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Thysanotus racemoides (Asparagales: Asparagaceae), a new species from South Australia and western Victoria

Udani M. Sirisena[1,2,5], Terry D. Macfarlane[3] and John G. Conran[4]

[1]*Ecologia Environment, 1025, Wellington Street, West Perth, Western Australia 6005, Australia*
[2]*Western Australian Herbarium, Department of Environment and Conservation, Locked Bag 104, Bentley Delivery Centre, Western Australia 6983, Australia.*
[3]*Western Australian Herbarium, Manjimup Research Centre, Department of Environment and Conservation, Locked Bag 2, Manjimup, Western Australia 6258, Australia.*
[4]*Australian Centre for Evolutionary Biology and Biodiversity & Sprigg Geobiology Centre, School of Earth and Environmental Sciences, Benham Building, DX 650 312, The University of Adelaide, South Australia 5005, Australia.*
[5]*Author for correspondence :Udani.Sirisena@DPaw.wa.gov.au/udani.sirisena@ecologia.com.au*

Abstract

The new species *Thysanotus racemoides* Sirisena, T.D.Macfarl. & Conran, from South Australia and western Victoria, is described and distinguished from the previously conspecific *T. juncifolius* (Salisb.) J.H.Willis & Court, by the presence of sessile subterminal umbels and relatively longer anthers and perianth segments. The revised distribution of *T. juncifolius* is New South Wales and eastern Victoria. Descriptions, photographic plates and a map are provided for the new species and *T. juncifolius*. The key in the *Flora of Australia* is amended to accommodate the new species.

Introduction

There has been no taxonomic publication solely on *Thysanotus* R.Br. since the pioneering work carried out by Brittan (1960, 1962, 1970, 1971a, 1971b, 1972a, 1972b, 1978, 1981, 1983, 1986, 1987). Recent molecular analyses recognised *Thysanotus* in a new family Laxmanniaceae (also known as Lomandraceae) (Chase et al. 1996; Angiosperm Phylogeny Group 2003) which was considered as an odd aggregation of genera due to the lack of obvious morphological synapomorphies to define the predominantly Australian family (Chase et al. 1995; Rudall and Chase 1996; Conran 1998). Most recently, the family was placed into a greatly expanded Asparagaceae under subfam. Lomandroideae (Mabberley 2008; Angiosperm Phylogeny Group 2009).

To improve and contribute to the taxonomic knowledge (morphological and molecular) on *Thysanotus*, a phylogenetic study was begun in mid-2006 by the first author as part of a PhD project, which has resulted in the description of one previous new species (Sirisena *et al.* 2009). Morphological and molecular analyses (Sirisena 2010) supported observations of Conran (1994) and Macfarlane (unpubl.) of possible taxonomic heterogeneity in *Thysanotus juncifolius* (Salisb.) Willis & Court. From these studies it was apparent that the geographically disjunct South Australian and western Victorian form of *T. juncifolius* is phylogenetically distant from populations in New South Wales and East Gippsland in Victoria. Further herbarium investigations revealed that specimens from South Australia and western Victoria represent a new species which is clearly and consistently morphologically distinguishable from the New South Wales and eastern Victoria form.

Methods

Living plants and herbarium specimens were examined (specimens listed below, observed among the three authors) including use of light microscopy, dissecting microscopy and SEM (Scanning Electron Microscopy). Morphological descriptions were based on these observations.

Stem anatomical studies were carried out using dried material, re-hydrated in warm water with a drop of detergent and hand sectioned. The specimens were then stained in 0.05% aqueous Toluidine blue and mounted in Glycerine.

The specimens examined are summarised according to the following geographic regions: 'Botanical divisions' of New South Wales (Jacobs and Pickard 1981, modified from Anderson 1961), 'Natural regions' of Victoria (Conn 1993), and 'Floristic regions' of South Australia (Jessop and Toelken 1986).

Results

The descriptive terminology of Brittan (1981, 1987) is followed to describe the new species *Thysanotus racemoides*, as well as to redefine *T. juncifolius* s. str.

