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Revision of the multi-ovulate species of *Thysanotus* (Asparagaceae), with three new species

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Abstract

Macfarlane, T.D. & French, C.J. Revision of the multi-ovulate species of *Thysanotus* (Asparagaceae), with three new species. *Nuytsia* 35: 55–76 (2024). The group of *Thysanotus* species having more than two ovules per ovary locule (the multi-ovulate species) is taxonomically revised. The three previously described species, *T. brachyantherus* Brittan, *T. lavanduliflorus* Brittan and *T. nudicaulis* Brittan, are maintained and redescribed, with *T. nudicaulis* being redefined following removal of two new species previously included in its concept. Three new species are described: *T. argillaceus* T.Macfarlane & C.J.French, *T. ellipsoideus* T.Macfarlane & C.J.French and *T. prospectus* C.J.French & T.Macfarlane. The South Australian records of *T. nudicaulis* are recognised as belonging to *T. ellipsoideus*. A key to the group and illustrations of some characters are provided and all species are mapped and illustrated photographically.

Introduction

Thysanotus R.Br. (Asparagaceae subfamily Lomandroideae, Gunn *et al.* 2020) currently has 56 accepted, described species (Brittan 1981, 1987; Council of Heads of Australasian Herbaria 2006–; Macfarlane *et al*. 2020; Wang & Silcock 2022; Wang *et al.* 2023), all occurring in Australia with two of them extending outside of Australia. Most occur in Western Australia, especially in the south-west. New species have been recently described (Sirisena *et al.* 2009, 2013, 2016; Macfarlane *et al.* 2020; Wang & Silcock 2022) but more undescribed species are known. The work reported in this paper commenced with investigation of a presumed new species that came to our attention, followed by our observation of another suspected new species within the current concept of *T. nudicaulis* Brittan. The subsequent comparison of those species revealed a further species within *T. nudicaulis* and resulted in this revision of all multi-ovulate species of *Thysanotus*.

Thysanotus had been considered to have two ovules in each of the three ovary locules in all species (Baker 1876; Bentham 1878) until Brittan (1972) reported the occurrence of the multi-ovulate condition, with up to 17 ovules per locule in two of the species he described (*T. brachyantherus* Brittan and *T. nudicaulis*). A third species, *T. lavanduliflorus* Brittan, was later reported as having 4–6 ovules per locule (Brittan 1981). These three species are all tuberous and resemble each other morphologically, being relatively short plants with little-branched panicles or occasionally with a single umbel and leaves usually withered at flowering time. They occur in Western Australia's southern and south-eastern wheatbelt and the woodlands and shrublands to the east, with *T. nudicaulis* also on the Eyre Peninsula of South Australia (Western Australian Herbarium 1998–; State Herbarium of South Australia 2022). Three further multi-ovulate species are newly described here, and the three previously named species are redescribed. The biggest change concerns *T. nudicaulis* from which two of the new species are segregated. A key is provided to all six species and illustrations are provided for all species to assist with identification.

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The multi-ovulate condition appears on morphological grounds to define a group of related species and to be an apomorphic condition that has evolved within the genus. Although there has been no adequately representative molecular phylogenetic study that includes multi-ovulate species, a study by Sirisena (2010) indicated that tuberous species form a clade that is embedded within the genus. Additionally, the following related genera in the *Arthropodium* group of Asparagaceae subfamily Lomandroideae (Gunn *et al.* 2020) are multi-ovulate: *Arthropodium* R.Br. (Brittan 1987), *Dichopogon* Kunth (Brittan 1987), *Eustrephus* R.Br. (Conran & Clifford 1986) and *Trichopetalum* Lindl. (Conran 1998). An appropriately representative molecular phylogenetic study of *Thysanotus* would help to resolve the questions of whether the multi-ovulate state is derived within *Thysanotus*, whether it is a synapomorphy of a clade, and whether the multi-ovulate species are part of a larger tuber-bearing clade.

Before N.H. Brittan's collections from 1950 onwards and relevant publications (Brittan 1972, 1981), none of the multi-ovulate species had been named and had scarcely been collected. This is due to a combination of factors: their occurrence remote from Perth, the annual above-ground phase that is dependent on adequate rainfall, the rather inconspicuousness of the plants even when in flower, the short life of the flowers (each flower opens for only a few hours in the middle of the day, for a single day) and their late flowering seasons. The earliest collections of this group were not from the main distribution of the group in Western Australia but from the limited distribution of *T. ellipsoideus* T.Macfarlane & C.J.French in South Australia, by J.S. Browne in 1874–75 (cited in Brittan 1981, MEL 2215472A, MEL 2215473A, MEL 2215474A). The next collection was by A.D. Black in 1935 (AD 96021022, apparently the Port Lincoln specimens referred to under *T. tuberosus* R.Br. by J.M. Black (1943, p. 191)).

Methods

This study was based on specimens at the Western Australian Herbarium (PERTH), including the relevant type specimens, as well as field observations, photographs and new collections. The field studies have proven to be invaluable for understanding the taxa, especially for investigating the important taxonomic characters provided by root system morphology. So important is the root system morphology that certain species, e.g. *T. nudicaulis*, *T. ellipsoideus* and to some extent *T. prospectus* C.J.French & T.Macfarlane cannot be morphologically differentiated with confidence in specimens lacking underground parts. Consequently, there are a few specimens, formerly identified as *T. nudicaulis*, that are unallocated following this study and are mapped in Figure 1A.

In collecting specimens for this study, plants were excavated so as to obtain the rootstock, roots and entire tubers where possible, then photographed for the purposes of data gathering and establishing a reference collection. A more sustainable technique we recommend for future work consists of the careful removal of soil in layers from around the plant base (or part of it) until the tubers are just exposed (Figure 2), recording or photographing the morphology and attachment of tubers, and replacement of the soil. A single tuber could also be collected as part of a specimen. The regenerative buds for roots, leaves and annual inflorescences are located on the rootstock, the perennating organ. To avoid damaging the rootstock, inflorescences taken as a specimen should be cut rather than pulled up.

Thysanotus flowers soon close after the plant is collected and they cannot be adequately revived for examination using the usual herbarium technique. We photographed flowers before collection, pressed the plant immediately after collection, and separately dried individual open flowers in a notebook, subsequently placing them in packets with the main specimen. Such preparations, used extensively for *Thysanotus* by N.H. Brittan (e.g. illustrated in Brittan 1972), were used for our floral measurements, including of the delicate fimbriae, while the photographs recorded colours, three dimensional shapes and relationships between floral parts.

Several measurements require explanation. (1) *Roots and tubers*. All of the multi-ovulate species of *Thysanotus* exhibit root storage of varying morphology, from uniformly thickened roots, to roots with extensive thickening that in part becomes swollen, often gradually, to elongated non-thickened roots with an abruptly swollen and relatively short to long terminal tuber (see included Figures for each species).

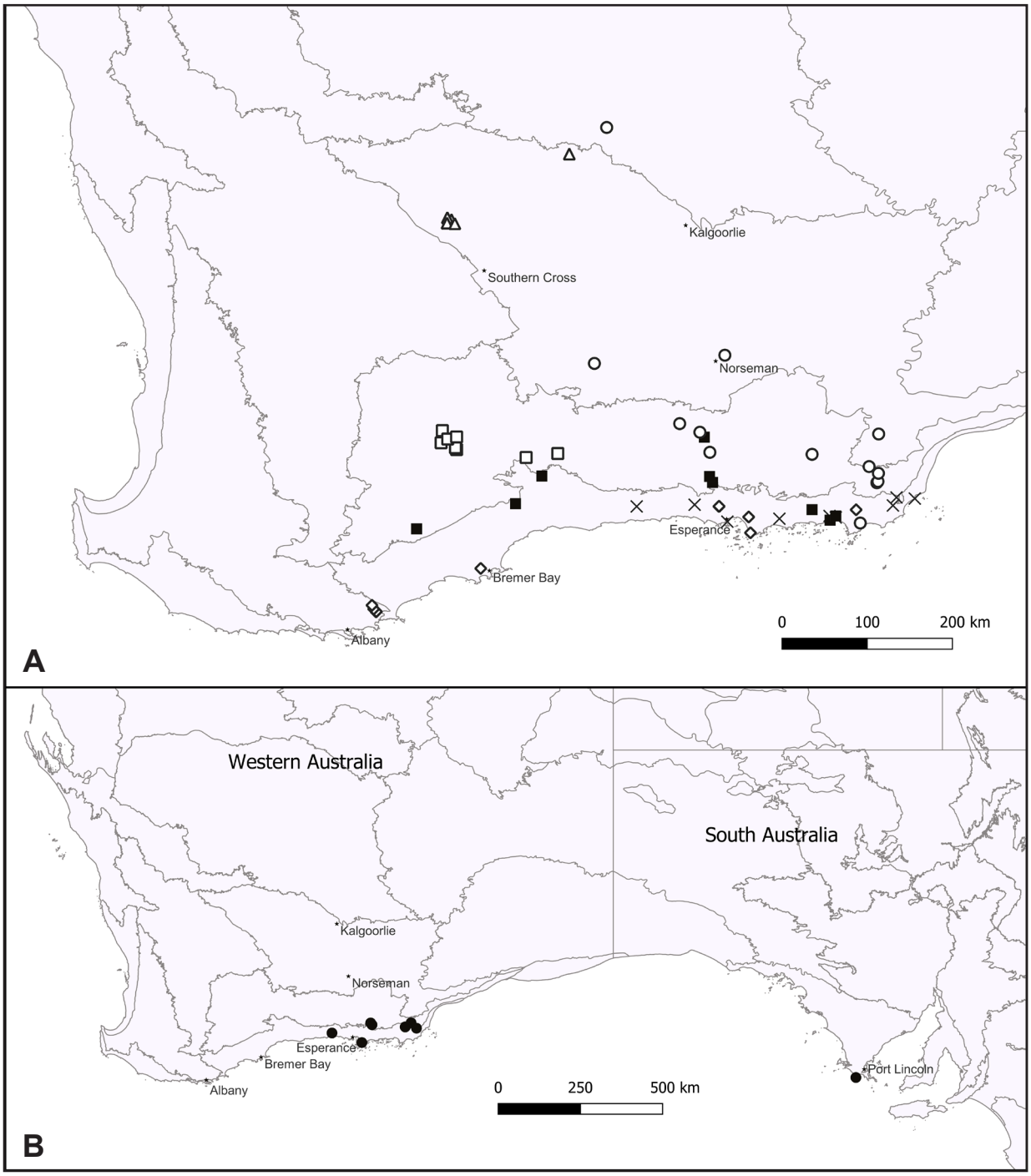

Figure 1. Distribution of the multi-ovulate species of *Thysanotus* based on specimens at PERTH. A – *T. argillaceus* (△), *T. brachyantherus* (○), *T. lavanduliflorus* (□), *T. nudicaulis* (■), *T. prospectus* (◇), unallocated specimens formerly identified as *T. nudicaulis s. lat.* (X); B – *T. ellipsoideus*.

