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Three new species and three new records for the *Thelymitra pauciflora* R.Br. (Orchidaceae) complex in Victoria

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Abstract

Three new *Thelymitra* species, *T. asperifolia* R.J.Mitchell, *T. aurorae* R.J.Mitchell and *T. serpentina* R.J.Mitchell, along with three new species records for Victoria, namely *T. batesii* Jeanes, *T. latifolia* R.J.Bates and *T. pallidifructus* R.J.Bates, were identified, collected and described. iNaturalist was employed to approximate their respective distributions and thereby rapidly assess the conservation statuses of this poorly recorded group. A key to the Australian members of the complex is provided.

***Keywords*:** sun-orchid, *Thelymitra* longifolia-complex, taxonomy, citizen science

Introduction

Thelymitra J.R.Forst. & G.Forst is a large genus of more than 110 recognised species, several named hybrids and at least 20 undescribed taxa (Backhouse *et al.* 2019; WFO 2025). They are tuberous, geophytic orchids that occur mostly in temperate regions of Australia, along with 19 species in New Zealand (NZNOG 2025), and a few species in New Caledonia, New Guinea, Indonesia and the Philippines. Their common name of 'sun orchids' reflects their flowering habit: they open when conditions are suitably sunny, warm and humid. They are also unusual among Orchidaceae for having a largely undifferentiated perianth; the labellum is unadorned and typically similar in size and appearance to the other tepals, giving the flower a nearly actinomorphic appearance. Approximately half of the *Thelymitra* species are allied to a large species complex of taxa centred on *T. longifolia* J.R.Forst. & G.Forst, the type species of the genus first described from New Zealand (Jeanes 2004). The members of the complex are characterised by mostly blue/purple perianth segments lacking spots or prominent stripes, a column with a simple, tubular hood – referred to as a post-anther lobe – with two finger-like lateral lobes adorned with hair-like cilia called trichomes (Bates 2010).

Identification of new *Thelymitra* species belonging to the *T. longifolia* complex is an area of ongoing research. In Australia, the complex was divided into two groups, namely the *T. nuda* R.Br. complex comprising larger, melittophilous species that have coherent pollinia and are normally

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scented (revised by Jeanes (2013) into 15 Australian species), and the *T. pauciflora* R.Br. complex, consisting of smaller, autogamous and often cleistogamous species that have incoherent pollinia and are generally unscented (revised by Jeanes (2004) into 23 Australian species). Since then, an additional nine Australian species have been described (Jeanes 2005; Bates 2010, 2019). The molecular phylogeny of *Thelymitra* was recently published in Nauheimer *et al*. (2019) and showed multiple sub-clades with overlap between the *T. nuda* and *T. pauciflora* complexes, confirming the artificial nature of the division. However, these artificial complexes remain important for taxonomic identification, habitat requirements and conservation considerations, as autogamous species are not limited by pollinator availability as compared to melittophilous species.

The six taxa evaluated in this paper belong to the autogamous *Thelymitra pauciflora* complex, which have proved difficult to study due to a lack of high-quality herbarium specimens and the loss or obfuscation of important characteristics during preservation (Jeanes 2004; Bates 2010). Field studies are the most effective method for distinguishing undescribed ('new') species within this complex, however, the *T. pauciflora* complex has proved to be particularly challenging to elucidate due to the many cryptic species that are primarily cleistogamous and which rarely open if at all during the flowering season when conditions are not sufficiently warm and sunny. This is particularly true of early flowering species in cool coastal areas. The success of this study was due in part to the changed public access of a large reserve containing both a high density and diversity of *Thelymitra* species, allowing the examination of large numbers of each species present.

Hybridisation is another critical factor to consider when determining new species within the genus. Allopolyploidism has been shown to be an important mechanism of species formation within *Thelymitra*, particularly when hybrid characteristics are present (Molloy & Dawson 1988; Dawson, Molloy & Beuzenberg 2017; Jones, Lehnebach & Tate 2025). Allopolyploids form by the duplication of the parental genomes after fertilisation, which provides a mechanism to overcome infertility normally observed in F1 (haploid) hybrid crosses caused by factors such as Dobzhansky–Muller incompatibilities and structural inhibition in the nuclear genome (Abbott *et al*. 2013; De Storme & Mason 2014).

Species in this study were defined on the basis of displaying unique characteristics, exhibiting reproductive fertility and not being suspected as having hybrid origins. They displayed consistent form over a relatively large range, having unique traits compared to other taxa, showed evidence of recruitment and were involved in the production of hybrids with other known species. By contrast, the hybrids observed in the field during this study appeared to be infertile, usually appearing as a single cluster of offspring of equal maturity (though hybrids swarm are also possible), tend to be present in a restricted area of only a few square metres, show traits that could be ascribed to parent species and show no signs of recruitment. In instances where a suspected species displays hybrid traits and fertility is difficult to determine, chromosome analysis can determine whether an entity is allopolyploid, as this can help identify new species that would otherwise be overlooked.

In a departure from prior examination of a species' range using only samples present in herbarium collections, the iNaturalist platform was employed to detect and map the range of the new species. Accurate identification of the species within the *Thelymitra pauciflora* complex has previously proved difficult from flower images alone, however, Bates (2010) noted that the lines and pigmentation in the perianth segments were species specific in this autogamous complex. This additional metric was found to allow for accurate differentiation of similar species across their ranges when combined with other key characteristics such as column structure. It should be noted that the use of floral segment lines for identification may not be applicable to outcrossing species of *Thelymitra*, which often display greater genetic diversity. The benefit of this approach is that it provides rapid detection of more common species, allowing for field resources to be conserved and utilised elsewhere. The downside is that iNaturalist observations have a strong bias to more frequented areas and species that are easily observable (Mesaglio & Callaghan 2021).

Key to members of the *Thelymitra pauciflora* complex of Australia

1 Post-anther lobe with a glaucous or glistening bloom 2

1: Post-anther lobe without any bloom 5

2(1) Post-anther lobe narrow at base and widening toward top; trichomes on the lateral lobes sparse, often connate at the base, 0.05–0.1 mm wide, bright yellow, strongly embracing the post-anther lobe 3

2: Post-anther lobe widest near the middle and narrowing only slightly above and below; trichomes on the lateral lobes dense, not connate at the base <0.05 mm wide, pale or creamy yellow, not embracing the post-anther lobe 4

3(2) Plants usually 12–30 cm tall; flowers usually 3–6, perianth segments >10 mm long, ovate-lanceolate; post-anther lobe with much sparkling bloom, the two apical halves <1 mm apart at their widest; trichomes of the lateral lobes adpressed outside the post-anther lobe, not inserted into the orifice and often exceeding it in height; predominantly SW Australia ..... ***T. mucida*** Fitzg.

3: Plants always <12 cm tall; flower usually solitary, sometimes two; perianth segments <10 mm long, shortly ovate; post-anther lobe with a sparse silvery bloom, the two apical halves >1 mm apart at their widest; trichomes of the lateral lobes at least partly inserted into the orifice of the post-anther lobe and not exceeding it in height; SA, Vic ..... ***T. orientalis*** R.J.Bates

4(2) Post-anther lobe very inflated, brown grading into yellow at the apex, covered in a thick, waxy bloom, deeply bilobed, the lobes 1.5–2.5 mm long, c. 1 mm wide; trichomes on the lateral lobes 1.2–1.6 mm long, usually cream or yellow; plants from dry to moist woodland habitats; flowering season late Sep. to early Nov.; predominantly SA (Southern Lofty region), Vic ..... ***T. inflata*** Jeanes

4: Post-anther lobe somewhat inflated, mostly black with a yellow apex, with a thin, sparkling bloom, bilobed, the lobes 1.2–1.6 mm long, c. 0.6 mm wide; trichomes on the lateral lobes 1–1.2 mm long, usually white, sometimes cream; plants from swampy habitats, often standing in water at anthesis; flowering season mid-Oct. to mid-Dec.; SA, Vic ..... ***T. lucida*** Jeanes

5(1) Trichomes on the lateral lobes usually cream or yellow, proximal trichomes often red, at least basally 6

5: Trichomes on the lateral lobes usually white, rarely pink to mauve, proximal trichomes not red 8

6(5) Post-anther lobe very inflated, mostly brown grading into yellow at the apex, deeply bilobed, the lobes ± parallel, 1.5–2.5 mm long; SA, Vic, Tas ..... ***T inflata*** Jeanes

6: Post-anther lobe semi-inflated, mostly black with a distinct yellow apex, bilobed, the lobes usually diverging, 0.8–1.5 mm long 7

7(6) Perianth segments usually 8–11 mm long; trichomes on the lateral lobes 1.2–1.8 mm long, rather sparse and of an untidy appearance; flowering season mostly Nov. and Dec.; SE Australia ..... ***T. holmesii*** Nicholls

7: Perianth segments usually 12–15 mm long; trichomes on the lateral lobes 1–1.5 mm long, very dense and of a neat appearance; flowering season mostly late Sep. and Oct.; SW Australia ..... ***T. xanthotricha*** Jeanes

8(5) Post-anther lobe more or less erect, not curved forward; plant usually < 14 cm tall; flowers 1–3; lower sterile bract entire or deeply bifid; rock outcrops in WA ..... ***T. frenchii*** Jeanes

8: Post-anther lobe curved forward for up to 90º; plant usually >14 cm tall; flowers often >3; lower sterile bract entire 9

9(8) Post-anther lobe semi-cylindric, widely open on the ventral side; sterile bracts 3–4, lower ones often leaf-like; E Australia ..... ***T. planicola*** Jeanes

9: Post-anther lobe not semi-cylindric, sterile bracts usually 1–3, none of them leaf –like 10

10(9) Leaf lanceolate, usually less than half height of inflorescence (often much less than half), blade more or less flat, thin-textured, often with red margins, veins and suffusions, even wholly red; post-anther lobe often deeply and irregularly slit at the apex, usually red, orange-red or red-brown; SE Australia ..... ***T. brevifolia*** Jeanes

10: Leaf linear to linear-lanceolate, usually greater than half the height of the inflorescence, often fleshy and canaliculate; post-anther lobe often notched, but not irregularly slit, usually brown to black with a yellow apex 11

11(10) Post-anther lobe strongly compressed dorsally in the distal half; apical orifice small; trichomes purple or white 12