Taxonomy

1. *Thysanotus racemoides* Sirisena, T.D.Macfarl. & Conran **sp. nov.**

Herba perennis. Rhizoma cylindricum, c. 1–5 cm longum; radices fibrosae haud tuberosae. Planta aphylla; scapus c. 60 cm altus, tuberculatus vel glaber. Umbellae floribus 1 vel 2, bracteis ovata, c. 2 mm longis, membranaceis. Pedicelli 5–6 mm longi, prope basin articulati, florescentes erecti, fructiferi erectes. Segmenta perianthii 8–9 mm longa: tepala exteriora lineari-oblonga, 1.2–1.5 mm lata, mucronata; tepala interiora elliptica, c. 3.2–3.5 mm lata. Stamina 6 poris terminalibus dehiscentia; antherae exteriores 3 strictae, tortae, 3–6 mm longae; antherae interiores 3 curvatae, tortae, c. 6–12 mm longae. Capsula 4–7 mm x 3–5 mm, perianthio persistenti inclusa. Semina nigra, arillata, c. 1.5 mm x 1.5 mm.

Type: Lucindale Road, [Hundred] of Coles, south east South Australia, 16 Dec 1963, *A.C. Beauglehole 5923*; (holo AD96446095; iso MEL2214357A) (see Notes below).

Perennial herb with a rhizomatous rootstock, horizontal and more or less cylindrical, 1–5 cm long, pale brown or straw coloured. *Roots* fibrous, not tuberous. *Plant* leafless when flowering, aerial stems (scapes) to c. 60 cm tall with bracts along the scape, 2.5–5 mm long. *Scapes* ascending, branches often 2 or 3 per node, sometimes further subdivided, ridged, tuberculate basally, tuberculate or glabrous distally, node bracts lanceolate. *Umbels* terminal above, several sessile subterminal umbels, commonly 2-flowered sometimes with 3 or 4 flowers, bracts ovate, membranous, c. 2.5 mm long. *Pedicels* 5–6 mm long, erect in flower and fruit, articulating basally. *Perianth* segments 12–15 mm long, outer three linear-oblong, c. 2 mm wide, inner three elliptical, c. 6 mm wide, fimbriate, fimbriae c. 4 mm long. *Stamens* 6, dehiscing by posteriorly extended terminal pores, outer 3 anthers 3–6 mm long, purple (sometimes yellow), straight, slightly twisted, inner three anthers 6–12 mm long, purple, curved, twisted, filaments c. 3 mm long. *Ovary* sessile, globular, ovules 2 per locule, style curved, 5–10 mm long. *Capsule* globose, 4–7 × 3–5 mm, enclosed in persistent perianth remains, forming a short tail. *Seeds* c. 1.5 × 1.5 mm, black, globose; testa periclinal walls strongly convex, without microsculpturing; aril straw-coloured (Fig.1).

Derivation of epithet: Derived from the fact the sessile subterminal umbels make the flowering branches resemble a raceme.

Flowering period: Late October to mid to late November.

Habitat: This new species is restricted to the deep sands of inland western Victoria, eastern South Australia and the sand plains and lateritic gravels of Kangaroo Island (Brittan 1981). The species grows in a wide range of habitats from dry open forest to mallee woodland and low heaths.

Distribution: The species occurs in south eastern Australia from the Eyre Peninsula and Kangaroo Island in South Australia to western Victoria with an apparently outlying occurrence near Anglesea, SW of Geelong (Fig. 3, indicated in green).

Notes: The mapping of the AD and MEL replicates of the type collection (*Beauglehole 5923*) in AVH (2013) do not coincide (AVH 2013). Based on a comparison of Beauglehole's collections on 15 and 16 December 1963,

