New *Lachnagrostis* (Poaceae) taxa from South Australia and South-west Victoria

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Introduction

Lachnagrostis Trin. has only recently been accepted in Australia (Jacobs 2001, 2002, 2004); species in it having formerly been included in *Agrostis* L. The majority of *Lachnagrostis* species grow in lowland habitats, in contrast to the largely montane habitats of endemic species of *Agrostis* (an exception being the widespread *A. venusta* Trin.).

Two species, *L. aemula* (R.Br.) Trin. and *L. filiformis* (G.Forst.) Trin. extend from lowland to upland environments but even across their lowland habitats, show a wide range of morphological forms (Walsh & Entwistle 1994). To more closely investigate these forms, extensive collection and examination of lowland populations of *Lachnagrostis* in south-east Australia was undertaken across south-west Victoria and South Australia from the early 1990s through to the present. Work with *L. billardierei (*R.Br.) S.W.L.Jacobs, *L. punicea* (A.J.Br. & N.G.Walsh) S.W.L.Jacobs and *L. robusta* (Vickery) S.W.L.Jacobs established new combinations (Brown & Walsh 2000) and relationships among some of these taxa and with *L. aemula* and *L. filiformis* (James & Brown 2000; James *et al.* 2002).

While work examining the variation within *L. filiformis* and *L. aemula* continues, a number of populations with characteristics substantially different from existing taxa, have been separated out for further study and reporting here. Specimens from Victoria having spikelet glume apices with long setae and inflorescences with prominently deflexed branches are here segregated as *L. deflexa* while plants with similar spikelets but with congested and somewhat contracted panicles and sterile florets are here designated *L.* ×*contracta*. Specimens from the Mount Lofty Ranges with very fine inflorescences and small spikelets with almost glabrous lemmas and short, straight awns are named *L. batesii*, while taller plants from similar environments with hairy lemmas, small spikelets and wide leaves are described here as *L. perennis*. Plants with strongly purple inflorescences, spikelets similar to *L. aemula* but with narrow leaves, from the border country between South Australia and Victoria, are here segregated as *L. palustris*. Finally, plants from a restricted area to the west of the southern Grampians in Victoria and similar to *L. aemula*, but with more or less awnless lemmas and narrow leaves are designated as *L. leviseta*.

Abstract

Unusual and indeterminate populations of *Lachnagrostis* Trin. were examined, both as herbarium specimens and in the field. Some of these entities were also studied as potted plants grown from field collected seed to determine if morphological departures from currently circumscribed taxa were the result of environmental change or could be concluded to be genetically based. Although vegetative growth (particularly leaf width) was markedly increased by artificial growth conditions, morphological characteristics of inflorescences, spikelets and florets were largely unaltered. As a result of these studies, this paper describes four new species; *L. batesii* A.J.Br. from South Australia, *L. deflexa* A.J.Br. and *L. leviseta* A.J.Br. from Victoria and *L. palustris* A.J.Br. from the border region of the two States. The status of *Agrostis avenacea* var. *perennis* Vickery is raised to species level, *L. perennis* (Vickery) A.J.Br. but restricts its distribution to the Mount Lofty Ranges of South Australia. In addition, an apparently sterile interspecific hybrid *L.* ×*contracta* A.J.Br., probably *L. deflexa* × *L. adamsonii* (Vickery) S.W.L.Jacobs, from Victoria is reported.

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Table 1. Field collections of *Lachnagrostis* taxa selected for spikelet morphology comparison (* new taxa).

Species	Selection	Voucher specimen collection details
L. adamsonii	Caramut, Vic.	7.xii.1995, *Brown* 1013 (MEL)
	Dereel, Vic.	15.xii.1995, *Brown* 1056 (NSW, MEL)
	Moorabool, Vic.	18.xii.1995, *Brown* 1075 (MEL)
	Barunah, Vic.	21.xii.1995, *Brown* 1113 (MEL)
***L. aemula* A**	Scott Creek, SA	i.2001, *Bates* 58025 (MEL)
	Mt. Bold, SA	i.2006, *Bates* 67484 (MEL)
	Prospect Hill, SA	10.xii.2003, *Bates* 61922 (MEL)
	Mt. Remarkable, SA	27.xi.2003, *Bates* 61834 (MEL)
***L. aemula* B**	Lake Mundi, Vic.	31.xii.2003, *Brown* 1766 (AD, MEL)
	Nangwarry South, SA	31.xii.2003, *Brown* 1769 (AD, MEL)
	Arapiles, Vic.	8.xii.2005, *Brown* 1758 (MEL)
	Balmoral, Vic.	22.xii.2003, *Brown* 1770 (MEL)
L. batesii*	Scott Creek, SA	30.i.2001, *Bates* 58030 (MEL)
	Aldgate Valley, SA	i.2001, *Bates* 58038 (MEL)
	Scott Bottom, SA	29.xii.2003, *Brown* 1638 (NSW, MEL, HO)
	Jupiter Creek, SA	i.2006, *Bates* 67482 (MEL)
L.* ×*contracta*	Streatham, Vic.	11.i.1994, *Brown* 877 (AD, MEL)
	Skipton, Vic.	16.xii.1996, *Brown* 1222 (AD, CANB, MEL)
	Derrinallum, Vic.	21.xii.2005, *Brown* 1721 (NSW, MEL, HO)
L. deflexa*	Streatham, Vic.	11.i.1994, *Brown* 871 (AD, NSW, CANB, MEL, HO)
	Mininera East, Vic.	11.i.1994, *Brown* 875 (NSW, CANB, MEL, HO)
	Lake Bolac, Vic.	31.xii.2003, *Brown* 1718 (NSW, CANB, MEL)
	Deep Lake, Vic.	18.i.2006, *Brown* 1723 (NSW, MEL)
***L. filiformis* A**	Connewarren, Vic.	5.i.1996, *Brown* 1119 (MEL)
	Nangwarry, SA	31.xii.2003, *Brown* 1771 (AD, NSW, MEL)
	Glenisla Crossing, Vic.	7.xii.2005, *Brown* 1772 (MEL)
	Dorodong, Vic.	18.i.2006, *Brown* 1773 (AD, MEL)
***L. filiformis* B**	Beaumont, SA	1.xii.1946, *Cleland* s.n. (AD97222056)
	Penola, SA	16.xi.1969, *Wilson* 1284 (AD)
	Tallangatta, Vic.	29.xi.2006, *Brown* 1764 (AD, MEL)
	Shepparton East, Vic.	30.xi.2006, *Brown* 1765 (AD, MEL)
L. leviseta*	Gatum, Vic.	22.xii.2003, *Brown* 1645 (MEL)
	Glendinning, Vic.	31.xii.2004, *Brown* 1713 (MEL, HO)
	Moorella, Vic.	6.xii.2005, *Brown* 1714 (CANB, MEL)
	Victoria Valley, Vic.	6.xii.2005, *Brown* 1715 (AD, NSW, MEL)
L. palustris*	Nangwarry, SA	15.i.2001, *Bates* 58010 (AD, MEL)
	Nangwarry South, SA	31.xii.2003, *Brown* 1643 (AD, MEL, HO)
	Heathfield, Vic.	31.xii.2003, *Brown* 1644 (AD, MEL)
	Topperwein, SA	17.i.2006, *Brown* 1709 (MEL)
L. perennis*	Mount Adam, SA	27.xii.2000, *Bates* 57934 (AD, MEL)
	Hindmarsh Valley, SA	29.i.2001, *Bates* 58026 (MEL)
	Little Para River, SA	30.xii.2003, *Brown* 1640 (NSW, CANB, MEL)
	Hansborough, SA	30.xii.2003, *Brown* 1724 (NSW, MEL, HO)

This paper provides the results of morphological assessment of these new taxa in comparison with currently well established species.

Materials and Methods

Spikelet Morphology

Selections of populations typifying the new entities (Table 1) were subjected to assessment of spikelet and floret characteristics in comparison to some typical *L. filiformis*, *L. aemula* and *L. adamsonii* collections. Comparisons were made by selecting and measuring four mature spikelets of a specimen from four separate populations for each taxon.

Considering the range of existing forms of *L. filiformis* and *L. aemula*, the choice of suitable populations for this comparison was not straight forward. For *L. filiformis*, it was decided to use the 'typical' hairy-lemma, narrow-leaf, weeping inflorescence form, commonly found across southern Australia, particularly on roadsides, in drainage ditches and waste places (denoted as A). This is the form that is also indigenous to New Zealand and a number of Pacific Islands and introduced to the western USA. In addition, a selection of more perennial-like forms with thick culms (2.5–3.0 mm), large inflorescences and relatively wide leaves (3–4 mm) were also measured (denoted as B) to compare with *L. perennis*.

Two separate groups of *L. aemula* were also represented in the comparison. The first from the Mount Lofty Ranges in South Australia (denoted as A) as a direct comparison with *L. perennis* and the second from the South Australian/Victoria border and western Wimmera region (denoted as B) to compare with *L. palustris* and *L. leviseta*. These populations were identified as *L. aemula*, rather than *L. filiformis* on the basis of their stiff and rather scabrid leaves, stiff, erect inflorescences and relatively large spikelets. The form of *L. aemula* found across the plains of south-west Victoria with very large spikelets (commonly 6.5–8.5 mm long) that has been previously used in comparison work with *L. billardierei*, *L. punicea* and *L robusta* (Brown & Walsh 2000; James *et al.* 2002) was not used here.

A typical population of *L. adamsonii* with completely glabrous lemmas (except for the callus) was used as a comparison to *L. batesii* because of the reduced awn in both entities.

Growth Study

In order to study growth characteristics and vegetative morphology, seed of a wide range of *Lachnagrostis* populations from South Australia and Victoria was sown into seedling mix (potting mix, sand and perlite) under glasshouse nursery conditions on 26th September 2001. Table 2 provides details of the accessions reported here. Results for other accessions used in the pot study, including those of *L. billardierei, L. robusta*, *L. punicea*, *L. adamsonii*, *L. filiformis* and *L. aemula* are planned for future publication. *Lachnagrostis leviseta* was only recognised from field collections after the pot study and therefore was not included at the time and obviously the sterile *L.* ×*contracta* could not be grown from seed.

At 3-4 leaf stage, seedlings were pricked out into forestry tubes containing starter potting mix and again transferred to 10 cm nursery pots on 21st November 2002

Table 2. *Lachnagrostis* seed accessions grown from September 2001 to March 2002 (* new taxa).

Accession code	Species	Seed source location	Voucher specimen	No. of potted plants Nov/Jan – Jan/Mar
MMC	*L. adamsonii*	Barunah, Vic.	*Brown* 1113 (MEL)	8 – 4
SAS2	*L. aemula*	Scott Creek CP, SA	*Bates* 58025 (MEL)	4 – 4
SSe	*L. deflexa**	Streatham, Vic.	*Brown* 871 (AD, NSW, CANB, MEL, HO)	2 – 2
SAA	*L. batesii**	Aldgate Valley, SA	*Bates* 58038 (MEL)	8 – 4
SAS1	*L. batesii**	Scott Creek CP, SA	*Bates* 58030 (MEL)	10 – 8
WM	*L. filiformis*	Connewarren, Vic.	*Brown* 1119 (MEL)	8 – 4
NAN	*L. palustris**	Nangwarry, SA	*Bates* 58010 (AD, MEL)	8 – 4
SAH2	*L. perennis**	Hindmarsh Valley, SA	*Bates* 58026 (MEL)	8 – 4
SAM	*L. perennis**	Mount Adam, SA	*Bates* 57934 (AD, MEL)	8 – 4

Table 3. Comparison of means of morphological characters of four spikelets and florets from each of three or four field collections of new *Lachnagrostis* taxa and compared to collections of *L. filiformis*, *L. aemula* and *L. adamsonii*; mean values in the same column that share the same letter are not significantly different (ANOVA t-test lsd: $p = 0.001$).