11: Post-anther lobe not strongly compressed; trichomes white, pink or cream 13

12(11) Post-anther lobe mostly glossy black; trichomes white; sterile bracts usually two, flowers pale blue; Vic, S NSW ..... ***T. atronitida*** Jeanes

12: Post-anther lobe reddish-brown; trichomes usually purple or mauve, rarely white; sterile bracts usually 3; flowers slate-blue to purple; E and SE Australia, New Zealand ..... ***T. malvina*** M.A.Clem., D.L.Jones & Molloy

13(11) Lateral lobes not glabrous at the base, with trichomes extending more or less along their entire length in a toothbrush-like arrangement 14

13: Lateral lobes glabrous in at least the basal quarter to half, with trichomes in a more or less, terminal mop or fan-like arrangement 23

14(13) Perianth segments often >12 mm long; mature plants tall and stout; flowers > 8, (at least on many plants) 15

14: Perianth segments rarely >12 mm long; mature plants rather small and slender; flowers rarely more than 8 even on mature plants 18

15(14) Post-anther lobe deeply notched, black with a yellow apex; flowers white or very pale blue; sterile bract usually solitary; near-coastal Vic. only ..... ***T. pallidiflora*** Jeanes

15: Post-anther lobe emarginate, red-brown with a yellow apex; flowers usually blue to purple; sterile bracts usually two 16

16(15) Lower pedicels often partially decurrent on rachis; sepals mostly green on exterior surface; base of upper sterile bract often only half encircling the scape; sterile bracts to 15 cm long; flowers normally pale blue with thick stripes in lateral sepals, mostly in SA, rare in Vic and Tas ..... ***T. bracteata*** J.Z.Weber ex Jeanes

16: Pedicels never decurrent on rhachis; sepals mostly purplish on exterior surface; sterile bracts to 10 cm, upper sterile bract usually scape encircling, to 5 cm long; flowers mostly mauve to purple with fine lines in the perianth segments 17

17(16) Mature plants 45–80 cm tall, often forming clumps by vegetative reproduction, 1–2 sterile bracts, Lower bract longer, to 10 cm, fertile bracts just covering pedicels, long narrow ovaries to 20 mm, flowers normally purple with blue streaks and 9 fine lines in the petals, post-anther lobe tubular, not inflated, trichomes tufts close together, often compressed into single brush; Vic, SA?... **3. *T. serpentina***

17: Mature plants <45 cm tall, not clumping, sterile bracts similar length, fertile bracts often covering base of ovary, medium length ovaries to 12 mm, Flowers mauve with faint lines, 3 fine lines prominent in lateral sepals, post-anther lobe inflated, trichomes tufts well separated, SE Australia ..... ***T. arenaria*** Lindl.

18(14) Post-anther lobe narrowest at the base and broadest toward the apex, deeply notched; SW Australia ..... ***T. vulgaris*** Jeanes
18: Post-anther lobe and location not as above 19
19(18) Post-anther tubular, orange to light brown, Flower pale blue or lilac, 10–22 mm across, clumping, to 30 cm tall. SA .... ***T. tubulina*** R.J.Bates
19: Post-anther lobe not tubular, usually slightly inflated, broadest near the middle, narrowing only slightly above and below, emarginate to shallowly notched; south-eastern Australia 20
20(19) Plants short and stout, often forming clumps by vegetative reproduction; leaf nearly as long as, or longer than inflorescence; lowest fertile bract often with proximal margins connate 21
20: Plants slender, not clump-forming; usually; leaf much shorter than inflorescence; fertile bracts with margins entirely free, SA 22
21(20) Leaf very thick, fleshy, brittle and at least as long as inflorescence; S Vic ..... ***T. basaltica*** Jeanes
21: Leaf moderately fleshy, flexible and shorter than inflorescence; SE Australia ..... ***T. exigua*** Jeanes
22(20) Flowers 1–10, usually white; post-anther lobe reddish brown with a yellow apex; trichomes in elongate tufts; SA ..... ***T. albiflora*** Jeanes
22: Flowers 1–5, usually blue; post-anther lobe entirely dark blue to magenta; trichomes in sub-globose tufts; SA ..... ***T. cyanapicata*** Jeanes
23(13) Leaf blade flat, scape emerging at soil level; flowers lilac; post-anther lobe not inflated; SA, Vic ..... ***5. T. latifolia*** R.J.Bates
23: Leaf blade at least partly channelled, often fleshy; scape usually emerging well above soil level; flowers blue; post-anther lobe inflated 24
24(23) Perianth segments reflexing strongly back toward the ovary at temperatures above 25º; post-anther lobe black to greenish-black throughout; coastal Vic ..... ***T. reflexa*** Jeanes
24: Perianth segments not or hardly reflexing; post-anther lobe never wholly black or greenish-black 25
25(24) Perianth segments whitish, often with tiny blue dots, plant short with narrow V-shaped leaf and 2 sterile bracts, post-anther lobe deeply cleft with auxiliary lobes that project forwards, trichomes basally pink with white apex, arranged in terminal fan, Vic ..... ***2. T. aurorae***
25 Perianth segments normally pigmented, trichomes not basally pink 26
26(25) Leaf 3/4 of the height of the inflorescence or longer 27
26: Leaf less than 3/4 of the height of the inflorescence 28
27(26) ..... Plant with an overall pale greenish appearance; leaf fleshy; sterile bracts usually two; post-anther lobe shallowly notched at the apex; flowering season late Oct. to early Dec.; near-coastal Tas. ..... ***T. viridis*** Jeanes
27: Plant without an overall pale greenish appearance; leaf thin-textured; sterile bracts usually 3; post-anther lobe usually deeply bilobed at apex; flowering season June to Oct.; Qld, N NSW ..... ***T. angustifolia*** Jeanes
28(26) Flowers with some degree of outcrossing, perianth segments > 12 mm long; trichomes of lateral lobes often with cream to pale yellow apices; grassy woodland plants usually growing in vernal pools; SA (Southern Lofty region) ..... ***T. hygrophila*** R.J.Bates
28: Flowers hardly outcrossing, perianth segments <12 mm long; trichomes of lateral lobes always white; woodland or heath-land plants rarely growing in vernal pools 29
29(28) Flowers fragrant, exterior surface of the buds and sepals slate grey; post-anther lobe black; SA ..... ***T. odora*** R.J.Bates
29: Flowers not fragrant, exterior surface of the buds and sepals not slate-grey; post-anther lobe not black 30
30(29) Scape, bracts and sometimes ovary red to deep purple-red; trichomes on lateral lobes in elongate tufts, flowers small, 9–12 mm across 31
30: Scape, bracts and ovary not red to deep purple-red with small flowers, trichomes on lateral lobes in sub-globose or fan-like tufts 32
31(30) Post-anther lobe hardly crenulate in its apical portion, the apex with a cleft > 1 mm deep, the orifice >0.5 mm across; trichomes of the lateral lobes not obscuring the orifice of the post-anther lobe; SA (southeast, only N of Mt Gambier) ..... ***T. rubricaulis*** R.J.Bates
31: Post-anther lobe distinctly crenulate in its apical portion, the apex with a cleft < 1 mm deep, the orifice < 0.5 mm across; trichomes of the lateral lobes usually at least partly obscuring the orifice of the post-anther lobe; SA (southeast) ..... ***T. crenulata*** R.J.Bates
32(30) Leaf finely abrasive, V-shaped cross-section, often with red margins to 12 mm wide, scape and sterile bract normally deep red, rarely green, post-anther lobe narrow at base, expanding towards apex with v-notch and large apical overhang, trichome tufts in fan like arrangement, often diverging, flowers 17–20 mm across. Vic, possibly SA, Tas. and NSW ..... ***1. T. asperifolia***
32: Leaf scabrous or smooth, lacking red margin. Post-anther lobe not expanding towards apex from narrow base, trichomes on lateral lobes in sub-globose tufts 33
33(32) Leaf narrow, typically terete, usually <0.5 mm wide, scape slender, perianth segments narrow with minimal overlap and fine lines, post-anther lobe not inflated, entire to emarginate, lateral lobes bending sharply upwards 34
33: Leaf with V-shaped to flat cross section usually >0.5 mm wide, scape slender to robust, perianth segments relatively broad with moderate overlap, often vibrant colouration with thick diffuse lines, post-anther lobe bifid, deeply cleft, with large apical overhang, lateral lobes projecting forwards with gentle upwards curve 35
34(33) Single sterile bract; ovary very pale, yellow-green; exterior surface of sepals lilac with pale edges; post-anther lobe margin often crenulate or dentate, with moderate apical overhang, late flowering typically mid Oct. to Nov. SA, southern Vic ..... ***6. T. pallidifructus*** R.J.Bates
34: Sterile bracts 1–3, ovary dull green, exterior surface of sepals dull green to brownish, post-anther lobe margin entire or emarginate with small apical overhang, sometimes with small axillary lobes present as incurved spurs, early flowering, late Sept. to mid Oct. in Vic and SA. SE Australia ..... ***T. pauciflora*** R.Br.
35(33) Plants of dry hills; leaf usually <10 mm wide; mature flower buds inflated, about 10 mm in diameter, subacute at apex; exterior of sepals pink with darker striations; post-anther lobe very deeply cleft, maroon with yellow apex, orifice often widely gaping, the two apical halves often compressed, SA, Vic ..... ***4. T. batesii*** Jeanes
35: Plants of various habitats include damp areas; leaf usually >10 mm wide; mature flower buds not inflated, <8 mm in diameter, acute at apex; exterior of sepals ranging from brown to grey and pale-edged; post-anther lobe orifice hardly gaping, the two apical halves not compressed; widespread in SE Australia ..... ***T. peniculata*** Jeanes

Methods

Taxonomic identification and collection

Five *Thelymitra* species were identified during *in situ* field studies of populations at various locations across the Mornington Peninsula over a five-year period (2020–2024). Flowering season typically ranged from mid-September to mid-November. Flower images were captured by the author using a Pentax K3 DSLR with a Pentax D FA 100mm f2.8 Macro WR lens. Flash was usually employed to maximise detail and minimise shading. Collection of voucher specimens occurred in 2022 and 2024. Collected materials comprised all above-ground parts of the plants and were both pressed and preserved in 70% ethanol. In the case of newly described taxa, a single specimen for each taxon was collected for use as the holotype with some material sampled and vouchered separately for DNA analysis. DNA samples were taken from a section of excised leaf, the sample being sliced into small sections and placed in silica gel, and the remaining specimen then preserved as a spirit collection. iNaturalist entries were also made by the author for the selected plants (including the holotype specimens). Additional plants were collected as isotypes to be preserved as sheet specimens. Selected materials held at MEL (herbarium acronyms follow Thiers 2025+) was also examined, with a Victorian specimen of *T. latifolia* identified along with some additional specimens of the new species described here. The *in situ* images of *T. latifolia* were provided by Russell Stanley from plants photographed in the Chetwynd area in western Victoria.