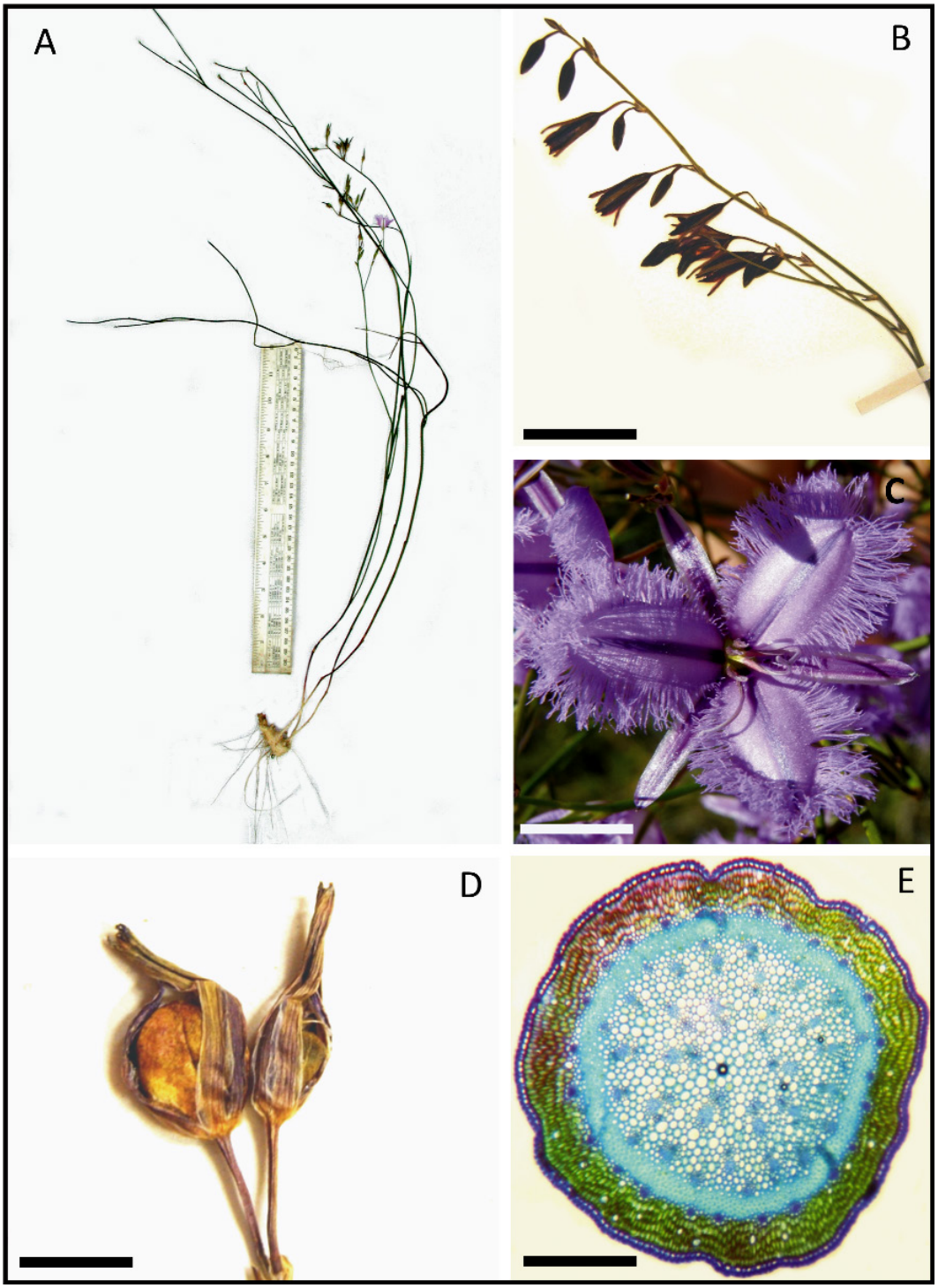

Fig. 1. *T. racemoides* A. Habit. B. Sessile subterminal umbels below a terminal umbel. C. Flower. D. Fruit. E. Transverse stem section (Specimens – A. *B. Saunders s.n.*; B. AD96020128; C,E. *US/Trujillo 1*; D. AD96446095. Scale bars: B = 3 cm; C = 12 mm; D = 5 mm; E = 500 µm. Photos - A. John G. Conran; B, D, E. Udani M. Sirisena; C. Cecilia Trujillo)

the AD geocode appears to be more likely to be correct, indicating that the collection was from c. 5 km SE of Callendale, east of the Callendale Main Road.

Proposed Conservation status: *Thysanotus juncifolius* is currently listed as 'not threatened' under Conservation Codes for South Australia (Barker *et al.* 2005) and Victoria (Walsh & Stajsic 2007) and this also seems to be appropriate for the segregated *T. racemoides*.

