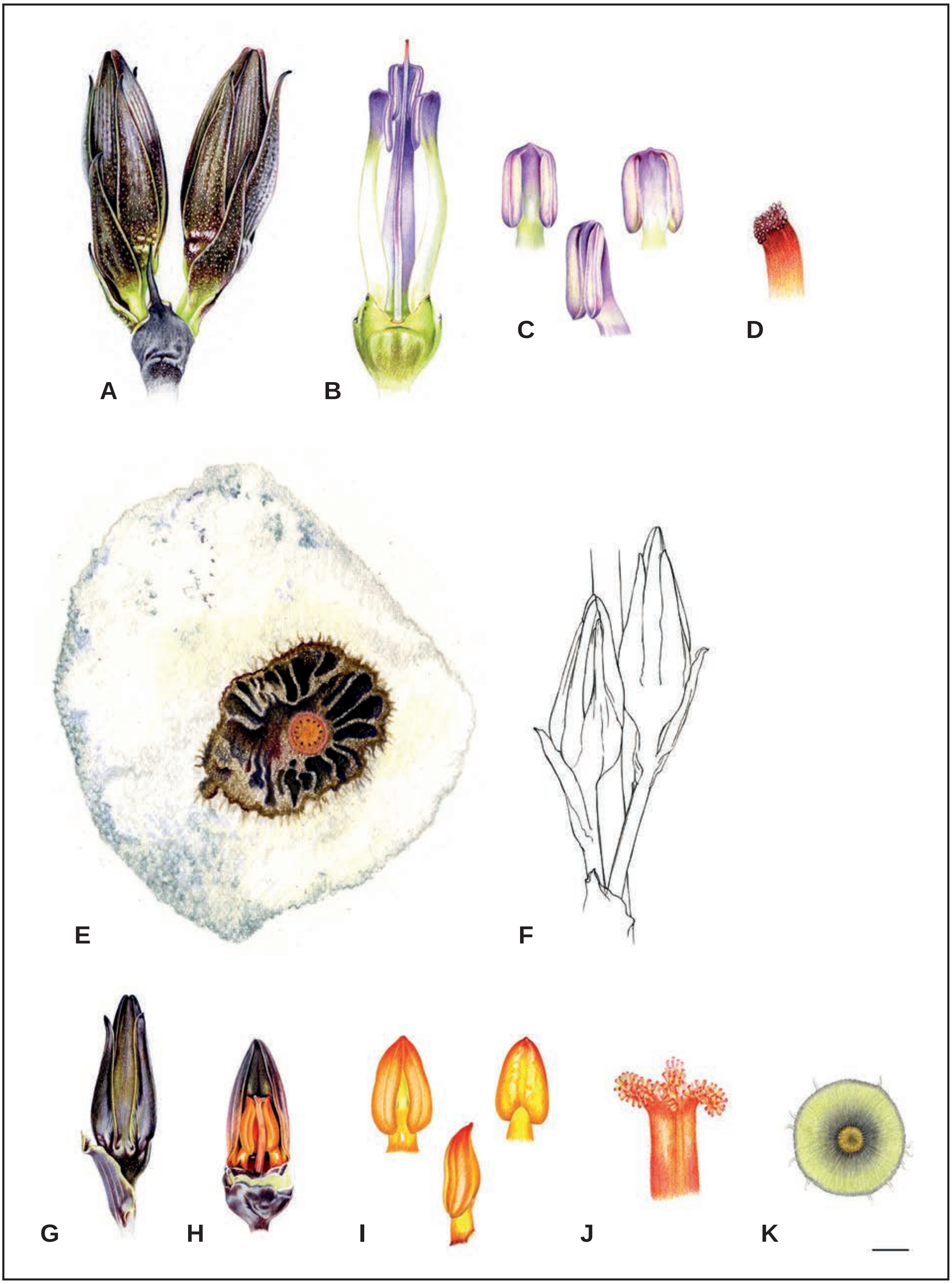

Figure 5. Comparison of character traits in *Haemodorum* subg. *Gemina* species. *H. spicatum* (A–E): A – pair of flowers showing the equal pedicels; B – gynoecium, stamens and style; C – anthers: front, back, side view; D – unlobed stigma; E – root cross-section showing sand-binding sheath called the Nan-ga by Noongars (Grey 1840) meaning 'beard of the mearn – *H. spicatum*' (ngarnak = beard, hanglet; von Brandenstein 1988). *H. sandifordiae* (F–K): F – pair of flowers showing the unequal pedicels; G – single flower; H – gynoecium, stamens and style; I – anthers: front, back, side views; J – trilobed stigma; K – root cross-section with no sand-binding sheath. Scale bars = 2 mm (A, F, G); 1.25 mm (B, H); 1 mm (C, E); 0.65 mm (I); 0.15 mm (D, J); 0.5 mm (K). Illustration by E.J. Hickman.

Affinities and notes. *Haemodorum* subg. *Gemina* contains just three species, all endemic to the Southwest Australian Floristic Region: *H. spicatum*, *H. brevisepalum* Benth. and *H. sandifordiae* Hopper & E.J.Hickman. *Haemodorum spicatum* is a species with large edible bulbs known across Noongar dialects as *miern* (Albany), *koolung* (Mingenew; Meagher 1974), *bohn* (Perth), *borana* (Margaret River), *kogarn* (Jerramungup) and *quagarn* (Esperance district; Lullfitz *et al.* 2022). The subgenus is readily diagnosed by its paired flowers, and is sister to a large clade comprising *H*. subg. *Antiqua* from Tasmania and the central eastern Australian coast and *H*. subg. *Haemodorum.*

Haemodorum sandifordiae Hopper & E.J.Hickman, *sp. nov.*

Type: North end of 'George Gardner Rock', *c.* 550 m north of Nelson Rd, 6.8 km east of Preston Rd, south-east of Shannon, Western Australia, 1 December 2015, *E.M. Sandiford* 2174, *S.D. Hopper & N.K. McQuoid* (*holo*: PERTH 08744599; *iso*: CANB, K, NSW).

Haemodorum sp. East Northcliffe (E.M. Sandiford *et al.* 2174), Western Australian Herbarium, in *Florabase*, https://florabase.dbca.wa.gov.au/ [accessed 22 May 2025].

Geophyte. *Aerial stems* 85–144 cm long, usually 100 cm. *Roots* not sand-binding, almost glabrous with root hairs scarcely present to absent. *Bulb* 4.5–8 cm below soil surface, orange to red, to 15 mm diameter. *Basal leaves* 1–2; lamina orange-red to white below soil surface, green above, terete to subterete, 120–310 mm long, *c.* 1.5–2 mm wide above ground. *Inflorescence* much longer than the leaves, a slender sparsely flowered spike, rarely with one branch 1.5–9 cm long, flowers paired, up to 10 pairs on scape, the pairs widely spaced up to 8.5 cm apart. *Inflorescence bracts* with lamina greenish brown to black, narrowly triangular, 8–35 mm long, the veins obscure abaxially, margins paler, opaque, undulate, scarious. *Floral bracts* greenish black, acute, triangular with undulate opaque marginal wings, 7–10 mm long, 2–4 mm wide, reaching to ovary at anthesis. *Flowers* glossy. *Pedicels* unequal, shortest 2–4 mm long, longer 5–10 mm long. *Sepals* black to dark brown, narrowly triangular, 7–10 mm long, 2–2.5 mm wide at base, acute. *Petals* lanceolate, 7–9 mm long, 1.5–2.0 mm wide at base, abaxial surface dark brown to greenish in basal two-thirds, becoming black apically; adaxially pale orange basally, then cream, apical half dark purple-black with a few prominent vertical dark stripes. *Stamens* unequal, the longest 4 mm long, two shorter 3 mm; filaments pale orange cream, 1–2.5 mm; anthers enclosed within flower, tops reaching to mid-length of the petals, orange, 2 mm long. *Style* at anthesis reaching to top of anthers, 2.5–4 mm long, pale orange; *stigma* split into three lobes, orange. *Fruits* 3-locular, glossy blackish purple above, producing a dark red juice when squashed while immature. *Developing seeds* with white circular endosperm flanked by narrow maroon wing. *Mature seeds* uniformly maroon, circular, flat, 5–6 mm diameter, exuding a pale pinkish maroon pigment onto paper under sticky tape. (Figures 2, 3, 5–7)

Diagnostic features. *Haemodorum sandifordiae* is readily distinguished by its glabrous roots, its slender sparsely flowered spike 85–144 cm tall with paired flowers, each pair on unequal pedicels and spaced up to 8.5 cm apart, its multicoloured petals differing inside and out, its short orange stamens and style, three-lobed stigma, and uniformly maroon seed.

Other specimens examined. WESTERN AUSTRALIA: 75 km S of Manjimup on Walpole Highway, 2.2 km S of Preston Road, 300 metres E of highway, 14 Nov. 1985, *S.D. Hopper* 4728 (PERTH 01735063); Keystone Forest Block, 7 km NW of Walpole, Angove Road 1.6 km S of Logging Rd (small dam on verge) then 80 m N onto perched peat swamp, 28 June 2022, *S.D. Hopper* 8713 (PERTH 09714472); 300 m S of Nelson Road, *c.* 6.4 km W of Preston Rd, Mount Frankland National Park, SE of Shannon, 1 Dec. 2015, *E.M. Sandiford 2176, S.D. Hopper & N.K. McQuoid* (CANB, PERTH 08744505, NSW); adjacent to N end of granite outcrop, *c.* 550 m N of Nelson Road, 6.8 km E of Preston Road, SE of Shannon, 26 Jan. 2016, *E.M. Sandiford 2184, S.D. Hopper, N.K. McQuoid & E.J. Hickman* (PERTH 08804672); E side Deeside Coast Road *c.* 960 m N of Chesapeake Road, 27 Jan. 2016, *E.M. Sandiford* 2186, *S.D. Hopper, N.K. McQuoid & E.J. Hickman* (PERTH 08804656); *c.* 160 m E of Deeside Coast Road along old track, 200 m N of Preston Road, 27 Jan. 2016, *E.M. Sandiford* 2185, *S.D. Hopper, N.K. McQuoid & E.J. Hickman* (PERTH 08804664); N side Chesapeake Road *c.* 3.3 km E of intersection with Deeside Coast road, 27 Jan. 2016, *E.M. Sandiford 2187, S.D. Hopper, N.K. McQuoid & E.J. Hickman* (PERTH 08804796); 30 m W side Pingerup Road, adjacent small dam, *c.* 560 m N from intersection with Marron Road, 27 Jan. 2016, *E.M. Sandiford 2188, S.D. Hopper, N.K. McQuoid & E.J. Hickman* (PERTH 08804818); *c.* 60 m SE of South Western Highway, 1.38 km from intersection with Bull Road and 1.9 km NNE of Shannon Airstrip, 27 Jan. 2016, *E.M. Sandiford 2189, S.D. Hopper, N.K. McQuoid & E.J. Hickman* (PERTH 08804826); *c.* 50 m W of Angove Road, 3.6 km from intersection with South Western Highway, NW of Walpole, 8 Apr. 2016, *E.M. Sandiford 2193* (CANB, K, PERTH 08804680).

Phenology. Flowers November–January.

Distribution. Endemic to the high rainfall region between Northcliffe and Walpole (Figure 8) in the Muir Botanical District of Gioia and Hopper (2017; Figure 1). The possibility of *H. sandifordiae* extending to peat swamps on Denbarker Road NW of Denmark needs investigation. Specimens in dehisced fruit have been seen in April. It is proposed to name the type locality as George Gardner Rock. Gardner was a well-known naturalist and anthropologist from Northcliffe, who first introduced SDH to ‘his’ rock containing a population of the rare species *Kennedia glabrata* Lindl. (Figure 8).

Habitat. *Haemodorum sandifordiae* occupies the most distinctive habitat for the genus within the Southwest Australian Floristic Region in being confined to waterlogged peat swamps dominated by *Homalospermum firmum*. It is often associated with *Cephalotus follicularis*, *Empodisma gracillimum*, *Cosmelia rubra, Reedia spathacea* (listed as Threatened – Endangered) and *Brownseya serpentina.*

Phenology. This *Haemodorum* species has been seen in flower November–January only, within a year following hot summer burns.

Etymology. Named for Elizabeth M. Sandiford (1960–), rediscoverer in 2018 of *Acacia prismifolia* E.Pritz., a plant last seen in the Stirling Range in 1933, distinguished consultant botanist, co-author of the 2011 Albany Regional Vegetation Survey and significant contributor to the Albany Regional Herbarium, who has surveyed much of the Albany district flora and beyond and is an acknowledged expert in the taxonomy and communities of south coast plants. Libby is also an enthusiastic photographer. She was the first to notice the new species on a survey of granite rocks and peatlands with SDH and landscape ecologist Nathan McQuoid in December 2015 following the big wildfire that burnt much of the Northcliffe-Walpole district in February 2015.

Conservation status. *Haemodorum sandifordiae* has been recorded at 22 locations and is usually sparsely distributed but common where it grows. Some populations occur within the WA-listed Priority One Ecological Community *Reedia spathacea - Empodisma gracillimum - Schoenus multiglumis* dominated peat paluslopes and sandy mud floodplains of the Warren Biogeographical Region, and the federally listed Threatened Ecological Community *Empodisma* peatlands of southwestern Australia (Endangered).

Feral pigs are known to have consumed bulbs (Figure 7C), and the peat swamps in which it grows are increasingly drying out with global warming, rendering them vulnerable to destruction by fire such as notably frequent prescribed burning in recent years (Bradshaw *et al.* 2018). It would be well to monitor *H. sandifordiae* in the future to ensure that it does not become a threatened species.

Vernacular name. Sandiford’s Bloodroot is recommended.

Affinities and notes. The earliest collection of *H. sandifordiae* was in fruit, made in November 1985 by SDH. At the time, although the habitat was unusual, the collection was determined as *H. spicatum* by Terry Macfarlane. It was not until the species was seen fresh in flower in the wild in December 2015 that the differences from *H. spicatum* became clear (Figures 2, 3, 5). *Haemodorum sandifordiae* differs from *H. spicatum* by its glabrous roots (covered by a thick rhizosheath of root hairs in *H. spicatum*), its shorter scape averaging 1 m (up to 2.3 m in *H. spicatum*), floral pairs spaced up to 8.5 cm apart on

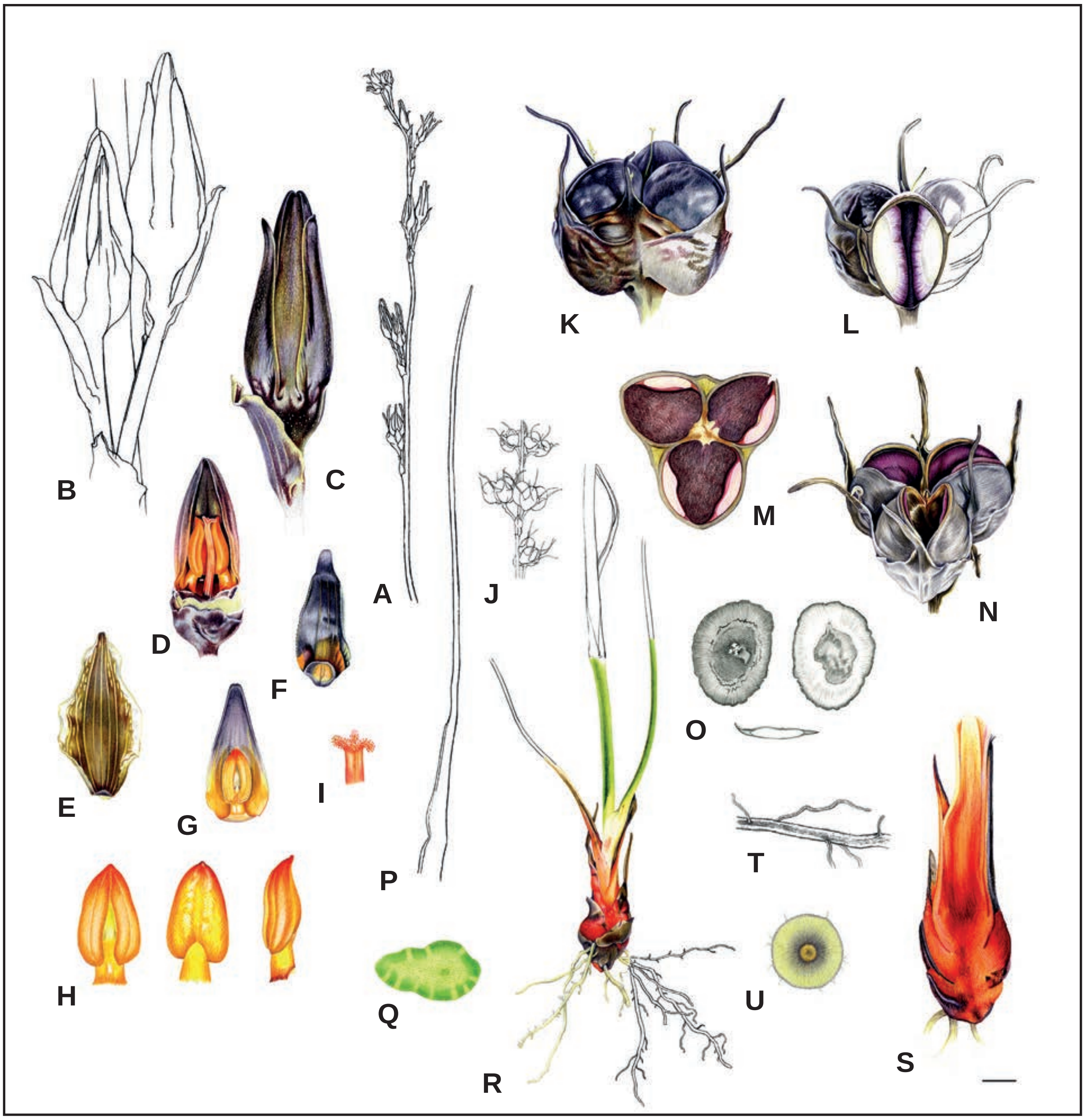

Figure 6. *Haemodorum sandifordiae* from type locality: A – flowering inflorescence; B – pair of flowers; C – single flower; D – flower with part of perianth removed to show stamens, style and ovary position; E – inflorescence bract, interior view; F – sepal; G – petal with stamen attached; H – anthers viewed from front, back and side; I – stigma; J – fruiting inflorescence; K – fruit; L – fruit with part of carpel wall removed to show developing seeds; M – cross-section through fruit to show three carpels with two maroon seeds developing in each; N – dehisced fruit; O – seeds – dorsal, ventral and cross-section; P – leaf; Q – leaf cross-section; R – below-ground parts; S – longitudinal-section through bulb; T – part of root; U – cross-section through root with no sand-binding sheath. Scale bars = 1 cm (A, J, P, R); 4 mm (S, T); 1.25 mm (B, C, D, E, F, G); 0.65 mm (H, Q); 0.4 mm (I, U); 2 mm (K, L, M, N, O). Illustration by E.J. Hickman.

the few-flowered scape (floral pairs densely aggregated on the many-flowered *H. spicatum*), pedicels of each floral pair unequal (equal in *H. spicatum*), short floral bracts with undulate opaque margins (longer floral bracts with straight margins in *H. spicatum*), multicoloured petals differing inside (3-coloured) and out (2-coloured) – uniformly coloured or 2-coloured in *H. spicatum*, its short orange stamens, and style half the length of the petals (lilac-purple anthers on longer filaments almost as long as the petals in *H. spicatum*), three-lobed stigma (undivided stigma in *H. spicatum*), and uniformly maroon seed (black in *H. spicatum*). There is a pronounced habitat difference, with *H. sandifordiae* favouring waterlogged perched peat bogs and their margins, while *H. spicatum* grows in free-draining sand on elevated slopes and hills or on the margins of, not within, peat swamps.

Figure 7. *Haemodorum sandifordiae* from type locality. A – fruiting scape alongside white inflorescences of *Cephalotus follicularis*; B – scape (to the right) and basal leaf emerging from waterlogged peaty soil adjacent to pitchers of *Cephalotus follicularis*; C – pig damage to base of scape where bulb has been dug up and bitten off; D – flowers and floral bracts revealing paler brown colour of basal two thirds of the petals; E – longitudinally sectioned flower showing unequal filaments and orange anthers; F – maroon-coloured seeds; G – squashed predehiscent fruit releasing red dye and showing immature seeds with white endosperm surrounded by maroon wing; H – Libby Sandiford holding scapes of her namesake species; I – orange-red bulb adjacent to dark brown flowers. Photographs by S.D. Hopper.

The exudation from seeds of *H. sandifordiae* of a pale pinkish maroon pigment onto paper under sticky tape is also prominently seen in the central east coast Australian species *H. tenuifolium* and, to a lesser extent, the Tasmanian endemic *H. distichophyllum*, the two species here placed in *H.* subg. *Antiqua* (Figures 2, 3). This latter species differs from *H. sandifordiae* in many ways, however, including its shorter branched inflorescence, tiny flowers, and preference for well-drained sands.

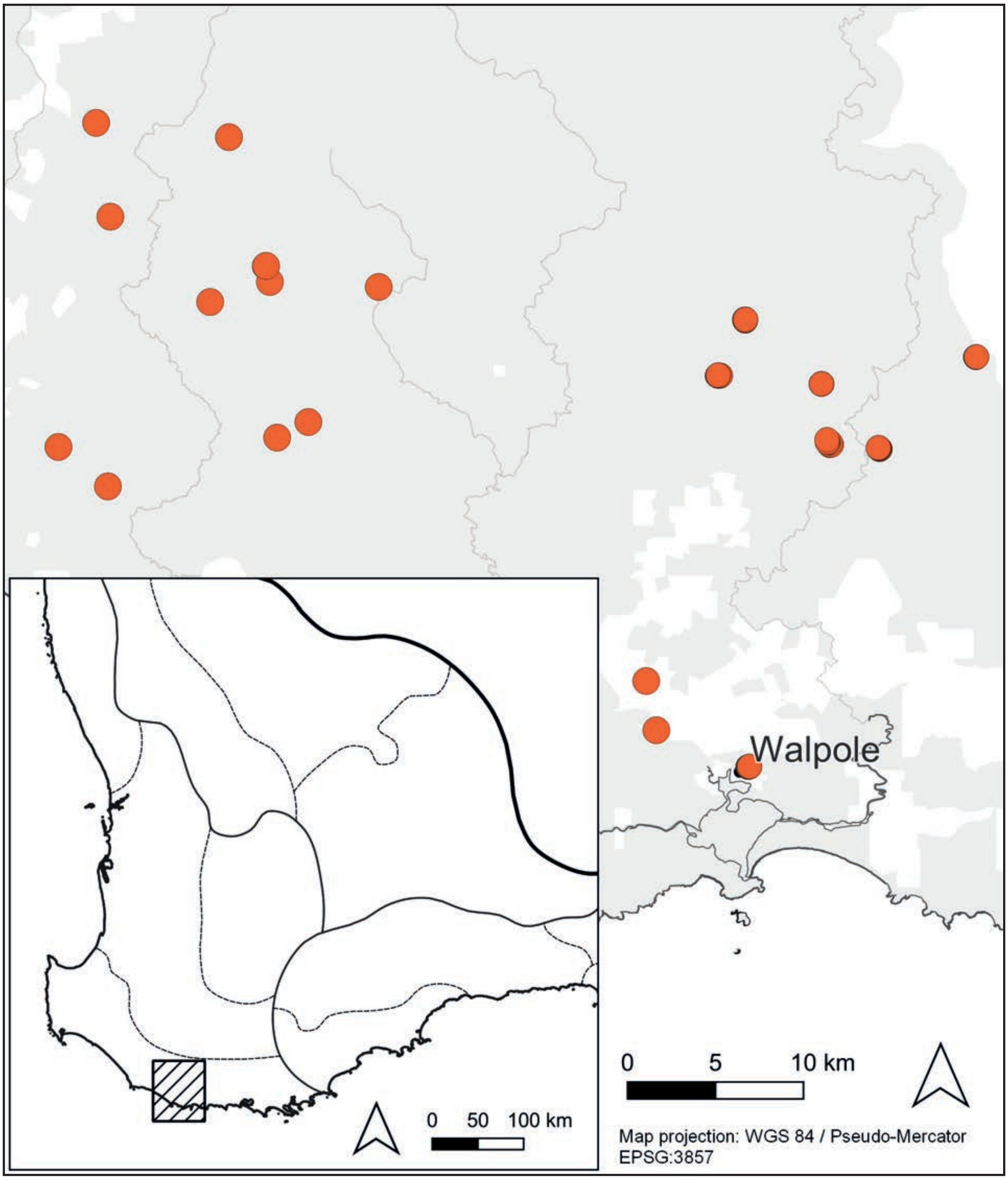

Figure 8. Distribution of *Haemodorum sandifordiae* (●) between Northcliffe and Walpole in highest rainfall peat swamps of the Muir Botanical District (Gioia and Hopper 2017). Inset map shows location in relation to Botanical Provinces and Districts recognized by Gioia and Hopper (2017) – see Figure 1.

Haemodorum sandifordiae joins many other relictual plants and animals confined to the highest rainfall parts of the SWAFR and living in wet habitats. *Cephalotus*, for example, is estimated to have diverged from its nearest relatives in the American Brunelliaceae at about 95 million years ago (Pillon *et al.* 2021).

Haemodorum sandifordiae has small edible bulbs, as do other members of the genus. There is a delay but eating a small amount leaves a tingling curry-like sensation at the tip of the tongue and back of the throat. Perhaps cooking would reduce this sensation. A tantalising comment made by the late George Gardner (pers. comm., 3 August 1987) on Marron Road 9.5 km due north of the north-west end of Broke Inlet was that the 'Aborigines used the local *Haemodorum* roots pounded into flour as a bitter laxative taken straight'. Precisely which *Haemodorum* he was speaking of was not made clear, but *H. sandifordiae* was and is common in the area, much more so than *H. spicatum* or *H. sparsiflorum*.

Haemodorum subg. **Haemodorum**

Haemodorum clarksonii Hopper & E.J.Hickman, *sp. nov.*

Type: 0.5 km south of Watson River crossing on the Aurukun to Merluna Road *c.* 40 km north-east of Aurukun, Queensland, 2 December 1981, *J.R. Clarkson* 4044 (*holo*: BRI AQ0405383; *iso*: CNS (QRS 69946.1, MBA 7355.1, MBA 7355.2), DNA D0053837, K, MO, NT, PERTH).

Haemodorum clarksonii Hopper ms, in R.J. Smith, S.D. Hopper & M.W. Shane, *Plant Soil* 348: 467 (2011), *nomen nudum*.

Geophyte. *Aerial stems* 10–35 cm long, with inflorescence much shorter than the leaves, sometimes barely protruding from the ground. *Roots* sand-binding, to 5 cm long, 4 mm diameter. *Bulb* 10–12 cm below soil surface, dark red. *Basal leaves* 1, rarely 2 or 3; lamina orange–red to white below soil surface, green above, subterete, 10–45 cm long, *c.* 1 mm wide above ground. *Inflorescence* tightly corymbose, pyramidal, with flowers subsessile, tightly clustered on short axes 5–35 mm long, 8–12 flowers per unit, the flowers white to pale pink with darker longitudinal lines where petals exceed the sepals. *Inflorescence bracts* minute, green with scarious white fine margins and acute apex. *Floral bracts* two, slender acute, green, 3–5 mm long, <1 mm wide, shorter than individual flowers. *Flowers* 3–5 mm long; pedicel <1 mm long. *Sepals* cream to pale pink, narrowly triangular, acute, 3–4 mm long, about three quarters the length of the petals. *Petals* lilac, aging to deep purplish blue, broadly linear, obtuse, 3–5 mm long. *Stamens* lilac with the filaments white tending to lilac at the tips, unequal, one shorter than the other two, tallest pair level or half emergent from petals at anthesis; filaments 2.4–4.0 mm long; anthers lilac at anthesis, erect and held vertically, 1.0–1.2 mm long. *Style* at anthesis pale orange to cream with minute darker orange to red stigma, 3–4 mm long, equal to the petals. *Fruits* 3-locular, each member greenish to black and maturing pale bronze to dark orange-red, spherical, 2–3 mm diameter. *Seeds* black, discoid, with distinctly thickened marginal wings, *c.* 1.5–2.5 mm wide; wing 0.5 mm wide. Following dehiscence of seed, fruit has bright orange-red inner walls of the carpel cavities. (Figures 2, 3, 9–11)

Diagnostic features. Very short-scaped geophyte. This new taxon differs from *H. brevicaule* F.Muell. (Figure 11) in having white to lilac subsessile flowers instead of deep red or purplish black sessile flowers, and white to lilac stamens with one stamen shorter than the other two, instead of three yellow to red stamens that are equal in length (Figures 2, 3, 11).

Other specimens examined. NORTHERN TERRITORY: near east branch of Wildman River, Arnhem Highway, 29 Nov. 2013, *I.D. Cowie* 13660 & *N. Cuff* (BRI, DNA D0234151, SPIRIT, PHOTO at DNA; MEL 2414271A; PERTH 08837562). QUEENSLAND: Lakefield National Park, vicinity of Lake Emma, 24 Jan. 1993, *A.R. Bean* 5570 & *P.I. Forster* (BRI); 12.5 km north of Laura on the Peninsula Development Rd, 20 Dec. 1988, *J.R. Clarkson* 7704 & *V.J. Neldner* (BRI AQ0464055, DNA D0061305, L, PERTH, QRS); 6.1 km N of the North Kennedy River on the Peninsula Development Road, 20 Dec. 1988, *J.R. Clarkson* 7705 & *V.J. Neldner* (BRI AQ0464056); 0.9 km N of Big Coleman River on the Peninsula Development Rd, 21 Dec. 1988, *J.R. Clarkson* 7723 & *V.J. Neldner* (BRI AQ0464059); 13.0 km N of Musgrave Station, 10 Dec. 1983, *C.F. Puttock* UNSW 15865 (BRI, MEL 0719792A, NSW 811720, UNSWDB11421); 8.1 km SW of the Balurga turn off from the Pompuraaw Rd, 9 Dec. 2013, *S.L. Thompson* ST 13560 (BRI AQ0914496); about 17.6 km S of Piccaninny Homestead, on SE boundary of Piccaninny Plains WS with Wolverton, 9 Dec. 2013, *R. Jensen* 3079 & *J.E. Kemp* (BRI AQ0880510); 5.5km SW of Peninsula Development Rd on Dixie, 8 Dec. 2013, *S.L. Thompson* ST 13549 (BRI AQ0914495).

Phenology. Flowers December–January.

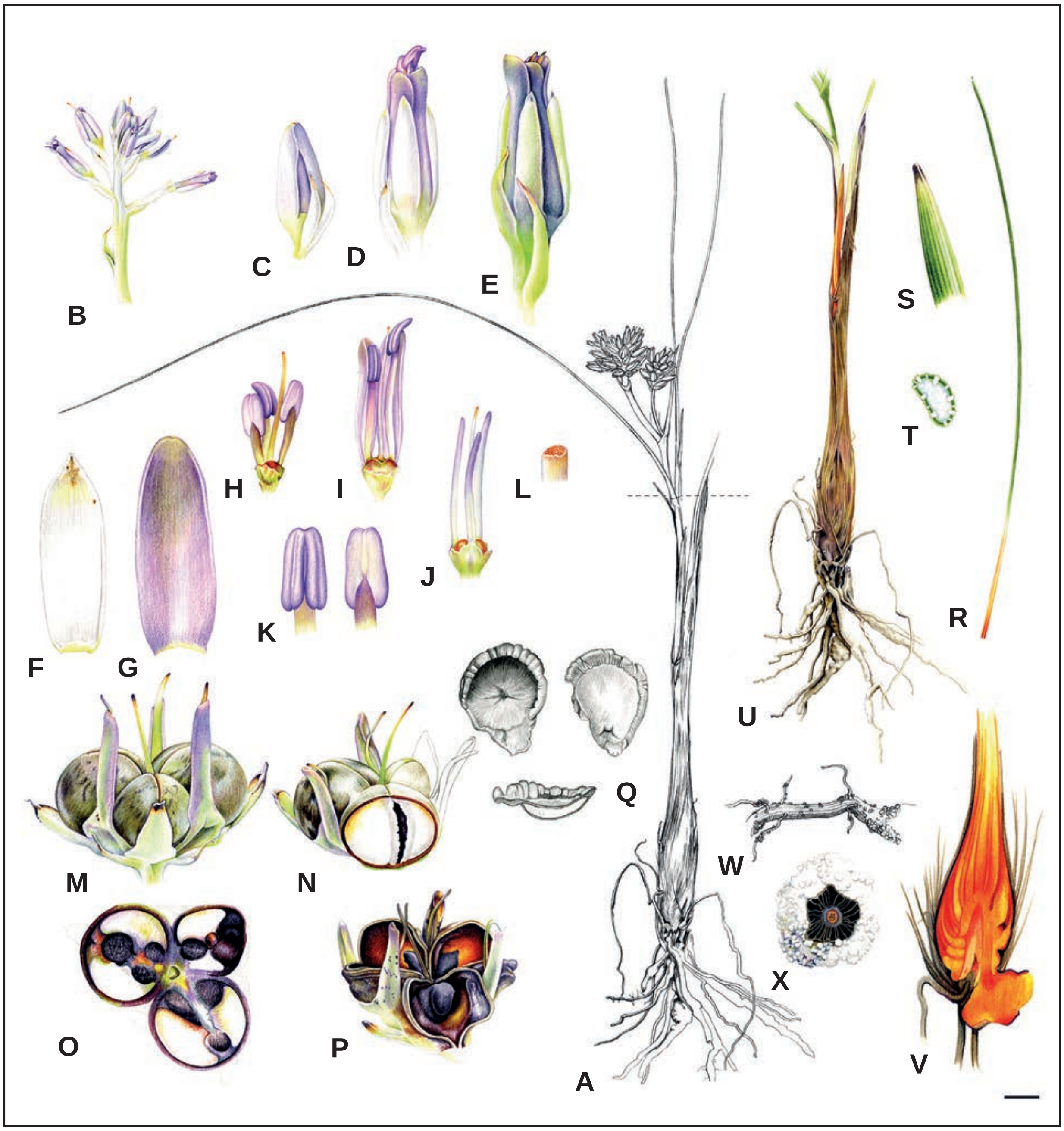

Figure 9. *Haemodorum clarksonii*. A – whole plant (dashed line represents soil level); B – inflorescence; C – flower bud; D – young flower; E – old flower; F – sepal; G – petal; H – flower with perianth removed; I – young flower with anthers attached; J – old flower with anthers detached; K – anthers viewed from front and back; L – stigma; M – fruit; N – fruit with part of carpel wall removed to show developing seeds; O – cross-section through fruit to show three carpels with two seeds developing in each; P – dehisced fruit; Q – seeds: dorsal, ventral and cross-section; R – leaf; S – leaf-tip; T – leaf cross-section; U – below-ground parts; V – longitudinal-section through bulb; W – part of root; X – cross-section through root with sand-binding sheath. Scale bars = 1 cm (A, R, U); 4 mm (B, V, W); 1.25 mm (C, D, E, H, I, J, M, N, O, P, Q, S); 0.65 mm (F, G, K, T, X); (L) = 0.2 mm. Illustration by E.J. Hickman.

Distribution. *Haemodorum clarksonii* extends across a 370 km range from the latitude of Cooktown to just north of Arukun in Cape York Peninsula, Queensland, and is known from one location near the Wildman River in Arnhem Land, Northern Territory (Figure 11).

Habitat. In Queensland the new species is found in sand in tropical grassy savannah with trees such as *Corymbia clarksoniana C. dallachiana*, *C. polycarpa*, *Eucalyptus cullenii*, *E. leptophleba*, *E. megasepala*, *E. platyphylla*, *E. tetrodonta*, *Acacia leptocarpa*, *Brachychiton diversifolius* subsp. *orientalis*, *Cochlospermum gillivraei*, *Erythrophleum chlorostachys*, *Melaleuca viridiflora*, *M. citrolens*,

Figure 10. *Haemodorum clarksonii*. A – plant and leaf; B – bulb, leaf bases and sand-binding roots; C – pig damage to *Haemodorum clarksonii* and Cockatoo grass *Alloteropsis semialata*; D – habitat near the Big Coleman River. Photographs by John Clarkson (A); S.D. Hopper (B, C, D).