Estimation of species extent and conservation status

Thelymitra observations available on the iNaturalist platform were individually inspected by the author to determine the range extents of the six taxa addressed in this paper. This effort also provided an opportunity for the identification of new populations of other vulnerable *Thelymitra* species. The search primarily involved observations made in Victoria, South Australia, New South Wales and Tasmania. From the data obtained from iNaturalist and field observations, a preliminary estimate of each species' threatened status was made using the IUCN Red List 3.1 criteria (2012).

New species of Victorian *Thelymitra*

1. *Thelymitra asperifolia* R.J.Mitchell, *sp. nov.* (Figs. 1a, 2a-c)

Type: **Australia.** Victoria, Frankston Nature Conservation Reserve, throughout fire break beside Boundary West Track, 15 Oct 2024, *R.J. Mitchell 4* (holotype, MEL 2549820A, iNaturalist observ. *robert1534 247421359*), *R.J. Mitchell 8* (isotype, MEL 2549829A).

***Differential diagnosis*:** *Thelymitra asperifolia* is distinguished from the morphologically similar *T. pauciflora* R.Br. by (contrasting characters in parentheses) its more broad, V-shaped leaf 3–12 mm wide (narrow, terete leaf 3–6 mm wide), robust scape 1.5–3 mm wide (slender scape 0.5–1.5 mm wide) bearing 1–9 flowers, (1–3(–5) flowers) that open freely at mild temperatures above 19 °C (open tardily above 23 °C), the post-anther lobe expanded towards the apex when viewed from above, with an emarginate to deep V-shaped notched apex (post-anther lobe tubular, apex entire to emarginate), with large post-anther lobe extension 1–1.5 mm long (short post-anther lobe extension 0.4–0.7 mm long) and lateral lobes that curve gently upwards and terminate in a fan-shaped arrangement of trichomes (lateral lobes bend sharply 90° in middle and terminate in a mop-like arrangement of trichomes).

Glabrous terrestrial herb. *Tubers* not seen. *Leaf* linear to linear-lanceolate, 15–25 cm long, 3–12 mm wide, erect, fleshy, with finely scabrous texture like emery board, V-shaped in cross section, sheathing the scape for 1–6 cm, abaxial ribbing at base, emergent leaf maroon, usually with red leaf margins and suffused red base at flowering, sometimes all green, apex acute to aristate. *Scape* 20–50 cm tall, 1.5–3 mm wide, straight with slight kink at sterile bract, usually red to reddish brown, covered with fine powdery bloom. *Sterile bract* usually 1, rarely 2, 3.5–6 cm long, closely sheathing until the apex that becomes separated from kinked scape, red to maroon, covered in powdery bloom, apex acute. *Fertile bracts* 4–20 mm long, 2.5–5 mm wide, sub-terminal bracts often gaping at flowering due to floral rotation, red to maroon, subtly ribbed, covered in powdery bloom, apex acute to acuminate and incurved. *Pedicels* 3–8 mm long, relatively short, mostly enclosed by sterile bract. *Ovary* 5–15 mm long, 2.5–4 mm wide,

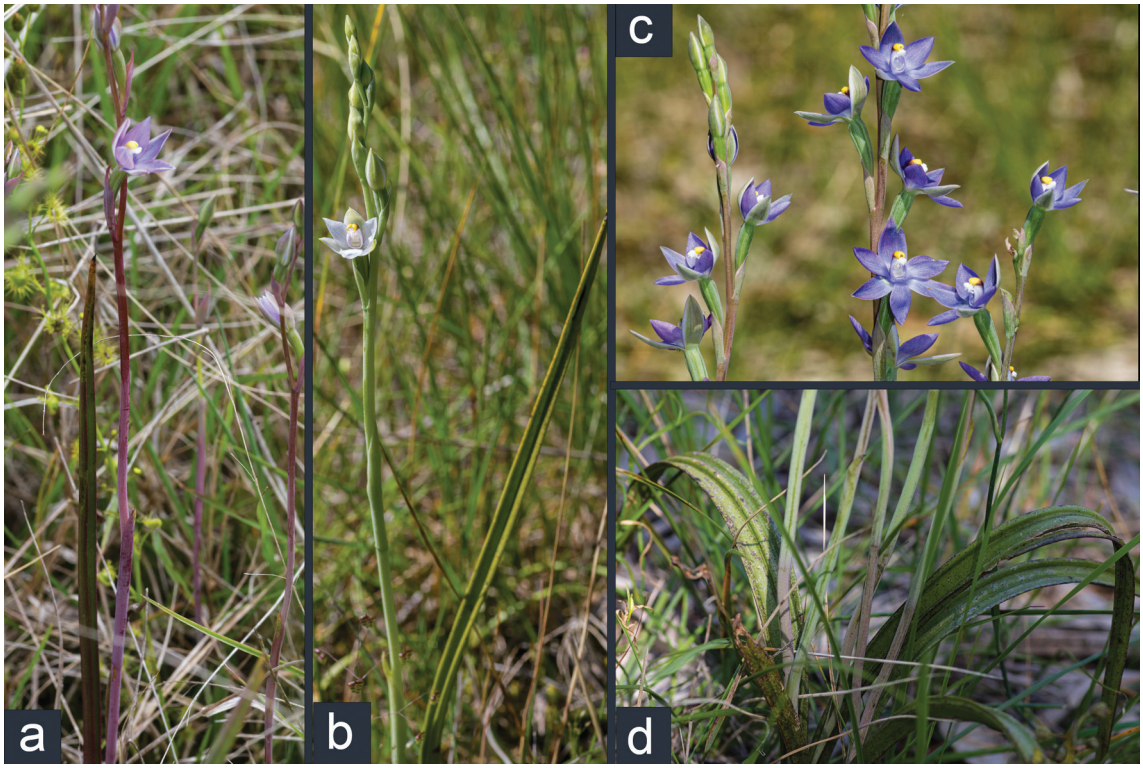

Figure 1. Habit and leaf characteristics of the new species. **a.** *Thelymitra asperifolia*; **b.** *T. aurorae*; **c, d.** *T. serpentina*.

narrow-obovoid, olive green, ribbed, covered in fine powdery bloom. *Flower buds* narrow-ovate, apex acute, olive-green grading to reddish-brown with darker lines, segment edges white. *Flowers* 2–9, 16–20 mm across, light purplish blue to purple with bluish streaks, opening in sequence on warm days above 19 °C, while other *T. pauciflora* complex species remain closed, sub-terminal flowers rotated at opening, often giving the inflorescence a contorted appearance. *Perianth segments* linear-lanceolate to ovate-lanceolate, 8–12 mm long, 2.5–5 mm wide. apex acute to acuminate and sometime aristate. *Dorsal sepal* ovate-lanceolate, wider than other segments, with an alternating pattern of dark and faint fine lines, *Lateral sepals* linear-lanceolate, with an irregular pattern of faint and dark lines, central line often faint/absent, producing a pale central stripe. *Petals* ovate with c.11 fine lines. *Labellum* linear-lanceolate, narrow, with c. 9 fine lines. *Column* erect from the end of the ovary, 5–6 mm long, 2.5–3.0 mm wide, whitish with pale blue spots/lines, often with narrow blue stripe at post-anther lobe junction; *post-anther lobe* 2.2–3 mm long, 1.5–2 mm wide, bending sharply at 90° from the top of the column, hooding the anther, tubular, open on ventral side, narrow at base and expanding towards the apex, fishtail shaped from above, apex emarginate to deeply V-notched/bifid, sometimes crenulate, or dentate on ventral margin; *post-anther lobe extension*, 1–1.5 mm long, up to 50 % of the length of the post-anther lobe; *auxiliary lobes* absent or two small flaps below the post-anther lob; *lateral lobes* converging, 0.7–1.2 mm long, dactyliform, porrect at base, curving gently upwards at c. 45°, each with a sub-terminal fan-like tuft of white trichomes, often diverging, sitting below the apex of the post-anther lobe, the individual trichomes 0.8–1.2 mm long. *Anther* inserted above centre of the column, ovoid, 2–2.5 mm long, 1.5–2.0 mm wide, the connective produced into an apical beak. *Pollinarium* 1.5–2.2 mm long. *Viscidium* more or less circular, c. 0.5 mm diam. *Pollinia* mealy, friable, white. *Stigma* situated at base of column, ovate-quadrate, 1.7–2.2 mm long, 1.7–2.2 mm wide, margins irregular. *Capsules* obovoid, 10–15 mm long, 3–7 mm wide, erect, ribbed.

***Specimens examined*: VICTORIA.** Frankston Nature Conservation Reserve, fire break beside Boundary West Track,

19 Oct. 2022, *V. Stajsic, 10347, D.J. Ohlsen, R.J. Mitchell* (MEL 2555003A).

***Select iNaturalist observations*: VICTORIA:** Heywood**,** 20 Oct. 2023, *lorrainecphelan 189748281*; Dergholm, 20 Oct. 2022, *jessica_sambell 171526076*; Ledcourt, 22 Oct. 2022 *mrwhitehead 139734199*; Tyaak 10 Oct. 2024, *jeni38 246573427*; Anglesea, 11 Oct. 2023, *light-up-gold 187101912*; Mt Bruno, 11 Oct. 2024, *reiner 250772347*; Panton Hill 2 Oct. 2023 *skyecielitaflor 185864838*; Langwarrin FFR, 11 Oct. 2008, *reiner 7034677*; Blind Bight, 25 Sept. 2023, *ladydawn 185125335*; Wonthaggi, 11 Oct. 2023, *bushbandit 187871879*; Wilsons Promontory, 17 Oct. 2024, *johnmifsud 249753681*. **SOUTH AUSTRALIA:** Nangwarry, Sept. 2023 *ky_the_orchid_guy 186127523*. **NEW SOUTH WALES:** Bega Valley, 7 Oct. 2024 *muddy77 246260972*. **TASMANIA:** Rocky Cape, 20 Oct. 2024, *tassietravelsblog 248203952 & 248204040*.

