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ROYAL BOTANIC GARDENS VICTORIA

East Gippsland's Clubbed Spider *Caladenia* (Orchidaceae: Caladeniinae)

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Introduction

The taxonomic status of a number of clubbed spider *Caladenia* R.Br. taxa in East Gippsland (here defined as that part of Victoria east of Longitude 147° – roughly east of Sale and Wodonga) has been a matter of uncertainty among botanists since formal recognition of taxa within the *C. reticulata* Fitzg. group began in 1991 (Carr 1991). In this work, the formally described clubbed spider *Caladenia* species recorded for E. Gippsland are considered, namely: *Caladenia aestiva* D.L.Jones, *C. ancylosa* (D.L.Jones) G.N.Backh., *C. australis* G.W.Carr, *C. clavigera* A.Cunn. ex Lindl., *C. fitzgeraldii* Rupp, *C. flavovirens* G.W.Carr, *C. montana* G.W.Carr, *C. oreophila* (D.L.Jones) G.N.Backh., *C. osmera* (D.L.Jones) G.N.Backh., *C. peisleyi* (D.L.Jones) G.N.Backh. and *C. valida* (Nicholls) M.A.Clem. & D.L.Jones. *Caladenia turneri* Kosky is described here as new as part of this revision.

This study was informed by extensive field studies carried out over a period of more than 20 years, involving careful examination and analysis of specimen characteristics supported by detailed photographic records of all studied populations of these species within E. Gippsland, supported by similar observations made from populations elsewhere in Victoria, South Australia, New South Wales and the Australian Capital Territory to allow for detailed comparisons and a holistic overview of this group across a wide range. Specimens, including type materials, of the taxa in question were also examined at CANB, MEL and NSW (acronyms per

Abstract

All currently described clubbed spider *Caladenia* species known from East Gippsland (Victoria, Australia) are considered and the taxonomy of the group revised following extensive fieldwork and systematic analysis of population-based morphological measurements. *Caladenia fitzgeraldii* is recognised as occurring in Victoria; *C. oreophila* is reduced to a synonym of *C. fitzgeraldii*; *C. osmera* is reduced to a synonym of *C. montana*; *C. aestiva* is reduced to a synonym of *C. flavovirens*: and *Caladenia turneri*, with affinities to *Caladenia montana*, is described as new. An updated key to the group is provided.

Keywords: *Caladenia*, taxonomy, population analysis, labellum teeth-counting

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Thiers 2021 [continuously updated]) with the following exceptions:

1. Certain types are represented by illustrations, namely R.D. Fitzgerald's illustration of *Caladenia clavigera*, Fitzgerald (1876), nominated as the type for *C. fitzgeraldii* by Rupp (1942); and, for *C. valida*, W.H. Nicholls' illustration of *Caladenia reticulata var. valida* (Nicholls 1969: 67).
2. For *C. clavigera*, the lectotype and two syntypes held at K were examined via high resolution images available from http://apps.kew.org/herbcat/.
3. For *C. australis*, there are historic but no recent records from E. Gippsland. For this species, field studies and detailed photographic records of the nearest populations in South Gippsland, at Won Wron, Mullundung, and both at and near its Wilsons Promontory type locality, were used for the purposes of comparison.

The publications *Bush Gems* (Backhouse *et al*. 2016) and *Orchids of East Gippsland* (Turner *et al*. 2018) contain a good selection of *in situ* photos of all these species showing many of the variations described here. *Caladenia turneri* appears in these under the common name Turner's Spider-orchid. *A Complete Guide to Native Orchids of Australia* (Jones 2021: 119,125,131) contains excellent line drawings of the flattened labella of *C. australis, C. clavigera, C. fitzgeraldii, C. flavovirens* (as *C. aestiva*), *C. montana* and *C. valida*.

Issues in distinguishing like species

In the descriptions of *Caladenia australis* and *C. montana* (Carr 1991), *C. ancylosa* (Jones 1991), *C. oreophila, C. osmera* and *C. peisleyi* (Jones 2006b), little if any commentary and no keys were provided to distinguish between the taxa, nor they from *C. fitzgeraldii* which, at various times, has been said to be present in E. Gippsland (Rupp 1942; Clements 1993; Walsh & Entwisle 1994). VicFlora (2019) treats any Victorian plants identified as *Caladenia fitzgeraldii* as 'misapplied for *Caladenia montana*'. Prior to this interpretation, *C. montana* was regarded as a taxonomic synonym of *C. fitzgeraldii* (Clements 1993; Walsh & Entwisle 1994).

Caladenia flavovirens and *C. aestiva* were described within two months of each other and referenced plants from common populations, with Jones (1991) referencing as *C. aestiva* a specimen (MEL 2149601) from the *C. flavovirens* type locality, and a specimen from Mt. Cobbler (MEL 578989) cited by Carr (1991) as *C. flavovirens*.

A review of relevant literature (Rupp 1942; Carr 1991; Clements 1993; Walsh & Entwisle 1994; Riley & Banks 2002; Jones 2006a, 2006b, 2021; Swarts *et.al*. 2014; Backhouse *et al*. 2016; Backhouse 2018; Turner *et al*. 2018; VicFlora 2019; New South Wales Flora Online 2019) reveals a variety of differing methods and traits deemed acceptable for the circumscription of these species, as well as disparate opinions and degrees of uncertainty regarding their taxonomy, distribution and population size for all of these species save *C. clavigera* and *C. ancylosa*. In many instances, the descriptions and any keys they contain rely on a range of distinguishing features, including size, location, tepal posture, a particular consistent clubbing arrangement (including length of sepal clubs, and the presence or absence of petal clubbing), colour and colour placement, or features common to more than one species. Some, such as VicFlora (2019), Walsh & Entwisle (1994) and Jones (2021) have descriptions and illustrations of labellum shape, teeth shape and placement, and in some cases refer to teeth numbers, but there is no consistent, sophisticated and systematic comparison of these features across like species, nor any detailed examination of variation within species.

In VicFlora (2019), the descriptions are qualified by comments such as: "*Caladenia montana* is similar to, and could be confused with, a few other eastern species; see *C. oreophila, C. peisleyi, C. osmera* and *C. australis*. It is also difficult to distinguish from the NSW species *C. fitzgeraldii*." This uncertainty is reflected in herbarium collections and may lead to the misidentification of plants used in scientific and pollinator studies. *See* Supplementary Tables 1 & 2.

Population studies

A characteristic of E. Gippsland's clubbed spider *Caladenia* is considerable variation in the traits that might be used to identify a particular species, and also to distinguish it from like species. Further, many of the traits that have traditionally been used to identify these species are common to more than one species.

A number of populations of each species, from locations across their distribution, were examined

over multiple seasons to determine which traits were taxonomically useful, as well as the extent of their variation within each species.

Study objectives

The principal objectives of this population study were to:

1. Determine to what extent, if any, these species can be distinguished by:
   - 1.1 a unique labellum, including labellum shape, the number, shape and placement of labellum margin teeth [teeth, labellum teeth] and lamina calli [calli]
   - 1.2 reference to particular forms and arrangements of tepal osmophore formations
   - 1.3 size measurements
   - 1.4 other traits.
2. Clarify the taxonomic status of some of the named taxa, particularly:
   - 2.1 *Caladenia fitzgeraldii* and whether it can be distinguished from *C. montana* and *C. turneri*
   - 2.2 *C. oreophila* and its distinctiveness from *C. fitzgeraldii*
   - 2.3 *C. osmera* and its distinctiveness from *C. montana*
   - 2.4 *C. aestiva* and its distinctiveness from *C. flavovirens*
   - 2.5 The clubbed spider *Caladenia* at Raymond Island, referenced in Backhouse *et al*. (2016) as *Caladenia* 'Raymond Island' and in Turner *et al*. (2018) as *C.* aff. *valida*, and its distinctiveness from *C. valida.*
3. Provide a practical working key with associated notes to facilitate the identification of these often difficult to distinguish species.

Methods

Type and other representative specimens, as well as protologues and other published descriptions were used to apply existing names with as much accuracy as possible.

For each species, close up digital photographs were taken of selected parts of pressed specimens, as well as of living plants *in situ*, to illustrate key diagnostic characteristics. The broadest possible sample of living plants or pressed specimens were captured for each taxon and individually labelled. Selected traits of individual plants were identified and recorded in multiple Excel spreadsheets by population and date. As an example, the data for *C. montana* was contained in two multi-page workbooks containing 26 site-specific pages and 22 linked summary tables and charts. These working spreadsheets were used to determine the relevant traits for each species, trait frequency, the degree of trait variation in, and across, populations, and to compare the different species, the gist of which is described in this paper.

In this study only teeth discernible as such were counted, as opposed to irregular or minutely serrate margins.

Assessment of diagnostic characters

Labellum characteristics

Labellum shape and teeth placement: *Caladenia clavigera* is readily distinguished from all other E. Gippsland clubbed spider orchids by its unique cordate labellum (and inter alia by the size and arrangement of its tepal osmophore formations).

Caladenia flavovirens (including *C. aestiva*), *C. valida* and *C. ancylosa* have similar, reasonably consistent, obscurely 3-lobed labella with erect, more or less uniform, acinaciform (i.e. scimitar-shaped, in all instances herein with apical notching on the convex rather than concave side of the curve – see side lobe teeth Figure 12b) to somewhat linear edge teeth beginning near the base and decreasing in size to the tip. Whilst this serves to distinguish them from other E. Gippsland clubbed spider *Caladenia*, the differences in their labella are subtle, and other traits must be used to distinguish between them.

For *Caladenia australis, C. fitzgeraldii* (including *C. oreophila*), *C. montana* (including *C. osmera*), *C. peisleyi* and *C. turneri,* whose labellum margin teeth are not continuous from the base to the tip, it is their unique labellum morphologies that are a principal indicator of their identity. These differing morphologies are described in the body of this paper. For this group, while labellum characteristics – such as overall size and shape, and the shape, formation and number of calli and teeth – on flowers in a patch of plants of a single species does vary, these variations occur within reasonably narrow, quantifiable limits that, at the population level, are characteristic for that species.

Teeth counts: Of particular interest in this study was determining whether *Caladenia australis, C. fitzgeraldii* (including *C. oreophila*), *C. montana* (including

C. osmera), *C. peisleyi* and *C. turneri* could be reliably distinguished by counting and comparing the number of labellum teeth pairs seen on plants of each species. Table 1 contains a summary of the conducted count of teeth pairs.

Comparing the typical teeth count range of a pair of species like *C. fitzgeraldii* (7–12 pairs) and *C. turneri* (9–14 pairs) shows considerable overlap that might lead one to conclude that they are one species if one disregards the other traits that readily distinguish them. In such cases, the ranges of the teeth count figures cannot be used to distinguish between species, they merely illustrate the considerable degree of variation in teeth numbers encountered in nature.

However, when a teeth count for a population of 20 or more of any one of these five species is averaged, it produces a mean value that is unique to that species, revealing a reliable indicator of species identity. Further, in a population by population breakdown of the data for each of these species, the variation in mean teeth pair counts of different populations of 20 or more plants of a given species rarely exceeds the mean count for all populations of that species ± 1. This is demonstrated in Table 2a.

This data, matched to labellum morphology, establishes that the different mean teeth count for each species is determined by the physical characteristics of the labellum, such as relative length of labellum, and the general placement of teeth along its margin. Thus *C. australis* (mean 17.00), which of the five species has a longer, larger labellum (12–15 mm long, ~10 mm wide) and the most extensive coverage of teeth (from near the base to near the tip), produces a higher mean teeth count than *C. peisleyi* (7.66), which has a shorter, stubby labellum (6–9 mm long, 5–8 wide) with teeth generally limited to the middle of its margins. This is visually illustrated in Table 2b.

Calli: In all species studied, the calli are more or less the same shape, of moderate thickness, foot-shaped to linear, without bulbous heads, and in all species arranged in 4–6 sparse to moderately crowded rows, often with a shorter and/or irregular outer row when six rows are present. There is trait variation within and between species, including in the percentage of plants with six or four rows of calli, and the extent to which calli extend towards the distal part of the labellum. For these species, calli examination is not a reliable character for distinguishing between taxa.

Tepal osmophore formations

The term 'osmophore' is here used strictly to refer to scent glands. All the subject species produce osmophores that are present on some or all tepals; these are sessile and either spherical or elongated (obovoid) and generally

Table 1. Summary of teeth counts for E. Gippsland spider *Caladenia*

C. peisleyi						
Typical	96	12	**7.74**	5-10	78%	2-15
Fat-legged *C. peisleyi* (with broader tepals, Lees Ck)	17	1	**7.35**	4-10	82%	3-10
C. peisleyi	113	13	**7.68**	4–10	80%	2–15
C. fitzgeraldii[1] Vic & *C. oreophila* type locality NSW	106	7	**9.08**	7–12	77%	3–15
C. fitzgeraldii[2] NSW	22	13	**8.98**	8–11	77%	6–14
C. montana above 900 m elevation	189	12	**13.61**	10–16	85%	5–26
C. montana[3] E. Gippsland Coast to 900 m elevation	81	5	**13.17**	10–16	91%	7–22
C. turneri	94	3	**10.63**	9–14	89%	6–15
C. australis - South Gippsland	84	3	**17.00**	12–20	81%	10–27

Teeth counts are of pairs. i.e. on either side of labellum

[1] These are plants described as *C. oreophila* by Jones (2006b). They include 13 plants (12%) from the *C. oreophila* type site that returned an average teeth count of 9.

[2] The lower sample size means that these figures are not as robustly supported as others quoted.

[3] These are plants described as *C. osmera* by Jones (2006b), including 32 plants (40%) from or within 500 m of the *C. osmera* type locality.

less than 1.5 times longer than they are wide (*see* Figure 1 a–c). Figure 1 also includes examples of stalked (1d) and hair-like (1e) osmophores for comparison. Apart from *Caladenia clavigera*, which either lacks or has tiny lateral sepal clubs, and *C. flavovirens*, in which the sepals vary between clubbed and tailed (Figure 2), the subject species mostly comprise populations with clubbed dorsal and lateral sepals. These are distally covered with more or less spherical osmophores, and show some thickening of the sepal ends, forming clubs of varying lengths, but typically comprising no more than one-third of total sepal length. Where the distal thickening is slight (≤1.4× wider than the narrowest part of tepal) the clubs are described as 'light clubs' (Figures 2c, 4a). Where they are noticeably thickened (>1.4× wider than the narrowest part) they are described as 'heavy clubs' (Figures 2d, 2f, 3a, 4c, 4g). Figures 1–4 show examples of sepal clubs that are more or less terete in section ('round clubs'), flattened ('flat/flattened clubs'), or with a central channel along their adaxial surface ('channelled clubs'). The covering of osmophores may be reasonably dense and end fairly abruptly; these described as 'well-defined clubs'. Conversely, where sepal ends are only slightly thickened, the osmophore cover moderately dense to sparse distally and increasingly sparse proximally and scattered further along the sepal, they are described as 'poorly-defined clubs'.