Pate and Dixon (1982) classified the latter tuber type in particular as root tubers produced by a special adventitious root. The distance of any swelling of the root or distinct tuber from the rootstock is indicated for each species, using the term root rather than alternative terms such as pedicel, stalk or stele. The tip of the tubers may bear one to several fine roots or a single thick root like the proximal root. (2) *Perianth length*. Flower size is represented as the length of the perianth which, for practical purposes, is taken as the length of the sepals in mature flowers (Figure 3A). The sepals and petals are essentially equal (the petals are very slightly shorter, allowing the minute apical group of papillae to adhere to their slightly sub-apical counterparts on the sepals, i.e. the 'tepal apex trichomes' (TAT) of Macfarlane and Conran (2017)) but the sepals are more readily visible and measurable because of their firmer texture than the delicate

Figure 2. Excavation exposing tubers *in situ*. *T. nudicaulis*, *T.D. Macfarlane & C.J. French* TDM 7469. Photograph by C.J. French.

petals, which are usually less accessible on specimens and collapse as flowers close. Mature flowers are taken to be open flowers or, if none are present, full-sized buds whose opening is imminent, or very recently closed flowers. (3) *Anther length*. The anthers of 6-stamened *Thysanotus* species consist of two whorls, the so-called outer and inner anthers, corresponding with whether they are attached at the base of the outer tepals (sepals) or inner tepals (petals) respectively. In the open flower, however, the anthers often appear to be in two groups, corresponding to the two whorls, as a result of bending of the filaments. When the anthers of the two whorls are unequal (and often also dimorphic) as in the multi-ovulate species, the inner whorl anthers are longer than the outer, providing a practical way of identifying the whorls which may therefore be referred to as inner (long) anthers vs outer (short) anthers. Inner (long) anther length is taken as the straight distance from anther base to tip, i.e. across the curve (Figure 3B), chosen because the anthers hold their shape consistently, no treatment such as soaking is required, and the feature is readily visible in open flowers. The outer (short) anthers are usually straight or nearly so, making length measurement straightforward. (4) *Petal measurements*. The petals when viewed externally (abaxially) have a central greenish, thickened band that contains the veins, a wing area on either side composed of delicate coloured tissue, and the fringes (fimbriae) consisting of spreading coloured hairs. The central, solid part of the petal, i.e. the part excluding the fimbriae, is the body and its width was measured at the widest point. The length of the fimbriae similarly were measured at their greatest length.

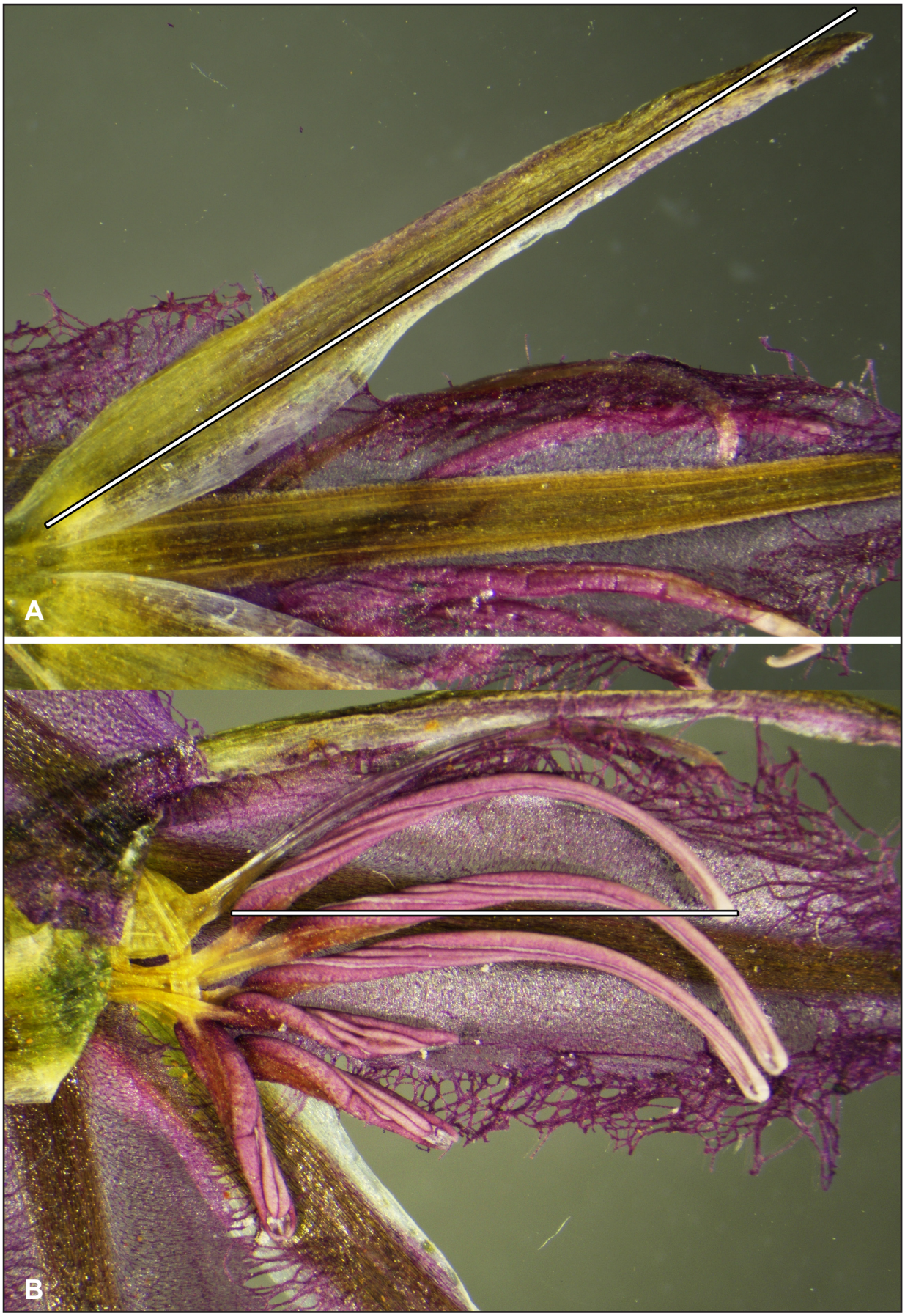

Figure 3. Explanation of floral measurement characters. A – length of the perianth is measured on sepals of fully-developed flowers, from the base of the free margin to the apex; B – length of the inner (long) anthers, from the base of the anther across the curve to the outer edge of the anther tip. Images from *T. nudicaulis*, *T.D. Macfarlane & C.J. French* TDM 7375. Photographs by C.J. French.

Taxonomy

Thysanotus argillaceus T.Macfarlane & C.J.French, *sp. nov.*

Type: Ennuin former pastoral lease, NNW of Bullfinch, Western Australia [precise locality withheld for conservation reasons], 13 October 2021, *T.D. Macfarlane & C.J. French* TDM 7329 (*holo*: PERTH 09504710; *iso*: CANB, MEL, PERTH 09504818).

Thysanotus sp. Ennuin (N. Gibson & M. Lyons 2665), Western Australian Herbarium, in *Florabase*, https://florabase.dbca.wa.gov.au/ [accessed 14 Dec. 2023].

Herbs with a small subterranean perennating rootstock, storage roots, and annual leaves and inflorescences. *Roots* forming defined tubers; *tubers* ellipsoid to fusiform, up to 17 per plant, 24–48 mm long, 5–11 mm diam., borne on long, thin, wiry roots up to 35–90 mm long, current and previous years' tubers present. *Leaves* several, basal, not seen when green but apparently not conspicuously equitant, narrowly sheathing to just above ground level, withered at flowering time. *Inflorescence* 1 or occasionally 2 per plant, 40–200 mm tall (above ground), a relatively short panicle comprising the upper part, branching from about 1/2–2/3(–4/5) of the height; *scape* erect, terete to angled, glabrous, usually lacking sterile bracts, occasionally 1 present; *panicle* small to well-developed, rachis 14–73 mm long, with 1–4 fertile (branch- or umbel-bearing) nodes, including a terminal umbel, *branches* 1–3 per node, diverging at an acute angle (by up to 70°), maximum length 10–50 mm, simple, with a terminal umbel of flowers and occasionally a sessile one shortly below the terminal one, or sometimes secondarily once-branched. *Umbels* (1–)3–5(–6)-flowered, the flowers at different developmental stages. *Pedicels* (5–)7.5–9 mm long, erect in flower and fruit, articulate at about 1/4 to 1/2 (0.25–0.55 of the length from the base) and usually slightly below the apices of the outer umbel bracts. *Perianth* 13–17.5 mm long; sepals 2.1–3 mm wide; petals purple, body 4–5.5 mm wide, fringe well-developed, slightly irregular, the longest fimbriae 2.5–4 mm long. *Stamens* 6, the anthers of the two whorls held in two separate groups, dissimilar and unequal, the shorter outer anthers in a parallel group projecting forward above the longer inner anthers which form a parallel down-curved group. *Outer anthers* straight to slightly curved, twisted, 3.5–5 mm long, reddish purple, the dorsal surface (connective) thickened, drying with a rough surface, with terminal pore *c*. 0.4 mm long on the ventral face of the apex. *Inner anthers* strongly curved, twisted, 6–8.5 mm long (measured across the curve), reddish purple, the dorsal surface (connective) thickened for only a very short distance at the base, dehiscent by a pore *c*. 0.4–0.5 mm long on the ventral face of the apex. *Ovary* spherical, whitish, with 6–9 ovules per locule; style curved, positioned alongside the long anthers; stigma short, simple, positioned about level with the apices of the long anthers. *Fruit* globular, enclosed in the withered perianth, not seen mature. Seeds not seen. (Figure 4)

Diagnostic features. *Thysanotus argillaceus* may be distinguished from all other members of the genus by the following combination of characters: ellipsoid tubers on long, thin, wiry roots; leaves withered at flowering time; inflorescence an annual erect panicle; pedicels articulate at 1/4–1/2 of the length from the base; anther whorls unequal and held in two groups; anthers reddish purple, outer anthers straight, inner (long) anthers curved, 6–8.5 mm long (measured across the curve); ovules multiple, 6–9 per locule.