Distribution and habitat: Victoria, South Australia, New South Wales and Tasmania. Grows in variety of habitats including grasslands, heathland and woodlands on various soil types, often in firebreaks and disturbed habitats. Appears to be more common across the coastal plains of Victoria from Wilsons Promontory to the border region of South Australia. Also with observations in S.E.

Figure 2. Flower and column comparison. *Thelymitra asperifolia* **a.** Front, **b.** Side, **c.** Top; *T. pauciflora* **d.** Front, **e.** Side, **f.** Top; *T. pallidifructus* typical form **g.** Front, **h.** Side; *T. pallidifructus* tubular form **i.** side.

New South Wales and N.W. Tasmania. Yet to be formally identified among collections of the relevant herbaria outside Victoria or to have local conservation status assessed.

***Conservation status*:** Widespread, abundant and well conserved, assessed as least concern (LC). The species has been observed by the author at many reserves across the Mornington Peninsula in large numbers, with population at the type locality likely numbering in the thousands.

***Flowering period*:** Late September to October.

***Pollination biology*:** This species is facultatively autogamous and sometimes also cleistogamous.

***Distinguishing features and notes*:** *Thelymitra asperifolia* is a species that was previously overlooked as smaller plants could be easily confused with the similar looking *T. pauciflora*. *Thelymitra asperifolia* was initially identified on the basis of its robust size and, unusual V-shaped fleshy leaf with red margins (plants lacking this red colouration do occur) and a finely scabrous surface with the texture of fine emery board. The leaf is up to 25 cm long and 12 mm wide. The scape is moderately robust, 20–50 cm tall, 1.5–3 mm wide, with a single sterile bract that is associated with a slight kink in the scape resulting in the apex of the sterile bract being detached. The large fertile bracts are up to 20 mm long, with reddish colouration and noticeably gape at flowering. It has up to 9 flowers that are 17–20 mm across with variable colouration, from pale blue to vibrant purple-blue, an increased degree of red pigmentation in the leaves correlating with more purple flower colouration. The tubular post-anther lobe expands towards the apex from the narrow base, the apex notched, giving it a distinctive "fish tail" appearance when viewed from above. It has a large post-anther lobe extension 1–1.5 mm long and the lateral lobes are short, gently curving, glabrous at the base, with two fan-like, terminal tufts of trichomes underneath the post-anther lobe that often diverge. The flowers open widely at moderately warm temperatures above 19 °C, lower than for most other early flowering members of the complex.

In contrast, *Thelymitra pauciflora* is a slender species with fewer flowers. The leaf is usually narrow, rarely exceeding 6 mm wide, semi-canaliculate and terete, with a smooth to tuberculate texture and lacking red margins. The scape is slender, 0.5–1.5 mm wide, with 1–2–(3) closely sheathing sterile bracts. It typically has 1–3(–5) flowers that are slightly smaller, 15–17 mm across, normally with a purplish-blue colouration. The post-anther lobe is relatively short and tubular and does not expand towards the apex when viewed from above, with a short post-anther extension, 0.4–0.7 mm long. The lateral lobes are proportionally longer, with a 90° upwards bend in the middle, with a dense, terminal, mop-like arrangement of trichomes that brush the ventral side of the post-anther lobe apex. The flowers open tardily above 23 °C and are typically found in more sheltered habitats such as native forest. Figure 2 shows a comparison between the flowers of these two species. *Thelymitra crenulata* and *T. rubricaulis* could also be confused with *T. asperifolia* due to similarity in scape and bract colouration, however, these two species are less robust with small flowers to 12 mm across. *Thelymitra asperifolia* has been observed to form hybrids with *T. ixioides*, *T. pauciflora*, *T. serpentina* and *T. pallidifructus*.

Etymology: Latin: *aspera* (rough, harsh) + *folium* (leaf); the leaf has an abrasive texture similar to that of fine emery board.

2. *Thelymitra aurorae* R.J.Mitchell, *sp. nov.* (Figs. 1b, 3a-c)

Type: **Australia.** Victoria, Mornington Peninsula (location obscured for conservation purposes), 15 Oct. 2024, *R.J. Mitchell 2* (holotype, MEL 2549821A, iNaturalist observ. *robert1534 247417927*), *R.J. Mitchell 3* (isotype, MEL 2549828A).

***Differential diagnosis*:** *Thelymitra aurorae* is distinguished from the morphologically similar *T. peniculata* Jeanes by (contrasting characters in parentheses) its early flowering period of late September to mid-October (mid-October to mid-December), small leaf 10–20 cm long, 3–8 mm wide (14–25(–44) cm long, 5–12(–20) mm wide), short scape 10–25(–30) cm tall (scape 20–50(–66) cm tall), small flowers 10–14 mm across (14–22 mm across), post-anther lobe deeply bifid for 2/3 of its length, with a cuboid shape (post-anther shallowly bifid for 1/3 of its length, with a bulbous shape), prominent auxiliary lobes that project forwards from the post-anther lobe apex (small auxiliary lobes that project downward from the ventral surface of the post-anther lobe) and basally pink trichomes that project upwards from the ventral surface of the terminal half of the lateral

lobe (white trichomes that project forwards from all surfaces of the terminal half of the lateral lobe).

Glabrous terrestrial *herb*. *Tubers* not seen. *Leaf* linear, fleshy, deeply V-shaped in cross section, 10–20 cm long, 3–8 mm wide, sheathing the scape for 2–4 cm, abaxially ribbed, light green throughout, erect at base, curving gently away from scape, apex acute. *Scape* 10–25(–30) cm tall, 1.5–2.5 mm wide, straight, pale green with a fine powdery bloom. *Sterile bracts* two, 2–6 cm long, closely sheathing, pale green with a powdery bloom, apex acute to aristate. *Fertile bracts* 5–17 mm long, 2.5–4.5 mm wide, pale green, apex narrow-acuminate. *Pedicels* 2.5–9 mm long. *Ovary* 6–12 mm long, 2.5–3.5 mm wide, obovoid, green, ribbed, covered in a fine powdery bloom. *Flower buds* ovate with acute apex, yellowish green with white segment edges. *Flowers* 1–8, 10–14 mm across, white, with yellow–white sepals, often with tiny blue dots concentrated near segment margins. *Perianth segments* linear-lanceolate to ovate-lanceolate, 6–10 mm long, 3–4.5 mm wide, apex acute to acuminate. *Dorsal sepal* ovate-lanceolate, rising only slightly higher than the

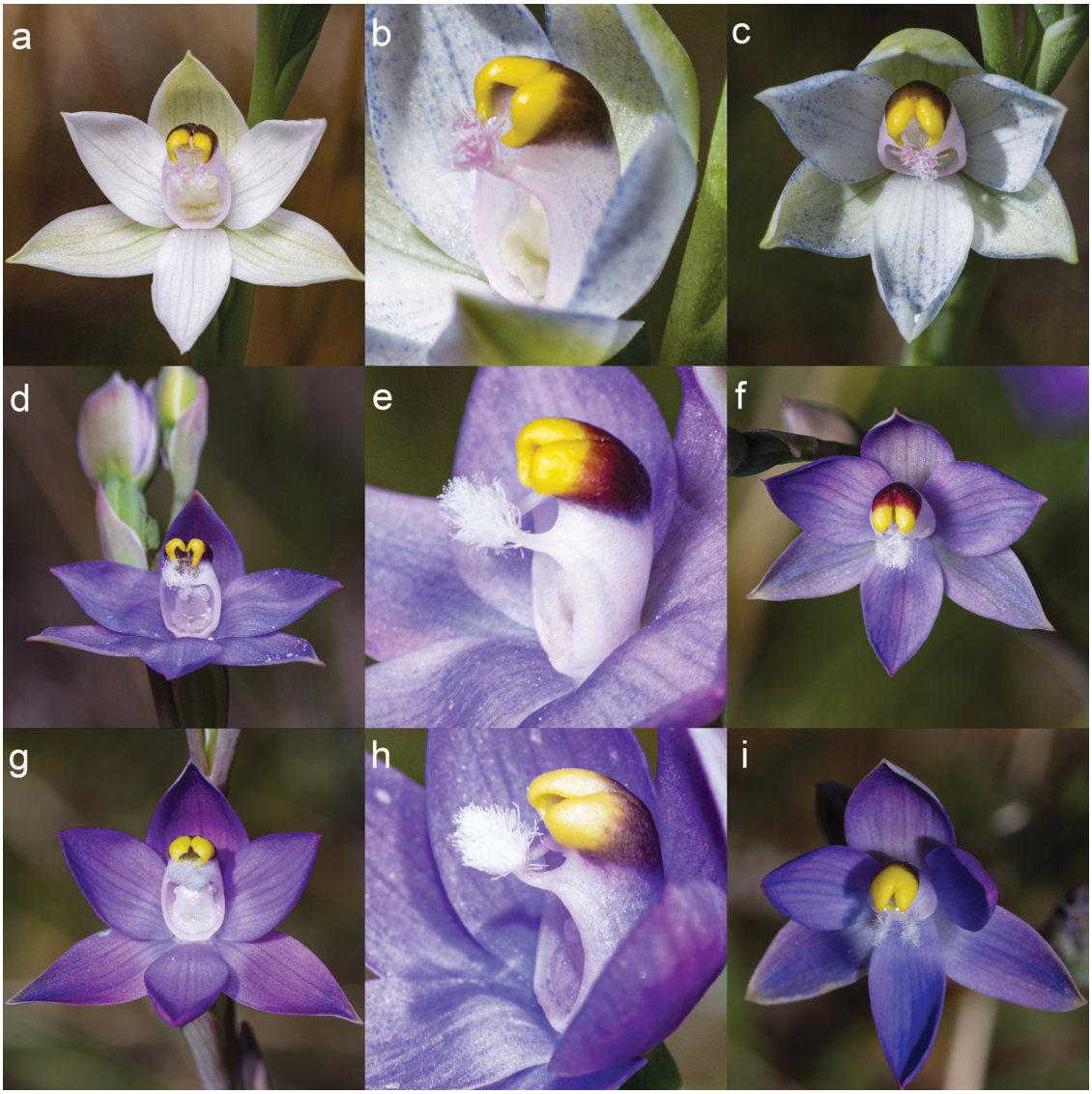

Figure 3. Flower and column comparison. *Thelymitra aurorae* **a.** Front, **b.** Side, **c.** Top; *T. batesii* **d.** Front, **e.** Side, **f.** Top; *T. peniculata* **g.** Front, **h.** Side, **i.** Top;