Some species have fairly uniform clubs across their range, or with one particular form predominating (e.g. *C. fitzgeraldii*), while in others a variety of different forms may be produced (e.g. *C. montana*). Some flowers of *C. flavovirens, C. ancylosa, C. australis, C. montana,*

Table 2a. Mean teeth pair counts for selected populations. Where stated, elevations are approximate.

Caladenia australis	**No. of labella counted**	**Mean no. teeth**	**Variation from mean**
Won Wron - Napier	28	16.61	-0.39
Won Wron - Dog Trap	48	17.29	0.29
Mullundung*	8	16.65	-0.35
Total:	**84**	**17.00**	
***Caladenia montana* (and *C. osmera*)**			
Cobungra (1100 m)	53	14.29	0.88
Anglers Rest North (1150 m)*	5	15.00	1.60
Knocker (1000 m)	30	14.00	0.60
Limestone Creek Track (1060 m)*	14	14.64	1.24
Cowambat (1300 m)	68	12.91	-0.49
Wulgulmerang (1000 m)*	15	11.93	-1.47
Total High Country	**185**	**13.61**	**0.21**
Noorinbee inc. *C. osmera* type locality (150–270 m)	58	13.10	-0.30
Stoney Pt Track (190 m)*	15	12.50	-0.90
Geno Pk Tk (50–110 m)*	8	14.30	0.90
All coast to foothills (incl. as *C. osmera*)	139	13.17	-0.23
Mt Tamboritha (1200–1260 m)*	17	12.59	-0.81
Goongerah (280–300 m)	21	13.24	-0.16
Total:	**304**	**13.40**	

Caladenia turneri	**No. of labella counted**	**Mean no. teeth**	**Variation from mean**
Lees Creek	76	10.75	0.12
Winkie type site	14	10.21	-0.42
Freestone Road*	4	9.75	-0.88
Total:	**94**	**10.63**	
***Caladenia fitzgeraldii* (inc. *C. oreophila*)**			
NSW various	22	8.98	-0.08
C. oreophila type locality*	13	9.00	-0.06
Coloquhoun	39	8.97	-0.09
Yalmay*	8	9.63	0.57
Goongarah	46	9.09	0.03
Total:	**128**	**9.06**	
Caladenia peisleyi			
Colquhoun	24	8.17	0.51
Total 11 sites each <20 plants*	11	7.61	-0.05
Fat Legged Peisleyi (Lees Creek)*	17	7.20	-0.46
Total:	**113**	**7.66**	
* samples from fewer than 20 labella			

Table 2b. Visual comparison of mean number of teeth between species.

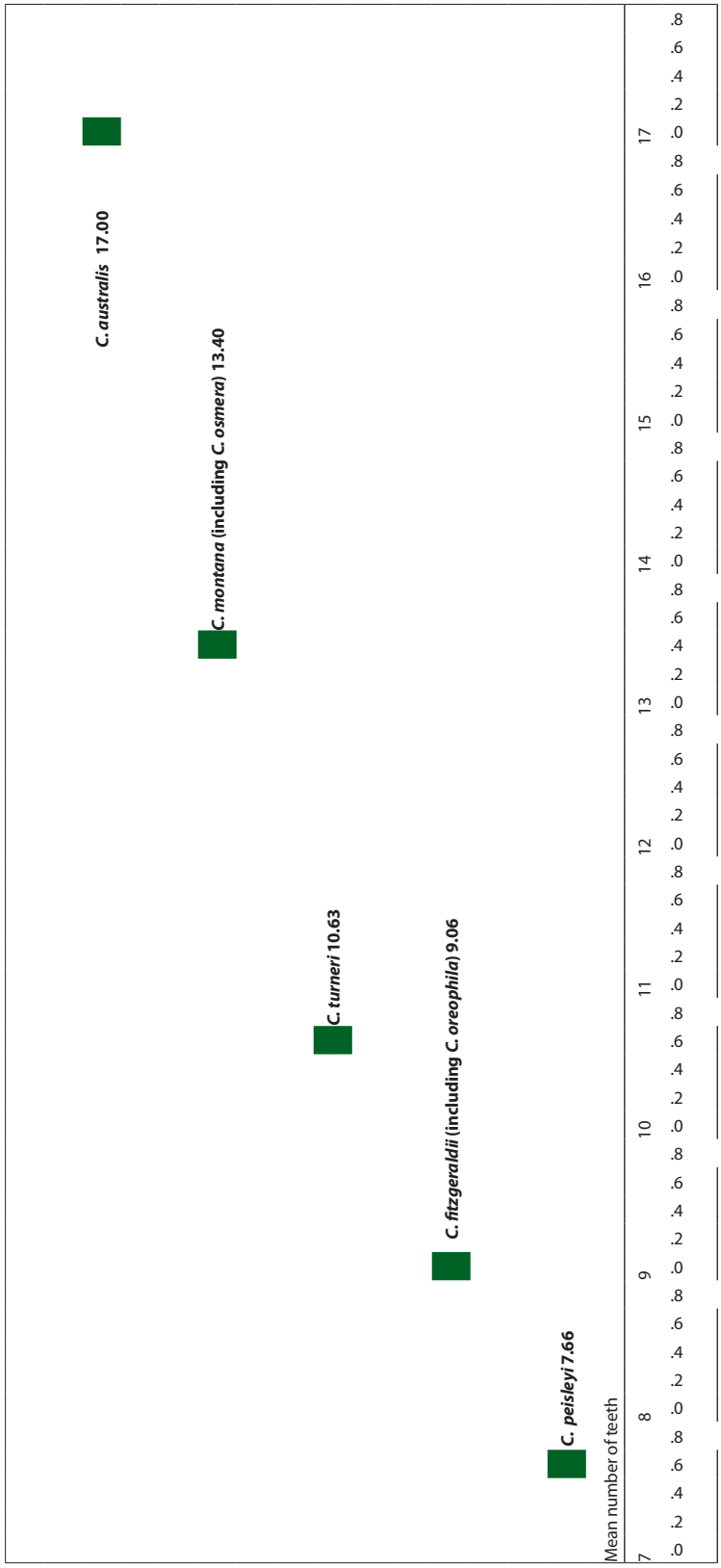

Figure 1. a–c. Lateral sepals with sessile, spherical to obovoid, osmophores; a–b. *Caladenia flavovirens,* showing non-contiguous osmophores, colour, shape and density: a, tailed form Montrose; b, clubbed form Cobungra South; c. densely clustered osmophores on the dorsal sepal club of *C. turneri,* near Lees Creek; d. stalked osmophores on the lateral sepal *C. fulva*, Three Jacks, Stawell; and e. hair-like osmophores in *C. filamentosa,* Limestone Track, Cobberas. (Photos a-b: R.Kuiter, c: L. Carrigan, d-e: W. Kosky)

C. turneri and *C. valida* have sepals without any distal thickening, a relatively sparse covering of osmophores that is proximally increasingly sparse, and often covering more than one third of the total sepal length, referred to here as 'tails' or 'tailed' (see Figures 1a, 2b, 2e, 3b 4d, 8c detail). In some cases, the distinction between clubbed and tailed formations is slight, with what are essentially tailed tepals having a very slightly thickened distal section, called 'indistinct clubs' (Figures 2a, 4a, 4e, 4f). In all the subject species except *C. clavigera,* the dorsal sepal is usually similar to the lateral sepals, though sometimes a little thicker, and all except *C. clavigera* and *C. ancylosa*, will to varying degrees have some flowers with osmophores on the ends of their petals, particularly following fire. Tepal clubbing can be remarkably inconsistent; for example, a double-flowered plant of *C. valida* was observed to have one flower with clubbed lateral sepals, its other flower with tailed lateral sepals Similarly, in many populations of *C. flavovirens,* flowers were observed with a variety of different tepal osmophore formations, including flowers with tailed lateral sepals, and clubbed petals and dorsal sepals.

The colour of osmophores varies in all species, and in some species more than others. In most cases osmophores are red to burgundy, but also sometimes translucent green, yellow or almost black. When osmophores form dense clusters on tepals, the colour of the club or tail is determined by the colour of the osmophores. When osmophores are sparsely distributed, the overall club or tail colour is determined by a combination of the colours of the osmophores and that of the tepal body, usually red/burgundy on yellow resulting in tan clubs or tails or, if colourless, the colour of the underlying tepal prevails (Figure 1a–c, 2, 4).

The clubbing arrangements seen in most populations

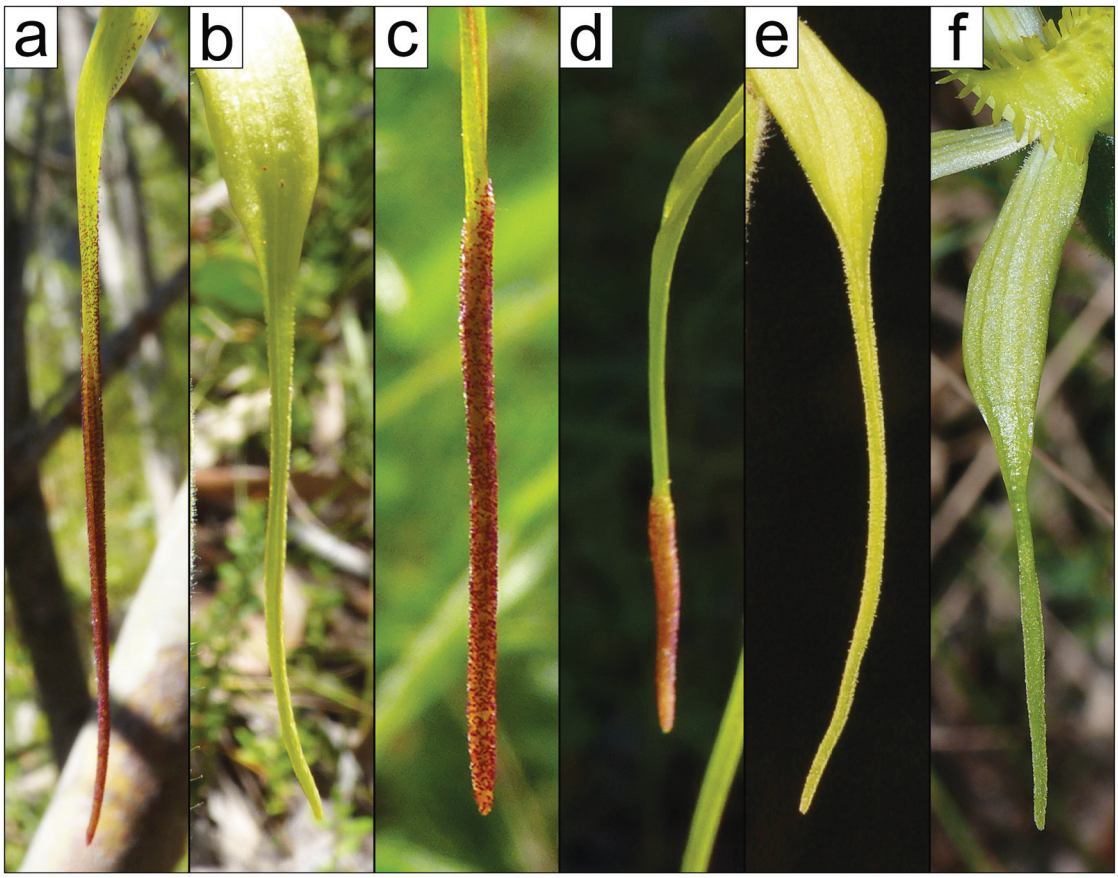

Figure 2. Examples of lateral sepal end osmophore formations in *Caladenia flavovirens*. a-b. Wombargo Creek, Wulgulmerang; c-d. Cobungra South; e. Healesville; f. Montrose type locality (Photos: a-d: W. Kosky, e: W. Probert, f: M. Rowan).

of *Caladenia montana* are illustrated in Figure 4, with a tendency for large plants with a longer covering of osmophores to occur in damper, less open, forests. The principal difference between the large plants of *C. montana* with tailed or tail-like indistinct clubs (e.g. Figure 4 d–f) and those of *C. flavovirens* with tailed or indistinct clubs is that in *C. montana* the osmophores are mostly contiguous, while in *C. flavovirens* they mostly are not.

This morphology does not support the contention that these species can be distinguished as separate species solely by their tepal osmophore formations, and in particular solely on the basis of having clubbed or tailed formations. The division of spider *Caladenia* into clubbed and tailed species is in itself somewhat artificial, and reference to the shape of their osmophores is more appropriate.

Size measurements

In this group of species, measurement of a single plant is of little use in determining its identity. The ratio of petal length to lateral sepal length is variable, but petals are usually shorter. The dorsal sepal is usually marginally shorter than the lateral sepals and, unlike the lateral sepals, is difficult to measure in the field. In this work, the length of lateral sepals has been found to be the better, more consistent and easier to measure indicator of flower size for comparison. However, across these species there

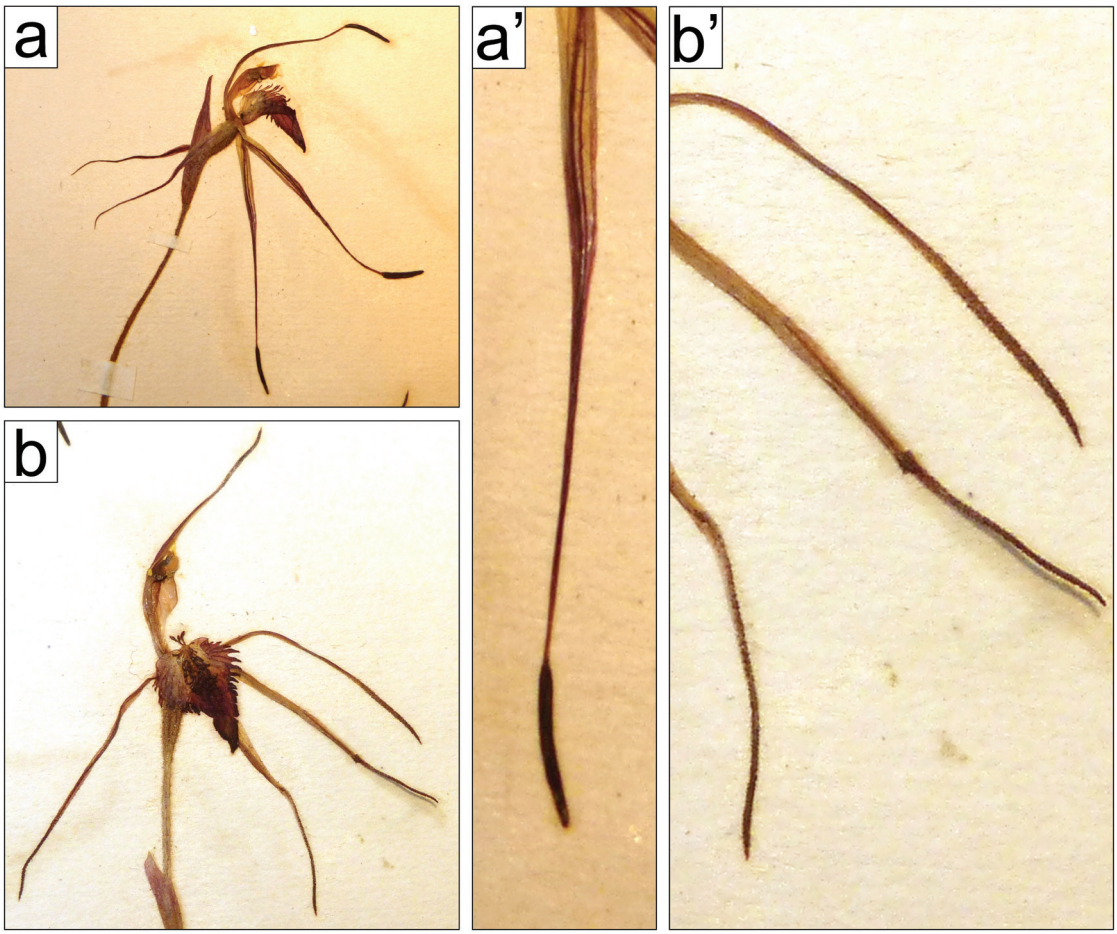

Figure 3. Detail of *Caladenia australis* holotype bearing plants labelled 'a' and 'b' (Wilson's Promontory, Victoria. *J.H.Willis* 17.x.1933. MEL 577737). a. plant 'a' with well-defined heavy sepal clubs bearing densely packed osmophores, petals without clubs that are shorter than the sepals. b. plant 'b' with tailed lateral sepals and left petal, the right petal and dorsal sepal indistinctly clubbed, length of sepals and petals similar. Whilst 'a' represents the more common form, plants like 'b' are often seen, for example in populations of *C. australis* in the Moe/Mirboo North region (Photos: W. Kosky).