Other specimens examined. WESTERN AUSTRALIA [localities withheld for conservation reasons]: 17 Oct. 1996, *N. Gibson & M. Lyons* 2665 (PERTH 05271053); 19 Oct. 1996, *N. Gibson & M. Lyons* 2696 (PERTH 05273471); 13 Oct. 2021, *T.D. Macfarlane & C.J. French* TDM 7317 (PERTH 09504702); 13 Oct. 2021, *T.D. Macfarlane & C.J. French* TDM 7325 (PERTH 09504753); 24 Oct. 2016, *P. Waddell* 675 (PERTH 08897212).

Phenology. Flowering in spring (all collections to date have been made in October). This species responds to rainfall for growth and flowering. In dry years no plants appear above ground, remaining dormant as rootstock and tubers below ground. Green leaves have so far not been observed, the leaves being withered at flowering time.

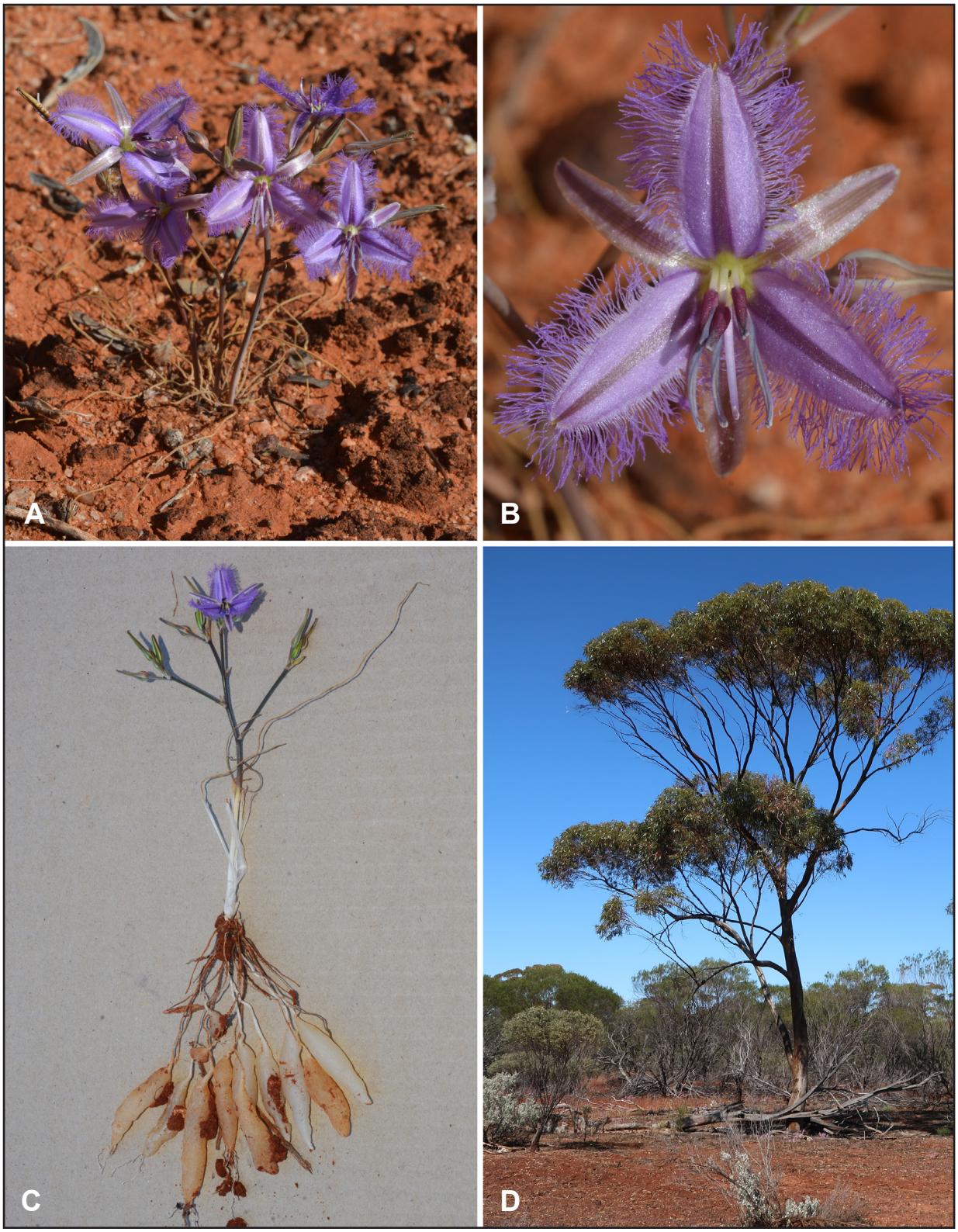

Figure 4. *Thysanotus argillaceus*. A – clump of flowering plants *in situ* showing the withered leaves; B – flower; C – whole plant showing the short stature, tubers and the panicle comprising most of the inflorescence height; D – a habitat. Images from *T.D. Macfarlane & C.J. French* TDM 7329. Photographs by C.J. French.

Distribution and habitat. Known to occur in two areas of the Eastern Goldfields in Western Australia, at several sites on the former pastoral station Ennuin, north-north-west of Bullfinch and 120 km east near former Jaurdi Station homestead, north of Boorabbin (Figure 1A). Grows in red or orange clay soil that feels crunchy underfoot (sometimes referred to as self-mulching clay) on flats or lower slopes of slight rises, in open eucalypt woodland with sparse to absent shrub understorey.

Conservation status. *Thysanotus argillaceus* is currently listed as Priority One under Conservation Codes for Western Australian Flora (Western Australian Herbarium 1998–), under the name *T.* sp. Ennuin (N. Gibson & M. Lyons 2665).

Etymology. The epithet is from the Latin *argillaceus* (clayey), in reference to the soil type on which it grows.

Notes. *Thysanotus argillaceus* is very similar to *T. lavanduliflorus*, differing in its larger flowers and larger floral organs such as anthers, mostly simple primary panicle branches, flowering time (*T. argillaceus* in October, *T. lavanduliflorus* in late November to December), geographical distribution and habitat type.

Thysanotus brachyantherus Brittan, *J. Roy. Soc. Western Australia* 54: 79–81, Figure 3 (1972). *Type*: near Russell Range, *c*. 100 miles [160 km] E of Esperance, Western Australia, 8 December 1960, *N.H. Brittan* 60/95-1 (*holo*: PERTH 00998710! (*Brittan* 60/95-1); *iso*: K 000794786 image! (*Brittan* 60/95-2), MEL 2295094 image! (*Brittan* 60/95-3)).

Herbs with a small subterranean perennating rootstock, storage roots, and annual leaves and inflorescence. *Roots* forming defined tubers; *tubers* ovoid or occasionally broadly fusiform, 5–18 per plant, (12–)18–60 mm long, 4.5–12 mm diam., borne on thin, wiry roots 40–115 mm long, current and previous years' tubers present. *Leaves* poorly known, 1–8 per plant, basal, not conspicuously equitant, sheathing at base with narrow translucent membranous margins, withered at flowering time; lamina erect, up to 150 mm long (above ground), more or less terete, glabrous. *Inflorescence* 1, occasionally 2 per plant, height relative to leaves inadequately known, 100–350 mm tall (above ground), a pyramidal panicle comprising the upper part; *scape* erect, terete, glabrous, with 0 or 1 sterile bracts, borne at 1/3–1/2 the inflorescence height when present; *panicle* few- to several-branched and few- to many-flowered, *rachis* 21–195 mm long with 2–3(–10) fertile (branch- or umbel-bearing) nodes, including terminal umbel, nodes with 1 branch, sometimes also bearing a sessile umbel instead of a branch or an umbel in the axil of a branch, *branches* 10–100 mm long, slightly to moderately spreading, simple with a terminal umbel or occasionally once-divided, in luxuriant plants 1 or 2 sessile umbels may occur along branches. *Umbels* 2–8-flowered, the flowers at different developmental stages. *Pedicels* 4.8–10 mm long, erect in flower and fruit, articulate at 1/5 to a little less than 1/2 (0.2–0.45 of the length from the base), usually slightly below the apex of the outer umbel bract, occasionally to slightly above all umbel bracts. *Perianth* 8.3–9 mm long; sepals 1.6–2.2 mm wide; petals purple, body 3–3.9 mm wide excluding the fringe, fringe well-developed, the longest fimbriae 2–3.3 mm long. *Stamens* 6, the anthers of the two whorls held in two separate groups, dissimilar and unequal, the shorter outer anthers in a parallel group projecting forward above the longer inner anthers which form a parallel slightly down-curved group. *Outer anthers* straight to slightly curved, twisted, 1.8–2.9 mm long; the dorsal surface (connective) reddish purple, somewhat thickened for most of the length, the surface drying rough, ventral surface pale purple; dehiscent by a pore 0.2–0.25 mm long on the ventral face of the apex. *Inner anthers* curved, twisted, 3–3.8 mm long (measured across the curve), dorsal surface (connective) thickened for a short distance at the base, pale reddish purple in the proximal half, transitioning to whitish on the distal half, ventral surface pale purple, whitish distally, dehiscent by a 0.2–0.25 mm long pore on the ventral face of the apex. *Ovary* spherical, pale green, with 4–8 ovules per locule; style curved, positioned alongside the long anthers; stigma short, simple, positioned near the apices of the long anthers. *Fruit* spherical, enclosed in the withered perianth that splits upon fruit enlargement, the distal part of the perianth empty and forming a tail. *Seeds* with distal face rounded and the proximal face flat to angled, 1.5–2 mm diam., black, aril colour unknown, forming two thin, spreading, appressed, flabellate lobes. (Figure 5)

Diagnostic characters. *Thysanotus brachyantherus* may be distinguished from all other members of the genus by the following combination of characters: forming discrete ovoid (occasionally broadly fusiform) tubers on long, thin, wiry roots; leaves withered at flowering time; flowers small (perianth 8.3–9 mm long), inner (long) anthers 3–3.8 mm long (measured across the curve), pale reddish; ovules several (4–8) per locule.