Species	Popl	Glt	Gut	Gls	Lt	Ls	H	Aa	At	Ab:Ac	Re	Pt	A
L. adamsonii	1	2.5	2.7	0.0	1.9	0.0	0.0	85	1.8	na	1.1	1.8	0.4
	2	2.7	2.8	0.2	2.2	0.1	0.0	70	2.2	na	1.6	1.8	0.5
	3	2.7	2.9	0.0	2.2	0.0	0.0	72	2.3	na	1.3	1.8	0.5
	4	3.0	3.0	0.0	2.4	0.0	0.0	69	2.1	na	1.5	2.1	0.5
	mean	*2.7*	*2.9*	*0.0*	*2.2*	*0.0*	*0.0*	*74*	*2.1*	na	*1.3*	*1.9*	*0.5*
		b	*c*	*a*	*f*	*a*	*a*	*c*	*b*	na	*b*	*c*	*bc*
***L. aemula* A**	1	4.2	3.6	0.0	1.9	0.3	0.4	45	5.1	2.0	1.6	1.6	0.7
	2	3.7	3.4	0.0	1.9	0.1	0.5	56	5.3	1.5	2.0	1.6	0.6
	3	4.2	3.8	0.0	1.9	0.1	0.3	46	5.8	1.7	1.8	1.7	0.6
	4	4.2	4.0	0.1	2.1	0.2	0.4	47	6.8	1.9	2.1	1.7	1.0
	mean	*4.1*	*3.7*	*0.0*	*2.0*	*0.2*	*0.4*	*48*	*5.8*	*1.8*	*1.9*	*1.6*	*0.7*
		d	*ef*	*a*	*de*	*b*	*de*	*a*	*ef*	*ab*	*c*	*b*	*de*
***L. aemula* B**	1	5.2	4.2	0.2	2.1	0.1	0.5	51	6.5	1.8	1.9	1.7	0.7
	2	4.3	3.7	0.1	1.9	0.1	0.5	48	5.2	2.0	1.5	1.5	0.6
	3	4.6	4.2	0.1	2.0	0.2	0.6	51	7.1	2.2	1.8	1.5	0.7
	4	4.3	4.1	0.1	2.2	0.2	0.5	48	6.8	1.7	2.0	1.7	0.7
	mean	*4.6*	*4.0*	*0.1*	*2.1*	*0.2*	*0.5*	*50*	*6.4*	*1.9*	*1.8*	*1.6*	*0.7*
		e	*fg*	*a*	*ef*	*b*	*ef*	*a*	*f*	*ab*	*c*	*b*	*de*
L. batesii*	1	2.5	2.5	0.0	2.0	0.1	0.5	72	1.8	na	1.1	1.5	0.3
	2	2.0	1.9	0.1	1.6	0.0	0.4	64	1.4	na	0.8	1.2	0.3
	3	2.4	2.4	0.0	2.0	0.1	0.6	71	1.8	na	1.1	1.5	0.3
	4	2.2	2.2	0.1	1.7	0.1	0.5	67	1.6	na	0.5	1.2	0.3
	mean	*2.3*	*2.2*	*0.0*	*1.8*	*0.1*	*0.5*	*68*	*1.7*	na	*0.9*	*1.4*	*0.3*
		a	*a*	*a*	*bc*	*ab*	*ef*	*bc*	*b*	na	*a*	*ab*	*a*
L.* ×*contracta*	1	4.0	4.1	0.8	2.1	0.1	0.0	71	2.7	na	1.3	1.9	0.8
	2	4.6	4.2	1.2	2.3	0.1	0.0	70	3.9	na	1.0	2.0	0.6
	3	4.2	4.5	0.8	2.3	0.1	0.2	68	3.7	na	1.1	2.0	0.6
	mean	*4.2*	*4.3*	*0.9*	*2.2*	*0.1*	*0.1*	*70*	*3.5*	na	*1.1*	*2.0*	*0.6*
		d	*gh*	*b*	*f*	*ab*	*ab*	*bc*	*c*	na	*ab*	*c*	*cd*
L. deflexa*	1	5.0	4.8	1.6	2.6	0.5	0.2	50	5.9	2.7	1.8	2.2	0.7
	2	4.6	4.5	1.1	2.3	0.4	0.2	55	5.1	2.7	1.5	1.9	0.6
	3	4.5	4.4	1.2	2.4	0.4	0.1	51	5.5	3.1	1.7	2.0	0.6
	4	5.3	4.9	1.5	2.8	0.5	0.2	46	5.8	3.1	1.8	2.1	0.7
	mean	*4.8*	*4.7*	*1.3*	*2.5*	*0.5*	*0.2*	*50*	*5.6*	*2.9*	*1.7*	*2.0*	*0.6*
		e	*h*	*c*	*g*	*c*	*bc*	*a*	*e*	*c*	*c*	*c*	*cd*
***L. filiformis* A**	1	3.2	2.9	0.1	1.4	0.0	0.3	54	3.9	1.7	0.9	1.2	0.3
	2	2.8	2.7	0.2	1.7	0.0	0.3	46	4.5	2.1	1.5	1.5	0.5
	3	3.2	3.0	0.1	1.6	0.1	0.3	55	4.4	2.0	1.0	1.3	0.3
	4	2.9	2.8	0.1	1.8	0.2	0.3	42	5.1	2.6	1.4	1.6	0.5
	mean	*3.0*	*2.8*	*0.1*	*1.6*	*0.1*	*0.3*	*49*	*4.5*	*2.1*	*1.2*	*1.4*	*0.4*
		b	*bc*	*a*	*a*	*ab*	*cd*	*a*	*d*	*b*	*ab*	*ab*	*ab*

Table 3. Cont.

Species	Popl	Glt	Gut	Gls	Lt	Ls	H	Aa	At	Ab:Ac	Re	Pt	A
***L. filiformis* B**	1	3.1	2.8	0.0	1.6	0.1	0.3	63	4.1	2.8	1.2	1.3	0.3
	2	3.9	3.5	0.1	1.6	0.1	0.4	54	5.7	2.1	1.2	1.4	0.3
	3	3.6	3.4	0.2	1.7	0.0	0.4	54	4.5	2.2	1.1	1.2	0.3
	4	3.6	3.3	0.1	1.9	0.1	0.3	54	4.9	2.0	1.4	1.4	0.4
	mean	*3.6*	*3.3*	*0.1*	*1.7*	*0.1*	*0.3*	*56*	*4.8*	*2.3*	*1.2*	*1.3*	*0.3*
		c	*d*	*a*	*ab*	*ab*	*cd*	*ab*	*d*	*b*	*ab*	*a*	*a*
L. leviseta*	1	3.7	3.6	0.0	2.0	0.1	0.7	94	0.2	na	1.9	1.6	0.8
	2	3.8	3.6	0.1	2.0	0.1	0.5	83	0.5	na	2.0	1.7	0.8
	3	3.7	3.4	0.0	1.9	0.1	0.5	74	0.0	na	2.0	1.7	0.8
	4	3.5	3.2	0.0	1.8	0.1	0.5	83	0.1	na	1.8	1.5	0.8
	mean	*3.7*	*3.4*	*0.0*	*1.9*	*0.1*	*0.6*	*83*	*0.2*	na	*1.9*	*1.6*	*0.8*
		c	*de*	*a*	*cd*	*ab*	*f*	*d*	*a*	na	*c*	*b*	*e*
L. palustris*	1	3.4	3.1	0.0	1.7	0.1	0.4	51	5.1	1.6	1.3	1.4	0.5
	2	3.4	3.1	0.0	1.7	0.2	0.4	47	5.3	1.6	1.4	1.3	0.5
	3	3.6	3.2	0.0	1.8	0.2	0.5	50	5.8	1.4	1.4	1.5	0.5
	4	3.6	3.2	0.0	1.6	0.1	0.4	53	5.9	1.9	1.2	1.3	0.5
	mean	*3.5*	*3.2*	*0.0*	*1.7*	*0.1*	*0.4*	*50*	*5.5*	*1.6*	*1.3*	*1.3*	*0.5*
		c	*d*	*a*	*ab*	*ab*	*de*	*a*	*e*	*a*	*b*	*a*	*bc*
L. perennis*	1	2.5	2.3	0.0	1.4	0.0	0.4	70	4.4	3.2	1.3	1.2	0.6
	2	2.7	2.6	0.0	1.6	0.0	0.5	65	5.2	3.3	1.5	1.3	0.5
	3	3.2	2.9	0.0	1.7	0.0	0.4	59	4.0	2.4	1.1	1.5	0.6
	4	3.0	2.8	0.0	1.6	0.1	0.5	57	5.0	2.5	1.0	1.4	0.6
	mean	*2.8*	*2.6*	*0.0*	*1.6*	*0.0*	*0.4*	*63*	*4.6*	*2.9*	*1.2*	*1.3*	*0.6*
		b	*b*	*a*	*a*	*a*	*de*	*b*	*d*	*c*	*ab*	*a*	*cd*
LSD	popl	0.3	0.2	0.1	0.1	0.1	0.1	7	0.6	0.3	0.3	0.2	0.1
LSD	means	0.5	0.5	0.2	0.3	0.2	0.2	13	1.3	0.7	0.5	0.3	0.1

* new taxa; Glt = total (including setae) lower glume length (mm); Gut = total upper glume length (mm); Gls = lower glume setae length (mm); Lt = total lemma length (mm); Ls = lemma setae length (mm); H = lemma hair length (mm); Aa = awn attachment from lemma base (%); At = total awn length (mm); Ab:Ac = awn bristle to awn column ratio; Re = rachilla extension length including hairs (mm); Pt = total palea length (mm); A = anther length (mm); na = not applicable.

(week 8 from sowing). Plants were removed from the glasshouse at this stage and placed on outdoor benches at the Department of Primary Industries Werribee Centre (formerly the State Chemistry Laboratory), Victoria. Water was applied as required with an overhead sprinkler but after a very hot weekend in mid December, when plants were observed to suffer stress, they were automatically watered twice/day. On 16th January 2002 (week 17) some plants of each accession were re-potted into 20 cm pots and grown on until 6th March 2002 (week 23).

Measurements of plant height, leaf colour, leaf width (to the nearest 0.5 mm), time to inflorescence emergence and inflorescence number were made periodically throughout the season. Measurements of vegetative, inflorescence and spikelet characteristics of these cultivated plants were compared to herbarium and field collections of the same entities. For statistical purposes, four of the potted plants for each accession (except SSe with only two pots) were sampled when inflorescences were mature and measurements of the characters of four selected spikelets/pot were made. Statistical differences were tested using Genstat 8.1 (Release PL16, Lawes Agricultural Trust, Rothamstead Experimental Station) for ANOVA. Test of significant difference (t-test) between means was set at LSD for a confidence level of 0.1% ($p = 0.001$).

The automatic watering was turned off at the end of the flowering season but the pots were left on the outdoor benches to receive rainfall alone. Plants were reassessed in August 2002 in terms of survival and vigour and counts of inflorescence numbers were made periodically over the following season.

Results and Discussion

Spikelet Morphology

Comparisons in spikelet and floret measurements between collections are presented in Table 3. The following notes outline the major differences observed between the new entities and current taxa.

L. deflexa

The most obvious difference between this taxon and *L. filiformis* (with which it probably has the greatest affinity) was the long setae at the glume apices. It also differed from *L. filiformis* (A & B) in its longer glumes (even with setae excluded), lemma, lemma setae, palea and anthers. Awn length, awn bristle:column and rachilla extension length were generally greater, while lemma hairs were shorter. The glumes of *L. deflexa* often had finely scaberulous surfaces and ciliate margins while the glumes of *L. filiformis* were normally smooth with entire margins. Lemmas of *L. deflexa* had glabrous dorsal surfaces but with some scattered hairs towards the margins, whereas the dorsal and lateral surfaces of lemmas of *L. filiformis* were hairy, to at least some extent.

L. ×contracta

This entity had comparable or overlapping ranges in glume, glume setae, lemma, palea and anther lengths to *L. deflexa* but had shorter lemma setae, awns and rachilla extensions. Awns were straight, curved or flexuose but not obviously geniculate like *L. deflexa*. Glumes were similarly scabrid and ciliate to *L. deflexa*. Lemmas were entirely glabrous or had an occasional hair near the margins. Although reproductive parts were present, anthers lacked pollen and seed was either undeveloped or replaced with ergot (an engorged receptacle of smut fungi).

L. batesii

Glumes, lemmas, awns and rachilla extensions were generally shorter in *L. batesii* compared to *L. adamsonii* but ranges in values did overlap. Palea and anther length were always shorter in *L. batesii*. Compared to *L. filiformis* A, *L. batesii* had overlapping ranges in lemma, palea, rachilla extension and anther lengths but glumes were always shorter. The lemmas of *L. batesii* have glabrous dorsal surfaces or have an occasional hair but with margins that are lightly to moderately hairy. The lemma hairs of *L. batesii* are significantly longer than for *L. filiformis* (at least for the populations used in this assessment). The lateral surfaces of the glumes of *L. batesii* were often finely scabrid, whereas those for *L. adamsonii* and *L. filiformis* were generally smooth.