column. *Lateral sepals* lanceolate, asymmetrical. *Petals* lanceolate, asymmetrical. *Labellum* linear-lanceolate, narrower than other segment, with c. 9 fine lines. *Column* erect from the end of the ovary, 4.5–5.5 mm long, 2–2.5 mm wide, pinkish-white with faint blue spots/lines; *post-anther lobe* 2.5–3 mm long, 1.5–2 mm wide, curving gently from the top of the column, mostly hooding the anther, open on ventral side, deeply bifid for two-thirds of its length, with a somewhat rectangular appearance, mostly brown with a yellow apex; *auxiliary lobes* present as inward- and forward-curving horn-like projections on the ventral apex of the post-anther lobe; *lateral lobes* projecting forwards, 1–1.3 mm long, dactyliform, basally glabrous for half their length, curving gently upwards, each with a sub-terminal fan-like tuft of trichomes that are basally pink, grading to white in the apical half, the individual trichomes 1.0–1.4 mm long. *Anther* inserted above the centre of the column, ovoid, 2–2.8 mm long, 1.5–2.0 mm wide, the connective produced into an apical beak. *Pollinarium* 1.6–2.3 mm long. *Viscidium* more or less circular, c. 0.5 mm diam. *Pollinia* mealy, friable, white. *Stigma* situated at the base of the column, ovate-quadrate, 1.7–2.2 mm long, 1.5–2.0 mm wide, margins irregular. *Capsules* obovoid, 10–13 mm long, 5–7 mm wide, erect, ribbed.

***Specimens examined*: VICTORIA.** Mornington Peninsula (precise location obscured for conservation purposes), 19 Oct. 2022, *V, Stajsic 10340, D.J. Ohlsen, R.J. Mitchell* (MEL 2554997A).

Distribution and habitat: Victoria, currently known from a single population of approximately 200 plants growing beside a weedy road verge adjacent to an artificial drainage channel. The population is restricted to mossy areas where grasses have been somewhat suppressed. Distribution map not shown.

***Conservation status*:** Assessed as critically endangered (CR) per IUCN Red list version 3.1 criteria, under categories B1a,c(iii), B2a,c(iii), C2a(ii). This species is known from a single population in a reserve and is restricted to an area of less than 1 hectare. The site is degraded from both invasive grasses and incursion by *Disa bracteata* Sw. and has been damaged by earth moving equipment used to conduct maintenance in the recent past. The taxon's apparent reliance on mossy soil also makes it susceptible to climate change which, in this region, currently tends towards unfavourable for moss coverage.

***Flowering period*:** Late September to mid-October

***Pollination biology*:** This species is facultatively autogamous and usually also cleistogamous.

***Distinguishing features and notes*:** *Thelymitra aurorae* is a small early flowering cryptic species with small, distinctive white flowers that have basally pink trichomes and a deeply cleft post-anther lobe. The flowers bear a resemblance to those of *Burchardia umbellata* R.Br. which flowers concurrently with *T. aurorae*. The species is hard to observe in flower as the pale flower buds require high temperatures in order to open, having only been observed to do so once in the four years of this study and that on a 30 °C day. Despite the small, white-budded inflorescences being readily observable, no other populations have been identified in this large reserve or surrounding areas to date.

Thelymitra aurorae appears to be most closely related to *T. batesii* and *T. peniculata*. A comparison between the flowers of these three species is shown in Fig 3. *Thelymitra aurorae* can be identified by its small size with a leaf 10–20 cm long, 3–8mm wide, with a deep V-shaped cross-section and lacking red colouration at the base. It has a short scape less than 30 cm tall with two sterile bracts and 1–8 flowers that are 10–14 mm across. The perianth segments are relatively narrow, being twice as long as they are wide, and the labellum has less width than the other segments. The mostly brown coloured post-anther lobe is not inflated, being slightly narrower than the underlying column, with a cuboid shape and deeply cleft for two-thirds of its length. It has noticeable horn-like auxiliary lobes that curve inward and forwards from the yellow apex of the post-anther lobe. The lateral lobes project forwards, are glabrous at their base and have a terminal arrangement of basally pink trichomes that project upwards from the dorsal surfaces.

Thelymitra peniculata is a more robust species with a larger leaf 14–25(–44) cm long, 5–12(–20) mm wide, with a V-shaped to flat cross section. The scape is 20–50(–66) cm tall and plants observed growing sympatrically were at least >50% larger than *T. aurorae*. While *T. peniculata* normally has vibrantly coloured purple-blue flowers, it does occasionally produce colour mutations with white flowers. The flowers are larger, 14–22 mm across, with an inflated bifid post-anther lobe with bulbous appearance that is cleft for about

one-third of its length. The lateral lobes have forward projecting terminal tufts of white trichomes in a mop like arrangement. It also has a later flowering period, typically between late October and early December at this location.

Thelymitra batesii is intermediate in size with a leaf 10–30 cm long, 5–11 mm wide and a slender scape 20–45 cm tall. The mature, unopened flower buds are distinctive, having a plump appearance with the exterior of the sepal having pinkish colouration and darker red longitudinal veins. The bud shape relates to the more ovate flower segments that are bright purple and flowers are 14–22 mm across. The mostly maroon coloured post-anther lobe has a cuboid shape and is deeply cleft, similar in shape to *T. aurorae* although with auxiliary lobes that curve beneath the post-anther lobe rather than forwards. The lateral lobes have forward projecting terminal tufts of white trichomes in a mop like arrangement. It has an early flowering period from late September to mid-October, similar to *T. aurorae*, but has a habitat preference for well-drained hillsides rather than wet, mossy habitat.

Thelymitra aurorae is also superficially similar to *T. pallidiflora*, however, the latter flowers later, has a single sterile bract, larger flowers >20mm across and has white trichomes that are arranged in a toothbrush arrangement along the entire length of the lateral lobes. Hybrids between *T. aurorae* and *T. peniculata* have been observed.

Etymology: Named for the nature-loving music artist Aurora (Aurora Aksnes, 1996–). The species, with its short stature and white flowers with pink trichomes, bears an uncanny resemblance (in *Thelymitra* terms) to the artist's stage appearance.

3. *Thelymitra serpentina* R.J.Mitchell, *sp.nov.* (Figs. 1c,d, 4a-c)

Type: **Australia.** Victoria, Frankston Nature Conservation Reserve, firebreak beside Boundary West Track, 15 Oct. 2024, *R.J. Mitchell 5* (holotype, MEL 2555003A, iNaturalist observ. *robert1534 247424288*), *R.J. Mitchell 6* (isotype, MEL 2549831A, iNaturalist observ. *robert1534 247425558* and *robert1534 247426870*).

***Differential diagnosis*:** *Thelymitra serpentina* is distinguished from the morphologically similar *T. bracteata* Jeanes by (contrasting characters in parentheses) its clumping habit (usually solitary), scape with kinks at the sterile bracts with bract apex separated (straight, lower sterile bracts closely sheathing throughout their length, upper bract often loose with only base attached), pedicels that are not decurrent with rachis (lower flowers often with pedicels that are partially decurrent with rachis), purple-blue flowers with reddish-brown sepal exteriors (pale blue flowers with bright green sepal exteriors), post-anther lobe long and tubular with post-anther lobe extension 0.7–1.4 mm long (post-anther lobe tubular and short, with a domed profile from the side, with post-anther lobe extension 0.5–1 mm long), and converging lateral lobes that project forwards well beyond the apex of the post-anther lobe, the trichomes often pressed together into a single tuft (lateral lobes bent sharply upwards in the middle, the trichomes embracing the apex of the post-anther lobe in separate tufts).

Glabrous terrestrial clumping *herb*. *Tubers* not seen. *Leaf* linear, 20–45 cm long 7–15 mm wide, canaliculate to flat, erect to suberect, often becoming lax beyond the mid-point, green with a purplish base, leathery, scabrous, sheathing at base, abaxially ribbed, upper surface with several shallow grooves/ridges, apex acute. Leaf emerging late autumn. *Scape* 30–80 cm tall, 2–5 mm diam., mostly straight, but often kinked below the apex of the sterile bracts, emerging pale green, usually darkening to reddish-brown by anthesis, covered in a pale bloom. *Sterile bracts* 1–2, 3–10 cm long, lower bract much longer than upper bract, green to brown, lighter coloured than scape, covered in a powdery bloom, closely sheathing for most of its length, then often becoming detached at the apex where the scape kinks away, occasionally becoming leaf like, apex acute. *Fertile bracts* 5–27 mm long, 2.2–5.5 mm wide, acuminate, green to brown, sheathing the pedicels and base of the ovary. *Pedicels* 5–16 mm long, narrow, never decurrent on rachis. *Ovary* narrow-obovoid, 7–20 mm long, 2–4 mm wide, ribbed, green with a fine, powdery bloom. *Flower buds* narrow-ovate, olive-green to reddish-brown, with darker brown lines, segment edges white, apex acute. *Flowers* (1–)5–17+, (15–)18–27 mm diam., purplish-blue to purple with bluish steaks, rarely pale blue, mature flowers opening simultaneously on warm days above 20 °C. *Perianth segments* linear-lanceolate to ovate-lanceolate 8–15 mm long, 4–6 mm

wide, concave, apex acute to shortly apiculate. *Dorsal sepal* ovate-lanceolate to lanceolate, apex subacute to acute. *Lateral sepals* lanceolate, with an alternating pattern of dark and faint fine lines, often with a blue-coloured band down their centres, contrasting against purple coloured margins. *Petals* ovate-lanceolate, with 9 fine lines that have an even distribution and thickness, similar to pinstripe fabric. *Labellum* narrow-lanceolate, significantly narrower than other segments, with 9 fine lines that have an even distribution and thickness. *Column* erect from the end of the ovary, 5–6 mm long, 3–4 mm wide, blue-white with darker blue lines and dots, ovate from front, dark blue-black junction with post-anther lobe, *post-anther lobe* hooding the anther, 3–3.5 mm long, 1.8–2.2 mm wide, tubular, sometimes with shallow grooves along its length, not inflated, curving sharply through c. 90° and tilted slightly downwards, base reddish brown to black with a yellow apex extending from halfway along its length, apex emarginate with small opening, *post-anther lobe extension* 0.7–1.4 mm, *auxiliary lobes* usually present as 2 tiny, incurved flaps that nearly meet, located on the lower apical margin of the post-anther lobe, *lateral*

Figure 4. Flower and column comparison. *Thelymitra serpentina* **a.** Front, **b.** Side, **c.** Top; *T. arenaria* **d.** Front, **e.** Side, **f.** Top; *T. bracteata* **g.** Front, **h.** Side, **i.** Top;

lobes converging, 1–1.5 mm long, dactyliform, porrect at base, curving gently upwards, each with a dense, toothbrush-like arrangement of trichomes that touch the ventral apex of post-anther lobe and extend 1 mm beyond the apex, the trichome tufts often pressed together to appear as if a single tuft, the individual trichomes 0.9–1.7 mm long, white. *Anther* inserted above centre of column, ovoid, 2.5–3 mm long, 1.5–2.0 mm wide, the connective produced into an apical beak. *Pollinarium* 1.9–2.5 mm long. *Viscidium* more or less circular, c. 0.5 mm diam. *Pollinia* mealy, friable, white. *Stigma* situated at base of column, ovate-quadrate, 2.5–3 mm long, 1.7–2.2 mm wide, margins irregular. *Capsules* narrow-obovoid, 10–20 mm long, 3–7 mm wide, erect, ribbed, sometimes not forming if cold weather immediately follows flowering.