Figure 5. *Thysanotus brachyantherus*. A – part of panicle; B – flower, front view showing positions of the two anther whorls; C – flower enlargement, showing side view of anthers; D – roots, showing defined ovoid or fusiform tubers; E – a habitat. Images from *C.J. French* 14718 (A, C–D; A, C photographed in cultivation), *T.D. Macfarlane & C.J. French* CJF 9820, TDM 7458 (B, E). Photographs by C.J. French (A–D), T.D. Macfarlane (E).

Other specimens examined. WESTERN AUSTRALIA: Ponier Rock, 11 Dec. 2009, *E. Adams & M. Hoggart* EA 618 (PERTH 08204381); 380 m SW of Emily Ann Mine, adjacent to access track in front of offices, 1.77 km N of the Hyden – Norseman Rd, 29 Nov. 2011, *P.G. Armstrong* PA 11/701 (PERTH 08800820); junction of Balladonia, Israelite Bay and Esperance tracks, near Mount Ragged, Russell

Range, *c*. 110 miles [177 km] E of Esperance, 8 Dec. 1960, *N.H. Brittan* 60/93 (PERTH 01121863, 01121871, 01121898, 01121901); 6 km NW of Salmon Gums, 9.2 km SW of Hobby Rd on Upper Salmon Gums Rd, 10 Dec. 1983, *M.A. Burgman & C. Layman* MAB 2849 (PERTH 01158953); 2.5 km S of Sampsons Well, Riverina Stn, 21 Sep. 1988, *R.J. Cranfield* 7572 (PERTH 02638037); 1 mile [1.6 km] S of Mount Ragged, 8 Dec. 1960, *A.S. George* 2117 (PERTH 01041444); Cape Arid National Park on Balladonia Rd, just N of Pine Hill, 17 Nov. 2000, *N. Gibson, K. Brown & B. Moyle* NG 5792 A (PERTH 08676771); 12 km NE of Mount Arid, Cape Arid National Park, 29 Oct. 1989, *G.J. Keighery* 11312 (PERTH 05101387); Red Lake Townsite Nature Reserve, N of Grasspatch, 7 Dec. 2022, *T.D. Macfarlane & C.J. French* TDM 7459 (PERTH 09630414); 18 km W of Coolgardie Esperance Hwy, approximately 122 km N of Esperance town site, 7 Feb. 2002, *M. Maier* BES MM 978 (PERTH 08350221); 30 km NE of Mt Heywood, *c*. 105 km NE of Esperance, 9 Oct. 1980, *K.R. Newbey* 8002 (PERTH 01041843); 12 km NE of Norseman (Norseman 1:250,000 sheet), 31 Oct. 1980, *K.R. Newbey* 8098 (PERTH 02005921).

Phenology. Flowering recorded from October to December, apparently varying between seasons, with one record in September at the most northerly locality. Fruits have been collected in November and December.

Distribution and habitat. The recorded range is from west of Lake Johnston to near Mt Ragged and Mt Arid in southern Western Australia, with an outlying collection from Riverina Station in the Goldfields, 280 km north of the next nearest location (Figure 1A). Specimens have recently come to our attention from surveys on the Nullarbor Plain, representing a substantial eastward extension in the known range. These specimens are not yet available for citation. The species grows in various vegetation types including open heath, mallee eucalypt low woodland, eucalypt woodland (sometimes with chenopod understories), open herbfields next to exposed granite, and in self-mulching clay depressions. The soils usually feature clay or are sandy overlying clay.

Conservation status. This species was previously listed as Priority Two under Western Australian conservation ratings but, with its wide geographic distribution and relatively recent increase in collections, it has been de-listed following a review (T. Llorens, pers. comm.). It is not regarded as of conservation concern.

Etymology. The epithet *brachyantherus*, Latin for short anthers, is apt for this species, which has the smallest flowers and shortest anthers of any species in the multi-ovulate group.

Notes. *Thysanotus brachyantherus* is the most distinctive species in the multi-ovulate group and is readily identified by its small anthers, with the longer ones, although curved, not long enough to have the long sweeping curvature of the other species; both whorls are particularly noticeably twisted. There is a range of plant sizes, from small plants with small inflorescences to tall, well-branched plants evidently grown in luxuriant conditions in good seasons.

Thysanotus ellipsoideus T.Macfarlane & C.J.French, *sp. nov.*

Type: intersection of Kau Rock Road and Mount Ney Road, south corner. Kau Rock Nature Reserve, NE of Esperance, Western Australia, 8 December 2022, *T.D. Macfarlane & C.J. French* TDM 7464 (*holo*: PERTH 09630473; *iso*: CANB).

Herbs with a small subterranean perennating rootstock, storage roots, and annual leaves and inflorescence. *Roots* forming defined tubers; *tubers* ellipsoid, sometimes fusiform, 5–18(–40) per plant, 11–30(–40) mm long, 3–11 mm diam., borne on long, thin, wiry roots (25–)40–110 mm long (sometimes appearing thicker when fresh), current and previous years' tubers usually present. *Leaves* apparently few, 1–4 per plant, basal, not conspicuously equitant, sheathing at base with narrow translucent membranous margins, withered at flowering time; lamina erect, straight, rather stiff, 80–250 mm long, glabrous, otherwise inadequately known. *Inflorescence* 1 per plant, a little shorter than to exceeding the leaves, 60–230 mm

tall (above ground), a panicle comprising the upper part or occasionally unbranched with a terminal umbel; *scape* erect, terete to compressed, glabrous, with (0)1 or 2 sterile bracts, the lowest borne at 1/3–3/4 the inflorescence height when present; *panicle* relatively small, few-branched and few-flowered, rachis 12–68(–96) mm long with 1–4(–5) fertile (branch- or umbel-bearing) nodes, including terminal umbel, *branches* 1 (rarely 2) per node, erect to widely spreading (by up to 60°), the longest branch 7–35 mm long, simple, each with a terminal umbel of flowers. *Umbels* 1–4-flowered, the flowers at different developmental stages. *Pedicels* (8–)9.5–12.5 mm long, erect in flower and fruit, articulate at *c.* 1/4–2/3 (0.27–0.61 of the length from the base), slightly (1–2 mm) above the apex of the outer umbel bract. *Perianth* (10–)12–15.5 mm long; sepals 2–2.8 mm wide; petals purple, body 3.8–7 mm wide excluding the fringe, fringe well-developed, the longest fimbriae 3–4.5 mm long. *Stamens* 6, the anthers of the two whorls held in two separate groups, dissimilar and unequal, the shorter outer anthers in a parallel group projecting forward above the longer inner anthers which form a parallel down-curved group. *Outer anthers* straight, twisted, 3.1–3.7 mm long, reddish purple; the dorsal surface (connective) somewhat thickened for most of the length, the surface drying rough; dehiscent by a pore 0.2–0.5 mm long on the ventral face of the apex. *Inner anthers* strongly curved, twisted, 6–8 mm long (measured across the curve), reddish purple, usually with a whitish longitudinal stripe; dorsal surface (connective) thickened for a short distance at the base; pore length unrecorded. *Ovary* shortly cylindrical, pale green or yellowish, with 9–11 ovules per locule; style curved, positioned alongside the long anthers; stigma short, simple, positioned about level with the apices of the long anthers. *Fruit* cylindrical, enclosed in the withered perianth which splits upon fruit enlargement. *Seeds* not seen. (Figure 6)

Diagnostic characters. *Thysanotus ellipsoideus* may be distinguished from all other members of the genus by the following combination of characters: discrete ellipsoid tubers formed on long, thin, wiry roots; leaves present but withered at flowering time; pedicels (8–)9.5–12.5 mm long, articulate below to above the middle (1/4–2/3 from the base); perianth (10–)12–15.5 mm long; inner (long) anthers 6–8 mm long (measured across the curve), reddish purple with a white stripe; ovules multiple (9–11 per locule).

Other specimens examined. WESTERN AUSTRALIA: 100 miles [161 km] E of Esperance, Esperance–Israelite Bay Rd, 6 Dec. 1960, *N.H. Brittan* 60/91 (PERTH 02972050, 02972069); Mount Ragged–Israelite Bay Rd, 14.15 and 14.65 miles [22.77 and 23.57 km] S of Mount Ragged, 8 Dec. 1960, *N.H. Brittan* 60/96 (PERTH 02972166, 02972158, 02971887); 3 miles [4.8 km] E of Lort River, Esperance–Ravensthorpe Rd, 13 Dec. 1960, *N.H. Brittan* 60/120 (PERTH 02971941); SW slopes of Mount Ragged, Jan. 1953, *N.H. Brittan s.n.* (PERTH 02971895); 1/3-1/2 way to summit of Mount Le Grand, 12 Dec. 1960, *A.S. George* 60/113 (PERTH 02971933, 02971925); *c*. 12 miles [19.3 km] SW of Mount Ragged, 6 Dec. 1960, *A.S. George* 2041 (PERTH 03016226). SOUTH AUSTRALIA: near Cape Carnot, 10 Dec. 1972, *E.C. Nelson* ANU 16865 (PERTH 03027775).