L. perennis

In comparisons of means with *L. aemula* (A & B), *L. perennis* had significantly shorter glumes, lemmas, awns, rachilla extensions and paleas. In all of these features, *L. perennis* was more comparable to *L. filiformis* A and to *L. filiformis* B, except for the significantly longer glumes of the latter (at least for collections 2, 3 and 4). Anthers in both groups and all collections of *L. filiformis* were significantly shorter than in *L. perennis*, which had anther lengths similar to *L. aemula*. In comparison to both groups of *L. aemula* and *L. filiformis*, with the exception of collection 1 of *L. filiformis* B, the awns of *L. perennis* had a higher bristle to column ratio and were inserted on average, 10% higher on the lemmas.

In other features, the glumes of *L. perennis* often had less scabrid keels and a firmer texture. While *L. aemula* and *L. filiformis* generally had transparent glumes, particularly towards the margins, the glumes of *L. perennis* were opaque or translucent throughout. Lemmas of *L. perennis* were densely hairy with long hairs like *L. aemula* and less like the only moderately hairy *L. filiformis* with its shorter hairs.

L. palustris

Spikelet and floret characteristics were significantly smaller in this taxon than for *L. aemula* B in all measurements, except that there was overlap in the range of means for the length of awns. This was also the case when comparing *L. palustris* with *L. aemula* A. In comparison with *L. filiformis* A, *L. palustris* had significantly

longer glumes and awns, while other measures were comparable or overlapped. Like *L. aemula*, the taxon generally had glumes without (or few) marginal cilia or scaberulous laterals. Lemmas were more or less covered with dense hairs, whereas *L. aemula* tended to be bare in the upper ¼ of the lemma back.

L. leviseta

Apart from the obvious lack of a significant awn, *L. leviseta* differs from *L. aemula* B in its smaller glumes and slightly longer anthers. From *L. palustris*, it differs in its generally longer lemmas, paleas, rachilla extensions and anthers. Although *L. leviseta* had comparable lemma hair density, it often displayed longer hairs than the other two taxa (mean of 0.6 mm compared to 0.4 mm and 0.5 mm for *L. palustris* and *L. aemula* respectively), though this feature varied from plant to plant.

Growth Study

Table 4 provides results of the plant growth study for the accessions. Under the well watered conditions of the study, undoubtedly assisted by the favourable nursery conditions for early development, tussocks generally grew more vigorously and produced wider and longer leaves with less in-rolling than commonly observed in the field. Also, it is probable that the potted plants produced more inflorescences than under field conditions. Nevertheless, relative morphological differences between taxa, observed in field populations, were upheld.

L. deflexa

In comparison to *L. filiformis*, this taxon displayed wider leaves, greater tiller formation and significantly more inflorescences (despite being three weeks later in emergence). These taxa appear to have a similar response to water stress; showing severe leaf wilting and death.

Both taxa displayed some leaf in-rolling by late winter. The two plants of *L. deflexa* had about 30–40% green leaf, whereas *L. filiformis* ranged from 10–30% green leaf and the weaker plants did not flower during the second season. The stronger plants of *L. filiformis* produced a similar average number of inflorescences to *L. deflexa* (35 and 39/plant respectively) but considerably fewer than for the first season's production. First inflorescence emergence was some 3–4 weeks earlier for both taxa, compared to the previous season.

L. batesii

Compared to *L. adamsonii*, this taxon displayed no significant differences in the measured growth parameters. Other observed growth characteristics however, were distinct between the two entities. The outer tillers of the tussocks were generally prostrate for *L. batesii* but erect for *L. adamsonii*. Flag leaves of *L. batesii* were often shorter than for *L. adamsonii* and tended to develop a purplish or reddish colouration on the lower surface, along with the upper leaf sheath. Stress due to summer drought appeared to affect *L. batesii* more so than *L. adamsonii* with more leaf wilting and death. Inflorescence emergence was earlier in *L. batesii* by 1–2 weeks but peak numbers were not too dissimilar.

By late winter (August 2002), *L. batesii* leaves remained flat whereas *L. adamsonii* leaves had in-rolled in response to the changed environmental conditions. The *L. adamsonii* tussocks had about 30–40% green leaves, whereas 8 of the 12 pots of *L. batesii* had 20% or less green leaves. Despite the low percentage of green leaves, all the *L. batesii* plants survived and flowered, although 3 of the pots with only 5% green material may have represented new seedlings growing from the centres of old dead tussocks. Compared to the first season, considerably fewer inflorescences were produced in the second season; averaging 10 inflorescences/plant for *L. adamsonii* and 27 and 43 for the *L. batesii* accessions (with only 3–4 late inflorescences for the 3 weak tussocks and an average of 47 inflorescences for the remainder). First emergence was ten days earlier in *L. adamsonii* and at least five weeks earlier in *L. batesii* compared to season one. Although most accessions tested in this study produced abundant new seedlings from self-sown seed, those of *L. batesii* seem to predominate and were found as invaders in most other trial pots during the second season.

L. perennis

This taxon produced significantly wider leaves than *L. filiformis* and eventually taller inflorescence culms.

Leaves for accession SAM were always significantly wider than for SAH2, suggestive of some genetic diversity within the taxon. Inflorescence emergence was 1–2 weeks later than for *L. filiformis* and peak numbers were 16–39% lower. In comparison to *L. aemula*, early plant height (12 weeks post sowing) and inflorescence culm height were greater. Early tillers were prostrate in *L. perennis* and erect in *L. aemula*. Inflorescence emergence was 4–5 weeks earlier and peak numbers were from 3–4 times higher. The inflorescences of *L. perennis* remained pale green throughout maturity, while those of *L. filiformis* developed a slight purplish cast and those of *L. aemula* became strongly purple-red.

Late winter observations showed that both *L. aemula* and *L. perennis* had retained flat leaves compared to the part leaf inrolling of *L. filiformis*. Whereas *L. aemula* had about 5–20% green leaf at this time, *L. perennis* had 20–30%. Accession SAM of *L. perennis* and accession SAS2 of *L. aemula* produced very few inflorescences (1–5 for the former and 5 from one plant only for the latter) in the second season. By contrast SAH2 (*L. perennis*) produced an average of 23 inflorescences/plant (about half of first season results).

Table 4. Means and ranges of plant measurements for pots in the growth study of *Lachnagrostis* accessions (*new taxa).

Measurement	MMC *adamsonii*	SAS2 *aemula*	SAA *batesii**	SAS1 *batesii**	SSe *deflexa**	WM *filiformis*	NAN *palustris**	SAH2 *perennis**	SAM *perennis**
8 weeks post sowing (21st November)									
Tussock height, cm	21 (14-26)	26 (24-28)	24 (14-27)	22 (20-27)	22 (21-22)	27 (21-34)	16 (13-20)	28 (24-33)	26 (21-29)
No. of tillers	13 (7-36)	12 (7-16)	18 (16-19)	21 (12-32)	35 (34-36)	18 (10-27)	21 (14-28)	11 (6-14)	12 (5-17)
Leaf width, mm	2.0 (1.5-2.5)	5.4 (5.0-5.5)	3.7 (2.0-4.5)	3.4 (2.5-4.0)	3.0 (3.0-3.0)	2.6 (2.0-3.0)	1.4 (1.0-2.0)	4.6 (4.0-5.0)	5.8 (5.5-6.0)
12 weeks post sowing (19th December)									
Tussock height, cm	25 (20-32)	25 (23-26)	30 (25-36)	32 (27-39)	22 (20-25)	26 (20-32)	18 (12-24)	31 (26-36)	29 (25-35)
Leaf width, mm	4.2 (3.0-5.0)	6.9 (6.5-7.0)	6.7 (4.0-8.0)	4.8 (3.5-6.0)	6.3 (6.0-6.5)	4.7 (4.0-5.5)	2.2 (1.5-3.0)	7.3 (6.0-8.0)	9.8 (8.0-11.0)
14 weeks post sowing (3rd January)									
Tussock height, cm	24 (18-35)	30 (25-32)	26 (20-41)	21 (18-26)	30 (30-31)	28 (22-31)	20 (15-31)	36 (21-45)	32 (29-35)
Inflor. height, cm	36 (33-40)		39 (35-44)	46 (33-60)		39 (31-45)		39 (25-47)	
Leaf width, mm	4.3 (3.0-5.0)	6.3 (5.0-7.5)	6.0 (4.0-7.5)	4.5 (3.5-5.5)	6.3 (5.0-6.5)	4.7 (4.0-5.5)	2.8 (1.5-3.5)	6.9 (5.0-7.5)	9.0 (7.5-10.5)
20 weeks post sowing (13th February)									
Inflor. height, cm	58 (47-70)	48 (46-49)	54 (48-60)	52 (48-57)	52 (48-55)	61 (45-71)	47 (37-66)	79 (72-91)	76 (71-82)
Leaf width, mm	2.6 (2.0-3.5)	6.9 (5.5-8.0)	4.3 (4.0-4.5)	3.5 (2.0-4.5)	5.0 (4.5-5.5)	3.3 (3.0-3.5)	2.0 (1.5-2.5)	4.8 (4.0-5.5)	6.5 (6.0-7.0)
Emergence of 1st inflorescence, weeks post sowing	14	19	13	12	16	13	16	14	15
Mean inflorescence number/pot at peak	84	12	71	89	90	57	109	48	35

L. palustris

Plant height (at least in early growth) and leaf width (throughout) was significantly less for *L. palustris* than for *L. aemula*. Early tillers were erect in both taxa. Inflorescence emergence was 3 weeks earlier in *L. palustris* and peak numbers were 10 times greater. On or within a couple of days of emergence, inflorescences of *L. palustris* (rachis, branches, pedicels and spikelets) were distinctly purple, whereas purpling of *L. aemula* inflorescences tended to develop with maturity. On maturing however, the purple colouration of *L. palustris* faded to a pale golden brown whereas the purpling of *L. aemula* was more permanent.

Both *L. aemula* and *L. palustris* had low green leaf content in late winter, with only one plant of each with 20% or more. Leaves of *L. palustris* were in-rolled by this stage. First emergence of inflorescences in *L. aemula* and *L. palustris* for the second season occurred about one month and three months earlier, respectively, than in the first season. The number of *L. palustris* inflorescences peaked at an average of 45/plant (about half of the first season average).

Tables 5 and 6 show comparisons in vegetative, inflorescence and spikelet characteristics between a typical plant of the original seed source population and specimens of the plants derived from the pot study. Although some difference in plant age at collection may have occurred for some accessions (e.g. emergence or non-emergence of inflorescence, in-rolling of older leaves), most measured features for most accessions are comparable.

The main vegetative character showing major difference between field and potted plants was the width of lower or tussock leaves (Table 5). In all cases,

Table 5. Comparison of vegetative and inflorescence morphology between a typical plant from each of the original seed sourced field populations and the range in plants grown in the pot growth study.