Specimens examined: South Australia: *South eastern region*: Mount Burr Forest Reserve, c. 12 km E of Millicent, *P. Wilson 1093*,11 Nov 1959 (AD96020128); Beachport, *R. Tate s.n.*, 13 Nov 1982 (AD96021026); Hundred of Robertson NW, *D. Hunt 258*, 21 Oct 1961 (AD96151151); Big Heath National Park, Hundred of Spence; 1 mile [1.6 km] S of and parallel to the fire break, mid-narrow neck, *C.R. Alcock 2903*, 4 Nov 1969 (AD96949199); Hundred of Caroline, Section 389, Caroline forest, *D.N. Kraehenbuehl 2562*, 30 Dec 1975 (AD97625135); Big Heath National Park, middle of park (firebreak), *J.Z. Weber 1836*, 6 Nov 1969 (AD97015200).

Kangaroo Island: 6.4 km SW of Cape Willoughby Lighthouse, *B. Overton, P. Canty, S. Kinnear NPKI40876* (AD99003160); Muston, Pelican Lagoon, *H.M. Cooper s. n.* 26 Nov 1962 (AD97915042); Some 32 km S of Kingscote and 6 km N of Destrees Bay, *C.R. Alcock 10706* 22 Oct 1986 (AD99020004, MEL715633A).

Eyre Peninsula: c. 50 m E of Long Beach Rd c. 100 m south of Jubilee Dr, Coffin Bay, Eyre Peninsula SA, *B. Saunders s. n.*, 22 Nov 2002 (AD97936175).

Murray region: Chauncey's Line – near Monarto South, *J.B. Cleland s.n.*, 30 Nov 1963 (AD96405327).

Southern Lofty region: S of Mount Compass, just before tree area of Square Waterhole, *D.E. Symon 309*, 25 Jan 1960 (AD98666202); Spring Mount, c. 8 km SE of Adelaide, *D.J.E. Whibley 1704*, 23 Nov 1966 (AD96849142); Scrub near Myponga, *D. Hunt 2904*, 26Dec 1968 (AD97011206); Cox Scrub Conservation Park near turn to Kyeema Conservation Park, *C. Trujillo US/Trujillo 1*, 17 Nov 2007 (ADU).

Victoria: *Murray Mallee:* Big Desert, c. 98.6 km from Murrayville, *E. Gardiner, G. Gardiner s.n.*, 22 Nov 1981 (AD98151033); 21.5 km WNW of Rainbow township, on unnamed track, *D.M. Parkes*, 11 Nov 1985 (MEL1545142).

Lowan Mallee: Wyperfeld National Park *A.C. Beauglehole* 29546,13 Nov 1968 (MEL535880); Little desert, 1 km SE of Broughton's Water Hole, *A.C. Beauglehole* 66628 and *A.J. Hicks*, 27 Nov 1979 (MEL595480).

Grampians: 1 mile [1.6 km from] Lake Wartook, *N.H. Brittan 59/89*, 15 Dec 1959 (PERTH2971976); Tea tree creek, Red rock creek area, S of Glenisla station, *A.C. Beauglehole* 39458, anno 1968 (MEL535882); Grampians, Black Range, track up east side of double headed mount, west side of Black Range Road, *A.C. Beauglehole* 30040, 11 Dec 1968 (MEL536387); Grampians, *A.C. Beauglehole* 67116, 8 Nov 1979 (MEL597877).

Otway Plains: S of Anglesea, *N.H. Brittan59/91*, 17 Dec 1959 (PERTH2971798); Slopes between great Ocean road and Harvey street, Anglesea, *R.V. Smith* 59/357, 3 Nov 1959 (MEL527769).

Wannon: Heath Road, Kentbruck, *C and D Woolcock* 1598, 27 Dec 1983 (MEL524045); Portland South west Portland, Emu hill area, between gorge west of Mount Richmond, *A.C. Beauglehole* 19537, anno 1946 (MEL535881); Portland far south west, Kentbruck heath, Heath Road, *A.C. Beauglehole* 39458, anno 1964 (MEL535883).

2. *Thysanotus juncifolius* (Salisb.) Willis & Court, *Muelleria* 1: 45 (1956).

Chlamysporum juncifolius Salisb., Parad. Londin. t. 103 (1808).

Type: R.A. Salisbury *loc. cit.*, t. 103. No specimen is known, so the type is the illustration accompanying the original description of cultivated plants whose origin was "Sponte nascentum prope Port Jackson, legit A. Gordon" and sent to England via E.J.A. Woodward.