Phenology. Flowering recorded from December to January. Flowers do not open until the middle of the day.

Distribution and habitat. *Thysanotus ellipsoideus* occurs in south coastal Western Australia, from Lort River to Mt Ragged, east of Esperance, and has a limited distribution in the Port Lincoln area, Eyre Peninsula, South Australia (previously treated as *T. nudicaulis*) (Figure 1B). There are several Western Australian specimens formerly identified as *T. nudicaulis* which may be *T. ellipsoideus* but, lacking tubers, cannot at present be allocated to either of these two species (Figure 1A). None of them would significantly extend the known range of *T. ellipsoideus* if they proved to belong to this species. We have seen only one South Australian specimen but are assuming that all records from this state belong to *T. ellipsoideus* given the tuber description as ellipsoid in Brittan (1986). The species grows in mallee eucalypt low woodland and low heathland in sand to sandy clay surface soil over clay, laterite or gravel.

Conservation status. With occurrence over a wide geographical range including in conservation reserves, this species is not regarded as of conservation concern in Western Australia. This taxon is listed as Endangered under South Australian legislation (Government of South Australia 2023), as *T. nudicaulis*.

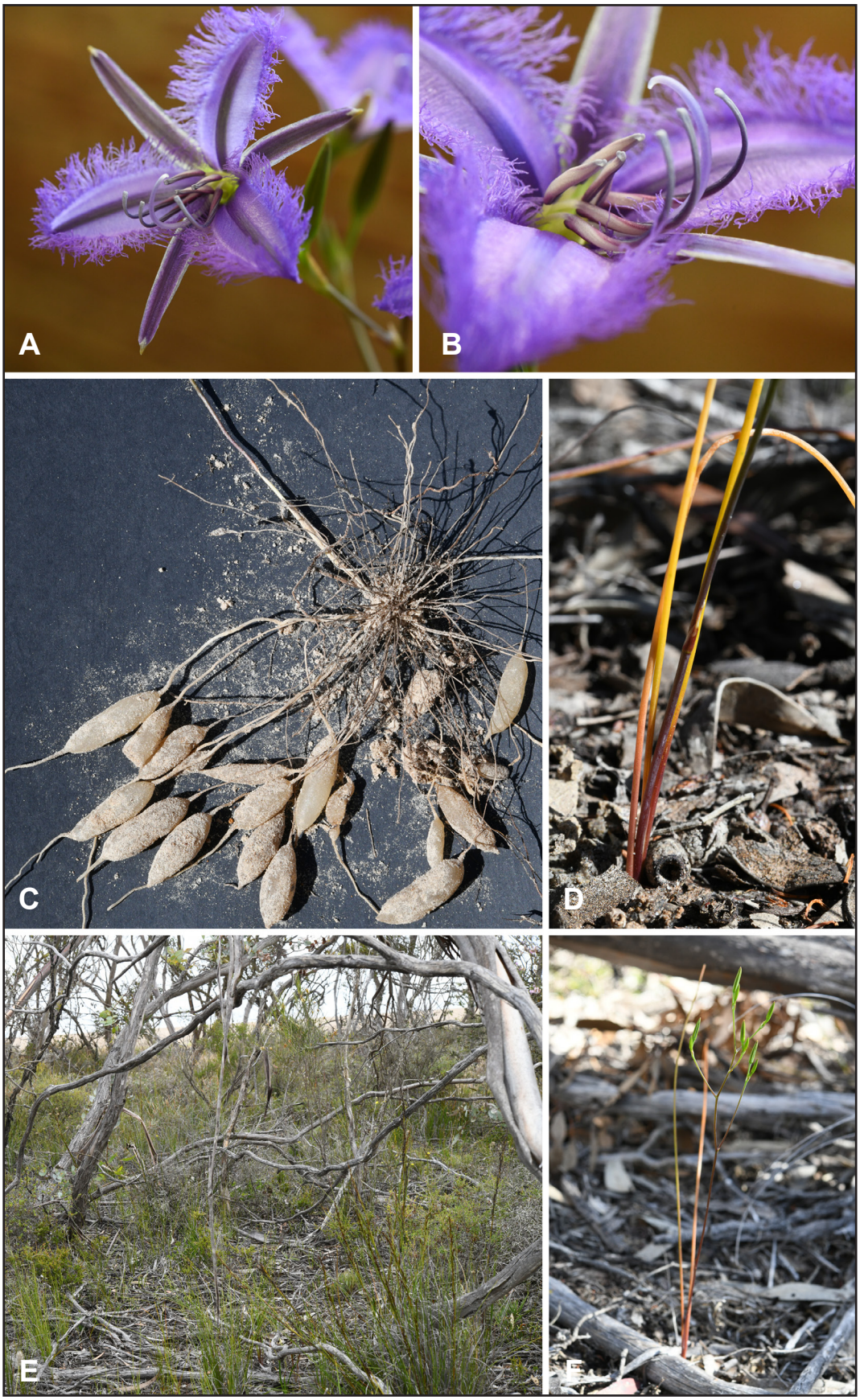

Figure 6. *Thysanotus ellipsoideus*. A – flower, oblique top view; B – flower enlargement, oblique side view showing positions of the two anther whorls and the style; C – roots, showing ellipsoidal tubers and thin, wiry roots; D – plant base showing three leaves, senescing at beginning of flowering time; E – a habitat; F – whole plant *in situ*, panicle with advanced buds, occupying upper part of inflorescence. Images from *T.D. Macfarlane & C.J. French* TDM 7464. Photographs by C.J. French.

Etymology. The epithet *ellipsoideus* is from Latin, referring to the ellipsoid shape of the tubers, characteristic of the species.

Notes. *Thysanotus ellipsoideus* (like *T. prospectus*) has until now been included in *T. nudicaulis.* It differs from both of those species by the form of the tubers and roots: the roots connecting the tubers are thin and, especially with age or drying, are wiry rather than thick and abruptly expand into a discrete tuber, rather than the roots being relatively thick and gradually expanding into the discrete tuber as in *T. nudicaulis*, or the whole root being uniformly thickened and lacking a discrete tuber as in *T. prospectus* (compare Figure 6C with Figures 8E & 9E). Some other features show differences or partial differences between these three species, with *T. ellipsoideus* tending to have smaller or fewer parts and *T. prospectus* having larger or more, while *T. nudicaulis* tends to span the ranges of the other two. *Thysanotus ellipsoideus* has few leaves, 1–4, that are not usually conspicuously equitant (in a fan-like arrangement) and are withered at flowering time whereas *T. prospectus* has more leaves, 3–8 arranged equitantly (the bases tightly packed on either side of the inflorescence axis in one plane) and green at flowering time. Inflorescence height and thus the overall size of the plant can be helpful for differentiation, with *T. ellipsoideus* the smallest at 60–230 mm compared with 180–410 mm but usually less than 300 mm in *T. nudicaulis* and 210–520 mm and usually more than 300 mm in *T. prospectus*. Pedicel length shows a trend of different lengths, with (8–)9.5–12.5 mm of *T. ellipsoideus* comparing to the usually longer 11–20 mm pedicels in *T. prospectus*, although in *T. nudicaulis* the 10.5–15 mm length spans the gap between the ranges of the other two species. Similarly, ovules per ovary locule appear, on the present limited data, to differ between the 9–11 of *T. ellipsoideus* and 13–17 in *T. prospectus* but *T. nudicaulis* having an overlapping 10–15 ovules. The flowers are similar in all three species in overall form, colour and the arrangement of stamens.

Thysanotus lavanduliflorus Brittan, *Brunonia* 4: 125–127 (1981). *Type*: 'Hyden–Newdegate road, 33.6 miles [54 km] S of Hyden', Western Australia, 27 November 1973, *N.H. Brittan* 73/62 (*holo*: PERTH 01011383!; *iso*: K 000794782 image!).

Herbs with a small subterranean perennating rootstock, storage roots, and annual leaves and inflorescence. *Roots* forming defined tubers; *tubers* fusiform, 6–8 or more per plant, 16–38 mm long, 4–7 mm diam., borne on thin, wiry roots 25–78 mm long (sometimes appearing thicker when fresh), current and previous years' tubers usually present. *Leaves* up to 8 per plant, basal, not conspicuously equitant, sheathing at base with narrow translucent membranous margins, withered at flowering time; lamina not seen when green. *Inflorescence* 1 per plant, height relative to leaves not known, 40–180 mm tall (above ground), an open more or less pyramidal panicle comprising the upper 1/2–2/3; *scape* erect, terete to compressed, glabrous, with 0 or 1 sterile bracts, borne at slightly below the middle when present; *panicle* relatively small, few-branched and few-flowered, rachis 38–92 mm long with 2–5 fertile (branch- or umbel-bearing) nodes, including terminal umbel, *branches* 1 or 2 per node, slightly to widely spreading (by up to 60°), the longest branch 12–55 mm long, simple or once divided, each with a terminal umbel of flowers. *Umbels* 1–5-flowered, the flowers at different developmental stages. *Pedicels* 6.5–10 mm long, erect in flower and fruit, articulate at *c.* 1/4–2/5 (0.23–0.39 of the length from the base), below the tips of the umbel bracts. *Perianth* 10–12 mm long; sepals 1.5–2.2 mm wide; petals bluish purple, 3.7–5 mm wide excluding the fringe, fringe well-developed, the longest fimbriae 2.3–3.1 mm long. *Stamens* 6, the anthers of the two whorls held in two separate groups, dissimilar and unequal, the shorter outer anthers in a parallel group projecting forward above the longer inner anthers which form a parallel down-curved group. *Outer anthers* straight, twisted, 2.7–3.4 mm long; the dorsal surface (connective) somewhat thickened for most of the length, the surface drying rough, reddish purple on back; dehiscent by a pore 0.2–0.25 mm long on the ventral face of the apex. *Inner anthers* strongly curved, twisted, 5–6 mm long (measured across the curve), dorsal surface (connective) thickened for a short distance at the base, reddish purple, ventral surface whitish to pale purple; dehiscent by a pore 0.3 mm long on the ventral face of the apex. *Ovary* spherical, white, with 4–6 ovules per locule; style curved, positioned alongside the long anthers; stigma short, simple, positioned about level with the apices of the long anthers. *Fruit* more or less spherical, enclosed in the withered perianth which splits upon fruit enlargement. *Seeds* not seen. (Figure 7)