***Specimens examined*: VICTORIA.** Wannon, Balmoral/Harrow Road 2.3 km E of Coleraine/Harrow Road intersection, 4 Nov. 2001, *D. Rouse JAJ1114* (MEL 2173085 & 2173121).

***Select iNaturalist Observations*: VICTORIA:** Mt Arapiles, Nov. 2020 *calamanthus 68147971;* Moyston Flora Reserve, 5 Nov. 2022, *leoniec1965 141141230;* Strangeways, 2 Nov. 2020 *melissa-morrison 64445249*; Murgheboluc, 22 Oct. 2021, *skruss 99063309*; Bells Beach, 2 Nov. 2021, *destino 100302435*; Sunbury, 7 Nov. 2022, *nicolelm 141336643*; High Camp, 2 Nov. 2020, *rosina_hc 64014707*; Humevale, 5 Nov. 2022, *lucy_holmes 141127349*; St Andrews, 15 Oct. 2024, *debjoliver 247587803*; Maryvale, 22 Oct 2024, *jimmycarr 248671975*; Longford, 29 Oct. 2007, *kenharris 101966768*. **SOUTH AUSTRALIA:** Mt Baker Summit, 6 Nov. 2022, *einadia 141256091*; Yundi, Oct. 2023, *yundinatureconservancy 193926839*; Heathfield, 30 Oct. 2024, *gert-jan-nl 249727886;* Kuitpo, 24 Oct. 2015, *orchidrose 189208111*.

Distribution and habitat: Victoria and South Australia. Grows in variety of habits including grasslands, heathland and woodlands on various soil types. Observations show it grows across a wide swathe of coastal and central Victoria, as far east as Longford in central Gippsland. It also has several high-quality observations in South Australia in the Southern Mt lofty Ranges region. Yet to be formally identified in the collections of the relevant herbaria outside Victoria or to have local conservation status assessed.

***Conservation status*:** Widespread, uncommon but probably well conserved. The species has been observed by the author at many reserves across the Mornington Peninsula, in small numbers, with the population at the type locality estimated at 80–150 mature plants. It may be more frequent in more inland areas where it has been reported in large numbers (Russell Stanley, pers. comms.). Assessed as Data Deficient until additional population data can be gathered.

***Flowering period*:** Mid-October to early November

***Pollination biology*:** This species is facultatively autogamous.

***Distinguishing features and notes*:** *Thelymitra serpentina* is a large and robust clumping species that rivals the largest members of the *T. pauciflora* complex. Mature specimens commonly grow to 60+ cm tall with flowers 19–27 mm across. It puts on a spectacular but short-lived display when the combined flowers of the clumped plants open simultaneously in response to warm weather. *Thelymitra bracteata* and *T. arenaria* are the most similar species as they also have large, fleshy leaves, comparably sized flowers and a similar flowering time. A flower comparison between these three species is shown in Fig. 4. *Thelymitra serpentina* can be identified by a number of features, it has been observed to produce additional mature plants via vegetive reproduction (observed by the author during the course of this study) resulting in clumps of similarly sized plants. It has 1–2 sterile bracts to 10 cm long that often induce a slight kinking of the scape, with the apex of the bracts detached and occasionally becoming leaf-like. The lower sterile bract is typically twice the length of the upper bract. The fertile bracts (other than those on the most basal flowers) are very short, only covering the pedicels, with long, narrow-obovoid, grooved ovaries to 7–20 mm long. The sepal exteriors are initially green but normally mature to a reddish brown. The flowers are purple blue and open widely. The petals have nine thin, prominent lines resembling pinstripe material, the lateral sepals often have a blue strip down their centres and purple margins. The labellum is narrower than the other segments and about the same width as the column. The column bends sharply beyond 90° at the post-anther lobe junction. The post-anther lobe is tubular, not inflated and tapers slightly towards the apex, which typically has a small, emarginate opening. Shallow grooves sometimes run along the length of the post-anther lobe. The lateral lobes converge, often resulting in the appearance of a single trichome tuft, which projects well beyond the apex of the post-anther lobe while touching its ventral surface.

Thelymitra bracteata is similarly sized to *T. serpentina* at 30–70(–100) cm tall, but it is not noted to be a clumping species. It can be distinguished by its straight scape with 1–3 long sterile bracts to 14 cm, the lower bracts closely sheathing the scape, while the upper bract is often loose and detached from scape with only the base attached. The fertile bracts are often very long and extend along the ovaries, sometime subtending the flowers. The pedicels of the lowest flowers are often partially decurrent on the rachis. The ovaries are 5–15 mm long, with those at the apex often being truncate while the basal flowers are in bloom. The sepal exteriors are bright green. The flowers are pale-blue and open widely, with thick, diffuse lines down the middle of the lateral sepals. The labellum is narrower than the other segments and about the same width as the column. The relatively short post-anther lobe is uninflated, tubular, with a very small apical opening, and has a humped profile from the side. The lateral lobes bend sharply upwards at 90° in the middle, with the trichomes embracing the apex of the post-anther lobe. Unlike *T. serpentina* where most of the flowers open simultaneously, *T. bracteata* usually only has a few flowers open at any given time.

Thelymitra arenaria is generally smaller in height, typically less than 45 cm, and does not normally form clumps. The scape is straight, typically with 2 relatively short sterile bracts, 2.5–8.5 cm long, that closely sheath the stem. The fertile bracts typically extend part way along the ovary. The ovaries are 5–12 mm long and not as proportionately narrow as those of *T. serpentina.* The flowers have an olive green to reddish-brown sepal exterior. The flowers are purplish-blue and open less widely than *T. serpentina* and *T. bracteata* due to ovate petal segments that are heavily cupped, although some populations may have narrower segments. The labellum is only slightly smaller in size than the lateral petals and is usually much wider than the column. The lateral sepals have three thin prominent lines, while the petal lines are faint, occasionally with a more prominent central line. The column is rounded with an inflated and flattened post-anther lobe with a large and often triangular apical opening. The post-anther extends minimally and the lateral lobes are well separated. The trichomes sit below the post-anther lobe, often with the appearance of pom poms in Victorian populations.

Thelymitra serpentina could also be misidentified with the melittophilous *T. nuda*, which has long-lasting, scented flowers with intact pollinia, an inflated post-anther lobe with apical v-notch and irregular fertilisation of flowers. Under normal conditions, *T. serpentina* shows the typical pattern of fertilisation in autogamous species, with all ovaries producing capsules, however, if cold weather immediately follows flowering, fertilisation can be interrupted, giving the impression of a melittophilous species due to the partial capsule formation. *Thelymitra serpentina* has been observed to form hybrids with *T. ixioides, T. arenaria, T. asperifolia and T. peniculata*, often resulting in hybrids that retain the large form and clumping habit of *T. serpentina*.

Etymology: Latin *serpentina* (snake-like), an allusion to the shape of the column, with the combination of the tapering and grooved post-anther lobe and singular trichome tuft, resembling the head of a snake.

New records of *Thelymitra* for Victoria

4. *Thelymitra batesii* Jeanes, *Muelleria* 19: 64 (2004).

Type: **AUSTRALIA.** South Australia. Spring Gully Conservation Park, Cascades Walk, 16 Sept. 2002, *J.A. Jeanes 1252* (holotype AD; isotypes CANB, MEL, NSW, HO, BRI).

Glabrous terrestrial *herb*. *Tubers* not seen. *Leaf* linear to linear-lanceolate, 10–30 cm long, 5–11 mm wide, erect, canaliculate, fleshy, ribbed abaxially, dark green with a purplish base, sheathing at base, apex acute to acuminate. *Inflorescence* 20–45 cm tall, 1.5–2.5 mm diam., slender, straight, green to purplish. *Sterile bracts* usually 2, linear to linear-lanceolate, 2–7 cm long, 4–8 mm wide, closely sheathing, acute to acuminate, green to purplish. *Fertile bracts* ovate-acuminate to obovate-acuminate, 7–20 mm long, 4–7 mm wide, sheathing the pedicels, green to purplish. *Pedicels* 0.5–10 mm long, slender. *Ovary* narrow-obovoid, 4–11 mm long, 2–3.5 mm wide. *Flowers* 2–8, 14–22 mm diameter, opening tardily on warm to hot days, usually mauve or bluish-purple inside, outside of sepals pinkish with darker longitudinal stripes, unopened flower buds inflated. *Perianth segments* 6–10 mm long, 3.5–6.5 mm wide, concave, often shortly apiculate; *dorsal sepal* ovate, obtuse to subacute; *lateral sepals* lanceolate to ovate, often asymmetric, acute; *petals* ovate to obovate,

obtuse to subacute; *labellum* obovate to oblanceolate, acute, often slightly smaller than other segments. *Column* erect from the end of ovary, 4.5–5.5 mm long, 2.5–3.5 mm wide, pink or purplish; *post-anther lobe* hooding the anther, 2.5–3.5 mm long, 1.9–2.7 mm wide, tubular, often somewhat compressed dorsally, curving abruptly through c. 90°, dark purplish, apex deeply bilobed, yellow, the lobes 1–1.5 mm long, margins thickened and recurved; *post-anther lobe extension* 0.5–0.8 mm; *auxiliary lobes* often present as 2 small incurved spurs on the lower apical margin of the post-anther lobe, sometimes touching near tip of anther beak; *lateral lobes* converging or more or less parallel, 1.3–1.7 mm long, dactyliform, porrect at base, curving gently upwards, each with a dense, sub-terminal, untidy, mop-like tuft of trichomes that embrace the apex of the post-anther lobe, the individual trichomes 1.1–1.5 mm long, white. *Anther* inserted about mid-way along column, ovoid, 2.5–3 mm long, 1.7–2.2 mm wide, the connective produced into an apical beak 0.5–0.7 mm long; *pollinarium* 1.9–2.5 mm long; *viscidium* more or less circular, c. 0.4 mm diam.; *pollinia* mealy, friable, white. *Stigma* situated at base of column, ovate-quadrate, 1.8–2.5 mm long, 1.7–2 mm wide, margins irregular. *Capsules* obovoid, 10–18 mm long, 4–7 mm wide, erect, ribbed. **Fig. 3 d–f.**

***Specimens examined*: VICTORIA.** Mornington Peninsula.15 Oct. 2024, *R.J. Mitchell 1* (MEL 2549822A, iNaturalist observ. *robert1534 247416351*); Mornington peninsula, 19 Oct. 2022, *V. Stajsic 10343, D.J. Ohlsen, R.J. Mitchell* (MEL 2554999A)

***Select iNaturalist observations*: VICTORIA:** Beechworth, 28 Sept. 2023 *roberthumphries 185266603;* Warrandyte 30 Sept. 2023, *kari268 185885093*.