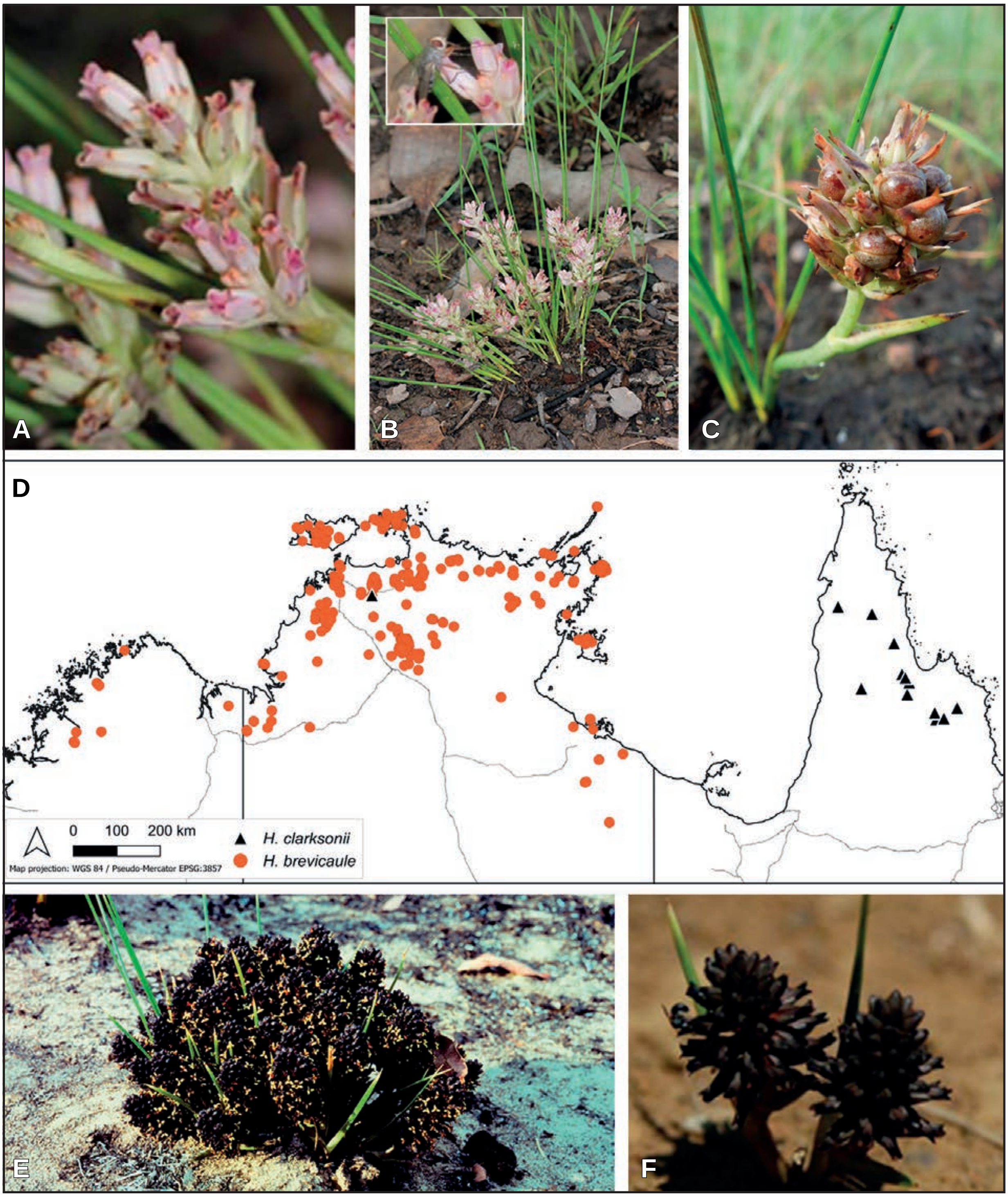

Figure 11. Geographic distributions and flowering plants of *Haemodorum clarksonii*. A – flowers; B – whole plant, inset: dipteran pollinating flower; C – whole plant in fruit; D – map showing distribution of *H. clarksonii* (▲) and its western sister species *H. brevicaule* (●); E – *H. brevicaule* habit, note the emergent yellow anthers; F – black flowers. Map derived from the Atlas of Living Australia. Photographs by Ian Cowie (A, B, D, Northern Territory); biology-assets@anu.edu.au (E); Ellen Hickman (C, Cape York).

Petalostigma banksii and *P. pubescens* (from specimen labels). Grasses recorded include *Heteropogon triticeus* and *Alloteropsis semialata* (from specimen labels). Underlying geology can be granite or sandstone.

On Artemis Station in May 2002, John Clarkson and SDH recorded *Haemodorum clarksonii* in a very open woodland of *Corymbia dallachiana*, *Eucalyptus tetrodonta*, *E. cullenii*, *Brachychiton* sp., *Melaleuca foliolosa*, *M. viridiflora*, *Alphitonia pomaderroides*, *Terminalia platyptera*, *Petalostigma banksii* and *Grevillea mimosoides* over grasses including Cockatoo Grass *Alloteropsis semialata* and Fire Grass *Schizachyrium* sp. The terrain was gradually sloping on the bank of a westward flowing creek. Tors and blocks of outcropping granite were evident. Golden Shouldered Parrots occur in this habitat and in 1993 pastoralist Sue Shepherd (pers. comm., 2002) observed these endangered birds feeding on sticky immature *Haemodorum clarksonii* fruits in the first few weeks after start of the Wet season. Their bills were stained black by the *Haemodorum* at the time.

At a second location, *c.* 300 m upslope from the Big Coleman River (Figure 10D), *H. clarksonii* was scarce in gritty sand and granite rocks in a 10–12 m woodland of *Eucalyptus tetrodonta*, *Corymbia hylandii* subsp. *peninsularis*, *C. dallachiana* and *C. clarksoniana* over *Melaleuca viridiflora*, *Grevillea pteridifolia*, *Petalostigma banksii*, *Melaleuca citrolens*, *Xanthorrhoea johnsonii*, *Acacia rothii*, *A. leptocarpa*, *A. calyculata*, *Grewia occidentalis*, *Exocarpos latifolius*, *Brachychiton ?heterophyllus*, *Xylomelum* sp., *Trema tomentosa* var. *aspera*, *Breynia cernua* and *Alphitonia pomaderroides* over grasses and herbs.

In the Northern Territory the habitat near the Wildman River on Arnhem Highway is given as 'in *Melaleuca viridiflora* low woodland with perennial grasses; drainage flat; poorly drained grey loamy clay (too heavy textured to support debil debil mounds)'.

Etymology. Named for John Richard Clarkson (1950–), distinguished north Queensland botanist, who has discovered many new species on Cape York and adjacent regions. Since 1979, John has been based in Mareeba in far north Queensland, working for the State government as a botanist, currently with the Queensland Parks and Wildlife Service. John has been a hospitable host during visits to the Atherton Tablelands and Cape York for field work by SDH, and also served in various capacities, including as President, for the Australasian Systematic Botany Society. He was the first to recognise this *Haemodorum* as a new species. Hence, it is fitting to name *H. clarksonii* for him.

Conservation status. Indeterminate. The species has a moderate geographical range of 370 km in Cape York and vast areas of suitable habitat exists in the vicinity of the Peninsula Development Road, as well as one location in the Northern Territory. However, detailed surveys of *H. clarksonii* are yet to be undertaken. Moreover, feral pigs target the bulbs of the species for consumption (Figure 10C). The finding of *H. clarksonii* in the Northern Territory, where it was recognised as new and labelled as *Haemodorum* sp. Wildman River (I.D. Cowie 13660 & N. Cuff), opens up the need for further survey in that disjunct region as well.

Vernacular name. Clarkson's Bloodroot is recommended.

Affinities and notes. *Haemodorum clarksonii* is a tropical species in *H.* subg. *Haemodorum*. It is recognised as a new species distinct from *H. brevicaule* from Western Australia and the Northern Territory into which specimens were previously placed. The flowers of *Haemodorum clarksonii* have white sepals that are significantly shorter than the lilac petals (Figures 9C, D, F, G; 10A). As the flower matures the sepals become greenish and the petals a deep purplish blue (Figure 9E). There are three stamens with one shorter than the other two (Figure 9H). The anthers are lilac and the filaments white tending to lilac at the tips (Figure 9H, I, K). As the flower matures the anther drops from the filament (Figure 9J). The style is white with a minute orange to red stigma (Figure 9L). The fruit is a pale green three-carpellate capsule (Figure 9M) which becomes pale bronze coloured once fully mature. When the fruit dehisces and releases its seeds it reveals the bright orange-red inner walls of the carpel cavities (Figure 9P). The discoid seeds have distinctly thickened marginal wings (Figure 9Q). These small statured plants have a deeply buried bulb (Figure 9A), which is orange-red in cross-section (Figure 9V). The leaves are sub-terete (Figure 9T). The roots are sand-binding (Figure 9X). *Haemodorum clarksonii* differs from *H. brevicaule* (Figure 11) in having white to lilac flowers instead of deep red or purplish black flowers, and white to lilac stamens with one stamen shorter than the other two, instead of three yellow to red stamens that are equal in length.

Haemodorum clarksonii was first collected by H. Flecker from Coen Aerodrome in 1947. A number of populations of this species were found on Cape York Peninsula during the 1980s by John R. Clarkson, who recognised it as a distinct species. *Haemodorum brevicaule* occurs in Western Australia on the Mitchell Plateau, and in north and north-eastern Northern Territory, including Melville Island and Groote Eylandt, while *H. clarksonii* occurs only on Cape York Peninsula in Queensland except for the single Northern Territory location near the Wildman River on the Arnhem Land plateau (Figure 11). There appear to be no significant morphological differences between this population and those found on Cape York. Photos indicate the clearly diagnostic combination of sepals white, petals mauve to pale lilac, and stamens purple-lilac (Figure 11). No other species of *Haemodorum* has this unusual combination of colours (e.g. Figure 2, 3), although *H. spicatum* does have lilac-purple anthers.

A single hover fly (Figure 11B) is the only record of a pollinator on *H. clarksonii*.

Although *H. clarksonii* has been confused with *H. brevicaule*, recent molecular phylogenetics investigations (Hopper *et al.*, unpubl.) indicate that *H. clarksonii* is sister to a larger clade of tropical taxa including *H. coccineum*, *H. ensifolium* F.Muell., *H. interrex* R.L.Barrett & M.D.Barrett, *H. condensatum* Hopper & R.L.Barrett, *H. subvirens* F.Muell., *H. brevicaule*, *H. leptostachyum* Benth., and *H. griseofuscum* R.L.Barrett, M.D.Barrett & Hopper. *Haemodorum clarksonii* diverged from this clade about 1.7 million years ago and, thus, it is a taxonomically isolated and distinctive tropical species, as is evident from its unusual coloration of white and lilac flowers.

Haemodorum discolor T.Macfarlane

Easterly populations of this species are distinguished by their more robust, thick, dark green, shorter leaves to 30 cm long (e.g. *R.J. Smith et al.* 240, PERTH 08813280, from Boorabbin National Park) compared with the much thinner and longer-leaved type from Wannamal. Further research is recommended.

Haemodorum ghungalorum Hopper, *sp. nov.*

Type: Blackdown Tableland National Park, Stony Creek Gorge, 400 m west of carpark, Queensland, 11 November 1998, *S.D. Hopper* 8405 (*holo*: BRI; *iso*: K, MEL, NSW, PERTH 09385894).

Haemodorum gungalorum Hopper ms, in R.J. Smith, S.D. Hopper & M.W. Shane, *Plant Soil* 348: 467 (2011), *nomen nudum*.

Geophyte. *Aerial stems* 80–150 cm long, usually 80–100 cm. *Inflorescence* to 150 cm long, much longer than the leaves. *Roots* sand-binding. *Bulb* 10–15 cm below soil surface, orange-red, to 15 mm diameter. *Basal leaves* 2–4; lamina orange-red below ground to white below soil surface, green above, flat, 50–90 cm long, *c.* 2–2.5 mm wide above ground. *Inflorescence* a narrow open panicle. *Inflorescence bracts* opaque, green, narrowly triangular, 8–35 mm long, the veins obscure abaxially, margins not differentiated. *Floral bracts* black, acute, narrowly triangular, 4–7 mm long, 1–2 mm wide at base, reaching to 2–3 mm below the base of ovary at anthesis. *Buds* brownish orange near base, brownish black above. *Flowers* solitary and well-spaced, 5–20 mm apart, 5–12 flowers per unit, glossy black, especially the sepals, 8–10 mm long, sepals slightly paler than petals, faintly fragrant like antiseptic aniseed; pedicels 6–8 mm long. *Sepals* 3/4 to almost as long as petals, glossy, obtuse, narrowly triangular, 6–7 mm long, 1.5–2.0 mm wide. *Petals* obtuse, narrowly navicular, pliant, 7–9 mm long, 1.5–2.5 mm wide, glossy black, reaching 1–2 mm above the sepals. *Stamens* equal, 7–9 mm long, anthers borne near top of petals, visible and partly exposed from above at anthesis, pale yellow to gold, 2–3 mm long; filaments dark purple, 5–6 mm long. *Style* barely shorter than petals, at anthesis reaching to middle or upper part of anthers, 7–9 mm long, purple. *Stigma* pale purple-cream. *Fruits* three locular, glossy blackish purple above, producing a dark purple juice when squashed while immature. *Seeds* black, circular, flat, 3–6 mm diameter. (Figures 12, 13)

Diagnostic features. *Haemodorum ghungalorum* may be distinguished from all other members of the genus by the following combination of characters. Geophyte, aerial stems 80–150 cm long, usually 80–100 cm. Inflorescence to 150 cm long, much longer than the leaves. Basal leaves flat, 500–900 mm long, *c.* 2–2.5 mm wide above ground. Inflorescence a narrow open panicle. Floral bracts black, acute, narrowly triangular, 4–7 mm long, 1–2 mm wide at base, reaching to 2–3 mm below the base of ovary at anthesis. Buds brownish orange near base, brownish black above. Flowers solitary and well-spaced 5–20 mm apart, 5–12 flowers per unit, glossy black, especially the sepals, 8–10 mm long, sepals slightly paler than petals; pedicels 6–8 mm long. Sepals 3/4 to almost as long as petals, glossy. Petals obtuse, narrowly navicular, glossy black, reaching 1–2 mm above the sepals. Stamens equal, 7–9 mm long; anthers borne near top of petals, visible and partly exposed from above at anthesis; filaments dark purple, 5–6 mm long. Style barely shorter than petals, at anthesis reaching to middle or upper part of anthers, 7–9 mm long, purple.

Other specimens examined. QUEENSLAND: Blackdown Tableland, South Mimosa Creek, 12 June 1977, *M.D. Crisp* 2974 (CANB CBG7703029); Blackdown Tableland, south of Dingo, 10 May 1975, *J. Donahue s.n.* (JCT-S5845.1); Blackdown Tableland, *c.* 32 km SE of Blackwater (campsite at Mimosa Creek), 0.8 km upstream from camp, elev. 600–900 m, 25 Apr. 1971, *R.J. Henderson* 847, *S.B. Andrews* & *P.R. Sharpe* (BRI AQ0002273); Blackdown Tableland, near old stockyard on Mimosa Creek, upstream from main N-S road, 10 Jan. 1973, *R.J. Henderson* 1397 & *P.R. Sharpe* (BRI AQ0396247; CANB 383512.1); E Blackdown Tableland National Park, Stony Creek Gorge, 400 m west of carpark, 11 Nov. 1998, *S.D. Hopper* 8404 (CANB, MEL, NSW, PERTH 09277277); Blackdown Tableland between South Mimosa Creek and Rainbow Falls, 23 Nov. 2001, *A. Worz* 23.11.17.01 (BRI AQ0847812).

Phenology. Flowers October–January, peaking in November.

Distribution. Endemic to the Blackdown Tableland (600–900 m elev.) at the north-west end of the Expedition Range, 180 km west-south-west of Rockhampton, Queensland (Figure 13B).

Habitat. Confined to grey-brown sandy loam soils within a few hundred metres of sandstone outcrops near creeklines. Grows in forest and woodland of *Blakella watsoniana* subsp. *capillata*, *Eucalyptus sphaerocarpa*, *E. longirostrata*, *E. melanoleuca* and *Livistona fulva* with an understorey of open scrub of *Acacia* spp., *Grevillea*, *Persoonia* and Fabaceae over *Themeda triandra* grassland with scattered herbs and low shrubs including *Thysanotus*, *Goodenia*, *Macrozamia platyrhachis*, *Thelymitra*, *Persoonia*, *Tricoryne*, *Poranthera* and *Dianella*.

Etymology. Named as a mark of respect for the Ghungalu people (Kangulu, Kanolu, Kaangooloo, Ghungalu and other variations), inland from Rockhampton in central Queensland, whose traditional lands include the Blackdown Tableland as well as open grassy plains and big rivers such as the McKenzie, Dawson and Comet Rivers. Rock art of Ghungalu people is a feature of the Mimosa Culture Track where *H. ghungalorum* grows.

Conservation status. *Haemodorum ghungalorum* is known from two populations 4 km apart, each of less than 50 plants. Both populations are in the Blackdown Tableland State Forest (now a National Park). Suitable habitat away from the main road and walking trails should be searched for the species. Recommended IUCN category: Data Deficient.

Vernacular name. Blackdown Tableland Bloodroot is recommended. The Tableland was given its European name in 1869 by pastoralist William Yaldwin, who named it after Blackdown House, his family home in Sussex, England. The Ghungalu people may have a name for this species.

Figure 12. *Haemodorum ghungalorum*. A – flowers and young glossy fruits; B – whole plant, 1 m tall; C – bulb and leaf bases from below ground, alongside flowers and buds; D – buds and flowers, one opened up, illustrating glossy black sepals, stamens with dark purple filaments and pale yellow anthers held with midpoints level with sepal apices, and pale purple-cream style and stigma; E – six dissected fresh flowers, each row showing (left to right) floral bract, three narrowly triangular glossy sepals, three narrowly navicular petals, three stamens and style in some cases. Photographs by S.D. Hopper from *S.D. Hopper* 8405, Blackdown Tableland National Park, Stony Creek Gorge, 400 m west of car park (type location).

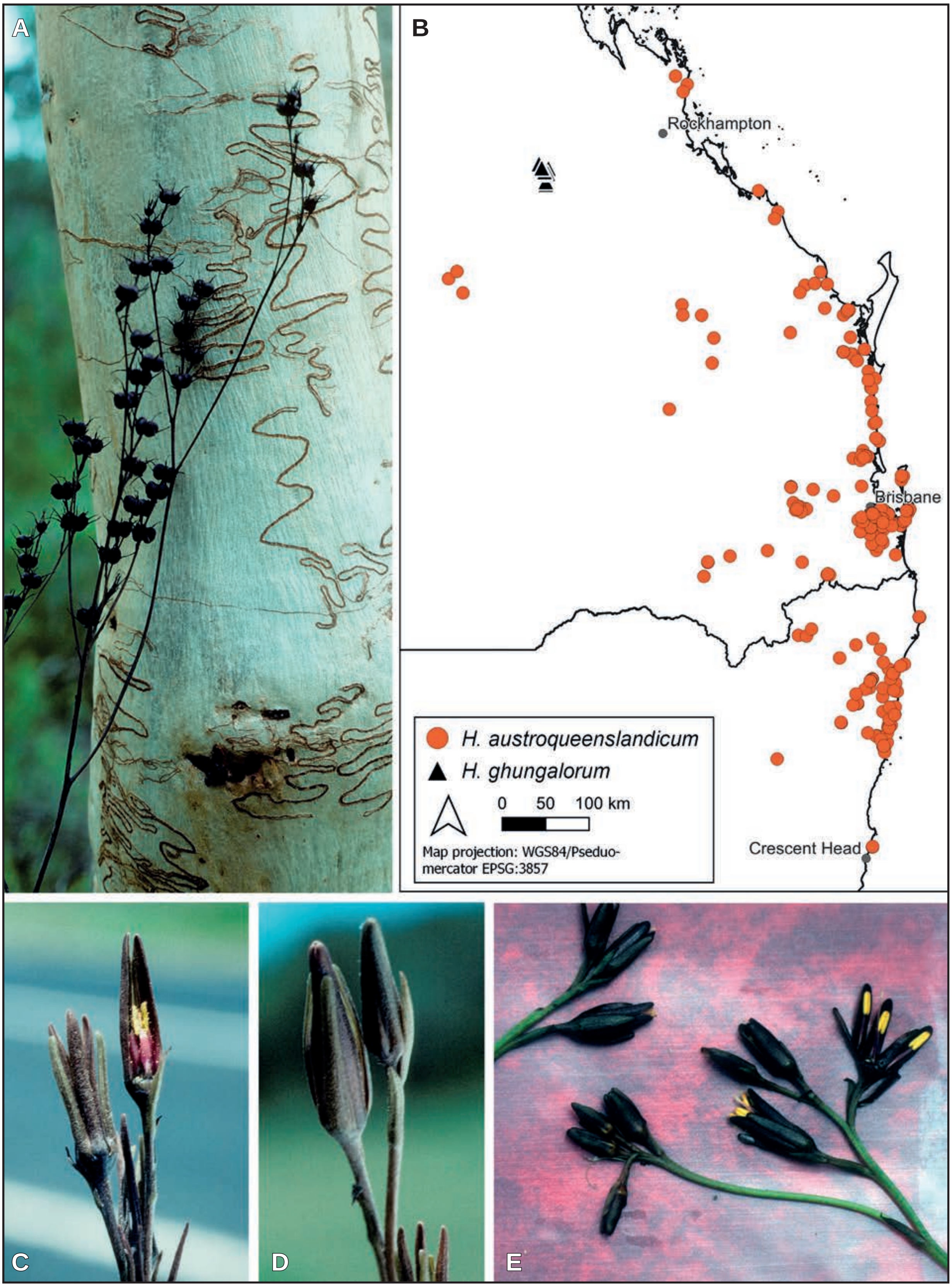

Figure 13. *Haemodorum austroqueenslandicum*: A – fruiting inflorescence against scribbly bark of *Eucalyptus racemosa*; B – geographical distribution of *H. austroqueenslandicum* (●) in south-east Queensland and north-east New South Wales (map from *Atlas of Living Australia*); C – mature flowers, one dissected to illustrate that the anthers attain only ½ the length of the petals; D – fresh flower and adjacent bud showing the greenish linear obtuse dull sepals and narrowly triangular obtuse black-brown dull petals. *Haemodorum ghungalorum*: E – flowers showing stamens about equal in length to the petals, buds; B – geographical distribution (▲). Photographs by S.D. Hopper.

Affinities and notes. Now placed in *H.* subg. *Haemodorum, H. ghungalorum* was first collected by Rod Henderson, S.B. Andrews and P.R. Sharpe in April 1971 in the same year as the opening of the forestry road up onto Blackdown Tableland. At the time, the species, in fruit, was regarded as *H. austroqueenslandicum* Domin (Figure 13), representing a considerable north-westerly range extension for that species. Other early collections were also in fruit only. Macfarlane (1987a: 144) consequently included *H. ghungalorum* within *H. austroqueenslandicum*, but noted that 'collections from the Blackdown Tableland, Qld, are atypical and require further study'.

In 1990, *H. ghungalorum* was seen (but not collected) growing with *Macrozamia platyrhachis* by David Jones (pers. comm., July 1998). Subsequently, SDH was able to collect flowering material of *H. ghungalorum* in November 1998 and compare it with fresh specimens of *H. austroqueenslandicum* and *H. planifolium* R. Br. within a few days. This confirmed the status of *H. ghungalorum* as a new species. Contemporary molecular phylogenetic studies (Hopper *et al.*, unpubl.) have affirmed that *H. ghungalorum* and *H. austroqueenslandicum* are sisters that diverged approximately one million years ago.

Haemodorum ghungalorum differs from *H. austroqueenslandicum* in its longer consistently narrow leaves to 90 cm, 1–2.5 mm vs 30 cm, 1.5–7 mm; floral bracts shiny and 4–7 mm long, 1–2 mm wide at base vs dull and 6–8 mm, 1 mm; flowers smaller, to 8–10 mm long vs 10–12 mm; sepals glossy black, 6–7 mm long vs dull grey-green, 9–11 mm; petals shorter, 7–9 mm vs 10–13 mm; and stamens longer with anthers partly visible atop perianth at anthesis, 7–9 mm vs 4–6 mm, not visible atop perianth at anthesis. *Haemodorum ghungalorum* is more distantly related to the *H. planifolium* group, from which it differs in its narrower leaves (1–2.5 mm vs 2–5.5 mm wide), smaller glossy black flowers (8–10 mm vs 11–16.5 mm long) with a faint antiseptic aniseed odour, vertically arranged in the slender inflorescence (vs paniculate with widely divergent branches), with stamens and style about as long as petals and sepals (vs somewhat shorter), and the anthers clearly visible and partly exposed at anthesis (vs not visible atop perianth).

Haemodorum laxum R.Br.

Atop Mt Lindesay (Western Australia), two morphs are evident (SDH unpublished observations, 28 December 1998). The typical morph grows in lateritic loam and has narrower dark green leaves 300–700 mm long, 3–7 mm wide. It grows with *Anigozanthos flavidus* in forest of jarrah and marri. A possibly undescribed morph grows in granitic sandy loam near rock outcrops. Its leaves are yellowish green, falcate or spirally twisted, and to 450 mm long, 7–11 mm wide. It grows to 50 cm tall in stunted mallee jarrah with scattered emergent *Xanthorrhoea preissii*, *Kingia australis*, *Beaufortia decussata* and *Banksia grandis* over low scrub of *Banksia*, *Dasypogon* and sedges such as *Lepidosperma hopperi*. Careful dissection of flowers revealed no distinct differences between these two morphs save more prominent venation in the bracts of the typical morph. The possibly undescribed granitic morph is illustrated in Macfarlane (1987a in Figure 53 based on Macfarlane 1583 (PERTH 0307928)) from Darling Scarp granites at Lesmurdie. Further taxonomic research is needed to ascertain the consistency of these differences between possible subspecies across the geographic range of *H. laxum.*

Haemodorum leptostachyum Benth.

Bentham (1873) named *H. leptostachyum* and *H. parviflorum* Benth. on the same page, distinguishing *H. leptostachyum* primarily by its simple scape, sometimes branching once below the middle (a panicle with racemose flowers in *H. parviflorum*), and its flowers sessile or nearly so (pedicellate in *H. parviflorum*). Macfarlane (1987a), on the basis of herbarium material, concluded that these two taxa should be treated as conspecific, and consequently synonymised *H. leptostachyum* under *H. parviflorum*.

We have been able to confirm through field work that Bentham's characters hold up in the wild. There is also a significant colour difference we have noted, with *H. leptostachyum* having bright red flowers when fresh, while those of *H. parviflorum* are yellow (Figure 14). In addition, the two taxa occur sympatrically south of Darwin in the Virgina area and do not appear to hybridise. Based on these observations, together with an examination of the relevant types, we conclude that *H. leptostachyum* is a distinct species and warrants reinstatement.

Haemodorum parviflorum Benth. and **H. flaviflorum** W.Fitzg.

A combination of field and herbarium studies indicate that two entities (Figure 14) are included within *H. parviflorum*, represented by the two specimens Bentham (1873) cited in the protologue of this species. Cunningham's specimen from Brunswick Bay, NW coast of the Kimberley, represents a taxon subsequently named as *H. flaviflorum* by Fitzgerald (1918) based on Edkins Range material. This taxon has narrow erect panicles of many-flowered (up to 20) racemes, with scapes to 85 cm tall. Interestingly, there appear to be disjunct populations of this taxon well to the east in Arnhem Land (Figure 15).

In contrast, Schultz's Port Darwin collection cited by Bentham (1873) has shorter scapes (to 45 cm) with broader more divergently branched panicles of fewer-flowered racemes (usually 4–5, never more than 10). This taxon appears to be endemic to the Northern Territory near to Darwin (Figure 14). Moreover, it bears the closest resemblance to the protologue of *H. parviflorum* because of its few-flowered racemes and its ''Panicle consisting of few, sometimes only 2 or 3 slender spreading branches'. For these reasons we lectotypify here *H. parviflorum* on the Schultz specimen and reinstate *H. flaviflorum* because this species was placed under synonymy within *H. parviflorum* by Macfarlane (1987a).

Haemodorum planifolium R.Br.

Macfarlane (1987a) mentioned variation in inflorescence form and relative dimensions of some floral parts that required further study in this species. Macfarlane and Barrett (2025) recently revised the *H. planifolium* complex and named three new species allied to *H. planifolium* – *H. brevistylum* T.Macfarlane & R.L.Barrett, *H. celsum* R.L.Barrett & T.Macfarlane and *H. collevatum* T.Macfarlane & R.L.Barrett.

Haemodorum subvirens F.Muell.

Regarded as a synonym of *H. coccineum* by Macfarlane (1987a), but reinstated by Hopper *et al.* (2009), and later accepted by Smith *et al.* (2011). Earlier collections had been made (see below), the first by A.C. Beauglehole in Western Australia in June 1976 and later by Kim Brennan of the Northern Territory's Conservation Commission, who on 23 November 1999 collected a yellowish-flowered Haemodorum while on a helicopter drop for a biological survey near Jasper Gorge in Judbarra/Gregory National Park. The species' status was confirmed when SDH, Tony Start and Trish Handasyde saw live material on 30 November 2000 also in Judbarra/Gregory National Park, Northern Territory. *Haemodorum subvirens* is easily distinguished from *H. coccineum* by its longer (to 80 cm), broader (10–12 mm wide, occasionally to 15 mm) bright green semi-glossy leaves, and its green or yellow-green flowers with prominently exserted cream anthers (Figure 16). Western Australian collections have crimson flowers with bright orange anthers and sepals, and petals green to brownish yellow basally. They may constitute a different subspecies. *Haemodorum subvirens* grows in alluvial soils along or adjacent to creeklines or seeps that are seasonally waterlogged, whereas *H. coccineum* favours better drained soils. Occurs in Western Australia and the Northern Territory (Figure 16).

Specimens examined. NORTHERN TERRITORY: Gregory National Park, south of Revolver Yards, NT/VR, 17 Apr. 1996, *R. Booth* 1750 & *M. Jones* (DNA D0130166; MEL 0252302A *n.v.*); Jasper Gorge, NT/DG, 23 Nov. 1999, *K.G. Brennan* 4282 (DNA D0143624); Gregory National Park, Joe Creek, 10 km W of the Victoria River Roadhouse, 30 Nov. 2000, *S.D. Hopper* 8522 (KPBG); Gregory National Park, 10 km NW of Victoria River Inn, NT/VR, 27 Feb. 1986, *B.G. Thomson* 1209 (DNA A0080576); Bradshaw Station, NT/DG, 3 June 1997, *G.M. Wightman* 6957 (DNA D0132701). WESTERN AUSTRALIA:

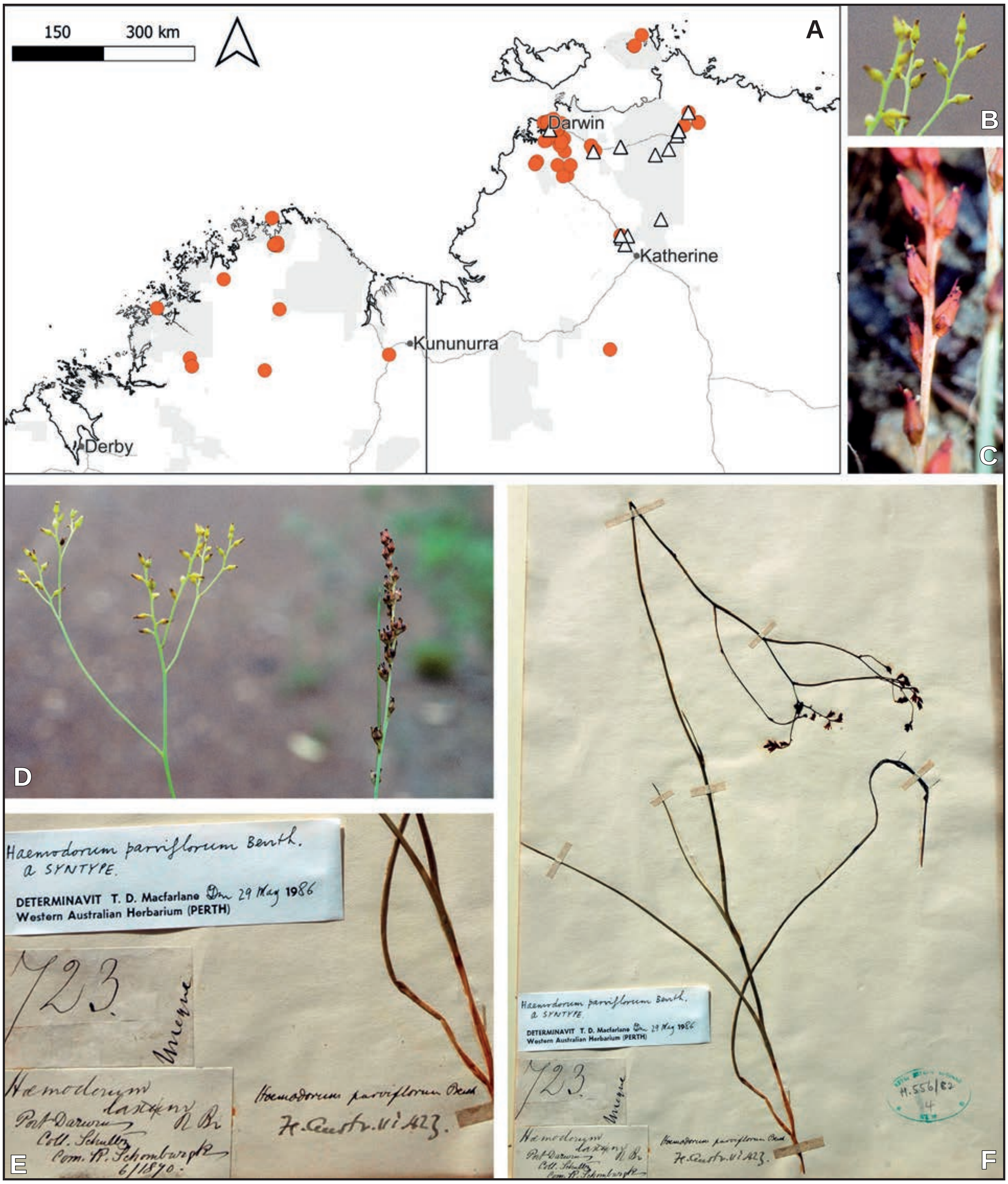

Figure 14. Comparison of floral features and distribution of *Haemodorum parviflorum* and *H. leptostachyum*. A – map of *H. parviflorum* (●) and *H. leptostachyum* (△) collections from *Atlas of Living Australia*; B – *H. parviflorum* yellow flowers; C – *H. leptostachyum* red flowers; D – *H. parviflorum* (left) and *H. leptostacyhum* (right) from sympatric populations at Virginia, NT; E – label details from a syntype of *Schultz* 723, Port Darwin collection (now the lectotype) of *H. parviflorum*; F– full sheet of the same. Photographs by S.D. Hopper.

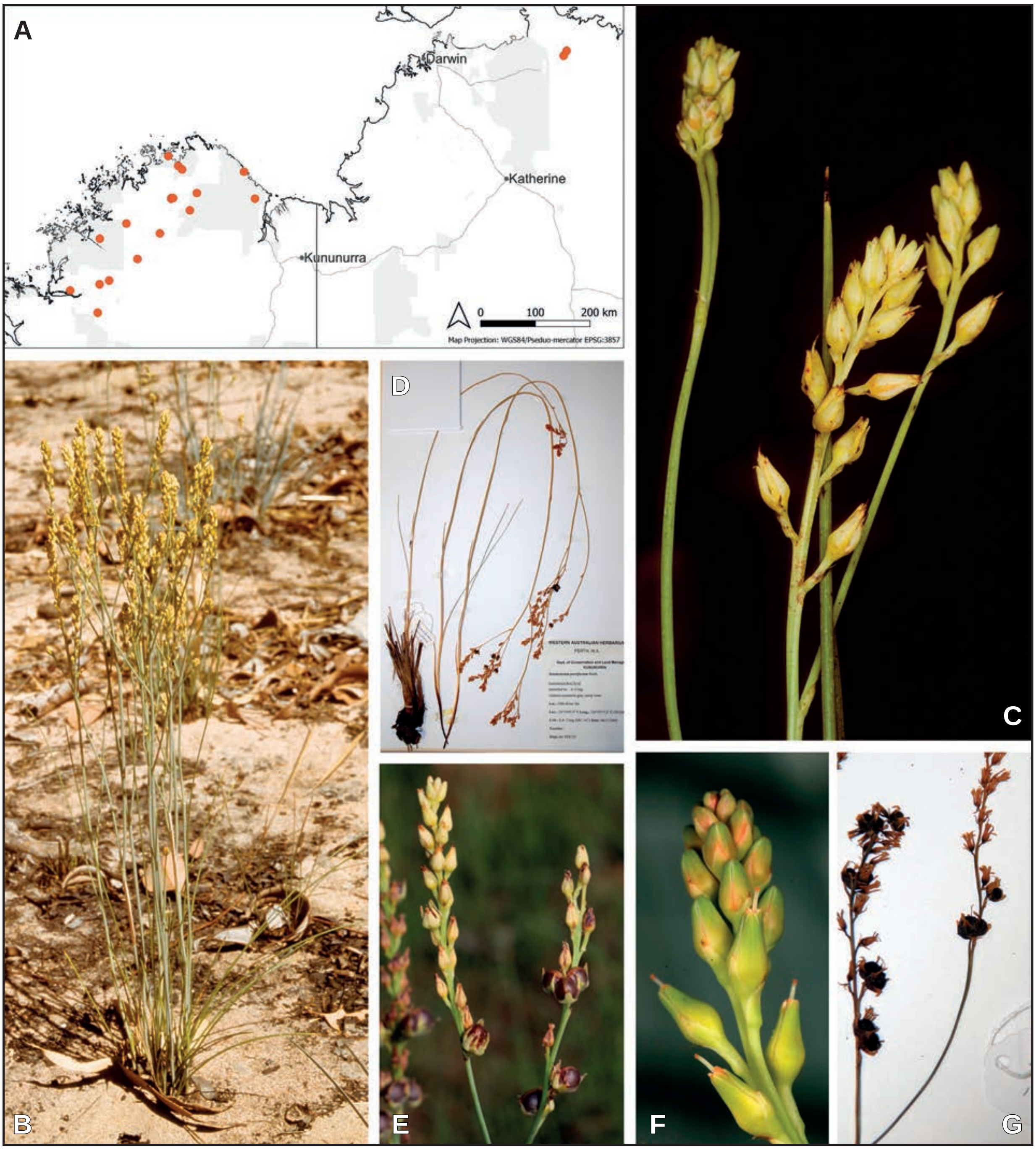

Figure 15. *Haemodorum flaviflorum*. A – distribution map of *H. flaviflorum* (●), specimen data from Atlas of Living Australia; B – plant *in situ* north of Kalumburu 2-10-96 BJC737; C – inflorescences (Princess May Range, *M.D. Barrett* 1015); D – specimen (Gibb River, *A.B. Craig* 1613); E – inflorescences (Synnot Range, West Kimberley); F – close-up of flowers (*R.L. Barrett* 5597 cultivated by R.L. Barrett, ex Drysdale River National Park); G – specimen showing inflorescence (0.8 km ENE of (new) Theda Station Homestead, *M.D. Barrett* 1120). Photographs by M.D. Barrett (C), S.D. Hopper (D, G), R.L. Barrett (E, F), B.J. Carter (B).