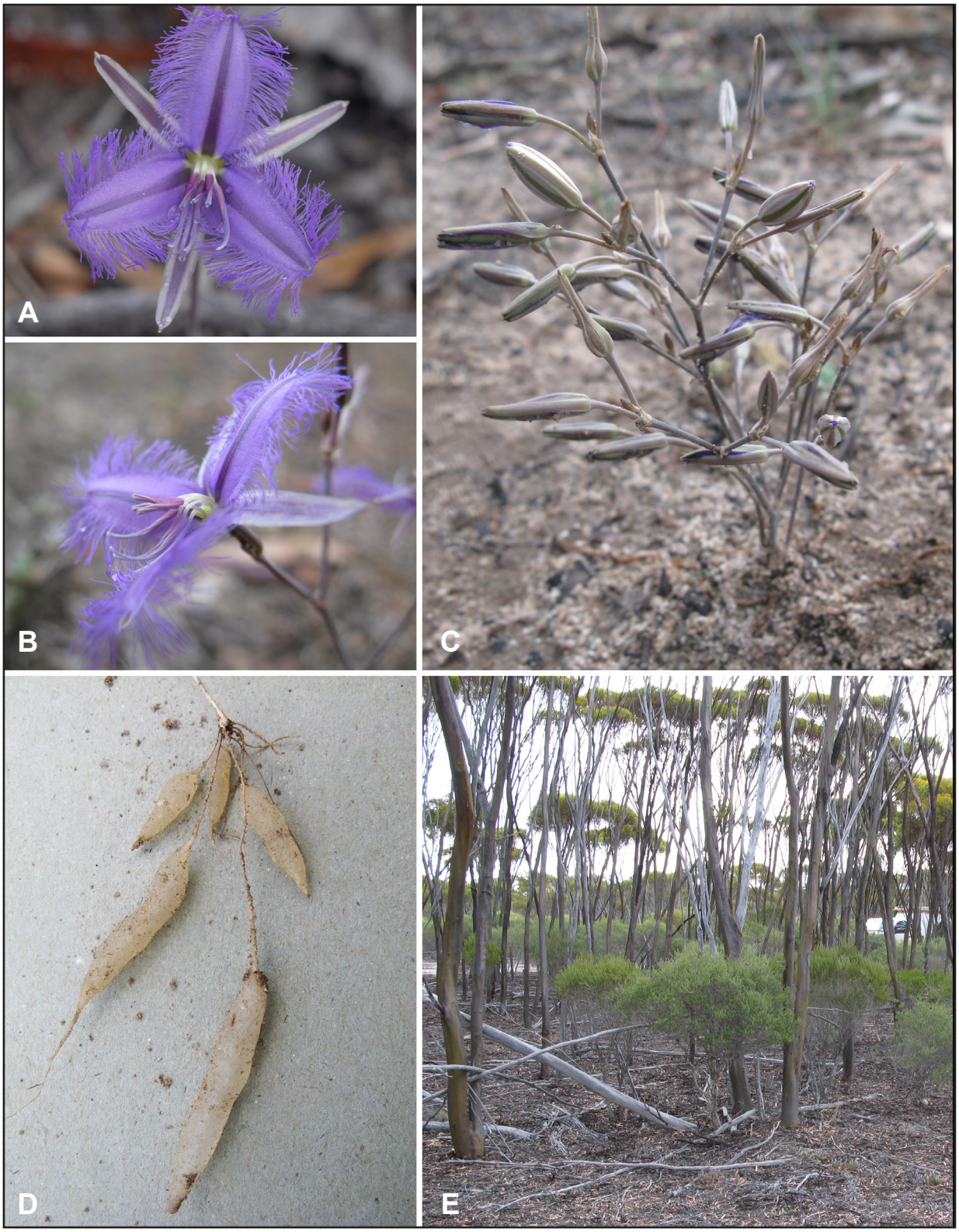

Figure 7. *Thysanotus lavanduliflorus*. A – flower, oblique view from above; B – flower, side view, showing positions of the two anther whorls; C – inflorescences, with typical dull, inconspicuous colouring and panicle occupying a large proportion of the whole inflorescence; D – roots, showing defined tubers; E – a habitat. Images from *C.J. French* 8546 (A, B, D, E), *C.J. French* 8544 (E). Photographs by C.J. French (A, C, E), T.D. Macfarlane (B, D).

Diagnostic characters. *Thysanotus lavanduliflorus* may be distinguished from all other members of the genus by the following combination of characters: discrete fusiform tubers formed on long, thin, wiry roots; leaves withered at flowering time; inner (long) anthers 5–6 mm long (measured across the curve), reddish; pedicels 6.5–10 mm long, articulate lower than the middle (1/4–2/5 from the base); perianth 10–12 mm long; ovules multiple (4–6) per locule.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 27 Nov. 1973, *N.H. Brittan* 73/63 (PERTH 01068881); 27 Nov. 1973, *N.H. Brittan* 73/64 (PERTH 01068903); 1 Dec. 1981, *N.H. Brittan* 81/43 (PERTH 01068946); 1 Dec. 1981, *N.H. Brittan* 81/44 (PERTH 01068938); 2 Dec. 1981, *N.H. Brittan* 81/45 (PERTH 01068954); 2 Nov. 1981, *N.H. Brittan* 81/46 (PERTH 01068911); 19 Nov. 2009, *C.J. French* CJF 8544 (PERTH 09663983, 09663975); 19 Nov. 2009, *C.J. French* CJF 8546 (PERTH 09602275, 09602313, 09602364); 7 Nov. 1990, *M. Graham* MSG 297 (PERTH 01487051).

Phenology. Flowering recorded from late November to December. Flowers do not open until the middle of the day.

Distribution and habitat. Most records of *T. lavanduliflorus* are from the Newdegate area in Western Australia, with additional collections from near Lake Pallarup and further south-south-east to the Vermin Fence, a range of 110 km (Figure 1A). The species grows in eucalypt low woodland and low mallee shrubland with a sparse understorey, in sand to sandy clay surface soil over clay, usually in the vicinity of salt lakes.

Conservation status. Currently listed as Priority Three under Conservation Codes for Western Australian Flora (Western Australian Herbarium 1998–). Under-explored, with a possibility that it may occur more widely outside the agricultural zone.

Etymology. The epithet *lavanduliflorus*, from the Latin for lavender-flowered, apparently refers to the description of the flowers as 'more bluish than other members of the genus with the possible exception of *T. baueri*' (Brittan 1981). The flowers do look more bluish purple than the pinkish purple seen in most species.

Notes. *Thysanotus lavanduliflorus* has smaller flowers than other members of the multi-ovulate group (except *T. brachyantherus*), with consequent smaller measurements for anthers. The species most similar to *T. lavanduliflorus* is *T. argillaceus*, which differs by its larger flowers and generally shorter inflorescence whose branches are seldom secondarily branched versus frequently so in *T. lavanduliflorus*.

The flowers of *T. lavanduliflorus*, with their bluish purple coloration, are rather dull and can be difficult to see from a distance. With the greyish colour of the inflorescence axes and flower exterior that merge with the background, and the leaves being withered at flowering time, the plants are difficult to see against the leaf litter and bare soil of their habitat. The flowers open in the middle of the day and close mid-afternoon. These factors all help to make this species difficult to find and contribute to its elusiveness in flora surveys and to the fact that most collections are still those made by the original collector, N.H. Brittan, during just a couple of field trips.

Thysanotus nudicaulis Brittan, *J. Roy. Soc. Western Australia* 54: 81, Figures 4, 5 (1972). *Type*: 65 miles [104 km] E of Esperance on Israelite Bay track, Western Australia, 11 December 1960, *N.H. Brittan* 60/106-1 (*holo*: PERTH 01221019! (*Brittan* 60/106-1); *iso*: K 000794780 image! (*Brittan* 60/106-2), MEL 2295104 image! (*Brittan* 60/106-3), PERTH 01221027! (*Brittan* 60/106-4)).