Thysanotus junceus R.Br., Prodr.283 (1810). *Chlamysporum junceum* (R.Br.) Kuntze, Revis. Gen. Pl. 708 (1891).

Lectotype (Brittan 1981, p. 123): Port Jackson, New South Wales, *R. Brown* [*Bennett 5684*], without date (BM *n.v.*, isolectotypes E *n.v.*, K *n.v.*, MEL) (see Notes below).

Perennial herb with rhizomatous rootstock. *Roots* fibrous, not tuberous. *Plant* leafless when flowering, aerial stems (scapes) to c. 60 cm tall. *Scapes* ascending, branching monopodially, rarely with 2 or 3 branches per node, ridged, smooth; node bracts lanceolate, 2–5 mm long. *Umbels* terminal, 1–5 flowered, bracts ovate, membranous, outer ones c. 1.4 mm long. *Pedicels* erect in flower and fruit, articulated near the base. *Perianth* segments to c. 12 mm long, outer three linear-oblong, c. 1.3 mm wide, inner three narrowly elliptical, 3.5–4 mm wide, fimbriate, fimbriae c. 1.5 mm long. *Stamens* 6, dehiscing by posteriorly extended terminal pores, outer 3 anthers 2.2–2.8 mm long, purple (sometimes yellow), straight, slightly twisted, inner 3 anthers 6–8 mm long, purple, curved, twisted; *Ovary* sessile, globular, ovules 2 per locule. *Capsule* globose, 3–5 × 2–3 mm, enclosed in persistent perianth segments which form a short tail. *Seeds* globose, black, c. 1 mm diam., aril straw-coloured (Fig. 2).