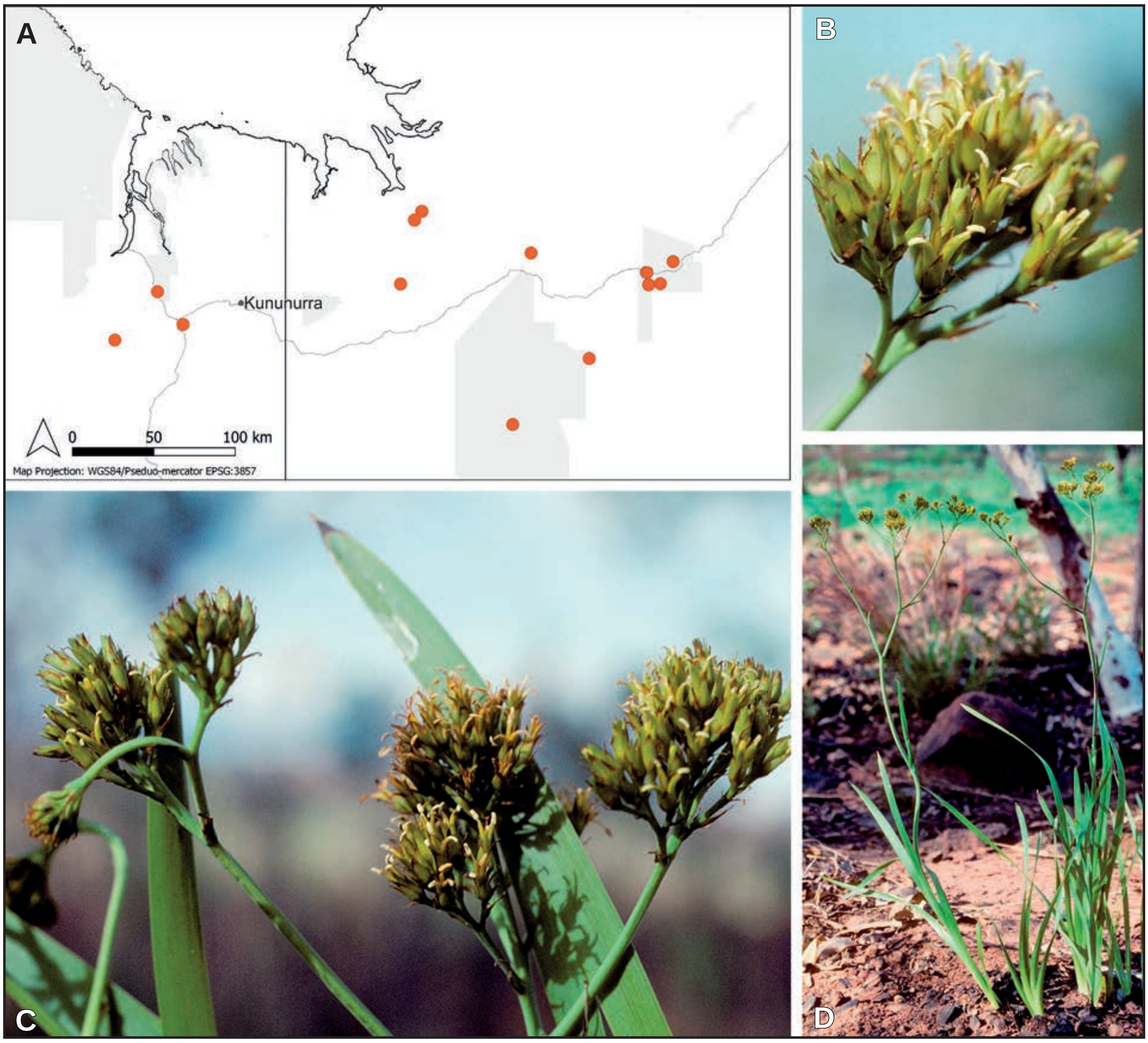

Figure 16. *Haemodorum subvirens*. A – map of geographical distribution (●) across Western Australia and the Northern Territory, modified from Australian Virtual Herbarium (accessed 13/8/2022); B – close-up of inflorescence showing the prominently exserted stamens; C – inflorescences and leaves; D – whole plant. Photographs by S.D. Hopper, taken on 30 November 2000 in the Northern Territory at Judbarra/Gregory National Park at Joe Creek, 10 km west of the Victoria River Roadhouse.

The Grotto, 2 km W of Great Northern Highway, 30 km SSE of Wyndham, Kimberley, 29 June 1976, *A.C. Beauglehole* ACB 54058 (PERTH 04964624); 7 km S of turn off from Gibb River Rd to El Questro Station HS, 15°59'S 128°01'E, 2 July 1989, *K.F. Kenneally* 10993 (PERTH 04964632); Victoria Highway, 11.2 km W of Weaner Creek, 27 Dec. 2000, *A.N. Start* ANS 1349 (PERTH 09021302).

Dilatris and Paradilatris

Dilatris P.J.Bergius is a small genus of three species endemic to the Cape Region of South Africa – *D. corymbosa* P.J.Bergius, *D. ixioides* Lam. (Figure 17) and *D. pillansii* W.F.Barker. Until now, a fourth species, *D. viscosa* L.f. has been regarded as an aberrant species of the genus, sufficiently distinct to merit recent subgeneric status as *Dilatris* subg. *Paradilatris* Hopper ex J.C.Manning (Manning & Goldblatt 2017). Early molecular phylogenetic analyses failed to resolve the position of *D. viscosa* versus other members of the genus (Hopper *et al.* 2009; Zuntini *et al.* 2021). Here, based on recent unpublished molecular phylogenetic studies that affirm that the species is sister to the other three, but morphologically and phylogenetically distinct, the new genus *Paradilatris* (Hopper ex J.C.Manning) Hopper is erected to bring the classification of these two clades in line with others in Haemodoraceae such as *Anigozanthos* and *Macropidia,* which similarly differ fundamentally in floral morphology and fruit dehiscence.

Dilatris P.J.Bergius, *Descr. Pl. Cap.*: 9, t. 3, Figure 5 ([Sep.] 1767). *Type*: *Dilatris corymbosa* P.J.Bergius

Paradilatris (Hopper ex J.C.Manning) Hopper, *stat. nov.*

Basionym: *Dilatris* subg. *Paradilatris* Hopper ex J.C.Manning, *S. Afr. J. Bot.* 113: 104 (2017). *Type*: *Paradilatris viscosa* (L.f.) Hopper.

The new genus *Paradilatris* is monotypic. It differs from *Dilatris* (Figures 17, 18) in having narrow yellow perianth segments rather than broad, lilac perianth segments. *Dilatris* have three stamens, with one yellow anther and two red anthers. *Dilatris ixioides'* yellow anthers are distinctly larger than the red anthers, while the yellow and red anthers of *Paradilatris viscosa* are essentially equivalent in size. The filaments of *D. ixioides* are all cream with a tinge of orange. The filaments of *P. viscosa* are yellow for the yellow anther, and red for the red anthers. The style of *D. ixioides* is cream with a tinge of orange. The style of *P. viscosa* is red. The stigma of *D. ixioides* is red and tuberculate. The stigma of *P. viscosa* is red and glabrous. The hairs of *D. ixioides* are tapering. The hairs of *P. viscosa* are topped with a gland filled with orange-coloured oil. As noted by Barker (1940), in *P. viscosa* the narrow perianth segments are persistent when the flower matures to a fruiting capsule. To disperse the seeds, the capsule splits from the apex halfway down the junction of the carpels. The carpel walls spread apart leaving the central column free at the apex, and a single ovule in each of the three carpels matures to a discoid seed. The seeds detach and are shaken out of the capsule, while the capsule remains intact.

In *Dilatris* species, with broad perianth segments, the perianth becomes papery and aids in seed dispersal by acting as a parachute. Usually only one of the three carpels has an ovule that matures to seed, while the other two carpels are aborted. The ovule matures to fill the entire carpel cavity and is clasped by a flange, formed from the pericarp, which projects inwards round the entire edge of each carpel. The carpel wall containing the ripe seed, held in place by the flange, begins to separate from the receptacle, starting at the base of the fruit, and continuing upwards, until it finally breaks away completely with the perianth attached at the apex, forming a parachute suitable for wind dispersal.

Etymology. From the Greek *para-* = by the side of, near, compared with, alluding to the sister relationship with *Dilatris.*

Affinities and notes. Although recent phylogenetic analyses firmly show that *Paradilatris* and *Dilatris* are sister groups, the classification of the former as a separate genus is somewhat controversial (APG IV 2016; Zuntini *et al.* 2021). Indeed, Manning (in Manning & Goldblatt 2017) erected *Paradilatris* as a subgenus within *Dilatris* after discussion with SDH on its placement in molecular phylogenies prior to the most recent study (Hopper *et al.*, in prep.). The latter unequivocally placed *Paradilatris* as sister to the other three species of *Dilatris*. This molecular evidence, combined with the extensive morphological differences between the two taxa illustrated in Figures 17 and 18, argue for their separation. Moreover, as noted above, the treatment herein is consistent with the tradition of monotypic sister genera to more species-rich genera that are recognised widely in Haemodoraceae. Classification has to recognise long branches and anagenesis, not solely cladogenesis, if the richness of evolutionary trends is to be more fully expressed in taxonomy.

Paradilatris viscosa (L.f.) Hopper, *comb. nov.*

Basionym: *Dilatris viscosa* L.f., *Suppl. Pl.* 101 (1781 [Apr. 1782]). *Type*: South Africa, Western Cape, ‘Cap. bonae spei.’ [‘in summitate Taffelberg [Table Mt] prope frontem’ *fide* Thunberg (1807)], *Thunberg s.n.* (*holo*: LINN [LINNHL63-3] image!; probable *iso*: UPS-THUNB [1237] microfiche!).

Figure 17. Yellow and red-flowered *Paradilatris viscosa* at Highlands, Kogelberg Nature Reserve, South Africa (A, B) and purple-flowered *Dilatris ixioides* with yellow and red coloured uneven anthers in the Cederberg south of Algeria, South Africa (C, D). Photographs by S.D. Hopper.

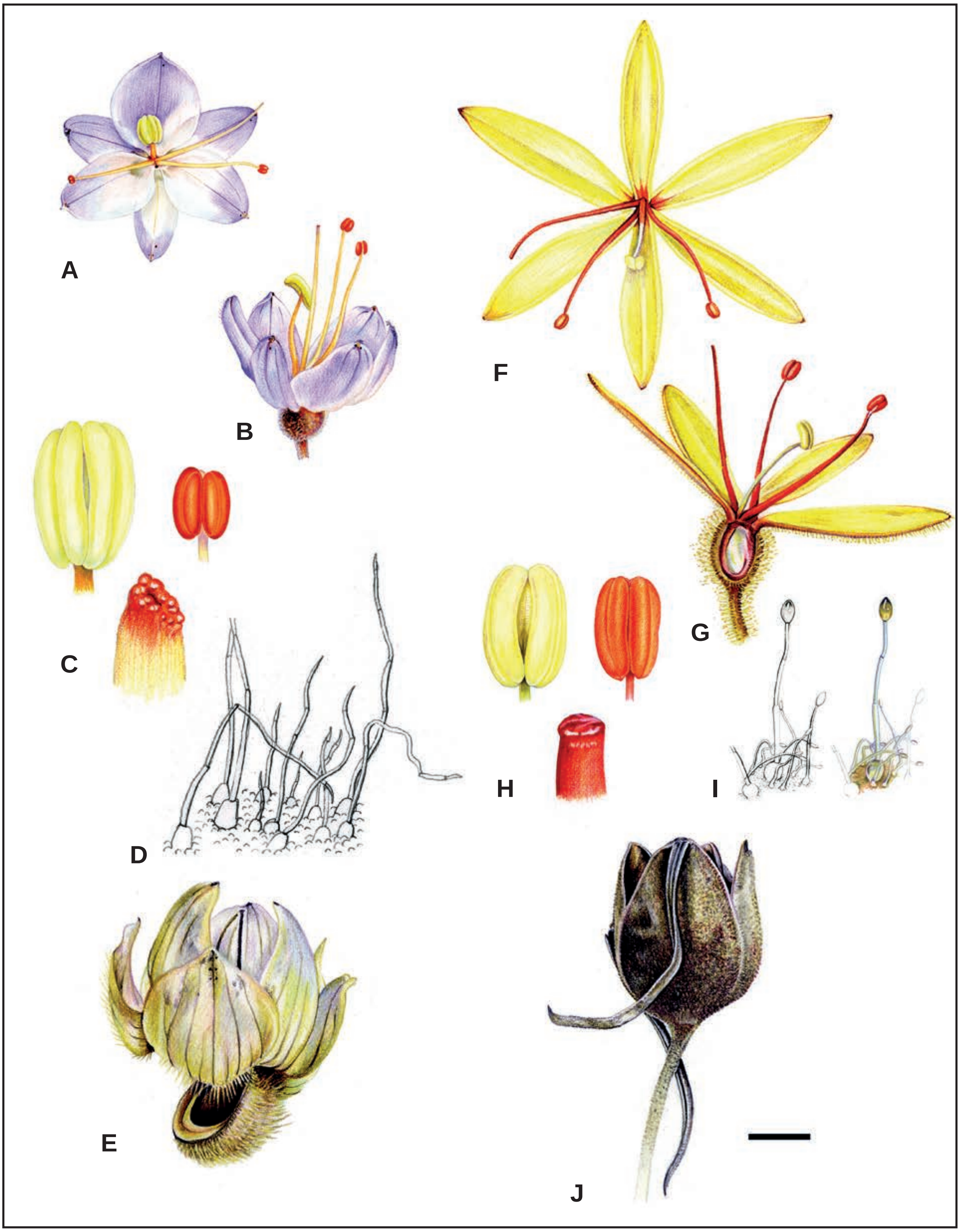

Figure 18. Comparison of floral features and fruits of *Dilatris* (left) with *Paradilatris* (right). *Dilatris ixioides*: A – flower viewed from top; B – flower viewed from side; C – anthers and stigma; D – tapering hairs; E – *Dilatris pillansii*, mature fruit; *Paradilatris viscosa*: F – flower viewed from top; G – flower viewed from side; H – anthers and stigma; I – glandular hairs; J – mature dehiscent fruit. Scale bars = 4 mm (A, B, F, G); 1 mm for anthers (C, H); 0.2 mm for stigma (C, H); 0.4 mm (D); 2.5 mm (E, J); 0.3 mm (I).

Wachendorfia Burm.

Wachendorfia is a small genus of five species recognised herein, all endemic to the Greater Cape Floristic Region of South Africa (*sensu* Born *et al.* 2007). The yellow flowers have a form of dimorphic enantiomorphy (directional asymmetry of the style and upper anther) with left- and right-handed flowers (e.g. Figures 19, 20) that has attracted considerable attention in recent years (Ornduff & Dulberger 1978; Jesson & Barrett 2002; Karron *et al.* 2021; Minnaar & Anderson 2021). Indeed, more recent exploration of this rare reproductive system in *Wachendorfia's* monotypic sister genus *Barberetta* Harv. further elaborates on enantiostyly as a feature in Haemodoraceae (Johnson *et al.* 2023).

Within *Wachendorfia*, polymorphism is pronounced in *W. paniculata* Burm. (Figure 20), whose species' limits were described as 'vague' (Helme & Linder 1992). Furthermore, *W. paniculata* was considered 'exceptionally variable with respect to plant size, leaf hairiness and shape, and flower size and structure. This has resulted in the large number of synonyms for this species' (Helme & Linder 1992: 64).

When discussing variation in *W. paniculata*, Helme and Linder (1992) picked up on three 'forms' previously identified by Barker (1950) in her treatment of Haemodoraceae for the *Flora of South Africa* and relevant sketches and descriptions deposited in the Compton Herbarium. A particularly relevant discussion to the taxonomy adopted herein relates to Form 2, described by Helme and Linder (1992: 65) as:

'Form 2: specimens from the mountains between Ceres and Pakhuis Pass are frequently very tall, with extremely lax panicles and long, thin leaves. This form does have a degree of environmental and geographical correlation, which suggests that it might be viewed as a subspecies (allopatric, genetically similar). However, the form is not strictly allopatric as the typical form of *W. paniculata* is known to occur in the area and for this reason we would not recommend the use of a formal subspecific rank for this taxon.'

However, this assessment did not consider an alternative hypothesis – that Form 2 is in fact a distinct species from *W. paniculata*. If so, this would explain the occasional sympatry of Form 2 with typical *W. paniculata*. SDH encountered Form 2 in fieldwork commencing in 1998 (e.g. Figures 19, 20; Table 1), and over the next two decades examined relevant specimens of Form 2 (= *W. laxa* herein) and *W. paniculata* in flower along a south-north transect from Kleinmond to Clanwilliam (Figure 20). This analysis established the presence of two distinct taxa that occasionally hybridise when sympatric. This view was adopted previously by Taylor (1996: 49) who listed *W. paniculata* and *W. laxa* W.F.Barker ms (= manuscript name) as both occurring in the Cederberg flora. However, a subsequent treatment by Goldblatt and Manning (2002) abandoned Barker's manuscript name of *W. laxa* for Form 2, acknowledging that while it appeared distinctive, a detailed study of morphology and genetics was required to ascertain its virtue as a recognised species (pers. comm., 1998 *et deinde*). Sufficient evidence is now at hand to formally name Form 2 as *W. laxa.*

Wachendorfia laxa W.F.Barker ex Hopper, *sp. nov.*

Type: Mitchells Pass near railway crossing, Ceres Conservation Park, South Africa, 12 November 1959, *W.F. Barker* 9104 (*holo*: sheet I, NBG; *iso*: sheets II, III, NBG).

Wachendorfia laxa Hopper ms, in R.J. Smith, S.D. Hopper & M.W. Shane, *Plant Soil* 348: 468 (2011), *nomen nudum*.

Slender rhizomatous perennial *geophyte*, 40–100 cm tall, usually 50–80 cm. *Rhizome* ovoid, up to 50 mm in diameter, appearing tunicate when dry. *Leaves* annual, plicate; often falcate and acute with a sudden narrowing forming a long petiole, or narrowly lanceolate or linear to broadly falcate, erect or spreading, bright glossy green, scarcely pleated, almost glabrous with few slender hairs, 3-nerved; 14–33 cm long, 0.6–2.1 cm wide, much shorter than scape, pliant when bent. *Scape*/*culm* 3–15 mm diameter, green to

Table 1. *Wachendorfia laxa* and *W. paniculata* populations (see map Figure 20) scored for morphology over the period 1998–2008 in a south–north transect from Kleinmond to Clanwilliam, South Africa.

Taxon	**Pop**	**Date**	**Location**	**Lat.**	**Long.**	**Flower colour**	**Leaf length (cm)**	**Leaf width (cm)**	**Scape height (cm)**
paniculata	1	10 09 1998	Sir Lowry Pass Rd footslope	34°07’52.26”S	18°34’34.60”E	pale yellow	23.5	1.8 – 3.3	20–40
paniculata	2	13 09 1998	Breede River flats SW of Worcester	34°40’14.22”S	19°24’50.54”E	pale yellow	30	2.1–2.7	na
paniculata	3	13 09 1998	8 km SW of Villiersdorp, Draaiberg farm entry	34°01’23.08”S	19°13’12.15”E	pale yellow	10.5–12	1.8–2.3	15–30
paniculata	4	13 09 1998	Threewaterkloof Dam 1.1 km NW of R321 on R45	34°01’00.93”S	19°12’25.34”E	pale yellow	na	na	na
paniculata	5	13 09 1998	Threewaterkloof Dam 3.6 km NW of R321 on R45	34°00’08.10”S	19°11’17.22”E	pale yellow	na	na	na
paniculata	6	27 08 2002	Klipheuwel 1.5 km W of on Philadelphia Road	33°42’16.68”S	18°14’00.06”E	fawnish creamy yellow	13	1.4	na
paniculata	7	10 09 2007	top of Verrfeld Pass 6.5 km NNW of Picketberg	32°50’59.53”S	18°44’00.24”E	yellow	18.5	0.5	20
paniculata	8	02 11 2008	Kleinmond, 1.2 km NW of Harbour	34°20’21.96”S	19°00’12.57”E	pale yellow	18	0.7	25
paniculata	9	02 11 2008	E of Pringlebaai, Nature Reserve SE of X roads on R44	34°20’26.57”S	18°50’42.22”E	pale yellow	na	na	na
paniculata	10	06 11 2008	Franschoek Pass Rd 1.5 km N of Jan Joobertsgard Bridge	33°55’44.26”S	19°09’36.38”E	pale yellow	19	1.5	30
laxa	1	11 09 1998	Pakhuis Pass 5 km E of Sevila Rock Art trail	32°04’13.57”S	19°07’26.44”E	gold	19–30	0.9–1.1	40–50
laxa	2	30 08 2002	250 m E along R366 from R365, Het Kruis, 34 km N of Piketberg	32°36’24.80”S	18°45’05.70”E	gold	25	2.1	50–70, 80, 90
laxa	3	05 01 2004	Bains Kloof walk-trail to Bobbejans Waterfall	33°36’52.58”S	19°06’59.94”E	golden yellow	14.5	0.6	70
laxa	4	10 09 2007	2.3 km due N of Clanwilliam Dam	32°09’51.06”S	18°52’20.42”E	golden yellow	30	1.9	80
laxa	6	07 11 2008	Rietvlei turn off, N7, 20 km NNW of Clanwilliam	32°01’15.68”S	18°46’59.27”E	gold	26	1.4	40–90
laxa	7	07 09 2010	Olifants Rivier, Algeria Brug, 21.5 km SSE of Clanwilliam	32°21’54.29”S	18°56’58.87”E	gold	32.5–33	1.5	50–100
laxa × *paniculata*	5	06 11 2008	Franschoek Pass Rd 11.4 km WNW of Villiersdorp	33°58’11.22”S	19°10’01.18”E	gold, yellow	14	1.5, 2.1	30–60

brown, densely hirsute with a short simple-haired indumentum. *Inflorescence* a lax racemose panicle comprising 5–20 cymes, each cyme few-flowered (1–5, occasionally to 10). *Peduncles* up to 7.5 cm long, unbranched; pedicels short (less than 4 mm long). *Flowers* lacking an odour. *Tepals* gold, 20–30 mm long, 11–14 mm wide; inner abaxial tepal same size as the rest; outer adaxial tepal darker brownish gold, shorter (16–20 mm) and narrower (8–10 mm) than the rest, sometimes recurved, margins fringed and densely hirsute with short silvery hairs. *Nectar guides* on upper tepals pale yellow, rimmed by darker gold to yellow-brown colouration. *Stamens* three quarters to tepal length, spreading; filaments 18–20 mm long; anthers 1.5–2.5 mm long, 1 mm diameter. *Style* 18–22 mm long. Young fruits with red-vermillion wings. (Figures 19, 20)

Diagnostic features. Slender geophyte usually 50–80 cm tall, sometimes 40–100 cm. Leaves bright glossy green, almost glabrous with few slender hairs, much shorter than scape, scarcely pleated, pliant when bent. Cymes usually few-flowered (1–5), occasionally to 10. Peduncles up to 7.5 cm long, unbranched; pedicels short (less than 4 mm long). Tepals gold, 20–30 mm long, 11–14 mm wide; outer adaxial tepal darker brownish gold, shorter (16–20mm) and narrower (8–10 mm) than the rest, sometimes recurved, margins fringed and densely hirsute with short silvery hairs. Nectar guides on upper tepals pale yellow, rimmed by darker gold to yellow-brown colouration. Anthers 1.5–2.5 mm long, 1mm diameter. Style 18–22 mm long. Young fruits with red-vermillion wings.

Other specimens examined. SOUTH AFRICA: Pakhuis Pass, *W.F. Barker* 285 (NBG); Olifants Rivier Dam, *W.F. Barker* 5741 (NBG); Ceres Wildflower Show, *R.H. Compton* 6335 (NBG); Mitchells Pass, Ceres Conservation Park, 6 Oct. 1941, *R.H. Compton* 11968 (NBG); Tulbagh Waterfall, *R.H. Compton* 12411 (NBG); Jonkershoek, *R.H. Compton* 15276 (NBG); Pakhuis Pass, 1940, *E.E. Esterhuysen* 3173 (NBG); Bidouw valley, *P. Goldblatt & J.C. Manning* 9394 (NBG); Jonkershoek, *R. Haynes* 1122 (NBG); Jonkershoek State Forest Upper Valley, *E. Kruger* 55 (NBG); Bidouw valley, *A. Middlemost* 1752 (NBG); N. Cederberg, Hueningvlei Mission settlement, roadside seepage (*Elegia capensis*) along river, locally common, 4 Nov. 1984, *H.C. Taylor* 11141 (NBG); between Heuningvlei and Pakhuis Pass, *c.* 850m, moist levelish ground near lowest point along jeeptrack, 22 Sep. 1985, *H.C. Taylor* 11376 (NBG); Devil's Tooth, Groot Drakenstein Mountains, *E. Wasserfall* 720 (NBG).

Phenology. Flowers mainly September–November, sometimes at high altitudes into January.

Distribution. *Wachendorfia laxa* has a north–south distribution with a possible disjunction in the middle of its 240 km range, which extends from Jonkershoek and Franschoek Pass Road to Mitchell's Pass in the Cape fold mountains and then from the Picketberg north to Clanwilliam on the N7 highway and adjacent Cederberg mountains to the east (Figure 20).

Habitat. Northern Cederberg populations favour incised mountain passes and river valleys or seasonally moist sites. Grows often near exposed rock outcrops in seasonal water discharge areas or in seasonally sodden clay loam adjacent watercourses in fynbos of *Protea nitida*, *Crassula extensa*, *Trachyandra divaricata*, *Montinia caryophyllacea*, *Didelta spinosa*, *Zygophyllum* sp., *Ornithogalum thyrsoides*, *Eriocephalus africanus*, *Dicerothamnus rhinocerotis*, *Euphorbia mauritanica*, and *Euryops speciosissima*. Southern populations on mountain slopes grow in fynbos with *Tetraria thermalis*, *Elegia capensis*, *Protea nitida*, *Metallasia barnardii*, *Crassula dejecta*, *Nivenia corymbosa*, *Cymbopogon marginatus*, *Ursinia crithnoides*, *Arctotis flaccida*, *Heterolepis aliena*, *Gnidia oppositifolia*, *Erica pinea*, *E. bergiana*, *Disa atricapilla*, *Corymbium villosum*, *Pseudoselago serrata*, *Watsonia schlechterii*, *Therianthus minutus* and *Psoralea restioides*.

Etymology. From the Latin *laxus, -a, -um*, meaning loose, flaccid, with parts distinct and apart from one another or in an open or loose arrangement, alluding to the relatively few-flowered, tall, open inflorescence compared with the compact, many-flowered, short *W. paniculata* (Figures 19, 20).

Figure 19. *Wachendorfia laxa* population l4 (see Figure 20) 2.3 km due north of Clanwilliam Dam on the Oliphants Rivier, slopes beside the N7 highway, South Africa. Note the tall slender scapes, golden yellow flowers with faint green nectar markings and green almost hairless leaves. Photographs by S.D. Hopper.

Conservation status. *Wachendorfia laxa* seems to be sporadic in occurrence, although locally abundant where it occurs. Moreover, the locations it occupies in the Cedarberg and Cape Fold Mountains are, in places, difficult to survey. At this stage, given its occurrence in several conservation reserves there, *W. laxa* appears not to be facing any major threats.

Vernacular name. Lax Wachendorfia is recommended.

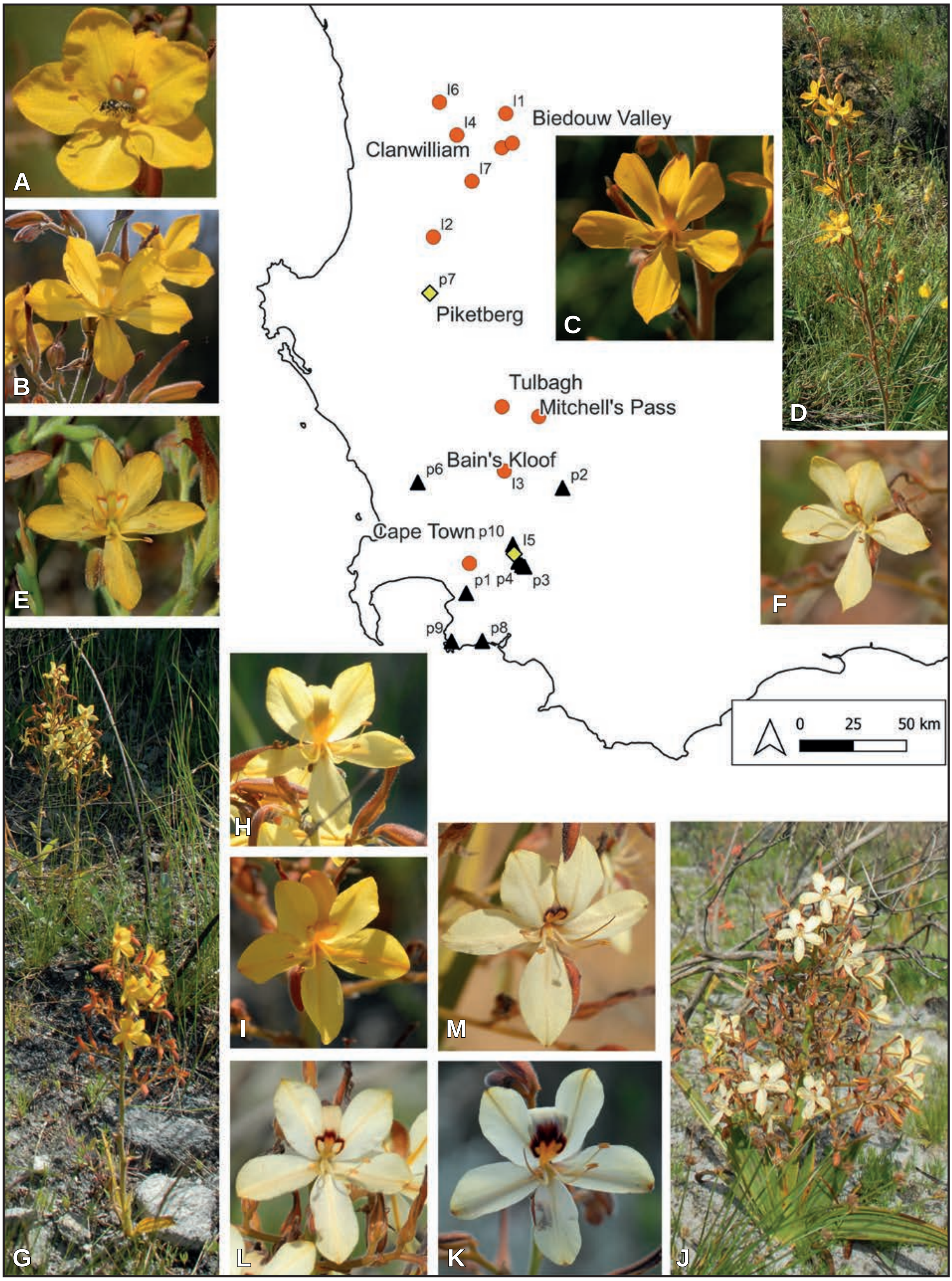

Figure 20. Geographical distribution and images of *Wachendorfia laxa* (●) (A, B, C, D, G bottom, I), *W. paniculata* (▲) (K, L, M, J), and introgressed *W. paniculata* (◇) (E, F, G top, H) along a north south transect undertaken by SDH east of Cape Town from Kleinmond northwards to Clanwilliam in South Africa. Numbered symbols prefaced with l (= *laxa*) and p (= *paniculata*) are sight records (see Table 1) whereas unnumbered *W. laxa* symbols are from herbarium specimen localities at NBG. Note that *W. paniculata* extends further east and west than indicated on the map. Photographs by S.D. Hopper.

Affinities and notes. Molecular analysis shows a very close sister relationship between *W. laxa* and *W. paniculata* (Hopper *et al.* unpubl.). It has taken careful field studies to determine the distinguishing features of these two taxa. *Wachendorfia laxa* differs from *W. paniculata* (Figure 20) in its taller scapes, its bright green, narrow, glossy, almost glabrous leaves that are sometimes scarcely pleated, and its golden flowers with nectar guides that are pale yellow, rimmed by darker gold to yellow-brown colouration (much darker rims in *W. paniculata*, Figure 20). In some populations where the two species are intermixed it is clear that natural hybridization and introgression are occurring (Figure 20). These populations would repay careful genetic and reproductive biological study. We are not perturbed by these occasions where reproductive isolation appears to break down. Other well accepted species of Haemodoraceae display similar interactions, especially in subfamily Conostylidoideae (e.g. Hopper 1977a, 1977b, 1978b, 1993). In the main, however, just as in *W. laxa* and *W. paniculata*, populations remain pure and distinctive.

Wachendorfia laxa, with its bright gold flowers on moderately tall scapes and bright glossy green leaves will make an important contribution to horticulture.

Anigozanthos Labill.

Anigozanthos was last revised by Hopper (1987a) and updated in a subsequent book (Hopper 1993) on the basis of morphometric (Figure 21; Hopper & Campbell 1977) and biosystematic data (Hopper 1980). In these treatments, 11 species and several subspecies were recognised, all endemic to the SWAFR. This taxonomy was the framework used in a cladistic morphological study (Anderberg & Eldenaas 1991) and a molecular phylogenetic study (Le Roux *et al.* 2010). The latter study affirmed *Macropidia* as sister to *Anigozanthos*, but found that *Anigozanthos* section *Anigozanthos* was paraphyletic, with *A. onycis* A.S.George and *A. preissii* Endl. embedded within *A.* section *Haplanthesis*. This finding is supported for *A. onycis* but not for *A. preissii* in our forthcoming unpublished work. A few species were included in subsequent molecular phylogenetic studies of the Haemodoraceae as a whole (Hopper *et al.* 1999, 2009; Zuntini *et al.* 2021), but thereafter a comprehensive study with near-complete taxon sampling was undertaken and is in preparation for publication. This has revealed the presence of three undescribed species and one subspecies of *Anigozanthos* meriting elevation, and indicated the need for some adjustment of the infrageneric classification. These are effected here.

Anigozanthos bicolor Endl. × **A. decrescens** (Hopper) Hopper & R.J.Sm.

This hybrid is intermediate between its putative parents (Figure 22, 23), having perianths 48–64 mm long, narrowing from 9.3–17.2 mm atop the ovary when flattened out to 3.3–6.3 mm wide at the narrowest point above the middle and below the anthers. Anthers are 2.7–4.3 mm long. (Figures 22, 23)

Specimens examined. WESTERN AUSTRALIA: Old Crossman River Bridge, Albany Highway, 22 Oct. 1976, *S.D. Hopper* 754 (PERTH 01962043); 0.4 km S of Old Crossman River Bridge on Albany Highway, 2 Nov. 1975, *S.D. Hopper* 779 (PERTH 01207911); 7.7 km W of Albany Highway, towards Marradong, 2 Nov. 1975, *S.D. Hopper* 780 (PERTH 01961861).

Distribution. Confined to an area between Boddington, Marradong Road and Crossman River (Figures 22, 23).

Habitat. In open wandoo–marri woodland on river flats in clay-loam, sometimes with a few plants of *A. manglesii* and rare hybrids with that species, or in remnant wandoo on weed infested road verges.

Affinities and notes. See discussion below under *Anigozanthos decrescens*.