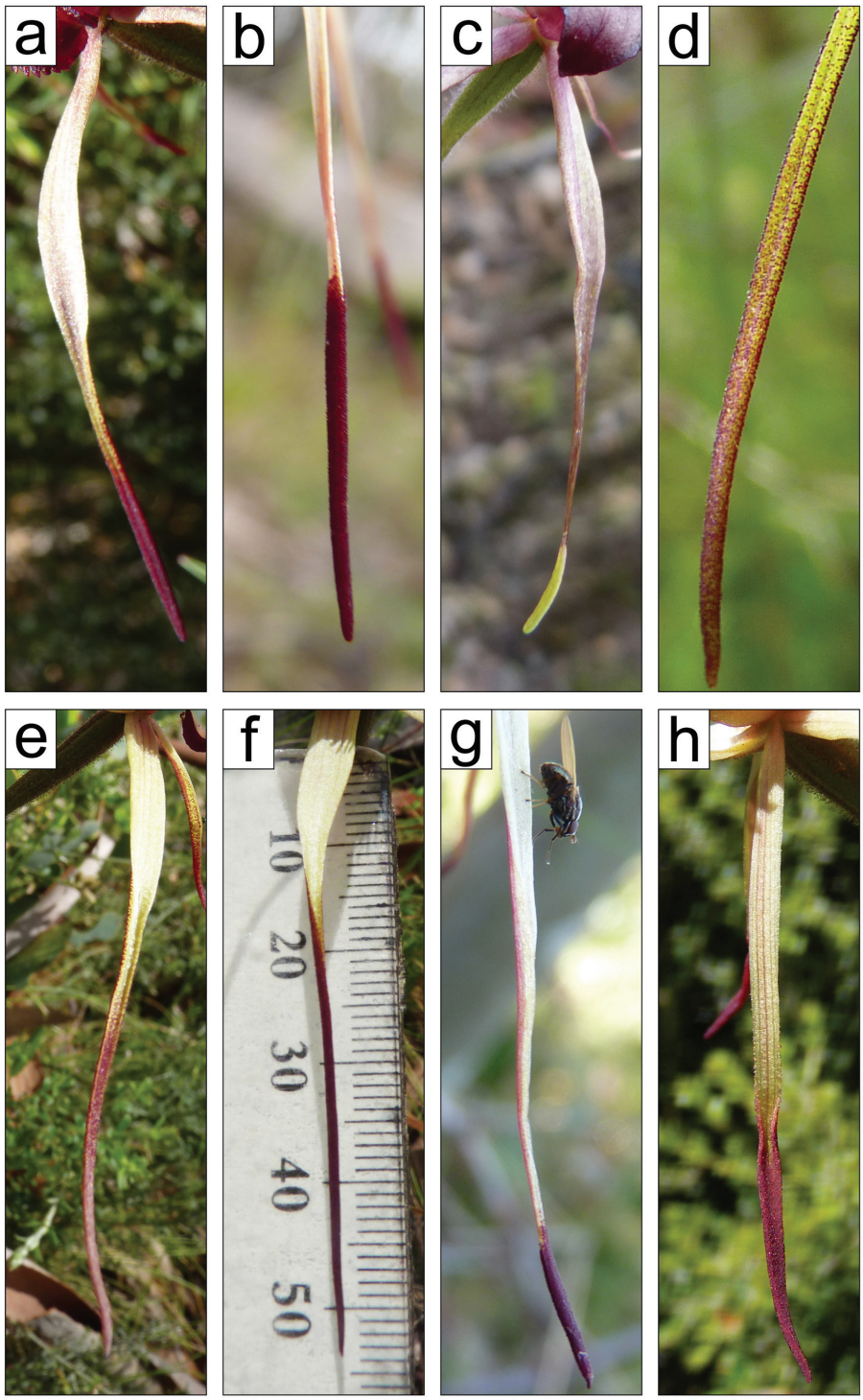

Figure 4: The variety of lateral sepal osmophore formations seen in *Caladenia montana*. a. Cobungra; b. Noorinbee at *C. osmera* type site; c. Genoa; d–f. Large plants at Cobungra South; f. lateral sepal 6 cm long, dense osmophore cover 3.5 cm; g. Cobberas; h. Cobungra, pinched and flattened (Photos: W. Kosky).

is an overlap in size that changes in response to various external factors. For example, in post-fire landscapes plants of the smallest species *Caladenia clavigera* and *C. peisleyi* may give rise to measurements comparable to medium to large species like *C. montana* and *C. australis*.

That said, measurements of populations of species, particularly over a number of seasons and across diverse locations, do allow for the degree of variation within a species to be characterised, and generate average values that allow for a generalised size comparison with other species. A 2004–2010 study of a small number of *C. valida* at Raymond Island established that, whilst the range of lateral sepal lengths for this population can vary considerably from year to year, the average length over the study period is reasonably consistent (A. Bould, pers. comm.). For example, in 2008 (the driest season) the range was 1.8–3.5 cm (mean = 3.1 cm), compared with 2010 (the best season), when the range was quite different, at 2.4–4.5 cm, but with a similar mean of 3.35 cm. The mean lateral sepal length over the study period was 3.17 cm, with annual variations within the range of 3.17 ± 0.2 cm.

Other traits

The morphological analysis in the next section, as well as the key and its notes, describe the traits that individually or in combination serve to identify the E. Gippsland clubbed spider *Caladenia*. The following should be noted:

- While details of the environment in which a plant occurs are relevant to our understanding of a given species (and orchid species concepts generally) and might be used to provide collaborative evidence about an orchid's identification, features such as location, habitat, elevation, aspect and climate are not endogenous attributes. As such, they should not be used or relied upon to identify a plant species, nor indeed to separate taxa into different species.
- Following fire, the range of variation and the vigour of plants reaches extremes, with petal clubbing and multiple flowers often being common in species among which they are uncommon in the absence of fire (for example *Caladenia peisleyi*, pers. obs.).
- In most subject species tepal posture changes with flower age.
- Flattening the curved surface of the area from the labellum base to its widest point often folds segments into pleats that visually under-represent the actual extent/area of the base section, including any side lobes.
- The labellum surface of all species treated here is grainy and sub-hyaline, giving a semi-glossy appearance. Labellum glossiness is not a reliable distinguishing trait as it is subjective and easily affected by wetness, secretions, sun, flash lighting and quality of ambient light.

Taxonomy

Caladenia fitzgeraldii, *C. montana* and *C. turneri*

The relative scarcity of *Caladenia fitzgeraldii* has given rise to uncertainty and differing opinions regarding the identity and distribution of *C. montana* and *C. fitzgeraldii* in south-eastern Australia; when both species occur together, the close morphology of the taxa has also resulted in a tendency to treat all plants at mixed populations as representing the one taxon or the other. This issue is compounded by the presence of apparent hybrids between the taxa at some locations; the appearance of *C. fitzgeraldii* resulting in its being designated by some authors as the hybrid *C. montana* × *C. clavigera*; the naming of plants indistinguishable from *C. fitzgeraldii* in the upper Cann River Valley near the Victoria–New South Wales border as *C. oreophila*; and plants in near-coastal E. Gippsland, indistinguishable from *C. montana*, being named as *C. osmera*. The key distinguishing characteristics of these taxa are set forth in Table 3 and illustrated in Figure 5.

Caladenia turneri can be distinguished from *C. fitzgeraldii* by way of its obscurely three-lobed labellum with elevated margins, including teeth, which begin on the rise from the base and extend up to halfway along the mid-lobe.

Caladenia fitzgeraldii and *C. oreophila*

Caladenia fitzgeraldii Rupp, *Austral. Orchid Rev.* 7: 64 (1942). *Arachnorchis fitzgeraldii* (Rupp) D.L.Jones & M.A.Clem. *Orchadian* 13(9): 394 (2001); *Calonemorchis fitzgeraldii* (Rupp) Szlach., *Polish Bot. J.* 46(2): 139 (2002). Type: Fitzgerald's plate in *Austral. Orch.* 1: pt 2! (1876) as *C. clavigera*.

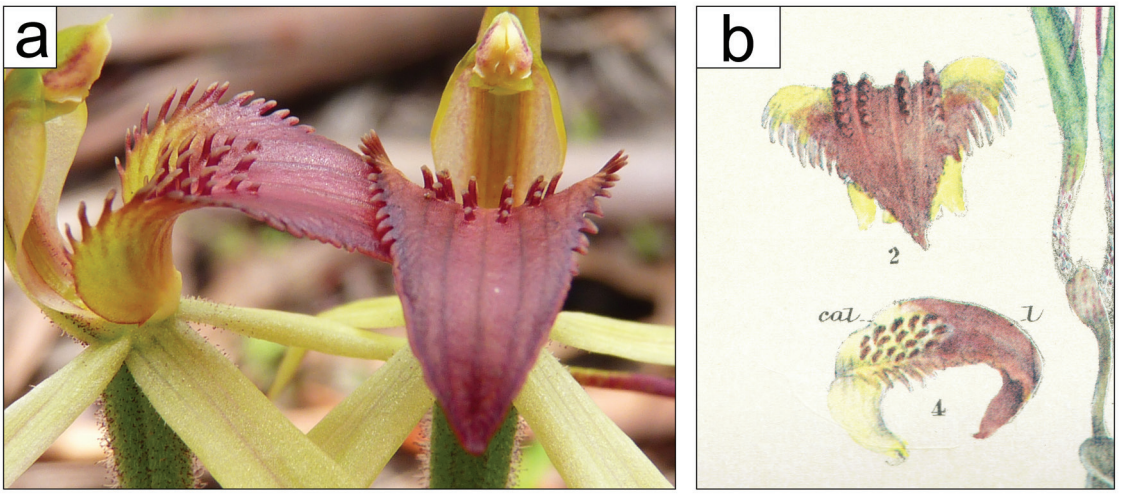

Figure 5. Differences in labellum shape, profile, distal protrusion, lateral cross sections, teeth number, cast and placement in: a. *C. montana*, Cobungra; b. *C. fitzgeraldii*. (Photo: a: W. Kosky, b: adapted from Fitzgerald (1876)).

Table 3. Key characteristics distinguishing *Caladenia montana* from *C. fitzgeraldii*.

Characteristic	*C. montana*	*C. fitzgeraldii*
Labellum shape	Obscurely 3-lobed, mid-lobe protruding forward markedly (forming an oblique platform) before decurving.	Unlobed (but deflexed margins and/or teeth can give an obscurely 3-lobed appearance), the distal section protruding forward moderately (without forming an oblique platform) before decurving.
Labellum lateral cross section	At widest point moderately to deeply concave, its margins (including teeth) elevated. Flattens somewhat into mid-lobe.	At widest point moderately to shallowly concave. Margins and teeth in mid-section where teeth begin usually mildly decurved to flaccid, less often horizontal, and rarely a continuation of concave upsweep. Flattens somewhat towards apex.
Number of calli rows	6 (~70% of plants) with outer rows often short. 4 in ~30% of plants.	Mostly 4.
Reticulate venation	Most light to heavy. Some without.	Most without. Some with light venation.
Teeth pairs	Mean 13.4 Typically 10–16 pairs.	Mean 9.06 Typically 7–12 pairs.
Teeth placement and form	Beginning elevated on rise from base, longer linear to acinaciform, longest 1–2(–3) mm, then decrescent and horizontal, shorter, broader, incised to just into mid-lobe.	Confined to mid-section of the side margins, beginning on or after the top of the rise from the base, short linear to serrate, longest 0.5(–1) mm, decrescent. Teeth mostly decurved, sometimes horizontal, rarely elevated.
Clubs	Variable. Light to heavy. Well to poorly defined. Some flattened, channelled or tail-like; occasionally tailed.	Reasonably consistent. Most light to moderately heavy, terete, well-defined.
Lateral sepal length	(2–)2.5–4.5(–6) cm.	2–4(–4.5) cm.
Detectable odour	Strong burnt plastic odour on hot days.	None.

Arachnorchis oreophila D.L.Jones, *Austral. Orchid Res.* 5: 55–56 (2006); *Caladenia oreophila* (D.L.Jones) G.N.Backh., *Victorian Naturalist* 124: 124 (2007). Type: New South Wales. Beside the Monaro Highway, south of Hopping Joe Creek, 4.x.2004, *D.T. Rouse 201* (holo CANB 656585!; iso MEL 2330125!).

The type of *Caladenia fitzgeraldii* (Rupp 1942) is based on Fitzgerald's plate illustrating three plants (two sharing the same sheath and collar) which Fitzgerald had identified as *C. clavigera*. (Fitzgerald 1876). In the notes accompanying his illustration, Fitzgerald gives the location of the plants as '*near Mudgee*'.