Herbs with a small subterranean perennating rootstock, storage roots, and annual leaves and inflorescence. *Roots* forming defined tubers; *tubers* fusiform, 5–15 per plant, 30–185 mm long, 2.5–5.5 mm diam., borne on thick, rather fleshy roots (the thickness persisting to maturity) 11–40 mm long, current and previous years' tubers present. *Leaves* 1–4 per plant, basal, not conspicuously equitant, sheathing at base with narrow translucent membranous margins, withered at flowering time; lamina erect, straight, rather stiff, 80–250 mm long (above ground), 0.4–1.4 mm diam., terete, tapering to an acute apex, glabrous. *Inflorescence* 1 per plant, a little shorter than to exceeding the leaves, 180–320 mm tall (above ground), a pyramidal to corymbose panicle comprising the upper part; *scape* erect, terete to compressed, glabrous, with 0–2 sterile bracts, borne at slightly below the middle to about 3/4 when present; *panicle* relatively small, few-branched and few-flowered, rachis 9–42(–60) mm long with 2–3(–6) fertile (branch- or

umbel-bearing) nodes, including terminal umbel, *branches* 1 (rarely 2) per node, slightly to moderately spreading (by up to 15°), the longest branch (4–)15–85 mm long, simple or rarely once divided, each with a terminal umbel of flowers. *Umbels* 1–6-flowered, the flowers at different developmental stages. *Pedicels* 10.5–15 mm long, erect in flower and fruit, articulate at *c.* 1/3–1/2 (0.31–0.56 of the length from the base), slightly above the apex of the outer umbel bract. *Perianth* 11.5–15 mm long; sepals 1.75–2.6 mm wide; petals purple, body 2.1–5.8 mm wide excluding the fringe, fringe well-developed, the longest fimbriae 1.8–4 mm long. *Stamens* 6, the anthers of the two whorls held in two separate groups, dissimilar and unequal, the shorter outer anthers in a parallel group projecting forward above the longer inner anthers which form a parallel down-curved group. *Outer anthers* straight, twisted, 3.5–4.2 mm long, reddish purple; the dorsal surface (connective) somewhat thickened for most of the length, the surface drying rough; dehiscent by a pore 0.2–0.3 mm long on the ventral face of the apex. *Inner anthers* strongly curved, twisted, 6–9 mm long (measured across the curve), reddish purple, usually with a whitish longitudinal stripe; dorsal surface (connective) thickened for a short distance at the base; dehiscent by a 0.2–0.25 mm long pore on the ventral face of the apex. *Ovary* shortly cylindrical, pale green or yellowish, with 10–15 ovules per locule; style curved, positioned alongside the long anthers; stigma short, simple, positioned about level with the apices of the long anthers. *Fruit* cylindrical, enclosed in the withered perianth which splits upon fruit enlargement. *Seeds* black, with whitish aril. (Figure 8)

Diagnostic characters. *Thysanotus nudicaulis* may be distinguished from all other members of the genus by the following combination of characters: fusiform tubers gradually expanding from thick roots; leaves withered at flowering time; inner (long) anthers 6–9 mm long (measured across the curve), reddish purple, usually with a whitish longitudinal stripe; pedicels 10.5–15 mm long, articulate at the middle or below (1/3–1/2); ovules multiple (10–15) per locule.

Other specimens examined. WESTERN AUSTRALIA: 28 miles [45 km] W of Esperance, Esperance – Ravensthorpe Rd, 13 Dec. 1960, *N.H. Brittan* 60/117 (PERTH 02971968, 02972042, 02972034); S side of salt lake, Israelite Bay Rd, 55.5 miles [89.3 km] E of Norseman – Esperance Rd, 11 Dec. 1960, *A.S. George* 2189 (CANB 336778.1 *n.v.*, K *n.v.*, PERTH 01978624); *c*. 2.5 km S of Scaddan, Coolgardie – Esperance Hwy, 7 Dec. 2022, *T.D. Macfarlane & C.J. French* TDM 7456 (AD, PERTH 09630392); 5 km N of Scaddan, Coolgardie – Esperance Hwy, just S of Phillips Rd, 7 Dec. 2022, *T.D. Macfarlane & C.J. French* TDM 7457 (PERTH 09630384); 2.8 km W of West River bridge, South Coast Hwy, W of Ravensthorpe, 9 Dec. 2022, *T.D. Macfarlane & C.J. French* TDM 7467 (AD, PERTH 09630430); Jerramungup – Gnowangerup Rd, opposite Gleeson Rd, *c*. 27 km W of Jerramungup, 9 Dec. 2022, *T.D. Macfarlane & C.J. French* TDM 7469 (CANB, PERTH 09630457).

Phenology. Flowering recorded from mid-November to mid-December, with one record in January.

Distribution and habitat. The recorded range is from west of Jerramungup to 90 km east of Esperance, on the south coastal region of Western Australia (Figure 1A). The species grows in mallee eucalypt low woodland with sedge or low to tall shrubland understorey, in sand or sand over clay.

Conservation status. With a wide geographical range, apparently growing in extensive populations and represented in at least one conservation reserve, this species is not regarded as of conservation concern.

Etymology. The epithet *nudicaulis*, from the Latin for naked stem, was not explained in the original publication (Brittan 1972). We assume that, given that the stem or scape usually bears bracts, the name probably did not refer to the stems themselves but to the fact that the leaves have usually dried out at flowering time, leaving a leafless flowering stem.

Notes. This revised concept of *T. nudicaulis* represents usually small plants with little inflorescence branching and rather few umbels, bearing roots that are relatively thick at the base and gradually expanding into an obvious tuber. The ovule number range 10–17 per locule given by Brittan (1972, 1981, 1987) is presumed by us to include observations of *T. ellipsoideus* and *T. prospectus*, so we have used our own observations here. Further comparisons between the three species that formerly comprised *T. nudicaulis* are given under *T. ellipsoideus*.

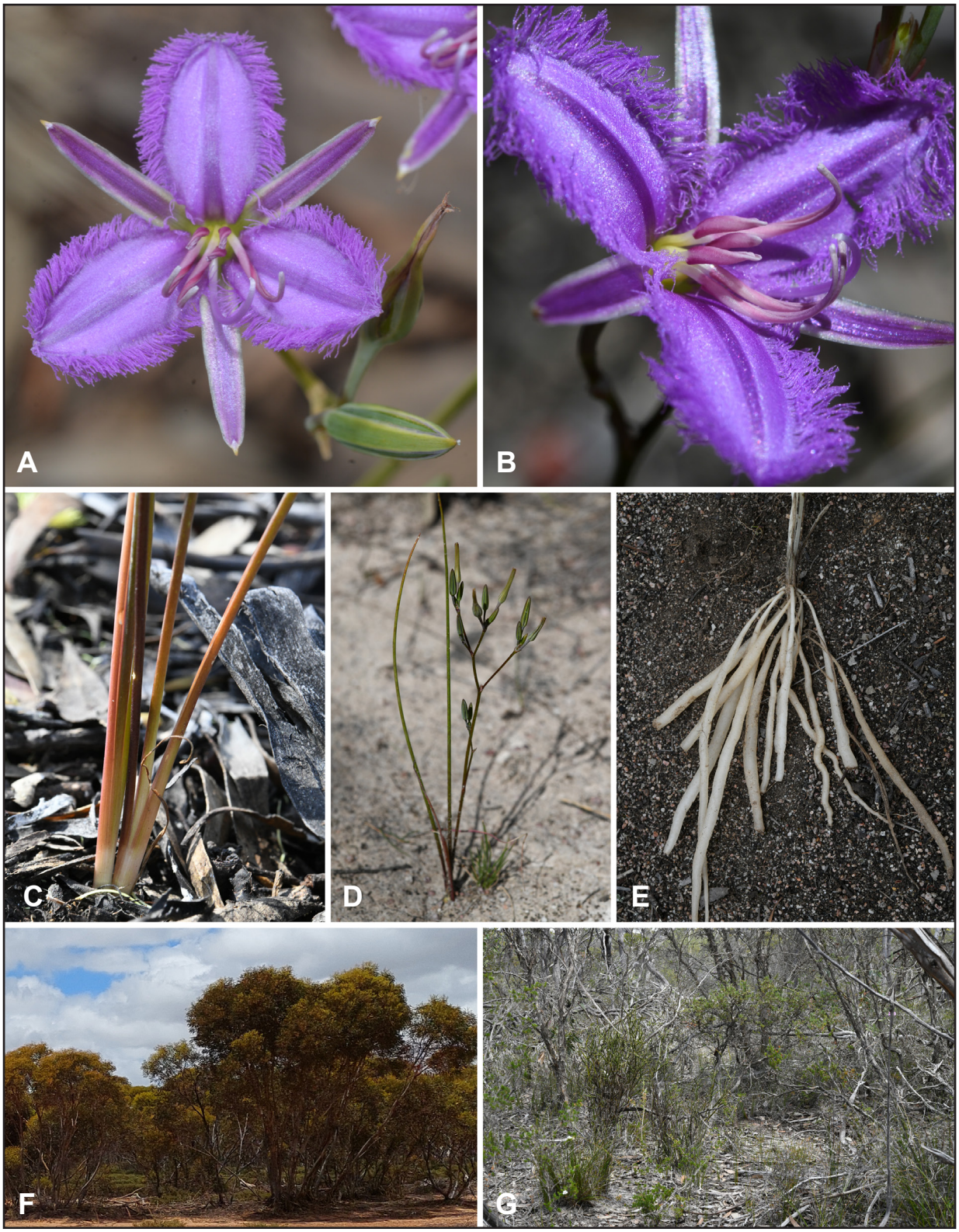

Figure 8. *Thysanotus nudicaulis*. A – flower, front view showing positions of the two anther whorls; B – flower, oblique view from above anthers showing the different forms of the two anther whorls; C – plant base with *c*. 4 leaves becoming senescent, showing a tendency toward being equitant, and a scape (darker in colour); D – a plant *in situ*, no flowers open; E – roots, showing relatively thick roots (not wiry) that gradually expand into long slender tubers that lack a well-defined beginning; E – a habitat, mallee eucalypts with red loamy soil; F – a habitat, mallee eucalypts with a fairly dense understory on grey sand over clay. Images from *T.D. Macfarlane & C.J. French* TDM 7375 (A), *T.D. Macfarlane & C.J. French* TDM 7456 (B, G), *T.D. Macfarlane & C.J. French* TDM 7461 (C), *T.D. Macfarlane & C.J. French* TDM 7469 (D), *T.D. Macfarlane & C.J. French* TDM 7467 (E), *T.D. Macfarlane & C.J. French* TDM 7375 (F). Photographs by C.J. French.

Thysanotus prospectus C.J.French & T.Macfarlane, *sp. nov.*

Type: Lake Pleasant View, near Manypeaks township, E side of the lake, Western Australia, 30 November 2021, *T.D. Macfarlane, C.J. French, E.M. Sandiford & S. Barrett* TDM 7356 (*holo*: PERTH 09504699; *iso*: AD, CANB, PERTH 09504745).