Accession	Species	Plant source	Lower leaf width, mm[1]	Flag leaf width, mm	Flag leaf length, cm	Ligule, mm[2]	Inflores. l × w, cm[3]	Peduncle, cm[4]
MMC	*L. adamsonii*	Field	1.5r	1.5r	5	5	22 × 10c	0
		Pot	3-5f	0.5-1r	2-8	3-5	32 × 24	2.5-9
SAS2	*L. aemula*	Field	4f	4f	11	8	34 × 27	9
		Pot	5-7.5f	3-5f	11-15	5-9	36 × 33	5-11
SAA	*L. batesii**	Field	3.5f	2f	6	2	16 × 14	2
		Pot	4-7.5f	1.5-2f	4-9	2-5	22 × 19	7-15
SAS1	*L. batesii**	Field	2.5f	0.5r	5	4	18 × 13	0
		Pot	3.5-5.5f	1.5f 0.5-1r	2.5-3.5	3-5	18 × 19	1-18
SSe	*L. deflexa**	Field	3f	1r	11	8	19 × 6c	0
		Pot	5-6.5f	2f 1.5r	6-6.5	6-7	20 × 13	8.5
WM	*L. filiformis*	Field	1.5f	2f	9.5	6	25 × 25	0
		Pot	4-5.5f	1-2f	4.5-9	4-6	28 × 29	3-8
NAN	*L. palustris**	Field	1.5r	0.5r	5	6	17 × 16	1.5
		Pot	1.5-3.5f	1.5-2.5f 0.5-1r	3-6	5-6	21 × 26	8-12
SAH2	*L. perennis**	Field	4f	2f	8	7	26 × 26	5
		Pot	5-7.5f	1-2.5f 1-1.5r	5.5-11.5	4-5	30 × 24	10.5-12
SAM	*L. perennis**	Field	4f	3f	12	8	15 × 17	16
		Pot	7.5-10.5f	3-4f 2.5r	9-16	4-8	33 × 29	11-16

* new taxa, [1] data for potted plants taken from 14 weeks post sowing, [2] ligule of the flag leaf, [3] largest inflorescence length (from lowest whorl) x width, [4] length of emerged peduncle, f = flat, r = inrolled or folded, c = contracted

Key to taxa Lowland south-east Australia

1 Leaves flat or loosely folded/involute (particularly on drying out), generally mid-green when young; culms often leafy (leaf blades above the main tussock often long and overlapping) **2**

1: Leaves tightly conduplicate/involute, often bluish-green when young; culms not particularly leafy (leaf blades above the main tussock often short and not overlapping) **13**

2 Leaves generally less than 3 mm wide (often less than 2 mm) or if wider, soft or lax and never firm or stiff (though they may still be scaberulous); panicle often enclosed by the upper leaf sheath until mature; lemma moderately hairy (lower dorsal surface readily visible) to near-glabrous **3**

2: Leaves generally 3 mm wide or more (or some leaves to 3 mm and the majority of at least 2 mm) and rather firm to stiff; panicle often well exserted from early development; lemma either very hairy (lower dorsal surface obscured) or completely glabrous (except for the callus) **9**

3 Glumes with finely scabrous lateral surfaces, marginal cilia and strongly scabrous keels ending in setae points 0.7 mm long or more (taxa of central south-west Victoria) **4**

3: Glumes not entirely as above **5**

4 Awn well developed, geniculate and inserted at about ½ lemma length; mature panicle spreading above but with strongly deflexed branches below ..... ***5. L. deflexa***

4: Awn reduced to a straight or curved non-geniculate bristle and inserted at about 2/3 of lemma length; mature panicle with erect and slightly divaricate primary branches but appressed secondary and tertiary branches ..... ***6. L. ×contracta***

5 Awn well developed, geniculate and inserted at about ½ lemma length ..... ***L. filiformis***

5: Awn absent or variously reduced to a minute point or a straight to curved bristle and inserted near lemma apex **6**

6 Glume margins and lemma and palea apices lacking cilia **7**

6: Glume margins and lemma and palea apices ciliate or fimbriate **8**

7 Lemma ½ to ¾ the length of the glume; awn absent or less than 1.0 mm ..... ***L. limitanea***

7: Lemma more than ¾ the length of the glume; awn 1.2 mm or more ..... **1. *L. batesii***

8 Lemma awn absent or less than 1.0 mm ..... ***L. scabra subsp. scabra***

8: Lemma awn more than 1.0 mm ..... ***L. scabra subsp. curviseta***

9 Most spikelets 3.5 mm long or less; panicle branches and spikelets never becoming strongly purple with maturity **10**

9: Most spikelets longer than 3.5 mm; panicle branches and spikelets often becoming strongly purple with maturity **11**

10 Panicle more or less erect or slightly drooping, all branches and spikelets remaining pale green until senescence; glumes less than 3.5 mm long, acute, rather firm, laterals opaque to translucent; anthers mostly 0.5–0.6 mm long ..... **2. *L. perennis***

10: Panicle drooping to weeping, terminal branches and spikelets often developing a purplish or greyish cast with maturity; glumes generally more than 3.0 mm long, acuminate, rather thin, generally transparent near the margins; anthers mostly 0.3–0.4 mm long ..... ***L. filiformis***

11 Lemma covered in hairs in the lower ¾ ..... ***L. aemula***

11: Lemma glabrous (except for the callus) **12**

12 Awn absent or reduced to a straight bristle, not or hardly exceeding the glumes (Bass Strait Islands and Tasmania) ..... ***L. billardierei subsp. tenuiseta***

12: Awn well developed, geniculate, easily exceeding the glumes ..... ***L. billardierei subsp. billardierei***

13 Awn absent (or appearing so) or if present, reduced to a straight or curved bristle, inserted near lemma apex (or at least, well above the mid-dorsal region) **14**

13: Awn well developed, geniculate and inserted well below lemma apex **15**

Cont. Key to taxa

14 Awn absent or less than 0.5 mm long (or occasional awn to 2.5 mm); lemma covered with long hairs ..... ***4. L. leviseta***

14: Awn 1.0 mm or more long; lemma glabrous or with scattered short hairs ..... ***L. adamsonii***

15 Awn inserted within lower ¼ of lemma length; palea setae mainly 0.4 mm long or more; leaves mainly conduplicate **16**

15: Awn inserted at or above ¼ of lemma length; palea setae mainly less than 0.4 mm long; leaves mainly involute **17**

16 Lemma covered in hairs in the lower ¾ ..... ***L. punicea subsp. punicea***

16: Lemma glabrous (except for the callus) ..... ***L. punicea subsp. filifolia***

17 Lemma hairy **18**

17: Lemma hairless (except for the callus) but strongly scaberulous in upper half ..... ***L. robusta***

18 Lower glume more than 3.0 mm long; emerging panicles strongly purple and rather stiffly erect; leaves bluish- or purplish-green ..... ***3. L. palustris***

18: Lower glume 3.0 mm long or less; emerging panicles purplish or green and lax; leaves mid-green ..... ***L. sp.***

except for *L. palustris*, lower leaves of potted plants were considerably wider than those collected in the field. This difference in leaf width was not apparent in flag leaves. In a few accessions, flag leaf length was longer in field collections. If environmental conditions can play such a large role in leaf size, then its use as a diagnostic criterion needs to be carefully considered. Ligule length was highly variable within most accessions, which on closer examination often related to the degree of laceration displayed at the apices.

Maximum inflorescence size was similar, regardless of growing conditions, except for accessions MMC and SAM where pot conditions were more favourable (Table 5). The degree of inflorescence emergence was generally in favour of the potted plants but whether this was due to maturity differences or to more vigorous culm elongation cannot be ascertained. What was obvious however, was the prolific production of inflorescences for most accessions under potted conditions, compared to the numbers normally observed, but almost never measured, in the field. Past field observations do note that tussocks of this genus readily respond to rainfall by producing new batches of inflorescences with each event. It may be that under normal field conditions of variable wetting and drying, inflorescences do not persist for long but flowering and seed set develop more quickly than under favourable moisture conditions. Study of plant response under field conditions could therefore be a useful pursuit, particularly when assessing the 'normality' of growth characteristics under nursery and/or potted conditions.

Spikelets and florets of potted plants were not significantly different from field plants for most accessions and characteristics (Table 6). Glume setae in *L. deflexa* were however, significantly shorter in field plants (therefore contributing to overall shorter glumes) but as these setae become somewhat fragile with maturity, it is likely that some had broken tips. Lemmas in field plants of *L. adamsonii* and *L. batesii* (SAS1 only) were slightly but significantly longer than in potted plants. Some significant variation among the potted plants of the same accession was apparent for glume length in *L. filiformis* and *L. adamsonii*, lemma length in *L. adamsonii* and *L. perennis* (SAM), awn length in *L. aemula* and anther length in *L. palustris*. This variation needed to be considered when determining useful diagnostic criteria for separating taxa.

Pot studies have been useful in demonstrating the maintenance of morphological differences among taxa observed in the field. However, vegetative characters of potted plants (e.g. leaf width) could not be used as a diagnostic criteria for field collected specimens.

Taxonomy

1. *Lachnagrostis batesii* A.J.Br. *sp. nov*.

Gramen parvum caespitosum, annuum vel perenne bevivivum, ad 40 cm altum. Culmi ascendentes numerosi, panuculae

Table 6. Comparison of means of characters of four spikelets of plants from each of the original seed source field populations and those subsequently grown in the pot growth study; mean values for potted accessions in the same column that share the same letter are not significantly different (ANOVA t-test lsd: $p = 0.001$).

Accession	Species	Source	Glt	Gut	Gls	Lt	Ls	H	Aa	At	Re	Pt	A
MMC	*L. adamsonii*	Field	3.0	3.0	0.0	2.4	0.0	0.0	69	2.1	1.5	2.1	0.5
		Pot 1	2.8	3.0	0.0	2.1	0.0	0.0	72	1.9	1.1	1.8	0.5
		Pot 2	2.8	3.0	0.1	2.1	0.1	0.0	73	2.2	1.1	1.8	0.5
		Pot 3	2.5	2.9	0.0	2.1	0.0	0.0	76	1.8	1.0	1.8	0.5
		Pot 4	2.3	2.4	0.0	1.8	0.0	0.0	75	1.7	0.9	1.5	0.4
		Mean	*2.6*	*2.9*	*0.0*	*2.1*	*0.0*	*0.0*	*73*	*1.9*	*1.1*	*1.8*	*0.5*
			b	*c*	*a*	*c*	*a*	*a*	*ef*	*a*	*bc*	*d*	*bc*
SAS2	*L. aemula*	Field	4.2	3.6	0.0	1.9	0.3	0.4	45	5.1	1.6	1.6	0.7
		Pot 1	3.7	3.2	0.1	1.9	0.3	0.6	46	5.8	1.8	1.4	0.6
		Pot 2	3.8	3.6	0.0	1.9	0.2	0.6	47	6.4	1.9	1.6	0.6
		Pot 3	3.9	3.7	0.0	2.0	0.3	0.7	45	6.9	2.1	1.6	0.7
		Pot 4	3.9	3.6	0.0	2.0	0.2	0.6	47	6.4	1.8	1.6	0.7
		Mean	*3.9*	*3.6*	*0.0*	*1.9*	*0.2*	*0.5*	*46*	*6.1*	*1.8*	*1.5*	*0.7*
			d	*e*	*a*	*b*	*b*	*c*	*a*	*e*	*f*	*c*	*d*
SAA	*L. batesii**	Field	2.2	2.2	0.1	1.7	0.1	0.5	67	1.6	0.5	1.2	0.3
		Pot 1	1.9	1.9	0.1	1.6	0.0	0.4	76	1.1	0.7	1.1	0.3
		Pot 2	2.2	2.2	0.0	1.8	0.0	0.5	75	1.8	1.0	1.4	0.3
		Pot 3	2.1	2.1	0.0	1.7	0.0	0.4	64	1.6	0.6	1.1	0.3
		Pot 4	2.1	2.1	0.0	1.7	0.1	0.4	68	1.4	0.6	1.3	0.3
		Mean	*2.1*	*2.1*	*0.0*	*1.7*	*0.0*	*0.5*	*70*	*1.5*	*0.7*	*1.2*	*0.3*
			a	*a*	*a*	*a*	*a*	*c*	*ef*	*a*	*a*	*a*	*a*
SAS1	*L. batesii**	Field	2.4	2.4	0.0	2.0	0.1	0.6	71	1.8	1.1	1.5	0.3
		Pot 1	2.0	2.0	0.0	1.7	0.0	0.5	69	1.5	0.9	1.3	0.3
		Pot 2	2.1	2.1	0.0	1.7	0.0	0.4	79	1.2	0.9	1.3	0.3
		Pot 3	1.9	2.0	0.0	1.7	0.0	0.4	81	1.0	0.9	1.3	0.3
		Pot 4	2.0	2.0	0.0	1.6	0.0	0.4	71	1.4	0.9	1.3	0.3
		Mean	*2.1*	*2.1*	*0.0*	*1.7*	*0.0*	*0.5*	*74*	*1.4*	*0.9*	*1.3*	*0.3*
			a	*a*	*a*	*a*	*a*	*c*	*f*	*a*	*ab*	*ab*	*a*
SSe	*L. deflexa**	Field	4.6	4.5	1.1	2.3	0.4	0.2	55	5.1	1.5	1.9	0.6
		Pot 1	5.0	4.7	1.5	2.3	0.4	0.3	54	5.5	1.7	2.0	0.6
		Pot 2	5.0	5.0	1.6	2.3	0.4	0.3	53	5.9	1.6	1.9	0.7
		Mean	*4.9*	*4.8*	*1.4*	*2.3*	*0.4*	*0.3*	*54*	*5.6*	*1.6*	*1.9*	*0.6*
			e	*f*	*c*	*d*	*c*	*b*	*bc*	*de*	*ef*	*d*	*cd*
WM	*L. filiformis*	Field	3.2	3.0	0.1	1.6	0.1	0.3	55	4.4	1.0	1.3	0.3
		Pot 1	3.7	3.4	0.2	1.6	0.1	0.4	62	5.1	0.9	1.4	0.3
		Pot 2	3.7	3.5	0.3	1.7	0.1	0.4	58	4.5	1.1	1.3	0.3
		Pot 3	3.1	3.1	0.1	1.6	0.0	0.3	52	4.6	0.8	1.3	0.3
		Pot 4	3.2	3.1	0.2	1.5	0.0	0.4	57	4.4	0.8	1.3	0.2
		Mean	*3.4*	*3.2*	*0.2*	*1.6*	*0.1*	*0.4*	*56*	*4.6*	*0.9*	*1.3*	*0.3*
			c	*d*	*b*	*a*	*ab*	*bc*	*c*	*b*	*ab*	*ab*	*a*

Table 6. Cont.