Caladenia oreophila (as *Arachnorchis oreophila*) (Jones 2006b) is based on a collection from 'New South Wales. Beside the Monaro Highway, south of Hopping Joe Creek' and its distribution given as *'Known only in the upper reaches of the eastern branch of the Cann River in south-eastern New South Wales and just over the border in adjacent areas of Victoria […] Alt. 450–480 m*'. The labellum teeth of the four pressed flowers in this type material, which includes a dissected flattened labellum mounted on a small card (Figure 6e), are short, linear to serrate, all beginning at or after the top of the rise from the labellum base and confined to the mid-section of the labellum margins. The labella bear 9 ±1 teeth pairs. These, the other characteristics of the type collection,

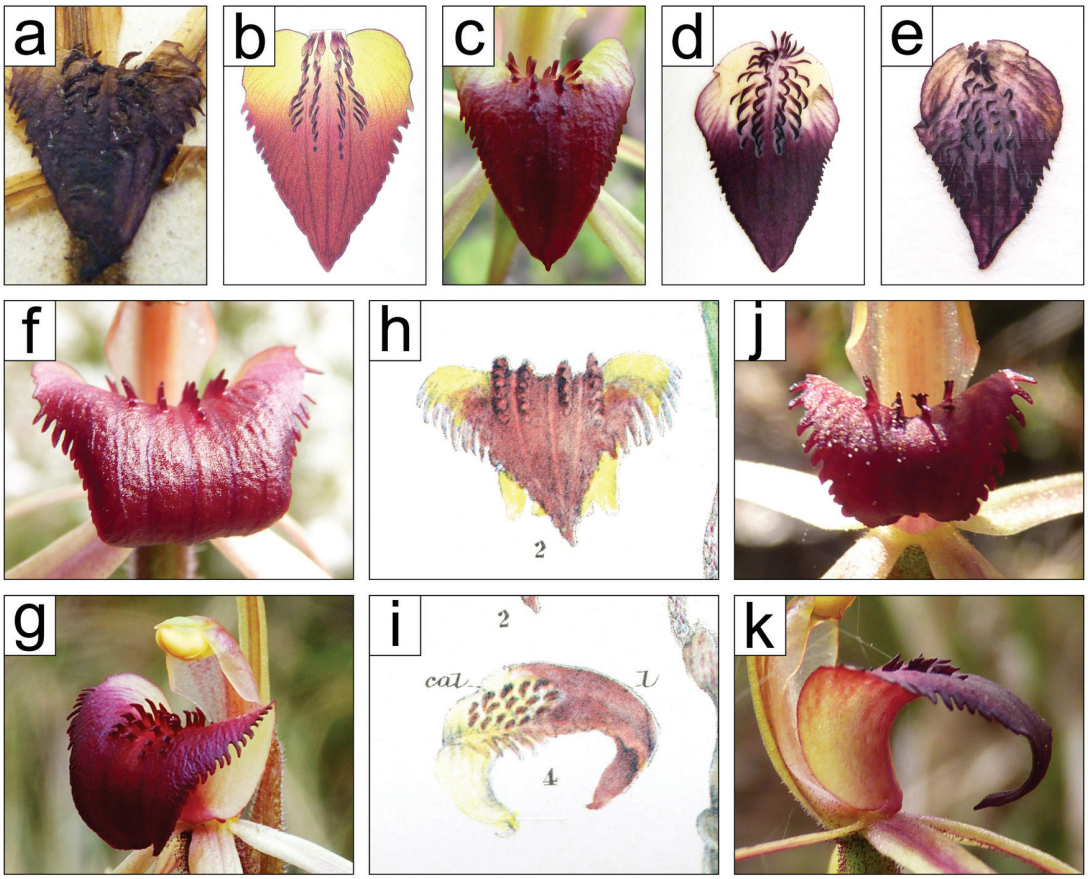

Figure 6. *Caladenia fitzgeraldii* labella images from the NSW Central Tablelands (CT), East Gippsland, ViC. (EG) and adjacent parts of south-eastern NSW (SE NSW). a. Genoa River, SE NSW, vicinity of *C. osmera* type locality, ex Rupp's personal collection, determined by N.A. Wakefield as *C. fitzgeraldii* (NSW51320); b. Kandos, CT. John Riley's illustration "C" (Riley & Banks 2002: 59); c. Goongerah, EG; d. Mt Canobolas, CT, determined as *Arachnorchis fitzgeraldii* (CANB 680293); e. *C. oreophila*, type locality Monaro Highway, SE NSW, detail from holotype (CANB 656585); f. Knocker, EG, nine teeth visible on left side; g. Mt Canobolas, CT, ten teeth on right side, supplied as *C. fitzgeraldii*; h-i. Labella details from Fitzgerald's (1885) illustration, near Mudgee, CT: h, with nine marginal teeth pairs, some longer than avarage, i: with eight or nine teeth (detail partly obscured by highlights); j–k. Labella from the *C. oreophila* type locality, with nine teeth pairs and nine teeth on the left side respectively (Photos: a-f, j-k: W. Kosky, g: C. Bower, h-i: adapted from Fitzgerald (1885)).

and indeed Jones's description of *C. oreophila*, consistently place this taxon within the established morphology of *C. fitzgeraldii*.

Northern distribution

The recorded northern distribution of *Caladenia fitzgeraldii* is the New South Wales Central Tablelands (Mudgee, Wellington, Lithgow, Bathurst and Orange districts). From this region, representative examples include Fitzgerald's type illustration from near Mudgee (Figure 6h–i), Riley's illustration (Riley & Banks 2002: 59) of *C. fitzgeraldii* from Kandos (Figure 6b), plants of *C. fitzgeraldii* photographed at Mt Canobolas (Figure 6g), a further photo of *C. fitzgeraldii* (as *Arachnorchis*) from the same location by Jones (2006a: 70), two separate Rupp specimens from Dripstone (45 km west of Mudgee) now held at NSW (NSW 651327, NSW 651328) determined by Rupp himself as *C. fitzgeraldii,* and those of the present author from the Central Tablelands held at CANB, determined as *Caladenia fitzgeraldii.*

Southern distribution

The known southern distribution of *Caladenia fitzgeraldii* (including the populations referred to by Jones as *C. oreophila*, included here within *C. fitzgeraldii*) encompasses E. Gippsland, Victoria, and the south-east corner of New South Wales, including the Australian Capital Territory. Prior to 2014, *C. fitzgeraldii* was only known to the author in Victoria from three locations: the Victorian population Jones refers to as *'just over the border'* from the *C. oreophila* type site; north of Lakes Entrance (several sites near Watershed Road); and the Knocker north of Omeo, with a specimen record from Diggers Hole track near the Buchan River Crossing, 12 km north-west of Gelantipy (MEL 1554925). Following the extensive 2014 bushfires north of Orbost, good populations of both *C. fitzgeraldii* and *C. montana* were found around Yalmy and Goongerah, midway between the coast and the Dividing Range. At all these locations, *C. fitzgeraldii* grows with or in close proximity to *C. montana*.

Ecology/Phenology

In Victoria, *Caladenia fitzgeraldii* grows in reasonably open to somewhat dense, often grassy or heathy mountain Eucalypt forests. It has a sparse distribution across the 250–1200 m elevation range. It usually flowers after fire, or slashing, after which it declines in subsequent regrowth. At lower elevations, it flowers in August, September and October, but November into December at higher elevations. Below 250 m, the similar *C. peisleyi* occupies habitats comparable to that of *C. fitzgeraldii*.

Notes

A photographic sample from 110 plants of *Caladenia fitzgeraldii* was collated from Victorian and near-Victorian locations, including 13 plants from at or near the *C. oreophila* type locality. Matching plants from the same locations are illustrated in Backhouse *et al*. (2016), Turner *et al*. (2014) and Jones (2006b) as *C. oreophila*. A comparison of all these plants with Fitzgerald's type illustration, the New South Wales Central Tablelands representative examples, and specimens of *C. fitzgeraldii* from south-eastern New South Wales and Victoria shows that all plants have a consistent set of common distinguishing characteristics. Examples of *C. fitzgeraldii* labella is provided in Figure 6: a–e show near identical, unlobed labella morphology, while f–k show marginal teeth (and adjacent labellum edge) decurved to flacid, none erect, and how this trait can create the impression that these labella are obscurely three lobed.

Selected Specimens Examined: New South Wales: Bondi State Forest. A few km N of Victorian border on Monaro Highway, 1.5 km S of Hopping Joe Creek crossing, 12.xi.2004, *D.T. Rouse 201* (Holotype of *Arachnorchis oreophila,* CANB 656585); Maragle SF 17.xi.2004, *P.G. Branwhite 266* (CANB); Brindabella Road opposite entrance to Brindabella National Park, 16.xi.2004, *D.L. Jones 19168* (CANB); Lithgow, fire trail running E. of Little Hartley Rd, 2.x.1998, *C. Bower ORG 1589* (CANB); Cultivated ex Lees Mtn, Canobolas, SF 12.ix.1998, *C. Bower ORG 1524* (CANB); Mt Canobolas 10.xi.1963, *B. Whitehead s.n.* (CBG 8103540 [at CANB]); Ilford-Rylstone Rd between Charbon and Kandos, 7.x.1999, *G. Bradburn ORG 2738* (CANB); Escort Rock, Eugowra 22.ix.1963. *W.E. Giles ?s.n?* (NSW 651332); Cann Valley Hwy. Xi.1992, *R.G. Tunstall ORG 1352* (CANB); **New South Wales ex Rupp's Herbarium of Australian Orchids:** Dripstone, N.S.W. x.1945, *G.W. Althofer s.n.* (NSW 651328); Dripstone, N.S.W. ix.1945, *G.W. & P. Althofer s.n.* (NSW 651327); Extreme S.E. of N.S.W. near Genoa River, ix.1940, *N.A. Wakefield ?s.n.?* (NSW 651320); **Victoria:** Cann Valley Hwy. South of Winnots Creek, ca. 40km N of Cann River, xi.1992, *R.G. Tunstall* ORG 1354 (CANB); The Knocker 11.xi.1999 *P.G. Branwhite 79* (CANB); East Gippsland. Buchan River at Diggers Hole Track crossing 6 km

south west of Mt. Seldom Seen, 3.xi.1986, *S.J. Forbes 3202* (MEL); Hillside above Yalmy Road, 800 metres west of Pinnak Road, 20.2 km NNW of Orbost, 21.ix.2014 *J. Turner 2021* (MEL); Near ridge top off Watershed Road, 8.ix.2014, *J. Turner 2019* (MEL); *1.3km up Watershed Track from Reformatory Road, C. 11km NW of Nowra Nowra 27.ix.2015 R.D. Phillips 373* (MEL).

Caladenia montana and *C. osmera*

Caladenia montana G.W.Carr, *Indig. Fl. Fauna AssoC. MisC. Pap.* 1: 10 (1991). Type: Nunniong Plateau area, Reedy River valley above gorge, 13.xi.1964, *J.H. Willis s.n.* (holo MEL 1532470!).

Arachnorchis osmera, D.L.Jones, *Austral. Orchid Res. 5*: 56-57 (2006*); Caladenia osmera* (D.L.Jones) G.N.Backh., *Victorian Naturalist* 124: 124 (2007). Type: Victoria. Cemetery Track, *ca*. 1.2 km N of Leslies Track, Noorinbee North State Forest, 4.x.2004, *D.T. Rouse 200* (holo CANB 656586!).

Caladenia montana was named without a detailed taxonomic description but with good notes on many of its distinguishing features (Carr 1991), including its *'broad labellum* [...] *projected forward distally to form an oblique platform'* and a representative type bearing two single-flowered plants, one with and one without petal clubs, with provenance from *'below Brumby Point, Nunniong Plateau area, +/- 3000 feet'* [914 m] (MEL 1532470). The further nomination of three representative specimens, two from alpine regions above 1000 m elevation and one given only as from Cann River (*N.A.Wakefield* 2741; MEL 1508361), allows one to readily identify this species. MEL holds four specimen sheets of *C. montana* from coastal E. Gippsland (Lakes Entrance to Genoa), including the cited Cann River specimen.

The type locality for *Caladenia osmera* (= *Arachnorchis osmera*) is 'the north end of Cemetery Track, Noorinbee North State Forest', approximately 15 km north of Cann River township (Jones 2006a). Its distribution is given in the protologue as 'East Gippsland from Lakes Entrance to Genoa, extending to border areas of south east New South Wales', and its elevation range given as 10–490 m.

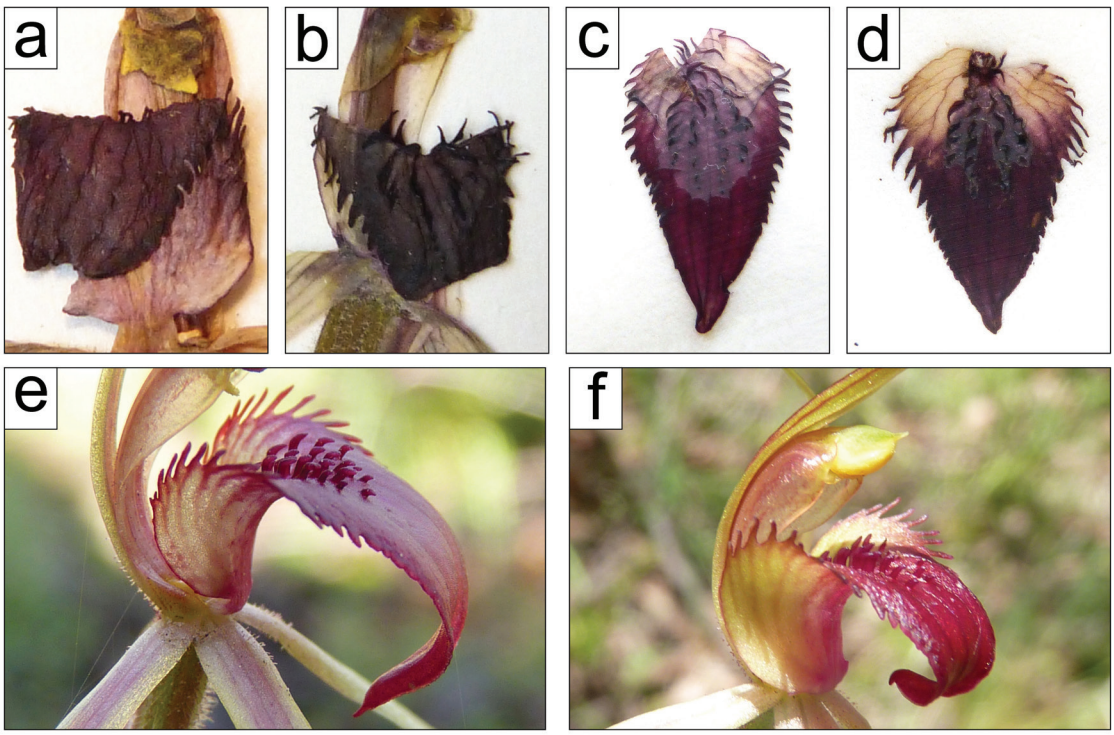

Figure 7. Various *Caladenia montana* labella. a. Detail of *C. montana* type, below Brumby Point, Victoria (MEL 153247); b. Part of *Arachnorchis osmera* type, Noorinbee, Victoria (CANB 656586); c. *A. montana*, Maragale, NSW (CANB 656014), note that side lobes are folded**;** d. *A. osmera*, Betka River, Mallacoota ViC. (CANB 3641); e-f. Labella showing the shape and placement of teeth, with mid-lobe "*projected forward distally to form an oblique platform*" as described by Carr (1991), e: from a robust plant, *C. osmera* type site, Noorinbe, 280 m elevation, f: smaller plant, Mt Stewart, 700 m elevation (Photos: a-f: W. Kosky).