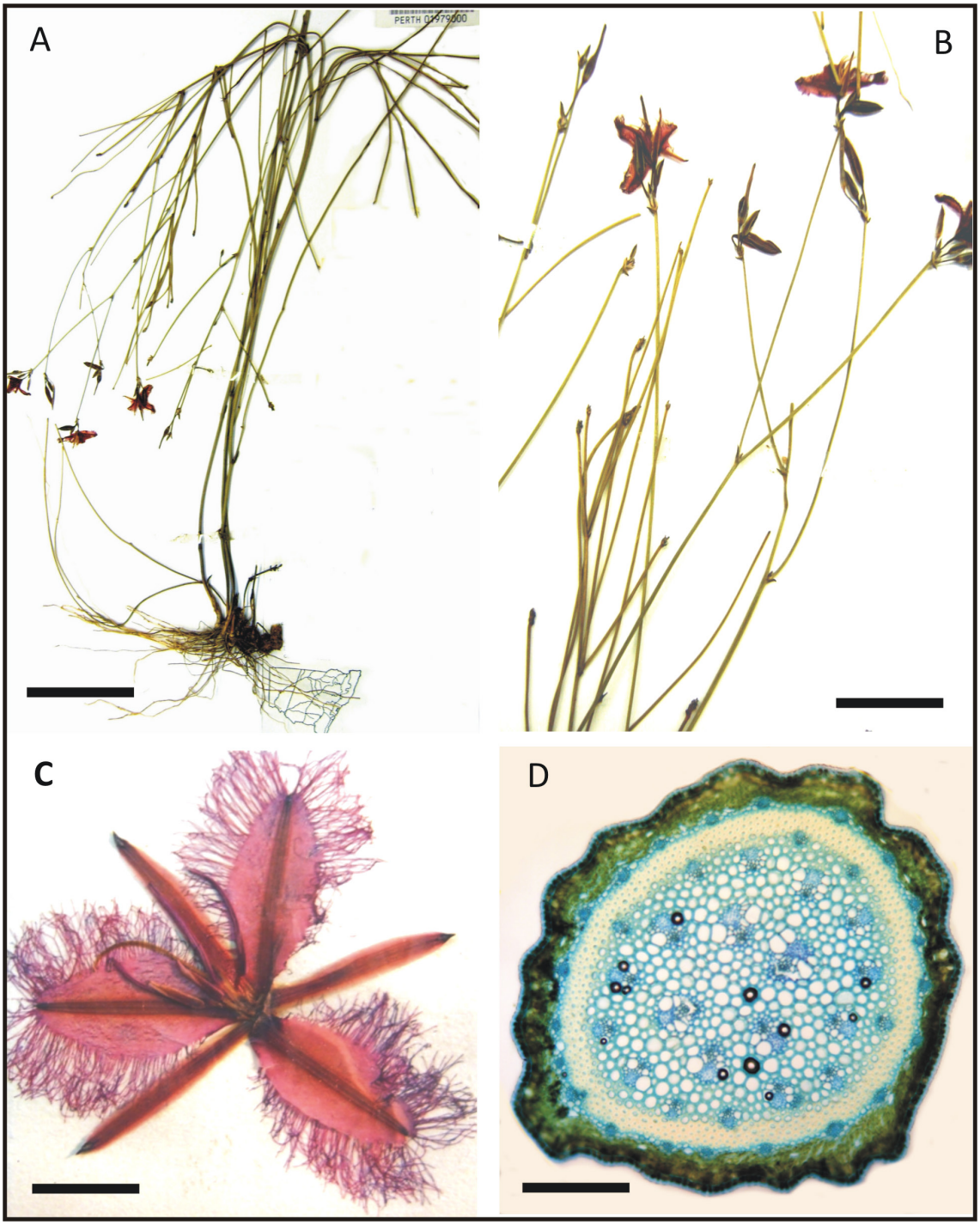

Fig. 2. *T. juncifolius* A. Habit. B. Absence of sessile umbels below the terminal umbel. C. Flower. D. Transverse stem section. (Specimens – A&B. PERTH1979000; C. PERTH3000516; D. *Dalby 94/09*. Scale bars: B = 2 cm; C = 7 mm; D = 500 µm. Photos - Udani M. Sirisena)

Flowering period: October–early November.

Habitat: *Thysanotus juncifolius* grows in very shallow, loamy soils in the Blue Mountains and sandy gravels over Hawkesbury sandstone in New South Wales and on coastal sands in eastern Victoria (Brittan 1981).

Distribution: The distribution is East Gippsland, Victoria and southern and central coastal New South Wales (Fig. 3).

Notes: The species epithet *Thysanotus junceus* R.Br. is here regarded as legitimate, supporting the conclusion of Brittan (1981), contrary to the listing as an illegitimate name in APC (2013) and APNI (2013).

Proposed Conservation status: Currently listed as 'not threatened' under Conservation Codes for NSW and Victoria, and this seems appropriate to the modified circumscription of the species.

Specimens examined: New South Wales: *North Coast:* West of Tilligery creek, *H. van Rees s.n.*, 6 Nov 1979 (MEL620710); Yambulla creek, *N.A. Wakefield s.n.*, 21 Dec 1948 (MEL541193); Bullahdelah, *Anonymous s.n.*, Nov 1923 (MEL2214370); Car park of headland south of Grants Head, *B. Rann 72 and and M. Kennedy*, 19 Oct 1993 (NSW278942); Tomago Sand Beds Tanilba Station No. 16/17. Zone 4. R22, *D.L. McNair 9184*,15 Mar 2002 (NSW712982); Peats Ridge, where Newcastle Expressway is crossed by Gosford water supply pipeline, *D.F. Blaxell 1289*, 6 Mar 1974 (NSW599673);

Central Coast: Port Jackson district, *Robert Brown s.n.*, 1802, (MEL244288–Isolectotype); Lane Cove, *Anon.*, Oct 1910, (MEL2214365); Port Jackson district, *Anon.*, Oct 1897 (AD96021075, AD96028166); Sydney, *J.B. Cleland s.n.* Oct 1897 (AD96021076); Belrose, *R. Coveny 11059 and P. Hind*, 12 Nov 1981 (NSW 599674, PERTH1979000); Princes Highway, c. 1 mile S of Sutherland, *N.H. Brittan 59/105-4*, 29 Dec 1959 (PERTH3000664); Princes Highway, c. 1 mile S of Sutherland, *N.H. Brittan 59/105-2*, 29 Dec 1959 (PERTH3000516); Hornsby, *W.F. Blakely s.n.*, 28 Feb 1995 (NSW50431); Near Sydney, Port Jackson, *E. Betche s.n.*, 30 Sep 1886 (NSW50434); Bundeena Drive, c. 100 m towards Bundeena from Sir Bertram Stevens Drive, *J.M. Dalby 94/09, T.D. Macfarlane and S.W.L. Jacobs*, 24 Nov 1994 (NSW363144, PERTH); Oatley, *J.H. Camfield s.n.*, 30 Nov 2002 (NSW50435); Waterfall, 8 miles (12.9 km) SSW of Sutherland, *R.G. Coveny 3413 and M.H. Zerk*, 4 Dec 1970 (NSW599678); Frenchs Forest, *M. Mills s.n.*, 22 Oct 1939 (NSW599679); Roseville Chase, *H. Salasoo 1296*, 2 Feb 1952 (NSW50437);