Accession	Species	Source	Glt	Gut	Gls	Lt	Ls	H	Aa	At	Re	Pt	A
NAN	*L. palustris**	Field	3.6	3.2	0.0	1.7	0.2	0.4	47	5.3	1.4	1.3	0.5
		Pot 1	3.4	3.1	0.0	1.7	0.2	0.5	50	6.0	1.6	1.3	0.4
		Pot 2	3.7	3.4	0.0	1.9	0.1	0.5	51	5.5	1.6	1.5	0.6
		Pot 3	3.6	3.1	0.1	1.8	0.1	0.5	53	5.3	1.5	1.4	0.5
		Pot 4	3.6	3.2	0.1	1.7	0.1	0.5	49	5.2	1.4	1.3	0.5
		Mean	*3.6*	*3.2*	*0.0*	*1.7*	*0.1*	*0.5*	*50*	*5.4*	*1.5*	*1.3*	*0.5*
			c	*d*	*a*	*a*	*ab*	*c*	*ab*	*cd*	*de*	*ab*	*bc*
SAH2	*L. perennis**	Field	2.7	2.6	0.0	1.6	0.0	0.5	65	5.2	1.5	1.3	0.5
		Pot 1	2.5	2.4	0.0	1.6	0.0	0.5	65	4.7	1.4	1.3	0.5
		Pot 2	2.7	2.6	0.0	1.6	0.0	0.5	62	4.6	1.5	1.4	0.6
		Pot 3	2.6	2.6	0.1	1.6	0.0	0.5	60	5.0	1.4	1.4	0.5
		Pot 4	2.5	2.4	0.0	1.7	0.0	0.5	60	5.2	1.6	1.4	0.5
		Mean	*2.6*	*2.5*	*0.0*	*1.6*	*0.0*	*0.5*	*62*	*4.9*	*1.5*	*1.3*	*0.5*
			b	*b*	*a*	*a*	*a*	*c*	*d*	*bc*	*de*	*ab*	*bc*
SAM	*L. perennis**	Field	2.5	2.3	0.0	1.4	0.0	0.4	70	4.4	1.3	1.2	0.6
		Pot 1	3.2	2.8	0.0	1.8	0.1	0.5	66	4.8	1.4	1.6	0.5
		Pot 2	2.6	2.4	0.0	1.6	0.1	0.4	67	4.4	1.3	1.3	0.5
		Pot 3	2.9	2.6	0.1	1.5	0.1	0.6	70	4.8	1.1	1.3	0.5
		Pot 4	3.1	2.8	0.0	1.7	0.1	0.6	70	4.9	1.4	1.5	0.5
		Mean	*2.8*	*2.6*	*0.0*	*1.6*	*0.1*	*0.5*	*68*	*4.6*	*1.3*	*1.4*	*0.5*
			b	*b*	*a*	*a*	*ab*	*c*	*e*	*bc*	*cd*	*bc*	*bc*
LSD	accession		0.2	0.2	0.1	0.1	0.1	0.1	5	0.5	0.2	0.1	0.1
LSD	accession *source	0.5	0.4	0.2	0.2	0.1	0.2	12	1.0	0.5	0.3	0.1	

* new taxa, Glt = total (including setae) lower glume length (mm); Gut = total upper glume length (mm); Gls = lower glume setae length (mm); Lt = total lemma length (mm); Ls = lemma setae length (mm); H = lemma hair length (mm); Aa = awn departure from lemma base (%); At = total awn length (mm); Re = rachilla extension length including hairs (mm); Pt = total palea length (mm); A = anther length (mm).

aliquot implexi. Spiculae plerumque 2.0–2.5 mm longae; lemmata dorsaliter glabra sed cum pili prope marginibus, arista ad 2.0 mm longa, inserta circa ¾ e basi lemmatis.

***Type*: SOUTH AUSTRALIA**. Scott Creek Conservation Park, 15.i.2000, *Bates 55750* (holotype: AD).

Mid to light green, tufted, glabrous, *annual or short-lived perennial*, 15–40 cm tall including inflorescences; culms 1.0 mm wide or less, ascending to weakly erect, often lodging with maturity, sometimes branched and somewhat tangled; nodes visible, glabrous, often purple or brown; sheaths smooth, sometimes purplish. *Leaf blades* spreading to lax, generally smooth except for finely scaberulous margins, flat, to 8(–12) cm long and (1–)2–3.5 mm wide; ligule membranous, acute becoming lacerate, 2–5 mm long. *Inflorescence* an open panicle to 25 cm long from the lowest whorl, exserted at maturity with divaricate to spreading, undulating, capillary branches; secondary and tertiary branches strongly flexuous; branches and pedicels green or sometimes with minute purple spots, finely scaberulous. *Spikelets* (1.8–)2.0–2.5 mm long, pale to light green; glumes acute, subequal or sometimes the lower 0.1–0.2 mm longer, keels scabrous, lateral surfaces smooth or finely scaberulous to minutely papillose, margins without cilia; lemma acute, 1.4–2.0 mm long, minutely (0.2 mm or less) 4-toothed at the apex, dorsal surface glabrous or with occasional to few hairs but lateral surfaces towards margins with a moderate covering of 0.4–0.6 mm long hairs, callus with hairs 0.3–0.5 mm long; awn reduced to a bristle inserted from about ¾ of the lemma length, 1.2–2.0 mm long, filamentous, straight or slightly curved; palea ¾ the length of the lemma; rachilla extension plumose,

Figure 1: *Lachnagrostis batesii*: a spikelets ×4; **b** anther ×18; **c** floret ×18; **d** tussock (*Brown 1638* MEL). *L. perennis*: **e** mature panicle ×0.25; **f** leaves and culms ×0.25; **g** immature panicle ×0.25; **h** spikelets ×4; **i** anther ×18; **j** floret ×18 (*Brown 1724* MEL).

Figure 2: Known distribution of *Lachnagrostis batesii* in South Australia.

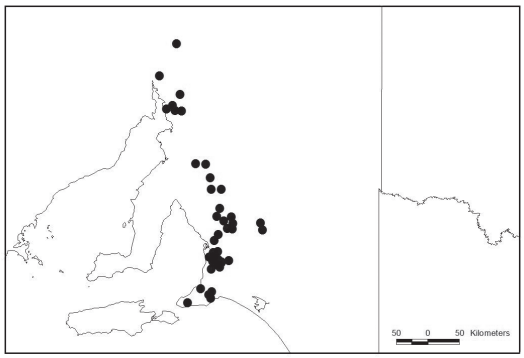

Figure 3: Known distribution of *Lachnagrostis perennis* in South Australia.

0.5–1.3 mm long including hairs; anthers 0.2–0.3(–0.4) mm long (Fig. 1a–d).

Notes: This taxon differs from *L. adamsonii* in its generally smaller glumes, lemmas and anthers, its slightly lower awn attachment and its flat, rather than in-rolled leaves. Its spikelets are of similar size to *L. scabra* but it generally has longer awns and lacks the cilia of the glume margins and fimbriate apices of the lemma and palea that are features of that taxon. Both *L. adamsonii* and *L. scabra* may have some or a few scattered lemma hairs but *L. batesii* always has relatively long hairs towards the margins.

***Distribution*:** Endemic to South Australia. Restricted to the southern Mt. Lofty Ranges from the Fleurieu Peninsula to the Little Para River (Fig. 2).

***Ecology*:** Confined to creek and stream edges and flats.

***Etymology*:** Named after Mr Robert Bates, naturalist of South Australia who, although better known for his work with orchids, has also made extensive collections of grasses over the past 30 years.

Common name: Bates's Blown-grass

Selected specimens examined: **SOUTH AUSTRALIA.** Upper Hindmarsh Waterfall near Victor Harbour, 27.i.1931, *Cleland 24C* (AD); Gawler River, 15.iv.1848 *Mueller s.n.* (MEL); Dismal Creek near Cut Hill, Victor Harbour, 30.xii.1940, *Cleland 24D* (AD); St. Peters, Adelaide, 16.xi.1967, *Kraehenbuehl 2944* (AD); Hindmarsh Valley Falls, 9.iv.1972, *Williams 4120* (AD); River Finniss, Yundi, 18.iii.1984, *Bates 3643* (AD); Creek beside Mylor Oval, xii.1989, *Bates 57945* (AD); Deep Creek below Cherryville, 3.ii.1996, *Bates 42272* (AD); Logania Dam, Bushnet Creek, ii.2000, *Bates 55925* (AD); Mount Compass, near Hindmarsh Falls, 12.iii.2000, *Bates 55025* (AD); Blackfellows Creek, xi.2000, *Bates 57999* (AD); Mylor, Aldgate Valley, 28.i.2001, *Bates 58038* (MEL); Coxs Creek, Bridgewater, iii.2003, *Bates 60572* (AD); Scott Creek at Scott Bottom, 29.xii.2003, *Brown 1638* (NSW, MEL, HO); Devils Nose Gorge, xii.2003, *Bates 61878* (MEL); Aldgate Valley Creek, Aldgate, 14.i.2004, *Bates 62062* (AD); Torrens River near Stoney Creek, 4.ii.2004, *Bates 62081* (AD); Sturt Creek near Ironbark, iv.2004, *Bates 62480* (AD); near bridge north of Gumeracha, 30.iv.2004, *Bates 62598* (AD); Hindmarsh Valley Reserve, vi.2004, *Bates 62793* (AD); Dorset Vale, ii.2005, *Bates 64670* (AD); Cudlee Creek, 20.iii.2005, *Bates 64910* (AD); Little Para River, below SA Water Reservoir, 21.iii.2005, *Bates 64925* (AD); Jupiter Creek South, Mt Bold, xii.2005, *Bates 67498* (AD).

2. *Lachnagrostis perennis* (Vickery) A.J.Brown *comb. et. stat. nov.* based on *Agrostis avenacea* var. *perennis* Vickery, *Contrib. N.S.W. Natl. Herb.* 1:114(1941).

***Type*: SOUTH AUSTRALIA**. Encounter Bay, i.1925, *Cleland H.242* (holotype: K).

Light to mid green, tufted, glabrous, *perennial*, 50–100 cm tall including inflorescences; culms 1.5–3.0 mm wide, erect, sometimes branching; most nodes enclosed or just extended beyond the leaf sheath, glabrous, generally pale brown; sheaths smooth. *Leaf blades* firm to rather stiff, erect to divergent, uniformly and finely scaberulous on both surfaces, flat, mostly15–25 cm long or flag leaves 5–12 cm long and all leaves (2–)3–5 mm wide; ligule membranous, acute becoming lacerate, 5–10 mm long. *Inflorescence* an open panicle 15–35 cm long from the lowest whorl, exserted at maturity with a visible peduncle 10–20 cm long and stiffly erect to gently drooping, never weeping, remaining relatively narrow until late maturity where it may become divaricate or spreading, the undivided part of a lower panicle branch often much shorter

than half the overall length of the branch; primary branches rather stiff and straight; secondary and tertiary branches straight or gently flexuous; branches and pedicels pale green or sometimes faintly purplish, densely scabrous. *Spikelets* (2.3–)2.5–3.0(–3.5) mm long and 0.4–0.5 mm wide, pale to light green, never with purple colouration; glumes acute, somewhat bulging with floret maturity, subequal or sometimes the lower 0.1–0.3 mm longer, opaque to translucent and rather firm, lower glume keel uniformly scabrous, upper glume keel scabrous to almost smooth, lateral surfaces generally very finely papillose and pale in contrast to the green keel, margins without cilia or occasionally with a few cilia; lemma acute but broad, 1.3–1.8 mm long, minutely (0.1 mm or less) 4-toothed at the apex, covered in 0.4–0.7 mm long hairs, callus with hairs 0.6–0.7 mm long; awn inserted from ½ to ¾ of the lemma length, 3.5–6.0(–6.2) mm long, weakly to strongly geniculate, the bristle often but not always being 3 or more times longer than the column, awns of terminal florets often reduced to short non-geniculate bristles or absent; palea 1.0–1.7 mm long; rachilla extension plumose, 0.8–1.8 mm long including hairs; anthers 0.5–0.6(–0.7) mm long (Fig. 1e–j).