Jones's description of *C. osmera* is consistent with that of *C. montana* encountered at all elevations, save that Jones indicates its labellum lateral lobes as being erect, with 8–11 pairs of teeth, and its mid-lobe with *'7–10 pairs of very short reddish teeth decrescent and forming an irregular marginal band towards the apex.*' Studies of specimens referred to as *C. osmera* do not support the suggestion of an '*irregular marginal band*' of small teeth toward the apex of the labellum as a feature of the species. The type collection comprises two plants with longer erect linear labellum teeth beginning on the rise from the base (i.e. part way into the side lobes), becoming shorter and broader, incised and horizontal part way into the mid-lobe, but not extending to the apex, one with 12 pairs of teeth (Figure 7b), the other with 11 teeth visible from one side, with a fold that appears to hide a few additional teeth. This is consistent with the average population teeth count of 13.4 for *C. montana*. Both Carr's and Jones's descriptions refer to the plants' particular odour, in both cases said to be reminiscent of burnt plastic.

Distribution

In Victoria *Caladenia montana* occurs in undisturbed to lightly disturbed forested areas in E. Gippsland, from the Eastern Alps to the E. Gippsland coastal foothills and west through the Great Dividing Range to Mt Tamboritha, Licola, Cathedral Ranges and Mt Samaria. It also occurs in south-east New South Wales and the Australian Capital Territory.

Ecology/Phenology

Caladenia montana grows in reasonably open grassy or heathy, mountain, foothill, and coastal Eucalypt forests from the coast to 1500 m elevation. At lower elevations it flowers from August–October, at higher elevations into November, December and early January. It flowers well after fire, but persists and flowers periodically in more open locations without fire.

Notes

It is not apparent whether, or how, Jones distinguished *Caladenia osmera* from *C. montana*, other than perhaps by treating *C. montana* as *'restricted to higher montane areas'*, given as 700–1000 m elevation (Jones 2006a). However, field studies and examinations of all accessible records establish that, in E. Gippsland, *C. montana* extends from alpine areas to the coast without any significant elevational separation or indeed any discernible morphological change. For example, a direct comparison of a sample of plants from the *C. osmera* type locality at 280 m elevation with *C. montana* plants from the Knocker at 960 m elevation showed that, within the range of variation exhibited by plants at both sites, they were clearly of the same taxon.

Caladenia montana was thoroughly documented photographically, capturing 333 plants across 22 populations extending from 1500 m elevation (the Victorian Eastern Alps west to Mt Tamboritha) through to the E. Gippsland coast. The sample set included 81 plants from near-coastal regions within the range of Jones's distribution of *C. osmera,* including 32 plants from at or near the *C. osmera* type locality. Whilst considerable secondary, often random, trait variation occurs both within and across populations, including different mixes of ancillary traits, these traits were found to be present in all populations. Moreover, all these populations, along with the type and specimens examined by Jones also studied as part of this work, demonstrate a consistent set of primary traits and mixes of ancillary variable traits that place them within the range of natural variation exhibited by *C. montana*. All populations of 20 or more plants have remarkably consistent mean teeth pair counts of 13.4 $\pm$1 (Table 2).

The principal characteristics of *Caladenia montana* labella are illustrated in Figure 7.

Selected Specimens Examined: Australian Capital Territory: Orroral, Upper Cotter 4.xi.1960**,** *N.T. Burbridge ?s.n.?* (NSW 651324)**;** Track to Nursery Swamp 26.x.2003 *D.L. Jones s.n.* (CANB 475170); **New South Wales:** 5 km along Two Sticks Road, Brindabella Valley. 16.xi.2004, *D.L. Jones 19142* (CANB); Maragle SF 17.xi.2004, *P.G. Branwhite 265* (CANB); Monaro Hwy, Bindi SF, a few (1-2) kms north of Victorian border. 1.x.2005, *D.R. Rouse 252* (CANB); **Victoria:** East Gippsland. Cann River, Spring 1947, *N.A. Wakefield 24719* (MEL); Above Bonang Road 5.2 km north of Goongerah, 28.ix.2014 *J. Turner 2021* (MEL); By old track up hillside not far from Bonang Road 2 km south of Goongerah School, 23.x.2014, *J. Turner 2043* (MEL); Betka River, 30.ix.1990, *A.D. Bishop J112/9-11* (CANB); The Playground below Cobberas No.1., 28.xii.1976, *E.W. Finck* ?s.n? (MEL); Cobungra, xii.1927, *H. Morgan s.n.* (MEL 1597954); Diggers Hole track, near Buchan River crossing. East Gippsland, 15.xi.1989. *K. Hill 3686* (NSW).

Caladenia flavovirens and *C. aestiva*

Caladenia flavovirens G.W.Carr, *Indig. Fl. Fauna AssoC. MisC. Pap. 1*: 5 (1991). Type: Montrose, Dandenong Ranges, Victoria, 7.xii.1980, *J. Eichler s.n.* (holo MEL 1532457!).

Caladenia beaugleholei D.L.Jones, *Austral. Orchid Res.* 2: 16 (1991). Type: Victoria; Gorae West near Portland, 14.xii.1942, *A.C. Beauglehole s.n*. (holo MEL 578984!)

Caladenia aestiva D.L.Jones, *Austral. Orchid Res.* 2: 14 (1991). Type: Victoria; Benambra-Wulgulmerang Rd, 7.i.1970, *A.C. Beauglehole 33327*, *K.C. Rogers & E.W. Finck* (holo MEL 652783!).

Caladenia flavovirens was published without any description beyond what was necessary to distinguish it from *C. pallida* Lindl. (Carr 1991), which Carr noted as being *'endemic in Tasmania'.* He indicated that *C. flavovirens* was *'widespread in the forest of the eastern highlands of Victoria'.* To establish the features that characterise *C. flavovirens* as a species, one is obliged to rely on Carr's type collection and representative specimens.

The *Caladenia flavovirens* type collection, from 'Montrose, Dandenong Ranges, Victoria' (MEL 15324570) [elevation *ca*. 300 m], is a double-flowered plant presenting tepals with round, relatively broad, filamentous distal portions that are longer than the broader basal part and more or less sparsely covered with osmophores. The top flower has dorsal and right-hand lateral sepals with slightly thickened indistinct clubs. The plant's other tepals are tailed (Figure 8a). Carr's representative specimens include: plants bearing flowers with tailed sepals, e.g. specimens from Mt Drummer (MEL518552) [300 m elevation] and Mt.

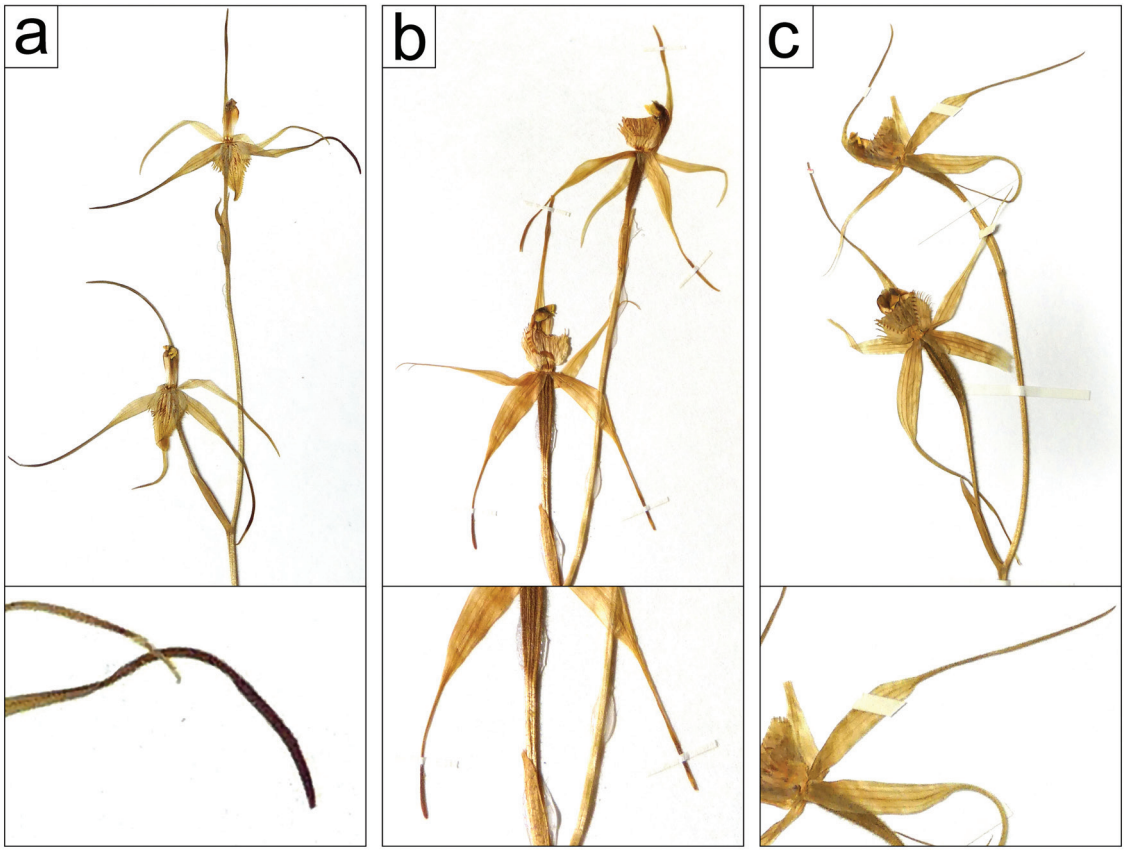

Figure 8. a. Detail of *Caladenia flavovirens* type material Montrose (MEL15324570); b. Detail of *C. aestiva* type material, Benambra-Wulgulmerang Rd, Wulgulmerang West (MEL 652783); c. Jones's representative specimen of *C. aestiva* from the Montrose type locality of *C. flavovirens* (MEL 2149601). The subtle differences between the tepal endings on these specimens is best assessed by viewing the actual specimens under magnification (Photos: a-c: W. Kosky).

Cobbler (MEL 578989) [900 m elevation]; a sheet of two single-flowered plants from Boronia with clubbed dorsal sepals and petals and indistinctly clubbed to tailed lateral sepals (MEL578990) [100 m elevation]; and a sheet bearing two single-flowered and one double-flowered plants from Ringwood (MEL578982) [90 m elevation]. One of the single-flowered plants on the latter sheet has well-defined heavy sepal clubs (Figure 9d), while the other has relatively thick sepal tails. The double-flowered plant has tepals that are hard to determine as either clubbed or tailed. Carr subsequently determined as *C. flavovirens* an indistinctly clubbed specimen from the Brindabella Ranges, New South Wales, 4,750 ft [1448 m elevation] (MEL646902).

In the protologue of *Caladenia aestiva* (Jones 1991), variation in floral morphology is noted as follows (the term '*osmophore*' is used therein to describe clubbed osmophore formations, i.e. the entire club rather than an individual gland). The perianth is described as having dorsal sepals *'linear in proximal half then abruptly tapered to a linear-filiform channelled cauda ca 0.5 mm wide, either glandular throughout with sessile, dome-shaped to clavoid glands or thickened into a brown or green terminal osmophore* […] *Lateral sepals* […] *oblong-lanceolate to lanceolate in proximal half then abruptly narrowed to a linear-filiform, cauda (either entire or with a terminal osmophore), similar to that on the dorsal sepal. Petals* […] *usually glandular near apex, sometimes with a terminal osmophore similar to those on the sepals. Labellum* […] *obscurely three-lobed* […] *lateral lobe [with] marginal calli scimitar-shaped,* […] *mid-lobe* […] *margins with numerous, short, tooth-like calli, decrescent towards the apex.*'. The accompanying drawing (Jones 1991, Figure 14) has a flower with well-defined heavy sepal clubs, the accompanying photo of a plant from Wulgulmerang with a well-defined, light dorsal sepal club, and tailed lateral sepals and petals.

The *Caladenia aestiva* type collection from Benambra-Wulgulmerang Rd (MEL 652783) consists of three plants with four flowers, their lateral sepals with osmophore formations that vary from light, well-defined clubs to barely thickened indistinct formations that are hard to attribute as either tailed or clubbed (Figure 8b). Jones's 'Selected Collections' include the Mt Cobbler tailed specimen (MEL 578989) Carr selected as representative of *C. flavovirens* and a tailed specimen from the *C. flavovirens* type locality at Montrose (MEL 2149601) (Figure 8c), which is a good match to the *C. flavovirens* type specimen.

Distribution

Caladenia flavovirens is currently only known from five locations in Victoria, viz: Montrose (where its continued presence is in doubt) and Healesville in the Dandenong Ranges, and Cobungra, the Cobberas and Wulgulmerang in the Eastern Alps. There are reliable records of it from the Upper Yarra/Boronia/Ringwood district, the Portland district, Mt Cobbler east of Mansfield and Mt Drummer and Omeo in E. Gippsland, however, searches in recent times have not found plants at any of these locations. There are two records from the Australian Capital Territory, namely a 1981 record of a single plant from the Namadgi National Park not seen since its discovery, and a 1962 sheet bearing four plants from Mt Murray. The only record from New South Wales is a 1970 specimen from the Brindabella Ranges. Many records in the form of herbarium specimens have, on close examination, proven to be of other species.

Ecology/Phenology

Caladenia flavovirens grows in reasonably open grassy or heathy Eucalypt forests in the 90–1500 m elevation range. At all elevations, it flowers from mid-December to mid-January.

Thynnid wasps have been observed to be attracted to the tepal osmophores and labella of *Caladenia flavovirens* at Cobungra South and Wulgulmerang, and in one instance one was photographed grappling with an indistinctly clubbed tepal, pseudocopulating with its labellum, and removing and departing with its pollen (Kuiter 2015, and Kuiter pers. comm.). Both Kuiter and the author have documented, at both locations, that Thynnid wasps and other insects consume secretions formed on the labellum teeth and calli of *C. flavovirens* plants.