Distribution and habitat: Originally described from South Australia where it is found in the Northern and Southern Mt Lofty ranges, typically on slopes in heathy woodland and heathy open forests. The known Victorian occurrence is a single population of approximately 200 plants growing in a sloped position in a reserve on the Mornington peninsula. However, several observations from iNaturalist indicate it may be present at other locations, with the two locations listed above at Warrandyte and Beechworth being consistent with the early flowering period and habitat preference of the species.

***Conservation status*:** Well-conserved in South Australia but poorly known in Victoria. The single known Victorian population would meet the requirements for an endangered rating at a state-level, per IUCN Red list version 3.1 category D. However, the suspected presence of other Victorian populations suggests a Data Deficient status is most appropriate at this time.

***Flowering period*:** Late September to mid-October in Victoria.

***Pollination biology*:** This species is facultatively autogamous and often also cleistogamous.

***Distinguishing features and notes*:** *Thelymitra batesii* is a cryptic, early flowering species in Victoria, with the cooler conditions relative to South Australia resulting in few opportunities to observe the species in flower at its known coastal location. *Thelymitra batesii* required temperatures over 25 °C for flowers to open and the flowers were observed to close shortly after midday. Its similarity to *T. peniculata* makes it hard to clearly differentiate from lower quality photographic observations. *Thelymitra batesii* can be identified by its slender form, with a leaf that is typically less than 10 mm wide, swollen buds with sub-acute apexes, pinkish colouration and dark red veins, a deeply cleft post-anther lobe with mostly maroon colouration and a cuboid shape, and an early flowering period of late September to mid-October. In contrast, *T. peniculata* is often more robust, with leaves that exceed 10 mm wide, flower buds with an acute apex and brownish colouration, an inflated post-anther lobe that is more bulbous and less deeply cleft, typically dark brown in colouration with a large yellow apex, and a later flowering period from late October to early December in Victoria. *Thelymitra peniculata* also grows in a wide variety of habitats compared to *T. batesii*, which is known to favour well-drained slopes. Hybrids between *T. batesii* and *T. peniculata* have been observed. A comparison between flowers of these two species along with *T. aurorae* is presented in Fig. 3.

5. *Thelymitra latifolia*, R.J.Bates, *J. Adelaide Bot. Gard.* 24: 25 (2010).

***Type:* AUSTRALIA.** South Australia. Southern Lofty region, Millbrook Reservoir, Pine Peninsula, in regenerating sandy patch, 12 Oct. 2004, *R.Bates 64051* (holotype AD)

Glabrous terrestrial *orchid* to 30 cm tall. *Tuber* ovoid 1–2 cm long, 5–10 mm wide. *Leaf* lanceolate, 5–10 cm long, 5–15 mm wide, blade flat, obliquely erect, leathery,

dark green with reddish tints mostly at base and on margins, lamina with several longitudinal ridges, not sheathing the scape or sheathing only at extreme base, apex acute. *Scape* 10–30 cm long, 2–4 mm wide, glaucous, green with pink or purplish tints. *Sterile bracts* usually two, linear lanceolate 2–5 cm long, closely sheathing except at the acuminate free apex, green with purplish tints sometimes glaucous. *Fertile bracts* ovate acuminate, 7–15mm long, 5–8 mm wide somewhat inflated, highly textured, purplish with some pale bloom. *Pedicels* 5–10 mm long, slender. *Ovary* obovoid, 5–8 mm long, 4–5 mm diam., green. *Flowers* 2–8, 14–20 mm across, pale to mid-blue sometimes mauve or pink, opening briefly and only on warm humid days, mostly in the morning; *buds* rounded, lilac to brown with pale greenish or bluish margins to sepals. *Perianth segments* 6–10 mm long, 4–5 mm wide, concave, shortly apiculate or blunt, with 6–12 longitudinal striations; *dorsal sepal* ovate, sub-acute; *lateral sepals* ovate, often asymmetric, subacute; *petals* obovate, obtuse; *labellum* obovate, obtuse, smaller than other segments. *Column* erect from the end of ovary, 5–6 mm long, 3–4 mm wide, pale pink; *post-anther lobe* hooding the anther, 3–4 mm long, 2–3 mm wide, tubular, curved gradually, yellow and brown or predominantly yellow including the apex, which is not or slightly notched rather than gaping, slightly ribbed longitudinally with somewhat crenulate margins; may appear to gape on pressed material due to squashing; *auxiliary lobes* often present as two short thick spurs on lower apical margins; *lateral lobes* converging, 1.2–1.5 mm long, porrect at base, curving gently upwards and forwards with a sub-terminal, elongated, mop-like, untidy tuft of white trichomes held well in front of the post-anther lobe, the individual trichomes 1–1.5 mm long, slender with a thickened apex, often drying a brownish colour. *Anther* inserted above centre of column, ovoid 1.6–1.8 mm long, the connective extended into an apical beak; *pollinarium* 1.5–2 mm long; *viscidium* ±circular c. 0.5 mm diam.; *pollinia* white, mealy, friable, rarely seen intact in open flowers. *Stigma* at base of column, ovate-quadrate, c. 2.2 mm diam., margins irregular. *Capsules* obovoid, 10–11 mm, long 4–8 mm wide, erect and ribbed. **Fig. 5a,b.**

***Specimens examined*: VICTORIA.** Grampians area. Private Property adjoining Wartook State Forest and close to McKenzie River. 2 Nov. 1988. *M.G. Corrick 10429* (MEL 1559753, Spirit MEL 2039528), **SOUTH AUSTRALIA.** Nangwarry NFR. Tower road at end of track. 30 Oct. 2008. *R.J. Bates 80111* (MEL 2352926)

***Select iNaturalist Observations*: VICTORIA:** Jilpanger NCR, Nov. 2020, *calamanthus 68147972;* Dergholm, 20 Oct. 2022, *jessica_sambell 171525749;* Powers Creek, 26 Oct. 2021, *jessica_sambell 116401813;* Deep Lead, 9 Nov. 2022, *leoniec1965 141521409*; Ararat, 20 Oct. 2023, *ivan-theaged 188975764*; Junortoun 14 Oct. 2024, *mallyicu 247303968*; Steiglitz, 8 Nov. 2022, *clownslaw 141503440*; Diamond Creek, 21 Oct. 2023, *warrencameron 98867103*; St Andrews, 23 Oct. 2021, *bushbandit 100986099*; Bend of Islands, 28 Oct. 2019, *hone 35035727*. **NEW SOUTH WALES:** Captains Flat, Oct. 2023, *christina_steele 188338119*; Captains Flat, Nov. 2023, *christina_steele 190724728;* Blue Mountains, 6 Nov. 2023 *margaretjb 250748685*; Jenolan, 11 Nov. 2023 *sapphfire 198678165*.

Distribution and habitat: Originally described from South Australia where it is found in woodland from the southern Flinders Ranges to the Victorian Border. In

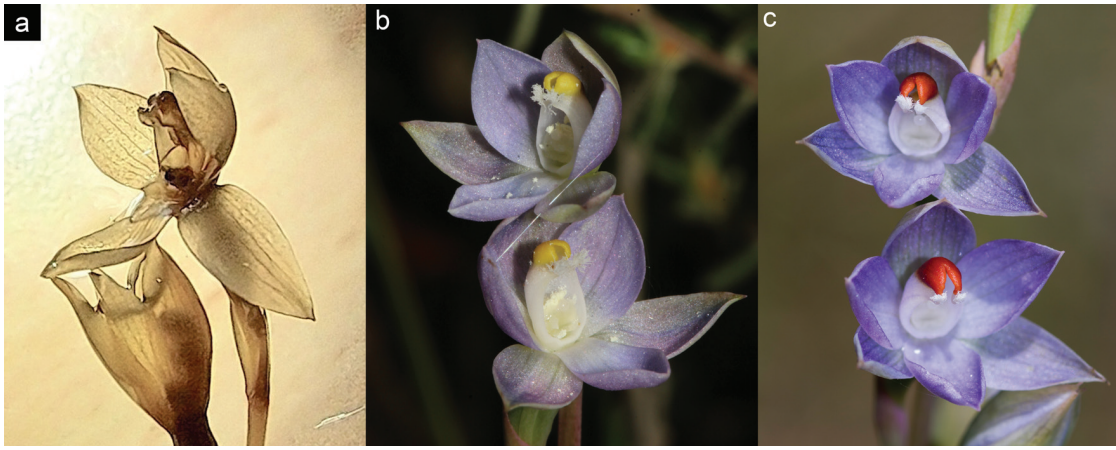

Figure 5. *Thelymitra latifolia* specimen comparison. **a.** *T. latifolia* ethanol specimen; **b.** *T. latifolia* from Chetwynd Victoria (Photo Russell Stanley) **c.** *T. brevifolia* (Mornington Peninsula)

Victoria, it is found through western and central regions as far east as Christmas Hills, often in box/ironbark forests. iNaturalist observations also indicate that it is present in New South Wales, with multiple observations in Captains Flat and on the western side of the Blue Mountain. It has yet to be identified within the NSW herbarium collection.