Notes: Jacobs (2001) provided *Lachnagrostis filiformis* as a new combination for *Agrostis avenacea* Gmel. but did not do so for Vickery (1941) varieties of this taxon. Vickery (1941) described *Agrostis avenacea* var. *perennis* as "Differs from the type in the perennial rootstock, anthers about 0.7 mm long, culms rather more rigid, about 70 cm high.", based on two specimens from South Australia: Encounter Bay, i.1925, *Cleland H.242* and Wilpena Creek, 10.xi.1928, *Cleland H.238* and two from Victoria: Wando Vale, no date, *Robertson 44* and Yarra, 1853, *Mueller s.n*. Although the culms of the holotype specimen from Encounter Bay are only 1.5 mm wide and the leaves are only 2–2.5 mm wide, spikelet observations e.g. lower glume length 2.7 mm, lemma length 1.7 mm, lemmas covered in 0.5 mm hairs, awn length 4.8 mm and anther length 0.7 mm, conform to measurements made on fresh field collected specimens of *L. perennis*. Additional specimens at AD, with culms 2.5 mm wide and leaves 4 mm wide, from the same general location, collected by J.B. Cleland, during the same period (i.e. Inman River, Encounter Bay, 1.i.1924, *Cleland s.n.*, Inman River, Fleurieu Peninsula, 20.i.1926, *Cleland s.n.*, Inman Valley, Fleurieu Pensinsula, 7.i.1929, *Cleland s.n.*) also conform to *L. perennis*.

Cleland's specimen from Wilpena Creek, seen only from a scanned image, appears to have leaves up to 3 mm wide, culms up to 2 mm wide and panicles and spikelets similar to the holotype of *L. perennis*. Although this specimen represents the most northerly collection of *L. perennis*, other more recent collections from the southern Flinders Ranges (Mt. Remarkable, Wilmington) have been made.

The Wando Vale collection, with its stiff, erect and appressed leaves (to 3 mm wide) and widely spreading panicle, appears to be a mature specimen of *L. aemula*. Measurements of spikelets revealed, lower glume 3.5 mm, lemma 2.0 mm, lemmas covered in 0.8 mm hairs and awn 5.4 mm.

The Yarra specimen, again seen only from a scanned image, appears to have culms about 2 mm wide and leaves to 4 mm wide. But the general appearance of its panicle and spikelets suggest it is probably a robust form of *L. filiformis*.

The recognition of varieties within *L. filiformis* is inhibited by the lack of uniformity in delineation of its diagnostic characters. Veldkamp (1982), after consideration of Vickery's brief description of var. *perennis*, decided that as her diagnostic characters could occur alone or in various combinations, such a variety could not be supported. While Veldkamp (1982) included within *Agrostis avenacea*, leaf widths up to 4.5 mm, spikelets (3.1–)3.25–4(–5.4) mm long, lemmas (1.5–)1.75–2.1(–2.65) and anthers (0.35–)0.4–0.5(–1), most Australian Floras are more restricted in their descriptions of this taxon. For example, Walsh and Entwisle (1994) note leaf width to 3.5 mm, spikelets 2–4.5 mm, lemmas 1.3–2 mm and anthers mostly 0.1–0.5 mm while Jessop and Toelken (1986) record leaf width 2–4 mm, spikelets 2.5–3.5 mm, lemmas nearly 2 mm and anthers 0.2–0.4 mm (except var. *perennis* at 0.7 mm). Veldkamp's descriptions are broad enough to encompass *L. aemula*.

While *Agrostis avenacea* var. *perennis* has been noted in State Floras in the past (Jessop & Toelken 1986; Walsh & Entwisle 1994), it is currently not accepted, even in South Australia (Barker *et al.* 2005). This appears to have been the result of uncertainty over delineation of annual and perennial forms of *L. filiformis*, rather than through use of other diagnostic

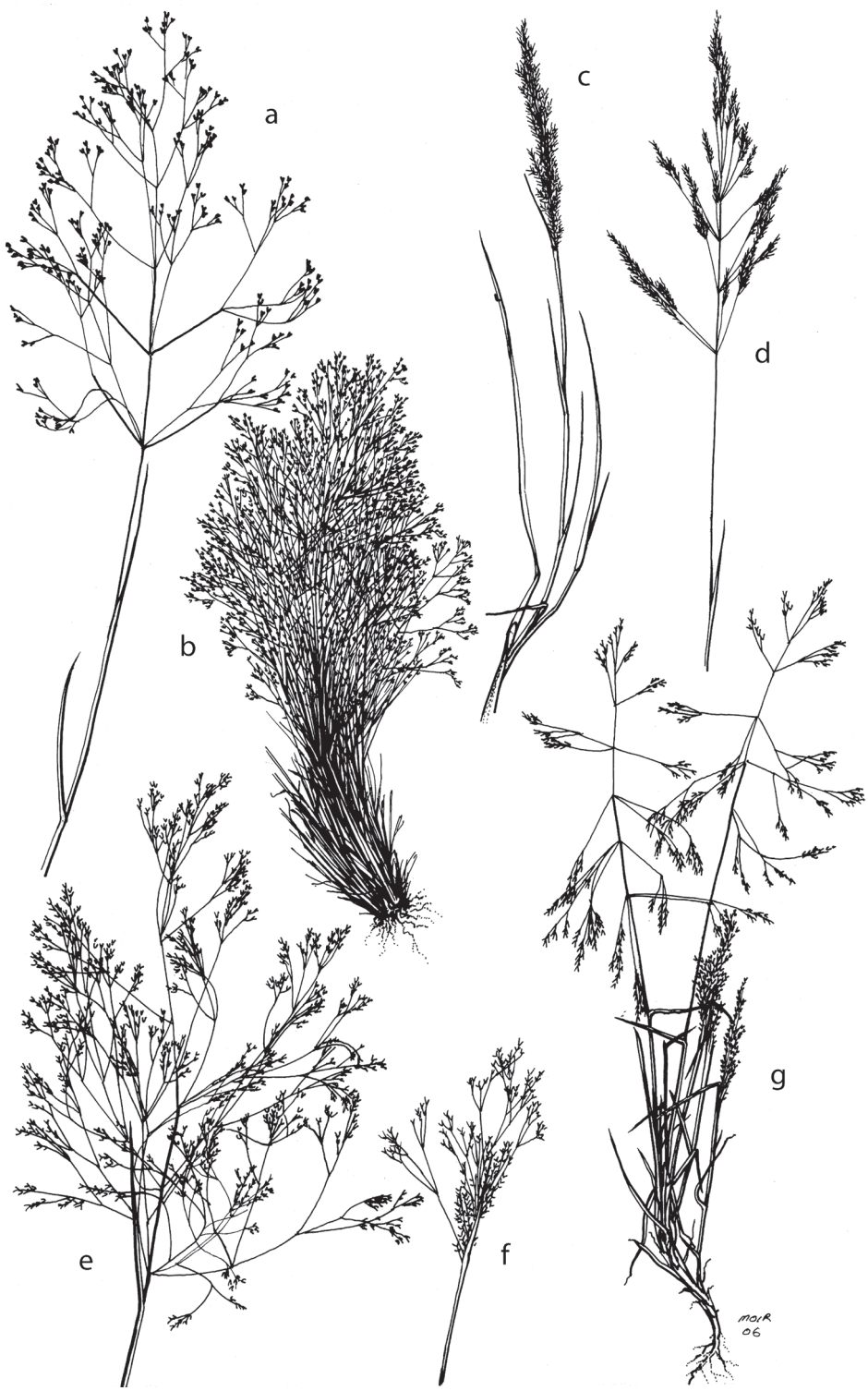

Figure 4: *Lachnagrostis leviseta*: **a** mature panicle ×0.25; **b** tussock ×0.1 (*Brown 1645* MEL). *L.* ×*contracta*: **c** immature panicle ×0.25; **d** mature panicle ×0.25 (*Brown 877* MEL). *L. palustris*: **e** mature panicle ×0.25; **f** immature panicle ×0.25 (*Brown 1643* MEL). *L. deflexa*: **g** tussock ×0.25 (*Brown 1722* holotype MEL).

features. This was found to be particularly so at AD, where a wide range of robust specimens, including a number of *L. aemula* collections, had been, at one time or another, determined as *Agrostis avenacea* var. *perennis* but seemingly with no other guide than their large size and appearance of perenniality.

On the other hand, in Victoria, only one specimen at MEL had previously been determined as var. *perennis* (Snowy Creek, Freeburgh, 21.iii.1984, *Scarlett 717* – cultivated from a piece of rhizome) and the robust forms of *L. filiformis* at MEL had not been separated out from typical *L. filiformis*. Although the *Scarlett* specimen conforms to *L. perennis* in terms of spikelet measurements (lower glume 3.0 mm, lemma 1.6 mm, anthers 0.5 mm), its rather long awns (5.6–6.0 mm) and weeping panicle suggests otherwise. During a field visit to the Freeburgh site, I found only a small population of typical, though moderately large, *L. filiformis*.

A further specimen at MEL (Broken River, East Shepparton, 14.xi.1991, *Thomas 474*) prompted another site visit, resulting in collections made from the river bank which are identical to those previously collected (leaves to 6 mm wide, culms to 3 mm wide, lower glumes 2.6–3.0(–3.3) mm, lemmas 1.4–1.7 mm, lemmas covered in 0.5–0.6 mm hairs and anthers 0.6–0.7 mm). In all these respects this population conforms to *L. perennis*, but again, the panicle is large and weeping and differs substantially in this respect. The panicles however, are more open and less crowded when compared to the population collected and measured as part of the *L. filiformis* B group (Shepparton East) (with its smaller anthers and larger spikelets), found growing in an irrigation ditch, only some 500 m away. I have occasionally made other collections of *L. filiformis* with small spikelets (less than 3.5 mm) and moderately large anthers (0.6–0.8 mm long) but the vast majority of *L. filiformis* have anthers less than 0.5 mm and often only 0.2–0.3 mm. Clearly, further work is required to resolve the taxonomic status of the robust forms of *L. filiformis*. At the present time, it appears unlikely that *L. perennis* grows in Victoria but that other as yet unnamed taxa do.

Despite the confusion surrounding this taxon and the work still required on *L. filiformis*, the present study has found sufficient diagnostic differences in *L. perennis* to separate it from the majority of robust *L. filiformis* plants and to raise Vickery's variety to specific status. While some specimens on herbarium sheets may remain difficult to determine because of insufficient material, advanced maturity or distortion following pressing, field observations of *L. perennis* populations leave little doubt as to their distinctiveness from *L. filiformis*. This distinctiveness was strongly supported by the pot study. Plants are always tall with wide and firm to rather stiff leaves and have well exserted, more or less erect, pale to light green panicles (superficially *Phragmites*-like in the early stages of development). While the glumes of typical *L. filiformis* are acuminate, relatively narrow, somewhat thin and have transparent marginal regions, glumes of *L. perennis* are acute, relatively broad, rather firm and opaque to translucent on the laterals.

***Distribution*:** Endemic to South Australia. Growing throughout the Mt. Lofty Ranges and the southern Flinders Ranges and occasionally extending into the western parts of the Murray River Valley through the eastern watershed of the ranges (Fig. 3).

***Ecology*:** Confined to creek lines and on river flats (many of which are now more or less saline, particularly in the more northerly regions).