Notes

Carr and Jones's respective characterisations and nominated specimens of *Caladenia flavovirens* and *C. aestiva* encompass plants with the same population-wide sets of morphological variation across a 90–1500 m elevation range. In each case, the specimens bear

flowers with tailed sepals, clubbed sepals, and others that are not easily defined as either. In describing *C. aestiva*, Jones described plants from Carr's designated populations of *C. flavovirens* as a new species in spite of the continuous range of variation that *in situ* studies of *C. flavovirens* populations show. The name *C. aestiva* clearly sits in synonymy with *C. flavovirens*, which has priority as the earlier of the two published names.

Across its range, *Caladenia flavovirens,* (including *C. aestiva*) is characterised by its: labellum without reticulate venation; relatively large flowers on inflorescences 20–40 cm tall, lateral sepals (2–)3–4.5(–5.5) cm long, tepal osmophores sessile, spherical to obovoid, grouped densely to sparsely distally, becoming

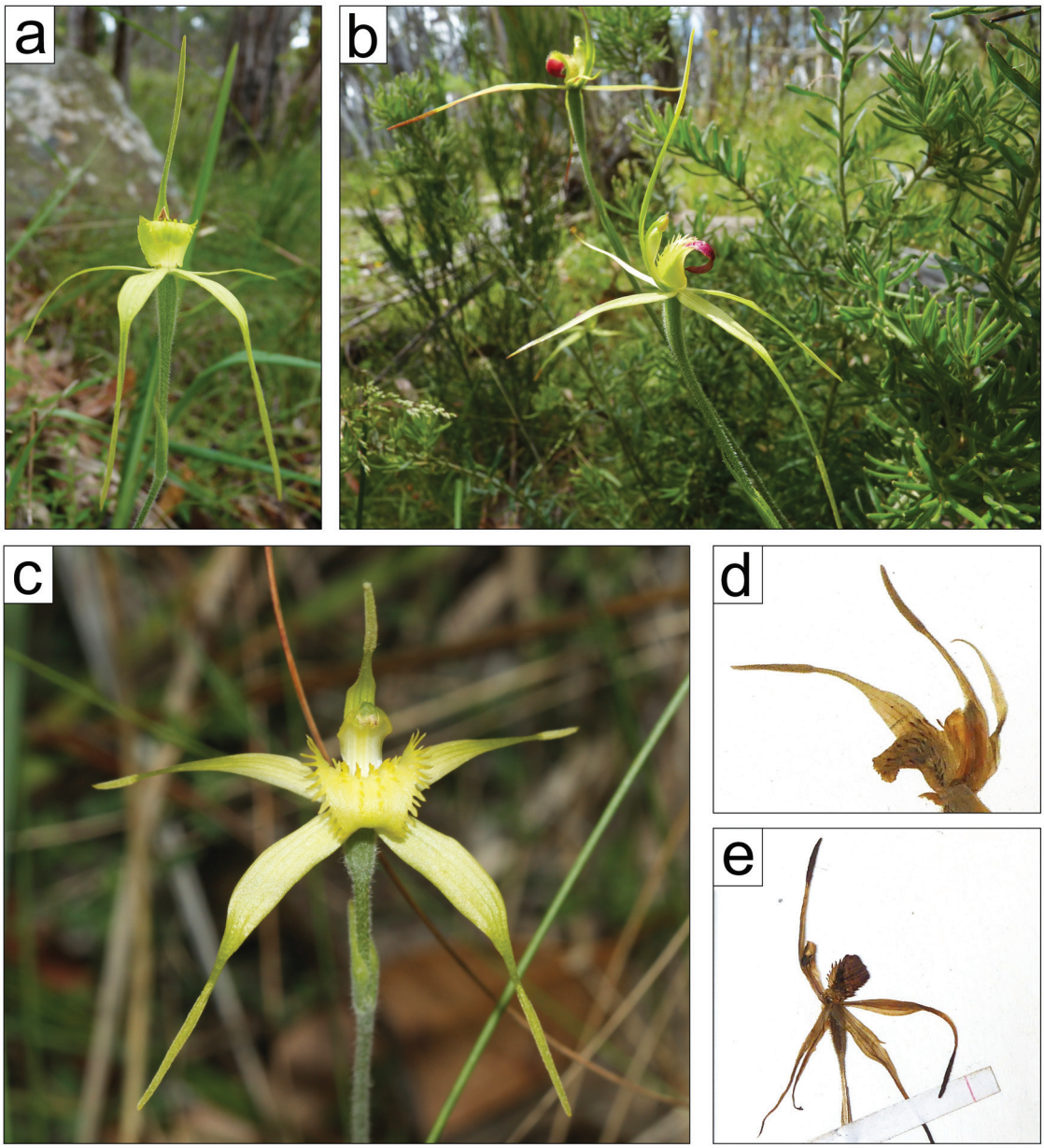

Figure 9. *Caladenia flavovirens* flowers. a. With relatively thick-tailed sepals, Montrose; b. With lightly clubbed sepals, Cobungra South; c–e. With distinct, heavy sepal clubs, c: also with clubbed petals, Montrose, 2011, d: detail of Ringwood material (MEL57898), e: detail of Box Hill material (MEL 2169604) (Photos: a-b, d-e: W. Kosky, c: W. Probert).

sparser proximally, rarely clustered (Figures 1a, 1b, 2), the extent of osmophore coverage of the distal section of the lateral sepals amounting to greater than half the sepal length; labellum obscurely 3-lobed, teeth beginning near the base, to a greater or lesser degree acinaciform and decrescent to the apex, those on the side lobes varying between broader, shorter, somewhat serrate teeth, to longer narrower somewhat linear teeth (Figure 9); ovary at anthesis *ca*. 10–15 mm long, *ca*. 3–4 mm wide, the ovary and the abaxial surface of the tepals near base with white/transparent glandular hairs, the glands sometimes red; effulgent flowers that are yellow to green, with a host of different colour highlights, typically reds to shades of orange, tan or brown on the labellum mid-lobe, teeth, calli, and clubbed or tailed tepal ends; flowering in December and January. Its known distribution includes coastal foothills to alpine regions, from the Dandenong Ranges to E. Gippsland, with outlying records from Portland and the Brindabella Ranges (NSW and ACT), and a typical habitat of sheltered ridges and slopes in usually grassy, open forest.

Careful examination of the *Caladenia flavovirens* populations in and around the Mt Dandenong area, Wulgulmerang, the Cobberas and at Cobungra South consistently found a highly variable mix of plants with clubbed and tailed tepal end formations. The clubbed formations are only occasionally distinctive, well-defined heavier clubs, more often well to poorly-defined light clubs, while many exhibit only a very slight thickening of part of the lateral sepal ends (indistinct clubs) that are hard to attribute as either tailed or clubbed (see, e.g. Figures 1a, 1b, 2, 8, 9).

Conservation Status: Good records of *Caladenia flavovirens* exist for 18 subpopulations which, at their peak, contained an estimated total population of 800 plants. Today it is only known from five locations, with a total population of no more than 250 plants. Occurrences of this order satisfy the IUCN Red List CR (Critically Endangered) Criteria C.2a,b(i,ii,iv,v), (IUCN 2012). This taxon is listed as critically endangered under the Victorian Flora and Fauna Guarantee Act.

Selected Specimens Examined with approximate elevation in metres in square brackets: **Australian Capital Territory**: Bendora Arboretum, Brindabella Ranges, 29.xii.1981, *C. Bower, s.n* (CBG 9703064.10) [900 m]; **New South Wales:** Along the track to Lewra Track from Lewra Gap, Brindabella Range, 14.i.1970, *R. Filson 11467* (MEL) [1450 m]; **Victoria:** Montrose, Dandenong Ranges, 7.xii.1980, *J. Eichler s.n*. (Holotype of *Caladenia flavovirens* MEL 15324570) [300 m]; Benambra-Wulgulmerang Rd, 7.xi. 1970, *A.C. Beauglehole 33327* (Holotype of *Caladenia aestiva* MEL 652783) [1000 m]; Gorae West, 14.xii.1942, *A.C. Beauglehole s.n.* (Holotype of *Caladenia beaugleholei* MEL 578984) [150 m]; Vicinity of Mt. Cobbler, i.1933, *D. Mathews s.n.* (MEL 578989) [900 m]; Mt. Drummer below Princess Highway, about 12 miles east of Cann River; R. Melville, 2843 (MEL) [90 m]; Ringwood19.xii.1927, *W.H. Nicholls s.n.* (MEL 578989) [300 m]; Western slopes of Mt. Dandenong, just above Montrose, 28.xxi.1947, *A.B. Court s.n.* (MEL 2149601) [290 m]; Boronia, xii.1930, *D. Paton ?s.n.?* (MEL 5789900) [A100m]; Box Hill, xii.1899, *C. French Jnr.,s.n.* (MEL 2169604) [100 m].

Caladenia valida

The basionym of this taxon is *Caladenia reticulata var. valida* Nicholls (1943). In elevating *C. valida*, Clements & Jones (1989) designate plate 251 in Nichols (1969) as the lectotype.

Backhouse *et al*. (2016) and Turner *et al*. (2018) treat the clubbed spider *Caladenia* at Raymond island as a separate taxon, however, a direct comparison of plants from there with the type illustration of *C. valida,* and plants from the type locality (Portland district), shows a good match with the Raymond Island plants, albeit with some differences in the incidence of different forms of tepal osmophore formation. In the absence of any published descriptions of the Raymond Island plants as a distinct taxon, this study regards that difference as sitting within the circumscription of *C. valida*, as per VicFlora (2019). For further details, see the supplementary notes available on the *Muelleria* web page.

Caladenia turneri Kosky sp. nov.

Diagnosis: ***Caladenia turneri*** shows an affinity with *Caladenia montana* but has a proportionally shorter, moderately protruding labellum, fewer labellum marginal teeth ((6–)9–14(–15) pairs), and generally smaller habit and flowers.

Type: Victoria, Gippsland: Winkie Creek, 15 km NNE of Briagolong, 24.x.2016, *J.R. Turner 3000* & *W.A. Kosky* . (holotype MEL 2402981, MEL 2402982 (spirit)).

Other specimens examined: Victoria: NW of Lees Creek Track, 1.35 km from Freestone Creek Road, 21.5 km north of Briagolong, 24.ix.2016, *J.R. Turner 2098* & *W.A. Kosky* (MEL).

Illustrations: Turner *et al*. 2014, p.39 (as *Caladenia* aff. *montana,* Freestone Creek); in Backhouse *et al*. 2016, pp. 151, 152 (as *Caladenia* Turner's form).

Description: Hirsute, tuberous, terrestrial *herb* (1)–20–30(–35) cm tall, scape not elongating in fruit, growing singly or in small groups of scattered plants. *Leaf* solitary, lanceolate, (8–)10–15(–20) cm long, 4–8 mm wide, patent, dull green, base red to purple-blotched; with an indumentum of hairs on both surfaces, hairs fine, eglandular, 4–6 mm long. *Scape* erect, 12–30 cm long, stem *ca*. 1.5 mm in diameter, terete, green with red flush to mostly green or mostly red, with fine eglandular hairs mostly to 4 mm long, but to 6 mm near base, the pedicel also with short hairs tipped with red spherical glands. *Sterile bracts* 1.2–2.2 cm long, closely sheathing stem, upper part sometimes divergent, ovate-oblong, acute, external surface with fine eglandular hairs; *fertile bract* 1.2–2.2 cm long closely sheathing pedicel, upper part sometimes divergent, external surface with fine eglandular hairs. *Ovary* at anthesis *ca*. 10 mm long, *ca*. 2 mm wide, green, covered with short hairs, these tipped with red spherical glands. *Flowers* 1, rarely 2, 3.5–5 cm across, overall pale yellow to pink, very rarely entirely yellow-green; *dorsal sepal* erect to incurved, petals and lateral sepals stiffly spreading, deflexed; *tepals* pale yellow to pink, usually with red veins, abaxially near base with short hairs tipped with red spherical glands; *tepal ends* with distinct, thickened, terete or channelled to flattened dark red clubs formed by densely packed sessile spherical osmophores (sometimes absent on petals); *dorsal sepal* 2–3.5 cm long, 2–3 mm wide basally then tapering to a thickened club 6–12 mm long; *lateral sepals* 2–3.5 cm long, 2–3 mm wide in the basal half, abruptly narrowing and then tapering to a thickened round, flat or channelled club 6–12 mm long; *petals* 1.5–2.5 cm long, 1–2 mm wide in the basal half gradually tapering to an acute apex with around 25% of population with a thickened club and 25% with a sparser

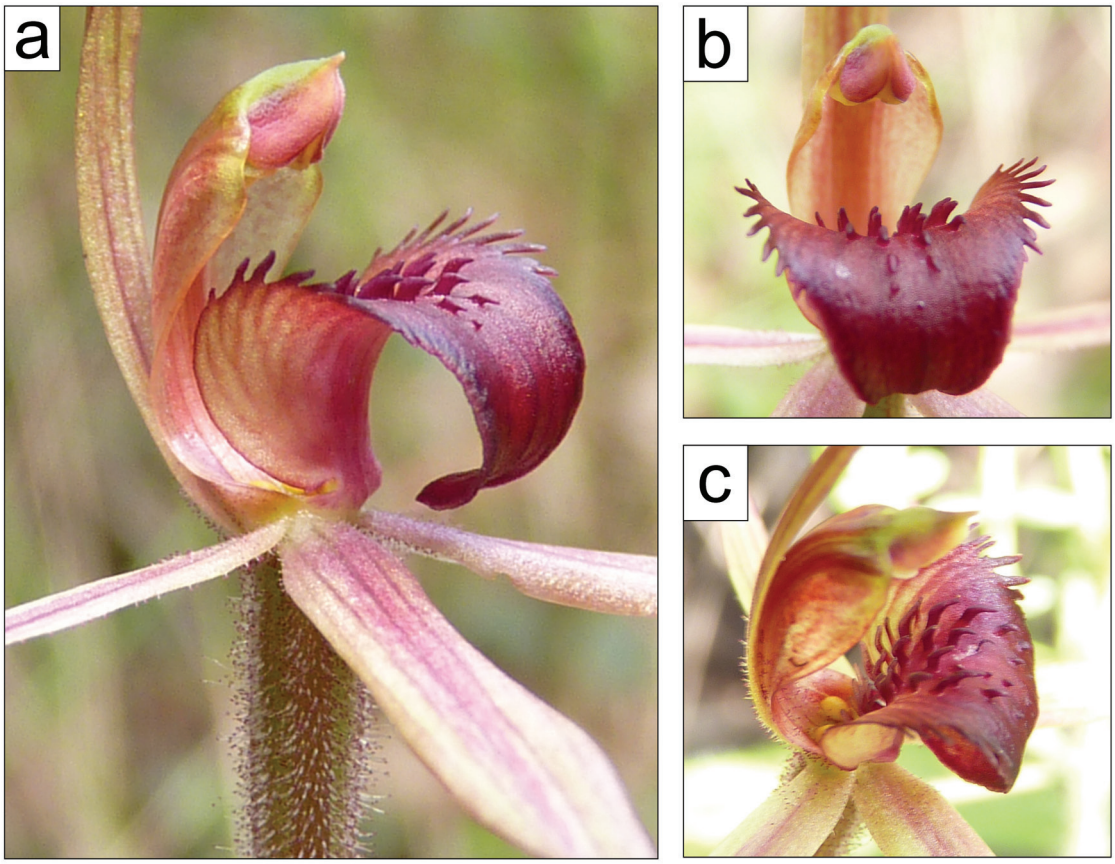

Figure 10: Labella and column detail in *Caladenia turneri*. a. from near Lees Creek, side view; b. front view; c. elevated view (Photographs: a-c: W. Kosky).