South Coast: Heathy flat near 'Pacific City', Jervis Bay, *F.A. Rodway 8929*, 15 Feb 1931 (NSW599681); plains by the east coast, Green Cape, *S. Mossman 210*, 1850 (E, photo seen).

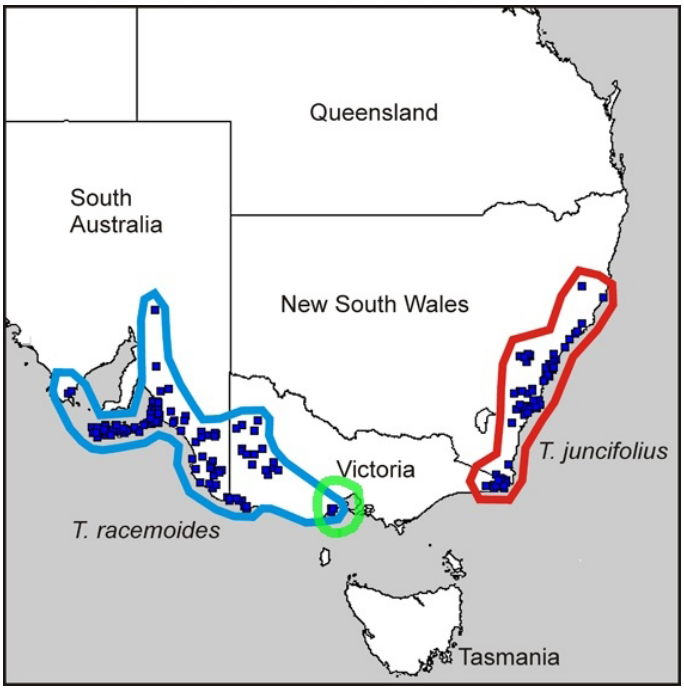

Fig. 3. Distribution of the *Thysanotus juncifolius* complex in south eastern Australia. *Thysanotus racemoides* encircled in blue, with Anglesea population encircled in green; *T. juncifolius* encircled in red.

Central Tablelands: Near Bowens Creek, Mount Wilson-Bilpin, *N.H. Brittan 59/108-1*, 31 Dec 1959 (PERTH3000834); Butlers Swamp, Tourist Road c. 7 km N of Robertson, *T.A. James 1427 and P.G. Kodela*, 9 Jan 1993 (NSW273284); Catherine Hill Bay, Lake Macquarie, *J.W. Dwyer1057*, 31 Jan 2000 (NSW50432); Belrose, *R.G. Coveny 11059 and P.D. Hind*, 12 Nov 1981 (NSW599674); Butler's Swamp, 11.7 km along Tourist Road from Bowral - Robertson Road, *A.N.L. Doust 421*, 19 Jan 1993 (NSW264192);