***Common name*:** Perennial Blown-grass

***Selected specimens examined*: SOUTH AUSTRALIA.** Torrens River, 28.xii.1847, *Mueller s.n.* (MEL); Onkaparinga River, Clarendon, 19.xii.1881, *Tepper 439* (MEL); Upper Broughton River, 1894, *Richards s.n.* (MEL); Inman River, Encounter Bay, 1.i.1924, *Cleland 30B* (AD); Morialta, 20.ix.1924, *Cleland 12A* (AD); Wilpena Creek, 10.xi.1928, *Cleland H.238* (K); Mt Remarkable National Park, 1.xii.1988, *Canty et al. 2584* (AD); Tothill Belt, 10.xii.1988, *Bates 16475*; creek by Martindale Stud Homestead, 16.xii.1989, *Bates 21714* (AD); near Eden Valley, 13.i.1990, *Bates 21930* (AD); Kaiserstuhl Conservation Park, 14.i.1990, *Bates 21963* (AD); Mouth of River Marne, 18.iii.1990, *Bates 22725* (AD); Wirrilda via Brukunga, 12.v.1990, *Bates 23031* (AD); Manneside Christian Reserve, Black Hill, 19.xii.1995, *Spooner 15686* (AD); Mambray Creek, 26.x.1997, *Bates 48729* (AD); creek at Melrose, 27.xii.1997, *Bates 49402* (AD); Harris Road, Lenswood, 1.i.2000, *Bates 55674* (AD); River Light, Hansborough Bridge, 23.i.2000, *Bates 55831* (AD); Truro Gorge, 23.i.2000, *Bates 55834* (AD); near Kapunda, 12.ii.2000, *Bates 55834* (AD); Mt. Adam area, 27.xii.2000, *Bates 57934* (AD, MEL); Sevenhill Creek, Clare, xi.2001, *Bates 60372* (AD); Hillam Track, Mt Remarkable, 27.xi.2003, *Bates 61846* (AD, MEL); Greenhood Track, Scott Bottom, Scott Creek Conservation Park, 29.xii.2003 *Brown 1639* (CANB, MEL, HO); Little Para River on Glenburnie Station at One Tree Hill, 30.xii.2003, *Brown 1640*

(NSW, CANB, MEL); Cannon Falls, Spring Creek via Wilmington, xii.2005, *Bates 66930* (MEL) (Figs. 4e-f, 5a-d).

3. *Lachnagrostis palustris* A.J.Br. *sp. nov*.

Gramen caespitosum, perenne, 25–80 cm altum. Culmi geniculati. Vaginae foliorum purpuratae, laminae foliorum involutae. Ramuli panicularum, pedicelli et spiculae primo purpurati, tandem ochracei. Spiculae plerumque 3.4–3.7 mm longae; lemmata dense pilosa, arista plerumque 5–6 mm longa, antherae 0.4–0.6 mm longae.

***Type*: SOUTH AUSTRALIA**. Nangwarry, 3.i.1996, *Bates 41870* (holotype: AD)

Bluish-green to purplish-green, tufted, glabrous, *perennial*, 25–80 cm tall including inflorescences; culms 1–2 mm wide, rigid, sometimes branched, erect but often strongly geniculate at the nodes and pulling away from the leaf sheath which flattens with age; most nodes enclosed or just exserted beyond the leaf sheath, glabrous, strongly purple; sheaths smooth. *Leaf blades* erect, smooth to scaberulous, generally involute when young but flattening with age, 5–15(–20) cm long and 0.2–1.5 mm wide; ligule membranous, acute becoming lacerate, (4–)6–8 mm long. *Inflorescence* an open panicle, 10–35 cm long from the lowest whorl, exserted at maturity with erect, divaricate to spreading, rather stiff, though fine, primary branches to 8 cm long but often less than 5 cm long; branches and pedicels becoming strongly purple soon after emergence but fading with age, scabrous. *Spikelets* (3.2–)3.4–3.7(–4.0) mm long, strong purple but

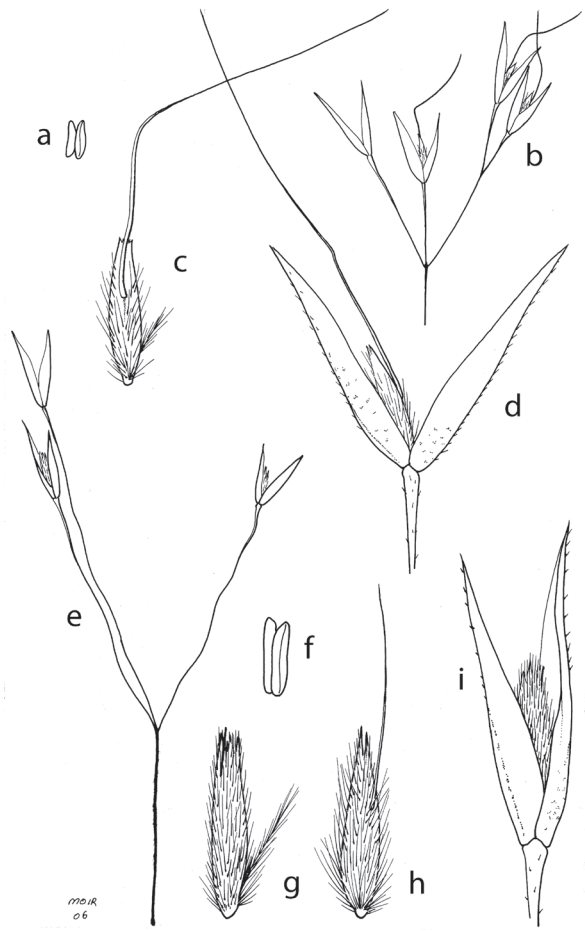

Figure 5: *Lachnagrostis palustris*: **a** anther ×11; **b** spikelet group ×2.8; **c** floret ×11; **d** spikelet ×11 (*Brown 1645* MEL). *L. leviseta*: **e** spikelet group ×2.8; **f** anther ×11; **g** floret side view ×11; **h** floret back view with occasional long bristle ×11; *i* spikelet ×11 (*Brown 1714* MEL).

fading with age to pale golden brown; glumes acuminate, unequal, the lower 0.2–0.4 mm longer, keels scabrous, lateral surfaces smooth to finely papillose, margins without cilia or with a few scattered cilia; lemma acute, 1.5–1.8 mm long, minutely (0.1–0.3 mm) 4–toothed at the apex or sometimes the lateral nerves extended into short setae (0.5–0.7 mm), covered in 0.3–0.5 mm long hairs, callus with hairs 0.5–0.7 mm long; awn inserted from near the mid-dorsal region of the lemma, (4.3–)5.0–6.0(–6.5) mm long, strongly geniculate, the bristle being 1.5–2.0 times as long as the column; palea 1.2–1.6 mm long; rachilla extension plumose, 1.2–1.6 mm long including hairs; anthers 0.4–0.5(–0.6) mm long.

***Notes*:** In the field, this taxon is readily distinguished from other *Lachnagrostis* by the combination of its involute leaves and its strong purple lower leaf sheaths and emerging inflorescences. Leaves often flatten with ongoing senescence and the purple of the inflorescences and culms fades quickly with age and in pressed specimens. These changes can make it difficult to distinguish this taxon from some of the more erect inflorescence forms of *L. filiformis*. The species generally grows in the central, wettest parts of the swamps it inhabits, along with more typical *L. filiformis*, while *L. aemula*, if present is confined to the edges.

Other, as yet undescribed, '*filiformis*-like' plants with smaller spikelets or longer and more lax inflorescence branches than *L. palustris* but with involute leaves have been found in similar environments to this taxon. Although they may have purple inflorescences, they generally lack the purplish to bluish-green leaves of *L. palustris*. They often display finer leaves and narrower, less rigid and less geniculate culms but some of these features may also be associated with more stunted forms of *L. palustris* and *L. filiformis*. Whether these populations are of one or more entities is still to be ascertained.

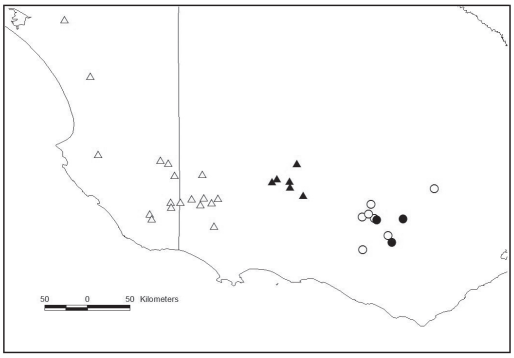

Figure 6: Known distribution of *Lachnagrostis palustris* △, *L. leviseta* ▲, *L. deflexa* ○ and *L. ×contracta* ● in South Australia and Victoria.

***Distribution*:** Mainly restricted to the central border regions of South Australia and Victoria but with isolated occurrences towards Meningie. Could be more widespread throughout south-east South Australia and south-west Victoria (Fig. 6).

***Ecology*:** Generally confined to fresh-water sedge (including *Eleocharis*, *Lepidosperma* and *Chorizandra* spp.) swamps and marshes but occasionally found growing in moist depressions in Eucalyptus woodlands or on swales.

***Etymology*:** Named for its habitat.

Common name: Marsh Blown-grass

***Other specimens examined*: SOUTH AUSTRALIA.** Big Heath Conservation Park, 4.xi.1969, *Alcock 2933* (AD); Big Heath Conservation Park, 6.xi.1969, *Weber 1838* (AD); Comaum, 1975 (?), *Alcock 58* (AD); Mary Seymour Conservation Park, 14.xi.1989, *Alcock 71* (AD); Caroline State Forest, 4.i.2000, *Bates 55641* (AD); Nangwarry, 15.i.2001, *Bates 58010* (AD, MEL); Penola Conservation Park, 27.xi.2003, *Murfet 4559 and Lowrie* (AD); Nangwarry, 31.xii.2003, *Brown 1641* (CANB, MEL, HO), *1642* (NSW, CANB, MEL); South of Nangwarry, 31.xii.2003, *Brown 1643* (AD, MEL, HO); Penola Conservation Park, Easter 2005, *Bates 64942* (AD); Topperwein Nature Forest Reserve (central waterhole), 16.i.2006, *Bates 67531* (AD, MEL); Topperwein Nature Forest Reserve (northern swamp), 17.i.2006, *Brown 1710* (NSW, CANB, MEL, HO); Gum Lagoon Conservation Park, 20.xi.2007, *Bates 75798* (MEL); east of Cape Jaffa, 20 ix.2007, *Bates 75890* (MEL); south of Yumali, 18.xii.2007, *Bates 76337* (MEL); The Marshes, Glencoe, 20.xii.2007, *Brown 2089* (MEL); Honans Native Forest Reserve, Glencoe, 20.xii.2007, *Brown 2091* (NSW, CANB, MEL). **VICTORIA.** Tullich Swamp, 24.xii.1998, *Brown 1533* (NSW, MEL, HO), *1534* (MEL); Heathfield, 31.xii.2003, *Brown 1644* (AD, MEL); Sims Road, Lake Mundi, 17.i.2006, *Brown 1711* (MEL); Heathfield, 18.i.2006, *Brown 1712* (MEL); West of Casterton, 18.i.2008, *Brown 1903* (MEL); Nangeela State Forest, 18.i.2008, *Brown 1910* (MEL); Weecurra State Forest, 18.i.2008, *Brown 1912* (MEL); Roseneath State Forest, Dergholm, 19.ii.2008, *Brown 2041* (MEL).

4. *Lachnagrostis leviseta* A.J.Br. *sp. nov*.

Gramen perenne ad 65 cm altum. Folii involuti. Paniculae erectae, diffusae. Ramuli panicularum et pedicelli et spiculae valde purpurati. Spiculae plerumque 3.5–4.0 mm

longae; lemmata dense pilosa, arista nulla vel minuta (ad 0.3 mm); antherae 0.7–0.9 mm longae.

***Type*: VICTORIA**. Grampians, west side near Henty Highway, 31.1.1975, *Peel s.n.* (holotype: MEL).

Bluish-green, tufted, glabrous, *perennial*, 50–65 cm tall including inflorescences; culms 1–2 mm wide, erect; nodes enclosed or very occasionally just extended beyond the leaf sheath, glabrous, purple; sheaths smooth to very slightly scaberulous, sometimes purplish. *Leaf blades* erect, scaberulous, involute, to 20 cm long but often less than 10 cm and 0.5 mm or less wide; ligule membranous, acute, (3–)5–6 mm long. *Inflorescence* an open panicle 15–25 cm long from the lowest whorl, exserted at maturity with a visible peduncle up to 15 cm long; branches divaricate to spreading, erect, rather stiff, scabrous, strongly purple; pedicels from 3–16 mm long, scabrous, strongly purple. *Spikelets* (3.3–)3.5–4.0 mm long, purple (particularly along the keels); glumes acuminate, unequal, the lower 0.2–0.3 mm longer, keels scabrous, lateral surfaces smooth to slightly scaberulous or papillose, margins without cilia; lemma acute, 1.7–2.1 mm long, entire or minutely (0.1 mm or less) 4-toothed at the apex, covered in 0.5–0.7 mm long hairs, callus with hairs 0.6–1.0 mm long; awn absent or reduced to a minute point or bristle, 0.5 mm or less, inserted from near the apex of the lemma and obscured by the lemma hairs or sometimes occasional lemmas with a fine bristle to 2.5 mm arising from ¾ of the lemma length; palea 1.4–1.7(–2.0) mm long; rachilla extension plumose, (1.5–)1.7–2.0 mm long including hairs; anthers 0.7–0.9 mm long (Fig. 4a–b, 5e–i).