cover of osmophores in the distal 3–7 mm; *labellum* stiffly articulated on a short hinge *ca*. 1.5 mm wide just above its axis, 9–12 mm long, 6–9 mm wide and ovate when flattened, the rounded base to the widest point considerably shorter than the irregularly triangular distal section, obscurely 3-lobed, base shallowly concave, side lobes obliquely erect, mid-lobe mostly flat, narrowing to the acute apex that is rolled under in an open curve, glossy dark red with a short, pale yellow or pink base sometimes with red radial branching stripes; *labellum marginal teeth* typically 9–14 pairs (average of 94 plants: 10.7 pairs) narrow, linear, *ca*. 1.3 mm long, dark red, erect to obliquely erect before the top of the rise from the base (being the highest part of the elevated labellum edge, and the widest when flattened), progressively decreasing in length, broadening and becoming incised and horizontal; mid-lobe margin usually entire from *ca*. half way or less towards apex, occasionally irregularly serrate or serrulate; *labellum lamina calli* in four rows, dark red, extending from the base to the mid-lobe base, or often extending well onto the mid-lobe, basal calli stalked, curved, often with slightly flattened apices, the longest *ca*. 1.5 mm long, progressively decreasing in size and becoming thicker and sessile towards mid-lobe, distal calli often reduced to tiny rounded projections. *Column* 11–15 mm long, 2–3 mm wide, incurved, with partially transparent wings broadening towards the apex, variably greenish or reddish, with two yellow ovoid basal glands at its base; *anther ca*. 2 mm long, *ca*. 2 mm wide, with a short acute rostrum; *pollinia* 4, in two flat, joined pairs, yellow; *stigma* elliptic; *ca*. 2 mm wide, sunken; *capsule* not seen (Figures 10, 11).

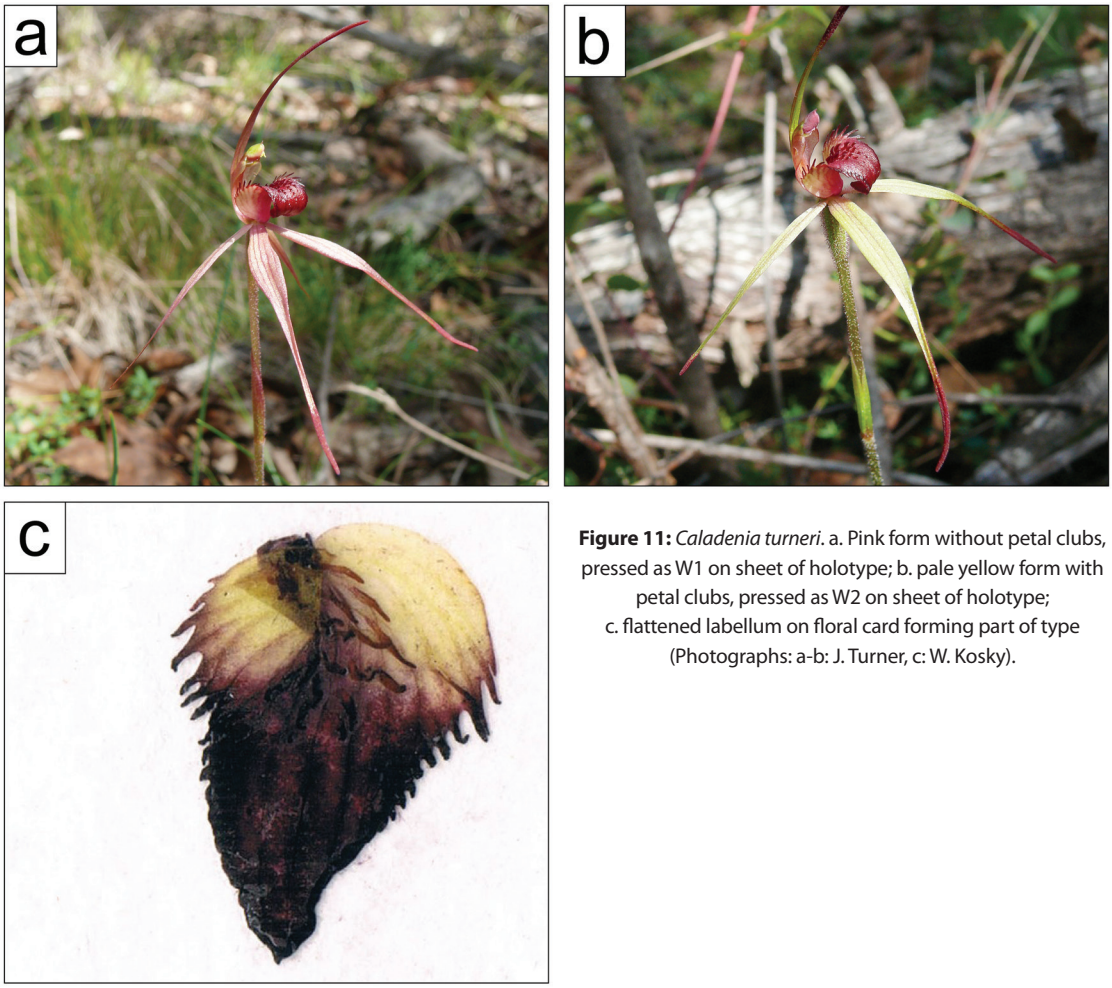

Figure 11: *Caladenia turneri*. a. Pink form without petal clubs, pressed as W1 on sheet of holotype; b. pale yellow form with petal clubs, pressed as W2 on sheet of holotype; c. flattened labellum on floral card forming part of type (Photographs: a-b: J. Turner, c: W. Kosky).

Distribution and Habitat: *Caladenia turneri* is known only from the upper Freestone Creek catchment in the foothills of the Great Dividing Range north of Briagolong, in Gippsland, Victoria, at an elevation of 170–370 metres. The species occurs in the *Shrubby Dry Forest* to *Shrubby Damp Forest* Ecological Vegetation Class (DSE 2004), usually in reasonably open areas. Associated species include *Eucalyptus bridgesiana* R.T.Baker, *E. croajingolensis* L.A.S.Johnson & K.D.Hill, *E. cypellocarpa* L.A.S.Johnson, *E. macrorhyncha* F.Muell. ex Benth; *E. polyanthemos* subsp. *vestita,* Schauer, *Acacia dealbata* Link, *Acrotriche serrulata* (Labill.) R.Br., *Bossiaea prostrata* R.Br., *Leucopogon fletcheri* subsp.*brevisepalus* J.M.Powell, *Phyllanthus hirtellus* Müll.Arg, *Poa labillardierei* Steud., *Caladenia parva* G.W.Carr, *C. peisleyi* (D.L.Jones) G.N.Backh., *Pterostylis alpina* R.S.Rogers, *P. nutans* R.Br. and *P. peduculata* R.Br.

Ecology/Phenology: Over summer, *Caladenia turneri* plants persist as dormant tubers. Given suitable seasonal conditions plants emerge as leaves in winter, with mature plants forming buds which flower from mid-September to mid-October. In dry years, plants in a given subpopulation may not emerge at all, but remain dormant for one or more years until favourable conditions return. Pollination is thought to be effected through the sexual deception of males of a parasitic thynnine wasp species which have been observed to be attracted to its flowers, but not observed removing pollen (pers. obs, and in Kuiter (2015: 38–38), where *C. turneri* is there misidentified as *C. brachyscapa*).

Notes: *Caladenia turneri* is a small to medium-sized clubbed spider *Caladenia* that can be distinguished from other clubbed spider *Caladenia*, principally by its moderately projecting, obscurely 3-lobed ovate labellum with an mean of 10.7 pairs of linear marginal teeth (typically 9–14 pairs amongst 89% of 94 measured plants, with a minority in the 6–15 pair extreme range), initially erect before the top of the rise from the base, and subsequently decrescent, becoming horizontal up to halfway into the mid-lobe, usually with four full rows of lamina calli, and by a combination of secondary characteristics namely: flowers with rather rigid, relatively narrow petals and sepals, the sepals with thickened, well-defined, terete, channelled or flattened clubs, about half of the plants with shorter petal clubs, and a mixture of both pale yellow and pink to red flowers; and an indumentum of fine hairs to 6 mm long on the leaf and base of the stem.

The determination of *Caladenia turneri* as a distinct species was based on detailed examination of fresh specimens in the field and careful analysis of photographs of 107 plants from three disjunct populations between 2010 to 2016. *Caladenia turneri* is most similar to *C. montana* which is generally larger, usually 25–45(–50) cm tall; with lateral sepals (2.5–)3–4(–6) cm long and a larger, obscurely 3–lobed, labellum (11–18 mm long, 6–11 mm wide), the mid-lobe protruding further forward to form an oblique platform before decurving, with a mean of 13.4 teeth pairs (10–16 pairs amongst 87% of 236 flowers measured, the remainder with 5–26 pairs); as in *C. turneri*, teeth begin on the rise of the labellum base up to half way into the mid-lobe, but are linear to acinaciform proximally, decrescent and incised distally, the majority with 6, not always full, rows of calli. *Caladenia montana* has not been encountered in the upper Freestone Creek catchment. It occurs further to the north and east, the nearest record being *ca*. 40 km away. *Caladenia turneri* is superficially similar to *C. fitzgeraldii* which, with a mean teeth count of 9.06 is reasonably close to that of *C. turneri* (10.7). However, *C. fitzgeraldii* is usually 15–40 cm tall; has lateral sepals 2.5–4 cm long, a labellum 10–15 mm long and 6–11 wide, being essentially intermediate in size between *C. turneri* and *C. montana*. It is readily distinguished from *C. turneri* by its unlobed labellum, its teeth being confined to the mid-section of its side margins beginning on or after the rise from the base, and short decurved to horizontal, rarely elevated (see Figure 5). The nearest record of *C. fitzgeraldii* is *ca*. 80 km east of the upper Freestone Creek catchment. At two sites, but not at its type locality, *C. turneri.* grows close to or alongside *C. peisleyi*, another related species. That species has a relatively short, stubby, unlobed ovate labellum 6–9 mm long and 5–8 mm wide, with fewer teeth pairs (mean 7.66, with 4–10 pairs amongst 80% of 113 flowers measured, the remainder in the 2–15 range) beginning on or after the top of the rise from the base and confined to the mid-section of the labellum margin. Plants of *C. peisleyi* are usually 15–30 cm tall, lateral sepals (1.5–)2–3(–3.5) cm long. No obvious hybrids or intergrades between these species have been observed.

Conservation Status based on IUCN Categories and Criteria, IUCN (2012): *Caladenia turneri* is only known from a population of *ca*. 90 mature plants in three disjunct subpopulations. Its known area of occupancy is less than 5 km^2. All known subpopulations are on Crown Land, part of the Briagolong State Forest. Surveys for clubbed spider *Caladenia* throughout Gippsland have failed to find the species anywhere outside the Freestone Creek catchment. It is likely that more plants are to be found in the extensive area of suitable habitat surrounding the type locality, as well as potentially elsewhere in unsurveyed pockets of similar habitat within the catchment, much of which is difficult to access. Its population is estimated to be greater than 150 but fewer than 500 individuals. In dry seasons, the number of mature plants is greatly reduced; extensive searches during the dry 2019 growing season by members of the Bairnsdale and Districts Field Naturalists Club only found 10 flowering plants at the Lees Creek subpopulation site and none at the other two sites (J. Turner, pers. comm). Even so, assessments of the known subpopulations over time show that numbers appear to be reasonably stable. That said, all subpopulations occur along the base and lower slopes of gullies with roads or rough tracks traversing them; parts of these subpopulations have been subject to direct disturbance, and thus population decline is likely from road making, forest fire management activities and resultant silting. Given the ongoing nature of these activities, in particular extensive forest fire management verge clearing in forests in the region, the single location of the population is likely to further decline unless these activities either cease or are modified to prevent further damage to the known subpopulations and potential habitat. Therefore, *C. turneri* satisfies IUCN 3.1 Red List CR (Critically Endangered) Criteria B1ab(ii,iii)+2ab(i,ii,iii) (IUCN, 2012).

Etymology: Named after eminent East Gippsland field naturalist James Robert Turner (1938–) who first documented and collected this species.

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The author offers his sincere thanks to: James Turner for introducing him to *Caladenia turneri*, as well as to numerous significant spider *Caladenia* sites throughout E. Gippsland; his wife Helen for the pleasure of her company in the field, and to Helen and John Saxton, for spotting all the plants that the author and his colleagues missed; Kerry Seaton (DELWP), Len and Josee Carrigan, and Anne U'Ren for locating populations and providing images; Graham Trigg and Rudie Kuiter for images of plants from the Knocker and elsewhere; Mischa and Colin Rowan for access to the extensive orchid photography on their website (www.retiredaussies.com); Colin Bower, for sharing his knowledge of *Caladenia fitzgeraldii* in the NSW Central Tablelands, the ACT and Victoria, for information on pollinators and images, and for first indicating the presence of both *C. fitzgeraldii* and *C. montana* at the Knocker in Victoria; Ron Howlet and Warrick Biggs for images; Andrew Bould for sharing his knowledge and longitudinal survey data of the *C. valida* population at Raymond Island, and David Pitts for information on other populations of *C. valida*; Wendy Probert, John Eichler and Rudie Kuiter for information and images of *C. flavovirens*; Mark Clements for sharing images of spider *Caladenia* from the ACT and SE NSW; Richard Thompson for sharing his vast knowledge of the ways orchids grow; Neville Walsh, Tim Entwisle, Gary Backhouse, Andrew Brown, Geoff Carr, and John Riley, for their generous time and assistance; the directors and curatorial staff at MEL, NSW and CANB for access to specimens, permission to use images of their specimens, and for assistance provided by Emma Toms, Anna Munro and Brendan Lepschi (CANB); Gill Tower and Peter Weston, NSW; Sally Stewart (MEL) for providing difficult to obtain texts; and special thanks to Catherine Gallagher, Team Leader Collections Curation, and Wayne Gebert, Curator of Monocots, at MEL for their assistance in locating and providing countless specimens for examination.

Supplementary Material

Supplementary notes and tables can be downloaded from the *Muelleria* web page. Any additional data is available from the author on request.