***Conservation status*:** Well-conserved in South Australia and present across a large area of Victoria. While population data is currently deficient, it is unlikely to require a threatened classification at this time.

***Flowering period*:** Mid-October to early November in Victoria.

***Pollination biology*:** This species is facultatively autogamous.

***Specimen identification, Distinguishing features and notes*:** *Thelymitra latifolia* has long been identified as present in western Victoria, being listed in the most recent Guide to Native Orchids of Victoria (Backhouse 2023), but the lack of any herbarium specimen had prevented its formal recognition. This study identified an anomalous Victorian specimen within the *Thelymitra brevifolia* Jeanes collection (MEL 1559753) that was consistent with *T. latifolia.* It showed a mostly yellow post-anther lobe, with a small, unruly mop of trichomes sitting below the post-anther lobe, and wide, more ovate perianth segments with faded yellow colouration. Its appearance is virtually identical to the South Australian specimen of *T. latifolia* collected by Bob Bates (MEL 2352926). In contrast, the *T. brevifolia* specimens had a mostly dark brown post-anther lobe, typically with a denser mop of trichomes that embraced the post-anther lobe, and perianth segments were narrower with a faded grey colouration.

The accompanying Victorian spirit specimen (MEL 2039528) of *Thelymitra latifolia* was also consistent with its published description and images, showing a small, dome-shaped, uninflated post-anther lobe with a neat notch, and lateral lobes protruding forwards beneath the post-anther lobe. In contrast, *T. brevifolia* has a post-anther lobe that is more tubular, with an apex that is irregularly and often deeply notched, and a neat mop of trichomes that embrace the apex of the post-anther lobe. Fig. 5 shows a comparison between the ethanol-preserved specimen of *T. latifolia* and photographs of both *T. latifolia* and *T. brevifolia.*

Thelymitra latifolia can be recognised by mature plants with a wide, leathery, ribbed leaf and a scape to 30 cm tall that emerges at ground level, with two sterile bracts. The flowers are 14–20 mm across, typically in pastel shades of mauve to blue, and often have a pale/white band at the base of the perianth segments near the column. The perianth segments have numerous fine lines and the labellum is often narrow and concave compared to the other segments. The post-anther lobe is narrower than the underlying column, uninflated and somewhat dome shaped, mostly yellow with a small brown collar at the rear and an apex that is neatly notched. The short lateral lobes project forwards below the post-anther lobe and terminate with a mop-like arrangement of somewhat untidy trichomes. *Thelymitra latifolia* is normally found in woodland habitats, with a late flowering period from mid-October to early November in Victoria. In contrast, *T. brevifolia* usually has a thin-textured leaf that is often suffused with red markings and a scape that is up to 60 cm tall. The perianth segments tends towards a lanceolate rather than ovate shape when compared to *T. latifolia* and the post-anther lobe has a tubular shape with red or dark brown colouration. The post-anther lobe apex often has sharp, ventrally facing points with an irregular or deep cleft. The lateral lobes are short and bend upwards, terminating in a neat mop of trichomes that embrace the apex of the post-anther lobe. *Thelymitra latifolia* has also been compared to *T. peniculata,* which is typically a more robust species with proportionately longer, linear leaves, brightly coloured perianth segments with thick diffuse lines and lacking the pale band around the column. The post-anther lobe is bifid and inflated, with long, lateral lobes that project well forwards of the post-anther lobe, terminating with a dense mop of relatively long trichomes. *Thelymitra latifolia* may grow sympatrically and flowers simultaneously with both *T. brevifolia* and *T. peniculata*, although the latter two species occupy a broader range of habitats.

6. *Thelymitra pallidifructus*, R.J.Bates, *J. Adelaide Bot. Gard.* 24: 30 (2010).

Type: **AUSTRALIA.** South Australia. South East region: Whennan Native Forest Reserve, Mt Burr, Top track in sandy scrublands, 30 Oct. 2004, *R.Bates 64170* (holo: AD; iso: MEL.)

Glabrous terrestrial *orchid* to 30 cm tall. *Tubers* ovoid, 10–20 mm long, 5–8 mm wide; *Leaf* shortly linear 10–15 cm long, 1–2 mm wide, obliquely erect, fleshy, canaliculate at first, lamina becoming flat distally on larger specimens, ribbed abaxially, green with a red tinted base, sheathing the scape for 3–5 cm, fistula narrow, apex gradually acuminate. *Scape* 15–30 cm long, 1–2 mm diam., slender, usually slightly flexuose, green or pinkish. *Sterile bract* single, linear lanceolate, 2–3 cm long, pale pink or green, closely sheathing, apex acute. *Fertile bracts* short, ovate to quadrate, 8–10 mm long, 4–6 mm wide, pinkish, glaucous. *Pedicels* 1–3 mm long, grading into the ovary. *Ovary* narrow-obovoid, 5–10 mm long, 3–5 mm wide, pale, yellow-green in live material, remaining pale when freshly dried. *Flowers* 2–10, 10–15 mm across, usually lilac but sometimes pale blue, opening only on warm, humid days and then only briefly; *buds* slender, lilac and green with pale lilac sepal edges. *Perianth* segments 6–10 mm long, 3–6 mm wide, concave, not apiculate; *dorsal sepal* ovate, obtuse to sub-acute, with c. 5 indistinct lines, often hooding the column; *lateral sepals* ovate-lanceolate, with indistinct lines, obtuse to sub-acute; *petals* somewhat broader, ovate, obtuse or sub-acute; *labellum* smaller, ovate-oblong, apex obtuse. *Column* erect from the end of the ovary, 4–5 mm long, 2–3 mm wide, quadrate, white or palest lilac; *post-anther lobe* hooding the anther, c. 2 mm long, tubular, curved forward, pale yellow with a brown to purple brown collar at the base, apex hardly to irregularly notched, not thickened, lobes not inflated, margins sub-crenulate to dentate, *auxiliary lobes* indistinct; *lateral lobes* converging, 0.8–11 mm long, dactyliform, curved sharply upwards near the base, each with an untidy mop-like arrangement of white trichomes, individual trichomes to 1 mm long, held in front of the post-anther lobes not embracing them. *Anther* inserted midway along the column, ovoid, 2–2.5 mm long, connective produced into an apical beak 0.5 mm long; *pollinarium* 1.3–1.5 mm long; *viscidium* more or less circular c. 0.1 mm across; *pollinia* friable, mealy white. *Stigma* situated at base of column, concave, quadrate, c. 1.7 mm wide, margins smooth. *Capsules* narrowly obovoid, 10–15 mm long, 5–7 mm wide, ribbed, pale greenish-yellow until dried. **Fig. 2g-i**

***Specimens examined*: VICTORIA.** Black Range State Park. Cherrypool /Balmoral Road 1.7 km N of Mountain Dam turnoff. 5–10 metres above Rocklands Reservoir highwater mark. 4 Nov 2001 *D. Rouse JAJ1111* (MEL 2173092, Spirit 2173122); Frankston Nature Conservation Reserve, eastern section of the reserve, beside boundary track, 19 Oct. 2022, *V. Stajsic 10341, D.J. Ohlsen, R.J. Mitchell* (MEL 2554998A); Frankston Nature Conservation Reserve, Boundary west track, 16 Oct. 2024, *R.J. Mitchell 10* (MEL 2549823A, iNaturalist observ. *robert1534 247579117*.)

***Select iNaturalist Observations*: VICTORIA:** Mumbannar, 2 Nov. 2013, *reiner 36279893*; Jilpanger NCR, 1 Nov. 2021, *calamanthus 103520087*; Grampians NP, 3 Nov. 2024, *leoniec1965 250266338*; Heywood, 16 Oct. 2024, *lorrainecphelan 248993992*; Steiglitz 6 Nov. 2022 *jordan-crooka1 141245597*; Moggs Creek, 13 Oct. 2023, *clownslaw 247283180*; Smiths Gully, 16 Oct 2024, *tobimycena 247590141*; Macclesfield, 8 Nov. 2023, *warrencameron 190390286*; Morwell NP, 27 Oct. 2024, *mattcampbellaus 252520281*; Wilson Promontory, 17 Oct. 2024, *johnmifsud 249753675*.

Distribution and habitat: Originally described from South Australia where it is found in damp and swampy heathland in the southern Mt lofty ranges, Western Kangaroo Island and the southeast of the state. This range continues through southern areas of Victoria to as far east as Wilsons Promontory. Often forming large populations in disturbed habitats such as regularly slashed fire breaks.

***Conservation status*:** Well conserved in both South Australia and Victoria.

***Flowering period*:** Mid-October to November in Victoria.

***Pollination biology*:** This species is facultatively autogamous and sometimes also cleistogamous.

***Distinguishing features and notes*:** *Thelymitra pallidifructus* is a late flowering species most easily recognised by the combination of high leaf fistula, short stature, narrow fleshy leaf, single sterile bract, pale yellow-green ovaries and fresh capsules and lilac buds. The flowers are widely opening with narrow segments that are typically lilac, but sometime blue or pinkish. Typical plants have 1–4 flowers 10–12 mm across but larger specimens have up to 10 flowers to 15 mm across. The post-anther lobe often has a narrow purple band at its junction with the underlying column, but the shape is quite variable, normally presenting as a short hood with a crenulate or dentate apex, sometimes becoming flattened or only forming a narrow tube (possibly related to environmental conditions). The lateral lobes bend sharply upwards near the base and terminate in an untidy mop of trichomes, held in front of the post-anther

lobes, not embracing them. *Thelymitra pallidifructus* has been confused with *T. pauciflora* which has a similar slender habit and narrow fleshy leaf. *Thelymitra pauciflora* flowers a few weeks earlier, typically late September to mid-October in Victoria. It has 1–3 sterile bracts, with dull-green ovaries and olive-green to brown coloured buds. The tardily opening flowers are slightly larger, typically 15–17 mm across and are typically pale blue. The post-anther lobe of *T. pauciflora* lacks the purple band at the junction with the underlying column and has an apex with a short overhang that is entire to emarginate, rather than crenulate or dentate. The lateral lobes have a 90° upwards bend in the middle, with a dense, terminal, mop-like arrangement of trichomes that brush the ventral side of the post-anther lobe apex. A comparison between these two species is shown in Fig 2.

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