Victoria: *East Gippsland:* Princes Highway between Mount Drummer and Genoa, *N.H. Brittan59/ 94,* 20 Dec 1959 (PERTH2934728); *Beauglehole 31977* and *E.W. Finck*,22 Nov 1969 (MEL535886); Tobins Creek, *D.L. Jones* 18118 and *B.E. Jones*, 15 Nov 2001 (MEL2283147). Princes Highway, between Mount Drummer and Genoa, between 318 and 319 mile pegs [c. 22 km E of Genoa], *N.H. Brittan 59/94-2*, 20 Dec 1959 (PERTH2934744); Maramingo Creek, Princes Highway, 4 miles [6.4 km] E Genoa (329 mile peg), *N.H. Brittan 59/96*, 20 Dec 1959 (PERTH2934701); Maramingo Creek, Princes Highway, 4 miles [6.4 km] E Genoa (329 mile peg), *N.H. Brittan 59/96-2*, 20 Dec 1959 (PERTH2934736); Mallacoota Inlet National Park, Spotted dog mine area, *A.C. Beauglehole 32469* and *E.W. Finck*, 16 Dec 1968 (MEL535885); Mallacoota Inlet National Park, ½ mi [0.8 km] south of Marshmead property, *A.C. Beauglehole 31602* and *J.H. Willis*, 8 Nov 1969 (MEL535884); Glue Pot Creek, near Genoa, *R. Melville* 2705 and *N. Wakefield*, 7 Jan 1953 (MEL537755, NSW599686); Marramingo Creek, *N.A. Wakefield s.n.*, 19 Dec 1947 (MEL2214345); Lower Reedy Creek, *N.A. Wakefield* 2868, 11 Dec 1948 (MEL541195); Cicada Trail, midway between Mueller and Wingan rivers, *A.C. Beauglehole 31977 and E.W. Finck*, 22 Nov 1969 (MEL535886); at intersection of Stony Peak Road and the Betka River, *R.K. Humphries and G.E. Earl s.n.*, 12 Nov 1989 (MEL119208).

Notes: Morphologically, anatomically and genetically there is a clear distinction between *T. racemoides* and *T. juncifolius* (Sirisena 2010). The presence of subterminal, sessile umbels towards the stem apex has sometimes led South Australian collectors to misidentify *T. racemoides* as *T. baueri* R.Br., as the latter may also possess sessile umbels towards the apex. However, the branched perennial habit, rhizomes and lack of tuberous roots clearly distinguish *T. racemoides* from *T. baueri*.

Thysanotus juncifolius lacks sessile subterminal umbels, which seems to be the most obvious distinguishing character separating it from the new species. Furthermore, the stems of *T. juncifolius* are always ridged and the anthers and perianth segments are shorter than those of the new species (Table 1). Anatomically there are differences in the chlorenchyma of the scape in transverse section (See table below). Molecular and combined data analyses indicate a close relationship between *T. racemoides* and the Western Australian *T. sparteus* R.Br., whereas *T. juncifolius* is distant and instead more closely related to *T. asper* Lindl. and *T. arenarius* Brittan, both also from Western Australia (Sirisena 2010).

Brittan (1981, 1987) reported the occurrence of *T. juncifolius* in south-east Queensland based on. *Mossman 210* which was colelcted from Green Cape, New South Wales (cited above). This record is maintained, in error, in the current census of the Queensland flora (Bostock and Holland 2010, p. 94). The specimen, of which we have seen a scan, has two labels, but they bear the same number; the words 'Moreton Bay', in different ink from the other writing, was presumably added in error. Samuel Mossman's Australian collections that we have found reference to are all from the Green Cape and Twofold Bay area of southern NSW and from Tasmania. There is no evidence of *T. juncifolius* occurring in Queensland.

Table 1. Character comparison of *Thysanotus racemoides* and *T. juncifolius*

Character	***T. racemoides***	***T. juncifolius***
Nodes with 2–3 branches	Common	Rare
Subterminal sessile umbels	Present	Absent
Number of flowers per umbel	Mostly 2 occasionally 3 or 4	1–5
Length of perianth segments (mm)	12–15	Mostly <12
Outer anther length (mm)	2–6	<4.0
Inner anther length (mm)	7–12	6–8
Chlorenchyma shape	Always elongate (Fig. 1)	Mostly irregular (Fig. 3)

Amended key to species of *Thysanotus*

The published *Flora of Australia* key by Brittan (1987) is amended to accommodate *T. racemoides* by inserting a new couplet after couplet 51. Amendments are indicated with asterisks.

48: Stems terete, smooth to ridged

49 Stems strongly ridged, with short, dense, simple or tuberculate hairs

50 Stems with tuberculate hairs; umbels to 8-flowered; perianth segments 7–8 mm long..... ..... **T. brachiatus**

50: Stems with short, dense, simple hairs, at least basally; umbels 1–3 flowered; perianth segments 10–12 mm long..... **T. virgatus**

49: *Stems rounded or slightly ridged, glabrous at least distally

51 *Subterminal umbels absent, all umbels terminal ..... **T. juncifolius**

51: *Subterminal umbels always present below terminal umbels

52 *Subterminal umbels always sessile .....**T. racemoides**

52: *Subterminal umbels pedunculate, rarely sessile.....**T. sparteus**

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