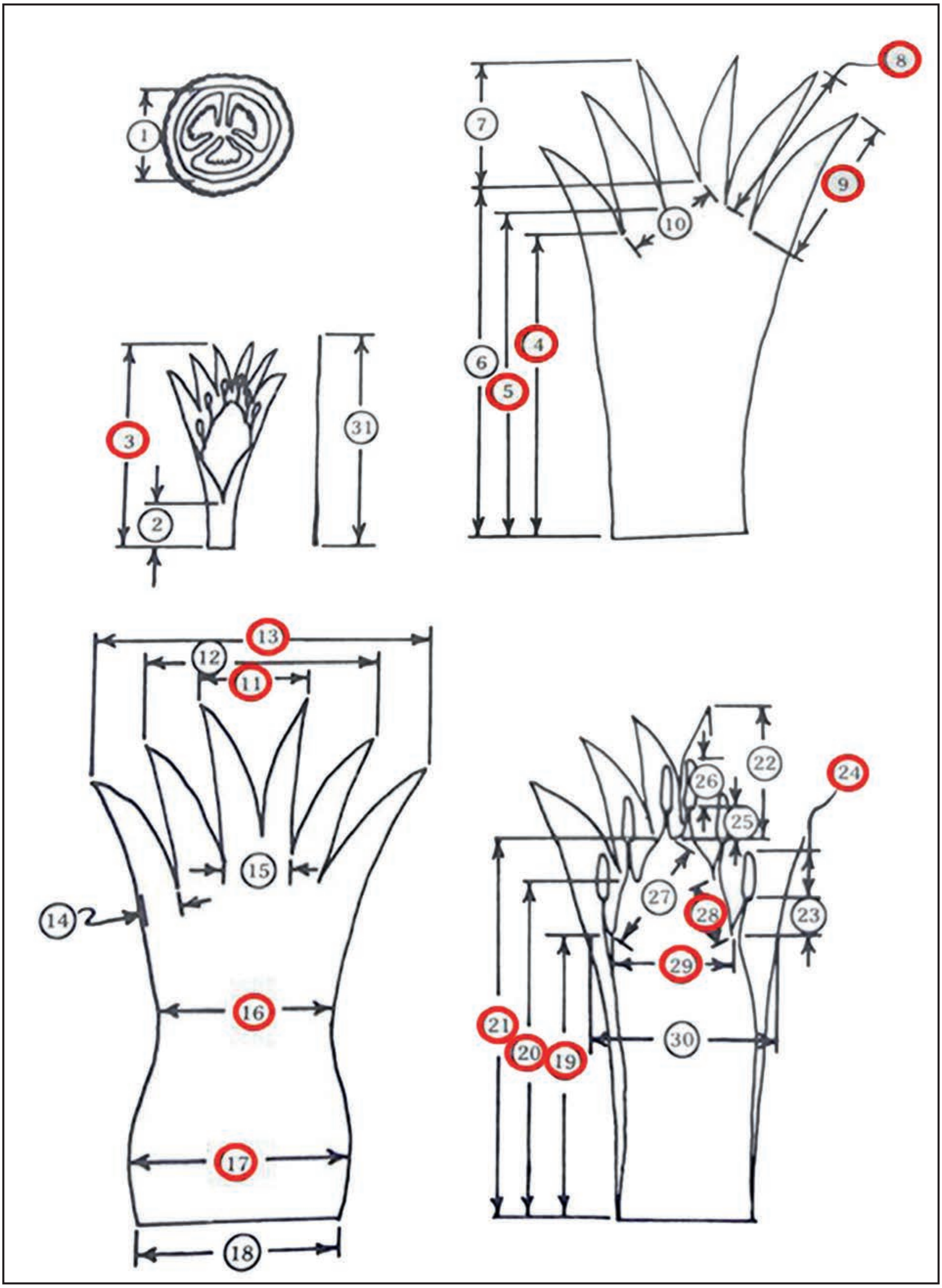

Figure 21. Thirty-one floral measurements used in an initial multivariate morphometrics study (canonical variate analysis) of six populations of *Anigozanthos bicolor*, *A. decrescens* and hybrids (first canonical variate scores of one flower per plant and map in Figure 22 and then 15 characters (red circles) used in a study across 37 populations of both species and their narrow hybrid zone (Figure 23). Illustration by S.D. Hopper.

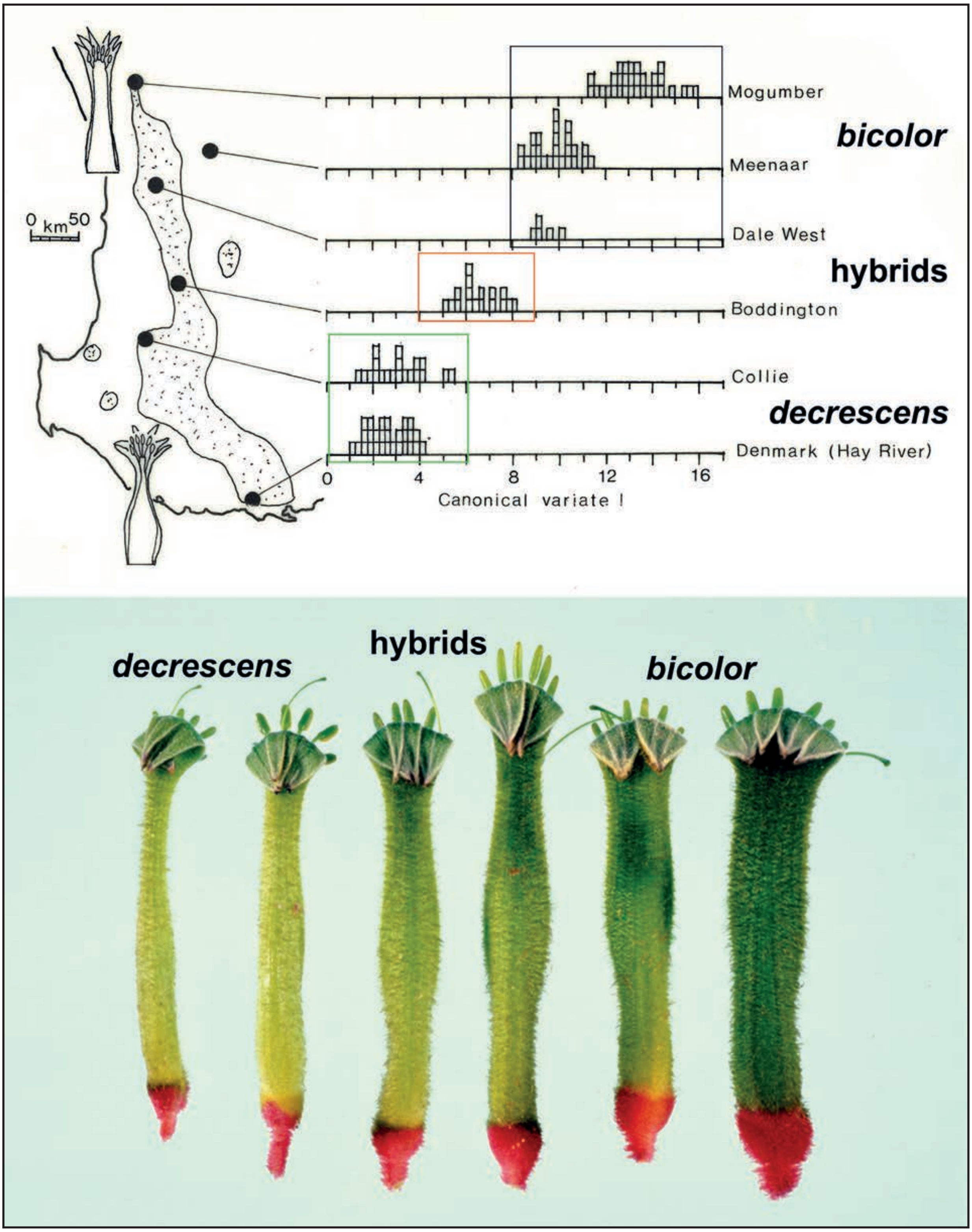

Figure 22. Top map illustrates first canonical variate scores of one flower per plant in an analysis of 31 floral characters (Figure 21) that first established the location of the narrow hybrid zone at Boddington involving *Anigozanthos bicolor* to the north and *A. decrescens* to the south. Below is a photo of flowers from six plants grown in an experimental garden at The University of Western Australia, Perth campus, of *A. decrescens* (two at left, synthesized F_1 hybrids (middle two) and *A. bicolor* subsp. *bicolor* (right two) illustrating inherited differences in perianth shape and ovary colouration. Photograph, illustrations and maps by S.D. Hopper.

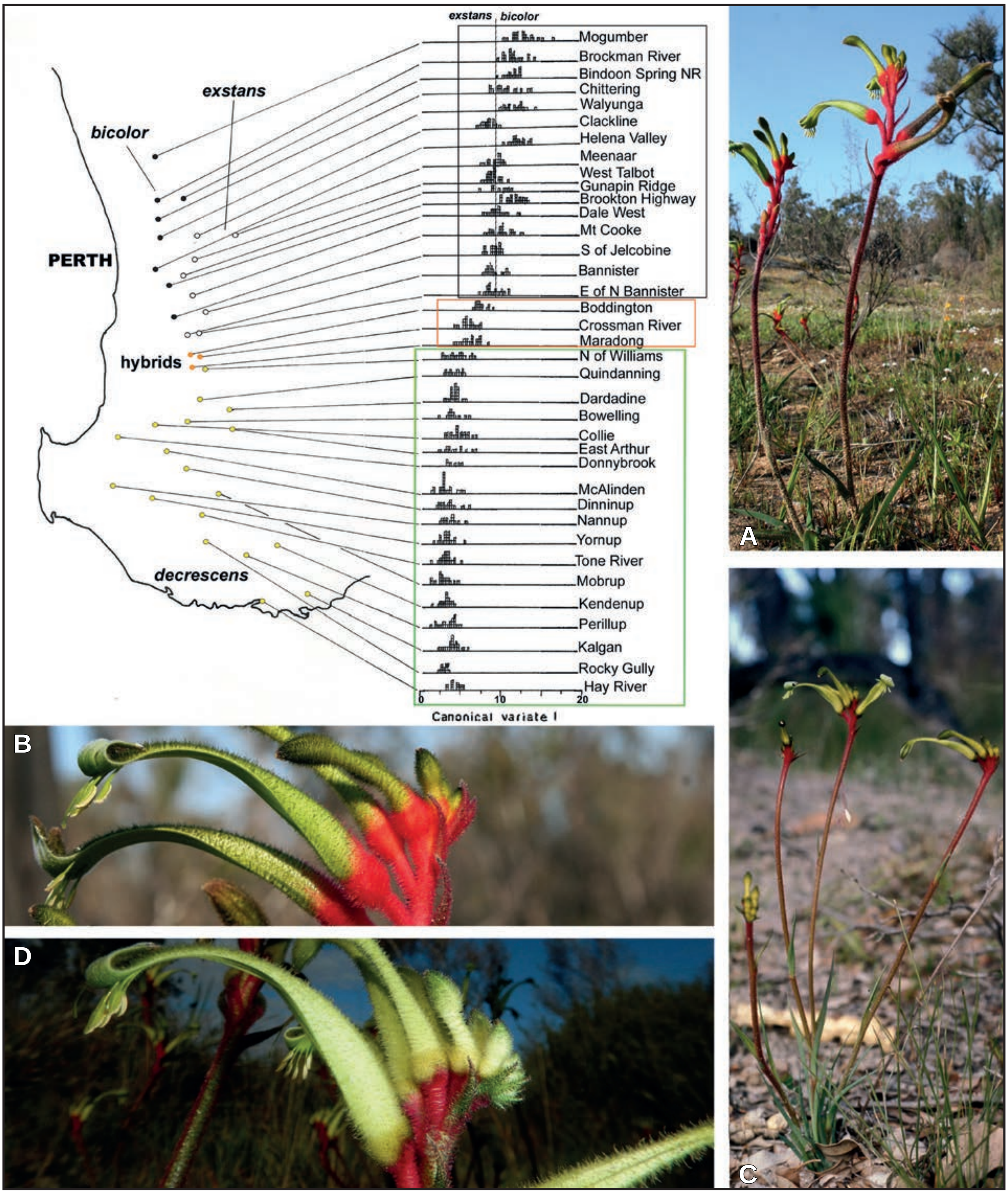

Figure 23. Multivariate morphometrics (canonical variate analysis) of 15 best discriminatory floral characters (Figure 21 red circles) for *Anigozanthos decrescens* and *A. bicolor* from the northern jarrah and wandoo forests and southern jarrah forest of southwest Australia respectively. The study spanned 37 populations of both species and their narrow hybrid zone (*A. bicolor* – black box, ● (subsp. *bicolor*), ○ (subsp. *exstans*); hybrids – orange box, 🟠; *A. decrescens* – green box, 🟡). Photographs: *A. bicolor* subsp. *bicolor* A – whole scape; B – flower. *A. decrescens* C – scape; D – flower. Photographs and map by S.D. Hopper.

Anigozanthos condingupensis Hopper & R.J.Sm., *sp. nov.*

Type: Condingup, Fisheries Road, Western Australia [precise locality withheld for conservation reasons], 7 September 1982, *S.D. Hopper* 2510 (*holo*: PERTH 00993239).

Anigozanthos bicolor Endl. var. *minor* Benth., *Fl. Austral*. 6: 446 (1873), *Anigozanthos bicolor* subsp. *minor* (Benth.) Hopper., *Fl. Austral*. 45: 455 (1987) *p.p.*, not as to type.

Illustrations. S.D. Hopper, *Kangaroo paws and catspaws*, pp. 128–129 (1993), as *A. bicolor* subsp. *minor* (Benth.) Hopper.

Small red and green rhizomatous *geophyte* to 45 cm diameter and 15 cm tall. *Roots* sand-binding. *Leaves* 3.2–12 cm long, 0.5–2.5 mm wide. *Scapes* 7–21 cm long. *Perianth* pale green, 30–40 mm long, lobes 4.5–6.0 mm long. *Anthers* 1.0–2.5 mm long; *filaments* to 2.5 mm long. *Style* 3.5–4.5 cm long. *Ovary* pale green for the upper quarter to three quarters of its height, red below. (Figures 24, 25)

Diagnostic features. Distinguished by its short stature (to 15 cm tall), narrow leaves (0.5–2.5 mm wide), small flowers (perianth 30–40 mm long) and the ovary pale green for a quarter to three quarters of its upper height, red below.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 29 Oct. 2004, *R. Butler* RHB 108 (PERTH 07028059); 29 Oct. 2013, *R. Daniel* RD FlOp-35 (PERTH 09061584); 12 Sep. 2013, *W. Gill, A. Hoggart & T. Gill* 1/913 (PERTH 08796777); 12 Oct. 1983, *K. Newbey* 9756 (PERTH 03517217); 7 Oct. 1963, *J.D. Skoss s.n.* (PERTH 00993204);14 Oct. 2008, *N. Swarts per R.J. Smith* RJS 207 (PERTH 08981523); 7 Aug. 2013, *J. Waters & W. Gill* 3/813 (PERTH 08796572).

Phenology. Flowers August–October.

Distribution. *Anigozanthos condingupensis* ranges from near Mt Baring west to near Lake Shaster (Figure 25).

Habitat. Grows associated with granite outcrops in waterlogged habitat in winter in *Dodonaea ceratocarpa*, *Acacia triptycha* and *Thryptomene australis* shrubland over herbs and grasses such as *Trachymene pilosa*, *Hypochaeris glabra* and *Aira cupaniana*. Other communities include open *Nuytsia floribunda* woodland over open granite heath with *Thryptomene saxicola*, *Acacia acuminata*, *Calothamnus quadrifidus*, *Melaleuca fulgens*, *Borya constricta*, *Tricoryne elatior* and *Labichea lanceolata*. Another is low shrubland over granite with *Verticordia minutiflora*, *Gonocarpus nodulosus*, *Drosera macrantha*, *Anarthria polyphylla*, *Nuytsia floribunda*, *Borya constricta*, *Chamaescilla corymbosa*, *Astus tetragonus* and *Lechenaultia formosa.*

Etymology. The specific epithet is derived from the name of the granite hill and adjacent village of Condingup, east of Esperance. Condingup is a Noongar word, which can be alternatively spelt as Korntdinup, meaning camp or place of shelters (kornt).

Conservation status. To be listed as Priority Two under Conservation Codes for Western Australian Flora (Tanya Llorens pers. comm.). *Anigozanthos condingupensis* is a relatively rare local endemic with a few populations known from conservation reserves but most on private land or road verges. Further survey to ascertain conservation status is recommended. A threatened status may be warranted, based on observations of the late Alan Carmichael (pers. comm., 30 September 1987) that the species may have disappeared from lands cleared for agriculture, such as the property at the north-east corner of Springdale Road and Masons Bay Road. Similar observations pertain even more so to *A. knappiorum* Hopper (see below), which Mr Carmichael had observed at four locations subject to clearing burns and now cropped.

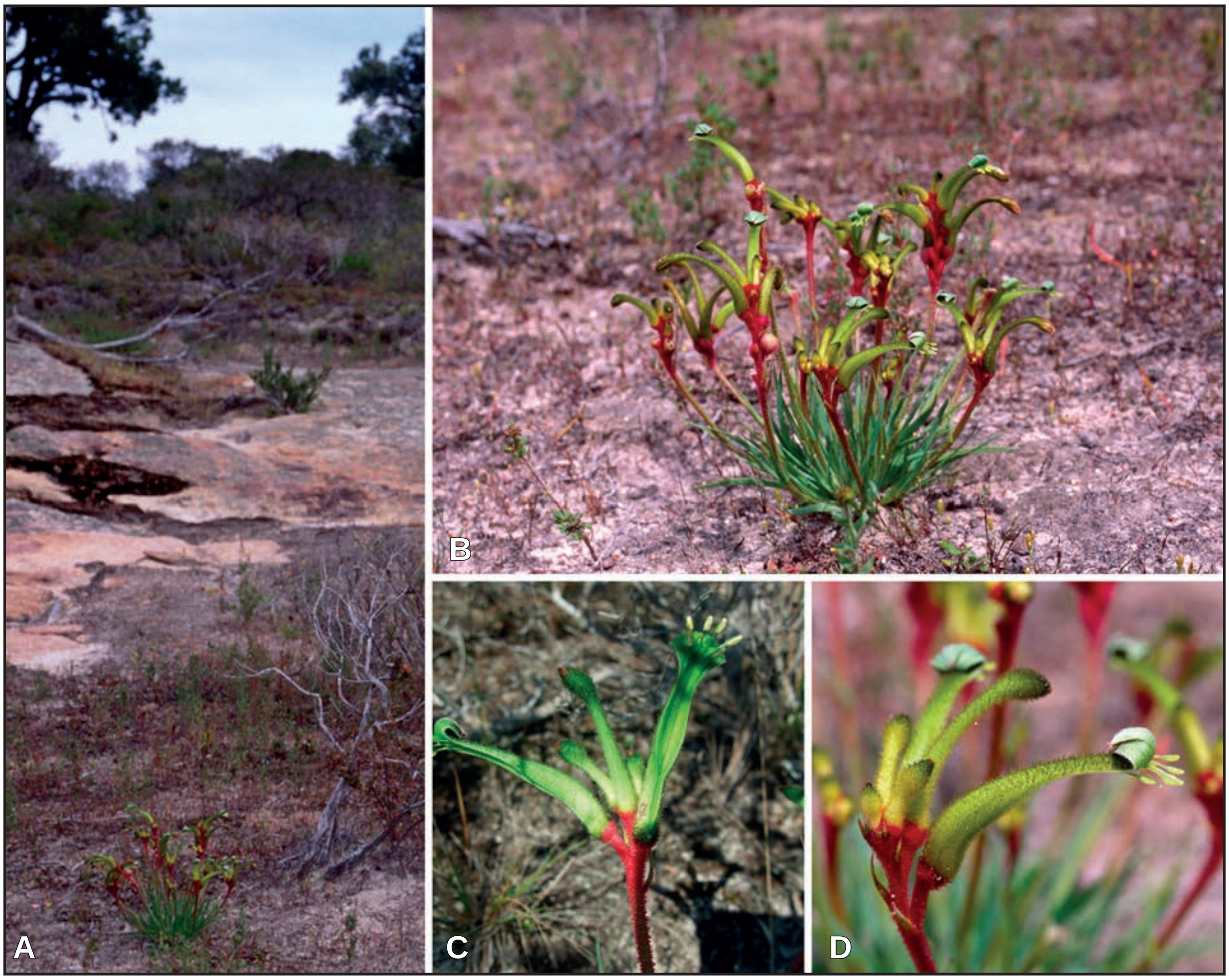

Figure 24. *Anigozanthos condingupensis*. A – plant adjacent granite outcrop, post-fire, at Condingup Peak; B – enlargement of same plant; C – inflorescence at Condingup Peak; D – inflorescence on same plant. Photographs by A.P. Brown (A–C); R.J. Smith (D).

Vernacular name. Condingup Dwarf Kangaroo Paw is recommended.

Affinities and notes. A diminutive red and green kangaroo paw endemic to granite outcrops of the eastern south coast region (Esperance Botanical District) of Western Australia. For a long time, this species was regarded as a cryptic easterly variant of *A. bicolor* subsp. *minor* (here regarded as meriting species rank as *A. knappiorum*), from which it differs in its ovary pale green for the upper quarter to three quarters of its height, red below. There are also subtle differences in the size and shape of the perianth. However, recent DNA studies have revealed that *A. condingupensis* is, in fact, sister to *A. decrescens*, not to *A. bicolor*. Red and green colouration has evolved independently in *Anigozanthos* at least twice. *Anigozanthos decrescens* is like *A. condingupensis* in having its ovary pale green for the upper quarter to three quarters of its height, red below. *Anigozanthos condingupensis* is much smaller in stature and leaf size, and also differs from *A. decrescens* in its special habitat of winter-wet margins associated with granite outcrops.

Bentham's (1873) reference to a G. Maxwell specimen at Kew collected at Stokes Inlet is likely to be *A. condingupensis* because a recent 2004 collection by *R. Butler* (RHB 108, PERTH 07028059) came from west of Stokes Inlet. Geerinck (1970) chose the Maxwell, Culham Inlet (as Mount Callum, *sic*) specimen at Kew as the holotype of *A. bicolor* var. *minor*, which we take to be a lectotypification for that taxon. *Anigozanthos bicolor* var. *minor* is cited below as a synonym for *A. knappiorum*.

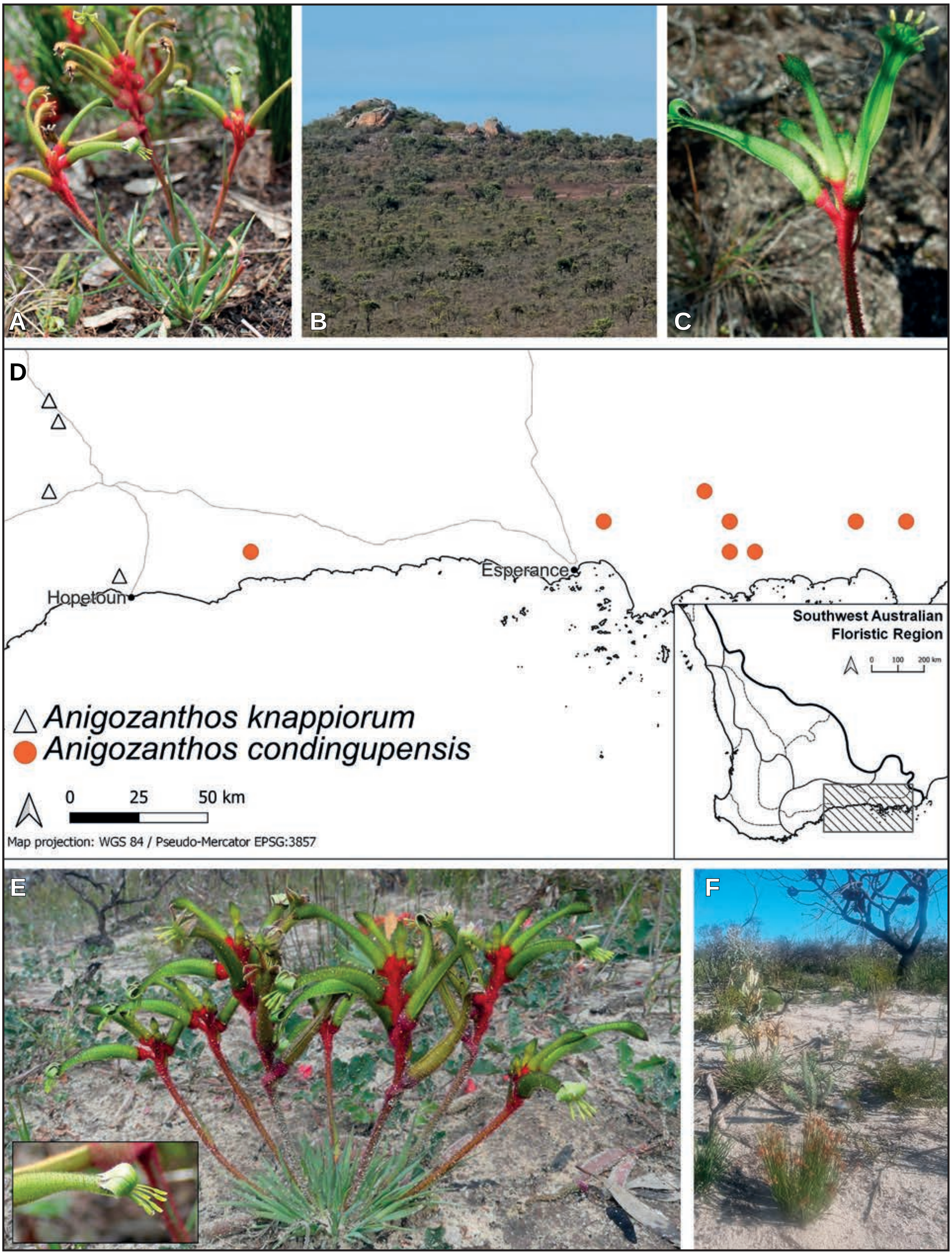

Figure 25. *Anigozanthos condingupensis*. A – habit; B – Condingup Peak viewed from the north, type location; C – flowers; D – distribution (●) mainly in the Esperance Botanical District (Gioia & Hopper 2017), and of *A. knappiorum* (△) in the Maalak Botanical District. Base map modified from Florabase. Inset map of the Southwest Australian Floristic Region shows location in relation to Botanical Provinces and Districts recognized by Gioia and Hopper (2017) – see Figure 1. *Anigozanthos knappiorum*. E – whole plant, west of Ravensthorpe, inset showing outer stamens held beneath the central four; F – sandplain habitat high in the landscape one year after wildfire with killed *Banksia media* plant prominent. Photographs by S.D. Hopper (A, B, D); R.J. Smith (C).

Anigozanthos decrescens (Hopper) Hopper & R.J.Sm., *comb. et stat. nov.*

Basionym: *Anigozanthos bicolor* Endl. subsp. *decrescens* Hopper, *Fl. Australia* 45: 455 (1987b). *Type*: 7 km south of Yornup, Western Australia, 13 November 1975, *S.D. Hopper* 773 (*holo*: PERTH 01224182).

Anigozanthos bicolor southern race, S.D. Hopper & N.A. Campbell, *Aust. J. Bot.* 25: 523–544 (1977); S.D. Hopper, *Aust. J. Bot.* 28: 659–680 (1980).

Illustrations. S.D. Hopper, *Kangaroo paws and catspaws*, pp. 126– 127 (1993), as *A. bicolor* subsp. *decrescens*.

Perennial herbaceous red and green rhizomatous *geophyte*. *Leaves* flat, 10–25 cm long, 2–5 mm wide, grey-green. *Scapes* several, 10–45 cm tall, slightly curved, red-purple with sparse plumose hairs becoming more dense near inflorescence and extending over a quarter of the lower ovary surface. *Floral hairs* uniformly yellow-green, covering upper three quarters of the ovary surface as well as the main perianth, the red and green colours usually separated by a blackish line atop the red-purple of the scape and lower ovary. *Perianth* falcate, 45–65 mm long, strongly constricted in upper part of tube, 3–5 mm wide at narrowest point above middle; lobes reflexed. *Stamens* biseriate, the outer pair lower than other 4; anthers 2.5–4.9 mm long; outer filaments 4.0–7.5 mm long. (Figures 22, 23)

Diagnostic features. Red and green geophyte. Leaves flat, grey-green. Scapes 10–45 cm tall, red-purple with sparse plumose hairs becoming more dense near inflorescence and extending over a quarter of the lower ovary surface. Floral hairs uniformly yellow-green, covering upper three quarters of the ovary surface as well as the main perianth, the red and green colours usually separated by a blackish line atop the red-purple of the scape and lower ovary. Perianth falcate, 45–65 mm long, strongly constricted, 3–5 mm wide at narrowest point above middle. Stamens biseriate, outer filaments 4.0–7.5 mm long.

Other specimens examined. WESTERN AUSTRALIA: Kalgan Plain, Sep. 1946, *A.M. Ashby* 87 (PERTH 01962019); W of Rocky Gully, 34° 30′ 41.0″ S 117° 0′ 42.0″ E, 14 Oct. 1966, *A.M. Ashby* 2023 (PERTH 01961942); Hall site, Muir Highway, Perillup, W of Mount Barker, 18 Nov. 1990, *E.J. Croxford* 6325 (PERTH 04501144); E of Denmark: 4.0 km E of Hay River towards Albany, 30 Oct. 1974, *S.D. Hopper* 805 (PERTH 01961896); *c.* 20 km N of Williams along Albany Highway, 2 Nov. 1975, *S.D. Hopper* 738 (PERTH 01961969); 3.1 km S of Donnybrook towards Kirup, 14 Nov. 1975, *S.D. Hopper* 772 (PERTH 01207946); 4 km S of Blackwood River, Nannup towards Pemberton, 13 Nov. 1975, *S.D. Hopper* 775 (PERTH 01961985); Bow River, Dec. 1912, *S.W. Jackson s.n.* (NSW); 3 km NW of western end Mount Manypeaks, Waychinicup N [National] Park, 23 Oct. 1986, *G.J. Keighery* 8500 (PERTH 01961829); Kodjinup Nature Reserve, NE corner, 21 Oct. 1997, *G.J. Keighery & N. Gibson* 2188 (PERTH 05249546); approximately 100 m N of Golf Club turnoff, S of Mt Barker township, 10 Oct. 1988, *T.D. Macfarlane* TDM 1807 (PERTH 04768523); SWATT Sandplain Survey, Mt Roe National Park, survey site SWA0103C, *c.* 43.12 km W (275.18 degrees) of Mt Barker and *c.* 19.06 km ESE (118.85 degrees) of Rocky Gully, 2 Nov. 2013, *R. Meissner* 5080, *C. McCormack* & *M. Langley* (PERTH 08916276); King Georges Sound, *s.dat.*, *T.R. Muir s.n.* (MEL, labelled in F. von Mueller's hand *Anigozanthos bicolor* Endl. var *longior*); 12 miles E of Twin Peaks, 8 Nov. 1964, *K.R. Newbey* 1641 (PERTH 01961993); Balingup, Dec. 2017, *R.H. Pulleine s.n.* (NSW); Bridgetown, 25 Sept. 1948, *R.D. Royce* 2702 (PERTH 01962000); W of Nornalup, 5 Oct. 1963, *R.D. Royce* 8113 (PERTH 01961950); 12 miles [19.3 km] along Lower King Road, from Emu Point Road, 16 Sep. 1966, *E.M. Scrymgeour* 1115 (PERTH 01961853); Kendenup, Kendenup railway siding adjacent to Carbarup Rd, 22 Aug. 2009, *R.J. Smith* RJS 283 *& S.D. Hopper* (K, PERTH 08813167).

Phenology. Flowers September–November.

Distribution. *Anigozanthos decrescens* has an L-shaped distribution, ranging from north of Williams on the Albany Highway southwest to Donnybrook and Nannup, then south-east to the Hay River east of

Denmark and across to the northwest side of Mt Manypeaks (Figures 22, 23).

Habitat. In winter wet flats, gentle slopes and adjacent to drainage lines of the southern jarrah forest in sandy clay loams. Associated vegetation includes woodland of *Corymbia calophylla*, *Eucalyptus marginata* subsp. *marginata* or *Melaleuca preissiana* over open shrubland of *Xanthorrhoea preissii* over open shrubland, rushland and fernland of *Hypocalymma balbakiae*, *Pericalymma ellipticum* var. *ellipticum*, *Melaleuca thymoides*, *Taxandria parviceps*, *Lyginia barbata*, *Styphelia pallida* and *Lindsaea linearis*. Other communities include heath to sedgeland with associated vegetation of *Xanthorrhoea preissii*, *Dasypogon bromeliifolius* and *Hakea ceratophylla*, woodland of *Banksia littoralis* and *Melaleuca preissiana* with *Hibbertia stellaris*, *Lepidosperma angustatum*, *Acacia saligna*, or in *Melaleuca cuticularis* open low woodland over regenerating sedges and *Anigozanthos flavidus*. *Anigozanthos decrescens* is common following summer wildfire or roadside disturbances.

Etymology. Named from the Latin *decrescens* (narrowing), alluding to the pronounced constriction of the perianth above the middle before widening again apically to present the anthers and perianth lobes (Figure 22).

Conservation status. *Anigozanthos decrescens* is common and relatively widespread, sometimes occurring in large populations following fire or other disturbances. It occurs in several conservation reserves. Not under threat.

Vernacular name. Forest Kangaroo Paw.

Affinities and notes. Recognition of *A. decrescens* at some rank dates back to earlier than 1896 when Ferdinand von Mueller wrote a manuscript name (*Anigozanthos bicolor* Endl. var. *longior* F. Muell., *ined.*) on an undated specimen at MEL (MEL2268868A, MEL2268877A) collected at King Georges Sound by T(homas) R. Muir. However, it was not until SDH's PhD research in the 1970s that *A. decrescens* was again recognised informally as '*Anigozanthos bicolor* southern race' (Hopper & Campbell 1977; Hopper 1980), thereafter published in 1987 in the *Flora of Australia* as *A. bicolor* Endl. subsp. *decrescens* Hopper (Hopper 1987b) and illustrated in colour under this name subsequently (Hopper 1993).

Our investigations of molecular phylogenetics (Hopper *et al.* unpublished) have established that the affinities of this taxon are not with *A. bicolor*. Rather, the sister to *A. decrescens* may be *A. condingupensis*. These latter two taxa share the extension of the green perianth colouration well down over the ovary, usually terminating at a blackish line that tops the red-purple colouration of the scape. Also there is a markedly constricted perianth, and differences in floral and scape size, with *A. decrescens* being the larger of these two taxa.

A zone of apparent hybridization was discovered between *A. bicolor* (subsp. *exstans* Hopper) and *A. decrescens* in the Crossman River/Boddington/Maradong area (Hopper & Campbell 1977 – in that publication *A. decrescens* was referred to as *A. bicolor* southern race). A future publication investigating this apparent hybridization was foreshadowed. An intensive sampling regime for a morphometric study was subsequently undertaken, but not published until now, to secure a freshly opened flower from up to 30 plants from 37 populations across the ranges of *A. decrescens* and *A. bicolor* (Figures 22, 23).

Firstly, the six populations across this range sampled by Hopper and Campbell (1977; Figure 22) were subject on their own to Canonical Variate analysis (Discriminant Function Analysis) of 31 floral metrics to better understand variation across these two taxa (Figure 21). The first canonical variate of this analysis accounted for 75% of the total separation achieved, and provided complete separation between *A. bicolor* (Mogumber, Meenaar, Dale West) and *A. decrescens* (Collie, Denmark) populations. The central population (Boddington) was assigned predominantly intermediate canonical variate scores which slightly overlapped at either extreme end with those of both the Collie population of *A. decrescens* and the Meenaar population of *A. bicolor* subsp. *exstans*. Character coefficients (Table 2) indicated that

Table 2. Results of the canonical variate analysis of five *Anigozanthos bicolor* and *A. decrescens* populations measured for 31 perianth characters, numbered in the same sequence as those in Figure 21. *weighted by multiplying the character coefficient by the within-groups standard deviation.