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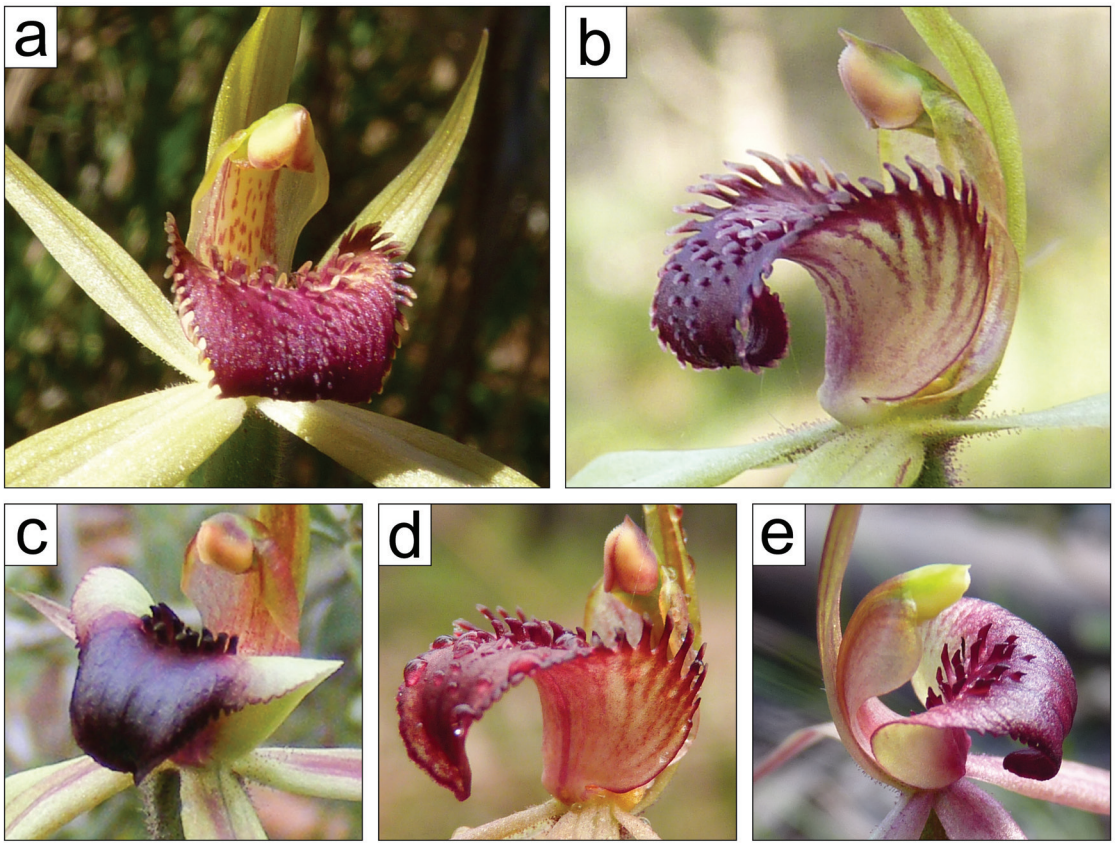

Figure 12. a. *Caladenia valida,* Raymond Island; b. *C. ancylosa*; C. *c. clavigera*; d. *C. australis; e. C. peisleyi* (Photos: W. Kosky).

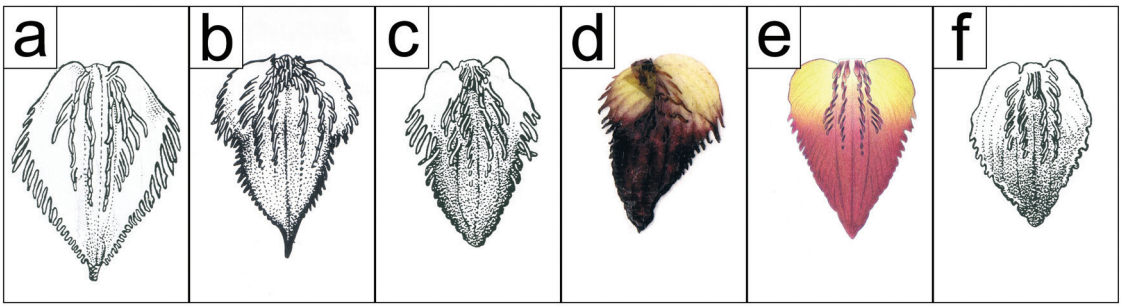

Figure 13. Labellum images showing relative size, flattened labellum shape, and teeth size, form and arrangement. a. *Caladenia flavovirens*. This taxon is obscurely 3-lobed with slight but distinct mid- and side lobes usually more prominent than illustrated, and acinaciform to somewhat linear teeth; b. *C. australis*. Longer side lobe teeth are typical; c. *C. montana*; d. *C. turneri*. The labellum is distorted when flattened; e. *C. fitzgeraldii*. Teeth are variable from serrate, as shown, to shortly linear; f. *C. peisleyi*. Teeth are variable from serrate as shown to linear (Images: a-c, f: adapted from Walsh & Entwisle (1994), where *C. montana* and *C. peisleyi* are labelled as labellum variants of *C. fitzgeraldii*, d: W. Kosky, e: adapted from John Riley's illustration "C" in Riley & Banks (2002: 59)).

Key to East Gippsland's Clubbed Spider *Caladenia*

Clubbed spider *Caladenia* are distinguished from other spider *Caladenia* by the following combination of characteristics:

(a) Two yellow glands present at the base of the column;

(b) Tepal osmophores that are sessile, spherical to obovoid, forming dense to sparse sepal end formations which, usually, but not always, exhibit some thickening of the underlying sepal tip, forming thickened tepal ends ('clubs') —as opposed to a more open grouping of osmophores scattered further along sepals without noticeable tepal end thickening ('tails'); and

(c) The absence of green, comb-like side lobe margins.

In the following key, mean teeth pair counts are provided in some cases along with the typical range of teeth pairs in order to provide an indicator of variation that may be encountered in the field. The average count will rarely vary by more than ±1 for groups of 20+ flowers, or ±2 for smaller numbers of flowers.

1 Labellum with erect, more or less uniform, acinaciform to somewhat linear edge teeth beginning near the base, descending in size to the tip; mid-lobe rolled under into a half to full circle 2

1 Labellum without uniformly shaped teeth extending to the tip; mid-lobe or front section decurved and loosely rolled under, roll usually no more than a half circle 4

2 Summer flowering. Flower colours effulgent, pale yellow to light green often with red, orange or tan features. Labellum without red stripe/s or veining. Tepals without central red stripe. Filiform distal section of lateral sepal >half total length, some with tailed tepals ..... ***C. flavovirens***

2 Flowering late winter to spring. Flower colour not effulgent. Labellum with red veining. Tepal abaxial surface with central red stripe/s, fainter or absent on adaxial surface. Filiform distal section of lateral sepals < half total length 3

3 Petals erect when flower fully open. Labellum with very light to moderate red veining ..... C***. valida***

3 Petals not erect when flower fully open. Labellum with moderate to heavy, dark red veining ..... ***C. ancylosa***

4 Labellum cordate. Lateral sepals with or without tiny clubs 2–3 (rarely–5) mm long ..... ***C. clavigera***

4 Labellum not cordate. Lateral sepals with clubs >3 mm long 5

5 Labellum distinctly 3-lobed, when flattened the rounded base to the widest point considerably shorter than the irregularly triangular distal section, teeth pair mean 17, typical range 12–20 for 81% of plants ..... ***C. australis***

5 Labellum obscurely 3-lobed, or not lobed 6

6 Labellum obscurely 3-lobed, when flattened the rounded base to the widest point considerably shorter than the irregularly triangular distal section, erect edge teeth beginning before the top of the rise from the base, thereafter shortening, broadening and incised horizontal, extending up to half-way along mid-lobe 7

6 Labellum unlobed, with a short fringe of linear to serrate teeth confined to middle of its edge beginning at, or after, the top of the rise from the base, thereafter decrescent up to half-way into the front section 8

7 Labellum mid-lobe protruding forward markedly to form an oblique platform before decurving, teeth near base linear to acinaciform, teeth pair mean 13.4, typical range 10–16 for 87% of plants ..... ***C. montana***

7 Labellum mid-lobe protrudes forward moderately (without forming an oblique platform) before decurving, teeth near base linear, not acinaciform, teeth pair average 10.7, typical range 9–14 for 89% of plants ..... ***C. turneri***.

8 When flattened, the rounded base of the labellum to the widest point considerably shorter than the triangular distal section, unflattened the distal section protrudes forward moderately (without forming an oblique platform) before decurving, teeth decurved to horizontal, rarely erect, teeth pair average 9.06, typical range 7–12 for 77% of plants ..... ***C. fitzgeraldii***

8 When flattened, the rounded base of the labellum to the widest point more or less the same length (or marginally shorter) than the triangular distal section, unflattened the stubby distal section does not protrude forward before decurving, teeth erect to horizontal, teeth pair average 7.7, typical range 4–10 for 80% of plants ..... ***C. peisleyi***

Additional useful characteristics for species identification

C. flavovirens: Labellum often with red mid-lobe and other red, orange or tan features. Lateral sepals usually with a lighter cover of osmophores forming red, brown, yellow or green, thickened clubs, to unthickened glandular tails. A variety of tepal osmophore formations often haphazardly arranged on flowers in a population. Leaf a lighter green and slightly hairier than that of other East Gippsland spider *Caladenia*, base green, occasionally with faint purple hue. A beautiful orchid with a variety of vibrant colour forms. Open grassy forest. Usually: 20–40 cm tall; lateral sepals (2–)3–4.5(–5.5) cm long. (Figure 13a)

C. valida: Tepals yellow cream to whitish, often with red suffusion, or subtle pink or green hues. Labellum with or without red mid-lobe. Lateral sepals usually with round clubs, otherwise variable; well defined (light to heavy) to poorly defined, occasionally tailed. Petal clubs rare. Grows in sandy coastal woodland in or near bracken. Flowers August to October. Usually: 20–40 (–60) cm tall; lateral sepals 2–4.5 cm long. (Figure 12a)

C. ancylosa: Tepals greenish yellow cream to white. Labellum base cream to white, mid-lobe, a dull, dark blackish red. Teeth and calli both a dull blackish red with pale tips. Lateral sepals usually with terete red or brownish clubs (some tan, green or yellow), many with a sparse cover of osmophores, otherwise clubbing varies between well defined (light to heavy) and poorly defined, some sepal ends tailed. Petals without osmophores, usually red-tipped. Grows in grassy woodland in clay/loam soils. Flowers September to November. Usually: 20–40(–50) cm tall; lateral sepals 2–4 cm long. Flowers with a light scent (Jones 2006b). (Figure 12b)

***C. clavigera*:** Labellum cross section at widest shallowly concave; mid lobe margins, including any teeth, flaccid or decurved. Transition to mid-lobe edge usually with a few tiny (to 1 mm long) indistinct teeth, often obscured, sometimes serrulate or entire. Labellum 10–12(–14) mm long, *ca.* 9 mm wide. Usually 15–25 (–35) cm tall; lateral sepals 1.5–3 cm long, with or without tiny clubs. Petal clubs absent. *Caladenia clavigera* is routinely said to form hybrids with *C. montana*, particularly after fire. This study has established that *C. clavigera* × *C. montana* hybrids are extremely rare, and that most plants said to be such hybrids are in fact *C. fitzgeraldii*, which may appear superficially intermediate between *C. clavigera* and *C. montana*. (Figure 12c)

C. australis: Labellum margins with linear to somewhat acinaciform teeth beginning erect on the rise from the base, and decrescent and horizontal to well into mid lobe, occasionally irregularly serrulate towards the tip. Labellum apex with short concave acuminate tip; red veining absent to light, rarely heavy. Lateral sepals, usually with terete clubs, otherwise clubbing varies between well defined (light to heavy) and poorly defined, some sepal ends tailed. Labellum 12–15 mm long, *ca.* 10 mm wide. Usually 20–40 cm tall; lateral sepals 2.5–4.5(–5.5) cm long. (Figures 12d, 13b)

C. montana: Considerable variation in size. Lateral sepals with round, flat or channelled clubs, varying from well defined (light to heavy) to poorly defined or tailed; some osmophore formations unusually long (to half sepal length, *ca.* 2+ cm on large flowers). Labellum 11–18 mm long, 6–11 mm wide. Usually 25–45 (–50) cm tall, red veining light to heavy, occasionally absent; lateral sepals (2.5–)3–4(–6) cm long. Emits strong burnt plastic odour, but only on hot, usually humid, windless days, which are infrequent at higher elevations. (Figure 13c)

C. turneri: A mix of yellow and pink hued flowers. Tepals stiffly held. Lateral sepals usually with well-defined, reasonably heavy, terete, flat, or channelled clubs. Labellum 9–12 mm long, 6–9 mm wide. Usually 20–30 cm tall; lateral sepals 2–3.5 cm long, red veining absent to light, rarely heavy. (Figure 13d)

C. fitzgeraldii: Labellum front section usually with somewhat flaccid decurved margins and teeth often creating the impression of three lobes, teeth reasonably uniform, red veining absent to light, rarely heavy. Lateral sepals usually with terete, light to medium-heavy, well-defined clubs. Labellum 10–15 mm long, 6–11 wide. Usually 15–40 cm tall; lateral sepals 2.5–4 cm long. (Figure 13e)

C. peisleyi: It is a characteristic of this species that there is considerable variation in teeth placement, length and shape in any small patch of plants. Lateral sepals usually with round, light to medium-heavy, well-defined clubs. Labellum 6–9 mm long, 5–8 mm wide. Usually 15–35 cm tall; lateral sepals (15–)20–30(–3.5) long, red veining absent to light, rarely heavy. (Figure 12e, 13f)

All except *Caladenia clavigera* and *C. ancylosa* will, to a greater or lesser degree, and more-so after fire, have some flowers with osmophores on their petal ends.

The flowers of *Caladenia australis, C. clavigera, C. fitzgeraldii*, *C. montana, C. peisleyi* and *C. turneri* have more or less the same basic colour combinations, namely: white to creamy-yellow tepals and labellum base; tepal abaxial surface with central reddish stripe/s, prominent to faint or absent on adaxial surface; labellum apex and clubs red/burgundy; some flowers with pink, green or yellow hues; some overlaid with a strong red hue. Leaves, stems and other parts are generally similar bar any particular differences in indumentum indicated. Leaves are green and moderately hairy, with a purple base. Leaf size is not indicative of eventual plant size at anthesis. All occur in forest to open woodland habitat, some in more open grassy, sedgy or heathy areas. All species flower from August to October at lower elevations. At higher elevations (up to *ca.* 1500 m), *C. clavigera*, *C. fitzgeraldii* and *C. montana* flower through to November and December, with *C. montana* flowering into January at some sites.