***Notes*:** The involute leaves and minutely awned or awnless lemma of this taxon easily distinguish it from other *Lachnagrostis* species.

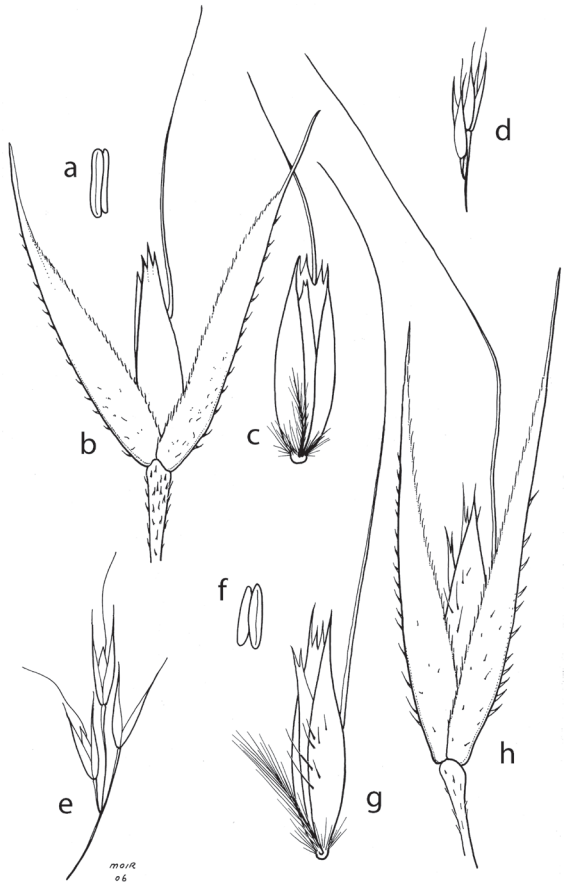

Figure 7: *Lachnagrostis* ×*contracta*: **a** anther ×11; **b** spikelet ×11; **c** floret ×11; **d** spikelet group ×2.8 (*Brown 877* MEL). *L. deflexa*: **e** spikelet group ×2.8; **f** anther ×11; **g** floret ×11; **h** spikelet ×11 (*Brown 1722* holotype MEL).

***Distribution*:** Victorian endemic. Restricted to a region adjacent the western edge of the southern Grampians in South-west Victoria (Fig. 6).

***Ecology*:** Confined to saline drainage lines, often in association with *L. adamsonii*.

***Etymology*:** Named for the insignificant awn on the lemma.

Common name: Awnless Blown-grass

***Other specimens examined*: VICTORIA.** Gatum, 22.xii.2003, *Brown 1645* (MEL); Cavendish-Glendinning Road, Glendinning, 31.xii.2004, *Brown 1713* (MEL, HO); Mooralla Demonstration Site, 6.xii.2005 *Brown 1714* (CANB, MEL); Middletons Crossing and Victoria Point Roads Corner, Victoria Valley, 6.xii.2005, *Brown 1715* (AD, NSW, MEL); Mooralla, 17.i.2006, *Brown 1716* (NSW, MEL, HO); Woohlpooer, 17.i.2006, *Brown 1717* (MEL); Glenisla, 18.i.2008, *Brown 1906* (MEL) (Figs 4g, 7e-h).

5. *Lachnagrostis deflexa* A.J.Br. *sp. nov*.

Gramen caespitosum, annuum vel perenne bevivivum, 20–70 cm altum. Culmi ascendentes valde geniculati. Folia plana in vivo, 1.5–3 mm lata. Paniculae valde exsertae, ramuli inferni valde deflexi ubi maturi. Spiculae plerumque 4.5–5.5 mm longae; glumae ad apicem setiformes, seta ad 1.7 mm longa; carinae valde scabrae, marginibus ciliatis; lemmata fere glabra, arista geniculata ad 6.5 mm longa, medifixa in carina lemmatis; antherae plerumque 0.5–0.7 mm longae.

***Type*: VICTORIA**. Lake Bolac, 17.i.2006, *Brown 1722* (holotype: MEL; isotypes: AD, NSW, HO).

Mid to light green, tufted, glabrous, *annual or short-lived perennial*, 20–70 cm tall including inflorescences but often less than 40 cm; culms 1.0–1.5 mm wide, ascending or occasionally erect, often strongly geniculate; nodes enclosed or occasionally extended beyond the leaf sheaths, glabrous, pale brown; sheaths smooth, often noticeably inflated. *Leaf blades* erect to spreading, scaberulous, flat but becoming inrolled on drying, to 12 cm long but often less than 5 cm, 1.5–3 mm wide when flat; ligule membranous, acute becoming lacerate, abaxial surface densely and finely scaberulous, (5–)7–9 mm long. *Inflorescence* an open panicle 10–20 cm long from the lowest whorl, exserted at maturity with a visible peduncle subequal to the panicle length; panicle often only half as wide with stiff, erect to spreading branches above and strongly deflexed branches below at maturity; secondary branches only slightly divergent or appressed to primary branches; branches and pedicels green or sometimes with a purplish cast, scabrous; pedicels 1–5 mm long. *Spikelets* (4.0–)4.5–5.5 mm long including glume setae, green or sometimes purplish-green; glumes acuminate, (3.0–)3.3–4.0 mm long, subequal or the lower longer by up to 0.3 mm, the central nerve of each glume extended to a fine seta 1.0–1.7 mm long, keels strongly scabrous, lateral surfaces finely scaberulous, margins ciliate; lemma acute, 2.2–2.7(–3.0) mm long with the nerves extended into short setae 0.3–0.7 mm long, glabrous except for a few occasional hairs towards the margins, callus with hairs 0.5–0.6 mm long; awn inserted from near the mid-back of the lemma, geniculate, 4.5–6.5 mm long with the bristle about 2.5–3.5 times longer than the column; palea 1.9–2.2 mm long, minutely bifid; rachilla extension plumose, 1.5–2.0 mm long including hairs; anthers 0.5–0.7(–0.8) mm long.

***Notes*:** Bentham (1878) described var. *aristata* for *Deyeuxia forsteri* (Roem. & Schult.) Kunth *nom. illeg*. (syn. *Agrostis avenacea* J.F.Gmel., *Lachnagrostis filiformis*) as having long points on the outer glumes. Vickery (1941) considered that the specimens cited by Bentham (from the Swan and Murchison Rivers, Western Australia) were scarcely different from the typical species he described and as a consequence, did not accept this variety. In Victoria, I have occasionally found specimens of *L. filiformis* with glume setae up to about 1 mm in length but the spikelets are always smaller than in *L. deflexa*; the overall length of the lower glume (including the seta) never exceeding about 4 mm. This appears to be the same for Western Australian specimens. Unlike *L. deflexa*, mature panicles of *L. filiformis* are generally as broad as they are long and, although it can display branch deflexion, it is normally restricted to an occasional branch of the lowest whorl.

Observations of the narrow, disarticulated mature panicles of *L. deflexa* show that they fall and lodge largely in or near the mother plant and are not picked up and carried by the wind. In addition, unlike *L. filiformis*, spikelets appear to readily shed their florets as soon as they start to senesce. These characteristics may explain why this species has a limited distribution. However, it is also probable that the species has been overlooked to some extent, being merely regarded as part of the *L. filiformis* populations with which they share their habitat.

***Distribution*:** Endemic to Victoria. Restricted to the central parts of South-west Victoria (Fig. 6).

***Ecology*:** Confined to saline or brackish flats, swamps and lake verges.

***Etymology*:** Named for the strongly deflexed branches of the panicle.

Common name: Deflexed Blown-grass

***Other specimens examined*: VICTORIA.** Mininera East, 11.i.1994, *Brown 874* (MEL)*, 875* (NSW, CANB, MEL, HO)*, 876* (NSW, MEL, HO); Streatham, 11.i.1994, *Brown 871* (AD, NSW, CANB, MEL, HO); Streatham, vi.1994, *Brown 994* (AD, MEL, HO)*, 995, 996, 997* (MEL); Lake Bolac, 31.xii.2003, *Brown 1718* (NSW, CANB, MEL); Chinamans Swamp, Westmere, 26.iii.2004, *Brown 1719* (MEL); Chinamans Swamp, Westmere 16.iii.2005 *Brown 1720* (MEL, HO); Deep Lake, Derrinallum, 18.i.2006, *Brown 1723* (NSW, MEL); Lake Burrumbeet, 6.xii.2007, *Brown 2148* (MEL, HO); Lake Bookar 17.i.2008, *Brown 1891* (MEL).

6. *Lachnagrostis* ×*contracta* A.J.Br. *nothosp. nov.*

Apparenter hybrida inter L. deflexa et L. adamsonii. Gramen sterile hybridum ad 90 cm altum. Folia plana in vivo, plerumque 2–3 mm lata. Paniculae subdiffusae, ramuli primarii leniter divergentes, ramuli secundi et tertiarii appressi. Spiculae plerumque 4.0–4.5 mm longae; glumae ad apicem setiformes, seta ad 1.6 mm longa; carinae valde scabrae, marginibus ciliatis; lemmata glabra, arista ad 4 mm longa, inserta circa ⅔ e basi lemmatis; antherae sterile, 0.5–0.8 mm longae; flosculus saepe fungo infectus.

***Type*: VICTORIA**. Skipton, 16.xii.1996, *Brown 1222* (holotype: MEL; isotypes: AD, CANB).

Mid green, tufted to shortly rhizomatous, glabrous, *annual or short-lived perennial*, 45–90 cm tall including inflorescences; culms 1.5–3 mm wide, ascending to erect; nodes enclosed by leaf sheaths, sheaths smooth. *Leaf blades* erect, scaberulous, flat becoming inrolled on drying, to 25 cm long or flag leaves to 10 cm, 2–3(–4) mm wide when flat; ligule membranous, acute becoming lacerate, 5–7 mm long. *Inflorescence* a contracted to semi-open panicle 10–20 cm long from the lowest whorl, exserted at maturity with a visible peduncle up to 10 cm long or more; primary branches stiff, erect to slightly divergent; secondary and tertiary branches strongly appressed and crowded; branches and pedicels green or purplish, scabrous; pedicels 1–3(–4) mm long. *Spikelets* (3.5–)4.0–4.5(–5.5) mm long including glume setae, green or purplish-green; glumes acuminate, 3.0–4.0 mm long, subequal or either glume up to 0.5 mm or more longer than the other, the central nerve of each glume extended into a fine seta 0.6–1.6 mm long, keels strongly scabrous, lateral surfaces finely scaberulous, margins ciliate; lemma acute, 2.0–2.5 mm long, entire or minutely (0.1–0.2 mm) 4-toothed at the apex, glabrous or with a very occasional hair towards the margins, callus with hairs 0.3–0.4 mm long; awn reduced to a straight or curved bristle (2.2–)2.5–4.0(–4.8) mm long, inserted about ½ of the lemma length; palea 1.8–2.1 mm long; rachilla extension plumose, 0.7–1.4 mm long including hairs; anthers 0.5–0.8 mm long, pollenless; seed undeveloped or replaced with an engorged receptacle of smut (ergot) (Fig. 4c–d, 7a–d).

***Notes*:** The parentage of this entity is unknown but is expected to include *L. deflexa* given its similar distribution (growing in association on at least one site), growth habit and similarities in some spikelet and floret characteristics. The other parent is likely to be *L. adamsonii* which also has a reduced awn and has been found growing at all currently known locations of *L.* ×*contracta*.

On first appearance, the inflorescence is similar to that of *Agrostis stolonifera* L. or an immature *A. capillaris* L.

***Distribution*:** Endemic to Victoria. Restricted to the central parts of South-west Victoria (Fig. 6).

***Ecology*:** Confined to saline swamps.

***Etymology*:** Named for the contracted habit of the panicle.

Common name: Contracted Blown-grass

***Other specimens examined*: VICTORIA.** Streatham, 11.i.1994, *Brown 877* (AD, MEL)*, 878* (MEL, HO); Derrinallum, 21.xii.2005, *Brown 1721* (NSW, MEL, HO).

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examination of the distribution and habitats of these taxa was made possible by my role in the CRC for Plant-based Management of Dryland Salinity, whereby a number of surveys were conducted on the vegetation of primary saline sites as part of that research program.

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