Character	**Canonical Variate 1**		**Canonical Variate 2**	
	Coef.	Wtd Coef.*	Coef.	Wtd Coef.*
1 Ovary diameter	.36	.19	-.16	-.09
2 Perianth closure length	-.23	-.26	.05	.06
3 Perianth length	.29	1.08	-.39	-1.47
4 Base – outer sinus	-.11	-.35	.43	1.42
5 Base – second sinus	.09	.37	-.05	-.16
6 Base – central sinus	-.02	-.07	-.28	-.93
7 Central sinus depth	.12	.14	.34	.40
8 Second sinus depth	-.38	-.42	.19	.21
9 Outer sinus depth	.40	.43	.22	.24
10 Central – outer sinus	-.52	-.29	.15	.09
11 Central lobe tips width	.24	.41	-.12	-.21
12 Second lobe tips width	.03	.05	-.04	-.07
13 Outer lobe tips width	-.48	-1.03	.04	.09
14 Outer lobe basal width of central lobes	-.11	-.04	.16	.06
15 Basal width of central lobes	-.67	-.38	-.36	-.20
16 Minimum upper perianth width	1.55	.92	2.00	1.19
17 Maximum lower perianth width	-.44	-.79	.13	.23
18 Basal perianth width	-.10	-.18	-.35	-.63
19 Base – outer filament	-.04	-.13	-.37	-1.16
20 Base – second filament	-.24	-.76	.16	.50
21 Base – central filament	.13	.40	.28	.89
22 Apex – central filament	-.13	-.14	.00	.00
23 Outer filament length	-.12	-.08	-.87	-.60
24 Outer anther length	1.70	.65	-.08	-.03
25 Central filament length	.19	.12	.98	.62
26 Central anther length	-1.00	-.41	.27	.11
27 Outer – central filaments	.20	.15	-.55	-.39
28 Outer – second filaments	-.65	-.44	1.06	.72
29 Width across outer filaments	1.27	.75	-1.77	-1.05
30 Perianth width at outer filaments	.09	.09	.61	.62
31 Style length	.08	.38	.14	.65
Canonical root	17.09		3.07	
Wilk’s lambda	.002		.031	
% of total separation	75.1%		13.5%	

perianth length, width across the outer perianth lobes, minimum upper and maximum lower perianth widths, distance between the outer filaments, a contrast in distances from the perianth base to the second and central filaments, and anther length were all important discriminatory characters. Examination of perianth tracings (Figure 22) and photographs of flowers (Figure 22, 23) confirmed that *A. bicolor* from Mogumber, Meenaar and Dale West has perianths that are relatively broad in the area of constriction (4.6–9 mm), and longer anthers (3.2–5.0 mm). In addition, the outer filaments are about the same length as the anthers and are not displaced far down the perianth from the central four. In contrast, *A. decrescens* from Collie and Denmark has perianths that are narrower in the area of constriction (2.8–5.2 mm). It has outer filaments that are much longer than the anthers and are displaced a relatively large distance down the perianth from the central four. Anthers are shorter (2.7–4.5 mm). The two taxa also differ in the colour of their ovaries (red-purple, sometimes topped with a blackish line, and then yellow-green above in *A. decrescens*, red in *A. bicolor*; cf. Figure 23). The Boddington population (Figure 22) and synthesised inter-specific F_1 hybrids (Figure 22) are intermediate in these parameters.

After successive elimination of characters that showed little or no discrimination between *A. decrescens* and *A. bicolor*, the first canonical variate of an analysis of the remaining 15 perianth characters (red circles in Figure 21) measured on 39 populations of *A. bicolor* and *A. decrescens* (Figure 23; Table 3) accounted for 77% of the total separation. As in the 31-character analysis, the 15-character analysis was instrumental in discriminating between most of the 15 populations of *A. bicolor* and the 18 populations of *A. decrescens* analysed. Populations of *A. bicolor* subsp. *exstans* on the eastern margin of *A. bicolor* subsp. *bicolor* (e.g. Meenaar, Clackline) showed a greater similarity to *A. decrescens* than their western congeners. Overall, *A. bicolor* displayed greater between-population variation in canonical variate scores than did *A. decrescens,* consistent with recognition of two subspecies in *A. bicolor* in the study area.

A suite of three central populations (Boddington, Crossman River, Maradong) were morphometrically intermediate between *A. bicolor* subsp. *exstans* and *A. decrescens*. *Anigozanthos bicolor* extended over a 200 km range, *A. decrescens* extended 250 km, while the zone of intergradation was no wider than 25 km. Character coefficients (Table 3) indicated that perianth length, contrasts in distances from the perianth base to the second and central filaments, and contrasts in widths of minimum upper, maximum lower and outer perianth lobe tips were important discriminators (see red circles in Figure 21).

The second canonical variate accounted for only 7% of the total separation achieved, and discriminated between populations in an apparently random geographical fashion. The Meenaar population (*A. bicolor* subsp. *exstans*) was given a considerably higher mean canonical score than any other population for this variate, while the Brockman River population (*A. bicolor* subsp. *bicolor*) was given the lowest. Other high scoring populations included Boddington (zone of intergradation), Mogumber (*A. bicolor* subsp. *bicolor*) and Collie (*A. decrescens*), while other low scoring populations included Chittering Valley (*A. bicolor* subsp. *bicolor*), Mount Cooke (intermediate between *A. bicolor* subsp. *bicolor* and *A. bicolor* subsp. *exstans*) and Nannup (*A. decrescens*). Character coefficients (Table 3) were weighted in a similar fashion to those of the first canonical variate, suggesting that the Meenaar population differed from most others in the relative positions of its filaments in perianths and in relative perianth widths.

The identification of the Crossman River/Boddington/Maradong area as a localised zone of hybridization between *A. bicolor* and *A. decrescens* will enable more rigorous investigation of reproductive interactions between the two species. Some early evidence on seed set and pollen fertility of progeny from experimental hybridization (Hopper 1980) shows that some reductions in reproductive performance may be expected in the wild hybrid zone. However, this will need experimental tests to affirm or falsify. Also next generation phylogeographic studies would be a powerful approach to testing the geographical pattern revealed through multivariate morphometrics.

Perhaps some taxonomists would regard a zone of hybridization like that found here as evidence that varietal/subspecific rather than species rank is more appropriate to use for the two taxa. However, such a treatment would render *A. bicolor* paraphyletic, disguising the true affinities of *A. decrescens* with *A. condingupenesis*. Moreover, the pattern revealed is consistent with that predicted under a classic

Table 3. Results of the canonical variate analysis of 35 *Anigozanthos bicolor* and *A. decrescens* populations measured for 15 perianth characters, numbered in the same sequence as those in Figure 21. *weighted by multiplying the character coefficient by the within-groups standard deviation.

Character	**Canonical Variate 1**		**Canonical Variate 2**	
	Coef.	Wtd Coef.*	Coef.	Wtd Coef.*
3 Perianth length	.16	.62	.13	.48
4 Base – outer sinus	-.00	.00	-.04	-.15
5 Base – second sinus	.00	.03	.06	.21
8 Second sinus depth	.13	.15	.29	.34
9 Outer sinus depth	.12	.15	.23	.28
11 Central lobe tips width	.05	.08	.02	.04
13 Outer lobe tips width	-.37	-.77	-.51	-1.06
16 Minimum upper perianth width	1.29	.72	-1.70	-.95
17 Maximum lower perianth width	-.38	-.60	.26	.41
19 Base – outer filament	-.09	-.27	-.30	-.94
20 Base – second filament	-.28	-.87	-.27	-.84
21 Base – central filament	.27	.86	.55	1.77
24 Outer anther length	.51	.20	-.46	-.18
28 Outer – second filaments	-.33	-.25	-.22	-.17
30 Perianth width at outer filaments	1.20	.58	1.58	.76
Canonical root	12.22		1.14	
Wilk's lambda	.062		.133	
% of total separation	77.3%		7.2%	

biological species concept (Grant 1971). There is no evidence of broadscale introgression over extensive distances occurring in this case. Substantial but not complete reproductive isolation is found in the hybrid zone, and the majority of populations to the north and south have predictable morphometrics consistent with two species interacting only at the relatively narrow zone of contact.

This is a classic case where univariate characters may overlap, but multivariate character combinations deliver consistent distinguishing characteristics of perianth size and shape found in the two taxa. Resolution of species boundaries is sometimes challenging, but still tractable with an appropriate sampling and analytical strategy in place.

Anigozanthos humilis Endl. subsp. **grandis** Hopper, *subsp. nov.*

Type: Minyulo Nature Reserve, north-northeast of Cataby, Western Australia [precise locality withheld for conservation reasons], 12 October 2022, *S.D. Hopper* 8716 (*holo*: PERTH 09723161; *iso*: CANB, K).

Anigozanthos humilis subsp. 'grandis', informal name in S.D. Hopper, *Kangaroo paws and catspaws*, p. 117 (1993).

Anigozanthos humilis subsp. Badgingarra (S.D. Hopper 7114), Western Australian Herbarium, in *Florabase*, https://florabase.dbca.wa.gov.au/ [accessed 1 Nov 2022].

Illustrations. S.D. Hopper, *Kangaroo paws and catspaws*, pp 116– 117 (1993); K.S. Downes, *Germination Requirements of the Lesser Known Kangaroo Paw and Catspaw Taxa*, p. 9 (2016).

Scapes tall, up to 100 cm long (averaging 52 cm). *Leaves* large, up to 35 cm long (averaging 19.8 cm); the node of one of the larger leaves sometimes producing a second scape. *Flowers* yellow and orange-tipped on perianth segments, with perianths that are slightly curved, about 35 mm long, with lobes slightly reflexed. (Figure 26)

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 20 Sep. 1988, *S.D. Hopper* 6730 (PERTH 06076882); 19 Dec. 1988, *S.D. Hopper* 7111 (PERTH 01190598); 22 Oct. 1983, *G.J. Keighery* 6931 (PERTH 01173731); 26 Sep. 1991, *S.J. Patrick* SP 818 & *A.P. Brown* (PERTH 02113716); 26 Sep. 1991, *S.J. Patrick* SP 820 & *A.P. Brown* (PERTH 02113708); 26 Sep. 1991, *S.J. Patrick* SP 828 (PERTH 03146197); 27 Aug. 2009, *R.J. Smith RJS* 286 & *S.D. Hopper* (PERTH 08813027); 31 Oct. 2013, *V. Yeomans & A. Sleep* D2-02 (PERTH 08631735).

Phenology. Flowers late September–November.

Distribution. Confined to an area near Gingin, Cataby and Moora (Figure 27).

Habitat. Grows in rich, sandy clay loam, along creeks and near swamps in kwongkan adjacent to open wandoo woodland (Figure 26D).

Etymology. From the Latin adjective *grandi*s, *-e*, large or big.

Conservation status. Listed as Priority Two under Conservation Codes for Western Australian Flora (Western Australian Herbarium 1998–), as *Anigozanthos humilis* subsp. Badgingarra (S.D. Hopper 7114). Not considered threatened, even though a relatively local endemic and succumbing readily to rust disease.

Vernacular name. Giant Catspaw is recommended.

Affinities and notes. Readily distinguished from the typical subspecies of *A. humilis* (Figure 26B) by its taller stature (*A. humilis* subsp. *humilis* averages 13–18 cm tall) and uniformly yellow flowers, occasionally with the perianth lobes tipped with orange-red (Figure 26E). *Anigozanthos humilis* subsp. *chrysanthus* Hopper is intermediate in stature between these two other subspecies (averaging 32 cm) and consistently yellow with shorter broad flowers. *Anigozanthos humilis* subsp. *grandis* intergrades at its type locality with *A. humilis* subsp. *humilis*, the latter occurring in deeper sand in kwongkan. The two subspecies are ecologically divergent and occur in pure populations away from this narrow zone of intergradation. It seems, on the basis of pollination studies elsewhere (Hopper & Burbidge 1978, 1986; Hopper 1993), that *A. humilis* subsp. *grandis* has evolved to favour perch-feeding by honeyeaters, whereas the considerably shorter *A. humilis* subsp. *humilis* favours pollination through honeyeaters mainly standing on the ground.

Anigozanthos knappiorum Hopper, *sp. nov.*

Type: west of Ravensthorpe, Western Australia [precise locality withheld for conservation reasons], 30 September 1987, *S.D. Hopper* 6154 (*holo*: PERTH 09214283).

Anigozanthos bicolor Endl. var. *minor* Benth., *Fl. Austral*. 6: 446 (1873); *Anigozanthos bicolor* subsp. *minor* (Benth.) Hopper, *Fl. Australia* 45: 455 (1987); *p.p.*, as to type. *Type*: McCallum [Culham] Inlet, Western Australia, 1873, *G. Maxwell s.n.* (*lecto*: K, barcode K000846250, designated by D. Geerinck, *Bull. Jard. Bot. Natl. Belg.* 40: 274 (1970), as *holo*).

Small short-lived rhizomatous red and green *geophyte* to 30 cm diameter and 20 cm tall. *Roots* sand-binding. *Leaves* 3–10 cm long, 1.5–2.5 mm wide. *Scapes* several, 5–20 cm long, straight, erect to obliquely ascending with flowers held facing outwards (vs gently curved with flowers facing inwards to centre of the plant). *Flowers* red and green, top of ovary marks the upper extent of red coloration. *Perianth* in life green, 30–50 mm long, gently curved throughout, when flattened out 30–50 mm long and 7–12 mm

Figure 26. *Anigozanthos humilis* subsp. *grandis*. A – whole plant illustrating tall erect inflorescences, large leaves and kwongkan habitat adjacent to *Eucalyptus wandoo* at type locality; B – whole plant (right) beside two orange-flowered and much shorter *A. humilis* subsp. *humilis* at type locality; C – pure yellow morph showing details of inflorescence; D – kwongkan habitat adjacent to wandoo woodland lining Minyulo Creek at type locality; E – morph with red tips to buds and perianth lobes; F – rhizome and roots, which are not sand-binding. Photographs by S.D. Hopper.

wide at base, 3–5 mm wide at narrowest point, basal third parallel-sided when opened out then strongly constricted at the level of the outer stamens; *style* 30–40 mm long; outer *anthers* tucked under the four central anthers with outer anther apices reaching only to half way along the four central anthers; outer *filament* length 4–5 mm long. (Figure 25)

Diagnostic features. Small short-lived rhizomatous geophyte to 30 cm diameter and 20 cm tall. Scapes several, 5–20 cm long, straight, erect to obliquely ascending with flowers held facing outwards. Perianth when flattened out 30–50 mm long and 3–5 mm wide at narrowest point, conspicuously constricted below the stamens. Top of ovary marks the upper extent of red coloration. Outer anthers tucked under the four central anthers with outer anther apices reaching only to halfway along the four central anthers.

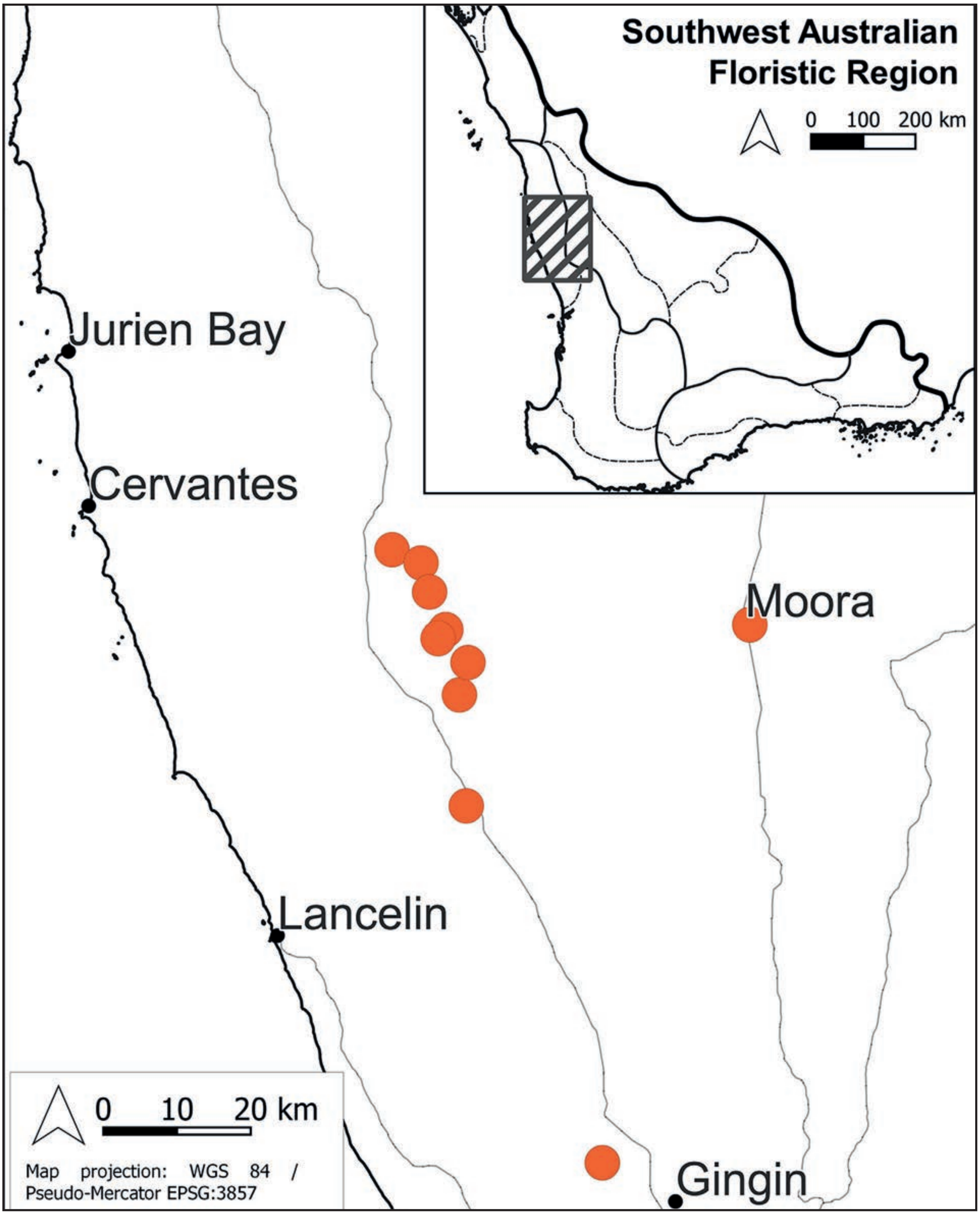

Figure 27. Geographical distribution of *Anigozanthos humilis* subsp. *grandis* (●) based on specimen data from the Atlas of Living Australia. Inset map of the Southwest Australian Floristic Region showing Provinces and Districts as in Gioia and Hopper (2017) – see Figure 1.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 25 Sep. 2006, *M. Bennett* 1076 (PERTH 07518099); 8 Dec. 2006, *J.A. Cochrane* JAC 6241 & *T. Erikson* (PERTH 07504144); Nov. 1935, *C.A. Gardner s.n.* (PERTH 00993212, 00993190); 26 Sep. 2006, *T. Nicholls* TN 40, *N. Perkins & A. Coates* (PERTH 08356475).

Phenology. Flowers September–late October, mostly setting seed late December.

Distribution. A microendemic species with a restricted range north and north-west of Ravensthorpe (Figure 25).

Habitat. Occupies high positions in the landscape (OCBILs) in kwongkan dominated by *Eucalyptus pleurocarpa* and *Banksia media*, with other members of Haemodoraceae including *Anigozanthos humilis*, *A. rufus*, *Conostylis seorsiflora* and occasional *Haemodorum spicatum*. Rare hybrids of *A. humilis* × *A. knappiorum* have been seen. The species itself is only seen for one or two years after hot summer wildfire, from which it regenerates only from seed.

Etymology. Named for members of the Merningar Bardok Knapp family who have contributed greatly to recent understanding of caring for country from a cultural perspective along the south coast from Israelite Bay to west of Walpole. Today's Knapps still enjoy continuous oral history passed down particularly by Alf Knapp and his sister Aunty Bonny. Dr Lynette Knapp has played a central role in collaborating with University of Western Australia Albany campus staff, and in recording family oral history (e.g. Knapp 2011; Knapp *et al.* 2024). Her children, especially Dion Knapp and Shandell Cummings, have played an increasing role in recording family history, and Lynette's son Michael is a gifted artist.

Conservation status. Listed as Threatened under State and Federal jurisdictions with a ranking of Vulnerable (State of Western Australia 2025) and Endangered (Department of Climate Change, Energy, the Environment and Water 2025), respectively, under the name *Anigozanthos bicolor* subsp. *minor*. The conservation status of *A. knappiorum* will be reassessed because the current listing incorporates occurrences of what is now recognised as *A. condingupensis*.

Vernacular name. Knapp's Dwarf Kangaroo Paw is recommended.

Affinities and notes. *Anigozanthos knappiorum* has proved to be one of the most elusive species in the genus due to its propensity to flower only after hot wildfire. It has been variously confused with *A. gabrielae* Domin and *A. bicolor.* It is readily distinguished from *A. bicolor* in its smaller flowers which are held facing outwards away from the plant, and the unique way in which the two outer stamens are held beneath the central four and do not extend forward to the same degree. Specifically, *A. knappiorum* differs from *A. bicolor* in its scape straight, erect to obliquely ascending with flowers held facing outwards (vs gently curved with flowers facing inwards to centre of the plant), smaller red and green flowers (measurements below; vs larger, longer flowers); the green perianth in life 30–50 mm long (vs 45–75 mm), gently curved throughout (vs abruptly downcurved approaching the stamens); perianth when flattened out 30–50 mm long and 7–12 mm wide at base, 3–5 mm wide at narrowest point (vs 45–75 mm long and 11–13 mm wide at base, 4–12 mm wide at narrowest point), basal third parallel-sided when opened out then strongly constricted at the level of the outer stamens (vs gently narrowing from the base to the constriction at the outer stamens); style 30–40 mm long (vs 40–75 mm long); top of ovary marks the upper extent of red coloration (same in *A. bicolor*); outer anthers tucked under the four central anthers with outer anther apices reaching only to half way along the four central anthers (vs outer anthers splayed apart from the four central anthers and outer anther apices almost attaining the apices of the four central anthers); outer filament length 4–5 mm long (vs 2–7.5 mm long). The flowers of *A. gabrielae* are even smaller and quite broad relative to length when flattened out compared to the slender constricted flowers of *A. knappiorum*. In addition, the red-purple coloration on *A. gabrielae* extends only part way up the ovary, whereas the bright red colour of *A. knappiorum* extends to the top of the ovary. *Anigozanthos yorlining*, described below, differs in a similar way from *A. knappiorum* to *A. gabrielae*. *Anigozanthos condingupensis* has red-purple coloration extending only part way up the ovary.

See *Affinities and notes* section under *A. condingupensis* for discussion regarding the type of *Anigozanthos bicolor* var. *minor*.

Anigozanthos viridis Endl. subsp. **metallicus** Hopper, *subsp. nov.*

Type: 1.5 km north of Wongonderrah Road, along Yerramulla Road, east of Cervantes, Western Australia, 9 October 2008, *R.J. Smith* RJS 182, *S.D. Hopper & L. Sweedman* (*holo*: PERTH 08804214; *iso*: K).

Anigozanthos viridis Endl. subsp. 'metallica', S.D. Hopper, *Kangaroo paws and catspaws*, pp 134–135 (1993).

Anigozanthos viridis subsp. Cataby (S.D. Hopper 1786), Western Australian Herbarium, in *Florabase*, https://florabase.dbca.wa.gov.au/ [accessed 22 May 2025].

Illustrations. S.D. Hopper, *Kangaroo paws and catspaws*, pp 134–135 (1993).

Leaves flat, 10–20 cm long. *Scapes* intermediate in height between those of subsp. *viridis* and subsp. *terraspectans* (12–40 cm tall, usually 15–30 cm). Like subsp. *viridis*, the flowers open towards the axis of the plant. *Perianths* almost iridescent green and 50–70 mm long. *Floral hairs* distinctively dark metallic-green. (Figure 28)

Other specimens examined. WESTERN AUSTRALIA: *c.* 400 m S of Wongonderrah Road at *c.* 4 km W of Yerramullah Road, SE of Cervantes, 20 Oct. 2007, *A. Crawford* 1452 (PERTH 08008310); 8 km along Wongonderrah Road from Brand Highway, Badgingarra, 21 Oct. 1978, *J. Dodd s.n.* (PERTH 01205803); SE corner, Moore River National Park (Reserve 28462), NW of Gingin, 17 Oct. 1992, *E.A. Griffin* 7282 (PERTH 03422402); SE corner, Moore River National Park (Reserve 28462), NW of Gingin, 17 Oct. 1992, *E.A. Griffin* 7285 (PERTH 03422364); 12 km W of Gingin – Dongara road on road to Nambung National Park, 29 Nov. 1974, *T.A. Halliday* 165 (PERTH 03911624, AK); Beermullah, 10 km N of Gingin along Jurien Bay road, 7 Oct. 1975, *S.D. Hopper* 26 (PERTH 03911659); *c.* 25 km SE of Cervantes, 16.1 km W of Brand Highway and 2.5 km N of Coowarloo [Cooljarloo] road, 28 Oct. 1976, *S.D. Hopper* 729 (PERTH 03911667); *c.* 15 km SW of Cataby Roadhouse, 9.4 km SW of Brand Highway along Mimegarra road, 28 Oct. 1976, *S.D. Hopper* 748 (PERTH 03911632); 1 km W of Brand Highway along Beermullah West Rd, 6 Nov. 1975, *S.D. Hopper* 814 (PERTH 01205838); 31 km N on Mimegarra road, start 18 km E of Lancelin (*c.* 50 km ENE Lancelin), 17 Oct. 1981, *G.J. Keighery* 4127 (PERTH 03911640); intersection of Wongonderrah and Munbinea Roads, NW corner, 11 Sep. 1991, *S. Patrick* 789 (PERTH 06889549); 61 mile peg Gingin Road [14 km N of Gingin on the Brand Highway], 22 Sep. 1974 *C.I. Stacey* 319 (PERTH 01679317); along Great Northern Highway 1.5 km N of Bullsbrook, 30 Sep. 1982, *A. Strid* 20650 (PERTH 03911675).

Phenology. Flowers August–September. October and November specimens are post-flowering.

Distribution. Occurs between Beermullah and Nambung National Park in the Lesueur Floristic District of Gioia and Hopper (2017) (Figure 29).

Habitat. Favours low heath and sedge in winter-wet flats and swamps.

Etymology. Named from the Latin adjective *metallicus, -a, -um*, metallic, alluding to the almost iridescent green flowers.

Conservation status. Not under threat. Known from a few conservation reserves.

Vernacular name. Metallic Green Kangaroo Paw is recommended.

Affinities and notes. Readily distinguished from *A. viridis* subsp. *viridis* by its shorter stature and metallic green flowers. From *A. viridis* subsp. *sophrosyne* Hopper this subspecies differs in having terete, not flat leaves and shorter stature. Smaller specimens of *A. viridis* subsp. *metallicus* have been confused with

Figure 28. *Anigozanthos viridis* subsp. *metallicus*. A – close-up of inflorescence; B – whole plant highlighting the iridescent green colouration. Photographs by S.D. Hopper.

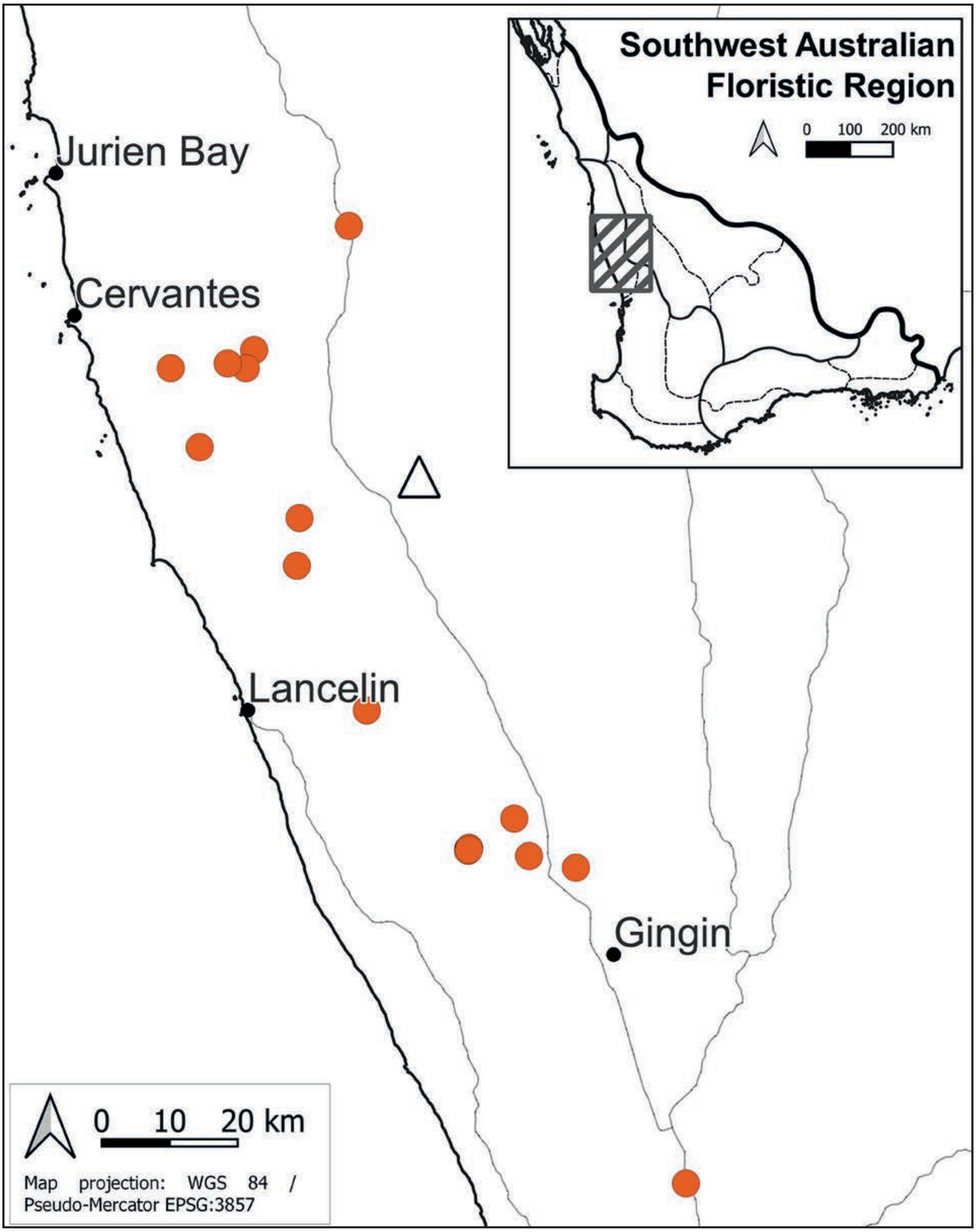

Figure 29. Map showing the geographical distribution of *Anigozanthos viridis* subsp. *metallicus* (●) and *A. viridis* subsp. *sophrosyne* (△) adapted from Florabase. Inset shows location within the Southwest Australian Floristic Region *sensu* Gioia and Hopper (2017) – see Figure 1.

A. viridus subsp. *terrespectans* Hopper, but its flowers overhang the recurved scape rather than being thrust outwards away from the scape.

Anigozanthos viridis Endl. subsp. **sophrosyne** Hopper, *subsp. nov.*

Type: ENE of Cataby roadhouse on Brand Highway, Western Australia [precise locality withheld for conservation reasons], 12 October 2022, *S.D. Hopper* 8717 (*holo*: PERTH 09723145; *iso*: CANB).

Illustrations. K.S. Downes, *Germination Requirements of the Lesser Known Kangaroo Paw and Catspaw Taxa*, p. 12, (2016), as *Anigozanthos manglesii* var. × *angustifolius*.

Leaves flat, 23–30 cm long, 4–9 mm wide. *Scapes* tall, to 40–60 cm; like *A. viridis* subsp. *viridis* and *A. viridis* subsp. *metallicus*, the flowers open towards the axis of the plant. *Perianths* rich green, rarely yellowish, and 50–55 mm long. (Figure 30)

Other specimens examined. None.

Phenology. Flowers late September–October.

Distribution. Confined to a narrowly endemic range east of Cataby.

Habitat. Favours *Eucalyptus rudis* woodland on winter-wet flats, swamps and water courses.

Etymology. Named from the Greek virtue, *sophrosyne*, female, (Σωφροσύνη) which is an ideal of excellence of character and soundness of mind. Many historians wrote about it and Heraclitus stated:

‘Sophrosyne is the greatest virtue, and wisdom is speaking and acting the truth, paying heed to the nature of things’.

The epithet celebrates the three female grandchildren of S.D. and C.G. Hopper, Sofia, Ioanna Rose and Melina Eve, the latter two of whom were born as twins on the day SDH collected the type specimens of the new subspecies. It is his fervent wish that they are sophrosynous in their lives, wise, acting the truth and paying heed to the nature of things. Sofia is already on this track. Rosie and Mel will surely follow. Their Australian flower will be there as a symbol of this great virtue.

Conservation status. To be listed as Priority One under Conservation Codes for Western Australian Flora (Tanya Llorens pers. comm.). Potentially threatened given its narrow geographical range in an extensively cleared landscape. Further field survey is necessary. Also, bringing the subspecies into *ex situ* seed storage and cultivation should be a priority.

Vernacular name. Virtuous Kangaroo Paw is recommended.

Affinities and notes. This rare subspecies was first brought to the attention of SDH in photos by Curtin University’s Dr Katherine Downes during a study of seed germination of kangaroo paws (Downes *et al.* 2014; Downes 2016). At the time, noting the flat leaves, SDH was unaware of the population structure but suggested the taxon resembled hybrids of *Anigozanthos manglesii* × *viridis*. Consequently, it was labelled as such by Downes *et al.* (2014) and Downes (2016). Seeing a population in the wild called for a revision of this first diagnosis. The subspecies occurs in pure populations of many individuals, not intermixed with putative parental taxa as a hybrid would be expected to be. Hence, we have no hesitation in naming it as a new subspecies. The subspecies is readily distinguished from others in *A. viridis* by its flat leaves, tall scapes and rich colouration.

Figure 30. *Anigozanthos viridis* subsp. *sophrosyne*. A – whole plants in habitat; B – stamens, stigma and upper style; C – common coloured morph (right) and rare yellow morph (left); D – richly coloured inflorescence; E – close-up of flat leaves with inkspot disease; F – flat leaves and inflorescences in bud with prominently red-maroon scapes. Photographs by S.D. Hopper (A, C–F); Katherine Downes (B).

Anigozanthos yorlining Hopper, *sp. nov.*

Type: Mount Arid, southwest ridge, Cape Arid National Park,122 km east of Esperance, Western Australia, 29 November 2005, *S.D. Hopper* 8682 (*holo*: PERTH 09283722).

Illustrations. P. Nikulinsky & A. Nikulinsky, *Cape Arid*, Figure under 22 September 2009, pp. 56 & 57 (2012), as *Anigozanthos gabrielae*.

Small short-lived rhizomatous *geophyte* to 15 cm diameter and 21 cm tall. *Roots* sand-binding. *Leaves* 3.2–12 cm long by 0.5–2.5 mm wide. *Scapes* 7–21 cm long, straight, erect. *Flowers* smaller (measurements below), red and green, semi-closed, almost cleistogamous, more stiffly held obliquely erect; the green *perianth* in life 15–16 mm long, evenly tubular and united for more than half its length to just below the point of insertion of the outer filaments, when flattened out 18–20 mm long and 9–12 mm wide at base, 8–9 mm wide at narrowest point, almost parallel-sided when opened out and flattened with a slight constriction at the level of the outer stamens; *perianth lobes* split apart for their full length and spreading separately, reflexed backwards 120–180 degrees in a spreading star-like array; *style* 14–15 mm long; *anthers* at three overlapping levels held in a tightly appressed tubular bundle; outer *filament* length 1.5–2.0 mm long. (Figures 31, 32)

Diagnostic features. Erect-stemmed dwarf caespitose red and green herb to 25 cm tall. Scape straight, erect. Perianth in life evenly tubular, 15–16 mm long, when flattened out 18–20 mm long and 9–12 mm wide at base, 8–9 mm wide at narrowest point, almost parallel-sided with a slight constriction at the level of the outer stamens; style 14–15 mm long; anthers at three overlapping levels held in a tightly appressed tubular bundle; outer filament length 1.5–2.0 mm long.

Other specimens examined. WESTERN AUSTRALIA: S slope of Mount Arid, Cape Arid National Park; 122 km E of Esperance, 30 Nov. 2005, *S.D. Hopper* 8683 (PERTH 09283757); Mt Arid, slopes *c.* 1 km due southwest of summit with Mt Arid, 31 Jan. 2006, *L.S.J. Sweedman* 6775 (KPBG 21981).

Phenology. Flowers September–late November, mostly setting seed late January; cultivated specimens at Goode Beach in first flower in early August.

Distribution. A microendemic species with an extremely restricted range extending over a maximum of 4 km from near the summit of *Yorlining* (Mt Arid) south-west to 2 km east-north-east of Cape Arid. Elevation ranges from 20 to 290 m above sea level (Figure 32).

Habitat. All of the eight populations documented were found adjacent to massive sheet granite in wet shallow sand and recently burnt or unburnt granitic herbfields and low scrub with *Taxandria marginata*, *Melaleuca globifera*, *Lepidosperma hopperi*, *Hakea drupacea*, *Goodenia trinervis*, *Platysace compressa*, *Anthocercis viscosa*, *Centrolepis aristata*, *Siloxerus humifusus*, *Stylidium breviscapum*, *Isotropis cuneifolia*, *Wurmbea cernua*, *Thysanotus nudicaulis*, *Haloragodendron glandulosum*, *Verticordia minutiflora*, *Microtis quadrata*, *Cypselocarpus haloragoides*, *Stypandra glauca*, *Goodenia decursiva*, *Diuris pulchella*, *Astus tetragonus* and *Senecio glossanthus*.

Etymology. The species takes its name from the *Noongar* word for Cape Arid – *Yorlining*. This is derived from *yorl/yauwarl* = paperbark *Melaleuca*, *in/an* = kept, and in^{y} = essive case for ‘as’, e.g. for a character at a particular point in time (von Brandenstein 1988). Thus a translation for *Yorlining* might be where the paperbarks are kept, which is significant for Mt Arid which lies near the eastern limit for the salt water paperbark *Melaleuca cuticularis*. It seemed particularly appropriate to choose this noun in apposition for the new species as a mark of respect for the *Noongar* people of Cape Arid, the Merningar Bardoks, to whom the word Noongar itself belongs to designate a male warrior who has gone through both coastal and desert law (von Brandenstein 1988; Elder L. Knapp pers. comm.).