Herbs with a small subterranean perennating rootstock, storage roots, and annual leaves and inflorescence. *Roots* thickened and fleshy along their whole length, not forming defined tubers, thickened from the base, often slightly broader in the mid–region, 6–22 per plant, up to 180 mm long, 1.5–3 mm diam., current and previous years' roots present. *Leaves* 3–8 per plant, basal, often equitant (forming a fan-like arrangement), sheathing at base with narrow translucent membranous margins, green at flowering time (sheath and lower part of the lamina usually reddish); lamina erect, straight, rather stiff, 100–390 mm long (above ground), 0.8–2.2 mm diam., terete or adaxially concave in the proximal part, tapering to an acute apex, glabrous. *Inflorescence* 1 per plant, slightly to well exceeding the leaves, 155–520 mm tall (above ground), a more or less corymbose panicle comprising the upper part; *scape* erect, terete to compressed, glabrous, with 0–2 sterile bracts, borne at slightly below to slightly above the middle when present; *panicle* usually relatively large and well-branched, the rachis 20–330 mm long (lowest branch to base of terminal umbel) with 2–7 fertile (branch- or umbel-bearing) nodes including terminal umbel, *branches* 1 or 2 per node, narrowly to fairly widely spreading (by up to 30°), the longest branch 20–170 mm, simple with a terminal umbel of flowers or more often compound with a terminal umbel-like group of secondary branches each bearing a terminal umbel of flowers, the lower 1 or 2 branches often well-developed and comprising secondary panicles. *Umbels* (2–)3–4(–8)-flowered, the flowers at different developmental stages. *Pedicels* 11–20 mm long, erect in flower and fruit, articulate at *c.* 1/3–3/5 (0.3–0.61 of the length from the base), slightly to well above the apex of the outer umbel bract. *Perianth* 13–18 mm long; sepals 2–3.9 mm wide; petals purple; body 3.5–7.6 mm wide, the fringe well-developed, the longest fimbriae 2–5 mm long. *Stamens* 6, the anthers of the two whorls held in two separate groups, dissimilar and unequal, the shorter outer anthers in a parallel group projecting forward above the longer inner anthers which form a parallel down-curved group. *Outer anthers* straight, twisted, 3.1–5.6 mm long, reddish purple at the base and along the sides, the dorsal and ventral surfaces whitish; the dorsal surface (connective) somewhat thickened for most of the length, drying with a rough surface; dehiscent by a pore 0.3–0.4 mm long on the ventral face of the apex. *Inner anthers* strongly curved, twisted, 6.5–8 mm long (measured across the curve), reddish purple at the base and along the sides, the dorsal and ventral surfaces whitish; the dorsal surface (connective) thickened for only a short distance at the base; dehiscent by a pore 0.2–0.3 mm long on the ventral face of the apex. *Ovary* shortly cylindrical or somewhat conical, yellowish, with 13–17 ovules per locule; style curved, positioned alongside the long anthers; stigma short, simple, positioned about level with the apices of the long anthers. *Fruit* cylindrical, 7–7.5 mm long, enclosed in the withered persistent perianth which splits upon fruit enlargement. *Seeds* black, with whitish aril. (Figure 9)

Diagnostic characters. *Thysanotus prospectus* may be distinguished from all other members of the genus by the following combination of characters: roots thickened and fleshy for their whole length but not forming discrete tubers; leaves green at flowering time, several (3–8), often equitantly arranged; inner (long) anthers 6.5–8 mm long (measured across the curve), reddish purple at the base and on the sides, whitish dorsally and ventrally; pedicels 11–20 mm long, articulate at or below the middle (1/3–3/5); ovules multiple (13–17) per locule.

Other specimens examined. WESTERN AUSTRALIA: S of Mount Merivale, 12 Dec. 1960, *N.H. Brittan* 60/109 (PERTH 02971828); Lake Pleasant View, near Manypeaks, 10 Dec. 2020, *C.J. French* CJF 13704 (MEL, PERTH 09504729); at base of Mount Le Grand, 12 Dec. 1960, *A.S. George* 60/111 (PERTH 02971836, PERTH 02971844); *c*. 1 mile [1.61 km] S of Mount Merivale on track to Mount Le Grand, 12 Dec. 1960, *A.S. George* 2205 (PERTH 03016242); site SPS 134A, Western shore of White Lake, within Helms Arboretum, *c*. 18 km NNW of Esperance, 24 Oct. 2000, *M.N. Lyons* 2863 (PERTH 06834345); North Sister Nature Reserve, N of Manypeaks township, the western lake at W end of the reserve, SE corner of the lake, adjacent to Mount Pleasant Rd, 30 Nov. 2021, *T.D. Macfarlane, C.J. French &*

Figure 9. *Thysanotus prospectus*. A – flower, front view; B – flower, oblique front view showing positions of the two anther whorls; C – plant base showing an equitant fan of leaves, green at flowering time; D – inflorescence; E – roots thickened from the base, constituting evenly thickened tubers; E – a habitat, showing a lake in the background. Images from *T.D. Macfarlane & C.J. French* TDM 7356 (A, C, F), *T.D. Macfarlane & C.J. French* TDM 7359 (B) and *C.J. French* 13704 (E). Photographs by C.J. French.

E.M. Sandiford TDM 7358 (PERTH 09504737); Lake Corimup, eastern edge of the north easterly lake (or lake part), Lake Corimup Nature Reserve, N of Manypeaks township, 30 Nov. 2021, *T.D. Macfarlane, C.J. French & E.M. Sandiford* TDM 7359 (PERTH 09504680); Cape Arid National Park, E of Esperance, 29 Nov. 1971, *R.D. Royce* 9826 (PERTH 01978616); NW fringe of Lake Velleia, Helms Forestry Reserve 23527, Gibson, 15 Dec. 2011, *C.D. Turley & R.M. Hoggart* 25/12-11 (PERTH 08438056).

Phenology. Flowering late November to December.

Distribution and habitat. Known from several populations from Manypeaks to near Cape Arid, a range of approximately 500 km (Figure 1A). Grows in damp to wet sandy soil near the shores of more or less permanent fresh to brackish lakes or in the adjacent gypsum dunes, in association with paperbark trees (*Melaleuca cuticularis*).

Conservation status. *Thysanotus prospectus* is not considered to be of conservation concern, given its extensive range and occurrence in conservation reserves, although because of the limited extent of its specialised habitat, populations are scattered and of relatively limited numbers of plants.

Etymology. The epithet *prospectus* (an outlook, view) is a Latin noun used in apposition, a reference to the occurrence of the plant on sites overlooking lakes, particularly the lake where we first saw it, Lake Pleasant View.

Notes. *Thysanotus prospectus* has formerly been included in *T. nudicaulis*. Clearly Brittan was aware of an unusual degree of variation in *T. nudicaulis*, judging from his mention of well-developed panicles on luxuriant specimens, which he, unusually, used a second photographic plate to illustrate (his Figure 5 of *A.S. George* 60/111-1, accompanying his Figure 4 depicting the holotype of *T. nudicaulis*) in the original description (Brittan 1972), and in a later discussion (Brittan 1981, p. 131). He reports his one-time belief that there were two taxa within *T. nudicaulis*, which he ultimately decided against, referring to differences in the degree of thickening of the tuberous roots, and in the thickness of the non-tuberous parts of the roots near the rhizome (rootstock), as well as unspecified correlated differences in stamens and ovary, in addition to geographical distribution. A subsequent collection, *Lyons* 2863, was identified as *T.* aff. *nudicaulis*, emphasising the poor fit of some plants with that species. We went through a similar process to Brittan, with a similar outcome, based on the same root features plus the inflorescence size, until we saw the plants here described as *T. prospectus* in the field and carried out a detailed herbarium study. That study along with further field work resulted in the recognition of a third root and tuber form (representing *T. ellipsoideus* as described above) within *T. nudicaulis*. The root tuber forms and differences in their connecting roots are too divergent to accept within a single species and, taking into account plant size trends, leaf number, structure and greenness at flowering time (also mentioned by Brittan) together with habitat differences, have led us to recognise three species in place of Brittan's (1972, 1981, 1987) concept of *T. nudicaulis*. The flowers of the three species are very similar: the most reliable distinguishing features are in the roots and tubers, with additional differences involving plant height, leaf number, leaf greenness at flowering time and habitat (see under *T. ellipsoideus*).

Key to multi-ovulate *Thysanotus* species (more than 2 ovules per ovary locule)

The length of the main axis (inflorescence length) is measured from ground level to the base of the bracts of the terminal umbel. The panicle (or rachis) length is measured from the base of the lowest bract that subtends a branch, umbel or flower to the base of the bracts of the terminal umbel.

1. Perianth 8.3–9 mm long; inner (long) anthers 3–3.8 mm long ..... **T. brachyantherus**

1: Perianth 10–18 mm long; inner (long) anthers 5–8.5 mm long

2. Perianth 10–12 mm long; flowers bluish purple; ovules 4–6 per ovary locule..... **T. lavanduliflorus**

2: Perianth 11.5–20 mm long; flowers purple to pinkish purple; ovules 8–17 per ovary locule

3. Tubers well-defined, ellipsoid to fusiform, swelling abruptly from the roots, attached by long, fine, wiry roots

4. Inflorescence axis lacking sterile nodes (marked by a bract) below the inflorescence (rarely a sterile node present); pedicels (5–)7.5–9 mm long [growing on brown self-mulching clay]..... **T. argillaceus**

4: Inflorescence axis with 1 or 2 sterile nodes (marked by a bract) below the inflorescence (rarely none present); pedicels (8–)9.5–12.5 mm long [growing on sand to sandy clay soil] ..... **T. ellipsoideus**

3: Tubers less well-defined or undefined, consisting either of thick roots that gradually swell into a tuber or of thick roots that are more or less the same diameter throughout

5. Tubers swelling gradually from thick attaching roots, becoming fusiform; leaves usually withered at flowering time, the group of leaves not conspicuously equitant (fan-like) at base [plants not associated with lakes or swamps]..... **T. nudicaulis**

5. Tubers undefined, consisting of thick roots of even diameter throughout or slightly thicker in the middle; leaves green (fresh) at flowering time, the group of leaves usually conspicuously equitant (fan-like) at base [growing near lakes or swamps, associated with paperbark trees (*Melaleuca cuticularis*)] ..... **T. prospectus**

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