Conservation status. To be listed as Priority Two under Conservation Codes for Western Australian Flora

Figure 31. Comparison of floral features of sister species *Anigozanthos yorlining* (voucher *S.D. Hopper* 8682) and *A. gabrielae* (*S.D. Hopper* 2640). *Anigozanthos yorlining*: A – inflorescence, note the fused perianth in lower half above ovary; B – plant *in situ* (with *Goodenia trinervis*) highlighting the inflorescences held on a straight, erect scape; C – flowers ventral and side view; D – inflorescence. *Anigozanthos gabrielae*: E – three flowers ventral, side and dorsal views; F – inflorescence. Photographs by S.D. Hopper.

(Tanya Llorens, pers. comm.). Careful searches in 2005/06 over Mt Arid and vicinity following a large bush fire in early 2005 revealed only eight populations of *A. yorlining*, with an estimated total of 400 + plants counted. Thus, even after seemingly ideal conditions for germination post-fire and flowering, fewer than 500 individuals have been observed by competent rare flora experts (SDH, Dr Colin Yates, Kings Park and Botanic Garden's Seed Collector Luke Sweedman). All eight populations occur within Cape Arid National Park, a place under increasing threat from successive wildfires associated with global warming. Consequently, it is recommended that *A. yorlining* be nominated as threatened under the State legislation.

Vernacular name. Cape Arid Dwarf Kangaroo Paw is recommended.

Affinities and notes. The discovery of this species by SDH and Colin Yates in November 2005 was unexpected. The genus had been comprehensively surveyed by SDH and many others over several preceding decades, including Mt Arid itself by a range of botanists. *Anigozanthos yorlining* is clearly related to *A. gabrielae*, both being diminutive red and green kangaroo paws associated with moist habitats of or near major inselbergs (Mt Arid and the Stirling Range respectively, Figure 32). However, there are many morphological differences between these two taxa on close examination. Specifically, *A. yorlining* differs from *A. gabrielae* in its scape straight, erect (vs curved, often obliquely ascending in *A. gabrielae*), smaller red and green flowers (measurements below), that are semi-closed, almost cleistogamous, more

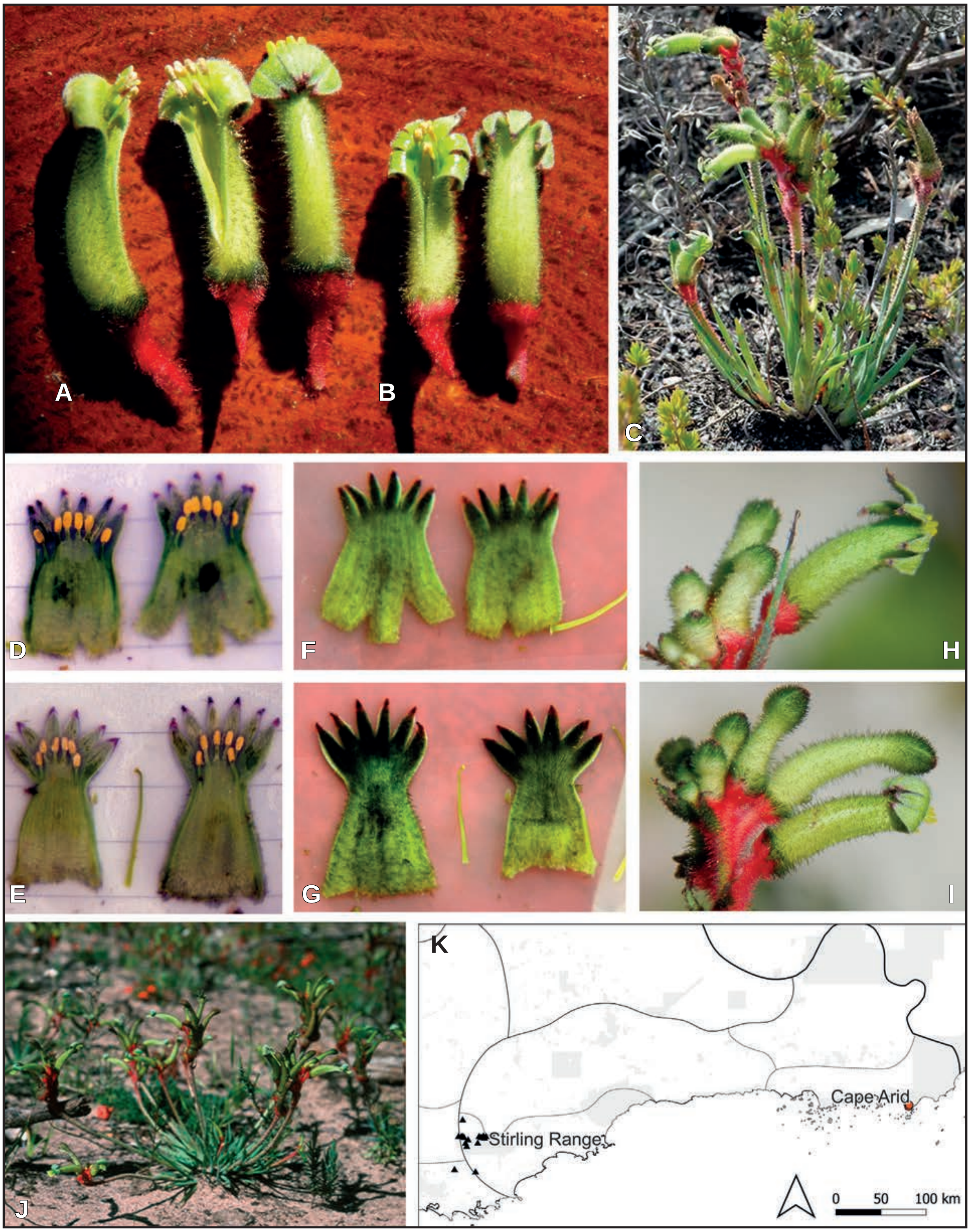

Figure 32. Comparison of floral features and distribution of *Anigozanthos gabrielae* and *A. yorlining*. *Anigozanthos gabrielae*: A – three flowers from side, ventral and dorsal views; E – two perianths cut off at the ovary and then flattened out, with style; G – dorsal view of two perianths cut off ovary and then flattened out; I –inflorescence; J – whole plant *in situ* at Camel Lake Nature Reserve N of Stirling Range, illustrating curved scapes. *Anigozanthos yorlining*: B – flowers from ventral and dorsal views; C – plant *in situ* at Yorlining (Mt Arid) illustrating straight erect scapes; D – two perianths cut off at the ovary and then flattened out; F– dorsal view of two perianths cut off at ovary and then flattened out; H –inflorescence. K – map showing geographic distribution of *A. gabrielae* (▲) (Stirling Range) and *A. yorlining* (●) (Cape Arid) based on map in Figure 1 (from Gioia & Hopper 2017). Photographs by S.D. Hopper; P. Nikulinksy (C).

stiffly held obliquely erect (vs larger flowers, somewhat tremulously held horizontal in *A. gabrielae*); the green perianth in life 15–16 mm long (vs 19–20 mm in *A. gabrielae*), evenly tubular and united for more than half its length to just below the point of insertion of the outer filaments (vs the tube unites for a third the perianth length then expands to a prominent dorsal hump before the margins flattening and narrowing at the stamens); perianth when flattened out 18–20 mm long and 9–12 mm wide at base, 8–9 mm wide at narrowest point (vs 23–26 mm long and 11–13 mm wide at base, 6–7 mm wide at narrowest point), almost parallel-sided when opened out and flattened with a slight constriction at the level of the outer stamens (vs conspicuously narrowing and constricted at the outer stamens), perianth lobes split apart for their full length and spreading separately, reflexed backwards 120–180 degrees in a spreading star-like array (vs united at the base for a third to two thirds their length, held in a tight reflexed cluster consistently at 145 degrees or more from horizontal); style 14–15 mm long (vs 15–20 mm long); anthers at three overlapping levels held in a tightly appressed tubular bundle (vs anthers splayed so that central four form a flat array at the same level above the outer two); outer filament length 1.5–2.0 mm long (vs 2.0–3.0 mm long).

In other cases in the genus such as *A. condingupensis* and *A. decrescens*, or *A. rufus* Labill. and *A. pulcherrimus* Hook., fewer characters separate clear genetic sisters. Hence we are confident that regarding *A. yorlining* as a species sister to *A. gabrielae* rather than as a subspecies of it is the appropriate taxonomic treatment. The geographical disjunction of some 500 km between these two species, combined with gravity-dispersed seed, suggests that prolonged separation in space and time has likely occurred. These are classic endemic species of OCBILs (old, climatically buffered infertile landscapes), so common in the SWAFR (Hopper 2023). Genetic studies of sisters on OCBILs in the SWAFR continue to illustrate dramatic genetic divergence, sometimes over remarkably short distances of just a few kilometres (e.g. in *Banksia seminuda* in the Walpole region on granite inselbergs – Robins *et al.* 2021).

The semi-closed, almost cleistogamous flowers of *A. yorlining* are unique in the genus. The perianth is tubular almost up to the stamens, which therefore are tightly bundled around the style (Figures 31, 32). Cross-and self-pollination studies may prove rewarding, given that most species are strongly xenogamous (Hopper 1980).

Anigozanthos yorlining adds to the list of dwarf kangaroo paws that are pollinated by honeyeaters standing on the ground (Hopper 1993). Outgroup comparison suggests that this is the ancestral form for the kangaroo paws – species of *Conostylis* and of *Blancoa* that are bird-pollinated are all short-statured and nectar is consumed from a standing position on the ground. An experimental study of feeding behaviours of honeyeaters on kangaroo paws of differing scape heights may well provide further insight on this process.

Undoubtedly, *A. yorlining* is the most vulnerable species in the genus to the effects of climate change, given it has such a narrow range confined to the summit and southern slopes of the Mt Arid massif. Regular monitoring of the species is needed, and further seed collections made, to ensure it survives *ex situ* at least, should wild populations go extinct.

Conostylis R.Br.

Conostylis is the largest genus of Haemodoraceae, sister to *Blancoa*, and now comprising 49 species, with four recognised as new or elevated to species rank herein. The genus has been examined from a molecular phylogenetics perspective (Hopper *et al.* 2006; Zuntini *et al.* 2021), calling for a revision of the infrageneric classification offered by Hopper *et al.* (1987) now that it is evident that vertebrate-pollinated flowers arose independently four times in *C.* subg. *Pendula* Hopper, and other relationships have been clarified. New taxa and species are described below.

Conostylis subg. **Appendicula** (Geerinck) Hopper, *comb. et stat. nov.*

Conostylis sect. *Appendicula* Geerinck, *Bull. Jard. Bot. Etat.* 39: 64 (1969). *Type*: *C. aurea* Lindl.

Conostylis subg. **Divaricata** (Hopper) Hopper, *comb. et stat. nov.*

Conostylis sect. *Divaricata* Hopper, *Fl. Australia* 45: 457 (1987). *Type*: *C. phathyrantha* Diels

Elevated to subgeneric status on the basis of molecular phylogenetic evidence (Hopper *et al.* 2006). *Conostylis neocymosa* Hopper is removed from this subgenus due to its ovules being few, reflexed from the underside of the placenta. This key character is diagnostic of *Conostylis* subg. *Pendula* Hopper. *Conostylis* subg. *Divaricata* is thereby rendered monotypic, distinguished by its placenta covered with ovules on lateral and lower sides and its loosely cymose inflorescence.

Conostylis R.Br. sect. **Conostylis**.

Type: *C. aculeata* R.Br.

Differs from *C.* sect. *Terraflora* Hopper by many-flowered inflorescences borne well above the soil on elongate scapes.

A section of ten species, highly variable with subspecies especially in *C. aculeata* and *C. candicans* Endl. Natural hybridisation is frequent at interzones between habitats occupied by parental taxa. At least three stabilised hybrids are formally recognised as taxa – *C. pauciflora* Hopper subsp. *pauciflora*, *C. pauciflora* subsp. *euryrhipis* Hopper and *C. bracteata* Lindl. *Conostylis stylidioides* F.Muell. is likely an ancient allopolyploid (Krauss & Hopper 2001).

Conostylis sect. **Terraflora** Hopper, *sect. nov.*

Type: *C. serrulata* R.Br.

A section distinguished by the compact or loose relatively few-flowered cymose or umbellate inflorescences on short scapes held at or close to ground level.

Etymology. From the Latin *terra* (land) and *-floris* (flower), alluding to the flowers being held at close proximity to the ground.

Affinities and notes. Five species are included in *C.* sect. *Terraflora*: *C. serrulata, C. glabra* Hopper, *C. juncea* Endl., *C. laxiflora* Benth. and *C. magna* Hopper. These species are quite divergent morphologically from each other, a pattern also evident in the number of changes in DNA sequences documented (Hopper *et al.* 2006). *Conostylis juncea*, with its unique bristle-like floral hairs, is quite variable vegetatively and warrants further taxonomic study. Two new local endemics of the northern sandplains in *C.* sect. *Terraflora* have been discovered and are described below.

Conostylis glabra Hopper, *sp. nov.*

Type: Watheroo National Park, Western Australia [precise locality withheld for conservation reasons], 6 October 1997, *S.D. Hopper* 8394 (*holo*: PERTH 09323414; *iso*: CANB).

Conostylis sp. Watheroo (S.D. Hopper 7668), Western Australian Herbarium, in *Florabase*, https://florabase.dbca.wa.gov.au/ [accessed 22 May 2025].

Conostylis glabra Hopper ms, in R.J. Smith, S.D. Hopper & M.W. Shane, *Plant Soil* 348: 466 (2011), *nomen nudum*.

Caespitose tufted shiny *perennial herb* in clumps up to 50 cm diameter, 60 cm wide, glabrous, viscid. *Roots* sand-binding. *Leaves* clearly striate with *c.* 10 parallel veins raised above lamina, linear to slightly falcate, flat, to 30–50 cm long, 5–12 mm wide, slightly glossy green becoming yellowish cream and very viscid near base; margins yellow-green or brown near base with minute upward facing pointed indurate bristles every 2–5(–10) mm. *Inflorescence* geoflorous, a compact or loose cyme, basal, very viscid, much shorter than leaves, 3–7 cm long, to 5-flowered. *Bracts* 2–4, scarious, conduplicate, yellow-cream, lanceolate to navicular, to 4 cm, 7 mm wide basally, becoming narrow linear and 2 cm, 0.5 mm, scarious, brown. *Floral bracts* very narrow linear, to 0.5 mm wide, 25 mm long. *Pedicels* pale greenish yellow, 0.5–1.5 cm long. *Flowers* greenish yellow, glossy. *Perianth* divided for four-fifths of length; *lobes* 7–11 mm long, glossy pale yellow with white margins abaxially, cream adaxially, becoming golden yellow at base, apical margins ferruginous, dark brown. *Stamens* erect, held away from spreading perianth. *Anthers* cream, 4–6 mm long on a 1.5–2.5 mm golden yellow filament. *Style* pale greenish yellow, *c.* 5–8 mm long. *Stigma* as long astop of anthers. *Ovary* glossy pale green on sides, golden yellow on top, 9–12 mm long. *Ovules* 30 or more per locule, all over a small placenta. *Seeds* narrow-elliptic, orange-brown undulating surface with white clusters of 3–4 linear marks. (Figure 33)

Diagnostic features. *Conostylis glabra* is the only mostly glabrous species in the genus. The species has striate leaves to 500 mm long, 10 mm wide, margins with minute upward facing pointed indurate bristles every 2–5 mm. Inflorescence geoflorous, of up to 5 flowers, much shorter than the leaves. Flowers greenish yellow, glossy. Perianth is divided for four-fifths of perianth length, the lobes are 7–11 mm long. Anthers are erect, held away from the spreading perianth, cream, 4–6 mm long on a filament 1.5–2.5 mm long. Style pale greenish yellow, *c.* 5–8 mm long, stigma equalling top of anthers. Ovules 30 or more per locule, all over a small placenta.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 13 Oct. 1989, *S.D. Hopper* 7668 (BRI, CANB, MEL, NSW, PERTH 09214607); 10 Oct. 2008, *L.S. Sweedman* 7456 & *S.D. Hopper* (PERTH 08764247, K).

Phenology. Flowers September–early October.

Distribution. Endemic to Watheroo National Park in the border of the Lesueur-Wongan Botanical Districts of the Southwest Australian Floristic Region (*sensu* Gioia & Hopper 2017, Figure 1).

Habitat. Confined to gradually rising hills of deep sand supporting low woodlands of *Callitris arenaria*, *Banksia prionotes*, *B. attenuata*, *B. burdettii* and *Xylomelum angustifolium* over shrubs of *Acacia*, *Lachnostachys eriobotrya*, *Calytrix*, *Synaphea*, *Hakea orthorrhyncha*, *Conospermum*, *Melaleuca*, *Petrophile*, *Verticordia*, *Daviesia*, *Jacksonia horrida*, *Stirlingia latifolia*, *Adenanthos cygnorum*, *Leptospermum*, *Eremaea pauciflora*, *Lysinema ciliatum*, *Banksia leptophylla* and *Isopogon drummondii* over very open perennial herbs of *Patersonia*, *Mesomelaena*, *Drosera* spp., *Thysanotus* and *Desmocladus flexuosus*.

Etymology. From the Latin adjective *glaber*, *-ra*, *-rum* = hairless, in reference to the almost hairless state of the whole plant.

Conservation status. Listed as Priority Two under Conservation Codes for Western Australian Flora (Western Australian Herbarium 1998–), as *Conostylis* sp. Watheroo (S.D. Hopper 7668). *Conostylis glabra* is presently known from four populations on firebreaks within Watheroo National Park. Population estimates range from 200 plants to ten plants.

Vernacular name. Glabrous Cottonhead is recommended.

Affinities and notes. Molecular phylogenetic studies (Hopper *et al.* 2006; Zuntini *et al.* 2021) place *Conostylis glabra* as sister to a clade of *C. juncea*, *C. serrulata* and *C. laxiflora* (with significant missing sequences and poor support at the *mat*K and ITS loci), or sister to *C. serrulata* with 95% bootstrap support and 17 changes evident indicating considerable evolutionary divergence. Hence *C. glabra* may be

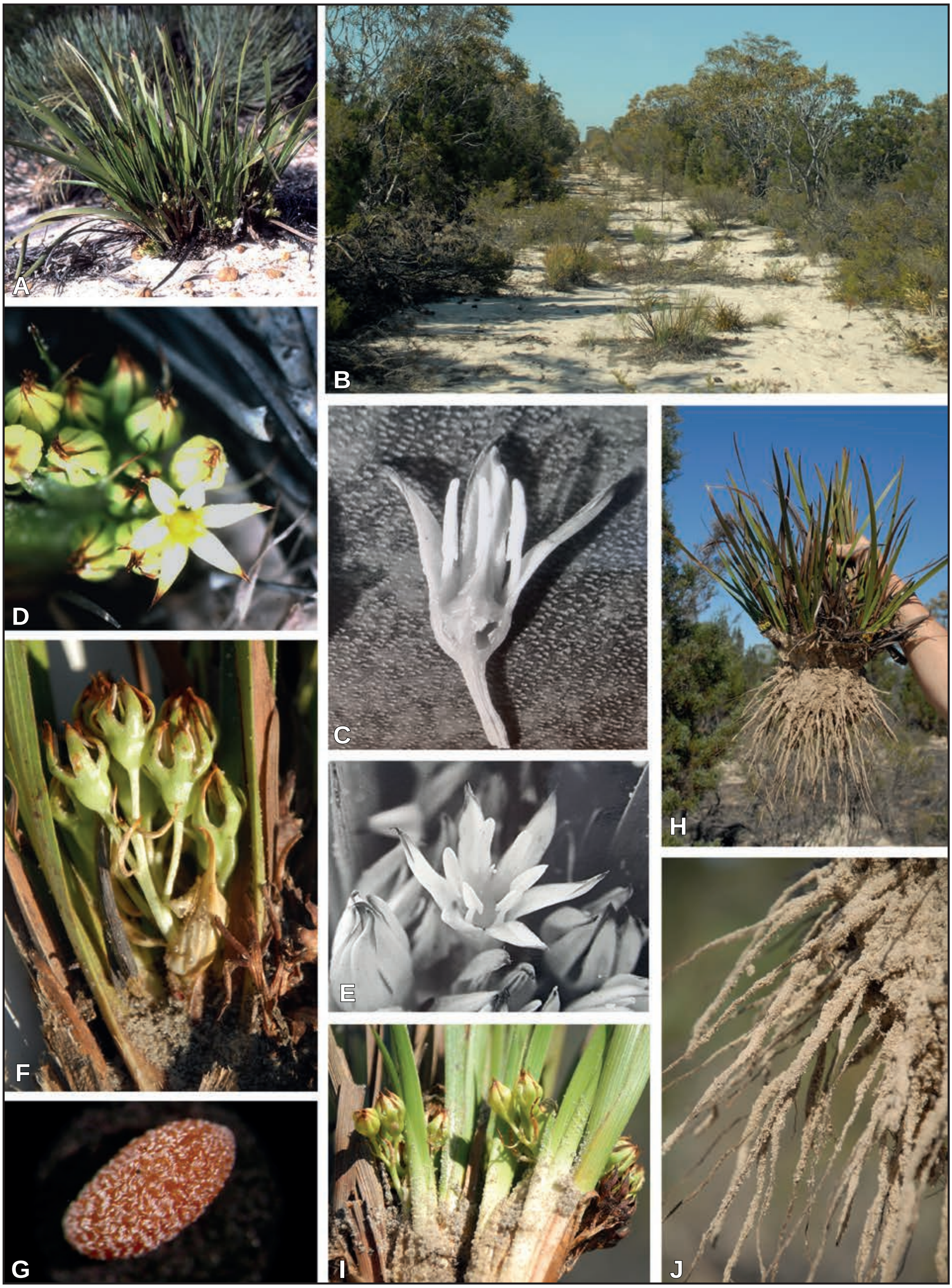

Figure 33. *Conostylis glabra*. A – whole plant *in situ*; B – habitat in Watheroo National Park; C – sectioned half flower showing erect stamens and placentation; D – flowers open and recently finished; E – same illustrating erect stamens; F – inflorescence in young fruit; G – microscopic view of seed; H – excavated whole plant showing sand-binding roots; I – viscid leaf bases and young fruiting inflorescences; J – close up of sand-binding roots. Photographs by S.D. Hopper (A–F, H–I); L. Sweedman (G).

reasonably regarded as a somewhat isolated endemic species of *C.* sect. *Terraflora* confined to Watheroo National Park sandplains.

Conostylis glabra is readily distinguished from *C. serrulata*, *C. juncea* and *C. laxiflora* in its glabrous plants with glossy yellow-green flowers (*C. juncea* with very long scattered hairs on yellow-green and white flowers; *C. laxiflora* with a loosely villous short-haired creamy yellow and green perianth; flowers cream and finely hirsute in *C. serrulata*), leaves glossy green with margins with minute upward facing pointed indurate bristles every 2–5 mm (usually dull blue-green leaves with minutely denticulate-serrulate margins in *C. serrulata*), pedicels glabrous and pale greenish yellow, 1–1.5 cm long (vs minutely hirsute, pale greenish cream, to 6 mm long in *C. serrulata*), erect stamens held away from the spreading perianth (vs reclined against the perianth in *C. serrulata*). *Conostylis glabra* and *C. serrulata* have a compact or loose, cymose, few-flowered inflorescence *c.* 5 cm tall (less than a tenth the length of the leaves), whereas *C. juncea* has a shortly capitate inflorescence, ground-hugging and many flowered, while *C. laxiflora* has a loose cyme to 15 cm tall, several-flowered, up to a third the length of the leaves.

The discovery of such a morphologically distinctive endemic by SDH in 1989 came as a surprise given the extensive field surveys conducted on *Conostylis* at the time. The species remains poorly collected to the present day, in need of detailed survey within the narrow confines of its known range. At present it appears to be the only narrow endemic plant confined to Watheroo National Park.

Conostylis magna Hopper, *sp. nov.*

Type: Alexander Morrison National Park [precise locality withheld for conservation reasons], 6 October 1997, Western Australia, *S.D. Hopper* 8395 (*holo*: PERTH 09323538; *iso*: K ex PERTH 09323546).

Conostylis sp. Eneabba (M. Hislop 3864), Western Australian Herbarium, in *Florabase*, https://florabase.dbca.wa.gov.au/ [accessed 22 May 2025].

Conostylis magna Hopper ms, in R.J. Smith, S.D. Hopper & M.W. Shane, *Plant Soil* 348: 466 (2011), *nomen nudum.*

Caespitose *herb* in clumps up to 50 cm diameter, 65 cm wide. *Roots* sand-binding. *Leaves* glabrous, green when young with acute scarious apex, greyish green to blue-green, striate with 9–12 prominent parallel longitudinal veins with conspicuous yellow marginal veins, 26–65 cm long, 4.5–7 mm wide. *Inflorescence* geoflorous, to 12 cm high, a compact or loose cyme, branches hidden by densely aggregated flowers above. *Bracts* broadly navicular to linear, dark brown, scarious, mostly glabrous except for the tightly tomentose base with creamy yellow hairs, to 30 mm long, 13 mm wide, apex acute. Flowers creamy yellow, tightly tomentose outside, inner perianth lobes evenly tricoloured with brown apices and apical margins, cream medially and becoming gold in basal third. *Perianth lobes* free, splayed widely, scarcely connate, closing with perianth lobes vertical and separated by clearly visible gaps, 7–9 mm long. *Anthers* 4–5 mm long, reclined parallel to splayed perianth lobes, cream, on short golden filaments *c.* 1 mm long. *Style* golden, short (*c.* 2–3 mm long), its base flaring obliquely to form a golden broad cone atop the ovary. *Stigma* simple. *Seeds* not seen. (Figure 34)

Diagnostic features. *Conostylis magna* may be distinguished from all other members of the genus by the following combination of characters. Caespitose herb. Sand-binding roots. Large glabrous, greyish green to blue-green leaves, 26–48 cm long, 4.5–7 mm wide, with smooth yellow margins. Geoflorous inflorescence to 12 cm tall, a compact or loose cyme, branches hidden by densely aggregated flowers above; bracts broadly navicular to linear, dark brown, scarious, mostly glabrous except for the tightly tomentose base with creamy yellow hairs; flowers creamy yellow, tightly tomentose outside, inner perianth lobes evenly tricoloured with brown apices and apical margins, cream medially and becoming gold in basal third; perianth lobes free, splayed widely, scarcely connate, 7–9 mm long. Anthers 4–5 mm long, reclined parallel to splayed perianth lobes, cream, on short golden filaments *c.* 1 mm long.

Figure 34. *Conostylis magna*. A – leaves and inflorescences; B – close-up of bud, flowers and closed flowers; C – whole plant. Photographs by S.D. Hopper.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 25 Sep. 2005, *L. Aerne* LA 38 *& S.D. Hopper* (PERTH 08643970); 9 Sep. 2004, *R.K. Brummitt* RKB 21198, *A.S. George & E.G.H. Oliver* (PERTH 06962238); 10 Aug. 2014, *R. Davis* RD 12456 *& K.R. Thiele* (PERTH 08616183, 08633312,); 21 Oct. 1987, *E.A. Griffin* 4716B (PERTH 04365453); 17 Nov. 2008, *M. Hislop* 3864 (CANB, PERTH 08182043); 11 Oct. 1989, *S.D. Hopper* 7661 (PERTH 07440472); 27 Aug. 2015, *G.J Keighery & B.J. Keighery* 2760 (PERTH 09203273); 8 Oct. 2008, *R.J. Smith* 173, *S.D Hopper & L. Sweedman* (PERTH 08804133); 8 Oct. 2008, *L.S.J. Sweedman* 7451 & *S.D. Hopper* (PERTH 08764255).

Phenology. Flowers September–early October.

Distribution. Endemic to the Alexander Morrison National Park district in the Lesueur Botanical District of the Southwest Australian Floristic Region (*sensu* Gioia & Hopper 2017).

Habitat. Grows in kwongkan in deep white sand high in the landscape (i.e. on OCBILs) with *Eucalyptus todtiana*, *Banksia attenuata* and *B. burdettii* 3–5m tall very open low woodland over heath and scrub of *Banksia candolleana*, *B. micrantha*, *B. shuttleworthiana*, *Eremaea*, *Conospermum*, *Jacksonia*, *Adenanthos cygnorum*, *Verticordia*, *Lechenaultia*, *Dasypogon*, *Hovea stricta*, *Hibbertia subvaginata*, *Synaphea spinulosa*, *Calothamnus sanguineus*, *Stirlingia*, *Lambertia multiflora*, *Hakea orthorrhyncha*, *Caustis* sedges, *Conostylis seminuda*, *C. teretifolia*, *C. crassinerva* ssp. *absens*, *Haemodorum venosum*, *Macropidia fuliginosa* and *Phlebocarya pilosissima* subsp. *pilosissima*.

Etymology. From the Latin adjective *magnus, -a, -um* = large, alluding to the larger dimensions of the plant compared with its possible sister species *C. serrulata*.

Conservation status. Listed as Priority Two under Conservation Codes for Western Australian Flora (Western Australian Herbarium 1998–), as *Conostylis* sp. Eneabba (M. Hislop 3864).

Vernacular name. Large Cottonhead is recommended.

Affinities and notes. First collected by E.A. Griffin in 1987, and then two years after by SDH in 1989, *Conostylis magna* was another surprising discovery within the Lesueur Botanical District as its morphological affinities appear to be clearly with the more southerly species *C. serrulata* of forest and woodlands. *Conostylis magna* differs from *C. serrulata* primarily in its longer leaves (to 48 cm vs 40 cm) with prominent, yellow-veined, glabrous leaf margins (vs thin margins with minutely denticulate-serrulate hairs). The tricolour pattern of the inner perianth segments of *C. magna* is not as well-marked in *C. serrulata*, which may become uniformly golden coloured in some populations. Buds and the outer perianth segments of *C. magna* are brownish/golden yellow whereas they are creamy yellow in *C. serrulata*.

Despite the close morphological similarities of these two species, which led SDH to initially consider subspecific status for *C. magna*, DNA sequencing revealed substantial differences. However, the *C. magna* sample had significant missing sequences so its placement in the phylograms (Hopper *et al.* 2006) may be dubious. Nevertheless, we here place *C. magna* with its likely sister *C. serrulata* and allies in *C.* sect. *Terraflora*.

There are no other species in *Conostylis* that could be readily confused with *C. magna*. For example, *C. glabra* differs from *C. magna* in lacking any hairs and having glossy yellow inflorescences and leaf bases (Figure 33).

Conostylis aculeata R.Br. subsp. **bolghinup** Hopper, *subsp. nov.*

Type: Black Point, Lake Bolghinup, Western Australia [precise locality withheld for conservation reasons], 10 April 2014, *S.D. Hopper* 8690 (*holo*: PERTH 09723153; *iso*: CANB, K, MEL, PERTH 09865497).

Loosely caespitose robust perennial *herb* to 50 cm high. *Stems* stoloniferous, 6–16 cm long. *Leaves* to 50 cm long by 3–7 mm wide, in loosely flattened, narrowly fan-shaped clusters; marginal nerve inconspicuous; bristles along whole margin, spaced 3–5 mm apart, tightly angled upwards, usually 1–2 mm long. *Inflorescence* a compact terminal cyme or raceme; scape simple, erect, 16–30 cm tall, the flowers held at *c.* three-quarters the length of the leaves. *Flowers* 11–15 mm long. (Figures 35, 36)

Diagnostic features. Robust herb to 50 cm high; stoloniferous stems 6–16 cm long; leaves to 50 cm long, 3–7 mm wide, marginal nerve inconspicuous, bristles along whole margin, tightly angled upwards, usually 1–2 mm long; inflorescence compact, terminal, scapes to *c.* three-quarters the length of the leaves; flowers 11–15 mm long.

Other specimens examined. WESTERN AUSTRALIA: None seen, other than S.D. Hopper's field collection number 83313 under sticky tape in fieldbook 94 p. 40, collected at the type locality on 6 November 2014.

Phenology. Flowers October–December.

Distribution. *Conostylis aculeata* subsp. *bolghinup* occurs in the Muir Botanical District (Gioia & Hopper 2017), where it is endemic to the low dunes atop the Black Point basalt peninsula within D'Entrecasteaux National Park. This location also has a morphologically distinct population of *Banksia occidentalis* (Hopper 1989; Robins *et al.* 2024) and is the only known place of occurrence in Western Australia of *Plantago australis*, a species otherwise confined to Victoria.

Habitat. Grows in coastal low scrub of *Agonis flexuosa* 1.5 m tall with *Anthocercis littorea*, *Olearia axillaris*, *Cassytha*, *Desmocladus flexuosus*, *Jacksonia*, *Ficinia nodosa*, *Lepidosperma gladiatum*, *Acacia cyclops*, *A. littorea*, *Scaevola crassifolia*, *Banksia sessilis*, *B. occidentalis*, *Hibbertia stellaris*, *Adenanthos meisneri*, *Ornduffia parnassifolia*, *Patersonia*, *Brachyscome iberidifolia*, *Olax phyllanthi*, *Xanthorrhoea preissii*, *Muehlenbeckia adpressa* and marram grass (*Ammophila arenaria*). Coastal dunes are of yellowish sand with occasional limestone outcropping.

Etymology. Named from the small Lake Bolghinup on Black Point. *Bolghinup* is a Noongar word also rendered as *Bolganup* in the Porongurup Range. Hassell (1940) indicated that *Bolganup* meant place of the old ghosts or spirits. Given that it starts with *bol/bal* which means he, him, she, them, it and don't, leave it, finish with, beware (von Brandenstein 1988; Bindon & Chadwick 1992), the name *Bolganup*/*Bolghinup* seems to signify a very special place, full of ancestral spirits that command respect, reverence and caution. The robust bristle-laden leaves of *C. aculeata* subsp. *bolghinup* do indeed command respect, and the home of this subspecies is well known as a special place for camping and tool making (Figure 35) by Noongars.

Conservation status. A narrow endemic that is locally scarce to common. However, surveys southeast and northwest adjacent the coastline are yet to be undertaken to determine whether or not it is a true endemic of Black Point alone, although 7 km due east of Black Point on limestone *C. aculeata* subspp. *aculeata*/*gracilis* intergrades are to be found (Figure 36). It is best, for the time being, for *C. aculeata* subsp. *bolghinup* to be regarded as of indeterminate conservation status.

Vernacular name. Black Point Spiny Cottonhead is recommended.

Affinities and notes. *Conostylis aculeata* subsp. *bolghinup* is the most robust subspecies known, attaining

Figure 35. *Conostylis aculeata* subsp. *bolghinup*. A – view south-east at dry Lake Bolginup in February dominated by brown sedges, Black Point; B – fruiting inflorescence and typically broad leaves reddening towards the base; C, G – flowering inflorescence in November; D–F, H, I – Noongar artefacts collected at Black Point mostly by the late George Gardner, not to same scale, including hand-held grinding stone, black obsidian blade (a very rare rock in Noongar country [E]), backed blade of basalt, large chopper, grinding stone; J – single inflorescence and leaf fan; K – whole plants on bare dunes; L – close up of leaves showing obliquely ascending marginal spines; M – close-up of flowers showing six stamens and trifid stigma. Photographs by S.D. Hopper, courtesy George Gardner Museum Northcliffe (D–F & H–I) .

Figure 36. A – *Conostylis aculeata* subsp. *aculeata/gracilis* intergrades from 7 km E of Black Point on calcareous grey loam and limestone; B – *C. aculeata* subsp. *bolghinup* from Black Point illustrating longer, broader leaves and longer stem segments. Photographs by S.D. Hopper.

a height up to 50 cm, and with the broadest leaves 3–7 mm wide (Figures 35, 36). It is embedded within the geographic distribution of *C. aculeata* subsp. *aculeata* and possibly *C. aculeata* subsp. *gracilis* Hopper (Figure 36), but distinguishable by most of the characters listed above under diagnostic features. *Conostylis aculeata* subsp. *cygnorum* Hopper is another robust subspecies which differs from *C. aculeata* subsp. *bolghinup* in its globular inflorescence held above the leaves and in its leaves with a prominent yellow marginal vein and bristles confined to the apical half of the leaf.

Conostylis bungalbin Hopper, *sp. nov.*

Type: Helena and Aurora Range, Bungalbin Hill, Western Australia, 4 September 1984, *S.D. Hopper* 4038 (*holo*: PERTH 09276920).

Long-lived rhizomatous herbaceous obligate-seeding *perennial* lithophile forming clumps to 50 cm diameter and 20 cm high. *Roots* tough, wiry. *Leaves* flat, narrowly linear, to 23 cm long, 1.6–2 mm wide, grey-green, hairy and villous; *margins* with short tightly appressed bristles. *Floral bracts* ventricose, 20–22 mm long, 7 mm wide near base, scarious, thin, dry, opaque, apex acute, brown, attaining base of perianth lobes. *Flowers* solitary, 39–40 mm long with obliquely ascending never reflexed perianth lobes for *c.* half the length of the perianth; dark purple hairs on outside of perianth lobes for *c.* upper two-thirds of lobe length; perianth tube straight, pale green, *c.* 10 mm diameter. *Stamens* pale yellow-green; filaments *c.* 8 mm long; anthers 5–6 mm long. *Style c.* 32 mm long, green with green stigma. *Placentation and seeds* not seen. (Figures 37, 39)

Diagnostic features. *Conostylis bungalbin* is distinguished from other *Conostylis* in its tufted caespitose habit, banded ironstone habitat, short narrow villous leaves, its floral bracts half the length of the perianth, the straight perianth with dark purple hairs on the outside of the perianth lobes for two-thirds the length of the lobes, and its green style to 32 mm long with a green stigma.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 26 July 1995, *N. Gibson* & *M. Lyons* 3361 (PERTH 05393191); 15 May 1978, *G.J. Keighery* 1759 (PERTH 02011492); 2 Nov. 2000, *M. Sheriff* 217 - MS 217 (K, NSW, PERTH 06342728).

Figure 37. *Conostylis bungalbin*. A – plants *in situ* atop Bungalbin Hill, A.P. Brown for scale, 3 September 1984; B – buds and leaves; C – leaf fans atop stilt roots penetrating rock fissures *in situ*; D – flowers and leaves; E – flower – note the green style (arrowed). Photographs by G. Cockerton (B, D, E); S.D Hopper (A, C).

Phenology. Recorded in flower early August.

Distribution. Endemic to the Helena and Aurora Range, notably at Bungalbin Hill (Figure 39).

Habitat. Grows in fissures in banded ironstone with *Neurachne annularis* (Conservation status P3), *Tetratheca aphylla* subsp. *aphylla* (Threatened), *Lepidosperma bungalbin* (Threatened), *Stenanthemum newbeyi* (P3) and *Banksia arborea* (P4). Other associated species include *Acacia shapelleae* (Threatened), *Ptilotus obovatus*, *Melaleuca nematophylla*, *M. filifolia*, *Allocasuarina acutivalvis*, *Chamaexeros macranthera*, *Alyxia buxifolia*, *Dianella revoluta*, *Melaleuca leiocarpa* (BIF Form), *Grevillea zygoloba*, *Eucalyptus ebbanoensis* and *Calycopeplus paucifolius.* The occurrence of so many associated species of conservation concern in the Helena and Aurora Ranges led to their proposal as a national park in 2021.

Etymology. The specific epithet, a noun in apposition, is a Kalamia Kapurn (Gubrun) traditional name for the Helena and Aurora Ranges.

Conservation status. To be listed as Priority One under Conservation Codes for Western Australian Flora (Tanya Llorens pers. comm.). *Conostylis bungalbin* is a narrow endemic confined to the Helena and Aurora Ranges and one location (Koolyanobbing) further south. Its conservation status requires further investigation. At present the Helena and Aurora Ranges is a proposed National Park, although several mining tenements are still current over the habitat of *C. bungalbin*.

Vernacular name. Bungalbin Conostylis is recommended.

Affinities and notes. *Conostylis bungalbin* is sister to the widespread *C. argentea* (J.W.Green) Hopper (Figures 38–39), from which it differs in its somewhat larger broader leaves, its floral bracts half the length of the perianth, the perianth tube straight, dark purple hairs confined to two-thirds the length of the perianth lobes, and its shorter green style and green stigma.

Conostylis bungalbin is a banded ironstone inselberg endemic apparently restricted to just two inselbergs – Bungalbin Hill and Koolyanobbing Range. It is noteworthy in being the only species of *Conostylis* found outside the boundaries of the SWAFR *sensu* Gioia and Hopper (2017).

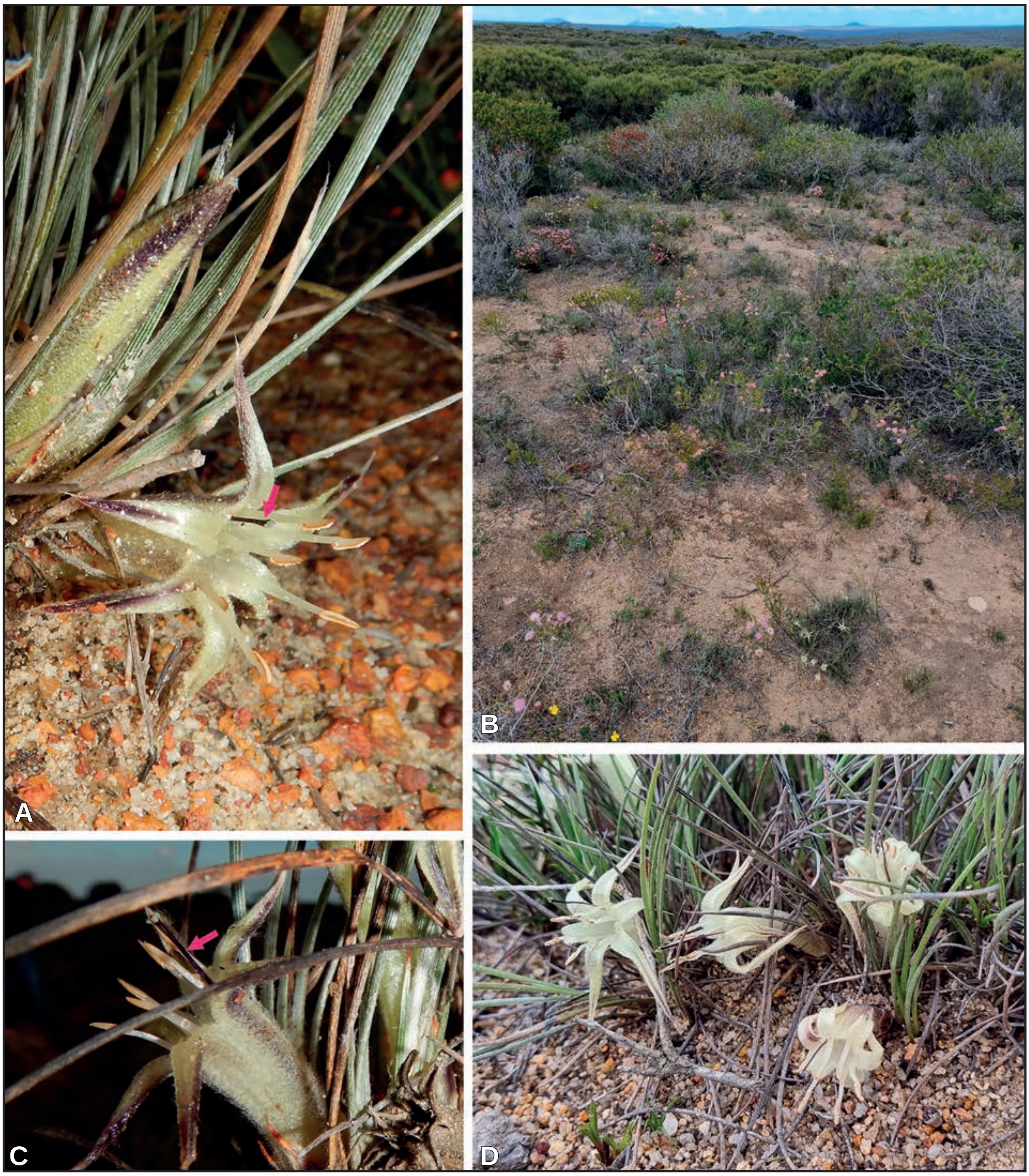

Figure 38. *Conostylis argentea*. A – leaves, bud and flower with black style arrowed; B – plant *in situ*, foreground, Tarin Rock, 10 August 2015; C – flower showing black style (arrowed); D – close-up of four flowers, Bald Rock Creek, Old Ongerup Road. Photographs by S.D. Hopper.

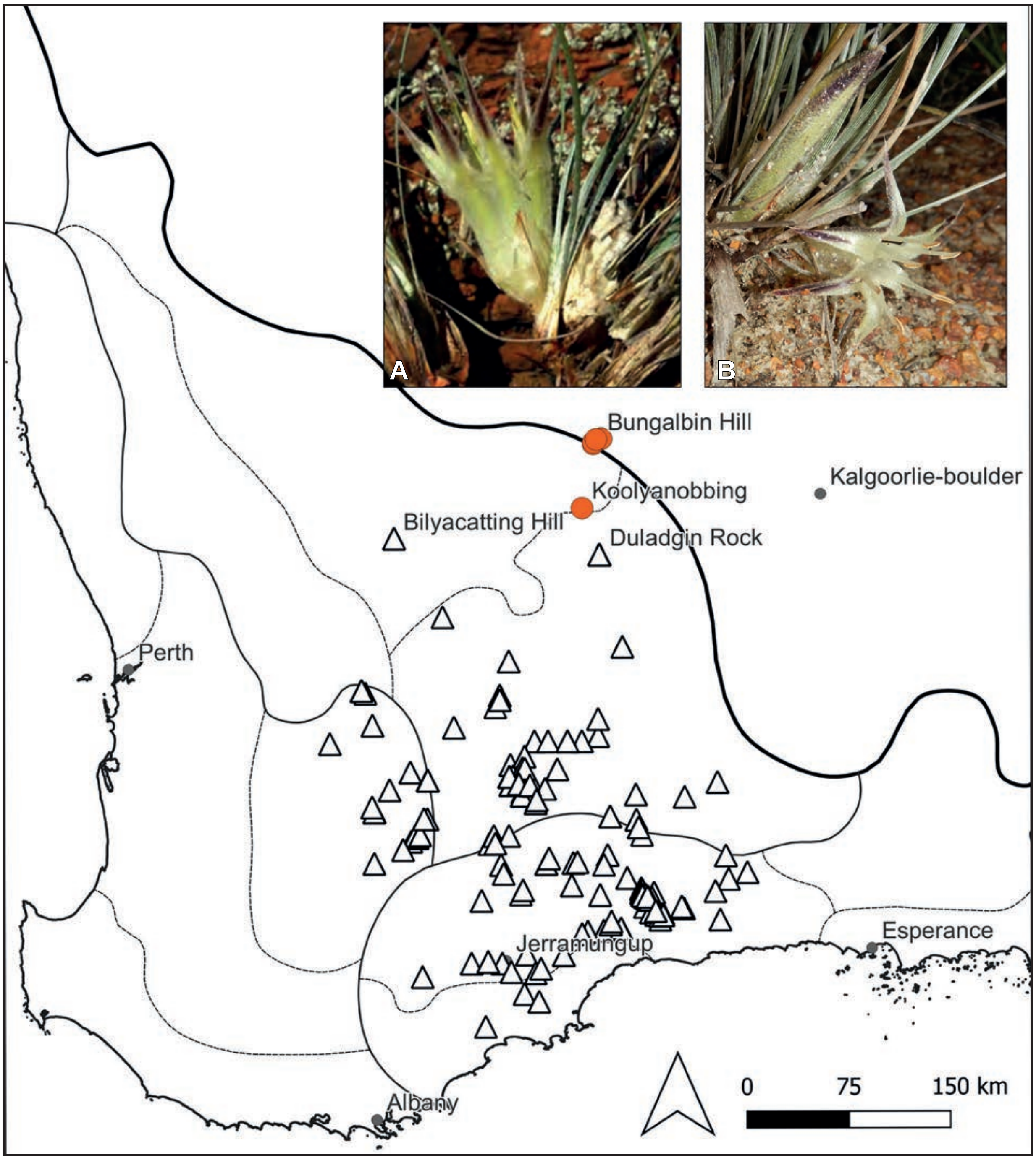

Figure 39. *Conostylis bungalbin* (A) and *C. argentea* (B) plus map of specimen distributions of *C. bungalbin* (●), *C. argentea* (△), specimen locations from *Atlas of Living Australia* accessed 11 Sept 2022. Map of the Southwest Australian Floristic Region shows location in relation to Botanical Provinces and Districts recognised by Gioia and Hopper (2017) – see Figure 1.

Conostylis dasys (Hopper) Hopper, *comb. et stat. nov.*

Basionym: *Conostylis setigera* subsp. *dasys* Hopper, *Fl. Australia* 45: 463 (1987). *Type*: north of Kojonup, Western Australia [precise locality withheld for conservation reasons], 12 November 1985, *S.D. Hopper* 4707 (*holo*: PERTH 01036246; *iso*: AD, CANB, MEL).

This combination is based on DNA evidence (Hopper *et al.* 2006), which places *C. dasys* as sister to *C. teretifolia* J.W.Green, not *C. setigera* R.Br., with moderate support.

Conostylis robusta Diels subsp. **hickmaniae** Hopper, *subsp. nov.*

Type: 200 m west of Ogilvie Road on verge *c.* 5.3 km S of George Grey Drive intersection, 18 km (bearing 350°) north of Gregory, Western Australia, 31 August 1997, *S.D. Hopper* 8390a (*holo*: PERTH 09323376; *iso*: PERTH 09323384).

Erect, procumbent to climbing *perennial herb*, usually to 40 cm tall, occasionally to 130 cm. *Stem segments* 5–15 cm long. *Leaves* 120–250 mm long, 4–8 mm wide. *Scape* 23–40 cm long, exceeding leaves. (Figures 40–43)

Other specimens examined. WESTERN AUSTRALIA: southern boundary, Kalbarri National Park on S side of Vermin Proof Fence, 21 Oct. 1974, *J.S. Beard* 7126 (PERTH 02103214); Kalbarri National Park, S of township between Red Bluff and Park boundary, 21 Sept. 1982, *M.G. Corrick* 8145 (PERTH 02103095); 47 km NW of Northampton, 1.2 km E of Yerina Springs road along West Ogilvie road, 19 Aug. 1975, *S.D. Hopper* 588 (PERTH 02103087); 2.5 km E of Meanara Hill, Kalbarri National Park, 13 Sep. 1979, *S.D. Hopper* 1268 (PERTH 07295898); 1 km SE of Junga Dam, Kalbarri National Park, 13 Sep. 1979, *S.D. Hopper* 1299 (PERTH 07295901); mouth of Murchison River, 1965, *W. Rogerson* 222 (PERTH 02103265); Junga Tank, 25 Sep. 1953, *N.H. Speck* 966 (PERTH 02102943).

Phenology. Flowers September.

Distribution. *Conostylis robusta* subsp. *hickmaniae* occurs in the Kalbarri Botanical District (Gioia & Hopper 2017), where it is endemic in kwongkan near the coast south of the Murchison River (Figure 42).

Habitat. Grows on crests and slopes of rolling coastal hills in scrub to 3 m tall of *Acacia ligulata*, *A. spathulifolia*, *A. teretifolia*, *Allocasuarina campestris*, *Banksia menziesii*, *B. victoriae*, *B. attenuata*, *Nuytsia floribunda*, *Grevillea leucopteris*, *Olearia revoluta*, *Dianella revoluta*, *Ptilotus polystachyus*, *Melaleuca*, *Jacksonia*, *Enchylaena*, *Ecdeiocolea* and *Hibbertia*. Also inland in coarse pale yellow sand among foothills with *Acacia scirpifolia* (2–3 m), scattered *Grevillea leucopteris* (2–3 m) and *Chamelaucium uncinatum* (1–1.5 m) over dwarf scrub and sedges.

Etymology. Named for Dr Ellen J. Hickman, gifted prize-winning botanical artist and author/artist of several illustrated biological books, as well as scholarly articles associated with botanical art and taxonomy. Ellen is a coauthor of the present paper, and has worked with SDH and RJS in the field on Haemodoraceae for many years, bringing to life some of the extraordinary colour variation now known in this family through her meticulously crafted artwork (e.g. several figures herein). Ellen was travelling with SDH on the field trip that was key to identifying the subspecific characters distinguishing the two subspecies in *C. robusta*.

Conservation status. A narrow endemic, common in Kalbarri National Park, and not under threat.

Vernacular name. Hickman's Cottonhead is recommended.

Affinities and notes. *Conostylis robusta* subsp. *hickmaniae* is the tallest taxon in the genus, attaining up to 1.3 m when pushing up through dense kwongkan. Even in more open conditions, the subspecies attains heights of *c.* 40 cm. It varies in habit, from erect, procumbent to climbing, to tightly caespitose (Figure 40). It is a near-coastal form, differing from the typical inland *C. robusta* subsp. *robusta* (Figure 42) in its longer stem segments (5–15 cm vs 0–6 cm, rarely longer) and shorter leaves (12–25 cm vs 28–54 cm). The two subspecies of *C. robusta* hybridise inland from Kalbarri, and intergrade on the margins of southern populations of *C. robusta* subsp. *robusta* (Figure 42).

Figure 40. *Conostylis robusta* subsp. *hickmaniae* with Ellen Hickman illustrating the range of plant habits found in the subspecies within Kalbarri National Park (Red Bluff, A) and immediately south (B–F). A – broadly caespitose/procumbent; B, C – vine-like erect plant to 1.3 m tall through extension of stem segments in dense *Banksia attenuata* kwongkan; D – evenly caespitose on moderately extended stem segments; E – caespitose with some longer stem segments post-fire; F – tightly caespitose on shorter stem segments. Photographs by S.D. Hopper.

Figure 41. *Conostylis robusta* subsp. *hickmaniae* from Red Bluff, Kalbarri National Park (B, E) and inland to the south-east (A, C, D, F, G). A – young plant post-fire with dark red new stem segments; B – pale-coloured globular inflorescence with white inner perianth lobes; C – golden yellow and white inflorescence with more typical golden yellow inner perianth lobes, almost white towards the apex; D – mature leaf bases off stem segment with some red colouration ; E – underside of inflorescences showing bracts; F – mature blue-green leaf with marginal bristles; G – whole plant, with *Anigozanthos manglesii* subsp. *quadrans*, post-fire. Photographs S.D. Hopper.

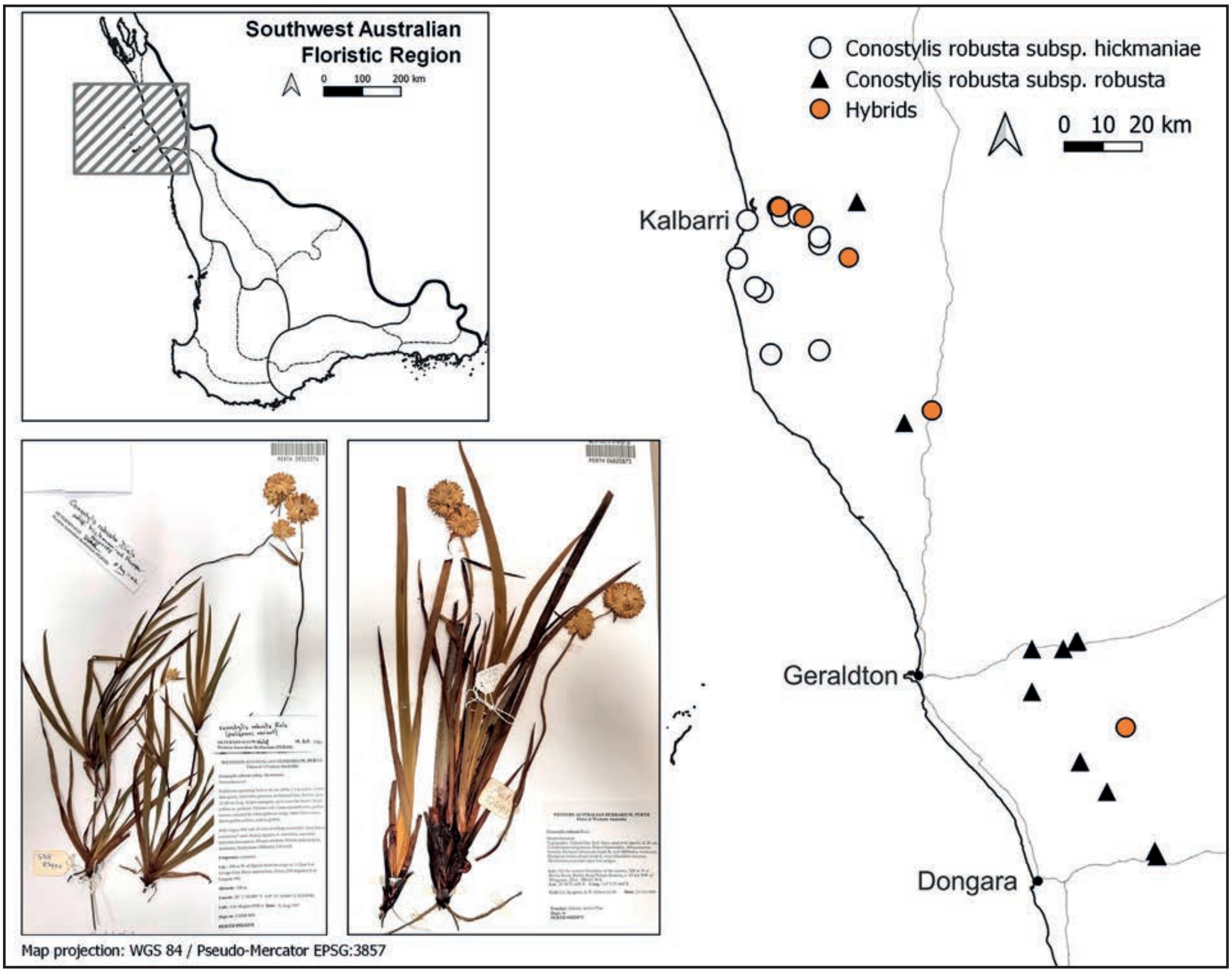

Figure 42. Geographical distribution of *Conostylis robusta* subsp. *hickmaniae* (○), *C. robusta* subsp. *robusta* (▲) and hybrids or intergrades of the two subspecies (●). Top inset: hatched box shows location within the Southwest Australian Floristic Region *sensu* Gioia and Hopper 2017 (see Figure 1). Bottom insets: highlighting relative leaf and inflorescence dimensions of *C. robusta* subsp. *hickmaniae* (left) and *C. robusta* subsp. *robusta* (right). Photographs by S.D. Hopper.

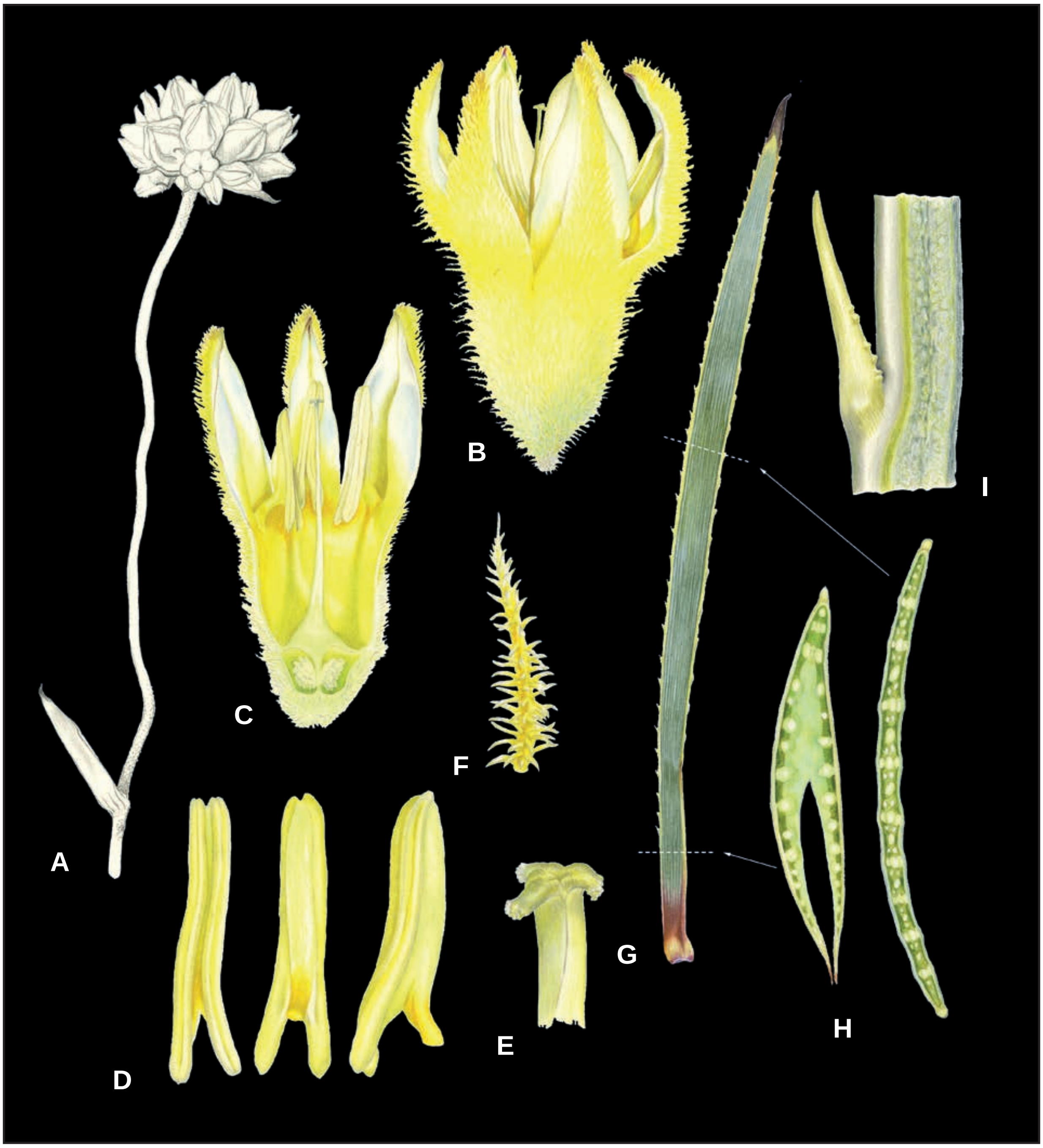

Figure 43. *Conostylis robusta* subsp. *hickmaniae* from Red Bluff, Kalbarri National Park. A – inflorescence; B – whole flower; C – sectioned half flower; D – anthers; E – stigma; F – floral hair; G – leaf; H – leaf transverse sections; I – spine on leaf margin. Illustrations by E.J. Hickman.

Updated Classification for Haemodoraceae

To help navigate the following checklist, Table 4 provides an updated classification including the ranks of Subfamily, Tribe, Genus, Subgenus and Section recognised herein.

Table 4. Updated classification for Haemodoraceae.

Subfamily	Tribe	Genus	Subgenus	Section
Haemodoroideae R.Br.	*Haemodoreae* R.Br.	*Dilatris* P.J.Bergius		
		Haemodorum Sm.	*Haemodorum* Sm.	
			Antiqua Hopper & R.J.Sm.	
			Gemina Hopper & R.J.Sm.	
		Lachnanthes Elliott		
		Paradilatris (Hopper ex J.C.Manning) Hopper		
	Wachendorfieae Dumort.	*Barberetta* Harv.		
		Cubanicula Hopper, J.E.Gut., E.J.Hickman, M.Pell. & R.J.Sm.		
		Pyrrorhiza Maguire & Wurdack		
		Schiekia Meisn.		
		Wachendorfia Burm.		
		Xiphidium Loefl.		
Conostylidoideae T.Macfarlane & Hopper	*Conostylideae* Lindl.	*Anigozanthos* Labill.	*Anigozanthos* Labill.	*Anigozanthos* Labill.
				Ceratandri Benth.
			Haplanthesis (Benth.) Hopper	
		Blancoa Lindl.		
		Conostylis R.Br.	*Conostylis* R.Br.	*Conostylis* R.Br.
				Terraflora Hopper
			Appendicula (Geerinck) Hopper	
			Brachycaulon (Benth.) Hopper	
			Bicolorata Hopper	
			Divaricata (Hopper) Hopper	
			Pendula Hopper	
		Macropidia J.Drumm. ex Harv.		
	Phlebocaryeae Meisn.	*Phlebocarya* R.Br.		
	Tribonantheae T.Macfarlane & Hopper	*Tribonanthes* Endl.	*Tribonanthes* Endl.	
			Boya E.J.Hickman & Hopper	
			Salina E.J.Hickman & Hopper	

Annotated checklist of Haemodoraceae

Accepted names are in **bold**. Synonyms are in *italics* and roman. Arrangement of taxa is alphabetical within each rank.

Haemodoraceae R.Br., *Prodr.*: 299. (1810). *nom. cons*. *Type*: *Haemodorum* Sm. (1798).

Conostylidaceae Takht., *Sistema Magnoliofitov:* 313 (1987). *Type*: *Conostylis* R. Br. (1810).

Dilatridaceae M.Roem., *Handb. Allg. Bot*. 3: 476 (1840). *Type*: *Dilatris* P.J. Bergius (1767).

Wachendorfiaceae Herb., *Amaryllidaceae*: 48 (1837). *Type*: *Wachendorfia* Burm. (1757).

Xiphidiaceae Dumort., *Anal. Fam. Pl.*: 59, 61 (1829) (as Xiphideae). *Type*: *Xiphidium* Aubl. (1775).

Haemodoraceae R.Br. subfamily **Haemodoroideae**. *Type*: *Haemodorum* Sm. (1798).

Haemodoroideae Arn., *Encycl. Brit*., ed. 7, 5: 133 (1832) (as Haemodoreae). *Type*: *Haemodorum* Sm. (1798).

Wachendorfioideae Arn., *Encycl. Brit.*, ed. 7, 5: 133 (1832) (as Wachendorfieae). *Type*: *Wachendorfia* Burm. (1757).

Haemodoraceae R.Br. tribe **Haemodoreae**. *Type*: *Haemodorum* Sm. (1798).

Haemodoreae Dumort., *Anal. Fam. Pl.*: 62 (1829); Arn., *Encycl. Brit*., ed. 7, 5: 133 (1832).

Dilatris P.J.Bergius, *Descr. Pl. Cap.*: 9, t. 3 Figure 5 (1767).

Dilatris P.J.Bergius subg. *Dilatris. Type*: *Dilatris corymbosa* P.J.Bergius.

Dilatris corymbosa P.J.Bergius, *Descr. Pl. Cap.*: 9 (1767).

Ixia hirsuta L., *Syst. Nat.*, ed. 12: 2 (1767); *Mant. Pl.*, 27 (1767). *Wachendorfia hirsuta* L., *Syst. Nat.* ed. 12, 2, 735 (1767).

Ixia umbellata Burm.f., *Prod. Cap.*: 2 (1768). *Wachendorfia umbellata* (Burm.f.) L., *Mant. Pl.* 2, 320 (1771). *Dilatris umbellata* (Burm.f.) L.f., *Suppl. Pl.*: 101 (1782).

Dilatris ixioides Lam., *Encycl.* 2: 282 (1786).

Dilatris pillansii W.F.Barker, *J. S. Afr. Bot.* 6: 155 (1940).

Haemodorum Sm., *Trans. Linn. Soc. London* 4: 213 (1798). *Type: H. corymbosum* Vahl.

Haemodorum subg. **Haemodorum**

Haemodorum austroqueenslandicum Domin, *Biblioth. Bot.* 20(85): 527 (1915).

Haemodorum basalticum R.L.Barrett, Hopper & T. Macfarlane, *Nuytsia* 26: 114 (2015).

Haemodorum brevicaule F.Muell., *Fragm.* 1: 64 (1858).

Haemodorum brevistylum T.Macfarlane & R.L.Barrett, *Nuytsia* 36: 126 (2025).

Haemodorum capitatum R.L.Barrett & Hopper, *Nuytsia* 26: 115 (2015).

Haemodorum celsum R.L.Barrett & T.Macfarlane, *Nuytsia* 36: 128 (2025).

Haemodorum clarksonii Hopper & E.J.Hickman, *Nuytsia* 36: 155 (2025).

Haemodorum coccineum R.Br., *Prodr.*: 300 (1810).

Haemodorum corymbosum var. *gracilescens* Domin, *Biblioth. Bot.* 20(85): 528 (1915).

[*Haemodorum corymbosum* auct. non Vahl: C.G.G.J. van Steenis, *Flora Malesiana* Ser. 1, 5: 113 (1954); R.L.Specht in R.L. Specht & C.P. Mountford, *Rec. Amer.-Austral. Sci. Exped. Arnhem Land* 3: 214 (1958).]

Haemodorum collevatum T.Macfarlane & R.L.Barrett, *Nuytsia* 36: 132 (2025).

Haemodorum condensatum Hopper & R.L.Barrett, *Nuytsia* 26: 117 (2015).

Haemodorum corymbosum Vahl, *Enum. Pl.* 2: 179 (1805).

Haemodorum corymbosum var. *typicum* Domin, *Biblioth. Bot.* 20(85): 527 (1915), *nom. inval*.

Haemodorum corymbosum Vahl var. *corymbosum*

Haemodorum teretifolium R.Br., *Prodr.*: 300 (1810).

Haemodorum discolor T.Macfarlane, *Fl. Australia* 45: 464 (1987).

Haemodorum sp. A, in T.D. Macfarlane, *Fl. Perth Region* 2: 856 (1987).

Haemodorum ensifolium F.Muell., *Fragm.*1: 64 (1858).

Haemodorum longifolium W.Fitzg., *J. Roy. Soc. W. Australia* 3: 127 (1918).

Haemodorum flaviflorum W.Fitzg., *J. Roy. Soc. W. Australia* 3: 128 (1918).

See comments in taxonomic section under *Haemodorum parviflorum*.

Haemodorum ghungalorum Hopper, *Nuytsia* 36: 160 (2025).

Haemodorum griseofuscum R.L.Barrett, M.D.Barrett & Hopper, *Nuytsia* 26: 118 (2015).

Haemodorum gracile T.Macfarlane, *Fl. Australia* 45: 464 (1987).

[*Haemodorum parviflorum* auct. non Benth.: W.V.Fitzgerald, *J. Roy. Soc. W. Australia* 3: 128 1918; C.A. Gardner, *W. Australia Forests Dept. Bull.* 32: 39 (1923).]

Haemodorum interrex R.L.Barrett & M.D.Barrett, *Nuytsia* 26: 120 (2015).

Haemodorum laxum R.Br., *Prodr.*: 300 (1810).

Haemodorum leptostachyum Benth., *Fl. Austral.* 6: 423 (1873).

Haemodorum loratum T.Macfarlane, *Fl. Australia* 45: 464 (1987).

Haemodorum macfarlanei R.L.Barrett, *Nuytsia* 26: 122 (2015).

Haemodorum paniculatum Lindl., *Sketch Veg. Swan R.*: xliv (1839).

Haemodorum strictum Endl. in J.G.C. Lehmann, *Pl. Preiss.* 2: 15 (1839).

Haemodorum parviflorum Benth., *Fl. Austral.* 6: 423 (1873). *Type*: Port Darwin, NorthernTerritory, *M. Schultz* 723 *comm. R. Schomburgk* 1870 (*lecto*, here designated: K barcode K 000846214).

Haemodorum planifolium R.Br., *Prodr.*: 300 (1810).

Haemodorum simplex Lindl., *Sketch Veg. Swan R.*: xliv (1839).

Haemodorum polycephalum Endl. in J.G.C. Lehmann, *Pl. Preiss.* 2: 16 (1846).

Haemodorum simulans F.Muell., *Fragm.*7: 117 (1871).

Haemodorum sparsiflorum F.Muell., *Fragm.*7: 117 (1871).

Haemodorum subvirens F.Muell., *Fragm.*1: 63 (1858).

Haemodorum thedae R.L.Barrett, *Nuytsia* 26: 123 (2015).

Haemodorum venosum T.Macfarlane, *Fl. Australia* 45: 464 (1987).

Haemodorum subg. **Antiqua** Hopper & R.J.Sm., *Nuytsia* 36: 145 (2025). *Type*: *Haemodorum distichophyllum* Hook.

Haemodorum distichophyllum Hook., *Hooker's Icon. Pl.* 9: t. 866 (1851).

Haemodorum tenuifolium A.Cunn. ex Benth., *Fl. Austral.* 6: 423 (1873).

Haemodorum subg. **Gemina** Hopper & R.J.Sm., *Nuytsia* 36: 145 (2025). *Type*: *Haemodorum spicatum* R.Br.

Haemodorum brevisepalum Benth., *Fl. Austral.* 6: 420 (1873).

Haemodorum sandifordiae Hopper & E.J.Hickman, *Nuytsia* 36: 150 (2025).

Haemodorum spicatum R.Br., *Prodr.*: 300 (1810).
Haemodorum edule Lehm. ex Endl. in J.C.G. Lehmann, *Pl. Preiss.* 2: 15 (1846).

Lachnanthes Elliott, *Sketch Bot. S. Carolina* 1: 47 (1816). *Type*: *Lachnanthes tinctoria* (Walter ex J.F.Gmel.) Elliott [= *Lachnanthes caroliniana* (Lam.) Dandy]
Camderia Dumort., *Anal. Fam. Pl.*: 80 (1829), *nom. illeg.*
Gyrotheca Salisb., *Trans. Hort. Soc. London* 1: 327 (1812), *nom. nud.*
Heritiera J.F.Gmel., *Syst. Nat.* (ed. 13) 2(1): 113 (1791), *nom. illeg.*, non *Heritiera* Aiton, nec *Heritiera* Retz

Lachnanthes caroliniana (Lam.) Dandy, *J. Bot.* 70: 329. (1932) (as '*caroliana*').
Anonymos tinctoria Walter, *Fl. Carol.*: 68. (1788), *nom. rej.*
Dilatris caroliniana Lam., *Tabl. encycl.* 1: 127 (1791) (as 'Caroliana').
Dilatris heritiera Pers., *Syn. Pl.* 1: 54 (1805), *nom. superfl.*
Dilatris tinctoria Pursh, *Fl. Amer.* Sept. 1: 30–31 (1813 [1814]).
Gyrotheca tinctoria Salisb., *Trans. Hort. Soc. London* 1: 327 (1812); *Gyrotheca tinctorum* W.Stone, *Pl. S. New Jersey* 1: 354 (1911 [1912]), *isonym*.
Heritiera gmelinii Michx., *Fl. Bor.-Amer.* 1: 21, pl. 4 (1803), as 'Gmelini', *nom. superfl.*
Heritiera tinctorium Walter ex J.F.Gmel., *Syst. Nat.* 2: 113 (1791), *nom. superfl.*
Lachnanthes tinctoria Elliott, *Sketch Bot. S. Carolina* 1(1): 47 (1816).
Lachnanthes tinctoria var. *major* Griseb., *Cat. Pl. Cub.*: 252 (1866).

Paradilatris (Hopper ex J.C.Manning) Hopper, *Nuytsia* 36: 169 (2025).
Dilatris subg. *Paradilatris* Hopper ex J.C.Manning, *S. Afr. J. Bot.* 113: 104 (2017). *Type*: *Paradilatris viscosa* (L.f.) Hopper.

Paradilatris viscosa (L.f.) Hopper, *Nuytsia* 36: 169 (2024).
Basionym: *Dilatris viscosa* L.f., *Suppl. Pl.:* 101 (1781 [1782]).

Haemodoraceae tribe **Wachendorfieae** Dumort., *Anal. Fam. Pl.*: 61 (1829) (as Wachendorfiaceae). *Type: Wachendorfia* Burm. (1757).

Wachendorfiaceae Herb., *Amaryllidaceae*: 48 (1837). *Type: Wachendorfia* Burm. (1757).

Wachendorfioideae Arn., *Encycl. Brit.*, ed. 7, 5: 133 (1832) (as Wachendorfieae). *Type: Wachendorfia* Burm. (1757).

Barberetta Harv., *Gen. S. Afr. Pl.*, ed. 2: 377 (1868). *Type*: *Barberetta aurea* Harv.

Barberetta aurea Harv., *Gen. S. Afr. Pl.*, ed. 2: 377 (1868).

Cubanicula Hopper, J.E.Gut., E.J.Hickman, M.Pell. & R.J.Sm., *PhytoKeys* 169: 5 (2020). *Type*: *Cubanicula xanthorrhizos* (C.Wright ex Griseb.) Hopper *et al.* (≡ *Xiphidium xanthorrhizon* C.Wright ex Griseb.).

Cubanicula xanthorrhizos (C.Wright ex Griseb.) Hopper, J.E.Gut., E.J.Hickman, M.Pell. & R.J.Sm., *PhytoKeys* 169: 11 (2020).

Pyrrorhiza Maguire & Wurdack, *Mem. New York Bot. Gard.* 9(3): 318 (1957). *Type*: *Pyrrorhiza neblinae* Maguire & Wurdack.

Pyrrorhiza neblinae Maguire & Wurdack, *Mem. New York Bot. Gard.* 9(3): 318, Figure 63a–g (1957).

Schiekia Meisn., *Pl. Vasc. Gen.* 1: 397; 2: 300 (1842). *Type*: *Wachendorfia orinocensis* Kunth. [≡ *Schiekia orinocensis* (Kunth) Meisn.].

Troschelia Klotzsch & R.Schomb., *Reisen, Br.-Guiana*: 1066 (1849), *nom. nud.*

Schiekia orinocensis (Kunth) Meisn., *Pl. Vasc. Gen.* 2(12): 300 (1842).

Schiekia congesta Maury, *J. Bot. (Morot)* 3: 269, f. 12 (1889), *nom. nud.*

Schiekia flavescens Maury, *J. Bot. (Morot)* 3: 269 (1889), in *Index Kewensis Suppl.* 1 as 'Sansevieria' in error.

Schiekia orinocensis subsp. *savannarum* Maguire & Wurdack, *Mem. New York Bot. Gard.* 9(3): 320 (1957).

Wachendorfia orinocensis Kunth, *Nov. Gen. Sp.* (quarto ed.) 1(3): 319 (1816).

Xiphidium angustifolium Willd. ex Link, *Jahrb. Gewächsk.* 1(3): 73 (1820), *nom. superfl.*

Schiekia silvestris (Maas & Stoel) Hopper, E.J.Hickman, R.J.Sm. & M.Pell., *PhytoKeys* 169: 30 (2020).

Schiekia orinocensis subsp. *silvestris* Maas & Stoel in P.J.M. Maas and H. Maas-van de Kamer, *Fl. Neotrop. Monogr.* 61: 21 (1993).

Schiekia timida M.Pell., E.J.Hickman, R.J.Sm. & Hopper, *PhytoKeys* 169: 34 (2020).

Wachendorfia Burm., *Wachendorfia*: 2 (1757). *Type*: *Wachendorfia thyrsiflora* Burm.

Pedilonia C.Presl, *Pedilonia*: 1 (1829).

Wacchendorfia Burm.f., *Fl. Ind. (N. L. Burman) Prodr. Fl. Cap.*: 2, sphalm. (1768).

Wachendorffa Cothen., *Disp. Veg. Meth.* 3 (1790), *orth. var*.

Pre-Linnean synonyms:

Asphodelus Breyne, *Prodr. Rar. Pl.* [sec.]: t. 22 (1739).

Erythrobulbus Pluk., *Almagesti Botanici Mantissa* 70 (1700).

Wachendorfia thyrsiflora Burm., *Wachendorfia*: 3 (1757).

Wachendorfia elata Salisb., *Prodr. Stirp. Chap. Allerton*: 45 (1796).

Pre-Linnean synonym: *Asphodelus latifolius* Breyne, *Prodr. Rar. Pl.* [sec.]: t. 22 (1739).

Wachendorfia paniculata Burm., *Wachendorfia*: 4 (1757).

Aspidistra lurida Sieber ex C.Presl, *Flora* 12: 568 (1829), *nom. illeg.*

Asphodelus latifolius Breyn. ex Schult.f., *Syst. Veg*., ed. 15 bis 7: 485 (1829).

Pedilonia violacea C.Presl, *Pedilonia*: 1 (1829).

Wachendorfia brevifolia Sol. ex Ker Gawl., *Bot. Mag.* 27: t. 1066 (1807).

Wachendorfia breyniana D.Dietr., *Syn. Pl.* 1: 170 (1839).

Wachendorfia graminea Thunb., *Prodr. Pl. Cap.*: 1: 12 (1794), *nom. illeg.*

Wachendorfia graminifolia L.f., *Suppl. Pl.*: 101 (1781).

Wachendorfia herbertii Sweet, *Hort. Brit.*: 400 (1826), based on *Wachendorfia paniculata* var. (i) Herbert (1826).

Wachendorfia hirsuta Thunb., *Prodr. Pl. Cap.* 1: 12 (1794). *Wachendorfia paniculata* var. *hirsuta* (Thunb.) Baker, *Fl. Cap.* 6: 2 (1896).

Wachendorfia humilis Salisb., *Prodr. Stirp. Chap. Allerton*: 45 (1796).

Wachendorfia paniculata var. *brevifolia* (Sol. ex Ker Gawl.) Baker, *Fl. Cap*. 6: 2 (1896).

Wachendorfia tenella Thunb., *Prodr. Pl. Cap.* 1: 12 (1794); *Wachendorfia paniculata* var. *tenella* (Thunb.) Baker, *Fl. Cap*. 6: 2 (1896).

Wachendorfia villosa L., *Syst. Nat.* ed. 10, 2: 864 (1759).

Wachendorfia villosa Andrews, *Bot. Repos.* 6: t. 398 (1804).

Wachendorfia laxa W.F.Barker ex Hopper, *Nuytsia* 36: 172 (2025).

Wachendorfia brachyandra W.F.Barker, *J. S. Afr. Bot.*15: 41 (1949).

Wachendorfia multiflora (Klatt) J.C.Manning & Goldblatt, *Strelitzia* 9: 709 (2000).

Babiana multiflora Klatt, *Abh. Naturf. Ges. Halle* 15: 351 (1882).

Wachendorfia parviflora W.F.Barker, *J. S. Afr. Bot.*15: 39 (1949).

Xiphidium Aubl., *Hist. Pl. Guiane* 1: 33, pl. 11 (1775). *Type*: *Xiphidium caeruleum* Aubl.

Durandia Boeckeler, *Allg. Bot. Z. Syst*. 2: 160, 173 (1896).

Tonduzia Boeckeler ex Tonduz, *Bull. Herb. Boissier* 3: 464 (1895), *nom. nud.*

Xiphidium Loefl., *Iter Hispan.*: 179 (1758), *nom. nud.*

Pelligrini *et al.* (2020: p. 42) claimed, following Maas & Maas-van de Kamer (1993), that *Xiphidium* Loefl. was the earliest publication of the generic name, citing Dorr and Wiersema (2010) as supporting this view. In a subsequent personal communication from Larry Dorr to Marco Pelligrini, Dorr (in litt. 11 Feb. 2021) highlighted that he and John Wiersema observed that Loefling (1758 pg 179) had simply listed *Xiphidium* of authors as a synonym of *Ixia* and did not describe *Xiphidium* as a new genus. The mistake was acknowledged immediately by Marco Pelligrini (in litt. 11 Feb. 2021) and plans initiated to publish a correction. Here, the correct attribution of authorship of the genus *Xiphidium* by Aublet (1775) is made.

Xiphidium caeruleum Aubl., *Hist. Pl. Guiane* 1: 33, pl. 11 (1775).

Durandia macrophylla Boeckeler, *Allg. Bot. Z. Syst.* 2: 173 (1896).

Eccremis scabra Kuntze, *Revis. Gen. Pl.* 3(3): 316 (1898).

Ornithogalum rubrum Ruiz & Pav. ex D.Don, *Edinburgh New Philos. J.* 13: 235 (1832), *nom. inval.*

Tonduzia macrophylla Boeckeler ex Tonduz, *Bull. Herb. Boissier* 3: 464 (1895), *nom. nud.*

Xiphidium albidum Lam. in J.-B. Lamarck & J.L.M. Poiret, *Tabl. Encycl.* 1: 131 (1791), *nom. superfl.*

Xiphidium album Willd., *Sp. Pl.* ed. 4, 1(1): 248 (1797).

Xiphidium caeruleum var. *albidum* Backer, *Handb. Fl. Java* 3: 80 (1924).

Xiphidium floribundum Sw., *Prodr.*: 17 (1788).

Xiphidium floribundum var. *albiflorum* Hook., *Bot. Mag.* 84: t. 5055 (1858), *nom. superfl.* (≡ *X. floribundum* Sw. var. *floribundum*).

Xiphidium floribundum var. *caeruleum* (Aubl.) Hook., *Bot. Mag.* 84: t. 5055 (1858).

Xiphidium fockeanum Miq., *Linnaea* 17: 63 (1843).

Xiphidium giganteum Lindl., *Edwards's Bot. Reg.* 32: page prior to t. 67 (1846).

Xiphidium loeflingii Mutis, *Diario* 2: 51 (1958), *nom. nud.*

Xiphidium rubrum D.Don, *Edinburgh New Philos. J.* 13: 235 (1832).

Xiphidium pontederiiflorum M.Pell., Hopper & R.J.Sm., *PhytoKeys* 169: 49 (2020).

Xiphidium xanthorrhizon C.Wright ex Griseb., *Cat. Pl. Cub.* 1: 252 (1866).

Haemodoraceae R.Br. subfamily **Conostylidoideae** T.Macfarlane & Hopper, *Fl. Australia* 45: 454 (1987). *Type*: *Conostylis aculeata* R.Br.

Haemodoraceae Tribe **Conostylideae** Lindl., *Veg. Kingdom* 153 (1847) (as Conostyleae). Amaryllidaceae R.Br. tribe Conostylideae Benth., *Fl. Austral.* 6: 425. *Type*: *Conostylis aculeata* R.Br.

Haemodoraceae Tribe *Anigozantheae* Z.H.Feng, *Plant* 13 (3) 149 (2025). Type: *Anigozanthos* Labill.

Anigozanthos Labill., *Voy. Rech. Perouse* 1: 409 [octavo edn; = 410 quarto edn] (1800). *Type*: *A. rufu*s Labill.

Anigosia Salisb., *Trans. Hort. Soc. London* 1: 327 (1812). *Type*: *A. flavida* (DC.) Salisb.

Schwaegrichenia Sprengel, *Pl. Min. Cogn. Pug.* 2: 58 (1815), *nom. illeg.* – includes the type of *Anigozanthos* Labill. *Type*: *S. rufa* (Labill.) Sprengel.

Anigozanthos Labill. subg. **Anigozanthos**

Anigozanthos Labill. sect. **Anigozanthos**

Anigozanthos sect. *Dianthesis* Benth., *Fl. Austral.* 6: 442 (1873), *nom. inval. Type*: *A. rufus* Labill.

Anigozanthos rufus Labill., *Voy. Rech. Perouse* 1: 409 [octavo edn = 410 quarto edn] t. 22 (1800).

Anigozanthos tyrianthinus Hook., *Bot. Mag.* 76: t. 4507 (1850).

Schwaegrichenia rufa (Labill.) Sprengel, *Pl. Min. Cogn. Pug.* 2: 58 (1815).

Anigozanthos pulcherrimus Hook., *Bot. Mag.* 71: 4180 (1845).

Anigozanthos sect. **Ceratandri** Benth., *Fl. Austral.* 6: 442, 443 (1873) (as *Certandra). Type*: *A. flavidus* Redouté.

Anigozanthos sect. *Concatenati* Hopper, *Fl. Australia* 45: 455 (1987). *Type: A. preissii* Endl.

Anigozanthos flavidus Redouté, *Les Liliacees* 3: t. 176 (1807).

Anigozanthos coccineus Lindl. ex Paxton, *Mag. Bot.* 5: 271, & tab (1839).

Anigozanthos grandiflorus Salisb., *Parad. Londin.* 2: t. 97 (1808).

Schwaegrichenia flavida (Redouté) Sprengel, *Pl. Min. Cogn. Pug.* 2: 58 (1815).

Anigozanthos flavidus Redouté var. *bicolor* Lindl., *Bot. Reg.* 24: t. 64 (1838).

Anigozanthos preissii Endl. in J.G.C. Lehmann, *Pl. Preiss.* 2: 26 (1846).

Anigozanthos preissii Endl. var. *plumosus* Endl. in J.G.C. Lehmann, *Pl. Preiss.* 2: 26 (1846).

Anigozanthos Labill. subg. **Haplanthesis** (Benth.) Hopper, *Fl. Australia* 45: 455 (1987).

Anigozanthos sect. *Haplanthesis* Benth., *Fl. Austral.* 6: 442, 444 (1873). *Type: A. manglesii* D.Don.

Anigozanthos bicolor Endl. in J.G.C. Lehmann, *Pl. Preiss.* 2: 26 (1846).

Anigozanthos bicolor Endl. subsp. **bicolor**

Anigozanthos bicolor var. *major* Benth., *Fl. Australia* 6: 446 (1873).

Anigozanthos bicolor subsp. **exstans** Hopper, *Fl. Australia* 45: 455 (1987).

Anigozanthos condingupensis Hopper & R.J.Sm., *Nuytsia* 36: 181 (2025).

Anigozanthos bicolor Endl. var. *minor* Benth. (1873) *p.p.*, not as to type.

Anigozanthos decrescens (Hopper) Hopper, *Nuytsia* 36: 184 (2025).

Anigozanthos bicolor subsp. *decrescens* Hopper, *Fl. Australia* 45: 455 (1987).

Anigozanthos gabrielae Domin, *J. Linn. Soc., Bot.* 41: 257 (1912).

Anigozanthos humilis Lindl., *Sketch Veg. Swan R.*: xlvi (1840).

Anigozanthos minimus Lehm., *Pl. Preiss.* 2: 274 (1848).

Anigozanthos dorrienii Domin, *J. Linn. Soc., Bot.* 41: 256 (1912).

Anigozanthos humilis Lindl. subsp. **humilis**

Anigozanthos humilis subsp. **chrysanthus** Hopper, *Fl. Australia* 45: 456 (1987).

Anigozanthos humilis subsp. **grandis** Hopper, *Nuytsia* 36: 188 (2025).

Anigozanthos kalbarriensis Hopper, *Nuytsia* 2: 181 (1978).

Anigozanthos knappiorum Hopper, *Nuytsia* 36: 189 (2025).

Anigozanthos bicolor subsp. *minor* (Benth.) Hopper, *Fl. Australia* 45: 455 (1987), *p.p.*, as to type.

Anigozanthos manglesii D.Don in R.Sweet, *Brit. Fl. Gard. Ser.* 2, 6: t. 265 (1834).

Anigozanthos manglesii var. *leptophyllus* Domin, *J. Linn. Soc. Bot.* 41: 257 (1912).

Anigozanthos manglesii D.Don subsp. **manglesii**

Anigozanthos manglesii var. *flavescens* Ostenf., *Biol. Meddel. Kongel. Danske Vidensk. Selsk.* 3(2): 35 (1921).

Anigozanthos manglesii subsp. **quadrans** Hopper, *Fl. Australia* 45: 456 (1987).

Anigozanthos manglesii var. **×angustifolius** Lindl., *Bot. Reg.* 23: t. 2012 (1837).

Anigozanthos manglesii var. **×virescens** Ostenf., *Biol. Meddel. Kongel. Danske Vidensk. Selsk.* 3(2): 35 (1921).

Anigozanthos onycis A.S.George, *Nuytsia* 1: 367 (1974).

Anigozanthos viridis Endl. in J.G.C. Lehmann, *Pl. Preiss.* 2: 25 (1846).

Anigozanthos viridis Endl. subsp. **viridis**

Anigozanthos viridis subsp. **metallicus** Hopper, *Nuytsia* 36: 192 (2025).

Anigozanthos viridis subsp. **sophrosyne** Hopper, *Nuytsia* 36: 196 (2025).

Anigozanthos viridis subsp. **terraspectans** Hopper, *Fl. Australia* 45: 456 (1987).

Anigozanthos yorlining Hopper, *Nuytsia* 36: 198 (2025).

Blancoa Lindl., *Sketch Veg. Swan R.*: xlv (1840). *Type: B. canescens* Lindl.

Blancoa canescens Lindl., *Sketch Veg. Swan R.*: xlv (1840).
Conostylis canescens (Lindl.) F.Muell., *Fragm*. 8:19 (1873).

Conostylis R.Br., *Prodr.*: 300 (1810). *Type: Conostylis aculeata* R.Br.

Conostylis R.Br. subg. **Conostylis**. *Type*: *C. aculeata* R.Br.
Conostylis sect. *Euconostylis* Benth., *Fl. Austral.* 6, 429, 434 (1873), *nom. inval.*

Conostylis R.Br. sect. **Conostylis**

Conostylis aculeata R.Br., *Prodr.*: 300 (1810).

Conostylis aculeata R.Br. subsp. **aculeata**
Conostylis aculeata var. *typica* Domin, *J. Linn. Soc., Bot.* 41: 256 (1912), *nom. inval.*
Conostylis cymosa Benth., *Fl. Austral.* 6: 439 (1873).

Conostylis aculeata subsp. **bolghinup** Hopper, *Nuytsia* 36: 208. (2025).

Conostylis aculeata subsp. **breviflora** Hopper, *Nuytsia* 2: 261 (1978).

Conostylis aculeata subsp. **bromelioides** (Endl.) J.W.Green, *Proc. Linn. Soc. New South Wales* 85: 348 (1961).
Conostylis aculeata var. *abbreviata* Domin, *J. Linn. Soc. London* 41: 255 (1912).
Conostylis aculeata var. *bromelioides* (Endl.) Ewart, *Proc. Roy. Soc. Victoria* 19: 37 (1906).
Conostylis bromelioides Endl. in J.G.C. Lehmann, *Pl. Preiss.* 2: 18. (1846).

Conostylis aculeata subsp. **cygnorum** Hopper, *Fl. Australia* 45: 457 (1987).
[*Conostylis bracteata* auct. non Lindl.: S.L.Endlicher in J.G.C. Lehmann, *Pl. Preiss.*2: 16 (1846).]
Conostylis harperiana W.Fitzg., *Proc. Linn. Soc. New South Wales* 28: 106 (1903).

Conostylis aculeata subsp. **echinissima** Hopper, *Fl. Australia* 45: 458 (1987).

Conostylis aculeata subsp. **gracilis** Hopper, *Fl. Australia* 45: 458 (1987).

Conostylis aculeata subsp. **preissii** (Endl.) J.W.Green, *Proc. Linn. Soc. New South Wales* 85: 349 (1961).

Conostylis preissii Endl. in J.G.C. Lehmann, *Pl. Preiss.* 2: 18 (1846).

Conostylis aculeata subsp. **rhipidion** J.W.Green *Proc. Linn. Soc. New South Wales* 85: 348 (1961).

Conostylis aculeata subsp. **septentrionora** Hopper, *Fl. Australia* 45: 458 (1987).

Conostylis aculeata subsp. **spinuligera** (F.Muell. ex Benth.) Hopper, *Fl. Australia* 45: 458 (1987).

Conostylis bracteata Lindl., *Sketch Veg. Swan R.*: xlv (1840).

Conostylis aculeata subsp. *bracteata* (Lindl.) J.W.Green *Proc. Linn. Soc. New South Wales* 85: 350 (1961).

Conostylis candicans Endl. in S.L. Endlicher & E. Fenzl, *Nov. Stirp. Dec*. 3: 20 (1839).

Conostylis candicans Endl. subsp. **candicans**

Conostylis dealbata Lindl., *Sketch Veg. Swan R*: xlv (1840).

Conostylis candicans subsp. **calcicola** Hopper, *Fl. Australia* 45: 459 (1987).

Conostylis propinqua Endl. in J.G.C. Lehmann, *Pl. Preiss.* 2: 17 (1846).

Conostylis dealbata var. *sarmentosa* Endl. in J.G.C. Lehmann, *Pl. Preiss.* 2: 17 (1846).

Conostylis candicans subsp. **flavifolia** Hopper, *Fl. Australia* 45: 459 (1987).

Conostylis candicans subsp. **procumbens** Hopper, *Fl. Australia* 45: 459 (1987

Conostylis festucacea Endl. in J.G.C. Lehmann, *Pl. Preiss.* 2: 18 (1846).

Conostylis festucacea Endl. subsp. **festucacea**

Conostylis festucacea subsp. **filifolia** (F.Muell.) Hopper, *Fl. Australia* 45: 460 (1987).

Conostylis filifolia F.Muell., *Fragm*. 8: 18 (1873).

Conostylis misera Endl. In J.G.C. Lehmann, *Pl. Preiss.* 2: 22 (1846).

Conostylis gladiata Benth., *Fl. Austral.* 6: 434 (1873).

A case could be made for placing *C. misera* in a monotypic section sister either to *C*. section *Conostylis* or *C*. section *Terraflora*. However, current molecular evidence on sister relationships is equivocal (Hopper *et al.* 2006). Further research is recommended.

Conostylis pauciflora Hopper, *Nuytsia* 2: 258 (1978).

Conostylis pauciflora Hopper subsp. **pauciflora**

Conostylis pauciflora subsp. **euryrhipis** Hopper, *Fl. Australia* 45: 461 (1987).

Conostylis prolifera Benth., *Fl. Austral*. 6: 436 (1873).

Conostylis racemosa Benth., *loc. cit.*

[*Conostylis stylidioides* auct. non F.Muell.: J.W. Green, *Proc. Linn. Soc. New South Wales* 85: 352 (1961). *p.p.* as to green-leaved specimens.]

Conostylis robusta Diels in L. Diels & E. Pritzel, *Bot. Jahrb. Syst.* 35: 109 (1904).

Conostylis aculeata subsp. *robusta* (Diels) J.W.Green, *Proc. Linn. Soc.* New South Wales 85: 348 (1961).

Conostylis robusta Diels subsp. **robusta**

Conostylis robusta subsp. **hickmaniae** Hopper, *Nuytsia* 36: 214 (2025).

Conostylis seorsiflora F.Muell., *Fragm.* 1: 158 (1859).

Conostylis seorsiflora F.Muell. subsp. **seorsiflora**

Conostylis seorsiflora subsp. **longissima** Hopper, *Fl. Australia* 45: 462 (1987).

Conostylis seorsiflora subsp. **trichophylla** Hopper, *Fl. Australia* 45: 462 (1987).

Conostylis stylidioides F.Muell., *Fragm.* 8: 17 (1872).

Conostylis sect. **Terraflora** Hopper, *Nuytsia* 36: 202 (2025). *Type*: *C. serrulata* R.Br.

Conostylis glabra Hopper, *Nuytsia* 36: 202 (2025).

Conostylis juncea Endl. in S.L. Endlicher & E. Fenzl, *Nov. Stirp. Dec.* 3: 19 (1839).

Conostylis involucrata Endl. in J.G.C. Lehmann, *Pl. Preiss.*2: 23 (1846).

Conostylis juncea var. *involucrata* (Endl.) Ostenf., *Dec. Kg. Danske Vidensk. Selsk. Biol. Meddel.* 3: 32 (1921).

Conostylis laxiflora Benth., *Fl. Austral.* 6: 439 (1873).

Conostylis magna Hopper, *Nuytsia* 36: 205 (2025).

Conostylis serrulata R.Br., *Prodr.*: 300 (1810).

Northern populations have inner sides of perianth lobes with prominently gold and white colouration, whereas southern (typical) populations tend to gold and creamy gold colouration. Possibly subspecies could be recognised?

Conostylis subg. **Appendicula** (Geerinck) Hopper, *Nuytsia* 36: 201 (2025).

Conostylis sect. *Appendicula* Geerinck, *Bull. Jard. Bot. Etat.* 39: 64 (1969). *Type*: *C. aurea* Lindl.

Conostylis angustifolia Hopper, *Fl. Australia* 45: 458 (1987).

Conostylis aurea Lindl., *Sketch Veg. Swan R.*: xliv (1840).

Conostylis sulphurea Endl. in J.G.C. Lehmann, *Pl. Preiss.*2: 17 (1846).

Conostylis hiemalis Hopper, *Fl. Australia* 45: 460 (1987).

Conostylis resinosa Hopper, *Fl. Australia* 45: 461 (1987).

Conostylis aurea var. *longiscapa* Ewart, *Proc. Roy. Soc. Victoria* 19(2): 37 (1906).

Conostylis seminuda Hopper, *Fl. Australia* 45: 462 (1987).

Conostylis tomentosa Hopper, *Fl. Australia* 45: 463 (1987).

Conostylis subg. **Brachycaulon** (Benth.) Hopper, *Fl. Australia* 45: 457 (1987).

Conostylis sect. *Brachycaulon* Benth., *Fl. Austral.* 6:428, 430 (1873). *Type*: *C. breviscapa* R.Br.

We have retained this subgenus to minimise nomenclatural change pending further molecular studies. Present evidence (Hopper *et al.* 2006) indicates that the subgenus forms a moderately supported early branching clade with *C.* subg. *Bicolorata* and *C.* subg. *Divaricata* that is sister to *C.* subg. *Pendula*.

Conostylis breviscapa R.Br., *Prodr.*: 30l (1810).

Conostylis subg. **Bicolorata** Hopper, *Fl. Australia* 45: 456 (1987). *Type*: *C. vaginata* Endl.

We have retained this subgenus to minimise nomenclatural change pending further molecular studies. Present evidence (Hopper *et al.* 2006) indicates that the subgenus forms a moderately supported early branching clade with *C.* subg. *Brachycaulon* and *C.* subg. *Divaricata* that is sister to *C.* subg. *Pendula*.

Conostylis vaginata Endl. in J.G.C. Lehmann, *Pl. Preiss.* 2: 23 (1846).

Conostylis subg. **Divaricata** (Hopper) Hopper, *Nuytsia* 36: 202 (2025).

Conostylis sect. *Divaricata* Hopper, *Fl. Australia* 45: 457 (1987). *Type*: *C. phathyrantha* Diels

We have retained this taxon and upgraded it to subgenus for consistency to minimise nomenclatural change pending further molecular studies. Present evidence (Hopper *et al.* 2006) indicates that the subgenus forms a moderately supported early branching clade with *C.* subg. *Bicolorata* and *C.* subg. *Brachycaulon* that is sister to *C.* subg. *Pendula*.

Conostylis phathyrantha Diels in L. Diels & E. Pritzel, *Bot. Jahrb. Syst*. 35: 111 (1904).

Conostylis subg. **Pendula** Hopper, *Fl. Australia* 45: 457 (1987). *Type*: *C. setigera* R.Br.

Androstemma Lindl., *Sketch Veg. Swan R.*: xlvi (1840). *Type: C. androstemma* F.Muell.

Conostylis subg. *Androstemma* (Lindl.) Hopper, *Fl. Australia* 45: 456 (1987).

Conostylis subg. *Greenia* (Geerinck) Hopper, *Fl. Australia* 45: 457 (1987). *Type*: *C. bealiana* F. Muell.

This is the largest subgenus with 25 species. Several groups display chromosome dysploidy and polyploidy. Not a single interspecific hybrid has been collected from the subgenus. The inclusion of five species with elongate perianths perhaps indicative of vertebrate pollination in the subgenus (*C. androstemma, C. argentea, C. bungalbin, C. bealiana, C. albescens*) is based on molecular studies (Hopper *et al.* 2006).

Conostylis albescens Hopper, *Fl. Australia* 45: 458 (1987).

Conostylis androstemma F.Muell., *Fragm*. 8: 19 (1873).

Conostylis androstemma subsp. *androstemma*.

Conostylis argentea (J.W.Green) Hopper, *Fl. Australia* 45: 459 (1987).

Conostylis androstemma subsp. *argentea* J.W.Green, *Proc. Linn. Soc. New South Wales* 85: 367 (1961).

Conostylis bealiana F.Muell., *Fragm*. 9: 50 (1875).

Conostylis bungalbin Hopper, *Nuytsia* 36: 210 (2025).

Conostylis canteriata Hopper, *Fl. Australia* 45: 459 (1987).

Conostylis caricina Lindl., *Sketch Veg. Swan R.*: xlv (1840).

Conostylis caricina Lindl. subsp. **caricina**
Conostylis graminea Endl. in J.G.C. Lehmann, *Pl. Preiss.* 2: 19 (1846).

Conostylis caricina subsp. **elachys** Hopper, *Fl. Australia* 45: 460 (1987).

Conostylis crassinerva J.W.Green, *Proc. Linn. Soc. New South Wales* 85: 361 (1961).

Conostylis crassinerva J.W.Green subsp. **crassinerva**

Conostylis crassinerva subsp. **absens** Hopper, *Fl. Australia* 45: 460 (1987).

Conostylis dasys (Hopper) Hopper, *Nuytsia* 36: 213 (2025).
Conostylis setigera subsp. *dasys* Hopper, *Fl. Australia* 45: 463 (1987).

Conostylis deplexa J.W.Green, *Nuytsia* 4: 55 (1982).

Conostylis dielsii W.Fitzg., *J. Proc. Mueller. Bot. Soc. W. Australia* 1: 82 (1903).

Conostylis dielsii W.Fitzg. subsp. dielsii

Conostylis dielsii subsp. **teres** Hopper, *Fl. Australia* 45: 460 (1987).

Conostylis drummondii Benth., *Fl. Austral.* 6: 433 (1873).

Conostylis latens Hopper, *Fl. Australia* 45: 461 (1987).

Conostylis lepidospermoides Hopper, *Fl. Australia* 45: 461 (1987).

Conostylis micrantha Hopper, *Fl. Australia* 45: 461 (1987).

Conostylis neocymosa Hopper, *Bot. Not.* 133:224 (1980).
Conostylis cymosa Benth., *Fl. Austral.* 6: 439 (1873). *p.p.*, not as to lectotype.

Conostylis petrophiloides F.Muell. ex Benth., *Fl. Austral*. 6: 431 (1873).

Conostylis pusilla Endl. in J.G.C.Lehmann, *Pl. Preiss.* 2: 20 (1846).
Conostylis minima Endl. in J.G.C. Lehmann, *Pl. Preiss.* 2: 21 (1846).

Conostylis rogeri Hopper, *Fl. Australia* 45: 462 (1987).

Conostylis setigera R.Br., *Prodr.*: 300 (1810).
This species includes a polyploid complex in need of further taxonomic revision.
Conostylis aemula Lindl., *Sketch Veg. Swan R.*: xlv (1840).
Conostylis assimilis Endl. in J.G.C. Lehmann, *Pl. Preiss.* 2: 20 (1846).
Conostylis discolor Endl. in J.G.C. Lehmann, *Pl. Preiss.* 2: 20 (1846).
Conostylis melanopogon Endl. in J.G.C. Lehmann, *Pl. Preiss.* 2: 18 (1846).
Conostylis melanopogon var. *major* Benth., *Fl. Austral.* 6: 432 (1873).

Conostylis psyllium Endl. in J.G.C. Lehmann, *Pl. Preiss.* 2: 21 (1846).

Conostylis setosa Lindl., *Sketch Veg. Swan R.*: xliv (1840).

Conostylis teretifolia J.W.Green, *Proc. Linn. Soc. New South Wales* 85: 360 (1961).

Conostylis teretifolia J.W.Green subsp. **teretifolia**

Conostylis teretifolia subsp. **planescens** Hopper, *Fl. Australia* 45: 463 (1987).

Conostylis teretiuscula F.Muell., *Fragm.* 8: 18 (1873).

Conostylis villosa Benth., *Fl. Austral.* 6: 433 (1873).

Conostylis wonganensis Hopper, *Nuytsia* 4: 17 (1982).

Macropidia J.Drumm. ex Harv., *Hooker's J. Bot. Kew Gard. Misc.* 7: 57 (1855). *Type*: *Macropidia fuliginosa* (Hook.) Druce.

Macropidia fuliginosa (Hook.) Druce, *Bot. Soc. Exch. Club Brit. Isles* 1916: 634 (1917).
Anigozanthos fuliginosus Hook., *Bot. Mag.* 73: t. 4291 (1847).0
Macropidia fumosa J.Drumm. ex Harv., *Hooker's J. Bot. Kew Gard. Misc.* 7: 57 (1855).

Haemodoraceae Tribe **Phlebocaryeae** Meisn., *Pl. Vasc. Gen.* 1: 396 (1842). *Type*: *Phlebocarya ciliata* R.Br.

Phlebocarya R.Br., *Prodr.*: 301 (1810). *Type*: *P. ciliata* R.Br.

Phlebocarya ciliata R.Br., *Prodr.*: 301 (1810).

Phlebocarya filifolia (F.Muell.) Benth., *Fl. Austral.* 6: 425 (1873).
Phlebocarya ciliata var. *filifolia* F.Muell., *Fragm.* 8: 23 (1873).

Phlebocarya pilosissima (F.Muell.) Benth., *Fl. Austral.* 6: 425 (1873).
Phlebocarya ciliata var. *pilosissima* F.Muell., *Fragm.* 8: 23 (1873).

Phlebocarya pilosissima (F.Muell.) Benth. subsp. **pilosissima**

Phlebocarya pilosissima subsp. **teretifolia** T.Macfarlane, *Fl. Australia* 45: 465 (1987).

Haemodoraceae Tribe **Tribonantheae** T.Macfarlane & Hopper, *Fl. Australia* 45: 454 (1987). *Type*: *Tribonanthes* Endl.

Tribonanthes Endl. in S. Endlicher & E. Fenzl, *Nov. Stirp. Dec.* 4: 27 (1839). *Type*: *Tribonanthes australis* Endl.

Tribonanthes Endl. subg. **Tribonanthes**

Tribonanthes australis Endl. in S. Endlicher & E. Fenzl, *Nov. Stirp. Dec.* 4: 27 (1839).

Tribonanthes brachypetala Lindl., *Sketch Veg. Swan R.*: xliv. (1840).
Tribonanthes odora Endl., in J.G.C. Lehmann, *Pl. Preiss.* 2: 28 (1846), *nom. illeg.*, *nom. superfl.*

Tribonanthes elongata E.J.Hickman & Hopper, *Nuytsia* 30: 125 (2019).

Tribonanthes keigheryi E.J.Hickman & Hopper, *Nuytsia* 30: 129 (2019).

Tribonanthes longipetala Lindl., *Sketch Veg. Swan R.*: xliv (1840).

Tribonanthes monantha E.J.Hickman & Hopper, *Nuytsia* 30: 115 (2019).

Tribonanthes porphyrea E.J.Hickman & Hopper, *Nuytsia* 30: 119 (2019).

Tribonanthes uniflora Lindl., *Sketch Veg. Swan R.*: xliv (1840).

Tribonanthes variabilis Lindl., *Sketch Veg. Swan R.*: xliv. (1840).

Tribonanthes violacea Endl. in J.G.C. Lehmann, *Pl. Preiss.* 2: 28. (1846).

There seem to be significant genetic differences between northern and southern populations. Further taxonomic research is recommended.

Tribonanthes subg. **Boya** E.J.Hickman & Hopper, *Nuytsia* 30: 145 (2019). *Type*: *Tribonanthes purpurea* T.Macfarlane & Hopper.

Tribonanthes purpurea T.Macfarlane & Hopper, *Fl. Australia* 45: 465 (1987).

Tribonanthes subg. **Salina** E.J.Hickman & Hopper, *Nuytsia* 30: 144 (2019). *Type*: *Tribonanthes minor* M.Lyons & Keighery.

Tribonanthes minor M.Lyons & Keighery, *Nuytsia* 16: 78 (2006).

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